Concept Consulting Group

Draft Discussion Paper on Developing Emergency Security of Supply Provisions

Prepared for the Electricity Commission

Concept Consulting Group

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Advice of Disclaimer

We have used every endeavour to ensure the accuracy and completeness of our report and we are confident in the conclusions we have reached. However, in view of the reliance on the information prepared by others, we do not accept any liability for errors or omissions in our report or for any consequences of reliance on our conclusions.

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1 Introduction

The Electricity Commission has engaged Concept Consulting Group[1] (Concept) to advise on its approach to emergency measures to cover circumstances worse than a 1 in 60 dry year.

This report follows a preliminary report on emergency measures discussed with the Commission and is drafted in the form of a discussion paper for consultation purposes.

It follows previous discussion papers prepared for the Commission by Concept ('Security of Supply Policy Development' and 'Tendering for Reserve Energy'). These papers have been taken into account in the preparation of this paper. This discussion paper is generally of a stand-alone form but readers may wish to refer to aspects of the previous papers[2].

2 Overview of this Paper

2.1 Context for This Project

With its relatively large hydro supply base, variable inflows and limited storage capacity, the New Zealand electricity system faces the risk of electricity shortages in extreme dry situations. This is explicitly recognised in Government's policy decision that the electricity market should be capable of delivering security of supply in a 1 in 60 year hydro drought. In circumstances worse than this, there is the possibility that electricity shortages will occur. Accordingly, the Electricity Commission is required to have contingency plans in place should such an event occur.

2.2 Security of Supply Framework

The Electricity and Gas Industries Bill (EGIB) and draft Government Policy Statement[3] (GPS) include a number of functions and responsibilities for the Commission relating to security of supply, including an overarching requirement to enhance the performance of the overall market.

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1 Concept has been supported in this work by Tony Baldwin.

2 [Insert references once earlier papers have been released for consultation by the Commission].

3 Draft Government Policy Statement issued September 2004. [Note to SAG – we have yet to formally review the latest draft of the GPS to check if there are any implications for this paper. A cursory review suggests there are none. Footnotes in this paper and references to the GPS therefore still relate to the July 2004 draft GPS].

The Commission is required to use reasonable endeavours to ensure security of supply in a 1 in 60 year hydro drought, without having to rely on emergency conservation measures, while minimising distortions to normal market operation.

Reserve energy procurement is available to the Commission as a back-stop measure to extend the level of security delivered by the market to a 1 in 60 dry year level. Up to 1,200 GWh of reserve energy contracts over any four month period can be procured by the Commission.

The Commission is required to define a minimum hydro zone, consistent with the 1 in 60 dry year security of supply policy, as the basis for triggering reserve energy contracts. We refer to this zone as the *minzone.* The Commission is also required to define a second zone, below the minzone, which would trigger emergency conservation measures. In this paper we refer to this zone as the *emergency zone*.

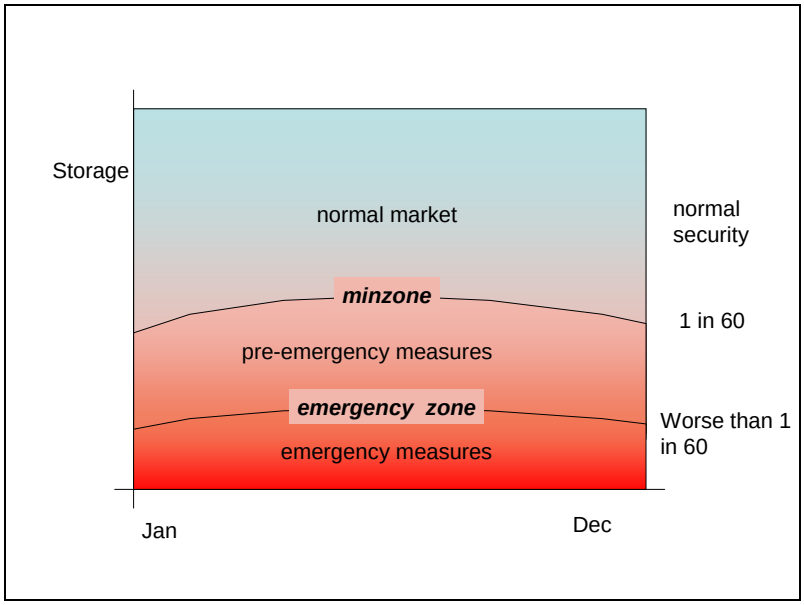
The Commission is required to have contingency arrangements in place to activate an emergency electricity conservation campaign and, if needed, coordinated rolling cuts to avoid uncontrolled blackouts. It is also required to ensure that ripple control of hot water heating load is able to be used to conserve energy in emergency security of supply situations. We have assumed that the Commission is not limited to the emergency measures specified in the GPS and EGIB.

The Commission will also need to have emergency measures available to manage major supply disruptions other than extreme dry year scenarios. Hydro droughts tend to evolve over a reasonable period of time whereas other major disruptions could occur with little warning. While the brief for this paper is confined to emergency measures for hydro droughts, having contingency plans in place to respond to other more sudden emergency events may be a higher priority, since they could occur at any time.

2.3 Approach to Emergency Measures

The Commission should develop its approach to emergency measures along the lines depicted in Figure 1.

Figure 1: Suggested Approach to Emergency Measures



Most of the time the market would be expected to operate above the minzone and the Commission's focus would be on monitoring and looking for ways to improve the overall performance of the market. For example, ensuring that market participants are incentivised to manage their commercial risks and have the information and capabilities to do so will assist the achievement of security of supply objectives in the market.

If it believes the market is not achieving adequate security, the Commission can procure limited quantities of reserve energy contracts to extend security to the 1 in 60 dry year level. At or near the minzone, reserve energy contracts would be triggered consistent with GPS requirements (outlined in detail in the Security of Supply Policy Development discussion paper).

In the region between the minzone and the emergency zone, the Commission would facilitate the availability in the market of *pre-emergency* measures. The aims of these measures would be to provide greater certainty about participant behaviours, to extract the most from the market when under stress and to reduce the likelihood of emergency interventions being required.

If the emergency zone is reached, the Commission would intervene directly with a range of relatively severe emergency measures. In doing so its primary objective would be to minimise disruption to consumers and damage to the economy, with participant commercial concerns becoming secondary. Consistent with this objective, and to ensure it has the flexibility to respond to circumstances at the time, the Commission would plan to implement emergency measures in any order or combination once the emergency zone is reached.

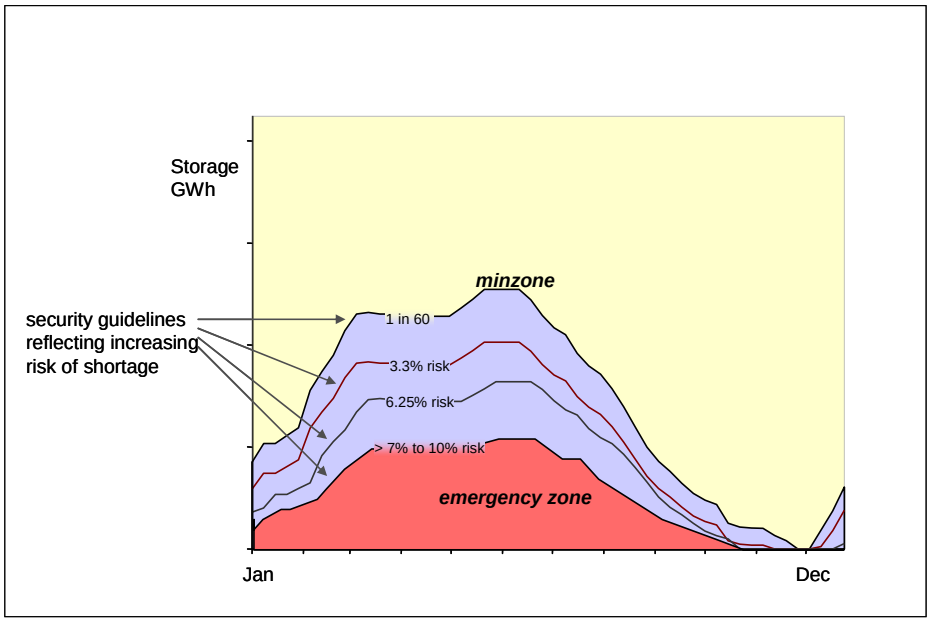
This approach should ensure that participants are strongly incentivised to take responsibility for managing their own commercial risks. There will always be a risk that emergency measures will be needed in extreme circumstances and the Commission will need to ensure that it is able to respond effectively. However, the Commission needs to design its response carefully, ensuring that it does not reward participants that fail to take responsibility for managing their commercial risks, and that it does not penalise participants that do take responsibility for managing their commercial risks.

The design of emergency provisions and the way they are to be triggered will therefore be important.

2.4 Triggering Emergency Measures

The Security of Supply Policy Development discussion paper proposed that the emergency zone be established on the same basis as *security guidelines* for triggering higher cost reserve energy contracts. These security guidelines would reflect physical shortage risks along the lines illustrated in Figure 2.

Figure 2: Triggering Emergency Measures



A variable cost would be assigned to each security guideline based on the 'expected' cost of shortage looking ahead from that level. The variable cost could be derived from the physical shortage risk at each guideline level and the value of lost load

implied from the GPS[4]. The emergency zone would be set at the security guideline which has a variable cost corresponding to the implied cost of emergency interventions. Reserve energy and emergency measures would thus be triggered in a consistent manner below the minzone as security risks rise.

2.5 Pre-Emergency and Emergency Options

Measures consistent with the approach outlined in section 2.3 include those outlined in Table 1 and Table 2.

Table 1: Pre-emergency Measures	
Short run contracting options to extract additional supply and demand response from the market	Facilitated short run arrangements between participants and retailers/ customers, including short term contracting by the Commission, with cost allocation mimicking the outcomes that would occur in a well functioning market[5].
Pre-arranged availability *in the market* of additional supply and demand options	For example, emergency generation sets, seeking resource consent flexibility in extreme situations, and greater demand side involvement/price signalling.
Pre-agreed relaxation of transmission quality standards	In 2003 Transpower operated parts of the grid less securely so as to overcome southwards transmission constraints to maximise thermal supply utilisation. Similar arrangements appear to be a useful addition to pre-emergency measures.

[4] The 1 in 60 dry year security requirement and the 20c/kWh trigger at the minzone level specified in the GPS imply a value of lost load of around $8,000/MWh. The derivation of this can be found in the Security of Supply Policy Development discussion paper.

[5] In the draft discussion paper "Security of Supply Policy Development", it is recommended that the Commission investigates short run contracting options to provide greater certainty about its assumptions (regarding participants) and participant behaviours when the minzone is reached.

Table 2: Emergency Measures	
Conservation campaign	A requirement defined in the GPS. The concept of a conservation campaign is potentially much broader than advertising, calls for savings etc and could include some of the other options noted below.
Ad hoc emergency relaxation of transmission / system operation quality	Based on circumstances at the time, increasing short term security risks to achieve greater overall energy utilisation under extreme circumstances (e.g. accepting higher risk of automatic load shedding to free up generation reserves or interruptible load for energy purposes to reduce risk of rolling cuts).
Extended water heating cuts	As outlined in GPS.
Rolling cuts	As outlined in GPS.
Enforced savings	Could include mandatory restrictions (street lighting, commercial signage, or targeted restrictions (e.g. savings at government departments, schools).
Suspending the market	Directing participants, directly coordinating supply/ plant outages/fuel supply and administered pricing.
Temporary over ride of resource consents	Secure access to emergency supply (e.g. Pukaki legislation, emergency generation and relaxed thermal emission or hydro limits).
Consumer voltage reductions	Lowering distribution delivery voltage levels to reduce overall demand.

The focus of this paper is on the Commission's approach to developing emergency measures that would be triggered in the emergency zone (the second zone below the minzone prescribed in the GPS).

2.6 Approach to Dry Year Emergency Preparedness

The GPS requires the Commission to have contingency arrangements in place for use of hot water load control, emergency conservation campaigns and coordinated rolling cuts, in order to avert the risk of uncontrolled blackouts. As outlined above, other options are available to the Commission. Some of these options may require considerable effort to develop so that they can be employed in the event of an

emergency situation. In the case of extended hot water heating cuts, the net merits need to be assessed (discussed in section 7.3).

Exactly how each option might be applied will depend to some extent on circumstances at the time (e.g. location, time of year, lead time, severity etc). Contingency planning and flexibility will be essential elements of an effective response to a dry year security of supply emergency situation. Key issues for the Commission are therefore to ensure that:

- Appropriate pre-planned emergency measures are available to be implemented if needed

- Effective contingency plans, and processes, are in place so that the Commission is able to respond effectively to manage the emergency

It is suggested that the Commission's overall response to dry year security of supply emergency events should be based on a formalised emergency response project structure and the concept of an emergency response plan (ERP).

2.6.1 Emergency response project structure

There would be a project structure, similar to the winter task force project established in 2003, under the direct control of the Commission (including a designated project manager). Overall control would rest with the Commission including stakeholder communications and public relations, day to day management of emergency measures, monitoring and analysis and enforcement and compliance issues. A project team would be structured around these responsibilities and capabilities. To ensure a consistent approach to communications, buy-in from participants and quick resolution of unforeseen issues the Commission should also consider convening a representative forum of participants (a liaison group) as part of its response to an emergency[6].

2.6.2 Dry year emergency response plan

An emergency response plan (ERP) would be developed, published and updated by the Commission setting out:

- The Commission's emergency zone[7]

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[6] Such a body could perhaps also be a useful means of resolving unforeseen operational issues quickly. . However, many implementation issues should generally be identified and resolved in the process of developing pre-arranged emergency measures and contingency plans for an extreme dry year noting that the Commission can resort to regulation if agreement among participants cannot be achieved.

[7] The basis for setting this zone has been spelled out in the Security of Supply Policy discussion paper. The actual emergency zone may be published as part of the policy rather than the ERP. Certainly the basis for the emergency zone would be part of the security of supply policy.

- Responsibilities, resourcing requirements and pre-arranged emergency measures (including advance planning / lead time requirements)

- The sequencing of emergency measures to be introduced if the emergency zone is reached (probably starting with a conservation campaign and with rolling cuts a last resort measure)

- The preparatory steps to be taken in advance of the emergency zone being reached and the trigger points for each (for example, activating the project structure discussed above, initial steps to activate an advertising campaign etc)

In developing these arrangements, the Commission should seek a high level of participant involvement, in particular with regard to the development of specific emergency measures. This would be consistent with requirements that the Commission consult widely and seek contractual solutions in preference to regulation. In this regard, the Commission's Security Advisory Group could assist in the development of emergency provisions for the dry year ERP. It is likely that specific industry groups will need to be convened to address some issues. e.g. distributor contingency plans for rolling cuts.

