7. THE LIMITS TO ELECTRIFICATION

It is probable the Sydney energy system attained its highest degree of electrification in the late 1970s. By the mid 1980s there were several signs that the energy system was entering a new phase of development, with a loss of momentum in many of the trends underlying the previous century of growth. The demand for electricity had been driven, in the first instance, by the same forces of population growth, urban expansion and modernisation which stimulated the demand for all urban infrastructure services, including communications, transport, and water supply. Energy demand per capita increased as Sydney's economy and technology developed. Superimposed over this general growth was the more specific phenomenon of "electrification", comprising both displacement and transformation. By displacing other fuels, electricity obtained an expanding share of an expanding market for traditional energy services. At the same time, the unique properties of electro-technology gave rise to new products, and transformed many processes to the extent that a reversion to any other energy form became impossible.

Electricity first penetrated those markets where it had a natural advantage, and then the impetus of organisational and physical growth in electricity supply took it into markets and geographical areas to which it was less well suited. The actively expansionist policies of Sydney's major electricity suppliers were assisted by declining costs of production, incorporation of smaller local systems and priority of access to the resources necessary for continued growth. The momentum was sustained into the 1970s, and led to an over-committment of resources to electricity supply at the expense of other means of meeting the demand for urban energy services.

By the mid 1970s the conditions which had led to the spectacular growth of the Sydney electricity system had disappeared one by one. The Sydney grid had effectively reached the state's boundaries during the 1950s and 1960s. It had also reached the limits of market penetration and displacement, and while there was no threat to the central position of coal-generated reticulated electricity in the NSW energy system, its role was circumscribed by other fuels and means of providing energy services, including non-grid electricity technologies. For the first time, electricity lost the initiative in the urban energy market to a new fuel, natural gas.

There were also limits in the underlying demand for urban energy services. Much of the growth in demand in the 1960s and 1970s had been due to a historic change in the Sydney energy system and to a sustained boom in manufacturing, both of which had largely run their course. The growth phase had been sustained for such a remarkably long time, however, that the managers of the generating system had come to regard it as interminable, and planned increments to generating capacity accordingly. Consequently the system was left in the 1980s with enormous excess capacity and indebtedness, and the organisation, planning and structure of electricity supply showed tensions on a scale not evident since the second world war. While the crisis of the 1940s was prompted by the temporary inability of the system to cope with rapid growth, that of the 1980s was symptomatic of an inability to cope with a slowing in growth. It exposed structural inefficiences in control and planning originating from the very beginning of electrification in NSW.

The political and institutional framework for electrification was founded on the vagaries of state and local politics in the 1890s. It had been modified from time to time through ad hoc responses to the pressing energy issues of the day, and in many cases by pure chance. Political control of electricity was fragmented and incomplete at all levels of government. Between the major periods of structural change in the 1880s, the 1940s and the 1980s, electricity utility managers had a largely free hand to pursue their objectives of growth. Outdated structures and organisational models persisted while the electricity system expanded its economic role and importance beyond recognition, becoming the largest single investment of public capital in NSW.

The condition of the Sydney and NSW electricity system in the 1980s reflected the historical ineffectiveness of central control, and the increasing abstraction of electricity suppliers from the underlying dynamics of energy demand. In one sense electricity imposed a false unity on the energy system, obscuring critical distinctions between the residential, commercial and industrial energy markets, and between the metropolitan energy system and the rest of the state. On the other hand it linked the entire techno-energy system functionally, technologically and geographically, and so created new opportunities for integrated management across organisational and state boundaries, and at all stages from resource deployment to end use conversion.

The end of electrification offered a historic opportunity for reassessing the management of the NSW energy system and for making it more efficient and more responsive to social needs. There were signs that such a reassessment had begun. Recognising the pressing need for co-ordinated electricity planning, the Unsworth Labor government altered the legislative framework in 1987 to better accommodate it. However, it lost office to the Greiner Liberal-National Party coalition in March 1988. It remained to be seen whether the trend towards more centralised planning, extending across the management of the entire energy system, an approach more associated in the past with Labor than with conservative state governments, would continue. Given the high level of physical integration of the NSW electricity system, and its historical fragmentation in policy and control, no other approach is likely to be productive.

7.1 ELECTRIFICATION AND URBAN ENERGY DEMAND

The Agents of Growth

The growth in the electricity system was driven by different sectors in turn. The percentages of centrally generated electricity sold to each consumer sector at ten year intervals from 1906 to 1986 inSydney and in the rest of NSW are charted in Figure 7.1. Electrification was well under way in the commercial light and industrial power markets by 1904. The number of buildings and factories with individual generators or taking supply from the few private companies numbered in the hundreds. They did not contribute to growth in the central system until the late 1900s, when the SMC acquired the private companies and began to attract formerly self-generating consumers. In the hiatus before the SMC began operation, tramway electrification emerged as the main agent of electricity system growth. The traction share of the total energy generated by the RD and SMC systems was as high as three quarters in 1906, and did not fall below a half until after the first world war. The decline in traction share was arrested with the electrification of the city railway after 1926, and it remained the largest single consumption sector until the second world war.

