NETWORK INFRASTRUCTURE

19

Key points

There is a risk that network infrastructure market failures relating to electricity grids, carbon dioxide transport systems, passenger and freight transport systems, water delivery systems and urban planning could increase the costs of adjustment to climate change and mitigation.

The proposed national electricity transmission planner's role should be expanded to include a long-term economic approach to transmission planning and funding. The Building Australia Fund should be extended to cover energy infrastructure. A similarly planned approach is necessary to facilitate timely deployment of large-scale carbon capture and storage.

There is a limited case for carefully calculated rates for feed-in tariffs for household electricity generation and co-generation.

The need to reduce the costs of mitigation reinforces other and stronger reasons for giving higher priority to increasing capacity and improving services in public transport, and for planning for greater urban density.

Opportunities to reduce costs as the emissions price rises will require good network infrastructure. So will effective adaptation to climate change.

Good infrastructure will not always be provided in a timely manner and adequate scale by the market. Network infrastructure is vulnerable to market failure. Effective government action may be necessary for its provision in relation to electricity transmission, transport of combustible gas and carbon dioxide, freight and passenger systems, water storage and transport, and planning of urban settlements. One of these—gas—provides an example, from eastern Australia, of the market finding ways to provide adequate network infrastructure in a timely manner. The others may require planning and regulatory and sometimes wider roles for government to correct market imperfections.

There are several sources of potential market failure that can block private sector provision of adequate infrastructure.

- **Public goods**—Infrastructure that is a pure public good (that is, non-rival and non-excludable) may be underprovided because the infrastructure provider is unable to capture the full benefits of its investment.
- **Natural monopoly**—Where infrastructure is best provided by a single firm, the firm may, without competition or regulation, underprovide and overcharge for use of the infrastructure.
- **Externalities**—Where infrastructure has positive or negative spillovers to third parties, the level of infrastructure provided may not be socially optimal. These spillovers include *early-mover spillovers* where the first party to invest in infrastructure may face all of the costs, while some of the benefits accrue to later movers; and *coordination externalities* where private companies may not coordinate provision of infrastructure where trust is low or the cost of reaching agreement is high.

There may be circumstances in which, with well-directed and minimal government intervention, private activity can overcome market failures. However, these market failures can mean that there is less than economically optimal investment in network infrastructure. If left unattended, this will increase the cost of adjustment to an emissions trading scheme and inhibit an effective response to the impacts of climate change. If the cost of a market failure exceeds the cost of government intervention, with all of its political economy and other risks and costs, then regulatory or fiscal intervention by government may be required.

19.1 The transmission of electricity

19.1.1 Public good aspects of interconnectors

Interconnectors are the high-voltage transmission lines that transport electricity between adjacent regions. An interconnector's ability to transfer electricity is constrained by the extent of its physical transfer capacity.

The adequacy of interstate interconnection will be a key infrastructure issue for the National Electricity Market[1] in the near future. There are public good arguments for reducing constraints in light of the expected changes required for Australia's transition to a carbon-constrained future.

Both the emissions trading scheme and international prices for fuel source commodities such as tradable coal and natural gas will result in changes to regional comparative advantage associated with different fuel sources. Adequate interconnection will allow the National Electricity Market to accommodate structural change in the electricity sector as costs and demand change rapidly and differentially across the power sector.

Without a network of interconnectors with enough capacity to cope with the potentially large shifts in interstate flows of electricity over time, much of the generation capacity must remain within a region, even if there are more economic sources elsewhere. Confidence in the capacity of a national system will be particularly important for the period of transition. Interconnector constraints will be reflected in unnecessarily high, and more regionally differentiated and volatile, energy and emissions permit prices.

While it may seem inefficient to have permanent abundant excess capacity in the interconnectors between regions, in the world of structural change that Australia is entering, generation cost differences will exceed the distribution losses and infrastructure costs for higher levels of capacity.

Adaptation to climate change and more frequent disruptions of electricity supply will require deeper interconnection capacity. Climate impacts and pressures on electricity infrastructure are forecast to increase and include changes to demand for electricity (particularly daytime peaks from increased air conditioner use), more rapid deterioration of assets, and increased network failures resulting from severe weather events (see Box 19.1) (Maunsell 2008). The operator of the National Electricity Market (NEMMCO 2008) has also identified water scarcity as a factor that could affect generation capacity.

These pressures cumulatively threaten the overall security and reliability of electricity supply. Adaptation to climate change and more frequent disruptions of electricity supply will require deeper interconnection capacity that can provide additional security for the system as a whole by allowing electricity to be supplied from alternative areas if one section of the network is damaged.

Having excess capacity in interconnectors provides additional security for the system as a whole in the light of the pressures likely to arise from both climate change and an emissions trading scheme.

Box 19.1 Benalla bushfire blackouts

On 16 January 2007, a bushfire tripped the two Dederang to South Morang 330 kilovolt lines in northern Victoria, leading to the electrical separation of South Australia, Victoria/Tasmania and Snowy/New South Wales/Queensland into three 'islands'.

The power failure hit as Victoria was experiencing high temperatures leading to record high demand of over 9000 megawatts of electricity to run air conditioners and fans, and was drawing extra power from New South Wales through the interconnector transmission lines.

