

A case study prepared for
the New Zealand Productivity Commission

How funding and financing affects productivity: Implications for three- waters reform and for local government funding and financing

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June 2019

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Based in the capital city of New Zealand, CSA provides strategic policy advice to government and private sector clients. CSA has deep expertise in regulatory policy, market design, pricing theory and practice, competition and infrastructure issues, and the implications of innovation and technology change for regulatory design, productivity and economic growth.

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Acknowledgements: Sincere thanks to the Commissioners and members of the local government funding and financing inquiry team – particularly Steven Bailey, Ron Crawford and Geoff Lewis – for their input into this note.

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1 Introduction and purpose

As requested by the Minister of Finance, the Productivity Commission (the Commission) is undertaking an inquiry into local government funding and financing (LGFF) in New Zealand. In parallel with this work the Government is also considering reforms to the regulation, funding and provision of drinking water, wastewater and stormwater services (commonly referred to as the three-waters sector).

A key component of the Government's reform effort is to better enforce health and environmental standards and reduce discretion about meeting some of those standards. These changes are likely to increase the three-waters funding and financing requirements on some councils, and very large increases could occur for some councils serving small populations.

Capital expenditure on three-waters is expected to exceed 31% of total capital expenditure of local government over the next ten years. Clearly, councils will need to increase the productivity of the three-waters sector to contain their funding and financing pressures and minimise affordability pressures on their communities.

The Commission therefore engaged Capital Strategic Advisors (CSA) Limited to undertake a case study of the three-waters sector, to identify changes councils could make to how they fund, finance and operate their three-waters activities and their business services more generally.

The Commission requested the case study:

1. Identify the implications of the three-waters reforms for the work the Commission is undertaking on Local Government Funding and Financing (the LGFF Inquiry).
2. Assist the Commission to form a considered view on the three-waters reform programme that is coherent with the Commission's position on the LGFF Inquiry.

2 The concerns and focus of both workstreams

At a high level the drivers for the three-waters reforms and the LGFF Inquiry are similar: both are driven by concerns about service levels and quality of supply, increasing costs and rising performance expectations. The rest of this section explores these interrelationships in more detail.

2.1 Concerns leading to the three-waters reform programme

Concerns about the performance of the three-waters sector have been bubbling away for many years. Those concerns boiled over during and after the Havelock North contamination of drinking water, which resulted in several deaths, long-term chronic health problems and the widespread outbreak of illness. About 5,500 people became ill and around 45 were hospitalised.

The Government inquiry into that event reported the outbreak was likely caused by sheep faeces seeping into a bore due to heavy rain causing an overflow of a pond located some 90 metres from an aquifer (Government Inquiry into Havelock North Drinking Water, May 2017, p3). However, the inquiry report made it clear the illnesses may not have occurred had the water provider (Hastings District Council) adhered to the high level of care and diligence expected from them and likewise for

the regulators (the Hawke's Bay Regional Council and drinking water assessors from the Hawkes Bay District Health Board) (p2).

The inquiry report also made it clear the provider's failings applied especially to its mid-level managers, who delegated tasks but did not adequately supervise or ensure their implementation despite a similar outbreak in 1998 at the same bores and a significant history of positive E.coli test results. According to the inquiry report, the provider did not properly manage the maintenance of plant equipment or keep records of that work, it carried out little or no supervision of necessary follow-up work, it was slow to obtain a report on bore head security (a key plank in source water security) and it did not promptly carry out recommended improvements (Government Inquiry into Havelock North Drinking Water, May 2017, p4).

The reality is that many communities cannot be certain that drinking water is safe. The Ministry of Health estimates that between 18,000 and 35,000 people become ill every year by consuming unsafe drinking water. During stage 2 of the inquiry the inquiry members accepted an estimate that up to 100,000 people per year may become ill from unsafe drinking water (Government Inquiry into Havelock North Drinking Water, December 2017, p31). It also reported there were at least 13 other waterborne outbreaks in the 10 years preceding the Havelock North outbreak (p19).

Compliance with current drinking water standards is 88.4% for supplies serving populations of 10,000 or greater, and the rate declines as population declines. The compliance rate is 31.5% for supplies serving populations of 101-500 people (Minister of Local Government and Minister of Health, 2018, p6).

The Havelock North Inquiry reported in its stage 2 report:

almost 10 years after the 2007 amendments [introducing mandatory drinking water standards in the Health Act], there are still 759,000 people (20 per cent of the serviced population) who are supplied water that is not demonstrably safe to drink. Of these, 92,000 are at risk of bacterial infection, 681,000 of protozoal infection, and 59,000 at risk from the long-term effects of exposure to chemicals. (p25)

there has been no marked improvement in the number of suppliers supplying safe drinking water throughout the 2009-2016 period. (p26)

A 2014 survey by Local Government New Zealand (LGNZ) distinguished between minor breaches of current drinking water standards and non-minor breaches. It showed that 60% of local councils serving metropolitan areas had minor breaches and none had non-minor breaches, although 15% of councils serving metropolitan areas did not respond to the survey. This contrasted markedly with the results for councils serving provincial and rural areas, where 25% had minor breaches, about 5% had non-minor breaches and the non-response rate was about 50% (Local Government New Zealand, 2014, p17).¹

Council wastewater systems are also performing poorly. Wastewater plants are degrading freshwater and coastal water quality, and sewage overflows are occurring at a frequency that is no

¹ The high non-response rate to the LGNZ survey may mean the amount of non-minor breaches is greatly under-estimated. For example, if half of the non-respondents had non-minor breaches then around 30% of provincial and rural councils may have had non-breaches, rather than the 5% presented in the survey.

longer acceptable for communities. In many regions, regional councils do not (and are not required to) publish sufficient information to provide assurance about the impact of wastewater services on the environment.

If comprehensive information were available, it is likely many hidden problems would become exposed. An audit of the Waikato and Manawatu-Whanganui wastewater systems showed that 50% of plants were non-compliant with consent conditions in 2017-2018. Ten percent of wastewater treatment plants are legally operating on expired consents for long periods of time (in some cases, decades), and this may soon become far worse as 20% of consents are due to expire by 2022.

There are also challenges facing council stormwater services, but their nature is different to those facing reticulated drinking water and wastewater, in large part because stormwater is an open system that is closely associated with roading and urban land use. There is a lack of good quality information about the condition of stormwater infrastructure and its susceptibility to climate change.

The Department of Internal Affairs (DIA) has marshalled considerable evidence about areas of under-performance in the three-waters sector, which include:

1. Serious breaches of health and environmental requirements by reticulated water providers.
2. Poor monitoring and enforcement of breaches.
3. Limited public transparency about breaches, service levels, and the condition of water assets.
4. Concerns about increasing affordability issues, particularly in relation to paying for the costs of meeting existing regulatory standards and the prospect of more stringent standards.
5. Poor governance and management capabilities by many reticulated water suppliers, and concerns about the productivity and efficiency of the sector.

To address the areas of under-performance, the government is considering extensive reforms to the regulatory regime for the three-waters sector and altering the way in which water services are delivered in New Zealand. Section 6 discusses the three-waters reform programme in more detail.

2.2 Concerns leading to the local government funding and financing inquiry

The terms of reference for the LGFF Inquiry identifies a mix of factors driving the Government's request for the LGFF Inquiry: significant and on-going increases in local government rates and costs, limits on their borrowing, and increased expenditure demands, particularly regarding infrastructure. The terms of reference requests an independent inquiry into local government cost pressures, decision making and affordability.

In addition to the work on the three-waters sector, the Government has significant work underway to address constraints on urban growth, relating primarily to constraints on land supply, development capacity and infrastructure provision. Both sets of work will likely involve funding and financing issues. The terms of reference for the LGFF Inquiry requires the Commission to complement the current work on these projects rather than duplicate them.

Although the three-waters and urban growth work will provide useful context for this Inquiry, they are focused on specific aspects of the funding and financing system (eg, funding and financing infrastructure to support housing supply) or on specific classes of infrastructure (three-waters). The

LGFF Inquiry is an opportunity to take a holistic look at the funding and financing system as it applies across the range of local government functions.

The Commission has in recent years undertaken significant reviews of some local government functions. However, the last comprehensive review of local government funding and financing was the Report of the Local Government Rates Inquiry (the Shand Report), published in 2007. The terms of reference for the LGFF Inquiry also requires the Commission to have regard to previous reports, inquiries and reviews, but it should also look to bring new and innovative thinking to these issues.

2.3 The terms of reference for the LGFF Inquiry

The terms of reference for the LGFF Inquiry requires the Commission to examine the adequacy and efficiency of the current local government funding and financing framework. It goes onto state the inquiry will investigate:

Cost pressures

- The factors (including the mix of services and investment) that drive local authority costs now and in the foreseeable future. This is to include an investigation of the drivers of cost and price escalation, in particular:
 - Whether this is a result of policy, and/or regulatory settings.
 - The role of growth/decline in population (including visitors and other temporary residents).
 - The impacts of Treaty settlement arrangements and costs of climate change on local authorities.
- In addition, the Commission should have regard to current frameworks for capital expenditure decision making, including cost-benefit analysis, incentives and oversight of decision making.

Funding and financing models

- The ability of the current funding and financing model to deliver on community expectations and local authority obligations, now and into the future.
- Rates affordability now and into the future.
- Options for new local authority funding and financing tools to serve demand for investment and services.
- Appraise both current and new or improved approaches considering suitable principles including efficiency, equity, affordability and effectiveness.
- How the transition to any new funding and financing models could be managed.

Regulatory system

- Any constitutional and regulatory issues that may underpin new project financing entities with broader funding powers.
- Whether changes are needed to the regulatory arrangements overseeing local authority funding and financing.

2.4 Interaction opportunities of three-waters and LGFF workstreams

The supply of three-waters services accounts for a significant portion of total local government expenditure in New Zealand. In 2017, operational expenditure (opex) on drinking water and wastewater, for example, accounted for nearly 14% of aggregate local government operational expenditure (excluding the costs of museums). Capital expenditure (capex) in these two areas accounted for 24% of aggregate capex for all councils in 2017, however five councils had water sector capex exceeding 45% of their total capex.² The costs of stormwater appear to be part of roading costs and are not separately identified.

Funding and financing pressures on councils from three-waters activities appear likely to increase over the next decade. According to their long-term plans, local government capex on three-waters is projected to be 31% of total capex over 2019–2028. This is a significant jump from the 24% average for 2017.

Inevitably some of the recommendations and guidance from the LGFF Inquiry will be applicable to local government's provision of three-waters activity. As three-waters activities are a significant part of local government activity, reforms to the three-waters sector may provide an early opportunity for local government to improve their productivity and ameliorate the funding and financing pressures they face. Focusing on the three-waters area may also provide an immediate opportunity for central government to present practical and tangible benefits of the Inquiry's recommendations.

3 General framework for high performance and productivity

Some of the key concerns driving the LGFF Inquiry and the three-waters reform programme are about lifting the productivity of the local government sector. Higher productivity means lower unit costs for providing a given service level, which in aggregate improves affordability. In effect, the Inquiry's terms of reference require the Commission recommend funding and financing arrangements commensurate with achieving high performance and productivity in the local government sector.

This section presents a general framework for high performance and productivity in relation to standard areas of economic activity: where monopolies, public goods, club goods and externalities are largely absent. This provides a baseline for considering the special characteristics of local government and the three-waters sector.

3.1 The macroeconomic perspective about drivers of productivity growth

At the macroeconomic level, a country's productivity growth is driven by technology advances and the accumulation of physical and human capital. Rapid and widespread adoption of technology is

² These figures are indicative only, as councils categorise expenditures differently. The five councils, excluding Christchurch, were Invercargill, South Wairarapa, Whanganui, Horowhenua and Whakatane. As a group, these councils also had high levels of capex for their water activities over the five years ending 2017, averaging 28% against an average of 18% for all councils over that period.

important for maximising productivity growth, and this often requires investment in new physical capital, workers learning new skills and hiring workers with suitable education, experience and skills. High levels of capital per worker also increase productivity and can be important for “catching up” with the productivity levels of the most advanced economies but in the very long-term it doesn’t increase productivity growth rates.³

Paul Conway, for the Commission, shows that New Zealand’s labour productivity growth has since 2006 “kept up” with the average labour productivity growth of the top 17 members of the Organisation for Economic Co-operation and Development (OECD), but there is a sizable productivity gap versus the OECD average and there is no evidence of any “catching up” with the OECD (Conway, 2018).

Conway posits two core reasons for this failure to catch up. The first is that productivity enhancing technologies may be spreading too slowly from firms operating at the global productivity frontier to firms operating at the domestic frontier and then onto domestic laggards. The second reason may be due to low productivity surviving in parts of the economy for too long, and so their resources are not reallocated to high productivity firms. There is some evidence for both slow diffusion of technology and slow reallocation of resources to high productivity firms.

Similar to the concerns about slow diffusion of technology, New Zealand firms may not be creating enough high value new products and new varieties of products and may have a poor ability to capture the commercial returns to them. The economic returns from these innovations can be extremely high and are likely a key enabler of long-term productivity growth for high-performing countries. Teece (2019), for example, states that “Investment, employment growth, wage growth, and economic expansion are driven by firms that earn exceptional profits.”⁴

Creating new products and new varieties of products requires repeated and disciplined experimentation. Creating high value ones requires innovations of significant value to the rest of the world. The potential profits and personal rewards can be very high for innovative people, their colleagues and the owners of their organisations.

In comparison, copying and adapting existing technology that is already widely known and widely adopted in the high-income OECD countries seems likely to deliver comparatively modest profits and rewards for NZ asset owners⁵ and managers undertaking the activity. However, the economic benefits for New Zealand as a whole can be very significant if a significant portion of firms make modest productivity gains, which may ultimately flow into correspondingly higher wages for labour.

Adopting widely-used technology is relatively low risk whereas creating new products and new varieties of products requires an appetite for higher risk and a relatively high tolerance of failure. The latter depends on social, political and cultural tolerance for risk and failure (“institutional settings”), which are sometimes reflected in commercial practices and in the law.

³ This point is very well established in the endogenous growth literature. An excellent treatment is provided in Romer (1994).

⁴ However, New Zealand’s innovators may face high costs and poor ability to fully commercialise or capture the commercial returns to their creations. Teece (2019) emphasises the difficulty entrepreneurial firms face appropriating the value they create. Value capture can be problematic for countries too if their firms are part of a global supply chain.

⁵ Asset owners include owners of human capital, including innovators with high value intellectual property assets.

Although central government plays a key role in shaping institutional settings, local government is also likely to have an impact, at least at the local level. Before considering the special characteristics of local government, the next subsection outlines why high performance and productivity in general requires an experimental and adaptive approach to producing goods and services. This is intended to provide a granular microeconomic framework for considering how industry specific policies affect productivity.

3.2 Improving productivity requires innovation

Complexity and uncertainty are fundamental features of most supplier activities, covering production, distribution and marketing. Suppliers in competitive markets strive to minimise complexity and uncertainty for consumers to attract their custom, and so the impact of these factors on suppliers may not be obvious to most people, including government officials and other policy-makers.

In practice, supply chains are generally very complex, involving considerable technology and workers with specialised knowledge and skills. They also often involve many sub-contractors and suppliers of intermediate goods and services, and various forms of collaboration with them such as informal relational contracts and formal joint ventures. There are many intricacies and nuances involved in supplier activities even for low technology environments, reflecting relationships and the need for co-ordination.

Suppliers face considerable uncertainty about future demand and cost conditions. Suppliers in competitive situations face buyers switching away from them and face considerable uncertainty about their future competitive advantage. They have imperfect knowledge about the capabilities and strategic choices of existing and potential competitors. In addition, technology, consumer expectations and government incentives and rules change frequently.⁶

Uncertainty also arises because of asymmetric information about partners, which affects the extent of co-operation among partners in a supply chain. In many cases collaboration can deliver large benefits for all or most partners in a supply chain but each sub-supplier gains from pursuing their own interests provided they retain the full co-operation of everyone else. Suppliers do not know with certainty the true attributes of their partners – that is, when circumstances change, will a partner serve his own interests without regard for the group's interests? As their partner's actions are costly to observe and verify, each supplier is uncertain about the circumstance in which full co-operation will be provided or withheld.⁷

It is generally impossible for a supplier to know with confidence the likely development path for their business and industry beyond a five to 10 year period. Often it is near impossible for them to know

⁶ Monopoly suppliers face very limited risks in relation to most of the factors mentioned in this paragraph, with perhaps the main exception being risks arising from changes in government price control regulation.

⁷ This type of problem is referred to as a prisoner's dilemma problem in the economics literature.

with any confidence the probabilities of various industry development scenarios beyond a 10 year period, and yet they often need to make decisions about long lived and irreversible investments.⁸

Sound and timely investment decision making increases productivity when the benefits of the investment outweigh its opportunity costs. But (as discussed above) it is very difficult in practice to determine which investments are best or even which have a reasonably high likelihood of commercial success. Option valuation techniques can assist in making these decisions but in reality investment decisions remain a 'trial and error' process.

David Teece and many other strategic management scholars characterise the business world as having *deep uncertainty* (Teece, 2019). William Janeway, a venture capitalist, states it aptly by writing "the Innovation economy ... is saturated in an unquantifiable uncertainty" (Janeway, 2012). This type of uncertainty has been well known since Knight (1921) discussed it almost 100 years ago, and it is often called Knightian uncertainty.

The consequence of deep uncertainty is that businesses and governments make operating and investment decisions that often under deliver relative to the "business cases" made for them. Some decisions under deliver so badly they compromise the viability of the operation or significantly harm shareholder and stakeholder value. Bad mistakes attract the attention of management and boards (and some are highlighted in the media). But many mistakes are not noticed by senior management because the under-performance in each case isn't material to the operation. But collectively, of course, a suite of moderately poor decisions can be material. They can 'creep up' unnoticed by managers and boards because their effects accumulate incrementally over time.

This isn't a criticism of government or private suppliers. Poor operating and investment decisions are made regardless of whether the supplier is private or government owned and they occur in all industries, including in the provision of public services. It also isn't making a case for smarter or more intelligent or more competent decision makers. The reality is highly educated and clever people make lots of mistakes too, and there are many examples of them making really bad mistakes.

The prevalence of mistakes reflects that suppliers face incredible complexities and uncertainties. This is one of the reasons for the evolution of various organisational and industry structures. People deal with complexity by specialising and joining teams of people with other skills (and assets) to collaborate to deliver the goods and services customers want. These organisations give considerable weight to what has worked best in practice. They build internal cultures, and rely on conventions and heuristics ('rules of thumb') that have evolved over time and have served their organisation well.

However, what has been right in the past is not necessarily going to serve a supplier well for the future. Suppliers have to be forward looking to make the most of their assets and capabilities. They'll often undertake considerable forecasting and analysis of their future world, and take into

⁸ Section 4 of this paper considers the special features of local government, one of which is their involvement in local natural monopolies, for example in the three-waters sector. Relative to firms in competitive industries, local natural monopolies face lower uncertainty arising from customer choices because customers are unable to switch to another supplier. But on the other hand, they face greater uncertainty because they're providing infrastructure services for which the investment horizon is typically far longer than for most firms in competitive industries.

account futures prices where they exist. But ultimately they deal with their complexities and uncertainties by experimenting, failing and refreshing their experiments until they've discovered what works well. Some undertake this experimental activity to proactively build their competitive advantage and some only do it in reaction to declining competitive advantage.⁹

Suppliers experiment about how to better satisfy their customer's demands or how to reduce their costs of supply. They're learning and adapting to the changing needs and preferences of their current and potential customers. They're also learning and adapting to the changing needs, motivations and capabilities of their partners, including their owners, workers, financiers, sub-contractors etc. Experimentation and failure can be very costly, and so they need to experiment thoughtfully and with discipline.

