

The long term development of New Zealand's electricity supply industry

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Abstract:

During the course of the 1980s and 1990s the New Zealand economy went through a process of considerable economic reform. One aspect of this reform was the corporatisation of state-owned enterprises, the opening up of these enterprises' markets to competition and in some cases their privatisation. One of the most important of these policy reforms of the 1990s was the restructuring of the New Zealand electricity supply industry. This process was encouraged by the perception that the state owned Electricity Division of the Ministry of Energy that generated and transmitted electricity in New Zealand, as well as the regional power boards that distributed and retailed it, performed poorly in the 1970s and early 1980s. During the 1990s the industry was fundamentally reformed through a process of the corporatization and then breaking up of the generation and transmission industry in New Zealand into competing generator companies and an independent, regulated transmission company that operates the countries' wholesale electricity market. The article observes the long term performance of the New Zealand electricity supply industry. In particular the growth in demand for electricity, the productivity growth of the industry as well as electricity prices, profits and debt levels are all presented. In doing so an evaluation is made of the degree that these reforms and industry restructuring have improved the productivity and efficiency performance of the industry.

Introduction

Prior to its restructuring the supply of electricity in New Zealand was largely carried out by the Electricity Division of the Ministry of Energy. This department was not only the main generator and transmitter of electricity in New Zealand but was also responsible for the general regulatory functions of the industry and in addition was the main provider of policy advice to the government. During the 1980s and 1990s this structure was progressively dismantled by the New Zealand Government and replaced with one that separated commercial activities from that of regulatory and policy functions (and corporatised the commercial functions) and introduced competition into the wholesale and retail segments of the industry.

This process was carried out for a variety of reasons but was inline with reforms that were taking place elsewhere in the New Zealand economy at the same time and with changes that were occurring internationally in the electricity industry (Brash 1997; Easton 1997; Evans, Grimes, Wilkinson and Teece 1996; Evans and Meade 2005).

Since the 1980s the electricity industry in many countries has been through a process of restructuring and reform. The general trend of this reform has been toward the opening up of the industry to competition in order to encourage efficiency gains. In some cases, as well, the privatising of government-owned assets has occurred in order to both enhance competition and transfer risk from the public to private sector and make additional resources available to government (Wolak and Patrick 1997; Steiner 2000; Hirsh 1999; APEC/ABARE 2002; Abbott 2008).

Before reform occurred other government owned electricity around the world which possessed similar characteristics to that of the New Zealand electricity industry were the subject of a great deal of criticism. This criticism was levelled at vertically integrated electricity utilities, both government and privately owned, which in turn drove the reform process in New Zealand and abroad.

Taking a long-term view is important in terms of understanding the justification for the present structure of the industry, which relies upon the functioning of a competitive wholesale market for electricity, phased in retail competition and the separation of the various parts of the industry.

The purpose of this paper is to look at the performance of the electricity industry in New Zealand both prior to the restructuring process in the 1980s and 1990s and after. In particular the growth in demand for electricity, the improvement of productivity of the industry, as well as electricity prices, profits and debt levels will be examined. In this way it will be possible to gain an appreciation of the reasons why the satisfaction with the institutional structure of the electricity industry in the 1960s and 1970s turned to dissatisfaction in the 1980s and how successful measures were at overcoming this dissatisfaction.

The electricity industry

The pressure to reform the electricity industry during the 1980s and 1990s was driven by a number of factors, differing in their intensity across various countries. These factors involved such things as technological changes, evidence of under-performance in the industry and a general trend toward privatisation.

In looking at its structure the electricity industry can be separated into five different elements; generation, transmission, systems operation, distribution and retail. In the electricity industry it is generally accepted that transmission, distribution and system operation are natural monopoly elements. Originally generation was also viewed as being a natural monopoly as well because of the large scales of efficient generation units and the losses that occurred with long distance transmission, which made it more efficient to have local areas served by large local plant. It was, therefore, felt natural for the generation, transmission and distribution elements to be provided for by monopoly companies, either state or privately owned.

Monopoly control, however, meant that there were concerns that a profit maximising company could create dead weight losses of inefficiency by raising prices and constraining supply. In many countries this meant that it was felt that this justified government ownership of the industry in order that abuses of monopoly power could be avoided (or alternatively government regulation of privately owned utilities).¹

In some countries, such as New Zealand, it was not just the concern with possible abuses of monopoly power that encouraged the government to take-over the industry but also the difficulty faced by private companies in mobilising investment funds and employing sufficient technical expertise. This latter reason, perhaps, explains best why the electricity industry in New Zealand evolved in the way that it did back in the 1920s as were similar organisations around the world outside of Western Europe, North America and Japan. The existence of capital market failures perhaps best explains the early development of public electricity companies in a number of countries.²

The main alternative to state control was to have private, but regulated monopolies. As monopoly firms are assumed to be able to abuse their market power at the expense of consumers regulators concentrated on constraining prices, often using rate-of-return regulation. During the course of the twentieth century the United States, Canada, Germany, Japan and Hong Kong all provide examples of investor-owned, but regulated regional monopolies.

In most countries, therefore, all of these sectors have been typically tied together within a single company. Increasingly, however, it became perceived that the generation and retail segments of the electricity industry are potentially competitive and that the natural monopoly characteristics were confined to the transmission and distribution networks and did not extend to the generation sector. Over time the minimum efficient size of new generation plants fell from 1,000 MW in the early 1980s to between 50 and 350 MW as the development of combined cycle gas turbines greatly expanded thermal efficiency (International Energy Agency 1999). Combined cycle gas turbine plants also had the advantage of requiring shorter construction and planning time horizons. This meant that increasingly it was possible to have a number of competing generator companies. In addition technological improvements reduced the losses that occurred during transmission, making it more feasible for generator plant in different locations to compete with one another (Borenstein and Bushnell 2000).

¹ Private development of electricity was widespread in the United States, Japan, Canada, Germany, Spain, England and France. In the latter two the industry was nationalised in the immediate post-World War Two period. New Zealand had a number of privately owned power stations constructed in the earlier decades of the twentieth century but were progressively superseded after the First World War by state owned hydro electricity.

² For a review of productivity analysis of private versus public ownership see Abbott (2005). On the whole this world has tended to find that private ownership is associated with higher levels of efficiency especially in the generator sector of the industry.

