

# Temporal Issues in Strategic Infrastructure Planning



**Discussion Paper**

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## Table of contents

<b>Introduction.....</b>	<b>4</b>
What is meant by the term strategic? .....	5
<b>A changing world – implications for infrastructure planning .....</b>	<b>6</b>
Current approaches to dealing with temporal considerations .....	9
Uncertainty and risk.....	13
<b>Fiscal policy settings – implications for infrastructure investment .....</b>	<b>15</b>
<b>Infrastructure spending cycles .....</b>	<b>18</b>
Backlogs, prospective needs and stimulus spending .....	18
Taking advantage of low interest rates.....	23
Infrastructure expenditure rules or guidelines – benefits and drawbacks .....	24
<b>Conclusion and recommendations.....</b>	<b>26</b>
Recommendations.....	27
<b>Notes .....</b>	<b>29</b>

## Introduction

This paper was prepared to assist the ITF Working Group on Strategic Infrastructure Planning consider the temporal dimensions of strategic infrastructure planning. Planning and investment decisions taken by the current generation leave a legacy (good or bad) for future generations. In practical terms, these temporal dimensions are reflected in two broad questions:

- What are governments and private infrastructure owners planning to do over the medium to long-term, and why?
- How much should be spent in the short-term, on what and, again, why?

Given the long-term consequences of infrastructure decisions, the ‘what’ question needs to be considered first. On the other hand, as governments only have authority to make decisions in the short-term, answers to the ‘how much’ question are, in some ways, more consequential. Clearly, though, the two questions are inter-related. Decisions about strategy have implications for investment and policy decisions taken in the short-term. The two questions also involve a number of second-order considerations. In the case of the first question, these are:

- What is the assumed medium to long-term context/future (or futures) within which the plans are being developed?
- Is there a plausible alignment or concordance between the anticipated future context, the aspirations/objectives to which the plans are directed, and the plan’s priorities for investment and policy reform?

In the case of the second question, given the long-term context underpinning a plan, and given the plan’s strategic priorities, the subordinate considerations are:

- How much should governments and private infrastructure owners spend now? Will the current scale of investment in infrastructure reasonably: address the future context; give effect to relevant plan(s); and adequately support the well-being of future generations? Underspensing now, relative to some assessment of need, may: (a) leave insufficient capacity to meet demand for infrastructure services in the medium to long-term, and (b) affect the condition of existing assets to the point where their ability to meet users’ needs is compromised. The consequences of underspending in the short-term will probably become harder to correct in the future. Conversely, overspending may constrain the ability of future generations to fund new infrastructure.
- Are the financing and funding arrangements for current infrastructure investment (or at least some large projects, notably those developed as public private partnerships) leaving an unreasonable burden on future generations? As in other areas of public policy, infrastructure decisions taken by the current generation can leave a legacy of debt that has to be repaid, or place calls on government finances (e.g. in the form of ‘shadow tolls’ paid by governments) that constrain the ability of future generations to deal with problems facing that generation and, in turn, their preparations to bequeath a positive legacy to generations still further into the future.
- What short-term priorities should be pursued when spending scarce funds? In other words, does the current mix of investment (i.e. essentially regardless of the scale of investment) best equip future generations to deal with prospective problems? This is a particular issue now that there is

a greater sense that various megatrends – climate change (especially), patterns of settlement, economic change, technological change – are likely to require a shift in the nature of infrastructure investment. Given the increasingly urgent need to decarbonise the global economy, some types of capital expenditure will quickly need to form a larger share of spending than others (e.g. public transport over road transport, and renewable energy over fossil-fuel projects). In addition, given potential constraints on government finances, if existing networks show signs of material degradation, maintenance expenditure may need a higher priority than capital expenditure.

The ‘how much’ question is particularly relevant at this time. Governments around the world are looking to accelerate infrastructure spending as part of economic stimulus packages developed in response to the Covid-19 pandemic. In addition, even before the pandemic, various parties were arguing that governments should take advantage of historically low interest rates to spend on new capital projects. Clearly, there are inter-relationships with the ‘what’ question mentioned above. Governments need to be careful that short-term spending avoids, wherever possible, leaving adverse legacies for future generations.

Uncertainty (as opposed to risk) pervades these matters. It obviously bears on the timing of investment decisions. However, uncertainty affects not only answers to questions about the timing of projects. In a deeper sense, it also raises questions about what and how much to spend on, including in the short-term. Obviously, short-term decisions may reflect political considerations rather than robust implementation of (hopefully) well-conceived plans. Even if short-term investment decisions flow from reasonably well conceived plans, if the context for the plan does not reasonably acknowledge major future challenges, or if the context has changed since the plan was developed, short-term decisions may still be counter-productive. Staging projects is a reasonable means of dealing with some level of uncertainty. However, staging also leads to expectations that projects will be ‘completed’, creating a path dependency for investments for which the strategic case no longer holds.

These issues are at the core of infrastructure planning and the decisions that governments make, both decisions that follow clearly from their current plans and decisions that are less obviously connected with existing plans. The point here is that both plans and decisions have strategic consequences.

This is not to suggest that governments should place themselves in a permanent state of planning. Decisions need to be taken. ‘Paralysis through analysis’ would eventually generate a reaction, leading to calls from various stakeholders to ‘get on with the job’ and to ‘cut red tape’. That said, it is difficult not to conclude that planning and investment decision-making processes need to take greater account of the challenges outlined below. In addition, those processes need to be made more transparent, so that citizens have some opportunity to inform themselves of the difficult trade-offs that governments and, ultimately, they as participants in a democracy, will have to contemplate.

## **What is meant by the term strategic?**

It is crucial to understand what is meant by the term ‘strategic’ and whether it requires some difference in perspective compared to other forms of infrastructure planning and decision-making. Different parties will have different views as to what the term means and how it might be applied to infrastructure planning and decision-making. However, most would agree that the term reflects one or both of the following considerations:

- Plans that look out over the long-term (at least 10 years, probably more than 20 years and perhaps 50+ years), and decisions (on investments and policy) that will have similarly lasting

implications (perhaps because of the scale of the investment or because the policy will take time to have full effect<sup>1</sup>

- Plans or decisions that are consequential in the sense that they represent a significant change in direction, e.g. plans for significant urban development in previously rural areas; plans for extensive redevelopment in established areas, a shift in policy on charging for infrastructure; decisions to set ambitious emissions reduction standards (or otherwise); focussing on the need to adapt to climate change.

Explicitly or otherwise, these issues shape decision-making about: the nature and focus of project business cases; the scoping and staging of projects; which projects to construct and what policies to adopt; the inter-relationships between projects and the development of portfolios of related projects; inter-relationships with other fields of planning, notably land use planning; and how projects are funded and financed. The paper addresses these issues, and is structured under the following broad headings:

- The scale of change that is in prospect, and its implications for infrastructure planning and decision-making
- The prospective fiscal context bearing on governments' ability to manage and address these challenges
- The need to:
  - address infrastructure backlogs (and take steps to maximise the value of such spending)
  - utilise opportunities arising from low interest rates for effective additional spending (whether to redress backlogs or provide for future needs).

A number of concluding comments and recommendations round off the paper.

## **A changing world – implications for infrastructure planning**

There is a growing appreciation of the scale of change and the uncertainty that pervades the world in the early 21<sup>st</sup> century. For example, in its *2015 Australian Infrastructure Audit*, Infrastructure Australia argued that a striking confluence of major shifts in the global environment is posing challenges for the planning and provision of infrastructure (Infrastructure Australia 2015).

Box 1 provides a list of matters where: (a) long-term shifts from past norms are apparent across a range of countries; and/or (b) where economic, social and environmental challenges are proving difficult to address. Clearly there will be some differences between countries in the scale of these challenges. For example, population growth rates and the distribution of population within a country will vary between countries.<sup>2</sup> Similarly the impacts of climate change will vary across countries and regions within countries. However, taking a broad view, these issues are proving problematic for most if not all nations.

### Box 1. Major shifts bearing on infrastructure planning and decision-making

Declining rates of productivity growth and consequences for economic growth – The OECD has noted that “Productivity growth in most countries remains well below historic averages. The slowdown in labour and multifactor productivity growth has been a common feature across countries, and underlying long-term trends suggest that it was underway prior to the [2008 financial] crisis.” In many countries, rates of productivity growth have been falling for several decades. At a global level, growth in total factor productivity growth is estimated to have declined from an average of 1% per year between 2000 and 2010 to 0.1% between 2010 and 2017. Explanations for the slowdown remain elusive. Some suggest this may be at least partly explained by methodological difficulties in measuring the value of new technologies to society, while others suggest falling rates of investment and differences between firms in the rate of technology diffusion may be factors.

Governments are not acting quickly enough on climate change – In total, the Nationally Determined Contributions (NDCs) committed by governments are insufficient to achieve the centrepiece of the Paris Agreement, i.e. limiting the rise in global temperature to 1.5 degrees above pre-industrial levels. Moreover, it appears that the emissions pledge pathway that includes NDCs has a 90+% probability of exceeding 2°C. The current policy pathways have a higher than 97% probability of exceeding 2°C. It is increasingly acknowledged that climate change is affecting, and will affect, rates of economic growth. The impacts of a changing climate and extreme weather events are increasing. Governments and other infrastructure owners will need to address climate risks in the selection of future projects, and in the design, operation, and maintenance of their assets.

