APPENDIX O

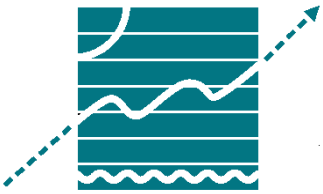
Economic impact assessment

New England Solar Farm
Economic Impact Assessment

Prepared for

EMM

By



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EXECUTIVE SUMMARY

UPC Renewables Australia Pty Ltd (UPC) proposes to develop the New England Solar Farm, a significant grid-connected solar farm and battery energy storage system (BESS) along with associated infrastructure, approximately 6 kilometres (km) east of the township of Uralla, which lies approximately 19 km south of Armidale in the Uralla Shire local government area (LGA) (the project).

The project is a State Significant Development (SSD) and an environmental impact statement (EIS) is a requirement of the approval process. This Economic Impact Assessment report forms part of the EIS.

While the project is located in the Uralla Shire LGA, the broader regional economy comprising Uralla Shire LGA, Tamworth Regional LGA and Armidale Regional LGA, has the potential to contribute to the project and derive economic benefits from both the construction and ongoing operation of the project.

The project will provide economic activity to the regional economy during both the construction and operation phase. It would also result in some contraction in regional economic activity from current sheep farming activity within the development footprint. These regional economic impacts were assessed using Input-Output analysis.

The peak construction year (Year 2) of the project is estimated to make up to the following total contribution to the regional economy:

- $408M in annual direct and indirect output;
- $159M in annual direct and indirect value added;
- $88M in annual direct and indirect household income; and
- 1,071 direct and indirect jobs.

Proportionally less impact would be felt in Year 1 and Year 3 of the construction phase of the project.

The project operation phase is estimated to make up to the following total annual contribution to the regional economy for 30 years:

- $86M in annual direct and indirect regional output or business turnover;
- $26M in annual direct and indirect regional value added;
- $3M in annual direct and indirect household income; and
- 39 direct and indirect jobs.

While there is a loss of agricultural activity to the region, this is a private economic decision made by the landholders for which they are compensated. The regional economic activity impacts of foregone agricultural activity are less than those of the construction and operation of the project. Therefore, as well as the private landholders being better-off than they were before, in terms of economic activity, the regional economy will also be better-off. Impacts on agricultural activity are for the term of the project and will not impact the capability of the land for future agricultural production.

UPC proposes to work in partnership with the Councils (i.e. Uralla Shire, Armidale Regional and Tamworth Regional) and the local community so that, as far as possible, the benefits of the projected economic growth in the region are maximised and impacts minimised. In this respect, a range of general economic impact mitigation and management measures are proposed and would include:

- Employment of regional residents where practicable – i.e. where they are motivated to work, have the required skills and experience and are able to adhere to occupational health and safety policies, construction and operations protocols and demonstrate a cultural fit with the relevant organisations.
- Participating, as appropriate, in business group meetings, events or programs in the regional community.
- Purchase local non-labour inputs to production, preferentially where local producers can be cost, terms and quality competitive, to support local industries.

Project design to enable continued grazing within the three array areas will minimise the level of agricultural impacts. It is noted that this will require landholders and UPC and its contractors involved in operations to reach agreement on the protocols for such grazing.

The proposed community benefits sharing initiative would contribute an annual payment that can be directed to a range of community infrastructures and programs.

1 Introduction

1.1 Overview

UPC Renewables Australia Pty Ltd (UPC) proposes to develop the New England Solar Farm; a significant grid-connected solar farm and battery energy storage system (BESS) along with associated infrastructure, approximately 6 kilometres (km) east of the township of Uralla, which lies approximately 19 km south of Armidale in the Uralla Shire local government area (LGA) (the project).

The project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). Therefore, a development application (DA) for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning (Minister), or the Minister's delegate, is the consent authority.

An environmental impact statement (EIS) is a requirement of the approval process. This Economic Impact Assessment report forms part of the EIS. It documents the economic impact assessment methods and results, the initiatives built into the project design to avoid and minimise economic impacts, and the additional mitigation and management measures proposed to address any residual impacts not able to be avoided.

1.2 Site description

The project will be developed within the Uralla Shire LGA. At its closest point, the project boundary is approximately 6 km east of the township of Uralla, and the northern array area starts approximately 8.6 km south of Armidale.

The project boundary, which is defined as the entirety of all the involved lots, encompasses a total area of 8,380 ha. The project boundary encompasses 61 lots, the majority of which have been modified by historical land use practices and past disturbances associated with land clearing, cropping and intensive livestock grazing. The properties within the project boundary are currently primarily used for sheep grazing for production of wool and lambs, with some cattle grazing for beef production.

The development footprint is the area within the project boundary on which infrastructure will be located. The development footprint encompasses a total area of 2,787 ha, which includes 1,418 ha within the northern array area, 625 ha within the central array area and 653 ha within the southern array area. Within the development footprint, approximately 1,000 ha will be required for the rows of PV modules. The remaining area is associated with power conversion units (PCUs), space between the rows, internal access tracks and associated infrastructure (including substations BESSs). The development footprint also includes land required for connection infrastructure between the three array areas as well as land required for new internal roads to enable access to the three array areas from the surrounding road network. Subject to detailed design and consultation with the project landholders, security fencing and creek crossings may be required on land outside of the development footprint, but within the project boundary.

The land within the project boundary is zoned RU1 Primary Production under the Uralla Local Environmental Plan 2012 (Uralla LEP).

The project is ideally located close to Transgrid's 330 kilovolt (kV) transmission line, which passes through the northern and central array areas. It also has access to the regional road network; including the New England Highway and Thunderbolts Way.

