Electricity Price Review: comments on the First Report for Discussion

Introduction

I have been asked by Energy Trusts of New Zealand (ETNZ) to provide comments on the First Report for Discussion of the Electricity Price Review ("FRfD"), published on 30th August 2018, focusing on those parts of it that are most directly relevant to EDBs in general and to the EDB's that are classified as Energy Trusts in particular.

In responding to the request, I am aware that the report forms part of the Review's first phase, which is to gather facts and consider industry and public submissions with the aim of identifying any existing or emerging problems. I am also aware of New Zealand's high standing in international rankings of electricity policy performance, which I believe is well merited. Both those points shape the comments that follow.

It is, of course, good practice to keep sectoral policies under review from time to time, and wise to do so with an eye on comparative experiences and a view to learning from them, including from their mistakes. An existing high standing can be a spur to continued seeking out of improvements and of adaptations to changing circumstances, but it can also serve as an obvious warning that there is a long way to fall if performance deteriorates (see the UK). First do no harm is a sound working principle in this regard.

As another opening comment, let me also express my view (which I have been advocating in the UK for two or three years now) that some of the most significant policy mistakes that have occurred across electricity systems in recent years have been correlated with rhetoric that is heavily focused on the achievement of 'fairness'. The problem is not that fairness considerations are unimportant: quite the reverse in fact. It is rather that what is meant by the words 'fair' and 'unfair' is left unexplored and unexamined.

Thus, when it appears in policymaking contexts the word 'fair' is usually only vaguely defined at best and is therefore left open to multiple, different interpretations. This opens up considerable scope for arbitrariness in decision making, and the resulting 'policy uncertainty' then tends to be an adverse influence on economic performance or economic efficiency.

Whereas there are obviously trade-offs between 'fairness' and efficiency with which economists are well familiar, the point that I will argue is that greater clarity and specificity in the meaning of 'fairness' *for operational-decision making purposes* can be expected to be highly positive for economic performance, particularly in the longer term. I very much hope, therefore, that the Panel will build on the FRfD's existing emphases on the importance of 'fairness' to address this issue of 'arbitrariness in meaning'. I can think of few issues of greater importance for the electricity sector.

In what follows, I will start with discussion of some rather general points concerning the economics of distribution systems. Those who are already convinced that economies of scale are a minor or non-existent issue in electricity distribution can safely skip parts of the material (and equations are in any case relegated to the Annex). But do read The Story of Mr

Maton, because it also has wider implications, including in particular for technological innovation. The remainder of the paper offers a range of comments on other matters covered by the FRfD.

The first part of the paper serves to develop some points made in a previous, short paper ("GY1") that I wrote at the request of the ETNZ and which is generously referred to in the FRfD. The underlying problem it addressed was that the IEA Review of electricity in New Zealand (to which GY1 was a response) served to introduce or at least promulgate in NZ an intellectual virus: that economies of scale in distribution raised significant issues warranting detailed public policy consideration. Whereas economies of scale were touched on at multiple points in the IEA's Review's special chapter on NZ electricity distribution, economies of density and their implications were not considered. Yet it is economies of density that are central to the economics of electricity distribution, and in particular to the policy issues that can arise at this stage of the electricity value chain.

The term 'economies of density' is itself a shorthand expression drawn, like the concept of economies of scale, from a conceptual framework that does not pay attention to the structures of networks[1] and their implications for costs. A short commentary is no place to start re-writing the textbooks and for current purposes it is sufficient to bear in mind the point that the costs to serve any particular customer can be highly sensitive to geographic factors such as: the precise location of the customer (e.g. in terms of geographic co-ordinates); the structure or topology of the relevant network; the type of terrain covered by the network; and the human settlement pattern of the area covered by the network.

As a final introductory comment I will unashamedly recommend to the Panel a quick glance at some of the presentation outlines at the most recent annual conference of the Regulatory Policy Institute (September 2018). They illustrate some of the current re-thinking about regulation that is going on in the UK and the messages (though not the mathematics) of Sir John Vickers's Zeeman Lecture, "Regulation and captive customers", are particularly germane for thinking about competition and fairness issues in retail energy markets.

The economics of distribution networks

Professor Sam Peltzman of the University of Chicago can be the first guide in relation to my central point (that it is economies of density, not scale, that are central to understanding the economics of EDBs). Speaking in 1987 of economic sectors where state-owned enterprises (SOEs) are to be most commonly found he said[2]:

"An understanding of why SOE's survive has to follow from an understanding of why the state intervenes in a particular way in a few industries. Here are a few simple observations about the nature of the industries that seem to attract this intervention may be helpful. Most

[1] A network structure can be represented by a map of the EDB's lines (the connections) and its various nodes, both large (e.g. offtake points from a transmission system, inputs points for power stations, transformers) and small (connection points to end-users of electricity).

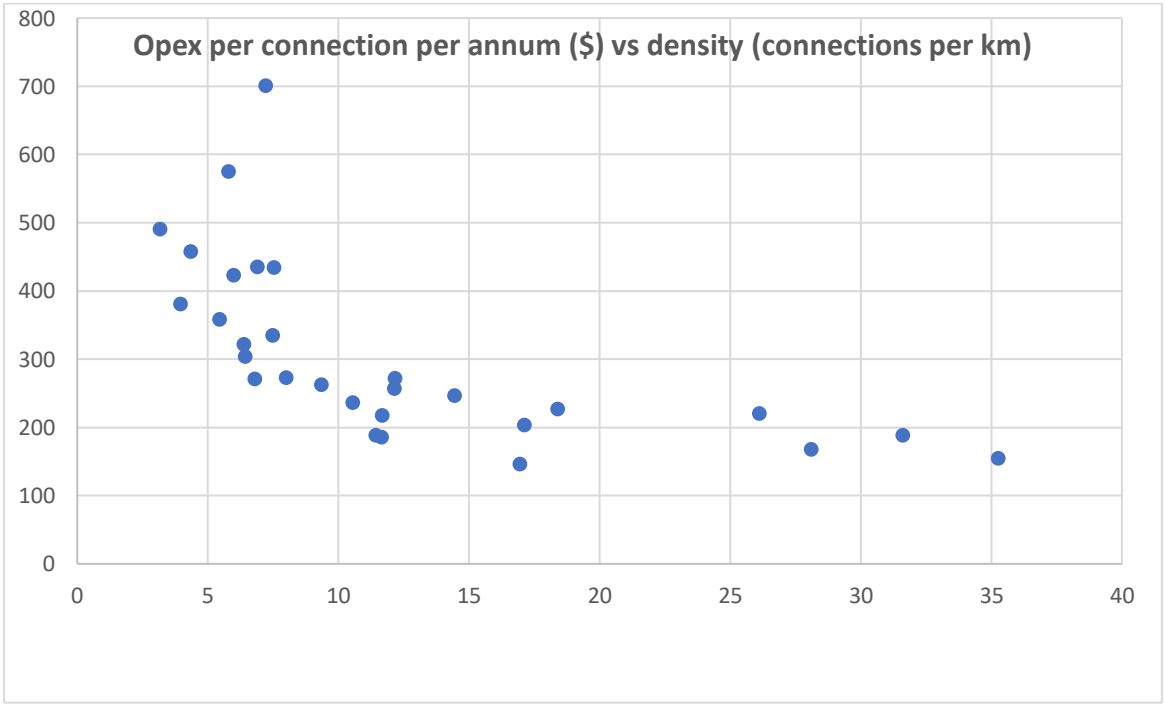
[2] Sam Peltzman, Comment on R. Zeckhauser and M. Horn, "The Control and Performance of State-Owned Enterprises" in P. MacAvoy, W. T. Stansbury, G. Yarrow and R. Zeckhauser, *Privatization and State-Owned Enterprises*, Boston: Kluwer, 1988.

