Annex 3: Efficient pricing benchmark

220. This Annex links to Part E of our paper under the heading "Competitive price benchmark".

Purpose

221. Some parties may perceive that our proposal could allow the use of a general SRMC benchmark that does not adequately allow for recovery of fixed costs, capital charges in particular. In our view, this perception is misplaced. To the extent that this issue is real, it applies equally to the HSOTC provision as it does to our proposal. In other words, the same choices sit inside the HSOTC mechanism as it relates to offers in general and pivotal situations in particular.

222. This Annex distils the issue and why MDAG's proposal makes sense in relation to assessing whether offers represent an exercise of significant market power.

Fundamentals of efficient pricing

223. It is useful first to briefly recap some of the fundamentals of efficiency in electricity prices.

Concept of efficiency

224. As Prof William Hogan observes, efficient pricing is a central feature of a competitive electricity market. It is essential if the benefits of a competitive market are to flow through to customers and other market participants.[195]

225. In general economic terms, prices are efficient when products and services are produced at the lowest sustainable cost, and no one can be made better off without someone else being made worse off. Inefficient prices tend to deliver inefficient outcomes.[196]

226. In the context of a wholesale electricity market, clearing prices tend to be efficient if (in broad terms):

    a. they reflect the cost of meeting the next unit of demand from the lowest cost source, whether generation or demand reduction (that is, system marginal cost – the standard determinant of competitive market pricing197); and

    b. prices and costs are subject to strong and sustained downward pressure, which is ordinarily best delivered by competition.

227. Prices systematically above marginal cost are viewed as indicating market power.[198]

[195] Hogan, 2001.
[196] Electricity Price Review, "First Report for Discussion", 30 August 2018, footnote 16
[197] This is the simple definition of the market-clearing price where supply equals demand. In concept, this production level just balances the marginal benefit of additional consumption with the marginal cost of production - see Hogan, 2001 at page 17
[198] Littlechild, 2001 – see footnote 14 of that article, which cites as an example Joskow and Kahn, 15 January 2001, p. 9 (earlier version of their March 2001 paper): "The more the observed price exceeds the competitive benchmark price, the more one can presume that either market power was being exercised or some other source of market imperfection has interfered with the competitive interplay of supply and demand. The competitive benchmark that we utilize is the short run marginal cost of supplying electricity from the last unit that clears the market in

228. Within this framework, the benchmark for efficient electricity pricing turns on four component elements:

a. market design;

b. what costs are included in marginal cost;

c. when the additional unit of electricity is to be produced (in the short or long run); and

d. the degree of competition assumed.

Market design and economic costs

229. Four design features of the New Zealand electricity spot market have particular salience: it is energy-only (there is no separate payment for the cost of capacity); spots prices are not capped; the grid is long and 'stringy'; and the market is hydro dominated and most hydro power stations are 'run of river' rather than reservoir-fed, and there is limited storage capacity with limited water storage.[199]

230. Among other things, this means that fixed costs – that is, costs that do not vary with changes in output, in particular the cost of capital invested in the assets required for generation – have to be recovered from within the energy price over time. It also means that, given grid constraints and the dominance of hydro with its variability in water inflows and limited water storage, *opportunity costs of hydro fuel (water)* and *scarcity rents* are relatively significant and highly variable components of marginal costs.

Opportunity costs of water

231. The opportunity cost of using water to generate electricity today is the value of using it at some time in the future to generate electricity, or its value in some other use.[200] Using water to generate electricity now extinguishes the opportunity of using that same water later, or for an alternative (non-hydro) use. The value of that lost opportunity at any given time will depend upon several things, including, current storage levels, forecast hydrological conditions and whether river inflows will be high or low, and expected future electricity prices, which will, of course, depend upon the same conditions throughout the rest of the country's hydro schemes.[201]

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each hour. Comparing realized prices with marginal supply costs in this way is a widely accepted method for measuring the presence of market power."