It will take some time for the Commission to develop a full ERP and formalise a project structure along the lines advocated. In the meantime, an extreme dry year security emergency could occur, requiring an emergency response from the Commission. The Commission will therefore need an interim strategy.

2.6.3 Interim arrangements for dry year emergencies

Hydro droughts evolve over a period of time, typically months. The Commission could therefore expect some warning and a reasonable lead time to develop and implement an emergency response. There is considerable experience from previous dry years which the Commission could draw on. In particular, aspects of the approach taken in 2003 could be adapted to suit the current environment. The 2003 winter task force project structure was established relatively quickly once the risk of shortage became evident (and could have been in place earlier had better security monitoring been in place). The 5 stage conservation plan developed in conjunction with the Grid Security Committee (GSC) would be a useful starting point for planning purposes.

The Commission could also establish a participant liaison group. A significant number of ad hoc operational issues were able to be resolved expeditiously in 2003 through an independently chaired representative forum of executives. A coordinated approach to stakeholder relations was also able to be achieved. Some major issues relating to rolling cuts and water heating controls were not fully resolved but could now be addressed by the Commission through regulation if necessary.

2.7 Responding to other emergency security of supply scenarios

While outside the brief for this paper, the Commission may have to respond to emergency security of supply events in addition to extreme dry year events (for

example major damage to Cook Strait cables or major gas supply system disruptions). In time, it would be sensible for the ERP to be extended to cover emergency preparedness for a range of credible security of supply contingencies, not just extreme dry years.

In the meantime, there is the possibility that a major security of supply scenario could occur without warning requiring an ad hoc emergency response from the Commission. In particular, the Commission may need to manage rolling cuts with little or no warning and for a period of time[8] (at least until other emergency measures can be implemented). If this were to occur, the Commission could set targets for rolling cuts (in conjunction with the system operator to ensure real time security). However, it would want to be assured that distributors would implement instructions for rolling cuts in a way that minimises disruption to consumers. Ensuring that appropriate plans are in place within each distribution network therefore appears to be a high priority for the Commission.

In advance of developing these capabilities through an extended ERP, the Commission could respond to an unforeseen emergency by establishing a project team and an ad hoc representative liaison committee along the lines suggested for the interim approach to dry year emergencies.

2.8 Conclusions

It is proposed that that the Commission:

1. Adopt a policy that involves:

    - A series of emergency measures that can be applied by the Commission when hydro storage falls to the emergency zone

    - The facilitation by the Commission of pre-emergency measures that would be available in the market between the minzone and the emergency zone.

2. Develop in consultation with participants a multi stage Emergency Response Plan (ERP) including:

    - A designated project manager with clear accountability to the Commission for implementing the plan

    - The establishment of a project structure, to support the project manager, including a project team and a participant liaison group reporting to the Commission through the project manager

[8] A sudden and short term loss of MW capacity would be managed by the system operator, or through pre-arranged demand shedding as provided for in Part C of the EGRs, through existing real time security policies. Sustained loss of MW could create energy shortage risks requiring ongoing energy savings in order to avert blackouts.

- A series of pre-arranged emergency measures and related implementation steps and requirements (including a national conservation campaign as required by the GPS)

- The steps to be taken in advance of the emergency zone to activate the project structure and to ensure that emergency measures can be implemented within the minzone according to ERP requirements

3. Adopt an interim strategy, in advance of the ERP being developed, based around the ERP project structure (project manager, project team, participant liaison group) using the 2003 five stage conservation plan as a starting point.

4. Undertake a desk top exercise to establish the merits of extended water heating cuts for conserving energy (not just for dry year emergencies). This is a priority as the GPS requires the Commission to have arrangements in place to implement water heating cuts.

5. Establish an industry group (comprising distributors, retailers, consumers and the system operator) to advise the Commission on the best means of implementing rolling cuts in emergency situations. This is a priority as rolling cuts could be needed with little warning (for emergencies other than an extreme dry year) and the GPS requires the Commission to have contingency arrangements in place. The Commission should specify criteria to guide the group including that contingency plans be developed to ensure that instructions from the Commission can be implemented by distributors so as to minimise disruption to consumers and risks to real time security of supply.

6. Request the above group to consider the use of extended water heating cuts (subject to the outcome of 4 above) and distribution voltage reductions as emergency measures.

7. Investigate additional emergency interventions which the Commission could utilise within the emergency zone including relaxing transmission/ system operation quality, temporarily overriding resource consents, market suspension/ direction.

8. Investigate a range of pre-emergency measures that could be available in the market in a worse than 1 in 60 dry year including the options in Table 1

9. Extend the scope of the ERP to include contingencies in addition to extreme dry years.

10. Clarify its relationship with, or responsibilities to, Civil Defence.

3 Project Brief

The brief from the Commission specifies the following tasks:

Task 1: Investigate and recommend a set of emergency security of supply provisions to cover circumstances that are worse than a 1 in 60 year event.

Task 2: Identify the information and modelling requirements necessary to implement the recommended approach.

Task 3: Identify any particular regulatory powers that might be necessary to implement the recommended approach.

Task 4: Prepare a discussion paper, suitable for release by the Commission, which outlines all the issues, discusses the options considered, and outlines the reasons for the recommended emergency provisions.

3.1 Relationship with Other Security Policies

The draft GPS[9] places responsibility on the Electricity Commission to establish arrangements to extend system security to meet a 1 in 60 dry year standard. The GPS also indicates that a primary mechanism to extend system security to meet this standard is for the Commission to contract for reserve energy. The use of reserve energy is likely to be triggered if hydro storage levels fall below a "minimum zone". In this regard, the Commission has previously considered and issued discussion papers relating to 1 in 60 dry year security policy development, including the role of reserve energy, and tendering for reserve energy.[10]

The GPS states that within a minimum zone, the Electricity Commission should have a second zone that would trigger a conservation campaign, on the basis that there is a significant probability that a worse than 1 in 60 event could occur. The GPS also requires the Commission to have contingency arrangements in place to ensure that ripple control of hot water heating load can be used as part of a conservation campaign, and that rolling outages can be scheduled in extreme circumstances to avert blackouts.

The aim of this project is to consider the approach the Commission should take to ensure it has effective arrangements in place so that these emergency provisions can be triggered in the event of a worse than 1 in 60 dry year event. We note that the GPS also requires the Commission to have arrangements in place should other

9 Draft Government Policy Statement of July 2004.

10 [Add references once formally released by EC]

emergencies threatening electricity shortage arise. This brief does not extend to emergency situations other than a worse than 1 in 60 dry year but key aspects of this paper will be applicable to other emergency situations.

3.2 Approach

In considering how the Commission should develop its approach to emergency measures, we have:

- Reviewed the GPS and EGIB[11] to identify the policy expectations and regulatory context for emergency measures
- Applied our knowledge and experience of the NZ hydro-thermal system and in particular risks relating to physical supply and market/ commercial arrangements
- Reviewed the experience of addressing security of supply emergencies in NZ and in other markets
- Considered key interrelationships between this project and the Commission's 'security of supply policy development' and 'tendering for reserve energy' work streams
- Developed a framework within which to consider the Commission's approach to emergency measures taking account of its wider responsibilities to enhance the performance of the market and management of risks relating to security of supply
- Outlined the steps the Commission should take to ensure it has effective emergency measures in place to respond to a dry year worse than 1 in 60

4 Government Objectives and Policy Framework

The purpose of this section is to place this project in the context of the Commission's overall security of supply objectives and the policy framework within which it is required to operate.

[11] The Electricity and Gas Industries Bill (as reported by the Commerce Select Committee on 30 June 04)

4.1 Overall Security Objective

Under the EGIB, the Commission is required to achieve a specific outcome where *"risks (including price risks) relating to security of supply are properly and efficiently managed"*[12]. The scope of security of supply is potentially wide[13].

In the GPS, the Commission's role in relation to security of supply is more targeted. It focuses primarily on the objective of managing a 1 in 60 dry period[14]. The GPS requires the Commission to "*use reasonable endeavours to ensure security of supply in a 1 in 60 dry year without assuming any demand reductions from energy conservation campaigns, while minimising distortions to the normal operation of the market*". The GPS also requires the Commission to have certain contingency arrangements in place should a worse than 1 in 60 dry year inflow sequence occur.

The GPS has three levels of implementation relevant to this project. These are:

- A general preference for market-based solutions
- Some prescribed components to be implemented by the Commission
- Some scope for making regulations

These levels are outlined in the following sections.

4.2 Preference for Market-Based Solutions

There is an emphasis in the draft GPS that the Commission should, as far as possible, seek to achieve the Government's policy objectives for electricity by facilitating efficient market mechanisms. Recourse to regulatory powers is proposed only if market-based remedies are unavailable or unsuccessful. In the event of the Commission resorting to regulation, the draft GPS puts considerable emphasis on designing regulatory measures in a way that minimises distortions to efficient prices and normal markets. Some examples of this emphasis in the draft GPS include:

- A clear focus on promoting efficient wholesale and retail markets (paragraphs 77 and 116)
- Achieving the specific outcome of minimising barriers to competition in electricity (paragraph 2c)

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12 Proposed section 172N(2)(b)

13 Paragraph 37 of the July draft GPS refers to four key components of security of supply: meeting ongoing demand growth; managing extended dry hydro periods; coping with extreme dry sequences or other unexpected supply disruptions; and ensuring reliability of the transmission and distribution systems.

14 Paragraph 38, July draft GPS.

- The importance placed on innovation (paragraph 10)

- The emphasis on efficient risk management – *"risks (including price risks) relating to security of supply are properly and efficiently managed"* (paragraph 2b)

- The value put on efficiency and avoiding market distortions – *"maximise static and dynamic efficiency…"* (paragraphs 52 and 66) and *"minimise impacts on the 'ordinary' market"* (paragraphs 54b, 57 and 65)

Avoiding distortions to the "ordinary" market is a recurring theme in the draft GPS. The Government is clearly concerned to ensure that any regulatory measures do not distort market participants' perception of their respective supply risks and their commercial options for managing those risks. Failure by market participants to "take ownership" of their supply risks, and to enter into commercial arrangements to mitigate those risks, will only increase the size of the potential security of supply problem.

4.3 Key Components of Security of Supply Regime

The draft GPS is relatively prescriptive in relation to the key components of the security of supply scheme. It requires the Commission to:

- Monitor market supply and demand conditions relative to a published "minimum hydro zone"

- Purchase reserve energy if the Commission determines the market is unlikely to provide sufficient energy to meet a 1 in 60 dry period

- If there is a high risk of shortages, put in place a conservation campaign, which could also trigger use of ripple control of hot water

- In the extreme event that blackouts are also required, put in place plans for co-ordinated rolling outages

The last two components are to be used in other security of supply situations, not just a dry period worse than 1 in 60[15].

[15] Under paragraphs 73 and 74 of the draft GPS, conservation campaigns and ripple control are to be used where there is a *"high risk of shortage"*. A worse than 1 in 60 dry period is given as an *example*, which implies that these measures may also be used in other (unspecified) *"high risk"* situations. Note that the EGIB refers to *"material risk"*. The draft GPS states that ripple control may be used for *"major and unexpected plant or transmission line outages",* but does not give examples of other security situations in which a conservation campaign may be used.

4.4 Regulatory Elements Relating to Emergency Provisions

The EGIB gives the Commission an express function "to manage emergency conservation campaigns to avoid material risk of supply shortages"[16].

This is augmented by two further functions[17] given to the Commission by the draft GPS:

- Ensuring that "contingency arrangements are put in place for the use of ripple control of hot water heating". This is to complement conservation campaigns, and to help manage "major and unexpected plant or transmission line outages".

- Putting in place "contingency arrangements to provide for the scheduling of rolling outages in the extreme event that blackouts are required"[18].

Except for conservation campaigns, these functions can be performed by either contract[19] or regulation. The relevant regulation-making powers[20] cover:

- Use of ripple control of hot water heating for security of supply or load management purposes

- The management and coordination of outages for "security of supply", not "electricity conservation" purposes (which has been deleted from the EGIB)

Other regulation making powers which could be relevant are:

- Maintaining "minimum levels of demand-side management programmes and interruptible load"

- Establishing and operating "markets for exchange of demand-side savings"

4.5 Implications of Policy Framework

The Commission is required to respond to the risks of shortage from a worse than 1 in 60 year dry period using conservation campaigns, ripple control and/or coordinated rolling cuts. The Commission's approach to these measures is the primary focus of

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16 Proposed 172O(1). The counterpart to this provision in the draft GPS (paragraph 73) refers to "high risk of shortage", instead of "material risk".

17 Under proposed section 172O(1)(j), GPS objectives and outcomes that are not set out in section 172N rank as statutory functions, rather than statutory objectives.

18 Paragraphs 74 and 75, draft GPS.

19 Proposed section 172O(2) – "The Commission's functions may be carried out by contracting with other parties,…or other means"

20 Proposed section 172D(11 to 14)

this project. However, while these are the only requirements referred to expressly in the regulatory framework, we assume that other emergency responses are not precluded.

In the past when there have been concerns about energy shortages a number of other emergency measures have been employed or at least considered. Examples include procuring emergency fuel supplies, reinstating mothballed plant and enacting special legislation to access hydro storage in Lake Pukaki. Other extreme options also exist – such as suspending the market or directing participants.

An important issue for the Commission will be to determine its approach to emergency measures and whether these are to be limited to the measures prescribed in the GPS.

In considering the emergency options it wishes to pursue, and the order in which they might be applied, the Commission needs to have regard to its wider obligations under the regulatory and policy framework. This includes a preference for market-based solutions, enhancing the operation of the normal market, minimising market distortions, and ensuring that participants take responsibility for managing risk, and have the information and capability to do so.

Another important issue for the Commission will be to what extent it is able to rely on contractual options in emergency situations rather than regulatory powers. The policy requirements make it clear that regulatory options are to be a last resort for the Commission. In the case of emergency security of supply situations it is possible that, at least as a backstop measure, additional regulations may be needed.

We explore these issues in section 6 which considers the Commission's overall approach to emergency measures. Before doing so, we explore the context within which emergency measures might be needed.