Technological change – The pace and breadth of technological change has been a feature of the last 50 years of human history, offering benefits in many sectors including the planning, design, construction and operation of infrastructure, but also presenting challenges for those working in technology-exposed industries. Artificial intelligence and machine learning are expected to become more widespread. The implications of this change for the demand for infrastructure and the means of paying for infrastructure (e.g. impacts on government revenues as a result of transfer pricing, and the capacity of potential users to pay for infrastructure services) is unclear.

Growing government debt – Even before Covid-19, the capacity or willingness of governments to raise revenues has not kept pace with growth in demands on government budgets. As a result, across OECD-member countries, general government gross debt grew on average from 72.7% of Gross Domestic Product (GDP) in 2007 to 110.0% in 2017. Per capita government gross debt grew by 5% per annum over the same period. Analysis of prospective budgets over the long-term (discussed below) suggests that the gap between government revenues and outlays is likely to continue, and probably grow.

Population growth and settlement patterns – In many OECD countries, population growth is slowing; the population is largely stabilising or beginning to fall. Like the fall in productivity growth rates, this is contributing to a slowdown in economic activity. The proportion of global population living in cities has been increasing, reaching 55% in 2018, and projected to rise to 68% in 2050. For a variety of reasons, the concentration of population growth in cities probably adds to costs, e.g. the need to place projects in tunnels, the higher cost of land, and stronger environmental controls (such as restrictions on construction hours). Might settlement patterns change, for example as a result of Covid-19, and, if so, by how much?

Growing inequality – Income inequality in OECD countries is at its highest level for the past half century. The average income of the richest 10% of the population is about nine times that of the poorest 10% across the OECD, up from seven times 25 years ago. Growing calls for greater social inclusion and equity will have



implications for infrastructure planning, e.g. in the geographic distribution of spending, and the types of projects that are funded.

Sources: OECD (2019), The Conference Board (2019), OECD (2019a), United Nations (2018), United Nations Development Programme (2019), Climate Change Tracker (2019), OECD (2019b), Acemoglu & Restrepo (2020).

Are any of these trends likely to change over the next few decades? Challenging as it may be, the answer is probably ‘No’ or ‘Unlikely’. The momentum behind these trends is probably too great for any material shift to occur. If they are likely to change (and it is to be hoped that they might), what is the evidence that they might? What early signs should we be looking for? When might they shift and why? What might drive a shift? Are there particular risks and opportunities that need to be managed?

If we think these are broadly the challenges (and potential opportunities, in the case of technological change) that governments, the private sector and communities will face over the next several decades, what does it mean for infrastructure? In particular, what mix of infrastructure should governments be investing in now, and what should they be planning for? What supporting structures (e.g. training) should be pursued? The answers to these questions can only be speculative in this paper. However, governments should be prepared to challenge conventional thinking and contemplate some ‘brave decisions’.

The issue here is not so much one of how to deal with uncertainty. Rather it has more to do with asking whether a change in direction is required to best prepare for what appears to be a difficult and challenging future. This could fundamentally challenge the merits of current patterns of investment and the planning and appraisal tools we use.

For example (and it is only an example), in an era of climate change and slowing growth in real incomes, should we be more rapidly and radically changing the types of infrastructure in which governments and private owners invest to forms that are more likely to mitigate greenhouse gas emissions and support mobility for larger numbers of less well-off people, including ‘passive’ transport modes such as cycling and walking as well as shared transport? Might this pattern of infrastructure development also play a part in slowing down, if not arresting, the rate of decline in productivity?

The New Zealand Ministry of Transport has embarked upon an ambitious project – the Generational Investment Approach – that aims to address some of these challenges, and consider associated governance changes. They include: extending the current 10-year horizon for planning to a 50-year view; expanding what it sees as a constrained choice of interventions to respond to infrastructure needs; developing a ‘whole of transport’ perspective on funding (as opposed to the current approach which is largely modally-based); and extending the basis for project prioritisation beyond benefit cost analysis. The benefits are expected to lie in: improved certainty for large transport investments; a greater chance of achieving mode neutrality in decision-making; a stronger focus on reducing greenhouse gas emissions; optimisation of the freight supply chain; equity across the funding system; and explicit thinking about how evolving technologies can benefit the transport system. While there are some aspects of the project which are necessarily specific to New Zealand (e.g. unifying the separate funding and project evaluation arrangements for different modes), the overall project suggests promising directions for reform to address the contextual factors set out in Box 1.

The Infrastructure Commission for Scotland has recommended similarly fundamental changes in the approach to infrastructure planning and decision-making. For example, it has recommended that the Scottish Government develop and publish a new infrastructure assessment framework and methodology by 2021 that will enable system wide infrastructure investment decisions to be prioritised on the basis of their contribution to inclusive net zero carbon economy outcomes. The Commission’s January 2020 ‘Phase

1 - Key Findings' report recommended that, "By the end of 2020, the Scottish Government should require all public sector infrastructure asset owners to develop asset management strategies containing a presumption in favour of enhancing, re-purposing, or maintaining existing infrastructure over developing options for new infrastructure. New infrastructure should only be considered where the relevant authority has demonstrated this is the most appropriate response."

In its July 2020 'Phase 2 - Delivery' report, the Commission reinforced the earlier findings, observing, "We have ... considered the evidence we have received in relation to the short term impacts of the Covid-19 pandemic and have reflected on the impacts that the pandemic may have on the infrastructure needs, usage and delivery in Scotland over the long term. What has become clear during that process of reflection is that the pandemic has served to reinforce many of the drivers and conclusions we highlighted in our Phase 1 Report and to amplify the need for urgent action and change: the importance of an inclusive net zero carbon economy; the need for an integrated cross-infrastructure approach to prioritisation and investment; the importance of continuous broadly-based engagement with all of the people who develop, construct, manage and use infrastructure, particularly through places where we live and work; the need to make better use of existing assets and resources; the need to engage and reflect in an informed way with the public; and the importance of strategic long term, independent advice." (Infrastructure Commission for Scotland (2020).

Sweden is making changes too, developing an alternative model based on a different constitutional tradition to the 'anglophone' countries. New legislation and some small supervisory government organs have been established. Work has commenced to strengthen the country's focus on productivity and financial stability and climate change policies. As in New Zealand and Scotland, the time frames for infrastructure planning have been made longer.

These examples demonstrate that, although some of the propositions above are difficult and confronting, they are starting to receive government attention.

## **Current approaches to dealing with temporal considerations**

Current infrastructure planning and decision-making uses two broad approaches to address temporal considerations:

- Setting a time horizon for strategic infrastructure and land use plans that is used, in turn, to prioritise investment (at a high-level) and sequence land use decisions
- Using discount rates in the economic appraisal of project proposals.

### **Plans**

It appears that infrastructure planning and decision-making have not evolved to reflect the scale of these shifts and uncertainties, or their potential implications. Or, if they have evolved, there seems to be a little evidence that any new practices are being widely used. For example, the International Transport Forum noted in a 2017 report on strategic planning that scenario planning is not widely used (ITF 2017).

With the exception of telecommunications, there is also little if any comprehensive evidence that the types of infrastructure investment are shifting. No doubt, change is happening in some jurisdictions. For example, it appears that some governments are increasing investment in public transport as a share of overall investment in transport. However, it is at least arguable that governments are (more or less) providing the same types and mix of infrastructure as in the past. That said, it is unclear whether there

truly is little shift in the types of new investment or whether the problem lies in a lack of evidence; a shift may be occurring (albeit slowly) and perhaps we are unaware of it because of the patchy data and as yet limited analysis of the available data.

There does not appear to be any research reviewing the range of time horizons used in strategic plans. The author's experience working across various jurisdictions suggests that they typically have a 20-year horizon, with some adopting a 25 or 30-year outlook. Relatively few plans look further into the future. These periods are arbitrary, but probably reflect a view that events beyond, say, 30 years into the future are too uncertain to anticipate or plan for. This may be the practical limit of how far out plans can reach.

Nevertheless, there are questions about whether a different portfolio of projects and policies might be advocated if a longer horizon is applied. For example, in a city or region that is still growing and is likely to be growing in population for some time, setting a 20-year horizon is likely to drive certain types of transport investment and land use decisions, whereas, if a 40 or 50-year horizon is adopted, the extent of land use change in some areas might be such that different investment decisions might be planned for and taken in the short to medium term.

In addition, it appears that the extent to which these different trends are being addressed in planning processes is quite variable. Climate change mitigation and adaptation are being addressed; although it remains a fraught area of policy and practice in several jurisdictions. As noted by the International Transport Forum, "best estimates indicate that the transport-related pledges up to 2030 are not in line with limiting global warming to 2 degrees Celsius, let alone with the 1.5-degree scenario envisaged by the Paris Agreement." (ITF 2018).

Technological change is being addressed, e.g. through efforts to implement intelligent transport systems, and the use of Building Information Management (BIM) systems in construction. Digital infrastructure is also featuring in the post-pandemic stimulus plans of various nations. For example, a EUR 8.2 billion *Digital Europe* program, and a second round of the *Connecting Europe Facility*, feature in the European Commission's response to the pandemic and its Multiannual Financial Framework 2021-2027 (European Commission 2020).

However, it is arguable that some of the economic and fiscal trends are not truly being grasped. Equity issues are perhaps being addressed in part; certainly local politicians will argue for investment in their electorate. On the other hand, comprehensive analysis of the distributional implications of various infrastructure plans and investment programmes appears to be a rarity.

