DOMESTIC FIREWOOD SUPPLY

FROM NEAR URBAN LAND

by

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STATEMENT

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university and to the best of the author's knowledge and belief the thesis contains no copy or paraphrase of material previously published or written by other persons except when due reference is made in the text of the thesis.

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ABSTRACT

This study is an incremental, but important, component of a wider energy question facing Tasmania.

In 1981 Tasmania had an unresolved energy problem in the context of future electricity supplies. Faced with rising prices for home heating Tasmanian homeowners were finding their own solution to escalating heating bills. They were turning to firewood to satisfy their domestic heating needs.

This study provides information about the trends in firewood use in the domestic sector, and shows that the upward growth in demand for wood results from its price advantage over other heating fuels. Unlike the oil and electricity supply industries, the firewood industry is not well documented. By collecting information from a wide range of sources this study provides basic data about this industry. It examines the availability of firewood from near urban land within a 50 km radius of Hobart. It shows the importance of the private forest resource to wood supplies and that this resource is shrinking. It shows, for the first time, the involvement of farmers in the firewood business, and the opportunities for these land holders to make more money from their residue timber. The study also indicates that a growing number of people are turning to Crown Forest to collect firewood, and that they can obtain licences from the Forestry Commission for this purpose.

A cautionary note is also raised in the text in relation to the long-term availability of firewood. This is because of the pressures on the resource from the Woodchip Industry, and the potential use of fuelwood by Industry as an energy source.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

CHAPTER 1

INTRODUCTION

CHAPTER 1: INTRODUCTION

The thesis is devoted to a preliminary investigation of the availability of firewood from near urban land for the use of Hobart residents. This introductory chapter outlines the aims and objectives of the study and it also provides background information for the reader. In addition, it provides details of the location of the study area and the field work undertaken. The chapter also describes the structure of the report and summarises the reasons why the work was initiated.

1.1 The Aims and Objectives of the Project

There is a serious lack of information about Hobart's firewood supply. The aim of this project was to gather basic information about the domestic firewood industry with particular emphasis on how land, both private and public, is managed to maintain wood supplies.

To achieve this aim, the study was directed towards the following objectives:

(1) to arrive at an estimate of the current trends in the demand for firewood used for domestic heating;

(2) to gain an appreciation of the current supply system, and to see if it has any inherent weaknesses;

(3) to arrive at an estimate of the quantity of firewood being supplied for domestic use;

(4) to gain an understanding of the type of land the firewood is being supplied from, and how the land resource is being managed;

(5) to determine the types of trees that are being taken to supply firewood;

(6) to see if firewood sales from private land made a worthwhile or significant contribution to farm income;

(7) to gain a "*feel*" for the likely long term sustainable supply of firewood for domestic purposes to Hobart consumers.

1.2 Background

Firewood, often referred to as fuelwood in overseas literature, is not a new energy source. The use of wood for both heating and cooking has its roots in history. There is, however, a revival of interest in the use of wood for domestic heating by householders and consequently by researchers in many parts of the world[1], North America and Europe in particular. Such a resurgence of interest is also occuring in Tasmania with many home owners turning to wood for domestic heating. This is occurring because firewood, burnt efficiently in a slow combustion stove, provides the cheapest form of heating[2] when it is compared with oil or electricity (evidence to support this statement is produced in Chapter 2).

Firewood is also seen as a renewable energy source by some sectors of the Tasmanian public, particularly researchers with an interest in developing renewable energy supplies.

Despite the public recognising the cost advantage of using wood as a fuel for domestic heating, the role of firewood as a domestic energy source is a neglected topic in Tasmania's energy debate[3]. For government, for industry and for the Hydro-Electric Commission, and indeed for many other sectors of the community, the energy issue involves further development of dams on wild rivers in South West Tasmania.

The energy debate is about power for industry, not domestic comfort at least cost. In consequence, discussion, investigation and research, has focussed on centralised energy supplies that are capital intensive, more orientated to meeting the projected needs of industry (particularly bulk electricity users) than the needs of the small domestic consumers. There appears to be little recognition by the energy planners or suppliers of the quiet revolution that is taking place in home heating. Indeed, all predictions of future energy use in Australia made before 1980 showed a downward trend in the demand for firewood[4].

This was equally the case in Tasmania. However, the situation changed dramatically when home owners felt the full financial effects of rising oil and electricity prices on household expenditure in the late 1970s. In a situation of increasing cost for home heating, many people were faced with either a reduction of thermal comfort in the home or larger heating bills. However, if people took the opportunity to look at the different fuels available for domestic heating, from a price point of view, firewood was found to be the least expensive energy source. The fact that firewood does provide cheap heating has led to a rapid increase in demand. Access to firewood, particularly for the rising number of low income families, becomes an important consideration if wood prices are to remain cost competitive with oil and electricity. The management of the timber resource and the management of land, private and public, will determine if firewood can, or will be, supplied in the future at prices that are below the price of other heating fuels available in Tasmania. There is thus a need for a study of the firewood resource.

It is to this end that this investigation is directed.

1.3 The Study Area

The study was confined to an area within a 50 km radius of Hobart because it was thought that most of Hobart's firewood supply was drawn

from an area close to the city in order to minimise the costs associated with transporting firewood. Discussions held with firewood merchants, while collecting information for this report, substantiated this opinion. The study was also confined to this area because of the constraints of time and man power.

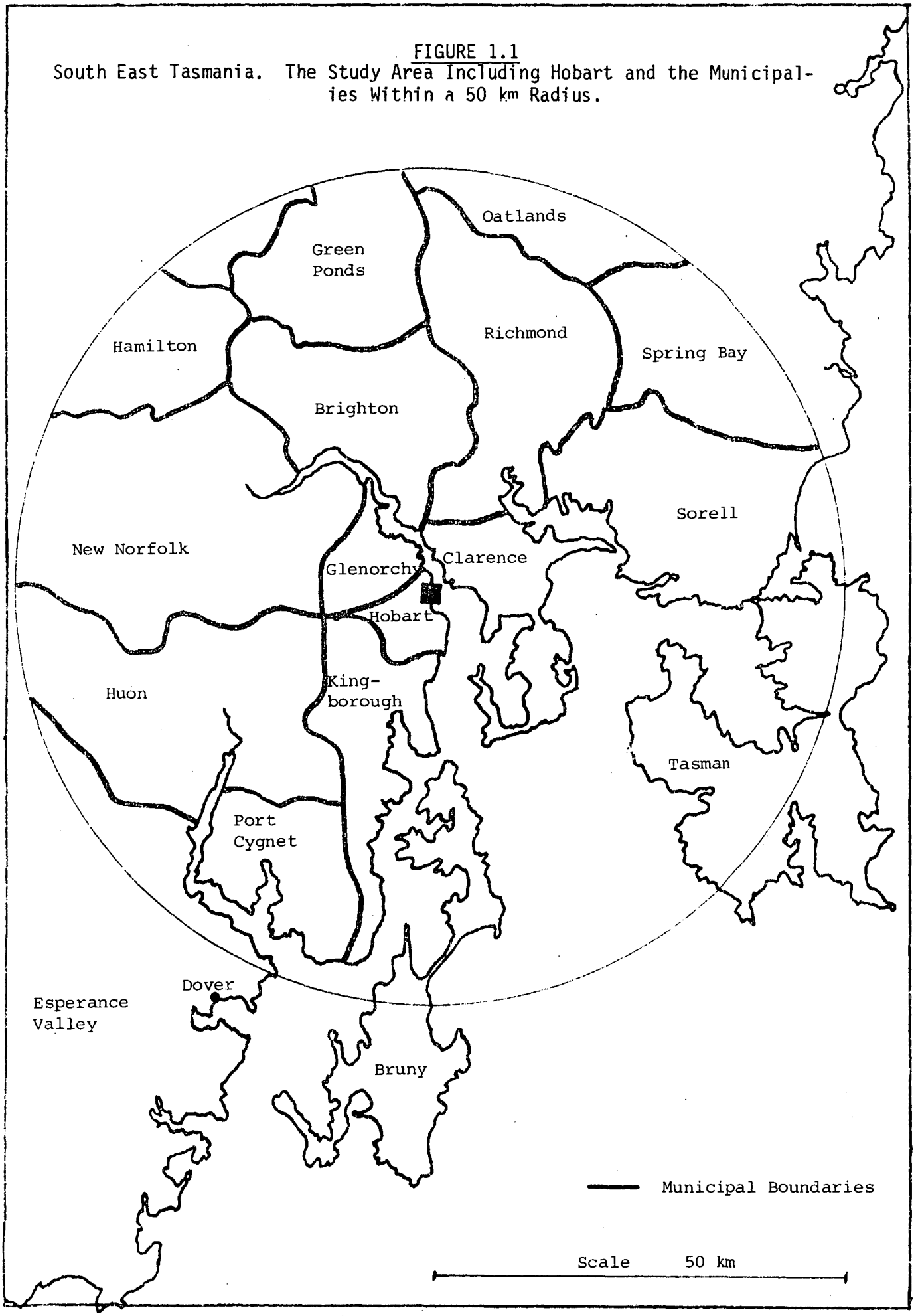
The region encompassed by the 50 km boundary includes 13 local government areas or municipalities (Figure 1.1 shows the boundary of the study area). The municipalities have a total land area of 618 500 ha[5] of which approximately 300 000 ha[6] are rural holdings in private ownership. The remaining area is taken up with roads, towns and villages, areas of parkland, recreation grounds, and substantial areas of crown land that are administered by a number of government instrumentalities (the most significant of which, for the purpose of this report is the Forestry Commission).

The study area has been described as near urban for two reasons. Firstly, many of the locations circled fall within commuting distance of the city of Hobart. Dover in the south-west is on the periphery in this regard (it is a town close to the Esperance Valley, an area having considerable potential to supply more firewood from Crown land as will be discussed in Chapter 4). Secondly, there are large tracts of country within the study area outlined that are timbered. They are therefore areas that might be expected to be used to supply the demand for firewood in Hobart. These timbered areas also potentially offer a means of keeping the price of a low value bulky commodity within bounds, since it seems that transportation costs are a major component of the price of firewood delivered to the city.

While there is this potential, there is also a problem of gaining access to the resource. This aspect will be referred to again in Chapters 3 and 4.

FIGURE 1.1

South East Tasmania. The Study Area Including Hobart and the Municipalies Within a 50 km Radius.



1.4 Field Work

While there is evidence that the public are aware of the competitive nature of wood for heating (a chapter on firewood demand follows), little is known about how this firewood is supplied. Furthermore, little is known, or available in any documented form, of where the firewood supplies come from, or indeed what is happening to the land that such timber is taken from. It is not known, for example, if the supply is sustainable in the long term, or if there are factors which could restrict availability.

So as to gain some answers to these questions, questions that are very much related to land management, the following approach was adopted.

In the first instance, telephone contact was made with fuel merchants advertising in the local press. This began in July 1981 and continued until October of the same year. The intention was to find out from these people where firewood supplies came from. It was quickly realised that making such contacts was not going to be an easy task. The reason why it was not easy can be explained as follows. The firewood industry had been an industry in decline until the late 1970s. The industry had not been highly profitable, indeed it had been characterised by being dominated by battlers (a term employed by one of the wood merchants to describe the often hardworking, but lowly paid, people who cut and cart firewood for a living, and who like to be their own boss). Many of these people are not in the firewood business as a full-time occupation. It seems that the wood suppliers are mostly part-time operators, either those holding second jobs, dole recipients seeking extra cash in hand, or others who, for one reason or another, did not want the income from firewood sales to be identified (this opinion is supported in a report by Newman for the Directorate of Energy[7]).

The consequence of this was that many enquiries made by telephone to people advertising firewood for sale in the Saturday Mercury (Hobart's principal newspaper) over the winter of 1981 revealed no more than the price per tonne for firewood. Names and addresses were not forthcoming, and questions addressed to such people about the quantity of wood they sold in a year, or about the area from which the wood came from, drew no response.

While direct phone calls were initially attempted in order to establish if wood was being taken from Private or Crown land, such an approach proved unsuccessful. The next step was a personal approach to the six major fuel wood merchants listed in the yellow pages of the phone directory, to solicit their help. The merchants were asked, amongst other questions, if they would indicate where their supplies were coming from. It transpired that the names of the merchants' suppliers were also treated with considerable confidence. Most merchants were reluctant to provide information other than *"the timber [they] sold came mainly from private land, with smaller quantities being taken from Crown, i.e. State Forest, areas"*.

Despite the apparent secretive nature of information about where firewood supplies were drawn from, two fuel merchants were prepared to nominate a small number of farmer contacts. It is through these people that practical field work began in late August with a direct approach being made to landowners for interviews. Farmers were contacted personally, and a structured interview was held with them. These initial contacts led to other land owners associated with production of firewood being interviewed and, in total, 20 provided information. Because of the difficulties encountered in gathering information, the time constraint, and the fact that the total number of people allowing firewood to be taken from their land is unknown, it cannot be claimed that the survey conducted would meet a statistician's requirement for a representative sample. Those who were prepared to be interviewed were interviewed,

and in this way useful data was collected.

1.5 Structure of the Report

To guide the reader, the following notes are offered as points of clarification. Chapter 2 of the report details the demand situation for firewood as it is known, and is based on the best information that is available to the author at the present time. Since there is no formal reporting or recording of firewood demand or use, the figures quoted must be treated with caution. Confidence in the demand *trends* can however be expressed as they are drawn from several sources that support each other. The chapter also describes the distribution system or supply chain for firewood.

Chapter 3 is divided into two parts and addresses the question of the supply of firewood from private land. Part one examines the information that is available about the resource and reports the findings of interviews held with a small number of farmers (20) who were involved in the firewood industry. The properties managed by these landowners were scattered throughout the study area, although most were found to be to the north and east of Hobart.

The second part of Chapter 3 highlights some of the problems facing the firewood industry if supplies of wood are to continue to be made available from freehold land. The incentives provided by government for farmers to grow trees are outlined briefly but, since there are no such incentives available for energy plantations these are shown not to be an alternative to the taking of residue timber for firewood.

Chapter 4 discusses the extent of the Crown timber resource in the study area and shows how more firewood could be supplied from Crown land if an integrated timber harvesting programme was initiated on similar lines to one operating in the Esperance Valley near Dover.

The chapter also shows the importance of the Forestry Commission's role if firewood supplies are to be expanded through such schemes.

Chapter 5 integrates the findings of the study with the objectives outlined in Section 1.1. In addition, where there are gaps in the knowledge of the factors affecting the firewood industry identified, remedial action is suggested which, if taken up, would help to develop a sustainable firewood supply for Hobart residents.

References and notes are to be found at the end of each of the chapters. Appendix A sets out the assumptions and details the workings of an investment appraisal for theoretical 50 hectare energy plantations. Appendix B provides details of the application forms available from the Tasmanian Forestry Commission for firewood collection from Crown land.

1.6 Summary

Home owners are turning to wood as an alternative means of home heating in the face of rising prices for oil and electricity.

There is little information available in any documented form that addresses the question of near urban land management for the maintenance of a firewood supply for Hobart residents, or indeed other major towns in Tasmania.

There is a need to know more about the quantity of firewood used and the trends in demand to ensure that supplies can be sustained in the long term.

The lack of documented information is a cause for concern when many people are becoming dependent on wood for domestic heating. This lack of information provides the motivation for at least a preliminary study of the current situation.

Notes and References

1. MALE, D.J., 1981; *Overseas Developments in Woodheating Technology;* paper presented at the Tasmanian Energy Research Committee Workshop on Wood Heating, 23 October, Hobart.

2. TODD, J.J., 1981; *The Combustion of Wood in Domestic Appliances;* paper presented at the 2nd Applied Physics Conference of the Australian Institute of Physics; Physics for Australia's Development, Royal Melbourne Institute of Technology, Melbourne, 30 November - 4 December.

3. AMOS, J., Minister for Energy, 1981; *Government Initiatives in Energy;* A document made available from the Minister's Office.

4. TODD, J.J., 1981; *Fuelwood Supply for Domestic Use;* Fuelwood Cropping Investment Seminar, International Tree Crops Institute, Melbourne, 13 March.

5. Australian Bureau of Statistics, 1979; *Compendium of Local Government Area Statistics, Tasmania;* Australian Bureau of Statistics, Hobart, June.

6. Australian Bureau of Statistics, 1981; *Agricultural Industry Tasmania, 1978 - 1979;* Australian Bureau of Statistics, Hobart, January.

7. NEWMAN, R.L. and ASSOCIATES, 1980; An unpublished report prepared for the Directorate of Energy, Premier's Department, Hobart.

CHAPTER 2

THE DEMAND FOR FIREWOOD

CHAPTER 2: THE DEMAND FOR FIREWOOD

This chapter provides details of the current estimated demand for firewood in Hobart and also describes the supply chain or distribution system that shows how that demand is serviced.

The first section of the chapter outlines the necessity for domestic heating in Tasmania. This is followed in the subsequent sections by estimates of the quantities of firewood used in the State both in tonnes and in dollar values. The situation for Hobart is examined in some detail, with evidence of the trends in demand being supported from several independent sources. The chapter concludes with an assessment of the effort needed to obtain on-going reliable information about the source of supply, the timber resource from which firewood is taken.

2.1 The Need for Domestic Heating

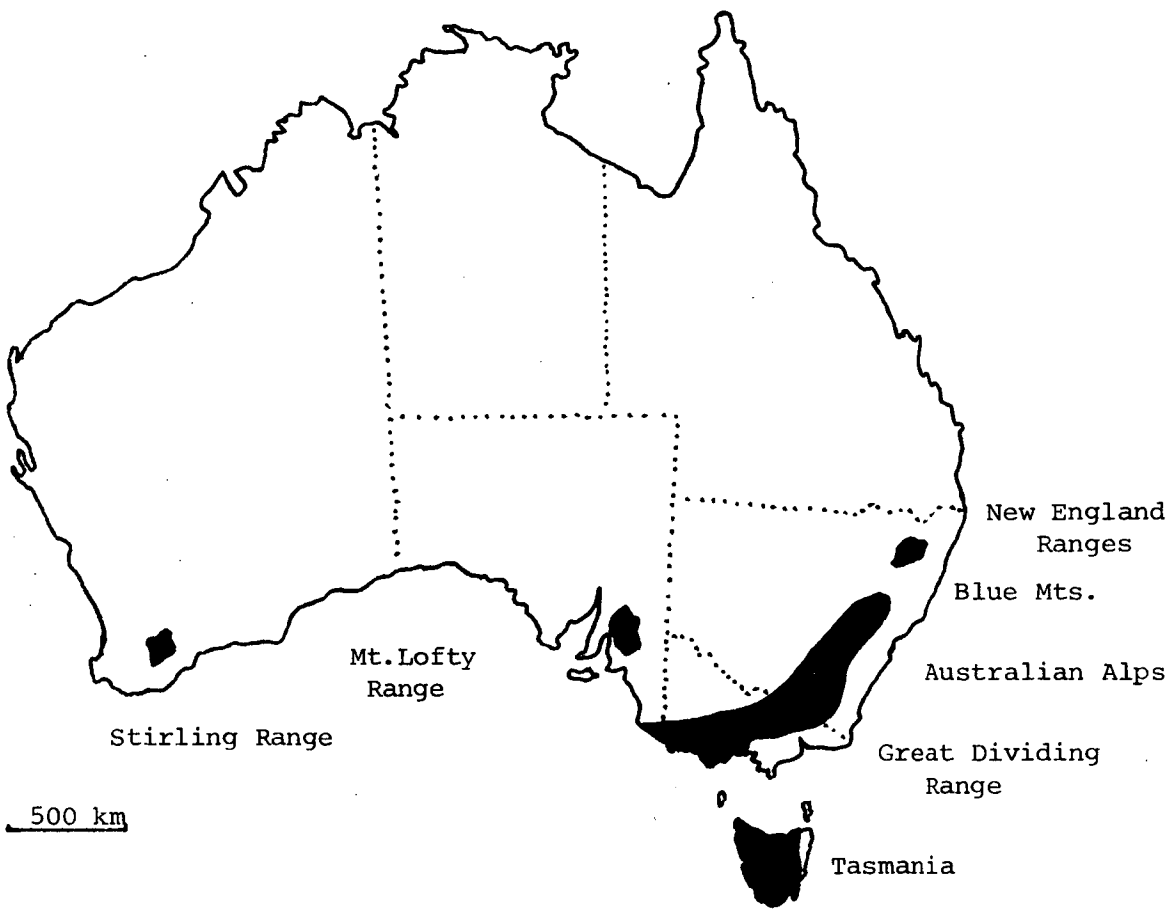
In order to appreciate why Tasmanians, and Hobart residents in particular, need to heat their houses, it is first necessary to accept that locations, city or country, can be ranked in order of their severity of climate. A knowledge of the severity of climate permits consideration of the need for domestic heating. Figure 2.1 illustrates the areas nominated by the Australian Department of Construction as those which experience cold winter climates[1].

As can be seen from the map, there is a very large part of Tasmania that has a cold winter climate; by definition a winter climate that has 50 days or more each year when the dry bulb temperature outdoors does not reach 15°C[2].

The severity of climate can also be expressed in terms of the *effective temperature*. The effective temperature with respect of any

FIGURE 2.1

Australian Cold Winter Climate Areas



Source: Experimental Building Station - Department of Construction N.S.B. 32, (see Note 1, Notes and References).

environmental combination of temperature, humidity and wind, is defined "as the *temperature of still saturated air in which a normally clothed sedentary worker would feel the same level of comfort or discomfort*"[3]. Studies have shown, for example, that the majority of people feel discomfort when the effective temperature is less than 15°C[4]. Table 2.1 shows that Hobart, when compared with other towns and cities in Australia, has an average of 239 days each year when the indoor temperature is below 15°C, the temperature at which cold discomfort is experienced.

TABLE 2.1
The Effective Temperature in Hobart Compared to Other Australian Towns and Cities.

Station	Period of Record	Average days per year Less than 15°C	15-27°C	Greater than 27°C
Adelaide	1955-72	128	234	3
Albury	1962-71	141	220	4
Alice Springs	1955-67	39	300	26
Brisbane	1951-70	6	356	3
Broome	1941-71	0	225	140
Canberra	1940-72	172	192	1
Carnarvon	1945-72	1	345	19
Ceduna	1955-71	77	279	9
Charleville	1942-72	28	316	21
Cloncurry	1940-72	1	268	96
Darwin	1955-69	0	225	140
Hobart	1944-67	239	126	0
Kalgoorlie	1940-72	66	281	18
Marble Bar	1957-71	0	220	145
Melbourne	1955-71	155	207	3
Mildura	1946-72	95	258	12
Perth	1944-71	57	302	6
Rockhampton	1940-72	2	337	26
Sydney	1955-72	69	295	1
Townsville	1941-69	0	333	32
Woomera	1954-72	73	279	13

Annual average frequency of days when effective temperature at 3 p.m. is lower than 15°C (cold discomfort), within 15-27°C (comfort), and higher than 27°C (heat discomfort). Indoors, normally clothed sedentary workers, air movement 5-8 metres per minute.
(From *Climate of Australia*, 1977-1978 Edition, Department of Science and the Environment, Bureau of Meteorology).

