Review of Electricity Default Price-Quality Path Draft Determination 2015

Report to Vector

August
2014

Acronyms and Abbreviations

AMPs	Asset Management Plans
Capex	Capital expenditure
The Commission	The Commerce Commission
DPP	Default Price-Quality Path
EDBs	Electricity Distribution Businesses
EECA	Energy Efficiency and Conservation Authority
GDP	Gross Domestic Product
GXP	Grid Exit Point (connects transmission and distribution systems)
HVAC	Heating, Ventilation and Air Conditioning
ICP	Installation Control Point
LEDs	Light-emitting diodes
MBIE	Ministry of Business, Innovation and Employment
MEPL	Mandatory Energy Performance Labelling
MEPS	Minimum Energy Performance Standards
PV	Photovoltaic (solar panel)
WACC	Weighted Average Cost of Capital

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Executive Summary

The Commerce Commission (the Commission) has released its draft determination on the Default Price-Quality Paths (DPPs) that will apply to non-exempt Electricity Distribution Businesses (EDBs) from 1 April 2015. The decision limits the average prices that EDBs can charge, and sets targets and incentives for service quality over the regulatory period (2015-2020).

Vector has asked Castalia to review the draft determination, focusing on the Commission's proposed approach to forecasting EDB revenue. Vector wants to ensure that the Commission's approach to forecasting key inputs is as robust and accurate as possible, while remaining consistent with the "low cost" intent of the DPP. We also provide comments on the Commission's approach to forecasting capital expenditure (capex).

The Commission's proposed forecasting approaches for revenue and capex raise concerns, which our suggestions address

The Commission's proposed revenue forecasting relies primarily on causal models—so that changes in revenue can be projected based on changes in other variables. Forecasting based on the relationship between revenues and other variables requires a clear historical link between revenues and those variables that is expected to persist over the regulatory period. Unlike other causal models used by the Commission (such as for forecasting operating expenditure), these conditions are not met for revenue forecasts:

- The Commission's analysis only finds a weak relationship between revenue and real regional GDP, and ignores data showing that this relationship is fundamentally changing. An important component of the Commission's commercial and industrial revenue forecasts is the relationship between GDP and electricity demand, but this relationship is not strong and has not been stable over time.
- Similarly, assuming constant residential demand per user overlooks the declining trend in electricity use per connection. Residential revenue forecasts are also affected by the Commission's decision to use population forecasts, which are not uniformly related to the number of electricity connections on each network due to demographic changes.

We suggest the Commission carefully assesses the conceptual basis for commercial and industrial revenue forecasts when updating its analysis. We also suggest the Commission accounts for the declining trend in electricity consumption per ICP in its residential revenue forecasts.

The Commission's proposed approach for setting a capex allowance relies on previous differences between forecast and actual capex. We consider this is inconsistent with the forward-looking nature of the regulatory regime and that a simplified form of menu regulation would achieve appropriate incentives, while respecting this aspect of the regulatory regime. However, if the Commission is unable to develop and apply a simplified form of menu regulation for this reset, then applying a uniform cap on capex allowances at 120 percent of historical averages would at least avoid introducing the unhelpful incentive to spend close to allowed levels of capex.

Table ES1.1 summarises our main concerns (those already noted as well as more secondary concerns), together with suggested solutions that would address each of these concerns.

Table ES1.1: Summary of Concerns and Specific Solutions to Overcome these Concerns

Forecast Element	Concern to be Addressed	Specific Solution(s)
Commercial and Industrial Revenues	The model relies on a relationship that may no longer hold if electricity demand and economic growth are "decoupling" The elasticity of revenue to changes in regional GDP is estimated for lines revenue over a period when prices are regulated, which may obscure the underlying relationship being modelled Line charges data appears to incorporate both pass-through and recoverable costs, when a better measure would be net of pass-through costs Vector is excluded from the analysis estimating the elasticity, yet the elasticity is applied to Vector (despite the relationship clearly not holding)	When updating its analysis, the Commission should use revenues net of pass-through costs and assess whether the results reflect underlying trends in commercial and industrial electricity consumption
Residential Revenues	Population growth does not provide an accurate basis for forecasting ICPs The downward trend in consumption per ICP is assumed not to continue, without sufficient evidence	Use household projections to forecast ICP growth and apply recent trends in kWh consumption per ICP to forecast residential revenues
Total Revenues	The potential that the concerns with the Commercial and Industrial, and Residential revenue forecasts identified above cannot be addressed using the methodology the Commission has proposed–specifically, that a robust relationship between GDP and Commercial and Industrial revenue cannot be identified; and available forecasts of Residential revenue growth are deemed to be too unreliable	Consider alternative approaches such as trend analysis of overall net revenues up until 2012, or volume trends incorporating an additional year of data
Capital Expenditure	Using forecasts to claw-back past returns is inconsistent with forward-looking regulatory regime and may penalise EDBs for factors outside their control	Apply a simple form of menu regulation OR Use one consistent cap based on historical expenditure levels (if a simplified version of menu regulation is not practical for this reset)

Our analysis draws on the data available. The Commission has indicated that it will incorporate more up-to-date information before the final decision is released by the end of November 2014. This will have some impact on the results presented in this report. We have highlighted where the Commission's updates may influence the concerns raised in this report.

1 Introduction

The Commission's draft determination for the 2015-2020 EDB DPP reset explains the approach that the Commission proposes to use to set limits on the maximum price (and targets and incentives for service quality).

This report focuses on the Commission's approach to forecasting revenue as part of the DPP reset. We also raise concerns about the Commission's approach to forecasting capex over the coming regulatory period.

The Commission's approach separately forecasts revenue for two user types and scales capex forecasts based on past performance

The Commission's proposed approach models revenue growth separately for residential users and for commercial and industrial users and combines the two to forecast overall revenues as shown in Figure 1.1.

Figure 1.1: Overview of Commission's Approach to Forecasting Revenue

Δ revenue =

Δ revenue due to residential usage

x

proportion of line charge revenue from residential users

\+

Δ revenue due to industrial and commercial usage

x

proportion of line charge revenue from industrial and commercial users

Source: Commerce Commission "Low Cost Forecasting Approaches for Default Price-Quality Paths" 4 July 2014, page 37.

The Commission's proposed approach to forecasting capex, is to set a cap of:

- 120 percent of historical capex for EDBs that spent close to forecast levels of capex from the last DPP reset
- 110 percent of historical capex for EDBs that did not spend close to forecast levels of capex from the last DPP reset.

We examine the Commission's proposed approach, identifying concerns that need to be addressed

This report examines the Commission's proposed approach to determining expected changes in electricity demand (and therefore revenues) and to forecasting capex. It identifies concerns with the proposed approach that may lead to inaccurate forecasts and identifies possible solutions to overcome these concerns.

When proposing solutions we have explicitly considered the balance between improving the accuracy of forecasts and maintaining consistency with the "low cost" regulatory intent of the DPP. Put another way, we have not developed alternative approaches that may lead to more robust forecasts if they would require audit, verification, or introduce much more complexity.

At a high level, the approaches available to the Commission can be thought of either being based on a trend relationship of the variable of interest, or a causal model based on the relationship with another variable. Table 1.1 compares the conditions where either a trend analysis or causal model will be best suited. Causal models are generally better when there is a strong and stable relationship with independent variables for which there are forecasts. For example, the Commission's approach to forecasting operating expenditure meets these conditions reasonably well, relying on known relationships that seem quite stable over time.

In contrast, trend analysis relies on the assumption that past trends will continue in the near future. This may be appropriate and different methods could be assessed given data is available for a number of previous periods. Unlike causal (or associative) models proposed, trend analysis does not rely on the relationship with other variables nor the ability to forecast these other variables.[1]

Table 1.1: Conditions Favouring Trend Analysis (Time Series Models) and Causal (Associative) Models

Trend Analysis	Causal Models
▪ Clear trends can be discerned that persist for a reasonable length of time ▪ Historical trends are likely to continue or be repeated over the forecast period	▪ There is a strong relationship between "dependent" and "independent" variables ▪ This relationship is stable and will remain valid in future ▪ Reliable forecasts of independent variables are available

Source: Castalia, drawing from "A Comparison of Time Series and Causal Models of Forecasting" by Praf Joglekar

In this report we explore whether causal models or trend analysis is more appropriate for forecasting EDB revenue. We examine whether the conditions for using causal models are found for each of the relevant variables, and whether a trend analysis would have provided better predictions of past revenues.

Structure of this report

The following sections of this report examine each component of the Commission's revenue forecast in turn:

- Commercial and Industrial Revenue (Section 2)
- Residential Revenue (Section 3).

Section 4 then addresses the Commission's capex forecasting approach.

[1] For example, see: "A Comparison of Time Series and Causal Models of Forecasting" by Praf Joglekar, available at: http://www.scribd.com/doc/18030104/A-Comparison-of-Time-Series-and-Causal-Models

2 Commercial and Industrial Revenue Forecasts

This section examines the Commission's proposed approach to forecasting commercial and industrial revenues. We identify specific concerns with the way the Commission has applied the relationship between lines revenues and real regional GDP to estimate commercial and industrial revenues. We suggest the Commission assess whether the concerns raised in this section are addressed when it updates its analysis (applying updated data) or whether alternative approaches would be more appropriate.