## Discount rates

The conventional approach in project appraisal is to use discount rates as an expression of a society's time preferences. High discount rates imply a greater emphasis on short to medium-term benefits from infrastructure investment, while lower discount rates imply an increased willingness to value long-term benefits. The use of higher discount rates has tended to favour investment in road projects rather than in public transport projects, where the benefits are perhaps more likely to accrue over a longer period. Table 1 shows the discount rates recommended in various jurisdictions' project appraisal/economic evaluation guidance.

Table 1: Discount rates used in the appraisal of infrastructure projects (various countries)

Country	Appraisal period	Central discount rate	Low discount rate	High discount rate	Lower discount rate used for long-term projects and policies?	Consideration of residual value at end of evaluation period?
<b>Australia</b>	30 years (roads, except bridges) 50 years (rail) 10 years (Intelligent Transport Systems)	7% real	4% real	10% real	No	Generally 'Yes'
<b>Canada</b>	30 years	10%	No	No	No	No
<b>New Zealand</b>	40 years, although 60 years is permitted < 10 years (Travel demand management)	4% nominal	3% nominal	6% nominal	Yes.	Generally 'No'
<b>Sweden</b>	40 – 60 years	3.5% real	Not stated	Not stated	No	Yes
<b>United Kingdom</b>	10 – 60 years	3.5% real	Not stated	Not stated	Yes. 3.5% (0 - 30 years); 3.0% (31-75 years); 2.5% (76-125 years)	Yes

Sources: Infrastructure Australia (2018), Transport Canada (2020), New Zealand Transport Agency (2020), HM Treasury (2018).

It is unclear why the discount rates vary so widely between countries. Relevantly, in a review of approaches to regulatory impact analysis, the OECD noted there is considerable divergence between countries on this issue. This divergence is evident both in the specific rates recommended (or the absence of such recommendations) and in the conceptual rationale advanced for the choice of discount rates (OECD 2009). That analysis was prepared a decade ago, and it is possible that discount rates have since consolidated in a smaller range, albeit that the examples in the table below suggests otherwise. The fact that the rates and the method of their determination vary somewhat is noteworthy. Although there may truly be cultural differences between countries that bear on the selection of a discount rate, the degree of variance suggests other factors are also relevant. For example, in Sweden, a 'tax factor' is taken into account. The project's estimated cost is increased by 30% in order to address 'deadweight losses', i.e. a reduction in efficiency as taxes are increased to pay for the investment.<sup>3</sup>

The central agencies of government, especially the finance ministries, are normally resistant to lowering discount rates for fear that this may encourage ill-disciplined decisions to proceed with certain projects. Given the history of projects that failed to live up to the demand or cost projections on which the business

case has been based, this is an understandable position. With that experience, it is possible some finance ministries may use higher discount rates as an implicit (rather than explicit) correction for optimism bias.

There has been theoretical debate for several decades over the most appropriate means of setting discount rates (Spackman 2004). Practical problems have limited the application of some approaches. Two broad approaches have been advocated, although there are variants of both:

Determination of a social time preference rate (following the work of Frank Ramsey in the 1920s) based on:

- pure time preference, i.e. the rate at which consumption and public spending are discounted over time, assuming no change in per capita consumption. This captures the preference for value now rather than later.
- a wealth effect, this reflects expected growth in per capita consumption over time, where future consumption will be higher relative to current consumption and is expected to have a lower utility.<sup>4</sup>

An assessment of the opportunity cost of displaced private investment.

Setting the discount rate involves making a number of assumptions, one of which concerns future rates of economic growth and consumption. It is unclear to what extent the trends and challenges listed earlier are being addressed when setting discount rates. Perhaps understandably, when setting discount rates, it seems governments give more weight to historical trends than looking forward. Nevertheless, this introduces its own risks and consequences for project appraisal. For example, the UK *Green Book* recommends a 3.5% real discount rate, comprising:

- A time preference component, assuming no change in per capita consumption (assumed to be 1.5%)
- A wealth effect component, associated with expected growth in per capita consumption, reflecting, in part, expectations of economic growth (assumed to be 2.0%).

In contrast to the social time preference rate approach noted above, some countries have regard to the opportunity cost of capital when setting discount rates. It is relevant then to consider whether discount rates used in project appraisal have fallen in line with falls in the cost of capital. Long-term bond rates have declined appreciably over the last 20 years or so. For example, US 30-year bonds were trading between 5.5 and 6.5% in 2000. By 2019 (i.e. before the Covid-19 pandemic) rates had fallen by more than half, with 30-year bonds trading between 2.3 and 3.0%. These are falls in nominal interest rates; falls in real rates would be less marked, due to a decline in inflation in the US from an average of 3.4% in 2000 to an average of 1.8% across 2019 (United States Treasury 2020). Even so, on the figures above, there appears to have been a fall in real rates.

No doubt, debate will continue among economists and infrastructure practitioners on the basis for setting discount rates.<sup>5</sup> However, the Ramsey approach (the basis for setting discount rates in the UK, France and required by the EU when assessing co-funded projects) is now used by a growing number of governments (Moore & Vining 2018).

The question then, is whether, in reviewing and setting their discount rates, governments are adjusting the wealth and per capita consumption inputs to the discount rate to reflect recent trends and perhaps difficult prospects.

For example, in arriving at the 2% assumption noted above, the authors of the *Green Book* have drawn upon the Office of Budget Responsibility's estimates of economic growth, which assume an average

productivity growth rate of 1.8% i.e. the average rate of productivity growth across the 19<sup>th</sup> and 20<sup>th</sup> centuries). However, the economic projections prepared by the OBR include a cautionary comment, “More recently productivity growth has been lower, reflecting the experience since around the time of the late-2000s financial crisis, so there is some uncertainty as to the most appropriate assumption for the next fifty years and in particular whether we should put most weight on the experience of the past decade, or the longer-run trends evident in the chart.”

Some governments have reduced their discount rates, whether because of changes in assumed time preferences, assumptions about growth in wealth, the fall in the cost of private capital, or for other reasons. For example, the discount rate used in New Zealand appraisal guidance has fallen from 10% in 2005 to 6% nominal in 2013, and 4% nominal as of August 2020. In France, the Commissariat général à la stratégie et à la prospective (known as the ‘Quinet mission’) was appointed to review approaches to cost-benefit assessment of public investments. Among a number of other wide-ranging recommendations in its 2013 report, the mission argued that the risk-free discount rate be lowered to 2.5%. (Commissariat général à la stratégie et à la prospective 2013). Other governments have also reduced their discount rates. Moore and Vining suggest that, as of 2018, most OECD countries were applying discount rates of between 3.0 – 5.5%.<sup>6</sup> Some jurisdictions, e.g. Australia, have not reduced their discount rates.

The previous OECD work, and the material shown in Table 1, also show that some countries are prepared to use lower discount rates for long-term projects. The Quinet mission also proposed a lower rate (1.5%) where the evaluation period extends beyond 2070.

The question then arises what to do with discount rates when things are uncertain, or where the signs provide cause for some pessimism rather than optimism. Interestingly, the 2005 French Government advice on public sector discount rates specifically addressed this matter, arguing:

*“The basic formula used for deriving the discount rate supposes that the mean rate of growth of consumption in the long term is known and constant. This optimistic vision of the future does not appear very realistic and the debates on sustainable development illustrate the degree of uncertainty which our societies face today when they consider the future. It appears more appropriate to introduce a precautionary effect to deal with the uncertainties of growth. This will tend to reduce the discount rate.”*

(cited in OECD, 2009)

## Uncertainty and risk

It is broadly agreed that uncertainty is different from risk. Uncertainty takes two forms: reducible (i.e. uncertainties that are at least partially capable of being reduced as a consequence of further research or by waiting for certain events to play out) or irreducible uncertainty (i.e. uncertainties that are essentially unknowable and beyond the capacity of decision-makers – and electorates – to know). Many of the issues that governments are grappling with in their strategic infrastructure planning efforts are matters that are (largely) subject to irreducible uncertainty. To deal with such uncertainty, governments can pursue the following approaches.

### Real options analysis

As noted by the Victorian Department of Treasury and Finance, risks and uncertainties require fundamentally different treatments, and therefore uncertainties cannot be considered and planned for

using the same tools as risks (Department of Treasury and Finance 2018).. Real options analysis is a tool for testing differences in the design, scoping and staging of projects where there is significant uncertainty.

### Box 2. What is real options analysis?

Real options analysis extends the traditional CBA framework. A real option comprises:

- - Option costs: Costs associated with creating flexibility to change investment strategy and maintain effective access to the option. For example, a hospital may be built in a way that it is readily upgradeable if demand increases more quickly than expected
- - An exercise cost: The cost to exercise the option. For example, the cost to upgrade the hospital
- - Life of an option: The time until the option is no longer valid or available. For example, some time before the end of the life of the hospital
- - An exercise trigger: The conditions that define when a real option should be exercised. For example, when the demand for services exceeds a particular threshold.

Source: Department of Treasury and Finance (2018).

Real options analysis tends to be used only on larger projects. It is unclear why this is the case and why the tool could not be used on a broader range of projects and programmes. It may be because of the additional evaluation work required compared to more conventional project assessment and benefit cost appraisal.

