Final report for Spark New Zealand and Vodafone New Zealand

Examining welfare effects of UCLL and UBA uplift

A review of the CEG submission dated March 2015

PUBLIC

Network Strategies Report Number 35010. 11 May 2015

NETWORK STRATEGIES

• Telecommunications Strategy •

0 Executive summary

CEG – on behalf of Chorus – has attempted to quantify the welfare effects of uncertainty in estimating the WACC for the unbundled copper local loop (UCLL) and unbundled bitstream access (UBA) services using a model developed by Frontier Economics for Transpower in the context of estimating the WACC for electricity lines and gas pipelines services (the Frontier-Dobbs model). This model was in turn based upon an approach by Professor Ian Dobbs.

Contrary to CEG's claims, we find that the Dobbs model is wholly inappropriate as a means of determining the optimal WACC percentile in the UCLL and UBA pricing reviews. The model considers the appropriate allowed rate of return on investment in circumstances where some future investment of the regulated entity is discretionary and / or deferrable. The focus of the model is regulated services. For all forms of new investment in the Dobbs model an allowed rate of return is to apply. As such the model does not accommodate unregulated services. In the context of the UCLL / UBA pricing review the Dobbs model can therefore only be relevant to existing sunk copper investment and new copper investment. The Dobbs construct cannot apply to fibre pricing in New Zealand as fibre prices have been set in commercial contracts.

Furthermore, the Dobbs model is based on the premise that firms respond to incentives. Results from the model are valid only if there is a real possibility of the regulated entity either deferring particular investment or declining to undertake potential investment. Clearly Chorus cannot defer or decline to undertake its existing UFB contract. Indeed as it is already engaged in this project additional incentives at this stage are irrelevant as regards UFB investment.* mergeformat

In attempting to make the Dobbs model fit with the UCLL / UBA pricing review CEG makes fundamental changes to the Dobbs construct. In particular, CEG collapses the Dobbs categories of sunk and new investment into one and includes already committed fibre-based network deployment. CEG also fails to introduce appropriate adjustments where Dobbs' assumptions are inappropriate for the current context. For example, the Dobbs model does not allow for demand cross-elasticity between sunk and new investment. Apart from characterising fibre broadband services as more elastic than copper broadband services, CEG offers no robust methodological fix for this.

The Dobbs model is highly sensitive to assumptions, including the assumed welfare standard. Our review of CEG's implementation has found that many of the assumptions used are incorrect or inappropriate for the UCLL and UBA process. Furthermore, CEG's implementation of the Frontier-Dobbs model incorporates a number of unexplained and undocumented changes to the original Frontier-Dobbs model. Thus even if CEG's assumptions were to be adjusted to more suitable values, the CEG model itself is unreliable in its current form.

In a separate cost-benefit analysis, CEG has cited studies that estimate the effect on consumer welfare of delayed migration to high-speed broadband without providing any evidence that higher UCLL and UBA prices will lead to a faster uptake of fibre services. We reviewed fibre and copper service offerings in countries with both relatively high fibre uptake and extensive copper footprints and found that, in general, DSL prices are lower than fibre prices and that service providers seek to differentiate fibre products based on the higher value they offer compared to lower bandwidth products. This finding is consistent with our previous research that has demonstrated that fibre uptake cannot be driven solely by price. Other key drivers include the quality of existing broadband services and the strength of demand for high-bandwidth applications. Finally CEG ignores the fact that even if additional fibre demand is generated, the addressable market for fibre may be limited in the UFB deployment stage in the short- to medium-term and for some New Zealand consumers fibre will remain unattainable in the long-term. For these end-users higher UCLL and UBA prices cannot promote consumer welfare.

We conclude that the Commission should disregard both the CEG implementation of the Frontier-Dobbs model and its cost-benefit analysis.

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1 Introduction

On behalf of Chorus, CEG has attempted to quantify the welfare effects of uncertainty in estimating the WACC for the unbundled copper local loop (UCLL) and unbundled bitstream access (UBA) services[1].

The report seeks to estimate the effect of uncertainty on incentives to invest, using a model developed by Frontier Economics for Transpower in the context of estimating the WACC for electricity lines and gas pipelines services. This model (the Frontier-Dobbs model) uses an approach developed by Professor Ian Dobbs. CEG claims that the Frontier-Dobbs model indicates that an uplift in the WACC should be in the range of the 56th to the 88th percentile, based on a consumer welfare standard, or above the 95th percentile based on a total welfare standard.

CEG also presents estimates of the effect on consumer welfare of delayed migration to high-speed broadband in New Zealand, relying on evidence from other studies.

We have reviewed the CEG report, as well as the underlying model (including both the original implementation and CEG's implementation). Our report is structured as follows:

- the Frontier-Dobbs model (Section 2)
- the benefits of high-speed broadband (Section 3)
- CEG's cost-benefit analysis (Section 4)
- concluding remarks and recommendations (Section 5).

1 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015.

Although this report has been commissioned by Spark New Zealand (Spark) and Vodafone New Zealand (Vodafone), the views expressed here are entirely our own.

2 The Frontier-Dobbs model

2.1 Background

In its draft decision on the cost of capital appropriate for the UCLL and UBA pricing reviews the Commission disregarded the 2011 findings of Professor Dobbs in relation to WACC uplift.

> We also considered the role of innovative new services when considering whether a WACC uplift should be applied. In particular, we considered a 2011 paper by Professor Ian Dobbs, which was relevant in our recent IMs WACC percentile review. However consistent with the IMs WACC percentile review, we have placed little weight on Professor Dobbs' model because it does not address the risk of misestimating the WACC (and instead addresses the risk created by fixing the allowed WACC over the regulatory period.[2]

In the IM WACC percentile review referred to by the Commission Frontier Economics presented an implementation of the Dobbs model in September 2014 which is publicly available on the Commission's website. The model was developed using the open source programming language and software environment R, with a Microsoft Excel front-end to facilitate its use. R is specialised software designed specifically for statistical computing and graphics. It is widely used by statisticians and those who require complex statistical analyses (for example in data mining applications).

2 Commerce Commission (2014), *Cost of capital for the UCLL and UBA pricing reviews, Draft decision*, 2 December 2014, paragraph 226.

We note that a number of criticisms were levelled at the Frontier-Dobbs model in 2014, including a critique from Dobbs himself, concluding that the model results are indicative at best:

> This kind of model articulates why a significant uplift is warranted, but in my opinion, it is unclear how much quantitative significance should be placed on the model predictions.[3]

Subsequently, the Commission decided not to rely on the Frontier-Dobbs model in setting the percentile for the electricity lines and gas pipelines WACC. The Commission found that the model:

- addresses the risk of fixing the WACC over the regulatory period, not on mis-estimating the WACC
- focuses on investments in new innovative services, not investment to maintain the existing network
- does not "adequately accommodate our "long term interests of consumers' objective" and "is likely to over-state the relative influence of the WACC uplift"
- is highly sensitive to input parameters.