5 Emergency Measures Context

5.1 Sequencing of Security Responses

Most of the time, the electricity system is expected to operate with little or no direct interference from the Commission. The Commission will have a role monitoring system security and providing information to participants, but if, in the Commission's view, the "normal market" is meeting (and will in the future meet) the Commission's 1 in 60 dry year security of supply objectives, then no further direct action is likely to be taken. The Commission is able to procure a limited quantity of reserve energy contracts if it considers that is necessary to extend the market's capability to the 1 in 60 dry year level.

As a security event approaches it is expected that the "normal market" will respond with prices increasing, more expensive thermal plant being dispatched, and some demand being curtailed in response to the higher prices. At a point in time where the 1 in 60 dry year security limit defined by the Commission (the minzone) is reached

there would be an expectation that all available non-hydro plant would be running to the capacity assured in the Commission's security assessments. At or near this point, reserve energy contracted by the Commission would be dispatched. This could take the form of generation or demand side reserve energy contracts.

If the security situation continues to deteriorate the Commission would trigger emergency measures with the objective of avoiding uncoordinated blackouts[21].

5.2 Extent of Dry Year Emergency Response Required

The amount of emergency response needed in a dry year will depend on the supply/demand balance at the time and the capability of the transmission network.

Assuming that all thermal stations are fully available and there are no transmission constraints, then a simple weekly energy balance suggests that around 7% demand savings would need to be made to avoid shortages in the worst inflow week on record assuming the hydro storage started at zero[22]. Expressed in another way, hydro storage could be maintained during the worst inflow week on record, with 7% of demand savings.

Transmission constraints are likely to prevent the North Island being able to use all of its thermal capacity to help the South Island. If the HVDC is restricted to an average 300MW south during the worst inflow week, then up to 5% savings would be needed in the North Island, and in excess of 30% savings may be needed in the South Island.

This analysis highlights one of the complex problems in maintaining security of supply in New Zealand. It shows the importance of maintaining hydro storage in the South Island and initiating demand response before storage levels become seriously depleted. If a response is left too late then a situation may arise where, no matter how much demand response occurs in the North Island, rolling cuts may still have to be initiated in the South Island to avoid storage falling below minimum limits.

It should be noted that this crude analysis has only focused on the security of supply situation when all thermal plant is available and fully fuelled. Thermal plant outages or fuel shortages during a security problem will change the supply demand balance and will tend to even out the level of demand response required between the two islands, while increasing the overall savings necessary.

5.3 Enhancing Risk Management in Normal Market Operation

In general, dry period risk is most efficiently managed if buyers and sellers accept and cover their own risks. In a well-functioning market, a range of options are

[21] This is a high level discussion only. For more detailed discussion about the sequencing of security measures refer to the Security of Supply Policy Development discussion paper.

[22] Based on previous Concept studies for 2005 supply / demand scenarios

available to participants, including hedging arrangements, fuel contracts, self-generation and/or demand reduction plans. Expected scarcity is signaled in prices over several periods: half-hourly, day-ahead, monthly, yearly and beyond. Efficient spot *and* forward markets are pivotal.

The best "insurance" option for a market participant will depend (among other things) on the cost of a particular party being unable to meet supply obligations (generator to retailer and/or retailer to consumer). Differences in value of unserved load among buyers and sellers will lead to a wide range of risk management practices. In a well-functioning market participants will have the information, capability and incentives to make good risk management decisions for their individual positions. These individual decisions will, in aggregate, lead to the right availability of fuel and generation to meet demand. Security of supply concerns would be significantly reduced in a well-functioning market.

6 Commission's Overall Approach

6.1 Need for Emergency Measures

As long as the New Zealand supply system remains vulnerable to hydro droughts there is the prospect of electricity shortages in extreme dry situations. The government's decision to adopt a 1 in 60 dry year security of supply standard, rather than seeking to cover dry years worse than 1 in 60, explicitly recognises this. There is also the prospect of other major security of supply contingencies. The Commission therefore needs to ensure that it has suitable emergency measures in place that can be activated should circumstances require. The GPS requires the Commission to have arrangements in place relating to conservation campaigns, ripple control of hot water heating and rolling cuts. Other options should also be considered by the Commission but first we wish to explore the context within which emergency measures generally might be considered.

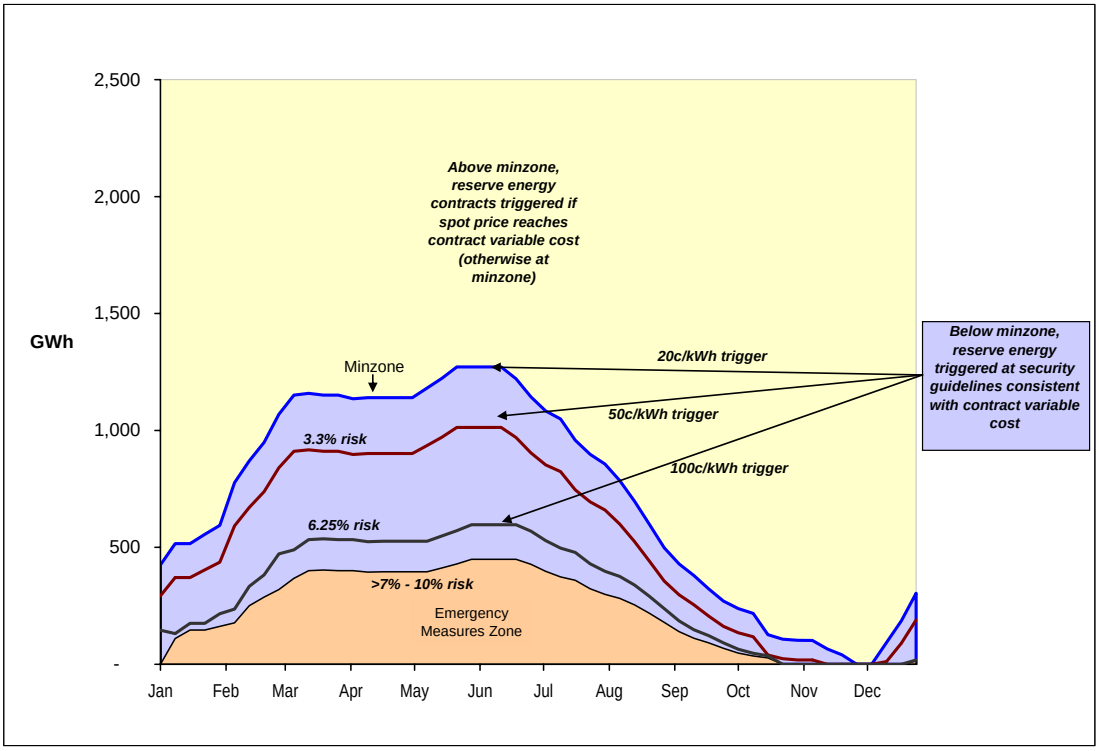
6.2 Consistency with Other Security Policies

The Security of Supply Policy Development and Tendering for Reserve Energy discussion papers include proposals relating to reserve energy and explore how to implement the minzone trigger requirements for reserve energy specified in the GPS. For the purpose of this project, we have adopted as working assumptions the proposals in these papers (noting that the Commission has yet to consult on and formalise its security of supply policies). In developing its approach to emergency measures, the Commission will need to ensure consistency with these other policy initiatives.

In particular in the Security of Supply Policy Development discussion paper, we proposed that reserve energy and emergency measures should be triggered along the lines shown in Figure 3. Emergency measures would be triggered at security guidelines corresponding to the (implied) cost of the particular emergency measure in the same way that higher cost reserve energy contracts would be triggered below the minzone. The security guidelines would be based on the physical risk of shortage at

the guideline level and the relative to the cost of shortage implied by the government's 1 in 60 policy and the 20c/kWh reserve energy trigger[23]. Reserve energy and emergency measures would thus be triggered in a consistent manner below the minzone as security risks rise. More severe (higher cost) emergency measures would be triggered at lower (higher priced) security guidelines.

Figure 3: Illustrative Approach to Triggering Reserve Energy and Emergency Measures



6.3 Incentives Are Important

The Commission's approach to emergency measures could have significant implications for the proper functioning of the normal market. If emergency measures were to weaken incentives on participants to manage their own risks, security of supply risks could increase. This could lead to a self-fulfilling chain reaction which has as its outcome an increased probability of shortage and intense pressure on the Commission to intervene and provide a "soft-landing" for those who did not cover their own risks.

23 Refer "Security of Supply Policy Development" discussion paper.

The prospect of only a "hard landing", for example rolling supply restrictions, would have the opposite effect. Participants would be strongly incentivised to manage their own risks. In a well functioning market, participants would take full responsibility for managing their own risks. They would have the information, capability and incentives to make good risk management decisions. These decisions would, in aggregate, lead to the right availability of fuel and generation to meet demand.

6.4 Improving the Normal Market is a Priority

This reinforces the discussion in section 5.3 - if the normal market works well, security of supply concerns for the Commission and the Government will be significantly reduced. Thus the Commission's primary focus in relation to security of supply should be to make the normal market work as effectively as possible by:

- Enhancing the competitiveness of the market, which is likely to involve issues of hedging, competition and market information (we note there are a number of work streams targeted at this objective)

- Ensuring that security of supply measures do not distort normal market operation by weakening incentives on participants to manage their own risks

The same strategies underpin the security of supply papers already reviewed by the Commission (Security of Supply Policy Development and Tendering for Reserve Energy).

6.5 Practical Risks

The GPS provides for the Commission to undertake a conservation campaign "*in the event that we are in a worse than 1 in 60 dry year event*". In practice, market prices are likely to be high before the minzone is reached reflecting rising security of supply risks. Some demand response to high prices is likely before the minzone is reached. At and below the minzone prices can be expected to continue rising, increasing the level of demand response. Triggering reserve energy contracts is likely to limit prices to some extent. However the Commission will inevitably face pressures from some market participants to initiate a conservation campaign in response to rising prices. When conservation campaigns have been triggered in the past this has typically been in response to political pressure relating to price risks, and perceptions about supply risk, rather than a pre-defined trigger point based on security of supply risks being worse than 1 in 60.

Government has indicated that a conservation campaign is preferable to black outs given the potential damage to the economy and disruption to consumers and public welfare that these would cause. However, it will be important for the Commission to have a well-defined trigger point for initiating any conservation campaign, and to avoid pressures to initiate a campaign too early.

Perceptions that the Commission may be pressured into an early conservation campaign may act to transfer responsibility for managing risks relating to security of supply from participants to the Commission in a way not intended by government.

The GPS requires the Commission to seek to achieve the outcome that "*risks (including price risks) relating to security of supply are properly managed*". Participants being able to manage, and taking responsibility for managing, their own risks is consistent with this requirement. Encouraging participants to manage their own risks is also consistent with the requirement "*minimise distortions to the operation of the normal market*".

It will therefore be important for the Commission to be clear about the point at which emergency measures will be triggered below the minzone in line with the GPS requirement (the emergency zone). Equally important will be the need to ensure that participants understand that once the minzone is breached, reserve energy contracts will be dispatched in line with security of supply policy, but that, until the lower emergency zone is reached, the Commission will not intervene directly in the market with emergency measures.

6.6 Pre-emergency Zone

The zone between the minzone and emergency zone should therefore be considered as a "pre-emergency zone". In this pre-emergency zone the Commission could facilitate market-based measures that would reduce the likelihood of the emergency zone being reached without the need for direct intervention.

It is reasonably likely that the market will, in practise, have potential to provide additional supply and demand options that could be contracted in response to a serious dry period or other unexpected security situation. For example, considerable additional thermal fuel was able to be procured at relatively short notice in 2003. In future the prospect of the Commission intervening in some way to procure fuel (or to require a generator to do so) would only serve to undermine participant incentives to manage risks.

It would be preferable for the Commission to consider means by which it could facilitate short run contractual arrangements between participants, or between retailers and consumers, leading into an emergency situation. In this regard, the suggestion in the Security of Supply Policy Development discussion paper that the Commission investigate short run contractual options could be extended to encompass heading into possible emergency circumstances i.e. ensure that supply and demand can balance through market-based contractual means with less need for emergency intervention.

Further, the Commission could consider options to facilitate pre-arranged additional supply being available 'in the market' as conditions worsen. By way of example, there may be barriers to the use of emergency diesel generators (in commercial buildings and the like) which the Commission could help to remove. More supply could then be available 'in the market' when the 1 in 60 policy is at risk, including the pre-emergency phase, thereby reducing the need for emergency measures. There were also resource consent issues relating to emergency diesel generators involving a number of different local bodies during the 2003 shortage. There were also concerns about lack of participant incentives to exploit this supply or technical impediments to operating the plant (e.g. owners not knowing what price they would receive). The

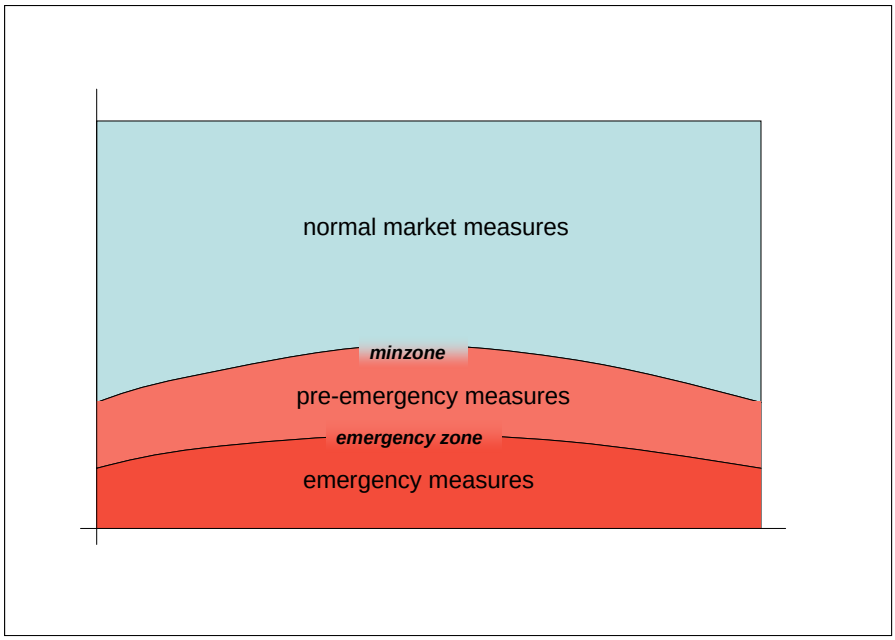
Commission might be able to facilitate these plants being paid the market price leading into emergency situations, directly or through retail contracts. It is possible that up to a few hundred MW of in-house generation exists in NZ which, while relatively costly to operate, could make a significant contribution.

