THE ENERGY CRISIS AND MANUFACTURING OUTPUT AND EMPLOYMENT:

a Case Study of Tasmanian Manufacturing
in the Context of Australian Manufacturing.

by

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PREFACE

This thesis provides the first detailed analysis of the relation between trends in energy use, employment and output in the Tasmanian economy. It is based on the major energy using sector of the Tasmanian economy, manufacturing. This approach has reduced the complexity of this type of analysis, but even despite this simplification, there still remained a large number of difficulties. This is one of the few analyses of this type carried out to date, and the first in Tasmania, so there was no straightforward direction to follow and certainly no blueprint for the results from a study of this type. Interest in energy related matters has only developed recently and there is an extreme shortage of official data on energy. A large amount of effort was required to develop a suitable data base for the thesis. These difficulties have meant that, while the recommended length for theses produced for the Master of Environmental Studies is 50 pages, it has been necessary to exceed this length in order to present a unified analysis of this topic.

I would like to thank my supervisors, Dr. Richard Jones and Dr. Peter Wilde, for the work that they have put into helping me and guiding the direction of the thesis. I would also like to thank Dr. John Todd and Dr. Aynsley Kellow for their valuable suggestions and ideas, my father and mother for their suggestions and support, Dr. Helen Turner for her invaluable contribution, Lyn Wilson for her highly accurate and fast keyboard work, most of all my co-students at Environmental Studies for their contribution to a stimulating and supportive working environment, the Federal Government for its financial support, the numerous institutions which have supported this study and finally all those people who have had to put up with me discussing "Jobs, Energy and Output in Tasmanian manufacturing"..."Huh? That's a controversial subject. Isn't it?..."

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ABSTRACT

In the past, Tasmania was seen as having enormous, possibly unlimited supplies of hydro-electrical power. This view combined with appreciation of Tasmania's difficult economic circumstances to lend support to development of energy intensive industries, such as the COMALCO aluminium smelter at Bell Bay. This pattern of industrial development, which also relied on the initial processing of Tasmanian resources, has been described as 'hydro-industrialisation'. Over the 1970s Tasmania has shared the worldwide development of problems with energy supply, which have centred around the 1973 OPEC oil price increases and embargo. Tasmania has also developed problems surrounding its major indigenous fuel hydro-electricity. These issues have combined to produce a new energy supply situation for Tasmania; one that is marked by shortage, not abundance. The energy supply questions have arisen at the same time as pressing unemployment problems and slowing of economic growth. Since one of the major thrusts of Tasmanian economic development has been energy intensive manufacturing industry, this thesis examines the response of manufacturing to this new energy supply situation, to see how Tasmanian manufacturing energy use, employment and output have been affected. It goes on to look at changes in manufacturing production and the structure of manufacturing, in terms of three ratios: energy use to output, energy use to employment and employment to output. This examination shows the likely implications of trends in manufacturing, and manufacturing structure coming from the changed energy supply situation. The analysis shows that trends in Tasmanian manufacturing energy use, energy intensity, production process and structure are largely a continuation of past trends. They have not shown a strong response to changes in energy supply over the 1970s. Continuation of these trends is likely to have important social implications for the stability of economic growth and employment in Tasmania, as well as being significant for future energy policy.

CHAPTER 1 - The Production, Employment and Energy Problem

When the Organisation of Petroleum Exporting Countries (OPEC) introduced large price increases and supported this with an oil embargo in 1973, the world became much more aware of energy as an issue. A major concern was the economic effect of the oil price increases and embargo. This concern directly related to the effects on economic growth and employment. Fears of the dire effects of the oil embargo were worst in the United States, which has the highest level of per capita energy use in the world. In the United States the oil embargo set off a flurry of studies aimed at determining the economic effects of the oil embargo (Commoner 1976; Eckstein and Heiem 1978; Grossman and Daneker 1977; United States, Energy Information Administration 1978; United States, Federal Energy Administration 1975; United States, General Accounting Office, Energy and Minerals Division 1979).

The changes that occurred in the oil market in 1973 have affected Australia and Tasmania differently to the United States. Australia's domestic supplies of energy, particularly oil and coal, have largely insulated it from events occurring in overseas energy markets. These Australian domestic supplies of energy have meant that Australia has not had the same experience of the 'energy crisis' as the rest of the world, but not that there has been no change in Australia's energy supply situation.

Australia has been affected by changes in overseas energy markets in two ways: through awareness of energy as an issue, especially as it relates to large economies such as the United States, and through energy price changes occurring in Australia. However, there have also been domestic energy issues which have affected Australia separately. These domestic issues include the debate over the construction of further hydro-electric dams in Tasmania, shortages of electricity, particularly in New South Wales, the development of the 'resources boom' (with its associated energy intensive mineral processing), and the debate over the mining and export of uranium. All four of these Australian energy issues have been associated with questions of employment and economic development. Further, while they are domestic Australian issues, or even indigenous to particular regions of Australia, they nevertheless have much in common with the energy related issues that have developed overseas. In summary, Australia has not had the same experience of energy issues over the 1970s, but it has had its own domestic energy issues which have a number of parallels with overseas experience.

This investigation of the economic effects of energy supply changes will begin with an outline of the importance of each of the three issues, energy, employment and output, separately, and then go on to examine the relation between energy use and, employment and output, using Tasmania as a case study, so as to provide a basis for the analysis carried out in this thesis.

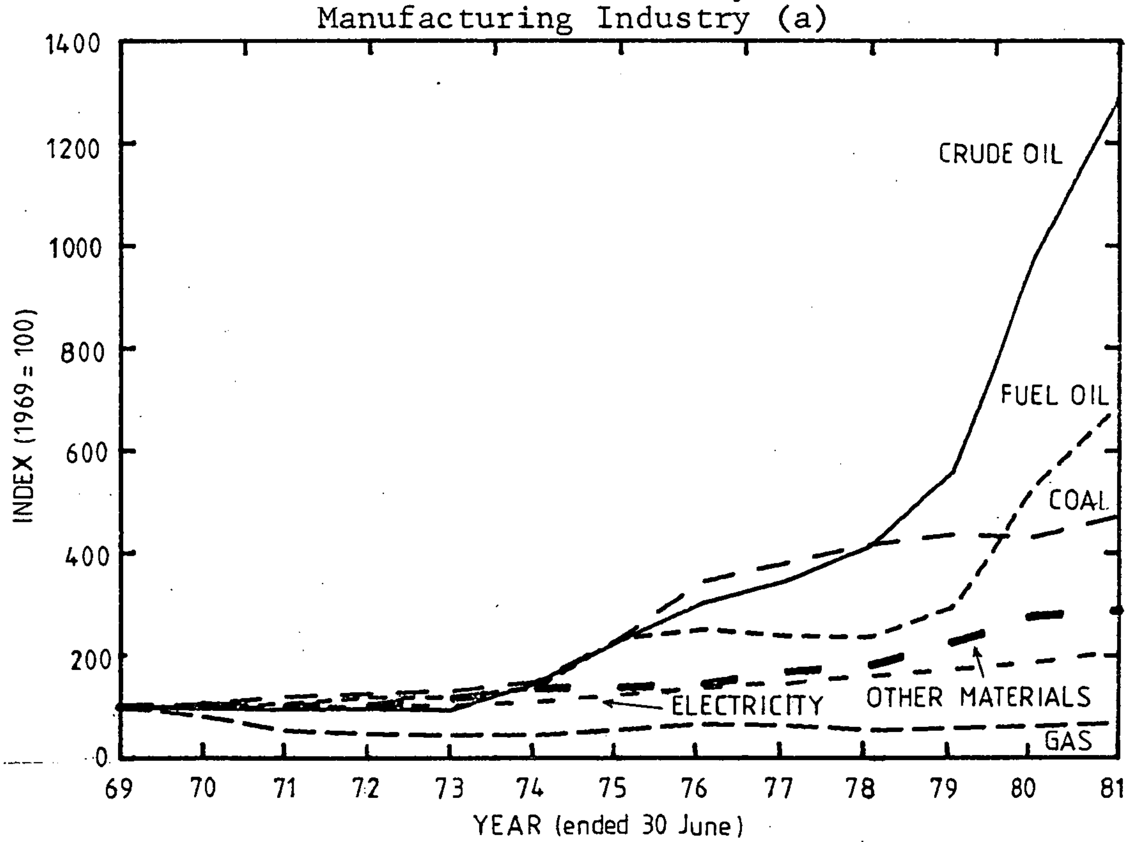
1.1 Energy Use

The most prominent aspects of the 'energy crisis' have been oil price increases and shortages of oil. These two aspects were particularly surprising for the United States and Europe. In Australia, these two aspects did not have the same impact until the introduction of world parity oil pricing by the Federal Government in the 1978 Budget.

Three periods can be identified with respect to Australia's energy situation during the 1970s and these are exemplified by the graph of energy price indexes for fuels used by Manufacturing Industry shown in Figure 1.1. The first period was between 1969 and 1974, when there was little change in

FIGURE 1.1

Price Indexes of Fuels Used by Australian Manufacturing Industry (a)



(a) Australia Bureau of Statistics; Price Index of Materials Used by Manufacturing Industry; unpublished components.

energy prices. The second period started in 1974, with the introduction of large oil price increases by OPEC. In Australia there were only comparatively small energy price increases during this period resulting from oil price increases being transferred to other fuels because of fuel substitutability, and the then Labor Government's limited world parity oil pricing policy. The introduction of full world parity oil pricing in 1978 by the Fraser Government marked the beginning of the third period. This period was characterised by much more steeply rising prices for petroleum fuels including fuel oil and crude oil.

These three periods have had a strong impact in Australia, and the large increases in oil prices give the impression that there has been a strong increase in all fuel prices. Figure 1.1 shows that, with regard to manufacturing industry in Australia, this is not the case . The graph of the price index for non-fuel material inputs to manufacturing in Figure 1.1, provides a measure of the general rate of inflation for manufacturing inputs. This graph can be used as a dividing line between fuels with real price increases and real price decreases. Two fuels are below this line, electricity and natural gas. Both these fuels have had falling real prices during the 1970s. The price of natural gas has even fallen in absolute terms despite the inflationary environment. While Australia has had increases in some energy prices, particularly oil prices, these increases have come later than for the rest of the world. They have not been as large and they have not affected all fuels.

Data limitations prevent the separation of different price changes occurring in Tasmanian manufacturing. However it is likely that price changes in Tasmania have been of a similar order and timing to those in Australia as a whole. One important difference for Tasmania is that it does not have access to the large supplies of natural gas available on the mainland. Therefore manufacturing industry in Tasmania was faced with strongly increasing prices for petroleum products, a smaller but still significant rate of increase in the price of coal and only one fuel with a declining real price, electricity. Thus Tasmania is likely to share most of the energy price changes occurring in Australia. However these changes have occurred later in Australia and Tasmania than they did elsewhere. Tasmania also shares some of the insecurity of uncertain supplies of petroleum products, but it is insulated from the full effect by Australia's high level of self sufficiency. Insecurity is likely to increase as Australia's self sufficiency declines in the 1990s.

It is more difficult to generalise about the events relating to electricity supply occurring during the 1970s. There have been a range of environmental, social and political issues affecting the supply of electricity around the world. These include controversy about the safety of nuclear electricity plants, the increased capital intensity of electricity supply, pollution problems, the expense of running oil fired plants and controversy over the damming of further rivers in predominantly hydro grids, not to mention black-outs and brown-outs.

In Tasmania the most important issues related to electricity supply has been the level of public opposition to development of further hydro-electric power resources in South West Tasmania, which has been coupled with a growing concern about the cost of further hydro-electric development. Public concern over the construction of further dams has developed as a greater proportion of the State's hydro-electric resources are used up, resulting in new developments being forced into more inaccessible locations. These locations are mostly in wilderness areas. As more wilderness is threatened by power and other developments (such as Forestry programs) more Tasmanians have become aware of the significance of wilderness. The most recent debate over the building of the Lower Gordon Power Scheme has been intense and divisive. The intensity of debate has increased since the debate over the flooding of Lake Pedder to the point where this issue contributed to the fall of the Labor Government in 1982.

The debate over the construction of further dams has arisen as the unused proportion of the State's potential hydro capacity has been reduced. The state has now used about 65% of its potential hydro-generating capacity (Tasmania, Hydro-electric Commission 1979), and is facing a shortage of hydro-electric power. It is important to distinguish between hydro-electric energy and hydro-electric power in this context. The existing hydro-electric dams in Tasmania will continue to provide renewable energy for a considerable period. However, the amount of energy that can be generated in a year, that is the State's hydro-electric power resources, is limited by rainfall in the dam catchments. With 65% of the State's potential hydro power resources used up and increasing public opposition to the building of further dams, Tasmania is now facing a shortage of hydro <u>power</u>.

This situation of hydro power shortage is in marked contrast to earlier views of Tasmania's power resources. In 1937 the Tasmanian Government regarded these resources as virtually, if not actually, unlimited, as shown by the following quote from the section of <u>Tasmania - Jewel of the Commonwealth</u> on Hydro-electric Development.

> The water power resources of the State are of such magnitude that complete utilisation by way of ordinary commercial and domestic requirements is not possible of attainment, but there is no doubt that this state with its cheap power will as the years pass, attract more industries which will bring in their train population and prosperity. (MacLean 1937)

While Tasmania may have been seen as a place with plentiful power resources in the past, now its power generation capacity is recognised as being quite small. The power demand of industries now being constructed elsewhere is much larger than Tasmania's generating capacity. For instance, new additions to mainland grids are the size of the whole Tasmanian grid. The Eraring power station in New South Wales is rated at more than 1 GW average, and the Loy Yang power station in Victoria is rated at about 2.5 GW average (Australia, Department of Industry and Commerce 1981), whereas the whole Tasmanian hydro-grid, including the Pieman, is only rated at 1.087 GW average (Tasmania, Hydro-electric Commission 1979).

During the 1970s the Tasmanian energy supply situation has undergone some significant changes. Oil prices have increased dramatically and supplies have become more uncertain. Tasmania is facing power shortages in its major indigenous fuel, hydro-electricity. Both these developments have overseas parallels but the Tasmanian situation is significantly different. Oil price increases have occurred later and the electricity situation has a number of unique elements. These changes are strikingly demonstrated by the comparison of the Tasmanian Government's view of the State's power situation in 1937 with that existing today. Just as overseas developments have prompted concern over the economic consequences of energy developments so in Tasmania it is necessary to investigate the economic effects of the changes in the energy supply situation that have occurred during the 1970s.

Tasmanian manufacturing industry takes on a special significance with respect to Tasmania's changing energy situation. Tasmanian manufacturing uses nearly 40% of Tasmania's energy and over 60% of its electricity. Since Tasmanian manufacturing is so heavily dependent on energy it provides a good starting point for an examination of the effects of the above changes. Studies of the economic effects of energy use have usually looked at the relation between energy use and, growth and employment over a whole economy. Selecting out the major energy user, manufacturing, means that a large number of other influences on employment or growth, apart from energy use, will have been eliminated by the exclusion of industries which are not significant energy users. This is not to pre-judge the significance of the relation between energy use and employment or growth, but merely to select the place where the relation is likely to be most direct.

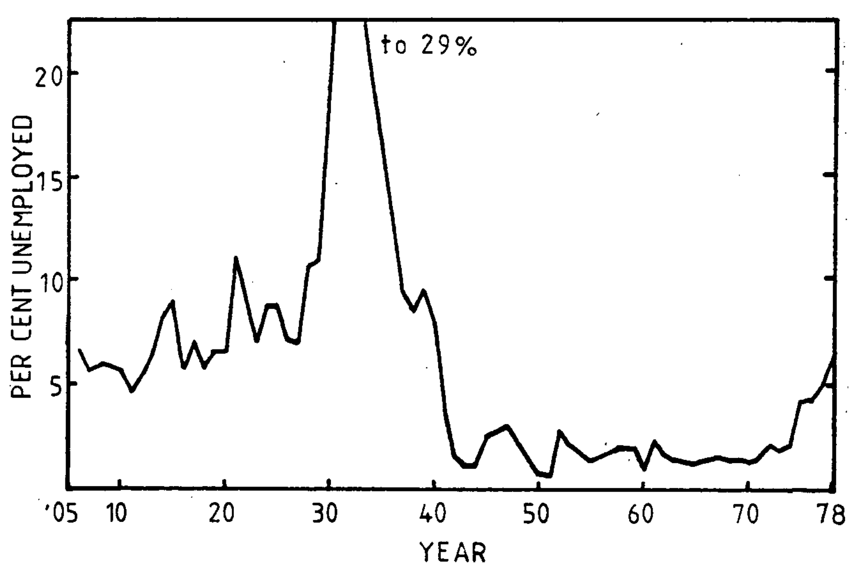
Because of the special significance of electricity in Tasmania, electricity will be studied as a separate component of energy use in this thesis. In order to do this, energy use will be split into two parts: non-electric energy use and electricity consumption. Although electrical power is of major concern in Tasmania, electrical energy use rather than electrical power use by Tasmanian manufacturing will be the subject of this thesis. However, these two characteristics are closely related in Tasmanian manufacturing. Ninety five percent of electricity used by manufacturing is purchased under bulk contracts on a take or pay basis. The electricity consumed under these contracts is used 24 hours per day, 365 days per year. Thus energy consumption could not be increased very much without increasing power consumption. Thus, for Tasmanian manufacturing, changes in electrical energy use are closely related to changes in electrical power use.

1.2 Employment

Unemployment has grown around the world over the 1970s. In a number of countries it has grown to its highest levels since the Great Depression. Australia has shared this world wide trend of increased unemployment. The graph of unemployment in Australia in Figure 1.2 shows that between 1942 and 1974, unemployment in Australia remained at its lowest level for this century. Prior to the Great Depression unemployment ranged between 5% and 10%. However, by 1978 unemployment had once again risen to these pre-depression levels.

FIGURE 1.2

Unemployment in Australia, 1906 to 1978 (a)



(a) WINDSCHUTTLE, K., 1980; Unemployment: a social and political analysis of the economic crisis in Australia, Revised Edition; Penguin Books Australia, Ringwood, Victoria.

In Tasmania the problem of unemployment is even worse. Over the 1970s Tasmania has often had the highest level of unemployment of all the Australian states (ABS annual b). Further, there are a number of problems with the official statistics measuring unemployment, particularly with the definition of unemployment. These problems, combined with the desire of Governments to play down the level of unemployment, mean that official estimates understate the problem (Windschuttle 1980). The official statistics exclude people who have left the labour force because they are discouraged in their search for work. The survey used for measuring unemployment is designed to accurately sample the whole Australian population. So it may miss the unemployed because of their special characteristics, such as high mobility and poverty. Further, since these statistics cover broad regions they hide the local severity of unemployment, and since Tasmania often has the highest level of unemployment, regional unemployment could be expected to be worse in Tasmania.

It is difficult to overstate the significance of having a job. Windschuttle (1980) has defined the role of employment in both a social and a personal sense. He argues that not only does work define

> people's status, their incomes, [and] their personal identity [but,] ... in modern Australia the workplace is the central defining institution of society.

For a majority of people in Tasmania, as in most other societies, having a job is of overriding importance. The definition of unemployment used by the Australian Bureau of Statistics (ABS), a person seeking work in the four weeks prior to the survey (ABS 1982), implies that most, if not all, persons categorised as unemployed, have been excluded from work against their wishes. Further, this measure excludes people not covered by this definition but who still want a job, and this group may be as large as the 'official' unemployed (Windschuttle 1980).

The issue of employment has been tied to that of power development during the current debate over future power development. Many proponents of construction of the Gordon below Franklin dam have claimed that there is a vital link between employment and the provision of more energy. This link could exist on two levels. First, there is the employment necessary for the construction of dams, estimates of which are included in the Hydro-electric Commission's Report on the Gordon River Power Development Stage II (Tasmania, Hydro-electric Commission 1979). However, an analysis of this link by Davies, Jablonska and McCuaig (1981) shows that the Hydro-electric Commission construction workforce has declined by over 1000 jobs between 1968-69 and 1977-78 and is characterised by an annual turnover rate of up to 64% per annum.

The second link is more indirect, but potentially more important. It is the general relation between energy use and employment in the economy. This link is often used as a basis for making the claim that increased job opportunities depend upon increased energy supplies, and in the Tasmanian case, the claim relates to electricity in particular. Related to this claim is the common concern that if development is limited in order to preserve aspects of the environment, for instance by the cessation of dam construction, the employment consequences will be disastrous. This second link will form part of the basis for the following analysis of the relation between energy use and employment in manufacturing.

1.3 Output

Economic growth has traditionally been a major concern around the world. Especially in developed countries the rate of growth has provided an index of the health of the economy. Economic growth has been seen as the basis for a wide range of social benefits, not the least of which is that, in a growing economy, it is not necessary for one person to be made worse off in order for another person's income to increase. Indeed it is possible for everyone's income to increase at the same time. Further, if increases in the workforce are not to result in unemployment, more jobs need to be created through economic growth. Hence any threats to the rate of economic growth have been seen as posing a threat to people's welfare, and possibly to social structure. In this context any threat to energy supplies has traditionally been seen as limiting the rate of economic growth, with potentially dire consequences.

The above traditional view of economic growth has come under considerable criticism as being a shortsighted view of the wellbeing of either individuals or society as a whole. Economic growth has usually been measured as the rate of growth of gross national product (GNP). Using GNP as a measure of human wellbeing is overly materialistic. People rely on a certain level of material consumption, but to use GNP as the most important measure of human welfare denies all the other aspects of human existence. GNP is limited even as a measure of material wellbeing since it excludes such activities as unpaid domestic work and do it yourself activities. Further, because GNP is a monetary measure it does not provide an adequate valuation of either material or non-material items. For instance it does not distinguish between use value and exchange value, nor can it be expected to adequately value items beyond the market, such as wilderness. These criticisms of GNP as a measure of human welfare mean that it must be used with great caution. A simple equation between the rate of economic growth and the development of human wellbeing does not exist.

Given this caution GNP does provide a measure of a society's material welfare. It is therefore interesting to investigate the impact of changes in the energy situation that have occurred over the 1970s on GNP. As was the case for employment, the relation between energy use and GNP is likely to be most direct in those industries which are heavily dependent on energy. Therefore manufacturing is also a good starting point for analysis of the relation between energy use and output. The simplicity of the Tasmanian economy, compared to larger economies, means that Tasmanian manufacturing is particularly interesting. Despite these two simplifying factors, the situation is complicated by Tasmanian economy's strong overseas connections and its status as a peripheral economy (Wilde 1980), since outside forces may have a large impact on Tasmanian manufacturing. For instance, such influences as decisions made in interstate and overseas head offices, and Tasmanian firms competing on world markets, may have a stronger influence on Tasmanian employment and output levels than energy supply changes.

In order to make an analysis of the relation between energy use and output with respect to manufacturing it is necessary to select out its share of GNP. An industry's contribution to national output is defined as the amount it adds to the value of its products, that is value added. Value added is the difference between the value of sales by an industry and the value of its material inputs. If output was measured by simply summing the sales of all industries in the economy, the value of sales between industries would be double counted. Because inter-industry sales are used as the input for an industry, their value is included in the value of total sales by the purchasing industry. Thus, simply adding up the total sales of all industries overstates the economy's production. Using value added as a measure of an industry's output overcomes this problem because it is the value of sales of the industry less the value of materials used by that industry.

The result of the subtraction process used to derive value added is that value added consists of a mixed bundle of the various costs of production. It includes such items as depreciation, workers compensation insurance, other insurance, pay-roll tax, income tax, rates, advertising, interest on borrowed funds, bad debts, wages, salaries and profits (ABS annual a). Thus value added measures not only the contribution of a firm or industry to total production but also the economic return of an industry to Tasmanians and others in terms of wages, salaries and profits, amongst other items.

Apart from its social importance, ouput has an important theoretical role in analysing the production process. This role is more complex than the roles of energy use or employment. Output is the end result of the production process, so it is related to all other aspects of the process. Standard economic theory recognises this importance by stating that the level of demand for each input to the production process is directly related to the level of demand for output. However, standard economic theory is highly abstract because of the strength of its simplifying assumptions. So it is unlikely that, in practice, the relation between inputs to the manufacturing process and output is as strong as this theory suggests. Nevertheless, the fact that producing output is the physical result of production means that output must be considered not only by itself or in relation to the other parts of the production process, but also in looking at the relation between other aspects of production. For instance, the role of output should be considered when analysing the relation between energy use and employment.

1.4 The Interaction of Energy Use, Employment and Output in the Manufacturing Process

Problems exist in relation to energy use, employment and economic growth. The problems in all three seem to have become worse during the 1970s all around the world. In Tasmania, the world wide influences have been added to by particular circumstances surrounding electricity supply. This thesis will investigate the interaction of energy use, employment and output by looking at the effect that the changing energy supply situation has had on employment and output in Tasmania. While the changes occurring in energy supply over the 1970s have been spectacular, there are a number of different influences on output and employment. An integrated investigation of energy use, employment and output needs to be made in the light of these influences.

1.4.1 Structural Change

Western economies have shared trends of change in the structure of employment over the 20th century. This changed structure has meant a declining proportion of employment in rural and manufacturing industries, which has been accompanied by increasing emphasis on employment in service industries. However, more recently the proportional decline in rural and manufacturing employment has become an absolute decline.

In Tasmania rural employment has declined from 38% of total employment in 1901 to 8% in 1976 according to the Population Census (Table 1.1). The share of employment by manufacturing has declined from 26% to 17% over the same period. While there have been times of high unemployment during this period of structural change (notably during the Great Depression and recently) unemployment declined to its lowest level of the century between the early 1940s and early 1970s, despite the continuing structural change. However, the late 1970s have brought increased levels of unemployment (Figure 1.2). The decline of employment in rural and manufacturing industries has not consistently led to high unemployment because of increased employment in service industries.

TABLE 1.1

Industrial Employment Shares (a)

Tasmania

Year		Rural Employment	%	Manufacturing Employment	%	Total Employment
1901	*	27 899	38.4	18 750	25.8	72 586
1911	*	31 027	40.8	17 268	22.7	75 969
1921	*	29 863	35.6	22 550	26.9	83 775
1933	*	25 466	28.8	16 013	18.1	88 337
1933		26 832	26.2	21 531	21.0	102 576
1947		21 785	21.7	20 595	20.5	100 318
1954		18 780	20.0	21 871	23.3	93 976
1961		17 157	13.1	29 531	22.6	130 918
1966		17 215	11.7	33 959	23.1	147 323
1971		13 772	9.2	31 532	21.0	150 215
1976		12 717	7.8	27 670	16.9	163 945

Australia

Year	Rural Employment	%	Manufacturing Employment	%	Total Employment
1901	397 407	24.3	431 103	26.4	1 635 985
1911	463 783	23.0	556 008	27.6	2 013 375
1921	511 635	21.8	717 806	30.5	2 349 661
1933	573 920	18.2	866 171	27.4	3 155 621
1947	498 019	15.6	799 215	25.0	3 196 431
1954	493 298	13.3	1 027 331	27.8	3 702 022
1961	458 885	10.9	1 140 335	27.0	4 225 096
1966	456 651	9.4	1 312 125	27.0	4 856 455
1971	386 407	8.8	1 215 618	23.2	5 240 414
1976	404 579	7.0	1 138 531	19.7	5 788 169

* Based on occupation rather than industry classification.

(a) Australian Bureau of Statistics, Population Census.

1.4.2 Macro-economic Policy

Both Australian and Tasmanian manufacturing are influenced by general changes in economic policy. The election of the Fraser Government in 1975 saw a major change in the stated aims of Australian macro-economic policy. The Fraser Government's stated aim, of fighting inflation first, was reiterated in the 1981-82 Federal Budget by the Treasurer, the Honourable John Howard.

> We have therefore opted for a Budget which gives priority to containing and reducing inflation and sustaining private sector growth.

Later in the Budget Speech, Mr. Howard stated that

> The tighter policy framework which is now essential for containing inflationary pressures does of course carry some implications in the short term for activity and employment.

While the stated aims of the Fraser government are quite clear, it has not not been able to directly translate these aims into economic policy. During its period of office, the domestic budget deficit has mostly been around $2 billion, and the growth in the money supply has been 11% or more in all years except 1977-78 (Commonwealth Budget Statement No. 2 - The Budget and the Economy).

The Fraser Government's attack on inflation has only been partially successful. Over its period of office inflation has been lower than it was prior to this, but it has not declined to the levels of the 1960s. Annual increases in the Consumer Price Index (excluding food and petrol) have not been lower than 7.6%, and in the Implicit Price Deflator for Private Final Consumption Expenditure the increases have not been lower than 9%. While the Fraser Government's attempts to reduce inflation have not been very successful, its policies have been one of the factors contributing to a contractionary economic environment for Australian and Tasmanian manufacturing over the second half of the 1970s.

1.4.3 Labour Productivity

According to the Manufacturing Census, manufacturing employment declined in absolute as well as relative terms over the 1970s, but this decline has not been matched by a decline in output by manufacturing industry (Table 1.2). In other words manufacturing output per job has been increasing. Output per job can only be increased by increasing the number of hours worked per job, or by increasing productivity per worker. The decline in average hours worked by males in Australian manufacturing from 44.1 hours per week in 1969 to 41.3 hours in 1980 (ABS annual c) implies that there has been an increase in labour productivity.

There are two ways in which an increase in labour productivity can be achieved. Firstly, the method of work organisation can be changed so production is more efficient. Secondly, technological change, through the introduction of new machinery, may allow fewer workers to produce a given amount of output. Intuitively, it may seem that introduction of new machinery to increase the amount of output produced per worker also implies an increase in the amount of energy used in the process. That is, human effort is replaced by inanimate energy. However, it may be that the new machinery is more efficient in its use of both energy and labour. There is no reason to assume that more energy is used. For instance, machinery based on microelectronics may allow for reduction in the use of labour, materials and energy. The concept of technological change having a range of impacts on the use of labour and materials was developed by Hicks (1965). Technological changes may be described as 'Hicks neutral' if they do not affect the ratios in which the process uses labour and material inputs.

TABLE 1.2

Manufacturing Employment and Value Added

Year	Employment '000	% Change	Value Added 1978$M	% Change
		Tasmania (a)		
1969	31.0	-	422	-
1980	26.2	-15	508	+20
		Australia (b)		
1969	1264.0	-	15 982	-
1980	1154.2	-9	19 920	+25

(a) Australian Bureau of Statistics; Census of Manufacturing Establishments Details of Operations and small area statistics Tasmania, Catalogue No. 8202.6; Australian Bureau of Statistics, Tasmania.
(b) Australian Bureau of Statistics; Manufacturing Establishments Details of Operations by Industry Class Australia, Catalogue No. 8203.0; Australian Bureau of Statistics, Canberra;

A number of authors have generalised from the overall trends in energy use and employment to suggest that technological change has consistently increased output per worker by substituting energy for labour. Fremont (1976) represents one viewpoint when he suggests that increased electricity use supports increased labour productivity. This view is not supported with detailed consideration of the multitude of industrial processes involved. Indeed there is not even any consideration of case studies of the effect of technological change on the ratio of energy use to employment. Thus this view is an unsound attempt to generalise from overall changes in the ratio of energy use to employment to a wide variety of specific industrial processes.

Another view is represented by Grossman and Daneker (1977). This view is that industry has substituted energy use for human labour to increase labour productivity, which in turn has had the effect of reducing industry's demand for labour. While these authors do not provide a detailed analysis of the effect of technological change on the ratio of energy use to jobs either, their argument is not dependent on this level of detail since it relies on changes in the overall ratio, and does not generalise this to individual industrial processes, or predict future changes in the ratio.

The effect of technological change on various aspects of manufacturing processes, such as employment, is particularly complex, as even a brief examination of the Myers Report on Technological Change shows (Australia, Committee of Inquiry into Technological Change in Australia 1980). Without detailed consideration of the manufacturing processes involved, generalisations about the effect of technological change on the ratio between employment and energy use must remain generalisations. Even with the large amount of work that has been put into investigating the effect of technological change on employment, it is not possible to make reliable generalisations about its effect in specific circumstances. Thus, in view of the small amount of work that has so far been put into investigating the role of energy use in industry it will not be possible to go further than discussing the overall trends in the ratio of energy use to employment, in this thesis.