2.2 Relevance of the Frontier-Dobbs model

Key features of the Dobbs model

The abstract Dobbs model[4] considers the appropriate allowed rate of return on investment in circumstances where some future investment of the regulated entity is discretionary and / or deferrable. The model assumes:

- a monopolist provides three types of services:
  - existing services (legacy services)

3 Dobbs, I.M. (2014), *Comments on the Application of the Dobbs [2011] model*, 17 September 2014, paragraph 4.

4 Dobbs, I. M. (2011), *Modelling welfare loss asymmetries that arise from uncertainty in the regulatory cost of finance*, Journal of Regulatory Economics, 39(1), 2011.

  - new services that will be deployed during the regulatory period or not at all (non-deferrable services)
  - services that might be deployed during the regulatory period or may be deferred to a later period (deferrable services)
- a rate of return is set for each service type, so in the cases of discretionary investment if the regulated entity decides to invest it will be subject to the allowed rate of return
- zero cross-elasticity across the services
- the regulator sets an allowed rate of return for each type of service investment
- quality of service obligations exist to ensure that ongoing investment occurs for all types of services
- the firm serves final retail demand
- demand grows exponentially.

The model results are highly sensitive to input assumptions for:

- demand elasticity and maximum willingness to pay
- the choice of welfare standard (consumer or total surplus).

In simple terms, if demand is highly inelastic and consumer maximum willingness to pay is high then the model results will indicate that the regulator should adopt a relatively high allowable rate of return. Indeed under these conditions we would expect that consumers will be prepared to pay higher prices to avoid the significant loss which would result from no new investment.

As regards the assumed welfare standard, should the regulator favour exclusively consumer surplus then the model results would indicate that a zero allowed rate of return for legacy services would maximise consumer surplus. Naturally this result changes if the regulator gives weight to the profits of the regulated entity.

Is the model relevant to the UCLL / UBA pricing review?

In the original Dobbs paper different allowed rates of return are estimated for each category of investment. For the existing investment category alone Dobbs calculates that total welfare will be maximised at an allowed rate of return below the median WACC.

CEG also estimates for this category of investment – using a total welfare standard – an optimal WACC below the median (45%). For the new investment categories the model indicates that optimal WACC should be above the median. CEG estimates that the optimal cost of capital percentile for new services is 99%. Dobbs also considers the optimal WACC with a blend of the three different types of investment. CEG estimates this as 99%. CEG argues that the same uplift should be applied to sunk investment as to new investment, apparently since today's sunk investments were previously new investments.

> In our view, the same uplift may reasonably be applied to sunk investment since doing so represents part of a commitment to adequately compensating [*sic*] new investment as well as existing investment.[5]

Thus CEG proposes to collapse into one the categories of sunk and new investment and include fibre based network deployment. However, the focus of the Dobbs model is regulated services. For all forms of new investment in the Dobbs model an allowed rate of return is to apply. As such the model does not accommodate unregulated services. In the context of the UCLL / UBA pricing review the Dobbs model can therefore only be relevant to existing sunk copper investment and new copper investment. The Dobbs construct cannot apply to fibre pricing in New Zealand as fibre prices have been set in commercial contracts.

Furthermore, the Dobbs model is based on the premise that firms respond to incentives.

> If they do not, then any uplift in AROR [allowed rate of return] is simply a windfall benefit to them, and a loss to consumers.[6]

Thus results from the Dobbs model are valid only if there is a real possibility of the regulated entity either deferring particular investment or declining to undertake potential investment. Clearly Chorus cannot defer or decline to undertake its existing UFB contract. Indeed as it is already engaged in this project additional incentives at this stage are irrelevant as regards UFB investment.

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5 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 51.

6 Dobbs, I.M. (2014), *Comments on the Application of the Dobbs [2011] model*, 17 July 2014. paragraph 36.

CEG suggests that apart from contractually committed UFB capex, there are other potential new investment options for Chorus such as:

- investment in rural broadband infrastructure outside UFB and RBI footprints
- future UFB contracts
- other non-UFB investment in high-speed broadband
- investment to enhance service quality and network capacity on the existing network.

The first three types of investment options are irrelevant to the Dobbs model as they would not be subject to price regulation in the current regulatory framework in New Zealand. Even if the Commission considers such opportunities relevant in a wider context (for example, in the context of dynamic efficiency) then it should be noted that opportunities for other new investment, either non-UFB or through UFB / RBI extensions, appear limited. We discuss this further in Section 2.3.

CEG's final option regarding investment on the existing network is the only one that is potentially relevant for the Dobbs model. However, due to Chorus' existing UFB commitments very limited new investment is possible in the existing copper network. In fact this type of investment should only occur in LFC areas while in its own UFB areas Chorus is committed to encouraging fibre uptake with limited avenues for copper investment.

We conclude that, CEG is mistaken in its belief that the Dobbs model is a 'good fit' to the current regulatory determination.

Consumer welfare or total welfare?

As already noted the results of the Dobbs model are highly sensitive to the assumed welfare standard. In relation to existing investment a consumer welfare standard indicates that maximum welfare is achieved at the minimum WACC.

Although the Telecommunications Act is not explicit on this matter, it seems clear that its primary emphasis on the long-term benefits of end-users is consistent with a consumer welfare standard. However CEG considers that a total welfare standard would better serve consumer interests:

> A static welfare analysis would potentially indicate that prices should be reduced to marginal cost, and the loss to producers or pricing below cost would ignored *[sic]*. However, as the Commission itself recognises this would not be in the LTBEU [long term benefit for end-users]. This is because any firm that fails to recover its costs of production, including a normal risk-adjusted return on capital, will exit the market over the longer term by redeploying its capital elsewhere.[7]

However CEG is wrong to claim that the regulated entity might not recover its costs of production for its regulated copper service. The pricing standard that is being applied in this review is not marginal cost as it includes a mark-up for common costs. As such cost recovery could certainly be achieved.

In view of the Act's emphasis on the long term benefits of end-users, if the Commission chooses to give weight to producer profits the rationale for the extent of the weighting should be clearly justified.

2.3 CEG's implementation of the Frontier-Dobbs model

CEG claims that the Frontier-Dobbs model was endorsed by Professor Dobbs as "a reasonably faithful application and extension" of his original model[8]. This is a mis-representation of the findings of Professor Dobbs' review of the model, in which he identified a number of its failings, in particular:

> Within the confines of the model itself, my main concern lies with the treatment of willingness to pay when demand is assumed inelastic. It is my opinion that the current implementation is likely to significantly exaggerate the loss of welfare that arises when new

7 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 98.

8 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 14.

investment does not occur (whether the objective function is consumer surplus or total welfare); as a consequence this may exaggerate the extent of uplift predicted by the model.[9]

Professor Dobbs had several additional concerns:

- the model's sensitivity to the weight on consumer surplus compared to firm profit in the welfare criterion
- the extent to which the model is appropriate for the task required ('goodness of fit'), due to sources of uncertainty that are explicitly ignored in the model, and the various mechanisms that can be employed by regulators to influence reliability and investment.

Frontier responded to Professor Dobbs' comments[10], highlighting a number of areas for further work. While Frontier performed some model modifications and sensitivity testing, it noted that additional work was required to validate and test the model, and that this was not possible in the time available. We found that only the original version of Frontier's model is available for download from the Commission's website, and we understand that no revised version was ever released.