It is not going too far to state: *no experimentation and adaptation, then no innovation and no productivity gains*. Doing everything the same this month as last month means zero productivity gain.¹⁰ Doing anything different this month is an innovation. Even if a supplier is just copying well known technology advances from other suppliers, they have different customers, different workers, and sometimes different competitors and governments. Copying involves supplier-specific choices and so it involves experimentation and adaptation.

When customers can choose from whom they receive their goods and services, suppliers don't survive if they stop experimenting and adapting. If there is no customer choice then competition in the "political market" will *eventually* lead to the election of new officeholders that take action on behalf of their constituents.

The key point is that suppliers are innovators. Fundamentally, it is successful innovation that drives supplier productivity and collectively the productivity of the wider economy. Among other factors, the next section explains in more detail why customer choice is also a key driver of sustained productivity growth for suppliers.

3.3 Maximising productivity requires institutions that foster disciplined innovation¹¹

As suppliers are fundamentally innovators, their performance and productivity can be greatly affected by how economic, social, political and cultural institutions foster experimentation and deal with failure. They can be greatly affected by how these institutions reward or punish success and failure. Local government is a key institution affecting suppliers, especially the suppliers that it owns and operates and others that it regulates.

⁹ According to Teece (2019, p10), high-performing firms engage in continuous or semi-continuous *sensing* (identifying and assessing treats, opportunities, and customer needs, *seizing* (mobilizing resources to address fresh opportunities while capturing value from doing so) and *transforming* (ongoing organisational renewal).

¹⁰ Measured productivity might change because of exogenous output price changes, but true productivity (amount of output produced per unit of input) wouldn't change.

¹¹ This section draws quite heavily on John Kay's (2004) book entitled *The Truth About Markets*.

For reasons of brevity, this section focuses on just a few key economic institutions. Other institutional features are also important for New Zealand's overall productivity performance but for the purposes of the three-waters reforms they can be considered exogenous factors.

Plurality is a key enabler of innovation

At the economic level, plurality is a key enabler of innovation. Plurality in this context refers to there being several suppliers (and other parties) available to finance and fund innovations.¹² Financing comes from tradable instruments (eg, debt and equity instruments traded on markets), banks and other financiers, Funding ultimately comes from customers paying for goods and services they receive. The structure and ownership of an industry affects how it is financed and funded.

Innovative people rarely own enough capital to finance the development of their ideas through to a fully-fledged business. And successfully building a new business to reach a profitable scale can be greatly assisted by teaming with others with the right business experience and expertise. Suppliers can be incredibly valuable to innovative people if they have the right teams and supplier relationships (particularly with financiers), and if they have large asset and customer bases. They make it far easier for innovative people to access finance at low cost, market-test their innovations and reach profitable scale as soon as possible.

History is replete with examples of now-successful innovators failing at the outset to convince their employer to finance and staff the research and development of their proposals. And often those proposals are rejected by multiple outside parties, and only a 'hungry minnow' decides to finance and support them. Typically, the more radical the idea the lower the chances of gaining approval from large established players, and the more important it is for significant plurality to be present.

In practice, most innovative ideas should be rejected. Ideas are plentiful but commercially viable ones are scarce. It is never obvious at the time which proposal is 'the one' that will succeed. That is only known with hindsight, and only if it was chosen and successfully developed.

A good plurality of suppliers is highly conducive to fostering successful innovation because it provides employment choices for innovative people. For innovative people, though, employment is about more than their take-home pay. It is also about the employer being a vehicle for funding and financing their ideas, and about teaming with other specialised employees and collaborating with supply chain partners, including universities and research institutions, in ways that increase the chances of successful innovation. A good plurality of innovation vehicles is no guarantee that a successful idea will find backing, but it greatly increases the chances it will.

On the other hand, single supplier situations typically involve less vitality, rivalry and experimentation. If an industry has only one supplier/employer then innovative employees can face insurmountable hurdles to progressing their ideas if their ideas are rejected by the employer. This

¹² Plurality differs from competition. Plurality refers to the number of options available, or in this context the number of suppliers in the market. In contrast competition refers to the degree of rivalry among suppliers. Competition authorities often refer to the degree of competition in terms of a supplier's ability to sustainably raise its prices.

isn't always the case, though, as monopolies sometimes create a strong innovation culture.¹³ But even if a monopoly is strongly pro-innovation – as seems to be the case for some gas, water and electricity utilities in New Zealand – the absence of plurality greatly reduces the chances that the truly value-creating innovation will be developed and implemented. There is also a significant risk the overall level of innovation will be stifled because far fewer innovations will be pursued compared with pluralist industries in which multiple suppliers are innovating.

In practice a single supplier may achieve high productivity from exploiting its economies of scale and scope. As it is the only supplier in the industry, its scale of operation could *in theory* foster greater capability and expertise inside the firm, enabling it to achieve high ongoing productivity growth. But there is a trade-off between these gains and the reduction in industry productivity growth from reducing the number of independent vehicles available to innovative personnel. Aggregating all suppliers into a single supplier may improve an industry's capability to develop and implement innovations, but are they the right innovations? A diversity of vehicles for innovation increases the chances the right innovation (a high value one) will be selected, developed with urgency, and enter the market and deliver high value gains to society.

Figure 1 on page 16 illustrates this trade off. It takes the extreme case where scale considerations imply that all suppliers should be merged to create a monopoly. But taking into account the loss of value from removing diversity of vehicles for innovation, the optimal industry structure is to have six suppliers.

In some cases an innovative person may be in a position where there is no current employer willing to back his or her proposal. This is often the case for innovations of totally new goods and services, but it can also occur for innovations of new varieties of existing goods and services. In these cases a plurality of financiers fosters experimentation and innovation.

Customer choice provides for disciplined innovation

Customer choice is another critical component of the process of successful innovation. As well as providing timely feedback, customer choice provides high-veracity (“no bullshit”) feedback on the usefulness of innovations. This greatly disciplines experimentation. Experimentation is either stopped or re-fashioned when customers reject it (by not taking up a new service offering or by switching to other suppliers). There is no greater disciplining force on innovators.

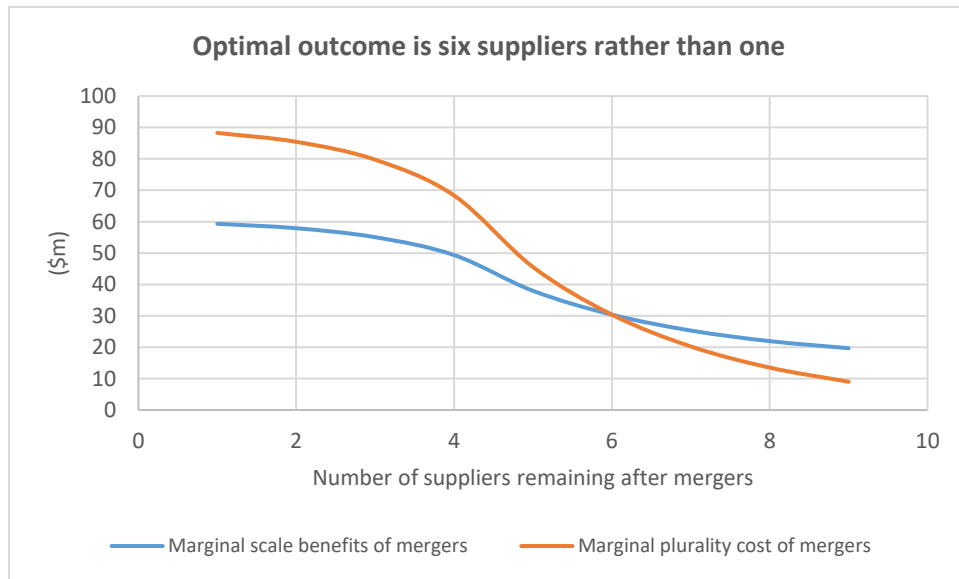
In contrast, in a single supplier situation there is no customer choice and “voice” becomes a key feedback mechanism. This includes commentary from customers and internal stakeholders, such as owners and organisational personnel competing for the resources that could be devoted to a fresh phase of re-experimentation. In general, voice feedback mechanisms provide weak discipline, and sometimes actually undermine discipline.

Table 1 on page 17 identifies some of the differences between customer choice and voice. In short, voice feedback mechanisms lack clarity and veracity.

¹³ There might be various reasons for this. The chief executive and board might have a pre-disposition for innovation or perhaps they have personal incentives (eg, reputation in the CEO and director markets or in society more generally) to foster innovation.

Figure 1: Trading-off scale benefits against plurality benefits

Consider a hypothetical industry with 60 suppliers, all of equal scale. Assume that merging suppliers increases their productivity for the reasons discussed in the main text above. The horizontal axis in Figure 1 shows the number of suppliers remaining after all mergers have occurred, and the vertical axis shows the marginal benefits from further increasing scale and the marginal cost of the consequent reduction in plurality.



The blue curve shows the marginal scale benefits of mergers is highest when all 60 suppliers are merged into a single entity, to create a monopoly supplier. This maximises the supplier's scale and specialisation of resources. However, the orange curve shows the marginal cost of reduced plurality when suppliers are merged.¹⁴ The marginal plurality cost of having a monopoly supplier is very high, and this reduces as the number of suppliers increases. Taking into account the costs of reduced plurality, the optimal industry structure in this case is six suppliers, rather than just one supplier if the impact on plurality is ignored.

¹⁴ Alternatively, the orange curve can be read as the marginal benefit of increasing plurality by reducing the number of firms in each merger (so that more firms remain after all mergers have occurred).

Table 1: The disciplining power of choice over voice

Customer choice	Customer voice
Consumers have no reason to misrepresent their views in the hope of private advantage	Consumers may have incentives to misrepresent their views (called “gaming”), and their responses can depend on how survey questions are framed
The intensity of customer views is revealed	Difficult to truthfully measure intensity of customer views
Views are easily aggregated as they show up in the form of “lost business”, and are measured financially	Often multiple options exist for aggregating views that, in turn, produce different headline results
Accounting processes automatically record and report customer choices to decision makers	Bespoke processes are often adopted for recording and reporting feedback; the timing and veracity of reports to decision makers can be manipulated
Significant financial consequences tend to attract the attention of senior managers and boards	The implications for customer value are inferred and not explicit. This makes it easier for boards and senior managers to defer action as the financial position of their firm is not greatly affected
The financial consequences of customer choice often provide a helpful counterfactual for building a business case for taking costly action	Difficult for management to motivate a business case for action. The costs of action are highly visible, but the benefits are largely intangible to the firm

The poor veracity of voice feedback often creates opportunities for internal experts and outside expert advisors to fill the “veracity void.” But in practice experts are a weak substitute for customer choice. Often every expert has a different view, and the breadth of views often drives inaction. There is often a strong desire to reconcile disparate views by establishing expert panels. But this often results in ‘group think’. History is replete with examples of expert panels dealing very poorly with deep uncertainty and being badly wrong about the future.

Effective collaboration and competition are important drivers of innovation and diffusion of innovations

Wherever reasonably feasible, it is advantageous to have several competing suppliers exploring how best to serve their customers, and learning from customer choices. Strong competition creates an intense necessity to experiment and adapt so as to prosper or in some cases just to ‘stand still’.

However, collaboration can also be very important for experimentation and in particular for timely and effective diffusion of successful innovation. In practice there are many forms of collaboration. At one end of the spectrum are high level agreements to co-operate in some manner, such as sharing information or tying services. These are usually called alliances. The strongest form of collaboration occurs when two or more parties are merged into a single entity. Joint venture arrangements lie between these two cases.

Alliances and joint ventures occur quite often between two or more for-profit businesses but they also occur between businesses and non-profit organisations, such as universities and research organisations. These forms of collaboration assist parties to leverage their specialised assets and capabilities by combining them with the specialised assets and capabilities possessed by other organisations.

It is therefore critical that competition law and competition authorities allow collaboration where dynamic productivity gains are likely to be significant and competition concerns modest. Achieving the right balance is of course very difficult in practice, but an overly strident pro competition approach risks diminishing opportunities for large value gains from higher productivity.

3.4 Maximising productivity requires decision-making rights to be held by those with the knowledge and incentives to make the best long-term decisions

With all productivity gains driven by some degree of trial and error, it is essential decision-making rights over investment, production, marketing, pricing etc are held by parties with the knowledge and incentives to make the best long-term decisions. In this discussion the term *knowledge* is used broadly, to encompass possession of information, skills and expertise, and also decision-making capability.¹⁵

As should be clear from the above discussion, even if decision rights are aligned with those that have the knowledge and incentives to make the best decisions it won't prevent big mistakes or even total failure occurring, but it should reduce the chances of them occurring and increase the chances of productive outcomes.

A similar logic applies to consumers as they also need to have good knowledge and incentives to make wise decisions. In cases where a consumer is likely to have limited knowledge, for example goods for which quality is hard to observe, then various other institutional arrangements arise to address the issue. For example, consumer research and advocacy agencies, such as ConsumerNZ, are funded by their members to investigate and inform them about quality.

In relation to standard areas of economic activity, the following arrangements drive outcomes, including in relation to innovation and productivity:

Knowledge

1. Suppliers need good *knowledge* about what services and service levels consumers want. They obtain this knowledge from trial and error: putting their offers out to the market and seeing what happens.
2. In forming their expectations for services and service levels consumers need *knowledge* about the cost of using more of the service and the cost of demanding higher service levels. This information is provided by *Service-based and cost-reflective pricing*. Without it there will be a disconnect between what consumers receive and what they're prepared to pay for.

¹⁵ Decision-making capability is different from decision-making rights. The former refers to human capacity to make decisions whereas the latter refers to rights prescribed or proscribed by law and contracts.

Incentives

3. Suppliers need to have appropriate *incentives* to deliver the desired services and service levels at minimum cost over time. Otherwise they'll try to act in their own interests rather than in the interests of their consumers. For standard goods and services, consumer choice and competition provide these incentives.
4. Consumers need appropriate *incentives* to reveal what services and services levels they're prepared to pay for. Otherwise many will over state what they want. For standard goods and services, service-based and cost-reflective pricing provides consumers with the appropriate incentives to choose the goods and services that provide them with value at least equal to the cost of supply.¹⁶

Decision rights

5. Suppliers also need to have appropriate *decision rights* to decide how best to meet consumer needs in a timely and cost effective way. Poor production and investment decisions can occur when out-dated or poorly developed regulations restrict suppliers from pursuing their incentives to earn an income by supplying what they know or believe consumers want.
6. Consumers need to have appropriate *decision rights* to reveal what they want etc. Poor consumer outcomes can occur when out-dated or poorly developed regulations, for example, restrict consumers from buying what they want.

The management literature often lists a host of factors driving high-performing organisations. These factors often include inspiring leadership, talented staff, strategic awareness and a great strategy, fostering an agile, innovative and results oriented culture, measuring what matters, adherence to common values, robust processes and so on.

But at a high level the key factors are **Knowledge**, **Incentives** and **Decision rights** ("the KIDs"). If they have good KIDs then organisations have all of the essential ingredients they need to pursue high performance: they know the goals they're trying to achieve and how they might achieve them, they're motivated/incentivised to achieve those goals and they have the mandate/decision rights needed to pursue those goals.

Sometimes the performance of organisations and institutional arrangements are reviewed after very poor outcomes have occurred. These reviews typically list poor leadership or stewardship, lack of adherence to defined processes and rules or standards, lack of training and capability, insufficient funding and resourcing, etc. And typically those reviews recommend interventions targeted at directly improving these deficiencies: get a better leader, make the processes more accessible and easier to use, more training about compliance etc. But if you ask why the failures occurred, my experience is that eventually the answer comes down to poor KIDs: poor knowledge, or poor incentives and/or a poor suite of decision-making rights. Very often the primary issue is poor decision rights in the form of poor organisational, regulatory and institutional design.

¹⁶ To see this, consider what happens if prices materially fall short of the cost of supply for sustained periods of time. In this case consumers will purchase goods and services when they don't value them as much as the cost of supply, which wastes resources. If prices are materially above the cost of supply for sustained periods then consumers will forgo goods and services that they valued greater than the cost of supply. This also creates waste because consumers spend their income on other goods and services that they value less highly than those they didn't consume.

The rest of section 3 discusses the allocation of decision rights about funding and financing, governance and organisational boundaries.

3.5 Maximising productivity requires funding & financing arrangements that encourage innovation wherever it is valuable

Independent funding fosters and disciplines innovation

The funding of most economic activity in New Zealand ultimately comes from consumers paying service-based and cost-reflective prices for goods and services they receive. This approach to funding is important for fostering and disciplining innovation, because it means supplier funding is determined by millions of independent views of supplier performance. It also gives suppliers critical information about what their customers value and incentives to invest and produce in ways that best satisfy customer demand.

In practice, prices for final goods and services are often sticky: they do not move quickly to remain aligned with the short-run cost of supply or to ration demand when temporary supply constraints occur. Price stickiness often occurs because raising prices to deal with temporary shortages can be unpopular with consumers and so retailers are reluctant to do it. But retailers know that unnecessary supply shortages are also unpopular with consumers, and so they each work to avoid shortages where possible and preserve their reputation as a reliable supplier. The loss of short-term price incentives on suppliers is replaced by reputational incentives, and the latter is particularly effective when consumers have several suppliers to choose among.

Service-based and cost-reflective prices, even if only crudely reflective of short-run costs of supply, play a critical role in fostering and disciplining innovation. In addition to providing useful information and incentives, they also foster innovation by providing suppliers with independent sources of funding.¹⁷ To appreciate this, suppose all suppliers are funded by a single decision maker such as the government. This would seriously reduce true plurality: it would reduce the number of truly independent innovation vehicles available to innovative people because suppliers would be concerned to act in accordance with the wishes of their funder (the government in this example) as that is their lifeline.

An independent funding system, based on prices paid by consumers, disciplines innovation because customer choices carry potentially significant financial implications for suppliers offering new goods and services or new varieties of them. Customer choice, combined with independently-set prices, provides high-veracity feedback to innovative suppliers, as outlined in Table 1 above on page 17. High veracity occurs even if prices are sticky and are only crudely reflective of short-run costs of supply. In most cases, the dynamic efficiency gains from independent funding (ie,

¹⁷ In the scenario discussed here, supplier funding is independent because it is determined by the supplier's pricing decisions, and this often works well because it is disciplined by effective customer choice. Sections 4 and 5 consider situations where the supplier is a local natural monopoly and its prices are set by local politicians and the agencies under their direct control. A degree of independent funding is restored when supplier's prices are instead set by regulators that are statutorily independent from politicians and their agencies.

independent pricing) is often far greater than the static efficiency gains possible from driving prices closer to the marginal costs of supply.

Independent financing also assists with disciplining innovation

Standard economic activity is financed by banks and other financial institutions, including equity and debt markets. Independent financiers have strong incentives to require suppliers to adopt reasonably accurate, transparent and robust (not easily manipulated) measures of their performance. This assists with disciplining innovation because the true effects of customer choice are better reflected in the performance information senior managers, boards and financiers act on.

Independent financing also plays a more direct role in disciplining innovation. This is most obvious with venture capital markets, which provide both finance and governance expertise to new start-ups. Venture capital financiers ‘pull the plug’ on innovations that, after further development and time, look unlikely to be sufficiently successful to justify the costs and risks involved. But more standard financiers also play this role to some degree for more standard suppliers when they impose financial covenants on their lenders. Independent financiers add discipline because they’re independent, they’re usually a few steps further removed from their borrower than the borrower’s board and managers and it’s their money, or their client’s money, at stake.

