6 COPING WITH CRISES

In this chapter we examine New Zealand's historical experience with supply insecurity and how such insecurities were managed under the centralised, engineering-based model of electricity provision. We then contrast that experience with the experience arising post the reforms. First we consider the 1992 winter power "crisis". We use the term "crisis" guardedly since the contemporary experience has been far kinder than that in previous decades. In 1992 electricity provision was still largely centralised under ECNZ, but with a clear commercial focus and a modified set of operating constraints. We then consider the 2001 winter power "crisis" and what we will call the 2003 winter power "scare". Whereas the 1992 events provide a contrast between pre- and post-reform experiences, the 2001 and 2003 events provide contrasts with that in 1992 because of the advent of the NZEM. To provide yet another point of contrast we discuss the transmission outage of February 2004, since the ongoing centralisation of grid operation and investment represents an enduring counter-example to the reforms instituted elsewhere in the sector, notably the decentralisation of generation. For completeness we also discuss the 1998 Auckland CBD outage, although it appears to be an outlier, rather than an insight into the reforms. With these events in mind, we then examine the role of spiking wholesale power prices in winter power "crises", arguing that such spikes are not only necessary but desirable. New Zealand's recent reserve generation scheme is then reconsidered, given that it necessarily places constraints on the rationing role of wholesale electricity prices.

ELECTRICITY SYSTEMS VULNERABLE TO SHOCKS AND CRISES

Overseas Events

All electricity systems are vulnerable to and experience shocks and crises. On 14 August 2003 the north-eastern US and parts of Canada suffered a spectacular outage plunging New York, among other major cities, into darkness for a day. Just two weeks later, human error lead to a transmission fault stranding London commuters and cutting power to hundreds of thousands, for hours in some cases. Soon after, nearly 4 million Danes and Swedes lost power for an afternoon; and in a separate incident that month, 50 million Italian electricity consumers were deprived of power for a day when transmission lines from Switzerland sagged and touched a tree. During the summer of 1998 in the US midwest, generation capacity shortages combined with high temperatures to result in major electricity price rises – peaking at US$7,500/MWh – although blackouts were avoided. These dramatic events were experienced both in countries with reformed electricity systems (e.g. England), and those yet to institute major reform (e.g. Italy). In the main they arose from transmission failures, but tight supply conditions were also a cause.[1]

Fuel Risks and the Weather

At a more basic level, electricity systems dependent on generation using fuel oil or gas are vulnerable to escalations in the price of oil (e.g. oil price shocks), sudden falls in supply (e.g. wars in the Middle East), gradual falls in supply (e.g. fossil fuel depletion), the vagaries of fuel exploration, and emissions taxes. Systems dependent on coal can be similarly exposed – and to other risks besides, such as industrial disputes. Other risks to any electricity system include extreme weather events or simply the weather itself. Not only can the weather affect generation reserves where hydro power is used, but it also drives seasonal demand patterns and creates peak loads – whether for heating in winter or cooling in summer – that have the capacity to stretch each link in the electricity system's chain to its limits. At the same time, electricity consumers are increasingly vulnerable to insecurities in electricity supply, with much of modern working and living having become electricity-dependent, not least the information and communications technologies now pervasive in industrial and even less-developed countries.

Changing Balance of Supply and Demand

In general terms, the single greatest driver of instability in an electricity system is that caused by the changing balance between supply and demand. If demand can be guaranteed to be within the supply capability of an electricity system at all times, then the chance of system failure is limited to drivers largely determined outside of that system. However, forecasting future electricity demand even in the short term is notoriously difficult, and in the longer-term prone to significant error.[2] The history of electricity systems is typically one of supply doing its best to keep ahead of an ever-growing demand, often with temporary periods of surplus as a result of the costly and "lumpy" nature of system expansion. Little regard has been had to the relative desirability of new demands, which are distorted when electricity prices are determined administratively rather than via decentralised market-based mechanisms. Supply security – where it has arisen – has typically required consumers or taxpayers to carry the cost of maintaining surplus system capacity. Where this excess capacity has not arisen, electricity systems must be run close to their technical operating limits, emphasising the trade-off between system security and available capacity.

1 The Californian crisis of 2000 discussed in Chapter 4 is an example where few would doubt the greatly exacerbating role played by faulty electricity-sector reforms and regulation. The root of the crisis, however, lay elsewhere, with a hotter-than-usual summer and dryer-than-normal year (reducing hydro inflows), strong economic growth feeding into increased electricity demand, and sharp increases in gas costs and the price of pollution permits.

2 Galvin (1985) assessed the historical record of electricity planning in New Zealand, reporting over-estimates of demand growth, that ranged between 33% and 51% for the periods considered.

Systemic Risks

More specifically, by their very nature interconnected electricity systems suffer the additional risk that failures or constraints in one part of the system may affect the operation of the rest of that system. In the case of failures, additional failures can be triggered elsewhere (the famous "cascade" effect so dramatically observed in the north-eastern United States and parts of Canada in August 2003, and in Italy soon thereafter). In either case other parts of the system can be required to take up any resulting slack, such as alternative transmission paths or generation being required when transmission constraints bite.

NEW ZEALAND'S VULNERABILITIES AND RESPONSES – BEFORE CONTEMPORARY REFORMS

Early Twentieth Century

In the early part of the twentieth century, New Zealand's electricity system was characterised by generation development leading to the creation of new energy demands that quickly outpaced supply. As such, the system – or in those days, more commonly, geographically distinct systems – suffered from an exposure to climatic conditions affecting demand, accentuated because most generation was hydro-based. More fundamentally, though, such systems risked being run at their technical limits, if only at times of peak demand, and had limited ability to call upon other parts of the system to compensate for any shortfalls or failures.