of them are or have been characterized by some combination of scale and density economies. This suggests that, absent state intervention, these industries would either be organized monopolistically or that resources would be wasted in rivalry. (On my short list of SOE-prone industries, this old story is least applicable to airlines.) <u>*Most important*</u>*, I believe, is that however they are organized,* <u>*these industries would sell*</u>*, in the absence of state intervention,* <u>*essentially similar services at vastly different prices to differently situated customers*</u>*.* [My emphasis.] *… … The pervasive tendency of state intervention has been to suppress these differentials, usually by creating monopoly rents which are partially dissipated either in cross-subsidies or via explicit subsidies to the high-cost consumers"*

The emphasis here is very heavily on economies of density ("most important"), not least because scale economies of varying degrees of severity are to be found in many sectors and markets across the economy, not just where SOEs are prevalent. In those sectors that do not typically attract public ownership or price regulation we routinely find large numbers of businesses operating successfully at sizes that, from a purely production cost perspective, are below minimum efficient scale. Scale is just one of a number of sources of competitive advantage and, where it is lacking, very frequently appears to be offset by other factors.

Exhibit A of the evidence supporting this view in relation to NZ EDBs is Figure 1 below, which shows a fairly clear relationship between unit operating costs and connection density across the full set of 29 EDBs in New Zealand. The only substantive outlier here is the highest cost observation, which is Buller Electricity and to which I will return later (to show that, when other factors are considered, it turns out not to be an outlier).

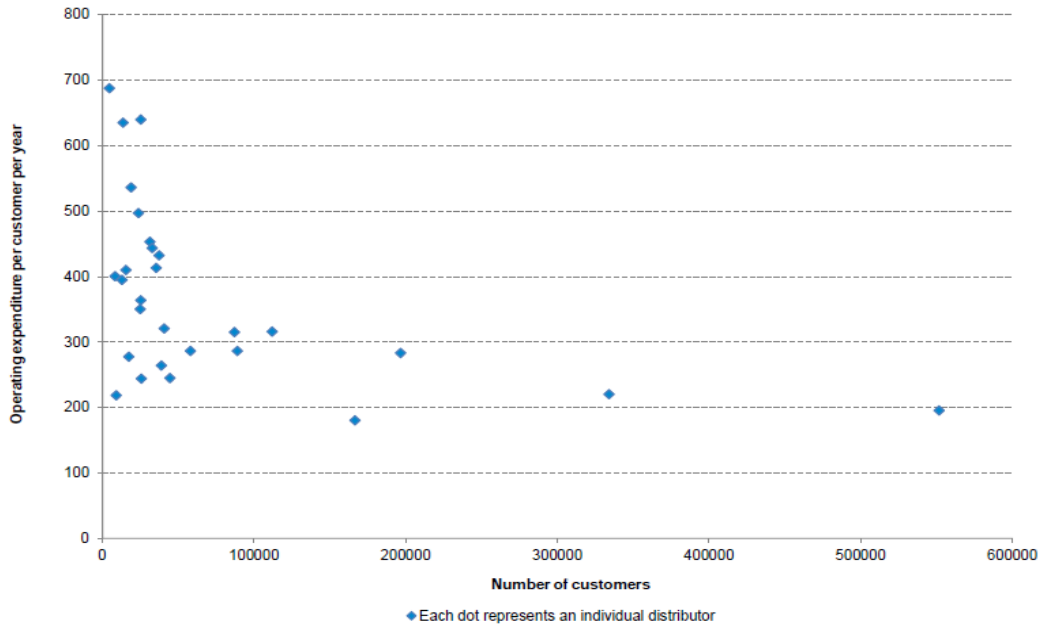
Figure 1.



Datasource: IEA Review Table 7.1, original data sourced from the Commerce Commission.

I start with this Chart because the shape of the implied relationship bears a strong similarity to Figure 24 of the FRfD below.

Figure 24: Distributors' operating expenses per consumer



Source: Commerce Commission.

Figure 24 is, I believe, based on a later dataset than Figure 1, but the chief difference between the two is the horizontal axis, which in the first case indicates connection density and in the second case indicates the total number of connections. The latter is a measure of the size of business, albeit not the only and certainly not the most economically appropriate measure of 'scale'. Since the Charts derive from similar datasets, barring any errors in calculation it must be possible to reconcile the two, at least in terms of broad shape, and that exercise is set out in the Annex to this paper.

The bottom line is that the picture painted by Figure 24 is <u>not</u> one of the existence of strong economies of scale, but rather a necessary consequence of (a) the existence of economies of density and (b) the empirical fact that, in New Zealand, the larger EDBs tend to be characterised by significantly higher connection densities than the smaller EDBs.

At a slightly deeper level, the basic point is simply that EDB's are networks. As correctly identified in the FRfD, their costs are influenced by a range of factors that include network configuration (the 'pattern' of nodes and connectors to be found in any network diagram), the pattern of human settlement, and terrain. For practical purposes, the effects of network configuration and human settlements can be proxied, at a relatively high level of aggregation, by the notion of 'economies and diseconomies' of density, although in principle any given network could be characterised by more one measure of 'density' (e.g. connections per line km, connections per sq km of area served) and any one density measure might represent a

range of different network structures/configurations/'patterns', as summarised in a network diagram. The latter point can be verified by examining the actual network configurations of any two NZ EDBS of similar density.

What Figure 24 of the FRfD does is to pick out two sets of recorded numbers that flow out of what are, in reality, a set of differentiated distribution systems, each with its own network configuration. The cost number used is only one of the two major cost components involved, opex, the other being capex. For the 29 EDBs considered collectively, recorded opex amounts to about 22% of total income/revenue and, since the evidence in the FRfD points away from any conclusion that there are excess profits to be found in the sector, this suggests that:

- a focus on opex alone could potentially give a misleading picture of average cost relativities: around 78% of total costs might be being neglected, and
- income/revenue per connection likely provides a much closer approximation to average costs (total costs per connection) than opex per connection.

The other point to note is that number of connections is itself an inadequate measure of EDB 'scale'. The total line length is an obvious alternative measure, as is the total kwh kms of electricity distributed.[3] It might be reasonable to say that, if EDB A has twice the line length and twice the number of connections as EDB B, then A operates at twice the scale of B. But, if it is only the connections number that has doubled, the more accurate description of the situation is that A operates with twice the connection density as B.

There is no harm in principle in examining the partial relationships between any two variables that might be observed across a data sample, but it is wrong to think will necessarily be informative about cost curves or functions. The temptation for anyone familiar with microeconomics is to look at the data in Figure 24 of the FRfD and think in terms of an average cost curve for widgets, which would be flat in the absence of scale economies. That, however, would be an 'associative' cognitive bias, a recourse to something familiar (the cost curve for producing widgets) when looking at something very different (data influenced by the electricity distribution network configurations in the various areas of NZ).