Notwithstanding the amount of work that may be involved, applying real options analysis to portfolios of potentially related (or un-related) projects is worthy of consideration. After all, portfolio analysis is common in private investment. A number of issues would increase the complexity of the exercise in the case of infrastructure planning and investment: longer-time horizons; a larger spread of objectives against which potential investment portfolios might be measured; and the fact that infrastructure is illiquid – once it is built, there is usually little or no ability to divest an underperforming asset. The task of communicating the trade-offs would also be significant. And decision-makers need to be attuned to the possibility of path dependency, i.e. that there is an implicit desire to ‘finish’ a project that is partly delivered.

That said, given the scale of the challenges ahead, developing and applying a real options capability to infrastructure investment portfolios appears to be a plausible step that governments could take to improve confidence and transparency in infrastructure planning. Relative to the scale of funds spent on infrastructure, it would be a modest investment. Linked to well-constructed and published scenarios, applying real options to infrastructure portfolios could:

- Acknowledge and minimise risks in adopting the ‘wrong strategy’
- Minimise regrets associated with poor investment trajectories and decisions
- Improve transparency, both within governments and with the public.

## **Application of the precautionary principle**

The precautionary principle involves taking a cautious and prudent approach where there is significant uncertainty and where there is significant risk attached to making a particular decision. It has been applied in areas such as environmental protection and the introduction of new medicines and medical devices.

However, it does not appear to have been used very widely in the infrastructure sector. This may be because application of the principle to infrastructure projects is difficult to define and apply. Application of the principle would favour reuse/repurposing/expansion of existing assets, and to pursue new investment only where there is a well-considered and debated case for doing so. This appears to be the philosophy underlying some of the proposals from the Infrastructure Commission of Scotland.

## **Fiscal policy settings – implications for infrastructure investment**

The matters canvassed in the preceding section are important for several reasons. Firstly, because much of a nation's infrastructure is funded by government. This is obviously the case in the transport sector. However, it is also relevant for other infrastructure sectors, where the provision of infrastructure is sometimes supported by government subsidies and/or where some users receive government support in paying charges for their use of utilities and other infrastructure.

Secondly, because the available evidence strongly suggests that the budget position of most if not all governments will come under great pressure over coming decades. Although fiscal policy in most countries aims for a balanced budget over the medium term, even before the Covid-19 pandemic, prospective expenditure was often projected to exceed prospective revenues over the long-term. For example, recent analysis suggests that 'demographically-sensitive public expenditure' (pensions, long-term care and health) is expected to increase by 6-10% of GDP across OECD member countries (Guillemette & Turner 2017). This prospective increase in such outlays dwarfs the 0.7-0.8% of GDP commonly spent on transport by OECD-member countries between 2008 and 2019 (ITF 2020).

Infrastructure, especially larger projects, is commonly (and appropriately) financed through the raising of debt. But the debts have to be serviced. Indeed, even if existing debts are being managed, financial market concerns about a government's creditworthiness are likely to feed back into borrowing costs. Historically, the need to service debt (and associated economic indicators such as debt to GDP ratios) have limited the capacity and willingness of governments to borrow funds to provide new infrastructure. This may be changing, at least in some jurisdictions. Previously conventional views that debt levels need to be managed within reasonable limits are being relaxed, or perhaps more correctly, those who advocate such views are finding it harder to secure an audience. These are broader issues of macroeconomic theory and policy that are beyond the scope of this paper. However they raise questions about the extent to which governments can or will continue to borrow funds for new infrastructure, and what might happen as debts are repaid or if governments find it harder to roll over existing loans.

Projects delivered through public private partnerships (PPPs) that rely on some form of availability payment also make claims on future government finances. Proponents of PPPs argue that the efficiency



of private sector ownership and management more than offset the higher costs of private finance. Certainly, there are instances where projects have been delivered at little or no cost to government.<sup>7</sup> However, as shown by the International Transport Forum, the ‘efficiency outcome’ is not guaranteed; a range of competition and other issues can lead to a different result (ITF 2018a). In short, while PPPs can be a useful means of delivering projects, governments need to carefully consider whether PPPs will in fact be lower cost and the on-going costs of such arrangements.

The fiscal policy frameworks applied by some nations help to illustrate the challenges. Some countries, e.g. New Zealand, the Netherlands, the United Kingdom, and Australia (and at least one sub-national government in Australia), make long-term fiscal projections and, in some cases, set ‘expenditure rules’ that are then applied to guide short-medium term fiscal policy with a view to maintaining manageable levels of debt in the medium-long term. These tools:

- Provide reference points to governments, industry and the community on long-term economic and fiscal prospects
- Set parameters for government expenditure that necessarily have implications for infrastructure spending.

Drawing on those fiscal projections, Table 2 shows the scale of the deterioration in the national governments’ budget position under a ‘business as usual’ scenario. It is important to note that these projections were made before the economic and fiscal impacts of the Covid-19 pandemic.

Most western nations are likely to be facing similar challenges.

As governments endeavour to keep their fiscal positions broadly in balance, spending on infrastructure is likely to decline as a share of GDP. For example, the long-term fiscal projections of the New South Wales Government (Australia) foreshadow a material reduction in the share of capital expenditure going to transport.

**Table 2: Long-term projections of fiscal position (various countries)**

Country (Year of projection)	Primary balance (See note below)	Growth in net debt
<b>Australia (2015)</b>	Primary balance moves from -1.8% of GDP in 2014-15 to -6.0% of GDP in 2054-55, equivalent to \$266.7 billion in 2014-15 AUD.	Net debt projected to grow from 15.2% of GDP in 2014-15 to 57.2% of GDP in 2054-55.
<b>Netherlands (2013)</b>	EMU government balance projected to grow from -4.7% of GDP in 2011 to -11.25% of GDP in 2060.	EMU government debt projected to grow from 69.0% of GDP in 2011 to 217.0% in 2060.
<b>New Zealand (2016)</b>	Primary balance moves from +0.5% of GDP in 2015 to -6.3% of GDP in 2060	Net debt projected to grow from 25% of GDP in 2015 to 205.8% of GDP in 2060.
<b>United Kingdom (2018)</b>	Projected to grow from -0.3 per cent of GDP in 2022-23 to -8.6 per cent of GDP in 2067-68, equivalent to £176.5 billion in that year in 2018 GBP.	Public sector net debt projected to grow from 80.0 per cent of GDP in 2022-23 to 282.8 per cent of GDP in 2067-68.

Note: The primary balance is the total of government receipts less spending on items other than debt interest.

Sources: Australian Treasury (2015), Bos & Teulings. (2013), New Zealand Treasury (2016), Office for Budget Responsibility (2018).

The reason for the projected deterioration in the governments' fiscal position is twofold. Firstly, the prospective fall in labour force participation rates (as older people make up a larger share of the population) will affect government revenue. Secondly, as noted above, an ageing population is expected to add to health and aged care costs. It is possible that a growing proportion of the electorate over retirement age will want to see health and other outlays maintained rather than cut. An ageing population may also add to pension costs, depending on how particular countries are providing for future retirement incomes.

These challenging fiscal projections raise profound questions about the capacity of governments to fund the provision of infrastructure into the future. It is possible that current infrastructure plans are, to a significant extent, undeliverable. How governments might respond is necessarily speculative; a range of measures – not only raising general or hypothecated revenues – is available to governments. The obvious lines of enquiry are set out below:

- Fostering demand management measures, including charging and pricing. However, governments will need to anticipate the possibility that a proportion of the population may not have the income to pay user charges that fully recover the cost of the infrastructure in question (even if the charges exclude payments for externalities). This raises two possibilities. Firstly, some parts of society are, in effect, excluded from using certain types of infrastructure (with attendant social costs). This is unlikely to be acceptable on ethical or political grounds. Secondly, governments may need to expand subsidy programmes associated with infrastructure user charges. Depending on the infrastructure in question and the design of the subsidy program, this might still involve substantial calls on government funding (albeit less than if governments provide infrastructure without any form of user charging).
- Pursuing taxation and policy reforms to enhance their funding capacity, e.g. broader reform of land taxation rather than project-specific 'value capture' mechanisms as a means of funding infrastructure projects and programmes (or at least some aspects of those projects, e.g. land acquisition costs).
- Improving productivity in the planning, construction, maintenance and operation of infrastructure: e.g. more rigorous project selection; minimising cost risks through greater investment in technical studies (e.g. geotechnical investigations) and concept designs before inviting tenders; securing the main environmental and other project approvals before inviting tenders; providing companies with sufficient time to prepare their tenders (especially on large and complex projects); investing in project delivery technologies, e.g. BIM, that can facilitate lower operational and maintenance costs.
- More rigorously seeking opportunities to stage projects over time, both to focus on addressing the most pressing needs, and to 'free up' funds that enable projects that address other needs to be pursued. Of course, staging may not be possible for some projects, e.g. development of some railways may be difficult to stage.
- Improving the rigour and transparency of planning and spending prioritisation processes, particularly by investing in the development of data, analytical tools and public reporting.

On one view, the fiscal projections suggest governments would be wise to spend significant amounts now, as the task of funding future investment is likely to become harder. There might be a case for using low-cost finance and investing in large projects that are likely to become difficult to fund in the future, and leaving such future fiscal space as there is for smaller projects. However, this risks spending scarce capital

funding on poorly conceived projects. The projections highlight the importance of rigorous project appraisal. Projects with a poor business case will impose a high cost.