The alternative to facilitating pre-emergency options would be for the Commission to wait until the supply is needed and seek to bring it into the market at the time and potentially at the Commission's expense. A number of specific contractual measures (both supply and demand side) could be considered by the Commission whereby it could enter arrangements with participants in the event of an emergency. However, this would leave the Commission having to recover costs from the market with significant potential to distort incentives by rewarding participants that rely on the Commission to manage their risks and penalising those who manage their own.

6.7 Proposed Strategy

The discussion in the previous sections suggests that the Commission should consider its approach to emergency measures along the lines depicted in Figure 4.

Figure 4: General Approach to Emergency Measures



Normal market measures

The Commission should place priority on improving the operation of the normal market, including the incentives and capability of participants to manage security of supply risks. For example, enhancing competitiveness; ensuring that participants have the information, incentives and ability to take responsibility for managing security of supply related risks; facilitating greater demand side participation.

Pre-emergency measures

In addition to reserve energy contracts it has procured, the Commission should explore ways to get the most from the market when it is under stress. For example, it could:

- Facilitate additional supply that could be accessed 'in the market' in extreme situations (e.g. removing barriers to emergency generation participating in the market and assisting participants to secure resource consents, emergency storage or thermal operation) for situations worse than 1 in 60 etc; encouraging the use of buyback or customer reward schemes for extreme situations to encourage natural savings etc)

- Extend the investigation of short term contracting options recommended in the Security of Supply Policy Development discussion paper (intended to provide more certainty about participant behaviours when the 1 in 60 policy is at risk) in order to consider how to extract more out of the market leading into an emergency situation

- Consider how, under certain pre-agreed circumstances, normal market transmission quality might be relaxed to increase effective supply (e.g. to overcome southward transmission constraints as occurred in 2003)

Emergency Measures

Measures such as the above would reduce the likelihood of emergency interventions by the Commission being needed. However, in the event that emergency measures are needed, the Commission should ensure that soft landings which transfer risks from participants to the Commission (and between participants) are minimised to the extent practical. In this regard, the Commission should:

- Clearly articulate the basis on which it would trigger emergency measures in an emergency zone so as to mitigate the potential transfer of risk from participants to the Commission

- Apply emergency measures in order to avert uncontrolled blackouts including:

    - the GPS requirements (a conservation campaign, availability of water heating control and rolling cuts)

    - other measures, such as other targeted enforced cuts (e.g. commercial signage, street light restrictions etc), suspending the market or directing participants

    - options to maximise supply under emergency conditions (such as accepting a greater risk of automatic load shedding by carrying less instantaneous reserves or temporarily overriding resource consents)

7 Developing Emergency Measures

There are several questions which the Commission will need to consider in developing its approach to emergency measures for an extreme dry year. For example:

- What other emergency measures should be considered in addition to conservation campaigns, water heating cuts and rolling cuts?
- In what order and when should emergency measures be triggered?
- How should the Commission meet its obligation to organise a conservation campaign that is effective in light of the proposed strategy?
- How should targets including regional requirements be established (e.g. for rolling cuts) and then outcomes monitored?
- What should the Commission do if targets are not being achieved in practice?
- What roles should the industry play in planning and implementing emergency measures?
- What potential liabilities could the Commission face if mandatory measures are implemented?
- Will the Commission need special powers to administer emergency measures?

We consider these questions further in the following sections. However, the answer to some of these questions will depend on the particular circumstances which exist at the time. In a worse than 1 in 60 dry year security event, the 'emergency' situation could be expected to evolve over time. The Commission could therefore monitor and publish shortage risks, taking account of market responses, and intervene if the risk of shortage reaches the emergency zone. Actions would need to be taken in anticipation of the emergency zone being reached to ensure emergency measures were able to be activated in a timely and pre-planned way.

7.1 Possible Emergency Measures

The strategy proposed in section 6.7 would focus the Commission's efforts on reducing the need for emergency measures through normal market enhancements and, to the extent practical, market-based pre-emergency measures. For example, with regard to pre-emergency measures, the Commission would develop options along the lines outlined in Table 3.

Table 3: Pre-Emergency Options	
Short run contracting options for use in pre-emergency situations	Facilitated short run arrangements between participants and retailers/ customers, including short term contracting by the Commission with cost allocation mimicking the outcomes that would occur in a well functioning market. (Extending the investigation into short run contracting options as recommended in the security of supply policy development paper).
Pre-arranged availability *in the market* of additional supply and demand options	Includes emergency generation sets, seeking resource consent flexibility in extreme situations, and greater demand side involvement/price signalling.
Pre-agreed relaxation of transmission quality standards	In 2003, Transpower operated parts of the grid less securely so as to overcome southwards transmission constraints to maximise thermal supply utilisation. Similar arrangements appear to be a useful addition to pre-emergency measures.

If efforts to improve the operation of the normal market and extend the market through pre-emergency measures are insufficient, the Commission would trigger emergency measures when a pre-set emergency zone was reached so as to avert un-coordinated blackouts.

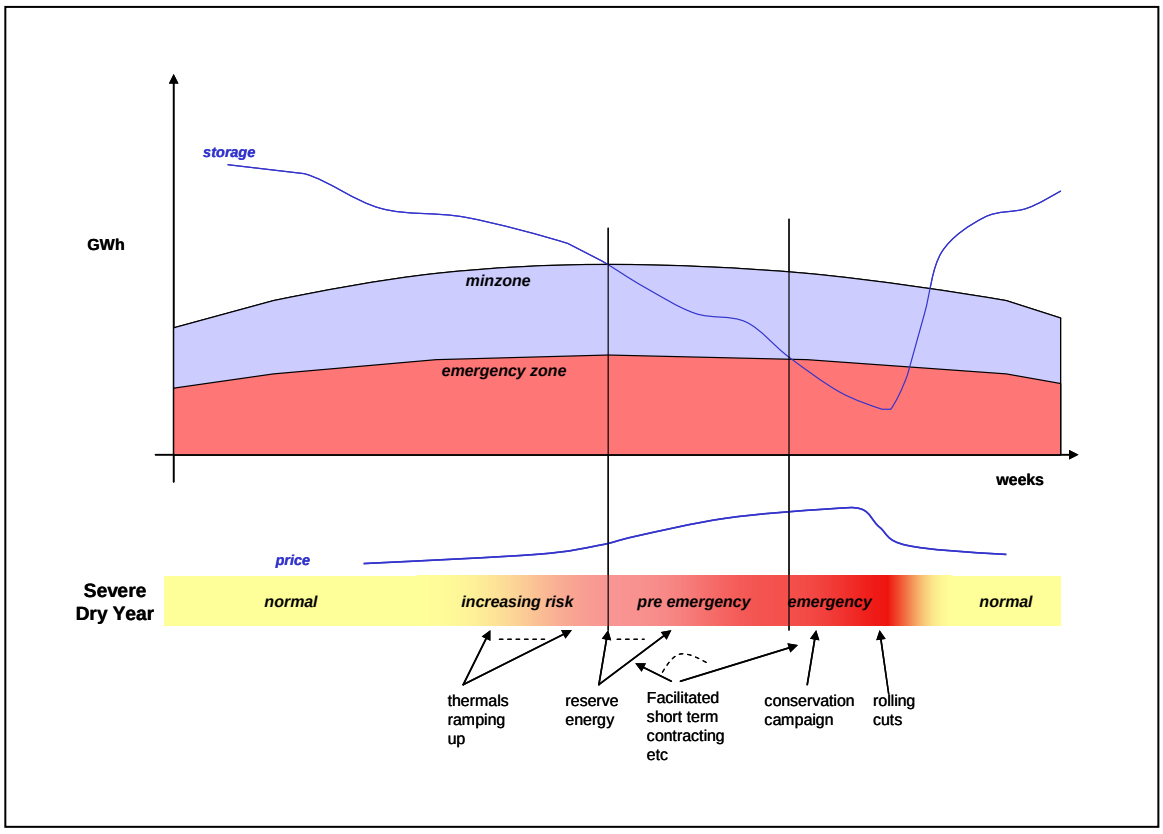
Table 4 summarises the sort of measures that could be considered within the emergency zone.

Table 4: Emergency Options	
Conservation campaign	A requirement defined in the GPS. The concept of a conservation campaign is potentially much broader than advertising, calls for savings etc and could include some of the other options noted below.
Ad hoc emergency relaxation of transmission / system operation quality	Based on circumstances at the time, increasing short term security risks to achieve greater overall energy utilisation under extreme circumstances (e.g. accepting higher risk of automatic load shedding to free up generation reserves or interruptible load for energy purposes to reduce risk of rolling cuts)
Extended water heating cuts	As outlined in GPS
Rolling cuts	As outlined in GPS
Enforced savings	Could include mandatory restrictions (street lighting, commercial signage, or targeted restrictions (e.g. savings at government departments, schools).
Suspending the market	Directing participants, directly coordinating supply/ plant outages/fuel supply and administered pricing.
Temporary over ride of resource consents	Secure access to emergency supply (e.g. Pukaki legislation, emergency generation and relaxed thermal emission or hydro limits).
Consumer voltage reductions	Lowering distribution delivery voltage levels to reduce overall demand.

All of the options in Table 4 are relatively severe measures. This is appropriate given the prospect of uncoordinated blackouts and the disruption to consumers and the economy this would cause.

The sequencing of emergency measures would depend to some extent on circumstances at the time of the particular dry year event. However, a dry year emergency would typically evolve over time as depicted in Figure 5.

Figure 5: Dry Year Emergency Scenario



In the context of hydro droughts, a clear trigger point for a conservation campaign will be very important for reasons previously discussed. However, once triggered, the Commission is likely to want to retain a degree of flexibility to respond to events as they unfold. This includes the approach to a conservation campaign as well as the order and extent of other emergency measures which could be applied. Once the emergency zone is breached, the Commission would have a toolkit of options at its disposal. In the case of a hydro drought, a conservation campaign would seem a logical first step and rolling cuts would be a last resort.

To ensure an effective response the Commission will need to have pre-planned measures in place. In terms of process, the Commission is also required to consider all other options before resorting to regulation. In this regard preparedness will be critical and the Commission should seek to involve participants in that preparation. In an emergency situation, there are likely to be a number of contractual/commercial issues that participants will be concerned about.

Appendix 1 summarises the current market structure and commercial arrangements between participants. How these arrangements could impact on emergency measures and vice versa will need to be considered when planning for and implementing emergency measures. For example, in 2003 the prospect of extended water heating cuts and possible rolling cuts prompted much debate about

responsibilities for planning and operational decision-making and related commercial and public liabilities. This included issues relating to liabilities and responsibilities for retailers and distributors regarding customers (complicated in an emergency situation by two different contractual models being used in the industry). The Commission should endeavour to agree in advance with participants how to resolve such issues, but may need to resort to regulation in some areas.

7.2 Conservation Campaign Issues

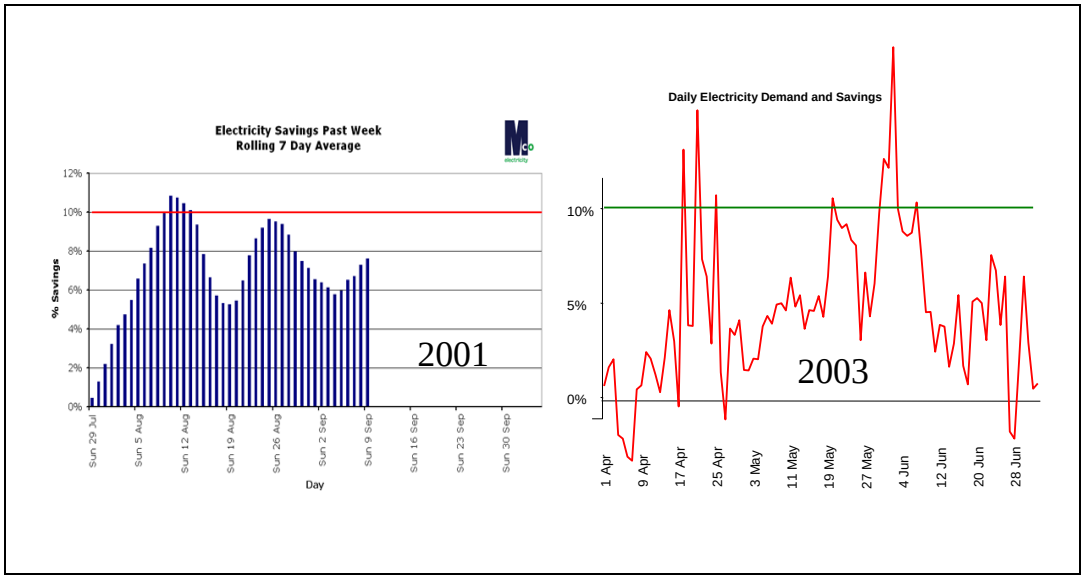
7.2.1 Background

The purpose of a conservation campaign is to conserve scarce energy by encouraging voluntary curtailment of demand by consumers to the extent that pre-emergency measures and price signals to consumers are insufficient to avoid the emergency zone being breached. In the context of dry year experiences in New Zealand, a conservation campaign has many facets and includes some of the demand side emergency measure options included in Table 4. Rolling cuts, being an involuntary demand side measure, would not be part of a conservation campaign. They would be a last resort measure.

Section 5.2 noted that ignoring any contribution from hydro storage, a crude energy balance suggests that in the worst historical inflow week on record, supply would fall short of normal demand by around 7%. The actual level of savings required could vary considerably depending on the balance of storage in each Island and between individual storage lakes. The availability of thermal fuel is also critical, noting that in 2003 constrained fuel supplies were a significant part of the problem.

Emergency conservation campaigns have been implemented in NZ a number of times. The most recent examples were in 2003, 2001 and in 1992. Regional campaigns have also been implemented, for example, the Mercury crisis in 1998. Figure 6 shows estimates of demand savings as published in the 2001 and 2003 dry year campaigns.