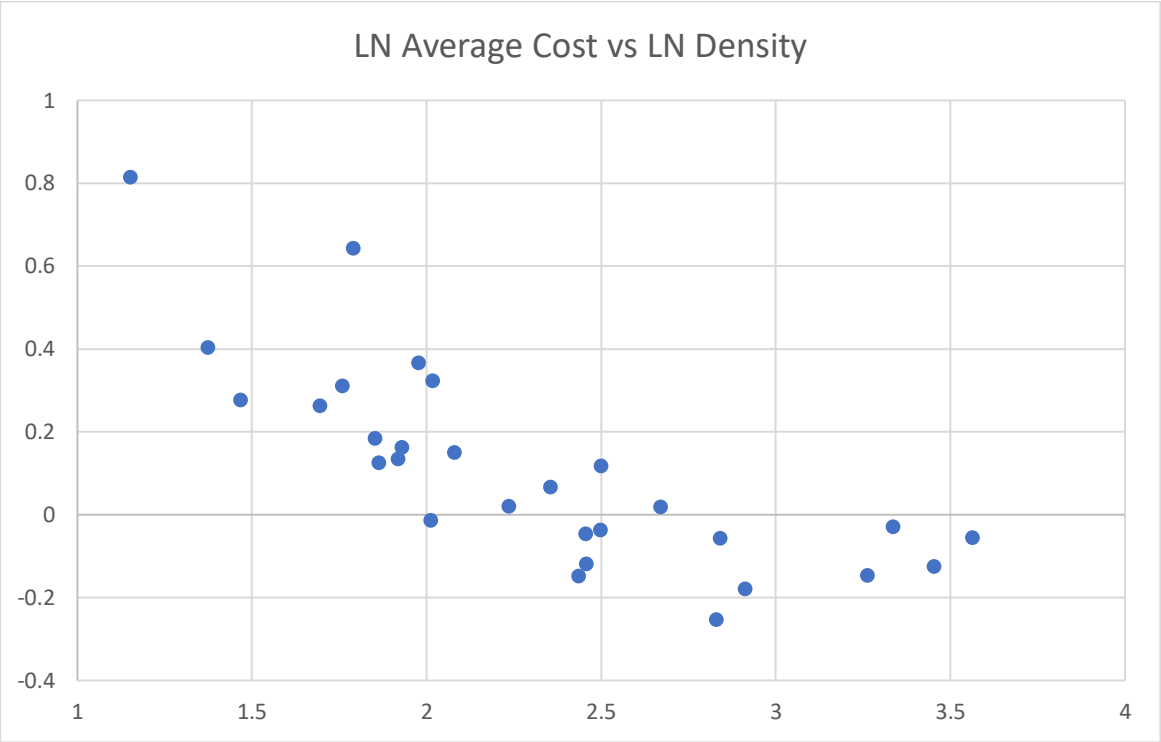
Further Analysis

Figure 2 reflects the discussion thus far by doing two things:

- Opex per connection is replaced by income/revenue per connection, otherwise known as average revenue and used as a proxy for average cost per connection. Average revenue (AR) is also a measure of the average charge per connection, which is a matter of much greater interest to consumers in aggregate than operating expenditure measures.
- The axes are logarithmic to take account of the likely strong curvature of the relevant relationship indicated by Figure 1.

[3] An analogy here might be the passenger miles or freight miles metric used in the transport sectors.

Figure 2



This now is a more tightly defined relationship and, although there is more variability at lower densities, there are no obvious outlying observations. Moreover, the higher variability of observations at lower densities is neither particularly marked nor particularly surprising: low connection-density EDBs might be expected to be so characterised because of the terrains and low per sq km population-densities of the areas that they serve, the influence of which factors might be expected to add to variability in a cross-sectional sample.

There is also a suggestion of curvature in the relationship and, interestingly, a suggestion of *diseconomies* of density past a certain point (see in particular the four, highest density observations), which would not be a particularly surprising finding. The Yatchew paper referenced in both GY1 and the FRfD, exhibits a sharp increase in costs when it comes to the largest of the Ontario distribution companies (the paper does not identify the individual point in the relevant Chart, but it is presumably Toronto). The effect is likely attributable to higher costs of building, repairing and maintaining distribution networks in the very cluttered (by other infrastructure) urban environments of some major cities.

I have experimented a little further with the data in ways summarised in the Annex and simply here report on one or two additional, provisional findings:

- There is indeed statistically significant evidence for diseconomies of density above levels of around 24-25 connections per km.

- There is a slight indication of modest scale economies, but it is not statistically significant, nor anywhere close to being statistically significant.
- Similarly, there is a slight indication of lower average revenues for those EDBs subject only to information disclosure requirements, although again it is not anywhere close to being of statistical significance.

The third of these findings may be of some relevance to the assessment of current regulatory arrangements, which are based on a dual-regime of price-quality path determinations and information disclosure requirements only, and to aspects of the assessment of EDB governance. If, for any given connection density, the differentiation within the regulatory regime has no effect on total costs/revenues, it can be said that the results are at least consistent[4] with the following propositions:

- The NZ regulatory regime strikes a good balance in its decisions as to which EDBs be subject to price-quality determination.
- There is no indication of inferior cost performance on the part of Trusts or smaller EDBs more generally.

Given the idiosyncratic features of individual EDBs and the relatively small size of the sample, I was slightly surprised by the clarity of the messages that the data seemed to provide. For example, as outlined in the Annex, a very basic log-linear regression of average revenue/cost on the two cost-drivers of line length and number of connections allows the data to attribute revenue/cost to either of the two, without any imposed constraints. It does so in this case by assigning almost equal and opposite weights to the two cost drivers, meaning that it is the ratio of the two, the connection density, and only that ratio, that matters in determining costs.

Distribution networks at small scale

The implications of business size for operational costs that are suggested by the relevant data sets should not, I think, come as any sort of surprise, particularly if the relevant economic activities are examined at a very concrete level.

Consider a household that is considering the installation of a solar power system, inclusive of battery storage. It is commonplace now to describe such households as pro-consumers, but a more accurate, if more cumbersome, label would be pro-dist-consumers. The battery will need to be wired up to accommodate inflows from the power source and outflows to various points in the house. It creates a new node and a requirement for new wire connections within a private household, wire-based distribution system that already exists (with nodes at ovens, lightbulbs, and so on, including in my own case a relatively costly external extension to a fish pond pump at the bottom of the garden). For those who own their own homes, these micor-micro distribution systems are household owned and controlled, and no one has ever suggested that mine should be taken over by the regional distributor (Scottish and Southern Distribution) or nationalized in the name of increased efficiency or the great march of human

[4] Of course they do not, and indeed cannot, 'prove' these propositions, not least since because results obtained are usually consistent with more than one set of auxiliary hypotheses.

progress. For rented properties these systems are landlord-owned with control shared between landlord (repairs) and tenant (switching things on and off).

This does not mean of course that all operations relating to the micro-distribution system are undertaken by the members of the household. Changing a fuse might be, but more complex tasks may call for a skilled electrician. The important point is simply that the household decides what and what not to 'contract out'. It has sovereignty over the system, sovereignty means having options, and options have economic value. That is a point often missed in economic appraisals, which is one reason why the British establishment was shocked by the Leave vote in the EU referendum.

Outside the house lies the local 'public' distribution system where, unlike inside the door, it is efficient to rely on shared assets and a form of shared sovereignty is entailed. How far out into the social and physical universes that sharing should extend is one of the central questions in the organisation of distribution systems. Asset sharing brings cost advantages, but also less individual or household influence/control/sovereignty (which, to repeat, has economic costs in the form of reduced optionality) and there are balances to be struck. Technological change coupled with increased valuation of environmental effects are obviously shifting the balances.