This process of technological development enabling the creation of competitive conditions in the generation market can be quite illustrated from the case of New Zealand. Table 1 provides data on the capacity of the New Zealand electricity industry between 1950 and 2005. In 1950 the largest power station in New Zealand (Karapiro) accounted for 16.3 percent of generating capacity. By 2005 this figure at Huntly had fallen to 10 percent. As well, although generating units increased in size over the period their proportion of total capacity fell as well, from 5.1 per cent in 1950 (30MW) to only 2.7 percent (240 MW) by 2005. In the future it is planned to build additional combined cycle generation plant of 100-300 MW in New Zealand. The proportion of capacity made up by the largest units in the New Zealand market will therefore, presumably, decline further in the future.

Table 1: Size of electricity generation plant in New Zealand

	System capacity MW	Largest Station	Largest station MW	Largest Unit	Largest Station %	Largest unit %
1950	682	Arunpuni	157	30	23.2	4.4
1960	1,509	Roxburgh	160	40	10.6	2.7
1970	3,683	Manapouri	300	120	8.1	3.3
1980	5,860	Manapouri	700	120	11.9	2.0
1990	7,182	Huntly	960	240	13.4	3.3
2000	8,845	Huntly	960	240	10.9	2.7
2005	8,858	Huntly	960	240	10.8	2.7

Source: Ministry of Economic Development

Table 2: Size of electricity generation plant in the North and South Islands of New Zealand

NORTH ISLAND						
	System Capacity MW	Largest Station	Largest Station MW	Largest Unit MW	Largest Station %	Largest unit %
1950	478	Arapuni	158	30	33.1	6.3
1960	1,080	Arapuni	158	30	14.6	2.8
SOUTH ISLAND						
	System Capacity MW	Largest Station	Largest Station MW	Largest Unit MW	Largest Station %	Largest unit %
1950	202	Coleridge	34.5	25	17.1	12.4
1960	412	Roxburgh	160	40	38.8	9.7

Source: Ministry of Economic Development

The other factor that helped to develop the possibility of a competitive New Zealand generator market was the development of its transmission network. Since the 1950s New Zealand's transmission grid has been developed, considerably, and line losses reduced helping to create a much more integrated national system. The construction of the Cook Strait cable that linked the North and South islands together also helped to create a single integrated market.

At the same time that these technological changes were occurring there arose in a number of countries a growing dissatisfaction with the performance both of state owned electricity supply companies and the regulated private monopoly suppliers. In particular there was a perception that the electricity industry performed at low levels of efficiency, accumulated

excessive debt levels in the construction of new plant with cost overruns and priced at too high levels to cover costs. The result was an industry characterised by a lack of competition, a concentration on the construction of inappropriate and costly plant, and organisations that were dedicated more to the achievement of technical and engineering standards of excellence rather than that of cost efficiency.

In the American case, for instance, Hirsh (1999), Joskow (1997, 2005, 2006) and Borenstein (2000, 2001) have all pointed out that the American industry suffered from the results of poor investment decisions in a number of states, which because of the monopoly nature of the industry were passed onto consumers. Kellow (1996) reviewed similar outcomes in a number of other countries including New Zealand, Canada, Australia and Sweden where the companies were predominately government owned.

Regardless of whether the vertically integrated companies were government or privately owned the perception was that because they lacked competitive pressures and were, therefore, not achieving the highest levels of efficiency possible and the cost of this was passed on to consumers. Competition, it was thought, provides better incentives for controlling construction and operating costs of new and existing plant, encourages innovation in supply and shift the risks of technological choice and cost mistakes from consumers to producers.³

The reform process in the electricity supply industry began in the United States in the late 1970s. The first step was the partial opening up of electricity generation to new entrants. In 1978 the United States adopted the *Public Utility Regulatory Policies Act*, which required that utilities buy electricity from “qualified facilities”, mostly co-generators and small Independent Power Producers (IPPs). The introduction of the new power producers took place to a varied degree across the United States, but in some states IPPs produced as much as 20 per cent of the market by the late 1980s (Borenstein 2000). This process of contracting IPPs to supply electricity to a dominant integrated company has become a very common one in a number of countries, which have accepted that new entrants might be able to construct and operate new plant more efficiently than incumbent utilities.

A similar Act to the American *Public Utility Regulatory Policy Act* of 1978 was passed in the United Kingdom in 1983. This Act was designed to encourage the growth of IPPs by removing barriers to entry to non-utility generators. Initially, however, the low rates of return that the Central Electricity Board offered to new entrants deterred them. By the time the industry was broken up in 1990 only one per cent of the generation of electricity in the United Kingdom was undertaken by IPPs (Electricity Industry Review 1997). Similar legalisation passed in Israel in 1996, for instance, also had a similar lack of impact on private investment in independent power production.

The failure of the 1983 Act to encourage new entrants and the concerns expressed during the 1980s about the market power possessed by the privatised British telecommunications and British gas companies encouraged the British Government to attempt the introduction of a more competitive structure into the industry when it was privatised. Under the Electricity Act of 1989 the industry was separated into three generation companies, a transmission company and twelve regional distribution companies. The generator companies compulsorily supplied electricity into a national wholesale electricity pool and an open access regime was developed to allow better access for IPPs to enter the market. Retail competition was

³ This is an important point in the context of privatisation. Although government ownership of assets can be retained with competition it does become more risky for governments to do so.

progressively introduced from 1991 onwards with full competition introduced in 1998. The industry was progressively privatised through public floatations.⁴

At the same time and since other countries moved in the same direction. In 1991 Norwegian Pool was established. This pool was extended in 1996 with the incorporation of Sweden and NordPool was formed which now includes Finland and Denmark. In 1994 the New Zealand wholesale electricity Pool was established. The Victorian pool in Australia was established in 1994, followed by the New South Wales Pool in 1996 and their joining together into an Australian national electricity market in 1998.

Following the creation of the English, New Zealand and Victorian/New South Wales electricity pools others followed around the world. These include ones in Spain (1998), California (1998), Pennsylvania-New Jersey-Maryland (1998), New England (1999), New York (1999), Texas (1997), the Netherlands, Germany (1998), Singapore (1998), Canada (Alberta 1996, Ontario 1998), and France (2001). In all of these markets retail competition was gradually introduced. In most cases retail choice was given first to large users when the pools opened and then progressively introduced for each successive tranche of yet smaller consumers.

