Output 3: Development of approaches to forecast EDB costs under a DPP framework

A REPORT PREPARED FOR THE ELECTRICITY NETWORKS ASSOCIATION OF NEW ZEALAND

April 2014

Output 3: Development of approaches to forecast EDB costs under a DPP framework

Contents

Output 3: Development of approaches to forecast EDB costs under a DPP framework

Figures

Tables

Executive summary

Frontier Economics has been engaged by the Electricity Networks Association of New Zealand (the ENA) to provide advice on how the efficient costs of electricity distribution businesses (EDBs) may be forecast for the purposes of setting allowances under a Default Price-Quality Path (DPP) framework. The purpose of this work is to identify possible improvements to the way cost allowances for EDBs were set by the Commerce Commission (the Commission) at the last DPP reset in 2012.

We have already provided the ENA with two reports:

- **Output 1 report:** which explored ways in which the Commission may improve opex and capex forecasts using information that is independent of the forecasts provided by EDBs.[1]

- **Output 2 report:** which considered the potential for cost forecasts contained within EDBs' asset management plans to by utilised by the Commission when setting cost allowances within the DPP framework.[2]

This report synthesises the key insights from the two preceding ones, and explains how the recommendations from those reports could be implemented going forward. Our main findings are the following:

- The most promising way to make best use of EDBs cost forecasts when setting DPP allowances would be to implement menu regulation. Menu regulation has been used in Britain to give regulators greater confidence in the integrity of forecasts provided by regulated businesses.

- Implementation of menu regulation should be deferred until at least the 2020 reset to give EDBs and the Commission sufficient time to understand the mechanics and implications of the scheme. However, a relatively low cost 'shadow-run' of the scheme could be implemented during the 2015 reset to help interested parties understand how menu regulation could work in practice.

- Top-down econometric models used by the Commission at the 2012 reset, and explored by us in our Output 1 report, can (along with other forecasting

1 Frontier Economics (2014), *Output 1: Top-down approaches for forecasting EDB costs under a DPP framework*, April.

2 Frontier Economics (2014), *Output 2: Using EDB AMP forecasts under a DPP framework*, April.

approaches) play a role in determining the Commission's initial baseline forecasts of EDBs' costs under a menu regulation scheme.

- There are a number of ways in which the top-down econometric models used by the Commission in 2012 may be improved right now, and over the longer term. The main areas for further improvement and exploration include:
  - Investigation and resolution of some apparent anomalies in data submitted by EDBs under existing information disclosure rules, and clarification of any ambiguous reporting definitions to reduce the chances of similar anomalies arising in future;
  - Exploration of ways to incorporate time effects in the forecasting models;
  - Exploration of additional driver variables;
  - Investigation of ways to deal with short-term fluctuations when forecasting certain driver variables; and
  - Implementation of post-estimation adjustments.
- There are also a number of possible improvements to the way forecasts of changes in input costs that EBDs face are derived. These include:
  - Basing forecasts of cost escalators on industry-specific and asset-specific inflation indices rather than general inflation indices;
  - Applying composite price escalators that reflect broadly the cost structures of EDBs, rather than relying exclusively on forecasts of a single inflation index for each major cost category; and
  - Combining input cost inflation forecasts from a range of forecasters to reduce the influence of forecasting errors.

1 Introduction

Frontier Economics has been engaged by the Electricity Networks Association of New Zealand (the ENA) to provide advice on how the efficient costs of electricity distribution businesses (EDBs) may be forecast for the purposes of setting allowances under a Default Price-Quality Path (DPP) framework. We have already provided the ENA with two reports:

- **Output 1 report:** which explored ways in which the Commerce Commission (the Commission) may improve opex and capex forecasts using information that is independent of the forecasts provided by EDBs.[3]
- **Output 2 report:** which considered the potential for cost forecasts contained within EDBs' asset management plans to by utilised by the Commission when setting cost allowances within the DPP framework.[4]

This Output 3 report synthesises the key insights from those two reports, and explains how the recommendations from those reports could be implemented going forward.

1.1 Background

When setting cost allowances, the Commission needs to forecast EDBs' opex and capex over the regulatory period. The purpose of default/customised price-quality regulation is to "provide a relatively low-cost way of setting price-quality paths for suppliers of regulated goods or services".[5]

In order to satisfy the requirement that customised price-quality (CPP) applications are the exception rather than the norm, it is necessary to have a process for forecasting costs and setting cost allowances that ensures that EDBs can invest in and maintain the quality of their networks, for the long-term benefit of end-users, without needing to apply often for a (more costly, time-consuming) CPP to cover their reasonable expenditure requirements.

At the 2012 DPP reset, the Commission used:

- Top-down econometric models to forecast (real changes) in network and non-network opex;
- EDBs' AMP forecasts to set network capex allowances; and

---

3 Frontier Economics (2014), *Output 1: Top-down approaches for forecasting EDB costs under a DPP framework*, April.

4 Frontier Economics (2014), *Output 2: Using EDB AMP forecasts under a DPP framework*, April.

5 Section 53K, Commerce Act (1986).

- Average historical levels of expenditure to determine non-network capex allowances.

The Commission is yet to finalise the forecasting approaches it will use for the 2015 reset and is presently consulting on this.

In our view, there can be a role for top-down econometric models for setting DPP cost allowances. These models provide a transparent, objective and systematic way of forecasting costs. However, as we discuss in section 3 of this report, there are also definite limitations to these models that need to be recognised.

As our Output 1 report demonstrated, there are ways in which the top-down forecasting models used by the Commission at the 2012 DPP reset may be improved now, and over the longer-term. The main areas for further development are discussed in, and we recommend that those improvements be pursued. However, for the reasons discussed above, there are limits to the gains that can be achieved from refining these models.

A process for determining DPP cost allowances that puts at least some weight on EDBs' own forecasts is, in principle, likely to result in allowances closer to EDBs' efficient expenditures than a process that relies exclusively on top-down forecasting models. This is because, as explained in our Output 2 report, EDBs are likely to have better information about their actual and prospective efficient costs than the Commission, and so are generally better positioned to derive more accurate forecasts of efficient costs.[6] Given the detailed knowledge that EDBs have about their own businesses, their forecasts are likely to be informed by valuable bottom-up considerations (including the realistic scope for savings to be made) that cannot be captured by top-down forecasting models.