Thus it can be seen that Hobart residents generally have a higher requirement for heating than the other cold winter cities of mainland Australia like Adelaide, Canberra and Melbourne. In fact Hobart's heating requirement is amongst the highest in Australia because the outdoors temperature only exceeds 25°C for an average of 96 hours per year[5,6]. The unique factor about Tasmania is that there is a heating requirement almost continuously, and it is not confined specifically to the cold winter period[7].

While it has not been possible to establish how much energy is used in Hobart for space heating, it is known that Tasmanians use proportionally more of their energy budget for space heating and cooling than the residents of other Australian states. The percentage of the energy budget used in each state is shown in Table 2.2.

TABLE 2.2
Percentage of Energy Budget Used for Space Heating or Cooling by State.

State	Percentage Energy Budget
Victoria	35
N.S.W.	21
South Australia	31
Tasmania	43
Queensland	10
Western Australia	20
Australia	26

Source: The Institution of Engineers, 1977; *Thermal Economy in Buildings;* Proceedings of the Conference on Energy; The Institution of Engineers, Australia, Canberra, July.

Although the table shows details of the energy budget used for both *heating* and *cooling* it is assumed that, since the temperature, at least in Hobart, is rarely over 25°C, then little energy is in fact used for cooling purposes and most of it is used for space heating.

But heating can only be achieved at a cost, and it is this factor which is increasingly making firewood an attractive alternative. This aspect is now discussed in the following section.

2.2 Firewood Used in Tasmania

Since Tasmania has, by Australian standards, a prolonged cold winter climate with nearly 240 days each year when the effective indoor temperature is below 15°C, it is not altogether unexpected that on a *per capita* basis Tasmania uses more firewood than any other Australian state[8]. The reason for the widespread, and now growing, use of firewood is not difficult to comprehend if the cost per unit of heat energy is compared between fuel types. Wood, particularly wood burnt in a slow combustion stove, produces heat at a very low cost per unit as is shown in Table 2.3.

It can be seen in column 6 that when the cost of energy is compared in terms of the *"effective unit price of energy"* (a figure that takes into consideration the efficiency of the use of the fuel type/energy source), then wood burnt in a controlled combustion stove produces heat at the low cost of only 0.26 cents per megajoule.

This is approximately half the cost of electricity on the restricted hour tariff and one quarter the cost of heating oil. The net result of the low cost of wood heating can be ascertained if comparisons are made with the annual fuel bill for each of the fuel types listed in column 9 of Table 2.3.

However, not all wood is burnt efficiently in slow combustion stoves. Many homes still have open fires, and some of these are used only for aesthetic reasons. There are also some home owners with open fires that use firewood as the sole means of domestic heating. For these people firewood could be an expensive form of heating if they have to purchase all their firewood from fuel merchants rather than

TABLE 2.3
Domestic Heating Energy Costs in Hobart (Winter 1980).

Fuel	Energy Content of Fuel	Fuel Price	Price Per Unit of Energy	Efficiency of Use	Effective Unit Energy Price	Annual Fuel Bill*
Electricity (household tariff)	3.6 MJ/kWh†	4.15 ¢/kWh	1.15 ¢/MJ	100%	1.15 ¢/MJ	$368
Electricity (off peak tariff)	3.6 MJ/kWh	1.64 ¢/kWh	0.46 ¢/MJ	90%	0.54 ¢/MJ	$174
Heating Oil	37.6 MJ/ℓ	28.1 ¢/ℓ	0.75 ¢/MJ	70%	1.07 ¢/MJ	$342
L.P. Gas (bottled)	50 MJ/kg	44 ¢/kg	0.88 ¢/MJ	73%	1.21 ¢/MJ	$387
Kerosene	36.5 MJ/ℓ	28.1 ¢/ℓ	0.77 ¢/MJ	75%	1.03 ¢/MJ	$330
Coal	24.6 MJ/kg	$90/tonne	0.37 ¢/MJ	60%	0.61 ¢/MJ	$195
Wood (open fire)	16 MJ/kg	$25/tonne	0.16 ¢/MJ	10%	1.56 ¢/MJ	$500 ($125 small comfort zone only)
Wood (controlled combustion)	16 MJ/kg	$25/tonne	0.16 ¢/MJ	60%**	0.26 ¢/MJ	$83

* Based on an annual delivered energy requirement of 32 GJ (30×10^6 BTU) per household (heating living area of 45 m² of typical Tasmanian house day and evening to 20°C; house fitted with ceiling insulation only, 100 mm). Note that it is not practical to heat the whole living area with an open fire.

† Units include: MJ = megajoule = 10^6 J; kWh = kilowatthour; ℓ = litre; kg = kilogram; ¢ = cents

** Well designed controlled combustion heaters will achieve efficiencies of at least 60% over a range of normal operating conditions.

Source: TODD, J.J., 1981; *The Use of Fuel for Domestic Purposes;* Presented at the Crop and Forest Residue Workshop, organised by the Commonwealth Scientific and Industrial Research Organisation on behalf of the National Energy Research Development and Demonstration Council, Canberra, July 7-8.

collect it themselves (see, for example, the annual fuel bill for wood heating with open fires in column 7, Table 2.3). Nevertheless, if wood is burnt efficiently it is apparent that the cost per unit of energy is low. Many householders have recognised this fact with the result that the demand for firewood is increasing. The problem that then follows is to arrive at some estimate of the demand.

While reaching such an estimate poses some difficulty, the Australian Bureau of Statistics has carried out surveys of household energy sources for the years 1975, 1978 and 1979. It is from these surveys that the total quantities of wood thought to be used for domestic purposes (mainly heating and cooking) for the three years have been derived. They are presented in Table 2.4 and are crude figures only because of the lack of more detailed information substantiated by research.

TABLE 2.4

Number of dwellings in Tasmania using firewood for heating, cooking and water heating. Figures in brackets refer to the percentage of occupied dwellings using firewood. Also shown are estimates of firewood consumed per annum.

	August 1975	June 1978	November 1979
Room Heating			
Open Fire	32 600 (27.9%)	29 500 (23.4%)	31 900 (24.7%)
Controlled Combustion Heater	17 300 (14.8%)	12 500 (9.9%)	14 700 (11.4%)
Estimated Wood Consumption for heating (air dried tonnes per annum)	215 000	185 000	204 000
Cooking	6 500 (5.6%)	4 000 (3.2%)	5 200 (4.0%)
Storage Hot Water	5 300 (4.5%)	3 700 (2.9%)	4 300 (3.3%)
Estimated total domestic fuel wood consumption* (air dried tonnes per annum)	313 000	245 000	282 000

* In addition about 1000 tonnes per annum of coal is used for domestic purposes in Tasmania

1980 survey results not yet available at time of writing this report.

Source: TODD, J.J., 1981; *Fuelwood Supply for Domestic Use*, (see Note 8 Notes and References).

There is no official recording of wood or energy use per household. The surveys undertaken by the Australian Bureau of Statistics, based on a 1.7% sample (approximately 2000 houses) of the total number of occupied houses in the State[9] report the method of heating not the quantities of wood used. In practice there is a considerable range in the quantity of wood used per dwelling, although a survey of woodyard deliveries to householders has shown an annual wood consumption figure per dwelling of 5 tonnes for homes with open fires and 3 tonnes for controlled combustion heaters[10]. These figures have been employed to calculate the *total* figures reported for each of the three years. However, since these figures were produced, interviews with several merchants undertaken as part of this study have revealed that some householders use more than one tonne per month throughout the year. In one case, where cooking and water heating were combined with other heating (open fires), deliveries of one tonne per fortnight were made. At the other end of the spectrum there are those home owners who only burn wood on *special occasions* for aesthetic reasons. These people perhaps use less than a tonne of wood for the year.

There will also be a difference in consumption between those householders who collect their own wood, often at little direct cost if they live in rural areas or have access to a rural wood supply, and those who buy from a recognised wood fuel merchant at the 1981 price of $27 - 35 per tonne in Hobart (lower prices may be operative in other centres).

Given the difficulties outlined, it is estimated that 300 000 tonnes of firewood are used each year in Tasmania for domestic purposes. The actual figure could be very much higher since many rural dwellings, 63% in 1978[11], used firewood as a principal source of heating. The rural home owner, often collecting wood at next to no direct cost, has

no incentive to burn wood efficiently. In consequence many of these people may well use in excess of 5 tonnes per year.

Nevertheless, if 300 000 tonnes of firewood is an acceptable figure, how much is this timber worth in dollar terms? In 1981, firewood prices ranged from less than $20 per tonne in rural areas[12] to a maximum of $35 per tonne in Hobart[13]. If the lower price is accepted, then consumers burn firewood to the value of $20 x 300 000 = $6 million per year. The figure of $20 may well be close to the actual cost to householders of collecting their own fuel. This statement assumes that there are some costs associated with the purchase of equipment (a chain saw) plus a component to cover the time spent in travelling and wood collection, loading and unloading (some people might regard wood gathering as recreation, but there are still associated costs). Should a higher figure be considered more appropriate, then the firewood industry appears to be worth very much more than $6 million. However, many of the financial transactions involving firewood remain unrecorded. It is very much a cash-in-hand operation. The result is that the real quantities of wood used for domestic heating remain calculated guesses. While this situation is true for Tasmania as a whole, it is less true for Hobart. More detailed studies of firewood use have been made for Tasmania's capital city, but they show wide variations in the estimates of the amount of wood used for domestic heating.

2.3 Firewood Used in Hobart

While it has been already stated that 63% of rural dwellings use wood as the principal heating source, and Todd maintains that one third of all Tasmanian houses use wood as their main heating fuel[14], fewer urban dwellings are heated with firewood. This has been the case in Hobart, but the situation is changing rapidly. In June 1978, 22.7% of dwellings in the Hobart statistical division used open fires or solid

fuel heaters[15]. However, less than eighteen months later the number had risen to 25.9%[16]. The increase of about 14% in the number of dwellings using wood as a heating fuel has influenced demand. This prompted Newman to report in 1980; "*during the past two years there has been a bottoming out of the supply position and all the [fuel] merchants ... indicated that there was a firmer demand than had been the case for several years*"[17].

While there is evidence of an increase in demand, and this will be supported further by subsequent comments, there are discrepancies in the quantities of firewood thought to be used. On the one hand, a figure of 15 - 17 000 tonnes has been quoted by a forestry consultant[18] while, on the other hand, a figure of up to 70 000 tonnes has been calculated from research carried out at the University of Tasmania[18]. The discrepancies may arise for several reasons. Firstly, Hobart might be viewed as the area encompassed by the administrative area of Hobart City Council or, alternatively, it can be viewed as the Hobart statistical division. This includes not only the city of Hobart, but also the municipalities of Glenorchy, Kingborough and Clarence. The difference in the area defined as Hobart offers one explanation for the discrepancies.

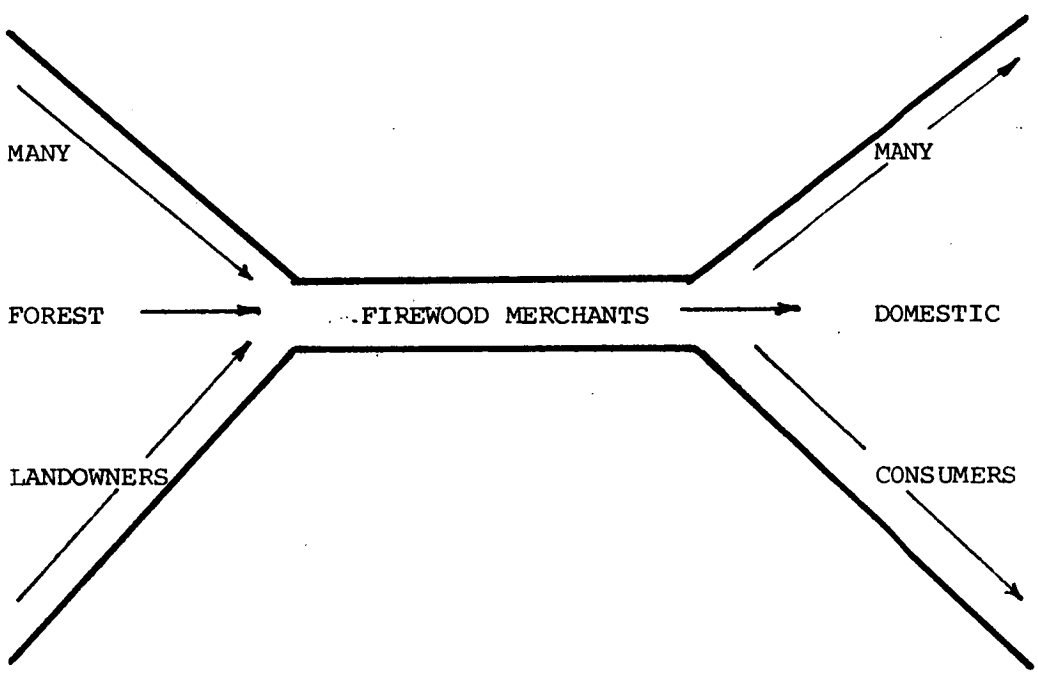
It is difficult to obtain accurate details of wood use, except perhaps through records kept by identified fuelwood merchants advertising through the yellow pages of the telephone directory. It is this source of information that seems to have been the basis of Newman's figures. However, the supply chain is not as simplistic as might be suggested by that author. An outline of the differing systems now follows.

2.4 The Supply Chain

For the purpose of this study the term supply chain (it can also be called the distribution system) is used to describe the channel by which firewood moves from the selling or collection point through to the end user. As will be shown, there are several links in the chain which take account of the physical handling of firewood between the buyer and the supplier. These lines were identified from the fieldwork undertaken for this study. The system can be best conceptualised by the use of a diagram. In the first instance a supply chain is presented showing how the firewood merchants are thought to be central to meeting the domestic demand for wood for home heating.

FIGURE 2.2

The basic supply chain assuming the merchants listed in the yellow pages supply most of the domestic demand for fire wood.



The system outlined shows many scattered forest land owners (which can also include Crown land) supplying wood to a small number of wood fuel merchants (in traditional marketing theory this might also imply a concentration of purchasing power but, in practice, this is not the case[20]). The merchants in turn then supply an expanding number of consumers. This picture of the supply chain shows a very restricted view of what is occurring in practice. In reality there are several means by which domestic users of firewood can obtain supplies. This is illustrated diagrammatically in Figure 2.3.

The situation outlined comprises the following groups of people:

Private and Crown Forest Land Owners

Wood Cutters

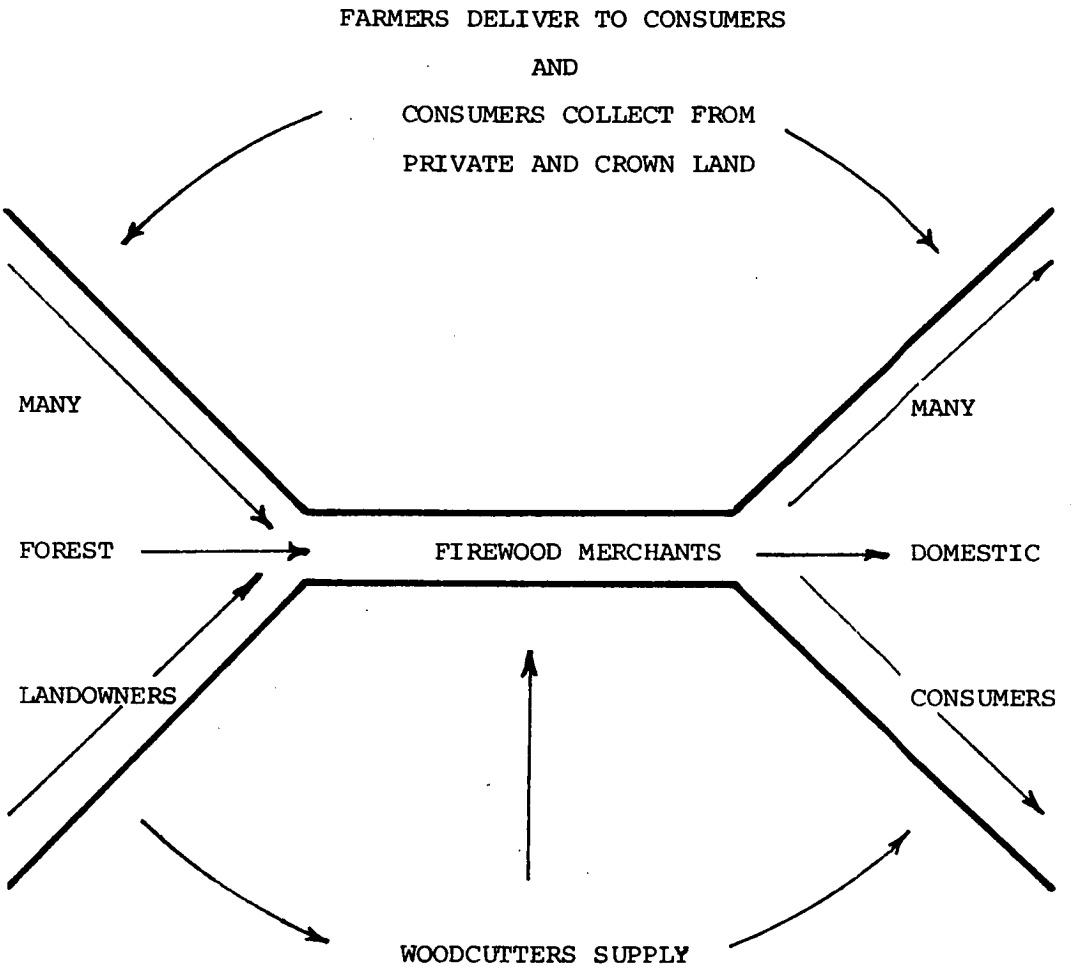
Wood Merchants

Domestic Consumers

Private landholders are, in the main, farmers and graziers who either own or, in some cases, lease land on which timber is growing. The Crown Forest is often land that is under concession to timber companies but which the Forestry Commission has a say in managing. More information about the Crown land timber resource in the study area, and gaining access to it for firewood collection, is to be found in Chapter 4. Private landholders either give access to wood cutters, merchants or the public to take firewood or cut and supply firewood to the public themselves.

Woodcutters are people who take timber for firewood from private and Crown land, cut it, split it into lengths and then either transport it to merchants or to domestic consumers. They sometimes make a

FIGURE 2.3
The more complex "Real World" firewood supply chain identified from this study.



nominal payment to the land owner for wood taken. Many cut firewood as a second job and do not seem to operate year round. It is these people who frequently advertise firewood for sale in the local press in the winter time. They do not seem to stockpile firewood to maintain continuity of supply but prefer to sell what they cut in loads of several tonnes when they have it to sell.

Wood Merchants differ from wood cutters in that they provide a year round wood supply. They stockpile firewood in the summer months within the limits of their storage facilities so as to be able to make regular supplies to their customers when and where required, mainly in the winter. Most buy their supplies of firewood from wood cutters and a few private land owners who deliver wood to the merchant's yard. They are willing to supply customers with loads of a tonne (less in some cases) but charge more for their wood because of double handling, the service provided, and to recover their additional overheads (for example, the costs associated with stockpiling).

Domestic consumers either buy firewood in large or small loads from farmers, wood cutters or wood merchants or alternatively collect firewood from private or Crown land themselves.

Thus, the means of obtaining firewood for home heating can be:

(1) the farmers supplying customers direct;

(2) the farmers supplying wood merchants who in turn supply customers;

(3) the Forestry Commission or farmers providing access to timber for wood cutters who then supply merchants;

(4) wood cutters taking wood from Crown or private land and supplying consumers direct;

(5) people collecting their own firewood from private or Crown land.

In fact all mechanisms of supplying and gathering firewood are practised.

Informal interviews held with wood merchants, land owners, as well as with members of the public, suggest that about 80 - 90% of firewood is supplied from private property (that is, from farmers having areas of timber on their land) and 10 - 20% taken from Crown forest (for the purpose of this study it is assumed that 80% of firewood is from freehold property). In terms of the quantities supplied, a personal judgement is that about 30% of all firewood is supplied through established merchants to home owners. Thirty to 40% is supplied from wood cutters who operate their own small businesses, and the balance, some 30%, is collected by people for their own use. This view is supported by work by Todd[21].

If this subdivision of the firewood distribution system is approximately correct (a not dissimilar situation is reported for New England and New Hampshire in the United States[22,23]), then an extrapolation of firewood supplies from the merchants to domestic users of firewood provides an estimate of the actual quantity of wood used for domestic heating in Hobart.

Interviews were held with the major fuelwood suppliers in Hobart and the suburbs, together with suppliers in Bridgewater, Cambridge, Sorell and Forcett. All said they made deliveries to Hobart. When their annual reported sales were totalled (none, incidentally, produced accounts for inspection) this amounted to in excess of 20 000 tonnes. While it is not possible to actually check this figure from accounting records, it is assumed that the merchants do know their own business. Their figures have therefore been taken at face value. This led to the conclusion, based on the percentage split earlier mentioned, that Hobart conservatively consumes 60 000 toness of firewood for domestic heating purposes each year. If all this wood was purchased at a minimum price of $27 per tonne, the local industry has a value of $1.62 million.

2.5 Demand Trends

Having indicated the estimated present level of firewood consumption, it is next necessary to know if this demand is stable or, alternatively, increasing or decreasing. It has already been shown that the proportion of all dwellings with either open fires or combustion stoves increased in the 18 months from June 1978 to November 1979 by 2.8% for Tasmania as a whole while the number using wood increased by approximately 14% in Hobart. This is perhaps the first observable indication that the demand for wood might be escalating. Following on from this was the statement, reported by Newman, that the merchants felt that the decline in the use of firewood for home heating had bottomed out. There is now further evidence that demand is increasing and that the trend is accelerating. The statement is supported by personal interviews with wood merchants and private forest owners conducted as part of this study and by the Tasmanian Forestry Commission. The fourth indicator of increased demand has been the number of people advertising firewood for sale at the weekend in the local Hobart newspaper, *The Mercury*.

As mentioned earlier, all the major wood merchants in Hobart were contacted at the beginning of this study. All reported an increase in sales of 10 - 20% for the 1981 winter. Some experienced difficulties in satisfying demand. Nearly all were concerned about their ability to stockpile enough wood over the summer to maintain supplies for the winter of 1982. Most thought their wood supplies came from private land.

Because of the importance of the private forest resource to the firewood industry, an extension of the study, reported at length in the next chapter, involved structured interviews with 20 land owners. Sixteen of these land owners made statements to the effect that the demand was increasing (four land owners did not know what was happening

to demand). When requested to substantiate their assertions that demand was increasing, the following comments were made by the farmers questioned:

(1) they had been asked by more wood cutters for access to a wood run (that is, a source of supply);

(2) they had had more people call at the door asking to collect wood than they had experienced previously;

(3) two farmers, previously not involved in the firewood industry, had been attracted to supply firewood because they were aware of the increased demand.