1940s and 1950s

It was during the course of the 1940s and 1950s that New Zealand's exposure to weather conditions – particularly as they affected available hydro storage – became a key challenge to the security of the then national electricity supply. Over the 1950s it was not uncommon for consumers to face supply cuts of 10-30% at various times of year, depending on where they lived, as a consequence of drought. Over the war years, in particular, adverse climatic conditions resulted in a wide range of measures to curb or otherwise control energy consumption so as to ensure security of ongoing supply, including public campaigns to reduce demand, load regulation by supply authorities, cuts to radio broadcasts, and the requiring of permits for (or in some cases prohibition of the use of) certain electrical appliances. Some price-based incentives were also used to encourage conservation, with examples of metering being installed and hourly electricity prices charged, but in the main restrictions and cuts were imposed on consumers where calls for voluntary savings were unsuccessful.

1960s and 1970s

The 1960s witnessed a favourable shift in the overall supply balance, particularly with new generation commissioned in the North Island, but the 1970s saw a return to supply shortages. Added to the previous problem of low hydro inflows into storage lakes were the oil price shocks (and embargo) of the 1970s, growing transmission constraints affecting regional demand/supply balances, and general demand growth requiring new generation capacity.

Once again government made calls for voluntary reductions backed up with threatened and actual cuts. Television broadcasting hours were sometimes reduced, hot-water cuts were applied where supply authorities had installed ripple control in domestic hot-water systems, and from July through to September 1973 blackouts were common 6:30-7:30pm weeknights, and early afternoon on weekends. Rolling blackouts were another tool used in the 1970s to manage supply shortages, and generation capacity reliant on oil was in some cases converted to cheaper or more secure fuels (e.g. based on newly developed indigenous gas supplies).

1980s

Water-heating cuts of up to 12 hours a day were required during the 1980s at the worst of the supply squeezes (arising from volatility in hydro inflows to storage lakes). In the main, however, New Zealand in these years – as in the 1960s – enjoyed a relatively secure electricity supply, even if it resulted from costly excess capacity.

NEW ZEALAND'S "CRISES" AND RESPONSES – AFTER CONTEMPORARY REFORMS

Earlier Lessons Forgotten

Supply crises in the years leading up to the contemporary electricity reforms – and the often-times draconian responses they spawned – appear to have been all-too-quickly and easily forgotten. With the first of two post-reform winter crises occurring in 1992 – the other in 2001 – the general discussion surrounding supply insecurity has often levelled blame at the structural and institutional arrangements arising under the reforms. Such attitudes have only been hardened in many quarters by the operation of a new device to alleviate supply shortages under the reforms – the wholesale electricity market that commenced full operations in October 1996. Calls are frequently made for government to intervene where the market is seen as having failed or been faulty, particularly where wholesale electricity prices have sky-rocketed and segments of the electricity sector have actually or seemingly reaped handsome profits during the crises. At times, some even call for an actual or effective return to "the good old days".

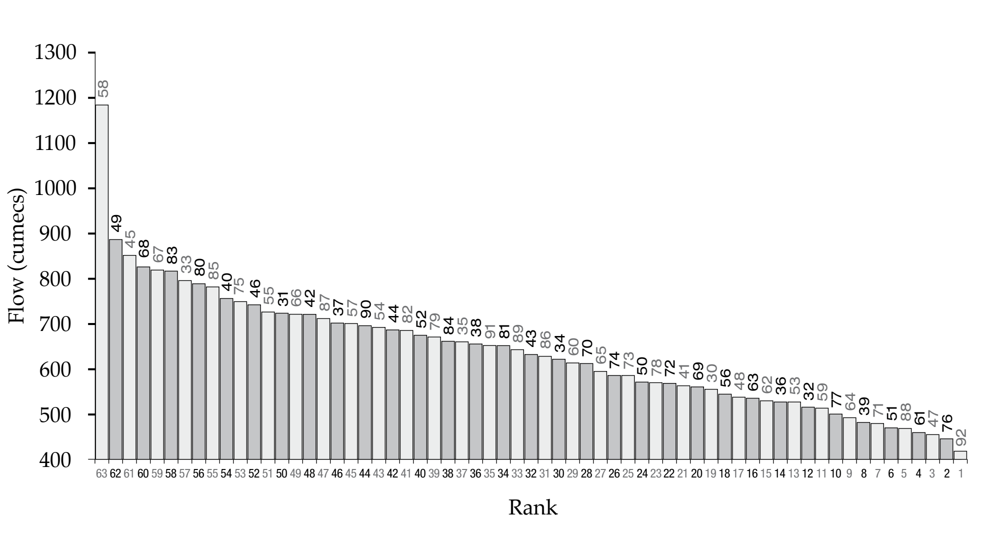
Since winter 1992, however, electricity reforms of various colours and intensity have continued with much the same thrust as their predecessors. But an abortive winter crisis in 2003 on the back of political impatience with the 2001 crisis coincided with moves by government to intervene where previously industry had been charged with finding the necessary solutions. The future of the market has been publicly threatened by government.[3]

1992 Winter Crisis

The 1992 winter power supply crisis arose after the corporatisation of state-owned monopoly generation and transmission, but before the corporatisation and deregulation of distribution and retailing, and also before advent of the wholesale electricity market. It provides a useful counterpoint not only against the pre-reform period, but also against later reforms, in particular the creation of a wholesale electricity market.

At this time generation – centrally planned and administered by the state-owned generator Electricity Corporation of New Zealand (ECNZ) – comprised 75% hydro (and hydro storage, when full, accounted for around only 12% of annual demand), and inflows remained characteristically volatile. What precipitated the 1992 crisis was an unusual succession of lower-than-normal inflows – with key hydro lakes from November 1991 through to May 1992 experiencing their lowest (or second lowest) inflows in 62 to 67 years, as illustrated in Figure 6.1.

FIGURE 6.1 **Lake Inflows in Major Catchments November 1991-May 1992**



Source: Electricity Shortage Review Committee (1992).

3 "Electricity Market's Survival linked to Crisis warns Government", *New Zealand Herald*, 9 April 2003.