From a regulator's perspective, the main stumbling block in using regulated businesses' own cost forecasts to set revenue allowances is that the businesses generally have both the commercial incentive and the ability (by virtue of their information advantage over the regulator) to inflate forecasts above efficient levels.[7] The Commission alluded to this potential problem at the 2012 DPP reset.

---

6 Of course, that is not to say that all EDBs will be equally good at forecasting their own costs. Forecasting ability depends as much on the effort actually invested by the businesses in understanding their cost drivers and developing suitable forecasting techniques as it does on natural information advantages. However, as we discuss in section 2, there are ways in which EDBs may be incentivised to improve their forecasting abilities, and to exploit their better information to produce, and reveal truthfully, sound cost forecasts.

7 This does not mean that EDBs deliberately pad their forecasts in an attempt to inflate their allowances. It may be that some businesses are unwilling to take the cost risks associated with forecasting in line with 'stretching targets' because, due to exogenous factors, businesses do in practice face uncertainty about future cost outturns. Regardless of whether inflated forecasts are due to regulatory gaming or risk aversion on the part of EDBs, the point is that because of the

It seems likely that the Commission would be more comfortable using EDBs' forecasts to determine allowances if the EDBs could be incentivised to:

- Forecast efficient costs accurately; and
- Reveal those forecasts truthfully.

Our Output 2 report explored a range of mechanisms that could be used to make use of EDBs' forecasts. In our view, the only mechanism that has the potential to really address the incentive problem described above, within the low-cost requirements of the DPP framework, is menu regulation. Menu regulation was developed, and is currently being used by regulators in Britain, precisely to address the issue at hand — namely, to give regulators greater confidence in the integrity of regulated businesses' forecasts by making these more incentive-compatible. In a recent consultation paper on issues related to the 2015 DPP reset (the 'consultation paper'), the Commission stated that it will, going forward, give consideration to how menu regulation could be applied.[8]

1.2 Report structure

The remainder of this report is organised as follows:

- Section 2 discusses the practical issues that need to be addressed in order to implement a menu regulation approach in New Zealand.
- Section 3 discusses the key areas that could be explored to improve further top-down forecasting models, which could be used within a menu regulation framework.
- Section 4 discusses possible improvements to the Commission's 2012 DPP approach to determining EDBs' input cost changes.

asymmetries of information the Commission faces, it would find it very difficult to detect if forecasts and by how much forecasts are being inflated.

8 Commerce Commission, Default price-quality paths from 1 April 2015 for 17 electricity distributors: Process and issues paper, 21 March 2014, p.14.

2 Menu regulation: A process for setting cost allowances that makes best use of EDBs' information

2.1 Overview

Our Output 2 report explained that menu regulation appears to be the most promising way of giving the Commission confidence in the integrity of EDBs' cost forecasts as a basis for setting DPP cost allowances. In fact, menu regulation was developed by regulators in Britain as a relatively low-cost way of obtaining accurate forecasts of efficient costs from regulated businesses by aligning their incentives to reveal accurate forecasts of efficient costs with their potential regulatory payoffs.

The details of how menu regulation works are explored in our Output 2 report. **Figure 1** summarises how a process for setting cost allowances based on a menu regulation framework could work in New Zealand:

- **Step 1. Setting key scheme parameters:** First, the Commission would publish a matrix (i.e. a menu) of payoffs that the EDBs could earn, depending on how they forecast costs relative to a baseline to be determined by the Commission, and actual cost outturns. The incentive properties of the mechanism would be most effective if the EDBs can see these payoffs before they develop their forecasts.

- **Step 2. Developing initial forecasts:** Next, the Commission would develop its initial baseline forecasts and, in parallel, the EDBs would develop their own forecasts. Ideally, the Commission's forecasts at this stage would be independent of the EDBs' forecasts. We explore below ways in which this could be done in practice.

- **Step 3. Consultation:** Subsequently, there would be a consultation phase where the Commission publishes its baseline forecasts and EDBs submit their own forecasts to the Commission along with appropriate supporting information to justify their forecasts (perhaps building on the businesses' AMPs). This information could include, for instance, audits conducted by independent experts verifying the reasonableness of the EDBs' forecasts. The extent of this phase would depend on the scope for the Commission to engage with the businesses within the strictures of the DPP process.

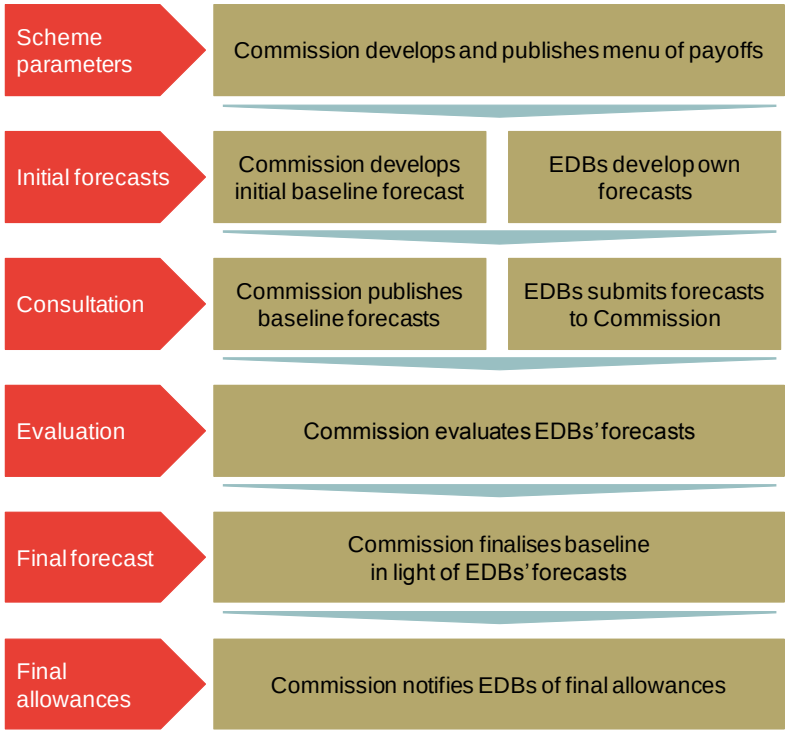
- **Step 4. Evaluation:** having engaged with the EDBs to the extent feasible within a DPP process, the Commission would consider the forecasts and

supporting information submitted by the EDBs, with a view to understanding whether the businesses' forecasts could usefully inform the Commission's baseline forecasts.