[199] For completeness, other key design features of the New Zealand wholesale electricity spot market are summarised in the Endnote to the Annex 3

[200] "The Economics of Electricity", Dr Brent Leyton, 4 June 2013 at para 17

[201] This paragraph comes from "Market power in New Zealand's wholesale electricity market: a critique of critiques", Hayden Green, 13 May 2019. See also "Cost Shifting: the single buyer model with price discrimination", Lewis Evans, New Zealand Institute for the Study of Competition and Regulation No. 3: 18 April 2013: "The electricity spot market gives a value to water that reflects alternative uses, the state of storage and scarcity or plenty of river flow"

232. If the storage lake is full, and more water is flowing in, there is no value in storing any water for the future, i.e. the opportunity cost of using water is zero. On the other hand, if there are low inflows to the lakes, and a spike in demand is forecast, the opportunity cost of using that water now is the price the hydro generator could have received had it held the water until the demand spike.[202]

Scarcity rents

233. In situations of scarcity, such as low lake levels because of drought, prices may need to rise in order to limit demand to available capacity. The extent to which prices must rise over and above the variable cost of the most expensive generating unit in order to limit demand to available capacity is called scarcity rent.[203]

234. Scarcity rent is the component of the price necessary to reduce demand to the point where it be met by available capacity.[204] As Prof Paul Joskow points out, scarcity pricing is not a departure from the basic principle of short run marginal cost pricing. Rather, changes in price (moving along the demand curve) when capacity constraints are binding reflect represent consumers' short run marginal opportunity cost of having more or less generating capacity.[205]

235. In the case of a hydro generator that is marginal when there is scarcity, the scarcity rent is the amount that the price must rise over and above the generator's water value (which, as noted above, is determined by the opportunity cost of the water) plus other operating costs at the time of dispatch in order to limit demand to available generation capacity.

Marginal cost

236. Marginal cost is the total cost of producing an extra unit of electricity from the least cost source (which includes demand-side options). Marginal cost is typically measured over two different frames of reference:

a. The total cost of producing one more unit of output when total installed capacity is fixed is the *short run marginal cost* (SRMC). It includes opportunity cost of water and scarcity rents as defined above.[206]

b. The total cost of producing one more unit of output over the longer term (that is, the period required to change capacity in the system) is the *long run marginal cost* (LRMC). It includes an appropriate risk adjusted return on investment if all inputs were adjusted optimally, including capital investments (which in reality take years to change).[207]

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[202] This paragraph comes from Poletti, 2018
[203] Bushnell, J, Flagg, M and Mansur, E (2017), *Electricity capacity markets at a crossroads,* UC Davis Energy Economics Program, DEEP WP 017, page 11.
[204] Bushnell, J, Flagg, M, Mansur, E, Electricity capacity markets at a crossroads, DEEP WP 017, UC Davis Energy Economics Program, page 11.
[205] Joskow, Paul L. 2008, "Capacity Payments in Imperfectly Competitive Electricity Markets," Utilities Policy, 16:159-170. While there may be few hours when capacity constraints are binding, energy prices would likely go to very high levels as demand is price-rationed and yield substantial revenue for all generators which would allow them to recover their capital costs in long run equilibrium -
[206] Yarrow, Decker, Nov 2014 at page 4
[207] Risk-averse investors require recovery of capital costs with a suitable premium for risk, as well as the fixed and variable operating costs they incur in operations -- "A Critique of Wolak's Evaluation of the NZ Electricity Market: Introduction and Overview", Prof Lewis Evans, Seamus Hogan and Peter Jackson, Working Paper No. 08/2011 at page 9

Price discovery process

237. Efficient economic costs of producing an additional unit of electricity are revealed in a process of competitive price discovery, which is an iterative process characterised by a continual updating of forecast information, with market participants adjusting their offers in response to the new information. In effect, a generator's offer is a short-term contingent forecast of its own costs at the relevant dispatch times. In highly competitive markets, competitive pressures may be sufficient to cause generators to bid close to their forecast economic costs. [208]

238. The information required for this includes the level and price sensitivity of demand, the level and availability of supply (including expected future values of water), which is influenced by the costs and expectations of rivals, and system conditions under which the demand is to be supplied. Offers also factor in relative degrees of contract cover, and availability and cost of alternative risk management options, recognising that contract positions can change quickly if the related hedge market is relatively liquid.