The shortage was exacerbated by an unexpected increase in electricity demand, and by ECNZ operating to a supply security standard that could cope with the lowest inflows observed over a 20-year period (a standard it had inherited from its public-sector predecessor, the Electricity Division of the Ministry of Energy). A consequence of that standard was that ECNZ had available, or ran, thermal generation in the lead-up to and during the 1992 winter at a level less than that required to conserve scarce hydro reserves. While it had certain supply security obligations under its supply contracts with the then 48 ESAs (which distributed energy to end customers) and a handful of direct supply customers, ECNZ was under no statutory obligation to ensure a secure electricity supply; this is a situation which pertained in the past and continues with generators today.[4]

Sea-Change in Response

The 1992 crisis witnessed a sea-change in terms of response. In May, ECNZ issued a press release advising of the drought conditions, the impact they were having on hydro reserves, and what measures it was taking to alleviate the problem. Soon afterwards industry representatives including ECNZ (which then included transmission), ESAs and other major electricity users – not government – took the initiative to coordinate industry's response. Following discussions with government they opted against the time-honoured approach of compulsory rationing, considering it to be inequitable, and chose instead to make greater provision for consumers to make their own price/security trade-offs. Already the reforms had attenuated political involvement in the industry, and focus had shifted to the needs of electricity consumers.

The resulting response continued to involve public campaigns to reduce consumption – seeking voluntary cuts of 10% over May through to August, and achieving 15-20% savings. Government departments were directed to make savings of 10%. Other measures involved ECNZ negotiations with NZAS (a major direct-supply customer representing 15% of annual electricity consumption) to shut down one of its three aluminium smelter pot-lines, increased thermal generation, and at times cuts to water heating of up to 18 hours per day.

Role of the Fledgling Wholesale Market

The bulk of energy supplied in 1992 was via direct contracts between ECNZ and ESAs or direct supply customers, specifying prices and, within ranges, supply quantities. While no formal wholesale electricity market was in operation, ECNZ posted half-hourly "spot" prices weekly in advance at which such customers could buy any additional

4 As noted in Chapter 8, under the Electricity Act 1968 the Ministry of Energy was (among other things) required to undertake "a continuous programme of works providing adequate supplies of electricity", which is not the same as an obligation to provide uninterrupted supply at any price. Even now, with the new Electricity Commission being charged with ensuring New Zealand's supply security, there remains no guarantee that all electricity demand will be met at any price regardless of hydrology or other factors affecting the balance of electricity supply and demand.

energy not covered by their contracts (or sell surplus energy back to ECNZ). Although capped at the cost of ECNZ's most expensive generation – at $150/MWh – these spot prices rose over the course of the crisis, both signalling the growing scarcity of hydro reserves and providing some encouragement for consumers to conserve.

However, the result of the energy savings made during the winter crisis resulted in ESAs enjoying a windfall gain of $57 million by selling energy arising from these savings back to ECNZ at the elevated spot price. With only one ESA passing this price signal back to end customers, it should come as no surprise that ECNZ's "spot" electricity market – a precursor to the current wholesale electricity market – had little success in influencing a demand-side response to the crisis. Nor could it have been expected to adequately signal ongoing needs for new generation capacity, or of itself provide any incentive for required generation investment.

The report of the subsequent Electricity Shortage Review Committee recommended, among other things, that ECNZ and the ESAs consider removal of the cap on spot prices, noting that the existing mechanism could "not be expected to bring supply and demand into balance during periods of shortage". It further recommended a shift to a 1-in-60 dry-year security standard (in place of the 1-in-20 dry-year standard then used by ECNZ), financial incentives and education (with a role for government) for consumers, to reduce demand and improve energy efficiency; and measures – notably longer-term contracts between ECNZ and its customers – to improve supply security by providing better information on demand trends and generation requirements. Referring to the contemporaneous work being undertaken by the Wholesale Electricity Market Study (WEMS), the Committee expressed a view that a wholesale electricity market could be expected to address the then concerns regarding supply security, information flows and incentives for electricity efficiency.

2001 Winter Crisis

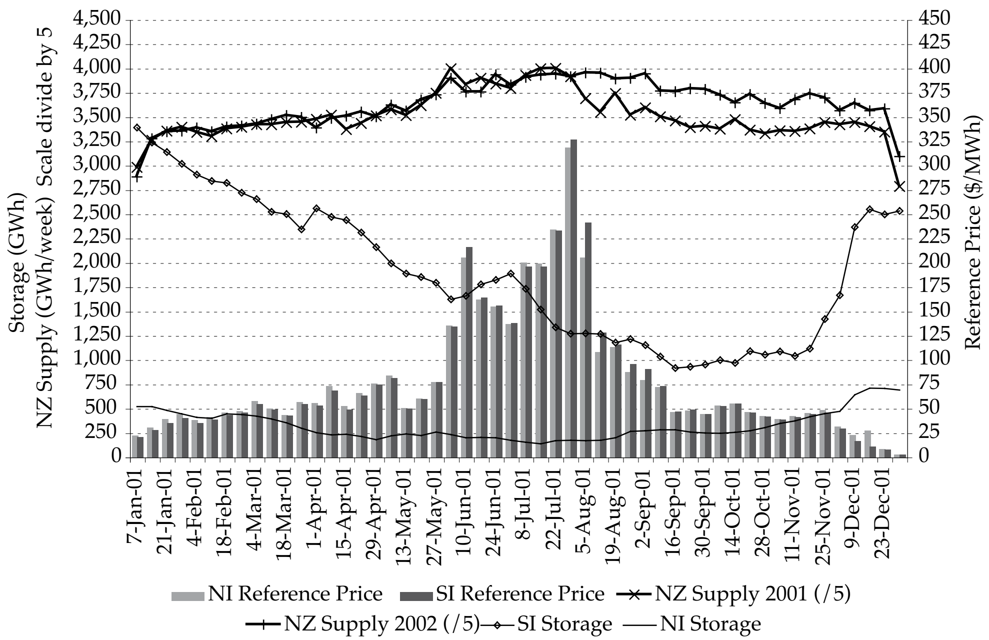
If the 1992 winter crisis showed that the reforms had provided a less government-directed, more industry-led and more customer-focused response to crisis – even with some imposed cuts to water heating – the 2001 crisis demonstrated the benefits of subsequent reforms. Most notable of those benefits were the signalling and rationing functions performed by the wholesale electricity market implemented in full since October 1996, and the benefits of competing generation created by the spinoff of, firstly, Contact Energy from ECNZ and then the further break-up of ECNZ into Genesis, Meridian Energy and Mighty River Power.