The sudden loss of 2000 megawatts of power—a quarter of the state's supply—caused an automatic load-shedding system to kick in, shutting down power to large areas of Victoria. Customer demand on the Victorian system was reduced by an estimated 2490 megawatts (NEMMCO 2007).

The blackout across Melbourne, Geelong and northern and eastern Victoria left an estimated 200 000 homes without electricity. Melbourne's public transport system and road network were also adversely affected.

Adequacy of current arrangements

At present, interconnector constraints do not appear to significantly affect short-term operations, in the absence of shocks to supply, demand or transmission infrastructure. The most constrained interconnector is DirectLink from New South Wales to Queensland, which was constrained for 285 hours in 2005–06 (Energy

Supply Association of Australia 2007). But the extent of current constraints is not the test of whether there is optimal interconnection capacity. The test is whether there would be a different pattern of investment in new generation capacity, and greater net value in greater insurance from shocks, if there were more interconnection capacity.

The current regulatory arrangements provide for the sharing of interconnection costs between the regions involved, subject to a dual test of reliability and market benefits. While the benefits of reliability often accrue to both regions, there can be differences in perceptions of the relative size of benefits. This can lead to difficult negotiations. Additionally, state governments may place limits on interconnectors to ensure that local generators are able to maintain market share within their region.

Reforms to the regulatory and institutional arrangements for the planning and funding of improvements to interconnector capacity are under way. The key focus of reform should be the facilitation of new private interconnection capacity to allow flexibility in the amount of interstate electricity trade.

19.1.2 Market failures in transmission network extensions

Rising average temperatures are likely to increase demand for energy, while an emissions trading scheme will make higher-emissions forms of energy generation more expensive, shifting demand towards lower-emissions sources. There are clear differences between the location and character of supply and demand today and into the future. Current transmission networks are geared to handle increments of supply that are near the established grid; have consistent supply; are on a large scale; and are highly centralised. The new technologies tend to be far from the grid (geothermal, thermal solar and wind), have intermittent supply (wind and solar), operate on a smaller scale (tidal), and be decentralised or embedded (photovoltaic solar and biomass). Without major changes in the transmission infrastructure, new technologies will find it difficult to compete, even in circumstances in which they are expected to be highly competitive once compatible infrastructure has been established. There are two barriers to successful network augmentation that could significantly slow or even halt the progressive deployment of lower-emissions generation technologies.

Free-rider problems and first-mover disadvantage

The current regulatory regime requires those seeking connection to cover the cost up to the point of connection. For a single remotely located generator the additional cost of connection is likely to be insurmountable. If the costs can be shared between multiple generators, the likelihood of a successful network extension increases. But the extension may not eventuate due to the strong incentive to free ride on the efforts of early movers.

The first party that connects to the network is faced with all the cost of extending the network. Later parties are then able to connect to the expanded network at a substantially reduced cost. The incentive is for potential larger-scale generators to delay investment in the hope that others will take the first step, or to select plant sizes and locations that simply 'use up' existing capacity in sections of the grid.

Barriers to achieving optimal scale in network extensions

Current processes for extending the electricity network may result in extensions without adequate capacity to carry future generation load. At present, regulatory arrangements stipulate that additional network capacity can only be funded by the broader customer base if it is judged to be the best alternative to meet reliability requirements or provides net market benefits. From this perspective, it will usually be better to install network capacity that is only adequate for current needs. When the next project to develop a resource in close proximity is proposed, the transmission network will have to be augmented, with the total cost greater than if the network had been built to that capacity from the outset.

These tendencies are exacerbated by the long lead times for transmission investment.

19.1.3 Expanded role for proposed national transmission planner

Current electricity market reform proposals involve the introduction of a national transmission planner to promote the development of a strategic and nationally coordinated transmission network.[2] The core function of the national transmission planner will be to prepare and publish an annual national transmission network development plan. The planner would have regard to 'the most efficient combination of transmission, generation, distribution and non-network options that will deliver reliable energy supply at minimum efficient cost to consumers under a range of credible future scenarios' (Australian Energy Market Commission 2008: 10). It would also take into account demand side, embedded generation and fuel substitution alternatives.

These new arrangements are expected to deliver a coordinated and efficient national transmission grid that meets local and regional reliability and planning requirements, and is flexible enough to respond to generation and load changes.

The Review endorses the recommendations for national transmission planning arrangements in the draft report by the Australian Energy Market Commission (2008). It suggests that the role of the national transmission planner be extended to incorporate an economic approach to transmission planning, and financial incentives for priority projects.

An economic approach to transmission planning

The Review endorses the Australian Energy Market Commission's recommendation that the national transmission network development plan should 'present a broad and deep analysis of different future supply and demand scenarios … taking account of various policy, technology and economic assumptions and looking out at least 20 years into the future' (Australian Energy Market Commission 2008: 23). The Review favours the national transmission planner adopting an economic approach to transmission planning that covers more forward-looking demand and supply scenarios, rather than simply focusing on technical feasibility.