In the English case the restructuring occurred in order to reduce the government's role in the economy, extend share ownership, and do it in such a way so as to limit the degree of market power. After privatisation generation concentration still existed and concerns were expressed about the degree to which the two major companies exerted market power. This led to the Office of Energy Regulation negotiating with National Power and PowerGen to sell off a substantial part of their assets. In the Victorian case the industry when it was privatised was separated down to the level of individual generator plant to ensure that there would be adequate competition in the market. The New Zealand approach was more like that of the English rather than Australian approach and involved the creation of three main, multi-plant, companies.

Although raising efficiency levels have been a more important motivation for introducing reform the desire to reduce the financial burden on governments has been a contributing factor. Although originally it was thought that in many cases only governments had the ability to raise the necessary capital to finance the construction of large-scale electricity plant and networks by the 1980s this attitude had begun to change. The globalisation of capital markets has meant that increasingly private sector firms are interested in investing in the development of electricity infrastructure. At the same time the demands on government resources have also grown putting pressure on public finances. In a number of countries assets were privatised, with the proceeds being used to reduce debt levels of the government. In these cases subsequent spending on government service provision of education, health and law enforcement has all been increased after the sale of assets were complete.

In a number of developing countries the concern has been the need to attract additional private investment, such that additional capacity could be built to keep up with rising demand. In the case of a number of Asian countries it was this reason why the previously state owned integrated businesses began to be reformed. Throughout the course of the 1990s a number of

⁴ The United Kingdom was not the first country to undertake reform of this type but it was to have the greatest impact on the rest of the world. Predating the English reforms were those that occurred in Chile from 1982. In that year a law was passed intruding competition into electricity markets by allowing large users to choose their supplier and freely negotiate prices. The establishment of explicit market mechanisms to determine the dispatch of generators and the wholesale price of electricity were later introduced along with privatization.

Asian countries moved to the second model whereby a dominant electricity utility remained in control of transmission (and possibly distribution) and the bulk of generation but IPPs were allowed into the market to supply the dominant company with electricity under contract (Malaysia, Thailand and Indonesia).

The driving force in a number of Asian countries has been the urgent need to find the funds to build additional capacity in order to meet rising demand. This circumstance differs from more developed countries that have been through the process of electricity industry restructuring because of the over building of capacity and the need to make better use of existing electricity capacity. This process was encouraged by the economic crisis in 1997 which intensified the worsening financial situation of government owned utilities in a number of Asian countries. With currency depreciation, the cost of financing foreign debt of the utilities denoted in foreign currencies ballooned; increased the capital cost of new projects because of increases in perceived risk and lead to higher local currency costs of imported fuel.

Before the Second World War

The basic model of the New Zealand industry before the reform process was one of state monopoly control over most aspects of the industry. This included generation and transmission as well as regulatory powers over the industry more generally. At the same time distribution and retail of electricity was conducted by local government or local distribution boards.

This monopoly control enabled the Electricity Department of the New Zealand government to charge a bulk, uniform tariff to distributors, regardless of location and underlying costs; which implied a considerable cross subsidisation of rural and regional consumers.

In New Zealand more generally, the approach to the provision of important transport and communications infrastructure in the nineteenth century was to provide it under the control of government departments. Private enterprise was unable to mobilise the funds necessary due to the under developed nature of New Zealand capital markets at this time and faced a shortage of expertise. These difficulties led to rural and business interests looking to the government to provide important infrastructure. After it was established in the Electricity Department of the New Zealand Government developed along these lines for similar reasons. The model however did take a number of years before it was developed to the extent described earlier.

Originally in New Zealand generation, transmission and distribution of electricity was carried out by small power companies in plants located close to consumers. These companies consisted of a mixture of private and local government owned enterprises (Martin 1991). The trend toward government ownership has generally been attributed to a combination of factors, including the significance of scale economies, the inability of the private sector to finance the large investments required, government concerns about the exploitation of market power and government decisions to use electricity pricing as a means of pursuing social and development objectives (particularly a wish to provide rural access to electricity)

In New Zealand, as in most countries, the first most important uses of electricity included public purposes – lighting of public buildings, street lighting and later electric traction. There was therefore appreciable local government interest in New Zealand in the supply of electricity in the 1880s and 1890s. Electricity generation and distribution, therefore, tended to be carried out by local government councils, by private companies under franchise to local

government, or by joint private-public bodies.

The first use of electricity in New Zealand was in 1861 when it was used for the private electric telegraph line between Dunedin and Port Chalmers. Subsequently the *Electric Telegraph Act* 1865 was passed which established government monopoly control over this type of use of electricity.

The first substantial use of electricity in New Zealand was for lighting. Various shops and small factories generated their own electricity for this purpose during the 1880s. In 1883 a generator was installed in Parliament to provide lighting. One of the first major initiatives in the generation of electricity came in 1886 at the quartz gold mine at Bullendale near Queenstown. This was also the first major hydro-electric generation plant. Other mines followed suit in the late 1880s and 1890s. Other privately owned plants were used in clothing and furniture factories, printing and food processing.

At first it was not feasible to transmit electricity over long distances so generating capacity remained small and plants serving limited local areas proliferated. Many local government authorities built small hydro electric or coal fired plant or purchased electricity from private companies.

The use of electricity for street lighting gave local government councils a strong early interest in the generation of electricity. As well local by-laws had to be passed that enabled distribution lines to be strung up along streets to deliver electricity which meant that active cooperation from local councils was necessary for generator plant to be brought into operation.

The town of Reefton was the first in New Zealand to receive public lighting. In 1888 a private company began supplying electricity to the local council and to the general public (a hydro scheme). This private company was to continue operating until 1946 when it was taken over by the Grey Electric Power Board.

Wellington streets were supplied by a private company (coal fired station) from 1889.⁵ In Auckland the City Council began to purchase electricity from the Auckland tramways in 1902 when it opened its plant. The council began to construct its own plant in 1906 (coal fired station). The first local government owned plant in New Zealand was opened in 1902 in Patea. This was followed in 1903 when the Christchurch Council received its first electricity from municipal owned plant. In Dunedin in 1902 the Dunedin Council began purchasing electricity from the tramways. In 1907 the Council built and operate its own power station, the hydro scheme at Waipori which still operates in New Zealand today. At the same time a number of smaller local councils also began to install their own plant or alternatively purchase electricity from private companies.