It is, therefore, easy enough to envisage small local distribution facilities, such as a block of flats or a new residential development, where the ownership and/or control of the localised distribution system lies with, say, the owner of an apartment complex, or with the developer of a new residential area, not with a regional distribution company.

Then again there is the story of Mr Maton, one of the most famous short stories in economics, brought to us by Professor Ronald Coase in his mini-classic study, *British Broadcasting: A Study in Monopoly* (1956). Inter alia, it shows that tensions between innovation and established governance systems are not a new phenomenon. Here it is told in a condensed version in the words of Professor Sir Alan Peacock in 1996:

"Mr Maton owned an electrical shop in an English village called Hythe near Southampton and had built himself a radio receiver back in 1924, that is two years after I was born. As an experiment he connected his set with a wire to a loudspeaker so that his wife could also listen to programmes in another part of the house. He was glad to find his experiment successful and he experimented further by wiring up his neighbours' speakers and eventually by 1926 secured 150 subscribers to his service, which required him to use ten miles of wire. When officialdom in the form of the Post Office, the new British Broadcasting Corporation and government authorities got to know of his initiative, he was faced with considerable interference with his business. The Post Office subscribers insisted that he must have a special licence. The BBC managed to persuade the Government that he and any imitators should be prevented from relaying any other programmes than those that it provided. Politicians were worried in case 'wire broadcasting' might lead to the transmission of 'unsuitable' programmes from foreign countries. The infant radio industry lent their weight to officialdom by supporting these restrictions, as they were worried about the effect of relaying on the demand for broadcasting sets."

This is telecoms, not electricity distribution, but telecoms was very much a poles and wires business in 1920's England. And the bigger point that Coase and Peacock were making is that what we see is not the growth of a local distribution network being thwarted for want of economies of scale, but rather local initiatives being thwarted by "officialdom" and vested interests. Indeed Mr Maton's local distribution activities were undercutting the competitors, substituting his service for then relatively expensive receiving sets (radios) and for the licence fees they generated for the Post Office, which in the latter case were *de facto* monopoly rents.

Particularly given the current interest in the opportunities opened up by new technologies in the electricity sector, the story is likely pertinent to other issues that the Panel will be considering, extending far beyond economies of scale issues. Its more generalised implications are neatly summarised by something that Sir Alan said slightly later in his presentation.

"This is a true story and encapsulates a struggle between enterprise and officialdom that takes place nowadays on an infinitely wider stage than occupied by the satisfied villagers of Hythe."

Comments on other electricity distribution issues raised in the FRfD

Profitability

Perhaps the only point that might be added to the FRfD's existing commentary on profitability is the observation that there is clearly a sub-set of Trusts that earn substantially less than the Commerce Commission's WACC, even at its later, reduced level.

There is nothing necessarily remarkable about this finding. First, the WACC used for regulatory purposes is, from a shareholder's perspective, gross of the often quite considerable transactions costs incurred in financial markets. If a Trust is able to generate internal funds sufficient for its own investment purposes, those costs can be avoided.

Second, since its owners are also its customers, Trusts can distribute surplus funds either by an explicit 'dividend' or by price discounts. In the latter case, conventional accounting systems will record it as lower profits.

There are obviously issues of democratic accountability surrounding these choices, but that is beyond the scope of this paper. It can, however, be noted that the decisions do bear upon issues of fairness, which the FRfD indicates are a major concern of the Review. For example, lower-income households might generally be expected to derive a greater benefit in proportion to their incomes from price rebates in lieu of dividends than the average household. That follows from the tendency of lower-income households to spend a greater fraction of their budgets on electricity than those who are more comfortably off. It is, in effect, a form of 'pre-distribution' made in advance of the accounting calculations, which shows up in the accounts as a lower revenue and hence a lower profitability than might otherwise be the case.

A distribution by way of an explicit 'dividend' payment has similarly 'progressive' effects on income distribution. If each household receives the same dividend, it will amount to a higher proportion of the income of poorer households than of more affluent households. The precise effects will, however, differ as between the two methods, depending for example on variations in the characteristics of individual households. There is no one correct way of making the relevant judgments – they are matters of local choice – and Figures 22 and 23 of the FRfD might suggest that different Trusts use their autonomy to strike different balances.

Distribution pricing

The structure of distribution pricing was one of the most difficult sets of issues that I ever faced in my time at Ofgem, and I think that the discussion in the FRfD outlines a balanced first approach to the challenges. In principle, it is easy enough for an economist to sign up to the notion that prices should reflect costs, but what is meant by cost reflectivity is itself rather elastic. For example, does it mean that charges should be set in rough proportion to attributable costs, or is it only necessary that charges are *ranked* in the same order as costs, so that lower costs do imply lower charges, but the two reductions are not necessarily very similar in magnitude, e.g. a 20% cost differential might be 'reflected' in only a 5% charge differential?

More important in practice are the difficulties in implementation of cost-reflective charging structures and the distributional impacts on businesses and consumers of any very radical reforms. As indicated, it is a feature of networks that they can give rise to very wide variations in costs both over time and from place to place. A charging structure that reflected these variations would be very complex indeed. Moreover, the precise causes of these variations are generally not at all transparent to businesses and consumers and pricing policies that seek very close linkages between (economic) costs and prices can give rise to what appear to consumers to be arbitrary effects on income distribution.

A short commentary is not the place to go into the detail of the relevant issues, an exercise that requires a concerted programme of work of the type that the FRfD suggests is already well under way in NZ. I will, however, make two rather general points which may possibly be helpful to the Review, not only in relation to any work done on electricity distribution charging reform, but also in thinking about issues in areas such as transmission pricing and retail market pricing.

The first concerns an awkward trade-off between the pursuit of economic efficiency, at least in its static version, and the inter-customer distributional consequences of that pursuit. It derives from a piece of general economic analysis called the 'envelope theorem', but I will illustrate it in a very simple form by considering the effects of a change in the pricing structure of electricity distribution. Many customers might benefit, by say ΔB for 'benefiting' customers in aggregate, whilst others will lose out, by say ΔC for 'harmed' customers in aggregate.

The net change in economic efficiency will be measured as $\Delta B - \Delta C$. What is nearly always the case is that, when the accounting is done, it will be found that both ΔB and ΔC are much larger numbers than $\Delta B - \Delta C$. *That is, the measured distributional effects are much greater*

than the estimated efficiency effect, and by much greater I mean something like, ten or fifty or a hundred times higher. Further, the disparity between the magnitudes tends to be greater the closer to optimality is the pre-reform charging structure. In the limit, the ratio approaches infinity, since optimality is defined by the condition that $\Delta B - \Delta C = 0$.

What this means is that, in any economic system or sub-system that is reasonably well-functioning, policy decisions are likely to be dominated by political considerations focused on distributional issues. Democratic politicians cannot ignore these issues and the financial numbers involved are likely to be an order of magnitude or more higher than any differences in efficiency between alternative proposals.

Failure to grasp this fact *ex ante* tends to lead to the sorts of problems discussed elsewhere in the FRfD in relation to changes in Transpower's transmission charging methodology. As recorded in the Report, there have been long delays in achieving a shift to a revised methodology and, although the issues have inherent technical difficulties that take time to think through, the major root cause of those delays stems from conflicts over the large distributional effects of reform, i.e. from the implications of the envelope theorem.