The Renewable Energy Transmission Initiative in California provides some important lessons for such an approach (see Box 19.2). The national transmission planner could undertake a similar process to that followed in California's Renewable Energy Transmission Initiative. Unlike the California initiative, the planning process should be technologically neutral and consider potential projects for both renewable and non-renewable fuels. The process would start with a resource assessment that analyses the resources considered in previous studies and identifies the most cost-effective potential power resources in areas throughout relevant parts of Australia. In particular, when analysing the need for new infrastructure, the national transmission planner must consider the effects of climate change on demand (higher temperatures) and supply (severe weather events, water scarcity and bushfires). Among other things, this analysis should take into account engineering feasibility and environmental factors.

Box 19.2 California's Renewable Energy Transmission Initiative

The Renewable Energy Transmission Initiative is a statewide initiative of the California Energy Commission that aims to identify the transmission projects needed to accommodate the state's renewable energy goals. The purpose of the initiative is to bring together all of the renewable transmission and generation stakeholders in the state to participate in a consensus-based process to identify, plan and establish a rigorous analytical basis for regulatory approvals of the next major transmission projects needed to access renewable resources.

There are five core steps to the process:

- identifying competitive renewable energy zones having densities of developable resources that best justify building transmission to them
- ranking zones on the basis of environmental considerations, development certainty and schedule, and cost and value to Californian consumers
- developing conceptual transmission plans to the highest-ranking zones
- supporting the California Independent System Operator Corporation, investor-owned utilities and publicly owned utilities in developing detailed plans of service for commercially viable transmission projects
- providing detailed analysis regarding comparative costs and benefits to help establish the basis for regulatory approvals of specific transmission projects.

The Office of Gas and Electricity Markets in the United Kingdom undertakes a similar exercise with its long-term electricity network scenarios.

Source: RETI Coordinating Committee (2008).

This analysis would be informed by a comprehensive stakeholder consultation process with private sector generation companies. Firms would submit proposals and estimates of the costs of developing the generation resources within an area and delivering that energy to consumers. These project and technology costs would by necessity be estimates, intended primarily to provide information to compare areas. The open and transparent process would support the emergence of a consistent set of assumptions.

Ultimately, based on analysis of comparative economics and other factors, potential power supply areas would be grouped into high-demand zones. These areas would then be allocated priorities on the basis of economic contributions.

Financial incentives for priority projects

The Australian Energy Market Commission (2008: ix) states that 'the [national transmission planner] will be required and resourced to produce its own development strategies, including its own transmission investment options'.

The role will need to be developed as the location and structure of Australian electricity generation and demand change rapidly. The national transmission planner will need to be alert to market failure leading to slow and suboptimal response to changing supply and demand.

The role of the planner should be expanded to include advising the Commonwealth Government on whether there is a need for initial public funding for transmission investments. The objective would be to ensure that optimal extensions of transmission capacity were not inhibited by first-mover problems, and that extension and expansion of the network were designed at optimal scale. Advice could include processes for recovery of investments as utilisation expands over time. Care would need to be taken to ensure that there was no crowding out of private provision of transmission capacity.

The Review proposes that funds be made available for this purpose from Infrastructure Australia, and its Building Australia Fund. The Building Australia Fund is currently earmarked for national transport (roads, rail and ports) and communications infrastructure (broadband) that cannot be delivered by the private sector or the states. It would be appropriate for the Building Australia Fund to be extended to finance high-value national electricity transmission infrastructure.

19.2 The distribution of electricity

19.2.1 Externalities of embedded generation

There are two main positive externalities created by embedded generation that may not be adequately priced. These could lead to inefficient investment decisions.

Network externalities arise from:

- **Deferred augmentation of the transmission and distribution systems**—The community expects the electricity distribution (and transmission) networks to be engineered to meet requirements in periods of peak demand. At sufficient scale, embedded energy generation (particularly during peak periods) can reduce the engineering requirements of the system to the extent that this allows deferral of network augmentation. This would lower the overall cost burden for end users.

- **Reduced transmission losses**—Energy losses from electrical resistance in transmission cables are significant when electricity is transported over long distances.[3, 4] Losses are exponentially related to load. By siting a generator near a load, the amount of energy required to be imported from the network is reduced. The non-linear relationship between load and loss means that all customers benefit from reductions in system losses. Current rules do not recognise the reduction in losses that embedded generation brings to the system as a whole.[5]

The market failure arises because the investor in the embedded energy infrastructure cannot appropriate the benefits created for others from deferred network augmentation or transmission losses.

The current regulatory framework prevents these externalities from being internalised. Distribution businesses receive revenue based on the value of the asset base, creating the incentive to build more distribution infrastructure. Rewarding embedded generators for the benefits of deferred network augmentation is in direct conflict with this arrangement. The first best solution would be reform of the regulatory framework for distribution businesses. The existing regulatory frameworks are the result of many years of reform and therefore the first best solution may not be achievable in the short term.

Feed-in tariffs can be used to internalise the positive externality for investors in embedded generation, though they can only do so at the margin.