1.4.4 Integration of Energy Use, Employment and Output

The above discussion provides a brief description of the way that employment and output interact in the production process. This picture of their interaction has been developed over a considerable period. However the role of energy use in the production process is not so well understood because interest in investigating energy related matters has only developed recently. Some studies have been carried out that look at the interaction of energy use with other aspects of the production process over the whole economy (Berndt 1977; Darmstadter, Teitelbaum and Polach 1971; Darmstadter, Dunkerley and Alterman 1977; Fremont 1976; Hudson and Jorgenson 1978; Linden 1976; Starr and Field 1979; Winger 1976), but these studies do not investigate the detailed level of interaction.

It is important to investigate the detailed level of interaction because of the wide variety of ways in which energy is used. This is especially important in the case of industry, where there is a large range of processes. The overall pattern of energy use by industry will be influenced by the combination of processes that constitute industrial structure. The combination of processes will be much more important in industry than in households, for example, because of the much smaller range of energy uses by households.

One group of authors has investigated the relation of energy use to the production process at a more detailed level (Andrews 1979; Commoner 1976; Grossman and Daneker 1977). Commoner began the investigation by analysing the way that the three crises of energy, employment and the economy were related in the United States. He argued that solutions to any one of the problems often appeared to aggravate the other problems, so that it was only by integrated study of all three that any acceptable solution could be found. Part of his investigation looked at the 'efficiency' with which various resources were used in the production process. Specifically he looked at the ratios of energy use, employment and capital stock to output. He found that in the United States economy there has been a trend towards increasingly energy and capital intensive production, and away from labour intensive production. These trends made unemployment worse and contributed to increased dependence on energy and thus on foreign oil supplies.

Grossman and Daneker (1977) carried on from Commoner, and looked at the structure of energy use in the production process as a basis for developing an alternative strategy for industrial development. Both Grossman and Daneker, and Commoner, saw major problems with supply of the energy necessary for continuation of the past trends of industrial development. Further, they argued that continuation of these trends would only make problems with the economy and employment worse. Their strategy involved the development of low energy intensity industries, supplied from renewable energy resources. Andrews (1979) has made a similar argument for Victoria. The unique features of Tasmania's energy supply situation and its industry mean that it is important to make a similar detailed analysis of energy use by Tasmanian manufacturing. This analysis should now be made to see how Tasmanian manufacturing energy use has been affected by the changes in energy supply over the 1970s, and how this relates to Tasmania's problems with growth and employment.

1.5 Conclusion

The aim of this thesis is to investigate the way that energy use interacts with employment and output. This investigation will be particularly concerned with the way that changes in the energy supply situation have influenced manufacturing employment and output over the 1970s. It will look at the response of Tasmanian manufacturing to these changes. While the changes in the energy supply situation over the 1970s have been particularly dramatic, there may not have been a strong connection between these changes and those in employment and output. Changes in employment and output must also be seen in the light of historical trends. While this analysis will concentrate on the response of manufacturing to the changes in energy supply, it will also shed some light on the potential policy freedom in Tasmania. For instance, it will show whether increased electricity supply has effectively contributed to job creation in manufacturing industry over the 1970s.

This type of investigation into the interaction of energy use, employment and output has rarely been undertaken anywhere in the world. It has never been attempted in Tasmania. This means that there is little precedent for undertaking a study of this type. It also means that there is little suitable information on which to base a study of this type. Therefore a major part of this thesis is devoted to developing a suitable data base. The procedure for developing this data base is described in some detail in the next chapter.

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Chapter 2 - A Data Base for Manufacturing Energy Use, Employment and Output

Manufacturing industry is one of the better described sectors of the Australian economy. The Australian Bureau of Statistics' Manufacturing Census provides regular and comprehensive information about manufacturing, including data on employment and value added. The Manufacturing Census also provides some data on energy use. Another source of information on manufacturing energy use is the Department of National Development and Energy (DNDE) survey of energy use. However, neither source of energy use data is particularly suitable for this integrated study. This chapter will describe four aspects of the data: which information sources are available, the way that these have been developed for this study, the problems that exist with this data and the implications of these problems for the use of the data. Data for the three areas, energy use, employment and output, will be discussed separately, and since obtaining data on employment and value added is more straighforward, these two will be discussed first, followed by a more detailed discussion of energy use.

The period covered by this study is largely determined by events occurring in relation to energy use. Manufacturing has been selected as the subject for the study and the major source of information about manufacturing is the Manufacturing Census. This census underwent a major change in 1969 due to the ABS Integration Project, which was aimed at integrating the ABS' collection of economic statistics. The effect of the Integration Project on the Manufacturing Census was to substantially change the basis for the collection, by introducing the the Australian Standard Industrial Classification (ASIC) (ABS 1979). This change makes it difficult to compare information on manufacturing collected before 1969 with that collected after 1969. However, this changeover date coincides with events occurring in the energy supply situation, giving three years of data prior to the 1973 oil embargo (no census was carried out in 1970-71). Thus the period covered by this study is between 1968-69 and 1979-80, the latest available Manufacturing Census.

One issue is particularly important in a study which looks at the relationship between three variables. It is the comparability of the data describing the variables. Measures of employment can differ considerably. For example, Tasmanian manufacturing employment in 1975-76 taken from the Manufacturing Census was 27 753, while that taken from the Population Census was 27 670, even though both measures are produced by the ABS. Thus in studying the relations between energy use, value added and employment it is best to obtain data about each of these from sources which are comparable. In line with this principle the data used in this thesis will largely be taken from one source, the Manufacturing Census, despite some problems with converting this data into a suitable form.

2.1 Employment

Information on employment was taken from the Manufacturing Census for Tasmania and Australia. Manufacturing Census employment is the average for the year and is based on the following definition:

> Working proprietors and employees on payroll, including those working at separately located administrative offices and ancilliary units.

Basically the measure shows the number of jobs provided by manufacturing industry. Use of this measure ignores the nature of the job, that is whether it is full time or part time, filled by a male or a female, has high or low skill levels or where it is located. All these aspects of employment are important, but the scope of this project has not allowed an analysis of the quality of jobs provided by Tasmanian manufacturing industry. It will concentrate on the number of jobs provided.

An analysis based on the number of jobs is important because of the personal and social significance of having a job, and because of the current levels of unemployment. Analysis of the number of jobs available, no matter what their quality, needs to be the starting point for analysis. In this respect the following analysis will differ from an economic analysis of the functioning of manufacturing industry, which would be more likely to investigate measures dealing with the input of labour to the production process. For example this would probably mean measuring labour input in terms of 'man-hours'.

2.2 Output

In this thesis output will be measured using value added. Value added provides a generalised measure of output which can be used across the wide range of manufacturing products. As mentioned in Chapter 1 value added is calculated as the difference between a firm's turnover (plus the change in net stocks) and its purchases of material inputs. Value Added data for this project has been taken from the Manufacturing Census.

As published in the manufacturing census, value added is in current dollars. Since value added is used as a measure of output in this thesis, it needs to be deflated, to allow for the effects of inflation. This will provide a measure of real output. The Price Index of Articles Produced by Manufacturing Industry, produced by the Australian Bureau of Statistics, has been used to deflate both Australian and

Tasmanian manufacturing value added. This is an Australia wide index and so it does not allow for regional differences in inflation. However, components of this index are available which measure price changes for each subdivision as well as the manufacturing division, and so it has been possible to deflate value added for each of these separately. This technique has provided a measure of real manufacturing production in 1978 dollars.

2.3 Energy Use

There are two sources of information about energy use by manufacturing industry: the Australian Bureau of Statistics Manufacturing Census (ABS annual a; ABS annual b) and the DNDE survey of industrial energy use (Australia, Department of National Development and Energy 1980). Both these sources cover manufacturing industry in Australia and Tasmania. They are both based on ASIC but the DNDE Survey has continued to use the 1969 edition rather than transferring to the 1978 edition. Both surveys provide information down to the subdivision or 2-digit level of the classification. (Appendix A provides a brief description of the manufacturing subdivisions of ASIC. Appendices B and C show the relevant tables of information from the DNDE Survey and the Manufacturing Census respectively.)

2.3.1 The Department of National Development and Energy Energy Use Survey

While the DNDE Survey has the advantage that it deals specifically with energy use by manufacturing industry in the energy units required by this study, this advantage is overridden by the following disadvantages. The Survey only provides reliable information from 1973-74 onwards. The survey was carried out in two years previous to this, 1971-72 and 1972-73, but this information is regarded by the Department as less accurate (Ian Walker, Executive Officer, Forecasting and Modelling Section, DNDE, Personal Communication). Electricity use data, from the Survey, is only provided back to 1976-77. The survey divides primary and secondary energy use separately. Practically, this means that electricity use cannnot simply be added to primary fuel use because some primary fuel use (that used for the generation of electricity) will be double counted. If electricity use by manufacturing firms is to be combined with their primary energy use an allowance must be made for self generation of electricity. The extent of self generation by firms is regarded as confidential by the DNDE, and the only estimates that can be made are by taking predicted proportions of purchased electricity to self generated electricity (Australia, Department of National Development and Energy 1981) and applying these proportions to the historical electricity use for each subdivision.

Lack of detail in the DNDE Survey data becomes a large problem with using the survey results for Tasmania. Confidentiality precludes the Department publishing a large number of fuels separately for subdivisions. Also, energy use is published in petajoule units which do not provide sufficient detail for the level of energy use in Tasmanian industry. Changes in energy use in Tasmanian subdivisions are often not reflected by the 1/10th of a petajoule units which are the minimum published from this survey.

The problem of comparability mentioned above exists with using energy use information from this survey. The only source of information about value added and employment in manufacturing industry is the Manufacturing Census, and this data is unlikely to be comparable with energy use data from the DNDE survey for the following reasons. First, the DNDE Survey has not changed to the 1978 edition of ASIC. Second, the Department gathers its information from a survey which covers 85% of primary fuel usage and 60% of electricity generated by public utilities (Australia, Department of National Development and Energy 1980). This subjects its results to sampling errors which are not present in the Manufacturing Census.

2.3.2 Manufacturing Census Energy Use Data

Energy use information from the Manufacturing Census, however, has the advantage that it is comparable with value added and employment. Because it is a census its results are not subject to sampling errors. It covers a longer time span than the DNDE Survey. The Manufacturing Census has a greater level of detail than the DNDE Survey but it still has some problems with confidentiality arising mainly from the small number of firms in some subdivisions in Tasmania.

A disadvantage of using the Manufacturing Census is that fuel usage information is not collected in energy units. For most fuels this does not present a great problem since usage is given in quantity (for example tonnes), but for Electricity and the grouping of Mains Gas and Other Fuels only expenditure information is reported and there are difficulties in converting this expenditure information to energy units. There are some problems with obtaining a continuous series of data from the Manufacturing Census. Since 1976 the census excluded firms employing less than four employees. In 1978 the ASIC was changed with the main effect being that iron ore pelletising was moved from Division C Manufacturing to Division B Mining. In Tasmania this meant the transfer of one firm, Savage River Mines. However, these two changes have not had a very large impact on the subdivision totals.

In conclusion it appears best to take the Manufacturing Census information on energy usage because of its comparability with other data, and only use the DNDE Survey information to fill gaps in the information taken from the Manufacturing Census. A comparison of the two sources shows that they often have different levels and different trends. In Table 2.1 the two sources are compared for manufacturing as a whole and for subdivision 29 Basic Metals as an example. It is beyond the scope of this study to investigate the reasons for this difference between the two sources of data,

TABLE 2.1

Comparison of Manufacturing Energy Use (excluding electricity) as measured by the DNDE Survey and as estimated from the Manufacturing Census

Year	Manufacturing Census PJ	DNDE(a) PJ	Diff. PJ	Subdivision 29 Census PJ	DNDE(a) PJ	Diff. PJ
			TASMANIA			
1968-69	15.051	n.p.	-	3.188	n.p.	-
1969-70	15.055	n.p.	-	3.581	n.p.	-
1970-71	n.p.	n.p.	-	n.p.	n.p.	-
1971-72	15.287	n.p.	-	3.453	n.p.	-
1972-73	15.709	n.p.	-	3.362	n.p.	-
1973-74	16.963	16.5	-0.5	3.480	3.5	0.0
1974-75	15.536	16.0	0.5	2.629	2.9	0.3
1975-76	14.788	15.1	0.3	2.254	2.7	0.4
1976-77	14.797	16.4	1.6	2.605	2.9	0.3
1977-78	12.293	15.6	3.3	0.925	2.9	2.0
1978-79	12.286	16.9	4.6	n.p.	3.4	-
1979-80	16.017	17.4	1.4	1.317	3.7	2.4
			AUSTRALIA			
1968-69	650.1	n.p.	-	380.3	n.p.	-
1969-70	451.7	n.p.	-	179.2	n.p.	-
1970-71	n.p.	n.p.	-	n.p.	n.p.	-
1971-72	386.9	725.5	338.6	128.2	350.1	221.9
1972-73	395.5	820.6	425.1	135.3	432.4	297.0
1973-74	425.7	864.0	438.2	158.9	424.1	265.1
1974-75	407.5	879.2	471.8	159.3	466.6	307.2
1975-76	417.5	865.2	447.7	176.0	436.1	260.2
1976-77	415.9	881.4	465.5	195.1	435.3	240.2
1977-78	368.0	879.9	511.9	177.0	431.7	254.7
1978-79	281.9	886.5	304.6	366.0	452.9	86.8
1979-80	389.1	894.9	505.8	195.4	446.8	251.5

n.p. - not published

(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia: 1960-61 to 1979-80; Department of National Development and Energy, Canberra.

but the difference does underline the difficulty of obtaining reliable data on energy use generally in Australia.

Using the Manufacturing Census as the basis for energy use data means that considerable effort must be put into converting the Census information into an appropriate form. This conversion is particularly difficult for electricity and gas. The following sections provide a description of the method used to convert the published information on each fuel into the appropriate energy use data for this thesis.

2.3.3 Electricity

Only expenditure on electricity is published in the Manufacturing Census (see Appendix C). Converting this money value into an energy quantity is difficult. In principle it is only necessary to divide the value of expenditure by a price to obtain a quantity. However, sales of electricity to manufacturing industry are characterised by secret contracts for large electricity users. Prices on these contracts are not publicly available and are usually substantially lower than published tariffs for other electricity users. Thus while it is necessary to rely on the basic approach of dividing value by price to obtain quantity, more sophistication is necessary if accurate results are to be obtained. Due to the complexity of Australian manufacturing, it has been necessary to take a slightly different approach to estimating electricity use in Tasmania and Australia. The method used for Tasmania is discussed first.

a) Tasmania

The Centre for Environmental Studies has already published estimates of industrial electricity use up to 1974-75 for each Tasmanian manufacturing subdivision in its Working Paper No. 9 Growth and Development of Tasmania's Energy System (Hartley, Jones and Badcock 1979). The method the authors used to estimate electrical energy use is described in their Appendix B.

Their method relied on estimating average prices separately for bulk consumers and for all other industrial consumers (general consumers). The average bulk price was estimated by dividing revenue from bulk electricity sales by quantity of bulk sales, both published in the Hydro-electric Commission (HEC) Annual Report. Four ASIC subdivisions were then selected, where most electricity was estimated to be consumed under bulk contracts. These were 26 Paper, Paper Products, Printing and Publishing, 27 Chemical, Petroleum and Coal Products, 28 Non-Metallic Mineral Products and 29 Basic Metal Products. The total expenditure on electricity by these four subdivisions was divided by the average bulk price to estimate bulk consumption. Then an average general price was estimated by subtracting bulk sales value and quantity from total industrial sales value and quantity published by the Electricity Supply Association of Australia (ESAA) in Statistics of the Electricity Supply Industry in Australia, and then dividing the resulting general value by the general quantity. Expenditure by the remaining subdivisions was divided by this average general price to estimate general consumption. Bulk and general consumption were then added to give total manufacturing electricity consumption.

The problem with this approach was that the estimated bulk quantity was becoming increasingly different from the amount of bulk sales published by the HEC after 1974-75, the latest year of Hartley, Jones and Badcock's published data. An estimate of the difference is shown in Table 2.2. HEC bulk sales are made to mining as well as manufacturing firms, so an allowance must be made for mining electricity use. Hartley, Jones and Badcock assume that 30% of mining electricity expenditure is made under bulk contracts, allowing the calculation of a mining bulk quantity by dividing this expenditure by the bulk price.

The resulting difference between the estimated total bulk sales and actual bulk sales shows that bulk electricity consumption was underestimated, and that the error nearly doubled in 1975-76. The error is the result of poor matching of bulk consumers with the electricity expenditures published in the Manufacturing Census, and of the variation in contract prices between bulk users. Thus it has become necessary to develop a different method of estimating the bulk usage of electricity.

The method used to estimate bulk electricity consumption in this thesis is based on the contract power demand of each bulk user. A table of the contract demand for each bulk user between 1968-69 and 1979-80 has been compiled from information published in H. Raggat (1969), HEC (1978) and HEC (1979), together with information about expansion programs by major companies published in the Tasmanian Year Book (Table 2.3). Each bulk consumer has been classified to its appropriate ASIC subdivision, thus providing an estimate of the contract demand of each ASIC subdivision.

Contract demand is published in MW, a measure of power demand (shown in Table 2.3). In order to convert this power quantity to an energy quantity (shown in Table 2.3) it is first necessary to assume that the contracted power demand is used 24 hours per day for the whole year, which is 8760 hours per year. While this stable energy demand situation is the implied condition of HEC bulk electricity contracts, all bulk consumers do not meet these conditions as shown by the ratio of total bulk sales to total contract demand. The factor derived from this ratio of total bulk sales to total contract demand is shown at the bottom of Table 2.3. This factor has been used to reduce the individual contract

TABLE 2.2

Estimated Bulk Electricity Usage based on Hartley, Jones and Badcock (1979) (a), compared with HEC Bulk Electricity Sales

Bulk Electricity Expenditure estimated from the Mining and Manufacturing Censuses

Year	Bulk Expenditure Subdivisions(b) 26,27,28,29 $'000 1	Mining(c) Total $'000 2	Mining(c) 2 x 0.3 $'000 3	Total Value 1+3 $'000 4	Estimated Quantity 4/8 GWh 5
1974-75	21 753	3372	1012	22 765	3545.950
1975-76	22 028	3858	1157	23 185	3326.399
1976-77	26 236	4283	1285	27 393	3880.028
1977-78	n.p.	5341	1602	-	-
1978-79	n.p.	6322	1897	-	-
1979-80	36 034	6547	1964	37 998	4773.618

Year	HEC Bulk Sales(d) Value $'000 6	HEC Bulk Sales(d) Quantity GWh 7	Price 6/7 c/KWh 8	Estimated from 5 GWh 9	Difference 7-9 GWh 10	Difference 7-9 TJ 11
1974-75	23 382	3639.745	0.642	3545.950	96.0	345.6
1975-76	24 380	3496.551	0.697	3326.399	170.2	612.7
1976-77	28 814	4079.014	0.706	3880.028	199.0	716.4
1977-78	31 899	4298.296	0.742	-	-	-
1978-79	38 172	4713.013	0.810	-	-	-
1979-80	37 944	4765.119	0.796	4773.618	-8.5	30.6

n.p. - At least one subdivision was not published from the Manufacturing Census in this year.

(a) HARTLEY, M.J., JONES, R. and BADCOCK, R.L., 1978; Growth and Development of Tasmania's energy system: a statistical analysis of supply and demand 1950-1975 , Environmental Studies Working Paper 9; Board of Environmental Studies, University of Tasmania, Hobart.

(b) AUSTRALIA BUREAU OF STATISTICS; Census of Manufacturing Establishments, Details of Operations and Small Area Statistics Tasmania; Australian Bureau of Statisitics, Tasmania.

(c) AUSTRALIAN BUREAU OF STATISTICS; Mining Tasmania; Australian Bureau of Statistics, Tasmania.

(d) HYDRO-ELECTRIC COMMISSION; Annual Report; Government Printer, Hobart.

TABLE 2.3

Electricity Demand Under Bulk Contracts in Tasmania, 1969 to 1980.

CONTRACT DEMANDS COMPANY		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
APPM: LONG REACH	GWH	0.000	0.000	0.000	0.000	39.420	39.420	39.420	39.420	39.420	39.420	39.420	39.420
	MW	0.0	0.0	0.0	0.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
NORTHERN WOODCHIPS	GWH	0.000	0.000	0.000	0.000	31.536	31.536	31.536	31.536	31.536	31.536	31.536	31.536
	MW	0.0	0.0	0.0	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
TPFH	GWH	0.000	0.000	0.000	46.428	46.428	46.428	46.428	46.428	46.428	46.428	46.428	46.428
	MW	0.0	0.0	0.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
TOTAL 25	GWH	0.000	0.000	0.000	46.428	117.384	117.384	117.384	117.384	117.384	117.384	117.364	117.384
APPM: BURNIE	GWH	201.480	201.480	201.480	201.480	201.480	201.480	201.480	201.480	201.480	201.480	201.480	284.700
	MW	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	32.5
APPM: WESLEY VALE	GWH	13.140	13.140	114.756	114.756	114.756	114.756	114.756	114.756	114.756	114.756	114.756	114.756
	MW	1.5	1.5	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
ANM	GWH	460.776	460.776	460.776	460.776	460.776	460.776	460.776	460.776	460.776	508.080	508.080	508.080
	MW	52.6	52.6	52.6	52.6	52.6	52.6	52.6	52.6	52.6	58.0	58.0	58.0
APM	GWH	30.660	30.660	30.660	30.660	30.660	30.660	30.660	30.660	30.660	30.660	30.660	30.660
	MW	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
TOTAL 26	GWH	706.056	706.056	807.672	807.672	807.672	807.672	807.672	807.672	807.672	854.976	854.976	938.196
ELECTRONA CARBIDE	GWH	89.352	89.352	89.352	89.352	89.352	89.352	89.352	89.352	89.352	94.608	94.608	118.260
	MW	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.8	10.8	13.5
TIOXIDE	GWH	26.280	26.280	26.280	26.280	26.280	26.280	26.280	43.800	43.800	43.800	43.800	43.800
	MW	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0	5.0	5.0	5.0	5.0
TOTAL 27	GWH	115.632	115.632	115.632	115.632	115.632	115.632	115.632	133.152	133.152	138.408	138.408	162.060
GOLIATH	GWH	65.700	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600
	MW	7.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TOTAL 28	GWH	65.700	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600
COMALCO	GWH	1296.480	1296.480	1296.480	1296.480	1296.480	1296.480	1296.480	1296.480	1296.480	2032.320	2076.120	2076.120
	MW	148.0	148.0	148.0	148.0	148.0	148.0	148.0	148.0	148.0	232.0	237.0	237.0
E.Z. HOBART	GWH	744.600	744.600	744.600	744.600	860.232	860.232	860.232	860.232	860.232	860.232	860.232	860.232
	MW	85.0	85.0	85.0	85.0	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2
SAVAGE RIVER	GWH	303.096	303.096	303.096	303.096	303.096	303.096	303.096	303.096	303.096	0.000	0.000	0.000
	MW	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	0.0	0.0	0.0
TEMCO	GWH	240.900	240.900	240.900	240.900	240.900	240.900	240.900	240.900	635.100	635.100	635.100	635.100
	MW	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	72.5	72.5	72.5	72.5
TOTAL 29	GWH	2585.076	2585.076	2585.076	2585.076	2700.708	2700.708	2700.708	2700.708	3094.908	3527.652	3571.452	3571.452
ABERFOYLE	GWH	26.280	26.280	26.280	26.280	26.280	26.280	26.280	26.280	26.280	26.280	26.280	26.280
	MW	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E.Z. ROSEBERY	GWH	45.552	45.552	45.552	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600	87.600
	MW	5.2	5.2	5.2	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
MOUNT LYELL	GWH	48.180	48.180	48.180	48.180	48.180	48.180	48.180	48.180	48.180	48.180	48.180	61.320
	MW	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	7.0
RENISON	GWH	35.040	35.040	35.040	35.040	35.040	35.040	35.040	35.040	70.080	70.080	70.080	70.080
	MW	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	8.0	8.0	8.0	8.0
SAVAGE RIVER	GWH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	303.096	303.096	303.096
	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6	34.6	34.6
TOTAL MINING	GWH	155.052	155.052	155.052	197.100	197.100	197.100	197.100	197.100	232.140	535.236	535.236	548.376
MANUFACTURING TOTAL	GWH	3472.464	3494.364	3595.980	3642.408	3828.996	3828.996	3828.996	3846.516	4240.716	4726.020	4769.820	4876.692
FACTOR		0.7963	0.8869	0.9198	0.9541	0.9267	0.9334	0.9040	0.8647	0.9119	0.8170	0.8884	0.8784
HEC BULK SALES	GWH	2888.772	3236.659	3450.337	3663.421	3730.833	3757.907	3639.745	3496.551	4079.014	4298.296	4713.013	4765.119
TOTAL CONTRACTS	GWH	3627.516	3649.416	3751.032	3839.508	4026.096	4026.096	4026.096	4043.616	4472.856	5261.256	5305.056	5425.068

TABLE 2.4

Electricity Consumption by Tasmanian Manufacturing and Tasmanian Manufacturing Subdivisions, 1969 to 1980.

SUBDIVISION 21-22

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	1.035	0.000	1.035	60.750	0.000	60.750	0.000	0.0	1.704	0.0
1970	1.092	0.000	1.092	64.305	0.000	64.305	0.000	0.0	1.698	-0.3
1972	1.376	0.000	1.376	72.090	0.000	72.090	0.000	0.0	1.909	7.6
1973	1.512	0.000	1.512	76.366	0.000	76.366	0.000	0.0	1.980	3.7
1974	1.681	0.000	1.681	85.551	0.000	85.551	0.000	0.0	1.965	-0.8
1975	2.000	0.000	2.000	90.439	0.000	90.439	0.000	0.0	2.211	12.5
1976	2.632	0.000	2.632	102.288	0.000	102.288	0.000	0.0	2.573	16.4
1977	2.981	0.000	2.981	117.347	0.000	117.347	0.000	0.0	2.540	-1.3
1978	3.009	0.000	3.009	107.015	0.000	107.015	0.000	0.0	2.812	10.7
1979	3.554	0.000	3.554	122.247	0.000	122.247	0.000	0.0	2.907	3.4
1980	3.747	0.000	3.747	106.852	0.000	106.852	0.000	0.0	3.507	20.6

SUBDIVISION 23

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	0.302	0.000	0.302	17.726	0.000	17.726	0.000	0.0	1.704	0.0
1970	0.324	0.000	0.324	19.080	0.000	19.080	0.000	0.0	1.698	-0.3
1972	0.359	0.000	0.359	18.808	0.000	18.808	0.000	0.0	1.909	7.6
1973	0.405	0.000	0.405	20.455	0.000	20.455	0.000	0.0	1.980	3.7
1974	0.421	0.000	0.421	21.426	0.000	21.426	0.000	0.0	1.965	-0.8
1975	0.389	0.000	0.389	17.590	0.000	17.590	0.000	0.0	2.211	12.5
1976	0.497	0.000	0.497	19.315	0.000	19.315	0.000	0.0	2.573	16.4
1977	0.513	0.000	0.513	20.194	0.000	20.194	0.000	0.0	2.540	-1.3
1978	0.502	0.000	0.502	17.854	0.000	17.854	0.000	0.0	2.812	10.7
1979	0.540	0.000	0.540	18.574	0.000	18.574	0.000	0.0	2.907	3.4
1980	0.512	0.000	0.512	14.601	0.000	14.601	0.000	0.0	3.507	20.6

SUBDIVISION 24

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	0.011	0.000	0.011	0.646	0.000	0.646	0.000	0.0	1.704	0.0
1970	0.012	0.000	0.012	0.707	0.000	0.707	0.000	0.0	1.698	-0.3
1972	0.013	0.000	0.013	0.681	0.000	0.681	0.000	0.0	1.909	7.6
1973	0.016	0.000	0.016	0.808	0.000	0.808	0.000	0.0	1.980	3.7
1974	0.021	0.000	0.021	1.069	0.000	1.069	0.000	0.0	1.965	-0.8
1975	0.017	0.000	0.017	0.769	0.000	0.769	0.000	0.0	2.211	12.5
1976	0.018	0.000	0.018	0.700	0.000	0.700	0.000	0.0	2.573	16.4
1977	0.019	0.000	0.019	0.748	0.000	0.748	0.000	0.0	2.540	-1.3
1978	0.017	0.000	0.017	0.605	0.000	0.605	0.000	0.0	2.812	10.7
1979	0.017	0.000	0.017	0.585	0.000	0.585	0.000	0.0	2.907	3.4
1980	0.018	0.000	0.018	0.513	0.000	0.513	0.000	0.0	3.507	20.6

<u>TABLE 2.4</u>

Electricity Consumption by Tasmanian Manufacturing and Tasmanian Manufacturing Subdivisions, 1969 to 1980, continued.

SUBDIVISION 25

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	0.685	0.000	0.685	40.206	0.000	40.206	0.000	0.0	1.704	0.0
1970	0.700	0.000	0.700	41.221	0.000	41.221	0.000	0.0	1.698	-0.3
1972	0.960	0.323	0.637	77.672	44.299	33.373	0.729	0.0	1.909	7.6
1973	1.376	0.482	0.894	153.928	108.775	45.153	0.443	-39.2	1.980	3.7
1974	1.545	0.610	0.935	157.149	109.565	47.585	0.557	25.6	1.965	-0.8
1975	1.726	0.717	1.009	151.746	106.120	45.626	0.676	21.4	2.211	12.5
1976	1.920	0.756	1.164	146.740	101.503	45.237	0.745	10.2	2.573	16.4
1977	1.939	0.995	0.944	144.209	107.048	37.160	0.929	24.8	2.540	-1.3
1978	2.095	0.882	1.213	139.040	95.899	43.140	0.920	-1.1	2.812	10.7
1979	2.162	1.069	1.093	141.880	104.284	37.596	1.025	11.5	2.907	3.4
1980	2.441	1.145	1.296	140.062	103.104	36.958	1.111	8.3	3.507	20.6

SUBDIVISION 26

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	1.612	1.531	0.081	567.022	562.268	4.754	0.272	0.0	1.704	0.0
1970	2.348	2.256	0.092	631.617	626.200	5.418	0.360	32.3	1.698	-0.3
1972	3.209	3.109	0.100	775.870	770.631	5.239	0.403	12.0	1.909	7.6
1973	3.543	3.439	0.104	753.692	748.440	5.253	0.459	13.9	1.980	3.7
1974	3.715	3.611	0.104	759.164	753.871	5.293	0.479	4.2	1.965	-0.8
1975	4.216	4.091	0.125	735.819	730.166	5.652	0.560	17.0	2.211	12.5
1976	4.342	4.147	0.195	705.980	698.401	7.578	0.594	6.0	2.573	16.4
1977	4.623	4.466	0.157	742.735	736.555	6.180	0.606	2.1	2.540	-1.3
1978	4.984	4.817	0.167	704.430	698.491	5.939	0.690	13.7	2.812	10.7
1979	5.758	5.647	0.111	763.379	759.561	3.818	0.743	7.8	2.907	3.4
1980	7.829	7.609	0.220	830.340	824.066	6.274	0.923	24.2	3.507	20.6

SUBDIVISION 27

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	1.009	0.999	0.010	92.670	92.084	0.587	1.085	0.0	1.704	0.0
1970	1.152	1.143	0.009	103.084	102.554	0.530	1.115	2.7	1.698	-0.3
1972	1.501	1.480	0.021	111.429	110.329	1.100	1.341	20.4	1.909	7.6
1973	1.744	1.721	0.023	108.314	107.152	1.162	1.606	19.7	1.980	3.7
1974	1.706	1.677	0.029	109.405	107.929	1.476	1.554	-3.3	1.965	-0.8
1975	2.138	0.672	1.466	170.828	104.536	66.292	0.643	-58.6	2.211	12.5
1976	1.662	0.818	0.844	147.938	115.138	32.801	0.710	10.5	2.573	16.4
1977	1.616	0.949	0.667	147.684	121.428	26.256	0.782	10.0	2.540	-1.3
1980	2.224	2.146	0.078	144.570	142.346	2.224	1.508	29.6	3.507	20.6

TABLE 2.4

Electricity Consumption by Tasmanian Manufacturing and Tasmanian Manufacturing Subdivisions, 1969 to 1980, continued.