- **Step 5. Final forecasts:** Following its review of EDB's forecasts and any supporting documentation, the Commission would either (a) revise its baseline forecast if it is persuaded to do so; or (b) retain its original baseline.

- **Step 6. Final allowances and payoffs:** Finally, the Commission would publish the EDBs' final allowances and potential payoffs, i.e. the expenditure each EDB would be allowed, the additional income it would receive and the incentive rate it would face in respect of actual expenditures that differ from the forecast allowances. The businesses would then be left to manage their service provision and costs for the control period, and would earn the payoffs specified in the payoff matrix according to the cost outturns that are achieved.

Figure 1. Process for setting cost allowances under a menu regulation scheme



Source: Frontier Economics

Menu regulation: A process for setting cost allowances that makes best use of EDBs' information

2.2 Implementation

This section explores the issues that would need to be resolved by the Commission and the industry, and the further work that would need to be undertaken, in order to implement the scheme described above.

2.2.1 Step 1: Establishing the menu of payoffs, additional income and incentive rate

The first implementation step for the Commission would be to calibrate the scheme parameters that would apply to EDBs. This would involve establishing the menu of payoffs that the businesses would be exposed to – specifically:

- the ratio of allowed expenditures to the Commission's baseline forecast for different ratios of the EDBs' forecasts to the Commission's baseline forecast;
- the 'additional income' that would be provided to the EDB irrespective of its actual outturn expenditure; and
- the incentive rate that would apply to the EDB, defining the extent to which the EDB would share in the benefits of any underspend relative to allowed expenditure and the costs of any over-spend relative to allowed expenditure.[9]

As discussed in section 4.2.3 of our Output 2 report, effective calibration of these parameters is a challenging task because, when doing so, the regulator must:

- Ensure that there is enough at stake for the businesses to invest effort in improving the accuracy of their forecasts; while
- Limiting the possibility of very large windfall gains or losses due to forecasting errors made by the businesses.

In Britain, recalibration of scheme parameters from one regulatory period to the next has been done incrementally, based on learning from previous periods. If menu regulation is adopted in New Zealand, we recommend that a similar incremental approach be followed, particularly since the scheme would be new to the Commission and to EDBs.

The most straightforward way of establishing initial scheme parameters would be to simply adopt the parameters used by Ofgem at DPCR5 (see below – also included as Figure 7 of our Output 2 report).

---

9 We note that work is currently being done to develop an incentive rate for reliability targets for the 2015 DPP reset (consultation paper, section 4). That incentive rate will determine determines the revenue reward or penalty attached to a deviation from the reliability target. In order to implement a menu regulation scheme, the Commission would also need to determine incentive rates that determine rewards or penalties depending on the accuracy of EDBs' cost forecasts.

Figure 2. Menu regulation payoff matrix used by Ofgem at DPCR5

Ratio of forecast to baseline	95	100	105	110	115	120	125	130	135	140
Incentive rate	0.53	0.50	0.48	0.45	0.43	0.40	0.38	0.35	0.33	0.30
Allowed expenditure	98.75	100.00	101.25	102.50	103.75	105.00	106.25	107.50	108.75	110.00
Additional income	3.09	2.50	1.84	1.13	0.34	-0.50	-1.41	-2.38	-3.41	-4.50
Actual expenditure										
90	7.69	7.50	7.19	6.75	6.19	5.50	4.69	3.75	2.69	1.50
95	5.06	5.00	4.81	4.50	4.06	3.50	2.81	2.00	1.06	0.00
100	2.44	2.50	2.44	2.25	1.94	1.50	0.94	0.25	-0.56	-1.50
105	-0.19	0.00	0.06	0.00	-0.19	-0.50	-0.94	-1.50	-2.19	-3.00
110	-2.81	-2.50	-2.31	-2.25	-2.31	-2.50	-2.81	-3.25	-3.81	-4.50
115	-5.44	-5.00	-4.69	-4.50	-4.44	-4.50	-4.69	-5.00	-5.44	-6.00
120	-8.06	-7.50	-7.06	-6.75	-6.56	-6.50	-6.56	-6.75	-7.06	-7.50
125	-10.69	-10.00	-9.44	-9.00	-8.69	-8.50	-8.44	-8.50	-8.69	-9.00
130	-13.31	-12.50	-11.81	-11.25	-10.81	-10.50	-10.31	-10.25	-10.31	-10.50
135	-15.94	-15.00	-14.19	-13.50	-12.94	-12.50	-12.19	-12.00	-11.94	-12.00
140	-18.56	-17.50	-16.56	-15.75	-15.06	-14.50	-14.06	-13.75	-13.56	-13.50
145	-21.19	-20.00	-18.94	-18.00	-17.19	-16.50	-15.94	-15.50	-15.19	-15.00

Source: Ofgem, DPCR5 Final Proposals – Incentives and Obligations, December 2009, p.111.

As discussed below in section 2.2.4, Ofgem's DPCR5 parameters could be deployed as part of a 'shadow-run' of the scheme. Based on the lessons from that shadow-run, the parameters might be refined for future resets, if the decision is taken to implement menu regulation fully.

If, contrary to our advice, the Commission were to propose to implement menu regulation at the forthcoming DPP reset without any trial run, we believe that at the very least, the more generous DPCR4 payoff matrix ought to be used to reduce the downside risks that EDBs would face from the sudden implementation of this mechanism. The DPCR4 payoff matrix was more generous to the businesses and exposed the businesses less to the implications of over- and under-spending than the DPCR5 matrix.

2.2.2 Step 2: Establishing initial baseline forecasts

As explained in our Output 2 report, the effectiveness of a menu regulation framework, and the outcomes to EDBs, will depend significantly on the Commission's baseline forecasts. Therefore, it is essential that these forecasts be as robust and transparent as possible. There are a range of options available to the Commission when determining initial baseline forecasts. These options are surveyed briefly below.

Top-down econometric models

A relatively low-cost approach to establishing initial forecasts would be to use top-down econometric models akin to those used by the Commission at the 2012 DPP reset to forecast opex. As our Output 1 report showed, it is possible now to improve on the opex models used by the Commission at the last reset. The models we developed in our Output 1 report to forecast network and non-network opex are richer, and offer better explanatory power than the models used by the Commission in 2012.