In contrast, government financing of suppliers can inhibit innovation by undermining the true plurality of suppliers. It can also reduce discipline on innovation because government-financing ultimately rests on the government’s power to increase rates or taxes. There is less financial discipline on the financiers to impose financial discipline on their borrowers! Discipline may also be reduced by incentives on accountable politicians (and their officials) to continue financing bad projects in the hope they’ll prove successful while they’re in office or at least fail after they’re no longer interested in seeking political office.¹⁸

Reputation and contractual mechanisms foster innovations in quality of supply

The above discussion about funding and pricing arrangements drew no distinction between quantity and quality of goods and services. Typically, customers pay a specified price or prices for the quantity and quality they receive.

However, if quality isn’t easily observable by consumers at the time of purchase then reputational and contractual incentives operate to better align supplier incentives with consumer needs.

For low cost and short-lived goods and services, if delivered quality falls materially short of promised levels then the supplier suffers reputational losses as word spreads to other customers, sometimes aided by consumer research organisations like ConsumerNZ and the media. The potential for loss of new and repeat business provides incentives for suppliers to be attentive to

¹⁸ Similar incentives can come in to play with retiring board members, but other players have strong incentives to look out for any such problems and address them expeditiously. These other players include the remaining directors, any owners with a large value at stake, and parties interested in conducting a take-over.

their promises. These incentives don't always work perfectly, but they work well where it is low cost for suppliers to meet their quality promises.

For high cost and long lived goods and services, suppliers typically include standard warranties for quality breaches. Warranties typically cover the cost of repairs and/or provide money-back guarantees, and where relevant they can offer compensation for direct damages to a consumer's assets where that is caused by a quality breach. Warranties offering additional coverage typically involve additional charges for purchasers that want them. Again, they don't work perfectly but they work well in many cases.

The Consumer Guarantees Act (CGA) reflects government attempts to improve on these voluntary mechanisms, by standardising requirements to reduce ex-post transactions costs for consumers and suppliers. The specific requirements in these types of Acts reflect political and government-agency knowledge and incentives and so don't work perfectly either. But in broad terms they reflect the sophisticated nature of many goods and services in modern economies and the asymmetry of knowledge between household consumers and suppliers.¹⁹

These funding arrangements – driven by warranties, reputation-induced loss of business and also by compensation requirements in the CGA – provide useful information and incentives for improving supplier performance. As with customer choice, compensation systems mean below-standard quality outcomes are recorded in their accounting system, providing high-veracity information about the quality the business has delivered on average and in particular circumstances.

Also, as the supplier's overall revenue depends on how often it meets its quality standards or the standards required by the CGA, it has financial incentives to find better ways to meet those obligations. The supplier has many potential innovations it could invest in, each with uncertain pay-offs. Suppliers are incentivised to invest in innovations to improve quality when doing so is likely to deliver larger net pay-offs than other innovations it could pursue. This trade off can potentially maximise productivity because the actions with the highest expected increase in net value²⁰ for the business are likely to be undertaken.

We return to these considerations in the application of the framework to the proposed reforms of the three-waters sector.

3.6 Maximising productivity requires ongoing experimentation of organisational boundaries

In the face of inadequate capacity and specialisation in a firm or industry, the first call of “practical people” is to merge suppliers to create larger units to reduce unit costs and increase expertise and specialisation of resources. In regard to standard economic activities, however, there is a trade-off

¹⁹ This asymmetry is particularly acute for consumers for goods and services they purchase rarely, as anyone that has contracted the services of a builder to build their first new home will attest. The discussion here about sophisticated goods and services and information asymmetry confronting consumers parallels the discussion of complexity and uncertainty facing suppliers in section 3.2.

²⁰ The increase in net value to the business is the present value increase in its revenue less the present value cost of the innovation and normal business costs.

between the benefits of greater specialisation from larger scale and the benefits forgone from reducing the number of innovation vehicles available to innovative people (see Figure 1, p16).

The reality is that all organisations, leaders, managers and experts make a great many mistakes, and the larger the scale of operation they control the larger the mistakes. Even very intelligent people make big mistakes, and often incredulous ones in hindsight.

Extremely large-scale experiments are extremely risky, as evidenced by very costly mistakes made by the governments of centrally-planned economies and by the large-scale mistakes in centrally-planned industries in market-economies such as the electricity industry prior to deregulation. Very large corporations are no exception: there are numerous examples of large-scale and costly mistakes in the 'big corporate' world.

A similar logic applies in regard to collaboration. Effective collaboration often requires aligned interests and objectives, and common views about key strategic variables. It typically requires people to proactively seek mutually beneficial interactions within and across organisational boundaries. Large-scale collaboration is often ineffective if it is mandated from above, such as occurs when suppliers are forcibly merged. Some mergers succeed but many fail to produce anything close to the promised gains. A portion of them fail because of the difficulties with maintaining effective and valuable collaboration across merged entities.

In reality no one knows for sure how best to organise suppliers and industries. Even if there was an obvious solution for current conditions, suppliers operate in dynamic environments in regard to technology, competitors, suppliers, partners, workers, and government. Maximising performance and productivity over a sustained period of time requires arrangements that foster timely change, Small-scale innovation and larger-scale adoption of successful ones. This means decision rights need to be held by parties with the knowledge and incentives to make the best decisions about alliances, joint ventures and mergers, as and when needed.

In practical terms, it matters who, why and how collaboration and aggregation decisions are made. Getting it right is tricky and often context specific. Teece (2019) states it aptly: "Merely putting two business units or departments under common ownership and common governance need not bring about 'integration' and the sense of achieving full alignment and cooperation ... Successful functional integration can be tremendously hard, especially in contrast with disaggregation, which is often simple to accomplish." (p19)

The approach in the standard part of the economy is an organic one: a process of experimentation, learning and adaptation of organisational arrangements, viz merger activity. Similar to above discussions, funding and financing arrangements in the standard part of the economy foster and discipline merger activity. This 'merger market' performs best when there are several parties available to undertake them and when they face the consequences of their decisions. In short, 'diversity and incentives' works well on average.

We also return to these considerations in the application of the framework to the proposed reforms of the three-waters sector.

3.7 Summary of productivity framework

Figure 2 summarises the above discussion in reverse order:

- The far left cell depicts that funding and financing arrangements affect innovation decisions through their effects on the knowledge, incentives and decision rights (KIDs) of suppliers and financiers.
- The next cell states that good KIDs – such as comes from independent funding and financing arrangements²¹ – are needed for plurality, customer feedback, competition and collaboration to be most effective.
- The third cell reminds us that effective institutions (ie, effective plurality, customer feedback, competition and collaboration) foster disciplined innovation – that is, innovation that consumers value more highly than the supplier’s cost of innovation.
- The cell on the right-hand-side completes the picture with the well-known fact that innovation is the key driver of long-term productivity growth. But it emphasises that it’s not just any old innovation: it needs to be disciplined innovation for productivity growth to occur. It needs to be innovation that delivers an above-normal social return on investment.

Figure 2: How funding and financing arrangements affect productivity growth



4 Special features of local government and the three-waters sector

Section 3 presented a productivity framework for standard economic activity, to provide a baseline for considering the special features of local government and the three-waters sector. This section provides a broad overview of these features and discusses how the special features of the three-waters sector relate to other utility sectors, such as the electricity, gas and telecommunications sectors. The implications for the funding, financing, structure, governance and regulation of the three-waters sector are examined in section 5.

²¹ Independent funding occurs when suppliers set their own prices rather than politicians and agencies they control. If the supplier’s prices are regulated by government then a degree of independence occurs if the regulator is independent of politicians and agencies they control.

4.1 Local governments deal with non-standard goods and services

Local governments often provide services that would be significantly over-priced if provided by unregulated privately-owned firms. This can occur for services provided by a natural monopoly, especially where consumers are willing to pay significantly higher prices rather than reduce their demand. It is useful to refer to these as *local natural monopoly services*.

For example, installing *reticulated* drinking water and wastewater assets for concentrated populations involves large economies of scale, making it efficient in many cases for there to be just one local supplier of reticulated water services to serve each population.²²

Local governments also provide goods and services that would otherwise be significantly under-provided locally if they're funded entirely by consumers (called *local public goods*).

Technically, a public good is a good or service with two characteristics:

1. The consumption of it by one consumer does not reduce the amount available to any other consumer – this is called the *non-rivalry condition*. Charging consumers based on the volume they consume – called volumetric pricing – can be inefficient in these circumstances.
2. It is too costly to exclude consumers that use the good or service without paying for them – this is called the *non-excludability condition*. This can make it difficult, and inefficient, to charge entry fees at levels sufficient to fully fund the costs of the good or service.

It is important to appreciate the above definition reflects the underlying characteristics of the good or service, and not who owns the provider. In principle, the provider of a public good can be publicly owned (eg, owned by local government) or privately owned. The non-excludability and non-rivalry conditions imply that a privately-owned provider may need to be publicly funded to some extent to provide an efficient level of service.

Economists often refer to local parks and reserves as local public goods because users can often enjoy them with zero or minimal impact on other users and entry is free.²³ In many cases, however, it isn't very costly to install the "fences" needed to exclude non-payers and yet no fence has been installed. The absence of a fence reflects that the parks are uncongested even without an entry fee, and introducing an entry fee would stop some people from using the park even though their park usage imposes no marginal costs on society.

Local governments also often provide *club goods*. These are goods that one consumer can consume without reducing the amount available for other consumers, but the supplier charges

²² In practice, the competitive situation is more nuanced. Suppliers of reticulated water assets compete prior to installation of their assets, but once the assets are installed the market for reticulated water services is foreclosed for the economic life of the assets. Also, for dispersed populations reticulated water competes against self-service by water consumers, with reticulated water systems chosen when it is expected to be cheaper per consumer than each consumer having its own dedicated water systems. Furthermore, reticulated water competes against bottled water, even in densely populated areas.

²³ Economists often assume entry is free because it has been too costly to install the mechanisms (fences, monitoring equipment, entry gates and tolling equipment) needed to ensure everyone using the park pays for doing so. This isn't always the case, however.

consumers for their use. For example, swimming pools, leisure centres and golf clubs are typically club goods.²⁴

The supply of roading and stormwater services appears to have both public good and club good attributes. Roads are local public goods when they're uncongested and it is too costly to toll parties using them. Some roads become a club good because users pay tolls to use them. For example users pay tolls for the Tauranga Eastern Link road in the Bay of Plenty, the Tauranga-Takitimu Drive road, and the Northern Gateway Toll Road north of Auckland (between Silverdale and Puhoi). These roads become impure club goods when traffic congestion occurs on them.

Local governments also regulate to reduce *local negative externalities* arising from private and public sector behaviour. For example, some privately-owned suppliers may produce considerable emissions (noise, bad odours, smoke, effluents) in the course of their production activities that negatively affect other suppliers, neighbours and the population generally. Local government-owned suppliers can also create negative externalities, for example the discharge of polluted wastewater and stormwater into the natural environment. Consumer activity can also negatively affect other consumers, and so these are local negative externalities too. For example, smoking, disorderly behaviour, etc.

Local government regulates these harms by constraining or restricting the decision rights of the parties creating the negative externalities.²⁵ In the case of wastewater and stormwater, local governments regulate suppliers by requiring them to treat the water to remove pollutants before discharges occur.

Finally, local governments often compete for *local positive externalities*. They often seek to attract economic, social and cultural activities they believe provide positive agglomeration and network externalities for their constituents. For example, attractive amenities and sporting and cultural events are often provided by councils to attract high-income earning populations. High-quality infrastructure services may also provide positive externalities, particularly transport, water, electricity and communications infrastructure.

4.2 Inherent features of the three-waters sector

Section 4.2 focuses primarily on conveyance services rather than on other components of the supply chain, such as the sourcing, extraction and treatment of reticulated drinking water or the retailing of it. These other components are discussed in more detail in section 4.3 below.

²⁴ In terms of the technical definition in the text, a pure club good fully satisfies condition (1) but not condition (2). A pure private good satisfies neither condition. In practice, club goods often exhibit some degree of rivalry or congestion, for example when a swimming pool becomes crowded the behaviour of one user can significantly impinge on the enjoyment of other users. In practice, most club goods are impure club goods. Technically, public parks are club goods when it isn't prohibitively costly to install exclusionary mechanisms, even if such mechanisms are not actually installed.

²⁵ Some regulations prohibit suppliers undertaking certain actions in some cases and in other cases they compel them to undertake certain actions. The former type of regulation constrains supplier decisions about undertaking an action and the latter constrains their decisions about not doing something.

The conveyance of drinking water and wastewater has inherent natural monopoly, club good and externality features

The Productivity Commission discussed inherent features of reticulated water in its report *Using land for housing*, focusing mostly on economies of scale and scope (New Zealand Productivity Commission, 2015, p. 242).

In practice the conveyance of reticulated drinking water and wastewater exhibits several inherent features:

- The conveyance of drinking water and wastewater exhibits large *economies of scale*. This applies to the conveyancing of drinking water and to the conveyance, treatment and discharge of wastewater. This means it is efficient to have only one supplier of reticulated drinking water and one supplier of reticulated wastewater services for each population cluster: a local natural monopoly for each reticulation system.
- There appear to be reasonably strong *economies of scope* in the provision of both drinking water and wastewater conveyance services. This means it is likely to be efficient for both monopoly services to be provided by one entity. In principle multiple parties could be involved in sourcing, extracting and treating drinking water. Multiple parties can be involved in retailing drinking water and wastewater services, as occurs in England and Wales for business customers.
- The quantity of drinking water and wastewater used by consumers is a *private good*. This is because it is rival and excludable. It is rival because an extra litre of drinking water (or wastewater) used by one consumer reduces by one litre the quantity of drinking water (wastewater) available in reservoirs.²⁶ It is excludable because consumers can be excluded from connecting to a reticulation system if they refuse to pay connection charges and they can be excluded from drawing water from the system if they refuse to pay volumetric charges.²⁷
- However, the quality of reticulated drinking water is a *club good*. Each time a consumer drinks reticulated water it experiences the same quality (taste, colour, smell and contamination levels) as other consumers served by the same reticulation system.²⁸ Similar comments apply in regard to wastewater, in relation to colour, smell and pollutants. This means collective decision making by water consumers – perhaps via elected

²⁶ Note if the short-run marginal cost of water is zero then water consumption is effectively non-rival: in this hypothetical case, any consumption of water by one party can be replenished at zero cost and so the amount available to other consumers is unaffected. In this case the quantity of water would be a club good rather than a private good.

²⁷ Technically, water consumption is excludable because the transaction costs of excluding non-payers from drawing water from reticulated systems is not prohibitive. Political concern about consumer access to reticulated water may in practice reduce a supplier's ability to exclude consumers, however these concerns are usually in relation to low income consumers rather than all consumers.

²⁸ Technically, water quality is a club good because consumers can't consume quality without consuming quantity, and quantity is a private good. Generally, consumers can choose alternative qualities of supply by purchasing bottled water or by establishing their own water supply, in which case they avoid paying for reticulated drinking water.

representatives – may, in some circumstances, assist with better aligning the supplier's decisions about quality of supply with the preferences of consumers.²⁹

- The quality of both drinking water and wastewater can also impose *negative externalities* on others. For example, unhealthy drinking water imposes costs on the health sector. The discharge of polluted or contaminated wastewater imposes negative externalities on the natural environment.

Stormwater conveyancing has strong economies of scope with local roading and urban design services, and exhibits public good and externality features

Like the conveyance of drinking water and wastewater, stormwater conveyance exhibits large economies of scale and therefore the service is a local natural monopoly. But stormwater conveyance also exhibits strong economies of scope with the provision of roading and urban design: stormwater conveyance is fundamentally about dealing with the design of roading systems and urban landscapes in a way that caters for the environmental effects from wet weather events and overflows of stormwater. This means stormwater conveyance services are best jointly provided with either urban design and/or roading services.

There is also some interdependency between roading and drinking water conveyance because the type of material used for roads and footpaths, and the depth of it, affects the costs those water suppliers incur to access their pipes. For similar reasons, there is also some interdependency between roading and wastewater conveyance. In both cases, achieving efficient outcomes requires some coordination between roading and providers of drinking water and wastewater conveyance services.

In contrast to drinking water and wastewater, the quantity of stormwater has strong externality features. If an effective stormwater system isn't in place then the development of upstream properties – particularly the installation of impermeable surfaces – can increase the rate and amount of stormwater flowing onto downstream properties, potentially flooding and polluting them.³⁰

The quality of stormwater also has negative externalities in terms of the contaminants discharged into the natural environment. In some cases very heavy rainfall events can result in stormwater mingling with the wastewater system, causing overflows of raw sewage.

The inherent features limit supplier risk appetites, limit outside options for innovative people and reduce the veracity of customer feedback

How do the above features affect innovation and productivity? Drawing on the productivity drivers identified in section 3, there appear to be three key impacts:

²⁹ For example, collective decision making over quality of supply may improve consumer welfare when reticulated supply has a very large cost advantage over alternative supply options: in these situations the supplier may choose to exercise market power by providing water at a lower quality than most consumers prefer but they do not alter their water consumption choices.

³⁰ Local councils seek to avoid these externalities occurring by constructing integrated stormwater systems. Some councils use targeted stormwater rates based on the size of impermeable surfaces.

- *Limited appetite for high risk innovation.* A natural monopoly supplier typically faces very limited contestability – that is, there is little prospect of an alternative supplier arising to take its market. In other words, natural monopolies operate in a more predictable environment, far short of the deep uncertainty experienced by firms in pluralistic markets. Also, natural monopolies often face considerable community pressure (often via regulators) to make quality, reliability and security of supply their top priority, which requires rigorous compliance with prescribed processes and procedures. Along with long lived assets and weak competitive pressure on their prices, these factors typically breed a more ‘steady as she goes’ culture than is commonly found in firms operating in workably competitive markets.³¹ This isn’t to say the culture eschews all innovation, but rather it is likely to foster low-risk experimentation and innovation.
- *Limited outside options for innovative people.* The natural monopoly feature limits funding and financing options available to innovators, because there is only a single entity supplying each market. This means innovative personnel incur far higher costs to access outside funding and financing vehicles to develop their ideas and get them to market. For example, they typically have to shift to other jurisdictions to work for a supplier in the same type of market.
- *Reduced veracity of customer feedback.* The natural monopoly, club good and externality features each limit the choices available to customers, leaving the entity with low-veracity customer feedback on the value of its innovations.

Other features are commercial and are not inherent

There are many other features associated with the three-waters sector in New Zealand, but they are not inherent to the activity. That is, they’re not driven by technological or transaction cost constraints.

Some of these additional (commercial) features include:

- In almost all cases the funding/pricing structure for water supply is determined by local government councillors and officials rather than by the supplier or an independent regulator.
- In almost all cases there is no joint management or ownership of water assets across local council boundaries.
- In almost all cases water assets are not incorporated in a company, and their financing is provided or determined by local government councillors and officials rather than by a company sourcing its finance directly from banks and other financial institutions.
- In almost all cases the governance of suppliers is carried out directly by local government councillors and/or local government officials.
- All water suppliers serving sizeable populations are owned by local government.

Section 3 emphasised the importance of institutional arrangements for fostering and disciplining innovation, and the importance of decision-making rights being held by parties that have the

³¹ Community pressure and preferences are actioned via regulators, the media and/or community owners (such as local trusts or local government).

knowledge and incentives to make the best long-term decisions. Clearly, the above commercial features may profoundly affect the productivity of the three-waters sector but none of them are inherent features: they can be changed, as evidenced by the different arrangements operating in overseas jurisdictions.³² Section 4.3 provides further detail on the commercial arrangements for water in New Zealand.