SUBDIVISION 28

YEAR	VALUE ($M) TOTAL	BULK	GENERAL	QUANTITY (GWH) TOTAL	BULK	GENERAL	PRICE (C/KWH) BULK	% CHA	GENERAL	% CH
1969	0.362	0.235	0.127	59.774	52.320	7.454	0.449	0.0	1.704	0.0
1970	0.357	0.256	0.101	83.640	77.692	5.948	0.330	-26.6	1.698	-0.3
1972	0.430	0.282	0.148	91.336	83.583	7.754	0.337	2.4	1.909	7.6
1973	0.463	0.289	0.174	89.964	81.176	8.788	0.356	5.5	1.980	3.7
1974	0.531	0.327	0.204	92.147	81.765	10.382	0.400	12.3	1.965	-0.8
1975	0.563	0.339	0.224	89.323	79.194	10.129	0.428	7.0	2.211	12.5
1976	0.682	0.346	0.336	88.807	75.749	13.058	0.457	6.7	2.573	16.4
1977	0.820	0.431	0.389	95.200	79.887	15.313	0.540	18.1	2.540	-1.3
1978	0.949	0.480	0.469	88.247	71.567	16.680	0.671	24.3	2.812	10.7
1979	1.103	0.587	0.516	95.573	77.824	17.749	0.754	12.5	2.907	3.4
1980	1.088	0.581	0.507	91.402	76.944	14.458	0.755	0.1	3.507	20.6

SUBDIVISION 29

YEAR	VALUE ($M) TOTAL	BULK	GENERAL	QUANTITY (GWH) TOTAL	BULK	GENERAL	PRICE (C/KWH) BULK	% CHA	GENERAL	% CH
1969	9.157	9.157	0.000	2058.625	2058.625	0.000	0.445	0.0	1.704	0.0
1970	10.642	10.642	0.000	2292.698	2292.698	0.000	0.464	4.4	1.698	-0.3
1972	12.480	12.480	0.000	2466.520	2466.520	0.000	0.506	9.0	1.909	7.6
1973	13.099	13.099	0.000	2502.645	2502.645	0.000	0.523	3.4	1.980	3.7
1974	14.764	14.764	0.000	2520.807	2520.807	0.000	0.586	11.9	1.965	-0.8
1975	14.836	14.836	0.000	2441.543	2441.543	0.000	0.608	3.7	2.211	12.5
1976	15.342	15.342	0.000	2335.326	2335.326	0.000	0.657	8.1	2.573	16.4
1977	19.177	19.177	0.000	2822.396	2822.396	0.000	0.679	3.4	2.540	-1.3
1978	17.934	17.934	0.000	2881.991	2881.991	0.000	0.622	-8.4	2.812	10.7
1980	26.895	26.895	0.000	3136.992	3136.992	0.000	0.857	6.0	3.507	20.6

SUBDIVISION 31

YEAR	VALUE ($M) TOTAL	BULK	GENERAL	QUANTITY (GWH) TOTAL	BULK	GENERAL	PRICE (C/KWH) BULK	% CHA	GENERAL	% CH
1969	0.097	0.000	0.097	5.693	0.000	5.693	0.000	0.0	1.704	0.0
1970	0.107	0.000	0.107	6.301	0.000	6.301	0.000	0.0	1.698	-0.3
1972	0.119	0.000	0.119	6.235	0.000	6.235	0.000	0.0	1.909	7.6
1973	0.134	0.000	0.134	6.768	0.000	6.768	0.000	0.0	1.980	3.7
1974	0.163	0.000	0.163	8.296	0.000	8.296	0.000	0.0	1.965	-0.8
1975	0.187	0.000	0.187	8.456	0.000	8.456	0.000	0.0	2.211	12.5
1976	0.239	0.000	0.239	9.288	0.000	9.288	0.000	0.0	2.573	16.4
1977	0.230	0.000	0.230	9.054	0.000	9.054	0.000	0.0	2.540	-1.3
1978	0.291	0.000	0.291	10.349	0.000	10.349	0.000	0.0	2.812	10.7
1979	0.317	0.000	0.317	10.904	0.000	10.904	0.000	0.0	2.907	3.4
1980	0.392	0.000	0.392	11.179	0.000	11.179	0.000	0.0	3.507	20.6

TABLE 2.4

Electricity Consumption by Tasmanian Manufacturing and Tasmanian Manufacturing Subdivisions, 1969 to 1980, continued.

SUBDIVISION 32

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	0.100	0.000	0.100	5.870	0.000	5.870	0.000	0.0	1.704	0.0
1970	0.109	0.000	0.109	6.419	0.000	6.419	0.000	0.0	1.698	-0.3
1972	0.213	0.000	0.213	11.159	0.000	11.159	0.000	0.0	1.909	7.6
1973	0.154	0.000	0.154	7.778	0.000	7.778	0.000	0.0	1.980	3.7
1974	0.165	0.000	0.165	8.397	0.000	8.397	0.000	0.0	1.965	-0.8
1975	0.205	0.000	0.205	9.270	0.000	9.270	0.000	0.0	2.211	12.5
1976	0.223	0.000	0.223	8.667	0.000	8.667	0.000	0.0	2.573	16.4
1977	0.237	0.000	0.237	9.329	0.000	9.329	0.000	0.0	2.540	-1.3
1980	0.261	0.000	0.261	7.443	0.000	7.443	0.000	0.0	3.507	20.6

SUBDIVISION 33

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	0.074	0.000	0.074	4.343	0.000	4.343	0.000	0.0	1.704	0.0
1970	0.077	0.000	0.077	4.534	0.000	4.534	0.000	0.0	1.698	-0.3
1972	0.146	0.000	0.146	7.649	0.000	7.649	0.000	0.0	1.909	7.6
1973	0.166	0.000	0.166	8.384	0.000	8.384	0.000	0.0	1.980	3.7
1974	0.146	0.000	0.146	7.430	0.000	7.430	0.000	0.0	1.965	-0.8
1975	0.186	0.000	0.186	8.411	0.000	8.411	0.000	0.0	2.211	12.5
1976	0.214	0.000	0.214	8.317	0.000	8.317	0.000	0.0	2.573	16.4
1977	0.205	0.000	0.205	8.070	0.000	8.070	0.000	0.0	2.540	-1.3
1978	0.256	0.000	0.256	9.105	0.000	9.105	0.000	0.0	2.812	10.7
1979	0.266	0.000	0.266	9.150	0.000	9.150	0.000	0.0	2.907	3.4
1980	0.307	0.000	0.307	8.755	0.000	8.755	0.000	0.0	3.507	20.6

SUBDIVISION 34

YEAR	VALUE ($M)			QUANTITY (GWH)			PRICE (C/KWH)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	0.009	0.000	0.009	0.528	0.000	0.528	0.000	0.0	1.704	0.0
1970	0.012	0.000	0.012	0.707	0.000	0.707	0.000	0.0	1.698	-0.3
1972	0.020	0.000	0.020	1.048	0.000	1.048	0.000	0.0	1.909	7.6
1973	0.024	0.000	0.024	1.212	0.000	1.212	0.000	0.0	1.980	3.7
1974	0.055	0.000	0.055	2.799	0.000	2.799	0.000	0.0	1.965	-0.8
1975	0.034	0.000	0.034	1.537	0.000	1.537	0.000	0.0	2.211	12.5
1976	0.057	0.000	0.057	2.215	0.000	2.215	0.000	0.0	2.573	16.4
1977	0.065	0.000	0.065	2.559	0.000	2.559	0.000	0.0	2.540	-1.3
1978	0.126	0.000	0.126	4.481	0.000	4.481	0.000	0.0	2.812	10.7
1979	0.139	0.000	0.139	4.781	0.000	4.781	0.000	0.0	2.907	3.4
1980	0.163	0.000	0.163	4.648	0.000	4.648	0.000	0.0	3.507	20.6

TABLE 2.4

Electricity Consumption by Tasmanian Manufacturing and Tasmanian Manufacturing Subdivisions, 1969 to 1980, continued.

DIVISION C - MANUFACTURING

YEAR	VALUE ($M) (SUM OR HEC)			QUANTITY(GWH)(HEC BULK SALES IN BRACKETS)			PRICE (C/KWH)(HEC AV.)			
	TOTAL	BULK	GENERAL	TOTAL	BULK	GENERAL	BULK	% CHA	GENERAL	% CH
1969	14.452	11.922	2.530	2913.795	2765.296	148.499	0.431	0.0	1.704	0.0
	(14.453)	(12.986)			(2888.772)		(0.450)	(0.0)		
1970	16.932	14.297	2.635	3254.313	3099.144	155.169	0.461	7.0	1.698	-0.3
	(16.932)	(15.233)			(3236.659)		(0.471)	(4.7)		
1972	20.825	17.674	3.151	3640.445	3475.360	165.085	0.509	0.0	1.909	7.6
	(20.826)	(18.549)			(3663.421)		(0.506)	(1.8)		
1973	22.636	19.030	3.606	3730.314	3548.188	182.127	0.536	5.5	1.980	3.7
	(22.636)	(20.053)			(3730.833)		(0.537)	(6.2)		
1974	24.915	20.989	3.926	3773.741	3573.936	199.805	0.587	9.5	1.965	-0.8
	(24.913)	(21.581)			(3757.907)		(0.574)	(6.8)		
1975	26.498	20.655	5.843	3725.777	3461.559	264.218	0.597	1.6	2.211	12.5
	(26.497)	(23.382)			(3639.745)		(0.642)	(11.9)		
1976	27.827	21.409	6.418	3575.542	3326.117	249.425	0.644	7.9	2.573	16.4
	(27.828)	(24.380)			(3496.551)		(0.697)	(8.5)		
1977	32.426	26.018	6.408	4119.564	3867.314	252.250	0.673	4.5	2.540	-1.3
	(32.425)	(28.814)			(4079.014)		(0.706)	(1.3)		
1978	32.017	25.722	6.295	4084.904	3861.023	223.881	0.666	-1.0	2.812	10.7
	(30.161)	(31.899)			(4298.296)		(0.742)	(5.1)		
1979	40.964	34.399	6.565	4463.325	4237.509	225.816	0.812	21.9	2.907	3.4
	(13.853)	(38.172)			(4713.013)		(0.810)	(9.1)		
1980	45.878	38.376	7.502	4497.384	4283.452	213.932	0.896	10.4	3.507	20.6
	(45.877)	(37.944)			(4765.119)		(0.796)	(-1.7)		

demands (now in energy units, KWh) to an estimate of actual demand for each year. Summing these demands provides an estimate of the bulk quantity of electricity used in each ASIC subdivision by bulk consumers.

TABLE 2.5

Matching of the Australian Standard Industrial Classification with groups of Bulk Electricity Consumers

YEAR	BULK GROUPING Hardwood Woodchips	Paper and Paper Products	Basic Chemicals	Cement	Basic Metals
	Nearest Grouping 1969 ASIC (a)				
	2516	261	2715	2831	29
	Nearest Published Grouping (b)				
1968-69	NO BULK	261	+2711,2,4	+2833	29
1969-70	NO BULK	261	+2711,2,4	+2832	29
1971-72	+2513	261	+2711,2	+2833	29
1972-73	2516	261	+2711,2	+2833	29
1973-74	2516	261	+2711,2	+2833	29
1974-75	+2515	261	2715	+2833	29
1975-76	+2515	261	2715	+2833	29
1976-77	+2513	261	2715	+2833	29
	Nearest Grouping 1978 ASIC (c)				
	2537	263	275	2871	29
	Nearest Published Grouping (b)				
1977-78	2537	263	275	+2873	29
1978-79	+2533,8	+2642,3	275	+2873	+276,323
1979-80	+2533,6,8	263	275	+2873	29

(a) AUSTRALIA, COMMONWEALTH BUREAU OF CENSUS AND STATISTICS, 1973; Australian Standard Industrial Classification, Preliminary Edition; Commonwealth Bureau of Census and Statistics, Canberra.
(b) AUSTRALIAN BUREAU OF STATISTICS; Census of Manufacturing Establishments, Details of Operations and Small Area Statistics Tasmania; Australian Bureau of Statistics, Tasmania.
(c) AUSTRALIAN BUREAU OF STATISTICS, 1979; ASIC, Australian Standard Industrial Classification, 1978 Edition; Australian Bureau of Statistics, Canberra.

In order to obtain an estimate of total electricity used by each subdivision (bulk consumption plus general consumption) it is necessary to return to the Manufacturing Census. The above bulk quantities (also shown in column 5, Table 2.4) must be matched as closely as possible with published expenditures on electricity. Fortunately in most years published groupings quite closely approximate the bulk consumption for each subdivision. Table 2.5 shows which ASIC grouping most closely approximates bulk demand, and which published grouping has had to be used in each year to approximate the bulk expenditure. For instance, the nearest ASIC grouping to the bulk consumers in subdivision 27 is Class 2715, but the nearest published value of electricity consumed in 1969-70 also included classes 2711, 2712 and 2714.

Once an estimate of the expenditure on bulk sales of electricity from the Manufacturing Census (shown in column 2, Table 2.4) has been obtained, a bulk price for the subdivision can be estimated (shown in column 7, Table 2.4) by dividing expenditure (column 2) by quantity (column 5). Comparing the estimated prices and their movements (shown in column 8, Table 2.4) shows the level of accuracy of this method of estimating bulk electicity consumption. For instance, in the example described above where a number of ASIC classes which were not bulk consumers had to be included with the desired class 2715, the 1969-70 bulk price derived was 1.1c/KWh (shown in Table 2.4). This bulk price is much higher than the price derived in 1974-75 of 0.6 c/KWh, when the actual ASIC class of bulk consumers (2715) was published. It seems unlikely that this considerable decline actually occurred in the five year time gap. Thus it appears that bulk expenditure has been overestimated in this case.

In order to obtain total electricity consumed by the subdivision, it is necessary to subtract the value of bulk consumption (column 2, Table 2.4) from total value (column 1, Table 2.4) to obtain a general value (column 3, Table 2.4). This general value must then be divided by a general price to obtain a general quantity. The only estimate of a general electricity price available is that derived from figures published by the ESAA. It is calculated by subtracting HEC Bulk Sales value and quantity from Tasmanian industrial sales value and quantity published by the ESAA. The remainder represents value and quantity of electricity for general industrial electricity consumers. An estimated general price is obtained by dividing the resulting general value by quantity (column 9, Table 2.4). This is the same general price used in Working Paper No. 9 of Hartley, Jones and Badcock, and must be applied as an average to all remaining general values. Bulk consumption (column 5, Table 2.4) and general consumption (column 6, Table 2.4) can then be added to obtain total electricity consumed by each subdivision (column 4, Table 2.4).

This method of estimating electricity consumption for Tasmanian manufacturing subdivisions eliminates the problem of a low estimate of bulk demand by specifically adjusting each bulk consumer's contract demand by a factor to bring total bulk consumption equal to the published HEC bulk sales. Nevertheless, there are still a number of problems with this estimate of electricity demand. Indeed, after attempting to follow the above method of estimation, the reader may be left with the impression that the results are almost ficticious. However, there are no other publicly available data on electricity usage by Manufacturing subdivisions available. This information was requested from the HEC, which advised that no such information was available.

In order to be able to use this information effectively it is useful to investigate the limitations presented by using this method of estimation of electricity usage. The first source of error in these estimates is from using the value of electricity from groups which poorly represent bulk consumers as described in Table 2.5. The effect of using these approximate groups is to reduce the estimated level of electricity usage. Estimated bulk usage is unaffected by this matching. However, the value of some general consumption has been allocated to bulk consumption. This does not increase the quantity of estimated bulk consumption, but that part of the general value is not divided by the general price and therefore does not contribute to the estimate of general quantity. Essentially because it was included with bulk value, it is lost altogether. Thus the overall estimate of electricity usage is reduced by poor matching of bulk consumers with the published values of electricity usage. Table 2.5 shows which years have been affected by this mismatching.

The second source of error in this method of estimation arises from the use of a general factor for the adjustment of each bulk consumer's contract demand. While it is obvious that bulk consumers as a group do not consume their full contract demand, it does not follow that each consumer's demand is less than their contract by the same amount. Actually there may be considerable variation in the extent to which bulk consumers do not reach their contracted demand. Since the extent to which this is true for each consumer is not known, it is not possible to say whether the resulting estimate of bulk demand is biased up or down. For example, if the larger bulk consumers were tending to consume a higher than average proportion of their contract demand, then using the average proportion for all bulk consumers would reduce the overall estimate of bulk demand considerably. While the larger bulk consumers may take a larger proportion of their contract demand, it is not possible to confirm this from publicly available information. Further, the extent to which various companies take their full contract demand will vary over time.

The third source of error in the estimated electricity usage comes from classification of the various bulk users into their ASIC subdivisions. For the Manufacturing Census establishments are classified under ASIC based on their primary activity. If an establishment produces more than one product and the value of production of the second item exceeds a certain limit ($2.8 million in 1979-80), that part of the establishment's production is classified to a different part of ASIC. For example, the primary activity at EZ Risdon is production of zinc metal which is classified to subdivision 29 Basic Metal products. However, at the Risdon works superphosphate is also produced. If the value of production of superphosphate exceeds $2.8 million then this activity would be classified separately for the Manufacturing Census. Even if the value of superphosphate production at Risdon were known there would be difficulties with apportioning the single bulk electricity contract for this plant between the two activities. The effect of this source of error on the final estimate is not likely to be large, since most of the major electricity consuming companies concentrate on the production of products which fall neatly into the subdivisions of ASIC. If certain activities were classified under the wrong subdivision in this estimation procedure, the effect would be to reduce the consumption of electricity in some subdivisions and increase consumption in others. Since the error would affect all years it is unlikely to change the comparison of various years.

The final source of error in this method of estimating electricity use arises from the use of an average general price for all subdivisions and firms. The actual rates applying to the supply of electricity to these general consumers are published and publicly available. However, they are progressive tariffs, which provide for reducing rates for larger usage. Thus the average tariff paid by consumers will vary as it will be made up of varying consumption at different rates. This source of error probably

TABLE 2.6

Tasmania - Comparison of Estimated Electricity Demand by Manufacturing with DNDE Survey
Units: GWh

	1976-77	1977-78	1978-79	1979-80
DNDE Survey	4217	4485	4919	5025
Estimate	4120(100%)	4085(100%)	4463(100%)	4497(100%)
Difference	-97(2%)	-400(10%)	-456(10%)	-528(12%)
Savage River Mines(a)	n.a.	248	269	266
Remainder	n.a.	-152(4%)	-187(4%)	-262(6%)

n.a. not applicable
(a) adjusted contract demand

accounts for most of the error in estimating general consumption. If the consumption of a particular subdivision has more than an average number of small consumers then the average price used in the estimation will be lower than that actually paid. This will result in electricity usage being overestimated. Similarly, if the number of small consumers is below average, then electricity consumption will be underestimated.

The accuracy of the final estimated demand for electricity may be seen by comparing it with electricity usage estimated from the DNDE Survey. This comparison is shown in Table 2.6. There are two limitations on this comparison. First, since 1977-78 the Manufacturing Census has used the 1978 edition of the ASIC as discussed above. This means that some of the difference between the two estimates results from the different classification of the consumption of electricity by Savage River Mines. Secondly, the Manufacturing Census only includes purchased electricity, while the DNDE Survey also includes electricity generated by the firm. According to the HEC total capacity for self-generation in Tasmania amounts to 44 MW (R.J. Harvey, Secretary, HEC, Personal Communication). If this generating capacity was run flat out for a full year it would be capable of generating 388 GWh of electricity. While the difference between the two estimates is within the capacity of privately owned generating plant, it actually arises in subdivisions that do not have their own generating equipment.

TABLE 2.7

Tasmania - Comparison of Electricity Consumption by Manufacturing Subdivisions as measured by the DNDE Survey and as estimated from the Manufacturing Census 1976-77

Subdivision	DNDE(a)	Census	Difference		Potential Self Generation(b)
	TJ	TJ	TJ	%	TJ
21-22	536.4	422.4	114.0	27.0	-
23-24,25	597.6	594.6	3.0	0.5	-
26	2401.2	2673.8	-272.6	-11.4	718.9
27	345.6	531.7	-186.1	-53.8	-
28	392.4	342.7	49.7	12.7	-
29	10738.8	10160.6	578.2	5.4	197.3
31,32,33,34	169.2	104.5	64.7	38.2	-
Manufacturing	15181.2	14830.3	350.9	2.3	916.2

(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia: 1960-61 to 1979-80; Department of National Development and Energy, Canberra.
(b) R.J. Harvey, Secretary, HEC, Personal Communication.

Overall it seems that the above technique of estimating total manufacturing electricity consumption is reasonably accurate. However, for individual subdivisions there are significant problems arising from the sources of error discussed above. Comparision of each subdivision with the DNDE estimate are shown in Table 2.7. While the differences are large for some subdivisions there does not appear to be any alternative to using Manufacturing Census based estimation. Mostly the errors have caused underestimation.

b) Australia

For Australia as a whole, as for Tasmania, there are two available sources of information on electricity use by manufacturing industry, the DNDE survey and estimated electricity use based on the Manufacturing Census. The DNDE Survey has a number of problems outlined above which make it unacceptable for use in this study, so it is necessary to use an estimate of electricity use based on the Manufacturing Census. Use of the same source of information for Tasmanian and Australian manufacturing should also improve the comparability of electricity consumption between the two. However, it has not been possible to make as good an estimate of electricity use for Australia as that made for Tasmania, mainly because of the complexity of Australian manufacturing.

The method of estimation is based on an estimated industrial price for electricity derived from the value and quantity of industrial electricity consumption published by the ESAA. Manufacturing Census expenditures were then divided by this price to obtain the quantity of electricity used. Not surprisingly the results of this procedure varied widely from estimates of electricity usage published by DNDE. Variations of up to 60% difference in the level of electricity consumption resulted. These were most probably caused by using an average price for all industry where actually there is a large variation in price between subdivisions and firms.

It seems likely that estimates of electricity use from the DNDE survey produce more accurate results than the above estimation procedure. However, the DNDE results do not cover the full period of this study, so the above estimates have been adjusted to reduce the difference in levels between the estimated electricity usage and DNDE figures. This was done by using a factor, measuring the difference over the period 1976-77 to 1979-80, to reduce the average price for subdivisions where the difference was greater than 10%. The same factor was used over the whole eleven year period so the level, but not the trends, of electricity consumption would be changed.

This method of estimation is subject to all the errors described in relation to estimating electricity usage in Tasmania. Thus the estimate is unable to provide more than a broad indication of the trends and levels of electricity consumption by Australian manufacturing industry.A comparison of the levels of electricity use estimated from the Manufacturing Census and the DNDE Survey is shown in Table 2.8. The comparison is best made in 1976-77 because of the use of different editions of the ASIC classification after this year. This table shows DNDE electricity usage compared with that estimated from the Manufacturing Census, after the level has been adjusted. The subdivisions for which adjustment was necessary have the factor used to adjust their price shown. Those without a factor were not adjusted. The difference shown is the DNDE estimate minus the estimate made from the Manufacturing Census.

TABLE 2.8

Australia - Comparison of Electricity Consumption by Manufacturing Subdivisions as measured by the DNDE Survey and as estimated from the Manufacturing Census 1976-77

Subdivision	DNDE(a)	Census	Factor	Difference		Self Generation(b)
	TJ	TJ		TJ	%	%
21-22	9 515	8 691	-	824	8.7	7.2
23-24,25	5 432	5 481	0.853	-48	-0.9	0.8
26	8 269	6 432	0.637	1 837	22.2	23.0
27	8 312	7 248	0.805	1 065	12.8	9.8
28	7 628	7 276	0.604	352	4.6	6.1
29	46 145	36 268	0.677	9 877	21.4	24.7
31,32,33,34	12 395	11 963	-	432	3.5	0.2
Manufacturing	97 697	83 358	-	14 339	14.7	16.0

(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia: 1960-61 to 1979-80; Department of National Development and Energy, Canberra.
(b) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1981; Forecasts of energy Demand and Supply - Primary and Secondary Fuels Australia 1980-81 to 1989-90; Australian Government Publishing Service, Canberra.

In comparing the two, self generated electricity must be allowed for, since the DNDE survey included self generated electricity and the Manufacturing Census excluded it. An estimate of the extent of self generation has been made from the DNDE projections of privately generated electricity as a proportion of total projected demand (Australia, Deparment of National Development and Energy 1981). The table shows that the resulting estimated levels of electricity demand closely approximate the DNDE levels, after allowing for self generation.

There are obviously major deficiencies in using information derived from the Manufacturing Census in this way. However, the use of this information is justified on the basis that it would be more misleading to compare energy use in Tasmanian manufacturing industry with that in Australia, excluding electricity, than by including a rough estimate of Australian manufacturing electricity use.

TABLE 2.9

Tasmania - Comparison of the use of Mains Gas and Other Fuels with the use of Coke and Coke Breeze by Manufacturing Industry 1968-69 to 1978-79

Year	Gas and Other Fuels(a)	Coke and Coke Breeze(b)			Gas and Other Fuels (excluding Coke)
	value $'000	value $'000	quantity tonnes	% 2/1	value $'000
	1	2	3	4	5
1968-69	1430	724	18 958	51	706
1969-70	2617	1660	44 799	63	957
1970-71			NO CENSUS		
1971-72	1168	168	7 263	14	1004
1972-73	1009	83	2 114	8	926
1973-74	1048	72	1 660	7	976
1974-75	1339	86	1 650	8	1253
1975-76	814	81	711	10	733
1976-77	4418	3700	60 796	84	718
1977-78	6855	5379	49 897	78	1476
1978-79	6716	5632	78 230	84	1084
1979-80	7039	5488	80 322	78	1551

(a) AUSTRALIAN BUREAU OF STATISTICS; Census of Manufacturing Establishments, Details of Operations and Small Area Statistics Tasmania, Table 7; Australian Bureau of Statistics, Tasmania.
(b) AUSTRALIAN BUREAU OF STATISTICS; Census of Manufacturing Establishmenst, Details of Operations and Small Area Statistics Tasmania, Table 7, Footnote (c); Australian Bureau of Statistics, Tasmania.

2.3.4 Gas and Other Fuels

The Manufacturing Census category of Mains Gas and Other Fuels provides some difficulties for developing comprehensive data on Tasmanian manufacturing energy use. The major aspects of this difficulty are connected with the use of gas and the use of coke and coke breeze, which are both included under the category of Mains Gas and Other Fuels. Total Manufacturing use of Coke and Coke Breeze is published as a footnote to the Fuel Usage Table in the Manufacturing Census, but this figure is not quoted separately for each subdivision so there is some difficulty in allocating it to the appropriate subdivisions. There is also some doubt as to whether the quantities included in Coke and Coke Breeze should be considered as fuels or as feedstock for Tasmanian manufacturing industry according to a letter from the Deputy Commonwealth Statistician to the Centre for Environmental Studies. Table 2.9 shows the significance of Coke and Coke Breeze in the Mains Gas and Other Fuels group. Because of these difficulties the Manufacturing Census category of Coke and Coke Breeze has been excluded from the estimates of energy use for Tasmanian manufacturing used in this study.

Table 2.9 also shows the remaining value of Mains Gas and Other Fuels after excluding Coke and Coke Breeze. This value is consistently about $1 million. It has been decided to ignore the energy value of this expenditure because of the difficulty of developing energy values from the expenditure figures and because of its low significance in total energy expenditure in Tasmanian manufacturing.

For Australia, the situation with gas is somewhat different. The importance of natural gas as a fuel has grown considerably over the 1970s. Thus to exclude gas from the overall measure of Australian manufacturing energy use would be misleading. Inclusion of gas in the estimates of energy use from the Manufacturing Census presents a similar difficulty to the estimation of electricity use in Australia, since only the value of gas expenditure is published in the Manufacturing Census. Gas sales to industry are also characterised by secret bulk contracts to large users. This problem leads to considerable difficulty in estimating an energy content from the expenditure figures published in the Manufacturing Census. Thus it was decided to use a composite approach to estimating Australian manufacturing gas usage.

The best available information on Gas use was that published in the DNDE survey, so this information has been used where available. Gas use derived from the Survey was published from 1973-74 onwards for all subdivisions separately, except for subdivisions 23 Textiles and 24 Clothing and Footwear, which were combined in the DNDE survey results. In order to separate these two subdivisions their total expenditure on gas from the Manufacturing Census was divided by the total quantity published from the DNDE survey to obtain an average gas price for these two subdivisions. The value of expenditure for each subdivision was then divided by this average price, separately, to give a separate estimate of the energy quantity of gas used by each subdivision.

Obtaining gas energy quantities for the years before 1973-74 was more difficult. It was necessary to estimate the price for gas in 1973-74, and project this price back to 1968-69 using the Gas component of the Price Index of Materials used by Manufacturing Industry. Gas expenditures from the Manufacturing Census were then divided by this price to estimate quantity. While movements in this price index do not follow movements in the price derived by dividing the Manufacturing Census value by the DNDE quantity, from 1973-74 onwards, this appeared to be the only way to estimate quantities of gas used in earlier years, for Australian manufacturing.

2.3.5 Coal and Petroleum Products

The estimation of the energy content of coal and petroleum products from quantities published from the Manufacturing Census is more straightforward than conversion of the expenditure values published for electricity and gas. Conversion factors taken from the DNDE Publication Demand for Primary and Secondary Fuels (1980) were used to convert the published quantities into energy contents. These factors are shown in Table 2.10 for all fuels. Coal mined in different States has differing average energy contents. Imports of coal into Tasmania published by the ABS could only account for 10% of that used in Tasmanian manufacturing so it was assumed that all coal used by Manufacturing had the energy content of Tasmanian coal. For Australia, most coal is mined in New South Wales and Victoria, which is also where most manufacturing industry is situated. For Australian manufacturing the energy content of black coal mined in these states has been used for conversion. Since, Tasmanian manufacturing only accounts for a small proportion of Australian manufacturing energy use, the small difference between the energy content of NSW and Victorian coal and Tasmanian coal would not cause a large error in the Australian estimates. Victoria is the major brown coal mining area the energy content of Victorian brown coal has been used for conversion.

The situation with the conversion of petroleum products is more difficult. The conversion of industrial diesel fuel and fuel oil is straightforward, since a standard conversion was available for industrial diesel fuel, and a small range was averaged for fuel oil. However, the Manufacturing Census category of light oils covers a range of petroleum products with different energy contents. Five of the quoted energy conversion factors in the DNDE publication fall within this Census category: Motor Spirit (not used in motor vehicles), Power Kerosene, Lighting Kerosene, Heating Oil and Automotive Distillate. A simple average of the energy contents of these five fuels has been used to convert the quantity of light oils to energy units. This procedure assumes that these five fuels make up equal proportions of the fuels used under this category.

In summary, fuel use information mainly based on the Manufacturing Census was formed into a time series of annual data to provide the basis for this thesis. For Tasmania, the only fuels considered have been electricity, black coal, industrial diesel fuel, light oils and fuel oil. In Australia this list has been extended to include brown coal, brown coal briquettes and gas. Energy use by fuel by subdivision between 1968-69 and 1979-80 for Tasmania are provided in Appendix D, and for Australia in Appendix E.

TABLE 2.10

Energy Conversion Factors (a)

Fuel	Factor
Electricity	3.6×10^{6} J/KWh
Black Coal - Tasmania	24.61×10^{9} J/tonne
- New South Wales	27.91×10^{9} J/tonne
- Victoria	27.91×10^{9} J/tonne
Brown Coal - Victoria	9.47×10^{9} J/tonne
Light Oils - average	36.823×10^{6} J/litre
Motor Spirit	34.360×10^{6} J/litre
Power Kerosene	37.180×10^{6} J/litre
Lighting Kerosene	36.660×10^{6} J/litre
Heating Oil	37.705×10^{6} J/litre
Automotive Distillate	38.211×10^{6} J/litre
Industrial Diesel Fuel	45.50×10^{9} J/tonne
Fuel Oil - average	43.70×10^{9} J/tonne
Fuel Oil - high sulphur	44.50×10^{9} J/tonne
Fuel Oil - low sulphur	42.90×10^{9} J/tonne

(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia: 1960-61 to 1979-80; Department of National Development and Energy, Canberra.