These comments support the contention that there is an upward trend in the demand for firewood. This is further confirmed by information provided by the Tasmanian Forestry Commission for the study area. Table 2.5 shows the number of licences issued for the collection of firewood from three South East Forestry Districts (Norfolk, Triabunna and Geeveston) together with the total quantities of wood taken expressed in cubic metres. The figures cover a period of eight months from January to August for the years 1980 and 1981.

TABLE 2.5

Firewood statistics and licences issued for three South East Forestry Districts.

Month	1980 m^3	1981 m^3
January	176.63	272.53
February	184.09	197.49
March	285.14	306.76
April	471.79	467.68
May	279.54	162.30
June	520.39	377.58
July	682.52	2034.99
August	440.68	747.67
Total	3040.78	4567.00
Number of Licences	39	95

Source: Personal Communication, Tasmanian Forestry Commission, October 1981.

The table shows an increase of about 50% in the quantity of wood taken for firewood, and a doubling of the number of licences issued. These increases further support the case that the trend in demand is upward.

To give further weight to this conclusion, in 1980 Todd[24] reported that there were about 30 small commercial operators supplying firewood (mainly wood cutters advertising at the weekends in *The Mercury*). A year later the number had risen to 45. This information was collected by a search through the weekend press over the winter of 1981 as part of this study. The increase in the number of suppliers implies that more people have been attracted into the industry to satisfy a growing demand.

While the evidence of the need for domestic heating in Tasmania has been outlined and the trend in the demand for firewood has been shown to be increasing, fundamental questions remain. How sustainable is Hobart's firewood supply? How is the resource being managed? What is happening to the land that the timber is coming from? Will firewood be available to meet future needs at prices that are competitive with now accepted alternatives?

Information about the private timber resource forms the basis of the following chapter.

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CHAPTER 3

FIREWOOD SUPPLIES FROM PRIVATE LAND

CHAPTER 3: FIREWOOD SUPPLIES FROM PRIVATE LAND

This chapter is divided into two parts. The first examines the information that is available on the timber resource on private land, the principal source of supply of firewood for Hobart. The second part draws attention to problems that confront the industry if firewood supplies are to continue to be drawn from freehold property. It also shows that, while there are opportunities and incentives to produce more wood, energy plantations are not a financially viable alternative.

PART I The Private Timber Resource

3.1 Introduction

The production and supply of firewood from private land meets 80% of the demand for wood burnt for domestic heating in Hobart. With the demand for firewood increasing, knowledge of the private forest resource and how that resource is managed is a vital factor in determining if future demands for firewood can be met from freehold property. As for the situation concerning wood use described in the previous chapter information on the private forest resource, particularly as it relates to firewood, is difficult to obtain. Notwithstanding the fact that, while this investigation was being conducted, the Australian Forestry Council was conducting an inventory of the private forestry resource in Tasmania[1], the following two sources of information form the basis of this investigation:

(1) published figures on the private forest resource produced by the Australian Bureau of Statistics, which are incomplete;

(2) the findings resulting from interviews held with rural land owners involved in the firewood industry as part of this study.

3.2 Bureau of Statistics Figures

This section enumerates and tabulates the number of rural holdings and the area of timber on them, within a 50 km radius of Hobart. The details are based on figures made available by the Australian Bureau of Statistics.

Unfortunately, the collecting and recording of data about the private forest resource is not part of a regular collection of statistics by the Bureau[2]. There is no recording of information specifically about firewood, only the extent of timbered land. The figures therefore have certain deficiencies from the point of view of this study. However, the Commonwealth Statistician's representative in Hobart was requested by the Private Forestry Division of the Tasmanian Forestry Commission in 1979 to include questions about forest and bushland utilization in the Agricultural Census for the year ended 31 March 1980[3]. The census is an annual collection of information about Tasmania's Agricultural Industry. A census form is sent to each rural land holder in the State. It is the details reported from this census that are used to produce an indication of the extent of the private forest resource on rural holdings for the study area.

A rural holding or establishment for statistical purposes has a particular meaning. It is defined thus: *An establishment for the purpose of the Agricultural Industry Statistics has been defined as a business unit which undertakes agricultural activity at one or more locations and for which the estimated value of agricultural operations is $1500 or more*[4].

The *near urban* area featured in this report encompasses 13 municipalities within the 50 km radius of Hobart previously mentioned. The boundaries of these local government authorities are shown in

Figure 1.1. The combined area of the municipalities is 618 500 ha[5]. Within the boundary, the area of rural holdings is precise but does not correspond with the municipalities as some properties are dissected by municipal boundaries. Within the confines of this limitation, it is concluded that less than 50% of the total 618 500 ha can be termed rural property. The balance is taken up with roads, urban and industrial development, small holdings, non-productive private land, water catchment areas, parks, reserves, recreation areas and Crown land, substantial areas of which are forested.

The main use of the land in rural holdings in the 13 municipalities is found in Table 3.1. However, before these allocations are discussed, it should be pointed out that there are year to year variations in the numbers of holdings in the Australian Bureau of Statistics figures. For example, in 1978/79 there were 1149 rural holdings that had a combined land area of 300 474 ha. In 1979/80 there was an increase in the number of farms to 1182, but the area of these properties had declined to 298 230 ha[6]. The explanation for the variations lie in use of the $1500 estimated value of agricultural operations being used as a cut-off point. The result of this is that, as incomes increase or decrease on some holdings in line with fluctuating prices for agricultural commodities, so the number of farms included in the Bureau's figures may rise or fall slightly. The other feature of the figures that should be drawn to attention is that there are some rural properties, bush blocks and other forested land in private ownership that produce no income from agriculture[7]. They avoid the statistician's net, and could produce supplies of firewood. For statistical purposes it is the word "agriculture", and the meaning given to it by the Bureau, that is all important.

Despite the limitations it is the figures produced by the Bureau that are used initially to provide an estimate of the timbered area on

private land that might be available to supply Hobart with firewood.

3.2.1 The extent of the private timber resource

The Census findings, produced by the Australian Bureau of Statistics for the year ended 31 March 1980 show the following information which is relevant to this study. The features are listed below and are reproduced in Table 3.1:

(1) the Municipalities in the study area,

(2) the area (in hectares) of the Municipalities,

(3) the area of the Municipalities in rural holdings,

(4) the area of crops for the rural holdings in each Municipality,

(5) the area of sown pasture,

(6) the balance of holdings,

(7) the area of native pasture,

(8) bush run not suited to grazing (native pasture),

(9) forest not suited to grazing.

From Table 3.1 the area of rural holdings accounts for 48.2% of the total municipal area (that is, column 3 as a percentage of column 2). The Bureau of Statistics then subdivided the area of rural holdings into three broad classifications. These are area of crops, column 2; the area of sown pasture, column 5; and the balance of holding normally referred to as mainly grazing and bush land, column 6. Therefore, if the area of rural holdings is taken as 100 percent, the area of crops accounts for 3.4%, the area of sown pasture 35.6% and the balance of holdings 61%. However, in the 1979/80 period the balance of holding was further subdivided to provide information about the private forest resource[8]. These subdivisions were: the area of native pasture, column 7; the area of forested bush run that was

TABLE 3.1

Statistics of land in rural holdings in the study area.

1 Municipalities in the Study Area	2 Municipal Area Hectares	3 Area of Municipalities as Rural	4 Area of Crops	5 Area of Sown Pasture	6 Balance of Holding	7 Area of Native Pasture	8 Forest/Bush Run Suited to Grazing	9 Forest Not Suited to Grazing
Tasman	48 000	18 919	213	4 611	14 095	5 624	4 321	1 517
Sorell	78 200	49 451	1 614	15 998	31 839	21 454	6 172	4 971
Richmond	56 800	49 258	2 353	19 425	27 480	18 298	9 430	1 106
Green Ponds	41 600	34 644	902	12 801	20 991	15 517	1 851	1 385
Brighton	44 100	35 269	1 458	11 950	21 861	12 157	5 651	728
New Norfolk	131 600	35 935	1 184	12 498	22 253	6 207	3 886	1 200
Huon	77 400	24 293	1 230	10 003	13 060	2 149	2 090	1 636
Port Cygnet	24 000	10 223	482	4 240	5 501	183	839	2 159
Kingborough	35 500	12 376	300	4 007	8 069	661	846	1 865
Bruny	36 200	15 527	139	5 132	10 256	3 840	3 067	272
Hobart	8 000	50	7	12	31	-	-	1
Glenorchy	12 000	1 681	75	609	997	213	203	186
Clarence	25 100	10 562	474	4 832	5 256	2 284	401	239
Totals	618 500	298 238	10 431	106 118	181 689	88 587	38 757	17 265

Source: (a) Australian Bureau of Statistics, 1981; *Agricultural Industry, Tasmania 1978-79;* Australian Bureau of Statistics, Hobart, June.

(b) Personal Communication, Mr. P. Reynolds, Research Officer, Agricultural Statistics, Australian Bureau of Statistics, Hobart.

suitable for grazing, column 8; and an area defined as timber not suited to grazing, column 9. It will be seen that when these three columns are totalled together they only add up to 144 609 ha, considerably less than the total for the balance of holdings, column 6; 37 080 ha are not accounted for. How much of this area is forest is unknown. It seems that the private forest resource might be 56 022 ha (totalling columns 8 and 9) to a maximum of 181 689 ha if all the area in the balance of holding figure is in fact forest or bush run. The added difficulty in arriving at even an approximate figure for the private forest resource is in the interpretation of the question, on the census form, by farmers. Their understanding of the terms native pasture, forested bush run and forest not suited to grazing, may be confused as the terms lacked definition in the census questions. It may well be that native pastures and bush run overlap, with the result that the area of bush run is very much greater and, in consequence, the timber resource much greater than is revealed in the table.

It can therefore be said that information about the timber resource on private land is very limited. Not only is the total area of the resource unknown, but neither is there information about how that resource is used or managed[9]. Certainly there is no information about the production of firewood from private land in the official statistics. And yet, 80% of Hobart's firewood supply is thought to come from this source.

This lack of knowledge of the private forest resource and the lack of information about firewood supplies from such forest prompted an enquiry of private property owners in the near urban area outlined involved in supplying firewood.

3.3 Farmer Interviews

The method of contacting the farmers who were interviewed has already been described in the introductory Chapter (pages 6 to 7). It is emphasised again here that the selection of those interviewed (20) can in no way be regarded as a "random selection" of farmers. Nor is it claimed that those interviewed are representative of all the farmers in the study area who may participate in the production and supply of firewood used for domestic heating in Hobart. Despite these limitations the interviews have produced worthwhile new information that has not previously been available. Furthermore, the interviews have contributed to an understanding of farmers' attitudes to the firewood business.

The farmers interviewed either owned or managed a total of 23 402 ha of land. This represents 7.8% of all land in rural holdings in the study area based on the Australian Bureau of Statistics figures used previously. The average property size was 1170 ha.

The average property size for the total study area is 252 ha.* This implies that it is the larger landowners who have timber and uncleared land on their properties, and who are willing to allow firewood to be collected. This view was supported by the findings of this study which also showed that, on average, only 35% of the land owned was cleared (that is, it was either in crops or sown to improved pasture). The balance, 65%, was bush run or forest. The unimproved pasture (native pasture) is included in this figure, and indeed could not be separated from the bush run component. This goes some way to explain the uncertainty of the results of the Australian Bureau of Statistics census figures mentioned on page 36 (bush run, referred to as rangeland by some[10], is a term that embraces areas of open grassland with a few scattered trees, to an open canopy forest with limited

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* $$\frac{\text{total area of rural holdings}}{\text{number of rural holdings}} = \frac{298\ 238}{1182} = 252$$

grazing [grass cover] beneath).

When it was established with the farmers contacted the size of their properties and the area of cleared land on the holding, a series of questions were then asked.

The questions were grouped under the following five broad headings:

(1) method of sale of firewood,

(2) the contribution of firewood sales to farm income,

(3) the type of tree taken,

(4) management of land,

(5) future involvement in firewood production.

A summary of the information gained from the farmer interviews is now presented.

3.3.1 Methods of selling firewood

Four methods of selling, or disposing of, firewood from the farms were common. The methods were:

(1) farmers selling direct to the public (using farm vehicles for deliveries to domestic users);

(2) farmers selling or allowing the public access to collect their own wood;

(3) farmers giving access to wood cutters (who could sell either direct to the public or alternatively to wood merchants);

(4) farmers selling to wood merchants.

Ranking the methods of sale in order of importance showed that nearly half of the sales were made by the farmer direct to the public (when the first two methods of sale are combined). Sales to wood

cutters were then found to account for a further 1/3 of all sales, and farmers selling to wood merchants was the least important sales avenue.

While the ranking used provides an indication of the importance of the method of sale, it says nothing about the quantities of firewood sold by each of the methods. It transpired that most of the farmers interviewed had no idea how much firewood was being taken from their land. This lack of knowledge of the quantity of firewood disposed of is explained by the second group of questions about the contribution of firewood sales to farm income.

3.3.2 Contribution of firewood sales to income

When questioned about the financial contribution that the sale of firewood made to farm income, by far the majority of those interviewed said sales of firewood made no contribution to farm income, or at best, a very small contribution. Only 3 of the 20 farmers interviewed said firewood made a *significant* contribution to income. These were farmers who were delivering loads of firewood direct to the public. The generation of *cash in hand* was important to these people. It was generally money that provided income at times of the year when there was little or no return from the sale of other farm produce.

The farmers who made money from firewood sales were mostly in the process of developing their properties, and they cut and sold firewood to generate income rather than work away from the farm.

In seeking to explain why most of those interviewed made no money from firewood sales, it was necessary to confront the question of royalties for firewood. A royalty is a payment made for the right to use or take. Thus, a wood cutter pays a royalty to a land owner for the right to take firewood. The royalty most commonly charged was a $1.00 per tonne.

However, less than half of the farmers interviewed said they received any royalty from firewood sales. The reason for this seemed to be based on the fact that the money was difficult to collect from wood cutters. The difficulties were of two types:

(1) there is no quick and easy method of assessing the quantity of wood taken by the wood cutter; measuring or weighing takes time and needs supervision;

(2) the royalty of $1.00 per tonne is not a great deal of money. For the time and effort involved in collecting it, most farmers seemed to feel the effort was not worth the reward, and so did not bother.

Why, then, do farmers continue to have an involvement in the supply of firewood when they apparently gain little financially from the exercise? The answer to this question seems to be found in the type of trees that are taken for firewood.

3.3.3 The type of trees taken for firewood

The type of trees taken for firewood fall into the following categories:

(1) ring barked trees,

(2) fallen limbs,

(3) fire damaged trees,

(4) dead trees,

(5) residues from wood chipping and logging,

(6) residues from land clearing (timber left in windrows that would otherwise be burnt).

The six categories are illustrated in Plates 1 to 7, and it can be seen from these that firewood comes from trees and branches

PLATE 1

A ring barked tree that would subsequently be felled for firewood after 3-5 years

PLATE 2

Fallen limbs

PLATE 3

Fire damaged trees

PLATE 4

Single dead trees

PLATE 5

Residues from woodchipping

PLATE 6

Windrow of timber

PLATE 7

Firewood taken from windrows before the residues are burnt

that are residues, residues that result from wild fires, land clearing, woodchip operations or just trees dying from age or disease. Very little is green wood. It is thus timber that appears to have no other commercial value. It is wood that farmers are keen to dispose of because it interferes with other management objectives for a particular area of land. This view is supported by comments volunteered by the farmers themselves.

The comments were along the lines of:

Removing residues *Tidying the bush*

Reducing fire risks *Improving bush run for grazing*

While it was apparent from the interviews that most farmers made little money from firewood, and the wood taken was mainly residues,

it should not be implied that the management of the land the timber was coming from is haphazard. The farmers interviewed had specific management objectives for parts of their farms that were timbered.

3.3.4 Management of the land

Not all farmers were concerned with managing the timber resource for future timber production. Many landowners were actively involved in land clearing and this is illustrated by Plates 8 to 10. They show that it is the level to undulating land that was mostly being cleared. With the timber removed, pasture was established, mainly for sheep. In some situations, woodchipping provided an opportunity to clear land at low cost[11,12]. Over half those interviewed indicated that, in their opinion, there were further areas of their properties that could or would be developed for agriculture. While it was not possible to gauge the full potential for land clearing on the individual farms (clearing depends very much on the profitability of agriculture particularly in the grazing industries and the individual land owners' financial and taxation situation as well as the physical attributes of the land also played their parts), it does mean that the total timber resource is being depleted. This aspect will be referred to again in Part 2 of this chapter, since it has important consequences for the firewood industry.

While land clearing was common and covered quite extensive areas within the study area, there were nevertheless areas on the farms visited that were being managed for long-term timber production. This was particularly the case in locations that had previously been woodchipped, where land was too steep, stony or otherwise unsuitable for agricultural development. Such areas were being regenerated, with natural regeneration being favoured by many farmers because of the cost of other regeneration methods[13]. Only two of the farmers

PLATE 8

Land clearing

PLATE 9

An open range situation

PLATE 10
A developed area

interviewed had actually reseeded areas that were intended for long-term timber production.

It was in situations where continued timber production was contemplated, even if it was integrated with developing bush run, that the removal of heads of trees for firewood (the residue from woodchipping) by wood cutters was a particular management benefit. The removal of such waste timber gave easier access to the future timber crop by machinery, it also allowed farmers who had livestock in these areas to muster the animals with less difficulty. The animals were easier to see and easier to chase when residues were removed. Such action also served to reduce fire risks and the danger of a hot burn damaging a future timber crop.

The importance of "bush run" to farmers should not be overlooked. The farmers interviewed saw themselves as farmers (or graziers) first rather than foresters. The additional carrying capacity for livestock, offered by selective timber removal in a bush run, meant an increase in annual income to the land owners. Wethers, (that is, dry sheep) were

producing up to $14 per head gross income from wool production in 1981[14]. The ability to carry an extra 500 - 600 sheep could therefore generate additional income of $7000 - $8000 per year. With regular mortgage repayments to service (that are often substantial), additional annual income is important to land owners. Regular income that helps to meet annual fixed commitments could be more important to farmers than the once-only sale of timber.

It seems that many farmers don't manage their timber resource for firewood, but they do manage the resource for purposes other than timber production[15].

Indeed, the farmers interviewed reported that trees did contribute to income when sold for reasons other than firewood. Nearly all the farmers indicated that trees were sold for sawlogs, woodchips and pulpwood or were used, on farm, for fence posts and other building materials. Several had sold timber at times of depressed farm incomes when money was unavailable from any other source. All farmers used firewood themselves for domestic heating purposes and were not disposed to remove every tree on the farm. In fact, timber areas were being protected for reasons of wildlife conservation, aesthetics and shelter.

3.3.5 Future involvement in firewood production

Nearly all farmers interviewed (18) indicated that they would continue to supply or provide access to others to gather firewood for 5 years or more. The remainder, because of age or some other reason, could not see themselves in the firewood business for more than one or two years. The majority maintained they could continue to supply firewood despite evidence of an increase in demand. When questioned further about the demand for firewood, they responded that they had experienced an upsurge in demand for wood over the 1981 winter. Their comments were based on an increase in the number of requests for wood runs by wood cutters seeking access to a source of firewood. In addition,

farmers reported an increase in the number of people calling at the farm gate and literally asking if they could *have a load of wood*. Farmers with land within 20 km of the city had experienced such a demand that they found they could not allow unrestricted access to firewood supplies. These land owners reported damage to roads, fences and a loss of livestock when access was uncontrolled. For these reasons, many were resorting to padlocking gates and trying to limit access by other means (see Plate 11).

It is the question of access that raises one of the several doubts about the availability of firewood supplies in the longer term. This, and other industry problems, are discussed in Part 2 of this Chapter which follows.

PLATE 11

Limiting access to firewood supplies

PART II Industry Problems and Opportunities

The information gained from interviews with farmers highlights several areas of concern. They could affect future firewood supplies to Hobart, and must be regarded as problems for the firewood industry.

3.4 Problems

As a generalisation, it has been shown that farmers make no money from allowing firewood to be taken from their land. This has several consequences. Without the incentive of a contribution to farm income there is little encouragement to maintain a supply unless there is some other benefit. The situation can be aggravated by the attitudes of some wood cutters who not only pay little royalty, but who also do considerable damage on farms in the process of getting wood out. The extent of the damage does vary but Plate 12 illustrates what can occur when access is difficult and vehicles become bogged. Often the landowner is left with the problem of tidying up, filling in gullies, repairing fences, and catching stock that have wandered because of thoughtless damage by wood cutters. In such situations it is not altogether surprising that farmers deny access to their land and lock gates.

The problems of lack of monetary reward and damage caused by wood cutters are not the only reasons why farmers might become uninterested in continuing in the firewood business. Several landowners while being interviewed mentioned that they would be willing to supply firewood to the public themselves if it were not for the fact that carting firewood on farm vehicles (flat tray trucks) resulted in loss of entitlement to a 40% rebate on vehicle registration. For some farmers this rebate could be worth $160[16]. In the farmer's opinion, the loss of rebate represented extra tonnes of firewood that would need to be

PLATE 12

Damage to private property

sold, and was enough of a disincentive to make the exercise unprofitable.

While the problems of individual farmers is one area of concern, turning to other industry problems several features emerge that could be of great consequence to the future of the firewood industry. They can be grouped under the following two headings:

(1) the depletion of the timber resource, and

(2) competition for the residues.

3.4.1 Depletion of the timber resource

As has been suggested by findings in this study, the timber resource on private land is being reduced as a result of land clearing for agriculture. This confirms results of surveys and statements made by others[17]. For example, a survey carried out by the Private Forestry Division of the Forestry Commission showed that, of the areas cut for woodchips between 1975/76 and 1977/78, the intended future use of the areas was principally for agricultural activity. These findings are reproduced in Table 3.2.

TABLE 3.2
Intended Future Use of Areas Cut for Woodchipping in Tasmania
1975/76 - 1977/78

Future Management	South East* %	North East %	North West %	Total %
Improved Pasture	54	43	12	38
Forest	-	27	88	36
Forested Range (Bush Run)	37	1	-	15
Open Range	8	-	-	3
Other	1	29	-	8
	100	100	100	100

* The area includes the near urban study area.

Source: Molland, B. and Walsh, J., 1979; *Range Management in Tasmania: Agroforestry with Eucalypts* (see Note 10, Notes and References).

It is the south east of the state that forms a large proportion of the study area, an area in which much woodchipping and land clearing is being practised. Indeed, the depletion of the timber resource on private land has been thought so serious that the 1977 Board of Inquiry into Private Forestry Development in Tasmania was moved to state:

> *The alarming fact which emerges from the surveys is that only 27 percent of the private land which has been logged [for wood chips] was expected to carry fully productive forest in the future*[18].

The situation some five years later seems little changed. The timber resource that presently provides 80% of Hobart's firewood is being reduced. This could have long-term consequences for the firewood industry.