A number of local roads traverse the array areas and their surrounds, including Gostwyck Road; Salisbury Plains Road; The Gap Road; Carlon Menzies Road; Munsies Road; Saumarez War Service Road; Hillview

Road; Elliots Road and Big Ridge Road, and will provide access to the three array areas from the regional road network throughout the construction and operation of the project.

The primary site access points will be from The Gap Road, Salisbury Plains Road, Hillview Road, Munsies Road and Big Ridge Road.

1.3 Assessment guidelines and requirements

The Economic Impact Assessment was prepared in accordance with the requirements of the NSW Department of Planning and Environment (DPE), which are set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, dated 11 October 2018. The SEARs identify matters which must be addressed in the EIS. A copy of the SEARs is attached to the EIS as Appendix A, while Table 1.1 lists the individual requirements relevant to this Economic Impact Assessment and where they are addressed in this report.

Table 1.1 Relevant matters raised in SEARs

Requirement	Section addressed
Including an assessment of the likely social and economic impacts of the development (including the workers accommodation facility), paying particular attention to the:	
- local community;	Chapter 4 of this report.
- demand for provision of local infrastructure and services; and	Refer Section 5.12 and Appendix N of the EIS.
- benefits of the development for the State and region.	Refer Section 5.12 and Appendix N of the EIS.

To inform preparation of the SEARs, DPE invited relevant government agencies to advise on matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs.

There are no economic assessment guidelines for solar farms.

1.4 Structure of the report

This report is structured as follows:

- Section 2 provides a description of the project;
- Section 3 provides an overview of the regional economy;
- Section 4 assesses the economic impacts of the project on the regional economy;
- Section 5 identifies measures to mitigate and manage economic impacts; and
- Conclusions are provided in Section 6.

2 Project Description

2.1 Overview

The project involves the development, construction and operation of a solar PV electricity generation facility, which consists of PV modules, inverters and associated infrastructure.

The development footprint incorporates the land required for the three solar array areas, up to three internal solar array substations and the grid substation, an associated battery and energy storage system (BESS) and operations and maintenance (OM) infrastructure including OM buildings, car parking facilities and other infrastructure. Security fencing will be placed within the project boundary. Electricity transmission lines between the three array areas will also be required. In addition, the project will require a new internal road network to enable access from surrounding local roads to the three array areas during construction and operations.

The project will have a targeted 'sent out' electricity generating capacity of up to 800 MW (AC) and up to 200 MW (AC) two-hour energy storage. The final number of PV modules within the development footprint will be dependent on detailed design, availability and commercial considerations at the time of construction.

Electricity generated by the project will be injected into the grid via TransGrid's 330 kV transmission line that traverses the northern and central array areas.

The infrastructure associated with the project will cover an area within the development footprint. During the preparation of the EIS, the development footprint within the project boundary has been refined on the basis of grid connection studies, environmental constraints identification and design of project infrastructure with the objective of developing an efficient project that avoids and minimises environmental impacts.

A construction accommodation village (CAV) for non-local construction employees may be established as part of the early stages of the project's construction. If constructed, the CAV may accommodate up to 500 workers (subject to demand).

2.2 Construction

2.2.1 Construction staging, duration and hours

Construction of the project will take approximately 36 months from the commencement of site establishment works to commissioning of the three array areas. It is anticipated that the project will be constructed in two stages.

Stage 1 will include complete construction of the northern array area including the grid substation and is anticipated to take approximately 25 months to complete.

Stage 2 will include complete construction of the central array area and southern array area and is anticipated to take approximately 20 months to complete. Stage 2 also includes the construction of the BESS, which is also anticipated to take approximately 20 months to complete.

Stage 2 will commence approximately 12 months after the commencement of site establishment works as part of Stage 1.

It should be noted that the exact timing of each stage, including the commencement of Stage 1, the commencement of Stage 2 and the subsequent duration of the overlap between the two stages will be determined during the contracting, detailed design and financing stage of the project following project

approval. Similarly, the overall duration of the project's construction will also be confirmed at this time once the preferred engineering and procurement contractor is selected and the detailed construction schedule is confirmed

Construction activities will be undertaken from 6am - 6pm Monday to Sunday. Exceptions to these hours may be required on limited occasions. Uralla Shire Council and surrounding landholders will be notified of any exceptions.

2.2.2 Construction workforce

The project will require a peak construction workforce of up to 700 people.

As part of Stage 1, a peak workforce of approximately 350 people may be required on-site. It is anticipated that the average construction workforce throughout the 25 month construction period for Stage 1 will be approximately 180 people.

As part of Stage 2, a peak workforce of approximately 650 people may be required on-site. It is anticipated that the average construction workforce throughout the 20 month construction period for Stage 2 will be approximately 290 people. It is noted that this assessment conservatively excludes any construction activities associated with the BESS and the associated workforce for that.

Stage 1 and Stage 2 overlap. The average annual construction workforce for years 1, 2 and 3 is 140, 515 and 193, respectively.

2.3 Operation

The operational lifespan of the project will be in the order of 30 years, unless the facility is re-powered at the end of the PV modules' technical life. The decision to re-power the plant will depend on the economics of solar PV technology and energy market conditions at that time. Should the PV modules be replaced during operations, the lifespan of the project may extend to up to 50 years. Throughout operations, a workforce of up to 15 FTEs will be required.

It is anticipated that the facility will require regular maintenance throughout its operational life. This will include the following ongoing tasks:

- site maintenance including:
  - vegetation maintenance;
  - weed and pest management;
  - fence and access road management;
  - upgrading drainage channels; and
  - landscaping;
- infrastructure maintenance including:
  - panel cleaning;
  - panel repair (if required); and
  - equipment, cabling, substation and communications system inspection and maintenance.