CEG claims that it has 'made a number of modifications to the model and adjusted parameters to reflect the circumstances of the fixed line telecommunications sector in New Zealand'[11]. While CEG is not explicit about the nature of the modifications, these appear to encompass 'different functional forms for demand, elasticities and maximum willingness to pay'[12]. It is unclear from CEG's report whether it has simply made changes to input assumptions or to the underlying Frontier code, but inspection of the CEG model reveals that changes have been made to the code.

Unfortunately CEG has not provided any model documentation and as such it is difficult to assess the reasons for the code changes and the impact without further detailed

9 Dobbs, I.M. (2014), *Comments on the Application of the Dobbs [2011] model*, 17 July 2014. paragraph 2.

10 Frontier Economics (2014), *A submission on Prof Ian Dobbs' comments on our implementation of his loss function model*, September 2014.

11 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 14.

12 *Ibid*.

investigation. It is clear, however, that given these changes the Commission should not assume that the detailed Frontier model documentation can serve as a substitute for the missing CEG model documentation. Furthermore, in the absence of model documentation Network Strategies has not been able to undertake a full audit of the CEG model, given constraints on time and resources.

CEG's version of the model includes additional R code that enables the outputs of 30 scenarios to be calculated within a single model run, as well as a Microsoft Excel post-processor to convert the scenario results into the optimal percentiles. Unlike the Frontier model the CEG model has not been designed for ease-of-use by non-experts. Note that CEG's additional code requires a specific structure for the scenario input data, as well as for the order of the scenarios, otherwise the end results may not be valid. This is not explicitly documented, but can be determined upon close inspection of the Excel spreadsheet and macro code.

CEG's spreadsheet input data includes some – but not all – of the model assumptions. The remaining assumptions are hard-coded within CEG's additional R code. These hard-coded assumptions (discussed in Section 2.4) are:

- demand served by existing services
- current retail price
- current input price
- regulation time period
- WACC – mean and standard deviation

Thus any person wishing to investigate the effect of these assumptions must modify CEG's code.

2.4 CEG's model assumptions

Demand served by existing and new investment

CEG assumes that the demand served by existing services is 1,758,153 lines, which is the quantum of UCLL services assumed in the Commission's model. Demand for the new service is assumed to be 75% of existing services – that is 1,318,615 – on the grounds that UFB will 'eventually extend to 75% of New Zealand premises'[13].

Although 75% appears to be CEG's base case assumption, CEG also tests sensitivity of its results to assumptions based on 10% and 25% of existing services.

By way of comparison, in the original Dobbs model demand for the new service was based on the proportion of deferrable investment to total investment which was assumed to be between 5% and 30%[14]. In the Frontier model 1% of demand served by existing investment was assumed for new investment.

There is a major problem with CEG's assumption that demand for new services should equal 75% of total demand. Although CEG claims that 'this reflects the future expected demand for fibre services in New Zealand'[15], committed and unregulated UFB investment would not qualify as new investment in the Dobbs abstract model, as discussed in Section 2.2.

As we have already identified the only new investment that should be considered in the Dobbs model in the context of New Zealand telecommunications would be enhancements to the copper network. Frontier noted that, in the context of electricity, demand served by new investment may be difficult to assess since there may be no physical difference in the retail services provided over existing or new investment, and consequently considers capex

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13 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 66.

14 Dobbs, I. M. (2011), *Modelling welfare loss asymmetries that arise from uncertainty in the regulatory cost of finance*, Journal of Regulatory Economics, 39(1), 2011. See Table 3.

15 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 38.

ratios[16]. Applying similar logic to telecommunications we can derive relevant estimates from Chorus' published accounts. From Chorus' 2014 annual report we note that total new copper investment in the 2014 financial year was $61 million, broken down as follows[17]:

- Network sustain: $35 million
- Copper connections: $15 million
- Copper layer 2: $10 million
- Product fixed: $1 million

As the Dobbs model assumes quality of service obligations, it is doubtful that much of the above would qualify as new investment. The largest category – network sustain – is not discretionary investment. In fact in the Annual Report Chorus characterises this investment as occurring where 'network replacement is deemed more cost-effective than reactive maintenance'[18].

Nevertheless let us assume that the entire $61 million represents new investment. Although there is no clear disaggregation between copper and fibre assets available in Chorus' 2014 financial accounts we have estimated the percentage share of Chorus' copper assets as at June 2014. Details of this calculation are provided in Annex A. Assuming $61 million for new investment, then as a proportion of the existing (sunk) copper network this investment is approximately 3.5%.

Furthermore, if we consider that, as CEG suggests, potential new fibre investments in future UFB and RBI extensions are relevant, the Government has indicated that these may amount to:

- $150 million for an extension of RBI funding, including $50 million for addressing mobile black spots

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16 Frontier Economics (2014), *Application of a loss simulation model to New Zealand*, August 2014. See section 3.1.3.

17 Chorus (2014), *Annual Report for the year ending 30 June 2014*, page 34.

18 *Ibid*.

- between $152 and $210 million for extension of UFB funding[19].

The details (including confirmation of areas to be covered) are still under development, but we can assume that for some of the new areas LFCs will have a competitive advantage over Chorus in that the new investment will simply be an extension of the existing network. So what percentage of the new funding can we assume that Chorus may win? Assuming that it is eligible for $100 million of the new RBI funding (that is, excluding the mobile black spot funding), and all of the UFB funding (which we assume in total is $181 million – the midpoint in the Government's range), a conservative approach is to adopt an estimate of 70% probability[20] of Chorus winning competitive tenders. This results in $197 million of new fibre investment. This new investment, then, represents approximately 11% of Chorus' existing copper investment. If we include total copper investment in this category of new investment the total is $258 million or 14.9% of existing copper investment.

This evidence suggests that CEG could only realistically make a case for new investment to be in the order of 3.5% (new copper only) to 14.9% (new copper plus non-UFB new investment) of existing investment. However in our view a correct interpretation of the Dobbs model would exclude new investment that is not subject to price control, and would also exclude investment required to sustain the network. Consequently even 3.5% represents an upper bound for new investment.

Demand elasticity

CEG states:

> Our base case assumes a demand elasticity of -0.43 based on the OECD's estimate for OECD countries in 2007, we have also tested a sensitivity of 0.95 as proposed by Spark. We consider that this can reasonably be applied to services provided over existing investments particularly given new services would include demand for ordinary telephony

19 See http://www.med.govt.nz/sectors-industries/technology-communication/fast-broadband/new-initiatives.

20 This estimate is based on Chorus' success in winning initial UFB funding.

> services (supplied via the unbundled copper low frequency service) which typically have [*sic*] been shown to be very inelastic to price. However, the elasticity for services provided over new investments is less certain. We consider alternative scenarios of -1.00 and -2.00. Capturing a higher elasticity may at least partly take into account the likely effects of a cross-price relationship between the existing service (copper) and the new service (fibre)[21].