The period of crisis (and the need for stimulus) is also a time to spend on:

- Feasibility studies and so called ‘project development’ – this has two benefits: firstly, it provides the foundations for better decision-making about projects and programmes. Secondly, it establishes a portfolio of ‘shovel-ready’ projects that can be funded and developed quickly when a crisis arises or persists.
- Testing concepts and technologies that might be used more widely after the crisis.

## Infrastructure spending cycles

The preceding sections outline a range of challenges that need to be addressed through sound infrastructure planning and decision-making, and illustrate the scale of the fiscal constraints facing governments and societies in addressing those challenges. They provide context for how governments might adjust their infrastructure spending in the short-term.

It has been suggested that infrastructure ‘backlogs’ have developed in many countries, following sustained periods of low expenditure, and that governments have subsequently proceeded with major investment programmes in attempts to rapidly redress the balance. This can put pressure on industry capacities, with limited numbers of contractors having the resources and financial capacity to bid for major projects. Price spikes and bottlenecks can result.

Questions about the appropriate scheduling of infrastructure expenditure programmes also embrace other issues. In recent years, sustained below-normal interest rates have led to frequent suggestions that governments should increase infrastructure investment to take advantage of the ability to lock in low-cost long-term financing. However, the potential benefits of this approach must be weighed against the potential costs of stretching industry capacity, as well as the need to maintain appropriate fiscal policy settings across the economic cycle.

### Backlogs, prospective needs and stimulus spending

#### Backlogs

Although there are differences between countries, across all infrastructure sectors, capital spending by governments and the private sector appears to have been relatively static or only slowly increasing over the last 5-10 years. Moreover, recent rates of investment are lower than they were in the past, and in some cases they appear to be appreciably lower than 40-50 years ago.

The reasons for this vary. In the case of government, it reflects pressure to avoid or reduce budget deficits while balancing recurrent expenditure needs in health, education and welfare. In the case of the private

sector, it may reflect concerns and uncertainties about investment returns and, in the case of regulated infrastructure networks, limits on revenue allowed by economic regulators.

For example, gross fixed capital spending on inland transport infrastructure among OECD countries averaged 0.7% of GDP in 2018 (ITF 2020a). This percentage has remained flat since 2014 and is lower than the 0.9% of GDP measured in 2008. In addition, the current level of expenditure is relatively low by historical standards. For example, the ITF notes that transport infrastructure spending in Western Europe has progressively declined as a proportion of GDP, from a high of around 1.5% in 1975 to 0.7% in recent years.<sup>8</sup>

It is possible, of course, that transport networks in some countries are already well-developed, and that, the economic returns from further investment in transport compares poorly with other sectors, notably telecommunications, which provides a partial substitute for transport. If so, for governments and private owners there may be a case for moderating transport outlays. However, this seems unlikely to be the case across all countries, and certainly in countries still experiencing moderately rapid population growth.

In fact, across the OECD-member countries, spending on telecommunications infrastructure (fixed, cellular mobile and other wireless) grew by 16.5% (or 26.5 billion USD) between 2010 and 2018, a surprisingly low figure given the level of discussion about the growth and importance of telecommunications (OECD 2019c).<sup>9</sup> The rate of increase may be explained (in part) by the efficiency of the investment, e.g. greater speeds and reliability benefits per unit of investment. Nevertheless, given the growing demand for telecommunications services, the growth rate is lower than might have been expected.

After rising by almost 40% between 2005 and 2010, investment in energy infrastructure fell by 8.4% from \$1,733 billion (USD 2018) in 2010 to \$1,588 billion in 2018. This is perhaps unsurprising, given the widely-discussed difficulties in the oil and gas sector. However, even in the electricity sector (generation, networks, and storage), investment increased by only \$33 billion (USD 2018) or 4.4% between 2010 and 2018 (albeit after rising from around \$460 billion in 2005 to \$743 billion in 2010) (International Energy Agency 2019). The International Energy Agency has recently forecast that investment will fall by around 20% (or \$400 billion USD) in 2020 as a result of the Covid-19 pandemic. It further states, “And while the overall share of global energy spending that goes to clean energy technologies – including renewables, efficiency, nuclear and carbon capture, utilisation and storage – will jump in 2020, this is only because fossil fuels are taking such a heavy hit. In absolute terms, it remains far below the levels that would be required to accelerate energy transitions.” (International Energy Agency 2020).

These flat or declining rates of investment are certainly suggestive of a ‘spending backlog’, but no more. They are an indirect assessment as to how much may need to be spent. Ideally, infrastructure service targets would be in place. These would provide a better indication as to whether underspending is in fact causing greater economic, social and environmental problems. Unfortunately, though, few if any countries are likely to have a comprehensive suite of targets that could be used to assess infrastructure performance, either overall or, even better, at a disaggregated level to inform meaningfully spending decisions by governments.

Even if aggregate levels of expenditure are broadly judged to be appropriate, e.g. using measures such as the depreciated replacement cost of existing assets and/or measures using the stock of infrastructure to GDP, the discussion of backlogs leaves open the possibility that:

- Specific patterns of capital expenditure are inappropriate – even if aggregate outlays are judged to be sufficient, capital expenditure may be occurring in the wrong place, in the wrong form, at the wrong time. We can’t be sure, because business cases (or strategic assessments) on programmes and portfolios of expenditure tend not to be published and cross-sectoral

information is limited. However, anecdotal evidence of ‘bridges to nowhere’ and projects experiencing cost blowouts suggest the problem is not just a theoretical consideration.

- Specific patterns of maintenance expenditure are inappropriate – even if aggregate levels of expenditure are appropriate, maintenance may be occurring in the wrong place, in the wrong form (e.g. prioritising pothole repair versus life-cycle maintenance), or at the wrong time.

We can conclude that backlogs are probably a real issue. However, governments, users and taxpayers do not know enough about service targets – as well existing and prospective service levels – to be confident that scarce funds are being spent wisely to fix those backlogs.

## Prospective needs

Current backlogs become more important when infrastructure needs are also expected to grow substantially, e.g. where:

- Demand for services increases as a result of population growth – this is a particular issue in a number of non-OECD countries. However, it is also an issue in some OECD countries.
- Investment is required to maintain or secure a competitive advantage
- Gaps in service quality within a country become significant enough that pressure builds to redress the service differentials.

In those circumstances, governments and private owners need to spend even more, not just to catch up but to sustain a rate of expenditure that avoids adding to the backlog.

Various estimates have been made from time to time about the prospective infrastructure spend that will be required to support global growth and development. For example, the McKinsey Global Institute suggested in 2013 that \$57 trillion of investment or 3.5% of global GDP (and, in fact, considerably more) would be required by 2030 (McKinsey Global Institute (2013)<sup>10</sup>). Much of this figure was associated with infrastructure investment in developing countries. Earlier analysis prepared in 2003 by staff from the World Bank estimated a lower figure. The modelling suggested that global investment and maintenance needs in roads, railways, telecommunications, electricity, water and sanitation (exclusive of “rehabilitation and upgrade needs”) would average around 2.1% of global GDP or about \$850 billion (USD) per year between 2000 and 2010. The percentage of GDP was lower in high income countries and higher in low income countries (Fay & Yepes 2003).

Other sector-specific studies also highlight the scale of the prospective need. For example, the OECD argues that “the present value of the additional investments needed until 2030 to achieve the Sustainable Development Goal of achieving universal and equitable access to safe and affordable drinking water for all is approximately 1.7 trillion USD .... This is about three times the current investment levels (OECD 2018).

Moreover, this estimate represents only a fraction of the water agenda: projections of global financing needs for water infrastructure range from USD 6.7 trillion by 2030 to USD 22.6 trillion by 2050. These figures do not cover the development of water resources for irrigation or energy.

## Infrastructure spending as a stimulus measure

Spending on infrastructure is commonly included as a part of economic stimulus packages. This is especially the case where infrastructure backlogs exist or are perceived to exist. However, decision-making rigour can suffer during a crisis. In a recession, governments are frequently more concerned about ‘getting money out the door’. Decisions in this environment present material risks, e.g. project business cases are

more likely to be weak, thereby presenting risks of cost overruns and disappointments in relation to demand projections.

It is unclear whether comprehensive, authoritative research has been undertaken to assess the efficacy and impacts of the infrastructure elements of stimulus packages introduced by governments in response to the global financial crisis in 2008. It is a particularly difficult area to obtain comparable data and, in turn, to draw meaningful conclusions as to the outcomes associated with that expenditure. Some research suggests that counter-cyclical expenditure on high quality measures during the global financial crisis (not just on infrastructure, it must be emphasised) was associated with inclusive growth outcomes (Bloch & Fournier 2018).

However, the Australian experience suggests that governments need to be careful about spending on infrastructure as a means of stimulating the economy. The package of infrastructure investments agreed to by national and territorial governments in 2008–09 no doubt had an impact on the economy; however, its stimulatory impact was probably less than hoped. There was a limited pipeline of ‘shovel-ready’ projects that could proceed quickly to construction. As a result, many projects took some time to commence and further time to deliver, undercutting the stimulus aims of the package. In fact, some of the larger projects were still under construction four, five and six years after the peak of the crisis.