After the turn of the century, developments in high voltage transmission provided opportunities for the development of larger scale enterprises. Technological developments at the turn of the century enabled the large scale generation of hydro electricity and transmission for AC power over long distances. In producing and supplying this electricity, increasingly the central government was seen as the only agency with the financial resources to enable the construction of large scale hydro schemes and transmission lines. The government's role also reflected the concern about the detrimental effects of private owned monopolies. Early

⁵ The Wellington City Council took over electricity generation in 1907

involvement of the central government meant that a national system was established early on and electricity was extended into rural areas at an early date.

Following advice from American experts, the New Zealand Government established the exclusive right to generate electricity using water power, under the *Water Power Act 1903*. This gave the state the sole right to generate electricity from water, or to grant dispensations to local government councils as well (private companies after 1908). The process of government involvement went further in the *Water Power Works Act 1910* when the Government gained authorisation to raise money to construct hydro-electric stations. Work began at Lake Coleridge which was the New Zealand Government's first hydro scheme (1911-15). The scheme supplied electricity to the Christchurch Council as well as the local harbour board, tramways board, various factories and other local councils. It established the principal of central government generation and transmission and local distribution. By 1923 it was also supplying Timaru.

The Hydro Electric Branch of the Public Works Department was established to build and operate the Lake Coleridge plant and in the 1920s and 1930s was to go on to build and operate a number of other schemes as well. The Mangahao hydro station was opened in 1924 which supplied Wellington and Manawatu. A transmission line reached Napier in 1927. Arapuni opened in 1929 and linked to Auckland and the Waikato. Waikaremoana opened in 1929 and linked to both Napier and Wellington. New Plymouth was linked to the lower North Island grid in 1931 and in 1934 the two halves of the North Island system were connected. In the South Island Waitaki was opened in 1934 and linked to Canterbury. In 1935 Canterbury and Dunedin were linked up. The Marlborough-Blenheim regions were not to be linked to Canterbury until 1956.

To encourage further extensions of electricity supply to country regions the *Electric Power Boards Act* was passed in 1918. This Act encouraged the extension of power supply to rural districts by allowing for the creation of local power boards that had the authority to raise loans. The Act also allowed the boards to generate electricity themselves.

At the time the Act was passed there were 53 local government councils and 11 private companies generating and supplying electricity. By 1934 this had changed to 47 local government councils, 46 electric power boards, six private companies as well as Southland and Rotorua which were supplied by the New Zealand Government.

In a number of cases local councils sold their electricity assets to the new power boards. The Auckland Electric Power Board, for instance, was established in 1921 and took over the Auckland City Council's power assets in 1922.

The linking of the various systems meant that the system was gradually standardised in terms of current and voltage supplied. The New Zealand Government concentrated on the construction and operation of large scale plant close to the source of power. Electricity was then sold in bulk to the local distribution authorities, which were left the duty of local distribution and retail. The aim was to achieve economies of scale by constructing large-scale generating plant close to the source of fuel and then transmitting it to the places of consumption. In the New Zealand case this meant building progressively larger scale hydro power plant.

What this meant in effect, however, was that the local government and private plant steadily lost ground in competition to the hydro plant of the New Zealand Government. Through the 1920s the proportion of electricity generated by gas, coal and oil fuelled plant rose fell

steadily, as did the electricity generated by the municipalities and private companies. In the case of the private companies these continued to operate their plant on into the 1950s but tended not to replace them.

Table 3: Generation by fuel type, percentage

	Hydro	Geothermal	Oil	Coal	Gas	Biogas	Wind	Other
1924	68.8	0.0	0.7	27.2	3.2	0	0.0	0.0
1934	75.8	0.0	5.4	18.3	0.5	0	0.0	0.0
1954	91.8	0.0	1.8	6.4	0.0	0	0.0	0.0
1964	76.4	0.0	0.0	23.6	0.0	0.0	0.0	0.0
1974	74.5	6.7	9.6	6.5	1.0	0.0	0.0	1.6
1984	74.0	4.7	0.0	2.7	16.7	0.4	0.0	1.4
1994	75.2	6.3	0.0	1.5	15.1	0.5	0.0	1.4
2004	64.8	6.2	0.0	9.3	15.9	0.3	0.9	2.5

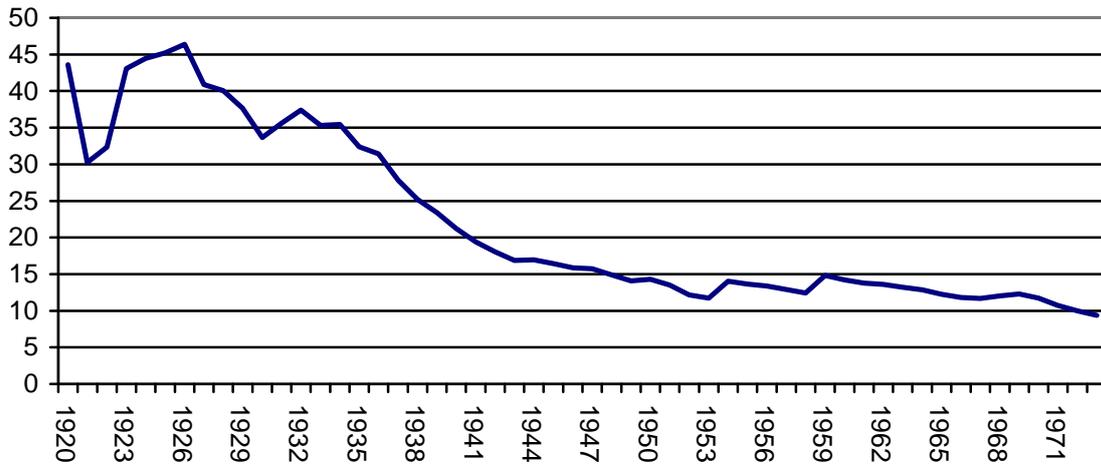
Source: Ministry of Economic Development.. *New Zealand Official yearbook*.

Table 4: Distributors of electricity in New Zealand

	Local government	Private	Power boards	NZ government	Joint trust/private	Total
1919	53	11	0	1	-	65
1934	47	6	46	2	-	101
1947	33	4	42	2	-	81
1964	34	2	41	2	-	79
1974	24	0	39	2	-	65
1985	21	0	38	2	-	61
1999	3	0	26	1	2	32
2007	3	2	20*	1	2	28

* Trusts.