3.4.2 Competition for residues

While the total timber resource has been shown to be shrinking, it has also been demonstrated in this study that it is the timber residues from the resource that are used to produce firewood. Questions that logically follow are what is the extent of these residues, and are they adequate to sustain a domestic firewood supply? The exact quantity of residues in a given area will reflect the extent and quality of the standing timber crop, its past management as well as harvesting efficiency. Indeed, residues of up to 200 tonnes per hectare have been reported from some parts of the study area[19] and it is known that, in some woodchip operations, up to 40% of the harvestable wood is left for cleaning up and burning before regeneration[20]. But the question is: how much of this material is available or accessible for firewood, and will it continue to be available? There is now an element of uncertainty over the answers to these questions for two reasons:

(1) the increasing efficiency of some woodchip companies, and

(2) an industrial demand for fuelwood.

Woodchip Companies

Forest Resources Pty. Ltd. (formerly Northern Woodchips) is currently taking smaller diameter wood formerly considered unsuitable for woodchips and is conducting economic feasibility studies into harvesting even small diameter material that was previously left on the forest floor[21]. Some of this material would undoubtedly have been accessible and used for supplying domestic firewood. In the future, it appears that this may not be the case. Forest Resources Pty. Ltd. is already harvesting timber for woodchips in the study area, and a change in the economics of their operation could influence residue availability if smaller wood is taken[22].

Industrial Demand for Fuelwood

The second source of pressure on demand for residue timber comes from a potential industrial demand for fuelwood. There are already a number of companies in Hobart using timber residues for heating or drying purposes, the Hobart Brick Company being but one example[23], There are also many small industrial boilers over 1 MW capacity in Tasmania[24]. About 70% of this installed capacity is accounted for by oil-fired boilers, and a number can be found in Hobart[25]. New technology, for example that currently under investigation in Sweden[26,27], may have application locally. Should this and other developments take place, with boilers being converted to use wood in various forms as a substitute for oil and electricity then timber residues will be an alternative source of such energy. The rate of adoption of new technology will depend on the price of other fuels, policy initiatives by government, and company planning. Nevertheless the trend is evident, and Australian Paper Mills (A.P.M.) Ltd. at Geeveston is an example of a company that has seen fit to use chipped residues for firing its industrial boilers[28]. Such developments highlight the need to have detailed knowledge of the private timber resource that is better documented than is currently available from the Australian Bureau of Statistics.

Without such information it is not possible to determine with any degree of precision the extent of timber residues or the likely timber productivity for the study area.

In the context of Hobart's firewood supply, these comments suggest that it would be wrong to be complacent about the sustained availability of domestic firewood at low prices. The picture that emerges from this study concerning firewood supply, and the growing interest of industry in the use of wood for energy purposes, is not all bleak, however. It will now be shown that there are opportunities for private landowners to make money from firewood, and that there are positive incentives available to grow trees on private land.

3.5 Opportunities

A firewood merchant, who did not wish to be identified, suggested that there were opportunities for farmers with trees to cull (either as part of a land clearing programme, as thinnings from a stand of timber, or as part of an integrated timber harvesting exercise) to make money from firewood. The proposition advocated was as follows.

Fuel merchants have a problem in stockpiling wood over the summer months for sale in winter. The nature of the problem is this: the merchant has to pay wood cutters for timber supplied to the merchant's yard for stockpiling. So, to build up a stockpile of 1000 tonnes, for example, the cost to the merchant would be about $20 000. If the money were borrowed, there is also an interest component that has to be added to this figure. The interest component could be as high as $1600 to $1800 for 6 months if based on 16 - 20% interest for loans of short-term money. In addition to the cost of financing such a borrowing, the merchant could well experience cash flow problems at times of the year when only small quantities of wood are being sold.

The cash flow problem, coupled with the problem of raising enough money to establish a worthwhile stockpile of firewood, tends to force wood merchants to buy wood in the winter when turnover is high. This means that wood cutters, to satisfy the merchants' needs for supplies, are operating in the winter months. The result is that moving heavy vehicles round a farm is more difficult. Vehicles become bogged, farm tracks are damaged and relations with private landowners deteriorate (see Plate (12)). Property owners then become reluctant to provide access to wood cutters at a time of year when firewood is in demand.

However, farmers with firewood to sell could reduce this problem in two ways. They could cut firewood (or employ someone to do it for them) in the summer and stockpile cut timber on the farm and then supply the merchants over the winter months from easily accessible wood stocks, or they could stockpile and sell direct to the public. This latter approach is widely used by private land holders in North America[29].

It is this type of opportunity that could be exploited by farmers in the near urban situation close to Hobart. The income derived and the costs associated with such a proposal are now outlined.

3.5.1 Farm stockpiling of firewood

The process could work like this: the landowner with timber on the farm works to a planned clearing or stand improvement programme, rink barking or killing unwanted trees 2-3 years ahead of the time they are felled for firewood. In many situations all the timber on a particular area of land could be taken for firewood. There need be little waste, and a yield of 250 tonnes per ha could be expected for east coast forest types if a 50-year rotation or harvest interval was assumed[30,31].

On many sites in other areas the yield could be much higher and would depend on location, soil, rainfall, forest type and previous management. However, assuming that each year 2 ha were cut and felled, then 500 tonnes of firewood would be produced. If this was valued at $20 per tonne at the farm gate, (the price wood merchants currently pay their suppliers) the gross income to the landowner would amount to $10 000. It might be expected that delivery to a fuel merchant would add a further $5 per tonne to this figure to cover freight charges (based on 10 cents per tonne per km)[32]. With 1981 wood prices in Hobart $27 - $35 per tonne, there is still a small profit margin for the merchants. Otherwise, if the farmer could deliver the wood to domestic users direct, there would be a further chance to improve income from firewood sales.

While these returns are possible, there would, of course, be costs to be covered. The trees have to be felled, cut, split and stacked in wood piles on the farm. This involves a labour component and machinery costs as well. While no accurate costs are available

(estimates have been made from discussions held with wood cutters), Table 3.3 shows figures which seem plausible. It is assumed that 8 tonnes can be handled by one man in a day. If these costs are approximately correct, then the returns to the landowner would be as outlined in Table 3.4.

TABLE 3.3

Costs of cutting firewood on farms

Costs	$ Values
(1) Chain saw operation, fuel and vehicle maintenance,	5.00 per tonne
(2) Labour $5 per hour, or $200 per week,	5.00 per tonne
(3) Miscellaneous overheads	2.00
Total Costs	$12.00

TABLE 3.4

Potential return to the farmer from firewood

Sales	500 tonnes @ $20	=	$10 000
Costs	500 tonnes @ $12	=	6 000
	Gross Margin or $2000 per ha		$4 000

The gross figure of $2000 per hectare would then have to service any other fixed costs such as rent, rates, or interest repayments on any capital borrowings for land or equipment. A further two hectares would then be cut for firewood the following year.

With such high returns, some farmers might want to compare the income from selling firewood as an alternative to the sale of woodchips or sawlogs. With royalties of $1.75 for woodchips and up to $12.00

for sawlogs, coupled with the more selective nature of such timber sales, firewood seems a most attractive alternative, but would require a greater labour input from the landowner.

3.6 Incentives

While there do seem to be opportunities for farmers to make money from firewood sales, as outlined in the previous section, it is generally recognised that there are a number of disincentives acting as barriers to growing trees on farms if conventional timber products (woodchips and sawlogs) are considered[33]. For example, trees are slow to grow and the land owner often only receives a once-in-a-life-time return from the sale of the timber crop. Also, with the long-term nature of a tree crop there are market uncertainties and, therefore, income is unpredictable; further, with sales from plantations, tax can be an added incentive[34]. Such barriers have been recognised by the Tasmanian Government as a problem for the timber industry[35].

As a result of the 1977 Report of the Board of Inquiry into Private Forestry Development in Tasmania, a series of incentive schemes are now available for landholders to grow trees[36]. It is hoped that these will reduce the considerable depletion of the timber resource on private land. The schemes are administered through the Private Forestry Division of the Forestry Commission and there are six specifically available to private land owners. The schemes are mainly aimed at assisting property owners to establish plantations, although there is a specific scheme for the regeneration of forest land cleared for pulp or sawlogs before 1978.

The schemes are now outlined in brief; they operate under the following titles[37]:

Native Forest Restoration Grant;

Special Species Plantation Establishment Grant;

Eucalyptus Plantation Grant;

Nursery Stock Grant;

Pine Plantation Development Loan;

Pine Plantation Annuity Scheme.

The conditions applying to the schemes are generally as follows. The plantation must be developed in a zone that is acceptable to the Commission, and must be of a minimum size (the maximum size varies with the type of scheme). The site has to meet certain requirements, and preparation has to be suited to the species. With these conditions satisfied, the debt is secured by a charge on the land, and the plantation has to be insured against fire and peril. The offers of financial assistance range from grants of 40 to 100% for special species and regeneration of native forest, to loans of 50 to 80% for nursery stock and the establishment of pine plantations.

The pine plantation annuity scheme is worthy of special mention because it offers farmers an annual sum of money, against the future value of the crop. For the first 10 years the annuity is $50 per hectare, and thereafter it is based on an annual figure derived from 75% of the expected discounted value of the harvest. The scheme helps the farmer with the year-to-year costs of managing the plantation, and for some farmers must be a positive incentive because of the regular income it provides.

To date, the schemes have been made available to private landowners to encourage, and to establish, traditional forest and plantation development for sawlogs and pulpwood production. The offers of assistance are also available for agro-forestry projects which yield the land holder income from crop or livestock production with a long-

term cash return from timber[38]. However, the schemes are not, or rather have not, been made available to any landowners in Tasmania specifically to grow trees for firewood[39] [*it appears doubtful that they would be;* my italics] or energy purposes. Nevertheless wood fibre can be used to produce energy, and it might be possible, or indeed necessary, in the future, under certain economic circumstances, to consider energy plantations (also called energy farms or short rotation forests) as a means of producing wood for domestic or industrial heating purposes by this method[40]. The energy plantation concept is now explored using investment analysis as a mechanism for assessing the viability of a theoretical 50 ha plantation. Detailed information about the assumptions made, together with cash flows for the proposals examined, are to be found in Appendix A. A summary of the findings is presented in the next section.

3.7 Energy Plantations

The energy plantation concept is not new and much research and attention has been given to short rotation forestry overseas[41]. The interest in energy plantations results from the generally increasing cost of energy in the 1970s, and a recognition that oil, including heating oil, is a finite resource. The research on energy plantations has mainly been aimed at reducing the rotation length, or harvest interval, between successive tree crops and maximising the annual biomass production of the above ground wood fibre yield. For the investment appraisal reported in this study, information made available from the United States for eucalyptus and Sweden for willows has been the basis of the productivity (yield), plant spacings and management techniques used[42]. There is a lack of research-based data for similar developments in Tasmania. In consequence, the figures employed tend to reflect the overseas emphasis on biomass production, rather than perhaps maximisation of financial returns.

It is recognised that the economics of the projects will be influenced by fertilizer strategies, irrigation costs, land costs, climatic situation and other factors of production, many of which are enumerated in the establishment costs and operating costs reported in the cash flow budgets in the Appendix (these variables would need to be examined under field trial, or experimental conditions, in order to establish their effect on plantation yield and the economics of such a project in Tasmania).

The results therefore have to be treated with caution and in the full recognition that the factors listed are inter-related and both singly, and in combination, influence the findings. It has been assumed that grants from the Forestry Commission in the form of incentives, already referred to, will not be available.

The period of analysis is 30 years, and the harvest interval for coppice eucalyptus is six years and for willows two years. Irrigated and non-irrigated situations are illustrated and reflect more an agricultural or horticultural approach to production than the traditional approach involving forest plantations. This, and the fact that harvesting is mechanised, indicate that developments cf this nature could be in competition with agriculture for land, although areas of Crown land might be suitable and available (the land question should be a separate aspect requiring further detailed study and investigation).

3.7.1 The Findings

For ease of understanding, the results of the analysis are presented in Table 3.5 showing the capital, establishment and operating costs; a rate of interest which is the real rate of return on the investment; and the net present value of the projects. The farm gate price of $25 per tonne and an annual productivity of 20 tonnes per hectare oven dry weight has been used throughout the analysis, except in the first willow example where an annual production of 10 tonnes per hectare has been used and irrigation is employed.

TABLE 3.5

Investment analysis: 50 hectare energy plantations

	Eucalyptus		Willow	
Harvest Interval	Irrigated 6 yrs	Non-irrigated 6 yrs	Irrigated 2 yrs	Non-irrigated 2 yrs
Annual Yield	20 t/ha^{-1}o.d.wt.	20 t/ha^{-1}o.d.wt.	10 t/ha^{-1}o.d.wt.	20 t/ha^{-1} o.d.wt.
Total Capital Cost ($)	181 300	61 300	181 500	61 500
Total Capital Cost/ha ($)	3 626	1 226	3 630	1 230
Establishment and Operating costs ($)	47 850	45 350	66 000	63 500
Establishment and Operating costs/ha ($)	957	907	1 320	1 270
Total Cost to End of Year 1 ($)	229 150	106 650	247 500	125 000
Total Cost to End of Year 1 per ha ($)	4 583	2 133	4 950	2 500
Real Rate of Return	0.5%	6.5%	5%	6.8%
Net Present Value ($)	-12 843	-486	-31 658	+326

As can be seen from the Table the establishment costs are high in terms of capital required in all situations. Many private landowners with access to such capital sums might favour alternative secure investments with reduced risk and market uncertainties. For example, interest rates of 15% are available in Tasmania from the Hydro-Electric Commission[43]. The annual operating costs are also high and add significantly to the total outlay at the end of year 1 of the development.

Not only is the requirement for capital a potential difficulty, and could be a deterrent for investors, but the returns on investment are also unsatisfactory. The situation is perhaps well summarised by the net present value of the projects. With the exception of the non-irrigated willow example the Net Present Value is less than ZERO[44]. As a consequence, the projects would not be acceptable to investors. The other feature that should be noted is that the annual production or yield figures quoted are exceptionally high. As mentioned in the Appendix, the maximum productivity reported under Tasmanian conditions for eucalyptus is 31 m^3 green weight, or 15 - 16 tonnes oven dry weight, per ha per year. To achieve a yield of 20 tonnes per ha^{-1} would require considerable research before such productivity estimates could be relied upon for field scale developments. Further, the price per tonne of wood fibre is approximately twice the royalty paid for the better sawlogs ($12.00 per m^3) and much above the present $1 per tonne royalty paid to farmers for firewood. The projects are therefore weighted advantageously in terms of their potential income earning capacity, especially when compared with current practices. They are, nevertheless, shown not to be viable.

While the results are pessimistic, the situation could change if the Forestry Commission were to make grants available for such projects, and if wood fibre was priced at its energy value. The follow-

ing illustrates this latter point: if wood burnt in a combustion stove replaced electricity used on the restricted hour tariff, (off peak), the domestic consumer could afford to pay over $60 per tonne for firewood; or, if wood replaced heating oil, the delivered price of wood could increase to over $120 per tonne and remain a viable alternative (assuming convenience and the cost of new heating equipment were not built into the equation). These estimates of wood's energy value are derived from work by Todd[45] and are reported in Table 3.6.

TABLE 3.6

The end use price of energy in Tasmania

Fuel	Fuel Price	Efficiency of Use	End Use Energy Price
Heating Oil	31.2¢/ℓ	70%	1.22 ¢/MJ
Electricity (Off Peak)	2.05¢/kWh	90%	0.63¢/MJ
Firewood	$27/tonne	60%	0.26¢/MJ

Thus, the electricity replacement value of firewood is derived as follows:

$$\frac{\text{Electricity } 0.63¢/MJ \times \$27 \text{ tonne}}{\text{Firewood } 0.26¢/MJ} = \$65.42,$$

and the oil replacement value of firewood:

$$\frac{\text{Oil } 1.22¢/MJ \times \$27/\text{tonne}}{\text{Firewood } 0.26¢/MJ} = \$126.69$$

When viewed as an energy resource, wood seems under-priced. With many of Hobart's domestic consumers recognising firewood's price advantage, the near urban timber resource will come under increasing pressure, and energy plantations may be an option that should not be ignored. However, there are other alternatives and one of these, the supply of firewood from Crown land, forms the basis of the following Chapter.

Notes and References

1. Australian Forestry Council, 1981; *Australian Forest Resources, Present Areas and Estimates of Future Availability of Wood;* Australian Forestry Council, Canberra.
2. Personal Communication, P. Renolds, Research Officer, Australian Bureau of Statistics, Hobart.
3. As above.
4. Australian Bureau of Statistics, 1981; *Agricultural Industry Tasmania, 1978-79;* Australian Bureau of Statistics, Hobart, January.
5. As above.
6. Australian Bureau of Statistics, 1981; *Crops and Pastures Tasmania, 1979-80;* Australian Bureau of Statistics, Hobart, June.
7. See Note 2.
8. See Note 2.
9. The Forestry Commission has commenced interpretation of aerial photographs of private land in the North West of Tasmania. This work is being followed up with point sampling in a grid system in the field. In time this activity will be extended to all areas of the state. The deficiency in this approach is that it is the potential yield of commercial timber that is being measured. The minor species and residue timber that might be used for energy purposes (domestic or industrial heating for example) are not taken into account.
10. MOLLAND, B. and WALSH, J., 1979; *Range Management in Tasmania: AgroForestry with Eucalypts;* presented at the Australian Forestry Development Institute Conference, Launceston, 25 October.
11. GILBERT, J.M., 1972; Woodchips - a New Product for the Farm; *Tasmanian Journal of Agriculture,* May, pp. 75-82.

12. WILSON, D.B., 1972; Woodchips and Farming on the East Coast; *Tasmanian Journal of Agriculture,* August, pp. 184-190.

13. Personal Communication, T. Rowlands, Farmer, Levendale.

14. Personal Communication, G. Bottomly, Animal Production Officer, Sheep, Tasmanian Department of Agriculture, Hobart.

15. WILSON, D.B., 1972; see Note 12.

16. Personal Communication, Transport Commission, Hobart.

17. MOLLAND, B. and WALSH, J., 1979; see Note 10.

18. EVERETT, M.J. and GENTLE, S.W., 1977; *Report of the Board of Inquiry into Private Forestry Development in Tasmania;* Government Printer, Tasmania, p.36.

19. HARRIS, A.C., 1978; *The Feasibility and Prospects for a Charcoal Industry in Tasmania;* A report prepared for and made available by, the Tasmanian Forestry Commission, Hobart.

20. WILSON, G. (ed.), 1980; Northern Woodchips now Buys Throughout Tasmania; *Australian Forest Grower,* September, p.4.

21. As above.

22. Forest Resources Pty. Ltd. is a company that has no direct access to concession areas (State Forest); it therefore has to buy timber from private land owners and is currently taking small wood down to 10 cm diameter.

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23. KEMP, A.G., 1981; *Brick Industry: Sawdust Firing of Kilns;* Crop and Forest Residue Workshop, Organised on behalf of National Energy Research, Development and Demonstration Council, Canberra, 7, 8 July.

24. SOUTHGATE, D., 1981; *The Potential for Substituting Coal for Oil in Industrial Boilers in Tasmania,* Environmental Studies Working Paper 12; Board of Environmental Studies, University of Tasmania, Hobart.

25. As above.

26. The National Swedish Industrial Board, 1980; *Solid Fuels;* National Swedish Industrial Board, Energy Division, Stockholm.

27. The National Swedish Industrial Board, 1980; *POD - List, a list with a short description of the prototype and demonstration plants, POD, within the energy sector that have been awarded grants;* SIND, National Swedish Industrial Board, Energy Division, Stockholm.

28. Personal Communication, B. Hickey, Forest Manager, Australian Paper Mills Ltd., Geeveston.

29. See the following:

(a) PALMER, L., McKUSICK, R. and BAILEY, M., 1980; *Wood Energy in New England: A Review and Bibliography No. 7.;* National Resource Economics Division, Economics, Statistics and Co-operatives Services, U.S. Department of Agriculture, Washington.

(b) DALTON, M.M., DURGIN, O.B., HERRINGTON, J.H. and ANDREWS, R.A., 1977; *Household Fuel Wood Use and Procurement in New Hampshire, Research Report No 59;* New Hampshire Agricultural Experiment Station, University of New Hampshire.
(See also, *Marketing Fuel Wood in New Hampshire by* ANDREWS, R.A. and DAMMAN, J.C., 1978; and *Economics in Fuelwood Supply Firms in New Hampshire,* by the same authors, 1979.)

30. The yield of 250 tonnes per hectare is based on production figures provided by J.M. Gilbert. See Note 10, and figures by JONES, R., Note 31.

31. JONES, R. (ed.), 1975; *The Vanishing Forests? Woodchip Production and the Public Interest;* Environmental Law Reform Group, University of Tasmania, Hobart, p.17.

32. For further comments regarding transport cost see page 85 Chapter 4.

33. DAVIES, R.J., 1981; The Advantages and Disadvantages of Growing Trees on Farms; unpublished essay, Centre for Environmental Studies, University of Tasmania.

34. ANDREWS, G., 1981; *Income Tax Aspects of Fuelwood Cropping;* paper presented at the Fuelwood Cropping Investment Seminar, The International Tree Crops Institute, Melbourne, 13 March.

35. EVERETT, M.J. and GENTLE, S.W., 1977; see Note 18.

36. QUICK, J.R., 1981; Opportunities for investment in plantations in Tasmania, 3. Sources of funds for the private forestry investor; *Australian Forestry* 44(2), 98-101.

37. Forestry Commission Tasmania, 1980; Private Forestry Division Assistance Schemes for Private Landowners;

    (i) Native Forest Restoration Grant;

    (ii) Special Species Plantation Establishment Grant;

    (iii) Eucalypt Plantation Grant;

    (iv) Nursery Stock Grant;

    (v) Pine Plantation Development Loan;

    (vi) Pine Plantation Annuity Scheme;

    Government Printer, Tasmania.

38. See, for example,

    (a) BROUGH, C., 1979; *Current Research into Agro-Forestry in Australia;* Australian Forest Council, Research Working Group 5, Myrtleford, Victoria 2-4 April.

    (b) RAMSHAW, D.G., 1980; Agro-Forestry Demonstration; *Journal of Agriculture Tasmania* 51(2), 29-31.

39. Personal Communication, J. Walsh, Private Forestry Division, Forestry Commission, Launceston.

40. Tasmanian imports 50% of its energy in the form of petroleum products, 30% of which is used in industry, 7% in the residential commercial sector. Some of this oil is used for heating and

could be replaced by wood-derived energy thus saving on oil imports and retaining money in the Tasmanian state economy. For more details of the energy situation in Tasmania see: *Energy in Tasmania 1980 - 2000;* proceedings of a public symposium sponsored by the Australian and New Zealand Association for the Advancement of Science, Tasmanian Division, 23 February, 1980.