Early 2001 shaped up to be even worse than the lead-up to the 1992 crisis, with storage lake inflows in the first seven months of the year being the lowest in 71 years. Combined with stronger-than-usual demand growth and an unusually cold early winter resulting in record June demand levels, winter 2001 again posed the prospect of supply shortages.

Figure 6.2 demonstrates the reaction of wholesale prices and electricity consumption in the lead-up to and over the course of the crisis, and their correlation with hydro storage levels relative to average. Up to May, wholesale prices gradually rose in response to rising demand and falling hydro storage levels, but then experienced sustained and dramatic rises over June and July with daily average prices the highest seen in the market since its inception, but with little response from demand. However, a dramatic decline in wholesale prices coincided with a sudden decline in demand in the first half of August, even though hydro storage levels continued to decline. Importantly, the resulting energy savings were secured long before hydro reserves recovered in November/December. Also of note is the fact that South Island prices were often higher than North Island prices as excess generation in the north of the country was required to supply the south owing to low southern hydro storage levels (the reverse typically being the case because of the dominance of demand in the north, and south/north transmission constraints across the Cook Strait and through the central North Island).

FIGURE 6.2

2001 Electricity Supplied and Hydro Levels (GWh) and Spot Wholesale Prices ($/GWh)



Source: Robertson *et al*. (2003).

Government Steps in on behalf of Industry

To combat the crisis, government – as opposed to industry – stepped in to support a "10% reduction for 10 weeks" voluntary electricity conservation campaign, reflected in declining wholesale prices over August through to November. Larger electricity customers who had not hedged all or enough of their electricity requirements faced the full wholesale spot price and, where they could, began reducing production and rescheduling maintenance so as to limit the impact of the price rises. Additionally, Transpower was able to alleviate some of the effects of the shortage that resulted from transmission constraints by relaxing certain system security standards (i.e. by running the grid harder). Peak seasonal demands were mainly over by September and, with storage levels then starting to trend towards normal, wholesale prices had fallen to more usual levels.[5] Compulsory restrictions, widespread water-heating cuts and blackouts had been avoided.

Residential customers Insulated but NGC Exposed

Importantly, residential customers remained largely immune from the wholesale price rises over the course of the crisis, continuing to enjoy stable retail prices despite the increased wholesale market volatility. However, the retail arm of Mighty River Power, Mercury Energy, even offered rebates to its 250,000 customers if they saved power, offering them an opportunity for financial gain. At one stage NGC, which had only recently acquired 76% of the then largest energy retailer, TransAlta New Zealand, attempted to increase its prices to better reflect its wholesale electricity costs. However, it found this could not be sustained since hedged parties – including generators that had begun to acquire or set up their own retail operations – did not face the same pressures to increase retail prices. Instead the company – originally a gas network operator and trader that diversified into electricity - opted to sell its retail customer base and exit its electricity industry investments following heavy losses.

NGC's exposure arose because hedge contracts it used to hedge its spot wholesale electricity price risk expired in May 2001, when the crisis was well underway, and it found itself unable to secure new hedges at prices it regarded as acceptable (having declined contracts in February and March at prices it regarded as too expensive).[6] This situation was argued to demonstrate a competitive failure of the reformed industry, in that the generators from which NGC sought new hedge contracts were now its main retail competitors. However, the question remained why NGC had not secured replacement hedge contracts well before its existing contracts had expired, and the fact that its attempt to raise retail prices was thwarted by the actions of those very same generators could also be interpreted as a plain example of retail-level competition benefiting residential customers in the midst of an industry crisis. By this measure, the wholesale market might be argued to have "weathered" the 2001 crisis commendably.

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5 Indeed, above-average storage inflows in December caused prices to fall to near zero, resulting in the first use of the market's must-run dispatch auction.

6 See "Mighty River Contracts 'Vindicated' in Wholesale Power Price Crisis", *National Business Review*, 24 August 2001.

Reformed Arrangements Criticised

Despite this, however, aspects of the industry and wholesale electricity market response to the crisis drew criticism. Retail prices – being in a sense fixed prices that energy retailers are prepared to offer so long as they can cover their electricity purchase or supply costs on a risk-weighted basis – began to rise following the winter crisis. In part this represented the market's recognition, conditioned by recent experience, that future wholesale prices might dramatically rise in a similar fashion in any future electricity shortage (in much the same way that insurers raise premiums following adverse claims episodes). Generators with capacity surplus to that required under customer contracts, or to satisfy their own retail customer demand, were potentially able to reap significant profits by selling into the wholesale market at unprecedented prices.[7] Net purchasers, though, bore higher prices on their wholesale market purchases. On the other hand, larger customers with electricity supply contracts potentially benefited from the high electricity prices by being able to voluntarily reduce demand and sell surplus power on the wholesale market at significantly higher prices. Increased transmission constraint rentals resulting from the higher prices were passed on to distribution companies as a windfall gain.

None of these were a "good look" for industry, particularly in the eyes of those users exposed to the spot price, and these events were accompanied by allegations of market-rule gaming and abuse of market power by generators, followed by the customary calls for government intervention and changes to market rules and industry structure. For its part government at that time resisted calls to explicitly cap wholesale prices and otherwise to intervene, instead warning the industry that the future of the market rested on the effectiveness of its response to the crisis.

Reformed Arrangements Rise to Challenge

Once again, however, it is worth noting that the responses to the 2001 winter crisis continue to demonstrate clear breaks with reactions of the past. While government took a greater role in supporting calls for voluntary savings than it did in 1992, and threatened industry that it needed to respond to the crisis effectively if the market was to endure, the 2001 crisis was characterised more by Adam Smith's "invisible hand" than by the guiding and constraining hand of government.