In practice the commercial features are not entirely divorced from the inherent technology-driven features, as they reflect community views about how best to provide services with those inherent features. However, community views can evolve over time. For example, proposals to introduce volumetric charging for water have been highly contentious before introduction but the contentiousness declined rapidly after implementation. Similar reaction patterns occurred for proposals to change some of the commercial features of other utilities, such as for telecommunications, electricity and airlines. The consistency of this pattern should be kept in mind in reading section 4.3 below.

4.3 Comparison of drinking water and wastewater sector with other utility sectors

Natural monopolies in the conveyancing components of the supply chain

As discussed above, drinking water, wastewater and stormwater conveyancing services are local natural monopolies. They are very similar to other natural monopoly conveyancing services, such as the transmission and distribution of electricity and gas. The main distinction is that electricity and gas transmission are nationwide natural monopolies whereas water conveyancing, and electricity and gas distribution, are local natural monopolies.

Drinking water and wastewater conveyancing typically has no physical connection from one major population cluster to another. In contrast telecommunications, electricity and gas transmission are entirely about connectivity across regions because of network and portfolio effects. In particular:

- Telecommunications services are typically more valuable to each consumer the larger the network of consumers using the service (“the network effect”).

This isn’t the case for drinking water or wastewater services, as no consumer values the water service more highly simply because other consumers are using the service.

- Electricity transmission services are valuable because they enable connected parties to achieve acceptable security and reliability levels at lower cost than would occur without the transmission service. A national transmission grid provides portfolio benefits, by diversifying the risk of the failure of generation and transmission components and reducing the cost of covering those risks. This enables larger generation plants to be built to meet demand, lowering average costs of generation. A similar logic applies to gas transmission.

³² See New Zealand Productivity Commission (2015, p248) for a discussion of commercial arrangements in England and France.

In contrast, the conveyance of drinking water has only localised portfolio effects: a local network of water pipes allows multiple sources of drinking water to feed key population clusters. A nationwide drinking water and pumping system would be very costly and add very little to water security and reliability. There do not appear to be any portfolio effects associated with wastewater conveyancing. The primary benefit of water conveyancing is to exploit economies of scale in regard to securing drinking water supplies and the discharge of wastewater.³³

The local distribution of drinking water has strong parallels with electricity and gas distribution. Each service reticulates a few sources of supply to consumers, in systems that are designed to flow one-way. The local distribution of wastewater is essentially the same, except that the flow is away from consumers rather than to them. Each service comprises pipes/wires and pumps/transformers to “push” the content to its destination (as well as using gravity).

There are of course important differences between them. For example, in regard to electricity, frequency and voltage levels need to be managed within tight tolerances to avoid conveyance failure. Shortages of electricity into the distribution system can impact consumers in milli-seconds whereas shortages in gas and water in-takes can take several hours before consumers are materially affected. Overall, electricity is an inherently more fragile system, and so it requires more spare capacity and faster back-up systems than either water or gas.

The transportation of water, gas and electricity occurs on dedicated platforms. In contrast, goods and people are transported via several platforms (road, rail, air or sea), which compete against each other to some degree. Physical transportation is pluralistic when consumers have multiple platforms available to them, however local roads are often a local natural monopoly service when they’re the only platform available for users to reach other transport platforms. Developments in drone technology may convert most local roads from a monopoly industry to a pluralistic one for some consumers.

Telecommunications services include phone calls, video calls, texting, web browsing etc, and the data underpinning those services can be transported via inter-connected telecommunication networks. The data transportation network has many features in common with physical transportation networks, such as congestion, bottlenecks and a combination of usage-based and access-based pricing.

Roading and other transportation platforms are similar to telephony in that the cargo (people and physical goods in the case of transport and data packets in the case of telephony) are created by the consumers of the service and they decide the final destination of each cargo. Both are one-to-one types of conveyance. In contrast, water, gas and electricity are one-to-many, as are radio and television broadcasting.

The conveyance of stormwater is akin to roading, telecommunications and electricity transmission, where congestion in one part of the interconnected system can result in congestion occurring elsewhere in the system. For example, congestion on a main highway often results in congestion on surrounding local roads and low utilisation of the highway downstream of the congestion. Similarly,

³³ Economies of scale imply lower average costs per unit of quality-adjusted volume of water. In practice, actual average costs may remain high because the underlying cost savings allow the community to afford higher-quality water services.

blockages and congestion in one part of an interconnected stormwater system can result in blockages and congestion elsewhere.

Inherently pluralistic in other components of the supply chain

The production and installation of conveyancing equipment is pluralistic as multiple suppliers are typically available. This applies to equipment for conveyancing of water, gas, electricity and telecommunications.

The sourcing and production of gas, and the building and generation of electricity, are also inherently pluralistic, as is the retailing of those goods to consumers. The same applies to the sourcing and extraction of drinking water, although geographic resource limitations mean a workably competitive market is unlikely to develop in most cases. Retailing of drinking water and wastewater is also pluralistic and is workably competitive in England, for example.

The cargo transported on telecommunication networks can take many outward forms for consumers (such as voice telephony, emails, downloading/uploading from/to the internet, radio and TV broadcasts), but fundamentally they're data packets. The production of most of these is inherently pluralistic and so is the marketing/retailing of them.

The quality of reticulated supply is an important club good

As discussed in section 4.2, the quality of reticulated drinking water is a club good. The same applies to reticulated gas and electricity. For example, the quality of electricity is reflected in fluctuations in frequency and voltage levels. All parties connected to a local electricity distribution network receive the same frequency of electricity and similar levels for voltage.³⁴ Similarly, gas quality refers to levels of specification, odourisation and pressure and all parties connected to a gas distribution system receive similar specification, odourization and pressure.

The Electricity Industry Participation Code 2010 specifies targets for frequency and voltage on the national transmission grid, and acceptable deviations from those targets. The Electricity (Safety) Regulations 2010 specify tolerances for frequency and voltage deviations from target levels for electricity distribution, and likewise the Gas (Safety and Measurement) Regulations 2010 specify requirements for odourisation of reticulated natural gas and pressure levels at points of supply.

The Electricity Authority monitors deviations on the transmission system, and significant deviations result in determinations on who the causer was and costs imposed on the causer.³⁵ WorkSafe New Zealand monitors quality of electricity and gas from distribution systems and enforces penalties

³⁴ In practice, thousands of consumers have their own electricity supply and so the quality they experience can in some circumstances be personal to them. Fonterra, for example, has its own electricity generation to provide it with greater quality (and security) of supply. As of 28 February 2019, around 20,000 consumers had solar panels at their premises. Some of these consumers are self-sufficient, which means their quality of supply is likely to differ from that provided by the electricity transmission and distribution system.

³⁵ Determining the causer can be difficult in some circumstances.

specified in the regulations. The Commerce Commission requires gas distribution businesses to disclose information about some of their performance regarding quality of gas supply.³⁶

Regulation of the quality of supply often occurs when a club good is provided by a monopoly or when consumers of an existing supplier face large costs to switch to an alternative provider. In principle, consumers could collectively specify quality requirements in long-term contracts with prospective monopoly suppliers. Provided they do this before sunk investments are made, consumers collectively retain considerable bargaining power.

However, once the initial investments have been made consumers sometimes have no low-cost alternatives available, potentially causing very high costs if they disagree with the supplier's subsequent quality of supply, investment and pricing decisions. Collective decision making over these matters can involve high transaction costs, as can a class action to enforce contract breaches. Moreover, new consumers entering the market sometimes have no low-cost alternative to the collective contract previous consumers have negotiated with the supplier.

These factors mean consumers expect their political representatives to establish effective regulations and regulatory institutions to deal with club-good aspects of quality of supply when the supplier has considerable market power, and wise representatives take care to design them in ways that provide suppliers with confidence their long-term investments will not be misappropriated by the regulator.

Although a separate regulator could be established to undertake these activities for each local reticulated supplier, having a single national regulator reduces transaction costs and facilitates greater resource specialisation and regulatory expertise within the regulator. These benefits can be considerable but typically come at the expense of quashing regional diversities in preferences. Regulation by a party outside of a local region can be beneficial when local government is the owner and provider of the local natural monopoly service, as is the case for reticulated water services.

Reliability and security of reticulated supply are also important club goods

Reliability and security of supply are also important club goods for reticulated water systems, but that is also the case for electricity and gas. The latter two industries achieve extremely high levels of reliability, at 99.9% for electricity distribution and 99.7% for gas distribution. Overall, security of supply of electricity and gas has been well-managed in the last decade despite some very trying conditions.

Reliability of supply is about equipment failure affecting a large part of the system, causing supply interruptions for consumers. The Commerce Commission specifies reliability targets for gas and electricity transmission and distribution, and it prosecutes suppliers for ongoing breaches of their targets where it deems that to be necessary.

³⁶ The Commerce Commission doesn't impose similar quality of supply disclosure requirements on electricity distribution businesses.

Security of supply refers to consumer concerns about future supply adequacy, which might be in relation to the next day, week, month, year or decade. Security of electricity supply was poor in the decades prior to the introduction of the wholesale electricity market in 1996, and in fact that was one of the reasons for introducing it. Although there have been several periods of weak security of supply, blackouts haven't occurred since 1996.

The quality of supply has important negative externalities

The externalities with respect to water are important and are regulated by Parliament, and the same occurs for safety of gas and electrical equipment. The economic rationale for this intervention arises from the fact that externalities, by definition, affect people and organisations that are not party to the bargaining between consumers and suppliers. In the absence of government intervention, the bargain will reflect the costs and benefits of the supplier and its customers, rather than the costs and benefits to society. In the presence of large externalities, the government in some cases may be able to intervene to improve on the private bargain and so achieve better outcomes for society overall.³⁷

Parliament sets non-contamination targets for drinking water to protect people's health and it regulates pollution from wastewater and stormwater discharges via legislation and national policy statements to protect the natural environment.³⁸ Similarly, Parliament sets technical requirements for electrical and gas equipment to protect people from injury. There are also arrangements to protect medically-dependent consumers from interruptions in electricity supply.³⁹

Tabular summary of inherent features

Table 2 on page 34 summarises the above discussion, using orange to highlight "no" answers and blue to highlight "yes" answers. Clearly, the inherent features of drinking water and wastewater conveyancing are essentially the same as for electricity and gas conveyancing.

Table 2: Summary of inherent features of a range of conveyancing services

³⁷ Parties to private contracts accept the state as the ultimate enforcer and arbiter of their contractual arrangements, as that is preferable to anarchy (ie, preferable to parties engaging competing "police forces" to enforce their interpretation of the contract, which typically involves considerable waste of resources if physical conflict occurs). The consequence is they accept the inherent quid pro quo, which is the state using its power to intervene in private bargaining on behalf of parties affected by private contracts to get better outcomes for society overall. But of course, it also exposes private parties to the risk of government abusing its intervention powers or unwittingly acting in ways counter-productive to society.

³⁸ In particular, the Health (Drinking Water) Amendment Act 2007 sets specific standards for drinking water and requires councils to report on drinking water quality within their districts. Discharges of wastewater or stormwater are not subject to specific standards, but the Resource Management Act 1991 (RMA) sets a limited range for the effects of discharges of wastewater or stormwater. Plans are used to manage environmental discharges and often contain rules that build off and add to the provisions of the Health (Drinking Water) Amendment Act 2007, including controls on what is in the discharge (New Zealand Productivity Commission, 2015, p. 237) . Further details of the regulatory framework for three-waters is provided in Appendix A.

³⁹ The Ministry of Health and district health boards monitor and enforce drinking water quality, regional councils monitor and enforce quality of discharges of wastewater and stormwater, and WorkSafe monitors and enforces safety standards for electricity and gas.

Inherent feature	Water*	Electricity	Gas	Telco
Local or national natural monopoly in conveyancing	Yes (local only)	Yes (both)	Yes (both)	No
Network/portfolio effects with conveyancing	Portfolio	Portfolio	Portfolio	Network
Pluralistic in rest of supply chain	Yes	Yes	Yes	Yes
Quality, reliability & security are club goods	Yes	Yes	Yes	Mostly No
Important negative externalities	Yes	Yes	Yes	No

* This column relates only to drinking water and wastewater services.

Comparison of commercial features

Section 4.2 identified commercial features associated with the drinking water and wastewater sectors in New Zealand that are not an inherent aspect of the activity. These included:

- *Lack of independent funding and pricing:* Except for Auckland, local government councillors and their officials determine the funding of water suppliers and determine the structure of their prices. Watercare sets its own charges but is required by Auckland Council to set them no higher than needed to cover costs. In contrast, all telecommunications, electricity and gas suppliers receive their funding from charging consumers directly and they set their own pricing structures. In regard to the monopoly conveyance component, the Commerce Commission sets maximum levels for revenue or weighted-average prices, providing a high degree of independence from political decision making.⁴⁰
- *Lack of scale and reach:* The scale of supplier entities for drinking water and wastewater generally matches the size of each local council's jurisdiction, which is very small in many cases. Auckland's Watercare achieves a reasonable scale, fostering effective levels of specialisation and expertise. In contrast, gas and electricity distribution businesses generally operate across multiple local council boundaries.⁴¹
- *Lack of collaboration:* In almost all cases there is no joint management of water assets across local council boundaries. The main exception is Wellington Water, which is a joint venture management company owned by five local councils in the Wellington region. There is also limited collaboration among electricity distribution businesses in New Zealand. There is one formal joint venture management company – called OtagoNet – which manages three large (and contiguous) electricity networks owned by local trusts and local councils and two small (and physically separate) electricity networks. Unison Limited provides electricity distribution services to the Hawkes Bay region and also has a management

⁴⁰ The statutory independence of the Commerce Commission provides suppliers with greater confidence the returns on their long lived investments will not be appropriated by politicians with short-term incentives.

⁴¹ Currently there are 29 electricity distribution businesses in New Zealand, compared with 67 local councils.

contract to run Central Lines, which is a neighbouring network. Nelson Electricity Limited serves Nelson City and is joint owned by Marlborough Lines and Tasman Networks.

- *Company structure and independent directors:* Except for Watercare and Wellington Water, the governance of drinking water and wastewater suppliers is carried out directly by local government councillors and/or local government officials. In contrast, all gas, electricity and telecommunications services are operated as limited liability companies, with management overseen by boards with independent and professional directors pursuing commercial objectives and obligations. Where a supplier is owned or part-owned by local community trust, the trust is governed by community-elected board members. The trust board appoints directors to the company boards.
- *Asset ownership and financing:* Watercare is the only major supplier of reticulated water incorporated as a company that owns the water assets. In all cases financing is provided by local government rather than by banks and other financial institutions.⁴² Watercare owns Auckland's water assets but it is not allowed to borrow against them. In contrast, almost all gas, electricity and telecommunications operating companies own the assets and can borrow against them. The two exceptions are the OtagoNet JV and Unison's management of Central Lines, where the electricity network assets are held by their owners rather than the operator.
- *Entity ownership:* Local government owns all reticulated water suppliers serving sizeable populations. Gas and electricity distributors and the conveyancing components of telecommunications are primarily owned by private capital or have significant private ownership in the form of local community trusts. Local government is a part owner in many cases, and a full owner in others. The national transmission grid is owned by central government.

Table 3 on page 37 summarises the above discussion, using red to highlight "no" answers and green to highlight "yes" answers. Lighter shading reflects mixed situations. Non-applicable situations are marked "N.A." and not coloured. The contrast with the summary in Table 2 is stark.

Concluding comments

Despite the obvious similarities across the water, gas and electricity utility sectors in regard to their inherent features (refer Table 2, p34), the commercial features for drinking water and wastewater differ greatly from those in place for gas, electricity and telecommunications.

⁴² Note that 30 local councils, along with the NZ Government, own the Local Government Funding Agency, which issues bonds to finance its council members.

Table 3: Summary of commercial features

Commercial feature	Water (excl. Akld)	Water-Care	Electricity distribution	Gas distribution	Telco
Independent funding and pricing structures	No	No & yes	Yes	Yes	Yes
Entities operate across multiple local government boundaries to increase scale	No*	N.A.	Yes**	Yes	Yes
Extensive/formal collaboration across entities to increase scale	No	N.A. ⁴³	No***	No	No
Company structure, governed by independent directors	No*	Yes	Yes	Yes	Yes
Operational company owns the assets & borrows against them	No	No	Yes***	Yes	Yes
Suppliers have some private-equity owners involved	No	No	Yes for 3# Most No	Yes	Yes

* One exception here: Wellington Water

** Vector has good scale even though it operates within the Auckland Council area

*** OtagoNet and Unison/Central Lines have extensive and formal collaboration agreements but they're both still reasonably small-scale operations. Both agreements are for management services and the assets are owned by others

Three large electricity distribution businesses have private-equity owners: PowerCo, Vector, and Wellington Electricity. These three companies supply almost half of all electricity connections in NZ.

5 Improving productivity in the drinking water and wastewater sector

As discussed in section 4, the drinking water and wastewater sector exhibit several challenging characteristics: in particular local natural monopolies in the conveyancing component of the supply chain, club-good dimensions to quality, reliability and security of supply, and the potential for large negative externalities to occur if supplier activities are not rigorously managed. Combined, these features reduce innovator options and customer choice, affecting innovation and productivity. This section elaborates on the innovation and productivity issues and discusses the implications for funding and financing, structure, governance and regulation of the drinking water and wastewater sector.

By way of an overview, achieving significant and ongoing productivity gains in the drinking water and wastewater sector is only likely to occur when (1) its structure, governance, funding and financing is organised in ways that foster disciplined experimentation and innovation and (2) an integrated and credible approach is adopted for regulating the health, environmental and economic dimensions of their performance. Although greatly increasing the operational scale of most of the reticulated water suppliers is critical for increasing the specialisation and expertise of their

⁴³ However, Watercare looks likely to supply water to Waikato District in the near future.

resources, merging all such suppliers into a single entity is very likely to be sub-optimal. It would be most beneficial if collaborative and merger arrangements were decided locally rather than by central government. However, central government should adopt a backstop plan in case some parts of the local government sector fail to take enough action.

The rest of this section discusses these matters in greater detail. Before doing so, it is important to note the empirical evidence is variable regarding the cost efficiencies from aggregating reticulated water providers (New Zealand Productivity Commission, 2015, pp 238-241). This isn't surprising as water supply costs are mostly capital costs, and as those costs are already committed there's modest scope for cost efficiencies unless significant capital renewal or expansion is required. Also, most of the studies consider entities that are already quite sizable and already achieve acceptable health and environmental standards. Finally, the proposition in this paper isn't that aggregation on its own will have significant impact; rather it is that aggregation is a critical enabler of higher performance and productivity when reforms are also made to funding, financing, governance and regulation.

5.1 Greater collaboration and aggregation of water suppliers is critical for improving water industry performance and productivity

Limited supplier risk appetite

Ongoing experimentation and innovation drive the productivity of the national economy, and the same applies to the local government sector and the provision of three-waters services.

However, as discussed in section 4.2, natural monopolies typically have a 'steady as she goes' culture and tend to favour low-risk experimentation and innovation and eschew high-value risky ones. This is probably broadly appropriate as they tend to have large, long-lived and irreversible investments. The social gains from innovation is greatest at the time these investments are designed and installed. Once that has occurred, considerable commercial and economic value could be wasted if they're displaced by innovations that create little value for consumers.⁴⁴

Once large irreversible capacity has been installed, the focus for innovation is most usefully on improving asset management and utilisation because these factors can deliver significant value gains for consumers by altering the timing of the next investment. Particularly in a very small country like New Zealand, the best value gains from natural monopoly entities is likely to come from adopting global frontier technologies and best-practices rather than from creating new technology.