As nearly always with concrete examples like the transmission methodology process, their examination helps in mitigating what might otherwise be the overly narrow attention that can be directed at problems of static efficiency. The delays involved in the process can themselves have consequential effects on commercial decisions and hence on *dynamic* efficiency, particularly when the economic landscape is relatively fast changing. Thus, an over-attentiveness to static efficiency arguments ("prices should reflect costs") may, by complicating the politics of reform, give rise to delays that harm dynamic efficiency.

My second general comment is that, in considering electricity distribution charging issues, it is important to take account of the economic realities of the vertical structure of today's electricity energy systems. *EDBs supply services to retailers, not to end consumers.* In thinking about alternative charging structures, therefore, it cannot be assumed that price signals sent by distributors to retailers will be simply passed though to all end consumers. The downstream effects will depend upon conditions in retail markets.

To illustrate, consider a situation in which distribution charging shifts from a simple per kWh charge at all times, calculated from average distribution costs (including a normal rate of return on capital), to a two-part tariff, comprising a fixed charge per household plus a much lower per kWh charge, possibly reflecting short-run marginal cost. This changes the cost structure of retailers and can therefore be expected to influence retailers' pricing structures.

To survive, retailers need to recover their own distribution costs and, being close to end consumers and with increasing amounts of information about their customers available to them, they have had increasing recourse to strategies of price discrimination. *To cut a long story short, these retail price discrimination strategies are the final stage in determining how the burden of recovering distribution costs varies among different types of consumer, including different types of residential consumer.* For example, end consumers who are not sensitive to prices in their choice of retailer can typically be expected to bear a higher share of the recovery of a retailer's distribution costs than more price-sensitive consumers.

It is also easy to see from this why a shift in the structure of distribution charges toward greater cost reflectivity involving the placing of a greater weight on fixed (non-volumetric) charge elements could, by increasing the fixed costs faced by retailers and reducing their marginal per kWh costs, lead to a widening of the spread between highest and lowest retail prices in the market.

I have elaborated these points a little because of the final paragraph of the FRfD's overview:

"Affordability should generally improve if prices reflect the cost of providing electricity at different times of the day and year, rather than being flat. But some consumers will be hurt by a move to such pricing. Targeted social welfare measures can help reduce energy hardship. But it is clearly a problem the industry, regulators and government must tackle together."

I agree with that, but the points just made take it a little further. The reason that affordability should generally improve comes from the improved economic efficiency likely to be yielded by more cost-reflective prices. If there were only a modest fraction of, say, poorer households who were harmed by the effects, then social welfare measures might be the recommended route: the scope of the problem would be limited and the affected households will likely be relatively easy to target for the provision of some or other form of compensation.

However, the discussion above suggests that the distributional issues arise on a much larger scale than that: the efficiency gains are the $\Delta B - \Delta C$ above, whereas the aggregated 'harms' are ΔC, which can be expected to be many times greater, i.e. not necessarily at all small and limited in scope. Moreover, well-targeted, compensatory mechanisms available are not necessarily readily available. Thus, at Ofgem, we found that, because of the sensitivities of distribution costs to factors such as location, terrain, variations in customer density and network topography, reform of distribution prices could be expected to lead to some quite large increases and decreases in charges, with a pattern that was not very easy for experts to understand and explain, let alone the politicians who might be the recipients of significant numbers of complaints. The explanation "Well, the overall average charge across the region has gone down by 1%" does not fare well against the response from a small business that "but my charge has gone up by 20% whilst the charge to my competitor in the next village/town along the road has gone down 20%: that's just not fair".

Consumers and prices

What consumers want

The general mantra concerning what it is that consumers require of their electricity system is that they want a service that is reliable and characterised by low and stable prices. In relation to the last of these, it is generally agreed that consumers are particularly averse to sharp hikes in prices (sharp falls in prices are a rather different matter – the bigger and sooner the better!)

There is usually no reference to fairness when this formulation is adopted, but it is arguably implicit in the way that the word 'low' is translated into operational policymaking. Traditionally, in evaluating prices regulatory practice has used the benchmark of costs-to-

serve and regarded prices that are significantly in excess of costs, i.e. high relative to the benchmark', as unfair, unreasonable or unjust.

This well-established set of assumptions takes us a long way in evaluations of what is and what is not in the interests of consumers, but not the whole way. There are at least two other factors that are increasingly relevant. The first is that consumers are interested not only in the electricity services they receive, but also *how* they are produced. The environmental/ sustainability issues noted in the FRfD are a case in point and it is a matter of simple fact that, for example, many consumers are willing to pay more for 'green energy' than for energy from fossil fuel sources.

This type of concern about carbon emissions and polluting gases can, I think, be generalised to the 'whole environment' in which we live, social as well as physical. Consumers will, for example, have views on things like the location and timing of public works arising from modification of local electricity, gas and telecoms networks, the siting of telecoms masts or of wind and solar farms, and so on. There is a 'collective consumption' aspect to such activities: whole sets of end consumers will be affected by them, and members of those individual sets may be intensely interested in how the consequences for them compare with the effects on 'benchmark' others, e.g. is my street /town/area getting a worse deal than your street/town/area?

Fairness

This brings us to the second aspect of consumer welfare which is frequently neglected, "fairness" itself. Consumers want to be treated fairly: it is something of value to them. Being treated unfairly in some way or other goes alongside price hikes as a motivation for seeking out alternative services, e.g. for switching between retail suppliers.

The FRfD goes much further than most reviews of this type in its coverage of fairness issues, for example in pointing to the importance of trust and noting the decline in the legitimacy of businesses and government which can occur, reduced legitimacy here being a form of reduced *trust in institutions*, rather than in particular persons. 'Fair' and 'unfair' are words used in many contexts, with correspondingly different meanings. As noted, prices might be judged unfair if they are high relative to costs to serve, but that is far from the only meaning and not typically uppermost in the minds of consumers. Very frequently, perhaps most frequently, fairness issues are to do with *horizontal equity*, with question how am I being treated compared with someone *in a similar position to mine.* And the salience of the comparison will vary according to a whole range of contextual factors.

For example, a few years ago people might not have had much interest in comparing their retail electricity prices with the lowest prices in a national market, and in all likelihood the great majority still don't have much interest. But it is a number that has been given considerable prominence by the media, politicians and sometime regulators, so it now commonly used as a benchmark or reference points in "fairness" comparisons or (usually quite wrongly) as an indicator of what a competitive price might look like.

The general point is that perceptions of horizontal equity depend on the reference points, which can show great diversity. Sitting in Oxford and reading that people in Durham face 20% lower energy prices than I do may not light up many neural pathways (it is way 'up north', a different sort of place, with a lower cost of living in general), but substitute Cambridge for Durham and a much larger area of the brain might light up. So works the human mind.

If the policy objective really is to respond to what it is that matters to consumers, then public policy should properly be sensitive to perceptions of fairness, and *it should be the consumers' own perceptions of "fairness" that should matter.* These might well be very different to the conceptions of philosophers, politicians, regulators, economists et all, and it is likely that the perceptions/judgments will be heterogeneous among consumers themselves: plenty of evidence for that second point can be found in the now numerous experimental results associated with the Ultimatum Game.[5] A corollary is that listening to consumer voices, as well as studying consumer behaviour, becomes a rather important consideration, and I stress the plural form here because there may be much more diversity of views on what is and what is not fair and on the relevance of 'environmental' matters (in the general sense that I have used that term) than there is on price levels (lower please) and security of supply (more of it please).