Two important qualifications on using this data as a measure of energy use need to be made. First, these fuels only account for the major commercially purchased fuels. They do not account for fuels which are supplied by the establishment itself. An important example of this type of internal supply is the use of wood waste to fire boilers in the Pulp and Paper industry. The exclusion of non-commercial fuels would result in misleading trends in energy use where internally supplied fuels were being substituted for commercial fuels over the period from 1969 to 1980. Second, the above method of estimating energy use measures energy content at the factory gate. Therefore, it does not take into account the amount of energy lost before the fuel is purchased or the efficiency (first or second law) with which the fuel is used to provide energy needed for the manufacturing process. Changes in the end use efficiency of energy use will show up in the data as changes in energy use.

2.4 Conclusion

The major source of data for this thesis is the ABS Manufacturing Census. It provides basic data for all three areas, employment, output and energy use. While the employment and output data could readily be used in this thesis, considerable manipulation was necessary in order to develop a suitable energy data base for the thesis. The development of energy use data for coal and petroleum products was comparatively straightforward, only involving the conversion of published quantities by standard conversion factors for both Tasmanian and Australian manufacturing. The conversion of electricity expenditure information was more involved. For Tasmania, it was possible to develop reasonably accurate estimates of electricity use because of the simplicity of Tasmanian manufacturing. However, estimates of electricity use for Australia provide only a broad indication of trends and levels. Petroleum, coal and electricity are the major commercial fuels used in Tasmanian manufacturing, but it was necessary to include Gas in the estimates of Australian manufacturing energy use. The estimation procedure for this fuel was based on DNDE estimates of gas use back to 1974-75, and before that on estimates made from Manufacturing Census expenditures.

2.5 References

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CHAPTER 3 - Method of Analysis

3.1 Previous Studies of the relation between Energy, Employment and Output

This chapter will develop the method of analysis to be used in this thesis. In order to do this it is necessary to first describe and evaluate previous studies of the role of energy use in the production process. From this investigation it will then be possible to develop a suitable technique for analysing the response of Tasmanian manufacturing to the changes in energy supply that have occurred over the 1970s.

Relationships between energy use, employment and output have usually been analysed looking at a whole economy. Mostly, studies have been done using data from the United States economy. The applicability of the results of these studies to the Tasmanian economy is questionable because the Tasmanian economy is much less diverse than large economies such as that of the United States. Manufacturing in Tasmania consists of a few large firms. So it would be unsound to extrapolate results from these larger diverse economies to Tasmania. However, some methodology from overseas studies is applicable to the Tasmanian situation and the following discussion will consider the results of these overseas studies, together with their methodology, to see what relevance they have for Tasmania.

Relationships between energy use and Gross National Product (GNP) have been investigated by Beijdorff (1979), Darmstadter, Teitelbaum and Polach (1971), Darmstadter, Dunkerly and Alterman (1977), Fremont (1976), Linden (1976), Sanchez-Cardona, Morales-Cardona and Caldari (1975), Starr and Field (1979) and Winger (1976), among others. These authors have mostly taken a whole economy as their unit of study by looking at the ratio between energy use and GNP. All the authors except Beijdorff, Darmstadter and his co-workers and Sanchez-Cardona et al. have used their investigation as the basis for making an energy demand prediction.

3.1.1 Studies Based on a Whole Economy

The four authors who used the GNP to energy use ratio as a basis for energy demand prediction (Fremont, Linden, Starr and Field, and Winger) have made an unconvincing attempt to establish the stability of this ratio as a basic aspect of society. In using the past stability of this ratio as a basis for energy demand prediction, they have attempted to make its stability a fundamental law of social structure. They have further attempted to construct a direct connection between the level of energy use and individual and social welfare.

Fremont and Winger have made the simplest attempts to show the past stability of the ratio between energy use and GNP, and energy use and employment. Fremont (1976) states that energy use per dollar of GNP increased by only 0.5% between 1950 and 1975 in the United States. Over the same period, he says that both GNP per job and energy use per job increased by 55%. Winger also implies that there has been little change in the energy use to GNP ratio when he states that 'over the last 20 years' both GNP per job and energy use per job increased by 40%. Both authors then extrapolate this trend into the future to predict a need for strong growth in energy supplies to maintain growth in output and employment. These authors provide a description of past trends in the United States. They do not provide analysis of the changes in the American economy or society that produced these trends. So they do not have a sound basis for making forecastes of future energy demand.

The procedure of describing historical trends in the energy use to GNP and energy use to employment ratios has been somewhat improved by Starr and Field (1979) and Linden (1976). These authors have quantified the past ratio, and then used the resulting mathematical function to predict future energy demand. These mathematical functions describe the past more accurately and completely. However, unless they are accompanied by an analysis of the connections between their components, they do not provide any more solid basis for demand prediction than simple comparison of growth rates.

Having described the close relation between energy use and GNP in the past, these authors go on to extend the relationship to include a wide range of social benefits, in what Linden says is a historical analysis. For example, Fremont describes what he sees as the underlying connection between increased energy use, particularly electricity, and increased economic welfare.

> It is the increased energy intensity per job - made still more productive through the increased use of electricity - that is responsible for the increased labour productivity and, consequently, for the gains in real income that we associate with a gradually increasing standard of living for the U.S. and the rest of the world. (Fremont 1976)

Linden expands this statement to claim that increased use of inanimate energy has provided

> for increasing affluence, personal freedom, education and physical and social mobility, and has led to abolition of slavery and child labour, the emancipation of women, increased life span, and nearly all good things that have come to mankind during the last two centuries. (Linden 1976)

Linden has desribed his investigation as a historical analysis. However, three of the papers, including his, are completely unreferenced and none of the four authors carry out any analysis beyond describing the stability of the ratio between energy use and GNP or employment up to 1973. None of them makes an analysis of the connections between energy use and GNP or employment, not to mention the even broader connections with individual or social welfare.

Beijdorff (1979), has looked at the ratio of energy use to Gross Domestic Product (GDP). While his investigation mostly deals with whole economies, he has extended the period considered up to 1978, and looked at many of the Organisation for Economic Cooperation and Development (OECD) countries. His investigation shows that for the OECD as a whole and for many of its member countries 1973 was a turning point in the ratio of energy use to GDP. After 1973 the ratio has declined in most of the OECD economies, and Beijdorff regards this as a strong indication of energy conservation. The recent decline in the energy use to GDP ratio shows that it is too simplistic to extrapolate the past stability of the ratio in the way that Fremont, Linden, Starr and Field, and Winger do.

While these authors appear to have taken a simplistic approach to the investigation of the energy use to GNP ratio in the United States, it is important to consider their statements in relation to Tasmania. One important aspect of the debate over further power development has been emphasis of the connection between the economic welfare of Tasmania, particularly economic growth and employment, and further electric power development. This emphasis continues despite the changes that have occurred in energy supply over the 1970s. In this sense these authors (Fremont 1976; Linden 1976; Starr and Field 1979; and Winger 1976) can be seen as stating a case that has rarely been written down in Tasmania, but which is often used to implicitly support the notion that continued economic and employment stability depend on increased energy and electricity supply. There has never been a detailed analysis of the underlying connections between energy use and output or employment in Tasmania. However, this analysis has been started in relation to some overseas countries.

3.1.2 Studies Involving Detailed Analysis

There is a different approach to studying the role of energy use. Rather than simply describing the stable historical ratio of energy use to GNP over a whole economy, this approach analyses society to discover how this stability arose. With the insight that this analysis provides it is then possible to compare the trends in energy use with likely energy supply problems to see how this is likely to affect society in general and the economy and employment in particular. This type of approach is much better suited to an investigation of Tasmania's response to its energy supply problems, than a simple extrapolation of past relations between energy use and output into the future.

One approach to this type of analysis has been used by Darmastadter, Teitelbaum, and Polach (1971), Darmstadter, Dunkerly and Alterman (1977) and Sanchez-Cardona, Morales-Cardona and Caldari (1975). All three of these works described the fairly constant ratio of energy use to GNP over a cross-section of economies. Darmastadter, Teitelbaum, and Polach (1971) were the first to describe the stable ratio of energy use to GNP over a large number of different economies. Their study showed that energy use and GNP had a correlation coefficient of 0.87 using 1965 data from 49 countries. While this is a good correlation, their study raised the more significant question of how there could still be quite large variations in energy use between countries with similar levels of GNP. For instance, how could Sweden maintain a similar level of GNP per capita to that in the United States while using much less energy? The study done by Sanchez-Cardona, Morales-Cardona and Caldari confirmed the correlation between energy use and GNP, and also showed that there could be considerable variation in energy use by countries with similar levels of GNP. This analysis suggested that there could be considerable room for energy conservation without reducing GNP. That is, it destroyed the supposed continuing connection between increased energy use and increased GNP which was the basis of the massive energy demand predictions made by such authors as Winger (1976).

Both these studies used a technique of structural analysis to explain variations in the energy use to GNP ratio or energy intensity. Since variations in the overall energy use to GNP ratio for an economy may result either from activities being more energy intensive, or from a greater predominance of activities with higher energy intensity, it is important to distinguish between them. The technique used in these two studies was to disaggregate the economy into various sectors so as to analyse the source of variations in energy intensity. On the one hand, this analysis may show that there is a greater concentration on energy intensive activities, implying a need for analysis of whether the particular economy has an appropriate structure. On the other hand it may show that major activities within the economy have a comparatively high energy intensity, suggesting that there may be potential for increased energy conservation in that activity.

Another group of authors has carried this type of analysis further. This group includes Andrews (1979), Commoner (1976) and, Grossman and Daneker (1977). The analysis carried out by Commoner and, Grossman and Daneker showed that there had been a strong increase in the energy intensity of United States production due to the increased importance of energy intensive industries such as the petrochemicals industry. Following from this analysis they investigated the social and environmental implications of the energy supply projects necessary for continuation of this trend, and found that these projects not only had large environmental impacts but also that they would have severe economic consequences, particularly on employment, growth and inflation. This led them to consider alternative industrial developments, based on their analysis of industry structure, that would not have such large energy demands leading to such damaging environmental consequences, and such adverse economic effects.

This type of analysis shows that there is more to investigation of the relation between energy use and production than simply taking the past stability of the energy use to GNP ratio and extrapolating it into the future. It shows that there is no necessary connection between growth in energy use and growth in GNP and employment. Thus it provides a useful approach to studying the response of Tasmanian manufacturing to growing problems of energy supply. The following section will show how this approach will be used to analyse the response of Tasmania manufacturing to its new energy environment, and to place the structure of Tasmanian manufacturing in the context of Australian manufacturing so as to comment on its appropriateness in this new environment.

3.2 Development of Methodology for this Thesis

The manufacturing process is usually described as the use of labour, capital and knowledge to produce output from material inputs. This thesis is particularly concerned with the role of energy use in Tasmanian manufacturing because of the changes that have occurred in relation to energy supply over the last ten years. A full analysis of the role of energy use would include all the above aspects of the production process. However, such a large investigation is beyond the scope of this thesis. So the limited aim of this thesis is to describe the relation of energy use to employment and output in Tasmania manufacturing between 1969 and 1980.

The first part of this analysis will simply be to describe the changes that have occurred in energy use, employment and output between 1969 and 1980. This description will examine the trends occurring in each of the aspects of the production process. Then it will go on to investigate the way that industry structure has influenced these trends. This investigation of manufacturing structure will be based on the 12 ASIC subdivisions of manufacturing, which are described briefly in Appendix A. It will determine whether trends in these aspects for manufacturing as a whole are reflected across all the subdivisions of manufacturing or whether the manufacturing trends are being dominated by a few subdivisions. It should also provide some insight into how manufacturing energy use has changed over this period, and what changes in employment and output have occurred at the same time.

The second part of the analysis will look at the energy intensity of manufacturing production. This will be done by looking at two ratios: 1) the energy use to output ratio (energy intensity of output), and 2) the energy use to employment ratio (energy intensity of employment). Investigation of these ratios is aimed at providing two insights. First, it will show how the manufacturing production process has changed in response to the changes in energy supply; that is whether it has become more or less energy intensive. Second, it will describe the structure of manufacturing in terms of energy intensity, and then relate this structure to the new energy supply situation. That is, it will describe which subdivisions are particularly energy intensive and which are not.

It is difficult to comment on the structure of one economy in isolation, so the Tasmanian manufacturing production process will be placed in the context of Australian manufacturing as a whole. Unfortunately, the data which will be used for Australia are not as reliable as that for Tasmania so this comparison can only be based on major differences. In making the comparison between Tasmanian manufacturing and Australian manufacturing as a whole it will be possible to compare not only structure, to see how vulnerable Tasmanian manufacturing is to changes in energy supply, but also to compare the trends in energy intensity, to see how Tasmanian manufacturing has responded to changes in energy supply in the context of the overall Australian response.

It must not be forgotten that the investigation of energy intensity is only a partial analysis of the whole manufacturing process. This aspect is particularly relevant when considering the connection between energy use and employment, since often manufacturing energy use may be overshadowed by other aspects of the manufacturing process. Labour has been one of the more significant considerations of manufacturing industry, partly because it is one of the major costs of manufacturing. Wages and salaries accounted for 17.5% of Tasmanian manufacturing Turnover plus Net Additions to Stocks in 1979-80 (19.9% for Australian manufacturing). Energy use, on the other hand, only accounted for 5.2% of Turnover plus Net Additions to Stocks (2.4% for Australian manufacturing) (ABS annual a, annual b). So, in cost terms alone, labour overshadows energy use.

The level of use of labour is particularly relevant when looking at the relation of energy use to employment. It is necessary to look at the energy use to employment ratio in the light of a third ratio, employment to output. The employment to output ratio is related to the concept of labour productivity, which has been a traditional concern of both the management of manufacturing firms and economists. In the past, labour productivity has been increasing, and this trend will be particularly relevant when looking at the ratio of energy use to employment.

The following chapter begins this analysis by examining Tasmanian manufacturing on its own. This examination will look at the trends and structure of manufacturing energy use, employment and output separately to see how these have changed over the period from 1969 to 1980. Then it will go on to look at manufacturing energy intensity by examining the ratios of energy use to output, employment to output, and energy use to employment. Then, in chapter 5, a comparison of these aspects of Tasmanian manufacturing with Australian manufacturing as a whole is made.

3.3 References

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Chatper 4 - Energy Use, Employment and Value Added by Tasmanian Manufacturing

The first part of this chapter is an examination of Tasmanian manufacturing in terms of energy use, employment and output. It will look at the structure of manufacturing in terms of each of these, then go on to look at the trends in each over the period from 1968-69 to 1979-80. Examination of the structure of manufacturing will show which subdivisions are most important in energy use, employment and output, and the comparative importance of subdivisions between each of these. This description of manufacturing structure will be useful when going on to look at the trends in energy use, employment and output, since it will be clear whether any subdivision has had a dominant influence on the manufacturing trend. Comparison of the trends in energy use, employment and output, will show whether there is the possibility that changes in the energy supply situation have influenced manufacturing employment and output.

4.1 Structure of Tasmanian Manufacturing: Energy Use, Employment and Output

Tasmanian manufacturing is dominated by two subdivisions of ASIC: Subdivision 29 Basic Metals and Subdivision 26 Paper, Paper Products, Printing and Publishing. Table 4.1 shows that these two subdivisions together account for 75% of manufacturing energy use. They also account for 88% of electricity consumption. Subdivision 29 alone accounts for 70% of manufacturing electricity consumption. While these two subdivisions are also important in terms of output and employment, their importance in these two aspects is much reduced. They account for 41% of manufacturing real value added, and 34% of manufacturing employment.

Two other subdivisions make a significant contribution to employment and output but not to energy use: subdivision 21 Food, Beverages and Tobacco and, subdivision 25 Wood, Wood Products and Furniture. Subdivision 21 is the major subdivision for employment accounting for 22% and it also accounts for 16% of real value added. Subdivision 25 accounts for 15% of real value added, and 14% of employment.

Table 4.1 also shows that there has been little change in the structure of the major manufacturing subdivisions over the period between 1968-69 and 1979-80. Apart from the increased importance of subdivision 25 Wood, Wood Products and Furniture in manufacturing electricity consumption, all other major subdivisions have the same ranked position, and largely have the same percentage contribution as they did in 1968-69.

TABLE 4.1

Major Tasmanian Manufacturing Subdivisions in terms of Energy Use, Employment and Real Value Added, 1968-69 and 1979-80.

Subdivision	1979-80	%	Cum.%	Rank	1968-69	%	Rank
			Electricity Consumption (TJ)				
29 Basic Metals	11 293	70	70	1	7 411	71	1
26 Paper	2 989	19	88	2	2 041	20	2
27 Chemicals	520	3	91	3	334	3	3
25 Wood	504	3	95	4	145	1	6
Manufacturing	16 190	100			10 490	100	
			Energy Use (TJ)				
29 Basic Metals	12 610	39	39	1	10 599	42	1
26 Paper	11 613	36	75	2	8 131	32	2
28 Mineral Prod.	2 408	8	82	3	2 708	11	3
21-22 Food	2 128	7	89	4	1 534	6	4
Manufacturing	32 207	100			25 541	100	
			Real Value Added ($'000)				
26 Paper	117 557	23	23	1	95 474	22	1
29 Basic Metals	116 528	22	45	2	91 705	21	2
21-22 Food	95 003	16	62	3	71 312	16	3
25 Wood	76 136	15	76	4	59 899	14	4
Manufacturing	508 461				422 178		
			Employment				
21-22 Food	5825	22	22	1	6398	21	1
26 Paper	5462	21	43	2	5631	18	2
25 Wood	3674	14	57	3	4539	14	3
29 Basic Metals	3577	14	71	4	4116	13	4
Manufacturing	26158	100			31074	100	

The importance of the four major energy using subdivisions in terms of electrcity consumption, employment and output is shown in Table 4.2. This table demonstrates that the proportional demand for energy by the two major subdivisions is not matched by their proportional contribution to output and employment. While these two major energy and electricity using subdivisions are also important in terms of employment and output their proportional contribution to these two is much less.

TABLE 4.2

The Importance of the Major Energy Using Subdivisions of Tasmanian Manufacturing in terms of Energy Use, Electricity Consumption, Employment and Value Added, 1979-80.

Subdivision	Energy Use		Electricity Consumption		Employment		Value Added	
	Rank	%	Rank	%	Rank	%	Rank	%
29 Basic Metals	1	39.2	1	70.6	4	13.7	2	22.0
26 Paper	2	36.1	2	19.5	2	20.9	1	23.0
28 Mineral Products	3	7.5	6	2.0	9	3.0	8	4.3
21-22 Food	4	6.6	5	2.4	1	22.3	3	16.4

4.2 Trends in Tasmanian Manufacturing Energy Use, Employment and Output.

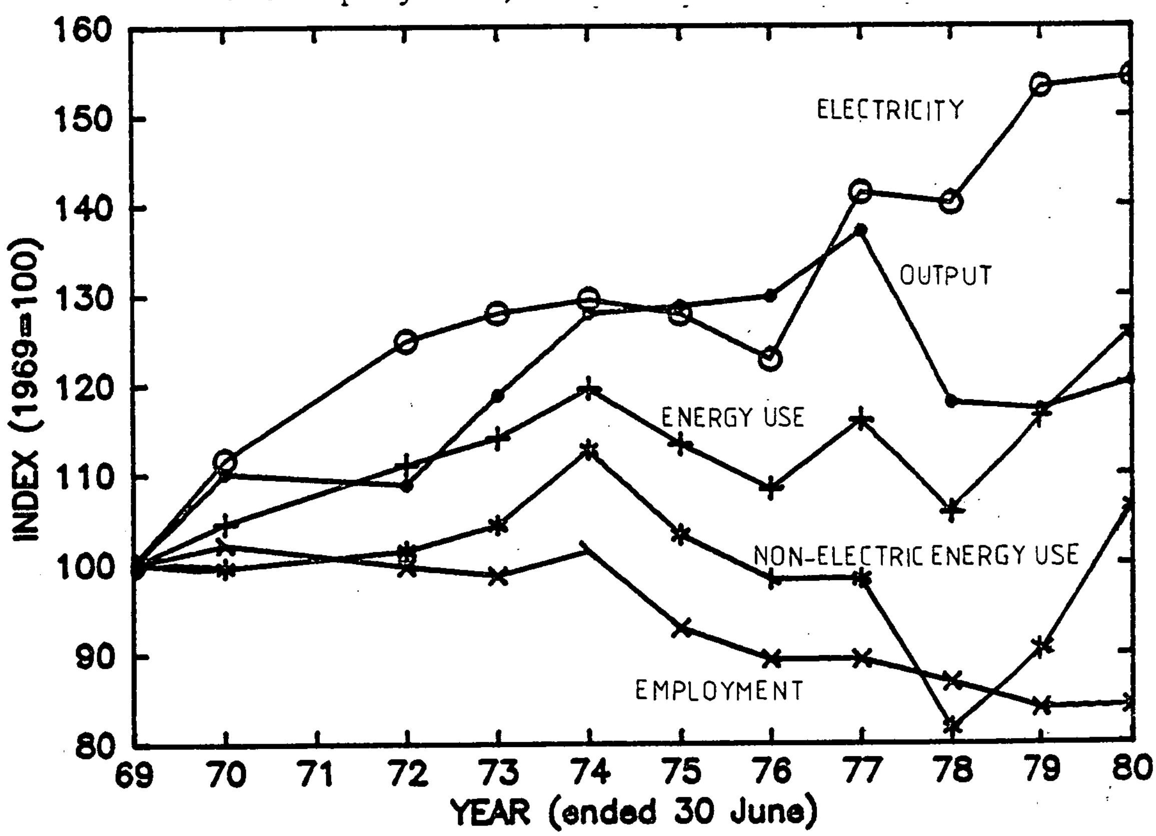
4.2.1 Energy Use

Chapter 1 provided an outline of the changes that have taken place in energy use, employment and output, and related these changes to the particular circumstances of Tasmania. In this section the trends of energy use, employment and output by Tasmanian manufacturing will be set in that broader context. The changes in energy supply for Tasmania largely amounted to a developing shortage of hydro-electric power, which is largely equivalent to electrical energy in the case of Tasmanian manufacturing, steeply increased prices for oil after 1978, increasing threats to imported fuel supplies and only one fuel with a decreasing real price, electricity. This section will outline the trends in energy use that have been associated with these changes, and then go on to examine the trends in output and employment that have been occurring at the same time.

Manufacturing energy use has increased by 26% between 1968-69 and 1979-80. This increase is surprising in the light of publicity about the 1970s energy crisis. However there has not been a steady increase in energy use over the whole period. Figure 4.1 shows that energy use was increasing until 1973-74 but then declined until 1977-78, before a steep increase to 1979-80. This complicated trend in energy use seems to contradict some of the major influences on energy use. For instance, the steepest oil price increases of the decade for Australian manufacturing occurred after 1978, yet this is when the strongest growth in Tasmanian manufacturing energy use occurred. It is likely that manufacturing energy use is closely linked to the type of capital equipment used by manufacturing and so will not change rapidly in response to sudden price increases. While full investigation of this long term response would be a major study of the manufacturing production process, considerable insight can be gained by dividing total manufacturing energy use into the various fuels used by different manufacturing subdivisions. Each subdivision has a different pattern of fuel use and so will have been affected by the changes in energy supply in different ways.

FIGURE 4.1

Indexes of Tasmanian Manufacturing Real Value Added, Energy Use, Electricity Consumption, Non-electric Energy Use and Employment, 1968-69 to 1979-80.



This break up will be done in two parts. First, manufacturing energy use will be divided up into different fuels, and second the trends for different fuels will be related to particular subdivisions. In this thesis fuels have been divided into two groups, electricity and non-electric fuels (for Tasmania petroleum and coal). This grouping separates out electricity, which has particular social significance for Tasmania, as well as being the major domestically produced fuel for Tasmania, and the only Tasmanian manufacturing fuel which has had a declining real price over the 1970s.

There has been a strong and continuous increase in electricity consumption by Tasmanian manufacturing over the 1970s. Electricity consumption increased by 54%, and this increase was continuous for all but three years, 1974-75, 1975-76 and 1977-78. The increase in electricity use was pervasive. All but two subdivisions (23 Textiles and 24 Clothing and Footwear) had increased electricity consumption over this period. The most important increase, however, occurred in subdivision 29 Basic Metals. Its electricity consumption increased by 52% and, because it accounts for 70% of manufacturing electricity consumption, its increase dominated the manufacturing trend.

A different trend occurred in the use of non-electric fuels by Tasmanian manufacturing. Although over the full eleven year period non-electric energy use increased by 6%, up until 1978-79 there had been a fall of 9%. The sharp increase in non-electric energy use between 1977-78 and 1979-80 was entirely due to a strong increase in non-electric energy use by subdivision 26 Paper, Paper Products, Printing and Publishing, which accounts for 54% of manufacturing non-electric energy use. The increase in non-electric energy use by manufacturing as a whole is not as pervasive as the increase in electricity consumption. Five of the twelve subdivisions of manufacturing had declines in their non-electric energy use.

While overall manufacturing energy use increased by 26% in Tasmania between 1968-69 and 1979-80, this increase is composed of a number of different trends. Non-electric energy use by manufacturing has been largely stable, corresponding to the strong increases in the real price of both coal and petroleum products. This stability contrasts sharply with the strong increase in electricity use. Thus the increase in manufacturing energy use has almost totally been due to an increase in electricity use. While this increase corresponds to the drop in the real price of electricity, it conflicts with the shortage of hydro-electric power now developing in Tasmania.

4.2.2 Output and Employment

Despite the 'difficult times' of the 1970s real value added by Tasmanian manufacturing increased by 20% between 1968-69 and 1979-80. The increase was, however, affected by a fall in real output in 1977-78, which has still not been made up. Up to 1976-77 real output had increased by 37% above the 1968-69 level. Since 1978-79 real output has grown only slightly. The overall increase in manufacturing real value added, however, has been pervasive. All but three manufacturing subdivisions (23 Textiles, 27 Chemical, Petroleum and

Coal Products, and 28 Non-metallic Mineral Products) had increases in their real output for the whole period. Since no particular subdivision dominates manufacturing output, the manufacturing trend has been the result of trends occurring in most manufacturing subdivisions.

Up till 1977-78 changes in the energy supply situation did not stop Tasmanian manufacturing increasing its output, although it is still possible that energy supply changes may have limited the rate of growth. However, after 1977-78, there has been a decline and then no growth in real output. While this change coincides with the introduction of world parity oil pricing by the Federal Government, it is not possible to connect these two conclusively in this thesis because of the wide range of other influences on manufacturing output. Further, it is not possible to determine the direction of causality, if any; that is, whether a fall in output caused reduced energy use, or whether the changes in energy supply limited or stopped the growth of output. These questions could only be answered by a much larger study.

One important aspect of the relation between energy use and output is that even though there may have been some dramatic events surrounding the supply of energy, these events have not reduced non-electric energy use, and they have not stopped total energy use growing. Indeed, during the period from 1977-78 to 1979-80, when there was no growth in output, both electricity consumption and non-electric energy use had some of their strongest growth for the decade. This coincidence suggests a weak relation between growth in output and growth in energy use, at least on a direct annual basis, though it would not be contradictory with the long run adjustments associated with capital use mentioned above (section 4.2.1).

Manufacturing employment has declined by 16% between 1968-69 and 1979-80, in sharp contrast to the growth in manufacturing output. This trend, however, has also been pervasive, with only three subdivisions of manufacturing having increased employment (31 Fabricated Metals, 33 Other Machinery and Equipment, and 34 Miscellaneous Manufacturing). The broad base of decline in manufacturing employment is demonstrated by the fact that no subdivision dominates manufacturing employment, the overall manufacturing trend being the result of changes occurring in most subdivisions.

The decline in manufacturing employment has occurred since 1973-74. Until that year, employment was largely stable. Since then the decline has been continuous. The decline in manufacturing employment has not been associated with a decline in total energy use. Actually, while employment was declining, energy use remained largely stable. There is little association between the trends in energy use and employment even when energy use is divided between the two fuel groups. While the period of decline in employment does coincide with the decline in non-electric energy use, there was no increase in employment associated with the sharp increase in non-electric energy use in 1979-80. With regard to the other fuel, electricity, there is definitely no association between increased electricity consumption and increased employment in manufacturing. Over the whole period of declining employment, there has been a steady growth in manufacturing electricity consumption. This combination suggests that, rather than there being an association between increased electricity consumption and increased employment, electricity is being substituted for jobs in Tasmanian manufacturing.

The exceptions to the general manufacturing trends are important. Four areas of manufacturing had growth in employment over the 1970s: subdivisions 31 Fabricated Metals, 33 Other Machinery and Equipment, and 34 Miscellaneous Manufacturing, and manufacturers with less than four employees. None of these areas is significant enough to affect overall manufacturing employment, so they have not affected the overall decline in manufacturing employment. However, the fact that they have had increased employment while the mainstream of manufacturing has had declining employment, means that there is some possibility of avoiding the historical trend of declining manufacturing employment, and suggests the need for further investigation of the circumstances surrounding these increases in manufacturing employment.

4.3 Trends in the Energy and Labour Intensity of Tasmanian Manufacturing

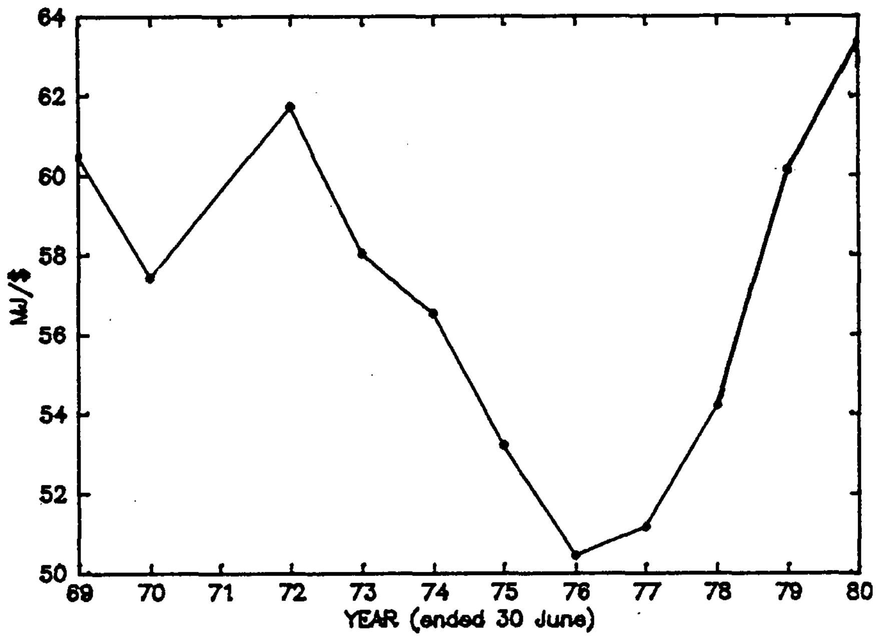
The above comparison of the trends in energy use, employment and value added in Tasmanian manufacturing suggests that there have been some major changes in the Tasmanian manufacturing process over the 1970s. One aspect of these changes will now be examined by looking at the energy and labour intensity of Tasmanian manufacturing. Energy intensity will be examined by looking at the ratios of energy use to real value added and employment, while labour intensity will be examined by looking at the ratio of jobs to output.

4.3.1 Energy Intensity of Output

In 1979-80 Tasmanian manufacturing used 63.3 MJ/$ of real value added. This represented a 5% increase on the 1968-69 level of 60.5 MJ/$. This slight increase may appear to support the notion that the past stability of the ratio of energy use to output overseas, is also reflected by Tasmanian manufacturing. This is not the case. The slight overall increase hides an 18% decline between 1971-72 and 1975-76, followed by a 25% increase to 1979-80 (Figure 4.2). These changes do not directly reflect the changes in energy prices affecting Australian manufacturing, since the 25% increase in energy intensity coincided with the largest increases in petroleum prices. However, analysis of the different fuel groups sheds some light on the reasons for this trend in the overall energy intensity of Tasmanian manufacturing.

FIGURE 4.2

Tasmanian Manufacturing
Energy Use to Real Value Added Ratio,
1968-69 to 1979-80.



The non-electric energy intensity of output has declined almost continually over the 1970s (Figure 4.3). It decreased by 12% over the 11 year period. While this decline in energy use apparently fits more closely with the recent changes in energy supply, it seems unlikely that it actually results from them. There was a continuous decline in non-electric energy intensity from 1968-69 to 1977-78, but a sharp increase in non-electric energy intensity began in 1978-79. Thus, the decline in the non-electric energy intensity appears to have been the continuation of earlier trends, while the recent increase bears little relation to price or supply changes.

