Consultation Paper

for

ELECTRICITY COMMISSION

Demand-side Bidding and Forecasting Proposal

Contents

1. Terminology

Act	Electricity Act 1992
Commission	Electricity Commission
DRS	Demand Response Schedule
DSBF	Demand-side Bidding and Forecasting
EGRs	Electricity Governance Regulations and Rules 2003
FIR	Fast Instantaneous Reserve
FRR	Frequency Regulation Reserve
GPS	Government Policy Statement on Electricity Governance
GXP	Grid Exit Point (this is typically a bus or feeder specific to one participant)
IL	Interruptible Load
NRS	No Response Schedule
NZEM	New Zealand Electricity Market
PDS	Pre-Dispatch Schedule
Rules	Electricity Governance Rules 2003
Scheduling period	The period for which forecasts of demand and price are created
SDPQ	Schedule of Dispatch Prices and Quantities
SIR	Sustained Instantaneous Reserve
SOI	The Electricity Commission's Statement of Intent 2004-2007
WMAG	Wholesale Market Advisory Group

2. New terms used in this paper

The following terms are introduced in this consultation paper

Conforming Load	Load that is predictable based on historical information (e.g. domestic load). More fully described in Section 8.
Non-conforming Load	Load that cannot be easily forecast based on historical information (e.g. load from some industrial processes). More fully described in Section 8.
NRS	No Response Schedule – a schedule created using a central forecast of conforming load plus customer bids for non-conforming load. More fully described in Section 6.
DRS	Demand Response Schedule – a schedule created on the same basis as the NRS but including price responsive bids for incremental demand changes. More fully described in Section 6.

3. Introduction and purpose

1 The demand-side bidding and forecasting (DSBF) proposal outlined in this paper contributes directly to the Electricity Commission's Statement of Intent 2004-2007 (SOI) and to the requirements of section 172N of the Electricity Act 1992 (Act) by promoting demand-side management and energy efficiency.

2 A number of problems with the wholesale market bidding process have been identified by industry participants. Consequently, the Electricity Commission (Commission) is seeking to improve the bidding process, and thereby improve forecast load and price accuracy. The proposal detailed in this paper also has benefits in enabling increased demand response to price, improved system security, reduced frequency regulating reserve (FRR) costs, reduced compliance and risk management costs, and increased dynamic efficiency (where demand response defers the need for investment while maintaining service levels).

3 The purpose of this paper is to:

a) present detailed design specifications for the DSBF proposal, building on the work undertaken to date on the high level objectives and design; and

b) invite interested parties to make submissions on the proposed design specifications for the DSBF proposal.

4 This paper does not constitute the formal consultation and submission process as prescribed in sections 172E(2) and 172F of the Act and should not be considered a formal statement of proposal. However, the Commission considers that, by inviting participants' feedback at an early stage in the development of the DSBF proposal, a greater understanding will be obtained of the practical alternatives, costs and benefits

5 This paper is also a means of gathering participants' views on certain technical aspects of the design, so that the specifications can be developed sufficiently to allow rule changes to be drafted. Therefore, this paper is a necessary first step towards a formal round of consultation which will meet the requirements of the Act.

6 The formal consultation round will take place once submissions on this paper have been analysed, the design specification for the DSBF proposal has been further developed, alternatives have been identified and assessed, and detailed rule changes have been drafted.

4. Submission requirements

7 The Commission would like to invite submissions on the proposal and in particular would like answers to the specific questions raised within the paper, by 5pm on Friday 17 June 2005. Please note that submissions received after this date may not be able to be considered.

8 The Commission's preference is to receive submissions in electronic form

(Microsoft Word format or pdf) and to receive one hard copy of the electronic version.

9 The electronic version should be emailed with the phrase "Submission; Demand Side Bidding and Forecasting Consultation" in the subject header to info@electricitycommission.govt.nz, and one hard copy of the submission should be posted to the address below:

Jenny Walton
Electricity Commission
Level 7, ASB Tower,
2 Hunter Street
PO Box 10041
Wellington
New Zealand
Tel: (04) 460 8860
Fax: (04) 460 8879

10 The Commission will acknowledge receipt of all submissions electronically. Please contact Jenny Walton if you do not receive electronic acknowledgement of your submission within two business days of sending it.

11 Your submission is likely to be made publicly available on the Commission's website. Submitters should indicate in a covering letter any documents attached in support of the submission, and clearly indicate any confidential information provided to the Commission.

12 All information provided to the Commission is subject to the Official Information Act 1982.

5. Background

13 Prior to the commencement of the Commission and the Electricity Governance Regulations and Rules 2003 (Rules), the New Zealand Electricity Market (NZEM) assessed the role of demand bids in the electricity market. This was a long-term development issue for the electricity market. At the time of handover from NZEM to the Commission, a proposal had been developed to capture the benefits of central load forecasting, while also facilitating demand-side price response through the bidding process.[1]

14 The Commission has continued with this work, developing the proposal to the stage where consultation with interested parties is appropriate.

[1] See the Market Price Working Group paper 'Demand Bidding and Forecasting Project – Draft Final Report' dated 22 October 2002.

(a) Demand bids

15 Under the Rules, purchasers are required to provide demand bids which, together with generator offers and transmission information, are used to create the pre-dispatch schedule (PDS). This is a schedule of forecast load and prices that is produced every two hours from 1pm with a maximum window of 72 trading periods and a minimum window of 24 trading periods ahead.

16 The schedule of dispatch prices and quantities (SDPQ) is a shorter term price and dispatch forecast. It is produced every 30 minutes from four hours prior to real time until real time. It provides a better dispatch price forecast because more accurate generation and transmission information is available at the time each schedule is run, and a centralised demand forecast is used rather than the forecasts of individual parties. Hence, demand bids are not used in the dispatch process, due (at least in part) to the significant inaccuracy of the aggregated load bid caused by cumulative errors in the data.

17 The issue of bidding obligations and of using demand-side bids in scheduling and dispatch processes has been a topic of much debate in the industry for many years. The key issue is that demand bids and relatively accurate price forecasts are necessary to enable price responsive demand in its most efficient form. However, the aggregate of all demand bids is not an accurate enough forecast to be used in the dispatch process (due to cumulative error effects). For this reason, bids are currently not used in the dispatch process and the system operator's load forecast is used instead.

(b) Demand-side bidding and forecasting proposal

18 The DSBF proposal is a three-step approach for development of the wholesale market, focusing on the way demand bids are used in the system operator's load forecasting and scheduling processes. The three steps are as follows:

a) Step 1: Improve dispatch prices (through improvements to the central load forecasting process);

b) Step 2: Improve forecast prices with a moderate extension of the scheduling period and increased scheduling frequency. This will be called the No Response Schedule (NRS). Facilitate demand response by signalling the value of changing consumption patterns through a new schedule called the Demand Response Schedule (DRS);[2] and

c) Step 3: Full extension of scheduling period and frequency so both DRS and NRS are produced in parallel every half-hour for the following 72 trading periods.