2.1 The Commission's Approach Relies on the Relationship between Lines Revenue and Regional GDP

The Commission forecasts commercial and industrial revenue by calculating the elasticity of lines revenue with respect to real regional GDP growth, and then applies this elasticity to forecasts of real regional GDP growth over the regulatory period.

To apply this approach, both real regional GDP and real regional GDP growth forecasts are mapped to each network according to the region(s) where each EDB's GXPs are located. The Commission then uses historical lines revenue and real regional GDP data to calculate the elasticity of lines revenue with respect to real regional GDP. The Commission intends to limit the revenue data series to only include revenue from commercial and industrial customers, although we understand that this requires further data to be collected from EDBs.

The Commission then applies this elasticity to forecasts of real regional GDP growth to project commercial and industrial revenue for each network.

2.2 The Relationship is Not Strong or Intuitive

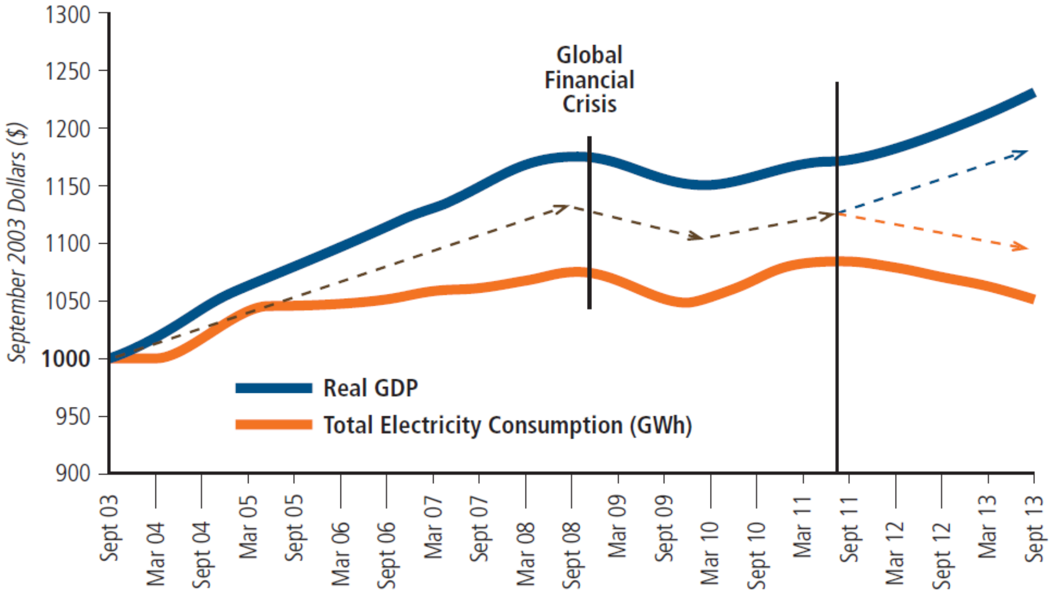
The relationship used by the Commission is not statistically strong—only 17 percent of the variation in lines revenue is explained by changes in real regional GDP. In many ways this is not surprising given the influence of other factors (such as the weather) on the variance in revenues. However, it does suggest that the Commission needs to be careful to understand what is driving the forecast. This section identifies three specific concerns with the Commission's approach.

The increased elasticity is counter-intuitive

In 2012, the Commission used the same approach to estimate an elasticity of 0.52 between lines revenue and real regional GDP. The calculated elasticity for this review of 0.73 is considerably stronger. However, the Commission does not explain why the elasticity has strengthened over the past two years, or explore whether there is an intuitive basis for an increasing correlation between revenue and GDP.

In fact, an increase in the elasticity is counter-intuitive when looking at past electricity consumption trends. Figure 2.1 suggests that there has been a decoupling in the relationship between total energy consumption and GDP growth since 2012. This implies a weaker relationship between lines revenue (or at least underlying electricity demand) and real GDP growth, not a strengthening relationship.

Figure 2.1: Growth in Electricity Consumption and Real GDP (2003–2013)

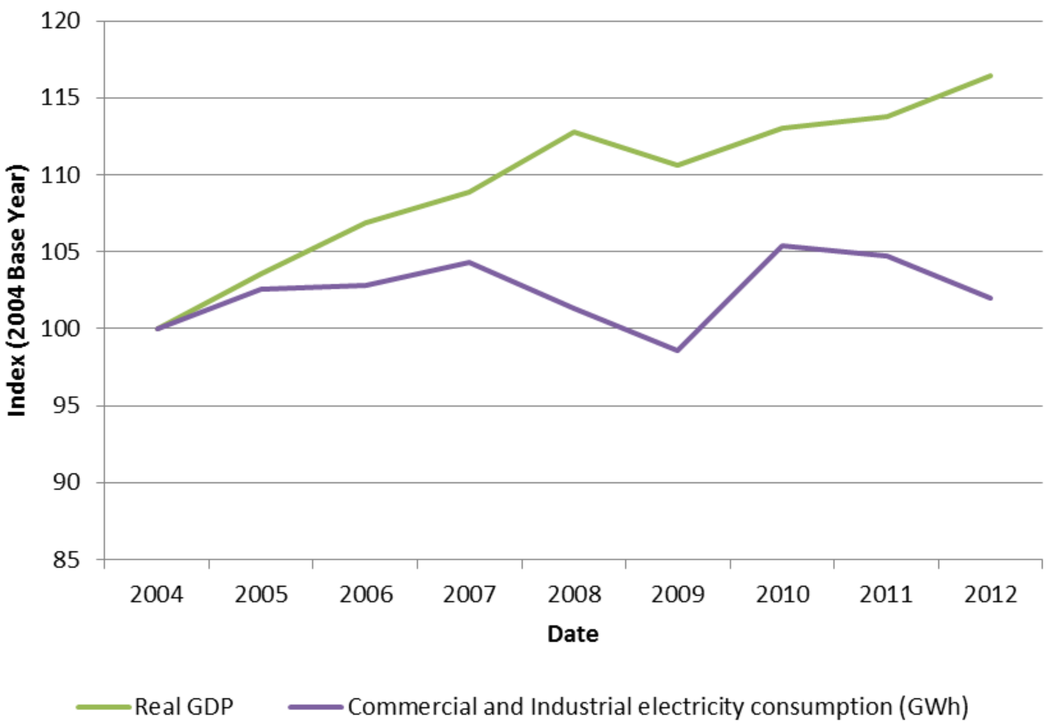


Source: Electricity Networks Association "Power Tracker: Issue 1, April 2014" based on information and analysis from the EA, NZIER, ENA, and PwC. Note: Both measures are 12 month rolling averages.

This suggests that the Commission should not expect an increasing relationship between real GDP growth and overall lines revenue. The same is also likely to be true for commercial and industrial revenue (once the Commission gathers the required data to test that relationship). This will in part reflect the significant energy efficiency initiatives carried out by commercial and industrial businesses (such as in HVAC installations and improved lighting).[2] Figure 2.2 shows that the decoupling is also observed with respect to industrial electricity demand at a national level.

[2] For example, see case studies and tools available at: http://www.eecabusiness.govt.nz/

Figure 2.2: Growth in Industrial Electricity Consumption and Real GDP (2004-2013)



Source: Castalia using MBIE and Commerce Commission information.

Using line revenue as the dependent variable introduces circularity

We are also concerned that lines revenue may reflect the impact of regulation, rather than an underlying relationship with demand. This is because part of the lines revenue series used to estimate the elasticity comes from an earlier DPP regulatory period. As a result, the estimated relationship may reflect a previous regulatory decision, rather than the underlying relationship between economic conditions and commercial and industrial electricity demand.

Put another way, using lines revenue as the dependent variable may introduce an element of circularity. The fact that prices are regulated means that revenue is not able to fully vary with economic conditions. Applying this relationship to forecasts of future changes in economic conditions will therefore not provide objective forecasts of future revenues.

The specification of line revenue may reflect changes in transmission costs

If line revenues are used, the data should be net of pass-through transmission costs. Attachment C of Commission's "Low Cost Forecasting Approaches for Default Price-Quality Paths" document suggests the Commission has applied total line charge revenue data. This suggests the data incorporates both recoverable revenues for EDBs, as well as transmission costs that are passed through to Transpower.

Our understanding is that the Commission separated pass-through costs in its 2012 DPP determination. We consider that approach is appropriate. EDBs do not control changes in pass-through costs, and do not benefit from any increases in this component of line revenues. The variable of interest should be net line revenue because this reflects income earned by each EDB at current prices (and should therefore be more directly related to underlying electricity demand).

The relationship may not apply to Vector and OtagoNet

We note that the calculations for the elasticity exclude data for Vector and OtagoNet, which are found to be outliers. While excluding Vector and OtagoNet may be appropriate for calculating a broader relationship, it also suggests that this broader relationship may not hold for these EDBs (which accounted for around 33 percent of ICPs or 35 percent of overall lines revenue in 2013). We query what level of confidence the Commission can have in the relationship when a third of ICPs or revenue are excluded from the analysis.