It is unclear from this statement whether CEG considers that -0.43 is more reasonable for the legacy copper service than the elasticity proposed by Spark[22] (which is actually -0.95 so we assume that the negative sign has been omitted inadvertently in the CEG statement quoted above). CEG's reasoning is also unclear. It appears to include relatively inelastic 'demand for ordinary telephony services' in fibre 'new services' but at the same time suggests that elasticity is less certain for these services.

CEG considers that:

> …demand for copper broadband services is relatively inelastic due to the lack of perfectly substitutable products and the 'need' for broadband services to utilise wide-range [*sic*] of internet-based services and products[23].

It appears that CEG is struggling with differentiating the demand curve for legacy copper services from the demand curve for new fibre services. One might equally state that the demand for fibre broadband services is relatively inelastic for the same reasons that CEG states that demand for copper broadband services is relatively inelastic. A growing proportion of consumers view broadband as an essential service, regardless of the delivery technology. Note that in an earlier statement in its report CEG appears to contradict the above statement concerning substitutability of copper broadband services:

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21 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 68.

22 Spark New Zealand (2015), *UBA and UCLL FPP pricing review draft decision*, 20 February 2015. See Attachment D. The figure used by Spark of -0.951 was an average of copper broadband own price elasticity over the period 2000 to 2008 from Shinohara, S., Y. Akematsu & M. Tsuji (2011), *Analysis of broadband services diffusion in OECD 30 countries: Focusing on open access obligations*.

23 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 67.

> … setting the price of the regulated services based on the cost of the fibre services will directly constrain the pricing of fibre services through substitution by end-users.[24]

Nevertheless in its modelling CEG seeks to characterise fibre broadband services as more elastic than copper broadband services, apparently as an attempt to address the problem that the Dobbs model assumes that demand for the new service is independent from demand for the legacy service. If the fibre services represent an upgrade of copper broadband services then it becomes highly problematic to apply the Dobbs model, as the model assumes there is no cross elasticity between current demand and service improvement. As Dobbs notes:

> In practice, launch of a new service can have big impacts on the level of demand for existing services (typically economic substitutes). This means there is a need to model this; technically, this is not totally straightforward, as one needs to have a well-defined measure of economic welfare; for example simply adding (cross)elasticity to iso-elastic demand functions runs into the problem that consumer surplus is then not well defined.[25]

CEG offers no robust methodological fix for this, apart from adopting a 'higher elasticity' for new services. Furthermore, we note that for new services CEG claims that the own price elasticity assumptions of -1.00 and -2.00 are based on a 2009 study[26]. We cannot find any evidence within the cited study that supports CEG's assumptions.

Maximum willingness to pay and demand curve

Frontier amended the Dobbs model in order to address the issues which arise with inelastic demand assumptions. The original model encompassed constant demand elasticity which implies infinite consumer surplus should demand be assumed inelastic. CEG also applied the Frontier amendment which involved truncating the iso-elastic demand curve using an assumption for maximum willingness to pay. CEG's estimate for this is based on

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24 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 34.

25 Dobbs, I.M. (2014), *Comments on the Application of the Dobbs [2011] model*, 17 July 2014. paragraph 15.

26 Dutz, Orszag and Willing (2009), *The substantial consumer benefits of broadband connectivity for U.S. households*, July 2009.

Greenstein and McDevitt's 2010 data[27] for New Zealand broadband subscribers, revenue and consumer surplus. While we can reproduce CEG's estimate of $523.01 we note that CEG has presented this estimate as current New Zealand Dollars, whereas in fact it is in 2010 USD. It therefore follows that CEG's observation that its estimate of maximum willingness to pay is more than six times the current retail price[28], is incorrect.

Furthermore, we note that CEG has used in its calculations end-of year broadband subscriber numbers whereas average subscribers is the correct measure. Using the same methodology with average subscribers results in an estimate of USD552.70 which is even higher than CEG's estimate.

As Dobbs warns in his review of the Frontier model implementation, assumptions regarding maximum willingness to pay will have a material impact on the model results. In simple terms the assumption selected for maximum willingness to pay will have a direct impact on the estimated consumer surplus and indeed the results are highly sensitive to this parameter. Furthermore, the behaviour of demand as the maximum price is approached is also important. Dobbs notes that demand is unlikely to 'choke off suddenly' at a maximum price but will decrease as that price is approached. As such Dobbs concludes that the Frontier results will overestimate the optimal percentile.

An alternative approach is to assume linear demand. CEG does include some estimates for linear demand functions although concludes that these are inappropriate since in these scenarios the implied maximum willingness to pay may be as low as $127.50 per month which CEG claims is 'likely to be unrealistically low for either new or existing services given current retail prices of $85 per line per month'[29].

However local survey evidence indicates that CEG may be completely wrong on this point. Research commissioned by Chorus in 2012 indicated that consumer willingness to pay for UFB may be $20 higher than for DSL[30]. A Commerce Commission survey on New

27 Greenstein and McDevitt (2012), *Measuring the broadband bonus in thirty OECD countries*, OECD Digital Economy Papers, No. 197, OECD Publishing, 2012.

28 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraph 71.

29 *Ibid*, Table 2 footnote.

30 Chorus (2012), *Chorus consumer segmentation research – Paving the Path to Delivering Ultra Fast Broadband*, 2012.

Zealand consumer willingness to pay for a high speed broadband service found that 40% of consumers (640,000 households) were willing to pay up to $5 extra per month for the service, 37% said that they were willing to pay between $5 and $10 extra per month and only 4% said that they were willing to pay more than $20 extra per month[31]. Thus a maximum willingness to pay of $127.50 per month is more feasible than CEG's assumption of $523.01 but based on recent survey data may still be too high.

As noted by Dobbs it is extremely important, given the sensitivity of the model results to willingness to pay, that a reasonable estimate is used. The CEG assumption for willingness to pay is based on research into consumer spending on DSL in 2010 and appears to be an average value rather than a marginal value. Given the focus of the Dobbs model on incremental investment it is doubtful that the CEG assumption is appropriate on theoretical grounds, as well as on empirical grounds in the light of the local evidence.

Demand growth

CEG purports to capture growth in both existing and new services by assuming 0% demand growth. Although CEG estimates growth in fixed broadband connections to be 4.90% in 2013 – 2014, it claims that this will be offset by fixed to mobile substitution.

We agree that there will be growth in mobile-only households, and based on the increase in households without fixed line telephone services over the period 2006-13, an assumption of zero demand growth appears very low. However CEG does not discuss migration between fibre and other services, such as cable. Given the sensitivity of the results for consumer welfare to the demand for services, we would suggest that the model be tested for demand being alternative percentages of existing services as well as for some potential growth assumptions.

31 Commerce Commission (2012), *High-speed broadband services demand side study final report June 2012*, 29 June 2012.

Current prices

CEG models retail demand rather than wholesale demand and with respect to current prices assumes:

- the input price for the existing service is $38.39 per line per month as per the Commission's Draft Determination
- the same input prices apply to the new investment
- average retail prices are $85 per line per month for both existing and new services
- full pass-through of input prices into retail prices.