41. JONES, R., TODD, J.J. and ELLIFFE, D., in press; *A Review of Short Rotation Forestry Yields,* A report for the Tasmanian Energy Research Committee, Centre for Environmental Studies, University of Tasmania, Hobart.

42. There are many references to the production aspects of short rotation forestry; however, the following have been found to be particularly useful:

(a) United States Department of Agriculture, 1980; *Energy and wood from intensively cultured plantations; research and development programme,* General Technical Report NC 58; North Central Forest Experiment Station, Forest Service, U.S.D.A., St. Paul, Minnesota.

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CHAPTER 4

FIREWOOD SUPPLIES FROM CROWN LAND

CHAPTER 4: FIREWOOD SUPPLIES FROM CROWN LAND

There is an element of uncertainty over future supplies of firewood from private land because of potential competition for the resource and access uncertainty. This Chapter looks at one alternative, the supply of firewood from Crown forest, and shows the important role the Forestry Commission can play in achieving greater supplies from this source.

The Chapter begins with an outline of the Commission's current and historic role in the firewood industry; a description of the area of Crown forest in the State and the study area, and how such forest is allocated follows. Subsequent sections detail developments in producing firewood as part of an integrated timber operation and show there is competition developing for the resource because of industrial demands for fuelwood. This leads to the final Chapter which integrates the findings of the study with the aims and objectives outlined in Chapter 1.

4.1 The Role of the Forestry Commission in the Firewood Industry

The Forestry Commission has in the past been involved in several practical aspects of the domestic firewood industry. This involvement has included;

(1) the issuing of the forest produce licences to collect firewood from Crown land;

(2) the nomination of areas from which firewood could be taken by the public;

(3) the provision of finance to fuel merchants by powers granted under the Firewood Act 1951;

(4) the provision of a firewood procurement officer in World

War II whose duty it was to provide a backup firewood supply for Hobart from a central point near the city[1].

The issuing of licences for firewood collection still continues, and two types of licence are in common use. They are known as 'A' and 'C' licences by the Commission staff. The 'A' licence is issued in advance of wood being taken from the forest and is applied for on Form 12 available from Commission offices (a copy of the various application forms for licences for wood collection are to be found in Appendix B). With the 'A' licence no payment is made at the time of issue, but a royalty is payable on the amount of timber taken within seven days of the expiry of the licence. The royalty is currently 46 cents per m^3 (stacked measure) and is the minimum royalty charged; it can be higher depending on where the wood is taken from and how accessible it is. This type of licence is usually supplied to regular and known wood cutters or wood merchants.

The second type of licence in regular use, the 'C' licence, is applied for on Form 11 and is issued to members of the public wanting to collect firewood. It differs from the 'A' licence in that payment has to be made at the time the licence is issued. That is, a royalty is paid for a quantity of firewood in advance of its being taken from the forest[2]. It is this type of licence that has been issued in greater numbers over the past two years, and this has been the reason for the considerable increase in the amount of firewood taken from the Norfolk, Triabunna and Geeveston areas mentioned previously on page 27 Chapter 2.

The licences are available from the Commission head office in Hobart or from the district forestry offices. They can be issued by a forester or a forest ranger, and they permit the licence holder to take timber from an area nominated by the Commission within a fixed

period of time (only dead trees and non-commercial species can be taken for firewood, not green standing timber). A written request to the Chief Commissioner for Forests requesting information about where the public could collect wood from Crown Forest produced the following information.

"Firewood is obtainable from the following locations in Southern Tasmania ;

Geeveston - Lidgerwood Road and Spurs Esperance Plantation, and most forestry roads ex Arve Road;

Norfolk - Current Plantation Clearing Areas;

Triabunna - As Specified in Licence.

In the case of Triabunna, the price of firewood is $0.76 per dry tonne plus a Tasmanian Pulp and Forest Holdings road toll in some cases. In the other locations the price is $0.46 cents per m^3 stacked plus a road charge of 3.8¢ per km (1 tonne = $1\frac{2}{3}$ m^3 stacked measure)."

Further personal discussions with several members of Commission staff indicated that, within the near urban study area defined, there were only a few areas that were available for public access for firewood gathering. The reason for the limited number of publicly accessible locations was that much of the Crown Forest in the study area is reserve land; for example, areas around Mt. Wellington to which there are no roads or ready means of gaining access, or part of water catchment areas (more information about the area of Crown Forest is to be found in Section 4.2).

Having detailed the two main types of licence issued, and shown where there is public access to firewood, it should be noted that there

is a third category of licence that can be made available to those people in *necessitous circumstances* for the collection of firewood for "domestic purposes". This licence, applied for on Form 15, is provided for under the Supplementary Forestry Regulation No. 284, clause 28 of 1976[3]. People issued with such a licence obtain their firewood free of charge. The licence appears not to be in widespread use, but given some publicity could help a growing number of low income families keep warm in the winter as they can obtain a free wood supply (however, they would still have to have equipment, such as a chain saw and a vehicle to collect the firewood).

While the issuing of licences shows one aspect of the Commission's current association with the firewood industry (and it has provided a mechanism by which the general public has gained access to domestic firewood supplies), the Commission has played a more dominant role in the past. For example, in 1951 the Firewood Act was introduced by the State Parliament giving the Commission a specific role in the Firewood Industry[4]. The purpose of the legislation was to provide a mechanism by which money could be made available to wood merchants to stockpile firewood.

The loan provisions were administered by the Commission and enabled merchants to built up stocks of firewood over the winter, thus avoiding shortfalls in supply. The Act set out the terms and conditions under which the money would be made available by the Commission to the merchants. The Act initially had a term of one year and was then amended each year for a further annual term. The legislation was not renewed after 31 December, 1963[5] when it seems there was a decline in the use of firewood for home heating. This appeared to coincide with the time that oil and electricity became the popular energy sources.

It is apparent that the Forestry Commission has had a long

association with the firewood industry and it is suggested that there are now other roles that could be further developed for the Commission particularly in relation to supply. The Crown forest resource could generate supplies of firewood in large quantities. The following sections outline the area of Crown forest, how the use of the resource is allocated in the study area, and how much more firewood could be made available to domestic consumers through an integrated logging programme supervised by the Commission.

4.2 The Area of Crown Forest

There are 1 277 000 ha of Crown owned commercial forest in Tasmania. It is Forestry Commission policy that this area be increased to 1 618 000 ha in the future[6]. There are, in addition, timber reserves, land kept aside for future supplies of timber and fuel of 973 000 ha[7]. These State owned forest lands are administered by the Forestry Commission through legislation introduced and passed by the State Parliament in 1920[8] under the Forestry Act. The intention of the Act was that State forests be managed permanently for the benefit of future generations. Thus Tasmanians have a commercial timber resource that covers 31% of the State land area, and it is land that is to be used for public benefit, a requirement set down, enshrined in legislation. While this seems a vast area of forested land there are a number of very large forest-based industries that need assured timber supplies for the production of pulpwood, woodchips, sawlogs and other timber products. This need for security of supply has led to concessions and cutting rights on Crown land (public land) being given by successive Acts of Parliament to 1 937 000 ha of forest. In this way commercial interests have been handed about 76% of Tasmania's forest, in some cases with exclusive rights to the timber[9].

However, not all concession areas have the *exclusive rights* provision. Indeed, the control and management of the concession areas allocated to the timber companies is not facilitated through the Forestry Act of 1920 (the Act that led to the formation of the Forestry Commission) but is governed by the various Acts that allocated the forest resource to the various commercial interests[10]. It is these Acts that are the key to the ultimate degree of control over the forest resource that can be exerted by the Forestry Commission.

So far as the Crown forests in the south of the State are concerned, (the area encompassing the near urban study area) the Commission does play a dominant role in managing the forest in the concession areas. The Crown land in the study area is shown in Figure 4.1. The map shows that Crown forest covers approximately 90 000 ha[11] of land within the near urban area outlined. It also shows that there are three classifications applied to the forest resource[12]. They are:

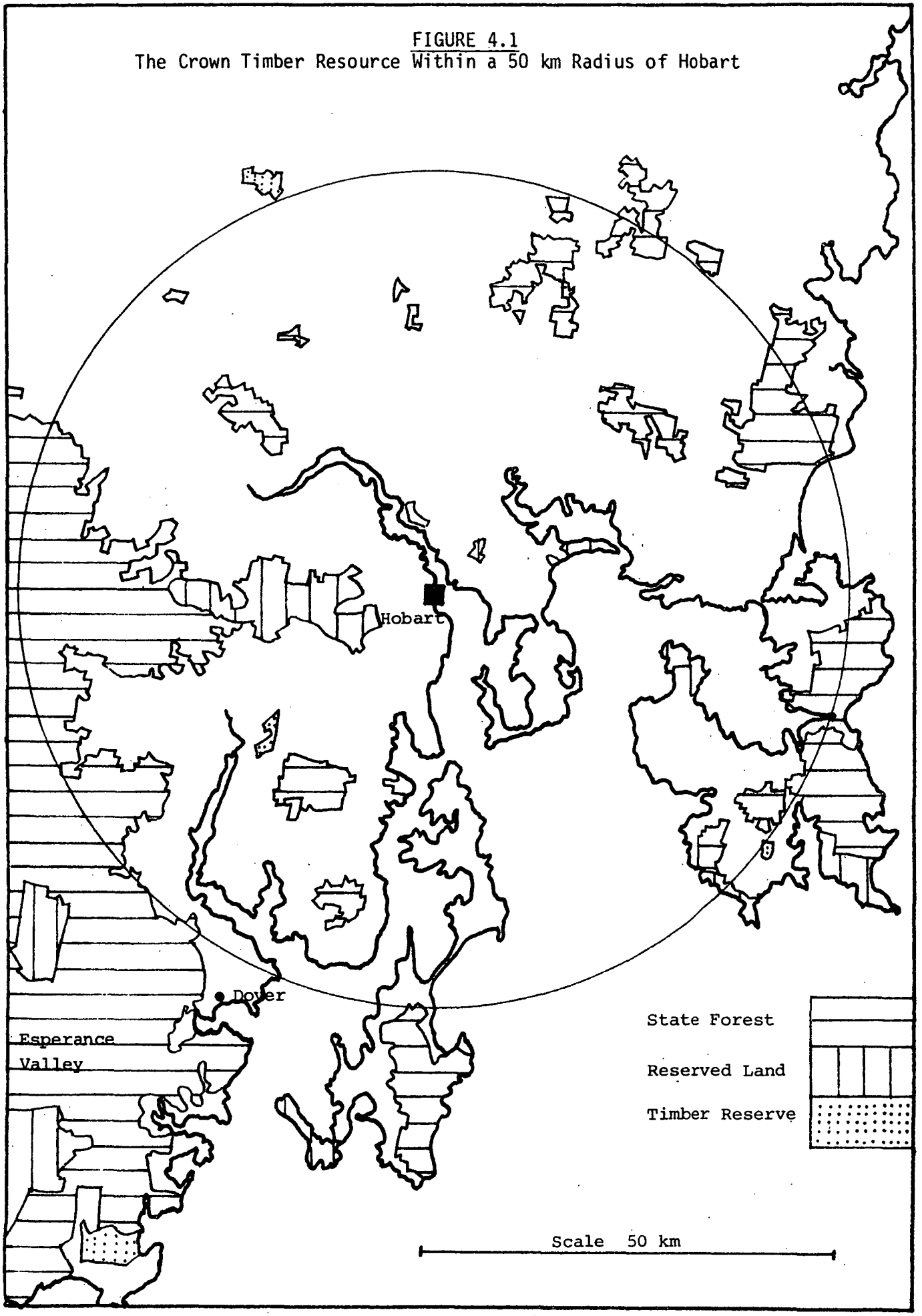
(1) State Forest - land set aside for commercial timber production;

(2) Timber Reserve - land not currently available for forest harvesting but which can be used for commercial timber production in time;

(3) Reserved Land - land set aside for recreation, scenic, conservation or ecological interest.

Each of the three classifications embodies particular features in relation to usage. It is mainly land in the State Forest category that would appear to be available for firewood gathering, and this is also land that is under concession to timber companies. However, in terms of management, the situation in the study area is that the Forestry Act of 1954, and the Pulpwood Products Industry (Eastern Tasmania)

FIGURE 4.1
The Crown Timber Resource Within a 50 km Radius of Hobart



Act 1968, do give considerable power to the Commission over the concession areas allocated to Australian Paper Manufacturers (A.P.M. Pty. Ltd.) in the south and Tasmanian Pulp and Forest Holdings Pty. Ltd. (T.P.F.H., a subsidiary of Australian Pulp and Paper Mills Pty. Ltd., A.P.P.M.) in the east.

North and slightly west, the study area also takes in a very small area of the Australian Newsprint Mills' concession granted under the Florentine Valley Paper Industry Act of 1935. This Act differs from the previous ones and appears to limit interference by the Commission in the company's operation. Australian Newsprint Mills Pty. Ltd. (A.N.M.) are, for example, responsible for regeneration and roading in the concession area[13]. The Commission role, particularly in the context of the potential for managing the area for firewood production as part of an integrated timber harvesting operation, is therefore much restricted. Nevertheless, firewood is taken, under licence, from the A.N.M. concession[14], but how far this could be expanded in the future would be more dependent on company policy than perhaps Commission initiatives.

With the exception of the Australian Newsprint Mills' concession, control of the forest by the Commission for management purposes is achieved by having particular terms and conditions built into the licences granted to the companies operating in the concession areas[15] (such terms and conditions are well illustrated in Schedule 2 of the 1954 Forestry Act to be found in Appendix B). It is through such provisions that there appear to be opportunities for increasing firewood availability should this be necessary in the future.

There are two points that could be of particular consequence to the firewood industry brought out in the legislation.

(1) Under the Forestry Act 1954 and the Pulpwood Products Industry (Eastern Tasmania) Act 1968, the Forestry Commission

is largely responsible for the planning of logging coups and for the regeneration of logged areas. While it has frequently been the policy of the Commission to burn timber residues after logging operations to achieve satisfactory regeneration[16], the Commission is now allowing some of these residues to be taken for firewood (a description of what is occurring in the Southern Forests follows in the next section).

An extension of this activity, allowing residues to be used for firewood, to other areas of Crown forest could make vast quantities of firewood available for domestic use, and at the same time produce additional royalties for the Commission. Should such a practice be adopted, even on a small scale, it might serve a dual function; such action would not only provide additional revenue for the Commission, but would also help to keep prices down for the domestic consumer by making more firewood available.

(2) The legislation mentioned also states, in general terms, that if, in the opinion of the Commission, any part of the concession area should be set aside for a *public purpose*, then the Commission may do so by notification of its intent in the Tasmanian Government Gazette. While such a notice is in force, the land is not subject to any rights granted [to the companies] under the Act. It would seem that if this second point is taken at its face value, in time the provision could be used in response to a public demand for firewood. At the moment this provision remains untried and untested for such a purpose, but the provision

> in Schedule 2 to set aside for a *public purpose* does seem to be an all embracing term that could be used to guarantee a firewood supply from a suitable near-urban area should this become necessary. If such a situation were to arise, it would then seem to be a question of the Commission's nominating forest areas close to urban centres (in this case, Hobart) that could be designated as being available for domestic firewood supplies. The management of such areas would have to have the stated aims of producing a sustainable timber supply. Such management practices could also imply that domestic consumers would only be allowed access to a pre-determined quantity of firewood on a monthly or annual basis as is currently the situation with the licence to obtain firewood for domestic purposes.

Rather than talk in theoretical terms at this juncture it is convenient to look at just what role the Commission is now playing to improve firewood production from Crown forest. This aspect is now discussed under the title Current Practices.

4.3 Current Practices

There is a very good example of an integrated forest operation that has the potential to produce large quantities of firewood to be found in the southern forests. The actual location of this operation is outside the study area in the Esperance Valley near Dover, some 70 km south west of Hobart, an area under concession to Australian Paper Manufacturers Pty. Ltd. (A.P.M.). The area produces quantities of pulpwood and milling timber (sawlogs) that are taken out by A.P.M. or its contractors. When this timber has been removed under the

supervision of the Forestry Commission, which is responsible for the planning of logging coups and their management in the concession, the area is then regenerated. It is as an aid to regeneration, and the future management of the plantation, to have dead trees cut down. In the Esperance Valley there are significant areas of dead standing trees that result from previous wildfires. These trees, called *stags* by the timber men, are large and if left become dangerous when future harvesting is carried out. They therefore have to be removed. The advantage of taking out the *stags* is that the risks of spreading fires from dead trees carrying a fire on a new plantation are reduced, and fire control is improved. In addition, the risk of dead timber falling on a new plantation and causing damage is eliminated and subsequent harvesting encounters fewer difficulties with fallen timber obstructing equipment. It is mainly this timber that is used to produce firewood[17]. The mechanics of producing firewood from such trees are illustrated in Plates 13 to 16.

PLATE 13

Dead trees (stags) are removed as part of the regeneration process in the Esperance Valley plantation

PLATE 14

The heavy equipment used to drag the fallen timber to the landing area

Plate 13 shows that the commercial timber on the hillside has been removed from the site and that all that remains are dead standing trees and old fallen decaying branches and limbs. Many of the standing trees can be up to 50 m high and can each contain 10 m^3 (8-10 tonnes) or more of firewood. The wood is relatively dry as the trees have been dead for 10-15 years. Being dry, they are also quite easy for wood cutters to split and are favoured by them[18]. In order to split the wood to firewood size, the trees first have to be felled. This work is carried out by contractors or Commission employees using a bulldozer. The cost to the Commission for this operation is about 50 cents per m^3. The wood cutter is not charged for felling as the Commission maintains that this work has to be done anyway for safety reasons[19]. The wood cutter is, however, charged for the cost of

hauling the felled trees to a landing or loading area. It is from the landing that the wood cutter handles the remainder of the operation.

Plate 14 shows the heavy equipment necessary to drag the fallen trees to the landing area. The Commission currently charges $1.50 per m^3 for the haulage involved. This price is estimated to cover costs.

PLATE 15

Logs assembled at the landing area ready to be cut and split

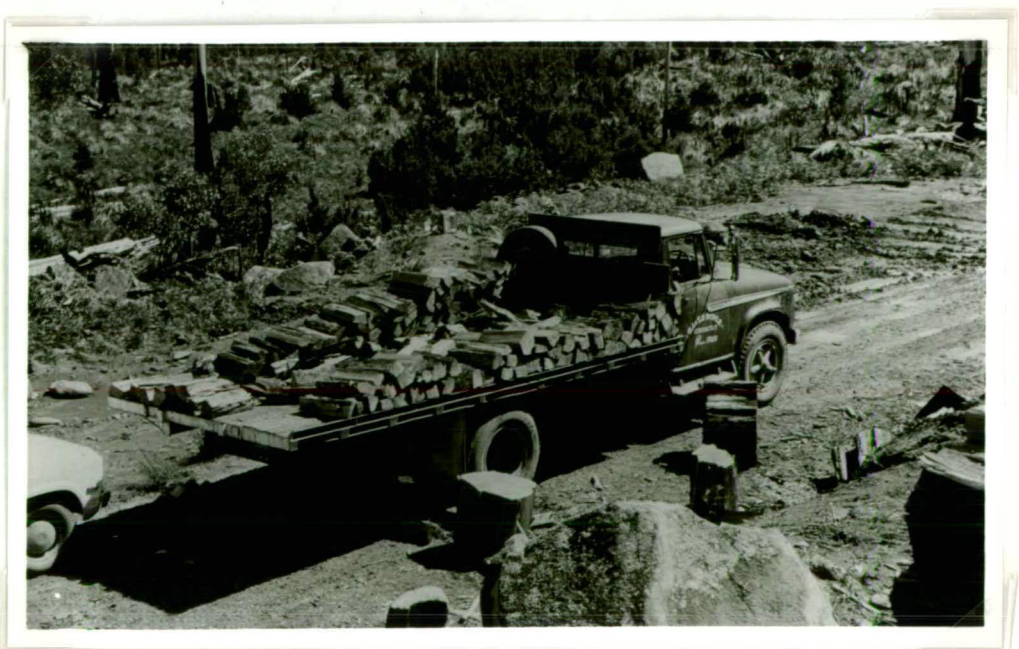
Plate 15 shows the landing area and illustrates the size of the trees handled. As can be appreciated, it is timber that the wood cutter would not be in a position to handle without access to heavy tractors or log skidders. It is not material that can be handled by individual members of the public with a small chain saw and a trailer. However, the wood cutter benefits by not having a high capital outlay for specialised equipment. The Commission benefits from the sale of otherwise unmarketable timber. In so

doing, it derives income that contributes to the cost of regeneration thus saving the public purse. In total, the wood cutter pays the Commission for haulage ($1.50); royalty for taking the firewood (46 cents per m^3); and a road toll (12 cents per m^3) for the use of the roads in the A.P.M. concession area. The total income for the Commission is thus $2.08 per m^3 and, on a per hectare basis, must amount to several hundred dollars, depending on the quantity of residues on the site.

Having paid the Commission, the wood cutter then has to cut and split the timber delivered to the landing area. To do this a chain saw is used to first cut firewood length blocks (20-60 cm or 9-24 inches firewood size) from the trunks or large branches of the trees. The blocks cut from the trunk are then split using an axe or a wedge and hammer. The chain saw may also be used for this work. The split timber, in convenient firewood lengths, is loaded by hand on to a flat tray lorry as shown in Plate 16.

PLATE 16

Split timber in firewood lengths being loaded for transport



A man can split and load about 1 tonne of firewood per hour[20]. The cost of handling depends on the cost of labour, or a charge for the owner/operator's time plus the cost of chainsaw operation. A total cost per tonne to a wood cutter is given in Table 4.1.

TABLE 4.1

An estimate of the cost of 1 tonne of firewood to a wood cutter operating in the Esperance Valley.

Payments to the Commission	$2.08
Labour @ $7.00/hour	7.00
Chainsaw Fuel and Maintenance	2.00
	$11.08

To this figure of $11.08 must be added a freight component for the delivery of the wood to the end user. This charge will be dependent on how transport is costed. For the owner operator using older vehicles a charge of 10 cents per tonne km may be realistic (actual costs are not available from published material). The wood cutter interviewed on site actually charged $26 per tonne for 6 tonne loads of firewood delivered to woodyards in Hobart.

This would involve a round trip of about 100 km and would approximate 10 cents per tonne km including labour, if $14 is the total freight cost (that is, approximately $12.00 for the wood loaded on the vehicle and $14.00 for delivery to Hobart with unloading).

The example of the integrated timber operation taking place in the Esperance Valley does show how firewood can be produced for domestic use at very competitive prices. It suggests that similar schemes could be employed in other locations should firewood demand or prices increase, or if supplies from private land become limited because of access problems. It is to the credit of the local forester that the initiative has been taken, and that firewood has been recognised as another product of the forest resource.

The benefits of such an integrated operation, as is taking place in the Esperance Valley, flow to the community in two ways. Firstly, firewood is produced and made available to the public inexpensively. Secondly, the cost of regeneration to the Commission is offset by income from firewood sales. This helps reduce the cost of operating the Commission that in 1980 required an injection of tax payers' funds to the extent of $9.5 million dollars[22]. Such benefits should not go unnoticed by those charged with formulating energy policy or with allocating funds to the Forestry Commission.