We raised this concern in response to the Commission's 2012 DPP reset.[3] While statistical tests can be used to identify outliers, economic theory is clear that outliers should only be excluded if a plausible explanation or hypothesis is provided as to why the data points identified are different from the rest of the sample (for example, due to entry or recording error or if the data points are thought to be drawn from a different sample). Without a credible explanation for the differences in the data that lead to Vector and OtagoNet being excluded, the grounds for forecasting based on the relationship become even weaker. In effect, the estimated relationship can only explain a small proportion in the variation in revenue even after one third of the data set is eliminated.

2.3 These Concerns Should be Addressed when the Commission Updates its Analysis

The concerns identified in this section may become more or less significant when the Commission updates its analysis to use commercial and industrial lines revenue as the dependent variable. To improve on the results presented in the draft determination, when the new data series is used we would expect the estimated elasticity to fall (reflecting recent declines in demand over a time period when GDP has grown). We would also expect that a large proportion of the data set would not need to be removed to make the relationship valid (or at least that any outliers are explained).

If the issues identified above remain after data on commercial and industrial revenue is used, then we consider that the Commission should explore other options, such as using trend analysis to forecast overall net revenue (rather than trying to separately model residential and commercial and industrial revenues when there are issues with the approaches and data availability for these). To avoid any circularity between line revenue and regulatory controls, the Commission could use net revenues earned until 2012 (before the first substantive DPP reset took place). Alternatively, the Commission could focus on the trends in underlying volumes and incorporate an additional year of data.

3 Castalia Strategic Advisors. "Review of Revised Draft Reset of the 2010-2015 Default Price-quality Paths, Report to Vector." September 2010. Available at http://www.comcom.govt.nz/regulated-industries/electricity/electricity-default-price-quality-path/2010-2015-default-price-quality-path/

3 Residential Revenue Forecasts

The Commission uses comparatively simple methods to forecast residential revenues, relying on a direct relationship between population statistics and electricity connections and a qualitative judgement on demand per connection. This section examines the Commission's proposal approach, identifying specific concerns with the assumptions underlying the Commission's analysis. We also suggest ways to address these concerns to develop more accurate and reliable forecasts. In our view, the precision of the Commission's approach can be improved, without adding unnecessary complexity.

3.1 The Commission's Approach Relies on Population Forecasts and Assumes a Constant Pattern of Electricity Consumption

The Commission forecasts the change in residential revenue by projecting the change in residential users (ICPs), and the change in electricity use per residential user. The Commission assumes that population growth in a region has a 1:1 relationship with the change in that EDBs' residential users or ICPs.

For consumption levels per user, the Commission makes a qualitative judgement that consumption levels will remain constant over the regulatory period. This is based on the view that recent declines in electricity usage per ICPs will be offset by other factors that positively affect energy consumption, such as improving economic activity, the moderation of electricity price increases, and the increasing viability of electric vehicles. The Commission proposes to rely on its suggested "likely pattern of future trends" to determine the consumption per user or ICP, rather than undertaking formal modelling or forecasting.

3.2 Using Population May Mis-Forecast ICP Growth and Electricity Consumption Per Capita is Declining

In this section we highlight concerns with two assumptions the Commission uses in forecasting residential revenues–that population growth equals ICP growth and that electricity consumption per user or ICP will remain constant.

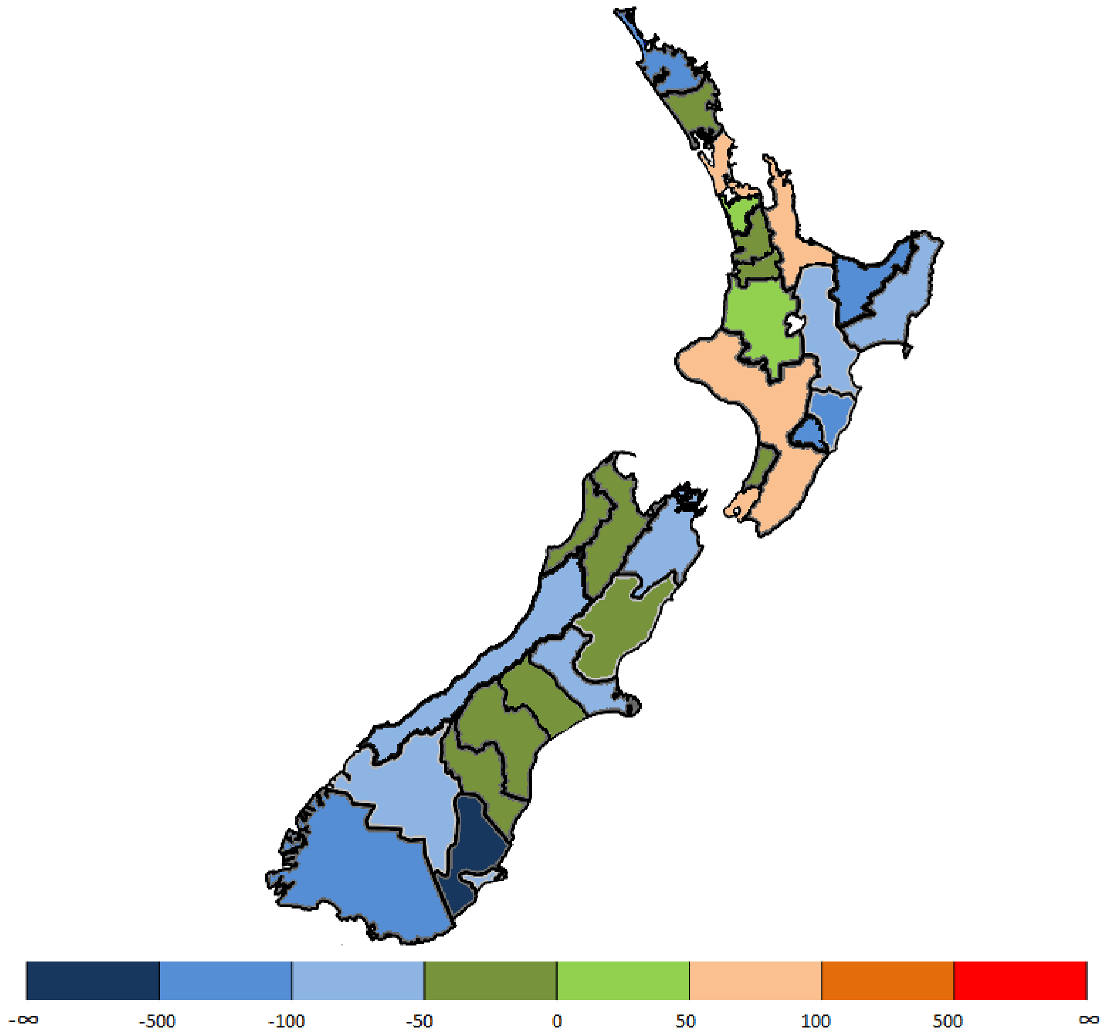
Population growth is materially different to ICP growth

Three possible data sources can be used to forecast the number of residential customers on each network: population, household numbers, and the ICPs recorded on each network. We agree with the Commission that using official statistics to forecast changes in ICP growth is likely to improve accuracy. This is because ICP numbers are frequently adjusted when the network registry or database is 'cleaned-up', suggesting that ICP trends may not be a reliable way to forecast future changes in residential customers. In contrast, both population and household statistics are official data series that are closely linked to ICP numbers and can be used to forecast ICP growth.

However, after investigating population and household statistics, we have found that using changes in population to forecast ICP growth results in material errors across most New Zealand regions and networks. Figure 3.1 illustrates the percentage differences between actual ICP growth for each EDB and ICP growth forecast using population growth between 2006 and 2013.

For most networks, population growth underestimates ICP growth—indicating that population increases at a slower rate than the number of ICPs. These networks are the blue areas in Figure 3.1. Notable exceptions to this trend are Auckland and Wellington, where population growth overestimates the actual change in number of ICPs by 63 percent and 91 percent respectively.

Figure 3.1: ICP Growth Forecast Error (Using 2006-2013 Population Growth)



Source: Castalia using Commission and Statistics NZ information

The spread of forecast errors suggests population statistics are obscuring the demographic changes that are more closely linked with the actual number of ICPs. Past submissions have suggested the number of households has been growing at a different rate to the population, which affects ICP growth forecasts.

In the draft determination, the Commission states that there is little difference between population growth and household growth for Wellington and Auckland between 2006 and 2013. However, in our view this response mischaracterises the data. Looking at the same data, we suggest that the demand forecast errors created by these assumptions across networks are in fact significant.

In Auckland and Wellington, population growth outstrips household growth, while the opposite is observed in the remainder of the country. Table 3.1 indicates the variation in the forecast error for non-exempt EDBs where the error is greater than 10 percent (higher or lower), using the population growth rate to predict household growth, across regions and networks. These errors are substantial. In Vector's case, these differences illustrate that it is forecast to earn revenue from nearly 4,000 customers that do not exist.