Whilst we believe that the models developed in our Output 1 report are better in a number of ways than the models used by the Commission at the 2012 reset, we nevertheless think that some further improvements could be achieved over time, with more work. The main areas for further exploration are discussed in section 3.

Models proposed by the Commission

The Commission's recent consultation paper has proposed the different categories of capex (i.e. asset replacement and renewal; system growth; consumer connection; and other categories of capex, including non-network capex) could be forecast separately. In addition, the consultation paper suggested that different techniques (summarised below in **Table 1**) might be used to forecast each of these categories of capex.

Table 1: Possible forecasting approaches for different categories of capex proposed by the Commission

Capex category	Possible forecasting approach proposed by the Commission
Asset replacement and renewal	Age-based survivor models
System growth	Augmentation capital utilisation models (based on asset utilisation rates)
Consumer connection	Econometric models to estimate statistical relationship between historic expenditure on consumer connections and population and demand; Simple extrapolation of historic trends
Other capex (i.e. 'Asset Relocations', 'Reliability, Safety and Environment' and 'Non-network capex')	Extrapolation of historic trends; EDB forecasts up to a capped level; An "absolute" forecast of costs (e.g. based on the proportion of total expenditure and assumed unit costs); EDB forecasts subject to a check against identified drivers to ensure consistency

Source: Commerce Commission, Default price-quality paths from 1 April 2015 for 17 electricity distributors: Process and issues paper, 21 March 2014, Attachment B

A detailed analysis of the merits of each of these proposed approaches is beyond the scope of this report. However, we consider that all these approaches proposed by the Commission are worthy of further investigation, and we make the following preliminary observations:

- As noted by the Commission in its consultation paper, and in our Output 1 report, age-based survivor models have been used by regulators overseas, including in Australia. Lessons from those countries could be useful when considering how such models might be implemented in New Zealand. Even if not used as the primary model for forecasting asset replacement and renewal, age-based survivor models may be helpful in sense-checking forecasts derived using other methods.

- Simple extrapolation of historic trends could be a valid and pragmatic approach for cost categories that tend to be small and relatively stable over time. Trend extrapolation would be an unreliable approach for forecasting large, lumpy costs.

- Use of EDB forecasts up to a capped level would be appropriate particularly for relatively small cost categories. The cap could be specified either as a fixed proportion of the amount forecast, or as a maximum proportional increase relative to historical average expenditure (e.g. as per the approach used by the Commission in 2013 when setting DPP capex allowances for gas networks). If the cost being forecast has a tendency to be lumpy, then the latter approach to determining the cap is likely to be unsuitable since historical costs may provide a very poor guide to EDBs' future expenditure requirements.

- Except for one capex cost category (i.e. customer connection), the Commission has not proposed to use statistical forecasting approaches. On the one hand, this may be understandable because capex can be large and lumpy, so econometric techniques that estimate relationships between costs and potential cost drivers using historical data may be unsuitable for forecasting purposes. However, our Output 1 analysis suggests that a top-down econometric model for network capex fits the data across EDBs almost as well as analogous models for opex. Further development work might show that top-down econometric models that deal properly with time effects, perhaps combined with appropriate post-estimation adjustments, are a reasonable way of forecasting network capex. The Commission should not, at this stage, rule such models out, and should at least consider these as a means to cross-check forecasts based on other methods.[10]

- Our Output 1 report was unable to recommend a top-down econometric model for the purposes of forecasting non-network capex. The various models we investigated could not fit a reasonable relationship between non-network capex data and the driver data investigated. By its very nature, non-network capex can be quite lumpy and variable over time as well as across EDBs. It also tends to make up a relatively small proportion of overall capex spend by EDBs.[11] As such, it seems particularly relevant to explore

---

10 For instance, the Commission might use an appropriate top-down econometric forecast of network capex to sense-check the sum of its forecasts for asset replacement and renewal, system growth, and consumer connection costs.

11 Commerce Commission (2013), Initial observations on forecasts disclosed by 29 electricity distributors in March 2013, 29 November, p.10

Menu regulation: A process for setting cost allowances that makes best use of EDBs' information

alternative approaches, such as the use of EDBs' own forecasts, for the purposes of setting non-network capex allowances.

2.2.3 Steps 3 & 4: Consultation and evaluation of forecasts

Our Output 2 report explained that menu regulation works in part by increasing the incentives of regulated businesses to invest effort in accurately forecasting their efficient costs. Rather than forecasting expenditures generously in anticipation of an 'easy life', menu regulation provides businesses with the prospect of higher returns from:

- Setting 'stretching' forecasts for their expenditures (i.e. as low as possible while meeting applicable service standards); and
- Having made stretching forecasts, to meet and beat those forecasts during the relevant regulatory period.

For EDBs to set stretching targets, they must invest time and resources to understand their businesses well and to identify elements of their intended expenditures that could be reduced or deferred at minimal cost to service quality.

Given EDBs' increased incentives to invest in improved business understanding and planning under menu regulation, menu regulation would work best if the Commission can utilise EDBs' improved information in setting expenditure allowances. This is an extension of the broader point that due to information asymmetries, businesses tend to know more about their efficient costs than do regulators.

Accordingly, the adoption of menu regulation would be most effective if there were a degree of interaction between the Commission and the EDBs. The businesses are more likely to invest effort if there is a real prospect of persuading the Commission to alter its baseline forecast. This has three major implications.

- Firstly, the Commission needs to commit credibly that it is willing to be persuaded by the businesses to change its mind about its initial forecasts. The credibility of such commitments would be strengthened over time if there are actual instances of the Commission revising its baseline in light of persuasive forecasts submitted by EDBs.

- Secondly, the need for interaction between EDBs and the Commission, of the kind described above, requires consultation and evaluation phases to be built into the process for setting DPP cost allowances.

- Finally, the EDBs and the Commission need to reach a common understanding on the standard and type of evidence that the Commission would find persuasive. For instance, would the Commission be more persuaded by audit assessments of forecasts provided by independent

experts? Would such audits be more persuasive still if the Commission were to appoint or pre-approve the experts used? The Commission would also need to decide on the level of effort that it considers appropriate to invest, within the DPP framework, in scrutinising the evidence submitted by EDBs.