Figure 1: Average real unit price of electricity



Source: *New Zealand Official yearbook*. Martin 1991

Demand growth for electricity was strong in the 1920s (10 percent on average per annum; 1921-1939). Demand for electricity was affected by the depression in the early-1930s, but picked up in the second half of the decade. This demand came from three main sources; the electrification of trains and trams in suburban centres, the increasing use of electricity powered machinery in factories and on farms and the spread of electrical appliances such as irons, toasters, stoves, heaters and radios into New Zealand homes. Freezing works, dairy factories and railways workshops converted to electrically driven power. The motorcar assembly plant when they were established in the 1920s and 1930s also used electricity-powered motors.

During the 1920s and 1930s the power boards extended their coverage across the country. This enabled the spread of powered machinery in the farming such as milking and shearing machines.

During the 1920s expenditure on hydro schemes became a prominent part of public works expenditure but this slackened off during the depression years and did not pick up substantially before the outbreak of the Second World War. After 1935 the Labour Party Government was more inclined to spend money on railways, roads and public housing rather than on additional generation capacity. Construction was curtailed further during the war which meant that demand ran ahead of supply and restrictions were necessary.

The 1950s and 1960s

The reduction of construction expenditure and much maintenance work during the Second World War meant that the industry had a great deal of difficulty keeping up with the further growth in electricity demand immediately after the war. At this time demand for electricity from both industry and from domestic consumers grew strongly. Strong growth of demand continued into the 1950s and the industry struggled to meet it with its pre-war plant.

Table 5: Annual average growth of real GDP, electricity consumption and productivity 1950 to 2005, per cent per annum

	Growth in electricity demand	Growth in NZ's Real GDP	Growth in electricity labour productivity	NZ multifactor productivity growth	Multifactor productivity growth electricity
1950 to 1959	8.1	4.4	5.4	na	1.7
1960 to 1969	7.6	3.1	4.4	na	1.6
1970 to 1979	5.0	2.2	1.4	0.2	0.1
1980 to 1989	3.5	4.2	9.8	0.9	3.0
1990 to 1999	2.1	2.9	10.6	1.7	4.8
2000 to 2005	2.1	3.7	3.5	1.8	3.3

Source: Martin 1991; MED. Statistics New Zealand. In calculating productivity measures the number of people employed in the industry was used as the labour input, generation capacity as the capital input and electricity consumption as the output. The change in the multifactor productivity of the electricity industry was estimated using a DEA Malmquist approach (Coelli 1996; Coelli et al. 1998).

Table 5 shows that the growth of electricity demand in New Zealand during the 1950s and 1960s exceeded that of the economy as a whole in the post-war decades. This growing electricity intensity of the economy was due to the increasing use of electricity in industry, at the expense of other energy sources such as coal, and the rapid growth in the mass consumption of electrical consumer goods. This growth in demand during the 1950s was stronger than growth of the economy in general (averaged 8.1 per cent per annum compared to 4.4 per cent). Real prices of electricity continued to decline after the war as larger scale plant was installed (Figure 1). Growth in demand was strong because of a combination of strong growth in domestic take up of electrical appliances as well as the introduction of electric heaters, televisions and later freezers and clothes dryers. The steady fall in real prices of electricity up until the 1970s would have encouraged this growth in demand.

After the Second World War there were periodic restrictions as the government struggled to construct enough generation capacity to keep up with demand. After the war the main construction was of the series of dams and generation plant on the Waikato River. In the South Island the Roxburgh station was completed on the Clutha River in the mid 1950s and others were added on the Waitaki River. In 1964 the two islands were linked with the Cook Strait link which meant that the larger North Island market could be supplied by power generated in the south.

The change in government in 1949 did not create any great change in approach to the structure of the industry. The National Party did however differ from the Labour Party in that it was more inclined to make use of private contractors in the construction of dams as well as make use of contractors from overseas.

Hydro reached a peak of its dominance of the industry during the 1950s (see Table 3) and attempts were made from the late 1950s to diversify from this sources of fuel. This was undertaken for a number of reasons including the need to reduce dependence upon climatic conditions, replace the old coal fired plant in Auckland and Wellington (Kings Wharf and Eden Bay) that were still operating in the mid 1950s, and to avoid the heavy construction costs that accompanied hydro developments.

The first major new coal fired station was built at Meremere in the late 1950s, after which the older two in Auckland and Wellington were shut down. Further non-hydro plant included the construction of the Marsden A and Marsden B plant in the 1960s and 1970s. The two were both oil-fired plant which looked economical in the 1960s but quickly became white elephants after the oil price rises in the early 1970s. The former operated for a short period (permanently into the mid 1970s and then as a back up into the 1990s) while the latter was mothballed and never operated.

An even larger coal-fired plant was constructed at Huntly in the 1970s and early 1980s along with a gas fired plant at New Plymouth which was originally planned to use coal but was redesigned so that it could take advantage of natural gas discovered at Kapuni and Maui. Additional gas fired plant was constructed at Stratford and Whirinaki.

Growth in demand was strong through the 1950s but finally began to fall in the late 1960s (to five percent per annum). At this stage industrial growth drove demand helped by the opening of the Tasman pulp and paper mill at Kaweru in 1955, the New Zealand Steel plant at Glenbrook in 1970, the Tiwai Point smelter in 1971 and expansion of the motorcar assembly plant.

Real prices of electricity continued to fall through the 1960s. From 1967 through to 1976 the bulk supply tariff remained unchanged which meant real prices fell substantially. Large increases then occurred. Prices increased because of the greater costs of building in less accessible regions. After 1978 demand growth slumped further.

From the mid 1960s electricity generation development began to become surrounding in controversy. In the 1960s the construction of the Manapouri hydro scheme in the South Island began to attract substantial environmental protests which has since then been a feature of the industry in New Zealand. Its first four units were commissioned in 1969 and three remaining in 1971 and it was for a number of years New Zealand's largest power station. Most of the station's power output feeds to the aluminum smelter operated by New Zealand Aluminum Smelters Limited (NZAS) at Tiwai Point near Bluff.

Reform

In the 1970s the New Zealand economy suffered from the aftermath of the 1973 oil crisis and from the loss of New Zealand's biggest export market upon Britain's entry to the European Economic Community. One of the responses on the part of the government in the late 1970s was to attempt to use the electricity industry to help to lift the New Zealand economy out of the doldrums.