Industrial and commercial demand were the driving forces in the growth of the non-traction load until the late 1920s. Residential sector demand then became the main agent of growth: it overtook the commercial sector around 1930, traction in the early 1940s and the industrial sector around 1950. Sector shares remained fairly constant from the mid 1950s until the mid 1980s. Each sector picked up some of the share lost by traction, with the commercial sector showing the largest gain during the 1960s boom in office construction.

The pattern of electricity use was quite different outside Sydney. The postwar expansion of the grid into rural areas was driven by the electrification of farms and isolated dwellings. The industrial sector share then increased steadily from the mid 1950s, as already electricity-intensive regional industries connected to the grid, and new ones were established. By the mid 1980s the industrial share of non-Sydney electricity consumption in the rest of NSW was twice the residential.

As long as electricity system growth was supported by the electrification of the residential sector neither problems of supply nor short term rises in production costs had much effect on it. Demand growth stalled only briefly during the depression of the 1930s, because rising household consumption compensated for the drop in industrial activity. The rate of residential electrification was virtually unaffected by the post war supply crisis and its attendant price rises, the main brunt of which was borne by business consumers. Yet demand growth in Sydney took three years to resume after a brief recession and a relatively minor supply crisis in 1981/2. The ECNSW ascribed the interruption to tariff increases, to "a more severe economic downturn than has been experienced since the early 1960s" and to "a Government-backed conservation program" (ECNSW 1983a,36). The Commission had, in its own words, "no comparable experience upon which to assess the change in usage patterns that might occur" as a result of these factors (ibid,37). It therefore missed the crucial point that with the 50 year long process of household electrification substantially complete by the late 1970s, demand growth was no longer supported by historical change.

Limitations

The industrial, commercial and public transport sectors were all rapidly and highly electrified by the 1940s, and further growth in their electricity demand was due more to increased activity and completely new manufacturing techniques than to further electrification. The electrification of the residential sector, on the other hand, took place in several stages. The first was the connection of all dwellings to the public supply systems in Sydney and in other urban centres, which was largely accomplished by the late 1930s. The second stage was the connection of dwellings in rural NSW. It was accomplished by the early 1970s and marked the geographical limits of grid extension. It was overlapped by the third stage, beginning in the late 1920s, of simultaneous mechanisation and electrification in traditional household tasks and the displacement of coal gas, coal, firewood and finally oil from residential thermal energy markets.

This third phase of household electrification reached its limit in the late 1970s. Households in Sydney and in the rest of NSW showed near saturation in ownership of electrical equipment supplying the most energy-intensive services associated with food and personal care. Environmental control and information services remained as potential growth areas but in the first electricity was subject to intense competition from other fuels, and in the second the energy component of the service was minor.

The continuous decline in the real cost of generating electricity between the mid 1950s and late 1970s was another important contributor to growth. It enabled electricity suppliers to support the extension of the grid into remote areas, and the penetration of electricity into the cooking and space heating markets. The expectation of indefinitely declining cost encouraged electricity utilities to market indiscriminately, and so contributed, in the end, to uneconomic over-electrification. The declining cost trend reversed in the mid 1970s. The limits of scale and technological efficiency were reached in base load thermal power station design, and the prime sites for hydro-electric development in NSW had all been used. These rising cost trends were compounded by the ECNSW's over-forecasting and over-construction. The expected resource-led boom in industrial activity in the 1980s failed to eventuate, and the price structure had to recover the costs of the resulting unproductive over-capacity.

There were also more subtle geographical shifts within the electricity cost structure, and a sharp reversal in the long decline of the gas industry's competitiveness. As long as Sydney was growing faster than the rest of NSW, the grid gained surplus revenue for the cross-subsidy of residential consumers in remote areas. Sydney's population growth faltered in the mid 1970s and the city's share of NSW population began to decline (NSWYB 1986,44), signifying the end of a trend to metropolitan concentration which had begun in the 1880s. Also in the late 1970s, the introduction of natural gas reversed the upward trend in gas prices and so began the displacement of electricity from thermal energy markets. The penetration of electricity into the residential cooking and space heating markets had been achieved largely on the strength of the promotional price structures introduced in the 1920s, and at the expense of a gas industry subject to severe postwar technological and financial difficulties. The loss of such loads represented a correction of historical over-electrification, and so probably desirable for the overall economics of the electricity system. However, the grid was also threatened with the loss to gas of the profitable off-peak water heating.

New trends in energy utilisation practice and technology also limited demand growth. Rising electricity prices made consumers more aware of their costs and stimulated the market for products and services contributing to more efficient electricity use. In the early 1980s the federal and NSW state governments began to promote energy efficiency in the design, selection and use of all electrical equipment. Although initially prompted by rising energy prices, efficiency gains are largely irreversible: the manufacturers of energy conversion equipment are unlikely to redesign products to be less efficient even if real energy prices fall. The trend toward greater product efficiency became a competitive selling point, and was likely to persist independently of trends in electricity price. The momentum of technological progress within the electricity system has passed from supply to utilisation.