Table 3.1: Household Growth Forecast Error for Selected EDBs

EDB	Number of Households[4]	2006	2013	Growth
Alpine Energy	Actual	22,299	23,583	1,284
	Forecast (using population growth rate)		23,023	724
	Percentage difference in growth			-44%
Aurora Energy	Actual	60,519	64,947	4,428
	Forecast (using population growth rate)		63,590	3,070
	Percentage difference in growth			-31%
Centralines	Actual	4,992	5,169	177
	Forecast (using population growth rate)		4,901	-91
	Percentage difference in growth			-152%
Counties Power	Actual	27,125	30,570	3,446
	Forecast (using population growth rate)		30,117	2,992
	Percentage difference in growth			-13%
Eastland Network	Actual	18,933	19,224	291
	Forecast (using population growth rate)		18,431	-502
	Percentage difference in growth			-273%
Electricity Invercargill	Actual	14625	14,408	-217
	Forecast (using population growth rate)		20,649	546
	Percentage difference in growth			-51%
Horizon	Actual	17,619	17,859	240
	Forecast (using population growth rate)		17,007	-612
	Percentage difference in growth			-355%
Network Tasman	Actual	17,475	18,885	1,410
	Forecast (using population growth rate)		18,465	990
	Percentage difference in growth			-30%
Orion	Actual	146,892	146,235	-657
	Forecast (using population growth rate)		148,417	1,525
	Percentage difference in growth			-332%
OtagoNet	Actual	8,129	8,431	302
	Forecast (using population growth rate)		8,224	95
	Percentage difference in growth			-69%

[4] We have used data for private, occupied dwellings. This is consistent with the figures used by the Commission in the draft determination.

Powerco	Actual	215,048	229,948	14,900
	Forecast (using population growth rate)		224,077	9,029
	Percentage difference in growth			-39%
The Lines Company	Actual	12,657	12,857	200
	Forecast (using population growth rate)		12,066	-591
	Percentage difference in growth			-396%
Top Energy	Actual	20,712	22,047	1,335
	Forecast (using population growth rate)		20,671	-41%
	Percentage difference in growth			-103%
Unison	Actual	81,090	85,431	4,341
	Forecast (using population growth rate)		82,600	1,510
	Percentage difference in growth			-65%
Vector[5]	Actual	412,577	442,881	30,305
	Forecast (using population growth rate)	412,577	446,858	34,282
	Percentage difference in growth			13%
Wellington Electricity	Actual	134,442	140,136	5,694
	Forecast (using population growth rate)		140,705	6,263
	Percentage difference in growth			10%

Source: Castalia using Statistics NZ information

The link between past drivers of consumption are weakening and new factors have led to decreasing consumption per capita

We have also examined each of the drivers the Commission states will increase energy consumption. We find there is no longer a strong relationship between electricity consumption and economic growth (as discussed in Section 2). The decoupling of this relationship has been occurring over the last decade, suggesting it is not simply a temporary shock but an underlying change in the pattern of electricity consumption. Lower electricity price rises and electric vehicles will also not have a material impact over the coming regulatory period.

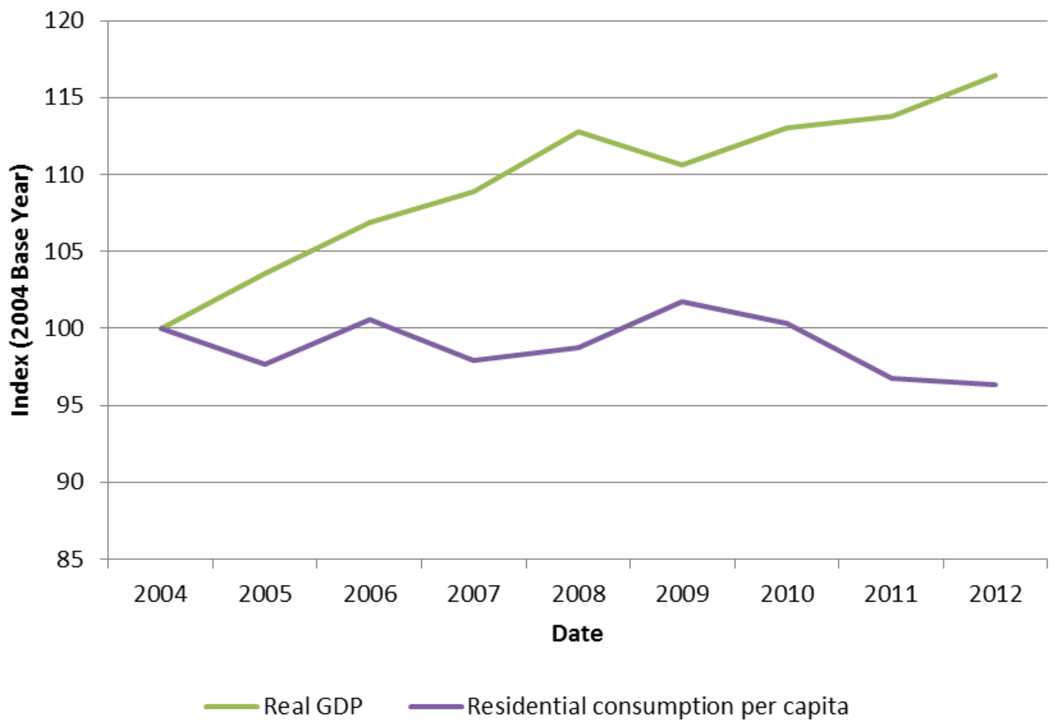
Electricity consumption per capita has decoupled from economic growth

In the past, economic growth has been used as an indicator of increasing electricity consumption. However, this relationship has been decreasing over time. Figure 3.2 illustrates how New Zealand's residential electricity consumption has decoupled from GDP over the last decade.

5 Population and household numbers may differ from those provided for Auckland and Wellington in the draft determination for a variety of reasons. In this report, we consider the number of households in each EDBs' service region, rather than using a generic interpretation of regional boundaries. We have used Statistics New Zealand dataset resources, which are slightly different to the figures used by the Commission (which align with Statistics New Zealand's media releases)

This phenomenon has also been observed in other OECD countries,[6] suggesting that at a certain point of development, users may adopt more energy efficient technologies and/or incorporate conservation beliefs into their consumption behaviour. The decoupling of this relationship indicates that changes in economic activity are not sufficient to suggest changes in energy consumption per capita.

Figure 3.2: Growth in Residential Electricity Consumption and Real GDP (2003–2013)



Source: Castalia using MBIE and Commerce Commission information

Residential prices are unlikely to decrease and demand is unlikely to respond to more moderate increases

Both the residential sales-based electricity prices (March 2014) and the Quarterly Survey of Domestic Electricity Prices (May 2014) report overall increases in residential electricity prices exceeding inflation in recent years (albeit by less than prior years).

The Ministry of Business, Innovation and Employment (MBIE) has examined the electricity price forecasts in its scenario analysis of electricity consumption. Factors placing downward pressure on prices include lower demand growth and technology improvements such as the uptake of solar PV, which would also decrease distribution revenues. Meanwhile, MBIE notes that "even if there are no long-term wholesale price increases, retail prices may still need to accommodate future investment in transmission and distribution infrastructure…[which accounts for a third of residential electricity costs]."

[6] See 'Figure 3.3 Relationship between per Capita Energy Consumption and GDP Growth' in International Monetary Fund, "World Economic Outlook 2011", 2011. Available at: https://www.imf.org/external/pubs/ft/weo/2011/01/pdf/text.pdf.

However, even if price increases were to moderate,[7] smaller price increases than previously experienced would not in themselves lead to increases in electricity consumption. Even if prices were to actually decrease (which has not been suggested), estimates of the price elasticity of demand for electricity suggest there may be little response. This is because the price elasticity of electricity demand is estimated to be particularly low in New Zealand. For example, the Electricity Authority has recently used an estimate of -0.26.[8]

This suggests that while more moderate price increases may lead to less of a response in terms of reduced demand, the response is fairly minor and unless prices actually decrease, demand will continue to reduce (just less than with higher price increases). For example, Statistics New Zealand CPI data suggests that electricity prices have increased 22 percent, or 5.11 percent per year between the start of 2010 and the second quarter of 2014. An elasticity of -0.26 implies an associated 1.3 percent reduction in demand per year. It would take a significant decrease in prices for demand to increase to any significant extent (even a 10 percent price decrease, while unlikely, would only increase demand by 2.6 percent).

Infrequent vehicle replacement means electric vehicles are unlikely to drive increased demand

The Commission also suggests that electricity consumption may be driven up by electric vehicles becoming more viable. Studies from the United States show that owning an electric vehicle does increase household electricity consumption, placing an additional peak load of 7 to 54 percent on the grid (depending on the vehicle's charging profile).

The most efficient of these vehicles consume up to 20 kWh of electricity per 100 kilometres.[9] On average, New Zealanders drive 12,000 kilometres a year,[10] although electric vehicles will tend to drive shorter distances (particularly while charging infrastructure is limited). At these rates, an electric vehicle is estimated to increase a household's electricity consumption by around 2,400 kWh per year.[11]

However, mass market penetration remains a long-term aspiration for electric vehicles in New Zealand. Instead, there has been greater growth of hybrid vehicles, which have a lesser impact on electricity consumption (in fact, no impact in the case of non-plug-in hybrids which have been more common to date). Even if electric vehicles were a more attractive alternative to petrol or diesel cars, vehicles are long-lived capital assets that are infrequently replaced. Furthermore, half of the vehicles entering New Zealand's fleet are second-hand imports, most from Japan.[12] This imposes an additional time lag as the

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[7] Some papers have suggested the recent price increases have driven some of the decoupling of electricity consumption and growth.

