The Economic Contribution of the Circular Head Wood Centre

Forestry Tasmania

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EXECUTIVE SUMMARY

TERMS OF REFERENCE

The consultants were requested to address the *following issues*:

- To determine the contribution of Circular Head Wood Centre (CHWC) to the following Tasmanian economic aggregates: Output, GSP (total income), and employment.
- To examine the special significance of the CHWC for employment in the Circular Head District.
- To identify any cost savings flowing from the integrated nature of the CHWC.

METHODOLOGY

The *following methods* were applied:

- An appropriate input/output (I/O), *Econsearch 1* model was applied to determine aggregative effects.
- The effect of job creation on Circular Head was determined from ABS data.
- Fixed costs savings were identified.

RESULTS

- Tasmanian aggregates:
  - The CHWC adds $70.9 million p.a to the value of Tasmanian output.
  - The CHWC adds $51.2 million p.a to Gross State Product (Total income).
  - The CHWC's DIRECT employment effects amount to 109 fte jobs: 100 in a rotary veneer plant and 9 in the merchandising yard.
  - The CHWC creates a further 95 jobs INDIRECTLY in Forestry (78) and 17 in all other I/O industries.

- The expansion of the current saw mill industry at Smithton will lead to :
  - Additional output of $1.389 million.
  - Additional total (state) income of $1.003 million
  - 3 additional fte jobs.
- In summary, the CHWC including sawmill expansion will create:
  - Additional output in all Tasmanian industries of $72.322 million p.a.
  - Additional GSP (total income) of $52.239 million p.a.
  - Additional employment of 208 jobs in all Tasmanian industries.
  - Effects on the Circular Head District: the CHWC will reduce the unemployment rate in the Circular Head municipality from its March 2002 level of 6.6 per cent to 4.8 per cent well below the Tasmanian average unemployment rate.
  - Cost Savings: Cost Savings from scale/scope economies associated with the multiproduct nature of the CHWC are represented by a reduction in fixed cost of 42 cents per unit of output to 24 cents per unit of output.
  - 49 jobs will be created in the construction industry during the construction phase of the project.
  - The substitution of veneer and saw log production for wood chip production is a quality improvement worth $130 per tonne of timber processed.

RECOMMENDATION FOR FURTHER ANALYSIS

Forestry Tasmania are advised to conduct a further analysis of the Scope Economies potentially available at the CHWC and Forestry in general. The joint nature of Forestry operations suggest the presence of substantial scope economies, particularly in relation to multiple forestry usage including tourism.

CONTENTS

1. INTRODUCTION

The Terms of Reference for this study were provided to the consultants by Forestry Tasmania and include the following specific objectives:

- To determine the impact of the Circular Head Wood Centre(CHWC) project on the value of output of Tasmanian industries particularly those in Circular Head; the job creation effects and the contribution to Tasmania's total income proxied by the Gross State Product (GSP).
- To examine the special significance of this project in the Circular Head region.
- The integrated nature of the project and the opportunities for achieving cost savings from this characteristic of the CHWC.

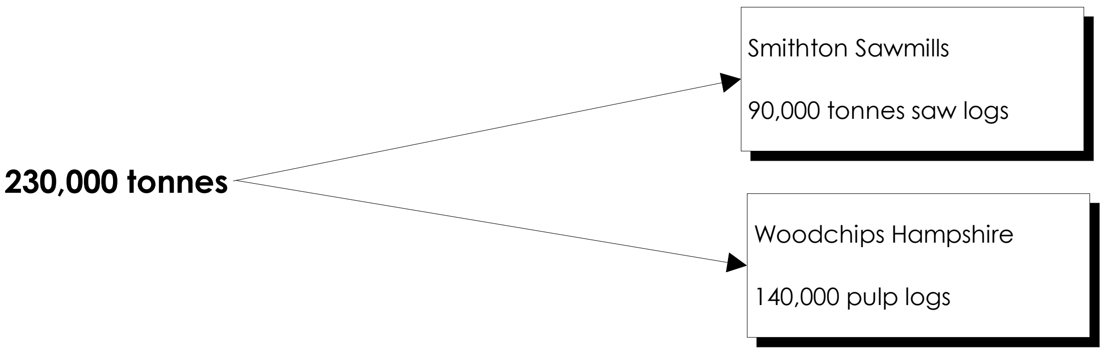
The study method, which is essentially based on the input/output (I/O) modelling approach, includes a simulation to make the I/O model utilised consonant with the latest technologies in the timber processing industries. The last decade of technical change has had a substantial impact on employment/output ratios in the forestry and timber processing industries. The I/O model utilised herein is subjected to an adjustment for this technical change manifest in updated employment/output ratios.

2. THE CIRCULAR HEAD WOOD CENTRE PROJECT AND THE REGIONAL FOREST AGREEMENT (RFA)

The proposal to establish the CHWC does not involve any additional demand on Tasmania's timber resource, rather it involves the substitution of one form of resource usage (chips) for CHWC another (veneer leaf). In this sense, the CHWC proposal is resource neutral. So it is precisely the kind of value added development which is encouraged by the RFA. The difference in end product quality is evident also in the pure difference between woodchips, $US 70 per tonne and veneer leaf $US 200 per tonne. The value added per tonne, if judged by this price difference, amounts to $US130 per tonne. So it is possible to assess the value added benefit of the timber substitution involved in the CHWC from at this premium price. The role of the RFA is identical here to the developments at Circular Head. In essence, the role of the RFA is to minimise sovereign risk and by so doing to encourage the vital investment required for the gestation of projects such as the CHWC. The investment required $25 to