In the Australian case, the infrastructure funded by governments as an economic stimulus also came onto a construction market that was already under pressure delivering major resources projects (and their associated infrastructure). Labour shortages became apparent, and prices for construction materials and equipment also rose appreciably. As a result, project proposals submitted to Infrastructure Australia in the years after 2008–09 were commonly assuming cost escalation rates of 6–7% per year, some two or more times the general rate of inflation in the economy.

The 2010 UK *Infrastructure Cost Review* also observed that growth elsewhere in the economy was expected to have flow on effects for the infrastructure sector; it forecast that indexation of costs would rise by four to five percent per year over the following five years (HM Treasury & Infrastructure UK 2010).

The Australian and UK experience points to industry capacity constraints as something that governments need to be aware of when designing stimulus packages.

Indeed as Australia considers stimulus packages to respond to the Covid-19 pandemic, industry capacity is still an issue. An already large infrastructure delivery program continues to present challenges for governments across Australia. Over the last 18 months, heads of government and ministers responsible for transport and infrastructure have been actively considering market capacity and capability constraints affecting the delivery of projects, especially in the large cities on the east coast of Australia. They have sought further advice from officials on policy options to:

- Better plan and match transport infrastructure construction demand and supply
- Deliver best practice major project procurement and risk allocation settings
- Review infrastructure construction regulatory arrangements. (Australian Transport and Infrastructure Council 2019).

Recessions and deeper economic crises have occurred throughout human history. We can be confident that such events will occur in the future; it is not a question of if but when. However, the scale of the challenges outlined earlier invites some speculation as to whether crises might be more common in the future, and whether they might be deeper, more interconnected and longer lasting. Doubtless, there will be various opinions on this question. The question does not need to be answered in this paper. What we

do know is that governments and, where possible, private infrastructure owners will need to be prepared with well-conceived investments to use as an economic stimulus when future crises materialise.

## Lessons

The experience in Australia (and probably elsewhere) suggests that, in a recession, governments should spend their ‘stimulus’ funding on: (a) the maintenance of existing assets; and (b) small capital projects, rather than on large or ‘mega’ projects. While this may seem like ‘common sense’, governments do not always heed, or are slow to learn, these lessons. Focusing stimulus efforts on maintenance and smaller capital projects is more likely to achieve the government’s economic stimulus objectives. The reasons are:

- Maintenance expenditure:
  - Can be deployed faster (relatively) than most capital expenditure, especially large projects. New projects (especially large projects) need to go through tender processes, whereas maintenance spending can often be increased or accelerated under existing contracts.
  - Can also be spread around a region or country, rather than concentrated on a small number of large projects. This is more likely to spread the stimulus benefits from the additional spending, as well as potentially lowering supply chain risks.
  - Will usually address what appears to be some of the most significant infrastructure backlogs.
- Smaller capital projects:
  - Are more likely to have higher benefit cost ratios than larger capital projects
  - Can be spread across a region or country
  - Have shorter lead times than large projects, e.g. because they are usually subject to simpler environmental assessment processes. In contrast, the environmental assessment processes for larger projects can take 2-3 years (or more) to complete. Even ‘streamlined’ processes are unlikely to be completed in under 18 months
  - Can be delivered by second and third tier contractors, whereas larger projects require the engagement of first tier contractors, both local and overseas, perhaps adding to cost pressures in the market and procurement lead times. These larger firms might also have balance sheet issues, e.g. in a ‘hot’ construction market created by stimulus funding, banks and other credit providers may impose higher credit standards.

Beyond, these overarching observations, governments will need:

- To maintain a disciplined approach to project appraisal during periods of economic crisis
- More ‘shovel-ready’ projects – Therefore governments need to spend more funds early on project development so that they have a portfolio of such projects ready when circumstances require
- Efficient delivery arrangements – governments will need to spend money and have a ‘pipeline’ of projects that are ready for delivery, including:
  - Facilitation of information provision, including technical investigations (e.g. geotechnical studies)

- Detailed designs. A recent paper published by the International Transport Forum recommended: (a) under a Design-Bid-Build delivery model, clients should produce a complete, detailed, fully approved and fully costed design before tender issue and ensure that constructability risks have been considered, and (b) under Design and Build, Engineer-Procure-Construct or collaborative delivery models, clients should, at a minimum, produce a fully costed reference design before tender issue.<sup>11</sup>
- An early and continuous focus on risk management for specific projects (and in particular risk allocation)
- Careful selection of delivery models and well-prepared procurement processes.

Governments might also consider obtaining necessary environmental approvals (or at least some elements of those approvals) to minimise the amount of time associated with approval processes when an economic crisis becomes apparent. That said, there may be limits as to how far these preparatory approvals can be taken. For example, environmental approval processes are likely to be seen by the community as a precursor to the delivery of a project or scheme. Having preparatory approvals will require some associated communication effort to improve public understanding of the fact that some projects that are subject to environmental approval processes may not proceed for some time. This raises other issues about the life of the environmental approval; in some jurisdictions, approvals must be acted upon within a certain period (say five years). If a project does not proceed, then the approval must be reviewed to ascertain whether the circumstances have changed sufficiently in the intervening period to warrant restarting the process or, at a minimum, revising aspects of the approval to address any substantive change in the environment surrounding the proposed project.

- Development of requisite skills, especially in difficult areas where there is already evidence of skills shortages, e.g. in technology-related areas such as rail signalling, intelligent transport systems and data analytics.
- A program of projects to maintain skills (ahead of or in time for when projects need to be ‘taken off the shelf’ as part of a stimulus package).
- Access to good project and program management skills, and systems for tracking projects.

The McKinsey Global Institute suggested the \$57 trillion figure quoted earlier could be reduced by 40% if measures such as mentioned above, and making the most of existing infrastructure, were widely used.

## **Taking advantage of low interest rates**

Media commentators, industry representatives and occasionally parliamentarians are sometimes heard to say, ‘With interest rates so low, there has never been a better time to borrow for infrastructure spending’. It has been a fairly common refrain in recent times.

If it can be secured on reasonable terms, locking in low cost finance is obviously a sensible thing for governments to pursue. Lower funding costs imply that lower internal rates of return would be needed to yield a positive net present value on a project. However, the risk is that comparatively inexpensive debt can create an impression that the projects financed with those loans are worthwhile projects to develop. They may not be; there is a risk that project appraisal standards are weakened.



Loans still have to be re-paid. Unless the borrowings are being used to finance worthy projects that help expand an economy or otherwise meet a well-documented strategic need, there is a risk that the loan will become a burden on future generations.

Although spending on infrastructure can be positively associated with rates of economic growth (Calderon, & Servén 2004), the results are mixed. Different studies have found different impacts on economic growth from investment in different sectors; different infrastructure stock levels and different institutional settings. (Egert, Kozluk & Sutherland 2009).

Low interest rates are therefore only useful if there is a supply of economically worthwhile projects that cannot otherwise be financed. In short, there is no substitute for rigorous decision-making. The tests need to be:

- Whether the project is economically and strategically worthwhile
- Whether there is a plausible case that the government in question can service the loan.

It is clear that, notwithstanding the availability of low-cost finance, some governments are concerned about the impact of high debt to revenue ratios on their standing with the rating agencies, and, in turn, on the cost of future borrowings. This is affecting their capacity and willingness to invest in new projects.

Governments need to be alert to signals that they may need to slow down or terminate infrastructure spending programmes financed with low interest loans. These signals are likely to comprise a mixture of macroeconomic indicators as well as infrastructure-specific indicators. However, the indicators include:

- Fiscal indicators, e.g. credit measures such as debt to GDP or debt to revenue used by the rating agencies
- Macroeconomic signals, e.g. a return to ‘normal’ rates of overall economic growth or capital investment
- Evidence that the construction market is becoming over-heated, e.g.
  - rising infrastructure delivery costs, as seen in escalation in tendered prices for projects, or real increases in the costs of materials and other construction inputs
  - lower than expected numbers of tenders for projects
  - comparatively higher number and size of variation claims on construction contracts.
- Other delivery cost indicators, e.g.
  - other signs of industry capacity constraints, e.g. advertising for positions, sourcing of specialist staff and consultants from overseas
  - delays in delivery.

The appropriate mix of indicators and the levels at which individual indicators (or the indicators collectively) trigger a reappraisal of the spending program is obviously a matter of judgement.

## **Infrastructure expenditure rules or guidelines – benefits and drawbacks**

Infrastructure and infrastructure investment need to be viewed through a medium to long-term lens. Although there may be short-term needs to spend on infrastructure projects (i.e. using infrastructure as a

stimulus measure that can also reduce backlogs) and opportunities (spending while interest rates are low), it needs to be remembered that infrastructure is about the medium to long-term needs of a community, region and nation. The assets themselves have long lives, and, because of their scale and cost, they often need to be financed and funded over the long-term.

The infrastructure needs of a nation are best served by a stable, medium to long-term investment horizon, within which spending can rise and fall depending on the economic and fiscal cycle.

This is relevant in considering whether there should be expenditure rules or guidelines on infrastructure spending. Various parties with an interest in infrastructure not infrequently state their views on these matters, with the aim of influencing government strategies and, in turn, their long-term interests. For example, at one point in the relatively recent past, the Business Council of Australia suggested that infrastructure expenditure (public and private) should be around 4% of GDP. It was felt that stimulus spending was still needed following the 2008 crisis, and that governments needed to facilitate private investment in infrastructure (and, particularly at the time, investment to facilitate Australia's mineral and energy exports). In other western countries, government capital spending appears to average between 1-1.5% of GDP; with transport accounting for 0.7 – 0.8% of GDP over the last decade (ITF 2020). Relevantly, the UK Government has issued a fiscal remit to the UK National Infrastructure Commission, requiring the Commission to ensure that its recommendations can be accommodated within a government funding envelope of 1-1.2% of GDP over the period to 2050.