[8] See: Electricity Authority "Improving transparency of consumers; electricity charges: Consultation Paper" 24 June 2014, available at: http://www.ea.govt.nz/development/work-programme/retail/improving-transparency-charges/consultations/#c12828. There are some even lower past estimates such as -0.12 for residential and -0.08 for commercial and industrial, see: http://www.climatechange.govt.nz/emissions-trading-scheme/building/regulatory-updates/modelling-for-the-eaf.pdf

[9] Consumption of electric cars: the top 13 in Wh/km, 2012. Available at http://www.technologicvehicles.com/en/green-transportation-news/1961/consumption-of-electric-cars-the-top-13-in-wh-km#.U9zbKqwcTnu.

[10] Automobile Association. 'Paying road user charges'. Available at http://www.aa.co.nz/cars/licensing-safety-fees/road-user-charges/paying-road-user-charges-ruc/.

[11] This is in line with international estimates. See http://www.afdc.energy.gov/fuels/electricity_charging_home.html.

[12] Statistics New Zealand, 'The dealer-to-household used-car market.' Available at http://www.stats.govt.nz/tools_and_services/newsletters/price-index-news/oct-13-used-car-market.aspx.

average age of a used car import is eight years.[13] The impact of the incoming electric cars will therefore not be sufficient to influence overall residential consumption by 2020.

Energy efficiency is driving significant decreases in consumption per ICP

Between 1990 and 2011, energy efficiency was the most influential factor on residential energy consumption, reducing residential consumption by 17 PJ overall.[14] However, the Commission has not considered the impact energy efficiency initiatives are having in reducing electricity consumption.

In considering the impact of energy efficiency on forecast revenues, the Commission will clearly want to ensure that the new D-Factor mechanism does not compensate EDBs twice for energy efficiency (once through the forecast, and then again through a D-Factor adjustment). This issue only applies to initiatives carried out by EDBs. However, most energy efficiency initiatives are implemented by other parties, namely consumers and government.

Consumption behaviour can generate energy efficiency improvements when consumers purchase eco-friendly or more efficient appliances, such as light-emitting diodes (LEDs) or whiteware. Formal initiatives targeting residential consumption have focused on developing consumer information (EECA), improving insulation (Warm Up New Zealand), using more energy efficient appliances (Energy Star), encouraging the uptake of solar power for lighting and heating, and the coverage and use of smart meters.

These formal and informal movements have generated energy savings and some have experienced considerable success with ongoing consumer adoption. The introduction of minimum energy performance standards (MEPS) and mandatory energy performance labelling (MEPL) from 2002 has generated $400 million in reduced energy costs.[15] In the last year alone, the energy savings from New Zealanders purchasing more efficient products are around 3 PJ, representing nearly a quarter of the overall reduced costs. Continuing recent growth suggests substantial momentum behind energy efficiency initiatives and greater opportunities for growth. Notably, the impact of efficient appliances is only one component of the much wider spread of initiatives.

KEMA's 2007 report to the Electricity Commission titled "New Zealand Electric Energy-Efficiency Potential Study" estimated there was around 6,437 GWh of electricity savings that were economic and could be realised by 2016. Using MBIE data on the actual residential consumption between 2007 and 2012 (the latest period the information is available), if we assume all of the decrease in consumption since the peak in 2009 was the result of energy efficiency measures, this accounts for 769 GWh of savings. This suggests there are still significant opportunities for efficiency savings, which would drive further reductions in electricity consumption per ICP.

As technology advances, these energy savings opportunities only become larger. For instance, the US Department of Energy anticipates that by 2020 a conventional LED light will use one-third of the energy a current LED consumes.[16] Developments in

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[13] Ministry of Transport. 'New Zealand Vehicle Fleet Statistics', available at http://www.transport.govt.nz/research/newzealandvehiclefleetstatistics/.

[14] Ministry of Economic Development, "Changes in Energy Use New Zealand 1990–2011".

[15] Energy Efficiency and Conservation Authority, "Energy savings from improved product energy efficiency." Available at http://www.eeca.govt.nz/resource/energy-savings-improved-product-energy-efficiency.

[16] See Solid State Lighting Program, Office of Energy Efficiency and Renewable Energy, US Department of Energy. Available at http://energy.gov/eere/ssl/solid-state-lighting .

technology and initiatives will be driven by support from governments and consumers for energy efficiency.

On balance, we expect consumption per user to continue to decline

Weighing the relative impacts of these drivers, we conclude there is insufficient evidence to suggest that recent declines in consumption per residential ICP will level off. For instance, to offset last year's 3 PJ of energy savings from more efficient appliances, MEPs and MEPLs, approximately 350,000 electric vehicles would have to be imported into New Zealand.[17] Optimistic forecasts have suggested New Zealand would have a total of 70,000 electric vehicles by 2020.[18] We therefore suggest this declining consumption per capita be reflected in the forecasts, as discussed next.

3.3 Household Estimates Should be Used with Household Electricity Consumption Patterns

In this section we suggest an alternative approach to forecasting residential revenue: using household data to estimate ICP growth and reflecting the downward trend in electricity consumption. We use readily available statistics and simple statistical tools to improve on the Commission's methodology, while maintaining a low-cost approach.

Household growth is a better reflection of ICP growth

Since ICP growth forecasts using population growth vary in their accuracy, we suggest using a different statistical measure for forecasting. We consider household growth to be a better proxy to project the number of ICPs. Household growth is closely related to ICP growth and would more accurately reflect the variety of demographic trends occurring across the country. Statistics New Zealand provides household projections in each territorial authority area at five year intervals from 2006 to 2031.[19]

This logic has been supported by comparing the estimates of ICP growth using population or household growth between 2006 and 2013. A summary of the percentage difference in growth between the estimates and the actual ICP figures is provided in Appendix A. For 19 of 29 EDBs (and a small majority of non-exempt EDBs), household growth provides a more accurate estimate of the growth in ICPs than using population growth. We note that using household growth still results in substantial forecast errors for some EDBs, overestimating the number of ICPs for a number of these EDBs (including Vector). This may be a reason to move away from this approach towards basing revenue forecasts on historical trend information for total revenues as discussed above.

Observed trend of consumption is a strong indicator of future behaviour

The Commission is reluctant to use historical analysis to anticipate electricity consumption per capita. However, the indicators used in the past (such as GDP growth) to indicate future levels of consumption are no longer as accurate. Historical data shows electricity consumption per user (or household) is declining and this should be incorporated in the Commission's forecasts.

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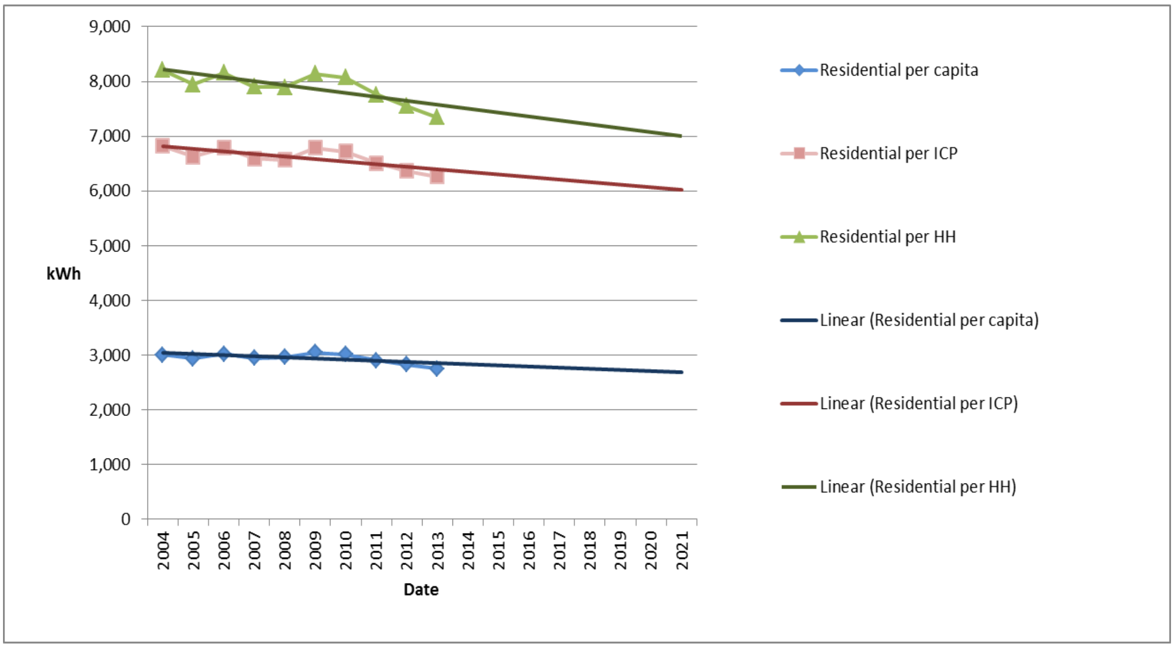
17 Assuming EVs each consume 2,400 kWh per year, which is equivalent to 8.6E-06 PJ.