Costly outside options for innovative people

A key additional factor, however, is that innovative personnel face more serious roadblocks for pursuing their ideas if they work for a natural monopoly than for a supplier serving a pluralist industry. Rejection by the monopoly's decision makers leaves an innovator with few outside options.

⁴⁴ This could occur if the existing investments are treated as a sunk cost.

In contrast, pluralist industries have multiple independent entities, affording innovators scope to switch to a competitor (ie, ‘shop around’ for funding and financing) if they really believe in their idea. Also, the portfolio of experiments occurring in a pluralist industry is more likely to discover high-value innovations than a portfolio of experiments undertaken by a monolithic entity.

The potential harm from a local natural monopoly is larger if the business includes non-monopoly components of the supply chain. In this case more economic activity is provided by a single entity compared with a situation where the non-monopoly components are separated from the natural monopoly ones and multiple suppliers allowed to form in those parts of the supply chain. The harms are only a potential because, in theory, the greater scope of economic activity under a single entity could perhaps result in greater specialisation of resources, and greater collaboration of those resources, boosting the chances of successful innovation (re Teece 2019 for industrial conglomerates).

Aggregating local natural monopolies is very likely to improve performance and productivity

The scale of an entity’s operations can critically affect its productivity by affecting the specialisation of its resources and their expertise. Small-scale organisations often struggle to recruit and retain the expertise needed to most effectively perform. Staff in small-scale entities typically have a reasonably broad range of responsibilities and typically encounter few useful opportunities to build their expertise on-the-job or from their (generalist) colleagues.

Small-scale entities can pursue the benefits of scale by collaborating with other entities in various ways. Sharing back-office systems and resources, or contracting-in these services, can bring efficiency gains and access to higher skill levels but it does little to build in-house expertise and dynamic capabilities, which Teece (2019) and others consider are the drivers of observed large differences in entity performances.

A better option for sustainably improving industry productivity growth is for several entities to establish joint venture management entities to spread and further develop their expert resources. This can work very well but the potential gains are more limited than could be obtained from merging several small firms so that management, governance and asset ownership are aligned.⁴⁵

But too much aggregation could harm productivity

These ‘scale and specialisation’ benefits often lead to suggestions to establish management joint ventures of small local natural monopolies across an industry or to merge them. Either approach could deliver significant specialisation, innovation and productivity gains if an effective scale is achieved and if it is done well so that effective collaboration occurs across old boundaries that theoretically no longer exist within the larger entity.

However, the productivity framework in section 3 suggests that aggregating local natural monopolies can harm innovation and productivity if too much aggregation is undertaken. For

⁴⁵ In both the management JV and merger cases competition wouldn’t be diminished because the JV or merger is among firms that do not compete with each other in the output markets.

example, if all local natural monopolies in the three-waters industry are merged then innovative personnel in the new entity will only be able to access alternative funding and financing options by switching to offshore entities supplying consumers in other markets. This greatly increases the hurdles facing innovative personnel and successful innovations are less likely to benefit New Zealand. On the other hand, if aggregation leaves several water monopolies operating across New Zealand, for example, then innovative personnel can more easily access alternative funding and financing options within New Zealand and produce benefits for New Zealand.

To recap the discussion in sections 3.3, there is a trade-off between the productive and dynamic efficiency gains from specialisation afforded by geographic aggregation and the productive and dynamic efficiency gains from diversity of options for innovators in a pluralist industry structure. Specialisation increases capability to develop and implement the selected innovations whereas diversity of options for innovators increases the chances a high value innovation will be selected and ultimately enter the market and deliver high value gains to society. This trade-off is illustrated in Figure 1 on page 16 and applies to all utility sectors including the water utility sector.

Maximising productivity requires a nuanced allocation of decision rights over collaboration and aggregation

Section 3.6 discussed how deep uncertainty about where best to have organisational boundaries means collaboration and aggregation decisions are experiments in themselves: they're trial-and-error processes and for that reason alone they shouldn't be one-off decisions. Ongoing technology change is another compelling reason for adopting dynamic arrangements – that is, arrangements that encourage timely organisational reconfigurations.

As in section 3.4, this suggests decision rights about collaboration and aggregation need to be held by the parties with the knowledge and incentives to make the best experimental decisions and to revise their decisions if the outcomes reveal the decisions were misguided or better options become available.

Knowledge about the most productive combinations of collaboration and aggregation likely lies with the local operators and owners of water assets. On the face of it, local government also has incentives to pursue the best options to achieve lower cost and more effective outcomes for their constituents, taking into account relationships and local particularities. In practice though, local governments also have incentives to resist change when it potentially involves losing local resources and local control.

Central government also wants better outcomes for its constituents and bears some of the political risks of inaction, but it knows far less about the local circumstances and the likely best combination of assets.

These considerations suggest a nuanced allocation of decision rights is required. Section 5.4 suggests that the regulatory regime can be used to strengthen the incentives on local decision makers to create an effective dynamic approach to collaboration and aggregation.

5.2 Independent funding arrangements are critical for improving water sector productivity

Low-veracity customer feedback reduces the chances the 'right innovations' occur

For standard economic activities, customer choice and independent funding and financing play a key role in disciplining innovation, so that as far as possible the right innovations are pursued, with urgency, to deliver value gains for consumers. However, a key feature of local natural monopolies is that customers generally do not have any choice about which supplier they obtain their services from, although they still choose their level of consumption.⁴⁶ But the lack of choice of supplier means customer choice provides low-veracity feedback.

In practice local natural monopolies can sometimes offer their customers choices regarding a suite of services and service levels, with prices for each. For example, a supplier of wastewater services might offer fast and slow restoration times for dealing with leakages and blockages, with a higher price for a fast response and a lower price for slower response. For standard economic activities, suppliers lose an entire revenue and profit stream when one of their customers switches to another supplier. In contrast, a local monopoly loses only the price difference between a de-selected service and a selected service. If the price differences reflect differences in incremental cost of the services, then the monopoly may not lose any profits at all.

This low-veracity feedback is compounded by the high predictability local natural monopolies have about their costs, revenues and surpluses.⁴⁷ On the one hand the high predictability reduces the need for innovation and on the other hand it reduces incentives for innovation.

In regard to innovation incentives, although customer selection choices are likely to be revealed in the supplier's accounting system and board reports, senior managers and directors have minimal imperative to be driven by that information. Tough decisions are easily delayed in the knowledge the supplier will continue to cover its costs overall. For example, to cull innovations in which large costs have been incurred but are looking less and less likely to be successful and initiate or speed up other innovations that are more likely to do so.

'Customer voice' therefore takes on a far more important role for disciplining the performance of local natural monopolies. However, as depicted in Table 1 on page 16, customer voice provides low-veracity feedback on innovations. This occurs even if customers are acting constructively but it is doubly so if many consumers act opportunistically and try to game the feedback system. For example, some customers may feel reliant on the supplier and moderate or cloak their negative feedback and other customers may feel greatly frustrated about their lack of freedom to choose alternative suppliers and inflame their feedback in various ways.

⁴⁶ In principle, water consumers in an area can collectively make a one-off decision prior to investments about which supplier is to supply them, and in principle they could agree a long-term contract with the supplier. But in practice this approach hasn't been durable due to changing circumstances and asymmetric information.

⁴⁷ This can be due to price regulation but more fundamentally it is often due to a very low price-elasticity of demand for local natural monopoly services, particularly in the range of prices needed to recover their total costs with a healthy margin on top. In the absence of significant contestability and/or price regulation, local natural monopolies can set their prices to ensure they always recover their costs of supply.

On the face of it, low-veracity feedback provides weak incentives for local natural monopolies to undertake innovation, weak incentives to select innovations with the highest expected pay-offs for consumers and weak incentives to successfully manage their innovations to deliver value gains with urgency.

Lack of customer choice makes it important for monopoly suppliers to be paid on the basis of their service and performance

The above discussion about low-veracity customer feedback focused on the implications for innovation and associated productivity gains. It implicitly assumed monopoly suppliers charged their customers for the services delivered to them. It showed that, even with Service-based and cost-reflective prices, the inability of customers to switch suppliers greatly reduces the veracity of customer feedback about changes in service offerings.

But low-veracity doesn't mean there is no value in having service-based and cost-reflective prices. Lack of customer choice leaves monopolies with a 'cushy life' because their risk of losing significant revenue is very low. Their incentive to perform their core business well – reduce waste and invest wisely – is far weaker than for firms operating in pluralistic industries. High performance of the core business requires adopting low-risk innovations and adapting well-established best practice, rather than pursuing relatively untested innovation. In the absence of disruptive technology changes, the nature of the service remains fairly static and so performing to best practice is where the gains lie.

Service-based pricing provides performance incentives based on the services actually delivered. If there are multiple distinct services, then there can be value in having multiple prices. Likewise, if there are multiple distinct service levels, then there can be value in pricing each of them. In each case, suppliers pricing a distinct service or service level improves industry productivity if it enhances supplier performance and/or improves the use and investment of resources by more than the transaction costs of managing the additional pricing regime.

For example, a core service for conveyance businesses is to deliver product to the consumer. Water, gas and electricity distributors deliver water, gas and electricity to consumer premises. Telecommunications delivers data packets. But all of these activities involve a core network (of pipes, wires, cell sites etc) that serve many properties and a spur (of pipes, wires, routers etc) that take the product from the core network and feed it to the consumer's premise. In regard to physical connections, some premises may be costly to provide spur lines to because they're very far from the core network or the terrain is difficult to access and transgress. Also, it can be more efficient to build all the spur lines for a new residential or business park in 'one go' before consumers have built their premises. Higher-capacity spur lines to serve businesses involve higher costs. Installing spur lines involves significant cost, and it is a pluralistic activity: multiple equipment providers and installers are available to perform the work. The asset only becomes a local natural monopoly once it is installed.

For those reasons, separately pricing the provision of spur lines increases industry productivity by more than the transaction costs of managing spur prices. In the gas and electricity distribution sector, spur prices are called connection charges. Often the consumer contracts for the network supplier to install the spur line but the spur asset is owned by the consumer. In some cases the network supplier is willing to own the spur line and levy an annual service charge. Similar

arrangements apply for fibre connections except that standard residential connections are free and only more complicated connections are charged.⁴⁸

Similar arrangements apply for connection of drinking water and wastewater pipes. Watercare, for example, levies a fixed-price infrastructure growth charge (IGC) for each new connection, although the charge varies by region. Their prices range from around \$13k for metropolitan areas to over \$31k in more remote locations, and they specify separate charges for site inspections, extending connections, and for installing, relocating, disconnecting, testing and auditing water meters. The IGC covers not only the connection cost but also contributes to the cost of installing higher capacity in the core part of the network, such as larger capacity treatment plants.

More broadly, local governments charge development contributions to recover the costs of providing new water and roading infrastructure to new subdivisions. Typically, connection charges and development contributions are specified in fixed price quotes rather than in the form of an hourly rate plus expenses.

Broadly speaking these arrangements provide consumers and property developers with incentives to consider locating their premises where access is easy and low cost. They also have incentives to plan ahead and coordinate with installers to reduce waiting time. The spur installers for gas, electricity and telecommunications earn a profit margin on their activity and so they have incentives to organise their business well, engage closely with customers about their requirements, forecast demand and provide enough resources to serve demand within timeframes acceptable to their customers. In short, connection of gas, electricity and telecommunication spur lines is responsive to customer needs.

None of this works perfectly but it works far better than when suppliers are not paid specifically for a spur service, or when the level of the connection charge is not allowed to contribute profits to the business or when the supplier is unable to finance capital outlays.⁴⁹

Charging customers different prices for different spur capacities empowers them to direct the supplier about what they want. It also encourages efficient investment. Businesses and other organisations typically have far larger capacity requirements than households. Charging businesses based on their capacity requirements encourages them to choose their capacity wisely: they're encouraged to take into account their current and future needs and the likely costs of adding extra capacity if needed in the future. In contrast, charging a flat price to all customers, irrespective of capacity, would result in most businesses over-specifying their capacity and imposing additional costs on all consumers. This would harm industry productivity.

Similarly, if suppliers charged different prices for fast versus slow service then customers would be empowered to influence the speed of service from the supplier. As suppliers in this case would earn additional revenue on fast-response services, they would have the funding and incentives to provision more stand-by resources to respond to work requests more quickly. However, it may not be worthwhile for suppliers to charge different prices for fast versus slow service: it depends on

⁴⁸ See www.chorus.co.nz/help-and-support/consent-and-access/getting-fibre-installed-going-cost-me-anything for details.

⁴⁹ Watercare, for example, is not allowed to obtain financing from banks and other financial institutions, restricting its ability to respond to customer demand. This is considered by some parties to be a serious constraint on the development of new housing in Auckland.

whether it enhances customer satisfaction by more than the additional transaction costs incurred by the supplier. If yes, productivity is improved, but not otherwise.

A similar example would be to charge customers for dealing with leakages and blockages in drinking water and wastewater spurs. The comparable issue for electricity distributors is maintaining tree clearances from overhead power lines located on the customer's premises, or for repairing them after storms. These charges are typically in the form of hourly rates plus materials costs.

Distinct prices are charged for the costs of dealing with leakages and blockages in water spurs and for tree clearances and storm repairs in electricity spurs, because it is easy to attribute the costs to specific customers, there are multiple suppliers that could perform the work and the quality of the work affects how likely repeat work is required. Customers can influence the chances of repeat work by their decisions about who undertakes the work for them and whether they're prepared to pay higher costs for more robust fixes. In contrast, distinct prices are generally not charged to consumers for the costs of undertaking the same tasks on the core network, because it is hard to attribute to specific customers and those customers would have no decision rights about the quality and cost of that work.

The key point is that higher productivity is likely when suppliers charge their customers directly for the services delivered, at prices that provide a reasonable margin over costs. It encourages customers to choose wisely, it encourages both parties to engage well with each other, and it encourages suppliers to perform well by adopting pricing policies and other practices that benefit consumers. It encourages suppliers to trade-off the costs visible to them against the intangible value gains to their customers. But as the supplier is a natural monopoly, their customers rightly want to know their supplier's costs and margins are reasonable. This is the role for economic regulation, discussed in section 5.4 below.

Volumetric pricing is another performance-based pricing mechanism

The above discussion about service-based and cost-reflective pricing focused on the service aspect. The cost-reflective aspect implies setting prices at levels broadly reflective of the costs of supply, where "cost" in this instance includes a normal rate of return on investment. Most suppliers incur variable, fixed and common costs to run their business, and so the issue arises about when it is productivity enhancing for a supplier to structure its prices in the same manner. And this leads to the issue of volumetric pricing.

Volumetric pricing refers to charges based on the volume of goods or services consumers receive. Alternatives to volumetric charges are fixed daily, monthly, or annual fees; connection, access or development charges (discussed above); peak demand charges; charges based on value impacts rather than quantity received; and charges unrelated to the service such as through a higher level for general rates.

A typical volumetric price for electricity for residential consumers is around 20-25 cents per kilo Watt-hour (kWh) of power consumed. Volumetric prices for reticulated natural gas to residential consumers are typically in the range of 7-8 cents per kWh of energy. Pure volumetric charging was once common for telecommunications services but nowadays the charges tend to be a fixed price

for various maximum-usage volumes. Watercare's volumetric charge is \$1.517 per kilo litre (kL) of water delivered to a consumer's premises and \$4.899 per 1,000 kL of wastewater removed from a small user (with a fixed annual charge of \$218). High users, such as businesses, pay far higher fixed charges and lower volumetric charges.

As noted above, a core service for conveyance businesses is the delivery of water, gas, electricity and data. One performance dimension for these businesses is the quantity delivered versus the amount injected into the system. As with other performance-based pricing methods, the case for volumetric pricing depends on whether it enhances industry productivity by more than the transaction costs of metering the quantity delivered and managing the volumetric pricing regime.

The cost-reflectivity principle implies volumetric pricing at levels broadly reflective of the variable opportunity costs of supply.⁵⁰ But some utility services involve relatively low variable costs and high fixed costs and so the question arises whether it is worth having volumetric pricing: the price would raise insufficient revenue to cover all costs and so some other charge, such as fixed monthly fees, peak demand charges or funding from local government general rates, is required to fully fund the supplier. It is quite possible it isn't worth the transaction costs of charging two pricing regimes.

The case for or against volumetric charging rests on the specifics of each case. But there are some general points relevant to all cases:

- Volumetric prices should *on average* reflect the long-run marginal cost (LRMC) of supply. LRMC is generally quite significantly above zero as it includes the costs of adding more capacity to the core network to supply additional volumes of water, gas, electricity or data.⁵¹
- Volumetric prices encourage consumers to use water wisely, and to consider the on-going costs of operating water intensive equipment.⁵² Volumetric pricing also encourages drinking water suppliers to monitor their network for leakages and repair them in a timely fashion. In Tauranga, and Kapiti, volumetric pricing appears to have reduced peak water consumption and waste by up to 30% (as noted below, some of these savings could be due to volumetric metering rather than pricing).
 - The Kapiti Coast District Council, for example, reports savings of 25% of peak daily water use.⁵³ A report by the Office of the Auditor-General (OAG) reports the Council's view that its initiatives overall have resulted in 75% of its ratepayers paying

⁵⁰ In the short-term capacity is fixed and so the variable opportunity cost of supply is given by the short-run marginal opportunity cost (SRMOC) of supply. This reflects situations where capacity is fixed and so the opportunity cost reflects the costs of additional non-capital inputs and/or the marginal value of consumption when demand is rationed to the level of available supply. Capital is variable in the long-term, and so the variable cost over the longer term is the long-run marginal cost (LRMC) of supply. Some authors refer to long-run incremental cost (LRIC) rather than LRMC because the term "marginal" generally refers to small additions or subtractions to the value of some variable.

⁵¹ Note that LRMC is zero if capacity limits will never be reached, because in that case no future investment is required. Note also that fixed charges should be used to cover the difference between LRMC and long-run average cost (LRAC). It is quite common for LRMC < LRAC for natural monopolies due to economies of scale in their investment activities. For example, a large water pipe with double the capacity of a smaller pipe may cost less than twice the build and installation costs of the small pipe.

⁵² For example, for residential consumers it encourages them to consider the on-going costs of swimming pools, fast-flowing shower heads, gardens requiring extensive irrigation and so on. Volumetric pricing provides similar incentives to water-intensive farmers and businesses.

⁵³ Refer p22 of their submission to the Productivity Commission's LGFF Inquiry, dated 15 March 2019.

less for water than they would if the Council had stayed with its previous approach of charging for water supply. The Council also informed the OAG its initiatives deferred the need for a new dam by about 40 years. (Office of the Auditor General, 2018, p9).

- A report for Water New Zealand identified a 30% reduction in Tauranga's peak water demand, which enabled a proposed water scheme to be delayed by at least 10 years. Taking into account the costs of installing and operating meters and associated billing systems, Water NZ estimates the average Tauranga City household would be paying at least an extra 40% per annum more for their water if water meters had not been introduced (Sternberg & Bahrs, 2011).
- Volumetric metering may provide useful performance information for suppliers even if there are no charges linked to it. If the benefits of volumetric metering exceed their costs they should be installed regardless of whether volumetric pricing is adopted.⁵⁴ And in this case the transaction costs of introducing volumetric pricing should include only the additional metering costs incurred for volumetric pricing to be adopted. For example, more meters or higher-grade meters may be required.

In recent years the cost of volumetric meters has declined and this is likely to continue over the next few years, with some parties suggesting prices may reduce quite rapidly to around \$60 per meter. The capability of remote reading, and back-office infrastructures to handle data flows, is improving rapidly and the costs are declining here too. In regard to the economics, any high-performing supplier should regularly review these costs and alter their pricing regimes when the productivity benefits are likely to exceed the transaction costs.