Electrification represented a simultaneous change in three separate aspects of the urban energy system. Electricity was first of all a substitute form of energy, with greater cleanliness and convenience than the other fuels of the time, albeit at a price premium. Secondly it was a control technology of unprecedented precision, revolutionising the quality of energy services at the point of use, even when restricted to a single generator powering lights and motors within a single building. Thirdly, and much later, electricity became the preferred medium for energy reticulation, so leading to the development of the Sydney and then the NSW grid.

As electrification reached its limits, two of the three functions of electricity were subject to increasing competition from later technologies and fuels. The control and energy functions became separated, allowing other energy forms to compete with electricity in the thermal market. Its greatest competitor, natural gas, was a completely different fuel in cost structure and chemical properties from the manufactured gases which electricity had displaced in the 1950s and 1960s.. Only the control function of electricity remained unassailable, and indeed reinforced by the development of electronics. As an illustration of the separation of roles, natural gas's penetration of industrial and residential thermal energy markets was greatly assisted by the development of electric fan-powered blowers and electronic controls to better regulate the heat supplied by the gas.

The energy reticulation function of the grid was also subject to competition. By the mid 1980s, alternative technologies for local collection of geo-energy were already competitive with subsidised central reticulation in some instances. A 1985 EnANSW report on the approximately 1500 permanently occupied dwellings in NSW not connected to the state electricity grid found that

> "RAPS [remote area power supply] systems consisting of combinations of battery/inverter with a diesel, petrol, a micro-hydro set or wind, and/or photovoltaic generator can provide twenty-four hour power at a cost comparable to grid connection in selected locations. These RAPS systems are also comparable in convenience..." (EnANSW 1986a,i).

One of the factors in the postwar expansion of the grid was the fact that connection to the central supply appeared cheaper and more convenient for remote townships, and isolated homesteads, than supply from their own small generators. In many cases it was cheaper only because of the cross-subsidy in capital and operating costs which those consumers received from others. This was tolerable to all consumers so long as generating costs declined, and the state government allowed the fund transfer mechanisms involved to be concealed. In 1988, however, the new Greiner coalition government commissioned a report which urged, among other things, the "corporatisation" of goverment-controlled trading enterprises, including the ECNSW. On the issue of cross- subsidy, the Commission of Audit stated that it

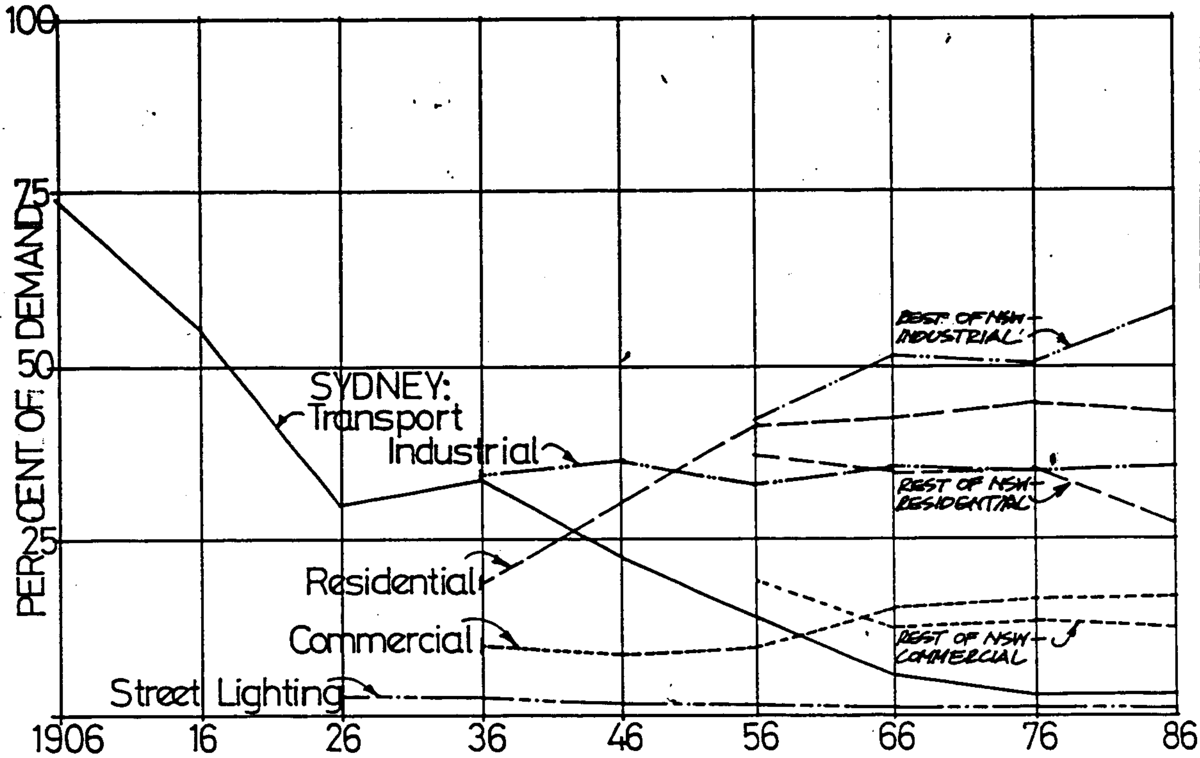
> "..strongly believes that where a cost to the [trading] Authority results from a Government directive to provide a non-commercial service, an explicit Government payment should be made to the Authority. The payment should be at full commercial rates as a customer to a service provider, rather than exist as a hidden cross subsidy. Direct payments have the distinct advantage over the more common mechanism of cross subsidy in that they permit more precise targeting of their objective and are more open to scrutiny" (vol 1,p45).