Having described the operation and the benefits of an integrated logging programme that includes the production of firewood for domestic use, it should not be implied that other uses cannot be found for this residue timber. There is competition for fuelwood developing from the industrial sector, and one example to be found in the study area will now be outlined in brief.

4.4 Competition for Forest Residues

While this study has been directed towards developing an understanding of the supply and availability of firewood for domestic use from near urban land, and it has been shown that firewood is produced from residue timber at prices that compare more than favourably with oil and electricity, this *waste* timber is also attracting the attention of industrial users of energy. Many industrial processes require heat and, with increases in the cost of oil and electricity, some manufacturers are looking at alternatives. Australian Paper Manufacturers Ltd. at Geeveston is one such operation. This company has already installed industrial boilers that use a combination of wood chips and coal[23]. The wood chips are produced by a mobil wood chipper that is illustrated in Plates 17 and 18.

PLATE 17

Loading the mobile Morebark Woodchipper to produce fuel for A.P.M.'s industrial boiler

PLATE 18

Woodchips are normally blown into a container for transportation but in this case the plate illustrated a demonstration situation only

Plate 17 shows the size of some of the timber that is loaded into the machine. The timber is delivered to the machine, a More-bark Chipper, by 4-wheel drive skidder (the larger logs are split length-wise before loading into the chipper by other equipment). The chipper has a capacity to handle timber to a width of 55 cm (22 inches) and of virtually any length. It has an output of 22 tonnes of chips per hour[24]. The chips are blown into a container mounted on a semi trailer and then carted to the A.P.M. factory. Plate 18 illustrates the blower mechanism for handling the chipped wood.

It is the use of woodchips produced this way, using residues from other forest harvesting, that could provide competition in the future for the domestic firewood industry. The A.P.M. situation may differ from that of other industrial users of energy in that the company has a ready access to residues from a concession area (Crown land) in which it already has a licence to operate. Further, the plant using the woodchips is located close to the source of supply. The company pay a fuelwood royalty for wood taken for energy purposes. Nevertheless, large quantities, 60 000 tonnes of woodchips per year, could be used by one single enterprise. This equates with the present estimated demand for firewood in Hobart. The effect of other industries turning to wood residues as an alternative form of energy could have a considerable influence on the availability of such material for domestic firewood. How far such a trend will develop will depend on the increased cost of conventional fuels, the cost of boiler conversion, and the delivered cost of wood to industrial factories, together with any policy incentives taken by government to encourage developments of this type.

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5. Personal Communication, T.M. Cunningham, Acting Chief Commissioner, Forestry Commission of Tasmania, Hobart.
6. Australian Bureau of Statistics, 1980; *Tasmanian Year Book, No. 14, Chapter 3;* Australian Bureau of Statistics, Hobart.
7. As above.
8. Parliament of Tasmania, 1977; *Forestry Act 1920;* Government Printer, Hobart (reprinted 1977).
9. The granting of *exclusive rights* to forest companies could prevent access by the public to firewood supplies. For a more complete discussion of the development of Forestry Legislation in Tasmania and how the timber resource in Tasmania is allocated refer to: Hoysted, P.A., 1981; *The Content and Historical Development of Forestry Legislation in Tasmania,* Project Report 1981/3; Centre for Environmental Studies, University of Tasmania, Hobart.
10. The Forestry Act 1920 with amendments has a clear objective in establishing the Forestry Commission and what the Commission is to control and manage. For further discussion of this point see note 9 above.

11. Personal Communication, J.R. Quick, Chief Commissioner, Forestry Commission of Tasmania, Hobart.

12. Details of the three classifications of Crown Forest are to be found in the 1920 Forestry Act and its amendments. See note 8.

13. The three Acts of Parliament relating to the concession areas within the near urban study area are:

    (1) The Florentine Valley Paper Industry Act of 1935;

    (2) The Forest Products Act of 1954;

    (3) The Pulpwood Products Industry (Eastern Tasmania) Act of 1968.

    The content and historical development of this legislation is discussed in Hoysted's report. See note 9.

14. Personal Communication, S. Lutterel, Forester, Forestry Commission of Tasmania, Hobart.

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16. BOWMAN, D.M.J.S. and JACKSON, W.D., 1980; Slash and burning in the regeneration of dry eucalypt forests, *Australian Forestry* 44(2), 118-124.

17. Personal Communication, G. Richards, Technical Officer, Forestry Commission of Tasmania, Geeveston.

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19. RICHARDS, G.; as note 17.

20. Personal Communication, S. Doyle, Wood Cutter, Dover.

21. RICHARDS, G.; as note 17.

22. Forestry Commission, Tasmania, 1980; *Annual Report;* Government Printer, Hobart.

23. Personal Communication, B. Hickey, Forest Manager, Australian Paper Mills Pty. Ltd., Geeveston.

24. As above.

CHAPTER 5

INTEGRATION

CHAPTER 5: INTEGRATION

The firewood industry is decentralised and poorly documented when compared with other domestic energy supplies like oil, electricity or coal. This study has gathered information from a wide range of sources and relates them to the firewood industry. The importance of the private timber resource to the supply of firewood has been reported. The farmer interviews, a particular feature of this study, provide the first available details of the attitudes and participation of private landowners in the firewood business. The documentation of the findings provides a basis for further studies or surveys.

This final chapter brings together the main points that have been raised in each of the preceding chapters. It has two main purposes;

(1) to integrate the findings of the study with the objectives outlined in Chapter 1,

(2) to discuss the implications of these findings.

The chapter is introduced by a recapitulation of the main factors that led to the study. This approach has been taken in order to provide a framework for the subsequent integration of the objectives with the findings and implications of the investigation.

5.1 The Study and its Objectives - Recapitulation

Tasmania is a State with no proven indigenous oil reserves, its coal deposits are still being explored, and its electricity prices are increasing. The events triggered in 1973 with the oil crisis have resulted in home owners feeling the influence of these events by way of increased domestic heating bills. Caught in a prices spiral for home heating, many householders have looked to alternative means

of heating their homes; firewood is one such alternative.

Fortunately, Tasmania is well endowed with timbered land, and although much of the resource is allocated to timber companies by Acts of Parliament, home owners still have access to firewood supplies from private as well as public land. The question is, how sustainable are these supplies, and will firewood continue to be available at competitive prices in the long-term? The aims and objectives of this study have been directed to collecting basic data about one small, but significant, part of a wider renewable energy question. Specifically, this study has set out to look at aspects of Hobart's firewood industry and, in particular, at the supply of domestic firewood from near urban timbered land within a 50 km radius of Hobart. The following section summarises the findings and implications of the study in terms of the specific objectives outlined in Section 1.2 of Chapter 1.

5.2 The Study Findings and Implications

Objective One:

> *to arrive at an estimate of the current trends in the demand for firewood used for domestic heating.*

Study Findings

The study has shown that Hobart residents live in a cold winter climate, and have an almost continuous need for supplementary domestic heating. Since firewood burnt in a slow combustion stove provides heating at a lower cost than (and has a price advantage over) other heating fuels, home owners are turning to wood to heat their houses. There has been a 14% increase in eighteen months in the number of

Hobart homes being heated with wood. This increase, coupled with an increase in the demand for firewood reported by fuel merchants and farmers, with the Forestry Commission also noting a doubling in the number of licences issued in the winter of 1981 to gather firewood from forest areas, supports the opinion that the demand for firewood is growing. This opinion is further supported by evidence of an increase in the number of people advertising firewood for sale in the local press.

Implications

As the demand for firewood is escalating, it seems that more information should be collected to establish how long the trend will continue upward, and what the implications of the trend are in terms of tonnes of firewood required within specific time frames. The collection of such information seems a pre-requisite to determining the "*sustainability*" of firewood supplies. There are three specific areas of investigation that would assist in this regard:

(1) an assessment of the quantity of firewood purchased or collected per household each year;
(2) the collection of information about the intentions of householders to convert to using wood as a heating fuel;
(3) the identification of any objections or barriers to householders using firewood for domestic heating, for example the cost of installing efficient wood burning appliances or difficulties in handling or storing firewood.

Objective Two

to gain an appreciation of the current supply system and to see if it had any inherent weakensses.

Study Findings

While the study has produced evidence of an increase in firewood demand (that seems to have taken place over a relatively short period of time) it has also shown that the demand is serviced by a fairly dispersed marketing channel or supply system. Domestic users of firewood can be supplied by farmers directly marketing firewood (that is selling it at the consumer's door); by wood cutters selling to customers or to wood merchants; by wood merchants cutting their own wood and selling it, or by buying it from wood cutters and re-selling it to the public. Also, householders collecting their own supplies from private landowners seems to be a major feature of the supply system.

Implications

It appears from this study that there are few weaknesses in the existing supply chain and it is working satisfactorily. The industry has expanded sufficiently and has been profitable enough to attract new entrants into the industry. However, these private operators have a cost structure which is largely unknown, particularly in relation to transport costs. Since transport costs are thought to be a significant component in the delivered price of firewood to the end user, some investigation of the operating costs of wood cutters and wood merchants might clarify this point.

Objective Three

> *to arrive at an estimate of the quantity of firewood being supplied for domestic use.*

Study Findings

The indications from this study are that 60 000 tonnes of firewood

are used each year in Hobart. Of this quantity, a personal judgement is that about 30% of the firewood is supplied through merchants, 30-40% via wood cutters advertising in the local press and the balance is collected by people for their own use.

The figure of 60 000 tonnes seems credible when it has been estimated that about 20 000 tonnes are supplied from established merchants located in Hobart and nearby towns, and it has been demonstrated that there are many more people selling firewood than the recognised wood merchants listed in the yellow pages of the phone book.

Implications

While it has been possible to arrive at an estimate of the quantity of firewood burnt for domestic purposes in Hobart each year, it is perhaps more important to realise what the demand trend is. The trend demonstrated in this study is quite clearly upward. It is this feature that requires monitoring by regular household surveys, by contact with wood merchants and by contact with suppliers of domestic wood burning appliances who could provide information from the market place about the demand for wood heaters, thereby indirectly acting as an indicator of firewood demand.

Objective Four

> *to gain an understanding of the type of land that firewood is being supplied from, and how the resource is being managed.*

Study Findings

From interviews held with wood merchants, farmers and members of the public it has been estimated that 80% of Hobart's firewood is

supplied from private land and the balance from Crown or state forest. While it has proved impossible to accurately determine this split-up, it does suggest the importance of the private forest resource to the firewood industry. It was for this reason that considerable attention was given to the available information about the area of private forest and how it was managed, in this study. It has been shown that documented information about the private forest resource is sketchy. An inventory of private forests in Tasmania is not due to be completed until the mid 1980s, and details made available from the Australian Bureau of Statistics for the study area suggest that the area of private forest might range from 56 022 ha up to a maximum of 181 689 ha. The apparent variation in forest area seems to be explained, at least in part, by the interpretation of the questions on the Australian Bureau of Statistics census form sent to farmers.

Since the area of private forest is imprecisely documented it is difficult to know or to predict or calculate how much firewood might be available from this source of supply. Interviews with farmers, however, show that farmers and graziers with timber on their land do not, generally manage the resource with the intention of producing firewood. It seems that firewood is produced as a by-product of other land management programmes, either land clearing or removing hazards, for example, in bush runs. The consequence of this activity is that the total forest resource on private land is being depleted, with significant areas of forest being converted to agricultural use. The area available to produce firewood is therefore being reduced.

If, for any reason, demand for firewood does outstrip the supply available from private land, or if farmers choose to deny access to firewood for some reason, there is an alternative. Within the study area there are considerable areas of State Forest which, while

under concession to timber companies, are nevertheless under the supervision of the Tasmanian Forestry Commission. Since the Commission controls regeneration practices in these areas, there seem to be opportunities for waste timber to be removed, after commercial logging operations, to supply firewood. There is already an example of this taking place just beyond the boundary of the study area, in the Esperance Valley, which is helping to reduce the cost to the Commission or regenerating cut over areas. An expansion of this activity to other near urban forest areas supervised by the Commission, would do much to make more firewood available and help to keep the price of the product down. The need for additional access to Crown Forest will depend on demand.

Implications

The lack of information about the private forest resource is a cause for concern particularly at a time when the demands on that resource are increasing. Since the area of private forest has been shown to be getting smaller efforts should be made to monitor trends in land use. The collection of such information is a necessary component of any study to determine if Hobart has a sustainable long-term firewood supply.

Objective Five

to determine the type of trees that are being taken to supply firewood.

Study Findings

Firewood comes from residue timber such as ring-barked trees, fallen limbs, fire damaged trees, and logging residues from wood-chipping and land clearing. It is wood that has little or no commercial

value at the present time, but the study has also referred to the initiatives by at least one woodchip company to take much smaller wood as part of the harvest operation. Should the economics of this development prove favourable, there is likely to be less residue left for firewood. There is also interest being shown by industry in fuelwood as a means of providing energy for heating. There is therefore competition developing for residue timber that could have an impact on the firewood industry and influence the price and availability of firewood for domestic use.

Implications

Tasmania has an energy problem; timber could be used to contribute to meeting future energy needs, and this study has drawn attention to the fact that householders have already found firewood to be an inexpensive heating fuel. In time the cost advantage of wood as an energy source could gain wider acceptance by those industries requiring heat for industrial processes. The demand for timber residues, should this occur, may well put pressure on the resource. Advance knowledge of the extent of such timber residues, could help considerably in future energy planning. There is a requirement to measure available timber residues and include not only stem wood and minor species in the calculations but also to include limbs and branches. Such studies could perhaps be linked with investigations currently being made in relation to the extend of the private timber resource.

Objective Six

> *to see if firewood sales from private land made a worthwhile or significant contribution to farm income.*

Study Findings

It appears from interviews held with farmers and graziers that the majority of them (18 out of 20 interviewed) will continue to provide access to firewood supplies despite the fact that many make no money from firewood sales. Farmers are prepared to continue to supply because the removal of residue timber from their land is a positive management aid. It reduces fire hazards in bush run, it removes obstructions to stock mustering and, for those continuing in timber production, it makes subsequent timber harvesting easier. While the study has shown the benefits farmers gain from having residue timber removed from their land, it has also shown that some farmers have suffered damage to property when heavy vehicles, loaded with firewood, become bogged. Fences can also be damaged and the net result is that farmers can become disenchanted with timber gatherers. There is a physical access problem to firewood supplies in the winter.

Implications

There are advantages and disadvantages for farmers involved in supplying firewood. There is also a problem for wood merchants having the space and the finance to build up an adequate stockpile of firewood in the summer for resale to customers in the winter. It would seem that these difficulties could be overcome if a number of farmers were encouraged to cut firewood in the summer and stockpile it on the farm (the financial benefits of doing this can be demonstrated from the example shown in this study). Farmers could then either supply merchants with ready cut timber, or sell firewood direct to the public in the winter months when demand is at its peak. The adoption of this suggestion would generate more money for the private landholder (and provide an incentive to maintain a supply of firewood) and at the same

time provide a service that would help to ensure a continuity of supply to the domestic consumer.

Objective Seven

> *to gain a "feel" for the likely long-term sustainable supply of firewood for the use of Hobart residents.*

Study Findings

With a private forest resource of between 56 022 ha and 181 689 ha and a Crown resource of approximately 90 000 ha it would be tempting to conclude that Hobart has a sustainable firewood supply. While the forest area is extensive, access to it for firewood gathering is not guaranteed. Private landowners are not obliged to allow the public access to their land. Also, in the study area much of the Crown land is committed to parks, reserves, water catchment areas and commercial interests.

These uses may not be compatible with firewood collection and therefore reduce the area available to supply Hobart's firewood needs. Still other timber areas in the locality are physically inaccessible to the public due to the lack of roads; other areas have an amenity value and there is already some evidence of local councils introducing tree preservation orders to maintain skyline features.

Implications

These limitations, coupled with a likely increasing demand for timber residues for other purposes (woodchips and industrial fuelwood) suggest that it would be wrong to be complacent about the supply of domestic firewood.

5.3 Conclusions

The study has shown that most of the firewood supplied for domestic use in Hobart comes from private land. It has also shown that the demand for wood has risen rapidly and that this is because firewood provides low cost home heating. Despite the growth in demand, the supply system has shown itself capable of responding to the need for greater supplies. The existing system is working, but the study has shown that there are opportunities for private landowners to make more money from their residue timber, and for wood merchants to reduce their problems of stockpiling adequate reserves. It seems there are no reasons why merchants could not negotiate with farmers to cut and stockpile firewood on the farm in the summer. If developed, this would have two advantages;

(1) some farmers would have the change of developing a new business and a new source of revenue,

(2) wood merchants, with limited storage space, could develop adequate stockpiles to satisfy the winter demand for firewood and, at the same time, reduce the need for wood cutters to work on properties in the winter when damage can occur.

Although this study shows that the private forest resource is the backbone of the firewood industry in terms of supply, it has also shown that more people are collecting firewood from Crown land. The growth in demand from the public for licences for firewood gathering, shown by Forestry Commission records, indicates that a growing number of people have realised that they have a right to firewood from state forests. The Commission has recognised this by designating areas that the public can go to for firewood collection. Access to Crown timber

provides a means by which people, especially those on low incomes, can obtain firewood at low cost. This, of course, assumes that there are readily available timbered areas near Hobart open to the public, and that transport costs are minimal. It is the maintenance of firewood supplies near the city that the Forestry Commission could give attention to in its planning. Indeed, access to such areas for firewood collection could have application state-wide as more people recognise wood's price advantage over other fuels used for domestic heating.

The study has also shown that wood is being used by industry for energy purposes. This, coupled with other demand pressures from the woodchip industry indicates that, in the longer term, the availability of firewood at low prices might change. In order to ensure firewood is available at competitive prices, planning initiatives could be required. The Forestry Commission as administrators of state forests needs to be alert to the growing recognition of wood as an energy resource. Such a recognition may require policy changes as information on the need for fuelwood becomes available.

Since the study has shown that home owners have, of their own initiative, turned to wood for domestic heating, the energy planners, those associated with the Energy Policy Unit of the Premier's Department, might well be interested in the possibility of wood fuel playing a more permanent and prominent role in the State's energy source mix. The needs of domestic consumers, the needs of industry, for firewood supplies could require an integration of energy planning with forestry management.

APPENDIX A

ENERGY PLANTATIONS - AN INVESTMENT ANALYSIS

APPENDIX A: ENERGY PLANTATIONS - AN INVESTMENT ANALYSIS

The purpose of this Appendix is to show the assumptions that have been made in order to assess the viability of a theoretical 50 ha energy plantation. The references used in making such an analysis are to be found at the end of the Appendix.

An Investment Analysis of Energy Plantations

It has been claimed that plantations are the most efficient means of producing wood[1]. This claim is made because the annual production of wood fibre from a plantation is greater than from a native eucalypt forest. The annual production of dry eucalypt forest in eastern Tasmania is, for example, in the order of 2 - 5 m^3, while for plantations on better sites elsewhere in Tasmania growth rates of up to 31 m^3 green weight have been achieved[2].

Table A.2 at the rear of the Appendix shows, by author, the wide range of productivity that has been reported in the literature for plantations from many locations in the world. The references cited are not exhaustive, but do show the range of productivity claimed for trees. If such high yields can be obtained from plantations, then they seem to offer a number of advantages over conventional practices.

The most significant of these are the more rapid production of a saleable commodity; a reduction in the land area required; an opportunity for mechanical harvesting; and, in theory, a more rapid pay back period (the time when all expenditure/costs of the project are met by returns).

To establish the contribution that an energy plantation might achieve by way of making a contribution to Hobart's firewood supply, two investment appraisals have been made for theoretical plantations of 50 hectares, a size that some private landowners could integrate

into their other farming activities. A number of these would be required if all Hobart's firewood was to be supplied from such plantations. Examples of the cash flow budgets for eucalypt and willow plantations are to be found in Tables A.3 to A.6.

The first example is of a coppiced eucalypt plantation with a 6 year harvest interval. The approach is based on information supplied by the Forest Service of the United States Department of Agriculture[3].

The second example uses willows as the means of producing wood fibre and is based on techniques under investigation in Sweden[4].

Example 1

A Theoretical Eucalypt Plantation

Assumptions

For the purpose of the investigation the initial yield chosen has been assumed to be 20 tonnes per ha oven dry weight per year. A literature search has shown a wide range of productivities reported as has been detailed in Table A.2. Since much of the literature cited and reviewed[5] has not stated the climatic conditions under which such yields have been obtained, or indeed what components of the tree made up the yields quoted, it is difficult to accurately determine just what yields might reasonably be obtained in the near urban area outlined in this study. For this reason, a yield of 20 tonnes per ha has been used as it seems to be a figure that might be attainable if twigs, branches, bark and the trunk of the tree are included in the yield figure. It has also been assumed for the purpose of the analysis that the farm gate price of firewood is $25 per tonne. This is a price that is well above the royalty paid to private land owners selling pulpwood or sawlogs. However, it may be more appropriate to view the wood produced from such energy plantations not just at the current royalty rate, but

at a price that is at least nearer to its oil or electricity replacement value. The price used is only a starting point for determining what price would be necessary to make an investment in an energy plantation financially attractive to landowners.

The rotation length of 6 years chosen for the sample might be criticised as being unrealistic by traditional foresters. Certainly traditional forest plantations of pines, eucalypts or poplars would be harvested after about 30 years, with thinnings or prunings being taken from 10 - 15 years after plantation establishment. But recent studies, mainly initiated after the 1973 oil crisis, have focussed attention on much shorter harvest intervals. As mentioned previously, short rotations shorten the pay-back period and therefore go some way to reduce the risk associated with a forest venture. A minimum rotation length of 6 years has been chosen since it appears to be the shortest realistically attainable for coppiced eucalypts based on United States research evidence[6].

The other reason for selecting this rotation length is that it should be most favourable to plantation economics. It helps to reduce financial risk and the long time interval between capital expenditure and a return on the plantation investment. The method used to determine the economics of the proposal is based on a computer programme for discounted cash flow analysis similar to that produced by the College of Forestry at the University of Minnesota[7] and made available by officers of the Tasmanian Department of Agriculture[8]. The programme follows the 6 basic steps listed in Table A.1.

Turning now to the actual figures used in the programme, there are two major components. These are the capital costs and the establishment and the operating costs associated with plantation management. These costs are now outlined.

TABLE A.1

Six steps in project analysis

1.	Estimate inputs and outputs.
2.	Derive unit value estimates for inputs and outputs.
3.	Calculate total value flow (cash flow) showing magnitudes and timing.
4.	Calculate measures of project worth.
5.	Analyse uncertainty associated with results.
6.	Draw conclusions and present results.

Source: Rose, D.W. and Gregerson, H.M., 1980; see reference 7.