The market mechanism did in fact keep the lights on, despite being distrusted by many because of its lack of any discernable personage taking responsibility for coordinating suitable responses to the crisis, and resented by politicians who begrudge real power in the electricity industry being out of their hands. It effectively rationed scarce electricity to those who valued it most, with exposed customers who could reduce their demand rationally choosing to do so (and possibly making on the deal by selling surplus power

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7 Although, as shown in Chapter 3, generator profits were not abnormally high, perhaps reflecting their fixed-price contract positions.

at the increased wholesale price), and others either being insulated from the price rises (notably residential customers or those with fixed supply contracts) or making the assessment that they would face worse costs than the wholesale electricity price if they chose not to consume. This is how markets are intended to work, using price to ration resources to those who value them most highly. The fact that the price in question experienced significant increases has been argued to indicate market failure, but instead it would appear a natural consequence of price-inelastic demand combined with tight supply,[8] and a useful response to a very real supply crisis caused by lack of rain.

Certainly it can be emphasised that residential-customer energy savings came about with a call, supported by government, for voluntary savings. This, however, gives no credit to those power companies offering their customers bill reductions for reducing consumption. Nor does it indicate a failure of the market and a need for government intervention: as the 1992 crisis demonstrated, the industry was capable of making such calls. And nor should a call for quantity reductions be taken to mean a failure of the price-based market mechanism. While it can be (and is in Chapter 7) debated whether the reformed industry structure dampened incentives for the adoption of price-based signals at the residential level, the reality was that in winter 2001 residential customers by choice or lack thereof faced fixed electricity charges that insulated them from the worst of the wholesale price rises without consumption being constrained.

Voluntary Savings Displace Rationing

In the absence of a price-based mechanism for such customers to be encouraged to reduce their demand when supply is under strain, more quantity-based measures are required. It is too much to expect sustained low prices and continuing demand in times of shortage at least across all consumers, irrespective of whether electricity supply is determined administratively or by market forces.[9] A subset of electricity consumers may be economically insured by fixed prices that incorporate a risk premium, provided that a significant portion of demand has the incentive and ability to vary in response to price changes. That calls for voluntary reductions were adequate, and reductions and blackouts avoided, demonstrate a clear improvement of the current regime over that prevailing before the reforms. It also indicates an improvement over the situation in 1992 when conservation signals were slower to arise, price-based rationing was of limited effect, and some supply restrictions were necessary despite strong voluntary reductions.

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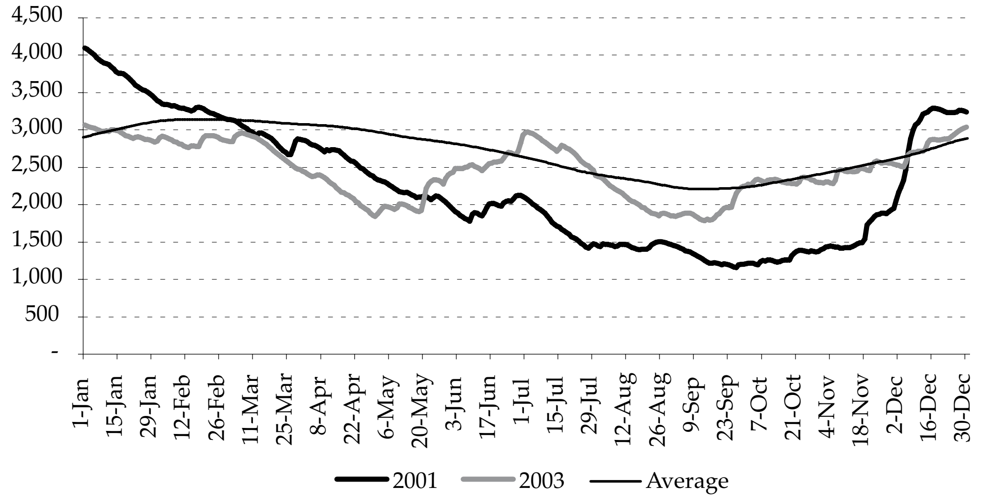
8 Short-term electricity supply should be expected to become more price-inelastic during a supply shortage, with the scarcity value of water – its "opportunity cost" or "shadow price" – sharply increasing. See Box 3.2.

9 In this regard it is instructive to recall New Zealand's response to past oil price shocks, before the widespread market-based reforms of the 1980s. Where petrol prices rose in response to the shocks, consumers had incentives to economise on fuel use and invested in fuel-efficiency by opting for smaller vehicles and converting existing vehicles to run on cheaper domestic compressed natural gas. Government augmented such price-based measures, however, by imposing car-less days and reducing the open-road speed limit to 80 Km/h, regardless of the unequal burden of such measures on different road users. So far residential electricity consumers have effectively been able to avoid either type of measure during the post-reform crises.

2003 Winter Power Scare

On the basis of observed hydro storage levels over the first five months of 2003, demonstrated in Figure 6.3, it was feared that winter 2003 was shaping up to be at least as much of a crisis as winter 2001. In fact, as early as December 2002 wholesale electricity prices rose strongly in response to lower-than-average November inflows, but quickly returned to more normal levels.

FIGURE 6.3 **Hydro Storage Levels – 2003 vs 2001 and Average (GWh)**



Source: M-Co data (unpublished).

Following government's 2001 warning that the market's survival depended on an effective industry response to the then winter crisis, industry participants formed a steering group to monitor and report on likely supply-shortage scenarios and to plan for a coordinated industry response in the event of another dry winter. In 2003 that group convened in February but, given the early indications of a looming winter crisis, the planning and preparation of industry's response was taken over in March by the Grid Steering Committee (GSC), with calls for 5% voluntary reductions being made in April.