239. Only when all supply-side and demand-side information is combined will the level of any opportunity costs (or scarcity rents) be determined. In technical economic terms, *economic costs* and prices are jointly and simultaneously discovered via the competitive process. They are not something that can accurately be determined *ex ante* for the simple reason that the information required will not be fully available ahead of the price determination process itself.[209]

240. It is argued that efficient price discovery is more to do with the discovery of efficient levels of economic rents than with achieving efficient dispatch in the very short term.[210]

Efficiency benchmark

Difference of views

241. There is a strong difference of opinion among some economists in relation to whether the frame of reference for efficient prices is SRMC or LRMC. The Authority in New Zealand and the AEMC in Australia consider that the correct measure of whether prices are efficient in the electricity spot market is whether average spot prices over time reflect long run marginal cost (LRMC).[211] This is viewed as consistent with a normal competition law approach. [212]

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[208] Yarrow, Decker, Nov 2014, page 21

[209] Yarrow, Decker, Nov 2014, page 21. In a submission for Meridian, Sapere similarly observes that the efficient price is the opportunity cost and this depends upon the expectations of the generator and marginal demand – see "A clearer High Standard of Trading Conduct Rule", Sapere (Kieran Murray, Toby Stevenson), 14 February 2018 at section 4.5

[210] Yarrow, Decker, Nov 2014 at bottom of p.7 and top of p.8

[211] For a description of the Authority's view, see EA, Dec 2017 at 9.4. For a description of the AEMC's view, see Yarrow, Decker, Nov 2014 at top of p.22 and "Market behaviour rules in New Zealand and internationally", Sapere (Kieran Murray, Toby Stevenson, Sally Wyatt & Eva Hendriks), 29 November 2012 at p.6. This LRMC approach was used by the 2018/19 Electricity Price Review (see "First Report for Discussion", New Zealand Government, 30 August 2018 at p.32) and the 2009 Ministerial Review of Electricity Market Performance (see Electricity Technical Advisory Group and the Ministry of Economic Development, August 2009, Volume 2, at 239 – cited with approval by "The Economics of Electricity", Dr Brent Layton, 4 June 2013 at para 17). See also "Cost Shifting: the single buyer model with price discrimination", Lewis Evans, New Zealand Institute for the Study of Competition and Regulation No. 3: 18 April 2013 at p.4

[212] Yarrow, Decker, Nov 2014 at top of p.22

242. Critics of the LRMC approach argue that it is inconsistent with the economic literature, which calculates market power rents by looking to see if prices are above the SRMC competitive benchmark.[213] Their view is that market power is being exercised whenever prices are consistently above [short run] marginal cost (treating investment costs as sunk), which may well be below the LRMC for many years.[214]

243. It has been pointed out that, in New Zealand's energy-only, hydro dominated system, such a narrow SRMC approach would not recover the risk adjusted capital costs of producing electricity from installed generation[215], and this would likely have a material adverse impact on incentives for new investment and security of supply.

244. We would also observe that seeking to model efficient prices benchmarks over long periods at a system-wide quantitative level in the New Zealand, where water values and scarcity rents are such significant and hard-to-model factors, is inherently difficult. Relatively small variations in inputs can have a substantial effect on modelling results.

No conceptual conflict between SRMC and LRMC

245. Prof George Yarrow and Dr Decker point out that short-run efficiency requires clearing prices to reflect economic cost, which includes scarcity rents.[216] As noted above, scarcity pricing is not viewed as a departure from the basic principle of short run marginal cost pricing.[217] Further, Prof James Bushnell (with two colleagues) observes that, in a competitive market with free entry, the scarcity rents will on average equal the cost of new capacity over time.[218] In short, the net present value of efficient SRMCs should equal LRMC over time. Yarrow and Decker appear to hold the same view.[219]