In reality local governments also have political issues to consider, with many of their constituents concerned about volumetric pricing being a first step towards privatisation of water services and others have cultural objections to charging directly for water. However, Nelson, Greytown, Kapiti, Tauranga and Auckland have volumetric charging, and volumetric charging (along with fixed daily or monthly charges) is standard for electricity and gas. Table 3 on page 37 shows these suppliers have overwhelmingly remained in public ownership despite many decades of volumetric pricing. This suggests the political issues are not insurmountable. Finding a way to make prospective cost reductions obvious and tangible to ratepayers would likely reduce political resistance to volumetric metering and pricing.

For local councils unable, or not wanting, to introduce volumetric charging on water consumers, one alternative is they could fund their reticulated drinking water and wastewater business on a volumetric basis (many councils already do this). This requires reasonably accurate forecasting of volumes to set prices at levels to at-least recover costs and perhaps a wash-up process to deal with significant forecasting errors. Although doing this increases costs it could provide a useful mechanism for councils to incentivise specific areas for performance improvement, such as reducing wastage through leakages. It could also allow local government officials to delegate greater discretion to managers of the water business.

⁵⁴ Some water suppliers have introduced volumetric metering but levied a zero per kL tariff.

The important factor to remember in all of this, however, is that independent funding of water suppliers is likely to be a key driver for improving water industry productivity. By independent funding we mean water suppliers (1) setting their own price structures rather than local government politicians and officials doing that and (2) receiving their funding directly from customers rather than from local government levying general or targeted rates. Even if volumetric prices are specifically prohibited, independent funding will allow a water supplier to develop other fit-for-purpose pricing/funding regimes to improve their productivity and improve their customer's decision making. Discretion to experiment with pricing and funding can be an important factor for improving performance.

For the interested reader, Appendix B extends this discussion to spot-market pricing, peak demand pricing and fixed versus variable pricing.

A broader and deeper discussion of options for infrastructure funding can be found in the Productivity Commission's report entitled *Better Urban Planning* (New Zealand Productivity Commission, 2017).⁵⁵ Chapter 11 provides a useful decision making framework, which is illustrated in Figure 11.9 on page 324 of that report.

5.3 High-quality governance & financing arrangements are critical for improving productivity

Section 5.1 discussed the way in which local natural monopolies leave innovative employees with limited outside options for pursuing their ideas and section 5.2 considered the implications of limited customer choice, and the importance of independent and performance-based funding/pricing regimes. Both factors make the adoption of high-quality governance and financing arrangements critical for improving water industry productivity.

Low-veracity customer feedback increases the importance of high quality governance and independent financing

Low-veracity customer feedback is inherent with natural monopoly suppliers, leaving them with relatively weak disciplining forces for poor performance, including in regard to their innovation performances. These types of suppliers have a 'cushy life' relative to suppliers operating in pluralistic industries, and the relatively static nature of their services (often accompanied by relatively static workforces) compounds these risks.

The relative stability of the operating environment for natural monopolies can lull people into thinking that high quality governance matters less for these businesses. But the weak disciplines mentioned in the previous paragraph counteracts those considerations. The weaknesses inherent in relying on 'customer voice' feedback, and the very large asset values often involved, means it is more important to have other high quality "voices" influencing the supplier's chief executive and senior management team. These voices can come from the board of the natural monopoly and its financiers.

⁵⁵ The report can be accessed at www.productivity.govt.nz/inquiry-content/2682?stage=4

In New Zealand, local natural monopolies are almost always owned by local government. In these cases, the voices of customer coalitions operate via elected representatives, either in negotiating collective service levels in a procurement regime or directing the supplier's chief executive and management through their position on the supplier's governance committee or board. If done well these processes can constructively aggregate consumer views, but if done poorly they can be destructive and further undermine supplier performance.

In practice, elected representatives face strong incentives to pursue the sectional interests of their likely voters even when those interests harm society more generally. Also, local government councillors tend to have limited or narrow business experience, and similarly for their officials. A report by Martin Jenkins and Associates for the DIA highlights the poor quality governance of water activities in New Zealand, due to the limited directorial experience and expertise of local councillors and local government officials.⁵⁶

High cost outside options for innovative people increases the importance of high quality governance and management

As discussed in section 4.2, local natural monopolies tend to have low-risk appetites, and are likely to favour low-risk innovations, for example focusing mostly on adopting recognised best practice from around the world. However, the 'cushy life' operating environment can make it all too easy for a risk-averse management culture to take hold and persist, focusing on preservation of their jobs by eschewing experimentation and risk altogether. These tendencies are often strongly reinforced by political imperatives for local government-owned and -funded providers to avoid noticeable failures of any kind and therefore avoid risk-taking.

These forces create organisational cultures that attract risk averse people and stifle whatever innovative people are in those organisations, particularly those with technical skills specific to their industry. If their next best option is to move to another location to work for a similar local natural monopoly with a similar risk-averse culture, then their innovation opportunities are blighted. This has the potential to encumber New Zealand with a suite of low-performing utilities.

Appointing high quality professional directors to the boards of natural monopolies is essential to avoid or arrest overly risk-averse cultures. They need to have the experience of managing or governing successful businesses in a pluralistic industry so that they know what innovation and risk looks and feels like. It may also be useful if they have experience of managing or governing a high-performing natural monopoly so that they understand the inherent weaknesses.

A high quality board with professional directors is essential to attracting, recognising and appointing high quality chief executives, and providing the oversight, guidance and remuneration needed to retain them. Choosing the right chief executive inevitably sets in train sequences of managerial appointments aligned with the board's and chief executive's imperatives.

⁵⁶ See the Martin Jenkins report at www.dia.govt.nz/three-waters-review#Cabinet

Franchising arrangements are another possible option to create stronger incentives for productivity improvement, but they require high skill levels and can involve material risk

An obvious feature of natural monopoly suppliers is the lack of competition they face *in the market*. There is a sizable economics and public policy literature on adopting franchising arrangements to introduce competition *for the market*. The aim is to replicate the kinds of performance incentives typically facing suppliers operating in workably competitive industries.

Franchising involves the asset owner, eg local government in the case of the three-waters sector, holding tenders that grant the winning bidder the right to govern and manage the assets, and provide the services to customers. This approach could be used to remove the ‘cushy life’ environment for the board and management, and in particular create stronger incentives for disciplined innovation.

Franchising has been used to good effect in the New Zealand electricity sector. The Electricity Industry Act 2010, for example, requires the Electricity Authority to tender all substantive market operation service provider roles rather than undertake them in-house. Another example is Central Lines Limited – an electricity distribution business in the central North Island – contracts out the management of its assets and services.

Naturally, a high level of skill and contracting expertise is required to avoid obvious pitfalls, such as choosing bidders that over promise and under deliver (viz the recent experience Wellington Regional Council has had with tendering for bus services). Another obvious risk is that incumbents may gain significant informational advantages over their potential competitors at the next tender round, making it risky for the tenderer to opt for other bidders. Incumbents will also strive to develop contractual and service innovations to try to lock-in their position.

If not managed well by the tenderer, these factors can discourage potential competitors participating in tenders and the incumbent may bid higher fees to carry on the job, particularly if their performance means they’re viewed as “a safe pair of hands”. But in principle the franchising approach has the advantage of shifting local government’s focus onto defining the services and service levels they want, and bringing in strong performance incentives for efficient service delivery, innovation and productivity gains.

In practice, franchising is consistent with the theme in this section about the critical importance of high-quality governance. Placing local government’s drinking water and wastewater assets in a company structure, and appointing independent and professional directors to govern the business is similar to franchising, except that franchising involves a one-off big decision about “hiring-in a team and their performance systems”.

A board recruits and appoints the chief executive and can dismiss that person for poor performance. In these circumstances new chief executives will typically make changes to senior management and often they’ll occur on their own accord anyway. So the difference between the governance approach and franchising seems to be one of granularity and associated risk. Franchising involves larger discrete changes, stronger tendering and contracting skills, larger risk but also larger potential reward.

In its report *Using land for housing*, the Commission reviews the literature on franchising and discusses similar issues about risks and skill requirements. The report noted the ability of councils

to establish contracting arrangements for water services in New Zealand is severely curtailed by the Local Government Act 2002, and that amendments to the Act in 2009 clarified that franchise arrangements are not permitted (New Zealand Productivity Commission, 2015, pp. 248-251).

The Commission concluded:

while on the available evidence the performance of local authorities with respect to working with the private sector over the provision of infrastructure is variable – with water providers below average in their procurement practices – there are no good reasons to prohibit such arrangements where opportunities are available to learn from and leverage off existing expertise in the public sector. (p 251)

Capital Strategic Advisors (CSA) endorses the Commission's recommendation that:

The Local Government Act 2002 should be amended to provide councils with a wider range of options for providing and managing water services. Legislative barriers to the use of contracting arrangements for water services should be repealed. (p 251)

5.4 High quality regulation of the water sector is important for improving productivity

In New Zealand the mandate of economic regulators is to intervene in certain aspects of the commercial decision making of specified natural monopoly suppliers, and to do so in a way that promotes the long-term interests of the consumers of those services. The Commerce Commission is the primary economic regulator in New Zealand, and it has reasonably broad discretion about the setting of maximum prices and minimum levels for continuity of supply and for quality of supply (above standards specified in legislation or regulations).

In contrast, the role of health and environmental regulators is to enforce standards prescribed in legislation. In practice the legislation allows suppliers to operate at lower standards if the costs of meeting the standards are deemed by the provider to be unaffordable. There is no requirement in the legislation for the provider to establish and adhere to a plan to reach affordability over a defined time period.

However, regulatory enforcement in three-waters has been weak. This may reflect regulatory capture by local government-owned suppliers. It may reflect that the health sector is a major service provider itself, with a “we’re here to help and care for you” culture rather than being a respected and feared regulator. Another reason for weak enforcement may be that the regulators are ill-equipped to deal with trade-offs between the prescribed standards and a vague opt-out provision for unaffordability, which reaches into economic issues relating to efficient investment, costs and prices.

Given that central government is likely to want to retain minimum quality of supply standards in legislation, the primary conclusions in this paper are that interim standards need to apply to each reticulated supplier based on their current performance, an effective process needs to be in place for below-par standards to be lifted over time to minimum national standards and financial penalties for egregious or serious breaches need to be pursued with rigour and vigour.

Also, drinking water and wastewater suppliers are just like gas and electricity distribution: they are all local natural monopolies supplying services with some club-good and externality attributes. They're best regulated by the regulator that specialises in regulating all other local natural monopolies in New Zealand, viz the Commerce Commission. Although the minimum quality of supply standards are to be retained in legislation, monitoring and enforcing compliance with them may be best left with the economic regulator because of inherent interdependencies of prices and quality of supply.

Light-handed economic regulation of water suppliers provides another voice feedback mechanism and could provide reputational incentives for performance

So far section 5 has identified arrangements intended to strengthen water supplier ability and incentives to innovate and improve productivity. But adopting these arrangements may also strengthen their ability and incentives to price aggressively; to exercise their local market power. In practice these risks may be minor if the suppliers remain publicly owned. However, market power can instead manifest as low quality services and slack effort, low productivity and minimal risk-taking. This certainly appears to be the case for some local government-owned three-waters services.

Consumers often want independent assurances about the cost and performance of local monopoly suppliers. Oversight by an independent regulator – often called light-handed economic regulation – can be a useful mechanism for providing that assurance. One form of light-handed regulation simply involves information disclosure to consumers but leaving it to them to analyse the data. Another form involves information disclosure but with the regulator also undertaking comparative analysis and benchmarking of performance. A third form involves regulators requiring providers to establish consumer consultation panels, consulting those panels about their information disclosure requirements and involving them in commitments to adjust prices according to agreed formulae.

A potential benefit of light-handed economic regulation is it can provide another feedback voice to the supplier to help compensate for the low-veracity customer feedback inherent with natural monopolies. The regulator's views, and the consumer panel's views, can be quite powerful, especially if suppliers view stronger forms of economic regulation as a real risk or threat.

The Commerce Commission operated a light-handed regime for electricity distribution businesses over the period 1994 – 2005. This involved the Commerce Commission requiring them to disclose information about their prices and service levels and how they performed in relation to self-determined targets.

Information disclosure, accompanied by comparative analysis by the regulator and other interested parties, can affect supplier reputation with their customers and with local and central government officials and politicians. In effect, the supplier can face quite strong reputational incentives to perform well, at least in activities that affect the metrics disclosed about them.

Also, comparative listing of disclosure information facilitates 'informal benchmark competition' among suppliers. Performing well relative to other suppliers can be particularly important for increasing labour market opportunities for directors, chief executives and other management and staff. For example, the general managers in high-performing local natural monopolies can point to

the public information about their comparative performance in interviews for chief executive roles. Similar benefits/incentives apply for chief executives seeking board roles or larger organisations to lead, and to many other managers and staff in high-performing local natural monopolies.

The role of benchmarking was canvassed in the Commission's report *Using land for housing*, which surveys the literature on the results from performance benchmarking in the water sectors in Mexico, The Netherlands and Sweden. The Commission reports that the Netherlands has achieved some particularly impressive results (New Zealand Productivity Commission, 2015, p. 264).

The Commission also reports the results of a survey by Berg and Marques (2010) of 18 studies on the benefits of using benchmarking to enhance value for money in the provision of water utility services. Berg and Marques conclude: *As would be expected, all the studies identified a positive impact from using benchmarking practices—whether or not an autonomous regulator was overseeing the sector* (p 18).

Water New Zealand has been undertaking voluntary benchmarking of the performance of three-waters services since it prepared a pilot benchmarking report for 2007-2008. The number of councils participating in the benchmarking has increased significantly since then and so has the breadth of performance metrics. The 2017-2018 report included results for 48 water providers that serve jurisdictions covering 94% of the New Zealand population (Water New Zealand, 2019, p. 6). Although the impact of Water New Zealand's National Performance Review hasn't been evaluated in this case study, it is likely to be having a positive impact on performance.

Explicit price control regulation also involves high-quality regulation of quality of supply

Stronger forms of economic regulation typically involve explicit price control. This type of regime was instituted for electricity transmission and for 17 of New Zealand's 29 electricity distribution businesses around 2005. The other 12 distributors are small and considered to be closely owned and controlled by their consumers, and so they're subject only to the information disclosure requirements. Explicit price control applies to all gas transmission and distribution businesses and to the local distribution component of telecommunications.

In addition to setting maximum prices or revenue, price control regimes also typically involve the economic regulator specifying minima for various dimensions of service, such as continuity of service, duration of service interruptions and quality of supply.

It is important to appreciate that the service standards are not instituted because unregulated natural monopolies under deliver on them. Rather they're instituted because they are price controlled: if price control significantly reduces a supplier's profits, the supplier has an incentive to restore its profits by cutting its service standards to reduce its costs.

In addition to setting revenue or price maxima, the stylised approach with explicit price control regulation is for the economic regulator to:

1. set supplier-specific standards for continuity of service and quality of supply
2. require public disclosure of information about the supplier's pricing, supply and quality performance
3. closely monitor and undertake comparative analysis of this information

4. provide regular and structured feedback to suppliers, including private warnings to under-performing suppliers
5. pursue legal remedies – typically prosecution seeking financial penalties on the supplier – where the under-performance has been egregious or serious.

Bullet points 1 – 4 apply also to light-handed regimes. Bullet point 5 references financial penalties, which provide both financial and reputational incentives for performance. Taking a prosecution action itself, which typically includes local or national media coverage, can have strong reputational effects and incentives on suppliers. This can be the case even if the prosecution is unsuccessful because the prosecution is often viewed as a signal that performance is below-par.

One advantage of financial penalties/incentives is they can be more easily calibrated than warning statements, to signal the severity of the breach. A more important advantage is that they're a high-veracity form of feedback to a supplier. As discussed in Table 1 on page 17, financial penalties can make it easier for the supplier's management to promote a business case for incurring costs to make service and quality improvements, because the benefits (avoiding future penalties) of the proposed action are monetised for them.

The Commerce Commission specifies minimum continuity of service levels (but not minimum quality standards) for price-controlled electricity distribution businesses and has taken prosecutions against those that have seriously breached them.⁵⁷

Enforcing financial penalties for performance breaches is key to improving health and environmental quality of water

The persistently poor quality of drinking water in New Zealand is deeply concerning. According to the Department of Internal Affairs (DIA), the source of the problem is:

a statutory regime that places relatively weak obligations on suppliers to provide demonstrably safe drinking water, including the ability to rely on affordability as a defence for non-compliance with drinking water standards. ... An implementation approach that has focused primarily on practical support, influence and persuasion to ensure compliance, combined with no formal enforcement for serious or persistent non-compliance. No formal enforcement action has been taken against suppliers since the regime came into force, despite widespread annual non-compliance with a range of regulatory requirements that could have a material impact on water quality and safety (Department of Internal Affairs, 2018, p. 6).

Similar regulatory weakness appears to be the case regarding meeting current wastewater standards. According to the same Cabinet paper, the DIA identifies the key problems as:

lack of public reporting on the environmental performance of wastewater treatment plants and the extent to which they comply with discharge consents. Many regions do not provide

⁵⁷ In principle, economic regulators could also adopt formal benchmark competition, which involves financial incentives based on relative performance. Currently the Commerce Act 1986 does not provide for the Commerce Commission to undertake formal benchmark competition. This is discussed later in this section.

any public reporting around this public infrastructure at all, and are not required to by the current regulatory regime. In the Waikato and Manawatu-Whanganui, 50 per cent of plants were non-compliant with consent conditions in 2017-2018, yet this information is not readily available and there is limited transparency or accountability for this poor performance;

high numbers (one in 10) of wastewater treatment plants legally operating on expired consents for long periods of time (in some cases, decades), with a bow wave of consents (one in five) due to expire by 2022;

little formal enforcement action on the part of regional councils where consent conditions are breached, and concerns over the technical capability of some regional councils to effectively regulate wastewater services to achieve good outcomes for the environment and local communities; (Department of Internal Affairs, 2018, p. 9)

One option to lift performance is to adopt light-handed economic regulation but a strong form of regulation of health and environmental standards. Under this approach the Ministry of Health and district health boards (DHBs) would prosecute drinking water suppliers for breaching maximum levels of contaminants and regional councils would prosecute wastewater suppliers for discharging water that breaches maximum levels of pollutants.⁵⁸ A strong desire by the regulators to monitor and enforce standards, and to take prosecutions, is essential to deliver effective results.

The Scottish experience is instructive. In 1945 Scotland had 210 water boards, owned and operated by local councils, with most of them lacking expertise and specialised resources. The number of suppliers was reduced to 13 in 1976.

The European Union introduced financial penalties on water suppliers for breaching health standards in 1980, called the 1980 Drinking Water Directive, however it took many years before enforcement was ramped up. Faced with the costs and reputational consequences of financial penalties and the requirements to comply with the EU Urban Waste Water Treatment Directive, the Scottish Office (of the UK Government) removed water and sewerage services from local authorities and engaged in another round of mergers, resulting in three suppliers by 1996.⁵⁹ However, water quality and environmental standards were still being breached too often and productivity was generally very low. Finally, in 2002 the three suppliers were merged into a single entity called Scottish Water.

Since 2002 Scottish Water has:⁶⁰

- reduced its operating costs by 40 percent
- reduced its number of lost-time accidents from around 30 per 1,000 employees to around 2.5 per 1,000 employees in 2015/16
- increased its customer satisfaction rating from 63% to 90%.