[2] The DRS will be reproduced as the PDS is now (every two hours from 1 pm with a maximum window of 72 trading periods and a minimum of 24 trading periods ahead), and the NRS will look ahead 16 trading periods (as opposed to the 8 trading periods of the SDPQ).

19 Step 1 was implemented in 2003 as part of an internal Transpower programme to improve grid security. The remaining steps of the DSBF proposal (steps 2 and 3) have yet to be initiated, and are the subject of this consultation document.

6. Proposal outline

(a) Overview

20 The DSBF proposal is centred on two new schedules, namely the NRS and the DRS. These will replace the SDPQ and PDS respectively. The idea is to have two schedules, one with market response to price and one without. This will enable participants to see the combined effect they could have on price by reducing demand during a given period.

21 The NRS is the schedule that has no price responsive load bids, while the DRS incorporates price responsive load bids. Therefore, the difference between these two schedules signals the value of a changed consumption pattern for that trading period (i.e. the shifting or curtailing of load).

22 In effect, not only will participants see a high price in the NRS, they will also know whether they (or another party or several parties together) can bring about a lower price by reducing demand (as reflected by the DRS price). Because the price responsive demand bids are centrally processed within the SPD solve, only the minimum load reduction to affect the price would be dispatched.[3]

23 The proposed changes represent an improvement over the current situation where, only a high price reflecting full demand is signalled in the SDPQ. Currently participants do not know for sure if they can affect the associated high price through demand response. Furthermore, when a high price is signalled, many participants may respond in unison, reducing load in excess of what was required to alleviate the constraint. Therefore, the current market design may lead to inefficient outcomes.

(b) Key changes to the Rules and market design with the DSBF proposal

24 A key aspect of the DSBF proposal is the rationalising of the bidding requirements to ensure obligations on participants are the minimum necessary to ensure efficient market outcomes. Only what are known as 'non-conforming loads'[4] will be obliged to bid their total demand under the DSBF proposal (note that this is no different to their current situation). All 'conforming load' will be centrally forecast, with price responsive load bids (for

---

3 The term 'dispatched' is used very loosely here; however, it is discussed in more detail later in this paper.

4 Further explanation of non-conforming and conforming loads is provided in section 8.

incremental load changes rather than absolute load) being voluntary.

25 The second key change under the DSBF proposal is the introduction of a new schedule, the DRS (replacing the PDS), to facilitate demand response to price. The function of the DRS is to signal the market clearing-price if the expected (i.e. bid) demand response occurs. Furthermore, the demand response is optimised centrally within the SPD solve, so only the minimum amount of load reduction (or increase) required to alleviate a high price or constraint is dispatched.

26 The proposed compliance regime for price responsive load bids is expected to be very light handed, with the focus on incentives rather than penalties. It is anticipated that participants will comply with their price responsive load bids because it is in their interests to do so (both individually and collectively).[5] In general, it seems unlikely that a participant would go to the trouble (and cost) of bidding if it did not intend to comply with that bid.

27 Conforming load will not be required to bid; hence conforming load can vary demand (to a degree) without fear of compliance penalty. Some participants may have the view that this will lead to an increase in load shifts (these would not be signalled by price responsive bids), or that it is inequitable, considering that non-conforming loads must bid. However, this is not believed to be an issue as there is no reason for participants to undertake more non-bid load shifts under the DSBF than they do currently. In fact, the incentives are to bid in (as price responsive load bids) some of the load shifts that are currently not bid. Consequently, the DRS is most likely to be considerably more accurate than the current SDPQ.

28 There is no equity issue with conforming loads not having to bid changes in load. By definition, the load is 'conforming'; hence any load shifts are immaterial to the accuracy of the schedules. If the load shifts were of significant magnitude, the conforming load would likely be reclassified as non-conforming.[6]

Q1 *What are your views on the DSBF proposal? Please consider, as you read the paper, where the proposal lies in the Commission's overall priorities.*

Q2 *Do you agree that the DRS is likely to be considerably more accurate than the current SPDQ?*

5 The bidding regime under NZEM was intended to have sufficient incentives to ensure accurate bidding, but this has been found not to be the case. The DSBF proposal is entirely different, because the participants have an individual benefit in bidding their demand response (of seeing the price impact of that behaviour change), as well as a collective benefit of overall more accurate forecasts. While the individual benefit relies on relatively accurate schedules, this is realisable because the schedules will be inherently more accurate than those under NZEM.

6 It is efficient for non-conforming loads to have to bid, even though this imposes a cost on them. Non-conforming loads cause significant uncertainty in the market if they do not reliably bid their demand. There is a cost associated with uncertainty in the market (for example, reserves, price risk, etc) and this cost should be borne by the causers of that uncertainty.

(c) Benefits of the DSBF proposal

29 This section briefly outlines the benefits of the DSBF proposal.

30 The benefits of the DSBF proposal would accrue in two areas.

31 Those benefits that are more easily quantifiable are:

(a) a reduction in compliance costs for those purchasers who will no longer need to provide bids (i.e. those with conforming loads);

(b) the underlying reduced national dispatch cost brought about by efficient demand response to high prices, and management of constraints by demand-side response; and

(c) cost savings from the potential streamlining of the system operator dispatch-related security processes (the improvement in forecast accuracy may be sufficient to allow the linking of the energy and security dispatch processes).

32 Some benefits that accrue from the DSBF proposal are believed to be material, but given their nature are difficult to quantify. These are:

(a) a gain in dynamic efficiency, whereby demand response defers investment in generation and transmission while maintaining service levels;

(b) a reduction in FRR costs through greater certainty of island load (particularly stepwise load changes) and hence more efficient use of available FRR bandwidth;

(c) a reduction for retailers in the cost of managing risk, due to increased demand response being an additional tool to manage price risk;

(d) market efficiency gains due to forecast price accuracy improvements; and

(e) eliciting a greater volume of demand response, especially industrial plants that require planning time to co-ordinate outages across either plant and/or processes as a result of the increased forecast timeframe and schedule accuracy.