Figure 6: 2001 and 2003 Demand Conservation Estimates[24]



As can be seen from these charts, the level of savings is either difficult to estimate, or very volatile, or both. For example, it is difficult to establish day to day temperature impacts or to separate out savings that would have otherwise occurred in response to market prices. The approach to routine monitoring of demand that has been proposed in the discussion paper on security of supply policy development would make future assessments less difficult. However, given the volatile nature of demand due in particular to climatic sensitivity, how the level of savings is communicated is particularly important. Explaining these short term effects credibly without damaging goodwill and therefore ongoing savings can be difficult. Similarly, there will be demographic and climatic factors which mean that regional savings will vary. In 2003, the concept of a risk meter was introduced to convey to the public the overall situation.

In 2001 and 2003, savings targets of 10% were established. Typically, a progressive approach to achieving targets has been adopted because a number of measures take some time to implement – for example advertising campaigns; retailer, EECA and task force initiatives; and corresponding consumer initiatives (e.g. supermarkets removing every second fluorescent light tube).

[24] The charts have been scaled so savings can be directly compared. The solid horizontal line on each chart represents 10% savings. The 2001 chart is based on a comparison of a rolling 7 day average (updated daily) with the corresponding week in 2000. The 2003 chart is based on the daily savings compared to an averaged day from the corresponding period in 2002.

Funding for these initiatives can be considerable. In 2003, some participants funded the task force activities and had committed to a sum of around $10m. Other agencies, for example EECA, and retailers also incurred costs to facilitate voluntary demand savings over. Generators also incurred additional costs to procure emergency fuel supply.

There is a large amount of material from previous campaigns which the Commission could readily draw on in developing its own plan. A bullet point summary of the initiatives that took place (or were planned to take place) in 2001 and 2003 is included in Appendix 2.

7.2.2 Commission's Approach

The overall approach taken in 2003 is of particular interest. This involved establishing a representative steering group and a national campaign manager. The steering group, an expanded Grid Security Committee[25], included very senior industry personnel and was able to deliver significant authority to the national manager and his project team (labelled the 2003 winter task force). This enabled a five stage contingency plan to be developed with initiatives being considered, agreed and implemented more quickly and effectively than otherwise. The details of the final stages of this plan which included the possibility of extended water heating cuts and rolling cuts (which would not be part of a voluntary conservation campaign) were still being worked through when the 2003 winter security event ended. Nevertheless, this five stage plan would provide a useful starting point in considering a future plan.

With the powers delivered by the EGB and the GPS, and the ability to propose regulations, the Commission could consider establishing and coordinating emergency conservation plan on its own. This might be relatively effective in terms of some initiatives (for example, advertising campaigns, communications generally, actively encouraging consumers with savings tips and monitoring progress). A conservation campaign will require a highly coordinated and consistent response operationally and publicly, particularly when accompanied by other emergency measures. As events unfold and more extreme measures are contemplated, it is likely that some particularly complex issues will need to be resolved. It is not practical to anticipate all of these in advance. A representative participant committee (with seniority and standing) may provide useful support to the Commission in managing an emergency situation as it develops.

Although it was difficult in 2003 to achieve a common approach on many issues, overall the industry responded well to the challenge. Having an independent campaign manager supported by a task force, enabled a coordinated industry response with a credible public face. In a future emergency situation, it will be

[25] The GSC membership included 4 generator/ retailer Chief Executives, 3 consumer representatives (major user, consumers institute and chambers of commerce), the Transpower Chief Executive and a distributor representative (Chief Executive) with an independent Chair. For the purpose of the 2003 winter campaign, additional distributor and generator/ retailer Chief Executives were invited to attend.

important for the Commission to provide the public face and coordination role but participants involvement would provide advice and feedback, and ensure consistent communication and public relations.

The Commission could take the lead in terms of key decisions and triggering emergency responses but it could take advice from, and interact regularly with, a participant group of the nature outlined above leading into and during a campaign. Steering groups or committee's are commonly established overseas for these purposes including involvement in preparation and contingency planning.

As suggested in the Security of Supply Policy Development paper, the Commission would routinely review (and publish) security of supply risks. Given the lead time to employ certain measures, even if pre-arranged, the Commission's contingency plan would need to include steps to be taken in advance of the emergency zone being reached.

The Commission will of course need to respond to an extreme dry year emergency in a well coordinated manner using a range of emergency measures, not just voluntary demand side conservation measures within a conservation campaign. It could therefore expand the scope of its plans and the approach outlined above to encompass all dry year emergency measures. This would suggest a model along the lines of:

- An emergency response plan (ERP)
- Implementing a project structure (defined in the ERP) to manage a dry year emergency
- A high level of participant advice, possibly through the Commission convening a group of senior participants

7.2.3 Conclusions

There is a significant amount of material and experience available to the Commission from previous dry year campaigns. The Commission should develop an ERP and associated project structure with a high level of participant input into the development of its emergency measures. While broader than a conservation campaign, a useful starting point for the development of a dry year ERP would be the five stage plan developed by the winter task force in 2003. It could be used by the Commission as an interim measure pending the development of its full ERP.

7.3 Extended Water Heating Cuts

7.3.1 Background

Water heating demand is able to be remotely controlled in New Zealand using ripple control systems to interrupt supply to hot water storage cyclinders. Short interruptions to supply have little impact on end users because hot water cyclinders will retain heat for extended periods. This facility is used routinely to manage peak

demand levels (for transmission pricing, energy risk purposes and managing congestion within distribution networks) and to provide interruptible load (IL) to the instantaneous reserves market.

Instantaneous reserves are procured in the market to cover the risk of sudden supply failures. IL competes with generation reserves in the instantaneous reserves market, typically providing around 30% to 50% of total instantaneous reserves requirements. The requirement for instantaneous reserves mainly relates to the largest thermal unit, or at risk HVDC transfer should one of the two poles trip. Around 400MW of IL can be required at times. In a dry year scenario, with the HVDC running at high southward transfer levels and CCGTs operating at full output, requirements in both Islands would be high. Controlled water heating load is understood to contribute significantly to the instantaneous reserves market and in particular the sustained reserves market[26].

The use of water heating load for short term peak demand management or as IL varies in different areas. In some instances, retailers use the water hearing load to manage energy pricing risks or to offer it into the IL market. In other instances, distributes use to it to manage network congestion, to manage peak demand at transmission off-takes or to offer IL into the market directly.

7.3.2 Water heating control and emergency measures

Several hundred MW of water heating load is able to be controlled. It is most commonly used for 'peak' load management or short term ancillary services. In these circumstances it has the effect of shifting energy from peak to off-peak periods without reducing overall energy consumption.

Control of water heating loads could also be used to 'ration' energy by implementing extended cuts to water heating. However, a number of technical and commercial consequences would need to be considered.

Firstly, there would inevitably be commercial implications for distributors and retailers. Secondly, extended cuts would reduce water cylinder temperatures and people would face cold showers[27]. Thirdly, there could be implications for the market and security if the availability of IL is restricted in both Islands in a dry year.

We believe the Commission needs to consider the following questions:

- Should extended cuts be considered?
- If so, how should the Commission implement cuts within the current commercial and regulatory arrangement?

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[26] Fast (less than 6 seconds) and sustained (within a minute) categories of instantaneous reserves are used.

[27] If cuts were not for an extended period there would be little actual energy saving.

7.3.3 Should extended water heating cuts be considered?

In 2003, there were significant debates about the role of extended water heating cuts. Some argued that it should be left to individual participants to manage commercial risks as they considered appropriate. The general view was that extended water heating cuts could be introduced if the risk of black outs increased significantly. Some felt that 8 hour cuts should be introduced first with cuts of up to 18 hours if circumstances deteriorated. Concerns were expressed that introducing extended water heating cuts too early could result in consumers' conservation efforts falling away.[28] Others were concerned that the extent of savings that could be achieved may not be worthwhile given the risks of backlash from consumers. There was also considerable debate about the level of savings that could be achieved from water heating cuts. We also know[29] that transmission constraints might prevent full thermal utilisation at times of low demand. The timing of water heating cuts in the North Island would need to consider this issue.

In at least one instance in 2003, a retailer is understood to have arranged extended heating cuts, although it is unclear whether overall savings in the region concerned were significantly different.

Finally, achieving agreement over who would 'call the shots' regarding the timing and extent of cuts proved difficult. There was a general view that the Water Task Force Project Manager could call for extended cuts, however, commercial issues were not resolved. Although a process had been initiated to try and achieve industry agreement, this was not concluded before the emergency was called off[30].

If commercial and contractual issues could be resolved, it is likely that that extended water heating cuts could provide a useful coordinated response to a sudden emergency situation, at least at the outset. It is less clear that extended cuts should be introduced for evolving events such as a dry year. Further analysis of the savings possible, and the likely consumer impacts, should be undertaken before extended water heating cuts are further considered.

7.3.4 Commercial/regulatory issues

Essentially there are two choices the Commission could make to address the commercial and regulatory issues involved in accessing water heating cuts. The first involves contracts and the second involves regulation.

The Commission could seek to contract with the relevant parties in advance, so that a coordinated extended water heating control program could be implemented. The wide range of commercial arrangements for normal water heating load control suggests that a number of different contracts would be necessary. This approach

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[28] Consumers facing cold showers might be less motivated to save in other areas.

[29] Analysis undertaken to assess reserve needs in 2004/2005.

[30] The issues relating to system operation were not considered in detail as far as we know.

would be consistent with the requirements in the EGIB to exhaust contractual options before regulation is considered.

The EGIB includes regulation making powers in relation to water heating controls that could be utilised. Provided that regulations could be readily drafted and enforced, this may be a more efficient means of implementation than potentially protracted and wide-ranging contract negotiations.

7.3.5 Conclusions

The Commission should arrange for a desk top study to be undertaken to assess the benefits and risks of extended water heating cuts as part of an emergency conservation campaign (including for circumstances other than a dry year).

If the benefits are confirmed, taking into account any particular circumstances in which this may or may not be so, the Commission should consider contractual arrangements to ensure that extended water heating cuts can be activated by the Commission as part of an emergency conservation campaign if needed.

Should that prove impractical, the Commission has the power to regulate if necessary.

7.4 Rolling cuts

7.4.1 Background

The aim of rolling cuts would be to reduce energy consumption by implementing forced cuts to selected distribution feeders in a coordinated manner so as to ensure that the system can continue to operate without widespread uncoordinated blackouts.

A key criteria in initiating rolling cuts would be to minimise disruption to consumers and the economy in general. Consistent with the overall approach outlined in section 6, the commercial implications for participants would clearly be a secondary and much less important consideration.

7.4.2 Implementation Issues

In theory, rolling cuts would be introduced at the time supply and demand would not otherwise balance. In practice, operating margins and difficulties accessing hydro resources under extreme conditions would require rolling cuts to be implemented before energy margins fall to zero. In triggering rolling cuts within the emergency measures zone, the Commission will need to make judgement calls based on specific circumstances at the time.

In terms of execution, distribution companies can disconnect blocks of load within their networks by switching off feeders. Transpower could also do this although at a coarser level and with less knowledge of which end users would be affected. A distributor should generally have better knowledge of load composition. Nevertheless, rolling cuts tend to be indiscriminate in nature and should be seen as last resort measure and avoided for as long as practical.

In the event that rolling cuts are necessary the Commission would need to direct distributors to shed a percentage of load. This may require special powers implemented through regulations. However, the Commission is required to consider all the alternatives first, including contractual options. In any event it would be sensible to work proactively with participants to ensure a coordinated approach is taken. Ultimately this is likely to be an area for regulation or legislation because of the considerable risk that not all participants will be able to agree on appropriate protocols.

Commercial issues between participants aside, perceived liability as a result of disconnecting load is likely to be a concern for some parties. The Commission will also want to be assured of its own position in this regard. Equity, fairness, health and safety, monitoring and enforcement issues are also likely to be particularly difficult to resolve. Legislation to limit the Commission's (and possibly others) liabilities and/or to give powers of enforcement may be necessary.

While the likelihood of rolling cuts being required is low, a good deal of preparatory work needs to be undertaken. For example, distributors should have (if not already) contingency plans for managing demand restrictions within their network with critical loads identified.

There are also questions about the approach to setting targets. Flexibility to achieve savings over a week would, in principle, be desirable and fair. The objective of rolling cuts is to achieve energy savings (MWh over time). However, while setting energy targets over time would offer the most flexibility to distributors to minimise the impacts of cuts, real time system security depends on MW at any point in time. Effective real time planning and coordination protocols for the System Operator and distributors will therefore be essential.

One of the most problematic issues is how to establish targets, and monitor progress, for different regions in an equitable manner. The Commission would have to make some difficult tradeoffs. These issues were not resolved in 2003, but consensus among participants should be attempted. Ultimately, however, the Commission will need to decide. It may need to consider voluntary savings achieved prior to cuts being needed. It would seem sensible that high voluntary savings efforts should not be penalised by rolling cuts. However, it is likely that differentiating accurately between regions would be difficult noting the problems highlighted in Figure 6 and climate/ demographic issues including access to alternatives to electricity varies between regions as well.

Communications and public relations will also be critical issues. Local retailer and distributor responsibilities with regard to consumers leading into and during rolling cuts will need to be clear, as will the Commission's overall role, to ensure a consistent and credible approach.

7.4.3 Commission's approach

Many of these issues are process matters which the Commission will need to work through with participants so as to develop a coordinated and workable approach. The Commission needs to work with participants to:

- Establish a number of credible dry year emergency energy shortage scenarios in advance

- Ensure that each distributor develops contingency plans to implement rolling cuts (i.e. to achieve savings targets within its network consistent with the level and timing of cuts likely for the scenarios defined by the Commission in a manner that minimises disruptions to consumers and impacts on the economy)

- Decide how to set and update individual targets for each distributor for the defined energy shortage scenarios

- Define responsibilities and protocols for real time coordination of rolling cuts (in particular for the System Operator and distributors) taking account of Part C real time coordination and emergency management provisions

- Consider monitoring and enforcement requirements

Most of these areas are likely to require rule development, or amendments.

Operationally, in relation to rolling cuts, the Commission's roles would primarily be to:

- Assess energy shortage risks; and decide when, as a last resort, rolling cuts would be triggered.

- Set, monitor and (where appropriate) enforce targets; and

- Manage public/ government relations and communications generally.

Real time coordination would largely be the responsibility of the System Operator (system security) and distributors (implementing cuts). As noted in Section 7.2, a high level of industry involvement would be helpful, possibly including a liaison group of appropriate standing. The development of pre-arranged measures and operational protocols should minimise the number of issues that would need to be resolved during a dry year emergency. However, such a Committee could prove useful in ensuring participant buy in to, and consistency with, the Commission's communications/ public relations strategy, including advertising.