It is reasonable to assume – at this point – that the input price is aligned with the Commission's Draft Determination, and naturally this should be replaced by the final price if this model was to be used to explore the WACC uplift. Whether or not the same input prices should apply to the new investment is uncertain, without knowledge of what that new investment will be. New investment may involve the deployment of lower cost technology, in which case the input price could be reduced. If the investment enables new services then it is feasible that the input price may increase.

The assumed average retail price should be a weighted average that reflects the demand mix by plan, including naked DSL plans. We note that $85 corresponds to the simple (unweighted) average of all the DSL plans offered by Spark and Vodafone (excluding those plans with bundled content services, such as Vodafone's NEON). We note that cheaper plans are available from other RSPs, such as Slingshot. Therefore CEG's assumption is unlikely to represent the average price paid by consumers.

Other assumptions

In its model CEG uses the Commission's proposed cost of capital from the Draft Determination for both existing and new investment. It estimates a standard deviation of 1.11% using the Commission's methodology from the IMs. When we applied the same methodology, we obtained the slightly lower figure of 1.08%.

For annual depreciation CEG assumes 3% which it claims is based on an assumed average 34 to 36 year asset life in the Commission's model. It is unclear how CEG reached 3%. If it assumed a straight line approach to depreciation over 35 years then the result would be 2.86% while with 34 years the deprecation would be 2.94%.

2.5 Results

CEG's scenarios

CEG presents results in Table 2 for 16 scenarios, all of which indicate that using a total welfare standard the optimal percentile (for a blend of existing and new investment) will be between 96% and 99%, while using a consumer welfare standard the range is much wider – from 1% to 88%.

With an isoelastic demand function and a consumer welfare standard it is evident that the results are sensitive to changing the assumption for demand for new services. At 25% (as a percentage of existing services) the optimal percentile is 1%, while at 75% demand the optimal percentile is 77%, *ceteris paribus*.

With a linear demand function an optimal percentile of 1% is obtained for a consumer welfare standard and 75% demand for new services, however the optimal percentile increases to 56% if elasticity for existing services changes (from -0.43 to -0.95).

It is clear that the results are extremely sensitive to the assumptions in the case of the consumer welfare standard, although this appears not to be the case in relation to the total welfare standard. This outcome is consistent with CEG's application of a model that depends crucially on demand elasticities and consumers' willingness to pay. For the most part CEG assumes relatively inelastic demand, a high consumer willingness to pay and a substantial amount of 'new investment' that may be deferred.

Additional scenarios

Using CEG's model we changed the demand for new services to 3.5% of existing services, as discussed in Section 2.2. The other assumptions used by CEG remain the same. CEG's Table 2 is reproduced below, together with the optimal percentile results with our changed assumption for demand for new services (Exhibit 2.1). It is notable that in all scenarios using the consumer surplus standard the optimal percentile collapses to 1%. With the total welfare standard the results are lower than CEG's scenarios, with a range of 78% to 97% (compared to CEG's 96% to 99%). This highlights the sensitivity of the results to assumptions.

Scenario	Elasticity for existing services	Elasticity for new services	Demand for new services	Demand function	Maximum price	Percentage of variable cost	Optimal percentile (CEG)		Optimal percentile with changed assumption[1]	
							Consumer surplus	Total surplus	Consumer surplus	Total surplus
1	-0.43	-1.00	75%	Isoelastic	$523.01	0%	88%	99%	1%	95%
2	-0.43	-2.00	75%	Isoelastic	$523.01	0%	77%	97%	1%	88%
3	-0.43	-1.00	75%	Linear	n.a.	0%	1%	97%	1%	87%
4	-0.95	-1.00	75%	Linear	n.a.	0%	56%	97%	1%	78%
5	-0.95	-1.00	75%	Linear	n.a.	30%	69%	97%	1%	87%
6	-0.43	-1.00	25%	Isoelastic	$523.01	0%	77%	97%	1%	95%
7	-0.95	-1.00	25%	Isoelastic	$523.01	0%	78%	97%	1%	88%
8	-0.43	-2.00	25%	Isoelastic	$523.01	0%	1%	97%	1%	88%
9	-0.95	-2.00	25%	Isoelastic	$523.01	0%	61%	96%	1%	87%
10	-0.43	-1.00	10%	Isoelastic	$523.01	0%	61%	97%	1%	95%
11	-0.95	-1.00	10%	Isoelastic	$523.01	0%	66%	96%	1%	88%
12	-0.95	-1.00	75%	Isoelastic	$523.01	0%	88%	99%	1%	88%
13	-0.95	-2.00	75%	Isoelastic	$523.01	0%	77%	97%	1%	87%
14	-0.43	-1.00	75%	Isoelastic	$250.00	0%	77%	97%	1%	93%
15	-0.43	-1.00	75%	Isoelastic	$523.01	30%	88%	99%	1%	97%

1 3.5% demand for new services. The other assumptions used by CEG remain the same.

Exhibit 2.1: *Results of Frontier-Dobbs modelling [Source: CEG and Network Strategies Limited]*

CEG presents only the maximum of the relevant surplus results, however we have broken down the results for existing (sunk) and new investment (Exhibit 2.2). We find that the optimal percentile for the existing service using a total welfare standard is 45% in all scenarios – that is, below the median estimate.

Scenario	*Consumer*			*Producer*			*Total*		
	Existing service	*New service*	*All services*	*Existing service*	*New service*	*All services*	*Existing service*	*New service*	*All services*
1	1%	96%	88%	100%	100%	100%	45%	99%	99%
2	1%	93%	77%	100%	100%	100%	45%	97%	97%
3	1%	69%	1%	100%	100%	100%	45%	97%	97%
4	1%	69%	56%	100%	100%	100%	45%	97%	97%
5	1%	80%	69%	100%	100%	100%	45%	99%	97%
6	1%	96%	77%	100%	100%	100%	45%	99%	97%
7	1%	96%	78%	100%	100%	100%	45%	99%	97%
8	1%	93%	1%	100%	100%	100%	45%	97%	97%
9	1%	93%	61%	100%	100%	100%	45%	97%	96%
10	1%	96%	61%	100%	100%	100%	45%	99%	97%
11	1%	96%	66%	100%	100%	100%	45%	99%	96%
12	1%	96%	88%	100%	100%	100%	45%	99%	99%
13	1%	93%	77%	100%	100%	100%	45%	97%	97%
14	1%	88%	77%	100%	100%	100%	45%	99%	97%
15	1%	97%	88%	100%	100%	100%	45%	99%	99%

Exhibit 2.2: *Breakdown of results with CEG's assumptions – optimal percentile [Source: CEG and Network Strategies Limited]*

2.6 Conclusion

As we have demonstrated, many of CEG's key assumptions – including demand, demand elasticities and willingness to pay – are either inappropriate or incorrect. CEG's results are particularly sensitive to these assumptions and therefore the results presented in Table 2 cannot be used as a means of balancing welfare losses against welfare gains in the Commission's pricing review. However even if CEG's assumptions were to be adjusted to more suitable values, the CEG model itself is unreliable. It incorporates a number of unexplained and undocumented changes to the original Frontier-Dobbs model. In the absence of any documentation we have been unable to audit the model within the time and resources available to us.