Q3 *Do you agree with the benefits of implementing steps 2 and 3 of the DSBF proposal? Why or why not?*

Q4 *Do you have a suggestion on how the benefits might best be quantified? Can you provide an estimate of your own expected benefit?*

(d) Costs of the DSBF proposal

33 The majority of the costs associated with step 2 of the proposal are one-off, and are incurred at implementation. These costs arise from the need to make changes to the SPD and COMIT software to facilitate data handling and processing to create and publish the NRS and DRS. These costs are

relatively well defined, and are approximately $600,000.[7]

7. Alternatives to the DSBF proposal

34 In order to put the DSBF proposal in context, it is useful to consider alternatives. Two alternative mechanisms to achieve the same (or similar) outcomes to the DSBF proposal described in this paper are considered below. These are:

(a) facilitating the volume benefit of demand response only (not the price benefit); and

(b) using a deviation schedule to illustrate (crudely) the price impact of demand response.

(a) Volume benefit

35 It is known that some demand-side response does occur in the current market framework. This demand response occurs primarily to achieve the volume benefit, as the price benefit of demand response is not signalled. Improving the price forecast accuracy (as has already been done under Step 1 of the DSBF proposal) may facilitate this type of demand response because if the forecast is reliable, participants are more likely to respond to it. Further amendments to the Rules to facilitate volume benefit demand response might include removing the requirement for conforming load to bid and only requiring non-conforming load to bid (as they do now). This change would have a much shorter implementation time and significantly lower implementation costs than the DSBF proposal.

36 The benefits of facilitating 'volume benefit' demand response include reduced compliance costs for those purchasers who are no longer required to bid and the potential for constraints being relieved during high price periods through increased price responsive demand.

37 Under this scenario, individual participants are unable to discover the marginal value (i.e. price effect) of their demand response, and can only be sure of the volume benefit. While participants may *hope* for a commensurate price reduction due to a given volume of demand response, they cannot currently evaluate the extent of any price reduction.[8]

38 The main problem with facilitating only the volume benefit demand response is that it does not signal, ahead of time, the full benefit or cost of reducing

---

7 Transpower has indicated verbally that their costs may change. The changes in costs relate to the SPD replacement project, and will be borne out in more detail in the updated cost information that has been formally requested.

8 Furthermore, if demand response does reduce price, it can be very hard for say, a trader, to explain to their Board that the reason the final price was so low (even though forecast price was high) was due to their reduced load. A Board may take the view that the final price was low, thus the load shouldn't have been dropped.

demand for a particular trading period. It also does not signal the price impact of returning load. Therefore, while this 'volume' benefit of demand response can be a crude mechanism to manage price risk, it is not optimal.

39 The secondary problem with this type of demand response is that it is not centrally co-ordinated. Every participant responds individually when they see a price higher than their willingness to pay. In this way, even if only 10 MW is needed to be dropped to relieve a constraint, all participants may respond, reducing consumption well below what would have been efficient to consume. Hence, while this type of demand response is simple to effect, it may not necessarily facilitate efficient demand response.

(b) Deviation schedule

40 The option of using a deviation schedule is slightly more advanced than simply facilitating the volume benefit of demand response alone (as above).

41 A deviation schedule is a schedule that would be prepared for each grid exit point (GXP), outlining the price impact of (say) a 5, 10, 20 and 50 MW load reduction (or increase) at that GXP.

42 The benefits of this option are similar to those for option (a) described above in paragraph 36. An added benefit of the deviation schedule is that the net price benefit of a reduction in demand and subsequent increase is indicated.

43 The disadvantages of a deviation schedule are as follows:

(a) the schedule assumes only one participant responds. The schedules are not co-ordinated centrally, they are all independent (i.e. if more than one participant reduces demand then the price will reduce more than expected, leading to inefficient load drops, as with the above option);

(b) participants do not know the price of returning load. While they have the 'deviation schedule' for a load increase, they do not know how other participants will behave; and

(c) there is a significant amount of data processing (with commensurate hardware costs) to create the deviation schedules for each GXP and for each trading period in the schedule.

44 The concept of deviation schedules is of primary benefit in markets where there are constraints with only one participant upstream of the constraint. In this scenario, there will always be only one party responding to the high price; hence, the lack of central coordination is not necessary. However, this is not the case in New Zealand.

Q5 *Are there any other alternatives to the DSBF proposal that have not been discussed here? What are these?*

(c) Alternatives compared with the current DSBF proposal

45 The two alternatives considered briefly above do not appear to achieve efficient outcomes from demand-side response. The alternatives would likely lead to inefficient consumption outcomes because the aggregate effects of participants' responses across the market are not centrally accounted for.

46 In order to achieve efficient outcomes (as prescribed in the GPS) some form of bidding of demand response is required to discover the efficient market price in any trading period.[9] It is this bidding of intended demand response that forms the basis of the DSBF proposal. The DSBF proposal aims to keep the bidding requirements (and associated obligations) to a minimum while still achieving efficient outcomes.

Q6 *Do you agree with this assessment of the alternatives compared to the DSBF proposal? Why or why not?*

8. Design specifications of the DSBF proposal

47 The Commission included the DSBF task on the Wholesale Market Advisory Group (WMAG) work plan. This section highlights the further developments of the DSBF proposal since it was handed over to the WMAG.

48 The WMAG considered that the NZEM proposal (outlined in Section 6 above) was not specified to a sufficient level of detail to develop a comprehensive set of rule changes on which participants' views could be sought. For example, the compliance regime and the definitions of both conforming and non-conforming loads are issues that required further consideration before rules could be drafted. Furthermore, the changes brought about by regulation and subsequent rule changes also subtly affect the original proposal.

49 The WMAG advised the Commission that, rather than attempting to draft rule changes based on the NZEM proposal, a high level specification for the rule changes should be drafted and subsequently used for an initial round of consultation.

50 The Commission engaged M-co and Transpower to develop these design specifications using the NZEM proposal as a starting point.

51 The primary areas of the NZEM proposal that have been further developed are:

a) identifying non-conforming loads;

b) agency issues and impact on reconciliation;

c) centralised versus decentralised dispatch of price responsive load bids;

d) bidding of demand increases as well as decreases;

9 Forecast prices are the signal for demand response, and demand can affect price. Therefore, demand bids are necessary to achieve efficient outcomes.

e) interaction of price responsive demand and the interruptible load market;

f) scheduling period (forecast duration);

g) forecast price accuracy; and

h) compliance.

52 These issues are discussed in more detail below.

(a) Identifying non-conforming loads

Overview

53 The DSBF proposal treats conforming and non-conforming loads in a different manner. For this reason, it is necessary to be able to quantitatively distinguish between load types.

54 Conforming load is predictable (inter-trading period) and can be readily forecast based upon historical information. Domestic load is a good example of conforming load as there is a strong daily pattern, as well as an annual pattern that can be forecast from only a few parameters (for example, time of day, time of year, and ambient temperature).

55 Non-conforming load cannot reasonably be forecast by the system operator to the same level of accuracy as conforming load. This load is often associated with an industrial process, which may be inherently variable due to production schedules.