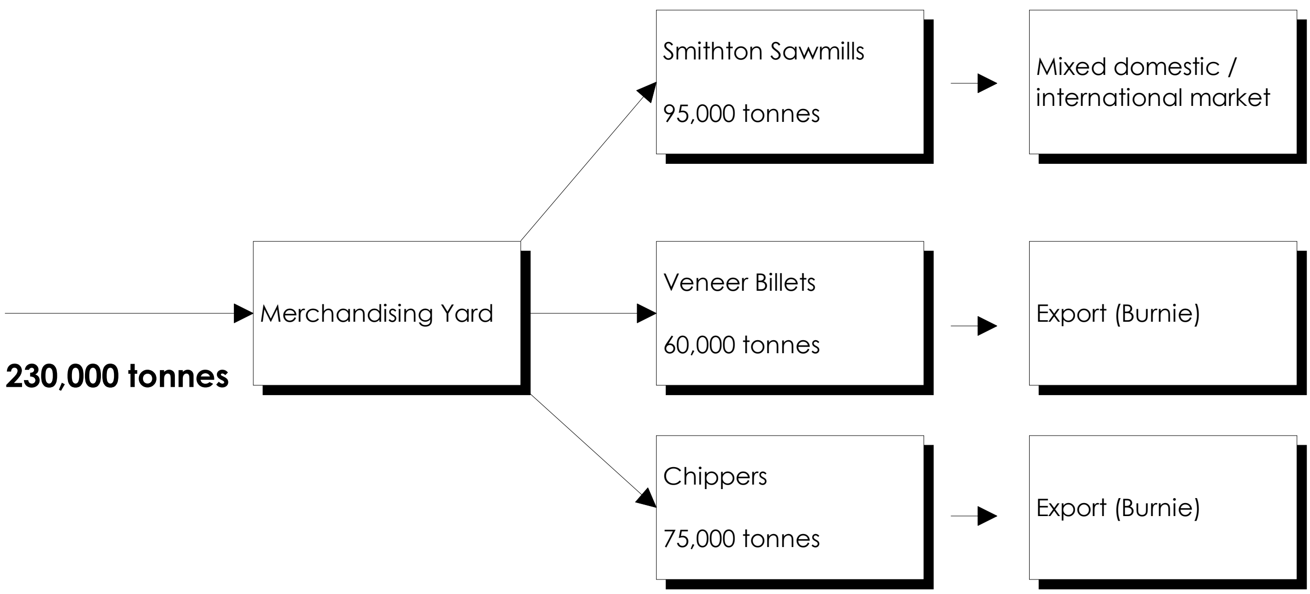
$30 million will not be put at risk unless there are guarantees about the continuity of supply of sufficient quality timber (resource security) for the economic life of the project. The difference between current operations at Smithton and the proposed CHWC are indicated in the following charts.

Chart 1: Current Smithon Operations



Currently 230,000 tonnes are distributed as follows: 90,000 tonnes as sawlogs to the two Smithton sawmills while 140,000 tonnes of pulp timber is road freighted to a chip mill at Hampshire (Burnie). The proposed CHWC involves the diversion of timber from pulpwood to veneer production. Initially, this diversion amounts to the transfer of 60,000 tonnes of the current pulp log resource to veneer production through a further initiative, namely a merchandising yard, which will improve the selection of logs. The CHWC as it appears in its first three year phase is shown as chart 2(a).

Chart 2(a): CHWC: Strucure in years (1) to (3)



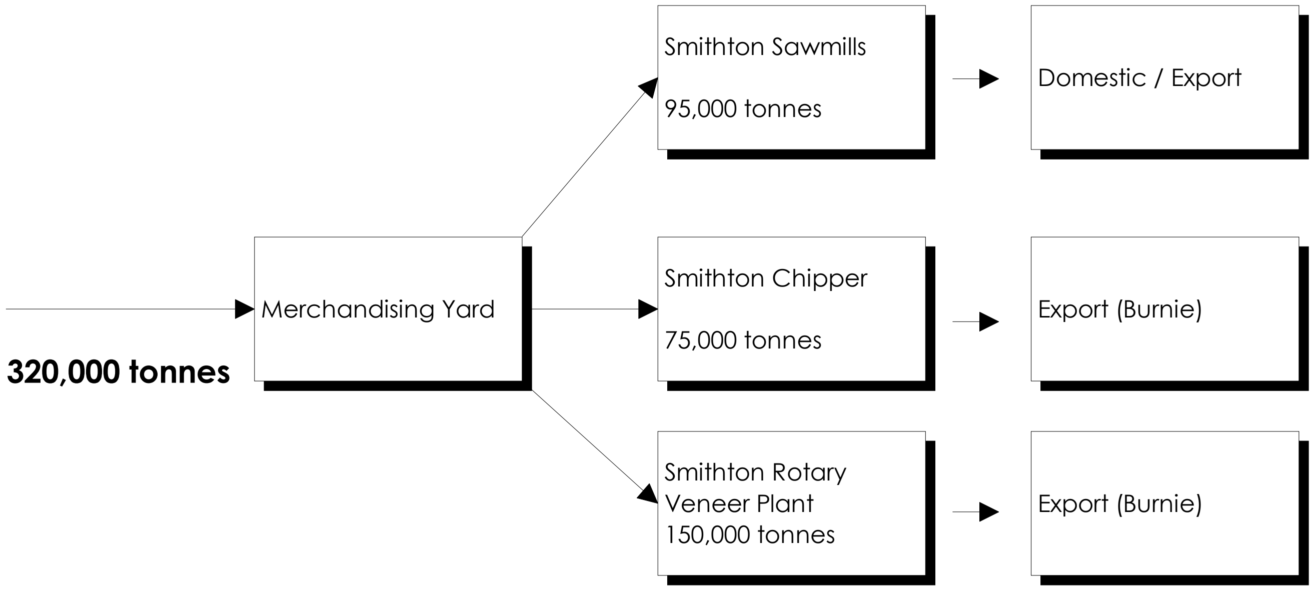
In chart 2(a), a merchandising yard comes into effect and 60,000 tonnes of timber suitable for veneer billets is processed. The timber required as veneer billets is diverted from the chip plant at Hampshire. The balance of the pulpwood formerly chipped at Hampshire is used firstly to increase the supply of sawlogs to the Smithton sawmills and 75,000 is chipped at Smithton. This reallocation of the timber resource is summarised as follows:

	Chips	Sawlogs	Veneer billets
Hampshire	-140,000	+5,000	+60,000
Smithton	+75,000		

The industry mix of logs has changed in favour of veneer billets and sawlogs resourced by reducing the supply of pulpwood.