If the government were to adopt this recommendation, it would limit another of the historical factors underlying the growth of the grid: the cross subsidy on which many rural county councils and their customers depend. However, the strong rural links of the National Party faction in the coalition, and the sympathy of conservative governments to the local government lobby, suggested that any movement in this direction would be slow. Nevertheless, for a combination of political and technological reasons, non-grid technologies are likely to become more competitive as their costs decline and the true costs of maintaining the always uneconomic and now deteriorating extensions of the 1960s rise. Indeed, a managed contraction of the grid may increase the overall cost-effectiveness of NSW energy supply, and reduce the burden of subsidy on the Sydney energy market.

Natural gas also introduced a number of new variables into electricity supply. Generation from natural gas on the consumer's premises emerged as another potential competitor to reticulated electricity, even in urban areas. For industrial consumers its attraction lay in the possibility of using the waste heat in manufacturing processes, and for commercial users the incentive was relief from the burden of subsidising the residential sector. The resource geography of natural gas also made it a potential generating fuel for small local grids in the west of NSW, should the contraction of the grid eastwards leave them isolated in the future.

Perhaps the most important potential impact of natural gas on electricity supply was associated with the pattern of residential cooking and space heating demands. The over-electrification of these services had contributed to steady deterioration in system load factor since the 1950s. Natural gas brought the possibility of correcting this by transferring tthose loads to gas, or alternatively installing natural gas-fired generating plant as the most cost-effective way to meet peaks in electricity demand, as proposed by the McDonell inquiry (McDonell 1986 I,14). Either way, natural gas represented yet another limit to the pattern of coal-based centrally-generated electrification which dominated the Sydney and NSW energy systems from the 1900s to the late 1970s.

FIGURE 7.1
SECTORAL SHARES OF ELECTRICAL ENERGY DEMAND
SYDNEY AND REST OF NSW 1906-86



7.2 URBAN ENERGY SERVICES: A DECEPTIVE UNITY

Sydney's original settlers supplied their needs for the major energy services of light, power and heat with relatively few types of simple energy conversion equipment, each capable of using a wide range of interchangeable energy forms, such as the fire grate, the cart and the rotative mill. Urbanisation, technological and economic development led to greater differentiation by function, location and building type, and hence to greater specialisation in the demand for energy services. The characteristic patterns of modern commercial, residential, manufacturing and urban transport energy demand were clearly evident well before the introduction of electro-technology. The concentration of these robust energy markets within a small area was ideal for the development of an energy reticulation grid, a function only partially filled by coal-powered gas and hydraulic systems. Electricity rapidly emerged as the superior medium for general power and light reticulation. It alone could conveniently supply every market, and its technology was consistent with contemporary trends towards finer control of energy at the point of use.

The Dynamics of Demand

The history of the Sydney energy system strongly suggests a natural hierarchy in urban energy markets. Each of the modern, capital-intensive energy technologies introduced to Sydney in the 19th century - steam, gas and electricity - penetrated the energy service markets it was capable of supplying in descending order of perceived social and commercial value. Street and commercial building lighting came first, followed by power for manufacturing and traction and, finally, thermal energy and the residential sector.

The demand for lighting and other environmental control services was stimulated by the needs of the government, the public and city businesses for safety and convenience in public spaces, both outdoor and enclosed. As building forms and functions altered, so did the patterns of energy demand for heat and light. Woolstores, hotels and other large buildings created an additional power demand for hoists and passenger lifts, and in due course for ventilaton and space conditioning. The density of the central business district created a ready market for reticulated energy services and for compact, quiet and clean energy converters. The gas engine, hydraulic and pneumatic systems all found niches in this market in the 1870s and 1880s. They were replaced in turn by electricity, but electrification, rapid as it was, did not transform the underlying dynamics of commercial sector demand. These remained, in the 1980s as they were in the 1880s, determined by the form, function, and standard of environmental services within commercial buildings.

Industrial sector energy demand responded more rapidly than commercial to the technological possibilities and prices of alternative energy forms. Steam allowed far greater engine powers and flexibility in location and operation than the renewable energy forms it replaced. Electricity, in turn, allowed the solution of the problems of power reticulation and fine control blocking the way to full mechanisation. Electrical machinery could perform traditionally manual tasks with so much more precision and control than any previous energy technology that entirely new processes became possible. Sydney manufacturers rapidly realised the potential of electricity to improve productivity, often in advance of the availability of grid supply. By the second world war urban manufacturing was irreversibly electrified, and the demand for electricity varied more with changes in process technology and the general level of industrial activity than with the price of competing fuels.