As noted in our Output 2 report, we propose that the Commission limit itself to revising its baseline forecasts *in the direction of the EDBs' forecasts*, to help minimise the actual or perceived scope for 'regulator gaming', and to increase EDBs' confidence in the regulatory process.

Ultimately, we note that even if the Commission were to reject *any* consultation with the EDBs following the submission of EDBs' forecasts, menu regulation would still (by design) result in forecast allowances closer to the EDBs' forecasts than the Commission's own internally-generated forecasts. Thus, some of the benefits of menu regulation may be achieved even without substantial interaction between the Commission and EDBs.

2.2.4 Steps 5 & 6: Final forecasts and allowances

Following its evaluation of the EDBs' expenditure forecasts and any reassessment of its own initial forecasts, the Commission would publish its forecast expenditure allowances for each of the EDBs as well as the payoff vector applicable to each business given the ratio between the businesses' forecasts and the Commission's final forecasts.

For example, using the DPCR5 IQI matrix and assuming that the ratio of an EDB's expenditure forecast to the Commission's final forecast is 110, the EDB would:

- Receive an expenditure allowance (ratio) of 102.5 and 'additional income' (income received irrespective of its outturn expenditure) of 1.13 (also as a ratio of the Commission's forecast).
- Face an 'incentive rate' of 0.45 (ie the EDB would be financially exposed to 45% of its over- and under-spending compared to the Commission's forecast).

Together, this would yield an ultimate 'payoff' (i.e. revenue in excess of expenditure) vector to the EDB of:

- 6.75 (again as a ratio of the Commission's forecast) for limiting actual outturn expenditure to a ratio of 90
- 4.5 for limiting actual outturn expenditure to 95
- 2.25 for limiting actual outturn expenditure to 100
- 0 for incurring outturn expenditure of 105

- -2.25 for incurring outturn expenditure of 110
- -4.5 for incurring outturn expenditure of 115
- -6.75 for incurring outturn expenditure of 120

...and so on.

The payoff vector would reveal to EDBs the benefits of lower spending and the costs of higher spending.

2.2.5 Shadow-run of menu regulation at 2015

Case for a shadow-run

As we explained in our Output 2 report, we recommend that menu regulation not be implemented at the 2015 DPP EDB reset. This is because the methodology to be used by the Commission to set its baseline forecasts is still uncertain and an abrupt shift to a new unfamiliar regulatory process would create substantial uncertainty for businesses. Moreover, since menu regulation works by putting in place incentives to influence the behaviour of firms, it is unlikely to be effective unless EDBs have sufficient time to understand the scheme, and to respond to the incentives created.

Therefore, we recommend that a 'shadow-run' of the menu regulation scheme be conducted in parallel to the 2015 DPP reset. This would allow the Commission and EDBs time to understand the practical and commercial implications of the scheme, and identify areas where refinements need to be made. Such a test would allow the parties to understand more about how applying menu regulation would affect their expenditure allowances and ultimate payoffs.

Under such a trial, the EDBs would be able to:

- Compare their AMP expenditure forecasts against the Commission's final forecasts to obtain the forecast ratio that would apply under menu regulation;
- Observe the forecast allowances, additional income and sharing ratio they would face had menu regulation been applied, thereby gaining an idea of what would be at stake financially under the scheme;
- Re-examine their forecasting approaches closely and identify the areas in which the most significant improvements in forecasting could be made; and
- See what would have happened had they forecast differently and, therefore, understand the potential gains from investing additional effort to improve forecasting at the next review.

A shadow run could also assist the Commission in undertaking its 2020 DPP reset. As noted in our Output 2 report, Ofgem has been able to analyse the impact of menu regulation on distribution network operators' expenditure forecasts and outturn expenditures in order to modify its regulatory approach.

Shadow-run process

If a shadow-run of menu regulation were to be implemented to coincide with the 2015 DPP reset, each of the steps outlined in sections 2.2.1 to 2.2.4 would need to be addressed in some manner.

We propose that if the Commission agrees with the idea of a shadow-run, it should inform EDBs of its intention to implement a shadow-run well in advance of the DPP reset (e.g. by the Draft Decision stage).

We recognise that the DPP process is meant to be relatively low-cost, so in order that the shadow-run does not impose unnecessary additional burden on the Commission and EDBs, it could work as follows:

- The shadow-run would be conducted separately for capex and opex for each EDB. It would not take account of service quality incentives or outcomes.

- The Commission would commit that the shadow-run would not have any financial implications for EDBs for the 2015-2020 period or beyond. This would be vital in order to ensure that the shadow-run process is not conflated with the actual DPP reset that the Commission would be administering.

- In order to operationalise the shadow run:
  - A payoff matrix would need to be agreed upfront. For simplicity, this could be the matrix used by Ofgem at DPCR5. This would avoid the need to design an entirely new matrix.
  - The Commission's shadow-run capex and opex allowances for each EDB could simply be the Commission's 2015 DPP opex and capex forecasts, so there would be no need for the Commission to do any additional modelling.
  - EDBs' shadow-run forecasts for capex and opex could simply be their 2014 AMP forecasts.

- EDBs would not need to provide any additional information to facilitate the shadow-run as all the information necessary to undertake the exercise would be available through EDBs' AMP forecasts and IDs.

Menu regulation: A process for setting cost allowances that makes best use of EDBs' information

- By comparing EDBs' actual cost outturns through the 2015-2020 regulatory period against original forecasts, and by using the agreed payoff matrix, EDBs would be able to work out for themselves their:
  - 'Allowed expenditure' (which would be above the Commission's final allowance/forecast if the EDB's expenditure forecast was greater than the Commission's final allowance)
  - 'Additional income' the EDB would receive (or pay) irrespective of its outturn expenditure
  - 'Incentive rate' to which the EDB would be exposed.

- We envision that the assessment of the outcomes of the shadow-run would essentially be a desk-top self-assessment that each EDB could undertake to evaluate its own payoffs under a simplified version of menu regulation. There would be no need for EDBs to do any additional modelling or reporting to the Commission on the outcomes of the shadow-run.

- However, in the lead-up to the 2020 DPP reset, the Commission could collate and publish its own assessment of the shadow-run (as it would, through the AMPs and IDs, have access to all the necessary information on each EDB). Any preliminary observations published by the Commission could form part of its consultation on whether menu regulation should be adopted for the 2020 DPP reset.