Regular light vehicle access will be required throughout operations. Heavy vehicles may be required occasionally for replacing larger components of project infrastructure including inverters, transformers

or components of the BESS. OM activities will typically be undertaken by specialist subcontractors and/or equipment manufacturers.

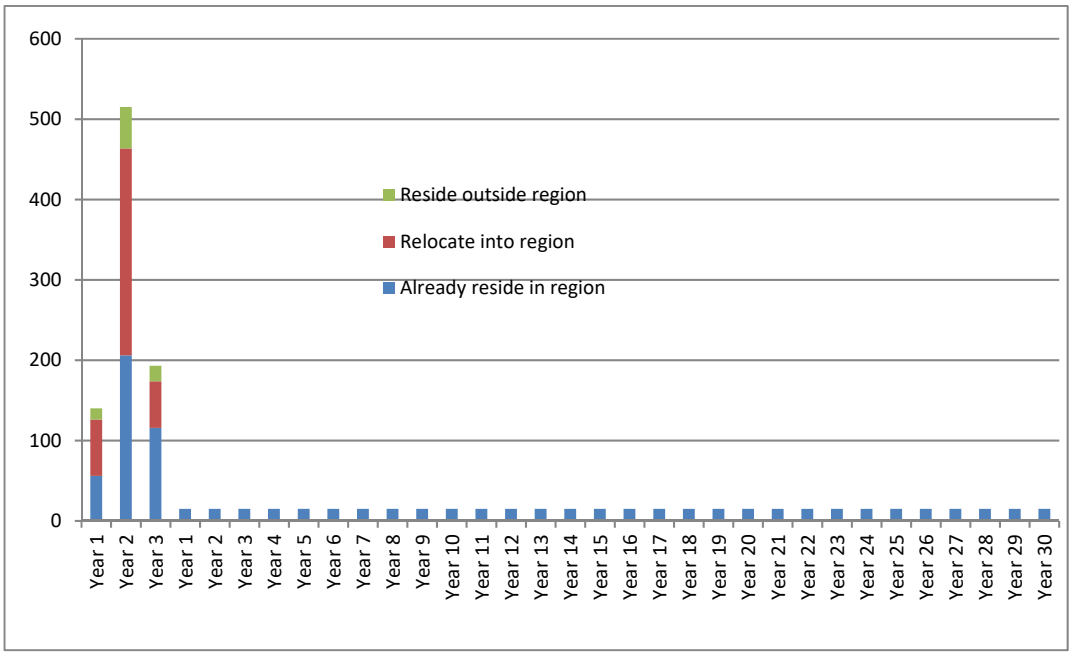
UPC is currently in discussions with a number of the landholders to enable sheep grazing to resume on portions of the three array areas following the completion of the construction of the project. A detailed protocol will be developed to ensure biosecurity is maintained and that grazing does not impact on the safe and efficient operation of the project or result in injury to farm workers or OM staff.

To ensure the optimal electricity production output for the project is maintained, the PV modules may need to be washed periodically to remove dirt, dust and other matter. Water for panel cleaning will be transported to the three array areas via water trucks. Washing will not require any detergent or cleaning agents.

The operational workforce will also be responsible for ongoing security monitoring of the three array areas and project infrastructure.

An indicative employment profile for the project based on the mean annual workforce throughout the life of the project is provided in Figure 2.1.

Figure 2.1 - Indicative Employment Profile (no.)



Source: UPC

2.4 Decommissioning

Once the project reaches the end of its investment and operational life, the project infrastructure will be decommissioned and the development footprint returned to its pre-existing land use, namely suitable for grazing of sheep and cattle, or another land use as agreed by the project owner and the landholder at that time.

Project decommissioning will require disturbance of the development footprint during the removal of equipment. A significant number of FTEs, including both staff and contractors, and vehicle movements will be required during the decommissioning stage of the project.

Any underground cabling below 500 mm will remain in-situ following project decommissioning.

UPC will attempt to recycle all dismantled and decommissioned infrastructure and equipment, where possible, and expects a secondary market for scrap may exist, including for example the steel in the piles and trackers and copper in the electrical cabling. Structures and equipment that cannot be recycled will be disposed of at an approved waste management facility.

3 The Regional Economy

3.1 Introduction

The project is located in the Uralla Shire LGA. However, the broader region including Tamworth Regional LGA and Armidale Regional LGA have the potential to contribute to the project and derive economic benefits from both the construction and ongoing operation of the project.

3.2 Characterisation of the region

Table 3.1 provides some characteristics of the usual residents of the three LGAs comprising the regional economy. In 2016, the regional economy had a population of 95,160 and a labour force of 43,725, with Tamworth Regional LGA being the largest. In 2016, there were 2,786 people unemployed with the majority of these located in Tamworth Region LGA although the unemployment rate was highest in Armidale Regional LGA.

The main occupations of usual residents was Professionals followed by Managers (which includes farm managers). The percentage of usual residents employed as Professionals was greatest in Armidale Regional LGA and Tamworth Regional LGA while the percentage of usual residents employed as Managers was greatest in Uralla Shire LGA.