The final stage of the Circular Head development involves the construction of a peeled rotary veneer plant at Smithton which will enable the CHWC to process the veneer billets into veneer leaf. This facility will come on stream in the fourth year of the project and requires the addition of 90, 000 veneer logs on site at Smithton, thus 320,000 tonnes will furnish the total complex each year, so that the merchandising yard will recover 95,000 tonnes of sawlogs for the two Smithton sawmills, 5,000 tonnes more then is currently supplied to them, 75,000 tonnes logs will be chipped from pulpwood and 150,000 veneer logs will pass though the peeled rotary veneer plant producing 70,000 tonnes of veneer leaf. The wood flows applying when the CHWC is in full operation are shown on chart 2(c).

Chart 2(c): CHWCin full operation mode



The evaluation of the statewide impact of this development presumes that the reduction of timber processed for pulpwood is not reflected in an incapacity to supply woodchip and if there is need to augment the supply of chips transported from Smithton then it will be drawn from the chip stockpile at Burnie. The assessment of statewide impacts does not include the modest increase in wood supplied to the two Smithton sawmills(+5,000 tonnes). The focus remains upon the statewide effects of the two new components of the CHWC, namely, the merchandising yard and the peeled rotary veneer plant.

The CHWC project is both vertically and horizontally integrated. Vertical integration is evident in three stages of production: harvesting in the forest; the infrastructure and merchandising operation and timber processing in three forms, veneer, sawmilling and woodchipping. Horizontal integration arises from the presence of three products: veneer product, sawlogs and woodchips. Vertical integration gives rise to the prospect of scale economies in production while horizontal integration raises the prospect of either potential savings in the form of scope economies or savings from joint production. The scale economies and joint production concept are well known, but the notion of economies of scope is less well known and requires some explanation. To quote, the authors who develop the concept of scope economies:

> *"cost savings which result from the scope (rather than the scale) of the enterprise. There are economies of scope where it is less costly to combine two or more product lines in one firm than to produce them separately".*

Panzar and Willig (1981, p.268)

Putting to one side the presence of scope economies for the moment, it is clear from Chart2(c), that the joint production of veneer, sawlogs and woodchips from a single resource means that the fixed costs of these three operations will be dispersed across three outputs and not a single output. If these products are to be produced separately then the unit cost of producing each must be higher than the joint unit expenditure.

3. METHOD AND DATA

3.1 Input Output Methodology

This study is based on application of the School of Economics (*Econsearch 1*) eleven industry Input/Output (I/O) model of the Tasmanian region. The details of the model are included in an appendix to the report. In an I/O model of the economy the output of each industry is spread across the remaining industries included in the model or is sold to a final demand. This arrangement of the input/output relationship of an economy is captured by the following I/O table:

$$X_{12} = a_{11}X_1 + a_{12}X_2 + \ldots + a_{111}X_{11} + F_1 \qquad (1)$$

$$X_{11} = a_{111}X_1 + a_{112}X_2 + \ldots + a_{1111}X_{11} + F_{11} \qquad (2)$$

Here X is the value of the total output of a particular industry and the subscripts 1…11 define the individual industry. In the Econsearch 1 model the industries are identified as follows:

1. Agriculture
2. Forestry
3. Fishing
4. Mining
5. Food and Beverage Processing
6. Mineral Processing
7. Timber Processing
8. Other Manufacturing
9. Construction, Transport, Utilities
10. Public Services
11. Private Tertiary

This selection of industries, not entirely ANZIC classifications, were selected to reflect the resources and first stage valued added characteristic of Tasmania's regional economy. For this reason, the services sectors are combined into two categories, public service and private tertiary. The use of this particular model for studies involving any Tasmanian services industry always requires splitting down either category 10, 11 and the addition of a twelfth industry. For example, a recent study aimed at assessing the impact of licensing supermarkets to sell alcohol involved the disaggregation of industry (11) Private Tertiary into two industries: supermarket retailing and other private tertiary services. This modification is not required here as the treatment of Forestry (2) and Timber Processing (7) are comprehensive as these are represented by specific industry categories.

The array of numbers comprising the I/O table is derived from a preliminary transactions table which shows the sales of these 11 industry outputs to all 10 remaining industries and to itself. These are referred to as inter industry sales/purchases. The model is closed with the addition of households to final demand and to the supply of labour. The methods adopted in developing the underlying transactions table are outlined briefly in the appendix.