18 Mcnicol, Hamish, "Near new electric cars may come first,". Available at http://www.stuff.co.nz/motoring/news/10057638/Near-new-electric-cars-may-come-first.

19 See 'Subnational Family and Household Projections – information releases'. Available at http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/subnational-family-and-household-projections-info-releases.aspx.

Using past trends is the best option to forecast electricity consumption per user over the next regulatory period. Figure 3.3 illustrates that this approach anticipates the downward trend in per user electricity consumption will continue to 2020, continuing to reflect a strong uptake in energy efficiency initiatives. Forecast residential electricity consumption levels at 2011, 2016 and 2021 are also provided in Table 3.2. This downward trend in electricity consumption per user is observed whether calculated on a per capita, per household or per ICP basis. Although polynomial trends were a better fit of the data (which would accelerate the decline in consumption levels over the forecast period), we have taken a conservative approach by using linear trends. However, regardless of the trend used, the model with the best fit applies consumption per household, which is calculated using Statistics New Zealand household estimates.[20]

Figure 3.3: Residential Consumption per User with Trend Forecast



Source: Castalia using Statistics New Zealand and MBIE information

Table 3.2: Forecast Residential Consumption per User (kWh) for 2011, 2016 and 2021

	Consumption per capita	Consumption per household	Consumption per ICP
2011	2,889	7,719	6,486
2016	2,785	7,361	6,255
2021	2,681	7,004	6,024

Source: Castalia using Statistics New Zealand and MBIE information

20 Ideally we would use a variable that reflects the total number of dwellings. However, such a variable is not currently forecasted. Instead we have used household growth estimates (which exclude non-private dwellings, unoccupied dwellings, and dwellings which are not the usual residence of people). This is consistent with other data presented on households.

If the Commission decides to continue to forecast residential revenue growth separately, rather than use a historical trend analysis to forecast total revenue growth, we suggest the Commission applies the forecast electricity consumption per household (or per ICP) over the next regulatory period to projected household growth in forecasting residential revenues for the affected EDBs. Table 3.3 outlines the annual consumption growth rates between 2011 and 2021 using this approach for non-exempt EDBs. The full calculations for changes in consumption are provided in Appendix B.

Table 3.3: Non-Exempt EDBs' Residential Electricity Consumption Growth Forecasts

EDB	Residential Electricity Consumption Growth (Using Consumption per Household)		Residential Electricity Consumption Growth (Using Consumption per ICP)	
	2011-2016	2016-2021	2011-2016	2016-2021
Alpine Energy	-0.37%	-0.75%	-0.15%	-0.51%
Aurora Energy	0.10%	-0.13%	0.32%	0.11%
Centralines	-0.21%	-0.99%	0.02%	-0.75%
Eastland Network	-0.37%	-0.53%	-0.15%	-0.29%
Electricity Ashburton	0.00%	-0.09%	0.23%	0.16%
Electricity Invercargill	-0.50%	-0.99%	-0.28%	-0.75%
Horizon Energy	-0.53%	-0.49%	-0.31%	-0.25%
Nelson Electricity	0.07%	-0.21%	0.30%	0.03%
Network Tasman	0.37%	0.05%	0.59%	0.30%
Orion	0.22%	0.05%	0.44%	0.29%
OtagoNet	-0.62%	-0.67%	-0.40%	-0.43%
Powerco	0.16%	-0.05%	0.39%	0.19%
The Lines Company	-0.81%	-0.96%	-0.59%	-0.72%
Top Energy	0.08%	-0.34%	0.30%	-0.10%
Unison	-0.08%	-0.27%	0.14%	-0.03%
Vector	0.97%	0.78%	1.19%	1.02%
Wellington Electricity	0.08%	-0.12%	0.30%	0.12%

Source: Castalia using MBIE and Statistics NZ information

4 Capex Forecasts

This section examines the Commission's proposed approach to forecasting capex. We identify specific concerns with the Commission's proposed approach, and suggest an alternative that would provide incentives to EDBs that provide a long term solution to forecasting capex.

4.1 The Commission's Approach Attempts to Address Ongoing EDB Incentives

One of the most challenging aspects of the DPP decision is to forecast the capex needs of each network over the coming regulatory period. This is because capex by its nature is network-specific and responds to a wide range of issues. This means that it is difficult to derive a clear relationship between capex needs and other objective variables (such as network growth, asset age, or other factors).

This creates a strong information asymmetry—regulated suppliers are clearly best placed to estimate capex needs through their Asset Management Plans (AMPs). In contrast, the DPP relies on objective information that does not need to be independently verified or audited. This creates a fundamental mis-match between company-specific capex forecasts and an industry-wide default price path.

Having tested other approaches to forecasting capex (such as econometric approaches and age-based survival models), the Commission has decided to again use the forecasts prepared in EDBs' AMPs to establish regulatory controls. However, to limit the impact of the obvious incentive to overstate capex requirements, the Commission proposes to apply a cap on any increase over historical capex levels.

The Commission proposes to apply a cap of:

- 120 percent of historical capex for EDBs that spent closer to forecast levels of capex from the last DPP reset
- 110 percent of historical capex for EDBs that spent less close to forecast levels of capex from the last DPP reset.

This distinction reflects the different level of confidence that the Commission has in EDBs that have spent close to previous forecasts.

4.2 The Approach is Not Consistent with the Regulatory Regime

The Commission's proposed approach is at odds with one of the key principles of any CPI-X regulatory regime—that price controls are set on a forward-looking basis, meaning that firms are not punished *ex-post* for spending less than their regulatory allowance.

Adhering to this principle requires considerable regulatory discipline—it is difficult for any regulator to resist the urge to look back at how much regulated suppliers have earned during the last regulatory period, and seek to claw back any perceived excess returns. However, good regulators do resist this urge.

Using the difference between forecasts and actuals is problematic because the Commission does not know the reason for the difference. It could reflect:

- Greater efficiency—either by substituting capex for opex, reducing capex through measures such as energy efficiency, or reducing costs through better management of capital works

- Inefficiency—for example, by not being able to deliver on a capex programme that would have been efficient due to poor planning or constraints on implementation
- Poor forecasting
- A combination of these or other factors.

By using the difference between forecasts and actuals for a future purpose, the Commission is signalling to regulated suppliers that they need to pay attention to those differences. In fact, the real power of CPI-X regulation (and when it provides the greatest benefits to consumers) is when regulated suppliers are solely focused on minimising costs. Those lower costs can then be passed on to consumers at the next reset.

4.3 Menu Regulation would Provide More Appropriate Incentives

We have previously argued that a simplified form of menu regulation (also known as the sliding scale) adopted for network businesses in the United Kingdom is uniquely suited to the DPP.[21] We remain of this view because menu regulation:

- Recognises that regulated businesses are the best source of information
- Provides incentives to regulated businesses to reveal that information.

A simplified form of menu regulation can be tailored to the DPP

We understand that the Commission has chosen not to adopt menu regulation for the DPP because it is too complex. We disagree, and think that a very simple form of menu regulation could be introduced for this DPP that:

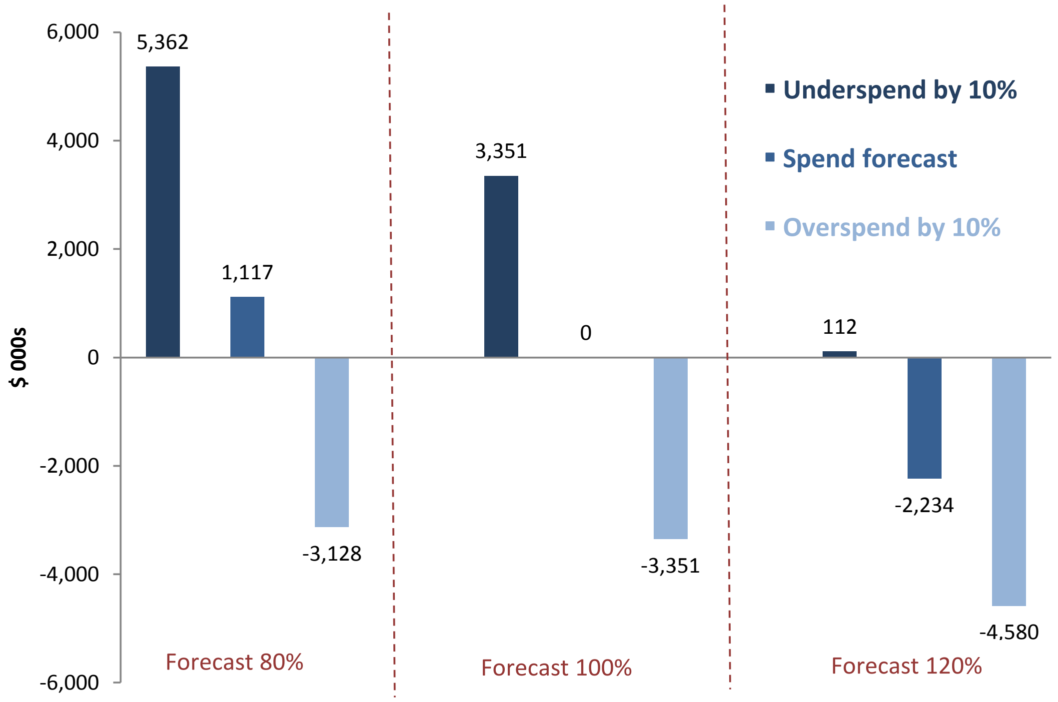
- Sets a baseline for capex at historical levels
- Allows regulated suppliers to choose a forecast that is some level higher or lower than their average historical levels. At its most simple, this could give regulated suppliers the option of choosing a level of forecast expenditure that is either 20 percent more or less than historical levels, with a default allowance equal to historical averages for EDBs that do not opt for a different level of forecast expenditure
- Allows regulated suppliers to keep a different proportion of any underspend, with those suppliers choosing lower forecasts being allowed to keep a greater proportion of any underspend. The retention rate for each of the three options needs to be "incentive compatible", which is a mathematic calculation.