Table 3.1 - Characteristics of Usual Residents

		Tamworth Regional		Armidale Regional		Uralla Shire		Total Region	
Demographics									
Population		59,663		29,449		6,048		95,160	
Median Age		40		36		46			
Unemployed	%	5.80%		7.70%		5.20%		6.37%	
	No.	1,609		1,032		145		2,786	
Youth Unemployment	%	12.23%		17.92%		14.33%		14.38%	
	No.	523		437		50		1,040	
In labour force		27,597		13,353		2,775		43,725	
Median household weekly income		1,180		1,173		900			
Unoccupied private dwellings	%	10.60%		13.40%		11.50%		11.52%	
	No.	2,580		1,588		297		4,465	
Median rent		260		250		200			
Occupations		**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Managers		3,399	13.1%	1,816	14.7%	499	19.0%	5,714	14.2%
Professionals		4,559	17.5%	2,865	23.3%	423	16.1%	7,847	19.5%
Technicians and Trades Workers		3,740	14.4%	1,373	11.1%	373	14.2%	5,486	13.6%
Labourers		3,678	14.1%	1,469	11.9%	368	14.0%	5,515	13.7%
Clerical and Administrative Workers		3,113	12.0%	1,524	12.4%	328	12.5%	4,965	12.3%
Community and Personal Service Workers		2,747	10.6%	1,426	11.6%	267	10.2%	4,440	11.0%
Sales Workers		2,557	9.8%	1,191	9.7%	204	7.8%	3,952	9.8%
Machinery Operators and Drivers		1,786	6.9%	497	4.0%	127	4.8%	2,410	6.0%

Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Community Profiles

The main industry sectors in which usual residents were employed in 2016 is provided in Table 3.2. Beef Cattle and Sheep Farming are significant industry sectors for residents of Uralla Shire LGA, while Hospitals and Higher Education are significant sectors of employment for residents of Tamworth Regional LGA and Armidale Regional LGA, respectively.

Table 3.2 - Top 5 Industry Sectors of Employment for Usual Residents

Tamworth Regional	No.	%	Armidale Regional	No.	%	Uralla	No.	%
Hospitals (except Psychiatric Hospitals)	1,382	5.3	Higher Education	1,242	10.2	Beef Cattle Farming (Specialised)	136	5.4
Secondary Education	767	3	Beef Cattle Farming (Specialised)	439	3.6	Higher Education	125	5
Supermarket and Grocery Stores	658	2.5	Hospitals (except Psychiatric Hospitals)	395	3.2	Sheep-Beef Cattle Farming	113	4.5
Beef Cattle Farming (Specialised)	629	2.4	Combined Primary and Secondary Education	360	2.9	Local Government Administration	98	3.9
Primary Education	616	2.4	Other Social Assistance Services	346	2.8	Sheep Farming (Specialised)	73	2.9

Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Community Profiles

An indication of the health of an economy can be gained from population changes. This theory of regional economic growth suggests that places that are able to attract population immigration create increased demand for goods and services and thus more jobs. This growth leads to increasing local multiplier effects, scale economies and an increase in the rate of innovation and capital availability (Sorensen, 1990). Conversely, population losses can contribute to a 'vicious cycle' of decline whereby reduced populations results in closure of services, which in turn makes it difficult to attract new populations (Sorensen, 1990).

Trends in regional economies of NSW as a result of globalisation and associated structural adjustment include:

- loss of significant industries such as abattoirs and timber mills from many rural areas;
- increased mechanisation of agriculture and aggregation of properties, resulting in loss of employment opportunities in this industry;
- growth of regional centres, at the expense of smaller towns;
- preference of Australians for coastal living, particularly for retirement; and
- preference of many of today's fastest growing industries for locating in large cities (Collits 2000).

The result is that there has been declining population in many rural LGAs that are located in non-coastal areas in NSW. There has also been a decline in the population of smaller towns even in regions where the population has been growing.

Against this backdrop, it is evident that the population of the region has grown relatively strongly, at a rate of 9.5% since 2006. This growth has been strongest in Tamworth Regional LGA.

Table 3.1 - Population growth

	2006	2011	2016	Growth 2006 - 2016	Growth 2011 - 2016	Growth Rate 2006 - 2016
Tamworth Regional	53,590	56,292	59,663	5.0%	6.0%	11.3%
Armidale Regional	27,597	28,502	29,449	3.3%	3.3%	6.7%
Uralla	5,734	6,034	6,048	5.2%	0.2%	5.5%
Total Region	**86,921**	**90,828**	**95,160**	**4.5%**	**4.8%**	**9.5%**
NSW	**6,549,177**	**6,917,658**	**7,480,228**	**5.6%**	**8.1%**	**14.2%**

Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Community Profiles

DPE population forecasts for the three LGAs are given in Table 3.2. This suggests continued population growth, predominantly driven by Armidale Regional LGA and Tamworth Regional LGA.

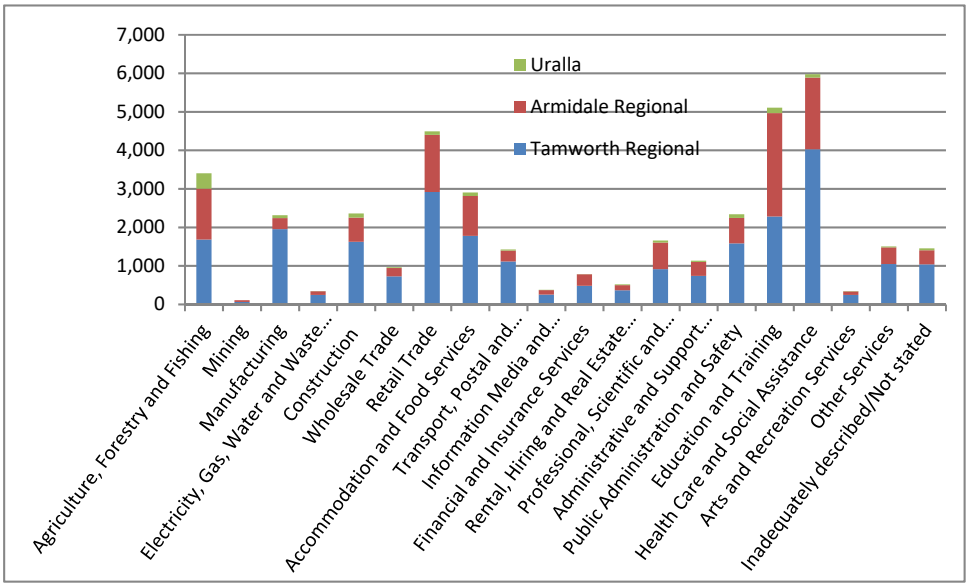
Table 3.2 - Population growth rate projections

	2016 to 2021	2021 to 2026	2026 to 2031	2031 to 2036
Tamworth Regional	4.6%	3.9%	3.4%	3.0%
Armidale Regional	6.0%	5.4%	5.0%	4.5%
Uralla	1.6%	0.8%	0.8%	0.0%
Total Region	4.8%	4.2%	3.8%	3.3%

Source: NSW Department of Planning and Environment, 2016 NSW population and household projections.