The approach described allows a degree of local flexibility to achieve energy savings over time. Combined with well developed contingency plans for implementing cuts within each network, this would reduce the risk of safety to personnel or disruption to sensitive / high value consumers. However, it is difficult to see how these risks and related liabilities can be eliminated and further consideration of this is issue should be undertaken – it is likely that legislation will be required.

7.4.4 Conclusions

Rolling cuts should be included in the Commission's ERP as a last resort measure.

The GPS requirement for the Commission to have arrangements in place for rolling cuts mean that the Commission will need to place priority on developing this capability as an emergency measure.

It will want to be assured that rolling cut instructions issued to distributors will be implemented so as to minimise disruption to consumers to the extent practical and to ensure that real time security of supply is able to be maintained. A group of relevant parties (distributors, retailers, customer and the system operator) should be convened to advise the Commission on the best approach to implementing rolling cuts. The Commission has the power to regulate to ensure that its requirements can be met if participants are unable to agree.

7.5 Issues relating to other possible emergency measures

7.5.1 Targeted mandatory cuts

The Commission might favour a regime involving targeted mandatory cuts being implemented. Rather than cut on a feeder by feeder basis, perhaps specific activities could be targeted instead. For example, street lighting, commercial sign lighting and the like could be targeted directly and required to be turned off. This might avoid some of the safety problems associated with rolling cuts but would probably be more difficult to enforce[31].

In the past, government departments have been required to make savings. However, these have been built into voluntary conservation estimates. More extreme targeted mandatory measures could be contemplated to avoid some of the problems with rolling cuts[32] but it is likely that such measures would be politically and publicly unacceptable. Legislation would also be needed and there would be enforcement issues to address as well. Targeted voluntary savings on a sectoral or institutional basis along these lines is likely to prove more effective and acceptable. While a blunt instrument, rolling cuts would provide a degree of flexibility to target less critical loads and may be more politically acceptable than targeted mandatory restrictions as a last resort measure.

7.5.2 Temporary over ride of resource consents

This option would certainly be seen as a severe measure. Efforts to pre-arrange access to additional energy during rare emergency situations using the normal RMA process would clearly be preferred. e.g. along the lines of some existing hydro storage consents whereby under emergency conditions some additional storage can be accessed. In the past, legislation has been used to secure additional storage (Pukaki in 1992). Temporarily over-riding a resource consent (which could be hydro, thermal, geothermal) would need to be considered in the context of potential effects

[31] We note that night time savings in the North Island may not be of significant benefit given possible transmission constraints limited thermal utilisation.

[32] For example, the possibility of targeted 4 day weeks was raised in 2003.

compared to the level of damage and disruption to the economy that would otherwise occur. In 1992, the government concluded that over riding Lake Pukaki low storage limits was in the national interests. It was reserved as a last resort measure however and was not used. It is difficult to envisage that rolling cuts would have been instigated before the emergency Pukaki storage was used. This legislation has since been repealed.

7.5.3 Suspending or directing the market

In extreme circumstances the Commission may need to consider suspending the market. For example, if prices were to collapse due to rolling cuts, or if it became impractical to continue dispatching plant according to market offers because of unacceptable real time security of supply risks. Similarly if the emergency zone were to be breached in a dry year with significant thermal fuel or hydro storage still available, the possibility of having to direct one or more participants could be considered. This would need to be considered carefully as the prospect of doing so carries considerable implications and possibly exposure for the Commission. For example, interfering with commercial relationships (generators to customers, fuel suppliers etc). It is difficult to mount an argument that once the emergency zone has been breached (if appropriately set), intervening in the market in this way would undermine the market.

The Commission should consider its approach to these issues. e.g. how should it 'administer' pricing if that were seen to be in the national interests due to otherwise inappropriate pricing outcomes within the emergency zone? Similarly, how would it administer pricing if it resorted to directing participants (would their offers be set by the Commission in some way) or actually resorting to coordinating supply and demand. A VoLL based approach to pricing may need to be applied within the emergency zone as a surrogate for market outcomes. Allowing prices to fall too low within an emergency zone would reduce incentives for voluntary savings and be inconsistent with the overall philosophy proposed in this paper.

7.5.4 Relaxing transmission quality

It is also possible that ad hoc relaxation of real time system security standards (transmission and system operation) might be acceptable in an extreme emergency situation. For example, if normal instantaneous reserves requirements would constrain the amount of thermal energy supply available or cause scarce hydro resources to be used inefficiently, a higher risk of automatic under-frequency load shedding might be acceptable if overall energy supply capability could be increased by carrying less generation instantaneous reserves. There may be other options depending on circumstances at the time. For example, temporarily overloading certain transmission lines or accepting a higher risk of loss of supply in some regions/ for some loads to achieve greater overall energy utilisation (such as increased thermal supply southward transfer). It may also be possible to consider operating parts of the grid at higher than normal voltage levels to reduce losses. In contrast to similar pre-emergency measures discussed previously, it would be difficult to confirm extreme measures such as this in advance. However, a range of options could be pre-identified.

7.5.5 Lowering distribution voltage levels

Under emergency conditions, there is the possibility of lowering the voltage levels at which consumers receive supply. This reduces overall energy consumption although it could carry some risk of damage to equipment or equipment being shut down automatically. Distributors could be asked to consider this option as a possible emergency measure for the Commission to call on. It would be useful to clarify what level of savings might be achievable without unacceptable risks to consumers. This option could be left for distributors to include in their contingency plans as a means of reducing demand within their networks as a contribution to achieving savings targets set by the Commission if rolling cuts are required. However, assuming that significant savings could be achieved without placing customers at risk, it would make sense to apply this measure universally before resorting to rolling cuts.

7.5.6 Conclusions

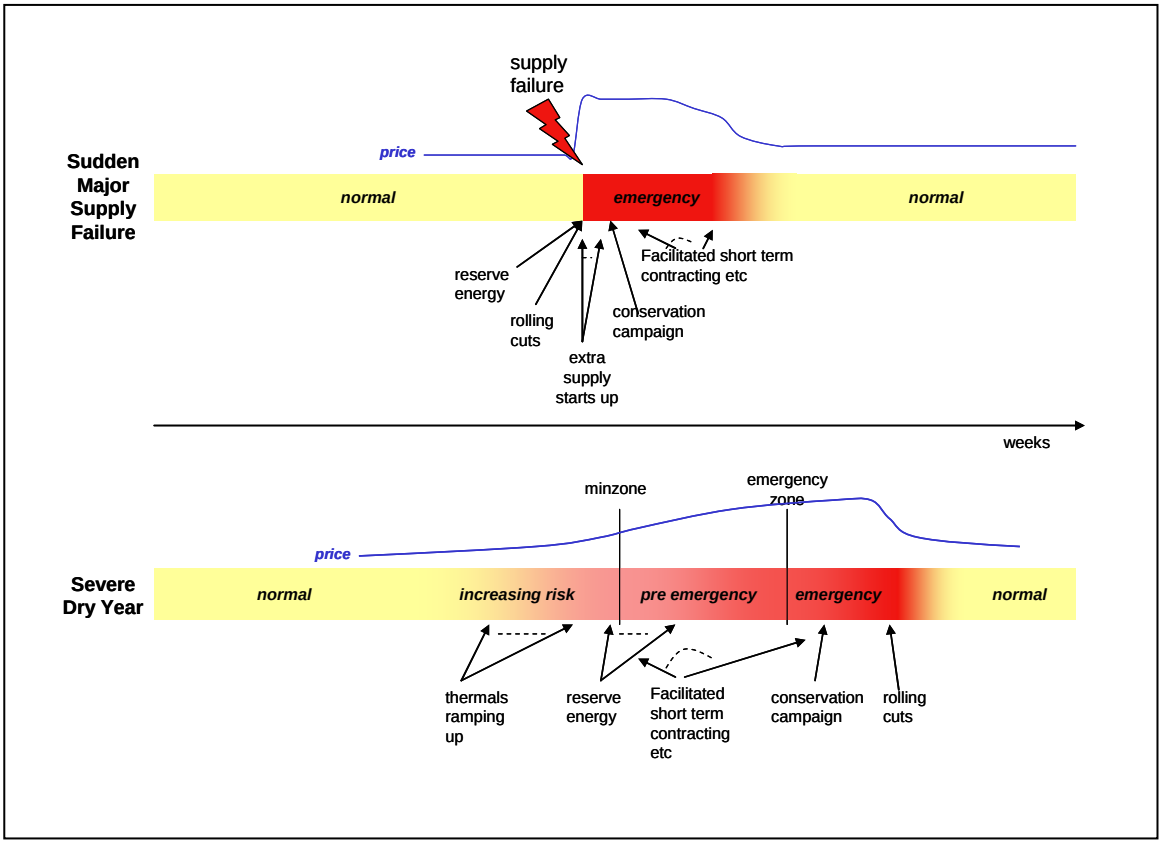
The Commission should investigate emergency measures in addition to those specified in the GPS in consultation with participants or relevant agencies. It should aim to identify and develop these measures in advance of being required and include them in the development of its ERP.

8 Other Emergency Events

8.1 Background

While the brief for this paper is limited to considering the Commission's approach to dry year emergency provisions, the Commission will also need to consider its approach to other emergency scenarios. Similar measures are likely to be called on for other energy shortage contingencies but the order and application of the measures could be different. For example, Figure 7 contrasts the sort of approaches that might be required for a serious dry year event compared to a sudden unexpected major supply failure. The examples shown are a major gas supply failure and a severe dry year.

Figure 7: Contrasting Emergency Responses



A major gas supply failure affecting multiple thermal generating sites could require the Commission to move immediately to rolling cuts to maintain the integrity of the system. The System Operator has real time responsibility and (under Part C of the EGRs) can request that demand be shed as a last resort to maintain real time security. However, if the gas supply failure was of significant duration then an extended period of demand restrictions could be needed depending on the time of year, the availability of other thermal plant and hydro storage.

In contrast, a dry year emergency would take time to unfold as depicted in Figure 7.

The key point of Figure 7 is that both preparedness and flexibility will be important. While the measures will be similar, the choice and sequencing of these measures would vary depending on the particular scenario. The Commission could be faced with the need to implement rolling cuts with no warning (for other than dry year events). This suggests a priority for the Commission to ensure that protocols are in place to implement rolling cuts. In particular, distributors should have contingency plans in place to implement rolling cut instructions from the Commission. If required at short notice, the Commission could relatively quickly decide the extent of cuts required, working in conjunction with the System Operator to ensure real time security is not compromised. However, ensuring that these were implemented by

distributors in a way that minimised impacts on consumers would rely on effective contingency plans being in place.

While not relevant to a dry year event, the Commission should also consider its role within a Civil Defence scenario involving energy shortage risks.

8.2 Conclusions

The Commission will need to have arrangements in place to respond to security of supply emergencies in addition to extreme dry year scenarios. The Commission should therefore consider other emergency scenarios that it may need to respond to.

In contrast to a dry year, other emergencies could occur with little or no warning requiring a different response form the Commission. Although the sequencing of emergency measures will differ, the measures to be employed are likely to be similar. The concept of an ERP and related project structure that has been proposed for dry year emergency management could be extended to encompass other emergencies as well.

The Commission may need to implement rolling cuts with little or no warning reinforcing the conclusion in section 7.4.4 that ensuring distributors are able to implement rolling cut instructions safely, minimising impacts on consumers and ensuring real time security can be maintained, is a priority.

9 Data and Modelling Requirements

The data and modelling requirements for security of supply assessment purposes have been explored in detail in the discussion paper on security of supply policy development. In addition to this, we have considered general requirements under emergency circumstances. These are set out in Appendix 3.

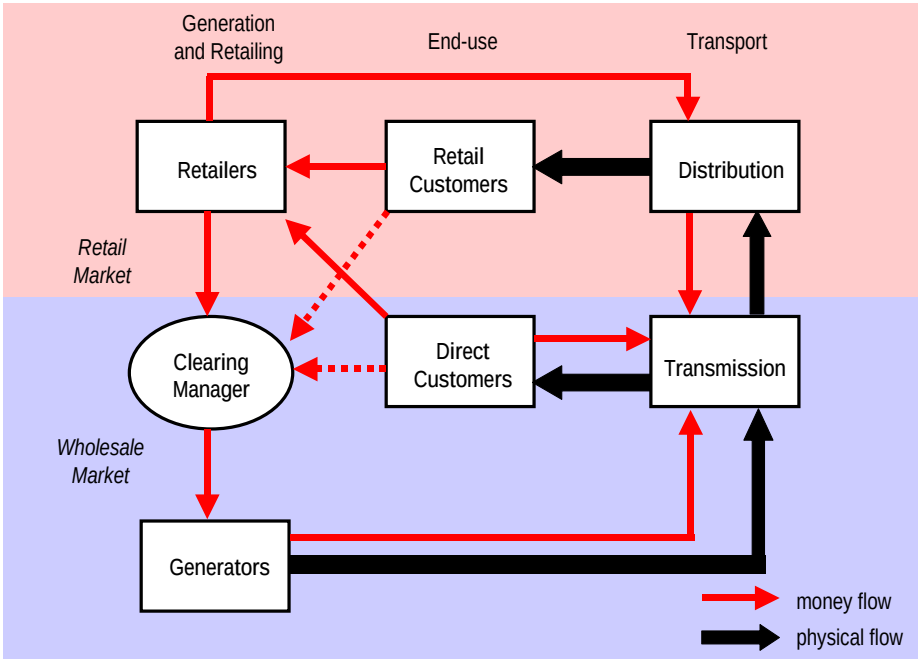
Appendix 1: General Commercial Arrangements

Any process for developing and implementing emergency provisions must take into account the structure of contractual relationships within the existing electricity market. This section outlines some relevant features of the New Zealand market. It is intended to be informative rather than definitive.

Industry Structure and Market Operation

The New Zealand electricity market operates according to a set of rules developed by industry participants over the last ten years and now operating as legislated rules administered by the Electricity Commission. The operation of the wholesale market, the retail market, and the contractual relationships, are illustrated in Figure 8.