19.2.2 What should the value of a feed-in tariff be?

Metering

There are two methodologies for calculating feed-in tariffs: gross metering and net metering.[6] Gross metering pays the embedded generator for all electricity it produces and does not discriminate between embedded and centralised generation. Net metering pays only for the energy exported to the grid (gross generation minus local energy consumed).[7]

The two externalities from embedded generation are present for every unit of electricity produced, not just the amount sold—implying that gross metering is the more appropriate approach for addressing this market failure.

Rate

The rate embedded generators receive per unit of electricity should be based on a rigorous quantification of the externalities described above and must include full accounting of implementation costs. This may result in a lower feed-in tariff than is currently being applied in most schemes. If governments opt for a higher tariff, then the rest of the customer base will be cross-subsidising embedded generators. The reintroduction of a cross-subsidy would run counter to the reforms of the last decade.

Where the network externalities of embedded generation (less implementation costs) are found to be positive and material, a consistent approach should be adopted across jurisdictions. This is not currently the case. The policy objective should be a consistent *methodology*, not necessarily the same tariff rate (which will depend on local conditions in each region).

19.3 Gas transmission infrastructure

Australia's gas transmission system is privately owned, and today serves the dual purpose of connecting gas fields to gas markets and interconnecting regional systems. Interconnections provide a degree of supply diversity and security.

While the potential impediments to private provision of optimal amounts of network infrastructure, such as first-mover and free-rider barriers, are not absent from the gas market, there is evidence that the market has been able to overcome them.

Australia's east coast gas transmission system has expanded rapidly over the last 30 years through private sector investment, with little government intervention. The construction of the SEA gas pipeline connecting the Victorian and South Australian gas systems through its link between Port Campbell and Adelaide provides a recent example. The pipeline connected the joint interests of gas producers in Victoria and a gas generator and gas retailers in South Australia, and was ultimately constructed as a three-way joint venture.

The majority of Australia's gas transmission pipelines are not regulated. Pipeline developers and owners, who can contract directly with shippers, use pricing structures that have avoided such a requirement. This contrasts starkly with the electricity market.

There is no reason to suggest that existing impediments would be any more significant following the introduction of an emissions trading scheme. This is an example of a network infrastructure market working efficiently without government intervention.

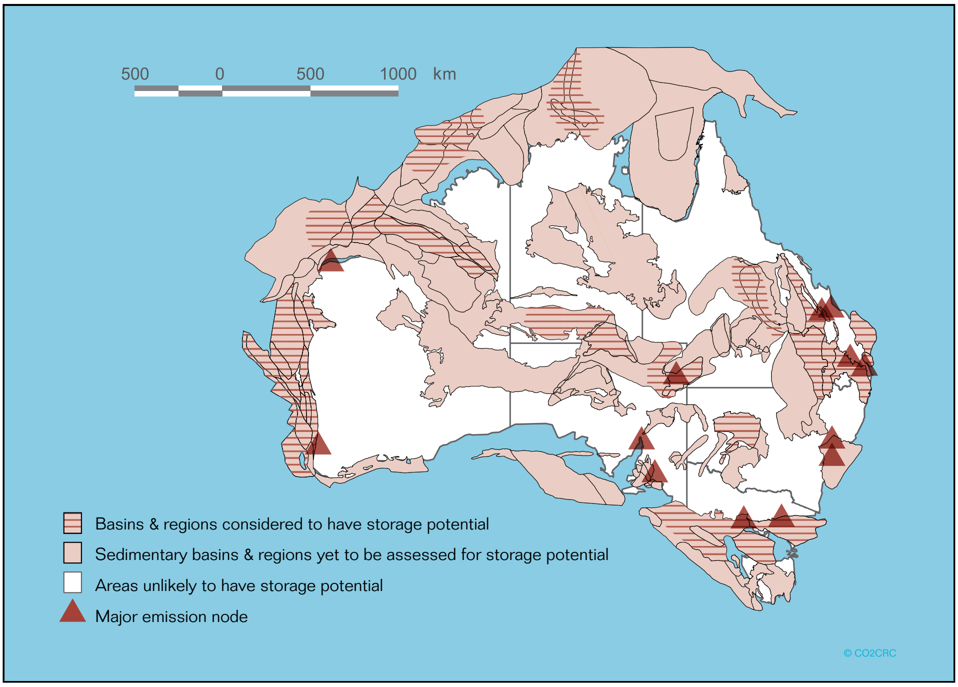
19.4 The transportation of carbon dioxide

19.4.1 Infrastructure challenges

Because of the relative immaturity of the technology for geosequestration of carbon dioxide, current projects in Australia are located close to storage sites of varying capacities, eliminating the costs of transportation over long distances.

As the number of sources of carbon dioxide and identified sequestration sites increases, there will be a corresponding increase in the need for pipeline networks to transport carbon dioxide between locations, some of which may be relatively isolated (see Figure 19.1). There may be good arguments for locating a point source far from a sequestration site. The current location of many coal-fired power plants close to coal seams is an example.

Figure 19.1 Major sequestration sites and carbon dioxide sources in Australia



Source: Image courtesy of CO2CRC.

Carbon dioxide gas is most efficiently transported when compressed to a supercritical state (a temperature and pressure at which it shows properties of both liquids and gases). Pipelines are the most economic mode for transporting large amounts of carbon dioxide over distances of up to 1000 km. This method of transporting pressurised carbon dioxide is already a mature technology in the United States, where about 40 million tonnes per year travels through a 2500 km network of high-pressure pipelines (mainly in Texas) for the purpose of enhanced oil recovery (IEA 2001).