56 It is this distinction between load types that determines whether a participant is obliged to bid their demand, or if bidding is voluntary. Those participants identified as non-conforming load will (as currently is the case) bid their gross demand.

Identifying non-conforming load

57 Ideally, the quantitative distinction between conforming and non-conforming load will be specified in a prescriptive format such that any party can determine if they are likely to be in one category or the other. Alternatively, it is possible to allow the method of this load-type categorisation to be determined by the system operator. This is less desirable as the process would not be as open to scrutiny as a prescriptive approach and may lead to perceptions of inequity.

58 Furthermore, the prescriptive approach allows participants to understand the aspects of their consumption behaviour that causes their non-conforming status. This means participants are able to:

a) understand the impact of their behaviour on the wider market; and

b) trade off the costs of having to bid their non-conforming load against the costs of modifying their behaviour (or processes) to give a more predictable consumption pattern[10]; or

c) demonstrate to the system operator[11] that their demand profile is actually forecastable, even though it may not be able to be picked up by the central load forecasting algorithm.

59 One option for a prescriptive approach is outlined below:

a) use a 'magnitude threshold' to determine if the inter-trading period load variations (at any particular GXP) will have a material effect on area forecast accuracy if that load is not bid (for example, a 1 MW non-conforming load has a much lower impact compared to a 100 MW non-conforming load); if the variations are material, then

b) determine if the GXP load is correlated[12] to the 'error in the area load forecast' in full or in part (for example, by looking at a rolling daily correlation for an annual data set). The error in the area load forecast represents the demand that was not accurately forecast, and typically represents the non-conforming loads. The difficulty here is that the correlation may only exist for short periods due to the inherently intermittent nature of many non-conforming loads; if the load is correlated, then

c) quantify the prevalence of the correlated episodes. That is to say, determine the respective percentages of time that the GXP load is highly and moderately correlated to the error in the area load forecast.

60 The three stages above would be applied to all GXPs such that they could subsequently be ranked in terms of contribution to forecast error.

61 Once all the GXPs are ranked, the 'cut-off' point would be determined such that the primary non-conforming GXPs that cause load forecast errors are identified. The objective is that these primary non-conforming loads bid their demand results to achieve the level of load and price accuracy collectively desired by the market participants.[13]

62 Whether a prescriptive approach to determining non-conforming load is adopted or not, the efficacy of the central load forecast (as well as the associated systems such as bidding of non-conforming load) will require ongoing monitoring. This is to ensure that the forecast price accuracy and dispatch integrity desired by the market are being achieved. Furthermore, it would be prudent to ensure that obligations to bid (as placed upon non-conforming loads) are kept to the minimum necessary to achieve the collectively desired outcome.

---

10 While possible and theoretically an efficient outcome, this is recognised as unlikely in most cases as the costs of bidding will be far less than the costs of changing demand patterns.

11 (or other authority which determines conforming and non-conforming loads)

12 This is likely to be a non-linear correlation assessment, linearity cannot be assumed.

13 An accurate demand forecast does not ensure forecast price accuracy (due to a variety of effects, one of which is including un-offered generation). However, an accurate load forecast is a key requirement for forecast price accuracy.

63 Consequently, it will be necessary to monitor the incremental improvement of forecast price accuracy as a result of non-conforming load bids. This will, by default, be the process by which participants who are currently defined as non-conforming loads can have their status changed to conforming if their bidding is shown to be accurate and does not materially contribute to the load forecast accuracy.

64 The monitoring is likely to be undertaken by the party who determines the non-conforming loads.

Q7 *Should the non-conforming loads be identified by a prescriptive means, or by methods determined by the system operator?*

(b) Agency issues and impact on reconciliation

65 This section discusses the issues around the bidding party and the incentives on various parties to bid price responsive load.

Agency issues

66 There is an incentive to bid significant load variations. If a participant chooses not to bid and is also not identified as a non-conforming load, then, under the proposal, they are largely free to vary their demand without any penalty. However by not bidding, they along with other market participants will not know the price impact of varying their demand. If the participants want to know the price impact, they must bid and, therefore, be bound to any compliance regime that is in place.

67 In this way, it is unlikely that there will be any increase in the non-bid demand response over that which currently occurs (for example, lines companies load shifting). This is because any increase in demand response over and above the current situation is almost certainly going to be price responsive, and the parties will be interested in the price effect and will bid their intended response.

Q8 *Do you agree with the reasoning above? Is there likely to be an increase in non-bid demand response over the current situation? Please explain.*

68 One option is to have the party who actually controls the load physically (the switcher) as the party who can bid. In this way the communication is simpler and compliance more likely to result.

69 An alternative view is that purchasers should bid price responsive load as they are the parties concerned with price (a lines company may be able to control hot water load, but does not generally have regard to wholesale electricity prices).

70 In addition, because bidding price responsive load may also incur compliance costs if bids are not reasonably adhered to, it is appropriate that it is the party benefiting from the price responsive load bid (i.e. the retailer) that is exposed

to the costs of compliance.

An option for controlling domestic hot water

71 In some regions, there may be multiple purchasers who could potentially use the same load management capability (for example, domestic hot water). It is expected that only one retailer would be permitted (via the Rules) to bid the controllable hot water load at a GXP.[14] This is necessary to ensure that a given price responsive load capability is only bid once in any one trading period. If two or more retailers at the same GXP bid the same hot water load in a trading period, this would be a distortion as it would overstate the available demand response.

72 The practical issue of who bids the load and who controls it would need to be managed by contractual arrangements between all the parties (retailers and the distributor) at the associated GXP (see Appendix A).[15]

73 There may be a perceived issue because the retailer who is using the domestic hot water as price responsive load can affect the price (and volume) of another retailer's customers at that GXP. However, this is no different from the current situation whereby the lines company uses the domestic hot water load to manage its own network peaks and constraints or to offer into the reserve market.

Reconciliation

74 No significant barriers to the DSBF proposal within the current reconciliation processes have been identified. However, process improvements (mainly in profiling) could be made to ensure that a retailer can fully capture the direct financial benefits of using domestic hot water capability for price response.

75 The current profiling arrangements see the benefits of hot water-based demand response accrue to all retailers at a GXP, regardless of the retailers' respective make-up of customers with and without ripple controlled domestic hot water.

Q9 *Do you agree with the analysis on agency issues and impact on reconciliation as discussed above? Are there any other related issues that should be taken into consideration?*

14 More specifically, one retailer would be permitted for each independently controllable block of hot water load.

15 Clearly, the consumer 'owns' the load in the first instance. It is their choice to use electric, gas or solar hot water based heating systems. Similarly, if electrically heated hot water is the preferred option, it is the consumer's choice if they want to meter that hot water separately and have it available for ripple control. It is only once the consumer contracts with a retailer and delegates the authority to control the hot water that things become less clear, though not irreconcilable (see Appendix A).