Steam and then electric motors transformed Sydney's transportation no less than its industry. While the city remained compact most trips were made by foot or by horse power. Suburban expansion, however, relied on the speed, carrying capacity and route flexibility achieved by succesive powered modes: the steam railway after 1856, the electric tramway after 1899, the electric railway and the motor bus from the mid 1920s and the motor car from the mid 1950s. Steam power brought the railway, but electricity allowed it to run faster, and to carry passengers closer to the major city destinations. The electrified modes which dominated Sydney's land transport from the turn of the century until after the second world war could have retained more of their prominence had not the political decision been taken to phase out trams in favour of buses in the 1940s and 1950s. The inexorable postwar combination of suburbanisation, road construction, falling car prices and rising incomes accelerated the spectacular rise in the share of transportation energy services supplied by petroleum.

Heat, the simplest energy service, could be supplied by the widest range of energy forms. The market for thermal energy was the most price-sensitive of all, particularly in industry where the largest quantities were used. Coal competed with firewood in the Sydney thermal energy market almost from its beginning, and both fuels remain in use to the present day. Coal gas, petroleum, electricity and methane were later competitors. Electricity penetrated the heat market partly on the strength of price manipulation by its suppliers and cross-subsidy from other energy service markets where it had no competition.

The residential sector was the most conservative in its pattern of energy demand. Householders were always the last to adopt new fuels and technologies, and the last group of consumers to which reticulated energy suppliers turned their attention. Electrification began last and took longest in the residential energy system, and when electricity did reach the household, it had a less transformative effect than in the other sectors. Of course the average Sydney dwelling of the 1980s housed a far wider range of energy conversion equipment than its counterpart of the 1880s, but almost all of the energy it consumed supplied services which would have been recognisable a century earlier. Rather than revolutionise established practice, as in industry, electricity accelerated developments already under way: the mechanisation of traditional household tasks such as cleaning and food preparation, and the displacement of older fuels from traditional thermal markets such as cooking.

The history of residential energy demand in Sydney confirms the hypothesis that household functions change slowly because of their close relationship to personal needs. Electricity assisted the development of household technology to better satisfy those needs but did not, on the whole, change their scope. This holds even for the services now most closely identified with elecricity. Household electrification was certainly critical to the diffusion of refrigeration, which together with developments in industrial food processing transformed the urban food distribution system. In that respect, it accelerated and brought to completion trends already under way. Of the electronic information services which have made the greatest impact on the household, both the radio and the telephone were technologically independent of household electrification. Information devices use so little energy that they can operate with batteries, and the fact that they are now designed to take mains power is a matter of convenience rather than necessity.

Forecasting and Managing Demand

The ubiquity of electricity supply, and the present high level of electrification in energy services, have obscured the differences between the underlying energy demands of each sector. The main determinants of commercial demand are built form and function. In the industrial sector they are process technology and energy service price. In the transportation setor they are transport technology and spatial form, and in the residential sector, household organisation and personal needs. All service markets are of course also affected by general levels of economic activity and prosperity and by government policies, and all are to some extent price responsive. But energy price is of much less importance in the residential energy market, for example, than in the industrial, and building design has less influence on residential electricity demand than commercial.

In unifying the Sydney and NSW energy system with a common technology and a single reticulation grid, electrification concealed these vital diferences in the geography, the costs and the dynamics of disparate energy markets. This was of less importance during the early and middle phases of electrification, from the 1910s to the 1960s, when electricity suppliers were concerned primarily with expanding supply to meet annual growth rates of about 8.5%.

However, the dynamics of the individual markets became critical to the management of the electricity system when electrification neared completion and system growth faltered. Failure to anticipate the limits to electrification led to expensive, wasteful over-supply of infrastructure, just as failure to provide for growth led in the past to costly under-supply. Furthermore, the cost of expansion rose so steeply that alternative ways of meeting the demand for energy services became attractive.

Different approaches are necessary for forecasting and perhaps managing electricity demand in each of the sectors. Econometric modelling is most appropriate to demands with a history of price responsiveness, such as the thermal energy markets within each sector. The analysis of trends in process technology is more appopriate for manufacturing. Trends in the quantity, design and service-intensity of built space are more useful than trends in energy price for projecting commercial energy demand. For the residential sector the most successful analytical approach is likely to incorporate household organisation and personal behaviour as well as appliance stocks, and the recognition that there may be natural limits to household demand for electricity.

Broad technological trends have major implications for the demand for energy services. The Australian economy, like most other advanced economies, experienced a shift from manufacturing to services in the 1970s.[1] Most of the fastest growing service activites are housed in commercial buildings, and an increase in their activity level is likely to stimulate demand for electricity-intensive commercial energy services such as information, lighting and internal transport. In the USA, it has been found that computers, other information devices and the environmental control of the spaces in which they are located have created one of the fastest growing areas of electricity demand (Squitieri et al 1986,30). The Australian economy was also affected by the growth of the global information technology industry.[2] Although electronic information technology is entirely dependent on electricity, it has mixed implications for energy demand. The impact on residential electricity demand was negative. By the early 1980s Sydney household expenditure was shifting from traditional appliances to electronic information services with a declining purchased energy component.