⁵⁸ Water New Zealand's National Performance Review shows that Regional Councils have undertaken two successful prosecutions since the 2015 financial year (Water New Zealand, 2019, p. 38)

⁵⁹ This description of events is based on personal correspondence the author had with Ken Hutchison, Managing Director of Scottish Water International, October 2017.

⁶⁰ Statistics obtained from a presentation to the Building Nations Symposium, 26 October 2017, by Ken Hutchison, Managing Director, Scottish Water International.

Since 2010 compliance with water quality standards has improved steadily from 99.83% to 99.93% and the number of environmental pollution incidents has reduced from around 750 per year to around 250 per year.⁶¹

An integrated approach to health, environmental and economic regulation would achieve better outcomes overall

According to the DIA one of the problems with the current regime is:

[a] lack of coordination between all players in the system, including suppliers, regional councils, district health boards, and the Ministry of Health, combined with inadequate whole-of-system oversight, which has led to poor understanding of risks and system performance (Department of Internal Affairs, 2018, p. 6).

The DIA goes on to state that:

for regulation, any future state needs to recognise that health, environmental and economic regulation of the three-waters have cross-impacts and are synergistic; that is, the combined sum of regulation across these areas is greater than the separate parts. Regulations across these areas therefore need to be viewed as a single coherent system (Department of Internal Affairs, 2018, p. 13)

Hence, another option is to adopt a strong form of regulation covering health, environmental and economic regulation under the aegis of an existing credible and independent regulatory agency. A credible regulator must be professional, independent and authoritative, and have the resources and resolve needed to take prosecutions. Shifting the regulatory responsibility to an experienced and respected regulator would provide the needed teeth, experience and whole-of-system oversight. In contrast, relying on “failed and flailing” agencies to lift their game seems an unpromising strategy.

The Commerce Commission already undertakes strong form regulation of many other natural monopolies in New Zealand and is a natural candidate to do so for the natural monopoly parts of the water sector. It has the right culture, and is clearly a professional, independent and authoritative organisation, with a feared “industry watchdog” reputation. It has a great deal of experience with applying supplier-specific regimes, and with managing light-handed regulation for some suppliers and explicit price control for others.

Integrating health, environmental and economic regulation of drinking and wastewater suppliers under the aegis of the Commerce Commission is likely to achieve better health, environmental and productivity outcomes than other options.⁶² It has considerable experience with information disclosure and financial penalty regimes applying to both prices and continuity of supply, which it applies to large and well-resourced entities. Centralising the enforcement of health and environmental regulation of water suppliers in one agency achieves scale, facilitating greater specialisation and expertise, and it would foster informal benchmark competition.

⁶¹ Ditto

⁶² The Commission would of course need additional resources to undertake the role but these would be at-least partially funded by reduced responsibilities on existing regulators: the Ministry of Health, DHBs, and regional councils.

As for other monopolies regulated by the Commerce Commission, drinking water service levels and quality standards need not be the same for all suppliers, and they need not remain the same over time. For example, variability in taste, colour and smell is likely to be appropriate (and acceptable to affected parties), and even some variability in maximum levels of contaminants may be appropriate and acceptable. The Ministry of Health could still specify maximum contaminant levels based on health sector evidence, and then it could be left to the Commerce Commission to regulate quality above those levels on a supplier-specific basis, taking into account costs and local preferences. Moreover, as some reticulated water suppliers are currently failing to meet maximum contaminant levels, the Commerce Commission has the expertise to set and enforce supplier-specific requirements for interim periods until the regulated maxima are achieved.

A similar approach could perhaps be adopted for setting and enforcing environmental standards for wastewater.

Economic regulation to encourage on-going innovation and productivity improvements

A common feature of explicit price control regimes is they impose performance incentives on suppliers to encourage them to innovate in ways that reduce their costs without compromising their service levels. These are called production efficiencies.

One common approach, which the Commerce Commission applies to gas and electricity transmission and distribution entities, is called the incremental rolling incentive scheme (IRIS). Under this scheme cost savings are shared with consumers via the Commission lowering the supplier's prices, in a manner that aims to reflect broadly what would occur in workably competitive industries. Under IRIS the Commission reduces prices or revenue in a way that over time leaves the supplier with declining fractions of its additional profits. Similarly, cost increases are passed onto consumers but also partially borne by the supplier. The aim of the scheme is to provide time-consistent incentives so that the supplier maximises its profits by making efficiency improvements as early as possible.⁶³

Formal benchmark competition is another performance incentive scheme but it is not allowed under the Commerce Act. Formal benchmark competition would involve the Commerce Commission setting prices for suppliers based on the cost performance of comparable local natural monopolies. For example, prices for all suppliers could be set based on the most efficient supplier in the industry.

However, the experience in overseas jurisdictions is there are significant variances in efficient costs of serving very different population densities and topographies. It becomes necessary to model efficient costs as a function of population and topology characteristics so that prices are not set at levels below what a supplier could ever hope to achieve. This leaves supplier profits exposed to the rigour of complex modelling exercises.

⁶³ Light-handed regulation in which providers commit to price adjustment formulae, can also provide these kinds of performance incentives.

The IRIS avoids these problems by providing dynamic performance incentives based on the supplier's own costs. The dynamic and supplier-specific nature of IRIS is in-tune with the risk-taking realities underpinning innovation and productivity growth.

The regulatory regime can be used to encourage collaboration and aggregation of water suppliers where that would improve health, environmental and productivity outcomes

It is reasonable to question, however, whether IRIS would provide strong enough incentives for structural change involving extensive collaboration and/or aggregation across local water suppliers. Local government ownership means they're not subject to normal capital market disciplines and there would appear to be relatively weak incentives on their owners to shake things up. Chief executives and senior managers rarely propose initiatives that could result in them losing their job. The performance of the New Zealand water sector in regard to health, environmental and productivity outcomes appears to be poor, to say the least.

The Scottish Water experience reinforces earlier points that the scale of operations affects the ability of suppliers to meet (and exceed) the health and environmental standards required of them. Large-scale operations facilitate development of in-house expertise and afford significant specialisation of resources. Large-scale operations support greater management expertise, which is critical to developing organisational cultures and processes supportive of innovations to improve quality, reliability and security of supply at lower costs, which flow into lower prices for consumers.

Section 3.6 discussed deep uncertainty about where best to draw organisational boundaries and suggested that collaboration and aggregation decisions are experiments. Consistent with the Scottish experience, collaboration and aggregation decisions are best thought of as a journey rather than as one-off decisions.

Section 5.1 argued that a nuanced allocation of decision rights is required because local operators and owners of water assets are likely to have the most knowledge about the best collaboration and aggregation options, taking into account relationships and local particularities. It also suggested local government owners would in theory have incentives to pursue the best options to achieve lower cost and more effective outcomes for their constituents, but noted that in practice they also have incentives to resist change if it involves losing local resources and local control.

The creation of Watercare by aggregating local water suppliers across Auckland, the introduction of water charges, and the adoption of a company structure with a professional board are all credited with lifting water industry performance in Auckland. The creation of Wellington Water, a joint venture by councils in the Wellington region, appears to have materially improved water industry performance in Wellington. Yet very few other councils and water suppliers appear to be taking much action to follow in the footsteps of either Auckland or Wellington, let alone learn from overseas experiences such as Scotland. The Waikato District Council, Hamilton City Council and the Waipa Council have had a highly valuable merger proposition on the table for many years and haven't been able to land it.

Central government also wants better outcomes for its constituents and bears political risks of inaction, but it knows far less about the local circumstances and the likely best combination of

assets and specialist resources. And as discussed above, structural change should be seen as a journey rather than a one-off.

Rather than central government directly deciding mergers of water suppliers, it could amend the Commerce Act to place the drinking and wastewater industry under integrated health, environmental and economic regulation administered by the Commerce Commission. As it does for service level breaches by electricity and gas businesses, the Commission would be required to set supplier-specific interim requirements and pursue financial penalties for health and environmental breaches of those requirements, via prosecution. Each supplier would have a specified path for improving their performance over time to reach minimum nationwide health and environmental minimum standards.

In addition, the legislation would require the Commerce Commission to design strong incentives for providers of reticulated water services to implement substantive collaboration or aggregation initiatives if they're not meeting minimum health and environmental standards. This could involve:

- The Commerce Commission committing to introduce an IRIS on reticulated water suppliers within a specified period (eg, five years) of the start of economic regulation.⁶⁴ This would leave local government owners reaping the full value of any cost savings made in the intervening years. Once the IRIS scheme began, any cost-savings would leave local government owners worse-off than if they had acted earlier because a portion of any savings would be required to flow through to consumers via lower water charges.
- Alternatively, the Commerce Commission could impose a significant downward price-adjustment for any supplier of reticulated water that, on a specified date, has poor quality of supply and productivity metrics.⁶⁵ If performance metrics are subsequently achieved then the IRIS could be suspended for a significant period of time (eg, five years) to allow local government owners to reap the full value of any cost savings during that period.
- A tournament scheme is another option, which could be adopted in addition to one of the first two suggestions. This could involve central government providing a large financial payment for the first two or three groups of small-scale water utilities to improve their performance to minimum levels.⁶⁶ This financial assistance could be used to address any affordability issues they have with upgrading to meet higher environmental and quality of supply requirements.
- In addition, the Commerce Act could be amended to empower the Commerce Commission to formulate backstop arrangements that would apply to suppliers of reticulated water that fail to achieve minimum health and environmental standards by a specified date. The backstop arrangement could be as simple as merging all laggards into one asset-owning provider, with a corporate structure and professional board, and water charges regulated by the Commerce Commission.

⁶⁴ This would require legislation empowering the Commerce Commission to impose and regulate water charges on council-owned water services that failed to achieve minimum performance standards.

⁶⁵ Scale would be defined as a weighted-average of several variables, such as customer numbers, asset values, number of specialised technical resources and so on.

⁶⁶ The financial payment would be sizeable for the tournament winners because in aggregate they'd still be quite small-scale, but it would be a pretty small financial commitment for central government.

Clearly the above suggestions are just that. Considerable work would be required to investigate realistic options, garner support and legislate them. But the broad principles underlying the above suggestions are:

1. As much as possible, leave key aggregation decisions with the water utility owners (ie, local government) but provide a sufficiently credible long-term threat of decisions being made in Wellington if the water industry doesn't move forward.⁶⁷ Utilising the independence, professionalism and reputation of the Commerce Commission would enhance the credibility of the threat across multiple electoral cycles.
2. As much as possible, create conditions in which changes to industry structure are a journey, with parties learning from the experiences of early movers. It will become increasingly untenable for laggards to remain on the side lines. The policy risks of instituting the backstop arrangements would be manageable because the laggards would have continued to under-perform in regard to meeting health and environmental standards.

5.5 Affordability issues can be addressed in ways that foster productivity

The discussion in section 5 suggests an informed and dynamic process for encouraging greater operational scale of drinking water and wastewater suppliers. The experience in Scotland and elsewhere suggests larger scale suppliers significantly improve productivity, which means lower costs on local communities and a greater ability to fund from water charges upgrades to water treatment facilities to achieve better health and environmental outcomes. The supplier-specific approach suggested in section 5.4 would also facilitate a manageable process in regard to affordability, as informed cost/quality trade-offs would be made on a case-by-case basis.

The rest of this section discusses other productivity enhancing ways to address pending affordability issues in the water sector.

The context and magnitude of the affordability issue

The DIA states affordability issues are increasing due to a growing need to replace ageing assets and the need to upgrade treatment plants to comply with existing health and environmental standards. As mentioned in section 2.1, the Havelock North Inquiry reported the outbreak was caused by sheep feces seeping into a bore, which reflects poor management performance rather than the poor performance of treatment plants. Nevertheless, the Havelock North Inquiry considered it important to increase drinking water standards by removing the affordability opt-out provision.

Beca prepared for the Havelock North Inquiry estimates of the costs of upgrading drinking water treatment plants to meet a potentially higher drinking water standard. Beca estimates capital costs in the range \$309m - \$574m and additional operation costs of \$11m - \$21m per annum. The cost increases are very steep for 1% of the population served by networks owned by non-council

⁶⁷ It will be important councils remove any poorly-specified liabilities that have built up from past performance so that the supplier's management and directors focus on improving future performance rather than managing the consequences of past performance.

parties. For example, the Beca report estimates annualised cost increases exceeding \$1,300 per year per affected household for four population clusters, each with 400-700 people, served by non-council owned water treatment plants.

GHD and Boffa Miskell (GHD/BM) has estimated the costs of upgrading wastewater treatment plants to meet the freshwater environmental standard defined in the National Environmental Statement for freshwater management, called NES-FM. They estimate capital costs of \$1.4b - \$2.1b. The cost impact is very uneven, with an average annualised cost increase of \$1,100 per household affected by the upgrades.⁶⁸ The annualised cost increase would be \$3,600 for areas with small populations (500 or less people). The costs would be considerably lower, at \$160m - \$240m, to address the largest degraders of water quality. However, the GHD/BM report does not include any costs for dealing with wet weather overflows or with discharges into saltwater environments.

There are also affordability issues arising from rapid population growth in some areas, creating the need for additional capacity.⁶⁹ Affordability issues are also arising for declining populations in other areas, which bite when existing assets wear out and new investment is made.

Forced cross subsidisation of water services is likely to harm productivity

Proposals to aggregate small reticulated water providers to create substantially larger ones has led to suggestions the larger business units will be able to cross subsidise the funding of upgrades serving small subsections of their catchments. This may be true, and the owners of the businesses may well be happy to do so. However, it presumes the cross subsidy funding burden is small relative to the utility's overall revenue stream. This may not be the case based on the cost estimates obtained by the DIA.

Moreover, a policy requiring or forcing cross subsidisation could slow-down and distort the voluntary aggregation of water suppliers, and harm longer term investment incentives:

- A slow-down could occur if the policy requirement is unclear about the expected magnitudes of cross subsidisation.
- It could distort the preferred grouping of suppliers if it encourages low-cost suppliers to shun high cost ones despite them being a good fit for the larger scale operation (due to commonality of equipment, proximity etc).
- It harms long-term investment incentives in the water industry because the policy rewards water supplier owners and their communities for having delayed upgrades (often for many years) and punishes those that “fronted up” and paid for the costs of their own upgrade when it was needed and now they’ll have to pay for their “slack neighbour” too.

These considerations mean that a forced cross-subsidisation approach is likely to reduce productivity if the cross subsidies are significant. The impact on long-term investment incentives is

⁶⁸ 152 plants would need upgrading, which serve 13% of New Zealand's population (645,000 people).

⁶⁹ The Commission has recommended several initiatives to address these issues in its report entitled *Better urban planning* (New Zealand Productivity Commission, 2017), and further recommendations are likely to be made in this inquiry.

particularly concerning and shouldn't be underestimated. The impact of distorting aggregation decisions (second bullet point) can also be particularly large and long-term.

Funding and financing options that address affordability and foster productivity

Subsidising standard goods and services is likely to result in subsidised consumers paying prices below the long-run marginal cost (LRMC) of supply. The situation is a little more complicated for natural monopolies because they can have very large economies of scale in investment. For example, a doubling of water pipe capacity doesn't involve a doubling of build or installation costs. In this case their LRMC can be significantly lower than their long-run average cost (LRAC). A subsidy that covers no more than the difference in these costs would leave water prices above or equal to LRMC.⁷⁰ Prices equal to LRMC would avoid harming allocative and productive efficiency.⁷¹

Current water industry arrangements mean average and marginal costs of supply are likely to be substantially higher than would be achieved under the changes suggested in this paper. Average costs and short-run marginal costs would be reduced by improving the utilisation of existing assets, for example through reducing leakages. Long-run marginal costs would be reduced through better investment decisions, for both large and small population centres.

For example, water quality expert Anthony Wilson argues modern, compact water-treatment plants now exist that provide drinking water at acceptable quality levels. He argues they're suitable for small population centres and that bulk purchasing them would result in much lower costs than traditional supply methods. But doing this requires many councils to join the bulk purchasing scheme and accepting a standard plant design.⁷² Watercare indicated bulk buying and standardisation could reduce costs by as much as 50 percent.⁷³

These considerations suggest the Government has an opportunity to leverage the proposed regulatory regime (refer to the last section in 5.4) to address affordability issues in ways that foster productivity. It could do this by:

- Subsidising only those suppliers that:
 - were originally serving a small population centre and have adopted the funding, financing and corporate governance arrangements suggested in this paper
 - are required by the Commerce Commission to achieve higher quality of supply standards than currently achieved or they have obtained Commission approval to pass on the costs of replacing ageing assets
 - adopt procurement objectives and practices approved by the Commission, designed to result in fit-for-purpose investments.
- Restricting the size of the per unit subsidy to a portion of the difference in long-run average cost and long-run marginal cost, as assessed by the Commission.

⁷⁰ That is, a per unit subsidy \leq (LRAC – LRMC).

⁷¹ In theory efficiency requires prices to always equal SRMOC, which would result in average prices equalling LRMC. See the discussion in footnote 48 and associated main text.

⁷² Personal correspondence, Productivity Commission meeting with Anthony Wilson, 25 January 2019.

⁷³ Personal correspondence, Productivity Commission meeting with Watercare, 19 February 2019.

The suite of restrictions in the first bullet point provide strong incentives for local government owners of water suppliers to undertake the reforms needed for the water industry and restricts the subsidy to situations where there is a high level of assurance it is needed and would be used wisely.

The last bullet point is intended to achieve two objectives. Restricting the subsidy to no more than the assessed difference in average and marginal costs should leave the supplier in a position of charging its customers prices no lower than charged elsewhere. Restricting the subsidy to a portion of the assessed differences, say 50-80% of the difference, introduces a co-payment type regime. For example, an 80% portion paid by central Government means the aggregated supplier covers 20% of the difference.⁷⁴

Summary of approach suggested in this paper

The key features of the approach derived in section 5 can be summarised as follows:

- *Greatly increase scale*: Councils should pursue far greater collaboration and aggregation of their suppliers of reticulated water services to achieve far larger scales of operation and specialisation of resources
 - but it's very important to have a reasonable plurality of suppliers in the industry so that innovative people have several innovation vehicles available to them. A corollary of this is that it's best not to force all suppliers to merge into a single nationwide entity
 - it's best to merge assets (to allow independent financing) rather than have management joint ventures
 - it's best to leave these decisions to local owners provided they achieve minimum performance levels.
- *Corporatise*: Councils should place their reticulated water services (assets and staff) in corporate structures, remove poorly-specified liabilities and appoint independent and professional directors
- *Introduce independent funding and financing*: Reticulated water suppliers should receive independent revenue streams, including from volumetric charges, and access independent finance.
- *Adopt an integrated and credible regulatory regime*: High-quality regulation of drinking and wastewater suppliers by an existing, credible and independent regulatory agency (eg Commerce Commission) that:
 - sets pragmatic, supplier-specific, *interim* health and environmental standards that over time drive the supplier to achieve minimum nationwide standards
 - enforces financial penalties for breaches of quality and externality standards
 - applies a backstop arrangement to suppliers that fail to sufficiently lift their health and environmental performance within a specified time period

⁷⁴ The last subsection of 5.4 suggested the Government create a tournament type regime. That approach could be adopted here, for example by the Government offering a 100% portion of assessed differences to the first supplier able to satisfy the conditions in the first bullet point.

- incentivises productivity improvement.
- *Address affordability separately from aggregation:* If subsidies are needed to assist some communities with affordability, they should be provided by central government and configured with the regulatory regime to:
 - reinforce incentives in the regulatory regime
 - restricts the subsidy to situations where there is a high level of assurance it is needed and would be used wisely
 - leave the supplier in a position of charging its customers water charges no lower than charged elsewhere
 - involves a modest co-payment from local government.