The FRfD addresses consumer voice issues, for example in Figure 3, but it is a surface treatment only at this stage. Trusts are mentioned in Figure 3, but only in a reference to "Shareholder and trust AGMs". However, the consumer voice at a Trust AGM is a rather different thing to the consumer voice at a private company AGM and the distinction should, I think, be recognised. The consumer voice is something of an interloper or 'third party' at the latter: the discourse is mainly between the shareholders (the principals) and managers (their agents). In contrast, at a Trust AGM electricity consumers are the principals. Their voice is rather louder in consequence, on all points: prices, stability of prices, security of supply, 'environment' and 'fairness'. In short, Trusts and other forms of local governance give consumers, collectively, more control over decisions, more sovereignty; and that is worth something – it is something that electorates are willing to pay for.

Governance

The private company and consumer-owned business are, in fact, two different governance systems and they differ in dimensions other than the conduct of AGMs. The general tendency is for Trusts to give greater strength to consumer voice across all the dimensions of EDB activity. There is a much shorter chain of causality between consumer views and actual production decisions and this direct route to being heard by those responsible for decisions serves to substitute for, or at least lifts the burden on, several of the other mechanisms listed out in Figure 3. Consumers themselves elect the Trustees, whose own responsibilities are to the consumer or to local interests more generally. It is a case of greater (collective)

[5] The Ultimatum Game evidence shows very clearly that (a) people are 'willing to pay' to avoid 'unfair outcomes', (b) different people are willing to pay different amounts, but (c) there is a nevertheless a reasonable degree of clustering in willingness to pay. In my own view, this and other evidence of a like nature defines a new agenda for public policymakers and regulators: *discovering consumers' valuations of fairness.*

sovereignty, greater control. The influence may sometimes be weak, but it can be expected to be stronger than in other types of commercial governance systems.

As discussed in GY1, different systems of governance each have their own strengths and weaknesses. In the end, assessment of the balances of advantage/disadvantages can only safely be done on a case study basis in specific contexts, because the various pluses and minuses are influenced by specific, contextual factors. Here I will add only two general thoughts.

The first is that it really is necessary to examine the facts of each case. It is, for example, all too easy to assume that a non-profit organisation will have weaker incentives to reduce costs than a privately-owned company, and in many contexts that will indeed be the case. However, the general assumption stems from an argument that the owners of a private business will have a more intense interest in costs because they are financially more affected by variations in costs: it affects the value of their investments. But when ownership is highly dispersed, because for example shareholders are typically portfolio investors, the assumed relativity is not at all obvious, *at least in the case of smaller, community-owned EDBs*.

A dividend from a local EDB might be the only form of 'investment' income that a household has (most households are not direct portfolio investors), electricity bills loom relatively large in many household budgets, the relevant consumer-owners are concentrated in local communities and can more readily organise themselves on major issues, and outages on local distribution services are a very major inconvenience. These things point to potentially significant 'interest' in the relevant EDB matters, including cost. At a minimum, they indicate that any general *presumption* about the incentives of non-profit organisations should be set aside for these organisations, as indeed the NZ evidence discussed above also suggests: there is no indication in the data that I have looked at to suggest that the higher charges levied by small EDBs are anything other than a reflection of the connection densities of their distribution systems.

The second point is that care needs to be taken not to confuse individual mistakes that are made by, say, Trustees with failures in the *system* of governance under examination. Mistakes/mis-judgements are an inevitable feature of decisions made in conditions of uncertainty. More pertinent questions are: How frequent and how significant are the mis-judgements? How does this system deal with potential mis-judgments? Does it do so adequately? How do the mistakes and mis-judgments compare with those of feasible, alternative governance arrangements?

To illustrate, both the IEA Review and the FRfD mention the issue of Trustees using EDB funds to diversify into non-distribution activities. The implication is that, in a particular case, a mis-judgment might have been made and it is recounted that the Auditor General investigated (which is itself an indication that the governance system possesses the normal kind of negative feedback loop). There is no conclusion that the relevant decision was a misjudgment in the sense that, at the time that it was made, it could clearly have been seen that the investment was not likely to be to the benefit of the local community. It seems to me,

therefore, that this individual piece of evidence does not even get to the first base of a study in comparative governance from which safe conclusions could be drawn.

Indeed, a comparative international study might, I suspect, reveal that small publicly or community-owned entities tend to be less prone to unbeneficial diversification than comparable private companies, not least since the underpinning legislation tends to be more restrictive concerning the allowed scope of their activities (a private company is allowed to roam freely across a wide range of activities that might make money).

Prices

The FRfD's discussion of electricity prices appropriately touches on a number of different issues, some of them very familiar in other jurisdictions. The one that surprised me most in terms of the degree of emphasis that it received was the comparison between household, commercial and industrial consumers, since this is a matter that has little bearing on the question of whether or not the NZ electricity system is performing well or performing poorly *qua an electricity system.* The issues seem to me to be much more issues of fiscal policy than of market assessment.

The normal relativity to be found in competitive energy markets is that household prices are higher than commercial prices which in turn are higher than industrial prices. That is the pattern that currently exists in NZ, but it wasn't always the case. In 1990, which is used as the base date for some of the calculations earlier on in the FRfD, commercial prices were higher than household prices. The obvious inference is that, at that time, there was a policy of cross-subsidisation of household consumers by commercial consumers, and that the policy was gradually unwound through the 1990s. And if for some reason the Government wanted to partially rewind part of that evolution it has the fiscal instruments to hand: it could reduce GST and/or tax commercial suppliers.[6]

Similarly, the share of distribution costs in total electricity costs in 1990 was abnormally low, carrying the inference that distribution was being under-priced relative to its economic costs. There also appears to have been a surge in wholesale electricity prices in the early years of the millennium. All these major shifts are, in one way or another, linked to public policy decisions and their net effect was that, by 2004, NZ price relativities had been shifted to within an internationally normal range: prices at these aggregated levels had become much more cost-reflective. My own view is therefore that 2004 or thereabouts is the better starting base for evaluating more recent price movements: the situation before then is non-comparable in major respects and the 1990 base introduces risks of giving misleading impressions of sector performance.

There remains the contrast between the steady upward rise in retail household prices and the flat profiles of commercial and industrial prices since 2004. If the UK is any guide, relevant

[6] If the two are combined so as to be fiscally neutral, the benefits to households from lower electricity prices will be offset by the increases in the prices of other goods and services that are induced by the higher energy costs of commercial suppliers of those goods and services. Thus, a household will benefit from the lower electricity prices, but, to take a specific example, might be harmed by increased prices in a local grocery store, required to recoup the higher costs incurred by the business in acquiring electricity.

factors in this divergence might be (a) the increase in GST from 10% to 15%, (b) the near inevitable increase in retail costs associated with the introduction of competition (competition almost always involves some duplication of efforts), and (c), more speculatively, correction of any under-pricing of retail activities in the *ancien regime*. Thus, in deregulating prices at the beginning of the millennium, Ofgem fully expected to see some widening of retail margins (revenues less all costs upstream of the retailing stage). What we didn't expect was that they would become quite as high as the levels eventually attained. There remain disputes as to the causes of that and likely the Panel will need to wrestle with broadly similar issues.