The system of equations (1) and (2) can be written in algebraic form:

$$\tilde{X} = A\tilde{X} + \tilde{F} \qquad (3)$$

where $\tilde{X}$ is a column vector (11 x 1) of Output values; A is an 11 x 11 matrix of I/O coefficients and F an (11x1) vector of final demands. This may be resolved for the Output Vector in three steps:

$$\begin{aligned} \tilde{X} - A\tilde{X} &= \tilde{F} \\ \tilde{X}(I - A) &= \tilde{F} \end{aligned} \qquad (4)$$

Where I is an 11 x 11 identity matrix and finally:

$$\tilde{X} = (I - A)^{-1}\tilde{F} \qquad (5)$$

3.2 Multipliers

This expression (5) suggests that if the vector of final demands for output $\tilde{F}$ is known then the product of $\tilde{F}$ and the matrix $(I - A)^{-1}$ gives the values of output ($\tilde{X}$). Note that the matrix $(I-A)^{-1}$ holds a special place in I/O analysis. It is referred to as the Leontieff inverse after its creator Wassly Leontieff.

The <u>output multipliers</u> measure the effect of a change in the final demand for a particular industry's output on the value of both its own output (the <u>direct</u> effect) and on the output all other j i industries in the economy (<u>the indirect effect</u>). The total of indirect and direct impacts will invariably be greater than the initial change in final demand; hence the phrase output multiplier effect. The output multipliers for each industry are to be found in the column sums of $(I-A)^{-1}$.

<u>Total income</u> (Gross State Product) (GSP) multipliers reflect the impact of a change in final demand on GSP. To define these, the system of output equations (2) and (4) must be converted into a set of total income (value added by industry) equations. This is achieved by multiplying the output system (1) and (2) by the ratio of value added by industry to the value of output V_i/X_i and transforming the same Leontieff system into a total value added (GSP) system as follows:

$$\Delta V_i = (I-A)^{-1}\Delta F_i \qquad (9)$$

<u>Employment multipliers</u> measure the change in the number of workers employed in each industry resulting from a change in the final demand for the output of one of the eleven industries comprising this system. These are derived in the same way by multiplying the output system (1) and (2) through by employment/output ratios E_i/Q_i and turning the Leontieff system over again and producing the impact of a change in final demand in one industry on employment in all eleven industries:

$$\Delta E = (I-A)^{-1}\Delta F \qquad (10)$$

Employment effects are calculated in a slightly different manner in comparison with output, and total income impacts. Employment effects are based on the physical relationship between output and employment and reflect the technology applying to production at the time the I/O model was developed. *Econsearch I* was developed in 1995 and so the employment/output ratios reflect the technology prevailing at that time. The impact of this characteristic on the calculation of employment impacts is that employment multipliers are related to the constant price (1995 base) real values of final demand changes. However, output, total income and wage income effects are related to current price values of final demand changes.

Final demand increases for the CHWC project are applied to output, and total income multipliers in the conventional fashion, but preliminary runs of *Econsearch I* reveal that a particular problem attends the calculation of employment impacts.

3.3 Adjusting employment multipliers for technical change

The problem referred to is that in preliminary runs of *Econsearch I* in its current 1995 format it is evident that employment impacts exceed reasonable expectations when these preliminary outcomes are compared to employment/output ratios proposed by FT for each of the two new activities comprising the CHWC. It was clear from this preliminary stage that the employment multipliers in *Econsearch I*, which were based on employment/output ratios in 1995, do not reflect adequately the impacts of technology. Modern sawmilling and veneer production have changed substantially in seven years and there is a need to update the *Econsearch I* I/O table to accommodate these. Revised E_i/Q_i 2002 ratios were calculated from data provided by FT and the revised ratios applied to the output (1) and (2) to give a set of employment equations of 2002 vintage. These revised employment multipliers were applied to changes in final demands in the way described in sections 3.1 and 3.2 and an updated set of employment impacts determined.

3.4 Determining the contribution of the CHWC project to unemployment in the Circular Head District

The output, total income and employment effects for each of the four activities comprising the CHWC are calculated in the way described and the focus of our methodology then shifts back to the issue of unemployment. This involves an assessment of the contribution the CHWC makes to a reduction of unemployment in Circular Head.

3.5 Cost Savings from the interdependent nature of the CHWC

An important characteristic of the CHWC project is its integrated nature. This is more evident in the case of the CHWC and Southwood developments than in relation to any previous timber processing development. The current sawmilling operation at Smithton and the two new components of the CHWC can be regarded as a single entity with each cost/profit centre linked. In terms of its technical structure, integration means that the single, physical, entity can operate on a more cost effective basis than its individual components. To demonstrate the cost effectiveness of the CHWC, the average (unit) cost of operating the CHWC in its entirety is compared with the average cost of operating each of its components individually. Costs savings are then determined in the following manner:

$$\text{Cost savings} = \sum_{i=1} \left[\left(\text{AFC}_i - \text{AFC}_T \right) \text{x TFC}_i \right] \quad (11)$$

Expression (11) captures an essential characteristic of the CHWC when compared with some earlier developments in Tasmanian forestry based on a single operation: for example, an individual sawmill or veneer plant. As already stated, the CHWC is comprised of an integrated wood processing activity so it may be viewed as a multi product firm potentially sharing a common resource, namely, timber. This would certainly create a case for cost savings from the sharing of fixed inputs. To capture at least some of the savings from the joint nature of production, the consultants believe it is appropriate to determine the extent of cost savings from the CHWC fixed costs across four integrated components. The spreading of fixed costs across a larger aggregated output is an issue about exploiting scale and scope economies only. These scale/scope economy cost savings are calculated according to expression (11) which suggests that CHWCs scale effects are the difference between AFC costs for each activity separately is expressed as the ratio TFC_i /$Output_i$ and TFC_i /Total Output CHWC multiplied by total fixed costs in each activity i (TFC_i).

The calculation of cost savings in each process i provides an answer to a very specific question: what are the cost advantages inherent in an integrated project such as the CHWC compared with the operation of single entities such as individual saw mills or veneer plants?