Finally, our examination of the original Dobbs model indicated that further material changes would need to be made to this model in order to render it appropriate for the current proceedings. It is simply not a good fit for WACC percentile guidance in this pricing review.

3 Benefits of faster UFB uptake

3.1 Key CEG assumption

CEG estimates the effect on consumer welfare of delayed migration to high-speed broadband, based on an analysis developed by Bell Labs on behalf of Alcatel-Lucent New Zealand[32]. CEG uses two approaches in its analysis:

- a delay in the realisation of consumer welfare benefits of one year or two years would reduce consumer welfare over a 20-year period by $757 million or $1.4 billion (in net present value terms), respectively
- if both the speed and the level of take-up were to be reduced by 20% from a baseline scenario, consumer surplus would be reduced by $5.8 billion over a 20-year period (in net present value terms).

We note that the Bell Labs study adopts a sectoral approach to evaluate the economic impact of high-speed broadband. As such it mixes benefits that may accrue to businesses through the availability of business fibre with those that accrue directly to residential users via the UFB. This is inappropriate in the context of the pricing reviews since deployment of fibre to businesses only would have been a far cheaper project than the UFB initiative which is directed primarily at offering connectivity to residential users. A more appropriate approach would be to consider what incremental benefits might accrue to consumers on fibre which are not already available via DSL. In fact, many of the applications listed in the Bell Labs study are feasible with DSL technology.

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32 Alcatel-Lucent (2012), *Building the benefits of broadband*.

CEG relies crucially on the assumption that higher UCLL and UBA prices will lead to a faster uptake of fibre services. Network Strategies has consistently found that fibre uptake cannot be driven solely by price. For example, the quality of existing broadband services, and the strength of demand for high-bandwidth applications are strong drivers for fibre uptake[33]. Furthermore, in New Zealand it is inappropriate to assume that all end-users may immediately switch to higher speed broadband services, as fibre services are simply not available as yet in numerous locations. Finally, 'high' prices for copper are likely to constrain the overall broadband market in New Zealand when compared with other countries.

3.2 Experience in other jurisdictions

The Scandinavian countries remain consistently amongst the world's leaders in fibre uptake. These countries have extensive copper networks and DSL services are still widely available as well as cable services. This is in contrast to some of the other leading countries which do not have extensive copper networks and as such have leapfrogged DSL to fibre (for example, Estonia, the Slovak Republic and Slovenia).

The latest available OECD data (for June 2014 – Exhibit 3.1) shows that in Sweden 40.7% of total broadband subscriptions are fibre connections, with 28% in Norway, and 19.8% in Denmark. In comparison 8.8% of total broadband subscriptions in the United States are fibre[34].

33 Network Strategies (2013), *Business case for UFB uptake in the Wellington region*, 8 March 2013. See Section 4.

34 OECD (2014), *Percentage of fibre connections in total broadband subscriptions (June 2014)*, available at http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm.

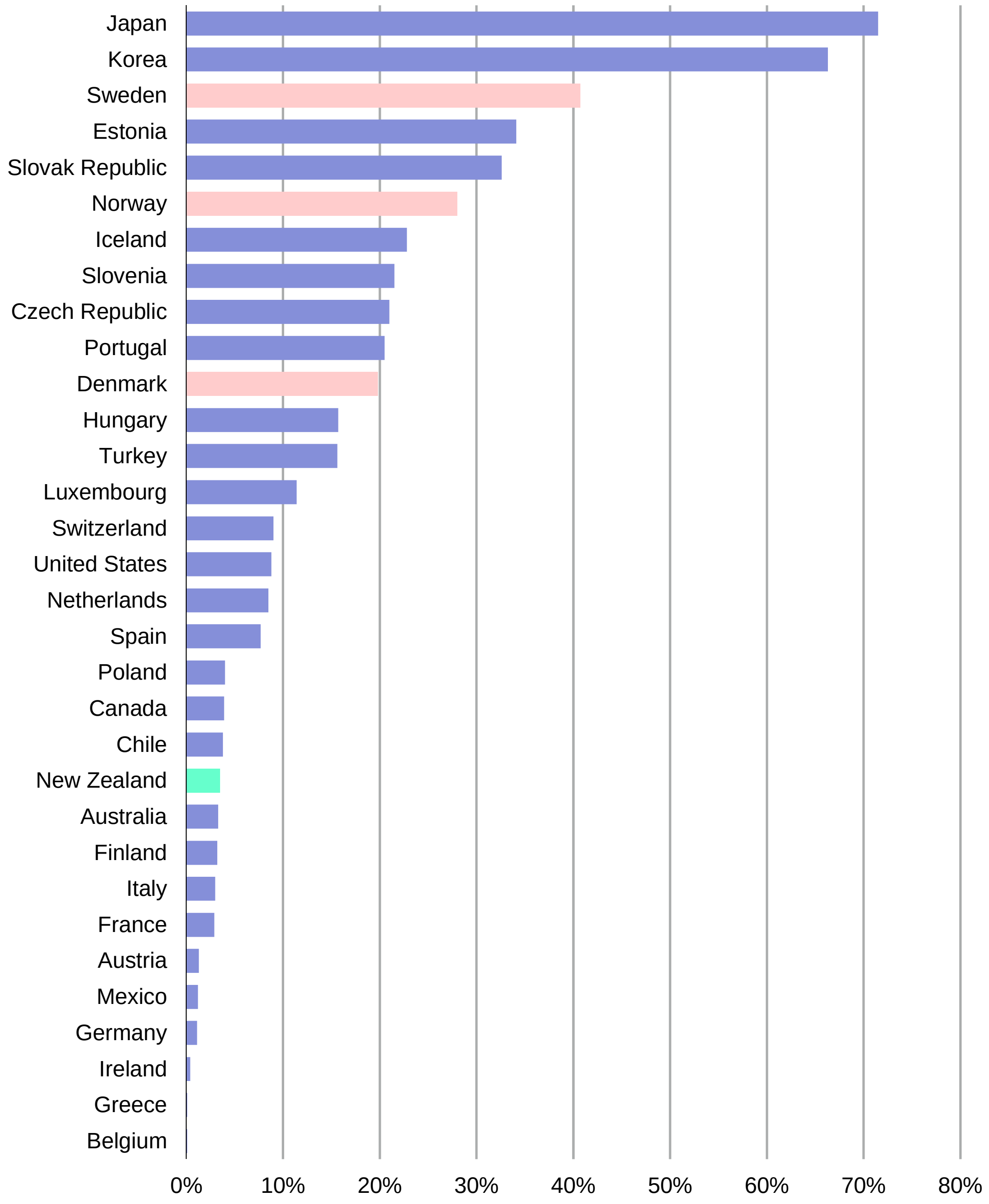

Exhibit 3.1: *Percentage of fibre connections in total broadband subscriptions, June 2014 [Source: OECD]*

We compared the current retail prices for broadband offerings in the Scandinavian countries and found that DSL offerings tend to be priced lower than fibre offerings (Exhibits 3.2 to 3.4). This indicates that relatively high DSL prices are not a key driver for fibre uptake.

