

People, Politics, Power Stations, Alternating Currents or Counter-Revolution: An Interpretation of Evidence of New Zealand's Electricity Reforms

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Abstract: Electricity reforms in New Zealand have been a topic of discussion and debate since their nominal introduction in 1987. Somewhat contrasting presentations have been made in two publications as to the influences and causes of electricity system development, both prior to and subsequently from the nominal reform date. The first focuses on the entire development of the New Zealand power industry since the 1880s. It conveys the major events that occurred and relates this to the influences of politics and powerful people. The second book interprets the developments from the viewpoint of competition theory, explaining what has occurred with reference to pricing, and supply and demand, the tenets of economic law.

This paper is an interpretation of the graphical data presented in both books. There are sufficient long term patterns that show deregulation has had no effect in many ways. Generation capacity appears to be saturating while energy supplied increases linearly along with consumer numbers and their consumption. Real prices continue to decrease. Returns to government also are unchanged by deregulation. Deregulation has changed other factors. It has generated more profits to companies, added volatility to prices and rates of return, and removed cross-subsidisation between consumer sectors. Customers are less interested in changing retailers. Reliability statistics have improved, reflective of improvements in engineering operation and maintenance.

1. INTRODUCTION

Electricity reforms in New Zealand have been a topic of discussion and debate since their nominal introduction in 1987. Somewhat contrasting presentations have been made in two publications as to the influences and causes of electricity system development, both prior to and subsequently from the nominal reform date [1, 2].

The first is a history of electric power development in New Zealand. It focuses on the entire development of the New Zealand power industry since the 1880s. It conveys the major events that occurred and relates this to the influences of politics and powerful people. The book is profusely illustrated with photos and illustrations from the archives that depict electric power systems as real physical entities; conceived, designed, built and operated by real people. This author was asked to review the book after it was published. Aspects of that review [3] are detailed in section 2.

The second book generally looks at more recent events, over the last 20 years. There are no photographs, but there are illustrations and written description to convey the global physical nature of the system it analyses. The book interprets the developments from the viewpoint of competition theory, explaining what has occurred with reference to pricing, and supply and demand. People and their decisions are more abstract to the tenets of economic law. The influence of politics, while embedded in the philosophy, is conveyed through the sequence of restructuring events that form the overall period we know as deregulation.

This paper is an interpretation of the graphical data presented in both books. This is achieved by selectively extracting what each published (most of which comes from other acknowledged sources) and piecing these together as in a puzzle to yield a new point of view.

2. A REVIEW OF “PEOPLE, POLITICS AND POWER STATIONS” [3]

People, Politics and Power Stations [1] relates the introduction of electrical energy by private gold fevered companies and manufacturing industries, to coordinated state control, through to its imminent return to private hands. It relates the early use of coal and municipal rubbish, then hydro, geothermal and fossil fuels. We were up there with the world in adopting new technology as we tried our hand at schemes larger than in other countries. There were mishaps, delays and cost overruns, dry years and restrictions, gluts and shortages.

But the book is much more than this. It records the individuals involved and their achievements, the companies and government organizations who took control, and the development of a national network to benefit all. It relates the enormous engineering efforts required to harness this power, in labour, materials, energy expended and capital, which has had a high impact on the economic welfare of a small nation. It highlights the see-saw of supply and demand and the difficulties of not always getting it right. The great depression and World War II gave rise to large national programmes as hydro-electric development superseded housing in priority and became second only to urgent defence construction.

The social conditions under which the workers who constructed power stations lived seem inhumane by today's standards. We see the rise of unions, the improvement in living and working conditions through community facilities, and free health care arising alongside the concrete walls of Waitaki. Environmental concerns were embodied into decision making as far back as Kaitawa at Lake Waikaremoana in 1931. In an understated fashion, the book shows that electricity is inextricably linked to human society. It has pervaded the lives of people in the 20th century.

The two new chapters of the second edition cover de-regulation and the electricity reforms of the 80s and 90s. They read of a confused state, chopping and changing of names, ownership and control. They are a little self-effacing of ECNZ in conveying their achievements, but do show real retail prices at an all time low.

To the enthusiast the book is a compendium of facts and wonderfully illustrated figures of power station construction. Here is the electricity equivalent of the development of the steam train, but unlike steam, it is still going on.