It is tempting also to argue that the CHWC project is capable of providing major savings in the form of scale/scope economies as defined above. The consultants believe that scope economies do exist in the CHWC project and Tasmanian forestry in general, but the identification of these is complex and requires more detailed analysis.[1] A warning word is appropriate here. It is easy to confuse the joint nature of forestry production with the "shared" nature of inputs which is the quintessential requirement for the existence of scope economies. Jointness in forestry production stems from the nature of a tree, which once harvested, provides several materials including saw logs, veneer logs and wood chips. These raw materials are jointly produced but some difficulty remains in interpreting the savings from the joint production of several input numbers with those savings created by scope economies. The argument for interpreting joint production cost savings as scope economies is strengthened if a single contractor/owner operates a multi product complex. For these reasons, the analysis of costs savings is confined to the scale/scope effects flowing from the spreading of fixed costs across a complex of products.

3.6 The Construction Phase of the Project

The expenditures on the construction of the various facilities comprising the CHWC project are also indicated on Table 1. These were also provided by FT and are used to estimate output, wage and job effects, but in this case are confined to the impacts in the twelve month construction period. Again the updated employment/output ratios provided by FT are applied to determine employment impacts.

It should be emphasised that construction effects endure for the length of the construction period only in comparison with impacts occurring in the wood centre which are annual effects spread across the life of the project. This life cycle could be as long as fifty years. The 12 month to 18 month construction period is a vital period for employment in the construction industry. However, output, wage income and total income (GSP) effects are of less interest, so the results reported in Section 4 are confined to employment impacts.

3.7 Data Set

The structure of the CHWC complex indicated on chart one comes to life commercially in the sales, turnover and construction expenditure figures recorded on Table 1.

[1] For a detailed account in relation to Scope Economies in Banking, see the study by Huang (1999).

Table 1: Construction Expenditure and Turnover Associated with the Establishment of the CHWC

$million

	Merchandising Yard	Veneer Plant	Total
Construction Cost $ mill (current prices)	1.690	24.482	26.172
Revenue $ mill. p.a.	18.672	29.250	47.922
Staff No FTE p.a.	9.0	100	109
Revenue $ mill p.a. (constant '95 prices)	16.678	26.125	42.803
Employment(1) Output Ratio 2002	0.0005	0.0038	0.0025
Fixed Costs($ mill) p.a	0.746	7.378	8.124

(1) Staff No constant value of revenue. Source: Forestry Tasmania

The economic contribution of the CHWC is confined to the major additional components at Smithton, notably, the peeled rotary veneer plant and the merchandising yard. The smaller effect which may flow from the expansion of the wood supply to the Smithton sawmill are excluded.

The individual project construction costs in current prices are recorded in the first row of Table 1 and $ 26.172 million requires an investment of $1.690 million in the construction of the merchandising yard and $ 24.482 million in the establishment of the rotary veneer plant. These construction costs are converted into constant 1995 prices to assess the job creation effects occurring in the construction industry.

The second row of Table 1 indicates the annual flow of revenues generated by the two new individual activities comprising the CHWC. Note that it is these current price values of revenue which are taken as the basis for calculating the total output, wage and total income effects of he CHWC in each of its new activities and in total they amount to $47.922 million p.a. Revenue flows represent the change in final demand for the output of each activity. The third row provides the full-time equivalent direct employment involved in each of the two new CHWC operations. So the direct employment effect sums to 109 fte jobs. Constant price (30th June 1995, CPI Hobart) values of revenue flows are shown in the fourth row of Table 1 and are calculated in the following manner:

$$\text{Current Price Revenue x} \frac{\text{CPI (Hobart; June '95)}}{\text{CPI Hobart (31.12.2001)}}$$

These output flows sum to an annual effect of $ 42.803 million. The output flows from the merchandising yard and the veneer plant act as proxies for the change in final demand in determining employment effects.

The final row of Table 1 shows the 2002 employment/output ratio in the two new activities comprising the CHWC. This is calculated by dividing the staff number in row 3 by the real value of output in row 5 and is employed to recalibrate the input coefficient table. The output equations of the I/O model are multiplied by the relevant E_i / Q_i and the resulting, modified I/O table is inverted to yield an updated set of employment multipliers which, as explained previously, more accurately reflect current technologies in timber production. The last element of data relate to the fixed and variable costs of operating the two new components of the CHWC are shown in the last row of Table 1. These are used to assess any savings from the jointness in production of the project.

4. RESULTS

The outcomes of this study are discussed in sequence and begin with an analysis of output and total income effects. Then employment impacts are discussed in detail and the relative importance of jobs created in the Circular Head district put into its appropriate context. Finally, the potential of the project to make cost savings by exploiting jointness in production is also discussed.

4.1 Output, Total and Wage Income Effects

The total output and total income impacts of he CHWC complex are indicated on Table 2. These outcomes were determined by applying the multipliers of the I/O model to the changes in final demand for the output of the seven activities comprising he CHWC. These appear as the current price values of total revenues recorded in the second row of Table 1. Both new CHWC activities are classified as timber processes and the relevant multipliers for industry 7 (Timber Processing) are applied to these final demands. The total output and total income effects in both new CHWC activities are reported on Table 2. The results are also disaggregated by I/O industry, so the impacts on each of the eleven I/O industries can be determined. The effects in the timber processing industry approximate the DIRECT effects of the new development while the effects in the ten remaining industries are referred to as the INDIRECT effects. These are identified in penultimate rows of Table 2, while the last row reveals the indicative Type I summary multipliers for output and total income.

The total effect of the CHWC complex when completed is to add $70.994 million to the value of Tasmania's production (output). The DIRECT effects felt in the timber processing industry amount to $37.827 million, while the INDIRECT or flow on effect in the 10 remaining I/O industries amounts to $33.167 million. There are no surprises in this analysis of second round flow on (INDIRECT) effects. The forest industries which supply the CHWC with raw material receive a production boost of $27.164 million while the remaining sectors are boosted by $5.95 million p.a.