This came in the form of the "Think Big" programme, a major interventionist strategy, sponsored by the Prime Minister, Robert Muldoon, and his http://en.wikipedia.org/wiki/Third_National_Government_of_New_Zealand National Party Government. Think Big saw the government borrow heavily overseas and use the funds to finance large-scale industrial projects, many of which were substantial consumers of electricity. This meant that there was a major investment in increasing the country's electricity capacity

The core Think Big projects included expansion of the New Zealand Steel plant at Glenbrook, electrification of the main trunk railway between Te Rapa and Palmeston North, construction of an ammonia/urea plant at Kapuni, construction of a synthetic petrol plant at Motunui, expansion of the oil refinery at Marsden Point, the building of a plant at Waitara to produce

methanol for export and construction of an aluminum smelter at Aramoana. The latter of these never occurred - mainly because of resistance from environmental groups.

To provide additional electricity capacity to enable these projects to operate the Clyde Dam was constructed. The power station has a capacity of 480MW. The completion of the Ohaaki and Clyde schemes in the 1980s brought to an end the large-scale construction of hydro schemes in New Zealand.

By 1984 the net public debt of the government had risen from five percent of GDP in 1975 to 32 percent. At the same time annual inflation had remained high, unemployment had risen and the current account deficit was in chronic deficit (as was the budget deficit). Many at this time saw the New Zealand economy as suffering from an excess of regulation, taxation and subsidisation.

The reform minded Labour Part Government of David Lange after it came to office in 1984 set about liberalising the economy. This involved a deregulation of financial markets, a floating of the currency and the phasing out of subsidies, tariff and import quotas. The government also arranged for the corporatisation of state owned enterprises and subsequent privatisation of a number of these.

In undertaking the latter it was hoped that by giving state-owned enterprises greater operational autonomy, but at the same time making their performance more transparent and accountable, it would raise their levels of efficiency and therefore profitability to the government.

In the case of the electricity industry there were claims in the mid 1980s that the industry was failing to deliver electricity at the lowest possible prices and had misallocated funds by over investing in generation as well as incurring over runs in construction costs. It was hoped that by corporatising electricity assets and introducing additional levels of competition, where possible, into the industry, a more prudent construction of power stations would occur and the industry as a whole would become more a contributor to the revenue of the government, rather than one that continually required funds for capital projects. Deregulation was also expected to create incentives for the generating companies to operate their power stations more efficiently.

In the early 1980s, a major inter-departmental review of the Crown's role in the electricity industry was commenced, looking to separate operational from other regulatory and policy functions, and to improve commercial performance and introduce commercial disciplines for trading activities (Ministry of Energy 1984). In April 1987 Electricity Corporation of New Zealand Ltd (ECNZ) was established as a company under the *State-Owned Enterprises Act*, to own and operate the generation and transmission assets of the Ministry of Energy. Policy and regulatory activities were separated out and largely retained in the Ministry of Energy. The new company was the subject of income tax as were other electricity suppliers from the same date.

Further investigation into the industry was undertaken by an Electricity Task Force which made its recommendations in September 1989. The Task Force's key recommendations were that ownership of generation and transmission should be separated and that a wholesale electricity market be created. It was further recommended that the electricity suppliers also be corporatised. In the early 1990s a separate transmission company (Transpower) was created and the electricity supply organisations were established as separate corporatised (mainly trust owned) entities.

The Government made its provisional announcements on the steps it would take in the lead up to the opening of the wholesale electricity market: ECNZ was split into two competing state-owned enterprises (ECNZ and Contact Energy). Contact Energy took on the former ECNZ power stations at Roxburgh, Clyde, New Plymouth, Wairakei, Ohaaki, Otahuhu, Stratford and Whirinaki, which represented 22 percent of total electricity capacity.

The wholesale electricity market began operation in October 1996 and further reforms occurred in 1998 when ownership separation of line and energy businesses was mandated. Retail competition and choice was also introduced for all customers from this time.

In March 1999 the Government announced the sale of a 40 percent shareholding in Contact Energy to the United States based Edison Mission Energy for \$NZ1.208 billion. The Government subsequently sold its remaining share of Contact Energy in May 1999. In order to further reduce the market power of ECNZ it was split into three separate, state owned enterprises in the same year (Genesis Power which owns the Huntly and Tongariro power stations; Meriden Energy which owns Waitaki and Manapouri power stations; and Mighty River Power which owns the Waikato Hydro system).

After regaining office in 1999 the Labour Government began to conduct a series of reforms into the industry which tended to bring the industry back into line with international trends after a number of years of “light-handed regulation”. The Electricity Commission was established and began operations in 2003. The Electricity Commission is a Crown entity set up under the *Electricity Act* to oversee New Zealand’s electricity industry and markets. The costs of the Commission are recovered from the electricity industry via a levy. As well regulation by the Commerce Commission of the distribution network companies became more intrusive after legislative changes in 2001.

By the mid 2000s the industry had been changed to a very substantial degree to what had been the case in the mid 1980s. Although the government was still heavily involved in the industry as a regulator (the Electricity Commission and Commerce Commission) and as an owner of generator companies and the transmission company the bulk of investment decisions in the industry had passed from the government to that of corporatised state owned enterprises or private companies. Generally speaking the aim of these changes was to create an industry that achieved higher levels of productivity (both productive and allocative).

At the same time as the structural changes occurred a change to the mix of generation types also occurred. With environmental concerns placing a constraint on the construction of new, large scale hydro projects new capacity tended to be constructed using either coal or natural gas. As well government policy began to encourage the use of renewables such as the use of biogas, wind and geothermal. At the same time demand growth has declined to around 2 per cent per annum and is projected to fall further to 1.5 per cent by the year 2010 (Electricity Commission; Ministry of Economic Development).

Industry performance

In terms of the industry’s performance there is no doubt that the industry managed to achieve far higher levels of efficiency and productivity in the 2000s than it did in the 1970s. The industry today employs far fewer people today than it did in the 1970s and capacity usage levels are at higher levels, which means that both labour and capital productivity levels are far higher today than the used to be.

First of all it would appear that some gains were made during the 1950s and 1960s. From table 5 it can be seen that in these decades growth in multifactor productivity in the industry was steady (1.7, 1.6 percent per annum) and labour productivity growth was particularly strong. A combination of large scale, hydro electric developments helped to boost labour productivity levels while at the same time allowing for a decline in the real price of electricity (see Figure 1).