(c) Centralised versus decentralised dispatch of price responsive load bids

76 It is necessary to decide whether price responsive load should be formally dispatched by the system operator (through normal dispatch instructions), or if the DRS price is sufficient to signal the dispatch of price responsive load.

Issue definition

77 In theory, the price discovered in the DRS immediately prior to a particular trading period (compared to a participant's bid price) is sufficient to signal to the participant whether or not their bid is cleared. In this way, formal dispatch instructions for price responsive load could be unnecessary.

78 However, in practice, without clear and binding dispatch instructions, some participants may not always comply with their bids. Therefore, it is possible that, in some trading periods at least, the actual demand will be materially different from that predicted by the DRS. If these differences are material (to price, or security) then dispatch by price alone may be deemed insufficient.[16]

79 The costs of dispatching demand would also need to be considered in determining whether to have formal dispatch instructions for price responsive load. These would include the costs of requiring participants to invest in 'Genco' systems to receive and acknowledge dispatch instructions.

Conceptual overview

80 At a conceptual level, the incentives for bid compliance are largely similar for each dispatch option. This is because:

a) price responsive load bids are voluntary, hence if a participant sees a benefit in bidding in the first place, they similarly face incentives to comply with that bid to capture the price benefit (unless their local circumstances materially change within the 2-hour gate closure period);

b) if an unforeseen change to demand is required inside the 2-hour gate closure, (for example, in an industrial process), then this will result in either a bona fide physical situation or non-compliance with bid situation; and

c) the same outcome is sought with each option (i.e. bid compliance), and therefore the same outcomes for non-compliance should result. This is to say, the option of 'self dispatch' against DRS price should give no more autonomy, and no less accountability, than the option of formal dispatch by the system operator.

[16] The lack of compliance with bids is only one of many possible causes of forecast inaccuracy. This must be considered in the context of the inherent forecasting error, un-offered generation (both of which materially impact on forecast price accuracy), as well as offer variability within the 2-hour gate closure period (for example, wind generation).

Related issue

81 The key theoretical benefit of dispatching load is more accurate dispatch. This arises because the system operator would receive acknowledgment of dispatch instructions from dispatched price responsive loads (and thereby become aware of non-compliant bids).[17] If the self-dispatch option is employed, and some participants do not comply with bids, then the system operator will see a deviation from forecast behaviour, but will not be aware of the reasons for the deviation.

Q10 *Should price responsive demand be dispatched by the system operator, or will the DRS provide a sufficient signal to relevant parties to activate their demand response in a specific trading period?*

(d) Bidding of demand increases as well as decreases

82 This section primarily discusses demand response where any load dropped is subsequently returned (such as domestic hot water). First, the issues at a conceptual level are discussed, then issues at an operational level.

Conceptual overview

83 Demand response is often thought of as the shedding of load in response to high prices. However, while this is the concept in its simplest form, operationally there is substantially more involved. Not only is it essential to signal at what price a volume of load will be dropped, but also when (and at what price, if relevant) this load will be returned. These load reductions and commensurate increases both need to be signalled for two reasons:

a) so the system operator can schedule sufficient generation for the load return as it will not be centrally forecast in the NRS schedule; and

b) so that the participant can determine the economics of the overall load shift by comparing the net benefit of both the load drop and return, not just looking at the load drop in isolation.[18]

84 Therefore, there are efficient incentives for participants to bid both price-responsive load increases and decreases.

Dependent bids (returning of load)

85 There is an issue in relation to gate closure, and the inherent dependency between some load-drop bids and subsequent load-increase bids. Consider domestic hot water. The participant must bid both the load drop and the load increase. It may be that the load drop is *not* cleared (due to the DRS price being too low), but the load return *will* be cleared as it will typically be at a

17 It is possible that participants could ‘auto-acknowledge’ dispatch instructions, regardless of their intent to comply or not, thus the benefit of more accurate dispatch may not arise in reality.

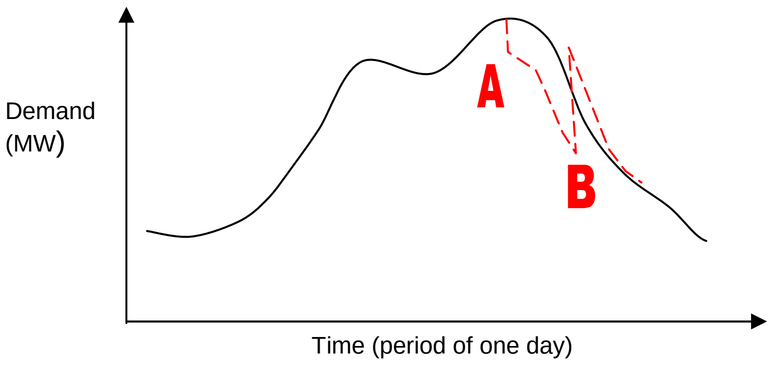
18 There is little point is shifting load from a high price period only to find that when it is reconnected, the price is as high or higher than when it was first dropped.

very high price (for example, a price related to penalties payable to customers for breaching the consumer/retailer contract). If the load drop and return were both to happen inside two hours, then the participant cannot change its bid for the load return if the load drop is not cleared. Therefore, it is possible that invalid bids may persist, with participants physically unable to comply with them.

86 While it may be a very useful feature, automatically removing dependent bids where the initial bid is not cleared is likely to be significantly complex. For example, if load is forecast to be dropped at 'A' (see figure 1 below), but the bid is not cleared, then the bid to increase load at 'B' must be removed, as it cannot be complied with. The SPD software treats each trading period in isolation, and there is no inter-temporal optimisation by SPD itself.[19]

87 This problem of dependent bids can be partially resolved by requiring bids to be relative to the NRS rather than 'absolute' (i.e. bid differences, not full demand) or relative to the DRS. However, this only solves the issue for demand response that is exactly energy neutral. Much demand response such as domestic hot water is not strictly energy neutral. There is an inherent cooling effect with hot water systems such that when hot water load is switched off, the systems that were already on cool down, and those that were already off (due to natural diversity of systems) may actually be ready to turn on. Therefore, when the hot water load is switched back on several hours later, there is a greater power (MW) demand than was switched out (see figure 1 below). Ideally, this increase should be bid as a price responsive load bid.

Figure 1. Return of dropped load



Q11 *It is proposed that this problem is not resolved by modifying SPD. Rather it is proposed that participants are responsible for removing dependent bids (if outside the 2-hour gate closure period). What are your views on this?*

Q12 *Is this likely to be a material issue? (how often are load drop and return cycles likely to be less than 2 hours?)*

[19] Optimisation of dispatch from one trading period to the next is achieved through bids and offers, thus the onus for optimisation in this time domain is on participants.