3. PATTERNS FROM “PEOPLE, POLITICS AND POWER STATIONS” [1]

In the appendices of this book are graphs of construction, capacity, production, consumption and price. Construction rate increased after the Second World War, with major projects both north and south adding stations to the system. The data stops in 1990 with Clyde, the last of the big hydro projects, leading to a decline in actual growth.

The system capacity is shown in Figure 1. New generation over almost the entire history of development of electricity in New Zealand expanded until the 70s decade, well before the adoption of market operation. The 80s and 90s saw the new capacity level maintained [2], even though the mix of primary energy varied. The national grid was established to its geographical limits during the 50s and 60s, as shown in Figure 2. The changes since then reflect an expansion in density to the increasing consumer base, upgrading in power capability and decommissioning redundant

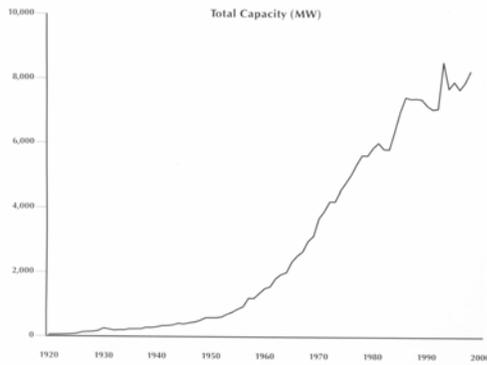


Figure 1: Total Capacity (MW)



Figure 2: Kilometres of Line

infrastructure. The energy generated from the system, as shown in Figure 3, shows a relatively smooth and continuous increase, with the period from 1970 to 2000 best described by linear and not percentage growth. Deregulation has had no effect at all on energy generated.

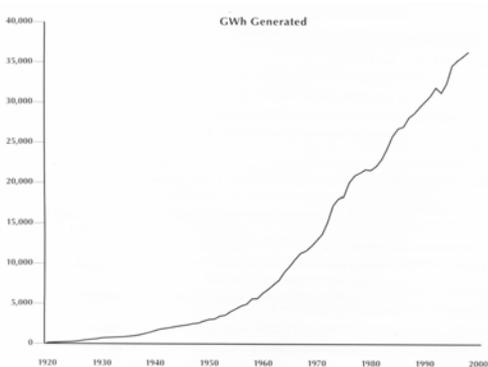


Figure 3: GWh Generated



Figure 4: Consumers (thousands)

In all this, the number of consumers increases, roughly linearly over time, as shown in Figure 4. Consumer prices, as shown in Figure 5, reflect the costs of both generation and transmission investment and operation. In real terms this has steadily declined since the 1920s, with only minor variations. The period of the 80s and 90s show no significant perturbations. More recent data from [2] confirms the continuing decline. Electricity was expensive to provide in the early years of development in New Zealand. The decline is a result of continuous engineering efficiency. Deregulation and market operation has had little long term effect on prices.



Figure 5: Real Retail Price (cents/unit)

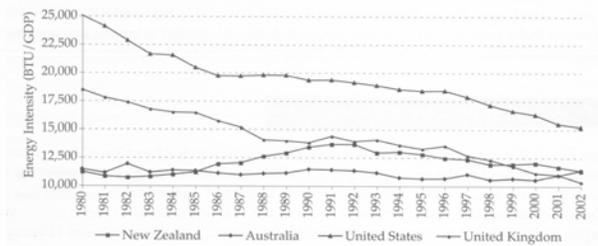


Figure 6: Energy Intensity (BTU/GDP)

4. PATTERNS FROM “ALTERNATING CURRENTS OR COUNTER-REVOLUTION” [2]

New Zealand’s energy intensity increased from 1980 until 1992 and has been declining since, as shown in Figure 6. However, the increase over the former years is distorted by the suppressed vertical axis origin. As presented in [4], there has been no significant change in energy intensity for New Zealand over this period.

The generation mix of providing New Zealand’s electricity is presented in Figure 7. The total amount from all different sources increases. Hydro and geothermal have declined relative to gas, with wind making a relatively insignificant entry to the market.