There was evidence that information technology was also transforming manufacturing processes in the more developed economies:

> "The growth of electronic automation parallels, in some respects, the introduction of electric motors in the early 20th century. The electric motor replaced the steam engine where power was already being used. At the same time, it... greatly extended the domain of "energised capital"... Electronic automation extends this domain in the same way, although automating equipment is notably abstemious in its use of electricity, and will probably not add much to [electricity] consumption" (Kahane and Squitieri 1987,244).

Another major technological trend affecting manufacturing, at least in the USA, was a fundamental change in the materials content of manufactured items:

> "Since the early 1970s there has been a marked trend in industry away from the processing of basic materials and towards more intensive fabrication and finishing of materials. While many believe this to be a temporary activity from the energy price shocks of the 1970s, our analysis indicates that this trend marks a passing of the era of matrials-intensive production and the beginning of a new era in which economic growth is dominated by high-technology products having a low materials content" (Williams et al 1987,140).

The history of Sydney's electrification demonstrates how rapidly global developments in electro-technology have been adopted and adapted. It is apparent that the Sydney economy continues to be affected by global trends in manufacturing, often through the agency of multi-national, multi-plant firms able to shift capital, technology and production (Fagan forthcoming,16). The impact of these trends on the Sydney energy system remains to be clarified. It may be that the manufacturing demand for electricity in Sydney will stabilise as new process technologies are adopted, whether or not sector activity increases. At the same time, electricity demand in the resource processing industries elsewhere in NSW may fluctuate with export commodity price cycles, or possibly decline if the US trends to lower materials intensity become general. These issues critically effect the future demand for enegy services, and the performance of the NSW government and the electricity supply industry in the early 1980s does not indicate an ability to come to grips with them.

While electricity has imposed an apparent and deceptive unity on energy service markets, it has actually unified for the first time all the disparate elements of the techno-energy system. Resource extraction, primary conversion, storage, transport and secondary conversion were quite discrete activities before electrification linked them in space and time. It follows that the performance of each element in the integrated system contributes to the performance of the whole. The price of energy delivered is only one component of the cost ofsupplying an energy service. It is the one on which the Sydney electricity suppliers have concentrated almost exclusively. Even so, electricity demand patterns and consequent supply investment decisions have generally been distorted, because costs could not be communicated to consumers through an impenetrable web of cross-subsidies, and costs such as environmental degradation have been excluded entirely.

The overall cost of delivering a presently electrified energy service may be considerably lower with other equipment and fuel combinations, or even non-energy substitutes such as improved building insulation. Improving the design of the refrigerator, and indeed the kitchen in which the refrigerator stands, may be a more desirable way of lowering the cost of food preservation, for example, than building a new power station. Conversely, the narrow objective of reducing the cost of only one part of the energy system, such as the cost of electricity production at the power station, may actually increase the total social cost of meeting the demand for energy services, which is the real historical and economic purpose of the urban energy system.

7.3 POLITICS AND THE ELECTRICITY SYSTEM

The course of Sydney's electrification has its parallels with other cities and with other changes in the techno-energy system. The factors which distinguished electricity supply in Sydney and NSW from other Australian cities and states in the 1980s could be attributed partly to geography and resources, but mostly to government and institutional politics. The organisation of the NSW electricity system evolved out of political circumstance, and it bore the heavy imprint of its history.

The Imprint of History

The most prominent political characteristics of the NSW electricity system were public ownership, the municipal basis of electricity distribution and its functional separation from generation, and the distortions of the pricing structure. The persistence of a 26 county council distribution structure into the 1980s was a relic of the municipalisation of public lighting, the antipathy of local government and private gas companies, and the fortuitous influence of the emerging Labor Party on notions of public ownership in the 1880s. The municipality or shire was traditionally charged with providing local services such as lighting, and so was the natural agent to bring electricity to each town, whether as supplier or as contractor with a private firm. The municipal model remained more dominant in NSW than elsewhere because of the quality, abundance and transportability of black coal, the state's main generating resource. There was not the need for special forms of organisation to develop hydro-electric or brown coal resources, as in Tasmania and Victoria.

Local government left a legacy of populism, parochialism and inefficiency, which spread from the Sydney Municipal Council to the rest of the NSW electricity system. Popularly-elected local councillors favoured residential consumers over other classes when setting prices. Electricity distribution systems stopped at municipal boundaries long after there was any technological need for them to do so, and indeed long after the costs of fragmentation became obvious, particularly in Sydney. For many councillors, local autonomy and the prestige of control outweighed considerations of cost and efficiency.

Local politics remained a factor even after the local power stations succumbed before the advance of the grid. After the war the regional supply authorities outside Sydney were faced with the loss of autonomy to state instrumentalities such as the EANSW, ECNSW and EnANSW in return for the benefits of cheaper electricity from the state grid. Once connected, each of them had the incentive to maximise the benefits of supply within its own area, secure in the knowledge that the costs would be spread throughout the state. Each vied with its neighbours in expanding its sales and reducing its tariffs, and so maximising the cross subsidy it received, ultimately, from metropolitan consumers.