Table 2: CHWC: Output and Total Income, Effects:
Total and Individual Industry Impacts

Number	I/O Industry	Output Effect $ mill			Total Income Effect $ mill		
		Merch Yard	Veneer Plant	Total	Merch Yard	Veneer Plant	Total
1	Agriculture	0.104	0.164	0.269	0.313	0.409	0.804
2	Forestry	10.584	16.580	27.164	7.047	11.040	18.087
3	Fishing	0.064	0.101	0.166	0.245	0.385	0.630
4	Mining	0.608	0.953	1.562	0.417	0.653	1.071
5	Food & Bev Processing	0.125	0.196	0.322	0.379	0.595	0.975
6	Mineral Processing	0.251	0.393	0.644	0.182	0.285	0.467
7	Timber Processing	14.738	23.088	37.827	9.804	15.359	25.164
8	Other Manufacturing	0.136	0.214	0.351	0.219	0.343	0.562
9	Const & Utility	0.754	1.182	1.936	0.625	0.979	1.604
10	Public Service	0.009	0.014	0.024	0.125	0.196	0.321
11	Private Tertiary	0.262	0.411	0.673	0.603	0.944	1.547
Total		**27.642**	**43.301**	**70.944**	**19.963**	**31.273**	**51.237**
DIRECT		14.738	23.088	37.827	9.804	15.359	25.164
INDIRECT		12.903	20.213	33.117	10.158	15.914	26.073
Total		**27.642**	**43.301**	**70.944**	**19.963**	**31.273**	**51.237**
IMPLIED TYPE I MULTIPLIER			1.88			2.03	

The total income effects assess the <u>value added</u> by the CHWC project to Tasmania's Gross State Produce (GSP) or total income. The GSP multipliers are also generated by the I/O model. The total effect is less than the effect on output which includes intermediate sales from one industry to another in the I/O structure of the economy. GSP from the production side is the sum of all industry value added and excludes intermediate sales/purchases. GSP measured in this way is recorded at factor cost and not market prices.

Total income (GSP at factor cost) is the recognised measure of regional economic activity and is valued for Tasmania in its entirety currently at approximately $11.2 billion. The CHWC project's contribution to GSP then is $51.237 million per annum, which means it will expand the economy by a sustained 0.46 percent per annum. This is a substantial contribution to the Tasmanian economy in comparison with other recent developments.

4.2 Employment Effects

The job creating effects of the CHWC project warrant separate emphasis because jobs effects are often of greatest significance in the public debate about Forestry. Further, a substantial effort has been made to determine jobs effects. The whole I/O mathematical modelling structure has been revised to capture the significant fall in employment/output ratios which has occurred as a result of technical changes to the timber processing industry. The methodology applied to determine employment effects resemble the formulas applied to determine output and total income effects. The difference in this case is that the change in final demands for each of the two additional CHWC outputs is the constant dollar value of annual revenue shown as row 4 of Table 1. The revised employment multipliers, updated for technical change, are applied to these constant dollar final demands. The employment multipliers for Industry 7 (Timber Processing) are applied to the constant dollar final demands for the two additional CHWC processes. The breakdown by industry and total employment impacts are shown on Table 3. From Table 3, the CHWC project will create 109 full time equivalent jobs DIRECTLY. The following breakdown in DIRECT job creation applies: 9 jobs in the Merchandising Yard and 100 in the Veneer Plant.

Table 3: CHWC Project: Employment Effects by Industry

and in Total: Job Numbers

Industry Sector		**Merchant Yard**	**Veneer Yard**	**Total (rounded)**
1	Agriculture	0.064	0.712	0.776
2	Forestry	6.462	71.909	78.272
3	Fishing	0.039	0.440	0.480
4	Mining	0.371	4.130	4.502
5	Food and Bev Processing	0.076	0.853	0.929
6	Mineral Processing	0.153	1.704	1.858
7	Timber Processing	8.999	99.996	108.996
8	Other Manufacturing	0.083	0.928	1.012
9	Construction and Utilities	0.460	5.119	5.580
10	Public Services	0.005	0.0645	0.070
11	Private Tertiary	0.160	1.780	1.940
Total Job Effect (rounded)		16.88	187.56	204.44
Total Indirect Job Effect (rounded)		7.88	87.56	95.44
Total Direct Job Effect		9	100	109

The INDIRECT flow on jobs effect in the ten remaining I/O industries amounts to 95 fte jobs. More than $26 million will be spent on the construction of the new CHWC facilities. The Construction phase of the project should not extend beyond 12 months and so a number of jobs will be created in this 12 month construction period. If the $26 million construction cost of the two additional CHWC projects is converted to constant 1995 dollars, then the inflation adjusted cost can be taken as the final demand for construction and utility services. The inflation adjusted final demand is $23.5 million. Applying the direct multiplier effect in industry (9) Construction and Utilities, the DIRECT employment effect in the Construction phase of the project is 49 construction jobs. These job effects do not extend beyond the construction period of the project.

4.3 Job Creation in the Circular Head District

By far the greater part of the direct jobs created by the CHWC project will be located in the Circular Head District. The jobs directly created by the CHWC after these adjustments is 109 directly. If these 109 direct jobs are removed from the latest labour force estimation by local government area unemployment, the unemployment rate in Circular Head will fall from 6.6 per cent to 4.8 per cent bringing Circular Head unemployment well below the Tasmanian average unemployment rate.