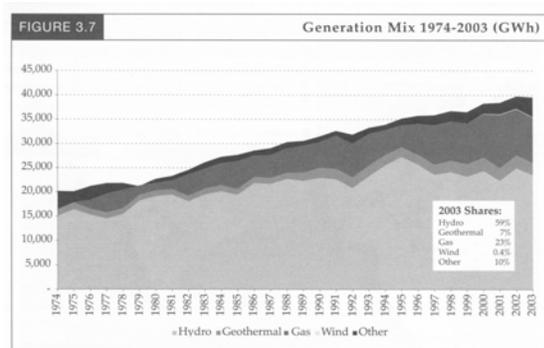


Figure 7: Generation Mix (GWh)

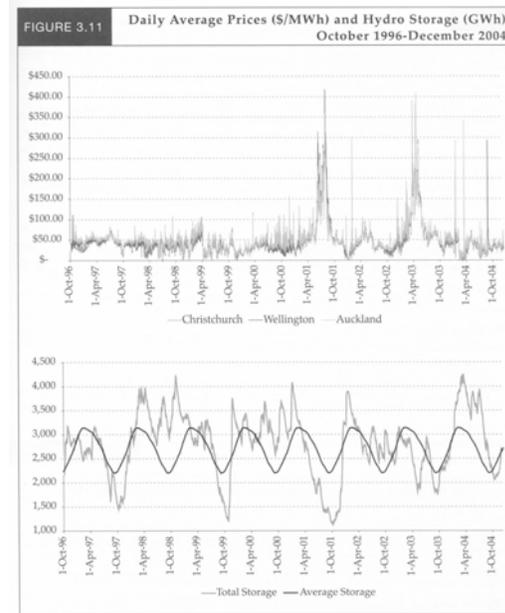


Figure 8: Daily Average Prices and Hydro Storage

The daily average price of electricity and hydro storage are presented in Figure 8. While there is a large price increase due to low total storage just before October 2001, no such association can be drawn for April 2003. There are reverse correlations around April and October 2004 and no price response for storage dips in October 1997 and 1999. There appears to be no correlation between the prices and average storage.

The overall trend patterns for the highs and lows of wholesale prices are shown in Figure 9. They have increased since ECNZ was split into its constituent companies. The daily average wholesale prices at the main centres are presented in Figure 10. The mean values on the figures appear to be around the wrong way. Recalculated mean values are about \$41, \$45 and \$49 for Auckland, Wellington and Christchurch respectively. Given that the HVdc link on average transfers much more power northwards than comes southwards and hydro generation is generally cheaper than thermal, the relativity of prices seems questionable. It could be expected that distant consumers pay more to reflect the cost of the grid infrastructure to get the power to them. The histograms of Figure 10 would suggest that there is a market distortion that produces exactly the opposite. In contrast, the spot wholesale prices for North Island centres were much higher than for Christchurch when there was a loss of the HVdc link [2], which seems a correct response to this outage.