Format of price responsive load bids

88 There is an issue relating to how bids are made, for example, should they be relative to the NRS load forecast, or the DRS load forecast. Here, it is necessary to consider simplicity, ease of implementation, and the interaction with the load-forecasting algorithm.

89 Consider the table of bids and outcomes below, along with the diagram in figure 2. Here the bids are relative to the NRS, and when the participant wants to signal the return of load previously dropped, they only have to bid 'zero'. Furthermore, the NRS is produced half-hourly (initially), as opposed to the DRS, which will be at least 2-hourly, hence the NRS is the most up-to-date schedule.

90 If the bids were relative to the DRS (see figure 3), then '+5 MW' would have to be bid to signal return of (previously dropped) load. In addition, a zero bid will signal that load will continue to be dropped if it was dropped in the previous trading period.

91 In both of the examples below the participant wants to drop 5 MW of demand in all periods except trading period 4, where there will be no demand response. Note that the tabulated bids to effect this result are much simpler if they are relative to the NRS, as opposed to the DRS.

Figure 2. Price responsive bids relative to NRS.

Period	Bid	Cleared
1	-5	0
2	-5	-5
3	-5	-5
4	0	0
5	-5	-5
6	-5	-5

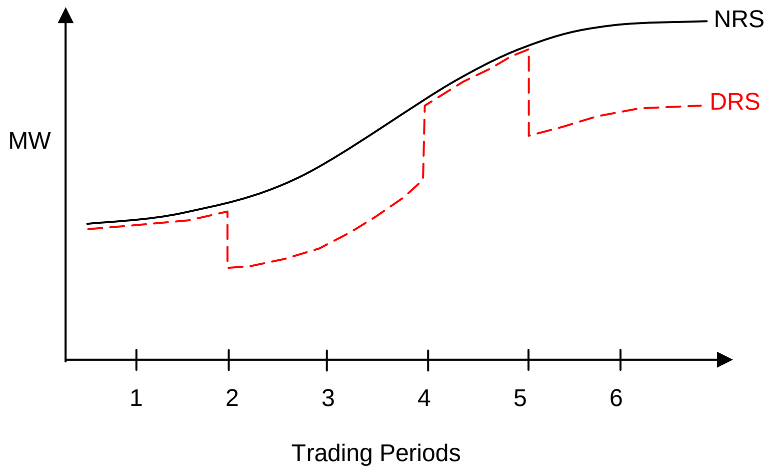
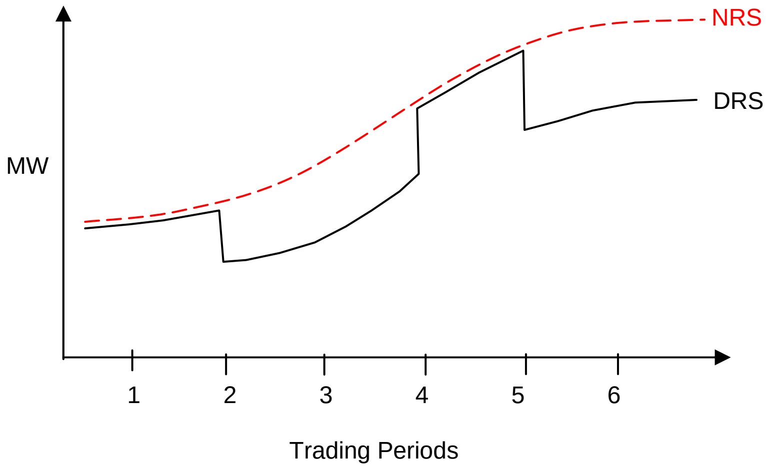


Figure 3. Price responsive bids relative to DRS.

Period	Bid	Cleared
1	-5	0
2	-5	-5
3	0	0
4	+5	+5
5	-5	-5
6	0	0



92 At this stage, it is considered that bids relative to NRS will be simplest for participants, and will most easily integrate with the central load-forecasting algorithm. In this way, a default bid of 'zero' signifies that no demand response will occur which adds a valuable 'fail-safe' aspect to bidding.

Q13 *Are there any other options (not discussed here) for the format of price responsive load bids?*

Q14 *Which option would you prefer for making price responsive load bids?*

(e) Interaction of price responsive demand and the interruptible load market

93 This section discusses the interaction between the price responsive load and the interruptible load (IL) market.

Conceptual overview

94 To dispatch a given volume of controllable load in any one trading period (when offered for both price responsive load and IL) could cause security issues because instantaneous reserves may then be under-procured. If the volume of controllable load is dispatched as price responsive demand, it is not available if called upon to be shed during an under frequency event.

95 Generally, the technical requirements for IL are more stringent than those expected for price responsive demand. Therefore, while all current IL may be able to be used as price responsive demand, not all price responsive demand will be able to be used in the IL market.[20] Therefore, there is expected to be a

[20] IL requires load to be shed within certain timeframes (i.e. so many seconds, depending if FIR or SIR), and requires under-frequency relays to shed the IL at the appropriate time. It may be possible that a physical 10 MW block of price responsive load can be equivalent to say 7 MW of IL by determining the response rate of the load drop (this is similar to current FIR).

reasonable volume of controllable load that can be used either for price response or in the IL market as that cannot be physically dispatched for both services at any one time.

Co-optimising load shifts and IL

96 Given the above observations, it is clear that a major issue is whether to dispatch a given capability of controllable load for IL or price responsive load. Furthermore, should this decision be made centrally (for example, in the SPD solve) or by individual participants? Depending on how the relationship between IL and price responsive demand is effected, the nationally optimal solution may not be optimal for individual participants. Related issues are as follows:

a) optimisation of energy (price responsive demand) and reserves (IL);

b) complexity and ability to calculate a solution for each trading/dispatch period with reasonable computer 'solve' times;

c) meeting participants' needs (simplicity, flexibility, optimality etc); and

d) achieving correct market signals for investment (for example, if there is a benefit in having domestic hot water controlled in small discreet blocks rather than one large block, this should be reflected in value derived from bidding in smaller blocks).

97 There are two key options for coordinating the dispatch of price responsive load and interruptible load. These are listed below and expanded upon in the table that follows (note that the second option does not preclude participants offering in the manner of the first option):

a) participants bid into both markets, though they are constrained to realisable dispatch scenarios[21]; and

b) participants signal 'willingness' and 'capability' through bids, optimisation between markets is discovered by SPD solve.

98 Consider the option of a total of 5 MW that can be used for either IL or price responsive load, and is broken down in 1 MW blocks.