19.4.2 Potential roles for government

The provision of a system of pipelines transporting carbon dioxide from points of capture to points of storage has the potential for market failure in three phases.

Pre-commercial planning

While carbon dioxide sequestration technology matures and approaches commercial feasibility, an appropriate independent body established by government could start assessing appropriate carbon dioxide sources, sequestration sites, existing projects and potential future projects with the aim of highlighting some of the possible long-term priorities for key pipeline infrastructure. This process could go beyond a study of technical feasibility and explore economic competitiveness based on consultation and proposals from the carbon capture and storage industry.

Government should not act on these assessments until substantial demand has been confirmed.

Establishment

Once the industry has matured to the point of being potentially commercially competitive, government will need to be prepared with efficient mechanisms for initial development and funding of a pipeline grid. As has been the experience with the gas industry in Australia (see section 19.3), it is possible that the physical infrastructure for carbon dioxide transport could be successfully provided by the private market, thereby requiring minimal intervention by government.

However, the potential for delays in overcoming inhibitions to private cooperation in a new market may warrant government intervention. This could involve supporting the construction of the main pipelines at a socially optimal scale, regulating pipeline construction, providing a contingent subsidy, or providing adequate information regarding sites and sources. If government funding were required in the establishment phase then early outlays could be recovered from future users of the spare capacity. Government could divest itself of the asset by sale to a private operator as the pipeline approaches full utilisation.

As with the electricity transmission infrastructure discussed in section 19.1.3, a program (also based on the Californian Renewable Energy Transmission Initiative) could provide an efficient mechanism to determine the initial coverage and scale of a carbon dioxide pipeline grid, and to fund identified carbon dioxide pipeline priorities if this proves to be necessary. Arrangements for cost recovery and eventual sale to the private sector should be structured so as to maintain incentives for purely private pipeline investment.

Long-term management and access

Since the pipeline system could be a natural monopoly, access arrangements for multiple users may be required. The gas industry has privately established these arrangements. The carbon dioxide sequestration industry may be able to do the same. If not, the Australian Competition and Consumer Commission would need to establish an appropriate regime.

19.5 The transport of passengers and freight

An emissions trading scheme will make higher-emissions forms of vehicles and, modes of transport more expensive, shifting demand to lower-emissions forms. The extent to which consumers can express these preferences will be strongly dependent on the availability of the appropriate network infrastructure.

In some cases, the private sector can deliver low-emissions options, such as inter-regional passenger coach services and private rail freight systems. In other cases, particularly in urban passenger transport, market failures will justify the involvement of government and affect the efficient provision of infrastructure and services.

The Review identified the following areas in which market failures would seem to warrant corrective action:

- The quasi–public good nature of road, bicycle and walking infrastructure.
- The natural monopoly characteristics of hard rail infrastructure.
- The coordination externalities of integrated service provision—Where two or more services combine to provide a passenger trip (such as a bus then a train), benefits accrue to the passenger if the infrastructure, ticketing, provision of information, and timing of these services are well integrated. This coordination does not always occur, resulting in a suboptimal outcome for passengers.
- The positive externalities associated with new transport infrastructure and services—New infrastructure, such as rail lines, can increase the value of local properties but the party providing the train line does not capture this benefit.
- Externalities in land use and transport—If the price of new housing does not reflect the cost of providing new infrastructure and services to that location, it can encourage development further away from current infrastructure than would otherwise occur.

To correct these sources of market failure, governments have traditionally funded transport infrastructure, funded and provided transport services, regulated pricing of natural monopolies, and regulated where people can develop land and build houses. Australian governments have attempted to introduce a larger role for markets in decisions by entering into public–private partnerships for some infrastructure development, corporatising or privatising the service provision, and increasing the reliance of service providers on ticketing and/or revenue. Despite this, most decisions regarding the location, timing and extent of infrastructure investments for public transport services are ultimately made by governments.

Are current arrangements suitable for managing the changing needs for transport infrastructure into the future? The increased demand for low-emissions transport options reinforces other and more powerful reasons for increased public policy focus in this area. Other reasons include rapid escalation of congestion costs and related equity issues at a time of rapid growth of population and incomes.

19.5.1 Funding

The current arrangements for transport funding may create biases in infrastructure spending in favour of roads relative to other modes.

As highlighted by the Victorian Competition and Efficiency Commission (2006), road bias could occur if funding for roads is 'more flexible, more accessible or gives greater autonomy to road project managers compared with project managers for other modes'. The Review proposes that state and territory governments investigate their current transport funding arrangements, including dedicated road funding.

Second, of the $12.3 billion the Commonwealth Government allocated to transport through Auslink in 2004–05 to 2008–09, the majority was directed to roads, including urban roads and grants to local governments (Department of

Infrastructure, Transport, Regional Development and Local Government 2008). Less funding has been directed to rail, and urban public transport was excluded.