Capital Costs

The following assumptions have been made: the price of land within a 50 km radius of Hobart has been costed at $1000 per ha for the purpose of the study. This figure was derived from an assessment of recent land sales in the region made by an officer of the Agricultural Bank of Tasmania[9]. This price is thought to be realistic if the plantation is to be managed intensively using agricultural as opposed to the more traditional forestry techniques. It has been assumed that the land would need to have a slope of less than 18 percent if mechanical harvesting is to be practised. Such a requirement puts the project in competition with agriculture and would, in fact, compete for the limited land available for cropping in the Hobart area. (See Table 3.1 Chapter 3 Statistics of the Land in rural holdings in the study area page 35).

It should also be noted that much of the land that might otherwise be suitable for plantation forestry has a rainfall of less than 750 mm per year. It is therefore marginal climatically for plantation forestry[10]. For this reason, in the first example showing the cash flow for a eucalypt plantation, a charge has been built into the figures

for the purchase of irrigation equipment. The capital cost of this equipment is high and has been estimated at $2400 per ha. The figure used is based on figures supplied by the Department of Agriculture for the cost of installing similar equipment in orchards and berry fruit plantations where the number of trees planted per hectare is similar [11, 12].

In higher rainfall areas, perhaps areas receiving 1000 mm of rain or more per year, such equipment might not be required. If this were the case, then there would be a considerable cost saving. Unfortunately, as will be shown, this saving is not enough to make a plantation a viable proposition unless wood prices are very much higher.

In addition to the purchase of land and irrigation equipment there are other capital items to be budgeted for. Although, not necessarily used solely on the 50 ha plantation, a contribution has to be made towards a tractor, spray equipment for weed control, a slasher for the more persistent weeds, small tools and a fertilizer spreader. While it has been assumed that the plantation makes a contribution to the cost of these items, it is recognised that they could be used elsewhere or could already be available on the property. A contribution of $4500 has been made for the tractor, $2500 for the spray equipment, $1200 for the slasher, $600 for miscellaneous small tools, and $2500 for a fertilizer spreader, in the establishment year. In addition to capital items there are also establishment and operating costs; these are now outlined.

Establishment and Operating Costs

In establishing a plantation certain non-recurring costs are incurred. It has been assumed in the analysis that the plantations are established on a site that was previously pasture. The cost of site preparation, including ploughing, has been based on 1981 figures

supplied by the Department of Agriculture Extension staff from several centres. A figure of $200 per ha has been allocated for this task (lower figures had been quoted from other sources but were for traditional plantations, and were therefore not considered appropriate since the energy crop is more akin to an agricultural or horticultural venture). In practice the cost of site preparation will vary with individual locations and the degree of cultivation required for satisfactory plant establishment.

In addition to preparing the site, trees have to be purchased. The price of seedling trees suitable for planting out has been set for the purpose of the analysis at $55 per 1000 trees. This charge is derived from prices quoted by the Forestry Commission[13] (the actual price of seedlings varies from $36 per 1000 to $117 per 1000 depending on species and whether the young trees are in pots). Because of the short harvest interval envisaged, six years, the planting density for the trees has been assumed to be 2400 trees per ha. This number was determined using plant spacings of 2 x 2.1 metres, approximately.

In a traditional plantation, about half this number of trees would be used and thinning would reduce this number further still. The labour involved in planting the trees has been estimated at $100 per 1000[14]. Mechanical planting by contractor could reduce this figure to less than half if the necessary equipment were available. Labour cost is an area of considerable uncertainty in the analysis and so the assumption should not have too much confidence attached to it.

Hand in hand with high planting density goes high applications of fertilizer since the objective of the energy plantation is to maximise biomass production. The amount of fertilizer used has been estimated to cost $150 per ha and it is applied in the establishment year and the year following[15]. No fertilizer is applied in years 3, 4 and 5, but it is again applied in years 6 and 7 after harvest. This pattern

is repeated through the life of the coppiced plantation. The actual mix of fertilizer applied would depend on site quality, soils and perhaps leaf analysis of the trees. Site selection and management would be an important consideration.

The other establishment and operating cost that has to be allowed for is weed control. This is particularly difficult to predict as it depends very much on the previous management of the land. A figure of $100 per ha has been built into the costing and this would include a component for some hand clearing of persistent weeds around small trees. The actual figure could be lower or higher in practice depending on the site selected. The pattern of weed control follows a similar programme to that of fertilizer applications.

There are also other operating costs that cannot be ignored. For example, there are costs associated with operating the tractor used for spray work, fertilizer application and carting of plants and tools around the site. A figure of $75 per ha has been included for the exercise (by comparison, a figure of $60 per ha has been used by the Department of Agriculture when costing a berry fruit orchard[16]).

The other remaining factor to consider in establishing the plantation is the annual cost of irrigation. As mentioned, in locations where the rainfall is less than 750 mm, irrigation is likely to be required if maximum wood fibre production is to be achieved. It is suggested that, on many sites in the near urban study area, costs would have to be incurred if a yield of 20 tonnes per ha is to be achieved. The annual cost of irrigating has been estimated to be $50 per ha. The figure is based on the cost of irrigation using trickle irrigation equipment. Should a mobile irrigator be used the amount of water used would increase considerably and add to the cost of water storage.

Finally the wood fibre has to be harvested. For the purpose of

the analysis it has been assumed that a contractor would be employed for harvest work. A charge of $8 per tonne has been estimated for this task. This is a theoretical figure and is based on the estimated capital cost of harvesting equipment valued at $80 000 - $100 000. An alternative way of arriving at a harvesting cost is to use estimates of harvest costs applied to more conventional forest plantations. The Forestry Commission in Hobart indicated a price of $6.50 per tonne for clearfelling and $9 - $11 per tonne for thinning[17]. The figure of $8 per tonne used for the purpose of this analysis seems a compromise figure.

The figures outlined so far are for a eucalypt energy plantation with 6 year harvest interval and a 30 year rotation length. The second investment analysis is applied to a willow plantation and it is now necessary to show in what way the costs used in this analysis differ from those in the first study.

Example 2

Willows

In terms of capital costs the differences are minor. There is a small additional charge of $200 for miscellaneous tools, the figures otherwise remaining the same. However, in terms of the operating and establishment costs, there are differences.

The cost of land preparation prior to planting (that is, the cultivation cost) is similar and for the 50 ha amounts to $10 000. The cost of trees is considerably more in total because of the planting density. The trees are priced at 5 cents each and the number planted per hectare is 10 000 giving a total cost for plants of $25 000. Labour for planting is an area of uncertainty, but the total cost for willows has been assumed to be $12 500, $500 more than for the eucalypt situation.

PLATE A.1

A harvested willow plantation - Sweden. The plant spacings and row widths illustrate the high plant density per hectare.

Source: Dr. T. Johannson, University of Lund, Sweden.

PLATE A.2

A mock-up of a prototype willow harvester

Source: Dr. T. Johannson. As above.

As regards the recurring or operating charges, fertilizer is a major item of expense and, although the cost per hectare, $150, is the same as for eucalypts, it is an expense that is incurred each year over the 30 year life of the plantation. Similarly, there are annual costs for weed control and after the establishment year, year one, the cost has been assumed to be $1500 in total, or $30 per ha. Tractor operating expenses are also higher since more work is involved in applying fertilizer and in applying sprays for weed control. Irrigation costs of $50 per ha also apply annually. Harvesting costs are written in at $10 per tonne but are estimates only. Harvesting takes place every second year (the plantation envisaged is illustrated in the following Plates and a conceptual harvester is also illustrated for interest only).

Results

The cashflow budget presented in Tables A.3 to A.6 for the irrigated and non-irrigated eucalypt and willow plantations show the high capital requirements and unattractive returns from energy plantations. The minimum capital requirement is $1226 per hectare for a non-irrigated eucalypt plantation and could be as high as $3626 if irrigation is employed. When the establishment and operating costs are added to these figures the cash outlay per hectare, to the end of the first year, ranges from $2133 to $4950 for the willow example. This makes the total financial requirement for the 50 ha plantation vary from $106 650 to a maximum of $247 500.

When this sizable monetary requirement is balanced against the returns of less than 1% to a maximum of 6.8%, and the negative net present values in all but one case (even when wood fibre prices are $25 and the yield is 20 tonnes per hectare per year), the risk is not worth the reward. Indeed, to meet Hobart's current firewood

demand of 60 000 tonnes per year on a sustained basis using energy plantations would require 60 such plantations, and they would cost between $7.5 and $13.75 million, and require 3000 ha of land.

With the returns illustrated in the analysis such developments appear not to be viable unless there is a marked change in the value and availability of wood for energy purposes, unless yields can be assured, and unless the Forestry Commission is prepared to make grants available towards the cost of establishing short rotation energy plantations.

TABLE A.2

Short rotation energy forests: species and yield. Details available in Wood Fuel Information Collection (W.F.I.C.), Centre for Environmental Studies, University of Tasmania.

Source/Author	Species	Reported Yield	Standardised Yield tonnes (O.D.)ha^{-1}
Barbadillo	Eucalyptus	15-25 cu m/ha/yr	15.0 - 25.0
Brown	Hardwoods	10-16 t D.M./a/yr	25.10 - 40.15
	Coppice Rotations	5-8 t D.M./a/yr	12.55 - 20.08
Carlisle	Red Alder	61 O.D. tonnes/ha/yr	61.00
	Poplar	48.1 tonnes/ha/yr	48.10
	Sycamore	14.3 tonnes/ha/yr	14.30
	"	21.8 tonnes/ha/yr	21.80
	Fuel Wood	9 tonnes/ha/yr	9.00
	Poplar	7.2 tonnes/ha/yr	7.20
	Natural Forest	0.72 " " "	0.72
Carter	Eucalyptus	300 cu ft/a/yr	10.29
	"	350 " " "/@ 4th yr	11.10
	"	460 " " "/@ 5th yr	15.76
	"	465 " " "/@ 6th yr	15.94
	"	564 " " "/yr	19.32
	"	286-429 cu ft/a/yr	9.81 - 14.71
	"	215-258 " " " "	7.38 - 8.83
Carlisle & Meuthuen (in Boyce, S.G.(ed.))	Populus euramericana	16.3 o.d.t./ha/yr	16.3
	" "	10.1 " " "	10.1
	" "	8.4 " " "	8.4
	" "	7.5 " " "	7.5
	" "	6.4 " " "	6.4
	" "	5.3 " " "	5.3
	" "	4.2 " " "	4.2
	Populus tristis	15.6-18.6 o.d.t/ha/yr	15.6 - 18.6
	Plantanus occidentalis	11.2 o.d.t/ha/yr	11.2
	" "	2.5-4.6 o.d.t/ha/yr	2.5 - 4.6
	Alnus rubra	4.2 o.d.t/ha/yr	4.2
	" "	5.3 " " "	5.3
	" "	7.7 " " "	7.7
	" "	15.2 " " "	15.2
	" "	13.0 " " "	13.0
Cromer *et al.*	Eucalyptus	1-30.3 tonnes/ha	1 - 30.3
Eimers	Sycamore		
	Loblolly Pine	6 B.D.T./a/yr	15.05
	Cottonwood		
Evans	Poplar	0.7 O.D.tons/a/yr	1.76
	Aspen	1.2 O.D.tons/a/yr	3.01
	Pine - Oak	2.0 O.D.tons/a/yr	5.02
	Hemlock	11.00.D.tons/a/yr	27.6
	Red Alder	4.0-17.3 o.d.t/a/yr	10.04 - 43.4

TABLE A.2 (cont'd)

Source/Author	Species	Yield	Standardised Yield tonnes (O.D.)/ha^{-1}/a^{-1}
Evans (cont'd)	Grey Birch	1.1 o.d.t/a/yr	2.76
	Hemlock	2.1 o.d.t/a/yr	5.27
	Douglas Fir	3.3-3.5 o.d.t/a/yr	8.28 - 8.78
	Hybrid Poplar	2.8-4.2 o.d.t/a/yr	7.03 - 10.54
	Red Alder	1.3-16.3 o.d.t/a/yr	3.26 - 40.9
	" "	1.3-10.4 o.d.t/a/yr	3.26 - 26.1
	" "	10.3-16.3 o.d.t/a/yr	25.85 - 40.9
	Sycamore	2.2-4.1 o.d.t/a/yr	5.52 - 10.29
	Hybrid Poplar	3.3-4.1 o.d.t/a/yr	8.28 - 10.29
	Black Cottonwood	1.0-5.2 o.d.t/a/yr	2.51 - 13.01
	" "	5.7-6.3 o.d.t/a/yr	14.30 - 15.81
	Red Alder	12.3-33.7 o.d.t/a/yr	30.87 - 84.57
	" "	16.6 o.d.t/a/yr	41.66
	" "	12.5 o.d.t/a/yr	31.37
	" "	18.0 o.d.t/a/yr	45.17
	" "	19.0 o.d.t/a/yr	47.68
	" "	18.2 o.d.t/a/yr	45.67
	" "	13.3 o.d.t/a/yr	33.38
Fege *et al.*	Hardwoods	4-8 Dry t/a/yr	10.04 - 20.08
Goddard	Several Species	7-10 o.d.t/a/vr	17.57 - 25.10
Frazer	Eucalyptus	22 o.d.t/ha/yr	22.0
	Radiata Pine	12-16 o.d.t/ha/yr	12 - 16.0
Hall	Rain Forest	35-50 t/ha/yr	17.5 - 25.0
	Deciduous Forest	15 t/ha/yr	7.5
	Evergreen Forest	22 t/ha/yr	11.0
Hunt	Eucalyptus	9 green t/a/yr	11.29
	Sycamore	5 green t/a/yr	6.27
	E. grandis	6.7 green t/a/yr	8.41
	" "	4.0 " " " "	
Hutchins	Blue Gum	21 dry t/a/yr	52.70
	" "	10 " " " "	25.10
Hyde & Wells	Commercial Forest	3.2 dry t/ha/yr	3.20
	Sycamore	9-13 dry t/ha/yr	9.00 - 13.00
	Sycamore	12.8 dry t/ha/yr	12.80
	Red Alder	33.0 dry t/ha/yr	33.00
	Eucalypts	20-50 t/ha/yr	20.00 - 50.00
Isebrands	Poplar	47.37 dry/t/ha @ 5 yrs	9.47
Johansson	American Sycamore	14 dry t/ha/yr	14.00
	Eucalypts	27 dry t/ha/yr	27.00
	Loblolly Pine	11 dry t/ha/yr	11.00
	Eastern Cottonwood	11 dry t/ha/yr	11.00

TABLE A.2 (cont'd)

Source/Author	Species	Yield	Standardised Yield tonnes (O.D.)/ha^{-1}/a^{-1}
Johansson (cont'd)	Black Cottonwood	14 dry t/ha/yr	14.00
	Hybrid Poplar	21 dry t/ha/yr	21.00
	Red Alder	20 dry t/ha/yr	20.00
	Douglas Fir	1.4 D.T.E./a/yr	3.51
	Loblolly Pine	2.7 " " "	6.78
	White Pine	2.5 " " "	6.27
	Balsam Fir	1.7 " " "	4.27
	Aspen	1.2 " " "	3.01
	Red Alder	2.5 " " "	6.27
	Eastern Cottonwood	4.9 " " "	12.30
	Black Cottonwood	5.8 " " "	14.60
	Sycamore	5.6 " " "	14.05
	Red Alder	8.5 " " "	21.33
	Hybrid Poplar	8.9-10.3 D.T.E./a/yr	22.33 - 25.85
	Loblolly Pine	4.5 D.T.E./a/yr	11.29
	Red Alder	10 " " "	25.10
	Eucalyptus	13 " " "	32.62
	Hybrid Poplar	5 " " "	12.55
	Hybrid Poplar	8 D.T.E./a/yr	20.08
	" "	7 " " "	17.57
	Eucalyptus	12 " " "	30.11
	"	12 " " "	30.11
	American Sycamore	8 " " "	20.08
	Hybrid Poplar	5 " " "	12.55
	Eucalyptus	12 " " "	30.11
Kemp C.C. & Szego G.C.	Hybrid Poplar	4-8 Air dry t/a/yr	8.72 - 17.45
	Sycamore	2-11 Air dry t/a/yr	4.36 - 23.99
	Southern Pine	2-5 Air dry t/a/yr	4.36 - 10.90
Ledig & Linzer	Sycamore	62 tons wet @ 4.5 yrs	6.90
	Sycamore	25 tons wet @ 4.5 yrs	5.60
	Black Cottonwood	2-10.2 tons dry yield	2.0 - 10.2
	Conifers	60 MT/ha/yr	20.00
	Deciduous trees	10-25 MT/ha/yr	5.0 - 12.50
Lejeune	Hybrid Poplar	20-30 dry t/ha/yr	20.00 - 30.00
	Hybrid Poplar	36 dry t/ha/yr	36.00
	Populus tristis	16-19 dry t/ha/yr	16.00 - 19.00
	Red Alder	23 dry t/ha/yr	23.00
	"	37 " " " "	37.00
	Eucalyptus	54 " " " "	54.00
	"	49 " " " "	49.00
	"	40 " " " "	40.00
	"	28 " " " "	28.00

TABLE A.2 (cont'd)

Source/Author	Species	Yield	Standardised Yield tonnes (O.D.)/ha^{-1}/a^{-1}
Lejeune (cont'd)	E. globulus	43 " " " "	43.00
	"	27 " " " "	27.00
	E. grandis	21 " " " "	21.00
	E. saligna	17 " " " "	17.00
	E. regnans	24 " " " "	24.00
Leon & Borges	Eucalyptus	40-50 cu m/yr	20-25
Mariani	E. globulus	32.5 green t/ha/yr	16.25
	E. globulus	20.5 " " " "	10.25
	E. globulus	15.0 " " " "	7.50
	E. regnans	22.6 " " " "	11.30
	E. regnans	11.0 " " " "	5.50
	P. radiata	17.0 " " " "	8.50
	P. radiata	15.0 " " " "	7.50
	P. radiata	10.0 " " " "	5.00
	E. grandis	16.0 " " " "	8.00
	E. grandis	8.5 " " " "	4.25
Myburgh	Eucalyptus	6.0 o.d.t/a/yr	15.05
Neenan *et al.*	Aspen	1.66 t.D.M./a/yr	4.17
	Willow	1.0 t.D.M./a/yr	2.51
	Alder	1.69 t.D.M./a/yr	4.24
	Aspen/Birch	1.28 t.D.M./a/yr	3.21
	Beech	1.34 t.D.M./a/yr	3.36
Ovington	Pseudotusuga taxifolia	9772 kg/ha/annum	9.77
	" "	7201 " " "	7.20
	Larix decidua	5979 " " "	5.98
	Pinus sylvestris	7869 " " "	7.87
	Pseudotsuga taxifolia	8714 " " "	8.71
	Larix decidua	5032 " " "	5.03
	Pinus sylvestris	7295 " " "	7.30
	Pinus nigra	8608 " " "	8.61
	Picea abies	6774 " " "	6.77
	Picea abies	7685 " " "	7.69
	Castanea sativa	3571 " " "	3.57
	Quercus robur	3477 " " "	3.48
	Fagus sylvatica	4140 " " "	4.14
	Quercus	2864 " " "	2.86
	Abies grandis	6889 " " "	6.89
	Abies grandis	12 395" " "	12.40
	Larix eurolepis	6482 " " "	6.48
	Tsuga heterophylla	10 277" " "	10.28
	Pseudotsuga taxifolia	6035 " " "	6.04

TABLE A.2 (cont'd)

Source/Author	Species	Yield	Standardised Yield tonnes (O.D.)/ha^{-1}/a^{-1}
Ovington (cont'd)	Picea onorika	9506 " " "	9.51
	Castanea sativa	-	
	Nothofagus obliqua	2858 " " "	2.86
	Picea abies	8191 " " "	8.19
	Chamaecyparis lawsontana	8499 " " "	8.50
	Pinus nigra	7617 " " "	7.62
	Quercus rubra	1611 " " "	1.61
	Quercus petraea	1347 " " "	1.35
	Alnus incana	4801 " " "	4.80
	Alnus incana	4018 " " "	4.02
	Larix leptolepris	3183 " " "	3.18
	Larix leptolepris	3311 " " "	3.31
	Pseudotsuga taxifolia	5031 " " "	5.03
	Pseudotsuga taxifolia	5327 " " "	5.33
	Pinus nigra	4441 " " "	4.44
	Pinus nigra	5080 " " "	5.08
	Betula alba	2051 " " "	2.05
	Betula alba	1868 " " "	1.87
Revelle	L. ucaena or Hawaiian Giant	12059 t/ha/yr	6.00 - 25.0
Rose	Aspen	8 t.D.wt/a/yr	20.08
Saddler *et al.*	Eucalyptus	15 t/ha/a	15.00
Saddler	Eucalyptus	16 t/ha/a	16.00
Siemon	Eucalyptus		
	E. globulus	32.5 t/ha/a	16.25
	E. globulus	20.5 " " "	10.25
	E. globulus	15.0 " " "	7.5
	E. regnans	22.6 " " "	11.3
	E. regnans	11.0 " " "	5.5
	P. radiata	17.0 " " "	8.5
	P. radiata	15.0 " " "	7.5
	P. radiata	10.0 " " "	5.0
	E. grandis	16.0 " " "	8.0
	E. grandis	8.5 " " "	4.25
Stanford	Not stated	5-10 t/a/yr	-
Szegoa & Kemp	Cottonwood	2.0 t/a/yr Air dry	4.36
	Cottonwood	3.1 t/a/yr Air dry	6.76
	Slash pine	3.8-4.8 t/a/yr Air dry	8.29 - 10.48
	Sycamore	1.6-11.2 t/a/yr Air dry	3.49 - 24.43
Walker	River Birch	10.35 kg/tree green	-
	Sycamore	4.94 kg/tree green	-
Walker & Hicks	Sycamore	16 t.D.M./a/yr	40.15
Zavitkovski	Red Alder	22.2 t/ha/yr Dry wt.	22.20

TABLE A.3

Investment Analysis: Eucalyptus Energy Plantation,
Yield 20 t/ha O.D.wt.
Irrigated, Low Rainfall Situation.