By its very nature, it would be difficult to incorporate every step required in an actual application of menu regulation in a shadow-run. In particular, it is not feasible to incorporate the consultation process that might take place between the Commission and EDBs following the tabling of the initial baseline forecasts, given the practical engagement required to make this step meaningful. However, even a simplified shadow-run (essentially an illustrative experiment using readily available forecast and outturn data), such as outlined above, would provide EDBs with a fairly good idea of what gains could be available from more ambitious expenditure forecasting and greater efforts to make efficiencies during the reset period.

3 Improving top-down forecasting models

This section explores potential areas for further work to improve the reliability of top-down forecasting models, which could be used within the menu regulation framework outlined in the previous section.

3.1 Limitations of top-down forecasting models

Top-down forecasting models, of the type used by the Commission at the 2012 reset, and explored by us in our Output 1 report, can play a role in setting DPP cost allowances. These models provide a transparent, objective and systematic way of forecasting costs. However, there are also definite limitations to these models that need to be recognised.

- Top-down econometric models rely on historical expenditures and drivers to forecast cost changes. The resulting changes are typically fairly smooth over time. However, EDBs' actual costs can be large and lumpy. Hence, top-down econometric models, by themselves, may produce forecasts that match poorly EDBs' future efficient expenditure requirements.

- In addition, there is a reasonable degree of heterogeneity between EDBs (e.g. in terms of scale and other network and non-network characteristics). Ensuring that all these salient characteristics are captured properly, for all EDBs, within a top-down model can be very challenging. This is partly because identification of the relevant cost drivers for inclusion in the models can be difficult, and partly because of limitations in the data to measure and project the drivers properly. Models of the sort used by the Commission in 2012, and investigated by us, fit general, industry-wide relationships between observed costs and specified drivers. Given the general nature of the relationships estimated, these models may produce fairly good forecasts for some EDBs, but poor forecasts for others.

It is partly in response to these limitations that we recommend that the DPP cost allowances not be derived solely using top-down forecasting models, and that the Commission find ways to utilise EDBs' own forecasts when setting allowances.

To the extent that top-down models are to be employed, it is worth investing some time in improving these, especially over future regulatory resets. As our Output 1 report demonstrated, there are ways in which the top-down forecasting models used by the Commission at the 2012 DPP reset may be improved now, and over the longer-term. The main areas for further development are explored below.

3.2 Summary of results from our preliminary investigations on alternative top-down models

Our Output 1 report conducted some preliminary analysis on whether and how the models used by the Commission at the 2012 DPP reset may be improved. By testing additional functional forms and driver variables, we estimated enhanced models for the purposes of forecasting network opex, non-network opex, and network capex. We were unable to estimate a statistically robust model for the purpose of forecasting non-network capex. The enhanced models we were able to estimate are summarised below in **Table 2**.

Table 2: Summary of enhanced models estimated by Frontier Economics

Cost category	Explanatory driver variables
Network opex	Number of connection points (ICPs)
	Electricity supplied to customers' connection points intensity
	Maximum coincident system demand intensity
	Proportion of overhead line length per total circuit length
	Proportion of overhead line length in rural terrain per total overhead line length
	SAIDI
	Remaining life over average expected life of system fixed assets
Non-network opex	Proportion of overhead line length in rural terrain per total overhead line length
	SAIDI
	Total circuit length
	ICP density
	Maximum coincident system demand density
	Total distribution transformer capacity density
Network capex	Total circuit length
	ICP density
	Electricity supplied to customers' connection points density
	Proportion of overhead line length in rural terrain per total overhead line length
	Total distribution transformer capacity density
	Remaining life over average expected life of system fixed assets

Source: Frontier Economics (2014), Output 1: Top-down approaches for forecasting EDB costs under a DPP framework*, April, section 5*

Notes: All variables in the models estimated were expressed in logarithms. Density variables are expressed on a 'per circuit km' basis, and intensity variables are expressed on a 'per connection point' basis. The variable SAIDI in the non-network opex model was not found to be statistically significant even at the 10% level. However, the Akaike Information Criterion selected the overall model that included SAIDI as an explanatory variable over an otherwise identical model that excluded SAIDI.

Our empirical testing suggested that these models were statistically robust and were better at explaining the variation in the data than the models estimated by the Commission at the 2012 DPP reset. However, we emphasise that we do not consider that these models are **the best** models for the purposes of setting DPP cost allowances. This is because we think that further exploration of the data and specification of the models is desirable. Further, as noted above, we do not believe that DPP allowances should be based **solely** on forecasts derived from such models since that there are fundamental limits to how reliably techniques of this kind can forecast EDBs' costs.

We now explore some of the ways in which these top-down models may be improved further, over time.

3.3 Data anomalies

In our Output 1 report we reviewed the econometric models used by the Commission at the 2012 reset to forecast opex, and also investigated whether those models could be improved. During this process, we noticed a number of potential data anomalies in the information disclosure (ID) datasets.

For instance, we noted in section 3.2.4 of our Output 1 report that for at least three EDBs (Nelson, Buller and The Lines Company) errors were identified in the data used by the Commission in its 2012 analysis. The Commission, when confronted with these apparent errors, dropped the relevant observations. A better approach would be to resolve the data errors with the EDBs in question or, if that is not possible, impute the correct values (e.g. through extrapolation or interpolation techniques).

In section 4.5 of our Output 1 report, we noted that some driver variables considered (e.g. length of urban network, length of rugged network) displayed a high degree of average annual variation. This could be indicative of errors when the data were recorded by EDBs because we would not expect these variables to change as much from year to year as indicated by our analysis. Furthermore, the change in these variables for some individual EDBs is, by definition, greater than the average annual change across all EDBs. So, the magnitude of any errors for individual EDBs in certain years could be quite significant. Any such errors would undoubtedly affect cost forecasts developed using these data. Therefore, these potential data errors should be investigated and, if confirmed, addressed.

In addition, we found that the average variation for certain variables was greater when the 2013 ID data were taken into account. We understand that the ID rules were modified by the Commission in 2013 and it is possible that some EDBs have misinterpreted how certain data should be classified and reported. For instance, the 2013 disclosure rules introduced a change in the categories that make up network opex. We received anecdotal evidence at one of the workshops with the ENA Working Group that EDBs may be classifying costs

differently from one another under the new rules when reporting: Service interruptions and emergencies; Routine and corrective maintenance; and Asset replacement and renewal.