The trend of electricity intensity has been more consistent with changes in prices. Over the 1970s electricity intensity increased by 28%. Figure 4.4 shows that this increase has largely occurred since 1975-76. Since electricity was the only fuel that did not have a sharply increasing real price over this period it would have been the logical source for increased energy use. The increasing electricity intensity of output provides a sharp contrast to the decline in non-electric energy intensity over this period.

FIGURE 4.3

Tasmanian Manufacturing
Non-electric Energy Use to Real Value Added Ratio,
1968-69 to 1979-80.

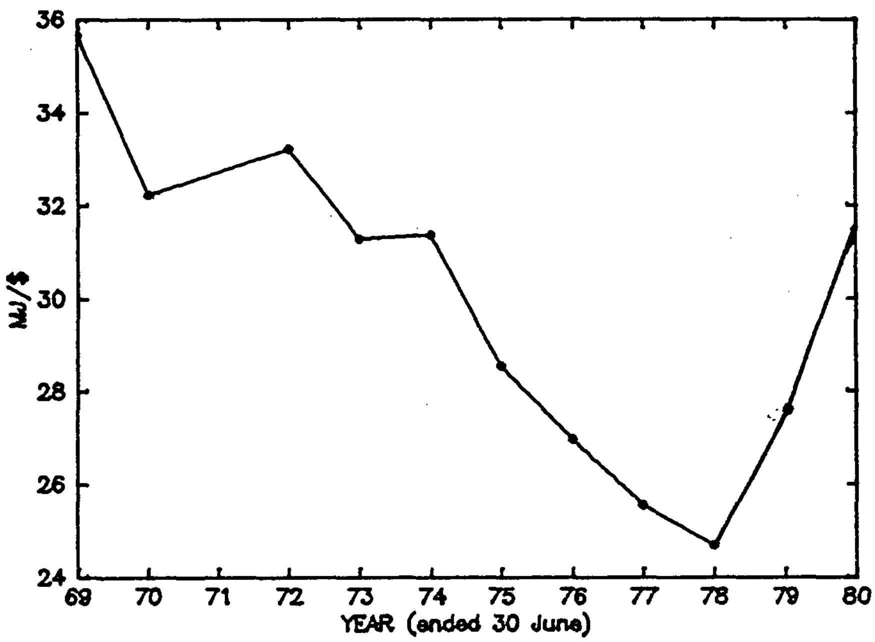
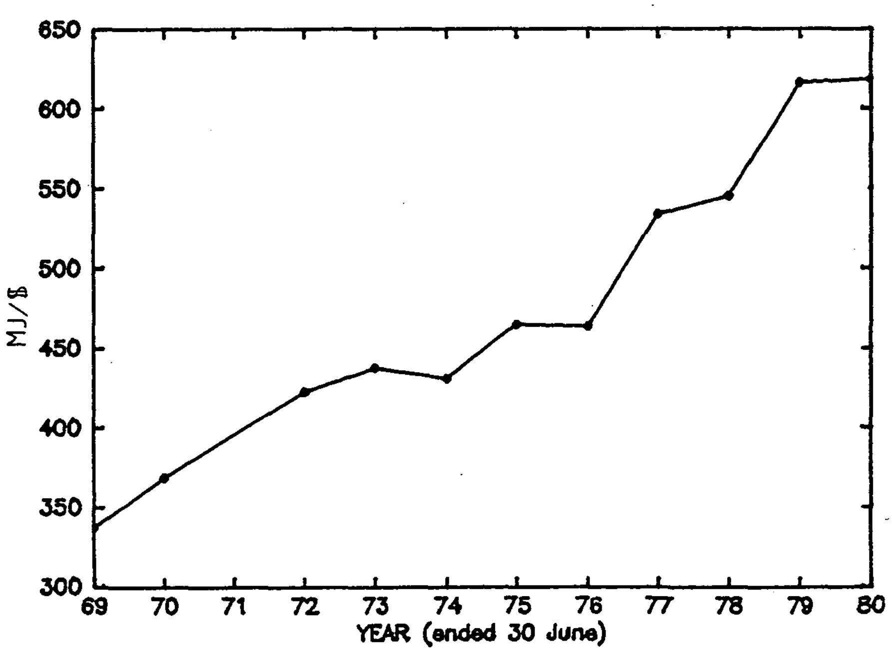


FIGURE 4.4

Tasmanian Manufacturing
Electricity Consumption to Real Value Added Ratio,
1968-69 to 1979-80.



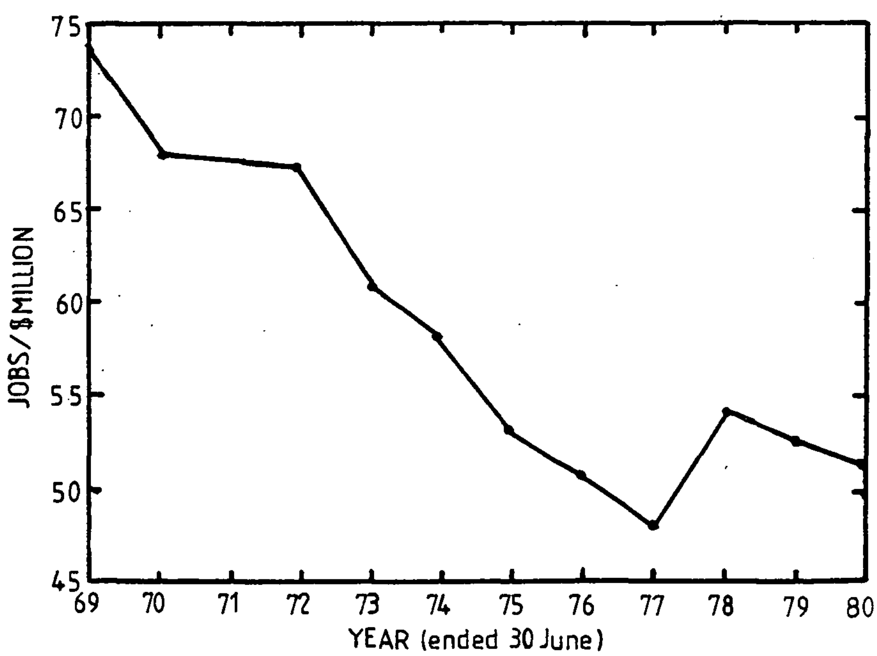
The trends in the energy intensity of Tasmanian manufacturing production show that the Tasmanian manufacturing process has not yet responded to the changing energy supply situation that has developed over the 1970s. While the trend of electricity intensity appears to be at least consistent with price changes, there has been no decline in non-electric energy intensity associated with the comparatively moderate increases in petroleum and coal prices in 1973-74, or the larger increases in oil prices since 1977-78. There has been a strong increase in electricity intensity in particular. This means that Tasmanian manufacturing power demand has also increased, despite Tasmania's developing hydro-power shortage. It may be that the 11 year period under analysis is too short to show a change in energy demand, since the demand for energy is likely to be closely related to the type of manufacturing process, and therefore changes in energy demand would necessitate some level of capital investment. However, it has not been possible to carry out analysis of this question since it would involve a much more detailed study of Tasmanian manufacturing.

4.3.2 Energy Intensity of Jobs

The direction of the trend in the energy intensity of jobs has been similar to that of the energy intensity of output, but the increase in the energy intensity of jobs has been

FIGURE 4.5

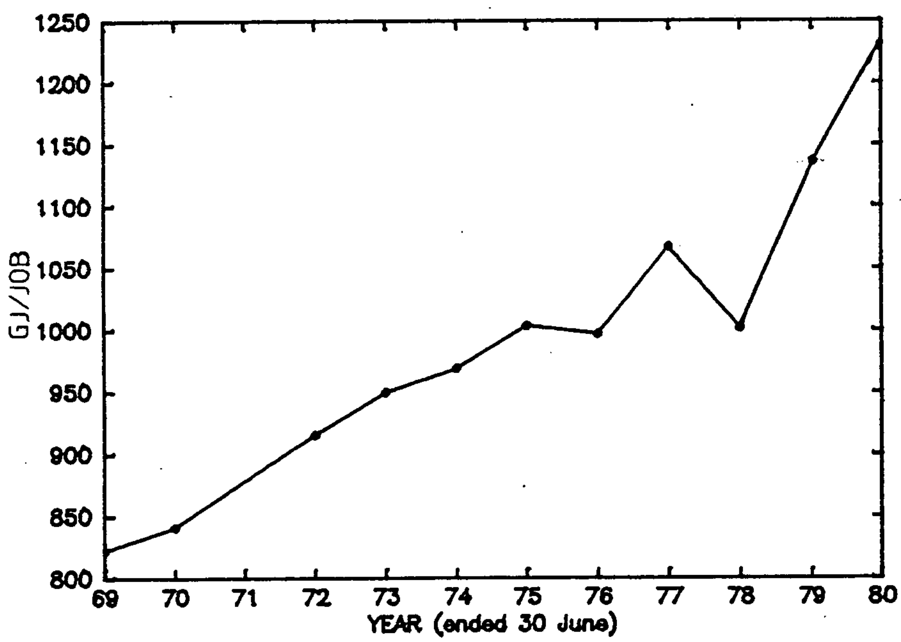
Tasmanian Manufacturing
Employment to Real Value Added Ratio,
1968-69 to 1979-80.



much larger. It is therefore necessary to examine these trends in the light of the trend in the labour intensity of output.

The number of jobs per $million of real value added has fallen by 30% over the 1970s (Figure 4.5). This trend has been so strong that, despite increasing real output, there has been an absolute decline in employment. The decline in labour intensity has been continuous over most of the 1970s, and has been pervasive across all manufacturing sub-divisions. The decline in the number of jobs per $million of real value added represents a continuation of the historical trend of increased labour productivity. As mentioned in Chapter 1, the number of hours worked in Australian manufacturing has been declining, so the reduction in the number of jobs per $million of output implies that there has been an increase in labour productivity. The decline in the level of labour use in manufacturing means that the increase in the energy intensity of jobs has been even larger than for the energy intensity of output.

FIGURE 4.6
Tasmanian Manufacturing
Energy Use to Employment Ratio,
1968-69 to 1979-80.



Tasmanian manufacturing used 1231 GJ of total energy per job in 1979-80, which was a 50% increase on the 1968-69 level of 822 GJ/Job. Figure 4.6 shows that the increase in the energy intensity of employment has been continuous over most of the 1970s, and was particularly steep after 1977-78. The increase in energy use per job pervades most of manufacturing industry, with only one subdivision, 24 Clothing and Footwear, experiencing a decline.

As for the energy intensity of output, the energy intensity of employment has two components: a strong and continuous increase in the electricity intensity of employment (83%) and a largely stable ratio of non-electric energy use to employment (6% decrease to 1977-78). However, the ratio of non-electric energy use to employment has increased sharply in 1978-79 (15%) and 1979-80 (30%). Thus the increase in the total energy use to employment ratio has also largely been due to increased electricity consumption per job.

The changes in these ratios mean that there has been very little correspondence between changes in energy use and changes in employment. The only period of correspondence was between non-electric energy use and jobs between 1968-69 and 1977-78, but this relation was destroyed by the sharp increase in the non-electric energy intensity of jobs after 1977-78. Therefore, it is too simplistic to say that increased energy use leads to increased employment. If anything, energy and labour have been substitutes in Tasmanian manufacturing over the 1970s. This overall trend in Tasmanian manufacturing agrees with that described by Grossman and Daneker (1977) in relation to the United States. They saw this trend as being the result of the introduction of technological and other changes into the production process which led to increased productivity per worker. However, following from the increase in productivity was the danger that less workers would be needed, unless there was a large increase in the demand for output.

4.4 The Structure of Tasmanian Manufacturing in Terms of Energy and Labour Intensity

The overall manufacturing energy use to real value added ratio describes the energy intensity of production in manufacturing as a whole. This ratio is made up of the energy intensity of the wide range of processes in manufacturing which each has its own energy intensity. It is beyond the scope of this thesis to investigate fully the varying energy intensity of all the individual manufacturing processes carried out in Tasmania. However, a first step in analysing the structure of Tasmanian manufacturing energy intensity is to look at the energy intensity of the subdivisions of manufacturing. Labour intensity is often seen as the converse of energy intensity and so it is useful to contrast the energy use to output and energy use to employment ratios, with the employment to output ratio. The description of manufacturing produced by this examination will then be placed in the context of the changes in energy supply that have occurred over the 1970s.

Tasmanian manufacturing consists of two distinct groups of subdivisions; those with high energy use to real value added ratios and those with low ratios. Table 4.3 shows the energy use to real value added ratios for each manufacturing subdivision. In this table, subdivisions 26 Paper, Paper Products, Printing and Publishing, 27 Chemical, Petroleum and Coal Products, 28 Non-metallic Mineral Products, and 29 Basic Metals form an energy intensive group with energy use to real value added ratios greater than 80 MJ/$. The structure of manufacturing based on energy intensity has changed little since 1968-69, since these four energy intensive subdivisions have remained the same. However, there have been some changes in energy intensity within this group. Increases in energy intensity occurred in subdivisions 26 and 27, and decreases occurred in subdivisions 28 and 29. Production in these industries is generally energy intensive around the world, since a similar group of high energy intensity industries was defined by Darmstadter, Tietelbaum and Polach (1971). Table 4.4 shows that the same group of industries has a high energy intensity of employment. The nature of production of these products requires high energy consumption.

TABLE 4.3

Tasmanian Manufacturing Subdivisions
Energy Use to Real Value Added Ratios

Subdivision	1979-80 Ratio MJ/$	Rank	1968-69 Ratio MJ/$	Rank
28 Mineral Prod.	130.11	1	144.34	1
29 Basic Metals	108.22	2	115.57	2
27 Chemicals	101.29	3	71.72	4
26 Paper	98.79	4	85.17	3
21-22 Food etc.	25.03	5	21.51	5
23 Textiles	14.46	6	18.38	6
25 Wood	9.71	7	5.29	9
34 Miscellaneous	7.07	8	7.54	8
33 Oth. Machinery	6.26	9	4.32	10
32 Transport Eq.	2.95	10	3.52	11
31 Fabricated Metals	2.78	11	1.68	12
24 Clothing etc.	0.86	12	7.64	7
Manufacturing	26.32		23.15	

The subdivisions with low energy use to real value added ratios may themselves be divided into two groups. Subdivisions 21-22 Food, Beverages and Tobacco and 23 Textiles both have energy use to output ratios which are much higher than the other subdivisions. Once again a similar grouping exists with the energy intensity of employment.

Apart from showing the energy intensity of employment for manufacturing subdivisions, Table 4.4 also shows the labour intensity of manufacturing subdivisions (employment to output ratio). Comparison of the ranking of subdivisions in terms of these two ratios shows that energy intensive subdivisions usually do not have high labour intensities. Because subdivisions have similar energy intensities of output and employment, the comparison between energy intensity of employment and labour intensity of output may be taken as a general comparison of energy intensity with labour intensity. When looking at the trends of energy use per job in the previous section, it appeared that energy and labour were substitutes. They also appear to be substitutes in the static comparison of subdivisions shown in Table 4.4.

TABLE 4.4

Tasmanian Manufacturing Subdivisions
Energy Use to Employment and,
Employment to Value Added Ratios,
1979-80.

Subdivision	Energy Intensity of Employment		Labour Intensity of Output	
	GJ/Job	Rank	Jobs/$M	Rank
29 Basic Metals	3525	1	30.70	12
28 Mineral Prod.	3075	2	42.31	11
26 Paper	2126	3	46.46	10
27 Chemicals	1931	4	52.46	7
21-22 Food etc.	365	5	68.53	4
23 Textiles	219	6	66.03	5
25 Wood	201	7	48.26	9
34 Miscellaneous	139	8	50.85	8
33 Oth. Machinery	76	9	82.13	1
32 Transport Equipment	50	10	59.21	6
31 Fabricated Metals	39	11	71.78	3
24 Clothing	11	12	79.84	2
Manufacturing	1231		51.45	

The most important aspect of the structure of manufacturing in terms of energy intensity becomes apparent when this structure is compared with the structure of output and employment. As described in section 4.2, manufacturing employment and output are concentrated in subdivisions 21-22 Food, Beverages and Tobacco, 25 Wood, Wood Products and

Furniture, 26 Paper, Paper Products Printing and Publishing, and 29 Basic Metals. Two of these subdivisions are among the group with the highest energy intensities: 26 and 29. Subdivison 21-22 has an intermediate level of energy intensity and subdivision 25 has the highest energy intensity among the low energy intensity group. Thus Tasmanian manufacturing employment and output tends to be concentrated among industries with relatively high energy intensities.

The concentration of Tasmanian manufacturing activity among high energy intensity industries has important implications for any growth prospects in Tasmanian manufacturing. If growth in Tasmanian manufacturing output is to be concentrated in these energy intensitive industries, then comparatively larger amounts of energy will need to be supplied in order to achieve a given level of growth in output or employment.

4.5 Conclusion

Over the 1970s Tasmanian manufacturing has been faced with some dramatic changes in energy supply: petroleum and coal price increases, threats to the supply of petroleum, and a growing shortage of hydro-electric power. This chapter has described the response of Tasmanian manufacturing to these changes in three ways. First, it looked at the effect of these changes on manufacturing energy use, and related this to changes in employment and output. Second, it examined the changes in the manfacturing process that coincided with these trends in manufacturing energy use, employment and output. Finally, it examined the structure of Tasmanian industry to see how it related to the changes in energy supply.

Tasmanian manufacturing is particularly vulnerable to threats to its energy supply because its employment and output are both concentrated in industries with high energy intensity. However, over the 1970s there seems to have been little change in the manufacturing process resulting from changes in energy supply. This is not to say that Tasmanian manufacturing has not changed over the 1970s. There has been a large increase in the electricity intensity of production, and a strong decline in the labour intensity of production. These two trends have been associated with the stable use of non-electric fuels. While these trends correlate to a certain extent with the changes in energy prices occurring over this period, it appears that they do not result from these price changes, but rather reflect continuing historical trends, particularly towards increased labour productivity.

The increased energy intensity, increased electricity intensity and declining labour intensity of the Tasmanian manufacturing process have been associated with increased energy use (26%), increased electricity use (54%), increased output (20%) and declining employment (16%). Apart from the increase in output, these trends do not fit in well with the change in Tasmania's circumstances that has occurred over the 1970s. Increased unemployment, energy price increases and threats to energy supplies mean that if these trends continue, Tasmanian manufacturing will be exacerbating two of Tasmania's major problems, unemployment and problems of energy supply.

4.6 References

1. DARMSTADTER, J., TEITELBAUM, P.D. and POLACH, J.G., 1971; Energy in the World Economy: a statistical review of trends in output, trade and consumption since 1925; Resources for the Future, Washington DC.

2. GROSSMAN, R. and DANEKER, G., 1977; Jobs and Energy; Environmentalists for Full Employment, Washington DC.

Chapter 5 - A Comparison of Tasmanian Manufacturing with Australian Manufacturing

This chapter will set Tasmanian manufacturing in the Australian context. It will compare the trends and structure of energy use, employment and output in Tasmanian manufacturing with those occurring in Australian manufacturing. First, it will deal with the trends in energy use, employment and output, then with trends in the energy and labour intensity of manufacturing production, and finally with the structure of manufacturing in terms of energy and labour intensity. However, one important question which must be discussed first is the importance of Tasmanian manufacturing within Australian manufacturing.

5.1 The Significance of Tasmanian Manufacturing in Australian Manufacturing.

Generally, Tasmanian manufacturing is an insignificant part of Australian manufacturing. Tasmanian manufacturing only accounted for 2.6% Australian manufacturing real value added and 2.3% of employment in 1979-80 (Table 5.1). In terms of energy use however, Tasmanian manufacturing is more significant. For instance, Tasmanian manufacturing accounted for 16% of Australian manufacturing electricity use. However, Tasmanian manufacturing can be more significant than this in particular subdivisions. For instance, Tasmanian subdivision 26 Paper, Paper Products, Printing and Publishing accounts for over 40% of the Australian subdivision's energy use.

The low proportion of Australian manufacturing accounted for by Tasmania means that trends occurring in Australian manufacturing are largely independent of those occurring in Tasmanian manufacturing. For instance, it would require a 100% increase in Tasmanian manufacturing value added to produce a 2% increase in Australian manufacturing value added. Even in non-electric energy use by subdivision 26 Paper, Paper Products, Printing and Publishing, where Tasmania accounts for the largest proportion of the Australian total, a 25% increase in non-electric energy use by subdivision 26 in Tasmania would only produce an 11% increase in Australian subdivision 26 non-electric energy use. The independence of the overall Australian trends from those in Tasmania means that in the following analysis they can be compared as if they were separate entities.

5.2 Comparison of the Structure of Tasmanian and Australian Manufacturing: Energy Use, Employment and Output.

The previous chapter showed that Tasmanian manufacturing was dominated by two subdivisions: 26 Paper, Paper Products, Printing and Publishing, and 29 Basic Metals. These two subdivisions were important in terms of energy use, employment and output. Two other subdivisions were important in terms of employment and output: subdivision 21-22 Food, Beverages and Tobacco, and subdivision 25 Wood, Wood Products and Furniture.

TABLE 5.1

Tasmanian Manufacturing Subdivisions as a Percentage of Australian Manufacturing Sudivisions in five Characteristics of Manufacturing, 1979-80.

Subdivision	Energy Use	Electricity	Non-electric Energy Use	Employment	Real Value Added
			Percentage		
21-22 Food	5.3	3.8	5.8	3.1	2.6
23 Textiles	6.4	2.8	8.0	4.7	4.5
24 Clothing	0.1	0.2	0.1	0.3	0.3
25 Wood	11.0	16.8	6.3	4.8	6.7
26 Paper	42.3	39.2	43.5	5.4	6.1
27 Chemicals	7.3	5.9	8.0	1.8	1.5
28 Mineral Prod.	4.2	4.1	4.2	1.7	1.7
29 Basic Metals	6.5	24.3	0.9	3.8	5.2
31 Fabricated	1.2	1.3	1.0	1.5	1.3
32 Transport Equipment	0.6	0.8	0.3	0.5	0.6
33 Other Machinery	1.2	0.8	1.9	0.6	0.5
34 Misc.	0.7	0.5	0.8	0.6	0.8
Manufacturing	8.3	16.1	5.6	2.3	2.6

Australian manufacturing has a different structure in terms of employment and output. Table 5.2 shows that while subdivision 21-22 Food, Beverages and Tobacco is also important in Australian employment and output, this is not the case for the other three major subdivisions. In Australian manufacturing employment the major subdivisions are 33 Other Machinery and Equipment, 32 Transport Equipment, and 31 Fabricated Metals. In output they are 33 Other Machinery, 29 Basic Metals, and 31 Fabricated Metals. While for Tasmanian manufacturing in both employment and output the major subdivisions were subdivisions 21-22 Food, Beverages and Tobacco, 25 Wood, Wood Products and Furniture, 26 Paper, Paper Products, Printing and Publishing, and 29 Basic Metals.

The importance of subdivisions 21-22 Food, Beverages and Tobacco, 25 Wood, Wood Products and Furniture, 26 Paper, Paper Products, Printing and Publishing and 29 Basic Metals, in Tasmanian manufacturing means that there is more concentration on initial processing in Tasmanian manufacturing than in Australian manufacturing. This concentration is increased because, in Tasmanian manufacturing, the major subdivisions account for a larger proportion of employment and output. The four major subdivisions in Tasmanian manufacturing account for 70% of total employment, while in Australian manufacturing they only account for 51%. In output they account for 76% compared to 52%. In Tasmanian manufacturing initial processing activities are much more important than in Australian manufacturing, and Tasmanian manufacturing is more heavily dependent on these activities. Because these activities tend to be more energy intensive, Tasmanian manufacturing is more heavily dependent on energy intensive activities than Australian manufacturing.

The difference in structure does not extend to energy use, however. The four major energy using subdivisions in Australian manufacturing are 21-22 Food, Beverages and Tobacco, 27 Chemicals, Coal and Petroleum Products, 28 Non-metallic Mineral Products, and 29 Basic Metals. The major difference in the structure of manufacturing energy use is that subdivision 26 Paper, Paper Products, Printing and Publishing is much less important in Australian manufacturing than it is in Tasmanian manufacturing.

Electricity consumption in Tasmanian and Australian manufacturing is dominated by subdivision 29. However, its dominance is much greater in Tasmanian manufacturing, accounting for 70%, compared to 46% in Australian manufacturing. While the other major electricity consuming subdivision in Tasmanian manufacturing, 26 Paper, Paper Products, Printing and Publishing, is also among the five major consuming subdivisions in Australian manufacturing, it is not nearly as important in Australian manufacturing electricity consumption as it is in Tasmanian manufacturing. Further, this significance is largely due to the large electricity consumption by Tasmanian firms, since these firms account for a large proportion of the electricity used by subdivision 26 in Australian manufacturing.

In Australian manufacturing, as was the case in Tasmanian manufacturing, proportional energy use and electricity consumption are not matched by proportional contribution to employment and output. Only two of the major energy using subdivisions have a similar proportional demand for energy to their proportional contribution to employment and output: 21-22 Food, Beverages and Tobacco, and 26 Paper, Paper

TABLE 5.2

The Structure of Australian Manufacturing Subdivisions in Electricity Consumption, Energy Use, Output and Employment, 1968-69 and 1979-80.

Subdivision	1979-80	%	Cum.%	Rank	1968-69	%	Rank
			Electricity Consumption (TJ)				
29 Basic Metals	46 538	46	46	1	18 768	34	1
21-22 Food etc.	10 009	10	56	2	5 635	10	3
27 Chemicals	8 859	9	65	3	6 102	11	2
28 Mineral Prod.	8 082	8	73	4	4 841	9	4
26 Paper	7 622	8	91	5	4 611	8	5
Manufacturing	100 669	100			54 710	100	
			Energy Use (TJ)				
29 Basic Metals	195 371	50	50	1	103 400	28	1
28 Mineral Prod.	57 107	15	65	2	94 219	26	2
21-22 Food etc.	40 322	10	75	3	50 856	14	3
27 Chemicals	28 358	7	83	4	35 294	10	4
26 Paper	27 460	7	90	5	29 153	8	5
Manufacturing	389 077	100			366 800	100	
			Real Value Added ($'000)				
21-22 Food	3 239 573	16	16	1	2 316 769	14	1
33 Other Machinery	2 622 243	13	29	2	2 193 151	13	2
29 Basic Metal	2 255 413	11	40	3	1 556 841	10	5
32 Transport Equipment	2 147 656	11	51	4	1 766 485	11	3
26 Paper	1 932 338	10	60	5	1 438 236	9	6
Manufacturing	19 920 945				15 982 568		
			Employment				
21-22 Food etc	186 353	16	16	1	184 806	15	2
33 Other Machinery	159 428	14	30	2	187 966	15	1
32 Transport Eq.	136 884	12	42	3	144 514	11	3
31 Fabricated Metals	108 985	9	51	4	112 793	9	5
26 Paper	101 579	9	60	5	101 565	8	6
M'facturing	1 154 184	100			1 264 037	100	

Products, Printing and Publishing. Since, much of subdivision 26's demand for energy occurs in Tasmania, where proportional demand for energy is much higher than proportional contribution to employment and output, the reverse situation must be true of firms in this subdivision on the mainland, where proportional demand for energy must be lower than proportional contribution to output and employment.

The three other major energy using subdivisions in Australian manufacturing, 27 Chemical, Coal and Petroleum Products, 28 Non-metallic Mineral Products and 29 Basic Metals make very low proportional contributions to Australian manufacturing employment and output. There is only one situation where one of these subdivisions rates among the five top subdivisions, that is subdivision 29 in the case of output.

5.3 Trends in Manufacturing Energy Use, Employment and Output

5.3.1 Energy Use

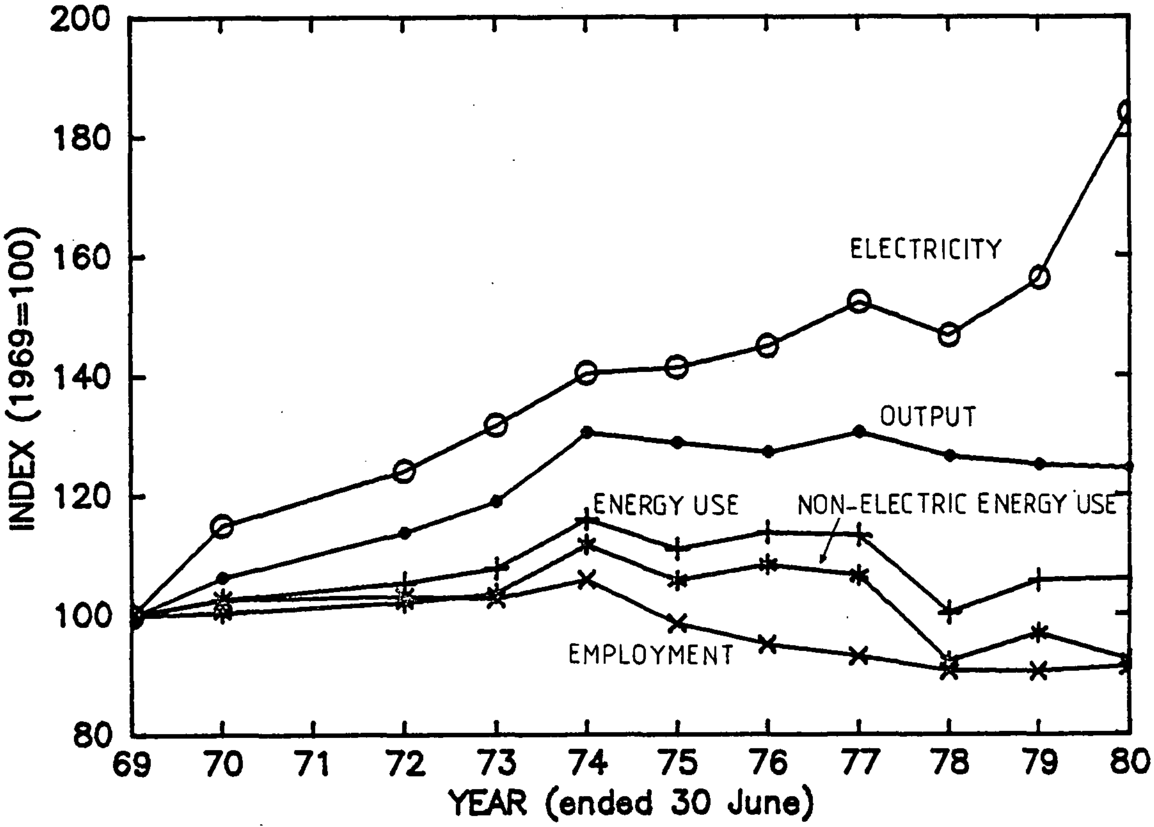
Australian manufacturing energy use increased by only 6% between 1968-69 and 1979-80 (Figure 5.1), compared with the 26% increase in Tasmanian manufacturing energy use. To a certain extent this comparison is misleading because the trend of Tasmanian manufacturing energy use is influenced by a 14% increase in energy use in 1979-80. Despite this final increase, the trend in Australian manufacturing energy use is consistently below the trend of Tasmanian manufacturing energy use.

The trend of Australian manufacturing energy use is heavily influenced by subdivision 29 Basic Metals, which accounts for 50% of Australian manufacturing energy use. Subdivision 29 had the largest increase in energy use between 1968-69 and 1979-80, of any Australian manufacturing subdivision, and it was only one of two subdivisions to have any increase in energy use. Thus the trend of Australian manufacturing energy use contrasts sharply with that taking place in Tasmanian manufacturing over this period, where all but three subdivisions had increased energy use.

The trend of Australian manufacturing energy use is made up of similar trends in electricity consumption and non-electric energy use to those occurring in Tasmania. The increase in electricity consumption by Australian manufacturing (84%) was larger than that for Tasmanian manufacturing (54%). There was a small decline in non-electric energy use (8%) compared to the small increase in non-electric energy use by Tasmanian manufacturing (6%). The much smaller increase in total energy use by Australian manufacturing occurred despite these similar trends in electricity consumption and non-electric energy use, because Australian manufacturing has a smaller proportional use of electricity. In 1979-80 Tasmanian manufacturing electricity consumption accounted for 50% of manufacturing energy use, while for Australian manufacturing it was only 26%. Therefore, even though the increase in electricity consumption by Australian manufacturing was larger than that for Tasmanian manufacturing, it did not have a large impact on total energy use.