246. In this sense, there is no conceptual conflict between using SRMC and LRMC as the efficiency benchmark.

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[213] For example, Poletti, 2018. Note that Hayden Green argues that Dr Poletti's SRMC-based benchmark provides for sufficient compensation to cover their fixed costs should already be factored into the scarcity values enshrined in Dr Poletti's competitive benchmarks, and that generators do not need even higher prices in order to earn a normal rate of return – prices at those levels are likely to deliver excess returns – see "Market power in New Zealand's wholesale electricity market: a critique of critiques", Hayden Green, 13 May 2019. Paul L Joskow and Edward Kahn state the orthodoxy for assessing price efficiency as follows: "The more the observed price exceeds the competitive benchmark price, the more one can presume that either market power was being exercised or some other source of market imperfection has interfered with the competitive interplay of supply and demand. The competitive benchmark that we utilize is the short run marginal cost of supplying electricity from the last unit that clears the market in each hour. Comparing realised prices with marginal supply costs in this way is a widely accepted method for measuring the presence of market power"- Joskow, Kahn, 2000, p. 9 (earlier version of their March 2001 paper)

[214] Poletti, S., (2018). *Market power in the New Zealand wholesale market 2010-2016,* University of Auckland at page 9, para 2

[215] Where the value of installed generation is related to LRMC over time

[216] Yarrow, Decker, Nov 2014 at p.4, 2nd to last para

[217] While there may be few hours when capacity constraints are binding, energy prices would likely go to very high levels as demand is price-rationed and yield substantial revenue for all generators which would allow them to recover their capital costs in long run equilibrium - Joskow, Paul L. 2008, "Capacity Payments in Imperfectly Competitive Electricity Markets," Utilities Policy, 16:159-170.

[218] Bushnell, J, Flagg, M, Mansur, E, Electricity capacity markets at a crossroads, DEEP WP 017, UC Davis Energy Economics Program, page 11.

[219] Yarrow, Decker, Nov 2014 at p.22, 1st para: "there is no conceptual difficulty in extending the definition [LRMC test] to encompass assessments of rather shorter term price movements, or periodic but recurring spikes in prices, which lead to a deviation between the NPVs of revenues and costs of equivalent value to that implied by the AEMC test as currently specified. In both cases the NPVs of the returns from above-cost pricing, which is the underlying measure of the potential for harm, would be the same".

247. In relation to assessing questionable high prices in short term pivotal situation, SRMC (with proper water values and scarcity rents) in a market with no significant market power would seem to be an appropriate efficiency benchmark.

248. We note in passing that, in its market performance review on the 2 June 2016 event, the Authority refers to short-run marginal cost (SRMC) as a relevant benchmark: "As last resort plant becomes more hedged, they would be net pivotal less often, and would have less incentive to raise offer prices above SRMC, resulting in fewer and less extreme price spikes"[220].

249. The Authority also cited SRMC as the appropriate counterfactual for pivotal situations in its feedback to WAG on a draft of their discussion paper. The Board noted that "ideally prices in a pivotal supplier situation would be notified well in advance to allow those affected to consider alternative arrangements, which would cause the price to settle at a level just below the *short run marginal cost* of the next best alternative"[221] (italics added).

250. Our proposal does not prescribe whether SRMC or LRMC should be used as the counterfactual. Which is appropriate will depend on the circumstances. For a short term pivotal event, SRMC may be best. If the offers in question have longer term implications, a comparison of trends toward LRMC may be better. It will be for the enforcement decision-maker (Authority, Rulings Panel or Courts) to decide.