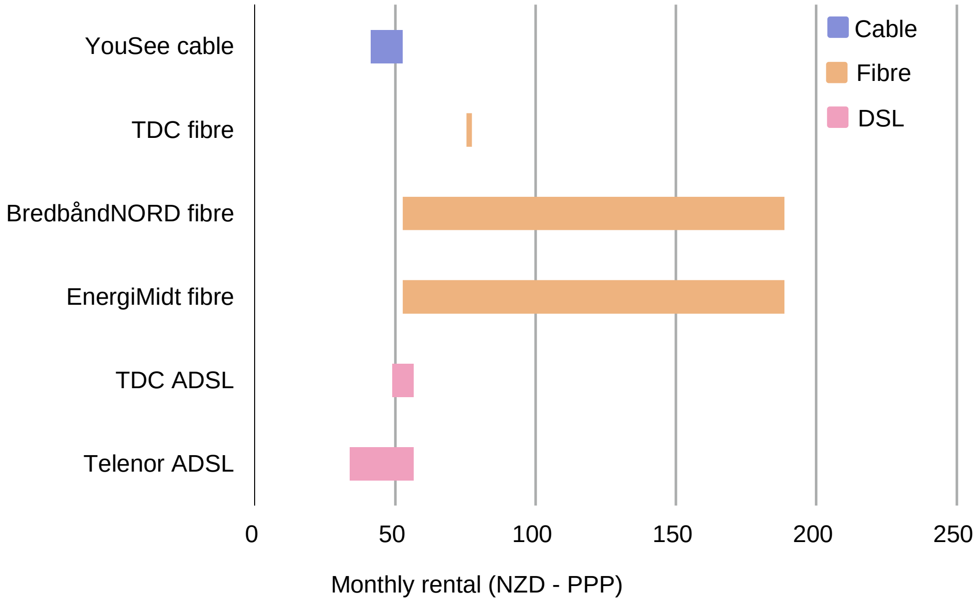

Exhibit 3.2: *Retail prices for broadband in Denmark, April 2015 [Source: Network Strategies]*

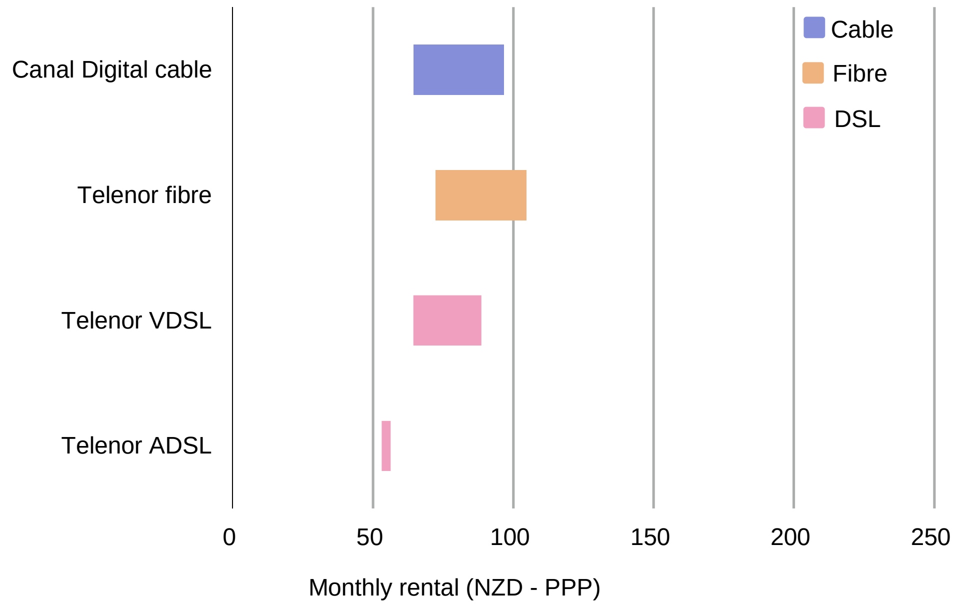

Exhibit 3.3: *Retail prices for broadband in Norway, April 2015 [Source: Network Strategies]*

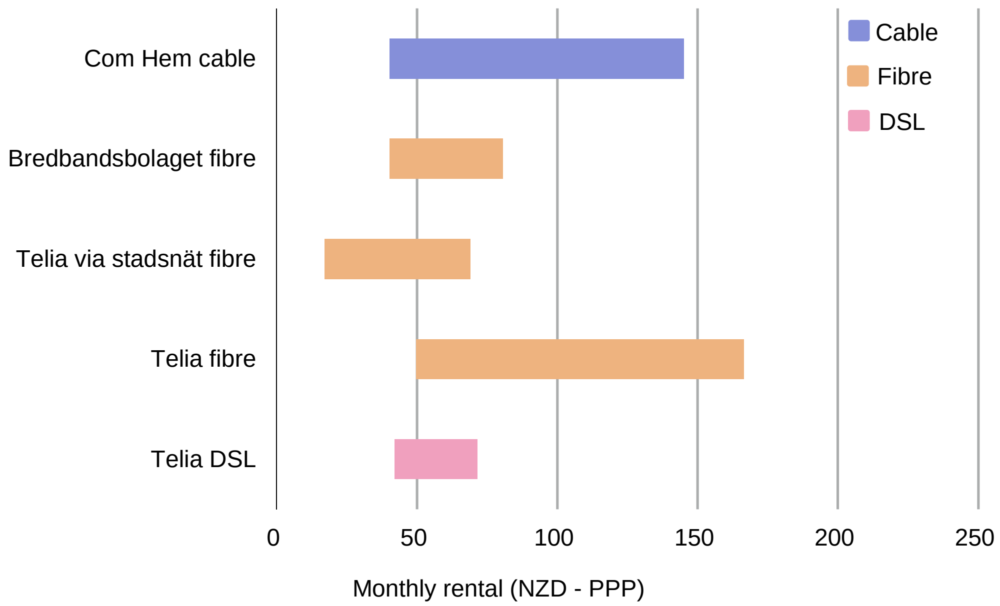

Exhibit 3.4: *Retail prices for broadband in Sweden, April 2015 [Source: Network Strategies]*

Those service providers that offer both fibre and DSL services clearly differentiate the various service offerings, with the higher value of fibre services – for example the ability to use high bandwidth applications or a guaranteed speed – being emphasised.

3.3 Conclusion

CEG has referred to studies that estimate the effect on consumer welfare of delayed migration to high-speed broadband without providing any evidence that higher UCLL and UBA prices will lead to a faster uptake of fibre services.

A review of fibre and copper service offerings in countries with both relatively high fibre uptake and extensive copper footprints illustrates that, in general, DSL prices are lower than fibre prices and that service providers seek to differentiate fibre products based on the higher value they offer compared to lower bandwidth products. This finding is consistent with other research undertaken by Network Strategies that has demonstrated that fibre uptake cannot be driven solely by price. Other key drivers include the quality of existing broadband services and the strength of demand for high-bandwidth applications. Finally even if additional fibre demand is generated, the addressable market for fibre may be limited in the UFB deployment stage in the short- to medium-term and for some New Zealand consumers fibre will remain unattainable in the long-term. For these end-users higher UCLL and UBA prices will not promote consumer welfare.