Wholesale Market gives Early Warning

By that time spot prices were almost as high as at the beginning of the 2001 crisis, reflecting not just lower-than-average hydro inflows, but also new fears over the security of domestic gas reserves required for thermal generation. Output from the country's main gasfield – Maui – had already begun to run down, but in 2003 its expected productive life was revised downwards, causing a reconsideration of gas-based generation projects already in train, and accelerating plans for further gasfield development and exploration. Once again the wholesale electricity market gave early warning of impending supply shortages and provided industry players with the necessary incentives to economise on demand and conserve scarce hydro resources for peak winter demands. The 2003 crisis failed to materialise, however, with mid-year hydro inflows being sufficient to alleviate earlier shortfalls and to return storage to average levels. Despite a dry start to the year, it rained.

Government Intervenes despite Disappearing Crisis

Regardless of this outcome, and reflecting industry's difficulty in establishing a comprehensive industry-wide governance system and government's stated dissatisfaction with industry's management of dry years, in May 2003 government announced the establishment of a previously foreshadowed Electricity Commission. Among other things, the Commission has been charged with managing the electricity sector so that demand can be met in a 1-in-60 dry year (i.e. the standard recommended following the 1992 crisis) without the need for national energy conservation campaigns. To this end it is required to contract with generators for dry-year reserve generation capacity and reserve fuel, and with customers for interruptible load. As such it appears government has adjudged the extra costs of reserve generation and interruptible load – direct and indirect, obvious and subtle – preferable to occasional calls for voluntary energy savings and the enhancement of price-based signals to residential customers for any necessary rationing. This is despite the apparent ongoing success of savings campaigns in California, and its switch towards meeting new demands through energy savings and efficiencies.[10]

In September further details of these measures were released, including the trigger price for dry-year reserve generation being set at $200/MWh (or lower should the Commission consider that lake levels are sufficiently low). Other measures included the reserve energy supply being capped at 1,200 GWh over a four-month period, an energy price levy to be borne by electricity consumers to fund dry-year reserve, and government contracting with Contact Energy to build and operate the 155 MW thermal station at Whirinaki to form part of the dry-year reserve at a cost of $100m (commissioned in June 2004).

While these moves cannot be attributed to the abortive 2003 winter crisis, the timing of their announcement by the government would appear to reflect apparent urgency as the crisis loomed. In the discussion below, and elsewhere in relation to matters such as encouraging investment in new generation (Chapter 10), the wisdom of these measures is considered.

10 Interview with Wally McGuire, designer of California's 2000 and 2001 savings campaigns, while he was in New Zealand to speak to the Energy Efficiency and Conservation Authority, on National Radio, 24 March 2004, and "'The Secret Surplus' Beats Power Crisis", *Dominion Post*, 23 March 2004.

1998 Auckland CBD Outage

Other than the above winter crises, the New Zealand electricity sector in recent times has not experienced other crises of nearly the same magnitude. In 1998 a sequence of critical high-voltage underground cables supplying the central business district of Auckland failed, with the result that downtown Auckland faced months of blackout. However, these failures were found by a Ministerial Inquiry to be reflective of poor maintenance and security planning by the local lines operator, then Mercury Energy. While poor corporate governance and accountabilities were found to have played a role in the poor practices leading to the crisis, these provide at the very most a tenuous link between the current reforms and the Auckland power crisis. The root cause lies more in long-term maintenance policies and network management preceding corporatisation. In any event the crisis was localised, and the national electricity system remained sound.

2004 Loss of the HVDC Link

Transitory spikes in the wholesale electricity price of the magnitudes experienced during the 2001 and 2003 winter crises have also been experienced in response to outages in the HVDC link and various generators with little fanfare. However, in January 2004 a more significant loss of the HVDC link occurred when strong seasonal gales toppled three South Island transmission towers. This resulted in physical separation of the South and North Island electricity systems for a number of days, and dramatic rises in North Island wholesale electricity prices. The extent of the price rise (from $50/MWh to $810/MWh at one point; and as high as $1,083/MWh, which compares with the peak of US$7,500, or $10,900 at the then exchange rate, experienced in the US midwest in summer 1997) caused some major electricity users to allege profiteering by generators and faults in the wholesale electricity market price-setting mechanism.[11] The incidence of these price rises was naturally determined by retail supply and hedge contracts, and offered some major users the opportunity to profit by curtailing demand and selling contracted power at the increased wholesale price.

Since the outage did not reflect an impending supply shortage, and occurred over the summer period when demand is traditionally lower, other power savings measures were not called for or required. A handful of major industrial users exposed to the spot market opted for production cutbacks and rescheduling of planned maintenance rather than bearing the increased power costs, but power savings by other users were not required as existing generation was able to meet demand (in this instance, within each of the temporarily disconnected North and South Islands).

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11 As discussed in Chapter 9, when summer floods in February 2004 caused a spike in fresh vegetable prices, with price rises of 200% in some cases, the market mechanisms for selling produce were not questioned, and even the chief executive of Consumers' Institute resignedly explained the increases in terms of basic supply and demand.

Reformed Arrangements Survive Major Challenge

Replacement transmission lines were installed by Transpower within days and wholesale prices returned to more normal levels. In this instance existing industry contingency plans and the wholesale electricity market alone were able to resolve a supply crisis, with wholesale prices rising to shed demand while maintaining supplies to those prepared to pay the considerably higher prices. Despite the loss of South Island generation to demand typically centred mainly in the North Island, the vast majority of electricity consumers were oblivious to the event. The outage did, however, illustrate dramatically the market and associated price separation that would occur with grid constraints.[12] With dry-year reserve generation since June 2004 being used during grid emergencies and when spot wholesale prices otherwise rise above $200/MWh, such dramatic price responses will be somewhat attenuated for future HVDC outages. This generation is funded by an electricity consumer levy, and dampens price cues for the optimal timing, scale and location of new generation.

DISCUSSION – WHOLESALE ELECTRICITY PRICE RISES: CURE OR DISEASE?