Figure 8: New Zealand Electricity Market Structure



Electricity Commission has regulatory oversight of Retail Market, Wholesale Market, Transmission Contracts
Commerce Commission has regulatory oversight of distribution and transmission pricing
Electricity Commission has contracts with service providers for market operation services; Clearing Manager is one of these

The diagram highlights that:

- Grid connected generators sell electricity to the clearing manager, at spot prices, through the wholesale market arrangements

- Retail end-use customers typically purchase bundled electricity and lines services through retailers

- Direct end-use customers (grid connected) typically purchase electricity from retailers, and transmission services from Transpower

- Retailers purchase electricity from the clearing manager, at spot prices, for on-sale to end-use customers

Contracting Arrangements

How participants in the sector contract for supply, delivery and purchase of electricity has implications for arrangements to meet security of supply objectives. It is therefore important to understand the contracting relationships. Particular features include:

- Thermal generators have contracts with suppliers of fuel (coal, gas, diesel etc). These often have fixed (e.g. take or pay) and variable components.

- Generators selling into the wholesale market (typically grid connected) have exposure to spot prices. When spot prices are high during security constrained periods net generators[33] benefit through exposure to high spot prices.

- Embedded generators (connected into distribution networks) do not usually have residual exposure to spot prices (but can have) and therefore do not normally benefit from high spot prices during security constrained periods.

- Large customers (transmission or distribution network connected) often have some exposure to spot prices because of their contracts with retailers. This means that they have a financial incentive to reduce demand in response to high spot prices during a security constrained period.

- Distributors tend to contract with the retailer at either the transmission supply point (ie GXP pricing) or at the network supply point (ie ICP pricing). Generally the distributor is insensitive to high energy pricing during a security constrained period, except to the extent that energy savings may reduce network revenue. The extent of this is relative to the distributors pricing methodology.

- Transpower contracts with Distributors and Direct Connect Customers for transmission services provided to the transmission supply point (GXP). Charges are a mix of fixed charges and charges based on averaging maximum demand over the last 12 months. As such they are relatively insensitive to a security constrained period.

[33] Generators with generation capability exceeding retail customer and wholesale contract commitments.

- Some large, and many medium industrial and commercial customers (connected to distribution networks) contract with retailers on the basis of fixed price for variable volume. Unless otherwise contracted to do so, these customers therefore lack any financial incentive to reduce demand during periods of high spot prices. Metering arrangements for these customers often include the ability to measure consumption on a half hourly basis, with feed-back and verification of performance in making savings during a security constrained period possible almost instantaneously.

- Small commercial and residential customers typically contract with retailers on the basis of fixed price for variable volume. Unless otherwise contracted to do so, they also lack any financial incentives to reduce demand during periods of high spot prices. Metering arrangements for these customers do not usually include half hourly metering, and with meter reading being reduced to two or even three monthly intervals in some cases, verification of performance in making savings during a security constrained period is difficult.

Relevance to Emergency Provisions

These commercial arrangements reflect quite different financial incentives and exposures for participants in the sector during any security constrained period. By way of example:

- A net retailer or large customer would be exposed to rising spot prices in a dry year. This would strongly incentivise these parties reduce consumption (or to encourage their customers to reduce load) to mitigate this exposure.

- On the other hand, a net generator could benefit from high spot prices. While this would encourage it to generate more, it would have weak short term commercial incentives to encourage its retail customers to respond.

- A large number of customers at present face no real signal to encourage savings when spot prices are high.

- In contrast, distributors and Transpower (with whom consumers, retailers and generators have contracts) are relatively unaffected by high spot prices under current commercial arrangements.

These issues will be relevant to the operation of the normal market as well especially in relation to issues of competitiveness, hedging and greater demand side involvement.

The current commercial arrangements also have a range of implications for participants should interventions in the market be necessary. For example:

- Many customers have little financial incentive to conserve energy when market prices are high.

- Contractual liabilities could be created as a result of interventions in the market (e.g. mandated cuts could impact on retail/distribution/end-use contracts; administered fuel co-ordination measures could have significant property right implications; etc).

- Different commercial arrangements between retailers and distributors, with different incentives, are likely to make it difficult for the Commission to procure voluntary agreement between these parties regarding coordination of emergency measures.

These arrangements need to be taken into account when developing and evaluating measures for the Commission to use in an emergency security of supply situation, and identifying any regulatory powers that might be required.

Appendix 2: Summary of NZ Experience

The following is a high level summary of experiences in previous NZ supply shortage scenarios.

Winter 2003 - Summary

- 'Taskforce' established by Grid Security Committee
  - Resulted from a proposal to the Grid Security Committee by the generator/ retailer CEOs forum
- Emergency provisions developed and/or implemented
- Fuel information disclosure program established
- Protocol for reduction in local transmission quality to increase energy transfer southwards
- Generator outage coordination

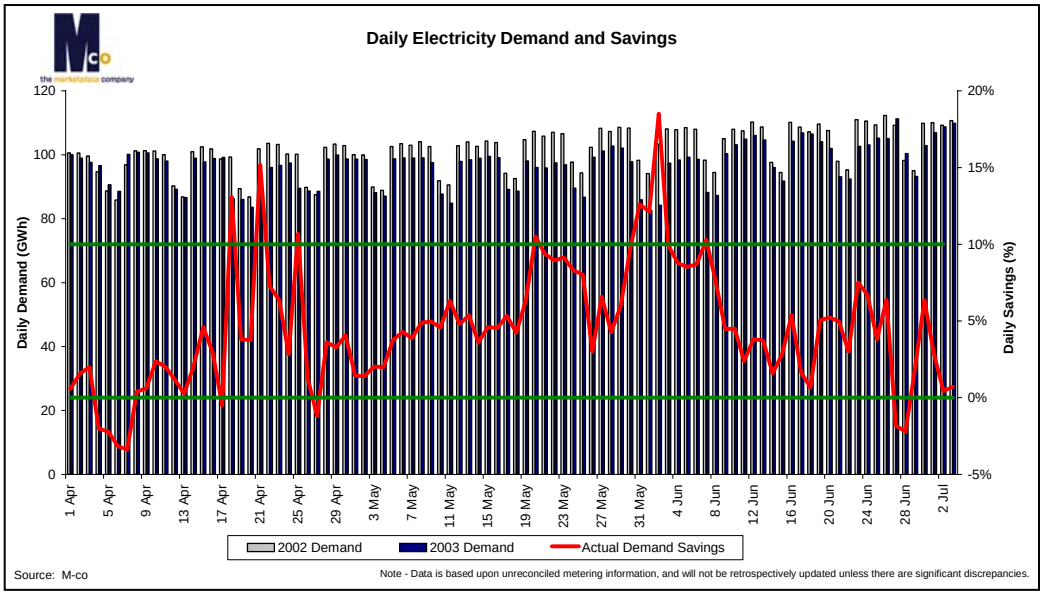
Winter 2003 – Conservation Plan

- Conservation plan never fully developed or implemented

	Stage	Savings (Cumulative)	
1	Media only	up to 5%	
2	Target 10% campaign	up to10%	Ongoing
	Buybacks		Retailer programmes
3	Extended Hot Water cuts	15%?	10hr & 20hr cuts
	Emergency Supplies		Distributed generation and non consented fuel
4	National initiatives	20%?	Street lights etc
5	Rolling Cuts	25%?	Feeder chop

- Stage 1 from 25 March
- Stage 2 from 28 April
  - Energy saving tips provided by EECA

– Advertising campaign costs $2.5M to 15 June



- Stages 3 & 5
  - Some national initiatives better placed before extended hot water cuts
  - Protocol for the management of extended hot water cuts and rolling outages
- Stage 4 national initiatives include
  - Street lighting cuts
  - Nine-day fortnights
  - Restriction of TV hours
  - Public building and event restrictions
  - Voltage reduction
  - Biggest gains estimated come from thermal load control: reduction of heating and air-conditioning in nation-wide groups of facilities such as educational institutions, supermarkets et cetera -rather than, say, from street-lighting

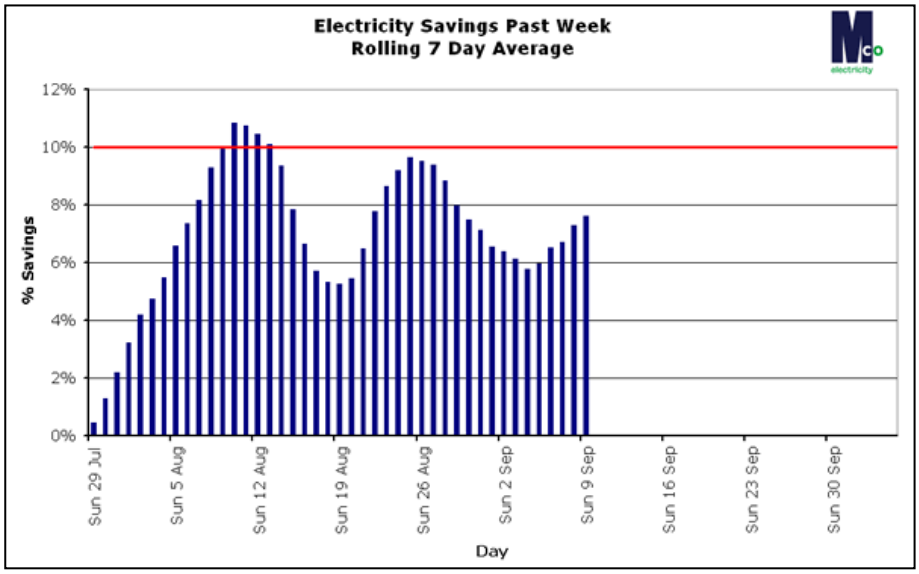
Winter 2003 – Issues

- "Central Agency" or incumbent retailer decision model for hot water cuts
- Processes for implementing cuts and established rolling outage targets not resolved
- Concerns over Commerce Act issues pertaining to the protocol
- Need to establish governance structure for national initiatives

- How to measure demand savings

Winter 2001 - Summary

- Minister of Energy signals 'moderate' hydro supply risk
- Emergency provisions developed and/or implemented
  - 10% Conservation campaign 27 July to 10 September
  - Demand exchange
  - Protocol for common quality standards to be reduced to enhance energy transfer (used again in Winter 2003)



Winter 2001 – Issues

- Access to demand information
- How to measure demand savings and use of embedded / stand-by generators

1998 Auckland CBD – Summary & Issues

- Summary
  - Caused by four power cable failures
  - Emergency provisions included
    - Stand-by generators
    - 53 customers participated representing an installed capacity of 23 MVA

- Buy-back scheme
- A week's involuntary load curtailment
- Priority customers defined (eg, emergency services including hospitals)

- Issues
  - Level of transmission supply security required

1992 - Summary

- Electricity Industry Committee established to respond to hydro shortages
  - Oversight by a Ministerial Committee chaired by Prime Minister

- Emergency provisions developed and/or implemented
  - Conservation campaign
  - Re-commissioning of Marsden 'A' and 4th unit at Otahuhu
  - Emergency Lake Levels
  - Reserve generators used at Whirinaki and Otahuhu
  - Comalco agreements to reduce demand
  - Accelerated commissioning of Clyde
  - HVDC capacity increased & full nameplate generation at Huntly
  - Transmission work postponed
  - Enhanced inspections of grid equipment at key locations
  - HVDC southward transfer increased with AUFLS relays in place at Comalco

- Conservation campaign
  - Savings peaked at over 20%
  - 18 hours/day cuts to water heating
  - Cuts to street lighting

- Emergency lake levels accessed at Lake Benmore
  - Application to access Lake Pukaki emergency storage (leading to Lake Pukaki Water Level Empowering Act 1992) – never used – later repealed
  - 404.5 GWh of emergency storage available = 145 Benmore + 31 Tekapo + 12.5 Cobb + 187 Hawea + 29 Waikaremoana

- Comalco agreement to close down 1 pot line
  - 14 days required to close
  - 121 days to restore = 30 days preparation + 91 days re-commissioning
  - Costs to Comalco in excess of $20M
  - Costs to ECNZ of under $10M

Pre-1992 - Summary

- Wartime restrictions
  - Cut advertising and display lighting
  - Reduce indoor and outdoor lighting including street lighting
  - Prohibit use of radiators and ranges at times
  - Extension of daylight saving by 30 mins
  - Prohibit without permit the manufacture or sale of almost all electrical appliances
  - Hot water cuts
  - Radio broadcasts cut by 30 mins
  - Periods of involuntary load curtailment: 15-30% cuts during 1946-8

- 1973
  - Hot water cuts
  - Some blackouts (weekday evenings 6.30-7.30pm or early weekend afternoons)
  - TV broadcasting hours cut
  - 5% cuts from July to September

- 1974
  - Oil use restricted
  - Water heating restrictions
  - Rolling blackouts
  - Restrictions on commercial and public lighting
  - Early shutdown of TV

- 5% cuts from February to July
- Huntly approved to cover expected shortfalls in late 1970s

- 1975-1978
  - Conservation campaigns to encourage 5-7% voluntary savings
  - Lake levels very low in Pukaki (1976) and Hawea

- 1983, 1984 & 1991
  - Some water heating cuts exceeding 12 hours

2003 SKM MED Study

- Emergency Power Generation Options
  - Existing gas or diesel emergency generation
    - Approx. 76 MW = 40 MW Auckland + 16 MW Wellington + 20 MW Christchurch
    - No commercial incentives
  - Geothermal steam take restrictions lifted
    - Extra 10 MW at Poihipi Geothermal Power Station
  - Re-commissioning old plant
    - 3.5 MW at Te Rapa
  - Rental or purchase gas turbine plant: operational in less than 4 months (air transport would shorten times)
    - Require resource consent approval
    - Plant generates at 11kV so may need transformation to higher voltage
    - Fuel supply requirements
- Power barges: 30-100 MW at US$300-420/kW, operational in 4-6 months
- Otahuhu A

Appendix 3: Modelling and Data Requirements

1. Introduction

The need for good quality, more frequently updated data will increase as security of supply risks worsen. Similarly, the modelling framework and models used to assess security of supply risks under more normal circumstances may be less appropriate in an emergency scenario (especially when the system and resources are under extreme stress and to enable more frequent and rapid 'what if' scenario analysis). Other models may have to be developed / modified during these periods. The following section describes how these requirements may change during a worsening security of supply scenario.