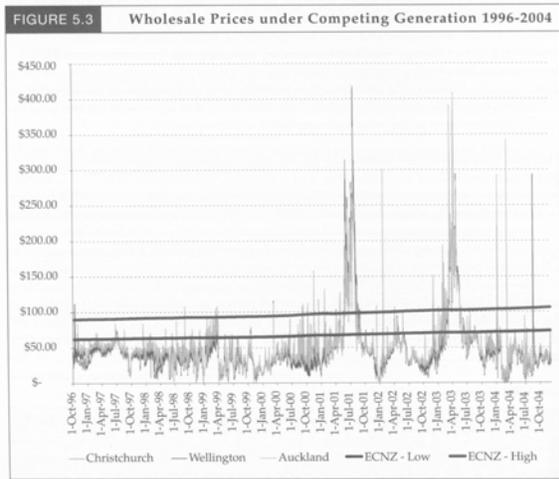


Figure 9: Wholesale Prices under Competing Generation

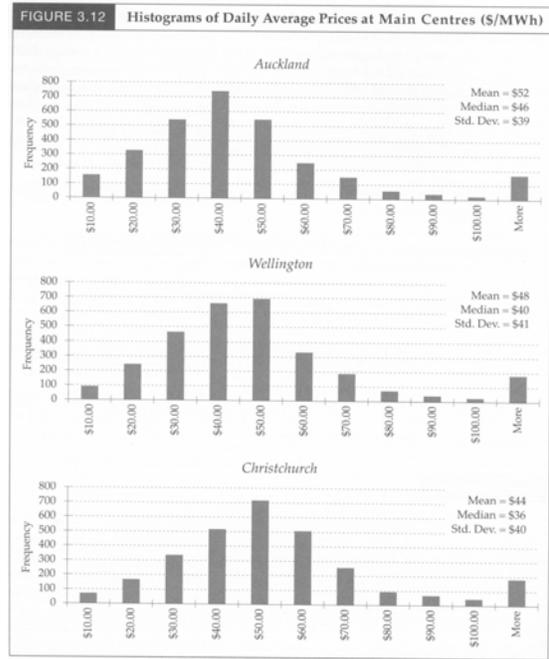


Figure 10: Daily Average Prices at Main Centres

The average transmission charge is shown in Figure 11. It decreases from 1.8 to 1.4 c/kWh over a period of 14 years, with some lesser yearly variations. The value should be compared to the wholesale prices of Figure 10 where \$50/MWh is equivalent to 5c/kWh. Transmission charges are the smaller portion of this price, the balance being due to generation costs. The reduction in transmission charges comes with a steady improvement in customer interruption statistics, as shown in Figure 12, and unplanned system interruptions, as shown in Figure 13. Transpower is a monopoly, functioning outside the market, hence such reliability improvements may be attributed to engineering through improved operation and maintenance.

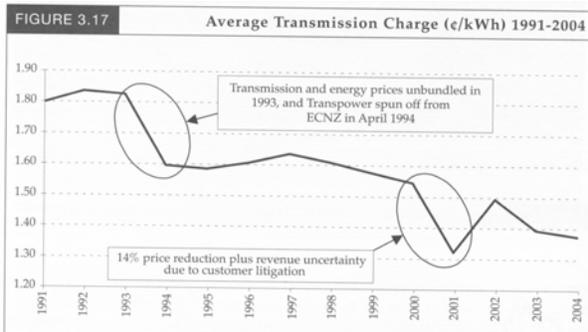


Figure 11: Average Transmission Charge

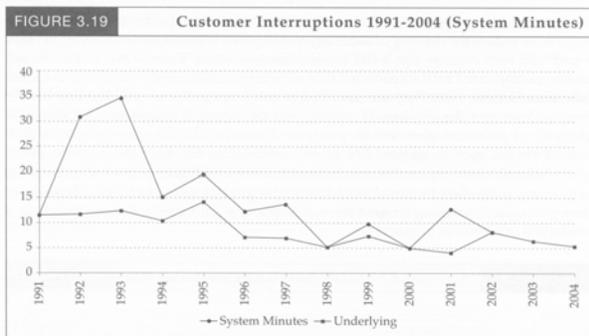


Figure 12: Customer Interruptions

The number of lines companies has decreased over the last 10 years due to mergers. Their average line length and hence infrastructure increased accordingly. Their sector consumer nominal and real average line charges converged to around 6c/kWh with the removal of cross-subsidisations, except for industrial consumers who were charged about an unchanging 1/3 of this [2]. Lines companies' reliability figures generally improved over this period, as shown in Figure 14. Again, their being natural monopolies, this can be attributed to improved engineering.