The 2001 winter crisis, abortive 2003 winter crisis and 2004 HVDC link loss provide three useful case studies with which to assess the reformed industry arrangements, and the wholesale electricity market in particular. Not only can the performance of the system during these crises be compared with the system's more typical performance, but it can also be contrasted with the performance of the pre-reform system under the various earlier crises.

Of particular interest is the role played by, and performance of, the wholesale electricity price. As noted above, wholesale electricity prices have risen sharply when impending winter hydro shortages have become apparent. In so doing they have provided early warning of possible shortages, and simultaneously encouraged conservation of scarce hydro reserves – by providing larger customers exposed to the spot price with the required incentive to reduce consumption, and by providing hydro generators with a market-based signal of what premium electricity consumers placed on conserving water for peak winter demands. In a sense sky-rocketing wholesale electricity prices provided a market-wide assessment of the value of increasingly scarce hydro reserves in the face of looming winter energy demands.[13]

In each case no individual or group of individuals has decided on behalf of consumers which of them must reduce demand in order to conserve supplies and, in contrast to the

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12 Such separation affects not just the spot price but also hedge arrangements. For example, in this episode a generator producing at the South Island spot price but with a customer hedge in the North Island would have to make significant payments under the hedge and at the same time get a lower price for its generation.

13 As mentioned earlier, a measure of the "shadow price", or "opportunity cost", of water.

pre-reform experience, imposed reductions have been avoided. Consumers have either been sheltered from drastic price increases, or have been able to choose for themselves their best course of action in the face of rising prices. Decision-making power has been in the hands of those facing the risks and costs of a poor decision rather than imposed on them by others.

Lack of Customer Choice?

It might be argued that some consumers exposed to rapidly rising wholesale electricity prices face no choice at all, in that they cannot afford to reduce their consumption. Such is the case in the short term for industrial customers with customer or production commitments. However, such customers have the option of entering into supply contracts with generators to hedge their exposure to wholesale prices, and in any event their inability to bear customer losses or plant shut downs if they reduced electricity consumption represent the very avoided costs that make the increased wholesale prices bearable. Should those prices continue to rise, a point will eventually be reached at which it becomes cheaper to lose customers and shut down plant rather than continue consuming electricity. It is precisely this mechanism that determines who values electricity the most, and ensures they can continue to receive it when it is in short supply. In the longer-term it also encourages such users to negotiate more flexible customer arrangements, and to invest in production flexibility.

The fact that certain customers have plant, cost structures or supply commitments affording them less flexibility in their electricity consumption than others is simply a reflection of their own business risks and decisions. While for some consumers this may reflect historical choices based on pre-reform electricity arrangements, after nearly 20 years of reform it is hard to see how those choices are not now those consumers' own responsibility. Similarly, the fact that dramatic rises in wholesale electricity prices can be required to bring available supply into balance with demand during times of crisis is not an automatic sign of profiteering by generators, but rather indicates the extremes to which certain customers are prepared to go to ensure security of supply.[14] As above, there will come a point at which wholesale price increases of sufficient magnitude and duration will encourage those customers lacking flexibility in their electricity consumption to explore more flexible and/or energy-efficient alternatives. When price signals are not available, other less-direct means are required to persuade consumers to change their consumption choices. In short, if there weren't electricity consumers willing to pay such high wholesale electricity prices to ensure ongoing supply, those prices would not need to rise so steeply to maintain balance between energy demand and available supply. Wholesale price spikes therefore encourage conservation.

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14 Similar extremes can be observed in other industries, such as pulp and paper mill operators requiring top-up log supplies to ensure plants do not suffer expensive shut-downs, or fishers needing to buy top-up fishing entitlements to avoid penalties for over-catching. That the needs of such operators can translate into apparently inflated log and fish quota prices are not automatic signs of failures in the forestry sector or quota market.

Larger Customers Bear Disproportionate Burden?

It appears that some larger electricity users regard themselves as bearing a disproportionate share of electricity price rises when tight supply conditions result in rapidly rising wholesale electricity prices.[15] This is particularly so given the fact that most smaller electricity users enjoy fixed-price contracts which shield them from those rises, and therefore do not induce conservation or efficiency measures at the small-consumer level in times of shortage. However, many such smaller users choose to bear higher-than-average fixed prices in exchange for granting suppliers an option to interrupt their load through ripple control on electric water-heating. Moreover, in times of supply shortage the small-customer sector is often exhorted to reduce, and responds by reducing, their consumption via voluntary energy-saving campaigns. Also, the suggestion that larger users bear a disproportionate share of wholesale price risk presumes that hedge contracts cannot be secured or, if they can be, only at high strike prices – which may well be true in the midst of a shortage, but then insurance policies are generally only useful when taken out before adverse conditions arise. Finally, the fact that larger electricity users face a greater exposure to wholesale prices than do smaller users is little different to the fact that large borrowers on the capital markets do not enjoy the same access as smaller borrowers to tailor-made lending options repackaged by financial intermediaries to better suit their risk preferences. If there is a rationale for financial intermediation it is that it allows such risk repackaging to occur, although larger customers will always find themselves needing to negotiate arrangements to suit their larger and/or more unusual requirements. Thus electricity retailing should be expected to offer smaller customers tailor-made risk-management options such as fixed-price contracts, but it would be ambitious to expect such options to be widely available for the largest customers.

Inadequate Capacity?

As a separate matter it can be argued that the frequency and extent of wholesale price rises during crises caused by the inevitable vagaries in the weather need not be as great, and reflect a failure on the part of industry to provide adequate capacity (or other market-based and non-distortionary solutions, such as widely-accessible power exchanges). If sufficient reserve capacity was on hand or non-hydro-based generation made available then the frequency or intensity of the crises would be reduced. Alternatively the high wholesale prices might be argued to be a reflection of artificial, arbitrary or faulty market rules or, as discussed in Chapter 9, generator gaming or abuse of market power.