I have touched on the structure of distribution charges above and the remaining broad-brush issue on which some comments might, hopefully, be helpful is the geographic variation in distribution charges which, other things equal, will mean that retail energy prices will be higher in some areas of the country than in others. This is quite normal when there is more than one distribution company – it was the case in the UK pre-privatization industry and has remained the case since. The only major difference is that the inter-area charge differentials are generally smaller in the UK and that, I think, is simply a reflection of the greater (proportionate) differences in inter-area customer densities and terrains in NZ. It is pretty much what is to be expected in the relevant conditions.

The question is: is this a policy 'problem'? If it is, it is largely a question of fairness, not of economic efficiency – this looks like envelope theorem territory in that the potential efficiency effect of moving toward or away from inter-EDB cost reflectivity appear very small in relation to the redistribution of income that would be at stake. And, if it is chiefly a question of fairness, the next question that suggests itself is: who decides on what is and isn't fair?

In this case it seems to me that the obvious starting points for the Panel, should it determine that the issue is worth investigative effort, are consumers in the less densely populated areas. They are the people paying the most for electricity distribution services: do they think that there is anything basically unfair about that? They have elected representatives to speak for them, should more detailed market research be considered disproportionate. If there is no strong feeling of unfairness from these sources – and I suspect that many would take the view that "if we impose the costs, it is reasonable that we should pay them" – it would be difficult to conclude that their views should be over-ridden.

Looking at things more generally, I think that the most important and most commonplace of the concepts of fairness in play is that of "proportionate fairness". People do not typically expect equality of outcomes, but they do attach normative significance to whether, in relevant comparisons (which can take many and varied forms), relative advantages or disadvantages are proportioned in some way (with varying degrees of tightness/looseness) to contributions to a shared purpose. A supplier makes contributions via the costs of making goods or services available, but that is only one of potentially many ways of making contributions to shared purposes. Thus, it is possible to imagine why the citizens of a particular area of the country might simultaneously think it fair that, because they live in a region with high costs to serve, they should pay more than the national average, whilst thinking it unfair that local farmers at specific locations in the area should pay significantly more because of the their

lower connection densities: those high-cost-to-serve consumers may be perceived as making other types of contributions to the local community.

This is speculation, but my main point is simply that it is consumers' own preferences and judgments that should, where possible, be determinative in these matters.

If it is concluded that there is a major fairness issue arising from differences in distribution charges between the regions/areas of NZ, there is one final point to make. As in the case of an unacceptable divergence between household and commercial prices, the fairness issues could be addressed by redistributive (micro) fiscal policies: differential levies and subsidies on EDBs could be applied from a zero-balance compensation fund. Importantly, it is not necessary to mess with the structure of the industry: taking the extreme case, it is not necessary to establish a single distribution company to achieve postalised pricing/charging throughout the country, if that were ever to become the policy aim.

By way of an illustration, Oxford Colleges have assets recorded as worth £5.9bn (almost certainly an undervaluation), which vary substantially from College to College, from around £600 million at the top to around £30 million at the bottom. At some point before my time, the professors decided that this was a little unfair to the members of the poorer colleges and established an equalisation fund. Richer colleges pay in, poorer colleges draw out. The solidarity was of a limited nature though, as is visible from the facts that (a) the fund has been running for many decades and (b) the major disparities in endowments continue to exist. A little 'fairness' was, collectively, judged better than a lot, and the judges were the Colleges themselves, acting collectively. Still, there was a degree of voluntary equalisation.

Technology

With respect to evolutions of the NZ system in response to changes in technology, it suffices to conclude with a restatement of points made in GY1, coupled with a reference back to the story of Mr Maton. Specifically:

- Without having been 'designed' for the purpose, it fortuitously turns out to be the case that the existing structure of electricity distribution in NZ is exceptionally well adapted for the kind of small-scale experimentation that current technological trends indicate will continue to acquire increasing economic significance. The underlying point lies in its *diversity*: in distribution, EDBs come in multiple shapes and sizes, with differing structures of ownership and control/governance. For innovation, adaption and evolution, such diversity is a Good Thing.
- "Officialdom" tends to like uniformity: it makes administration easier. An illustration of its deadening hand is the reference made in both the IEA Review and the FRfD to the <u>two</u> designs for distribution systems adopted as normative by the EU. Why two? This is just officialdom responding to the pressure of facts on the ground that are working against what would almost certainly otherwise be its first preference: 'one type of system fits all'. In reality (a) there are many different possibilities, not just two, most of which are currently unimagined (although a small number of alternatives have already been articulated), (b) the performance of these alternatives will vary

according to the 'environment' in which each is required to operate, and (c) 'environments' differ.

My own advice is to follow Coase and Peacock, who followed Adam Smith, who followed David Hume: work from observational evidence drawn from case studies of situations on the ground, i.e. of particular contexts, and infer or 'discover' principles from those. As noted, Buller Electricity is the smallest of the EDBs and from graphs drawn on paper it is easy to drawn the inference that its relatively high operating costs are an indication of diseconomies of scale. Even desk research from far away indicates that isn't so, once the factors such as its relatively low capital intensity and its connection density are brought into the analysis. The bigger point to emphasise, however, is that what should matter, if the notion of consumer sovereignty is to be taken seriously, is how things look to the people of Westport and along the coast to the north and south, not how things look to officials in Paris. Official views tend to be highly predictable, which implies that little can be expected to be learned from them. Westport is almost certainly a better place for discovery of new things.

In relation to technological change, the most interesting specific example given in the FRfD is on page 61 and I cite it in full (in an overview document it is necessarily brief):

"In some remote locations, distributors are already encouraging on-site generation and batteries because it is more cost-effective than maintaining overhead wires. However, legislation prevents existing consumers from being disconnected without their consent. Powerco is seeking consent from some consumers to use alternative means of supply where economically viable. It says the biggest hurdle is getting consent from all affected consumers. Powerco suggested we consider the fine tuning of relevant legislation to make this step easier. Although we note the problem may resolve itself when alternative technologies become more reliable and cheaper."

This specific case seems to go to some rather large issues. In discussions about the future of electricity distribution, some commentators have expressed concerns about voluntary disconnections from a network leaving remaining network customers with a higher financing burden that would see them facing higher charges (sometimes made melodramatic in presentations by reference to a 'death spiral' for electricity distribution companies). Here, however, we see an EDB voluntarily seeking out disconnection because it would reduce costs and presumably (other things equal) reduce charges to remaining, connected customers.

What is common to both possible contexts – unwanted shedding of connections, wanted shedding of connections – is that regulatory rule-books are in play. Powerco makes specific reference to a particular sub-set of the rules which affect the outcome. In the 'death spiral' case, the issues tend to concern the parts of the rules concerning the scope of EDB activities. Are EDB's allowed to respond to the situation by offering more customized charges, or by diversifying into economically related activities, such as supply of solar panels and batteries 'beyond the meter', or of offering bundled contracts that cover both traditional distribution services and the new activities.

In changing circumstances, my personal view is that these rule-book issues will acquire ever increasing significance and will raise a number of challenging questions. I don't know the

details of the specific case referenced and make no comments on it, but I would expect it to be one of many similar types of local issue that will arise with increasing frequency in the future.

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Annex

Some basic economic points relevant to economies of density

Imagine a pole-and-wire distribution line, built to be shared by a number of potential customers at a capital-and-repair/maintenance cost $F = \alpha L$, where L is the length of the line and α is the unit cost per km. Connections to this shared facility can be added, each at an additional capital-and-repair maintenance cost β. Suppose the line is used by N customers, i.e. there are N connections.