An indication of the nature of the regional economy can be gained by examining place of work employment by industry data - refer to Figure 3.1. This indicates the significance of the Health Care and Social Assistance, Education and Training, Retail Trade and Agriculture, Forestry and Fishing sectors.

Figure 3.1 - Place of work employment by industry



Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Working Population Profiles

Gillespie Economics has also produced an Input-Output (IO) table for the regional economy using the Generation of Regional Input Output Tables (GRIT) procedure developed by the University of Queensland and recognised internationally - Refer to Attachment 1. The Gross Regional Product (GRP) of the regional economy was estimated at $5,293 million for 2018.

The region is a net importer, with exports out of the region of $1,961 million and imports into the region of $3,343 million. Using the IO industry classifications, the largest exporting industries by value are:

- Meat and Meat Product Manufacturing ($503M);
- Sheep, Grains, Beef and Dairy Cattle Farming ($380M);
- Finance ($110M); and,
- Technical, Vocational and Tertiary Education ($109M).

Exporting sectors are considered to be key drivers of economies that are based on a region's endowments and competitive advantages.

Conversely, the largest importing industries in the region are:

- Sheep, Grains, Beef and Dairy Cattle Farming ($194M);
- Construction Services ($160M);
- Wholesale Trade ($102M); and
- Professional, Scientific and Technical Services ($91M).

The following analysis uses the IO table data but reports the findings in terms of both the IO industry classifications and the ANZSIC One digit industry classification.

Using the IO industry classifications, in terms of value-added, it is estimated that Retail Trade; Sheep, Grains, Beef and Dairy Cattle Farming; Health Care Services; Finance; and Technical, Vocational and Tertiary Education Services had the highest value added in total, equal to approximately 27% of the regional economy and 34% of regional employment - Table .4.[1]

Table 3.4 - Gross Value Added for the 5 Largest Industries in the regional economy (IO Sectors)

Industry	Gross Value Added ($m)	Proportion of Regional Economy (%)	Proportion of Regional Employment (%)
Retail Trade	313	5.9	11.8
Sheep, Grains, Beef and Dairy Cattle Farming	305	5.8	6.7
Health Care Services	283	5.3	9.1
Finance	268	5.1	1.3
Technical, vocational and tertiary education services	264	5.0	4.8

Source: Gillespie Economics Input-Output Table

Based on the ANZSIC One digit industry classification, in terms of value-added, it is estimated that Health Care and Social Assistance; Education and Training; Agriculture, Forestry and Fishing; Rental, Hiring and Real Estate Services; and Construction had the highest value added in total, equal to approximately 43% of the regional economy and 46% of regional employment - Table 3.5.

[1] Gross Value Added (GVA) measures the value of goods and services produced in a region.

Table 3.5 - Gross Value Added for the 5 Largest Industries in the regional economy (ANZSIC One Digit Sectors)

Industry	Gross Value Added ($m)	Proportion of Regional Economy (%)	Proportion of Regional Employment (%)
Health Care and Social Assistance	503	9.5	15.7
Education and Training	495	9.4	13.5
Agriculture/Forestry/Fishing	479	9.1	8.9
Retnal, Hiring and Real Estate Services	474	9.0	1.3
Construction	349	6.6	6.2

Source: Gillespie Economics Input-Output Table

4 Regional Economic Impacts

4.1 Introduction

The project would provide economic activity to the regional economy during both the construction and operation phase. It would also result in some contraction in regional economic activity from current sheep farming activity within the development footprint. These regional economic impacts are assessed using IO analysis.

4.2 Input-Output Analysis

IO analysis essentially involves two steps:

- Construction of an appropriate IO table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each existing sector of the economy; and
- Identification of the impact or stimulus of the project (construction/operation of the project and reduced sheep farming) in a form that is compatible with the IO equations so that the IO multipliers and flow-on effects for the impacts or stimulus of the project can then be estimated (West, 1993).

The IO method is based on a number of assumptions that are outlined in Attachment 2. Most notably IO analysis assumes that the regional economy has access to sufficient labour and capital resources (from both inside and outside the region) so that an individual project does not result in any regional price changes e.g. wages in other industries or house rentals, which would lead to contractions ("crowding out") of economic activity in other sectors in the same region. Any "crowding" out is assumed to occur outside the region where the project is concentrated and the regional impact analysis is focused. A dynamic computable general equilibrium modelling approach may overcome the limitation of IO analysis but is unlikely to be warranted at local or regional scale or with small scale impacts.

The consequence of the assumptions of IO analysis, is that IO modelling results provide an upper bound economic activity impact estimate. Notwithstanding, it provides some indication of relative positive and negative impacts.

IO analysis identifies the economic activity of a project on the economy in terms of four main indicators:

- Gross regional output – the gross value of business turnover;
- Value-added – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output. These costs exclude income costs;
- Income – the wages paid to employees including imputed wages for self employed and business owners; and
- Employment – the number of people employed (including self-employed, full-time and part-time).