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15 Political sympathy to such a view, where forthcoming, seems to be predicated on the idea that a loss of electricity supply (or voluntary reduction in demand) is more costly to firms than to households, and household demand has historically been regarded as interruptible with lesser adverse consequence. Research from the Netherlands by De Nooij *et al.* (2004), however, estimates the value of lost load (VOLL) of firms to be 6 euros per kWh, versus 16.4 euros per kWh for households.

However, the size and duration of wholesale price rallies and the resulting increased profits enjoyed by generators during supply crises signal to investors that new generation is required, and provides a source of the returns required to fund such investments.[16] Electricity generation investments are sunk and long lived, and therefore require risk management devices, such as long-term fixed-price contracts, for their justification. To invest requires the prospect of an expansion in demand at current prices, or of an increase in prices as a result of increasing costs of alternative fuels. Price spikes in low-inflow periods constitute part of the signals about longer-term industry supply and demand imbalances that are relevant for generation (and demand management) investments. Of themselves, these episodes enhance the incentive to invest over those incentives provided by assessments of longer term demand and supply considerations. Generator (and/or consumer) profits enjoyed during wholesale price spikes are a necessary "evil" if future generation is to be provided to satisfy growing demand in a timely fashion. If the market does not provide these signals and incentives, then costlier or less efficient solutions are likely to be the alternative. For these reasons, an argument is presented in Chapter 10 that such supply-security considerations are an oxymoron in the context of a freely operating electricity market.

RESERVE GENERATION RECONSIDERED

In the light of such comments it is useful to return to government's proposal, during the abortive 2003 crisis, for the new Electricity Commission to contract for reserve generation to avoid the need for voluntary demand savings in dry winters. As noted above, this approach favours the costs of maintaining idle energy reserves in case of a "non-rainy day" over the arguably cheaper alternative of calls for voluntary reductions and encouraging improved demand-side response to the required energy savings. Electricity consumers will be required to fund such reserve capacity through a levy on electricity prices, irrespective of whether they care for such "insurance". More to the point in this context, however, is the fact that such reserve generation will be operated with a maximum trigger price of $200/MWh, as set by government.[17]

Since the proposed reserve generation is for a maximum of 1,200 GWh over any four-month period, the proposed trigger price (which might be lower if the Commission chooses, and which applies any time wholesale electricity prices exceed the trigger price, not just in dry-year winters) is not a fixed cap on wholesale electricity prices.

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16 Of course, hydro generators may incur losses with higher spot prices if their hedge positions, for example, simply covered average inflow years and their output was reduced by the low inflows that produced higher prices. This prospect may induce supply-side response and investment in demand management by vertically integrated generator and retailers.

17 It is instructive to compare this trigger price with ECNZ's $150/MWh cap on the wholesale electricity price under its rudimentary spot market in 1992, and the Electricity Shortage Review Committee's comments on that cap's undesirability when attempting to bring supply and demand into balance during supply shortages.

Instead it will limit the duration of wholesale price rises, in effect reducing the area under the wholesale price chart (such as was shown in the upper graph of Figure 3.11) where prices rise over a crisis, such an area having been paid for in advance in the form of the reserve generation levy. If and when the reserve energy is depleted, wholesale prices would continue to rise as before, thereby continuing to provide the important signals and incentives to generators, consumers and investors alike as discussed above. However, the reserve trigger price will dampen the signals and incentives to these parties to suitably respond to crises, and reduce the necessary profits to generation over their course. Price caps – soft or hard – discourage conservation, and undermine new investment in generation and energy efficiency.

At the same time the reserve trigger price will "crowd out" the need for market players to establish their own desired means and levels of protection against supply insecurity, such as hedge contracts or self-generation, or will result in parties with such protections effectively paying twice for the privilege. To the extent that its level is set by government or subsequently by its agent, the Electricity Commission, uncertainties regarding the basis on which it is adjusted or applied present an additional risk to be considered by parties contemplating electricity-sector investments.

Further, the regime suggests that higher-cost generation be held in abeyance for times of shortage – because if it is not more expensive than existing plant then surely it would be economic to operate it at other times and thereby render it "just another" generator. Indeed, the model is one of a plant with high operating cost, which if unaccompanied by relatively low capital cost would be uneconomic to construct from scratch.[18] This suggests that older plant with sunk capital cost and higher operating cost would be appropriate for generation "in reserve"; but that was exactly the situation prior to the reserve generation regime.

The reserve proposal suffers the common "moral hazard" problem of any insurance policy, namely the dampening of incentives for parties to mitigate the very risk being insured. At the same time it diminishes the discretion of electricity consumers to determine for themselves the trade-offs they are prepared to make between price and security of supply. This ignores the fact that some consumers are well placed and quite prepared to bear the risk of shortages in supply – that discretion, to a point, has now been assumed by government on consumers' behalf. Finally, at a more subtle but important level for the long-term development of the sector, the process for setting and applying the reserve generation trigger price represents a new form of political risk to investors in new generation. This is not a head-on collision between politics and the market, but it is not just a near-miss either.

[18] The contrast here is between open-cycle plant, requiring low capital expenditure but with high operating costs and high emissions, versus more efficient combined-cycle plant, requiring high capital expenditure but with low operating cost and low emissions.

CONCLUSION

This chapter has argued that weather-driven supply insecurities are to some degree inevitable, given the finite resources to invest in the electricity sector. Indeed, this is even a desirable state of affairs given the cost of trying to ensure absolute supply security. The experience after the reforms – both in 1992 and subsequently – has in fact been considerably better than in the past, which typically involved the blunt instrument of blackouts. Since the reforms, and especially with the advent of the NZEM, supply insecurity has been felt more in terms of rising wholesale prices – but not retail prices, at least not immediately or extremely – illustrating how this innovation has provided a useful tool for managing supply insecurities. The reserve generation scheme reduces the effectiveness of this tool, and potentially exacerbates the problem of rationing tight supply. Hence, despite an often-expressed view that the reforms have worsened or even caused supply insecurity, in the main they have "weathered" tight supply situations better than before. The ability of the system to manage future supply insecurities may or may not have improved with the advent of the Electricity Commission.