	Option	**Bid Structure**	**Notes**
A	Participants bid such that their bids are simultaneously feasible, and participants are responsible for apportioning their capability between IL and price responsive load.	2 MW of IL, and 3 MW of price responsive load. The sum of their bids must be less than, or equal to, their physical capability.	Sub-optimal outcomes result from this option; participants cannot discover optimal outcomes with this kind of decentralised decision making.

21 Participants cannot offer their 5 MW into both markets with option 'A', as this is an invalid dispatch scenario (they only have 5 MW total capability). However, for option 'B', the capability can be offered into both markets as SPD will solve knowing that the capability is limited to 5 MW in total.

	Option	Bid Structure	Notes
B	Participants specify both individual capability for each market, and simultaneous demand response capability if constraints exist when offering in both markets. SPD solves according to price and constraints.	5 MW bid as both IL and price responsive load. The sum of their bids may be greater than their physical capability, though SPD must also know their capability and simultaneous constraints between markets.	Optimal dispatch is achieved, as SPD solves for optimal use of capability given the bids. However, an optimal solution may be physically unachievable due to the inability to 'partially dispatch' a marginal block of controllable load that is indivisible.

99 One potentially significant issue with both of these options is that of partially cleared bids when a bid is on the margin. In general, price responsive load will either prefer, or need, to be fully cleared or not cleared at all. For example, it may be physically impossible to partially dispatch a price responsive load bid due to the electrical configuration of domestic hot water ripple control systems. The materiality of this issue is not yet known.

100 The interaction of IL and price responsive demand causes further complexity to the issue of dependant price responsive load bids (discussed above). For example, if a unit of controllable demand is bid for IL as well as price response (drop, and later return, of load) and is dispatched for IL, then there may still be an active bid for the return of the un-cleared price response bid. This issue has yet to be resolved, though is not thought to be a significant issue.

Q15 *The proposal is to use option 'B' above. Participants would be responsible for managing 'partial dispatch' issues arising from marginal bids, with the requirement that IL takes precedence over price responsive load bids. What are your views on this proposal? Please elaborate with examples or technical limitations.*

101 It is worthwhile here to also consider the potential relationship between price responsive load bids and capacity reserves. While capacity reserves are yet to be introduced, they are of some relevance to the DSBF proposal.

102 Capacity reserves are another potential use for a given quantum of load management capability. In future, a participant will have to decide whether to use its controllable load for energy price response, in the IL market, or as a capacity reserve in the form of a demand inter-trip or transmission alternative. While the choice between IL and price responsive load bids can be optimised within SPD (as discussed above), this is unlikely to be the case with capacity reserves or transmission alternatives.

103 The introduction of capacity reserves is not expected to cause significant complications for the DSBF proposal. Awareness of the interactions between IL, price responsive load and capacity reserves is required to ensure that a given load control capability is not double or triple counted.

(f) Scheduling period (forecast duration)

104 Forecast prices play an important role in the market, though it is likely that participants have different needs regarding the length of the scheduling period. The NZEM proposal suggested a 72-trading period scheduling period, though this may not be optimal from the viewpoint of all participants.

105 It is also important to recognise the linkage between schedule period, and forecast price accuracy. For example, a factor affecting forecast price accuracy is the increasing volume of un-offered generation (or permissively offered generation such as wind power) that can vary in output substantially in time frames of greater than about four hours. It may not be prudent to have a long forecast period if several hundred megawatts of generation come and go from the dispatch schedule without being signalled in the forecast price schedules.

Q16 *What scheduling period would be of most use, and why? (Consider the proposed 72-trading periods , the existing PDS period, and any alternatives that you may prefer).*

(g) Forecast price accuracy

106 Many aspects of market efficiency (and security) are predicated upon forecast prices being a good proxy for final prices.[22] Forecast prices are one of the key triggers for generators to develop their near-term generation offers and also for participants curtailing load in higher price periods (and planning of production).

107 Given the importance of forecast price accuracy to the efficacy of the DSBF proposal, ongoing monitoring of price accuracy may be beneficial. This could involve regular publication of statistics on forecast price accuracy, and perhaps identification of those GXPs that were contributing the most to inaccuracies (be it through poor offering, bidding, or load forecast errors). This would then provide the necessary base information for market refinements to improve forecast prices if required. For example, it is possible that with the current offer requirements for intermittent generators, the expected increased volume of wind power may reduce forecast price accuracy. Regular monitoring and reporting of forecast price accuracy could allow this potential issue and relativities to be quantified.

108 Similarly, if a permissive approach to compliance for price responsive bids is employed, the monitoring of forecast price accuracy will allow a watching brief to be kept on the ‘price effects’ of non-compliance with bids.

[22] As well as market efficiency, security of the power system is reliant on the system operator having a reliable forecast of load and generation offers. This is necessary so that contingencies can be planned for. When forecast prices are closely related to final prices, it indicates that the forecast information is reliable.

Q17 *What level of accuracy is required in forecast prices? Would the ongoing monitoring and reporting of forecast price accuracy be useful?*

(h) Compliance

109 There are various options for a compliance regime for the DSBF proposal. These options range from permissive, through to fully prescriptive. The approach in the NZEM proposal is relatively permissive, suggesting that only material excursions of non-compliance with bids be examined. A threshold for materiality needs to be determined whereby only material discrepancies between forecast and actual behaviour are investigated.

110 While the NZEM proposal suggests using forecast versus final demand as the flag for compliance, this may at times be ineffective (in theory at least) as it only addresses bid compliance. There may be significant benefit in having a symmetrical compliance regime whereby bid and offer compliance are addressed concurrently.

Purpose of compliance

111 Demand response is predicated upon a degree of forecast price accuracy. Even if load can be dropped at a moments notice, forecast prices are generally required to be reliable to enable decisions about when the load could be brought back on.[23] The fundamental purpose of a compliance regime is to ensure that actual behaviour is consistent with that signalled prior to 2-hour gate closure, facilitating the required degree of price accuracy. However, there is little point in having an overbearing compliance regime that seeks to improve price accuracy beyond that required by the market.[24]

112 In any one trading period, the electricity price is discovered by the interaction between supply (generation) and demand. Therefore, the unforeseen variation of both demand and generation can affect the forecast price accuracy. Causes of variation in demand and generation are as follows:

a) generation variation: intermittent generation (for example, wind, run-of-river hydro) and unplanned outages (generation plant or transmission); and

b) demand variation: inherent forecast error, non-conforming loads (industrial processes), unplanned transmission outages and failure to enter price responsive bids.