FIGURE 5.1

Indexes of Australian Manufacturing Real Value Added, Energy Use, Electricity Consumption, Non-electric Energy Use and Employment, 1968-69 to 1979-80.



5.3.2 Output and Employment

Australian manufacturing real value added increased by 25% compared with the increase of 20% in Tasmanian manufacturing. As was the case in Tasmanian manufacturing the increase in real value added was quite pervasive. All manufacturing subdivisions had increases in real value added over the 1970s.

To some extent the size of these increases in manufacturing real value added appears to contradict the idea that manufacturing has been having a difficult time during the 1970s. However, both in Tasmanian and Australian manufacturing most of the increase in real value added occurred before 1973-74 (Figures 4.1 and 5.1). Australian manufacturing real value added did not suffer the major decline that occurred in Tasmanian manufacturing in 1977-78, but its real value added has not grown since 1973-74.

The increases in value added, which occurred in all Australian manufacturing subdivisions, contrast with the decline in manufacturing employment which occurred over the same period. Australian manufacturing employment, however declined by 9% (Figure 5.1), compared with the 16% decline in Tasmanian manufacturing employment. This decline in employment affected nearly all of Australian manufacturing, with employment in all but four subdivisions declining. The beginning of this decline coincides with the end of the growth in Australian manufacturing real value added. However, over the whole period Australian manufacturing has been characterised by increased labour productivity as was the case in Tasmanian manufacturing. When real value added was growing before 1973-74, the increase in labour productivity produced stable manufacturing employment. After 1973-74, when real value added was stable, manufacturing employment declined. This pattern is reflected in most Australian manufacturing subdivisions.

A major turning point in the trends in Australian manufacturing output and employment occurred in 1973-74. While this turning point coincides with the onset of the 'energy crisis' in the rest of the world, it does not coincide with the onset of large increases in energy prices for Australian manufacturing, which started in 1978. Further mainland Australia's large supplies of coal and its high self sufficiency in oil suggest that the stabilisation in energy use which occurred in 1973-74 did not result from restricted supplies. Further, while there was a decline in total energy use, affecting both electricity and non-electric energy, in 1977-78, this decline is not associated with a sudden decline in employment or output. It seems that for Australian manufacturing as a whole, reduced activity in manufacturing has led to reduced demand for energy, rather than changes in energy supply restricting growth in output or employment.

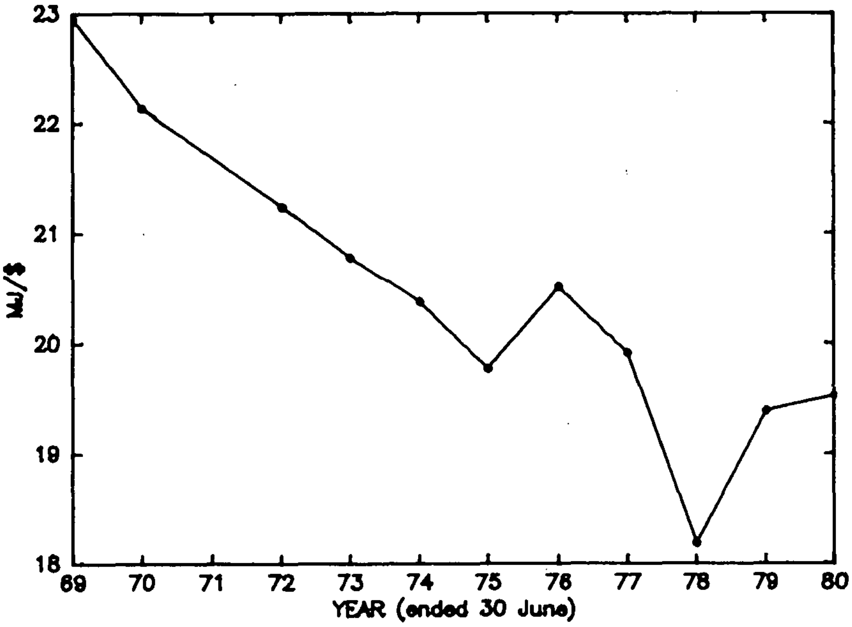
5.4 Trends in Manufacturing Energy and Labour Intensity

5.4.1 Energy Intensity of Output

While the energy intensity of output in Tasmanian manufacturing increased by 5% over the 1970s, in Australian manufacturing it declined by 15%. Figure 5.2 shows that most of the decline in Australian manufacturing energy intensity of output occurred before 1974-75, and since 1978-79 there has been little change. In Tasmanian manufacturing, the trend of overall energy intensity of output was made up of declining non-electric energy intensity and increasing

FIGURE 5.2

Australian Manufacturing
Energy Use to Real Value Added Ratio,
1968-69 to 1979-80.



electricity intensity. In Australian manufacturing the trends were in the same direction but the changes were larger (Figures 5.3 and 5.4). Non-electric energy intensity declined by 26% in Australian manufacturing, compared with 12% in Tasmanian manufacturing, while electricity intensity increased by 48% compared with a 28% increase in Tasmania.

The increase in total energy intensity of output in Australian manufacturing is not reflected in all manufacturing subdivisions. Actually only two subdivisions, 25 Wood, Wood Products and Furniture, and 29 Basic Metals, had increased energy intensity of output. The other subdivisions all had declines of about 20% or more. In Tasmanian manufacturing the trend of increased energy intensity of output was more pervasive with six of the twelve subdivisions having increases in their energy use to real value added ratios.

The trends in electricity intensity and non-electric energy intensity are similar for Australian manufacturing and for Tasmanian manufacturing. While these trends broadly fit with changes in the prices of energy for manufacturing as measured by the Price Index of Materials Used by Manufacturing Industry, they do not appear to have resulted from the price changes. Actually, there appears to have been a moderation in the decline, and even an increase in non-electric energy intensity just when the major price increases occurred.

FIGURE 5.3

Australian Manufacturing
Non-electric Energy Use to Real Value Added Ratio,
1968-69 to 1979-80.

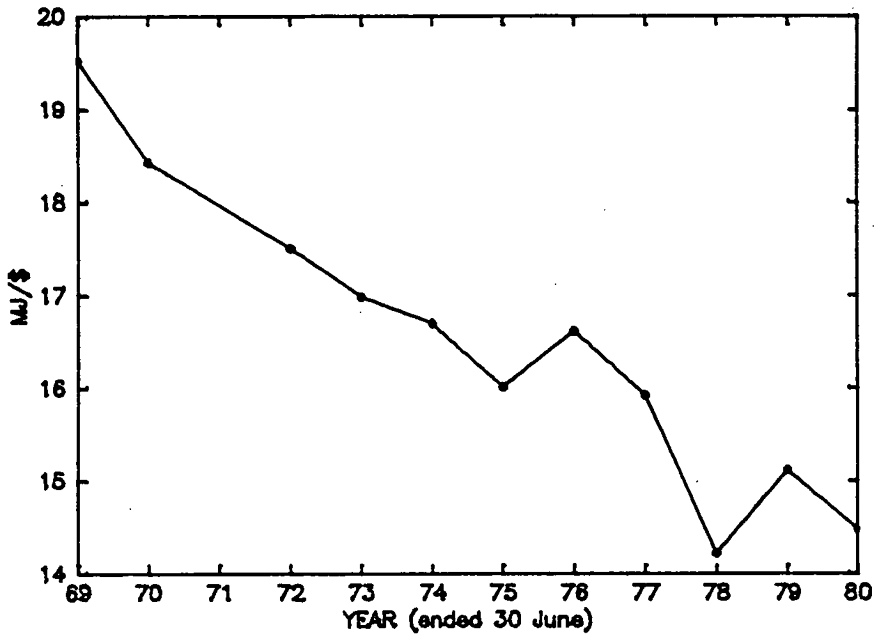
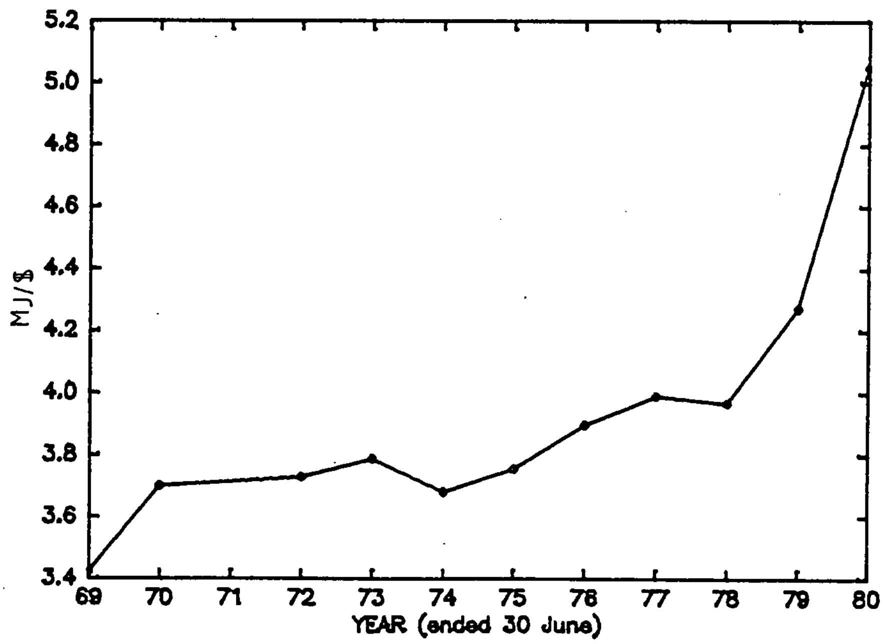


FIGURE 5.4

Australian Manufacturing
Electricity Consumption to Real Value Added Ratio,
1968-69 to 1979-80.

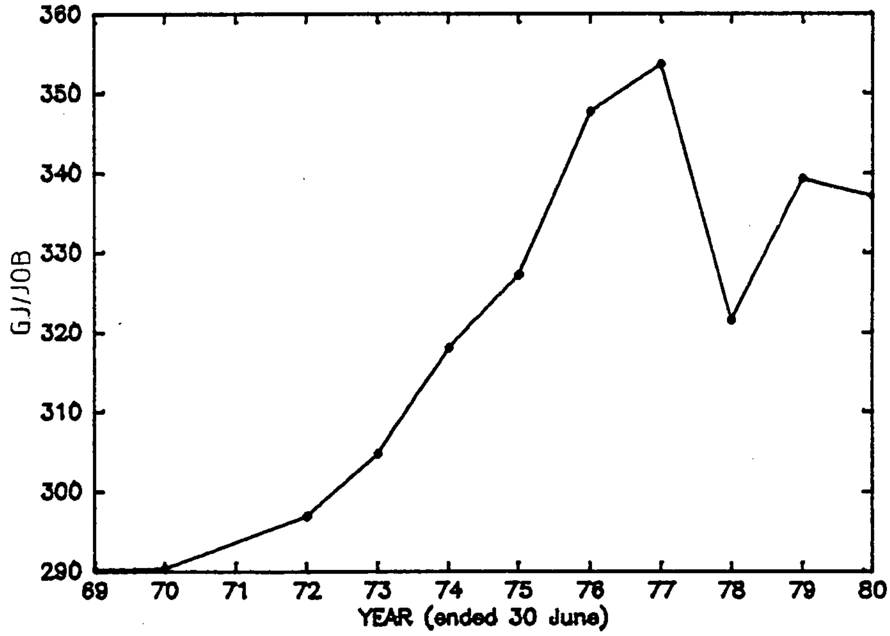


5.4.2 Energy Intensity of Jobs

In Tasmanian manufacturing the trend of increased labour productivity dominated the trends of the energy use to employment ratios. In Australian manufacturing the number of jobs per million dollars of real value added declined by 27% between 1968-69 and 1979-80. This decline was very close to the 30% fall that occurred in Tasmanian manufacturing. As shown in Figure 5.5 this decline occurred before 1976-77. Since then there has been a slight increase in the ratio of jobs to output. Tasmanian manufacturing reflected the same trend with a stabilisation occurring after 1976-77. In both Tasmanian and Australian manufacturing there has been a strong trend toward increased labour productivity over most of the 1970s.

FIGURE 5.5

Australian Manufacturing
Energy Use to Employment Ratio,
1968-69 to 1979-80.



In Australian manufacturing the energy intensity of employment increased less than it did in Tasmanian manufacturing; 16% in Australian manufacturing compared to 50% in Tasmanian manufacturing. While in Tasmanian manufacturing increased energy intensity of employment was a characteristic of nearly all subdivisions, the opposite is true of Australian manufacturing. Energy use per job increased in only two Australian manufacturing subdivisions: 25 Wood, Wood Products and Furniture, and 29 Basic Metals. Thus while there was a pervasive trend toward increased energy use per job in Tasmanian manufacturing, the opposite trend was just as pervasive in Australian manufacturing.

The trend of overall energy use per job is composed of an increase in the electricity consumption per job and largely stable non-electric energy use per job. Over the period from 1968-69 to 1979-80, Australian manufacturing electricity use per jobincreased by 102% compared with 83% in Tasmanian manufacturing. Over the same period non-electric energy use per job increased by only 1% in Australian manufacturing compared with 26% in Tasmanian manufacturing. However, to some extent this comparison of non-electric energy intensity is misleading since there was a sharp increase in the ratio for Tasmanian manufacturing in 1979-80. Up to 1978-79 the ratio had increased by 7% in Australian manufacturing, and 8% in Tasmanian manufacturing. With largely similar trends in the electricity use per job and the non-electrical energy use per job in both Australian and Tasmanian manufacturing, the difference in overall energy use per job was due to the lower proportion of electricity use in Australian manufacturing, resulting in a much larger influence for the stable trend in non-electric energy use per job in Australian manufacturing.

The higher proportional use of energy by Tasmanian manufacturing has resulted in larger increases in its energy intensity of output and employment. None of the trends in energy intensity appear to have responded to the changing energy supply situation which has developed over the 1970s. Ultimately these trends will come into conflict with the changes in energy supply that have developed over the 1970s. This is particularly important for Tasmanian manufacturing because it is becoming increasingly dependent on Tasmania's major indigenous energy source, hydro-electricity. Further, the increases in the electricity consumption to employment ratios imply that electricity is being substituted for jobs, which is in conflict with high unemployment in Tasmania and Australia.

5.5 Comparison of the Structure of Tasmanian and Australian Manufacturing in terms of Energy Intensity

The Australian manufacturing energy use to real value added ratio was 19.5 MJ/$ in 1979-80. The Tasmanian ratio was over three times this level, at 63.3 MJ/$. Tasmanian manufacturing as a whole was much more energy intensive than Australian manufacturing. The difference between Tasmanian and Australian manufacturing electricity intensity is even larger than the difference in overall energy intensity. Australian manufacturing uses 5.1 MJ of electricity per $, while Tasmanian manufacturing uses 31.8 MJ/$, or six times the Australian level. This high level obviously contributes to the higher energy intensity of Tasmanian manufacturing, but, to a certain extent it is to be expected because electricity is the major Tasmanian indigenous fuel. It is thus surprising to find that the non-electric energy intensity of Tasmanian manufacturing production is also higher than that for Australian manufacturing. The Tasmanian manufacturing non-electric energy use to real value added ratio is 31.5 MJ/$, or more than double the Australian manufacturing ratio of 14.5 MJ/$.

TABLE 5.3

Comparison of the Energy Use to Real Value Added Ratio in Australian and Tasmanian Manufacturing Subdivisions 1979-80

Subdivision	Energy Use to Real Value Added Ratio		
	Australia MJ/$	Tasmania MJ/$	Index (Australia = 1.0)
21-22 Food etc.	12.4	25.03	2.0
23 Textiles	10.2	14.46	1.4
24 Clothing	1.7	0.86	0.5
25 Wood	5.9	9.71	1.6
26 Paper	14.2	98.79	7.0
27 Chemicals	19.7	101.29	5.1
28 Mineral Prod.	53.2	130.11	2.4
29 Basic Metals	86.6	108.22	1.3
31 Fabricated Metals	3.0	2.78	0.9
32 Transport Eq.	2.9	2.95	1.0
33 Oth. Equipment	2.4	6.26	2.6
34 Miscellaneous	7.7	7.07	0.9
Manufacturing	19.5	63.34	3.2

The most energy intensive subdivisions in Australian manufacturing were the same as those in Tasmanian manufacturing. However, within this broad similarity there were some considerable variations between the energy intensity of output in Australian and Tasmanian manufacturing. Table 5.3 shows that there was a large difference between the energy intensities of subdivisions 26 Paper, Paper Products, Printing and Publishing, and 27 Chemical, Coal and Petroleum Products, in Tasmanian and Australian manufacturing. Tasmanian Subdivision 26 was nearly seven times as energy intensive as the Australian subdivision, and Tasmanian subdivision 27 was over five times as energy intensive. These two large differences led to different groupings of subdivisions based on energy intensity. In Tasmanian manufacturing these two subdivisions were grouped with the most energy intensive subdivisions, whereas in Australian manufacturing they are grouped among subdivisions with intermediate energy intensity.

Apart from this major difference, most Tasmanian manufacturing subdivisions were more energy intensive than their counterparts in Australian manufacturing. Only three Tasmanian subdivisions had a lower energy intensity of output, and of these only one was more than 10% lower.

The difference between the Australian and Tasmanian manufacturing energy intensity of employment was slightly larger than that for the energy intensity of output (Table 5.4). Tasmanian manufacturing energy intensity of output was 3.7 times higher than that for Australian manufacturing, compared to 3.2 times higher for energy intensity of output. This slight difference was reflected by only two Tasmanian subdivisions having a lower energy intensity of employment than their Australian counterparts. Overall, the structure of energy intensity of employment was similar to that based on energy intensity of output, and it reflects the same groupings.

TABLE 5.4

Comparison of the Energy Use to Employment Ratio in Australian and Tasmanian Manufacturing Subdivisions 1979-80

Subdivision	Energy Use to Employment Ratio		
	Australia GJ/Job	Tasmania GJ/Job	Index (Australia = 1.0)
21-22 Food etc.	216	365	1.7
23 Textiles	163	219	1.3
24 Clothing	22	11	0.5
25 Wood	87	201	2.3
26 Paper	270	2126	7.9
27 Chemicals	470	1931	4.1
28 Mineral Prod.	1248	3075	2.5
29 Basic Metals	2076	3525	1.7
31 Fabricated Metals	50	39	0.8
32 Transport Eq.	46	50	1.1
33 Oth. Equipment	39	76	1.9
34 Miscellaneous	121	139	1.1
Manufacturing	337	1231	3.7

While the difference between energy intensity in Tasmanian manufacturing and Australian manufacturing is important, it cannot be used as a measure of the comparative efficiency of energy use. The manufacturing subdivisions under consideration aggregate a wide variety of processes, with differing energy intensities. The observed differences in energy intensity at the subdivision level could be due more to the mixture of processes than the energy efficiency of these processes. For instance, within Subdivision 26 in Tasmania paper manufacturing is very important, while for the rest of Australia publishing activities are likely to account for a high proportion of output. This type of difference is likely to have a major impact on the energy intensity at the subdivision level.

5.6 Conclusion

It is not possible to base conclusions about the relative efficiency of energy use, on the above analysis. What this analysis can say, however, is that the higher energy intensity of Tasmanian manufacturing makes it more vulnerable to changes in its energy supply situation, no matter whether the difference results from the lower efficiency of energy use, or from a greater concentration on activities with higher energy intensities. Tasmanian manufacturing subdivisions mostly have a higher energy intensity of output and of employment than Australian manufacturing subdivisions. Further, Tasmanian manufacturing employment and output are concentrated on the most energy intensive subdivisions, whereas Australian manufacturing is concentrated on the less energy intensive subdivisions. This applies to electricity intensity as well as non-electric energy intensity, and so to the extent that energy supply problems affect manufacturing output and employment in these subdivisions in the long run, Tasmanian manufacturing will be more vulnerable to the changes in energy supply that have occurred over the 1970s.

Based on the trends in the energy use to output, energy use to employment and employment to output ratios, similar changes are taking place in Tasmanian and Australian manufacturing. In Australian manufacturing there has been a greater electrification of manufacturing industry. However, even though Tasmanian manufacturing electricity has not increased as fast as that in Australian manufacturing over the 1970s, the rate of increase in Tasmania is still important, because an increase in electrical energy consumption by Tasmanian manufacturing largely means an increase in electrical power use. Unless there is a continuing decline in

Tasmanian manufacturing output, the increased electricity intensity of Tasmanian manufacturing will conflict with Tasmanian's shortage of hydro-electrical power.

Chapter 6 - The Social Implications of Manufacturing Energy Use in Tasmania

Tasmania has faced dramatic changes in energy supply, employment and output over the 1970s. This thesis has carried out the first detailed analysis of the way that these changes were related in Tasmania's largest energy using sector, manufacturing. This analysis has differed from previous studies of the economic consequences of changes in energy supply by selecting the major energy using sector, rather than using a whole economy as the basis for analysis. By taking this approach, some influences on employment and output which are not related to energy use have been eliminated. Thus the above analysis has described the closest connection between energy use, and employment and output, that exists in the Tasmanian economy.

The recent development of interest in energy related issues means that there is little data on energy use, especially about detailed patterns of energy use. The only publicly available energy statistics were not suitable to use in this study because they lacked comparability with other data sources. This has meant that much of the work involved in this thesis was in the development of a suitable data base. The method used for estimating energy use by manufacturing for this study represents an improvement on methods previously used at the Centre for Environmental Studies, but there remain considerable problems with its accuracy, especially in relation to Australia. Until accurate and comparable official data are published in detail there will still be considerable difficulty in obtaining suitable data for studying energy use in Australia. Despite these problems the data base used for this thesis provides a sufficiently accurate and comprehensive picture of manufacturing energy use to draw some important conclusions about the response of manufacturing to the developments of the 1970s.

6.1 Tasmania's Pattern of Economic Development

Prior to the 1970s, Tasmania was seen as a place of plentiful energy, mainly due to its hydro electricity. However, during the 1970s a number of changes in energy supply have meant that, rather than having a plentiful supply of energy, Tasmania now has a number of energy supply problems. Similar problems have arisen around the world at the same time, and Tasmania's problems are partly connected with these overseas events, which centre around the OPEC oil embargo of 1973 and subsequent oil price increases. However, Tasmania's problems also relate to electricity supply. While Tasmania has a continuing supply of renewable energy from its hydro-electricity, its hydro-electric power resources are now small compared with other mainland Australian electricity grids. If past rates of growth in electrical power demand continue, Tasmania will eventually be forced to import the fuels necessary for electricity generation. This will mean that Tasmania will no longer be able to rely on such a high proportion of renewable energy, and that it will be increasingly subject to the uncertainties, and increasing prices of the world energy markets. Continuation of past growth rates of energy use will make this process inevitable, but it may be accelerated by the significant public opposition to further construction of dams.

Tasmania has always had problems with economic development and employment. Growth in gross product has been seen as providing for growth in job opportunities. These two interrelated problems have been connected with a third problem, that of net population outflow. Since Tasmanian job opportunities have been scarce, a significant number of job seekers have been forced to move to the mainland. From 1974 onwards Tasmania has shared the world-wide problems of reduced growth rates of output and high unemployment, but compared to the rest of Australia, Tasmania has suffered more, often having the highest rate of unemployment. The decline in manufacturing employment, of nearly 5000 jobs, has been a major component of this overall problem.

The past view of Tasmania as a place with plentiful energy resources combined with the difficulties with economic growth and employment, to provide the basis for development of energy intensive industries a number of which were involved with initial processing of Tasmanian raw materials. This pattern of development, sometimes described as 'hydro-industrialisation', has led to the present structure of Tasmanian manufacturing where employment and output are concentrated on energy intensive subdivisions. This industrial structure makes Tasmania particularly vulnerable to the changes in energy supply that have occurred over the 1970s. The conflict between past development policies and the current worsening of economic problems made it necessary to consider the response of Tasmania's largest energy using sector to the energy supply changes of the 1970s.

6.2 Trends in Energy Use, Employment and Output

The analysis of trends in manufacturing energy use presented in this thesis shows that energy supply changes have not yet reduced manufacturing energy consumption. Tasmanian manufacturing energy use increased by 26% over the 1970s, compared to the 6% increase in Australian manufacturing energy use. The increase in energy use by Tasmanian manufacturing is not only larger than the increase for Australian manufacturing, it is also more pervasive. Only two Australian manufacturing subdivisions had increased energy use, compared with eight Tasmanian subdivisions.

This difference in the rate of growth of energy use is a direct result of the larger proportional use of electricity by Tasmanian manufacturing. Similar trends in the use of electric and non-electric energy occurred in Australian and

Tasmanian manufacturing. Australian manufacturing electricity consumption increased by 84%, compared with 54% in Tasmanian manufacturing. Australian manufacturing non-electric energy use decreased by 8% compared with a 6% increase in Tasmanian manufacturing. The different trend in overall energy use results from 50% of Tasmanian manufacturing energy use being electricity, compared to 26% in Australian manufacturing.

While these overall trends in electricity consumption and non-electric energy use agree with changes in energy prices and supply, examination of the timing of changes in the trends in these two has shown that the detailed trends do not directly correspond to the changes in energy supply. Therefore there has been little response by Tasmanian manufacturing to the energy supply changes that occurred over the 1970s.

The larger growth rate for Tasmanian manufacturing energy use is particularly important. Since it results largely from growth in electricity use, it means that Tasmanian manufacturing is continuing to increase its demand for the major indigenous Tasmanian fuel, hydro-electricity. The increased demand for electrical energy by Tasmanian manufacturing is also an increased demand for electrical power which is in direct conflict with Tasmania's developing shortage of hydro-electric power. If this trend continues, it will mean that Tasmania becomes more dependant on external fuels with their associated price increases and uncertainty.

In the past it has been claimed that increased Tasmanian employment and gross product (output), depend on increased energy supply. The basis for this claim is an extrapolation of past trends in energy use, employment and output, as described by a number of authors in relation to the United States economy. Their analyses are inadequate, and the above analysis of Tasmanian and Australian manufacturing trends shows that their description of past events in the United States is not reflected by trends in Australia over the 1970s. While manufacturing energy use and output have increased by similar amounts in Tasmania (26% and 20% respectively), this is not the case for Australian manufacturing where the increase in output was greater than the increase in energy use (25% compared with 6%). Tasmanian manufacturing output increased much more than energy use between 1972-73 and 1976-77, but between 1976-77 and 1979-80 energy use increased much more than output. Further, despite the increasing output and increasing energy use, employment has fallen in both Australian and Tasmanian manufacturing. In fact, employment has fallen less in Australian manufacturing where the increase in energy use has been smaller. Any attempt to make a simple connection between increased energy use and increased employment or output based on Tasmanian manufacturing industry is wrong.

If there is a connection between energy use and employment, it is a very weak one. Any Tasmanian Government policy aimed at job creation in the major energy using industries, through the supply of larger quantities of energy is likely to be ineffective. During the 1970s the increases of 20% in output and 26% in energy use, did not prevent a fall in employment. Given the continuation of current rates of increase in labour productivity combined with concentration on the energy intensive industries, there would need to be very large increases in output and energy use by manufacturing to create any jobs at all. Considerable increases in energy use and output would be needed even to maintain the current levels of employment.

6.3 Changes in the Manufacturing Process

While there has been little response by either Tasmanian or Australian manufacturing to the changes in energy supply that have occurred over the 1970s, there have been changes in the manufacturing process which are important. Tasmanian manufacturing has become more energy intensive over the 1970s. The energy needed to produce a dollar of manufacturing real value added has increased by 5% while the energy use per employee has increased by 50%. These increases in Tasmanian manufacturing energy intensity are much greater than those occurring in Australian manufacturing, where the energy use per dollar of value added fell by 15% and energy use per employee increased by 16%.

Despite the differences in the direction and size of trends in overall energy intensity between Tasmanian and Australian manufacturing, it seems that changes in the manufacturing processes have been similar. Both Tasmanian and Australian manufacturing had declines in non-electric energy intensity of output and increases in electricity intensity of output. The differences in the trend of total energy intensity, once again, directly result from Tasmanian manufacturing's larger proportional electricity use. The similarities in the trends of the energy intensity of output extend to trends in the energy intensity of employment, with similar small increases in the non-electric energy intensity of employment up to 1978-79, and large increases in electric energy intensity over the whole period.

There have also been similar changes in the labour intensity of manufacturing production in both Tasmanian and Australian manufacturing. The number of jobs needed to produce a dollar of value added in Tasmanian manufacturing fell by 30%, and in Australian manufacturing it fell by 27%.

6.4 The Social Implications of Changes in the Manufacturing Process

Domestic and international changes in energy supply have had little effect on either Australian or Tasmanian manufacturing total energy use since there has been a continuing increase in total energy use despite strong increases in the price of major fuels and increased uncertainty of supply. Further, changes in energy use seem to be the result of changes in output rather than the cause of changes in output. Hence, over the period from 1968-69 to 1979-80, it seems that Tasmanian manufacturing has not been directly affected, to any large extent, by changes in energy supply. Instead, there has been continuation of trends towards increased energy intensity of Tasmanian manufacturing production, which contrasts strongly with the decline in Australian manufacturing energy intensity.

Over the 1970s problems related to economic growth and unemployment have intensified. Up to 1973-74 real output by Tasmanian and Australian manufacturing increased, but since then there has been little growth in output. Also in 1973-74, manufacturing employment began declining. These trends in manufacturing coincide with the intensification of problems in the larger economy. It seems therefore that while trends in manufacturing are part of the wider economy, manufacturing trends are intensified by structural changes which are leading to declining importance of manufacturing, and thus to declining manufacturing employment and little growth in manufacturing output. This stagnation is occurring despite the increase in total energy use, and the strong growth in electricity supply. The decline in employment and the stagnation of output are intensifications of past trends occurring in manufacturing. At present, it is not the result of constriction in energy supply. Tasmanian manufacturing output and employment problems will be assisted only with policies which recognise these historical trends, not through policies which aim to create jobs through increased energy supply.

Past development of Tasmanian manufacturing has caused it to be over three times as energy intensive as Australian manufacturing. Over the 1970s the trend in Tasmanian manufacturing was for this intensity to increase even more, and for the differential between Tasmanian manufacturing and Australian manufacturing to increase. Increasing energy intensity of Tasmanian manufacturing production conflicts with Tasmania's energy supply situation. Tasmanian manufacturing is heavily dependent on imported non-electric fuels and Tasmania's developing shortage of hydro-electric power means that this dependence will increase, resulting in larger energy price increases and greater uncertainty of energy supplies, as well as greater dependence on non-renewable energy. As the energy intensity of Tasmanian manufacturing increases, manufacturing employment and output will become increasingly uncertain.

The pattern of energy use by Tasmanian manufacturing described above has a large number of parallels with that of

United States industry described by Commoner (1976), especially with regard to increasing energy intensity. Commoner argued that similar trends in United States industry were increasing problems with the environment, the economy and employment. He concluded that this conflict between the trends occurring in United States industry and the interests of American society resulted from dependence on the profit motive. Decisions were taken to increase profit, and these decisions resulted in trends which conflicted with the interests of American society. The analysis of trends of energy use in Tasmanian manufacturing presented in this thesis suggests a similar conflict exists in Tasmania. Grossman and Daneker (1977) give a detailed account of an alternative industrial structure based on reduced energy intensity which would not worsen the problems of employment and the economy which currently exist. The similarity between their analysis of the problems in the United States and those in Tasmania suggest that this is also a suitable alternative for Tasmania. Tasmania's future industrial development should be based on its available resources. It should not be the result of continuation of outdated development trends.

6.5 References

1. COMMONER, B., 1976; The Poverty of Power: Energy and the Economic Crisis; Bantam Books, New York.

2. GROSSMAN, R. and DANEKER, G., 1977; Jobs and Energy; Environmentalists for Full Employment, Washington DC.

APPENDIX A: Description of Australian Standard Industrial Classification (ASIC) Manufacturing Subdivisions

TABLE A.1

Description of Australian Standard Industrial Classification (ASIC) Manufactring Subdivisions (a)

ASIC Code	Description
Division	
C	Manufacturing
Subdivision	
21-22	Food, Beverages and Tobacco
23	Textiles
24	Clothing and Footwear
25	Wood, Wood Products and Furniture
26	Paper, Paper Products, Printing and Publishing
27	Chemical, Petroleum and Coal Products
28	Non-metallic Mineral Products
29	Basic Metal Products
31	Fabricated Metal Products
32	Transport Equipment
33	Other Machinery and Equipment
34	Miscellaneous Manufacturing

(a) AUSTRALIAN BUREAU OF STATISTICS; Census of Manufacturing Establishments, Details of Operations and Small Area Statistics Tasmania; Australian Bureau of Statistics, Tasmania.