Interaction with Security of Supply Policy and Reserve Energy

How Emergency Provisions are expected to fit into the mix of security of supply measures has been outlined in section 5.1. As energy margins fall it is expected that if the minzone is crossed, all non hydro supply options will be generating at full capability. Reserve energy contracts would also be triggered:

- By market prices reaching the variable cost of a reserve energy contract;
- At the minzone for contracts with variable cost of 20c/kWh or less; or
- Below the minzone for higher variable cost contracts in order of increasing variable cost

For worse than 1 in 60 dry year scenarios, emergency measures need to:

- Be triggered in anticipation of shortage events to ensure that, for example, supply in a 1 in 100 dry year can be managed, and rationed if need be, to avert uncontrolled blackouts
- Have thresholds that are set consistently with the treatment of reserve energy
- Take into account the risk and implied cost of shortage in setting emergency measure thresholds

The reserve energy assessment would be calculated ignoring any emergency measures (in line with the GPS) but taking reserve energy triggering into account.

As a security of supply situation deteriorates, data and modelling requirements change.

Modelling Requirements

The modelling framework for assessing security of supply risks under most circumstances (including future reserve energy requirements) is based on a number of assumptions regarding system configuration and operation.

Concept Consulting provided a report to MED detailing the assumptions used currently in minzone modelling[34]. Any future model developed will make similar assumptions related to:

- Demand – anticipated demand including any correlation of low inflows with higher demand (eg dry, cold periods), and any impact of low inflows on embedded generation resulting in increases to GXP demand (if this is the demand base used).
- Thermal Plant Performance – treatment of extended contingencies and forced outages during extensive running.
- Fuel Deliveries.
- Transmission Outages.
- Requirements on thermal plant to provide other services – for example instantaneous reserves and frequency keeping.
- Any constraints on hydro running when lake levels are low – eg reduced efficiency due to lower head or due to running machines at lower loads.

There are often also approximations made to simplify the modelling such as:

- Reservoir balancing (ie assuming how each reservoir is used); and
- Approximating some smaller generation rather than using actual inflow data.

These assumptions and approximations may not be significant when used to forecast system security in the medium to long-term (minzone, long terms ESAs etc as proposed in the security of supply policy paper). However, during an emergency when the system is under extreme stress some of these assumptions are likely to be much more significant. We also note that the normal security assessment modelling framework would be specifically tailored to the 1 in 60 dry year risk policy. Inflows more severe than 1 in 60 and emergency supply and demand measures beyond the 1 in 60 policy would be excluded from that analysis.

[34] "Energy Security Assessment – Modelling and Analysis" – Feb 2004

Also the modelling framework has tended to focus on national security of supply assessments. Although a number of risks have been identified to date, consideration of locational issues (transmission and hydrology) has been limited. During an emergency, specific locational issues could become very important. Transmission constraints could have a greater bearing on the ability of constrained supply to meet demand and the impact that emergency measures may have. Similarly, the prospect of hydro reserves being trapped in individual storage lakes as overall storage falls to very low levels could have implications for emergency measures. It is likely that some of these issues will be more effectively dealt with through dialogue with participants and Transpower in order to simplify assumptions for modelling purposes.

Figure 9 shows how modelling requirements may change as security of supply worsens.

Figure 9 - Modelling Requirements with Worsening Security of Supply

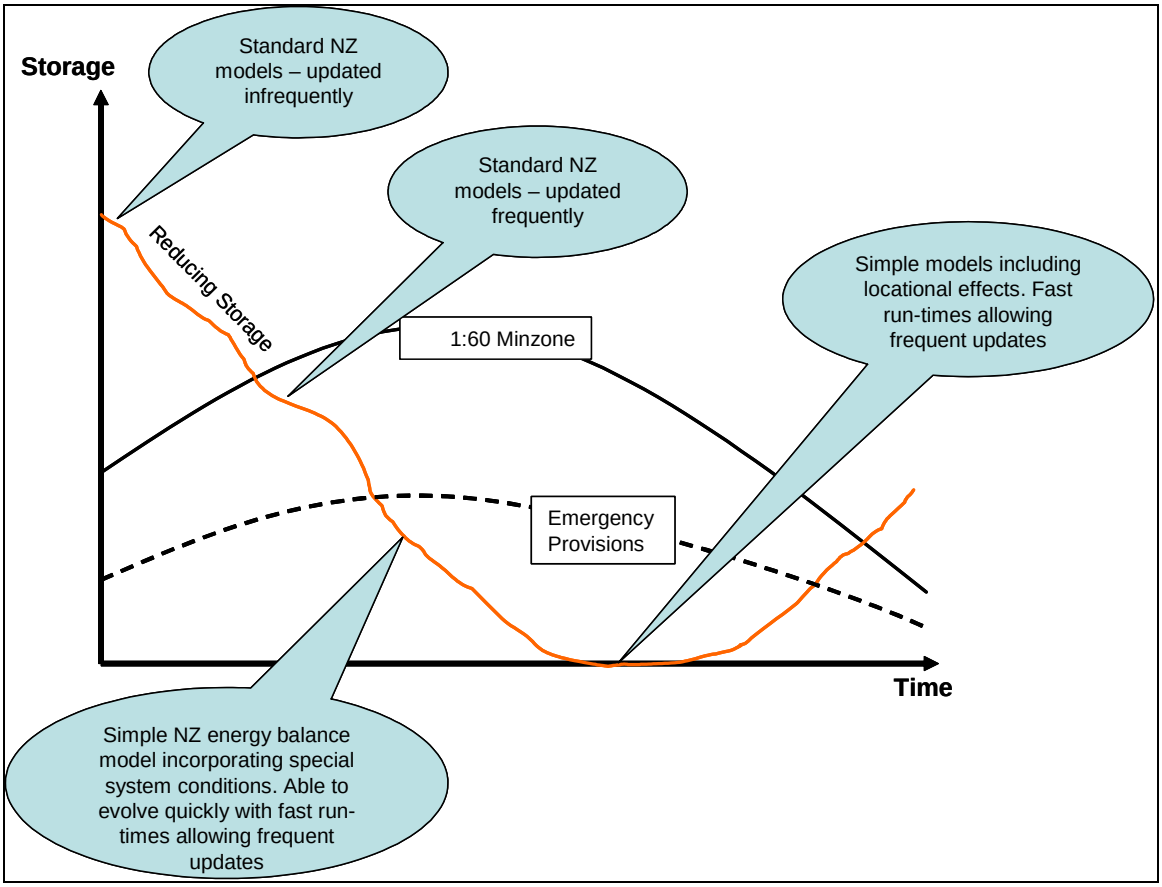


Figure 9 highlights how, as energy security margins tighten, standard models become less useful. The reasons for this include:

- The approximations inherent in most sophisticated modelling packages as noted above may become less reliable.

- Standard system models tend to have relatively long set up and analysis times. During emergencies the turnaround time will become important as more "what-if" runs will be required to assess possible measures as well as more regular data updates relating to current system security.

- As measures are introduced to assist the supply / demand situation, changes may be needed to the models. The standard models are generally not easy to change quickly. They have been designed to operate a business as usual scenario with a number of approximations having to be made that may no longer be applicable when the system is under extreme stress. Adapting these models, and ensuring the accuracy of the results, would probably prove challenging at the least and impractical at worst.

- At very low storage levels where supply is not able to meet demand and rotating cuts have been implemented – time of day and locational effects will become critical. The normal modelling framework has been designed to consider mainly national security of supply over extended timeframes – not for micro management of load-shedding or assessing the benefits (or otherwise) of emergency measures.

A more responsive and readily adaptable modelling framework will need to be developed to supplement the conventional modelling arrangements for emergency situations[35]. For example:

- Simple energy balance by location. The country should be able to be divided up into a small number of flexible regions with demand in each region readily adjustable. The number of regions would reflect the level of key transmission constraints that could impact on the effectiveness of emergency measures.

- Simple cumulative generation should be incorporated into each region. For example total thermal, hydro and other.

- Power flows between regions in the model should be able to be constrained reflecting actual constraints.

- Hydro inflows should be based around minimum daily – weekly flows into regions. They should be separated into controlled and uncontrolled to enable modelling of time-of-use generation.

[35] In the draft security of supply policy development discussion paper we also proposed that stripped down models be developed to enable this sort of analysis more easily. Detailed modelling would be required to validate the approximations and simplifications made in such a model.

- Use of fuel, both hydro storage and thermal, should be flexible – allowing the user to set how quickly different fuel stocks can be used. This data would be confirmed daily (or more frequently if need be) with the relevant generators, taking into account storage and fuel constraints, and be profiled to the extent possible.

- Ability to model half-hourly supply / demand. Reality checks with the market SPD model operated by the System Operator would also be undertaken.

Such a framework would provide the flexibility to change both the model and key assumptions easily to quickly evaluate security of supply risks and emergency measures – both supply and demand. It would also create a greater focus on the issues that really matter the most. It could be used to evaluate the effectiveness of, and targets for, various emergency measures.

Data Requirements

As with the modelling requirements, data requirements are likely to change from the status quo as system security deteriorates. This is demonstrated in Figure 10.

Figure 10 - Data Requirements with Worsening Security of Supply

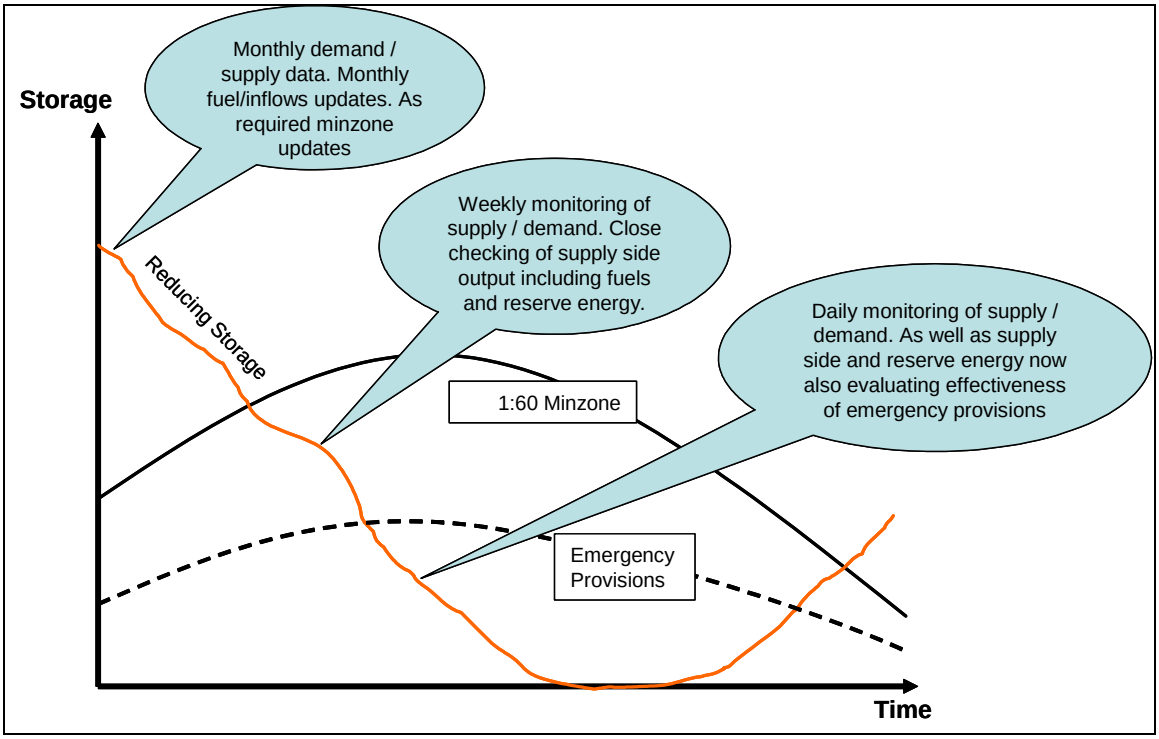


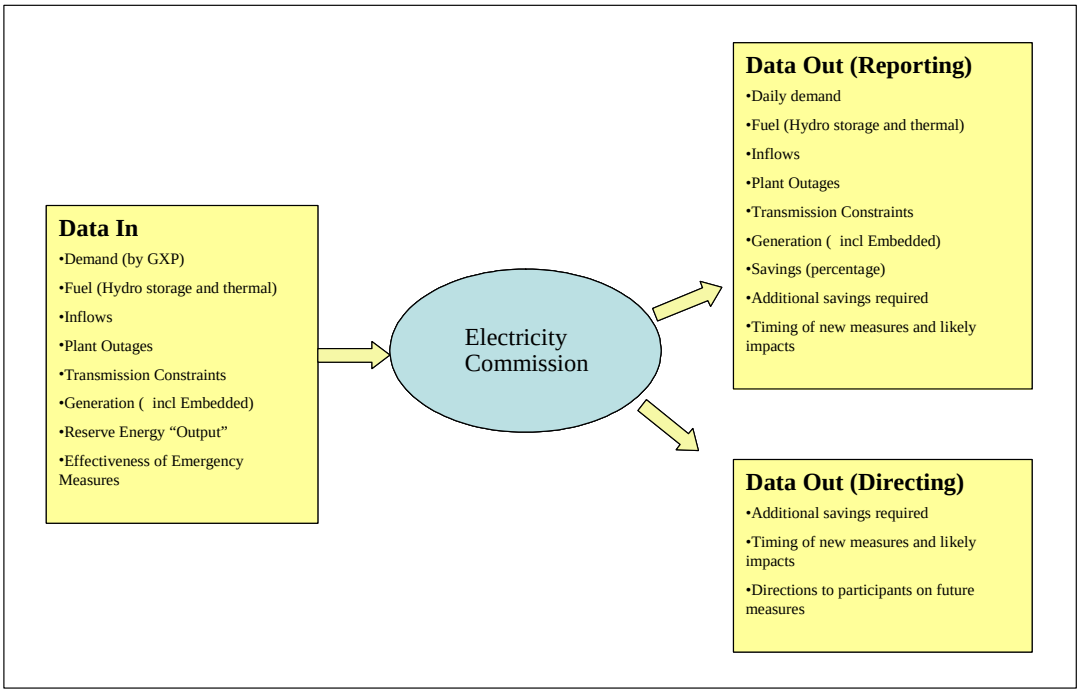
Figure 10 shows that as the situation deteriorates:

- More data is needed. For example monitoring the effectiveness of emergency measures may require data to be collected from individual supply feeders rather than aggregated GXP data.

- Data needs to be updated more frequently.

Data flows will need to go both ways – ie data that the Commission needs to monitor the situation and what the Commission needs to report to enable it to get the responses that it needs. Some indicative data flows are shown in Figure 11.

Figure 11 - Indicative Data Flows during a Security of Supply Emergency



Data requirements are likely to intensify in an emergency situation and will require much more frequent updating. Accuracy of key operational data will also be more critical.