As well as providing an indication of gross economic activity in a region, economic activity analysis can have important links to social impact assessment since changes in income and employment levels can impact population levels and their ability to maintain community infrastructure (schools, hospitals, housing etc), broader community and cultural value systems and inter-relationships.

4.3 Construction Phase

4.3.1 Introduction

Economic activity associated with the project construction is estimated to mainly occur within three sectors of the economy:

- the *heavy and civil engineering construction sector* which includes businesses involved in road construction, substation construction, pile installation, PV tracker and module installation, etc.;
- the *construction services sector* which includes businesses involved in site preparation services, concreting services, structural steel erection services, electrical services, hire of construction machinery with operator etc;
- the *electrical equipment manufacturing se*ctor which includes the manufacturing of electricity transmission equipment, transformers etc

4.3.2 Impact on Regional Economy

Given the largely specialist nature of capital equipment and the relatively small size of the regional economy, for the purpose of this analysis a conservative assumption is made that all such purchases are made outside the regional economy. Thus, regional economic activity from the project construction phase primarily relates to the *heavy and civil engineering construction sector* and *construction services sector*.

The average annual construction workforce required for the project during construction is estimated at 140 in year 1, 515 in year 2 and 193 in year 3. Based on the IO coefficients of the combined *heavy and civil engineering construction sector* and *construction services sector* in the regional economy IO transactions table, the level of expenditure required in these sectors to generate this level of employment is $64M, $236M and $89M, respectively.

The direct and indirect regional economic impact of this level of expenditure in the local and regional economy is reported in Tables 4.1, 4.2 and 4.3. See Section 4.3.3 for an explanation of Type 11A Ratio multipliers.

Table 4.1 - Economic Impacts of the Construction Workforce on the Regional Economy (Year 1)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*	ADJUSTED TOTAL EFFECT
OUTPUT ($M)	64	37	22	59	123	111
Type 11A Ratio	*1.00*	*0.57*	*0.34*	*0.91*	*1.91*	*1.73*
VALUE ADDED ($M)	23	15	13	28	50	43
Type 11A Ratio	*1.00*	*0.67*	*0.56*	*1.23*	*2.23*	*1.91*
INCOME ($M)	13	8	6	14	27	24
Type 11A Ratio	*1.00*	*0.65*	*0.43*	*1.09*	*2.09*	*1.85*
EMPL. (No.)	140	106	102	208	348	291
Type 11A Ratio	*1.00*	*0.76*	*0.73*	*1.49*	*2.49*	*2.08*

Note: Totals may have minor discrepancies due to rounding.

Table 4.2 - Economic Impacts of the Construction Workforce on the Regional Economy (Year 2)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*	ADJUSTED TOTAL EFFECT
OUTPUT ($M)	236	136	80	216	452	408
Type 11A Ratio	*1.00*	*0.57*	*0.34*	*0.91*	*1.91*	*1.73*
VALUE ADDED ($M)	83	55	47	102	185	159
Type 11A Ratio	*1.00*	*0.67*	*0.56*	*1.23*	*2.23*	*1.92*
INCOME ($M)	48	31	21	52	99	88
Type 11A Ratio	*1.00*	*0.65*	*0.43*	*1.09*	*2.09*	*1.85*
EMPL. (No.)	515	389	377	766	1,281	1,071
Type 11A Ratio	*1.00*	*0.76*	*0.73*	*1.49*	*2.49*	*2.08*

Note: Totals may have minor discrepancies due to rounding.

Table 4.3 - Economic Impacts of the Construction Workforce on the Regional Economy (Year 3)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*	ADJUSTED TOTAL EFFECT
OUTPUT ($M)	89	51	30	81	169	153
Type 11A Ratio	*1.00*	*0.57*	*0.34*	*0.91*	*1.91*	*1.73*
VALUE ADDED ($M)	31	21	17	38	69	60
Type 11A Ratio	*1.00*	*0.67*	*0.56*	*1.23*	*2.23*	*1.91*
INCOME ($M)	18	12	8	19	37	33
Type 11A Ratio	*1.00*	*0.65*	*0.43*	*1.09*	*2.09*	*1.85*
EMPL. (No.)	193	146	141	287	480	402
Type 11A Ratio	*1.00*	*0.76*	*0.73*	*1.49*	*2.49*	*2.08*

Note: Totals may have minor discrepancies due to rounding.

In estimating the total regional impacts, it is important to separate the flow-on effects that are associated with firms buying goods and services from each other (production-induced effects) and the flow-on effects that are associated with employing people who subsequently buy goods and services as households (consumption-induced effects). This is because these two effects operate in different ways and have different spatial impacts.

Production-induced effects occur in a near-proportional way within a region, whereas the consumption-induced flow-on effects only occur in a proportional way if workers and their families are located in the region or migrate into the region. Where workers commute from outside the region, some of the consumption-induced flow-on effects leak from the region. This is already accounted for in the modelling as 10% of workers are expected to commute into the region which is similar to the proportion of labour in the combined construction sectors that commute from outside the region. However, if in-migrating workforce do not have spending pattern similar to existing residents then some reduction in estimate consumption induced flow-ons would occur. For modelling purposes, it is assumed that 50% of construction workforce migrate into the region and reside in the CAV. Consequently, adjustment is made to the total effect to conservatively assume that the wages of these workers leak from the region.

The peak construction year (Year 2) of the project is estimated to make up to the following total contribution to the regional economy:

- $408M in annual direct and indirect output;
- $159M in annual direct and indirect value added;
- $88M in annual direct and indirect household income; and

- 1,071 direct and indirect jobs.

Proportionally less impact would be felt in Year 1 and Year 3 of the construction phase of the project as indicated in Tables 4.1 and 4.3.