While this could be understood if the intent were to distribute the fuel excise that is levied to pay for road development and to concentrate on roads or rail lines of significance for the national economy, it runs the risk of creating incentives for state and territory governments to give priority to road (where they can achieve matched funding) over rail projects (which they must fully fund) and non-urban over urban projects.

For this reason, the Review considers that federal funding for transport infrastructure should be broadened to include contributions to all modes of transport, in urban and non-urban areas. The establishment of the Building Australia Fund and recent commitments to contribute to road and rail projects to alleviate urban congestion in Melbourne are steps in this direction.

19.5.2 Prices for transport use

Charges that reflect mode use are important in ensuring optimal decisions on allocation of investment in various modes of transport. There are many sources of divergence between private and public benefits affecting investment in various transport modes:

- the equity benefits of some modes of transport and the many externalities generated, related to noise, air pollution, accidents and congestion
- the equity benefits of some modes of transport in some locations
- incomplete price signals in land-use decisions, as some costs associated with new developments do not reflect the full extent of subsequent government investment and private transport costs
- the difficulty of quantifying all these externalities and equity benefits
- the many charges levied by all levels of government and the private sector, including fuel excise, road tolls, registration fees and heavy vehicle duties
- the direct and indirect provision of subsidies from government.

The Review has not investigated to what extent users pay for the costs of use (including externalities) across modes. However, some specific externalities can be analysed and taken into account fairly precisely. Congestion charging has been estimated to provide multiple benefits in reducing road congestion independently of any mitigation considerations (Bureau of Transport and Communications Economics 1996). State governments should investigate congestion charging in major cities.

It is desirable to have closer links between pricing structures and the full cost of providing infrastructure and services. Then pricing structures would take account of such factors as distance travelled, mass of cargo (especially for trucks) and place of travel (especially to take account of congestion). This would enable users to maximise the efficiency of their travel and providers (road agencies and public transport service providers) to respond in areas and times of high demand. This would also enable people to respond to an emissions price more flexibly.

There are moves in this direction, such as trials on mass–distance–location pricing for freight, new roads with private investment that have tolls, and point-to-point fares for some public transport systems. Reform in this area should be accelerated. The Productivity Commission's recommendation that incremental pricing form a precursor to mass–distance–location pricing for freight is worth another look.

19.5.3 A coordinated transport policy

Delivering an effective national transport system requires balancing a wide range of objectives on a local and regional scale. As a result, although many jurisdictions have set out principles to guide transport planning, there is much ad hoc decision making. The lack of explicit principles in transport planning results in the implicit use of less desirable principles, which can create a bias towards some modes. The absence of principles can lead to systematic discrimination in favour of continuation of established trends, and in favour of expansion of modes at the time experiencing congestion. In contemporary Australia, this has favoured road infrastructure over rail, cycling and walking infrastructure.

Governments should plan transport infrastructure and land-use change with a horizon of 40 years or more. Transparent long-term planning will undoubtedly create controversy, as both higher urban densities and some new areas of development will be required. However, failing to make long-term plans will create a burden of poorly functioning cities that is difficult to unwind and will last for many decades.

Given the clear need for strategic policy to be coordinated across modes to make the whole system more efficient, the Review suggests that a single body in each state and territory should be responsible for transport policy and coordination across the transport portfolio. The institution could be supported by a number of service delivery agencies, each responsible for a single mode.

19.6 Water supply infrastructure

The eastern, south-east and south-west regions of Australia house the majority of Australians and produce most of Australia's irrigated output. These areas are likely to experience a decline in rainfall and higher temperatures causing increased evaporation. This is likely to diminish inflows to local, rainfed water supplies, compounding longstanding problems associated with a dry and variable climate and strong population growth in Australia.

Natural monopolistic characteristics in water supply, and equity dimensions in its use, have led governments traditionally to manage the supply and regulate the price of water in urban and rural environments. However, in the past 20 years, the water sector has undergone significant change. Governments have attempted to account for some of the environmental externalities by progressively capping extraction levels on most surface water systems, and there has been progressive introduction of market forces to water supplies. There is now a water market that allows irrigation water to flow to the highest value use. The majority of water provision has been corporatised or privatised. Water business providers increasingly rely on revenue from water sales.

19.6.1 Adequacy of current arrangements

Australia's water markets are, nevertheless, far from fully competitive and there is scope for greater integration of contiguous water systems. Extant physical and regulatory barriers lead to differential pricing and underinvestment in infrastructure. There are restrictions on the volume of trade between irrigation regions and there is only limited trade between urban and irrigation water systems. As a result, the price of water in different regions often does not reflect its scarcity value, with the result that it may be allocated to lower-value uses.

Urban water supply remains centralised, with government agencies generally undertaking the roles of planner, regulator, wholesaler, distributor and retailer (Productivity Commission 2008). This restricts the diversity of supply options, including decentralised local supply options, to those considered by governments. It has also left the market reliant on government infrastructure provision in most cities which, until the recent long drought, experienced low levels of investment, resulting in the need for stringent restrictions on water use in most major cities (Quiggin 2007).

Finally, current pricing arrangements do not reflect the long-run marginal cost of supply. This inhibits timely and efficient investment decisions.