If inconsistencies of this kind are in fact present, reliable forecasting of costs at more granular levels (e.g. below the level of non-network costs) would not be possible. It is possible that confusion over the classification of data under the new disclosure rules will be resolved over time. If, in due course, it becomes apparent that EDBs have mis-recorded data under the new rules, it would be important to go back and correct these errors in the historical data, to avoid distortions in future analyses.

3.4 Time effects

In our Output 1 analysis we tested if time variation, as well as cross-sectional variation, in cost and driver data can explain EDBs' expenditure. We did this by estimating panel models. We found some preliminary evidence that there may be changes in expenditures over time that cannot be explained by the essentially cross-sectional scale-related variables used by the Commission. However, at present, the driver data series available are too short to draw any definitive conclusions regarding the importance of time effects. Over time, the time series will grow and more reliable inferences about the significance of time effects may be made. As the data become available, we recommend that the use of panel data models be explored further.

One possible explanation for our tentative finding of a time effect (for non-network opex) could be that the consumer price index (CPI) adopted by the Commission to deflate historical nominal expenditure might not capture adequately the input cost increases over time faced by the EDBs. If that is the issue, the solution would be to find more suitable cost deflators. Section 6 of our Output 1 report considers a number of price indices that may reflect EDBs' input cost more closely than the CPI. The Commission should reconsider now the appropriateness of using CPI to deflate nominal costs when estimating top-down econometric models.

Whilst long time series on the driver variables are presently unavailable, time series data on EDBs' costs (split in terms of network opex, non-network opex, network capex and non-network capex), since 1999, do exist. We have not had an opportunity to investigate these data in detail as part of this assignment. An ongoing work programme could explore if these cost data can be used to develop econometric time series forecasting or trend extrapolation models that could be used alongside or in place of top-down econometric models. Any such work should:

- investigate the quality and consistency of the data across EDBs;
- investigate the level of aggregation of the data;

- account as well as possible for historical input price inflation; and
- check if models that fit the historical data well can be specified and estimated.

3.5 Exploration of additional drivers

In our Output 1 model we considered whether additional explanatory variables may be specified, alongside those used by the Commission in its 2012 analysis, to estimate a better statistical relationship between drivers and costs. We identified potential drivers by:

- Surveying EDBs; and
- Considering the high level drivers proposed by the Commission in its 2013 initial observations paper.

Given time constraints, the variables that we took forward for further investigation were selected by looking at the overlap between EDBs' responses to our survey and the variables in the ID dataset that mapped most closely to the high level drivers suggested by the Commission.

A fuller investigation of potential drivers would be to consider all drivers suggested by EDBs and the Commission. This would be a reasonably resource-intensive exercise, and in order for the analysis to be robust and useful for forecasting purposes the following things would need to be done:

- Ensure that consistent, reliable data exist to measure the drivers. We restricted our explorations to those drivers for which ID data were available because we considered that the ID reporting standards would maximise the chances of consistent data across EDBs.

- Ensure that there is a plausible rationale (i.e. sound economic or engineering reasons) for including the variable as a potential cost driver. Articulating in advance such a rationale would aid the interpretation and selection of models estimated. In order to articulate a plausible rationale, it may be necessary to have follow-up conversations with EDB survey respondents, to understand better why certain drivers were proposed and how these may be expected to influence costs.

3.6 Forecasting of variables subject to short-term anomalous fluctuations

If our Output 1 models are used to forecast future expenditure, then care is needed to ensure that anomalous short-term fluctuations in variables such as SAIDI or electricity supplied do not unduly influence cost forecasts.

Further work should be undertaken to investigate if suitable approaches to forecast such drivers can be derived. Alternatively, exploration of benchmark values for these variables (e.g. using weather-normalisation, or application of long-term trends/targets) would be worthwhile. If suitable forecasting approaches or benchmark values cannot be identified, it may be preferable to omit such variables from the forecasting models, or to set expected changes in these drivers equal to zero so that there is no impact on the forecasts where these items cannot be forecast appropriately.

3.7 Post-estimation adjustments

As discussed in section 1, top-down forecasting involves estimating relationships between historical costs and drivers, and then using these relationships to predict project costs. Given their reliance on historical data, top-down models can be poor at forecasting future step-changes (including those that can reasonably be anticipated). This can be problematic because EDBs' cost changes can be large and lumpy.

One way to deal with such problems is to apply post-estimation adjustments.[12] One method of making post-estimation adjustments is known as Bayesian updating. Bayesian adjustments are made by modifying the model forecast using a so-called 'prior', i.e. a forecast of the relevant variable using 'out-of-sample' information, e.g. by taking a weighted average of the two:

$$\text{Adjusted forecast} = w \times \text{Model forecast} + (1 - w) \times \text{Prior}$$

where the weights w and $(1 - w)$ depend on the degree of confidence in the model forecast and the prior, respectively.

The post-estimation adjustments applied when forecasting EDBs' costs could be similar in form to the equation above. In the present context, the most natural prior would be EDBs' forecasts of costs. These forecasts are likely to be informed by bottom-up considerations and other information that EDBs possess but the Commission does not have access to so, in that sense, would reflect out-of-sample information. The model forecast would be the Commission's unadjusted baseline forecast.

Within the menu regulation framework outlined in section 2, the post-estimation adjustment may be implemented at Steps 3 & 4 (see section 2.2.3), where the Commission consults on its initial (i.e. unadjusted) baseline forecast, evaluates submissions and forecasts from EDBs, and decides whether to modify its initial

[12] Note that the use of post-estimation adjustments need not be restricted to refining forecasts derived using top-down econometric models of the kind explored in our Output 1 report. In principle, such adjustments could also be used to improve forecasts obtained via other methods, including a number of those proposed recently by the Commission (summarised in **Table 1**, above).

baseline in light of the new information. The incentive-compatibility properties of the menu regulation scheme, perhaps coupled with supporting evidence and audits provided by independent experts, could give the Commission confidence in placing greater weight on EDBs' forecasts.

With Bayesian adjustments, greater weight is given to those estimates that are considered most reliable. So, if the Commission is relatively confident in EDBs forecasts (e.g. because they are well-justified, the evidence base for the forecasts is persuasive, and if the forecasts are verified independently by experts), then the Commission would put most weight on those forecasts and relatively little weight on its own. If the Commission has little confidence in EDBs' forecasts, then it would put most weight on its own baseline.