4.3.3 Multipliers

Multipliers are summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from IO analysis (refer to Attachment 2). Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.

The Type 11A ratio multipliers for the construction workforce of the project range from 1.73 for output up to 2.08 for employment.

4.3.4 Main Sectors Affected

The IO analysis indicates that construction is most likely to directly impact the heavy and civil engineering construction sector and construction services sector. Flow-on impacts from the construction of the project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added, income and employment flow-ons are likely to be *heavy and civil engineering construction*, *construction services, professional, scientific and technical services, wholesale and retail trade, food and beverage services and road transport*.

4.4 Operation Phase

4.4.1 Introduction

For the analysis of the operational phase of the project, a new project sector was inserted into the regional IO table reflecting average annual operation. The revenue and expenditure data for the new sector were obtained from financial information provided by UPC. For this new sector:

- the estimated gross annual revenue was allocated to the *Output* row;
- the estimated wage bill of those residing in the region was allocated to the *household wages* row, with any remainder allocated to *imports*;
- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added*;
- allocation was then made between *intermediate sectors* in the local economy and *imports* based on advice from UPC and regional location quotients;
- purchase prices for expenditure in each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the National IO Tables;
- the difference between total revenue and total costs was allocated to the *other value-added* row*;* and
- direct employment that resides in the region was allocated to the *employment* row.

The main expenditures accruing to the region relate to wages, equipment hire, vegetation maintenance, the proposed community benefit sharing initiative (refer to Section 4.6 of the EIS) and lease payments to project landholders. It was conservatively assumed that lease payments to project landholders were not reinvested in the region.

4.4.2 Impacts on the Regional Economy

The total and disaggregated annual impacts of the project on the regional economy (in 2018 dollars) is shown in Table 4.4.

Table 4.4 - Annual Economic Impacts of the Project on the Regional Economy ($2018)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	80	4	3	6	86
Type 11A Ratio	*1.00*	*0.05*	*0.04*	*0.08*	*1.08*
VALUE ADDED ($'000)	22	2	2	3	26
Type 11A Ratio	*1.00*	*0.07*	*0.07*	*0.14*	*1.14*
INCOME ($'000)	2	1	1	2	3
Type 11A Ratio	*1.00*	*0.43*	*0.37*	*0.80*	*1.80*
EMPL. (No.)	15	11	13	24	39
Type 11A Ratio	*1.00*	*0.71*	*0.87*	*1.58*	*2.58*

Note: Totals may have minor discrepancies due to rounding.

The project is estimated to make up to the following total annual contribution to the regional economy for 30 years:

- $86M in annual direct and indirect regional output or business turnover;
- $26M in annual direct and indirect regional value added;
- $3M in annual direct and indirect household income; and
- 39 direct and indirect jobs.

4.4.3 Multipliers

The Type 11A ratio multipliers for the project's impact on the regional economy range from 1.08 for output up to 2.58 for employment. Capital intensive industries such as solar farms tend to have a high level of linkage with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to a relatively high ratio multiplier for employment. A lower ratio multiplier for income (compared to employment) also generally occurs as a result of comparatively higher wage levels in the project compared to incomes in the sectors that would experience flow-on effects from the project. Capital intensive projects also typically have a relatively low ratio multiplier for output and value-added reflecting the relatively high direct output and value-added compared to that in flow-on sectors.

4.4.4 Main Sectors Affected

Flow-on impacts from the project are likely to affect a number of different sectors of the local and regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be Agriculture, Forestry and Fishing Support Services, Rental and Hiring Services (except real estate); and Retail trade.

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment opportunities would be generated by the project (Table 4.5).

Table 4.5 - Sectoral Distribution of Annual Employment Impacts on the Regional Economy

	Local Economy			
Sector	**Average Direct Effects**	**Production-induced**	**Consumption-induced**	**Total**
Primary	15	4	0	19
Mining	0	0	0	0
Manufacturing	0	0	0	1
Utilities	0	0	0	0
Wholesale/Retail	0	1	4	4
Accommodation, cafes, restaurants	0	0	2	2
Building/Construction	0	0	0	0
Transport	0	1	0	1
Services	0	5	6	11
Total	**15**	**11**	**13**	**39**

Note: Totals may have minor discrepancies due to rounding.

Table 4.5 indicates that direct, production-induced and consumption-induced employment impacts of the project on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in primary and services sectors, while consumption induced flow-on employment would be mainly in wholesale/retail trade, accommodation/cafes/restaurants and services sectors.

Businesses that can provide the inputs to the production process required by the project and/or the products and services required by the workforce would directly benefit from the project by way of an increased economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

4.5 Agricultural Impacts

UPC advises that the land within the project boundary is predominantly used for sheep grazing. During construction, agricultural production within the development footprint will be limited. The total longevity of impacts to agricultural activities in each array area will be dependent on construction staging (refer Section 2.2.1 of this report). For the purposes of modelling, it is assumed that there is no agricultural activity during construction. However, this conservative assumption will overstate impacts.

UPC is currently in discussions with a number of the project landholders to enable sheep grazing to resume on portions of the three array areas following the completion of the construction of the project. This could reduce the limit on agricultural activity within the development footprint to approximately 1,600 ha.

Detailed revenue, expenditure and employment information related to sheep farming within the project boundary was not available. However, to gain an indication of the magnitude of the agricultural impact of the project, NSW Department of Primary Industries (DPI) gross margin budgets were examined. UPC identified that the land within the project boundary is predominantly used for sheep grazing for production of wool and lambs. The gross margin budget for "Merino ewes (20 micron) - Merino Rams, wether lambs finished", indicate revenues of approximately $748/ha.

Foregone revenue during construction and operation phase of the project is therefore in the order of $1.8M pa and $1.2M pa, respectively.