4.4 Cost Savings explained by the integrated nature of the CHWC

The CHWC can be regarded as an integrated production unit which means that some fixed cost savings are achievable as the scale and scope of operation are expanded. Presently each component of the existing operation at Smithton has an unavoidable fixed cost overhead associated with it. The output, average fixed cost(fixed cost/output) for the current operation and two additional components are shown on Table 4.

Table 4: CHWC: Output, Fixed Cost, Average Fixed Cost

Item	Revenue	Output(1)	Fixed Cost	AFC (2)
	$ million	$ million	$ million	$ million
Current operation	15.615	13.947	5.809	0.42
Merchandising Yard	18.672	16.678	0.746	0.05
Veneer Plant	29.250	26.126	7.378	0.28
Total	63.537	56.751	13.933	0.24

The effects of spreading fixed costs across a greater scale of output and range of production are evident on Table 4. The average fixed costs of present operation(42 cents) are absorbed into the overall fixed cost of the augmented wood centre which is 24 cents per unit of output. These fixed cost reductions are influenced partially by the very low average fixed costs experienced in the merchandising yard and small fixed cost evident in the peeled veneer plant when it is operating at its full capacity. These scale/scope effects stemming from the spreading of fixed costs across larger output flows are not likely to be the only cost savings available in the CHWC project.

5 IMPACTS ON THE EXISTING SAWMILLING INDUSTRY

The analysis to this point has been focussed on the job creation and Tasmania wide income effects of developing a rotary peeled veneer plant at Circular Head. In addition, the flow of timber resource flowing to the existing sawmills at Smithton also increases. From chart 2(c), it is clear that the existing sawmills will benefit from an additional resource flow 5,000 tonnes of sawlogs. The utilisation of this additional resource will create the effects shown on Table 5.

Table 5: Additional Economic Effects Explained by Sawmill Expansion at Smithton

Increased Turnover	$ 0.938 million ($16.551 million-$15.615 million)		
Economic Benefits	**Additional Jobs**	**Additional Output**	**Additional Total Income**
	3	$ million 1.389	$ million 1.003

The diversion of the timber resource to the existing sawmills at Smithton will create additional revenue of $938,000 per annum. The direct and indirect job effects amount to 3 new fte jobs in Smithton, $1.389 million additional output annually and creates additional statewide income of $1.003 million.

These economic benefits should be added to those created for the Circular Head District in paragraph 4.3 above.

6 SUMMARY

The potential of the CHWC project is evident in the following summary table 6, where the output, total income and jobs effects are summarised.

Table 6: CHWC: Summary of Economic Benefits

	Output $ million	**Total Income $ million**	**Direct +indirect Jobs No.**
Merchandising Yard	27.642	19.963	17
Veneer Plant	43.301	31.273	188
Expanded Sawmill Operation at Smithton	1.389	1.003	3
Total	72.332	52.239	208

The CHWC including the expansion of the existing sawmill operation at Smithton will lead to an increased output of $72.332 million, increased total income (GSP) of $52.239 million and will create 208 permanent full time equivalent jobs in Tasmania.

7 THE REQUIREMENT FOR FURTHER ANALYSIS

It follows that a further detailed analysis of cost savings is required because there are several aspects of forestry and timber processing which involved joint production. The first step in such an analysis is to identify among Tasmania's current public and private forestry industry operations these timber and other resource inputs which are shared by various timber producers because the property of "sharedness" provides the underpinnings of the theory about scope economies. It will be, surprising indeed, if Tasmania's forestry industry does not produce cost savings in the form of scope economies in relation to its utilisation of the timber resource. This follows from jointness in production, but we should note the close connection between joint production and scope economies.

> *"Although our definition of economies of scope does not correspond exactly to joint production in the Marshallian sense, we show in Section 1 that it precisely characterises the conditions which lead to the formation of multiproduct firms…"*

Panzar and Willig (1981, p.268)

The cost efficiencies which are achievable in the CHWC in the scope sense deserve a public airing in the ongoing process of community education about forestry. A most important aspect of forestry generally is its multi usage characteristic and the vital link between forestry and tourism. This is bound to emerge in an analysis of economic integration of the forestry industries.

REFERENCES

Panzar John C and Willig Robert D (1981), "Sustainability Analysis: Economies of Scope" *American Economic Review Papers and Proceedings* of the American Economic Association, 93rd Meeting, Denver Colorado, May, p.268-272.

Tai-Hsin Huang (1999), "A Paramatric Estimation of Bank Efficiencies using a Flexible Profit function with Panel Data", *Australian Economic Papers* 38(7), 422-445.

APPENDIX A – INPUT/OUTPUT MODEL

The first transactions table for *EconSearch One* was developed in 1990 from a survey conducted by honours students in economics with funds provided by the Department of Economics. The original model was designed to capture the resource-based nature of the Tasmanian economy, so a deliberate decision was taken to select 11 industry classifications which reflected these characteristics. The 11 industries established on the first table were: Agriculture, Forestry, Fishing, Mining, Food and Beverage, Mineral Processing, Timber Processing, Other Manufacturing, Construction and Utilities, Public Services and Private Tertiary Services. A household "industry" was added to close the model.

The model was rebuilt in 1994 from a further survey funded by Unitas Consulting and the Tasmanian Farmers and Graziers Association (TFGA) who were interested in the agricultural based nature of the first model.