We recommend that the Commission consider the use of post-estimation adjustments, particularly if it intends to apply top-down models to forecast EDBs' costs.

Improving top-down forecasting models

4 Improving forecasts of input cost changes

When setting cost allowances under the DPP framework, the Commission forecasts real changes in EDBs' input costs, and then applies 'cost escalators' to these projections in order to derive forecasts of nominal costs. The cost escalators represent expected changes in input costs over time.

Section 6 of our Output 1 report explored possible improvements to the Commission's 2012 approach to forecasting input cost changes. Our key findings are summarised below.

4.1 General vs. specific input price indices

At the 2012 DPP reset, the Commission used projections of three general input price indices — the Capital Goods Price Index (CGPI), the Labour Cost Index (LCI) and the Producer Price Index (PPI) — in inflate real cost forecasts. Lower-level, industry/asset-specific versions of these indices are available. The Commission's recent consultation paper indicated tentatively that it proposes to use the same approach for the forthcoming 2015 reset.[13]

The pattern of input price inflation can vary between industries as the inputs to production vary. Hence, there is no reason to suppose that inflation projections based on general input price indices that cover all industries or asset groups will match closely changes in EDBs' input costs. Indeed, a comparison of changes in historical values of the general indices used previously by the Commission and subindices that appear more relevant to EDBs' costs reveals fairly material differences.

In principle, forecasting errors may be reduced by using projections that are as specific to the industry or asset groups of interest as possible. This would generally favour the use of lower-level subindices over high-level general indices.

We identified three official CGPI subindices (Insulated wire and cable, and optical fibre cables CGPI; Electricity distribution and control apparatus CGPI; Electrical works CGPI), and one LCI subindex (Electricity, gas, water and waste water services LCI), that would likely reflect changes in EDBs' costs more closely than the general CGPI and the general LCI. We recommend these subindices be used for the purposes of forecasting EDBs' nominal costs. We were unable to find a PPI subindex that would reflect EDBs' input cost movements better than the general PPI.[14]

---

13 Commerce Commission, Default price-quality paths from 1 April 2015 for 17 electricity distributors: Process and issues paper, 21 March 2014, p.65.

14 An 'Electricity and gas' PPI subindex is available, but it appears that this index is influenced far more significantly by the input costs of electricity generators and retailers than EDBs.

The Commission indicated recently in its consultation paper that one reservation it has about using specific, rather than general, indices is that the former can be difficult to forecast. We acknowledged in our Output 1 report that industry-specific indices are typically more volatile than broader, general indices. This greater volatility can make forecasting of specific indices more challenging.

However, it is worth noting a number points in respect of this concern:

- Firstly, the volatility associated with industry-specific indices is due partly to the relatively small number of respondents canvassed by Statistics New Zealand (SNZ) when compiling these indices. Some of this volatility may be eliminated by increasing the number of respondents surveyed by SNZ. The Commission could play a role in improving the quality of the indices available, by working with SNZ to expand the sample of firms canvassed.

- Secondly, some of the variation in the specific indices may be due to factors that are intrinsic to the industry, and therefore germane to considerations about future input cost growth faced by EDBs. These factors would simply be assumed away by using general input price indices. This would amount to throwing out potentially valuable information that the Commission ought to have regard to.

- Thirdly, we spoke with three organisations that specialise in producing inflation forecasts. All of these specialists told us that forecasting using industry-specific indices is more challenging than forecasting using general indices, for the reasons discussed above. However, they also told us that they have in the past developed bespoke inflation forecasts based on industry-specific indices.

- Finally, we acknowledge that forecasts of this kind may be quite 'noisy'. However, as discussed below in section 4.3, it is well-recognised in the forecasting literature that combining forecasts from a range of competent sources can improve the accuracy of forecasts.

There may be other useful sources of information that the Commission could draw on when determining input cost escalators. For example, the results of collective pay agreements negotiated between individual EDBs and unions representing the EDBs' employees may provide useful information about EDBs' expected labour costs. In Australia, the AER has in the past accepted labour cost forecasts based on existing collective pay agreements (known as Enterprise Bargaining Agreements) between network service providers and unions.[15]

15 See, for instance, AER (2014), Final Decision SP AusNet Transmission determination 2014–15 to 2016–17, January, pp.58-63.

Improving forecasts of input cost changes

4.2 Composite price escalators

Orion and Transpower have recently used composite price escalators by effectively employing a weighted average of forecasts of different price indices to reflect their particular cost structures. A composite approach of this kind is likely to result in forecasts that are more representative of EDBs' costs than if forecasts of a single inflation index were used. Our Output 1 report proposed a scheme for weighting forecasts of a number of indices and subindices, according to the major categories of costs faced by EDBs.

In order to calculate the weights that would be applied to the various indices, it would be necessary to have more detailed information on EDBs' cost structures than is presently available in the ID datasets. The data used to calculate weights should ideally be standardised and reported consistently across EDBs. If our recommendation is accepted, the existing ID requirements would need to be modified in order to facilitate the collection of the requisite data in a consistent way.

4.3 Single vs. multiple sources

Finally, we note that one potential source of forecast errors is mistakes in the projections of input cost escalators. Typically, these projections are sourced from third parties that specialise in producing inflation forecasts. The statistics literature suggests that errors of this kind may be reduced by combining forecasts from different sources, provided these forecasts have been developed using different methodologies and/or different data.

This has been recognised by the Australian Energy Regulator (AER), for instance. Recently, the AER:[16]

- based its assessment of the labour cost escalators, in part, on forecasts of the 'Electricity, gas, water and waste services' (EGWWS) wage price index (WPI), as opposed to the all industries WPI, compiled by the Australian Bureau of Statistics; and
- in doing so, combined through averaging the forecasts of the EGWWS WPI produced by two independent forecasters.

We have identified a few specialists in New Zealand from whom input inflation forecasts may be obtained.

16 AER (2014), Final Decision SP AusNet Transmission determination 2014–15 to 2016–17, January, p.58.

FRONTIER ECONOMICS | MELBOURNE | SYDNEY
Frontier Economics Pty Ltd 395 Collins Street Melbourne Victoria 3000
Tel: +61 (0)3 9620 4488 Fax: +61 (0)3 9620 4499 www.frontier-economics.com
ACN: 087 553 124 ABN: 13 087 553 124