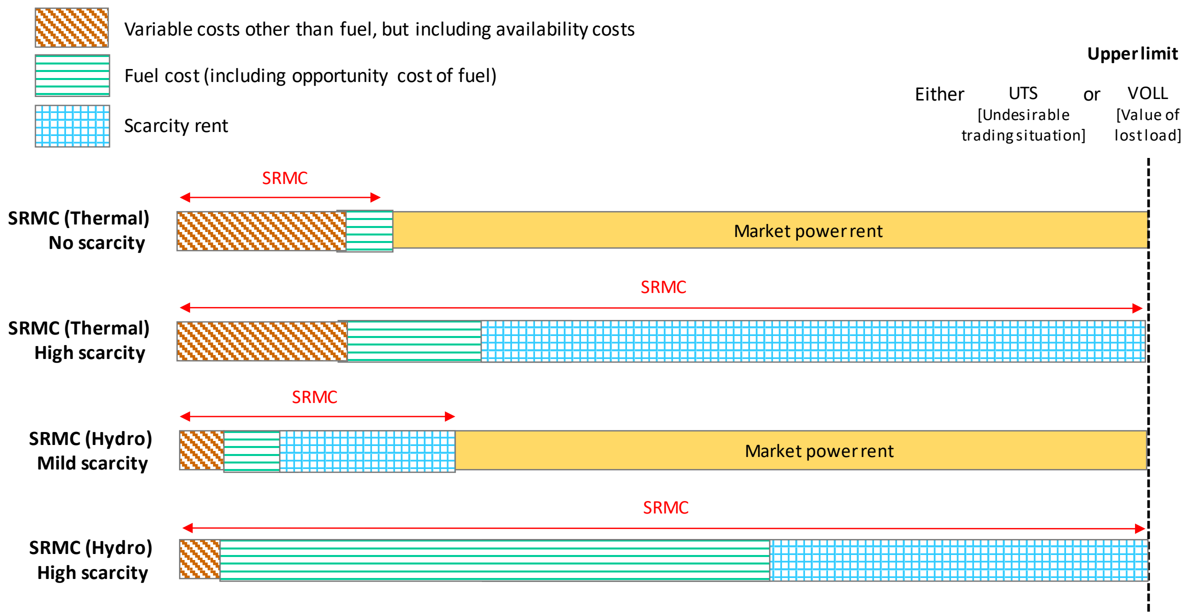
251. This is no different to the status quo. The same issue and choice arise in any application of HSOTC to a pivotal situation, or indeed any other offer.

Illustration of SRMC efficiency benchmarks

252. Figure 10 below shows how the level of the SRMC efficiency benchmark can vary across a wide price range, depending on supply and demand conditions. Among other things, the diagram also seeks to show that the opportunity cost of water tends to have a wider range of variation than for thermal fuel; and scarcity rents for thermal and hydro generation can vary across a similar range.

[220] EA, Dec 2017 at 8.24
[221] WAG, Sept 2013 at 3.1.5

Figure 10: Illustration of SRMC efficiency benchmarks



In conclusion

253. The real-world boundary between efficient SRMC and market power rent can be blurred. As Professor Bill Hogan has observed, the most difficult problem is distinguishing good high prices from bad high prices. In the presence of shortages, high prices can be efficient, a symptom of market failure, or the result of bad market design.[222] Similarly, Professor Paul Joskow suggests: "even the best-designed mitigation measures will inevitably 'clip' some high prices that truly reflect competitive supply scarcity and consumer valuations for energy and reliability as they endeavor to constrain high prices".[223]

254. As noted above, the test proposed by Yarrow and Decker for when there is 'significant' market power, is when the potential for inefficiency or harm is sufficiently high to warrant the incurring the costs of intervening.[224]

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[222] "Market power and Electricity Competition", William W Hogan, 25 April 2002 at slides 9 and 10

[223] Paul L. Joskow, "Comments on FERC's Standard Market Design Proposals", Center for Energy and Environmental Research, January 2003

[224] Measuring both potential harm/inefficiency and costs of intervention in net present value terms – see Yarrow and Decker, Nov 2014, at page 21, paras 4 and 5. For completeness, we note that, more broadly, there is a school of thought that, in the real world, competitive markets generally are not characterised by price equal to marginal cost – that it is the wrong benchmark for judging possibly anti-competitive behaviour, and that things are complex and more risky than the marginal cost criterion recognises. The proposition from this perspective is that, given the difficulties of satisfactorily defining and proving anti-competitive conduct, it is better to focus on structure and incentives in designing remedies (new entry, enforced divestment, contracts markets and the like), rather than on conduct - see Littlechild, 2001. We address this view in Part D of this paper.