APPENDIX B: Illustrative Source Data from the Department of National Development and Energy (DNDE) Energy Use Survey

FIGURE B.1

Illustrative Source Data from the Department of National Development and Energy (DNDE) Energy Use Survey (a)

TABLE 6.7 : END-USE DEMAND FOR PRIMARY FUELS BY FUEL TYPE - TASMANIA
(PETAJOULES)

ASIC TITLE	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80 p
Div-A Agriculture, etc							
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IDO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADO	1.7	1.4	1.5	2.2	2.4	2.9	3.2
Heating oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Power kerosine	0.1	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.8	1.5	1.7	2.3	2.4	2.9	3.2
Div-B Mining							
Black coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brown coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
IDO	0.3	0.2	0.2	0.2	0.1	0.0	0.0
ADO	0.9	1.2	1.0	1.2	1.2	1.2	1.2
Motor spirit	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Total	1.3	1.4	1.2	1.4	1.3	1.3	1.3
21-22 Food/Beverages/Tobacco							
Black coal	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Brown coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Bagasse	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	1.2	1.2	1.1	1.2	1.2	1.2	1.4
IDO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
ADO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Heating oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	0.2	0.3	0.4	0.4	0.3	0.3	0.3
Total	1.5	1.5	1.6	1.5	1.5	1.6	1.7
23-24 Textiles, etc							
Black coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
IDO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
ADO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heating oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
N.e.s.	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Total	0.6	0.7	0.7	0.7	0.7	0.7	0.6
25-26 Wood/Paper, etc							
Black coal	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Brown coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
LPG	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Fuel oil	4.7	4.4	3.7	4.3	4.0	4.4	4.6
IDO	0.0	0.1	0.1	0.3	0.2	0.2	0.1
ADO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
N.e.s.	2.5	2.7	2.6	2.7	2.5	2.5	2.8
Total	7.2	7.2	6.4	7.3	6.6	7.1	7.5
27 Chemical/Petroleum/ Coal Products							
Black coal	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Fuel oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
IDO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
ADO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heating oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	1.4	1.2	1.4	1.5	1.4	1.4	1.4
Total	1.4	1.2	1.4	1.5	1.4	1.4	1.4
29 Non-Metallic Minerals							
Black coal	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	2.0	1.9	1.2	0.3	0.4	0.4	0.4
IDO	0.0	0.3	0.3	0.3	0.3	0.3	0.3
ADO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heating oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
N.e.s.	0.1	0.0	0.6	1.7	1.6	2.0	1.7
Total	2.2	2.2	2.2	2.4	2.4	2.8	2.5

IDO - Industrial Diesel Oil ADO - Automotive Diesel Oil
LPG - Liquid Petroleum Gas N.e.s. - Not Elsewhere Specified
(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia 1960-61 to 1979-80; Department of National Development and Energy, Canberra.

FIGURE B.1

Illustrative Source Data from the Department of National Development and Energy (DNDE) Energy Use Survey (a), continued.

TABLE 6.7: TASMANIA cont

ASIC TITLE	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80 p
29 Basic Metal Products							
Black coal	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
IDO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
ADO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Heating oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	3.5	2.9	2.7	2.9	2.9	3.4	3.7
Total	3.5	2.9	2.7	2.9	2.9	3.4	3.7
31-34 Fabricated Metal Products/ Transport Equipment/Other Machinery/Misc. Manufacturing							
Black coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brown coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
IDO	0.1	0.0	0.1	0.1	0.1	0.1	0.0
ADO	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Heating oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	0.0	0.1	0.1	0.1	0.0	0.0	0.1
Total	0.1	0.1	0.2	0.2	0.1	0.1	0.1
Div-C Total Manufacturing							
Black coal	2.2	2.3	2.8	4.2	4.0	4.4	4.4
Brown coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood (e)	0.6	0.4	0.4	0.5	0.5	0.5	0.5
Bagasse	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.1	0.1	0.0	0.1	0.1	0.1
Fuel oil	12.7	11.3	9.3	9.3	9.0	10.2	10.8
IDO	0.9	1.5	2.0	2.1	1.7	1.4	1.2
ADO	0.1	0.4	0.5	0.4	0.4	0.4	0.5
Heating oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N.e.s.	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	16.5	16.0	15.1	15.4	15.6	16.9	17.4
Div-D Electricity/Gas/Water							
Black coal	0.3	0.2	0.2	0.2	0.2	0.0	0.0
Brown coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Fuel oil	0.3	0.8	0.0	0.0	0.0	0.0	1.0
IDO	0.3	0.1	1.3	0.0	0.8	0.0	0.0
ADO	0.2	0.3	0.2	0.1	0.1	0.1	0.1
Hydro-electricity production	20.9	21.2	21.0	24.3	25.4	27.1	28.0
N.e.s.	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Total	22.0	22.5	22.7	24.5	26.4	27.3	29.1
Div-E Construction							
Fuel oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IDO	0.5	0.1	0.1	0.1	0.1	0.1	0.1
ADO	0.6	0.6	1.0	1.5	1.4	1.5	1.8
Total	1.1	0.8	1.1	1.6	1.5	1.7	1.9
Div-F Wholesale/Retail							
Black coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LPG	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Fuel oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IDO	0.3	0.0	0.3	0.2	0.2	0.2	0.2
ADO	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Total	0.4	0.1	0.4	0.3	0.3	0.3	0.3
51 Road Transport							
LPG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADO	0.9	0.9	1.0	0.6	0.6	0.7	0.9
Motor Spirit	12.6	12.9	13.2	14.0	14.2	14.7	14.5
Total	13.5	13.8	14.2	14.5	14.9	15.4	15.4
52 Rail Transport							
Black coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADO	0.4	0.4	0.3	0.3	0.4	0.4	0.4
Total	0.4	0.4	0.3	0.3	0.4	0.4	0.4

IDO - Industrial Diesel Oil ADO - Automotive Diesel Oil
LPG - Liquid Petroleum Gas N.e.s. - Not Elsewhere Specified
(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia 1960-61 to 1979-80; Department of National Development and Energy, Canberra.

FIGURE B.1

Illustrative Source Data from the Department of National Development and Energy (DNDE) Energy Use Survey (a), continued.

TABLE 7.7 END USE DEMAND FOR ELECTRICITY - TASMANIA

(Gigawatt - hours)

ASIC TITLE	1976-77	1977-78	1978-79	1979-80 p
Div - A Agriculture	52	55	58	61
Div - B Mining	431	438	445	451
21-22 Food/Beverages/ Tobacco	149	150	152	157
23-24, 25 Textiles/Wood	166	169	172	177
26 Paper, Paper Products	667	670	673	696
27 Chemical/Petroleum/ Coal Products	96	99	97	102
28 Non-Metallic Minerals	109	113	115	121
29 Basic Metal Products	2 983	3 233	3 655	3 714
31, 32, 33, 34 Fabricated Metal Products/ Transport Equipment/ Other Machinery/ Misc. Manufacturing	47	51	55	58
Div - C Total Manufacturing	4 217	4 485	4 919	5 025
Div - D Electricity/Gas/ Water	611	624	669	693
52 Rail Transport	0	0	0	0
Div - G Transport/Storage	0	0	0	0
Public Lighting (A)	66	67	46	17
Div - E, F, H - K Commercial	229	239	224	207
Div - L Entertainment, etc.	1 295	1 347	1 429	1 505
Total	6 835	7 188	7 744	7 942

(A) Included in Division J.

(a) AUSTRALIA, DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY, 1980; Demand for Primary and Secondary Fuels Australia 1960-61 to 1979-80; Department of National Development and Energy, Canberra.

APPENDIX C: Illustrative Source Data from the Australian Bureau of Statistics Manufacturing Census

FIGURE C.1

Illustrative Source Data from the Australian Bureau of Statistics Manufacturing Census (a)

TABLE 7. MANUFACTURING ESTABLISHMENTS (a) : USAGE OF ELECTRICITY AND FUELS (b) BY INDUSTRY CLASS, TASMANIA, 1979-80 - continued

Industry class		Elect-ricity, value ($'000)	Black coal		Petroleum fuels (non-gaseous)						Mains gas and other fuels (c), value ($'000)	Total value of electricity, fuel, etc. ($'000)
					Light oils (d)		Industrial diesel fuel		Furnace and other fuel oil			
ASIC code	Description		Quantity (tonnes)	Value ($'000)	Quantity ('000 litres)	Value ($'000)	Quantity (tonnes)	Value ($'000)	Quantity (tonnes)	Value ($'000)		
	MISCELLANEOUS MANUFACTURING - continued											
	Other manufacturing -											
348	Total (e)	41	-	-	1	. .	283	56	-	. .	2	99
34	TOTAL MISCELLANEOUS MANUFACTURING ..	163	-	-	52	15	338	66	555	61	13	319
	TOTAL MANUFACTURING											
	TOTAL MANUFACTURING	45 878	174 566	4 590	4 096	913	26 918	5 153	236 734	25 170	7 039	88 742

(a) Excludes single establishment enterprises with less than four persons employed at 30 June.
(b) Excludes usage of electricity and fuels produced and used in the same establishments.
(c) Included in this column is 'Coke including coke breeze' valued at $5 488 000. The amount used was 80 322 tonnes.
(d) Light oils for heating and burning (kerosene, heating oil, motor spirit, automotive distillate, etc.). Excludes fuels used in motor vehicles.
(e) Total includes details in classes not specified above but listed in Table 2.

(a) AUSTRALIAN BUREAU OF STATISTICS, 1981; Census of Manufacturing Establishments, Details of Operations and Small Area Statistics, Tasmania; Australian Bureau of Statistics, Tasmania.

TABLE D.1

Energy Use by Tasmanian Manufacturing, 1968-69 to 1979-80.

SUBDIVISION 21 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	1035	218.699	47	4361	107.316	7	121	4.460	94	3236	147.236	545	24171	1056.257	1533.968
1970	1092	271.499	33	3031	75.811	34	537	19.751	120	3084	140.302	512	25504	1114.509	1581.912
1972	1376	259.525	38	3510	86.391	44	167	6.149	138	3228	146.874	626	25620	1119.594	1618.524
1973	1512	274.917	44	3542	87.169	42	650	23.535	143	3405	154.928	727	30280	1323.236	1864.184
1974	1681	307.982	39	3897	95.905	46	700	25.776	140	2987	135.909	911	30300	1324.110	1889.682
1975	2400	325.580	44	3000	73.830	53	589	21.689	258	4003	182.137	1423	26136	1142.143	1745.378
1976	2632	368.238	137	4500	110.745	55	551	20.269	387	4430	201.565	1526	30375	1327.388	2028.225
1977	2981	422.448	0	0	0.000	77	603	22.204	322	3448	156.884	1844	26652	1164.692	1766.229
1978	3009	385.252	0	0	0.000	98	771	28.351	414	4367	198.659	2069	32273	1410.330	2022.671
1979	3554	440.098	66	2365	58.203	85	523	19.258	685	4653	211.712	2428	32161	1405.436	2134.696
1980	3747	384.667	135	4736	116.602	79	335	12.336	1451	6257	284.654	3870	30421	1329.398	2127.696

SUBDIVISION 23 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	302	63.814	1	46	1.175	0	0	0.000	34	1079	49.094	221	11053	483.019	597.102
1970	324	68.687	0	26	0.650	1	11	0.418	16	485	22.051	211	12362	540.205	632.011
1972	359	67.710	0	34	0.837	1	3	0.110	20	548	24.934	293	13444	587.503	681.094
1973	405	73.639	1	51	1.255	1	12	0.442	18	491	22.341	296	13906	607.692	705.369
1974	421	77.133	0	25	0.615	0	1	0.037	11	295	13.423	324	13078	571.509	662.716
1975	389	63.325	0	24	0.591	39	555	20.437	17	289	13.150	436	10604	463.395	560.897
1976	497	69.534	1	40	0.934	0	1	0.037	94	1451	66.021	466	7526	328.886	465.462
1977	513	72.699	0	0	0.000	0	1	0.037	3	35	1.593	577	10007	437.306	511.634
1978	502	64.273	0	0	0.000	0	3	0.110	6	36	1.638	566	9798	428.173	494.194
1979	540	66.868	0	0	0.000	0	0	0.000	9	55	2.503	534	8935	390.460	459.830
1980	512	52.562	0	0	0.000	1	3	0.110	8	35	1.593	507	7671	335.223	389.488

SUBDIVISION 24 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	11	2.324	0	0	0.000	0	4	0.139	2	40	1.803	5	235	10.256	14.522
1970	12	2.544	0	0	0.000	0	0	0.000	1	34	1.526	5	218	9.546	13.615
1972	13	2.452	0	0	0.000	0	0	0.000	0	0	0.000	5	181	7.910	10.362
1973	16	2.909	0	0	0.000	0	0	0.000	1	16	0.728	4	179	7.822	11.459
1974	21	3.847	0	0	0.000	0	0	0.000	1	28	1.274	5	156	6.817	11.939
1975	17	2.767	0	0	0.000	0	0	0.000	2	25	1.138	2	53	2.316	6.221
1976	16	2.518	0	0	0.000	0	1	0.037	1	12	0.546	0	0	0.000	3.101
1977	19	2.693	0	0	0.000	0	1	0.037	0	4	0.182	0	2	0.087	2.999
1978	17	2.177	0	0	0.000	0	0	0.000	0	4	0.182	1	12	0.524	2.883
1979	17	2.105	0	0	0.000	0	0	0.000	1	8	0.364	2	18	0.787	3.256
1980	16	1.848	0	0	0.000	0	0	0.000	0	0	0.000	1	8	0.350	2.198

TABLE D.1

Energy Use by Tasmanian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 25 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	685	144.743	0	11	0.275	17	291	10.732	38	983	44.745	74	5665	116.455	316.958
1970	700	148.397	0	0	0.000	124	1855	68.294	17	424	19.277	46	3032	132.487	368.455
1972	960	279.619	0	0	0.000	163	596	21.547	56	1306	59.423	55	2992	130.750	491.739
1973	1376	554.142	0	0	0.000	173	2896	106.639	44	1083	49.277	50	2872	125.506	835.564
1974	1545	565.738	0	0	0.000	163	2330	85.798	79	1900	86.450	54	3160	138.092	876.079
1975	1726	546.286	0	0	0.000	203	2444	89.996	74	1194	54.327	83	2712	118.514	809.123
1976	1920	528.264	0	0	0.000	202	2077	76.481	116	1275	58.013	217	4075	178.078	840.835
1977	1939	519.151	0	0	0.000	199	1431	52.694	107	1001	45.546	236	4542	198.485	815.876
1978	2095	500.542	0	0	0.000	230	1695	62.415	116	980	44.550	294	3660	159.942	767.489
1979	2162	510.767	0	0	0.000	232	1160	42.715	154	1054	47.957	240	3443	150.459	751.898
1980	2441	504.223	0	0	0.000	235	941	34.650	257	1411	64.201	325	3119	136.300	739.374

SUBDIVISION 26 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	1612	2041.279	557	60891	1498.525	1	19	0.697	0	1	0.046	1614	105051	4590.744	8131.292
1970	2148	2273.822	634	74849	1842.027	2	30	1.115	7	181	8.229	1505	97030	4240.212	8365.405
1972	3209	2793.131	705	80073	1970.597	22	91	3.351	10	225	10.238	1503	95798	4361.173	9138.489
1973	3543	2713.292	757	81791	2012.877	17	321	11.820	4	91	4.141	1466	97410	4256.817	8998.946
1974	3715	2732.989	844	84303	2074.697	23	394	14.508	12	255	11.603	1657	105427	4781.960	9615.756
1975	4216	2648.948	1006	86849	2137.354	35	507	18.669	30	522	23.751	2630	115030	5026.811	9855.533
1976	4342	2541.526	1137	83188	2047.257	45	479	17.638	34	477	21.704	3500	83776	3661.011	8289.136
1977	4623	2673.848	1462	86822	2136.689	99	816	30.048	9	123	5.597	4025	93502	3649.037	8495.219
1978	4584	2535.949	1539	84117	2070.119	92	642	23.640	30	237	10.784	4424	78102	3413.057	8053.550
1979	5758	2748.164	2252	92166	2269.205	129	785	28.506	44	314	14.287	5773	82659	3612.198	8671.760
1980	7629	2989.224	2247	92050	2265.351	252	1243	45.771	3	12	0.546	14312	144452	6312.552	11613.444

SUBDIVISION 27 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	1009	333.614	0	0	0.000	0	0	0.000	251	8225	374.216	274	18591	812.417	1520.246
1970	1152	371.102	0	0	0.000	5	91	3.345	237	7797	354.754	291	18855	823.960	1553.161
1972	1501	401.145	53	1952	48.039	4	18	0.663	301	8658	393.939	428	21309	931.203	1774.989
1973	1744	389.929	40	1683	41.419	6	101	3.719	286	8293	377.332	439	22285	973.855	1786.253
1974	1706	393.859	40	1514	37.260	5	98	3.609	354	9927	451.679	431	21637	945.537	1831.943
1975	2138	614.979	160	3050	75.061	6	91	3.351	473	7985	363.318	626	20768	907.562	1964.269
1976	1662	532.578	70	1450	35.685	6	76	2.799	707	9484	431.522	2347	40774	1781.824	2784.407
1977	1616	531.663	420	8850	217.795	1	8	0.295	751	10782	490.581	1395	28461	1243.746	2484.093
1980	2224	520.452	0	0	0.000	10	46	1.694	2469	13466	612.703	2060	21706	948.552	2083.401

TABLE D.1

Energy Use by Tasmanian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 28 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	362	215.188	60	7635	187.903	7	98	3.624	46	2543	133.923	717	45586	2166.903	2707.540
1970	357	301.104	27	2710	66.685	25	466	17.143	35	1883	85.660	590	41618	1818.724	2289.317
1972	430	326.811	6	566	13.925	4	15	0.552	34	1378	62.659	677	40266	1759.624	2165.616
1973	463	323.870	6	539	13.265	7	181	6.665	35	1236	56.238	730	45411	1984.461	2384.498
1974	531	331.729	1	81	1.993	5	86	3.167	33	878	39.949	1890	58010	2535.037	2911.875
1975	563	321.563	3	195	4.795	3	57	2.099	259	4395	199.973	1673	42398	1852.793	2381.226
1976	682	319.704	307	21447	527.811	105	2562	94.341	462	6125	278.668	1260	26679	1165.872	2386.415
1977	620	342.719	1050	65665	1616.016	345	2925	107.707	320	4049	184.230	417	7581	331.290	2581.961
1978	549	317.688	1153	64990	1599.404	105	679	25.003	558	5610	255.255	429	7320	319.884	2517.234
1979	1103	344.062	1510	65967	1623.448	108	598	22.020	367	2933	133.452	707	8968	391.902	2514.883
1980	1098	329.046	1515	64395	1584.761	187	792	25.164	472	1963	69.317	1195	8598	375.733	2408.020

SUBDIVISION 29 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	9157	7411.050	0	0	0.000	1	19	0.697	694	23918	1069.253	693	48022	2098.573	10598.573
1970	10642	8253.714	0	0	0.000	23	522	19.234	52	2136	97.171	1221	78005	3408.837	11778.956
1971	12480	8879.471	0	0	0.000	65	292	10.752	60	2067	94.049	1525	76629	3348.687	12332.959
1973	13099	9009.523	0	0	0.000	30	706	25.997	31	1061	48.276	1730	75245	3288.207	12372.002
1974	14764	9074.904	0	0	0.000	36	866	31.885	60	1951	88.771	2115	76872	3359.306	12554.970
1975	14836	8789.557	0	0	0.000	70	1705	62.783	80	2452	111.566	2658	56176	2454.891	11418.797
1976	15342	8407.175	0	0	0.000	114	1956	66.343	118	1718	78.165	3226	48231	2107.695	10661.382
1977	19177	10160.627	0	0	0.000	133	1310	48.238	46	597	27.164	4489	57863	2529.487	12765.516
1978	17934	10375.168	177	8123	199.907	62	699	25.739	35	460	20.930	1051	15529	678.617	11300.362
1980	26695	11293.170	653	13376	329.193	0	0	0.000	406	3347	152.289	2232	19130	835.981	12610.623

SUBDIVISION 31 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	97	20.496	0	5	0.125	7	155	5.714	2	55	2.496	3	82	3.596	32.428
1970	107	22.684	0	2	0.050	7	117	4.321	2	38	1.710	5	148	6.482	35.247
1972	119	22.444	0	19	0.468	24	77	2.835	7	214	9.737	6	182	7.953	43.437
1973	134	24.364	0	2	0.049	20	274	10.090	10	309	14.060	5	141	6.162	54.724
1974	163	29.864	0	1	0.025	16	256	9.427	13	366	16.653	6	139	6.074	62.043
1975	187	30.442	0	1	0.025	27	326	12.004	18	288	13.104	5	168	7.342	62.917
1976	239	33.438	0	0	0.000	34	356	13.109	17	228	10.374	6	119	5.200	62.121
1977	230	32.594	0	0	0.000	42	336	12.373	24	327	14.879	3	37	1.617	61.462
1978	291	37.258	0	0	0.000	18	121	4.456	22	226	10.283	14	171	7.473	59.469
1979	317	39.254	0	0	0.000	31	251	9.243	17	119	5.415	16	168	7.342	61.253
1980	392	40.243	0	2	0.049	60	356	13.109	15	61	2.776	25	165	7.211	63.387

TABLE D.1

Energy Use by Tasmanian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 32 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	100	21.130	0	54	1.325	5	140	5.157	0	0	0.000	5	306	13.364	40.976
1970	109	23.108	0	62	1.525	6	117	4.321	0	0	0.000	5	316	13.808	42.762
1972	213	40.174	4	398	9.795	8	53	1.952	8	209	9.510	6	212	9.264	70.694
1973	154	28.001	0	0	0.000	16	402	14.803	0	1	0.046	7	233	10.182	53.031
1974	165	30.230	0	0	0.000	21	460	16.938	0	1	0.046	6	309	13.503	60.717
1975	205	33.372	0	0	0.000	23	425	15.650	0	0	0.000	9	323	14.115	63.137
1976	223	31.200	0	0	0.000	27	414	15.245	0	0	0.000	6	280	12.236	58.681
1977	237	33.586	0	0	0.000	33	346	12.741	0	0	0.000	6	133	5.812	52.139
1980	261	26.794	0	0	0.000	57	254	9.357	1	7	0.315	0	0	0.000	36.466

SUBDIVISION 33 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	74	15.636	0	0	0.000	4	72	2.648	9	240	10.910	7	252	11.011	40.205
1970	77	16.324	0	0	0.000	7	110	4.042	12	325	14.793	6	221	9.679	44.838
1972	146	27.537	0	0	0.000	12	35	1.289	11	269	12.240	12	357	15.601	56.666
1973	166	30.183	0	1	0.025	7	110	4.051	6	116	5.278	16	509	22.243	61.779
1974	146	26.749	0	0	0.000	10	141	5.192	8	157	7.144	13	341	14.902	53.986
1975	186	30.279	0	0	0.000	15	161	5.929	41	737	33.534	1	14	0.612	70.353
1976	214	29.940	0	0	0.000	9	88	3.240	46	626	28.483	5	65	2.841	64.504
1977	205	29.051	0	0	0.000	20	157	5.781	53	603	27.437	12	146	6.380	68.649
1978	256	32.777	0	0	0.000	14	102	3.756	67	631	28.711	13	144	6.293	71.536
1979	266	32.938	0	0	0.000	11	59	2.173	7	52	2.366	101	1183	51.697	89.174
1980	307	31.517	0	5	0.123	18	74	2.725	4	21	0.956	138	909	39.723	75.044

SUBDIVISION 34 ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	9	1.902	0	0	0.000	0	0	0.000	2	47	2.126	2	67	2.930	6.959
1970	12	2.544	0	0	0.000	1	19	0.697	2	86	3.929	1	22	0.977	8.147
1972	20	3.772	0	0	0.000	3	10	0.368	3	65	2.958	1	20	0.874	7.972
1973	24	4.364	0	0	0.000	6	127	4.677	0	0	0.000	1	21	0.918	9.958
1974	55	10.077	0	0	0.000	4	88	3.240	2	43	1.957	1	24	1.049	16.323
1975	34	5.535	0	0	0.000	6	81	2.983	1	21	0.956	1	25	1.093	10.566
1976	57	7.975	0	0	0.000	8	91	3.351	5	58	2.639	3	40	1.748	15.713
1977	65	9.211	0	0	0.000	11	100	3.682	14	140	6.370	6	44	1.923	21.186
1978	126	16.132	0	0	0.000	13	110	4.051	22	186	8.463	20	221	9.658	38.303
1979	139	17.212	0	0	0.000	14	85	3.130	55	330	15.015	27	290	12.673	48.030
1980	163	16.734	0	0	0.000	15	52	1.915	66	338	15.379	61	555	24.254	58.281

TABLE D.1

Energy Use by Tasmanian Manufacturing, 1968-69 to 1979-80, continued.

MANUFACTURING ENERGY USE IN TERAJOULES (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUAN. TNNS	BLACK COAL ENERGY TJ	LIGHT OILS VALUE $000	LIGHT OILS QUAN. KLTR	LIGHT OILS ENERGY TJ	I.C.F. VALUE $000	I.C.F. QUAN. TNNS	I.C.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TNNS	FUEL OIL ENERGY TJ	TOTAL ENERGY TJ
1969	14452	10489.664	665	73005	1796.545	49	916	33.725	1173	40766	1854.652	4181	260[illegible]81	11165.529	25540.419
1970	16532	11715.526	655	80729	1936.745	235	3676	142.720	503	16470	749.402	4389	277332	12119.428	26713.825
1972	20825	13105.603	807	86552	2130.945	352	1358	50.006	649	18187	826.599	5135	281010	12280.137	28392.389
1973	22836	13429.132	947	87608	2156.033	325	5779	212.800	578	16101	732.596	5561	288493	12607.144	29137.705
1974	24515	13585.468	924	89822	2210.519	330	5419	155.544	713	18788	854.654	7654	313453	13697.896	30546.281
1975	26456	13412.796	1214	93119	2291.659	484	6940	255.552	1254	21911	996.551	5822	274407	11991.586	28943.543
1976	27827	12871.952	1652	110625	2722.481	611	8551	314.873	1989	25864	1177.722	12967	241940	10572.778	27659.807
1977	32426	14830.431	2951	161337	3970.504	960	8035	255.873	1651	21109	960.460	13071	218990	9569.863	29627.130
1978	32017	14705.655	3534	171230	4213.970	670	5037	185.477	2033	19636	893.438	10134	160195	7000.522	26999.062
1979	40964	16067.570	4677	187614	4617.181	665	3919	144.305	3369	27511	1251.751	12637	174167	7615.468	29676.679
1980	45878	16190.582	4550	174566	4296.065	913	4096	150.827	5153	26918	1224.769	25170	236734	10345.276	32207.523

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80.

SUBDIVISION 21-22 ENERGY USE IN TERAJOULES(TJ) [10E12 JOULES]

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	28755	5634.712	2958	351661	9814.858	102	39726	376.201	1358	163224	3677.447	105	5276	132.588
1970	31673	6336.003	2840	323731	9035.336	115	45970	435.335	1440	174229	3925.374	95	4046	101.669
1972	36458	6997.751	2952	311696	8699.435	126	46947	444.588	1434	171292	3859.209	176	8322	209.132
1973	40535	7580.155	2962	302746	8449.641	33	11911	112.797	1576	188937	4256.751	54	2089	52.497
1974	44704	7906.369	3463	308415	8607.863	89	10005	94.785	1321	164233	3700.169	96	2260	56.794
1975	52529	8651.364	4570	309305	8632.703	57	5772	54.661	1526	181105	4080.296	139	2753	69.183
1976	63668	8469.139	5526	306296	8548.721	59	5011	47.454	1552	146623	3303.416	130	2317	58.226
1977	71028	8691.324	5796	267323	7460.985	236	14568	137.959	1764	143641	3236.232	55	601	15.103
1978	82584	9256.519	5611	259353	7238.542	5	480	4.546	1585	107919	2431.415	59	673	16.912
1979	91869	9517.840	5909	260042	7257.772	81	6002	56.839	2070	123975	2793.157	82	2362	59.357
1980	105435	10009.349	7006	267256	7459.115	0	0	0.000	2349	123934	2792.233	72	905	22.743

SUBDIVISION 21-22 ENERGY USE IN TERAJOULES(TJ) [10E12 JOULES]

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	795	17755	653.808	2186	66370	3019.844	10163	628489	27464.990	81.523	1699	0	0	2533	50855.972
1970	1146	20787	765.448	2360	81687	3716.777	10092	536967	23461.070	103.720	1779	0	0	3446	47880.732
1972	1540	7045	259.418	2986	95206	4331.873	13247	637765	27871.205	227.003	2285	0	0	3215	52899.611
1973	1714	33393	1229.530	3042	92613	4213.892	14049	647379	28290.462	316.879	2985	0	0	3112	54502.703
1974	1829	30920	1138.567	3807	144381	6569.336	16256	589766	25772.774	550.000	5181	0	0	3073	54396.657
1975	2672	32276	1188.499	4415	75919	3454.315	27308	552042	24124.235	732.000	5822	0	0	2731	50387.255
1976	3335	32274	1168.426	5527	128373	5840.972	32390	592816	25906.059	971.000	8242	0	0	4624	54333.413
1977	3797	35127	1293.482	5734	69989	3184.500	31310	493399	21561.536	1069.000	10198	0	0	4895	46650.120
1978	4632	35903	1322.056	7248	78923	3590.997	30261	446644	19518.343	1278.000	12084	1582	510	2115	44657.330
1979	4973	31739	1168.725	9245	66194	3011.827	35706	685061	29937.166	1340.000	14592	2452	1017	2257	55142.683
1980	5580	25503	939.097	13656	62898	2861.859	46686	336365	14700.025	1538.000	18730	3986	1511	1991	40322.420

SUBDIVISION 23 ENERGY USE IN TERAJOULES(TJ) [10E12 JOULES]

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	8582	1974.109	657	85771	2393.861	122	56160	531.839	556	59650	1343.923	2	82	2.068
1970	9128	2143.513	653	81807	2283.242	110	53218	503.975	520	60434	1361.572	2	90	2.272
1972	9281	2091.148	596	78671	2195.708	157	30518	289.005	441	47091	1060.960	2	77	1.935
1973	9914	2176.312	608	69723	1945.969	0	0	0.000	476	55182	1243.250	1	49	1.231
1974	10819	2246.167	542	49423	1379.396	63	29705	281.344	491	54622	1230.634	2	49	1.231
1975	10372	1866.195	631	49459	1380.401	8	3500	33.145	474	46626	1050.484	0	0	0.000
1976	11879	1854.907	609	34174	953.796	0	0	0.000	580	47464	1069.364	0	0	0.000
1977	12416	1783.456	590	31167	869.871	7	422	3.996	686	52274	1177.733	0	0	0.000
1978	13702	1802.852	462	21670	604.810	0	0	0.000	813	55447	1249.221	0	0	0.000
1979	15341	1865.724	410	20385	568.945	0	0	0.000	957	50006	1126.635	0	0	0.000
1980	17206	1917.455	481	22365	624.207	1	118	1.117	921	44894	1011.462	5	99	2.488

SUBDIVISION 23 ENERGY USE IN TERAJOULES(TJ) [10E12 JOULES]