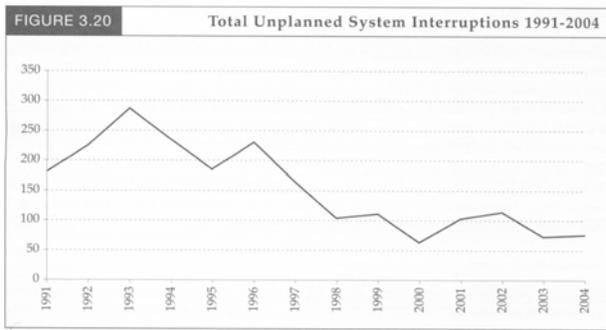


Figure 13: Total Unplanned System Interruptions

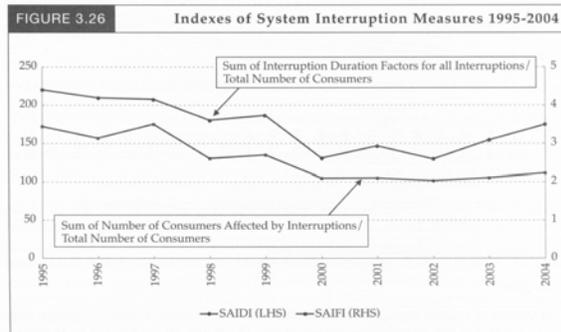


Figure 14: System Interruption Measures

Consumption per consumer in all sectors shows relatively linear growth, as shown in Figure 15. However, commercial consumer price has declined significantly, residential consumers pay more and industrial consumers appear to have fixed real prices. The patterns since 1997, shown in Figure 16, indicate abrupt volatility in wholesale price not presented in Figure 5 and the equivalent from [2].

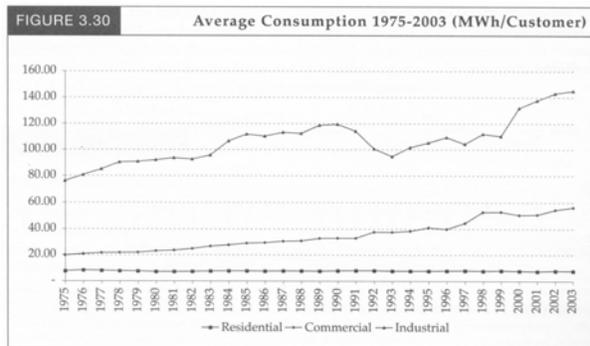


Figure 15: Average Consumption

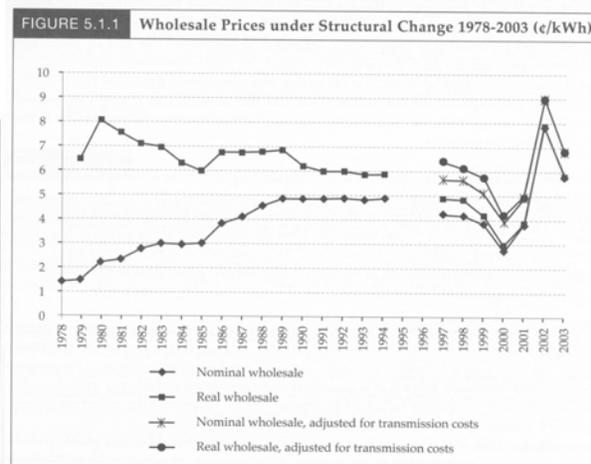


Figure 16: Wholesale Prices

In charging consumers, the returns that power companies make to government have been about \$500m per year, as shown in Figure 17, although the actual amounts are masked by the large anomalies at 1995/6/9. These are the result of accounting surpluses due to the splitting up of ECNZ into its constituent companies. No physical assets were dramatically altered in those years. The electricity system evolved rather than change abruptly as in a revolution. However, as shown in Figures 18, profits of the newly formed power companies went up.

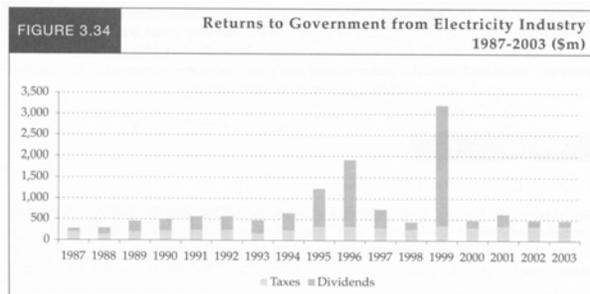


Figure 17: Returns to Government

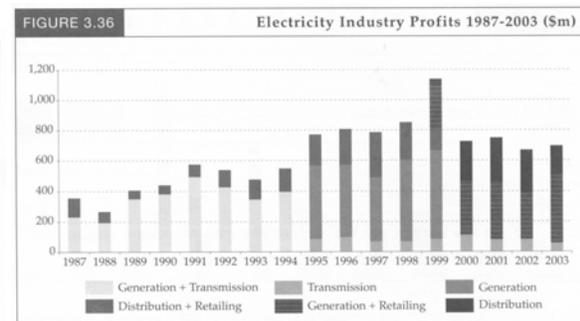


Figure 18: Electricity Industry Profits

In real terms, as shown in Figure 19, the overall electricity industry real economic rate of return has decreased since 1981. Deregulation since 1987 has added volatility to this longer term pattern. The greatest anomaly of 1995 was accompanied by secondary hedge market trading as shown in Figure 20, a practice that ramped up from 1994 and died out more rapidly by 1996.