The fragmentation of municipal supply made local government financially and organisationally incapable of undertaking the enormous capital works needed after the second world war. Something like the ECNSW became necessary to bring economies of scale to the disparate systems and to optimise the location of new power stations. The resulting functional separation of electricity generation from distribution was probably inevitable, though its precise form was a relic of the post-war crises: the SCC's difficulties in obtaining generating plant, and the state Labor government's desire to make Sydney's electricity resources and natural advantages the driving forces in the electrification of the entire state.

As the electricity system expanded in geographical extent and economic importance, state governments found it increasingly necessary to intervene to achieve objectives beyond the legislative and political scope of the local authorities. The centralisation of power to the state was incomplete, however, and the chosen mode of intervention was indirect: advisory committees and statutory authorities (such as the EANSW and the ECNSW) rather than direct ministerial control. This did nothing to reduce the complexity of the structure or the difficulty of achieving uniform and consistent policies. Much of whatever management effort state governments put into the electricity system was absorbed in the reconciliation or manipulation of competing interests to achieve short term objectives, often of a party political nature.

The corruption associated with the SMC's electricity undertaking in the 1920s gave the Stevens-Bruxner government of the mid 1930s the excuse to dispose of a troublesome power base for its Labor opponents. The government's eagerness to put the SCC beyond "political interference" in fact put it largely beyond effective political control altogether. H.R.Forbes Mackay, the manager of the undertaking, used the creation of the SCC under the Gas and Electricity Act 1935 to enhance his own autonomy, to the initial dismay of the elected coucillors. Over time a large measure of management independence became the accepted pattern not only within the SCC but also in the ECNSW. The county councils created under the Local Government Act 1919, such as St George and Prospect, were under more direct councillor control, but given their limited areas and resources, whatever they did was overshadowed by the influence of the SCC and ECNSW.

Independence made the management of the Sydney electricity system conservative and inward-looking. The durability of the management practices and tariff structures introduced during Forbes Mackay's long tenure was reinforced by the appointment of all successive general managers from within the SCC. The ECNSW had even greater independence. The composition of the government-appointed Commission changed far more slowly than that of the elected SCC, and the ECNSW's management was one step further removed from its elected political masters. From 1950 to the early 1980s it was largely left by state governments to pursue the directions set by its original chairman, H.G.Conde, and first chief engineer, F.Sykes.

The autonomy of the engineers was enhanced by temporal politics. The planning and construction time for power stations became so long that councillors and government ministers were forced to make decisions which would take effect well beyond their own expected tenures in office. They relied heavily on the advice of their electricity system managers, who were well placed to limit options, complicate them and exaggerate their urgency to suit their own professional and organisational objectives. Furthermore, the functional divisions in the system gave managers and engineers, like councillors, scope and incentive to enhance their own part of it at the expense of the rest.[3]

The managers of the SCC and the ECNSW were allowed a high degree of autonomy in engineering matters so long as the electricity system continued to satisfy the over-riding social requirements of universal availability and security of supply to all consumers, and a politically popular tariff structure, which came to be synonymous with state-wide uniformity and an entrenched cross-subsidy in favour of residential consumers. The SCC pioneered the consumer class cross-subsidy and so entrenched it in the system that it remained immovable until the 1980s. However, it could not asure security of supply, and so lost control of generation to the ECNSW. The circumstances of its creation made the ECNSW acutely aware that its organisational survival depended on its ability to guarantee supply and to meet load growth, at whatever cost. The unprecedented public criticism of the ECNSW following comparatively minor shortfalls in supply in 1981/2 confirmed that this was as true in the 1980s as in the 1950s.

Mainstream party politics affected the electricity system through its impact on the relations between local and state governments, rather than on the policies of either. The main effect of the SMC'c polarisation into Labor and conservative factions from the 1920s was to paralyse the council and leave the management even more in control. The conflicts between the SCC and state governments were certainly exacerbated during periods when they were under opposing party control, but party politics were not the underlying cause. State government electricity policy proved to be remarkably bipartisan from the 1930s on, although Labor goverments tended to be more interventionist and less hampered by sensitivity to local government interests. Conversely, local government resistance to any state government policy perceived to threaten autonomy was equally consistent and bipartisan.

Beyond Electrification

The politics of the Sydney and NSW electricity system were predicated on growth. State governments of all parties required the electricity system to play a redistributional role across consumer classes, regions, utility workers and managers. It was even better suited to this role than other public utilities such as water supply, which was not integrated into a state wide grid, or the railways, which imposed an all too visible burden on consolidated revenue. During the post war growth phase of electrification, the system was able to meet a wide range of social objectives and still deliver energy with greater security at declining cost. As electrification approached its limits, it became more difficult to satisfy all the traditional beneficiaries simultaneously. The system could no longer produce the surplus needed to sustain increasing (and perhaps unnecessary) levels of security, low worker productivity, poor management practices and the entrenched residential cross-subsidy. New ways to improve the overall system efficiency were necessary if the cost of energy services to consumers were to be contained.