Figure 4.1 illustrates how this simplified form of regulation could be applied at this reset, using Vector as an example. The baseline for forecast capex is set at the historical average of $111 million. Vector is then able to choose an allowance that is either equal to the historical average, or 20 percent higher or lower than the historical average (based on its particular circumstances). The vertical lines in the figure below show how much of any

[21] See "Evidence on the Impacts of Regulatory Incentives to Improve Efficiency and Service Quality." April 2012. Available at: http://www.comcom.govt.nz/regulated-industries/electricity/electricity-default-price-quality-path/2010-2015-default-price-quality-path/. The application of a sliding scale mechanism is further developed in "Review of the Draft Decision on the Revised Initial Default Price-Quality Paths for Gas Pipeline Services." December 2012. Available at: http://vector.co.nz/documents/101943/102866/Castalia+Report_06-12-12.pdf/020aa064-0166-4266-9693-f29ed691acb4.

underspend against that allowance Vector would be entitled to "keep" as a reward, and how much of any over-spend Vector would forego as a penalty. The key point is that if Vector aims to spend less, it keeps more of any underspend and is penalised less for any overspend. Conversely, if Vector states that it needs to spend more, then the company will not be rewarded for spending less than its allowance.

Figure 4.1: Illustration of Simplified Menu Regulation Applied to Vector



The incentives shown in Figure 4.1 are clearly not symmetrical. This is because the intended design is not for symmetrical incentives, but rather for incentives to reveal the best information. If an EDB chooses a low forecast, it is revealing to the regulator that it can meet expectations of service quality while spending less of consumers' money than it has in the past. To get an EDB to reveal this fact, under menu regulation the EDB is then allowed to keep more of any underspend than the penalty that applies if it does not meet that "stretch" target. Conversely, if an EDB reveals to the regulator that it really needs to spend more money than usual, it keeps very little of any underspend. But if the EDB fails to keep within this more generous allowance, then the penalty that applies is greater than if it had chosen a lower allowance.

The Commission will need to understand how the incentives provided through menu regulation would fit alongside the incremental rolling incentive scheme (IRIS) proposed for capex under the DPP. We consider that menu regulation and rolling incentives have some shared objectives, as well as some distinct objectives. Menu regulation encourages regulated businesses to reveal information on likely future costs, while also encouraging regulated businesses to spend no more than necessary to deliver the required services. Rolling incentives also promote cost efficiency, while maintaining the strength of incentives over the regulatory period. This suggests that the two regulatory mechanisms do not conflict, but that the strength of the incentives that apply will need to be assessed.

At a minimum, a uniform cap of 20 percent above historical capex should apply

Although we consider that a simple form of menu regulation is ideally suited to the DPP, we understand that there are practical limits on what can be achieved by 30 November 2014.

If the Commission does not use menu regulation for this DPP reset, then the problems identified above can be resolved by applying a uniform cap of 20 percent above historical capex levels. While such an approach may seem unsatisfactory because it allows regulated businesses to increase their returns by spending less than their allowance, it retains a clear focus on minimising costs where possible.

Appendix A: ICP Forecasts

Table A.1 compares for each network the ICP forecasts using population estimates and household estimates with actual changes in the number of ICPs between 2006 and 2013.

Table A.1: Comparison of ICP Growth Estimates using Population or Household Growth, 2006-2013

EDB	Number of ICPs[22]	2006	2013	Growth
Alpine	Actual	24,356	25,318	962
	Forecast (using population growth rate)		25,147	791
	Percentage difference in growth			-18%
	Forecast (using household growth rate)		25,759	1,402
	Percentage difference in growth			46%
Aurora	Actual	58,146	71,343	13,197
	Forecast (using population growth rate)		61,096	2,950
	Percentage difference in growth			-78%
	Forecast (using household growth rate)		62,400	4,254
	Percentage difference in growth			-68%
Buller	Actual	3,670	3,987	317
	Forecast (using population growth rate)		3,962	292
	Percentage difference in growth			-8%
	Forecast (using household growth rate)		3,967	297
	Percentage difference in growth			-6%
Centralines	Actual	6,399	6,830	430
	Forecast (using population growth rate)		6,282	-117
	Percentage difference in growth			-127%
	Forecast (using household growth rate)		6,626	227
	Percentage difference in growth			-47%
Counties Power	Actual	29,848	32,952	3,105
	Forecast (using population growth rate)		33,140	3,293

[22] Actual figure as calculated as 87% of total number of ICPs – reference to MBIE ICP data Excel file

EDB	Number of ICPs[22]	2006	2013	Growth
	Percentage difference in growth			6%
	Forecast (using household growth rate)		33,639	3,791
	Percentage difference in growth			22%
Eastland	Actual	21,252	19,707	-1,545
	Forecast (using population growth rate)		20,689	-564
	Percentage difference in growth			-54%
	Forecast (using household growth rate)		21,579	327
	Percentage difference in growth			-121%
Electra	Actual	34,877	37,044	2,167
	Forecast (using population growth rate)		36,316	1,439
	Percentage difference in growth			-34%
	Forecast (using household growth rate)		37,034	2,156
	Percentage difference in growth			-1%
Electricity Ashburton	Actual	13,287	15,000	1,713
	Forecast (using population growth rate)		15,068	1,781
	Percentage difference in growth			4%
	Forecast (using household growth rate)		15,008	1,721
	Percentage difference in growth			0.5%
Electricity Invercargill	Actual	14,625	14,408	-217
	Forecast (using population growth rate)		15,022	398
	Percentage difference in growth			-284%
	Forecast (using household growth rate)		15,435	810
	Percentage difference in growth			-474%
Horizon	Actual	19,973	20,582	609
	Forecast (using population growth rate)		19,279	-694
	Percentage difference in growth			-214%
	Forecast (using household growth rate)		20,245	272
	Percentage difference in growth			-55%

EDB	Number of ICPs[22]	2006	2013	Growth
MainPower	Actual	26,384	30,793	4,409
	Forecast (using population growth rate)		30,157	3,773
	Percentage difference in growth			-14%
	Forecast (using household growth rate)		30,416	4,032
	Percentage difference in growth			-9%
Marlborough Lines	Actual	19,770	21,178	1,408
	Forecast (using population growth rate)		20,173	403
	Percentage difference in growth			-71%
	Forecast (using household growth rate)		21,132	1,362
	Percentage difference in growth			-3%
Nelson Electricity	Actual	7,553	7,837	284
	Forecast (using population growth rate)		8,178	625
	Percentage difference in growth			120%
	Forecast (using household growth rate)		8,239	687
	Percentage difference in growth			141%
Network Tasman	Actual	29,654	32,237	2,583
	Forecast (using population growth rate)		31,334	1,681
	Percentage difference in growth			-35%
	Forecast (using household growth rate)		32,046	2,393
	Percentage difference in growth			-7%
Network Waitaki	Actual	10,002	10,454	452
	Forecast (using population growth rate)		10,301	298
	Percentage difference in growth			-34%
	Forecast (using household growth rate)		10,435	433
	Percentage difference in growth			-4%
Northpower	Actual	43,539	46,380	2,841
	Forecast (using population growth rate)		45,119	1,580
	Percentage difference in growth			-44%

EDB	Number of ICPs[22]	2006	2013	Growth
	Forecast (using household growth rate)		47,187	3,648
	Percentage difference in growth			28%
Orion	Actual	155,292	158,549	3,257
	Forecast (using population growth rate)		156,903	1,612
	Percentage difference in growth			-51%
	Forecast (using household growth rate)		154,597	-695
	Percentage difference in growth			-121%
OtagoNet	Actual	12,626	12,635	9
	Forecast (using population growth rate)		12,774	148
	Percentage difference in growth			1,518%
	Forecast (using household growth rate)		13,095	470
	Percentage difference in growth			5,040%
Powerco	Actual	255,739	261,500	5,761
	Forecast (using population growth rate)		266,476	10,738
	Percentage difference in growth			86%
	Forecast (using household growth rate)		273,458	17,719
	Percentage difference in growth			208%
Scanpower	Actual	5,655	5,770	115
	Forecast (using population growth rate)		5,406	-249
	Percentage difference in growth			-317%
	Forecast (using household growth rate)		5,685	30
	Percentage difference in growth			-74%
The Lines Company	Actual	20,207	19,448	-759
	Forecast (using population growth rate)		19,264	-944
	Percentage difference in growth			24%
	Forecast (using household growth rate)		20,526	319
	Percentage difference in growth			-142%
The Power	Actual	26,553	29,505	2,951