4 CEG's cost-benefit analysis

In its cost-benefit analysis[35] CEG seeks to compare the welfare effects of a higher WACC with those of a lower WACC.

Firstly CEG estimates the welfare effect of an increase in the copper price due to various uplifts in the WACC value[36], based on the Commission's approach[37] originally developed by Oxera. We have been unable to reproduce these results based on the information provided by CEG, however we note that consumer surplus is critically dependent upon two parameters: the maximum willingness to pay and the elasticity. This was also remarked upon by Professor Dobbs[38] who commented upon the importance of having a realistic maximum willingness to pay (or "choke price").

We have previously noted in Section 2.4 that CEG's assumption of $523.01 for the maximum willingness to pay appears to be greatly over-stated. This then suggests that CEG's estimate of the welfare effect may be similarly problematic.

CEG then compares the welfare loss from higher UCLL and UBA prices (as a result of a higher WACC) with its estimate of the welfare benefit of accelerated migration to fibre. As we discussed in Section 3 this latter estimate is based on flawed assumptions. Furthermore,

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35 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, section 4.5.

36 CEG (2015), *Welfare effects of UCLL and UBA uplift*, March 2015, paragraphs 108-109 and Table 3.

37 Commerce Commission (2014), *Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services*, 30 October 2014.

38 Dobbs, I.M. (2014), *Comments on the Application of the Dobbs [2011] model*, 17 July 2014. paragraphs 73-75.

there is no consideration of any welfare benefit from reduced copper prices (due to a lower WACC).

We therefore find that CEG's analysis cannot be used to support the case for an increase in the WACC.

5 Recommendations

We recommend that the Commission disregards both the CEG implementation of the Frontier-Dobbs model and its cost-benefit analysis.

The Dobbs construct is simply not appropriate as a means of determining the optimal percentile for the WACC in the context of the UCLL and UBA services. As such, the Commission rightly rejected consideration of the Dobbs model in its draft decision.

As examination of the key features of the Dobbs model reveals many fundamental differences in Dobbs' conception from the circumstances of the regulated UCLL and UBA services. In fact, results from the Dobbs model are valid only if there is a real possibility of the regulated entity either deferring particular investment or declining to undertake potential investment. Clearly Chorus cannot defer or decline to undertake its existing UFB contract, whereas CEG implicitly assumes that this option is available to Chorus.

As regards the cost-benefit analysis, CEG has presented no evidence that would support its implicit hypothesis that higher UCLL and UBA prices will lead to a faster uptake of fibre services. Moreover, as in the CEG implementation of the Dobbs model, a series of flawed assumptions invalidate the results.

Annex A: Chorus copper asset base

Since Chorus commenced its UFB deployment (at the date of separation) the majority of its fixed investment has been in fibre assets. In the seven months from 1 December 2011 (separation date) to 30 June 2012 Chorus spent $274 million on fibre assets[39]. Additionally $579 and $566 million were invested in fibre asset in 2013 and 2014 financial years, respectively[40]. Thus from 1 December 2011 to the end of the 2014 financial year gross fibre capex was $1 419 million, representing around 83.2% of the total capex, with the remainder being split between 10.5% for copper and 6.3% for common assets.

While Chorus' published information does provide a breakdown for capital expenditures, there is no disaggregation by copper and fibre business for total network assets. Hence assumptions are required to estimate the split of assets into copper and fibre.

The net book value (NBV) of Chorus' assets may be sourced from the latest available Chorus annual report[41]. The total NBV is the sum of NBV for various elements, including:

- copper cables
- fibre cables
- ducts and manholes
- cabinets
- property
- new electronics

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39 Chorus (2013), 2013 *Chorus annual report*.

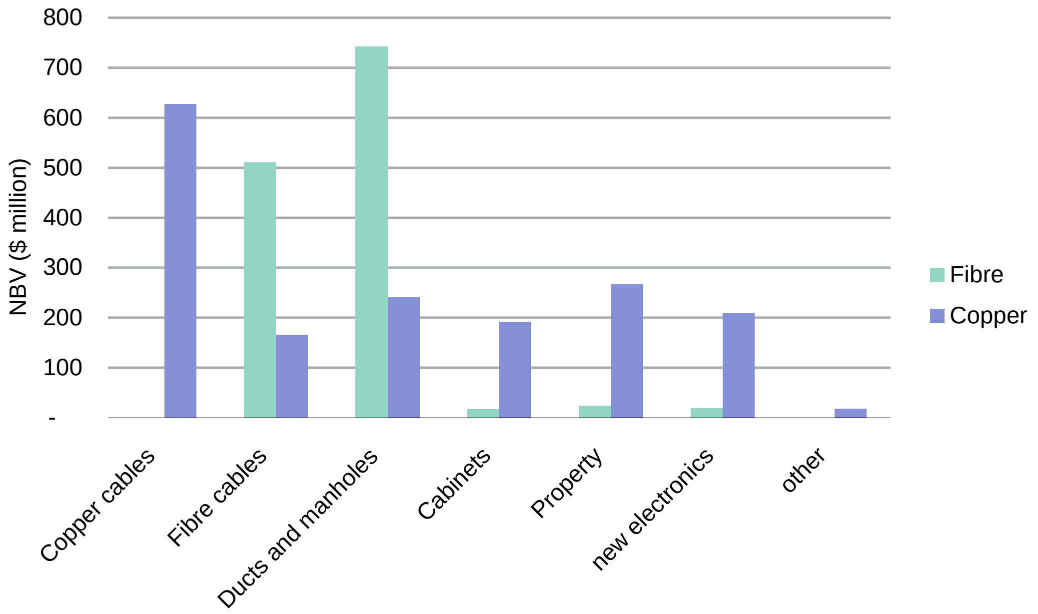
40 Chorus (2014), 2014 *Chorus annual report*.

41 *Ibid*.

- other
- and work in progress (WIP).

The total NBV is split into copper and fibre components (Exhibit A.1) based on assumptions and publicly available information described below:

- NBV for copper cables is allocated to the copper asset base.
- 75% of NBVs for fibre cables and ducts & manholes is allocated to the fibre asset base while the remainder is allocated to copper. This percentage has been assumed so that the ending fibre net book value approximates $1 313 million (namely, the depreciated gross fibre capex for years 2012 to 2014).
- the percentage of other asset categories allocated to the copper asset base is assumed to be equal to the ratio of copper revenue to total revenue. Consequently, the percentages of cabinets, property, network electronics and other assets is 92% for copper and 8% for fibre.



Note: NBV for work in progress (WIP) is not included in the fibre or copper asset bases and is assumed to be carried over to next year.

Exhibit A.1: *Elements of opening asset base for copper and fibre services of Chorus – 2014 financial year [Source: Network Strategies Limited]*

The estimated NBV for 2014 financial year is approximately $1 721 million for copper and $1 313 million for fibre. This represents around 57% and 43%, respectively, of the total NBV ($3 034 million[42]).

42 Total NBV excluding work in progress.