19.6.2 Continuing water reforms

Future reforms in the water market should focus on developing an integrated and competitive market. By removing or reconfiguring barriers to trade and supply, and encouraging prices based on long-run marginal cost, price signals would accurately reflect and mediate between demand and supply. Coupled with reform of institutional arrangements to allow for private investment in supply, this would lead to efficient, timely and effective competition among a greater diversity of supply options.

In such a market, government's role would be to ensure that equity, security and environmental considerations were met transparently. Equity considerations have led to many government interventions in water supply and pricing, but they need not do so. Community service obligations are a transparent method of ensuring that low-income households have access to basic services. The effects of higher pricing can be addressed efficiently through the income tax and social security systems (see Chapter 16). Water security can be provided through diversity of supply options, particularly where uncertainty about climate change makes it more difficult to forecast supply and demand. Regulatory approaches are necessary to secure environmental objectives.

19.7 The planning of urban settlements

Climate change is likely to affect all Australian communities, with coastal areas under particular pressure. This is largely associated with sea-level rise, storm surge and coastal flooding, and increased frequency and intensity of severe weather events. Acknowledging the strong preference of Australians for living on the coast, the relationship of climate change to coastal infrastructure will be a determining factor in the distribution of future settlements for a rapidly growing population.

The location of developments, the strength and stability of built structures, the thermal comfort of buildings, and the capacity and physical resilience of electricity networks and stormwater systems will be affected. Coastal communities experiencing rapid population growth will experience pressure for rapid development approval, with the risk that this will occur in advance of climate change considerations being factored into planning and assessment frameworks (Gurran et al. 2008).

Given the long functional life of most built infrastructure, ensuring resilience to anticipated future climate change impacts will be crucial. Poor decisions will result in outcomes that are costly to fix.

Across Australia, relevant planning policy and legislation has been slow to incorporate climate change considerations (Planning Institute of Australia 2007), both in the context of reducing the carbon intensity of settlements and developments (mitigation) and of building resilience to climate change impacts (adaptation). This section focuses on adaptation.

19.7.1 Current arrangements for strategic and statutory urban planning

The statutory framework for planning and development in Australia is set at the state and territory government level and administered by local government. The manner in which climate change adaptation is included in the high-level parameters set by state and territory governments is generally limited or in the early stages of development (Walsh et al. 2004). Similarly, few municipal planning schemes include specific provisions for climate change adaptation (Gurran et al. 2008).

Municipal councils have noted the presence of various barriers to the effective integration of climate change within local policy and planning schemes. Councils have expressed concern about:

- access to reliable data on potential climate risks
- the need for advice on the best way to reflect these matters in a planning scheme
- their capacity to develop an assessment of impacts that is defensible if reflected in planning permit conditions and subject to appeal.

Compounding these challenges are competing priorities, financial constraints and a chronic shortage of skilled planners across the country. The combination of factors has resulted in a wide failure to incorporate climate change into planning (Burton & Dredge 2007).

19.7.2 Minimising climate change impacts through improved planning

To reduce the impacts of climate change on future coastal settlements three factors should be considered:

- the location of new or infill developments and associated public and private infrastructure
- the resilience of the infrastructure in the face of new climatic conditions such as higher temperatures, wind and floods
- the capacity of the infrastructure to service demand given the expected climate.

Each of these can be addressed through the planning system.

Location

The fundamental role for planners in relation to minimising climate change impacts will be decisions on the allocation of land for development.

Impacts such as anticipated storm surge and inundation of coastal areas already present a challenge to planning in Australia. This is likely to be exacerbated by the speed with which governments will be expected to release land for new developments to keep pace with population growth.

Land-use zoning and other controls have historically prevented or discouraged development in areas where the risk of damage to infrastructure and buildings is thought to be too great because of the prospective incidence of severe weather events. Maintaining current approaches to zoning and development control may no longer achieve this end in a future altered by climate change.

There has been a growing call for local government to consider the risks posed by climate change in coastal development approval processes (Burton & Dredge 2007).

Where applications for development have been affected by assessments related to climate change, many have ended up before a civil appeals process (McDonald & England 2007; Thom 2007).

Resilience

Climate change will affect the resilience of infrastructure in new and existing settlements. Although improved resilience can be achieved by measures independent of the planning system, such as through building codes, sound planning can still play a useful role (see Box 19.3). For example, fixed-line networks and towers for electricity and telecommunications will need to be able to withstand more intense wind and storms (Maunsell 2008). Strategic decisions about the location of new installations can minimise exposure to the elements.

Box 19.3 The limits of planning: infrastructure to protect coastal settlements

There is already considerable coastal infrastructure in areas that may become prone to storm surge, coastal flooding and other climate change impacts in the future. For existing infrastructure the planning system offers little opportunity for adaptation to climate change.

A range of adaptation actions independent of planning may be successful in managing such situations. Examples of private actions include adjusting insurance risks or retrofitting buildings to improve resilience against particular threats such as wind or flood. However, if these options are exhausted and protection is still not adequate, there is a possibility that more intensive actions such as building sea walls or other protective structures may be necessary.