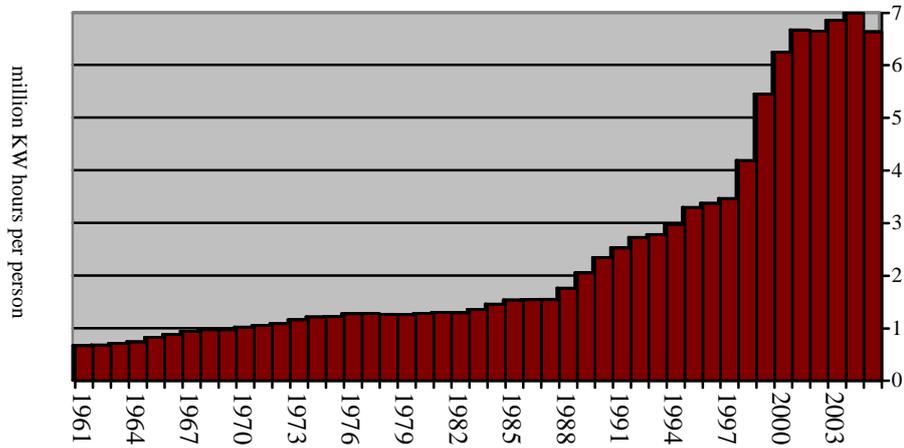
The situation in the 1970s was not so rosy. Productivity growth stagnated, a product of the over building of capacity, which ran ahead of demand, which meant capacity utilisation levels fell (see Figure 3). At the same time staff levels continued to rise in the industry even though growth in demand was starting to waver

This situation was altered during the 1980s. Productivity growth was stronger, especially labour productivity as staff levels were slashed, and capacity usage levels began to rise. This enabled the industry to increase its dividend payments to the government, and lower levels of real debt and real prices.

In some ways this resurgence in the performance is similar to that experienced in the 1960s. In both cases a period of heavy capital expenditure, with rising real prices of electricity, and high levels of debt, were followed by periods of strong productivity growth and declining real prices as the newer, larger scale plant came on stream. In the latter case the restructuring of the industry further enhanced this process. This process saw the drastic reduction of staff levels and corresponding surge in labour productivity levels.

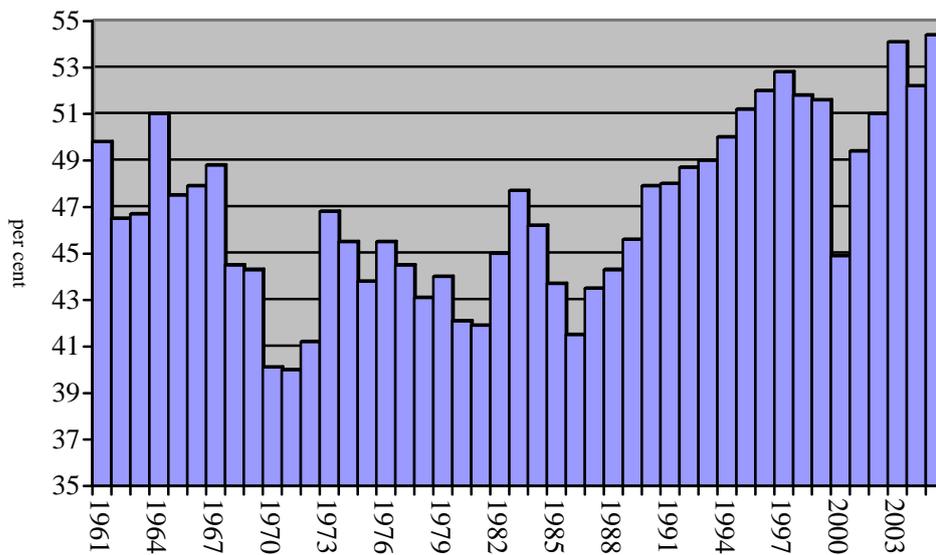
Real price levels also began to fall and this process continued through until the late 1990s. What is more noticeable, however, is the degree to which there has been a rebalancing of prices since the early 1990s. From Table 4 it can be seen that prices tended to keep falling for commercial customers long after they had begun to rise for residential consumers. This, perhaps, reflects the situation under departmental control when residential and industrial consumers tended to be favoured at the expense of small and medium sized businesses. Since the reform process has been undertaken overall, average real prices have not changed overly much but there has been a substantial rebalancing of tariffs that has favoured commercial customers and hurt residential customers.

Figure 2: Labour productivity in the New Zealand electricity supply industry; million KW hour per person employed.



Source: Ministry of Economic Development

Figure 3: Capacity usage in the New Zealand electricity supply industry, per cent.



Source: Ministry of Economic Development.

Table 6: Financial Results of the New Zealand electricity industry 2005/06

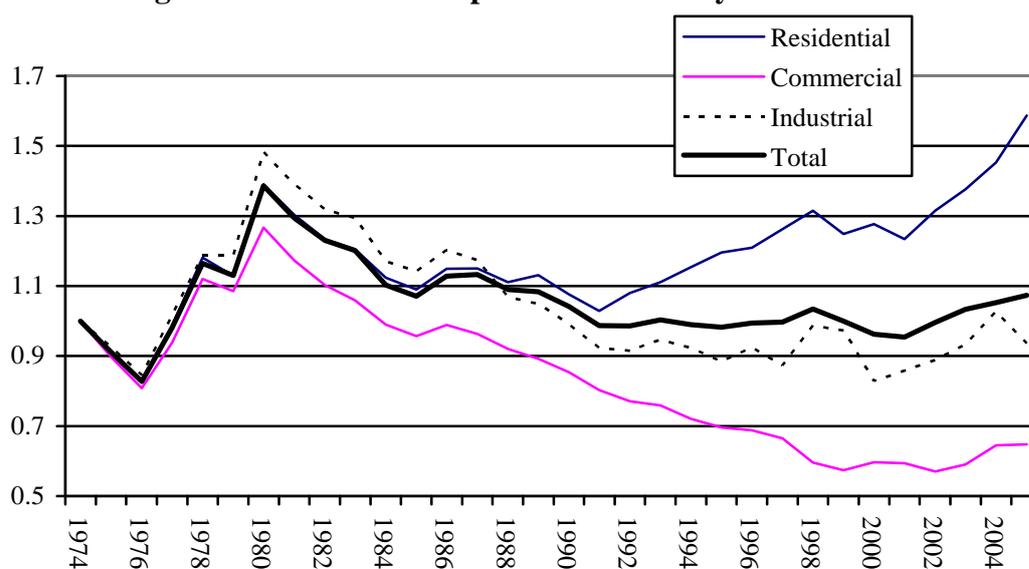
Company	Net surplus before tax \$000'	Total assets \$000'	Return on assets
Mighty River	172,441	2,708,914	6.4
Genesis Power	141,903	2,041,515	7.0
Meridian Energy	957,697	5,339,311	17.9
Transpower	147,321	2,888,295	5.1
Total SOEs	1,419,362	12,978,035	10.9
Contact Energy	423,825	4548439	9.3
Total	1,843,187	17,526,474	10.5

Source: Annual reports

Table 7: Financial surplus New Zealand Government electricity assets 1981-2006.