Principles of I/O Models

The principles of input-output models are described briefly. The essential feature is that the output of any industry is not entirely sold on a market for the industry's product; some of it will be used by industries associated in the chain of production as an input for production; an example is the output of the Sheet Metal Industry which will be in large part purchased by motor vehicle and white goods manufacturers as input to the production of motor vehicles and refrigerators. There will be a number of these inter industry relationships which reduce the proportion of any individual industry's output allocated to a final demand. This statement is true of both "open" and "closed" versions of the input-output model but the closed version differs from the open model in a most important way; the closed model incorporates a household sector. This specific recognition of the Household sector allows for household output which is the value of labour services provided. Now we may think of the linear input-output model in terms of a set of equations, one for each of the 11 industries and one for households in the closed model as follows:

$$
\begin{aligned}
X_1 &= a_{11}X_1 + a_{12}X_2 + \ldots + a_{158}X_{58} + a_{12}W + F_1 \\
X_2 &= a_{21}X_1 + a_{22}X_2 + \ldots + a_{258}X_{57} + a_{12}W + F_2 \\
&. \\
&. \\
&. \\
X_{12} &= a_{12}X_1 + a_{12}X_2 + \ldots + a_{1212}X_{58} + a_{1313}W + F_{12} \\
W &= a_{121}X_1 + a_{122}X_2 + \ldots + a_{1313}X_{58} + a_{1313}W + F_{13}
\end{aligned} \qquad (1)
$$

This is a general expression of the *EconSearch One* closed model, where the x_i's are individual industry outputs on the left hand side of (1) and W is the output of the household sector. The a_{ij}'s are input-output coefficients which measure the proportion of industry i's output which is absorbed by industry j as an input into the production process for industry. Note also that some of the output of industry i is absorbed by the household sector in the production of household output, which is the value of the labour supplied. Once these intermediate uses of each industry's output are taken into account, two residual expressions F_1, F_2, are the final demands for the output of each industry and it is this we are concerned with throughout this study. The reader will note that (1) is a simultaneous system in the X_i's industry outputs and this system may be solved for the 12 x_i's and W. The only variables driving the system are the final demands for the output of the various industries. The coefficients C_i's associated with the solution of (1) are combinations of the input-output coefficients shown – the a_{ij}'s in the system (1).

$$
\begin{aligned}
X_1 &= C_{11}F_1 + C_{12}F_2 + \ldots + C_{113}F_{13} \\
X_2 &= C_{21}F_1 + C_{22}F_2 + \ldots + C_{213}F_{13} \\
&. \\
&. \\
&. \\
X_{12} &= C_{12}F_1 + C_{122}F_2 + \ldots + C_{1213}F_{13} \\
W &= C_{13}F_1 + C_{13}F_2 + \ldots + C_{1313}F_{13}
\end{aligned} \qquad (2)
$$

The coefficients a_{ij} in (1) are arranged in rows and columns and are derived from what is known as the "Transactions Table" and from this the computer will provide an array of numbers which are the C_{ij}'s above in (2) and appear as follows:

Table A-1: Solution Coefficients: Input-Output Model

Industry/Final Demand	F1	F2	F3	F4	F5
1	C_{11}	C_{12}	C_{13}	C_{14}	$C_{15...}$
2	C_{21}	C_{22}	C_{23}	C_{24}	$C_{25...}$
3	C_{31}	C_{32}	C_{33}	C_{34}	$C_{35...}$
4	C_{41}	C_{42}	C_{43}	C_{44}	$C_{45...}$
5	C_{51}	C_{52}	C_{53}	C_{54}	$C_{55...}$
6	C_{61}	C_{62}	C_{63}	C_{64}	$C_{65...}$

In other words, the solution formulae for the outputs of each industry may be arranged as an array of numbers shown in Table A-1 and from the rows and columns of this solution table we may derive the relevant multipliers required for this analysis. These numerical solutions provide the required set of output and employment multipliers.

The Total Output Multiplier for any of the input-output industries i is the total dollar increase in Tasmanian output that occurs as a result of an increase in the dollar value of the final demand for the output of industry. They may be calculated for each industry i as the sum of the coefficients in the i column of the solution table. To obtain the output effects for activity "Timber Processing", we simply multiply the final demands for the outputs of the 12 Tasmanian input-output industries affected by Timber Processing by the appropriate multiplier and sum all of these industry effects.

These output effects can be calculated from Tables such as Table A-1, which is simply an array of the coefficients in a system such as (2), but we cannot use these coefficients to determine employment impacts without further adjustment, because they do after all come from the solution of a system of output equations. However, these output equations can be converted into employment equations by multiplying each output equation by the industry's employment ratio $e_i = E_i/X_i$; this is the ratio of the number employed in each industry in 1995 to the value of output of the industry in that year. The employment impacts estimated in this study reflect the technology of production as it was at this time. This is a weakness of "static" input-output models of the kind applied here and any employment impacts observed in 2001 will not accommodate technical change, nor substantial shifts in relative prices. This limitation is addressed in the present study.

Multiplying each row by the relevant industry employment output ratio. This will provide us with a 12 X 12 matrix of employment multiplier: this product (C_{11})

(e_1) will give the impact of a $1 increase in the final demand for the output of industry 1 on employment in that industry. In order to obtain an estimate of the impact on Tasmanian employment of an increase in the final demand of a particular industry we multiply each employment multiplier derived in the way described by the change in final demand for that industry and sum the results. This provides employment generated by each industry affected by Timber Processing. The sum of all industry employment effects give an estimate of the employment effects statewide of any change in the demand for Timber Processing output.

The Wage Income effect for each industry i is the increase in wages income in the industry i as a result of the changes in final demands generated by expenditure on Timber Processing. This can be calculated for each industry by applying the wage bill/output ratio to each industry output impact.

Total Income includes in addition to the income distributed as wages, the income accruing to capital and other inputs used up in the production process. These total income effects are calculated by applying the total income/output ratio for each industry to the output effect for that industry. The sum of all these total income effects is the contribution of expenditure on Timber Processing or Tourism to the State’s “regional income”, otherwise labelled Gross State Product (GSP).