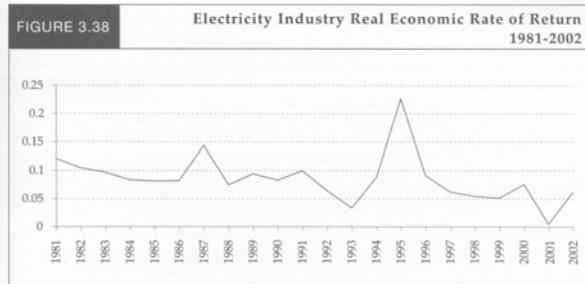


Figure 19 Real Economic Rate of Return



Figure 20: Secondary Hedge Market Trading

Customers have responded to all the changes made to the electricity system by changing electricity suppliers. The data since 2000, shown in Figure 21, indicates volatility on a quarterly basis, and a general decrease to a relatively constant annual level in the later years. This could reflect people moving house and the availability of more retailers to choose from, rather than discontent with the reliability of the electricity supply system, which has improved.

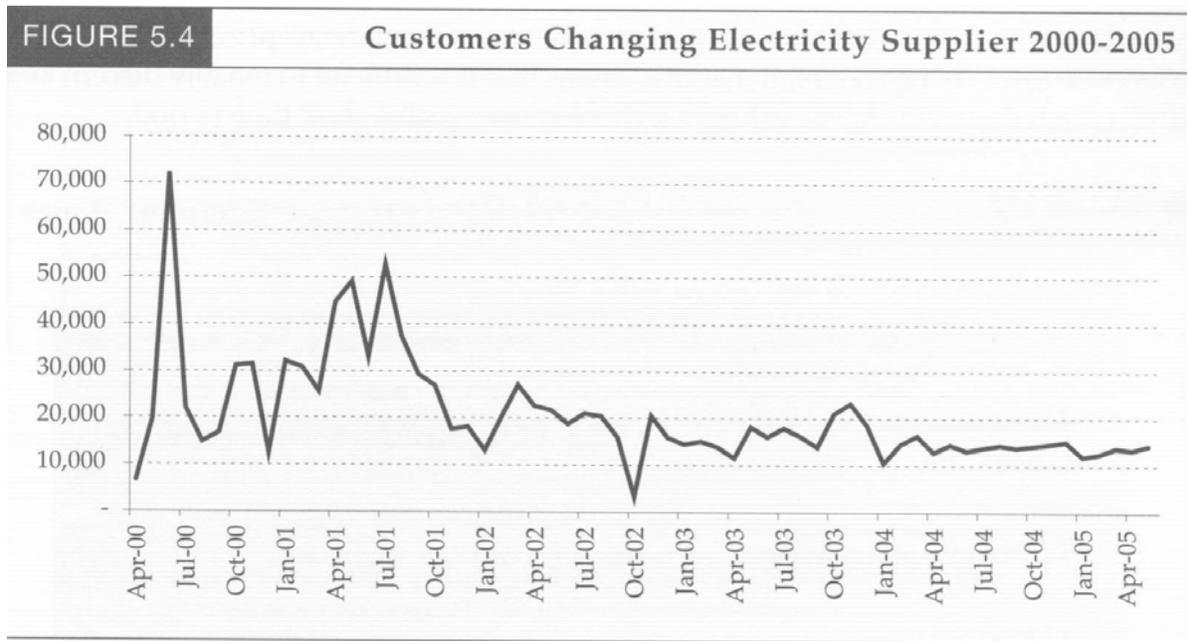


Figure 21: Customers Changing Electricity Supplier

5. DISCUSSION

The Australian electric power scene has also been given a comprehensive treatment [5]. This book is a combination of all the things covered by the two books [1, 2] reviewed in this paper. Unfortunately it is barely illustrated at all, neither by photos nor illustrations with only the occasional graphs of real data and a smattering of stylised theoretical curves.

There is one over-riding observation of Australia's power development that comes from [5]. The geographical vastness of that continent, combined with the separated social, political and economic development of its states, makes a national, free electricity market, complying with the "laws" of perfect competition, a virtual impossibility.