YEAR		0	1	2	3	4	5	6	7
YIELD (TONNES)								120	
PRICE ($ / TONNE)	25								
AREA (HECTARES)	50								
REVENUE			0	0	0	0	0	150000	0
CAPITAL COSTS									
LAND		50000							
IRRIGATION		120000							
TRACTOR		4500							
SPRAY EQUIP.		2500							
SLASHER		1200							
MISC.TOOLS		600							
FERT.SPREADER		2500							
TOTAL CAPITAL COST		181300	0	0	0	0	0	0	0
ESTAB.& OP.COSTS									
CULTIVATION			10000						
TREES			6600						
PLANTING LABOUR			12000					10000	
FERTILIZER			7500	7500				7500	7500
WEED CONTROL			5000	5000				5000	5000
TRACTOR OPERATING			3750	750	750	750	750	750	750
IRRIGATION OPER'G			2500	2500	2500	2500	2500		2500
HARVESTING								48000	
MISC.COSTS			500	500	500	500	500	500	500
TOTAL OPERATING COSTS			47850	16250	3750	3750	3750	71750	16250
TOTAL COSTS		181300	47850	16250	3750	3750	3750	71750	16250
NET CASH FLOW		-181300	-47850	-16250	-3750	-3750	-3750	78250	-16250

INTEREST RATE: 0.5% Real Rate of Return

NET PRESENT VALUE $: -12843.5

TABLE A.3 (cont'd)

8	9	10	11	12	13	14	15	16	17	18	19
				120						120	
0	0	0	0	150000	0	0	0	0	0	150000	0
0	0	0	0	0	0	0	0	0	0	0	0
				10000						10000	
				7500	7500					7500	7500
				5000	5000					5000	5000
750	750	750	750	750	750	750	750	750	750	750	750
2500	2500	2500	2500		2500	2500	2500	2500	2500		2500
				48000						48000	
500	500	500	500	500	500	500	500	500	500	500	500
3750	3750	3750	3750	71750	16250	3750	3750	3750	3750	71750	16250
3750	3750	3750	3750	71750	16250	3750	3750	3750	3750	71750	16250
-3750	-3750	-3750	-3750	78250	-16250	-3750	-3750	-3750	-3750	78250	-16250

TABLE A.3 (cont'd)

20	21	22	23	24	25	26	27	28	29	30
				120						120
0	0	0	0	150000	0	0	0	0	0	150000
0	0	0	0	0	0	0	0	0	0	0
				10000						10000
				7500	7500					7500
				5000	5000					5000
750	750	750	750	750	750	750	750	750	750	750
2500	2500	2500	2500		2500	2500	2500	2500	2500	
				48000						48000
500	500	500	500	500	500	500	500	500	500	500
3750	3750	3750	3750	71750	16250	3750	3750	3750	3750	71750
3750	3750	3750	3750	71750	16250	3750	3750	3750	3750	71750
-3750	-3750	-3750	-3750	78250	-16250	-3750	-3750	-3750	-3750	78250

TABLE A.4

Investment Analysis: Eucalyptus Energy Plantation,
Yield 20 t/ha $^{-1}$ O.D.wt.
None Irrigated, High Rainfall

YEAR		0	1	2	3	4	5	6	7
YIELD (TONNES)								120	
PRICE ($ / TONNE)	25								
AREA (HECTARES)	50								
REVENUE			0	0	0	0	0	150000	0
CAPITAL COSTS									
LAND		50000							
IRRIGATION		0							
TRACTOR		4500							
SPRAY EQUIP.		2500							
SLASHER		1200							
MISC.TOOLS		600							
FERT SPREADER		2500							
TOTAL CAPITAL COST		61300	0	0	0	0	0	0	0
ESTAB & OP.COSTS									
CULTIVATION			10000						
TREES			6600						
PLANTING LABOUR			12000					10000	
FERTILIZER			7500	7500				7500	7500
WEED CONTROL			5000	5000				5000	5000
TRACTOR OPERATING			3750	750	750	750	750	750	750
IRRIGATION OPER'G									
HARVESTING								48000	
MISC.COSTS			500	500	500	500	500	500	500
TOTAL OPERATING COSTS			45350	13750	1250	1250	1250	71750	13750
TOTAL COSTS		61300	45350	13750	1250	1250	1250	71750	13750
NET CASH FLOW		-61300	-45350	-13750	-1250	-1250	-1250	78250	-13750

INTEREST RATE: 6.5% Real Rate of Return

NET PRESENT VALUE $: -486.287

TABLE A.4 (cont'd)

8	9	10	11	12	13	14	15	16	17	18	19
				120						120	
0	0	0	0	150000	0	0	0	0	0	150000	0
				4500							
				1200							
				2500							
0	0	0	0	8200	0	0	0	0	0	0	0
				10000						10000	
				7500	7500					7500	7500
				5000	5000					5000	5000
750	750	750	750	750	750	750	750	750	750	750	750
				48000						48000	
500	500	500	500	500	500	500	500	500	500	500	500
1250	1250	1250	1250	71750	13750	1250	1250	1250	1250	71750	13750
1250	1250	1250	1250	79950	13750	1250	1250	1250	1250	71750	13750
-1250	-1250	-1250	-1250	70050	-13750	-1250	-1250	-1250	-1250	78250	-13750

TABLE A.4 (cont'd)

20	21	22	23	24	25	26	27	28	29	30
				120						120
0	0	0	0	150000	0	0	0	0	0	150000
										-50000
				4500						-2250
				1200						-600
				2500						-1250
0	0	0	0	8200	0	0	0	0	0	-54100
				10000						10000
				7500	7500					7500
				5000	5000					5000
750	750	750	750	750	750	750	750	750	750	750
				48000						48000
500	500	500	500	500	500	500	500	500	500	500
1250	1250	1250	1250	71750	13750	1250	1250	1250	1250	71750
1250	1250	1250	1250	79950	13750	1250	1250	1250	1250	17650
-1250	-1250	-1250	-1250	70050	-13750	-1250	-1250	-1250	-1250	132350

TABLE A.5

Investment Analysis: Willow Energy Plantation,
Yield 10 t/ha^{-1} O.D.wt.
Irrigated, Low Yield Situation.

YEAR		0	1	2	3	4	5	6	7
YIELD (TONNES)				20		20		20	
PRICE ($ / TONNE)	25								
AREA (HECTARES)	50								
REVENUE			0	25000	0	25000	0	25000	0
CAPITAL COSTS									
LAND		50000							
IRRIGATION		120000							
TRACTOR		4500							
SPRAY EQUIP.		2500							
SLASHER		1200							
MISC TOOLS		800							
FERT.SPREADER		2500							
TOTAL CAPITAL COST		181500	0	0	0	0	0	0	0
ESTAB.& OP.COSTS									
CULTIVATION			10000						
TREES			25000						
PLANTING LABOUR			12500						
FERTILIZER			7500	7500	7500	7500	7500	7500	7500
WEED CONTROL			5000	1500	1500	1500	1500	1500	1500
TRACTOR OPERATING			3000	3000	3000	3000	750	750	750
IRRIGATION OPER'G			2500	2500	2500	2500	2500	2500	2500
HARVESTING				10000		10000		10000	
MISC.COSTS			500	500	500	500	500	500	500
TOTAL OPERATING COSTS			66000	25000	15000	25000	12750	22750	12750
TOTAL COSTS		181500	66000	25000	15000	25000	12750	22750	12750
NET CASH FLOW		-181500	-66000	0	-15000	0	-12750	2250	-12750

INTEREST RATE: 5% Real Rate of Return

NET PRESENT VALUE $: -316158

TABLE A.5 (cont'd)

8	9	10	11	12	13	14	15	16	17	18	19
20		20		20		20		20		20	
25000	0	25000	0	25000	0	25000	0	25000	0	25000	0
				4500							
				1200							
				2500							
0	0	0	0	8200	0	0	0	0	0	0	0
7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
750	750	750	750	750	750	750	750	750	750	750	750
2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
10000		10000		10000		10000		10000		10000	
500	500	500	500	500	500	500	500	500	500	500	500
22750	12750	22750	12750	22750	12750	22750	12750	22750	12750	22750	12750
22750	12750	22750	12750	30950	12750	22750	12750	22750	12750	22750	12750
2250	-12750	2250	-12750	-5950	-12750	2250	-12750	2250	-12750	2250	-12750

TABLE A.5 (cont'd)

20	21	22	23	24	25	26	27	28	29	30
20		20		20		20		20		20
25000	0	25000	0	25000	0	25000	0	25000	0	25000
										-50000
				4500						-2250
				1200						-600
				2500						-1250
0	0	0	0	8200	0	0	0	0	0	-54100
7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
750	750	750	750	750	750	750	750	750	750	750
2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
10000		10000		10000		10000		10000		10000
500	500	500	500	500	500	500	500	500	500	500
22750	12750	22750	12750	22750	12750	22750	12750	22750	12750	22750
22750	12750	22750	12750	30950	12750	22750	12750	22750	12750	-31350
2250	-12750	2250	-12750	-5950	-12750	2250	-12750	2250	-12750	56350

TABLE A.6

Investment Analysis: Willow Energy Plantation,
Yield 20 t/ha^{-1} O.D.wt.
None Irrigated, High Yield Situation.

YEAR		0	1	2	3	4	5	6	7
YIELD (TONNES)				40		40		40	
PRICE ($ / TONNE)	25								
AREA (HECTARES)	50								
REVENUE			0	50000	0	50000	0	50000	0
CAPITAL COSTS									
LAND		50000							
IRRIGATION		0							
TRACTOR		4500							
SPRAY EQUIP.		2500							
SLASHER		1200							
MISC.TOOLS		800							
FERT.SPREADER		2500							
TOTAL CAPITAL COST		61500	0	0	0	0	0	0	0
ESTAB.& OP.COSTS									
CULTIVATION			10000						
TREES			25000						
PLANTING LABOUR			12500						
FERTILIZER			7500	7500	7500	7500	7500	7500	7500
WEED CONTROL			5000	1500	1500	1500	1500	1500	1500
TRACTOR OPERATING			3000	3000	3000	3000	750	750	750
IRRIGATION OPER'G									
HARVESTING				10000		10000		10000	
MISC.COSTS			500	500	500	500	500	500	500
TOTAL OPERATING COSTS			63500	22500	12500	22500	10250	20250	10250
TOTAL COSTS		61500	63500	22500	12500	22500	10250	20250	10250
NET CASH FLOW		-61500	-63500	27500	-12500	27500	-10250	29750	-10250

INTEREST RATE: 6.8% Real Rate of Return

NET PRESENT VALUE$: 326.1220

TABLE A.6 (cont'd)

8	9	10	11	12	13	14	15	16	17	18	19
40		40		40		40		40		40	
50000	0	50000	0	50000	0	50000	0	50000	0	50000	0
				4500							
				1200							
				2500							
0	0	0	0	8200	0	0	0	0	0	0	0
7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
750	750	750	750	750	750	750	750	750	750	750	750
10000		10000		10000		10000		10000		10000	
500	500	500	500	500	500	500	500	500	500	500	500
20250	10250	20250	10250	20250	10250	20250	10250	20250	10250	20250	10250
20250	10250	20250	10250	28450	10250	20250	10250	20250	10250	20250	10250
29750	-10250	29750	-10250	21550	-10250	29750	-10250	29750	-10250	29750	-10250

TABLE A.6 (cont'd)

20	21	22	23	24	25	26	27	28	29	30
40		40		40		40		40		40
50000	0	50000	0	50000	0	50000	0	50000	0	50000
										-50000
				4500						-2250
				1200						-600
				2500						-1250
0	0	0	0	8200	0	0	0	0	0	-54100
7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
750	750	750	750	750	750	750	750	750	750	750
10000		10000		10000		10000		10000		10000
500	500	500	500	500	500	500	500	500	500	500
20250	10250	20250	10250	20250	10250	20250	10250	20250	10250	20250
20250	10250	20250	10250	28450	10250	20250	10250	20250	10250	-33850
29750	-10250	29750	-10250	21550	-10250	29750	-10250	29750	-10250	83850

References

1. WISE, P., 1978; Solar Energy: *Are Forests for Fuel Viable?;* University of Sydney, School of Biological Sciences, Sydney.
2. Personal Communication, K. Felton, Silvicultural Research Officer, Tasmanian Forestry Commission, Hobart.
3. See, for example:
   (a) Bio Energy Development Corporation 1981 in Eucalyptus Plantations for Energy Production in Hawaii, 1980 Annual Report; Bio Energy Corporation, Hilo, Hawaii.
   (b) SACHS, R.M., 1980; Yields for Short Rotation Eucalpytus Grandis in High Density Plantations; Californian Agriculture, August/September.
   (c) United States Department of Agriculture 1980; Energy and Wood from intensively cultured plantations. Research and Development programme, General Technical Report NC 58; North Central Forest Experiment Station, Forest Services, United States Department of Agriculture, St. Paul, Minnesota.
   (d) United States Department of Agriculture 1976; *Intensive Plantation Culture: Five Years Research:* General Technical Report NC 21; North Central Forest Experiment Station, Forest Service, United States Department of Agriculture, St. Paul, Minnesota.
4. Royal College of Forestry, Sweden, 1976; Proceedings of the working meeting, *Premises and Potential of Short Rotation Forests in Sweden;* Department of Reforestation, Royal College of Forestry, Stockholm, Sweden, 11 - 12 October.

5. See, for example:

   (a) DAVIES, R.J., unpublished; *Report of Short Rotation Forestry Production;* Centre for Environmental Studies, University of Tasmania, Hobart;

   (b) JONES, R., TODD, J.J. and ELIFFE, D., in press; *A Review of Short Rotation Forestry Yields;* A report for the Tasmanian Energy Research Committee; Centre for Environmental Studies, University of Tasmania, Hobart.

6. See Note 3.

7. ROSE, D.W. and GREGERSON, H.M., 1980; *A General Computer Programme for Discounted Cash Flow Analysis,* Technical Bulletin 929; Agricultural Experiment Station, University of Minnesota.

8. Other literature on the cost of producing energy from plantations is also of interest. See, for example:

   (a) HALL, M.J., 1981; *Possibilities of Fuel Wood Production from Pine; especially where a pulpwood market is not available;* Paper presented at the Fuel Wood Cropping Investment Seminar, International Tree Crops Institute, Melbourne, 13 March.

   (b) ROW, C., KAISER, H.F. and SESSIONS, J., 1981; Discount Rate for long term Forest Service Investment, *Journal of Forestry* June, 367-368.

   (c) ROSE, D.W., FERGUSON, Karen, LOTHNER, D.C. and ZAVITKOUSKI, J., 1977; An economic and energy analysis of Poplar intensive cultures in the Lake States; Information supplied in a personal communication by Dean Urie, United States Department of Agriculture Forest Service.

   (c) ROSE, D.W., 1977; Cost of producing energy from wood in intensive cultures, *Journal of Environmental Management* 5, 23-35.

9. Personal Communication, R. Stewart, Senior Bank Inspector, Agricultural Bank of Tasmania, Hobart.

10. The Private Forestry Division of the Tasmanian Forestry Commission discourages plantation establishment in areas receiving less than 750 mm of rain on an annual basis; personal communication, Private Forestry Division, Forestry Commission, Hobart.

11. Personal Communication, P. Jacob, Agricultural Economics Section, Department of Agriculture, Hobart.

12. Personal Communication. M. O'Loughlin, Plant Production Officer, Department of Agriculture, Huonville.

13. Personal Communication, G. Clark, Technical Officer, Forestry Commission, Hobart.

14. WISE, P., 1978; see note 4.

15. The cost of fertilizer is almost double the $90 per ha cost of fertilizer applied for the establishment of soft wood plantations referred to in the 1980 Tasmanian Forestry Commission Annual Report. Since the plant spacings are much increased, in this theoretical plantation, the figure of $150 used in the study seems plausible.

16. Department of Agriculture, Tasmania, 1979; Mechanically Harvested Blackcurrants; An Investment Analysis; Agricultural Economics Section, Tasmanian Department of Agriculture, Hobart.

17. See note 13.

APPENDIX B

FOREST PRODUCE LICENCE APPLICATION FORMS AND SCHEDULE 2 OF THE 1954 FORESTRY ACT

APPENDIX B: FOREST PRODUCE LICENCE APPLICATION FORMS AND SCHEDULE 2 OF THE 1954 FORESTRY ACT

Members of the public in Tasmania are able to obtain a licence for the collection of firewood from forest areas administered by the Tasmanian Forestry Commission[1]. The licences are obtainable from any of the Commission's offices. The licence authorises the holder to collect firewood from a specific location. The price charged by the Commission for firewood in 1981 was 46¢ per cubic metre (stacked measure), but this fee may be waived for those low income people in necessitous circumstances. Copies of the three types of application forms for forest produce licences are reproduced for the benefit of those unfamiliar with the mechanism of obtaining firewood from Crown Forest.

Form 11 is a Forest Produce Licence and Receipt. It is issued in advance of firewood being taken from the forest, and is mainly issued to members of the public requiring small quantities of firewood.

Form 12 is a Forest Produce Licence issued to commercial operators taking quantities of firewood. The person issued with such a licence must, within seven days of the date of expiry of the licence, make a return to the officer issuing the licence.

Form 15 is a licence issued specifically to obtain firewood for domestic purposes. It does not provide for the holder of such a licence to resell wood or to act as a wood merchant. The licence is available for people to collect up to four cubic metres of firewood per month, free of charge.

Schedule 2, Section 3, Clause 1 of the Forestry Act 1954[2] provides a mechanism by which forest areas, even those under concession, can be set aside for a public purpose. As the demand for firewood escalates (assuming it maintains its price competitiveness with other heating fuels) it would seem possible for this provision to be used to guarantee public access to firewood near centres of demand, that is near urban centres. The clause is at present untried for this purpose.

FORM 11

(Regulation 21)

Tasmania

Forestry Act 1920

FOREST PRODUCE LICENCE AND RECEIPT

This licence authorizes ..... of .....,

to obtain forest produce in the Parish of .....

Land District of ..... Block .....

Compartment/Coupe .....

Area to which cutting or taking is restricted .....

Species	Kind of forest produce	Quantity to be obtained	Royalty Rate	Amount of Royalty

Logs to be converted at Mill No. ..... situated at .....

Duration of licence: From ..... day of ..... 19..... ,

to ..... day of ..... 19.....

And I acknowledge receipt of the sum of $..... being royalty payable on this licence.

.....

(Issuing Officer)

Issued at ..... on ..... day of ..... 19.....

This licence is granted subject to the *Forestry Act* 1920 and to the special conditions endorsed below.

SPECIAL CONDITIONS: .....

.....

.....

FORM 12

(Regulation 21)

Tasmania

Forestry Act 1920

FOREST PRODUCE LICENCE

This licence authorizes .... of .....

to obtain ..... from State forest/Crown land

in the Parish of ..... Land District of .....

Block ..... Compartment/Coupe .....

Area to which cutting is restricted .....

Rate of royalty payable for each species or kind .....

Duration of licence: From ..... day of ..... 19..... to .....

day of ..... 19.....

.....

(Issuing Officer)

Issued at ..... on the ..... day of ..... 19.....

A return of forest produce obtained under a forest produce licence (form 27) must be forwarded to the officer issuing the licence within 7 days of the expiration of the licence.

This licence is issued subject to the *Forestry Act* 1920 and to the special conditions endorsed below.

SPECIAL CONDITIONS: .....

FORM 15

(Regulation 28)

Tasmania

Forestry Act 1920

LICENCE TO OBTAIN FIREWOOD FOR DOMESTIC PURPOSES

This licence authorizes ..... of ..... to obtain and remove firewood for domestic use only, and not for sale, in quantity not exceeding four cubic metres stacked measure per month in any one year.

A licensee may remove any kind of dead timber or, at the discretion of the forest officer, green timber which in the opinion of the forest officer is unsuitable for any other purpose, with the exception—

(*a*) of the following species .....;

(*b*) felled timber bearing a brand or worked to a marketable shape or size, on or from Crown land, in the Parish of .....

Land District of .....

Area to which operation of licence is restricted .....

Duration of licence: From ..... 19..... to ..... 19.....

Licence issued at ..... on the ..... day of ..... 19.....

.....

(Issuing Officer)

Division VII—Licence to Obtain Firewood for Domestic Purposes

Licence to obtain firewood for domestic purposes.

28—(1) A forest officer who is satisfied that—

(*a*) a person is in necessitous circumstances and requires firewood for use solely for his own domestic purposes; or

(*b*) a charitable organization is acting on behalf of a person referred to in paragraph (*a*), free of charge,

may issue to that person or charitable organization a licence authorizing the person or organization to obtain and remove firewood from the area specified in the licence.

(2) A person referred to in sub-regulation (1) (*a*) or charitable organization acting on behalf of a person referred to in sub-regulation (1) (*b*) shall not obtain and remove more than 4 cubic metres stacked measure of firewood per person per month in any one year.

(3) A licence to obtain firewood for domestic purposes shall be in accordance with form 15.

(4) A licence under this regulation has effect to authorize the holder of that licence to obtain dead timber (other than any species of timber declared in that licence to be excepted from the operation of the licence) from Crown land specified in the licence.

(5) No fee or royalty is payable in respect of a licence under this regulation.

SCHEDULE II

(Section 3)

Terms and conditions to which a special licence is subject

1. Where, in the opinion of the Commission, any part of the pulpwood area or of the reserve area is required for use for any public purpose under the Principal Act or any other Act, the Commission may, by notice in the *Gazette*, exclude that part of that area from the operation of the licence, either indefinitely or for a specified period, and, while a notice under this paragraph is in force, the licensee has no rights over the part of the pulpwood area or of the reserve area, as the case may be, to which the notice relates.

Paragraph 2 substituted by No. 61 of 1959, s. 9.

2. All operations carried out by the licensee shall be carried out in conformity with the working plan.

3.—(1) The licensee shall, if so directed by the Commission, convert into case timber such quantity of the milling timber obtained by him from the pulpwood area (not exceeding one fourth of the quantity so obtained in each year) as the Commission may direct.

(2) In this paragraph, "case timber" means timber that is suitable or that, by a process of treatment, conversion, or manufacture, is capable of being rendered suitable, for use in the manufacture of cases for fresh fruit or processed fruit.

Paragraph 4 substituted by No. 69 of 1959, s. 9.

4. The licensee shall, on his own initiative, take prompt action to suppress any fire occurring within, or threatening, any area on which the licensee is directly responsible for carrying out any logging operations.

5. The licensee shall, at all times, comply with such of the provisions of the *Rural Fires Act* 1950 as are applicable to him.

Paragraphs 6 and 7 omitted by No. 69 of 1959, s. 9.

6. . . . . .

7. . . . . .

Paragraph 8 amended by No. 69 of 1959, s. 9 and No. 55 of 1965, s. 5.

8. The licensee, during the first two years after the date of issue of the licence, shall expend, to the satisfaction of the Commission, not less than $600 000 in or in connection with operations for the establishment or expansion of a wood pulp industry.

Paragraph 9 amended by No. 75 of 1973, s. 2 and 1st Sched.

9. The licensee shall, after the expiration of the period of 5 years after the granting of the licence, cut and remove at least 78 000 tonnes of pulpwood in each year.

Paragraph 10 substituted by No. 69 of 1959, s. 9.

10—(1) The licensee shall submit to the Commission for its approval reasonable specifications of any logging roads proposed to be constructed by the licensee within the pulpwood area or the reserve area as are necessary for the operation of any area for the logging of which he is, at any time, directly responsible.

(2) The licensee shall not construct any logging road within the pulpwood area or the reserve area unless the specifications thereof have been approved by the Commission.

References

1. HUGHES, T.J., 1977; Statutory Rules made during the year 1976, Number 284, Forestry Regulations; Government Printer, Hobart, Tasmania. p.641-696.

2. Parliament of Tasmania, 1977; Forestry Act 1954, number 49 of 1954, an Act to amend the Forestry Act 1920; Government Printer, Hobart (reprinted 1 September 1977).