113 Therefore, it is plausible to use price to flag potential non-compliance, as it captures both load and generation variances. In addition, it has the added

[23] It is often the case that loads can only be turned off for a given maximum period of time (for example, domestic hot water). In these cases, it is typical to decide prior to dropping the load when it will be brought back on. This is because the economic viability of the overall drop is contingent on price differences between when load is dropped and when returned.

[24] A secondary benefit of this compliance regime is that security processes undertaken by the system operator may be simplified if forecast demand is more accurately known.

benefit of being an inherent measure of materiality (load variations may in fact be non-compliant with a bid, but they may have no price impact).

Alternate view on compliance

114 An alternate view of the compliance issue is that no formal compliance regime is necessary. This is based upon the observation that the proposed bidding structure is voluntary, and only of benefit when bids are complied with. In this way, the penalty for not complying with a particular bid is that the commensurate price effect is not achieved.

115 This is reasonable in theory when considering one participant at a time. However, the current market effectively has a single clearing price[25], and hence non-compliance by one party affects all parties. If one party did not comply with a bid, this is likely to adversely affect other parties who would have complied with their own bids if they had been dispatched (that is to say, the next bid may have been cleared and complied with, if the non-compliant bid was removed).

Potential issue

116 If a participant chooses not to bid, and is also not identified as a non-conforming load, then under the DSBF proposal they are largely free to vary their demand without any penalty. This may be seen by some as a flaw in the design; however this is not the case.

117 Currently, participants can vary their demand without any penalty. However, as there are costs associated with changing demand (for example, switching costs), it is usually only done for good reason. Under the DSBF proposal there is no reason to expect an increase in non-bid load variation. However, there is reason to expect some of the current load variation to be bid, as currently some participants do attempt to respond to price. Therefore, under the DSBF proposal, we would expect a net reduction in non-bid load variation.

118 However, if the DSBF bid-compliance regime is too stringent, conforming load participants who require a degree of flexibility may prefer not to bid price responsive load (due to the commensurate compliance obligations) and may just shift load as desired. In this way, it could be said that it is the load forecast that is in error, not their bids or behaviour.

119 The trade-off here is the benefit derived from knowing the price impact of their bid (i.e. the difference between the NRS and the DRS at their market node), compared with the costs of having less flexibility to respond.

Q18 *Which type of compliance regime is likely to be most effective - the original proposal of monitoring aggregate load forecast versus actual, forecast versus final price or no compliance at all?*

25 If the grid is unconstrained, then there is typically one clearing price (i.e. one marginal generator), with nodal prices varying only by losses. Other markets may ‘pay as you bid’ rather than marginal pricing, which would have different outcomes here.

9. Analysis against Electricity Commission objectives

(a) Objectives

120 Under section 172X of the Electricity Act 1992 (Act), in formulating recommendations for rules, the Commission must give effect to its principal objectives and specific outcomes[26] and its GPS objectives and outcomes.

121 The principal objectives of the Commission are to:

(a) ensure that electricity is produced and delivered to all classes of consumers in an efficient, fair, reliable, and environmentally sustainable manner; and

(b) promote and facilitate the efficient use of electricity.

122 Section 172N of the Act and the GPS requires the Commission to seek to achieve the following specific outcomes:

(a) energy and other resources are used efficiently;

(b) risks (including price risks) relating to security of supply are properly and efficiently managed;

(c) barriers to competition in the electricity industry are minimised for the long-term benefit of end-users;

(d) incentives for investment in generation, transmission, lines, energy efficiency, and demand-side management are maintained or enhanced and do not discriminate between public and private investment;

(e) the full costs of producing and transporting each additional unit of electricity are signalled;

(f) delivered electricity costs and prices are subject to sustained downward pressure; and

(g) the electricity sector contributes to achieving the Government's climate change objectives by minimising hydro spill, efficiently managing transmission and distribution losses and constraints, promoting demand-side management and energy efficiency, and removing barriers to investment in new generation technologies, renewables, and distributed generation.

(b) Analysis of proposal against objectives

123 The Commission believes that implementing the DSBF proposal would give effect to the Commission's relevant principal objectives and specific outcomes under section 172N of the Act, as detailed in the table below.

[26] These are set out in s172N.

Objectives and outcomes under section 172N of the Act	**Response**
The Commission's principal objectives are as follows:	
• to ensure that electricity is produced and delivered to all classes of consumers in an efficient, fair, reliable and environmentally sustainable manner; and • to promote and facilitate the efficient use of electricity.	A contribution is made to this overall objective as indicated through the specific objectives below. In addition, the principal objective is achieved through the dynamic efficiency gains that accrue from facilitating efficient demand response and from more accurate forecast prices.
The Commission's specific outcomes are as follows:	
a) energy and other resources are used efficiently	Demand response facilitates efficient decisions in consumption, and hence efficient use of resources.
b) risks (including price risks) relating to security of supply are properly and efficiently managed.	Demand response enables consumers to respond to price, and manage some aspects of price risk.
c) barriers to competition in the electricity industry are minimised for the long-term benefit of end-users	Competition is facilitated by allowing consumers to have an active role in the price discovery process.
d) incentives for investment in generation, transmission, lines, energy efficiency and demand-side management are maintained or enhanced and do not discriminate between public and private investment	The proposed double schedule approach (NRS and DRS) signals the value that can be derived through demand response, and facilitates investment in demand side technologies where efficient.
e) the full costs of producing and transporting each additional unit of electricity are signaled	Contributions to this objective are made through more accurate forecast prices which are expected to result from implementing the proposal.
f) delivered electricity costs and prices are subject to sustained downward pressure	Through facilitation of demand response the following outcomes lead to reduced price: - dynamic efficiency gains - an additional means to manage risk - reduced cost in bid obligations
g) the electricity sector contributes to achieving the Government's climate change objectives by minimising unnecessary hydro spill, efficiently managing transmission and distribution losses and constraints, promoting demand-side management and energy efficiency, and removing barriers to investment in new generation technologies, renewables, and distributed generation	A direct contribution is made to this objective by facilitating demand response (demand-side participation).

APPENDIX A – Agency issues: An option for multiple retailers at a GXP

The consumer contracts with the retailer, delegating the authority to control their hot water, say, 'X' hours per day (if metered separately). The retailers contract with the distributor, passing on that load control capability. The distributor then contracts with one retailer (who values the capability most) to allow hot water load control to be used as price responsive load. Therefore, the one retailer will, in a small way, affect the load profile of other retailers. However, because of 'residual profiling' and the energy neutrality of hot water load shifting in any one day, this price/volume effect has no material impact on reconciliation, and does not require immediate changes to the reconciliation process. However, the price/volume change effect is diluted across all customers, rather than being attributed those customers who have ripple controlled domestic-hot-water cylinders. Note that this effect already happens at the moment (to a lesser extent) with the distributor load shifting and managing its network constraints.