EDB	Number of ICPs[22]	2006	2013	Growth
Company	Forecast (using population growth rate)		27,275	721
	Percentage difference in growth			-76%
	Forecast (using household growth rate)		28,134	1,580
	Percentage difference in growth			-46%
Top Energy	Actual	24,260	26,229	1,969
	Forecast (using population growth rate)		24,212	-48
	Percentage difference in growth			-102%
	Forecast (using household growth rate)		25,823	1,564
	Percentage difference in growth			-21%
Unison	Actual	88,370	92,377	4,007
	Forecast (using population growth rate)		90,016	1,645
	Percentage difference in growth			-59%
	Forecast (using household growth rate)		93,101	4,731
	Percentage difference in growth			18%
Vector	Actual	436,712	459,027	22,316
	Forecast (using population growth rate)		472,999	36,287
	Percentage difference in growth			63%
	Forecast (using household growth rate)		468,789	32,077
	Percentage difference in growth			44%
Waipa Networks	Actual	18,968	20,858	1,891
	Forecast (using population growth rate)		20,827	1,860
	Percentage difference in growth			-2%
	Forecast (using household growth rate)		21,179	2,211
	Percentage difference in growth			17%
WEL Networks	Actual	67,473	74,541	7,068
	Forecast (using population growth rate)		73,897	6,424
	Percentage difference in growth			-9%
	Forecast (using household		74,437	6,963

EDB	Number of ICPs[22]	2006	2013	Growth
	growth rate)			
	Percentage difference in growth			-1%
Wellington Electricity	Actual	137,828	141,193	3,365
	Forecast (using population growth rate)		144,248	6,420
	Percentage difference in growth			91%
	Forecast (using household growth rate)		143,665	5,837
	Percentage difference in growth			73%
Westpower	Actual	10,415	11,450	1,035
	Forecast (using population growth rate)		10,438	23
	Percentage difference in growth			-98%
	Forecast (using household growth rate)		10,936	521
	Percentage difference in growth			-50%

Source: Castalia using Stats New Zealand and MBIE information

Appendix B: Residential Growth Rates Applying Downward Trend in Electricity Consumption

Below we replicate the Commission's model 6b estimates used to forecast ICP growth and apply the downward trend in residential consumption to estimate the overall change in residential consumption. Table B.1 applies our proposed approach of using household figures to estimate ICP growth, while

Table B.2 uses the Commission's proposal of using population growth.

Table B.1: Residential Revenue Growth Rate using Household Growth to Proxy ICP Growth (Castalia's preferred approach)

Households								
	Alpine Energy	**Aurora Energy**	**Centralines**	**Eastland Network**	**Electricity Ashburton**	**Electricity Invercargill**	**Horizon Energy**	**Nelson Electricity**
Household Summary (from Stats NZ estimates)								
Households, 2011	24,000	68,006	5,300	20,600	12,300	22,000	19,100	19,100
Households, 2016	24,700	71,661	5,500	21,200	12,900	22,500	19,500	20,100
Households, 2021	25,000	74,817	5,500	21,700	13,500	22,500	20,000	20,900
Residential Consumption per household (kWh)								
2011	7719	7719	7719	7719	7719	7719	7719	7719
2016 (f)	7361	7361	7361	7361	7361	7361	7361	7361
2021 (f)	7004	7004	7004	7004	7004	7004	7004	7004
Residential Consumption per ICP (kWh)								
2011	6486	6486	6486	6486	6486	6486	6486	6486
2016 (f)	6255	6255	6255	6255	6255	6255	6255	6255
2021 (f)	6024	6024	6024	6024	6024	6024	6024	6024
Residential consumption (GWh)								
Using Consumption per HH								
2011	185	525	41	159	95	170	147	147
2016	182	528	40	156	95	166	144	148
2021	175	524	39	152	95	158	140	146
Growth in consumption								
Using Consumption per HH								
2011-2016	-0.37%	0.10%	-0.21%	-0.37%	0.00%	-0.50%	-0.53%	0.07%
2016-2021	-0.75%	-0.13%	-0.99%	-0.53%	-0.09%	-0.99%	-0.49%	-0.21%

Households	Network Tasman	Orion	OtagoNet	Powerco	The Lines Company	Top Energy	Unison	Vector	Wellington Electricity
Household Summary (from Stats NZ estimates)									
Households, 2011	19,100	165,000	8,709	297,731	16,956	22,800	116,703	488,350	191,200
Households, 2016	20,400	174,900	8,854	314,757	17,074	24,000	121,885	537,350	201,300
Households, 2021	21,500	184,300	8,999	329,956	17,100	24,800	126,387	587,150	210,300
Residential Consumption per household (kWh)									
2011	7719	7719	7719	7719	7719	7719	7719	7719	7719
2016 (f)	7361	7361	7361	7361	7361	7361	7361	7361	7361
2021 (f)	7004	7004	7004	7004	7004	7004	7004	7004	7004
Residential Consumption per ICP (kWh)									
2011	6486	6486	6486	6486	6486	6486	6486	6486	6486
2016 (f)	6255	6255	6255	6255	6255	6255	6255	6255	6255
2021 (f)	6024	6024	6024	6024	6024	6024	6024	6024	6024
Residential consumption (GWh)									
Using Consumption per HH									
2011	147	1274	67	2298	131	176	901	3769	1476
2016	150	1287	65	2317	126	177	897	3955	1482
2021	151	1291	63	2311	120	174	885	4112	1473
Growth in consumption									
Using Consumption per HH									
2011-2016	0.37%	0.22%	-0.62%	0.16%	-0.81%	0.08%	-0.08%	0.97%	0.08%
2016-2021	0.05%	0.05%	-0.67%	-0.05%	-0.96%	-0.34%	-0.27%	0.78%	-0.12%

Source: Castalia using information from Statistics New Zealand and the Commerce Commission

Table B.2: Residential Revenue Growth Rate using Population Growth to Proxy ICP Growth

Population	**Alpine Energy**	**Aurora Energy**	**Centralines**	**Eastland Network**	**Electricity Ashburton**	**Electricity Invercargill**	**Horizon Energy**	**Nelson Electricity**
Population Summary (from ComCom)								
Population, 2011	56,360	170,944	13,500	54,980	30,100	53,000	50,410	46,300
Population, 2016	57,090	176,766	13,500	54,770	31,200	53,500	49,430	47,700
Population, 2021	57,770	182,999	13,500	54,910	32,200	53,800	48,680	49,000
Residential Consumption per capita (kWh)								
2011	2889	2889	2889	2889	2889	2889	2889	2889
2016 (f)	2785	2785	2785	2785	2785	2785	2785	2785
2021 (f)	2681	2681	2681	2681	2681	2681	2681	2681
Residential consumption (GWh)								
2011	163	494	39	159	87	153	146	134
2016	159	492	38	153	87	149	138	133
2021	155	491	36	147	86	144	131	131
Growth in consumption								
2011-2016	-0.47%	-0.06%	-0.73%	-0.81%	-0.01%	-0.54%	-1.12%	-0.14%
2016-2021	-0.52%	-0.07%	-0.76%	-0.71%	-0.13%	-0.65%	-1.06%	-0.22%

Population	Network Tasman	Orion	OtagoNet	Powerco	The Lines Company	Top Energy	Unison	Vector	Wellington Electricity
Population Summary (from ComCom)									
Population, 2011	48,000	409,000	21,231	591,599	35,359	58,500	229,488	1,419,050	397,400
Population, 2016	49,700	422,000	21,317	603,083	34,395	58,900	232,229	1,519,450	409,400
Population, 2021	51,300	439,800	21,334	619,394	33,749	59,700	235,411	1,636,800	421,800
Residential Consumption per capita (kWh)									
2011	2889	2889	2889	2889	2889	2889	2889	2889	2889
2016 (f)	2785	2785	2785	2785	2785	2785	2785	2785	2785
2021 (f)	2681	2681	2681	2681	2681	2681	2681	2681	2681
Residential consumption (GWh)									
2011	139	1182	61	1709	102	169	663	4100	1148
2016	138	1175	59	1680	96	164	647	4232	1140
2021	138	1179	57	1661	90	160	631	4389	1131
Growth in consumption									
2011-2016	-0.04%	-0.11%	-0.65%	-0.35%	-1.28%	-0.59%	-0.49%	0.64%	-0.14%
2016-2021	-0.13%	0.07%	-0.74%	-0.23%	-1.13%	-0.49%	-0.49%	0.73%	-0.16%

Source: Castalia using information from Statistics New Zealand and the Commerce Commission

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