6 Current water reform options and implications for the LGFF Inquiry

As stated in the introduction, the objective of this research note was to:

1. Identify the implications of the three-waters reforms for the work the Commission is undertaking on the LGFF Inquiry.
2. Assist the Commission to form a considered view on the three-waters reform programme that is coherent with the Commission's position on the LGFF Inquiry.

These objectives are pursued by considering the Department of Internal Affairs' (DIA's) analysis of the drivers of poor performance in the three-waters sector and discussing the DIA's reform options in light of the analysis in this note.

6.1 The DIA understates the key drivers of poor performance of the three-waters sector

The DIA considers the problems with the sector are funding and financing challenges, capacity challenges and weak regulation. However, its analysis of these issues appears to consider the most obvious symptoms rather than the underlying drivers.

At paragraph 23, the November 2018 Cabinet paper states the following themes have emerged across all of the three waters:

23.1 funding and financing to upgrade infrastructure lies at the heart of the problems facing the three waters. Many councils are struggling to fund plant and pipe infrastructure to the level required to meet standards and community aspirations, keep pace with population growth, and build resilience against natural events. The challenges manifest in different ways for councils of all sizes, but for many smaller councils, there is no clear way forward given the scale of the challenges. There is also a relationship with debt levels, with internally and externally imposed debt restrictions contributing to some of the funding and financing challenges;

23.2 capability challenges sit hand in hand with funding challenges. Good capability is the key to designing, procuring, delivering, and managing three waters services, particularly given the specialist nature of much of the infrastructure. Capability is also central to public health and environmental risk assessment in complex areas such as geology, water flows, and the impact of land use. Again, the challenges increase as population size decreases – many smaller rural and provincial councils face a greater struggle to access and retain specialist skills. Smaller councils by nature have smaller teams, with wider and more general skills, rather than specialists;

23.3 regulation of three waters is weak across the system. In many parts of the country, consumers cannot be certain that drinking water is safe, or that the system is contributing to good environmental outcomes. Both drinking water and environmental regulation exhibit, in differing degrees, inadequate stewardship, compliance, monitoring, and enforcement practices. There is also no formal system of economic regulation to ensure that consumers' long-term interests are being protected, and that services are value for money. Given that three waters service providers are natural monopolies, this is at odds both with infrastructure of a similar scale in New Zealand (such as telecommunications or electricity networks), and with good practice in comparable overseas jurisdictions. (Department of Internal Affairs, 2018)

The financing aspect of the discussion at 23.1 is apt but the funding discussion focuses on affordability and doesn't indicate the critical importance of funding decisions being independent of local politicians and their officials. Along with high-quality governance and effective regulation, independent funding and financing is critical for incrementally and sustainably resolving the three-waters performance issues and facilitating fit-for-purpose investments. Choosing the right type and size of investments, and the right timing and financing of them, is critical for lifting productivity, minimising cost increases and mitigating affordability difficulties. Two of the broad reform options don't appear to reflect this criticality, however the third reform option certainly does.

The discussion of capability challenges at 23.2, and elsewhere in their other papers, identifies scale and specialisation as inhibiting supplier performance but doesn't indicate an appreciation of the incentives at play and the trade-offs involved. The discussion doesn't indicate why most providers are not seeking scale or specialisation whereas others have done so but have taken a very long time to get there (eg, Wellington Water) or have abandoned such plans after a long period and considerable cost has been incurred (eg, the Waikato proposals).

In CSA's view there is a risk the DIA may think of aggregation as a one-off deterministic problem rather than a journey involving trial and error. The DIA's papers don't indicate any appreciation that it matters who, why and how collaboration and aggregation decisions are made, and that getting it right is often context-specific. As Teece states it: "*Merely putting two business units or departments under common ownership and common governance need not bring about 'integration' and the sense of achieving full alignment and cooperation ... Successful functional integration can be tremendously hard...*" (Teece, 2019, p. 19).

The discussion of the current weaknesses of regulation at 23.3, and elsewhere in their other papers, reflects a view the problem is poor regulatory practice rather than inextricably linked to:

- poor regulatory design, ie, one-size-fits-all standards with vague and non-contestable opt-outs for affordability, which undermines ability to prosecute
- the absence of independent funding and financing, which cripples supplier ability to respond effectively to lift their performance
- lack of regulatory expertise.

However, there is some promise from the DIA's recognition that the natural monopoly feature of drinking water and wastewater conveyancing mirrors that in telecommunications and electricity.

The DIA recognises that the supply of three-waters services, and the regulation of it, is complex and interdependent, and that it spans multiple central and local government responsibilities. The November 2018 Cabinet paper states "*The response will therefore need to take account of these interdependencies, by taking a system-wide view, from source to tap and back again. It will be essential for any response to treat council drinking water and wastewater services as a single network.*" (para 8) But it's not clear the DIA appreciates that economic regulation inevitably requires regulation of service levels, which could include health and environmental standards.

6.2 The DIA appreciates the severity of the problems with the three-waters sector and is proposing sweeping reforms

The results of the Havelock North Inquiry and other information sources have led the DIA to conclude current arrangements for the three-waters sector are not sustainable in the long-term.

The DIA is investigating three broad reform options:

- Option 1: Proceed with regulatory reform only, with voluntary, sector-led reforms to service delivery arrangements.
- Option 2: Establish a three-waters fund to support voluntary service delivery improvements.
- Option 3: Create an aggregated system of dedicated, publicly owned drinking water and wastewater providers. (para 12)

Option 3 is far more comprehensive than appears at first sight, and is more akin to the approach developed in this note. The appendix to the November 2018 Cabinet paper presents Option 3 as follows:

- Creation of statutory, aggregated, self-funding water utilities, which could be configured in various ways, such as:
 - on a regional basis, with approximately 12 providers;
 - on a multi-regional basis, with approximately three to five providers.
- The water utilities would be asset owning, with professional skills-based boards of directors, mechanisms to ensure local democratic input, and local service delivery presence.

The discussion in the Cabinet paper appendix indicates that Option 3 would also involve economic regulation. This is very good. One main reservation CSA has is the overly deterministic view of how to achieve effective aggregation, which seems to be driven by a desire to use lower unit costs (from greater scale) and sheer size to address affordability issues in pockets of the merged entities.

Section 5.5 of this note identifies potential adverse productivity impacts that could arise if cross subsidisation was too-forced.

In CSA's view the Productivity Commission has an opportunity to assist the DIA to appreciate that Option 3, or something close to it, is the only realistic option with any chance of materially lifting the performance of the drinking water and wastewater industry.

The self-funding aspect of Option 3 is excellent, but there seems to be little awareness the economic regulation of water charges by an agency like the Commerce Commission has the potential to address the fundamental regulatory design and enforcement problems. This is reflected in discussion in the November 2018 Cabinet paper to consider the potential of a new regulatory agency with both environmental and drinking water regulatory functions:

66... consider the institutional arrangements, and oversight and stewardship needed to support and enable the drinking water and environmental regulatory reforms arising from the work described above. This will include:

66.1 options for the establishment of regulatory functions and the associated institutional arrangements, including the potential for co-location of environmental and drinking water regulatory functions;

Earlier in the paper the DIA states:

Work in this area will comprise targeted reform of environmental regulation of wastewater, aimed at lifting environmental performance within the existing framework of the Resource Management Act 1991. It will also include measures to give greater transparency around the operation of wastewater and stormwater systems, and to promote better practice. These proposals could comprise the following elements:

64.1 national-level environmental performance requirements for wastewater networks. Such requirements could include minimum standards for discharges from wastewater treatment plants, and targets for wastewater overflows;

64.4 improved compliance, monitoring and enforcement arrangements for wastewater and stormwater services, including for consent holders that rely on section 124 of the Resource Management Act 1991 (which enables resource consent holders to continue operating on expired consents).

6.3 Further research may be useful on structural separation and the stormwater sector

Further research and analysis could be undertaken on two matters this report hasn't considered in any depth.

The first relates to the productivity implications of structurally separating the competitive elements of the supply chain from the natural monopoly (conveyance) element. This type of separation was successfully undertaken in New Zealand for electricity and telecommunications, and it has also

been undertaken to some degree for drinking water and wastewater in other jurisdictions such as England and Wales.

The second matter potentially requiring further research is whether the productivity-improving arrangements discussed in section 5 of this report make sense for the stormwater sector. Section 4.2 suggested stormwater activities may have strong economies of scope with roading and/or urban design activities. Some parties, such as Watercare,⁷⁵ argue the business of providing stormwater services shouldn't be integrated with the business of providing drinking water and wastewater services, whereas other parties, for example Wellington Water,⁷⁶ argue it is best to keep the three-waters services integrated in one business.

It would be useful to undertake further analysis to determine how best to resolve the stormwater issue. For example, can the regulatory incentives discussed in section 5.4 (to encourage more efficient scale of operations through collaboration and aggregation) be applied to this issue too. If so, then the issue can be left for local governments to address over time, as they see fit.

⁷⁵ Personal correspondence, Productivity Commission meeting with Watercare, 19 February 2019.

⁷⁶ Personal correspondence, Productivity Commission meeting with Wellington Water, 2019.

Appendix A: Further description of the regulatory framework for three-waters

The following text is quoted from the Report of the Local Government Infrastructure Efficiency Expert Advisory Group (2013, pp52-54).

New Zealand's water management regime covers not only drinking water, but also wastewater and stormwater drainage. The LGA, Health Act 1956, RMA and Building Act are all components of the regime. The management regime includes mandatory requirements, voluntary codes of practice and community-derived self-regulation.

The delivery of drinking water infrastructure by councils to specific standards is controlled under a framework created mainly by the Health (Drinking Water) Amendment Act 2007, which amended the Health Act. The Act creates duties for councils by including a requirement to report on drinking water quality within their districts. The Act also creates an obligation on water suppliers and water carriers (including councils) to monitor drinking water and take all practicable steps to comply with standards.

The New Zealand Drinking Water Standards 2008, which are derived from WHO guidelines, prescribe the maximum allowable concentrations of potentially harmful contaminants that may be present in drinking water. The standards are exactly the same for all supplies, regardless of size or type, because they relate to health effects on people. However, the monitoring and compliance criteria become more detailed or stringent as population increases. This approach provides different levels of certainty that the standards are being met and is intended to help balance costs against public health risks. As the standards note: "From a public health perspective, the more people served the more certainty that is needed". There is also a degree of flexibility in the standards, as water suppliers may apply to have alternative treatment processes approved, other than those set out in the standard.

There is further flexibility for the smallest categories of water supply, in that the standards prescribe suitable treatments depending on whether the water catchment is protected, partially protected or fully protected. However, the greatest flexibility for small water supplies lies in Public Health Risk Management Plans (PHRMP) where communities can identify risks to their supplies, consider affordability and practicality and may prioritise addressing risks.

There is a phased timetable for compliance with the drinking water provisions of the Act. From the specified dates, a water supplier must comply with the duties to:

- Take all practicable steps to
 - ensure there is an adequate supply of drinking water
 - comply with the drinking water standards
- Take all reasonable steps to
 - protect raw sources of drinking water from contamination
 - provide wholesome drinking water
- Prepare and implement a PHRMP.

Supplies serving 10,000 or more population must already be compliant. Those serving 5,000 to 10,000 have until July this year (2013). Smaller supplies are progressively phased in over 2014 to 2016.

Part of the compliance regime is the use of a drinking water assessor (DWA), supported by “designated officers”. There are currently 33 appointed DWAs, whose employers are the district health boards. The DWAs have a statutory responsibility to assess the performance of drinking water suppliers to determine if they are complying with the Act and the standards, and whether or not public health risk management plans are being implemented. The DWAs and designated officers have extensive powers of inspection and recording. Non compliance with the standards can lead to a compliance order issued by the Medical Officer of Health. The water supplier may seek a review of decisions made the DWA.

The grading provisions, administered by public health unit staff in district health boards, have been effectively replaced by the statutory PHRMP process. Previously, the grading provisions were regarded as the principal driver of improvements in water quality. However, since 2007, grading is undertaken only when requested by a water supplier and is completely voluntary. The grading system is currently under review.

Another relevant provision is the National Environmental Standard for Sources of Human Drinking Water, produced under the RMA. This requires regional councils to consider the impact of possible contamination on sources of supply. In addition, the National Policy Statement for freshwater management provides a guide to councils on achieving national objectives for fresh water management through regional policy statements and plans.

The LGA requires councils to assess water, wastewater and stormwater in their districts. It also obliges councils to maintain existing water services for its communities, although it does not oblige the establishment of new services. There are provisions governing the closure or transfer to community ownership of small water schemes and requirements for any contracts entered into for the operation of water services.

The LGA enables but does not require the provision of wastewater systems. Under the Health Act, the Minister of Health can require a local authority to provide, alter or extend sewerage works. The Act also provides the basis for Parliament to provide grants or subsidies for sewerage works.

Appendix B: Further discussion of pricing issues

Spot market pricing and peak demand pricing can also improve productivity

Volumetric pricing is typically discussed in terms of administered flat rates, set for relatively long periods of time such as a year or two, and levied on a per unit basis for all units received. Sometimes the pricing regime may encompass different price levels for different volume tranches. But the important point is that consumers don't face price incentives to alter their demand for short periods when short-term supply conditions are tight.

In practice, long-term volumetric pricing is widely used for charging residential and business consumers of gas, electricity and telecommunications, but in the gas and electricity industries (some) consumers can choose to pay volumetric prices determined by repeated auctions, called spot markets.

For some industries the short-run marginal opportunity cost of supply varies greatly over the course of a day, week, month or season. For example, the short-run cost of electricity increases greatly when demand increases temporarily (eg, during a cold winter night) because high cost power plants are called on to supply electricity to the system. The cost of supply also increases when power plants that would've supplied the system are temporarily unavailable due to unplanned outages or fuel-supply restrictions or due to constraints on the transmission system limiting the amount of low-cost electricity able to be transmitted to where there is demand for electricity.

Large swings in short-run costs means that costs can be very high at times, and so reducing demand at those times can save substantial costs. This cost saving opportunity can make it worthwhile to incur additional transaction costs to operate a more sophisticated pricing regime, so that volumetric prices frequently adjust to reflect short-run cost variations.

One such regime is the NZ spot electricity market in which generators submit offers of electricity for half-hourly periods and purchasers submit bids for electricity for those periods. The spot electricity market produces half-hourly prices, set at the level that balances supply and demand in each half-hour period.

Spot market prices provide consumers with incentives to more accurately trade off the benefits of their consumption against the short-run marginal opportunity cost of supply. This improves productivity when it avoids or defers the need for investments in costly reserve plant that would sit idle most of the time, or when it avoids or defers the need for investments in conveyance systems, such as gas and electricity transmission and distribution systems.

Provided consumers have the option of paying longer term volumetric price (reflecting long-run average costs), they'll only participate in a regime of fluctuating volumetric prices if it benefits them: that is, when their expected cost savings exceed the additional transaction costs they incur from participating more intensely in the market and any additional worry about coping with unpredictable prices or bills.⁷⁷

⁷⁷ In the electricity sector, approximately one percent of residential consumers have chosen to pay spot market prices for their electricity.

Ten industrial consumers of electricity, accounting for more than 15 percent of total electricity consumption in New Zealand, choose to pay spot market prices for their electricity. The spot pricing regime has provided them with strong incentives to find clever ways to reduce their electricity demand when short-term supply conditions are tight.

Spot markets typically involve high transaction costs, to establish and operate them and for suppliers and consumers to participate in them. These transaction costs are not worth it when the short-run cost of supply is reasonably stable or predictable or when the market isn't demonstrably competitive.

A less costly option in these circumstances is for suppliers to specify different volumetric prices for different circumstances. For example, suppliers could set a high volumetric price when demand on the conveyance system reaches capacity. In these situations the conveyance system is congested and the price is called a congestion charge. The charge would be zero when there is no congestion.

Another option is for suppliers to set high volumetric prices for periods when demand is expected to be high regardless of whether congestion occurs (called peak demand prices) and a lower volumetric price for all other time periods (called off-peak prices). These pricing regimes incur lower transaction costs than spot markets but they produce coarser, and potentially less accurate, prices for consumers to react to, and so the associated economic benefits are smaller too. But the productivity gains would be greater than for spot market pricing if the ratio of economic benefits to transaction costs exceeds the ratio for spot market pricing.

As for volumetric charging generally, the choice of any specific type of volumetric charging (longer term pricing, spot-market pricing, peak demand pricing, congestion charging etc) rests on the specifics of each case. Recent and future developments in electricity pricing at the level of electricity distribution may foreshadow future developments for the water sector.

Currently, all electricity distributors set longer term volumetric prices for their services even though the short-run marginal opportunity costs of their service can vary greatly in some cases. However, rapid advances in metering and demand-response technology, and in Small-scale generation and storage technology, are increasing the economic costs of relying on longer term volumetric pricing. Prodded by the Electricity Authority, electricity distributors are putting considerable effort into developing shorter term pricing regimes, such as peak demand pricing.⁷⁸

Should capital costs be recovered with fixed charges or volumetric charges?

The previous subsection discussed spur prices for the connection of conveyance assets (eg, drinking water and wastewater pipes, gas and electricity lines), extending, shifting or expanding them, and installing, testing, monitoring, shifting and disconnecting meters. It also discussed customers paying different prices for different connection capacities.

⁷⁸ Although spot pricing applies at the transmission level in the electricity sector, to-date it hasn't been worthwhile to adopt a similar pricing regime at the level of electricity distribution, and this doesn't look likely to change in the medium term.

None of those prices are volumetric because the charges paid are not a direct function of the amount of goods (water, gas, electrons, data packets) delivered by the conveyancing activity. Rather, they're fixed charges for specified services and service levels that are easily attributable to specific customers. As discussed earlier, adopting these pricing regimes promotes productivity. Volumetric pricing would be a less productive approach in these cases.

In contrast, it is far harder to attribute specific costs in the core network to individual customers or small groups of customers. It can and is done to some extent, for example the additional costs of augmenting network capacity to provide for a new connection. But a substantial portion of network costs are fixed capital costs and they're incurred to serve all customers or large groups of them (these are called *common costs*).

The question arises about how best to recover these common network costs: with fixed charges, such as a daily or monthly fixed charge, or with volumetric charges such as a flat charge or a peak demand charge?

In practice, fixed charges are usually related to the customer's connection capacity. In effect, this means large commercial or industrial customers pay charges roughly related to their expectations of future peak demand at the time their connection asset was installed.

From a productivity perspective, two conditions need to be met for recovering common network costs:

1. Each customer and group of customers should pay a share of common network costs that at-least equals the incremental cost (IC) they face and does not exceed their stand-alone cost (SAC). This condition is often expressed as $IC < p < SAC$, where p is price.⁷⁹
2. Volumetric prices should *on average* reflect the long-run marginal cost (LRMC) of supplying a customer. This means fixed charges for the network component of the conveyance service should be set at a level to collect the difference between LRMC and LRAC, where LRAC is the long-run average cost of supply.
 - o Note, though, $LRMC = 0$ for networks where peak demand on the network is below network capacity and is not expected to ever exceed capacity. In this case fixed charges would be used to recover all common network costs.
 - o Note also the form of volumetric prices could be a simple long-term price, or a congestion charge regime, or a peak and off-peak pricing regime or a spot market pricing regime etc. From a productivity perspective, the specifics of each situation needs to be considered to determine the best volumetric option.

⁷⁹ Incremental cost is the additional costs of providing a customer or group of customers with new or additional services. Stand-alone cost is the total cost of providing the services or equivalent alternative services to the customer or group of customers. Standalone costs are usually estimated by considering the costs of a purpose-built conveyance facility or alternative facility to suit the needs of the customer(s).

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