The development of Australia's major city, Sydney, is recorded in [6]. It illustrates the electrical engineering infrastructure of a tight region and the people electricity effects. Perhaps the most interesting long term graph presented is of the average real price of electricity to residential consumers. In real terms it peaked in the early 1930s and has been declining ever since, with two noticeable but small increases on the way. This is very similar to the pattern of real prices in New Zealand.

An account of the South Island of New Zealand's major city's electricity development is given in [7]. It reads of the people, the power and the places, an integration of engineering for the city of Christchurch and its consumers. It's not unlike that for Sydney. The account of New Zealand's largest consumer of electricity, Tiwai Point Aluminium Smelter, also concentrates on the "potential, politics, power, potlines and, above all, people" [8]. It also presents the engineering infrastructure and links to the power station that most supplies it, Manapouri. All these texts show the unique features of electric power engineering which are regional but at the same time are linked at the national level.

New Zealand is a much smaller geographical area than Australia. Our social, political and economic character is more uniform and more strongly connected. For New Zealand, the most distinctive system feature is that we have a national electrical network of two ac systems connected by an asynchronous HVdc link. Our generation is significantly geographically displaced from our loads due to resource availability and accessibility and the locations of where people live and work. These characteristics give rise to distinctive power flows and operational conditions. It is difficult to see how such a national system, operated following a market approach, is superior to one that is coordinated through systems engineering and control.

6. CONCLUSIONS

This paper has presented an interpretation of the long term patterns presented in two books which discuss electricity generation in New Zealand. The first focuses on the entire development of the New Zealand power industry since the 1880s. It conveys the major events that occurred and relates this to the influences of politics and powerful people. The second book generally looks at more recent events, notably since deregulation. It interprets the developments from the viewpoint of competition theory, explaining what has occurred with reference to pricing and supply and demand.

There are sufficient long term patterns that show deregulation has had no effect in many ways. Generation capacity appears to be saturating while energy supplied increases linearly along with consumer numbers and their consumption. Real prices continue to decrease. Returns to government also are unchanged by deregulation.

Deregulation has changed other factors. It has generated more profits to companies, added volatility to prices and rates of return, and removed cross-subsidisation between consumer sectors. Customers are less interested in changing retailers. Reliability statistics have improved, reflective of improvements in engineering operation and maintenance.

Overall, the evidence supports that there are long term natural forces involved in electricity supply and demand, encompassing people, politics, power, markets and “revolutions”. It is indicative of the innate development of human society. People want electricity as it provides benefits well beyond not having it.

Because of the strong physical inter-connectedness of electricity systems, the planning of a total system should be coordinated at a national level, embodying sound engineering practice. The implementation of these plans through component operation can be undertaken on a more geographically regional basis, which maximizes efficiency and minimizes costs of supply.

7. REFERENCES

- [1] Martin, J.E., “People, Politics and Power Stations: Electric Power Generation in New Zealand 1880-1999”, ECNZ and Historical Branch of Internal Affairs, 1999.
- [2] Evans, L.T. and Meade, R.B., “Alternating Currents or Counter-Revolution”, Victoria University Press, December 2005.
- [3] Bodger, P.S., “Review of “People, Politics and Power Stations: Electric Power Generation in New Zealand 1880-1999””, History Now, October 1999, v5, n2, p. 44.
- [4] Bodger, P.S. and Mohamed, Z., "World, regional, country and New Zealand electricity patterns", invited paper, Proc. Royal Society of New Zealand (RSNZ) Conference, Christchurch, New Zealand, 18 November 2004, pp. 17-33.
- [5] Booth, R.R., “Warring Tribes: The Story of Power Development in Australia”, Revised Edition, Bardak Group, 2003.
- [6] Wilkenfeld, G. and Spearritt, P., “Electrifying Sydney: 100 years of EnergyAustralia”, EnergyAustralia, Sydney, 2004.
- [7] Alexander, M., “Christchurch: A City of Light”, Southpower, Christchurch, 1990.
- [8] Lind, C., “The People and the Power: The History of the Tiwai Point Aluminium Smelter”, New Zealand Aluminium Smelters Limited, Invercargill, 1996.