The fragmentation of the organisation of electricity in NSW - both geographically and functionally - was a fundamental barrier to the co-ordinated policies needed to address structural change. The local government framework inherited from the 1880s, under which county councils retained the power and incentive to pursue local at the expense of general interests, was inconsistent with the essential geographic unity of the system in the 1980s. With the bipartisan committment to a uniform tariff structure and technical standards across the state, the geographic boundaries of county councils appeared increasingly arbitrary.[4] Local distribution entities had some merit as administrative units within a state structure, but the benefit of elected local government participation was questionable. The more active county councillors diverted the benefits of the state grid to their own areas and generalised the costs. At the other extreme, some county councillors played an entirely ceremonial role of no consequence to any but themselves and to the constituent councillors who elected them.[5] Either way, the benefit of continued local councillor involvement in electricity supply was questionable.

Even as state governments were struggling with the centralisation of control state wide, the extension of the grid beyond NSW called into question any management structure which stopped at the state border. Federal government co-ordination was necessary to construct the Snowy Mountains Scheme in the 1950s, and federal sponsorship in the late 1970s assisted the further integration of the SA, Victorian and NSW systems. State electricity utility borrowings represented a significant proportion of Australian overseas debt in the 1980s, and it would be consistent with the federal government's constitutional responsibility for national economic policy to take a more direct role in the management of the emerging national electricity grid.

The functional fragmentation within NSW electricity supply made it difficult to pass price signals from producer to final consumer, and distanced the ECNSW from the dynamics of demand. The divisions between generation, retailing and utilisation made little difference during the growth phase of electrification. Even though the SCC and other retailers pursued organisational growth by promoting over-electrification of the residential sector, the price impact on non-residential consumers remained tolerable so long as the ECNSW was able to lower average costs by building new and more efficient power stations. With the reversal of the generating cost curve and the completion of electrification in the 1970s, however, the continued expansion of the generating and distributing organisations was likely to result in higher, not lower costs of energy services.

Utilisation practices and technological development held out the best prospects for continued decline in energy service costs. The government promoted greater efficiency in the use of electrical appliances during the supply crises of 1981/2, and followed it up with more systematic programmes aimed to change the behaviour of appliance purchasers and, ultimately, the design of appliances. However, it failed to integrate these policies with its management of the supply elements of the electricity system. Indeed, the government was publicly criticised for its pains by the generation and distribution organisations, who initially perceived the more efficient delivery of electrical energy services as a threat to their own expansion.

State governments had intervened on occasion to achieve objectives beyond the scope of the organisational structures of the time, but failed to establish a permanent, dominant focus for electricity policy and planning. The nearest approach was the EnANSW, established and progressively strengthened by the Labor government of 1976-88, but its ability to co-ordinate the entire system from generation to utilisation remained incomplete as long as the government allowed the various elements to retain conflicting objectives and sufficient autonomy to undermine or distort central policy.[6]

The divisions between forms of energy and forms of ownership were no less artificial than the functional distinctions within the electricity system. Electricity was only one component of an energy system in which gas and other fuels were equally capable of supplying most types of demand. During most of the century long process of electrification, local and state government had much less involvement with the gas supply system than with electricity. One reason was that most of the gas system was owned by private investors, because gas technology developed during a period which favoured private capital rather than public ownership of utilities. A second reason was that from the 1930s to the 1970s gas was eclipsed by electricity in almost every NSW energy market, and governments understandably showed more interest in a growing rather than a declining energy form. The different forms of energy moved closer together in the 1970s and 1980s. Natural gas replaced electricity as the more desirable energy form in a number of energy markets, including those where electricity had previously displaced coal gas. State governments began to show renewed interest in ensuring that the benefits of gas were equitably distributed, and in co-ordinating gas and electricity development to increase the efficiency of the entire reticulated energy system.

In the process it became apparent that the differences of private and public ownership were not necessarily bars to co-ordination, and in fact were rather less rigid than had come to be accepted. The Gas Act 1986 gave the state government almost as much control over the profitability, pricing and technical standards of private gas companies as over the publicly owned electricity system. Conversely, the need for direct public ownership of the electricity system was seriously called into question in the mid 1980s, for the first time since the nationalisation of the ELPSC in 1956.[7] Government could not abrogate the functions of electricity co-ordination and policy-making, but there appeared to be no compelling reasons why the individual elements of the electricity system need be publicly owned. Whether or not governments were aware that electrification was moving to a new stage in the 1980s, there was a reassessment of the political framework of electricity supply which had served Sydney and NSW tolerably well since 1950.

In the 1980s the energy technology of advanced economies was moving into a new phase. Just as the centralised electro-technology of the grid had thrived in NSW under centralised political control (however imperfect) it was likely that the new, more flexible and open energy technologies would also take root in what was by the 1980s a national Australian energy system. It was also likely that the political framework of the previous technology was no longer appropriate, and that it was on the point of evolving towards greater government co-ordination of policy on the one hand and progressive withdrawal from the direct provision of services on the other.

Despite its absorption into the national grid, the Sydney energy system still retained a distinct indentity, reflecting the economic and spatial structure of the city, the disposition and relationship of its energy markets and energy supply grids, and the particular history of its electrification. These created unique opportunities for a more complete integration of the Sydney urban energy system than even electricity had achieved: a balance of reticulated and renewable energy forms, communications systems, land use and built forms to supply the city with energy services in the era beyond electrification.