These sorts of investment or spending envelopes are best used as a medium-term guide to levels of expenditure. As a guide, rather than as a rule, such measures can help governments in maintaining budgets and policy settings that minimise extended periods of over or under investment in infrastructure. They might operate in a manner similar to the way governments and central banks use fiscal and monetary measures to maintain inflation within a particular band.

Such measures are not only useful to governments; used wisely, they can provide guidance to construction contractors, operators, service providers and other suppliers; underpinning their confidence to plan and invest in the firm's human resources, technological capabilities and business development. These measures support the operation of an informed infrastructure market.

There does not seem to be any particular merit in applying such measures as a rule. Applied as a rule, such measures could be unduly restrictive, forcing governments to over or underspend. It is not hard to imagine that a government may be tempted to contrive a spending result that complies with such a rule. Conversely, any breach of a spending rule (technical, minor or otherwise) could attract sufficient political opprobrium that a government may abandon any endeavour to maintain infrastructure spending at reasonable levels. Good governance is unlikely to be well-served by specific rules; rather, an approach that encourages the exercise of disciplined judgement is to be preferred.

Setting the target band for expenditure in the first place (and potential triggers for governments to consider adjusting their spending) requires a sound and transparent understanding of a region or nation's infrastructure and fiscal prospects. In various cases, some of the elements of such an approach are already in place. For example, many governments produce budgets that include forward estimates (over a four year period). They also have longer term (e.g. 10-year) fiscal projections, although these are less commonly published. Governments will also usually present a balance sheet with an estimate of the value of non-financial assets. This information may be broken down between general government assets and public non-financial corporations, and it may also be broken down by different types of assets, e.g. land, infrastructure systems, plant and equipment, and buildings. However, those highly aggregated figures need to be unpacked if they are to be more useful to parliamentarians, industry and the community in assessing the level of investment that is required to provide the infrastructure to which they aspire.

These fiscal projections need to be complemented with richer information and analysis of the jurisdiction's infrastructure networks, including:

- Service targets as well as current and prospective service levels expected to be achieved against those targets
- Asset condition (both now and prospectively under the anticipated maintenance funding)
- Demand projections
- External risks, e.g. assets that may be threatened by climate change-related weather events
- Assessment of technological changes and opportunities relevant to the networks
- Observations about industry and institutional capacity to maintain and develop the networks.

As with the fiscal projections, some if not much of the information outlined above is already held by infrastructure agencies in their asset management plans. The quality of these plans may vary; but, at least to some degree, the information exists. What is needed is to enhance and extend that information and then to link it more effectively with the government's fiscal projections and to publish the material.

Some will argue that such an exercise would be resource-intensive, and that few people would understand the material (or perhaps even be interested in it). There is no doubt that such an effort would require time and resources. However, in response to such criticisms, it is worth making the following points:

- Such an exercise is about trying to improve understanding and transparency of the fundamental infrastructure networks on which a region or nation's future depends
- As noted above, some of the necessary information is already collected and, in some cases, published
- This would not be the first time that governments have worked to improve the sophistication and presentation of their budgets and strategies. In many instances, the budget information presented today is greatly improved from what was the case 10 and 20 years ago.

## Conclusion and recommendations

Passing on a positive legacy for future generations while using available resources wisely has always been the *raison d'être* of strategic infrastructure planning. Those engaged in strategic planning and in decision-making on strategic matters – projects and policies with long-term impacts – have always had to contend with uncertainty. They have always had to make educated judgements about actions in the present that strike the right balance between meeting the needs of current and future generations.

In one sense, therefore, nothing has changed.

However, the environment within which strategic infrastructure planning is occurring has changed from that which prevailed one or two generations ago. Climate change is now better understood and decarbonisation has become a key target for most governments, even if action to mitigate and adapt to that change is not everywhere occurring as quickly as science indicates is required. Population growth, at least in parts of the west, has slowed and in some cases is reversing, although urbanisation continues apace. Technological change appears to be accelerating. The role of governments in fostering socially

inclusive economic development has also been highlighted in many jurisdictions, including, for example, the UN's Agenda 21.

Governments will be called on to address these challenges and mediate demands from (often) divided polities. And they will need to manage this while facing growing fiscal constraints. These constraints will have consequences for infrastructure planning. More likely than not, infrastructure agencies will be called on to 'do more with less'. In this context, the core elements of strategic planning and decision-making practice also remain unchanged. Governments need to be able to present a clear vision and objectives that particularise that vision. They need to analyse various problems and opportunities that bear on the attainment of those objectives. They need to consider carefully options to deal with those problems and take advantage of those opportunities.

Equally, though, strategic planning practice needs to evolve. The mix of capital investment will need to shift to take account of various megatrends. Decarbonisation is the main, but not the only, example. Governments will also need to make greater use of established techniques – for example, scenario planning and real options analysis – to better understand the durability and efficacy of decisions in an uncertain environment. These techniques can assist governments in taking decisions that are scalable and adaptable.

Importantly, there are signs of deeper, more fundamental shifts in infrastructure planning practice, driven by a recognition of the scale of the challenges posed by climate and economic change. For example, the Infrastructure Commission for Scotland's argument that there should be presumption in favour of enhancing, re-purposing, or maintaining existing infrastructure over developing new infrastructure is a significant philosophical shift.

The Generational Investment Approach being developed by the New Zealand Ministry of Transport reflects a similar ambition to take a long-term view and seeks to deal with uncertainty in a broad manner. In a sense, the approach appears to be translating some of the thinking behind project-based real options analysis to broader infrastructure spending programmes. The approach's focus on considering collections of potential investments, and avoiding decisions to proceed with "first ready" proposals, echoes arguments raised in other jurisdictions.<sup>12</sup>

Not all decisions will be scalable or adaptable. Given the fiscal constraints mentioned above and the materiality of those decisions, the need for rigour will be more important than at present. This highlights a broader message – governments will need to invest in understanding their infrastructure networks, both those they own and those they regulate. Development of this capability will assist governments in their stewardship of infrastructure assets. It will also assist them in engaging with the communities they represent, particularly in working with communities to understand and participate in what are likely to become more difficult planning and investment trade-offs.

Finally, a better understanding of each nation's infrastructure networks will encourage greater attention and spending on the maintenance of those networks. Although there will always be exceptions to the rule, the maintenance and lifecycle replacement of existing assets should be the first priority for infrastructure spending. This is particularly the case when recessions or periods of economic crisis demand stimulus spending by governments, and when finance is available at historically low rates.

## Recommendations

- Future infrastructure plans need to be developed using scenario analysis, and governments should engage with the public and private sector in the development and use of those scenarios

for planning purposes. Governments should establish a scenario planning capability within their infrastructure agencies, and where that capability exists, it should be developed.

- In light of the historical variation in discount rates used in project and policy appraisal, and prospective environmental, economic and fiscal challenges, governments should review their current discount rates and the conceptual basis for their determination.
- Given the potential risks associated with making large investments in an uncertain environment, governments should consider making wider use of real options analysis to assist in the planning and decision-making about medium to large-scale projects and programmes.
- Given prospective fiscal constraints, government should continue to expand the application of user charging and pricing as part of a broader suite of measures to manage the demand for infrastructure and defer the need for infrastructure investment. User charging arrangements will need to be complemented by subsidy programmes to address any social impacts associated with the charges.
- Governments need to invest more in the collection, analysis and presentation of data - including service targets and levels, asset condition, risks to assets (notably from climate change/extreme weather events), and demand projections - to assist in the prioritisation of infrastructure investment.
- Government should invest in feasibility studies and project development, both to provide the foundation for better decision-making and to establish a portfolio of projects that can be funded and develop quickly during a recession or economic crisis.
- Governments should focus on redressing maintenance backlogs and the development of smaller capital projects when designing stimulus programmes.
- Governments should invest in skills development (particularly in technology related areas such as rail signalling and intelligent transport schemes) and data analytics.
- Governments and Parliaments should consider establishing guidelines aimed at encouraging stable medium-term levels of expenditure on infrastructure, thereby increasing transparency for the public and creating an environment where firms working in the infrastructure sectors can invest.