	\$m nominal	\$m 1998
1981	222	638
1987	340	488
1988	196	264
1990	682	811
1993	405	462
1995	581	624
1997	377	391
2002	840	797
2006	1,419	1,275

Source: Annual reports

Figure 4: Indexes of real prices of electricity in New Zealand

Source: Ministry of Economic Development

Conclusion

The development and structure New Zealand's electricity has changed to a very substantial degree since the 1950s. To begin with the industry was dominated by a central government owned generator and transmitter of electricity which concentrated on the construction of progressively larger generation plant (mainly hydro) which gradually met the strong demand of New Zealand's electricity consumers while at the same time lower average unit costs and prices.

During the course of the 1970s this situation began to change as growth in demand for electricity began to slow and political support for the construction of larger hydro schemes began to decline. As well it became apparent that the industry was one that achieved low levels for productivity, with high employment levels and under utilised capacity. A number of controversial decisions such as the construction of oil fired plant at Marsden Point as well as hydro inspired industrial development projects such as the smelter at Bluff in the South island all brought the basic structure of the industry into question.

During the 1980s and 1990s the basic structure of the industry was altered; first it being corporatised and then broken up into constituent parts with some of these being privatised. Although those processes have been a controversial one there does appear to be evidence that the industry has improved its performance, however there is also evidence that not all New Zealanders have benefited equally from the process.

Reference

- Asia Pacific Economic Cooperation 2002, *Deregulating energy markets in APEC: economic and sectoral impacts*, APEC/ABAREconomics.
- Borenstein, Severin 2000, 'Understanding competitive pricing and market power in wholesale electricity markets', *The electricity journal* vol. 13, July, pp. 49-57.
- Borenstein, Severin 2001, 'The trouble with electricity markets (and some solutions)', University of California Energy Institute POWER working paper PWP-081.
- Borenstein, Severin, James B. Bushnell and Frank A. Wolak 2000 'Diagnosing market power in California's deregulated wholesale electricity market', University of California Energy Institute POWER Working Paper PWP-064r.
- Borenstein, Severin and James B. Bushnell 1999, 'An empirical analysis of the potential for market power in California's electricity market', *Journal of industrial economics* vol. 47.
- Borenstein, Severin and James Bushnell 2000, 'Electricity restructuring: deregulation or regulation?' *Regulation* vol. 23(2), pp. 46-52.
- Borenstein, Severin. Bushnell, James. B. and S. Stoft 2000, 'The competitive effects of transmission capacity in a deregulated electricity market', *RAND journal of economics* vol. 31.
- Bushnell, James B. and Frank Wolak 1999, 'Regulation and leverage of local market power: reliability must-run contracts in the California electricity market', POWER working paper PWP-070, University of California Energy Institute.
- Brash, Don, 1997, *New Zealand's remarkable reforms*, IEA, London.
- Coelli, Tim, 1996, *A guide to DEAP version 2.1: data envelopment analysis (computer) program*, Centre for productivity and Efficiency Analysis working paper 90/08, University of New England, Armadale.
- Coelli, Tim, Prasada Rao, D.S. and Battarsee, George, 1998, *An introduction to efficiency and productivity analysis*, Boston.
- Easton, B.H., 1997, *In stormy seas : the post-war New Zealand economy*, Dunedin, University of Otago Press.
- Evans, Lewis and Richard Meede, *Alternating currents or counter revolution? Contemporary electricity reform in New Zealand*, Victoria University Press, Wellington.
- Evans, Lewis., Arthur Grimes, Bryce Wilkinson, and David Teece, 1996, 'Economic reform in New Zealand 1984-95; the pursuit of efficiency', *Journal of economic literature* vol. 34, pp. 1856-1902.
- Hirsh, Richard F. 1999, *Power loss: the origins of deregulation and restructuring in the American electric utility system*, Cambridge, MA, London, MIT Press.

International Energy Agency 1999, Electricity market reform, OECD, Paris.

Joskow, P. 1997, 'Restructuring, competition and regulatory reform in the U.S. electricity sector' *Journal of economic perspectives* vol. 11 (3), pp. 119-38.

Joskow, P. 2000, Why do we need Electricity Retailers? Can you get it Cheaper Wholesale? Mimeo MIT

Joskow, P. 2003, 'Electricity sector restructuring and competition lessons learned', *Latin American journal of economic* vol. 40(121), pp. 548-558.

Joskow, P. 2006, 'Markets for power in the United States: an interim assessment', *The energy journal* vol. 27(1), pp. 1-36.

Kellow, Aynsley J., 1996, *Transforming power: the politics of electricity planning*, Cambridge, New York, Cambridge University Press.

Martin, John, 1991, Power, politics and power stations; electric power generation in New Zealand 1880-1990, Wellington.

New Zealand, Ministry of Energy 1984, *Review of the role and structure of the Electricity Division*, Wellington.

New Zealand, Ministry of Economic Development, various issues, *Energy data file*, Wellington.

New Zealand, Statistics New Zealand, various issues, *New Zealand official year book*, Wellington.

New Zealand, Ministry of Economic Development 2001, *Chronology of New Zealand Electricity Reform*, Wellington.

Steiner, Faye 2000, 'Regulation, industry structure and performance in the electricity supply industry', OECD Economics department working papers no 238, OECD.

Wolak, Frank A. and Robert Patrick 1997; 'The impact of rules and Markey structure on the price determination process in the England and Wales electricity market', mimeo, Stanford University.