The total cost of the line is then $C = \alpha L + \beta N$. By construction, there are no economies of scale: if line length and the number of connections were each doubled, total cost would double.

The average cost per customer is:

$$\frac{C}{N} = \beta + \alpha\frac{L}{N} = \beta + \frac{\alpha}{D}$$

where D = N/L is a measure of consumer density, the number of connections per km of line. Cost per connection served falls as density rises and the source of the economies of density is immediately apparent: it comes from an increase in the customer base over which a joint cost can be shared.

Reconciliation of Figure 1 and Figure 24 of the FRfD

Next consider inter-EDB variations in costs, in a context like NZ where settlement patterns and variations in topography/terrain and, associated with them, human settlement patterns can be expected to lead to networks characterised by variations in density.

Proceeding in the same way it might be supposed that the total cost of an EDB can be represented as:

$$C = \alpha L + \beta N + u \qquad \ldots(1)$$

where u is an error term, capturing all those other possible cost influences that are specific to a particular EDB – including differences in the geographic distribution of consumers, network topology and terrain/topography – and which are not fully reflected in the rather crude measure of density that is used. Hence:

$$\frac{C}{N} = \beta + \frac{\alpha}{D} + \frac{u}{N} \qquad \ldots(2)$$

Suppose next that, in a cross-EDB sample, it is found that there is an *empirical* relationship between measured customer density, D, and number of connections of the form:

$$D = \gamma + \theta N + v \qquad \ldots(3)$$

where again γ and θ are positive parameters and v is an error term. Such is the case for New Zealand, the most obvious illustration being that the Auckland area has both a large

population, and hence a relatively high number of connections, and a relatively high connection density (because of the geographic proximity of connections).

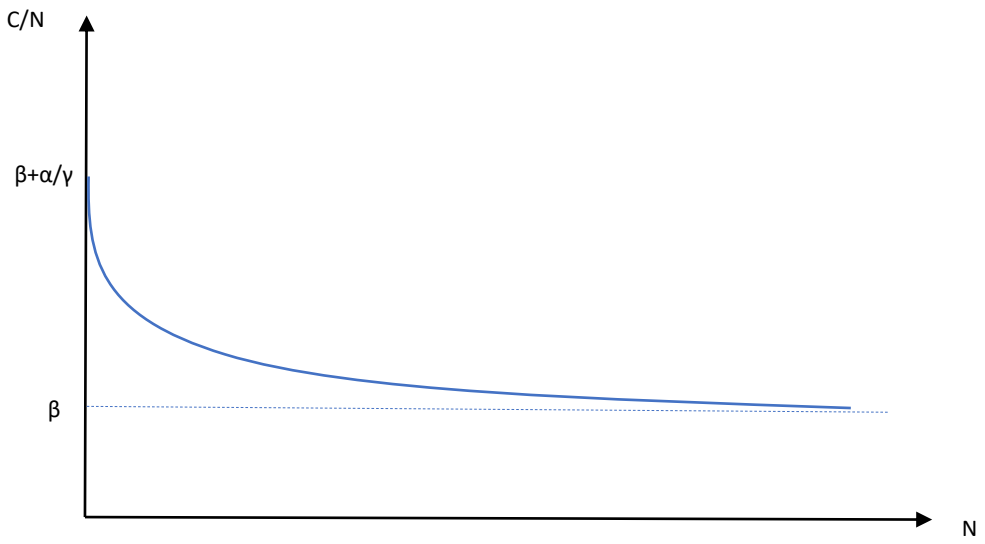
Substituting for customer density from equation (3) into equation (2) gives:

$$\frac{C}{N} = \beta + \frac{\alpha}{\gamma + \theta N + v} + \frac{u}{N} \qquad \ldots (4)$$

This then is the cross-sectional relationship to be expected between costs per customer and the number of customers served by an EDB on the assumptions made, including the assumption that *there are no economies of scale*.

Its precise shape will depend upon the parameters α, β, γ and θ, but its general shape is clear enough: operational costs per customer can be expected to be a convex, declining function of the number of customers, as illustrated in Figure 2 (which ignores the error terms).

Figure 2



This is not unlike a non-linear regression line that could be fitted to the data in Figure 24 of the FRfD. An immediate implication is that the data shown in Figure 24 do not suggest a *"link between distributors' size and operating costs, especially amongst the smallest distributors"*, as is suggested might be the case at the bottom of page 56 of the FRfD. Figure 2 above has been constructed on the back of an auxiliary hypothesis that there are no economies of scale. The suggestion is at best premature and, on the evidence given, very likely wrong.

Apart from the general shape of the implied regression line, the other outstanding feature of Figure 24 is the higher variance around such a line exhibited by smaller EDBs. This too is readily explicable by equation (4). Note that the final error term on the right-hand side is

u/N, implying that its variance will be equal to Var(u)/N^2. 'Terrain' and network topology are not included in equation (4) for measurability reasons and it will therefore be one of the components of the error term, u. The error variance of any differences in terrain between EDB's are, therefore, likely smaller at larger scale: there is an inverse-square relationship at work. The attributable (to different terrains) variance will be four times larger for a customer base of 10k than for a customer base of 20k, other things equal.

Some additional indications from the Commerce Commission dataset.

In the very limited time available, I have dug a little deeper into the EDB dataset and simply report one or two of the results that appeared interesting, with a health warning that these are all provisional: they are little more than the modern equivalent of back-of-envelope calculations, i.e. trial and error spreadsheet playing about.

The first of them goes back to the scale/density issue and the equation dipped into the data was:

$$Ln(AR) = \alpha + \beta Ln(N) + \gamma Ln(L)$$

If only density matters in explaining the inter-EDB differences in average revenues/costs – which it can be noted is a very strong proposition – the prediction is that $\beta + \gamma = 0$ or $\beta = -\gamma$.

If scale matters as well, $\beta + \gamma < 0$ and for reasonably strong scale economies we might expect something like $\beta + \gamma < -0.1$.

The results were:

β = - 0.3071

γ = 0.2929

$\beta + \gamma$ = - 0.0142.

There is a slight indication of scale economies in the last of these, but it is nowhere close to being statistically significant and the effect is small. The strong proposition that only density matters cannot be rejected. The estimated elasticity of average cost/revenue with respect to density is around -0.3 whereas the estimated scale elasticity is -0.0142, over twenty times smaller.

Adding a dummy variable for the type of regulation showed a slightly lower average revenue/cost for 'information disclosure only' EDBs, but, as for scale, the coefficient was a long way from statistical significance.

Second, as noted the relationship in Figure 2 suggests a degree of curvature and to test it out a quadratic term was added to the simple logarithmic association shown in the chart:

$$LN(AR) = \alpha + \beta\, LN(D) + \gamma\, (LN(D))\text{^}2$$

The coefficient γ is statistically significant and the relationships between actual, measured average revenues and average revenues 'predicted' by the fitted equation are shown in Figure 3. The blue diamonds are the actual values and the red squares are the 'predicted' values.

The eventuation of diseconomies of density in EDB areas characterised by the highest connection densities is apparent from the pattern of the red squares, although the actual magnitudes of the average revenue effects at higher densities are relatively small: the relevant observations are not far above the minimum of the curve, the curve being relatively flat around its minimum point.

There is a hint that the quadratic form is unduly constraining and that the data want the curve to be relatively flat at higher densities, but steeper than the quadratic form then allows at lower densities, but that is a possibility that has not been pursued and I very much doubt that any significant, further insight could be gained if it were.

Figure 3