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	99	1756	64.670	176	5552	252.636	1929	105251	4601.222	14.620	170	0	0	514	11178.948
1970	97	1824	67.179	257	9171	417.300	1891	105407	4606.284	19.734	179	0	0	707	11404.041
1972	134	648	23.861	270	8322	378.651	2253	108066	4722.494	56.085	315	0	0	829	10819.838
1973	253	4839	178.186	308	9960	453.180	2076	93960	4106.052	99.506	523	0	0	660	10203.687
1974	181	2859	105.277	316	8543	388.707	2402	85348	3729.708	129.567	681	0	0	929	9492.030
1975	306	3142	115.698	644	10812	491.946	3143	63212	2762.364	134.756	862	0	0	962	7834.989
1976	249	2396	88.228	765	10120	460.460	3426	58009	2534.950	211.557	1596	0	0	1071	7173.262
1977	388	3773	138.933	602	6517	296.524	3521	59261	2589.706	205.638	2145	0	0	693	7065.857
1978	327	2741	100.932	612	5471	243.931	3340	51561	2253.216	240.356	2621	117	2	565	6500.327
1979	381	2401	88.412	658	4629	210.620	3767	50243	2195.619	237.226	3250	161	19	556	6293.181
1980	604	2755	101.447	788	3559	161.935	5606	46666	2039.304	252.293	4202	454	11	479	6111.708

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 24 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	4748	1092.178	37	4136	115.440	0	0	0.000	4	303	6.821	1	66	1.660
1970	4843	1137.273	34	3551	99.106	11	2295	21.773	3	286	6.118	1	49	1.226
1972	5277	1188.987	22	1901	53.057	12	2400	22.720	3	188	4.236	0	10	0.251
1973	5522	1212.184	4	279	7.787	0	0	0.000	2	113	2.546	0	0	0.000
1974	5958	1236.959	5	328	9.154	0	0	0.000	2	110	2.478	0	0	0.000
1975	6240	1122.740	6	296	8.094	0	0	0.000	2	135	3.042	0	0	0.000
1976	6901	1077.592	2	80	2.233	0	0	0.000	3	128	2.884	0	0	0.000
1977	7261	1042.983	1	0	0.000	0	0	0.000	0	8	0.180	0	0	0.000
1978	7682	1010.765	0	0	0.000	0	0	0.000	0	0	0.000	0	3	0.075
1979	8543	1038.973	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000
1980	9769	1039.668	2	91	2.540	0	0	0.000	0	0	0.000	0	0	0.000

SUBDIVISION 24 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	147	2930	107.376	179	5419	246.580	393	25065	1096.216	18.232	212	0	0	76	2685.003
1970	122	2297	84.601	189	5696	259.154	330	16455	719.089	20.272	194	0	0	77	2348.812
1972	123	596	21.947	196	6534	297.297	383	16568	724.022	32.939	185	0	0	292	2345.463
1973	124	2645	97.397	233	7332	333.606	325	13756	601.137	36.720	193	0	0	306	2291.377
1974	154	2578	94.930	170	4572	203.026	302	13865	605.901	38.433	202	0	0	364	2195.881
1975	137	1781	65.582	194	3059	139.185	520	8967	391.858	49.244	315	0	0	375	1779.744
1976	168	1454	53.541	300	3569	162.390	506	7507	328.056	49.443	373	0	0	597	1676.138
1977	213	1729	63.667	332	3645	165.848	475	7055	308.304	33.362	348	0	0	251	1614.343
1978	251	1902	70.037	440	6771	308.081	515	7302	319.097	37.634	408	10	11	108	1745.690
1979	314	1936	71.289	562	4595	209.073	716	8719	391.020	41.774	585	6	13	156	1742.129
1980	394	1327	67.276	718	3477	158.204	1039	8228	359.564	43.707	852	46	3	183	1724.958

SUBDIVISION 25 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	8027	1846.443	191	30751	858.268	65	39735	376.327	14	976	21.998	3	201	5.055
1970	8486	1992.753	201	31724	885.405	70	41248	390.614	21	2783	62.697	4	217	5.464
1972	9582	2158.967	186	26186	730.851	61	36846	348.932	16	2017	45.443	3	98	2.463
1973	10837	2378.928	199	27795	775.758	68	40054	379.311	18	2146	48.349	3	126	3.166
1974	12038	2499.248	230	27875	777.991	71	39284	372.019	35	4347	97.938	2	108	2.714
1975	13427	2415.870	298	22837	637.269	68	31040	293.949	34	3904	87.957	1	60	1.508
1976	16229	2534.160	390	22661	632.469	76	28900	273.683	25	2335	52.608	6	375	9.424
1977	18477	2554.068	411	20677	577.095	86	28560	270.463	27	2291	51.616	16	757	19.023
1978	20039	2636.648	398	19586	546.645	117	32595	308.675	16	909	20.480	0	1	0.025
1979	23518	2960.184	421	20731	578.602	161	41756	395.429	0	6	0.135	0	1	0.025
1980	26905	2998.322	495	21955	612.764	170	41295	391.064	0	3	0.068	0	3	0.075

SUBDIVISION 25 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	280	4818	177.424	511	15076	685.977	643	35121	1543.538	0.397	68	0	0	1055	5515.418
1970	644	10806	397.916	492	17183	781.808	624	31452	1374.466	0.642	93	0	0	586	5891.765
1972	937	4062	149.575	436	14203	646.237	737	32029	1399.667	1.330	113	0	0	623	5483.464
1973	1004	18984	699.048	417	12268	558.194	886	37110	1621.707	1.623	129	0	0	720	6466.085
1974	1294	20433	752.404	588	22707	1033.169	1263	62119	2714.600	2.030	159	0	0	763	8252.084
1975	1747	19340	712.157	728	12918	587.769	1795	34991	1529.107	20.000	208	0	0	1063	6285.585
1976	2051	19195	706.917	1261	51998	2365.909	2396	39372	1720.556	18.000	311	0	0	887	8313.626
1977	2377	18217	670.965	1171	20160	917.280	2535	39011	1704.781	13.000	417	0	0	1165	6878.131
1978	2217	15116	556.616	1383	12668	576.394	2317	31057	1357.191	14.000	465	225	39	1143	6016.674
1979	2396	13531	498.252	1602	83797	3812.764	3044	34674	1515.254	13.000	680	287	45	1086	9673.645
1980	2233	9830	361.970	2283	11612	528.346	5682	41162	1798.779	14.000	623	399	36	1292	6705.388

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 26 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	12436	4610.754	2240	289945	8092.367	1226	570751	5405.014	200	36982	833.213	0	23	0.587
1970	14763	5587.707	2606	335909	9375.218	1108	543461	5146.580	278	56370	1270.010	1	38	0.945
1972	16200	5883.199	2880	328270	9162.016	1164	442105	4186.734	444	68806	1550.199	1	15	0.377
1973	17889	6329.463	3212	335752	9370.839	999	386854	3663.507	422	71233	1604.879	1	40	1.005
1974	19823	6633.350	4056	354409	9891.555	1278	479530	4541.149	301	47581	1072.030	0	9	0.226
1975	22483	6520.148	5136	324023	9043.482	1092	374575	3547.263	285	44572	1004.207	2	16507	414.821
1976	25618	6447.571	5312	291694	8141.180	1337	340095	3220.643	173	23735	534.750	0	14	0.352
1977	27782	6432.099	5643	306761	8561.700	1303	300376	2844.561	146	13625	306.971	1	20	0.503
1978	28852	6118.720	6320	279563	7802.603	1139	267525	2533.462	103	6721	151.424	0	6	0.151
1979	34381	6739.393	5215	211921	5914.715	1548	370903	3512.451	129	6989	157.462	0	4	0.101
1980	42433	7621.802	5648	212509	5931.126	1546	343963	3257.386	73	3813	85.907	0	2	0.050

SUBDIVISION 26 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	96	1955	68.294	185	5472	248.984	3641	225500	9854.358	39.892	258	0	0	1090	29153.463
1970	161	3172	116.796	269	8467	385.264	3465	211628	9248.131	51.290	273	0	0	988	31181.941
1972	189	770	28.354	260	18822	856.401	4675	272001	11886.444	243.294	760	0	0	1280	33797.018
1973	191	3672	135.214	244	7067	321.549	3922	224846	9825.770	513.804	1502	0	0	1192	31766.030
1974	213	3679	135.472	339	8980	408.590	4933	253927	11096.619	704.000	2058	0	0	596	34482.952
1975	357	3915	144.162	432	8035	365.593	7731	229657	10036.011	842.000	2468	0	0	744	31917.687
1976	288	2814	103.620	754	14883	677.177	8736	177927	7771.040	939.000	2655	0	0	326	27835.331
1977	443	3758	138.381	765	9620	437.710	7533	150351	6570.339	1167.000	3344	0	0	341	26459.263
1978	457	3254	119.822	1007	10218	464.919	7801	133710	5843.127	1302.000	4186	175	15	92	24336.228
1979	755	4568	168.207	1178	9952	452.816	8289	112063	4897.153	1506.000	6034	219	32	79	23346.298
1980	1155	5366	197.592	1644	9545	434.298	18814	188250	8228.273	1704.000	9192	415	51	66	27460.434

SUBDIVISION 27 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	24413	6101.715	1149	132127	3687.657	0	0	0.000	464	59710	1345.274	596	29478	740.788
1970	26356	6724.780	965	102618	2864.069	0	0	0.000	473	62064	1398.311	749	30246	760.090
1972	28424	6958.623	874	82519	2303.077	0	0	0.000	460	58362	1314.896	1021	29320	736.812
1973	31104	7419.850	1092	95555	2666.940	0	0	0.000	490	59530	1341.211	1100	30513	766.792
1974	35084	7914.295	1079	87624	2445.586	0	0	0.000	566	67307	1516.427	1252	32221	809.714
1975	37537	7338.416	1190	73187	2042.649	0	0	0.000	557	59369	1337.594	1721	34972	878.846
1976	41934	7114.763	1300	58695	1638.177	0	0	0.000	526	49516	1115.595	1927	30354	762.796
1977	46437	7247.579	1497	52195	1456.762	0	0	0.000	586	54791	1234.441	2689	35654	895.985
1978	53373	7630.374	1608	54708	1526.900	0	0	0.000	705	47220	1063.867	2772	32735	822.631
1979	60541	8000.027	1679	61600	1719.256	0	0	0.000	900	52633	1135.821	2836	31509	791.821
1980	73160	8858.642	1036	38975	1087.792	0	0	0.000	1148	61956	1396.770	3337	40000	1005.200

SUBDIVISION 27 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	403	8176	301.050	793	47942	2181.361	7988	472517	20667.339	268.415	584	0	0	8813	35293.598
1970	447	8410	309.691	844	29294	1332.892	8972	575081	25131.057	321.674	576	0	0	7184	38842.565
1972	384	1552	57.149	1014	32835	1493.993	10880	623000	27225.100	770.792	810	0	0	10800	40960.432
1973	383	7824	268.103	1038	33629	1530.120	9570	564709	24677.783	1549.674	1524	0	0	10931	40239.473
1974	774	25865	952.427	1256	33756	1535.898	12071	663358	28990.493	1509.000	1484	0	0	9707	45673.839
1975	453	5360	197.371	1657	37981	1728.136	31282	774009	33824.193	1750.000	1844	0	0	18664	49097.195
1976	579	5427	199.839	2643	61903	2816.587	35050	623631	27252.675	1780.000	2470	0	0	21996	42680.372
1977	1006	9774	359.908	6177	95920	4364.360	38479	620202	27102.827	2494.000	10488	0	0	22126	45155.863
1978	614	5073	166.803	4468	40238	1830.829	19687	256151	11195.547	3232.000	14107	906	6627	21231	27488.950
1979	1011	7096	261.296	5482	40255	1831.603	15650	206518	9025.711	3610.000	13256	1092	5223	16799	26425.535
1980	1875	11299	416.063	18778	86158	3920.189	18801	156544	6840.973	4832.000	17187	1782	9161	24993	28357.629

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 28 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	14284	4940.773	7718	1651092	46081.990	14	6787	64.272	466	60592	1365.142	573	36657	921.197
1970	15455	5346.895	7559	1221851	34101.854	12	8183	77.492	482	76532	1724.271	637	29936	752.303
1972	17402	5776.587	6291	935073	26097.887	89	15604	147.770	479	66600	1500.498	424	12536	315.030
1973	18920	6118.931	7602	1070320	29872.631	84	14745	139.673	450	63943	1440.636	357	9671	243.032
1974	21975	6721.498	7754	1016645	28374.562	106	13138	124.417	447	60784	1359.464	463	10659	267.861
1975	24174	6408.042	9391	1033339	28840.464	72	7436	70.438	517	61401	1383.365	719	13643	342.849
1976	28182	6483.304	12842	1155488	32249.670	80	7073	66.981	657	64284	1448.319	673	9541	239.765
1977	34383	7276.233	13997	939077	26209.639	80	7095	67.228	730	66588	1500.228	554	8703	218.706
1978	38279	7420.256	14666	839954	23443.116	93	5813	55.049	643	54739	1233.270	555	8540	214.610
1979	42077	7539.120	17882	842887	23524.976	127	7282	68.961	505	38622	870.154	391	4543	114.166
1980	49227	8082.224	19169	1076286	30039.142	126	6954	65.854	558	38651	870.837	374	3534	88.809

SUBDIVISION 28 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	378	7229	266.206	944	36648	1667.490	14400	887752	38794.778	217.329	2085	0	0	1801	94219.178
1970	676	12593	463.701	1432	55053	2504.910	14379	899566	39311.052	357.538	2823	0	0	1905	84640.016
1972	765	3475	127.960	2906	159271	7246.831	15191	804364	35150.707	1016.231	4709	0	0	3965	77379.500
1973	994	20162	742.425	1097	35064	1595.412	16237	846009	36970.550	1930.190	8370	0	0	2512	79053.470
1974	1514	24349	896.603	1364	38875	1768.813	19738	797558	34855.033	2732.000	11847	0	0	2801	77110.249
1975	1987	25248	929.707	2711	103018	4687.319	25334	532468	23268.852	2969.000	14680	0	0	3049	68900.034
1976	2493	32244	1187.321	3193	56176	2556.008	26930	504623	22052.025	3525.000	18032	0	0	4154	69808.393
1977	3864	42406	1561.516	3083	38644	1758.302	22242	401858	17561.195	3767.000	23076	0	0	3560	59920.046
1978	2842	23948	861.837	3380	32516	1479.478	22099	358724	15676.239	4088.000	28163	1619	297	976	54491.855
1979	3923	26972	993.190	6003	56609	2575.710	17174	233389	10199.099	4553.000	35351	1392	306	1368	50438.375
1980	4874	24234	892.369	5980	30103	1369.687	28935	240125	10493.463	5205.000	45364	2185	314	1267	57107.355

SUBDIVISION 29 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	54640	18767.848	3740	405051	11304.966	0	0	0.000	11	1009	22.707	20860	1004177	25234.963
1970	65101	22827.548	4423	518601	14474.152	0	0	0.000	10	893	20.121	22470	883189	22194.552
1972	74629	25108.382	4870	579488	16173.510	0	0	0.000	4	290	6.534	21845	674959	16961.720
1973	81944	26860.279	5076	589556	16454.509	1	203	1.922	14	1344	30.280	25027	780843	19622.585
1974	93644	29030.605	7918	795911	22213.876	0	0	0.000	35	1803	40.622	27865	778779	19570.716
1975	117106	31462.622	12596	1025965	28634.683	4	933	8.836	46	2218	49.972	36491	677267	17019.720
1976	143854	33541.729	15588	1094611	30550.593	0	0	0.000	5	265	5.970	37415	734030	18446.174
1977	169089	36267.462	18976	1135237	31684.353	0	0	0.000	7	293	6.601	45498	786020	19752.683
1978	164870	32392.083	20518	1168639	32616.714	364	3158	29.906	4	180	4.055	56967	765216	19229.878
1979	194183	35263.551	23545	1325001	36980.773	0	0	0.000	2	95	2.140	50097	784296	19709.358
1980	279665	46537.665	27126	1363701	38060.895	0	0	0.000	2	70	1.577	51395	757400	19033.462

SUBDIVISION 29 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	300	7801	267.252	4186	107385	4886.022	17526	977176	42702.573	193.510	1572	0	0	6727	103399.843
1970	422	10901	401.400	1773	86313	3927.254	18955	1224853	53526.077	265.939	1778	0	0	6857	117637.043
1972	451	2694	99.201	1433	48895	2224.723	27263	1535320	67093.484	518.132	2033	0	0	9330	128195.685
1973	741	23039	848.365	2057	71652	3260.166	26660	1507630	65883.431	2380.524	8741	0	0	8098	135342.060
1974	928	24683	908.902	3552	97412	4432.246	42564	1834649	80174.161	2557.000	9389	0	0	9308	158928.128
1975	1779	32912	1211.919	4400	83064	3779.412	74971	1702483	74398.726	2749.000	11081	0	0	16109	159314.888
1976	1971	26900	990.539	5590	79862	3633.721	109660	1968544	86025.373	2843.000	11811	0	0	21809	176037.099
1977	2040	21694	798.838	9086	121049	5507.730	135962	2245178	98114.279	2963.000	17267	0	0	21672	195094.945
1978	3158	29147	1073.280	7197	73615	3349.483	129250	1951448	85278.278	3072.000	21321	2731	1340	18701	177045.677
1979	3834	21766	801.489	10545	82989	3776.000	149547	2031325	88768.903	3354.000	25816	2809	1700	21785	188656.219
1980	2029	11112	409.177	17828	89453	4070.112	225653	1900136	83035.943	4222.000	35408	4628	4585	27230	195370.831

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 31 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	10835	2123.182	35	8652	241.484	0	126	1.193	17	1949	43.914	170	7621	191.516
1970	11616	2323.715	43	8607	240.123	5	836	7.919	13	2180	49.123	222	10047	252.487
1972	13106	2515.567	38	7259	202.599	5	795	7.567	19	1992	44.880	197	6279	157.791
1973	13780	2576.897	35	7452	207.985	0	5	0.047	17	2175	49.003	152	5146	129.319
1974	15271	2700.836	34	6483	180.941	0	3	0.028	21	2407	54.230	206	5997	150.705
1975	17071	2616.552	55	6320	176.391	0	0	0.000	61	6523	146.963	137	2869	72.098
1976	19340	2572.613	59	5337	148.956	0	0	0.000	70	5882	132.521	116	2374	59.659
1977	21319	2608.694	87	5948	166.009	0	0	0.000	87	5752	130.494	159	3204	80.517
1978	23880	2676.616	73	5061	141.253	0	0	0.000	68	4027	90.728	90	2040	51.265
1979	27670	2866.676	110	5895	164.529	0	0	0.000	89	4956	111.659	196	2160	54.281
1980	32868	3120.285	90	5076	141.671	0	0	0.000	117	5225	117.719	164	1565	39.328

SUBDIVISION 31 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	304	6120	225.369	746	22976	1045.400	975	51672	2258.055	51.812	1980	0	0	803	6181.906
1970	562	9815	361.400	717	34974	1591.306	953	56004	2447.373	62.212	1957	0	0	1071	7335.657
1972	748	3254	119.822	702	20769	944.990	1148	47393	2071.074	126.480	2335	0	0	1018	6190.769
1973	657	13086	481.866	684	20210	919.555	1094	45842	2003.295	144.937	2504	0	0	1181	6512.905
1974	718	12204	449.388	702	21394	973.427	1479	47962	2095.939	170.000	2937	0	0	1106	6775.494
1975	1010	11181	411.718	940	16124	733.642	1755	31006	1354.962	210.000	3311	0	0	1983	5722.327
1976	1000	9331	343.595	1186	27085	1004.868	2056	32686	1428.378	197.000	4151	0	0	1872	5887.590
1977	1247	9987	367.751	1251	14656	666.849	2049	27330	1194.321	336.000	4998	0	0	2181	5550.633
1978	1124	8131	299.408	1528	14347	652.789	2113	24974	1091.364	387.000	5555	985	424	122	5390.422
1979	1340	8019	295.264	1725	30829	1402.720	2255	24783	1083.017	408.000	6387	1177	513	207	6386.165
1980	1513	6879	253.305	2644	11511	523.751	2815	18294	799.448	433.000	7144	2143	616	196	5428.509

SUBDIVISION 32 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	13549	2655.007	157	17446	486.910	13	3002	28.432	175	24572	553.606	224	10156	255.219
1970	14473	2895.241	133	12546	350.005	10	2545	24.102	155	20363	458.771	216	8299	208.546
1972	16553	3177.184	122	9430	263.191	34	7177	67.966	51	5079	114.430	999	28525	716.833
1973	17637	3298.167	66	5001	139.578	24	5325	50.428	47	4833	108.887	1229	31348	787.775
1974	18486	3269.442	56	3862	107.789	40	8536	80.836	58	5831	131.372	1328	28077	705.575
1975	20199	3095.995	55	3381	94.364	17	5562	52.672	54	5961	134.301	1574	28823	724.322
1976	21759	2894.390	81	3981	111.110	17	5476	51.858	62	5989	134.932	1248	20268	509.335
1977	24950	3053.001	87	3065	85.544	42	5926	56.119	110	8669	195.313	1973	21422	538.335
1978	26199	2936.544	73	2776	77.478	29	4062	38.467	93	6852	154.376	1777	17934	450.681
1979	30394	3148.888	51	1896	52.917	49	6698	63.430	126	8256	186.008	2421	21792	547.633
1980	35310	3352.114	63	1479	41.279	50	6861	64.974	25	1301	29.312	3519	28929	726.986

SUBDIVISION 32 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	443	9383	345.511	266	9507	432.555	1562	91356	3992.243	98.356	1204	0	0	608	8847.839
1970	476	10995	404.985	268	9868	449.013	1574	89527	3912.324	135.897	1369	0	0	796	8838.773
1972	594	3241	119.343	489	15428	701.974	1826	93212	4073.364	319.153	1887	0	0	706	9553.439
1973	1036	19939	734.214	301	10640	484.120	1639	80096	3500.195	434.300	2403	0	0	604	9537.664
1974	786	14196	522.739	284	8782	399.581	2043	73142	3196.305	454.000	2512	0	0	769	8867.639
1975	660	8322	306.441	531	11697	532.214	2862	61055	2669.852	441.000	3132	0	0	935	8051.160
1976	779	7118	262.106	567	8038	365.729	2665	43800	1914.060	433.000	3541	0	0	1226	6676.520
1977	890	7296	268.661	663	7734	351.897	2483	35143	1535.749	372.000	4379	0	0	1471	6456.619
1978	1297	9361	344.700	512	5480	249.340	2332	33421	1460.498	391.000	4978	603	207	249	6103.084
1979	1556	10305	379.461	638	5381	244.836	2698	33384	1458.881	418.000	5940	1160	135	433	6500.053
1980	1937	9199	338.735	822	4265	194.058	3684	24517	1071.393	468.000	6966	1316	162	655	6286.849

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80, continued.

SUBDIVISION 33 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BRIQUETTES QUANTITY TONNES	BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	15743	3034.934	119	11670	325.703	0	0	0.000	14	1462	32.939	769	25878	650.302
1970	16847	3370.146	114	10069	281.014	0	6	0.058	15	1599	36.030	908	27418	689.009
1972	18499	3550.699	95	13705	382.507	0	0	0.000	5	474	10.679	774	21823	548.412
1973	18639	3485.544	144	22217	620.076	0	72	0.682	8	739	16.627	795	20206	507.777
1974	21611	3822.131	215	18352	512.204	0	10	0.095	12	1155	26.022	913	20754	521.548
1975	25004	3932.479	199	18464	515.330	0	0	0.000	8	299	6.736	870	15211	382.252
1976	27286	3629.593	258	15420	430.372	0	0	0.000	6	306	6.894	910	10549	265.096
1977	29216	3575.009	262	12849	358.616	0	0	0.000	11	610	13.743	912	10038	252.255
1978	32348	3625.762	380	12919	360.569	0	0	0.000	9	466	10.499	934	11193	281.280
1979	36080	3737.971	334	10950	305.615	0	0	0.000	13	543	12.234	1030	9779	245.746
1980	41329	3923.521	370	15167	423.311	0	0	0.000	16	528	11.896	1117	8837	222.074

SUBDIVISION 33 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	268	5394	198.609	529	16722	760.867	1455	93632	4091.697	42.733	1845	0	0	851	9187.785
1970	413	7797	287.113	703	25226	1147.795	1703	86477	3779.038	55.469	1971	0	0	1092	9645.670
1972	547	2494	91.937	607	19669	894.940	1500	67342	2942.845	104.299	2175	0	0	780	8526.217
1973	526	10436	384.285	636	20334	925.197	1313	57273	2502.830	115.602	2256	0	0	749	8558.620
1974	758	13070	481.277	634	18155	826.053	1398	49866	2179.144	132.000	2576	0	0	893	8500.474
1975	1038	10985	404.501	1217	21639	984.575	1909	42560	1859.872	158.000	3285	0	0	1415	8143.745
1976	1068	9767	359.650	1384	19421	883.656	2307	38548	1684.548	158.000	3966	0	0	1903	7417.809
1977	1150	9307	342.712	1468	18723	851.897	2198	29586	1292.908	130.000	4414	0	0	1629	6817.139
1978	1322	9666	355.931	1353	13789	627.400	1830	23417	1023.323	169.000	5031	1039	561	70	6453.764
1979	1400	7910	291.270	1521	24220	1102.010	1816	21574	942.784	154.000	5654	1112	567	46	6791.629
1980	1637	7172	264.055	1961	9342	425.061	2360	16843	736.039	186.000	6350	1710	542	36	6191.996

SUBDIVISION 34 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BRIQUETTES QUANTITY TONNES	BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	10096	1978.371	804	113217	3159.885	0	49	0.462	61	5801	130.705	12	661	16.621
1970	11194	2239.296	866	116714	3257.488	4	650	6.158	51	4956	111.660	12	593	14.911
1972	13213	2536.104	917	99108	2766.104	0	0	0.000	33	3365	75.813	41	2306	57.950
1973	14283	2670.960	940	99294	2771.296	0	0	0.000	40	3976	89.579	21	1105	27.769
1974	16347	2891.138	1093	96131	2683.016	0	0	0.000	46	4150	93.500	10	339	8.494
1975	17296	2651.038	1816	104893	2927.564	0	0	0.000	36	3232	72.817	1	31	0.779
1976	20158	2681.424	2359	113821	3176.744	0	0	0.000	33	2905	65.450	0	0	0.000
1977	22281	2726.409	2116	92241	2574.446	0	0	0.000	57	4130	93.049	0	0	0.000
1978	24701	2768.639	2417	100913	2816.482	0	0	0.000	44	3005	67.703	5	20	0.503
1979	28589	2961.886	2613	104499	2916.567	0	0	0.000	67	3157	71.127	0	1	0.025
1980	33274	3158.828	2593	93946	2622.033	0	0	0.000	67	3341	75.273	0	0	0.000

SUBDIVISION 34 ENERGY USE IN TERAJOULES(TJ) (10E12 JOULES)

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	69	1400	51.569	168	5053	229.892	1745	106995	4675.680	38.252	309	0	0	266	10281.436
1970	110	2101	77.353	228	9168	417.161	1856	107178	4683.672	51.157	339	0	0	587	10858.856
1972	147	677	24.929	209	5723	260.397	2374	114339	4996.614	125.482	488	0	0	191	10843.393
1973	188	3602	132.636	236	6197	281.964	2283	110874	4845.194	202.231	736	0	0	292	11021.628
1974	436	5674	208.934	319	7973	362.772	2709	103853	4538.376	269.000	979	0	0	326	11055.229
1975	386	4859	178.923	402	7509	341.660	4045	83627	3654.500	196.000	1429	0	0	431	10023.280
1976	284	2730	100.527	474	6056	275.548	4036	69002	3015.387	315.000	2300	0	0	222	9630.080
1979	333	3058	112.605	612	6534	297.297	3039	47739	2086.194	357.000	2844	0	0	199	8247.000
1978	688	5866	216.004	851	7893	359.132	1732	26040	1137.948	425.000	3560	305	25	18	7791.409
1979	584	4043	148.875	1364	11697	532.214	1916	22843	998.239	484.000	4097	342	232	24	8112.933
1980	870	4144	152.595	1820	8542	388.661	2973	25286	1104.998	507.000	4363	1207	282	41	8009.387

TABLE E.1

Energy Use by Australian Manufacturing, 1968-69 to 1979-80, continued.

DIVISION C - MANUFACTURING ENERGY USE IN TERAJOULES(TJ) [10E12 JOULES]

YEAR	ELECTRICITY VALUE $000	ELECTRICITY ENERGY TJ	BLACK COAL VALUE $000	BLACK COAL QUANTITY TONNES	BLACK COAL ENERGY TJ	BROWN COAL VALUE $000	BROWN COAL QUANTITY TONNES	BROWN COAL ENERGY TJ	BROWN COAL BRIQUETTES VALUE $000	BROWN COAL BRIQUETTES QUANTITY TONNES	BROWN COAL BRIQUETTES ENERGY TJ	COKE VALUE $000	COKE QUANTITY TONNES	COKE ENERGY TJ
1969	206108	54710.025	19805	3101519	86563.390	1542	716340	6783.739	3337	416231	9377.680	23315	1120277	28152.565
1970	229935	62924.870	20837	2767718	77247.013	1525	698417	6614.006	3468	462683	10424.256	25325	994170	24983.498
1972	258623	67943.198	19844	2473305	69029.943	1648	582196	5515.290	3388	425556	9587.777	25482	784270	19708.705
1973	281008	72106.669	21941	2625690	73283.008	1209	455173	4348.368	3556	454147	10231.932	28748	881137	22142.973
1974	315760	76872.037	26447	2765458	77183.933	1648	580216	5494.664	3336	414330	9334.855	32138	879251	22095.578
1975	363439	77381.460	35944	2971458	82933.393	1318	428824	4060.963	3599	415346	9357.745	41657	792136	19906.378
1976	426810	79301.126	44326	3102258	86584.021	1568	386549	3660.619	3691	349432	7872.703	42426	809822	20350.327
1977	484640	83358.319	50462	2866536	80005.020	1753	356951	3380.326	4212	352712	7946.601	51858	866419	21773.109
1978	516510	80275.778	52526	2765142	77175.113	1747	313633	2970.105	4088	287485	6477.037	63160	838361	21068.012
1979	593187	85540.233	58169	2865807	79984.673	1965	432641	4097.110	4857	289238	6516.532	57053	856447	21522.513
1980	746579	100668.875	64079	3118806	87045.875	1893	399197	3780.396	5278	293786	6393.699	59975	841274	21141.216

DIVISION C - MANUFACTURING ENERGY USE IN TERAJOULES(TJ) [10E12 JOULES]

YEAR	LIGHT OILS VALUE $000	LIGHT OILS QUAN. TNNS	LIGHT OILS ENERGY TJ	I.D.F. VALUE $000	I.D.F. QUAN. TNNS	I.D.F. ENERGY TJ	FUEL OIL VALUE $000	FUEL OIL QUAN. TONNES	FUEL OIL ENERGY TJ	GAS ENERGY TJ	MFD. VALUE $000	LPG VALUE $000	OTHER VALUE $000	OTH.FU VALUE $000	TOTAL ENERGY TJ
1969	3582	74614	2747.500	10868	344123	15657.609	62421	3701206	161742.689	1065.050	11986	0	0	25126	366800.248
1970	5276	101499	3737.481	9532	372102	16930.635	64793	3940455	172199.633	1444.505	13330	0	0	25196	376505.897
1972	6557	30507	1123.359	11409	445677	20279.304	81477	4351419	190157.010	3541.208	18095	0	0	33028	386884.794
1973	7812	161616	5951.186	10294	326964	14876.862	80052	4229480	184828.276	7725.980	31865	0	0	30356	395495.254
1974	9586	180509	6646.883	13361	415529	18906.570	107218	4575454	199949.088	9247.000	40005	0	0	30636	425730.607
1975	12531	159321	5866.677	18271	391975	17834.863	182655	4116122	179874.531	10251.000	48437	0	0	48462	407467.010
1976	14264	151651	5584.245	23644	462484	21043.022	230109	4156364	181633.107	11440.000	55448	0	0	60686	417469.669
1977	17748	166126	6117.258	30944	413191	18800.191	251827	4156113	181622.138	12907.000	83919	0	0	60181	415909.962
1978	18529	150107	5527.350	29980	301929	13737.770	223279	3344469	146154.169	14636.000	102479	10296	9996	45391	368021.374
1979	22469	140286	5165.751	40523	421147	19162.189	242578	3464596	151491.840	16117.000	121444	12210	9803	44797	389501.840
1980	24702	119321	4393.757	68921	330465	15036.158	363050	3002476	131208.201	19410.000	156381	20271	17275	58426	389073.176