Sea walls are only likely to be successful if they are built over a length of coastline. They are not suited to protecting individual properties (New South Wales Government 1990) and they are costly to construct. Consequently, this kind of infrastructure is unlikely to be provided by individuals or markets. In cases where a sea wall is likely to produce a net benefit, a public good market failure arises and government intervention may be appropriate.

Assessments of what constitutes a net benefit in relation to the development of sea walls will be difficult, and will depend upon judgments of how the benefits should be distributed among the relevant community. In addition, there is ultimately the question of whether protective infrastructure in a particular location is actually likely to produce greater benefit than abandonment, relocation or simply accepting risk. It will also be difficult to establish the most appropriate location for a sea wall, and the scale of climate change impacts it should be designed to withstand. These are complex issues that will have to be resolved under considerable uncertainty. There is a significant risk of large government expenditure with little actual benefit (Dobes 2008). Also, public provision of protection through sea walls would raise complex distributional issues.

Planning schemes already consider the risk of bushfire, which is expected to increase in both frequency and intensity with climate change. Development controls can stipulate building envelopes, access, height, design, materials and landscaping requirements (SMEC Australia 2007: 35). Such controls require revision to take climate change into account.

Capacity

The impacts of climate change may affect the scale of infrastructure required to service human settlements. For example, higher temperatures may result in greater use of peak-load electricity for the cooling of buildings. Drier conditions may create a need for new water supply infrastructure. Flooding from storm surge may increase the need for greater stormwater drainage capacity.

Decisions about supplementary infrastructure requirements are complex and will need to be made in the context of uncertainty about climate change impacts.

19.7.3 Changes to Australia's planning regime

Planning is facing some new and challenging land use and development issues because of climate change; nowhere more so than in our growing coastal settlements. To bring climate change adaptation into mainstream planning practices and long-term strategic directions a number of enhancements to the current planning system are required.

Councils must be able to demonstrate a sound evidence base for identifying and justifying planning responses to climate change. Many coastal councils, particularly those with a small rate-base, will need assistance in accessing, interpreting and applying consistent and reliable sources of scientific information about climate change scenarios (Gurran et al. 2008). The federal, state and territory governments have roles to play in:

- supporting local government to access information and build expertise
- undertaking vulnerability assessments[8] at a regional or local scale to support strategic land-use planning decisions and significant development assessment.

At a more detailed level, state and territory planning legislation and policy must clarify local governments' obligations in relation to developments that may present an unacceptable exposure to climate change. This can be done through a strengthening of the state planning policy frameworks. There is a case for developing nationally consistent planning guidelines, recognised within planning policy, that codify standards of acceptable risk for development approvals (A. Kearns 2008, pers. comm.). The principal aim of such guidelines would be to provide:

- clear guidance for councils as to how climate change should be factored into a development approval
- policy support for the decisions they make
- transparency for the community and developers on how planning applications as affected by climate change are likely to be determined.

Such guidelines may reduce the number of cases that appear before civil appeal.

Guidelines should encourage and enable consistency in decision making. This is particularly relevant for cross-boundary settlement planning and coordinated growth management along our coastline. However, they must be flexible enough to account for the variability of expected climate impacts in different regions. They must also be able to respond to unexpected changes, new technologies or new scientific information as it comes to hand (Gurran et al. 2008).

The federal government can play a role in ensuring that states, territories and local government have ready access to authoritative national and international data and information on climate science and the impacts of climate change.

Notes

1 The National Electricity Market is a wholesale market for electricity supply covering the Australian Capital Territory and the states of Queensland, New South Wales, Victoria, Tasmania and South Australia. In 2005–06, approximately 88.6 per cent of electricity generated was sent out in the National Electricity Market.

Because the vast majority of electrical energy in Australia is traded on the National Electricity Market, the Review's analysis of electricity infrastructure provision will focus on barriers to that market. The report commissioned by the Review from McLennan Magasanik Associates contains detailed discussion of market failures in the National Electricity Market (see <www.garnautreview.org.au>). That said, the analysis of potential problems and solutions is relevant to the other Australian electricity markets.

2 The Council of Australian Governments and the Ministerial Council on Energy have provided some guidance and prescription on the characteristics of the new arrangements.

3 The average weighted distribution loss in Australia in 2005–06 was 5.9 per cent, with the highest loss factor of 7.2 per cent in Tasmania (Energy Supply Association of Australia 2007).

4 There are technological solutions to transmission losses such as lower-resistance power lines, but the capital costs are currently prohibitive.

5 While National Electricity Market rules currently require network businesses to pass on these savings to larger embedded generators (known as the avoided transmission use of system charge), there is no requirement to similarly compensate the smaller embedded generators.

6 The selection of the type of tariff will depend on the technological capabilities of the meters installed.

7 Some argue that a gross-metered feed-in tariff is undesirable because, from a sustainability perspective, it does not encourage embedded generators to consume less electricity, whereas under a net-metered scheme profits can only be made by exporting more to the grid. This reasoning is erroneous because the incentives to consume should come through the retail tariff paid for electricity, not through the feed-in tariff system.

8 In this context 'vulnerability assessment' is used to describe the consideration of the environmental, social, cultural and economic issues that relate to land use and settlement patterns and as anticipated to be affected by climate change. For example, analysis of affected assets, population and natural landscapes.

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