## Notes

- 1 Although it is beyond the scope of this paper, what constitutes ‘planning’, and whether planning of complex infrastructure networks can now be undertaken by governments alone (or perhaps at all) is a matter deserving further consideration. In the early 21st century, planning is different from what it was in the mid-late 20th century. Around the world, trust in government has fallen. The role of the state is smaller. Globalisation and market concentration have continued, and large firms are increasingly making their own planning/investment decisions or shaping government decisions. Technological change is affecting infrastructure decision-making in many ways. Ride-sharing apps, readily available video conferencing software, and real-time locational information come to mind. Planning the development of those systems and how they may be applied is not entirely within government’s control. Wider use of social media, and a growing political divide across many developed countries, also point to (variously): a greater ability to participate in planning and other decision-making processes; the ability for those processes to be disrupted by ‘legitimate’ or ‘illegitimate’ campaigns aimed at influencing government decisions. That said, it is highly unlikely that the challenges outlined in this paper can be addressed effectively (if not resolved) without some form of government action, including in relation to infrastructure. The challenge for governments is to consider how the developments above (and others) may complement or make ineffectual their own efforts at infrastructure planning.
- 2 That said, the European migrant crisis of 2015-16 shows that population issues are not entirely within the control of individual states.
- 3 Strictly, the deadweight loss would vary with the type of taxation. For example, land-based taxes are generally regarded as having lower deadweight losses than, say, personal income tax.
- 4 Drawn from the UK Green Book (see reference above).
- 5 Spackman, M. (2004) “Time discounting and the cost of capital in Government”, *Journal of Fiscal Studies*, Vol. 25, No. 4, <https://doi.org/10.1111/j.1475-5890.2004.tb00547.x>
- 6 See reference for Moore and Vining above.
- 7 For example, some privately-developed tollways in Sydney and Melbourne were delivered in the late 1980s to early 2000s at no cost to government. They were developed in locations where: (a) there was substantial pent-up demand for an improved transport link; and (b) the road could be built comparatively inexpensively on corridors that had been previously set aside and acquired by the government. The combination of high demand and low capital costs enabled tolls to be set at a level that could meet capital and recurrent costs.
- 8 International Transport Forum (2015)(2018), *Statistics brief: Infrastructure investment*, July 2015, August 2018. See: <https://www.itf-oecd.org/sites/default/files/docs/2015-07-spending-infrastructure.pdf> and <https://www.itf-oecd.org/sites/default/files/docs/infrastructure-investment-stable-statistics-brief-revised.pdf>
- 9 Data for Colombia, Finland, Hungary, Ireland, Israel, Latvia, Norway, Poland and the United Kingdom is incomplete, and has therefore been excluded from the analysis.
- 10 The report noted that the estimate “does not account for the cost of addressing the large maintenance and renewal backlogs and infrastructure deficiencies in many economies. Nor would it raise the standard of infrastructure in emerging economies beyond what we would expect as part of a normal development trajectory. In short, while access to basic human services such as water, sanitation, electricity, and all-weather roads would continue to expand, this would happen at current, often inadequate, rates. The World Bank estimates that on current trends, universal access to sanitation and improved water is more than 50 years away in most African countries. Our projection also does not take into account the costs of making infrastructure more resilient to the effects of climate change or the higher cost of building infrastructure in ways that have less impact on the climate and the environment.
- 11 This recommendation, and other points listed here, are drawn from: Kennedy et al (2018).
- 12 For example, the Quinet Mission in France argued, “...we can only recommend that the review of projects should not be carried out only individually, but rather for sets of projects, in the context of multi-year programmes. This would avoid “races” between projects, of which we have seen unfortunate examples in past years. In these races, one is never sure that the approved project is really more efficient than all those that have not yet been examined.” *Commissariat général à la stratégie et à la prospective* (2013) *Cost benefit assessment of public investments: Final Report Summary and recommendations*, <https://www.strategie.gouv.fr/english-articles/report-cost-benefit-assessments-public-investments>

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## Annex. New Zealand Generational Investment Approach

The New Zealand Government is in the early stages of developing a new approach to identifying and evaluating transport investments which may occur over the next 50 years.

Traditionally in New Zealand, the land transport system has been supplied by government. This has generally resulted in incremental changes. The railway system has been in a managed decline for decades, and change is often thought of in simple terms of ‘catching up’ with deferred maintenance for the foreseeable future. The New Zealand Government wants to choose and deliver a transport system which will be relevant in 2070 and not outdated in a fast-changing world. The new Generational Investment Approach (GIA) will move away from predict and provide to focus on broader intergenerational investment needs that keep up with technology and societal demands, as well as driving understanding of whether funding frameworks and non-investment levers are fit for future purpose.

To be relevant in 50 years, the GIA aims to consider possible future scenarios and the radical interventions which these might entail. In doing so, such interventions can be continuously evaluated as an uncertain future unfolds. It is also possible to consider whether early action and effective planning can avoid some interventions. The GIA requires engaging people internationally to obtain their insights into how the world is and how it could change over the next 30 to 50 years. Interventions will be identified in order to respond to those futures (there will be many) and evaluate them using a multi-criteria decision analysis (MCDA) process to supplement the traditional efficiency and effectiveness analyses (such as cost benefit analysis).

The MCDA process involves the development of a common understanding of the strategic direction and planning of transport and land use, enabling structured and information-rich conversations among decision makers about the trade-offs and relationships between investment choices. It enables the value created by proposed interventions to be compared according to a broad range of criteria which align with the government’s *Transport Outcomes Framework* and *Living Standards Framework*. As the future draws nearer, interventions which have been proposed will either be discounted or, be prioritised as projects to be included in programmes which optimise the use of available funding.

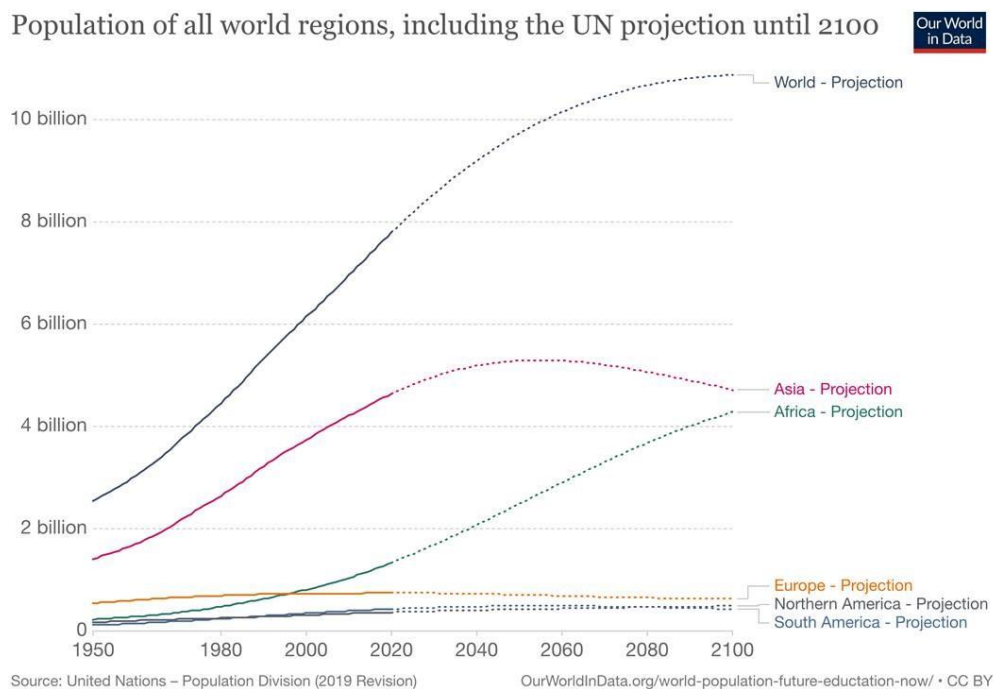
A lesson from responding and recovering from the Covid-19 pandemic is the value of having flexible frameworks that allow adaptation to unexpected events. This new approach is expected to result in a preferred future model which takes a long-term view and where new information can be incorporated as the components of potential interventions emerge from an uncertain future. This is different to traditional cost benefit analysis which typically depends on whatever information is available at the time an option is evaluated. With the GIA, potential future interventions will be discussed early in the conception stage when traditional cost benefit analysis wouldn’t be possible. This will reduce the risk of missing opportunities, or of going with the “first ready” proposals. Taking a broader view across a range of government services, this approach allows interventions to be tailored to make better use of available funding. It also has the benefit of establishing a common language and understanding of the future across the transport sector, resulting in greater alignment across transport planning efforts and confidence in short to medium-term investments.

The New Zealand Ministry of Transport has overall leadership responsibility for the transport sector. Part of the GIA will be to ensure that the nature of the role, and the relationships with the rest of government, are much better defined and aligned. This, in turn, will allow better joined up services for delivering a transport system that improves well-being and liveability for all New Zealanders.

A prototype of the MCDA process was trialled to evaluate and prioritise about 150 large scale options across different transport modes. The process usefully brought together multiple agencies to consider the long-term transport outcomes from different perspectives and to engage in meaningful discussion around co-benefits and trade-offs. It also enabled the comparison and prioritisation of projects across portfolios, for instance transport and urban development, on a value for money basis; and it allowed the comparison of different kinds of travel modes and intervention. A key lesson is that good information describing value is essential to successfully choosing the right interventions.

Source: New Zealand Ministry of Transport

**Figure 1: World population by region projected to 2100, 1950 to 2100**



Source: Our World in Data using United Nations medium population projections.

<https://ourworldindata.org/world-population-growth>

## Temporal Issues in Strategic Infrastructure Planning

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This paper considers the temporal dimensions of strategic infrastructure planning. Planning and investment decisions taken by the current generation leave a legacy (good or bad) for future generations. These temporal dimensions are reflected in two broad questions: What are governments and private infrastructure owners planning to do over the medium to long-term, and why? And how much should be spent in the short-term, on what and, again, why?

It was written for the ITF Working Group on Strategic Infrastructure Planning. All resources from the Working Group are available at: [www.itf-oecd.org/strategic-infrastructure-planning-working-group](http://www.itf-oecd.org/strategic-infrastructure-planning-working-group)