Using revenue, expenditure and employment ratios in the sheep, beef and dairy cattle sector of the regional IO table, the direct and indirect impact of this level of revenue is summarised in Tables 4.6 and 4.7.

Table 4.6 Annual Economic Impacts of Foregone Agriculture in the Construction Phase ($2018)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*
OUTPUT ($M)	2	1	0	1	3
Type 11A Ratio	*1.00*	*0.57*	*0.24*	*0.80*	*1.80*
VALUE ADDED ($M)	1	0	0	1	1
Type 11A Ratio	*1.00*	*0.69*	*0.37*	*1.05*	*2.05*
INCOME ($M)	0.2	0.2	0.1	0.3	0.5
Type 11A Ratio	*1.00*	*1.03*	*0.53*	*1.56*	*2.56*
EMPL. (No.)	6	3	2	5	11
Type 11A Ratio	*1.00*	*0.53*	*0.34*	*0.87*	*1.87*

Note: Totals may have minor discrepancies due to rounding.

Table 4.7 Annual Economic Impacts of Foregone Agriculture in the Operation Phase ($2018)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*
OUTPUT ($M)	1	1	0	1	2
Type 11A Ratio	*1.00*	*0.57*	*0.24*	*0.80*	*1.80*
VALUE ADDED ($M)	0	0	0	0	1
Type 11A Ratio	*1.00*	*0.69*	*0.37*	*1.05*	*2.05*
INCOME ($M)	0.1	0.1	0.1	0.2	0.3
Type 11A Ratio	*1.00*	*1.03*	*0.53*	*1.56*	*2.56*
EMPL. (No.)	4	2	1	3	7
Type 11A Ratio	*1.00*	*0.53*	*0.34*	*0.87*	*1.87*

Note: Totals may have minor discrepancies due to rounding.

The agricultural impacts of the project are in the order of 0.2% to 0.3% of agricultural activity in the region and hence are insignificant.

While there is a loss of agricultural activity to the region, this is a private economic decision made by the project landholders for which they are compensated. The regional economic activity impacts of foregone agricultural activity are less than those of the construction and operation of the project. Therefore, as well as the project landholders being better-off than they were before, in terms of economic activity, the regional economy will also be better-off.

Impacts on agricultural activity are for the term of the project and are not anticipated to impact the capability of the land for future agricultural production. Once the project reaches the end of its investment and operational life, the project infrastructure will be decommissioned and the development footprint returned to its pre-existing land use, namely suitable for grazing of sheep and cattle, or another land use as agreed by the project owner and the landholder at that time.

4.6 Impact of Construction Accommodation Village

The project includes an option to construct a CAV. This would enable the project to respond to insufficient capacity in the local accommodation markets to meet the construction accommodation requirements. Given that an accommodation capacity shortfall would result in economic costs on tourism and other activities and may lead to regional accommodation price rises, avoiding these effects are considered as regional economic benefits resulting from the CAV. The construction and operation of a CAV will also provide additional economic activity to the region from expenditure during its construction and expenditure in the region by those domiciled in the CAV.

If there is no accommodation shortfall and the CAV is constructed, the construction and operation of the CAV would see a redistribution of direct economic activity from existing accommodation providers to the CAV.

5 Mitigation and Management Measures

It is evident from Section 4 that construction and operation of the project will have net positive impacts on the level of economic activity in the regional economy.

UPC proposes to work in partnership with the Councils (i.e. Uralla Shire, Armidale Regional and Tamworth Regional) and the local community to help maximise the projected economic regional benefits whist minimising any impacts. In this respect, a range of general economic impact mitigation and management measures are proposed and would include:

- Employment of regional residents preferentially where they have the required skills and experience and are able to demonstrate a cultural fit with the organisation.
- Participating, as appropriate, in business group meetings, events or programs in the regional community.
- Locally source non-labour inputs to production where local producers can be cost and quality competitive, to support local industries.

Project design to enable continued sheep grazing within the three array areas will reduce the level of agricultural impacts throughout project operations.

The proposed community benefits sharing initiative would contribute an annual payment that can be directed to a range of community infrastructures and programs. Further information about this scheme is provided in Section 4.6 of the EIS.

6 Conclusion

The project will provide economic activity to the regional economy during both the construction and operation phase. It would also result in some contraction in regional economic activity from current sheep farming activity within the project boundary and, more specifically, the development footprint. These regional economic impacts were assessed using IO analysis.

The construction and operation of the project will have net positive impacts on the level of economic activity in the regional economy.

UPC proposes to work in partnership with the Councils (i.e. Uralla Shire, Armidale Regional and Tamworth Regional) and the local community so that, as far as possible, the benefits of the projected economic growth in the region are maximised and impacts minimised. In this respect, a range of general economic impact mitigation and management measures are proposed and would include:

- Employment of regional residents where practicable – i.e. where they are motivated to work, have the required skills and experience and are able to adhere to occupational health and safety policies, construction and operations protocols and demonstrate a cultural fit with the relevant organisations.
- Participating, as appropriate, in business group meetings, events or programs in the regional community.
- Purchase local non-labour inputs to production, preferentially where local producers can be cost and quality competitive, to support local industries.

Project design to enable continued sheep grazing within the three array areas will minimise the level of agricultural impacts throughout project operations.

The proposed community benefits sharing initiative would contribute an annual payment that can be directed to a range of community infrastructures and programs.

7 References

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ATTACHMENT 1 – THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). This means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A1.1 (Powell and Chalmers, 1995).

Table A1.1
The GRIT Method

Phase	Step	Action
PHASE I		ADJUSTMENTS TO NATIONAL TABLE
	1	Selection of national input-output table (1114-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
PHASE II		ADJUSTMENTS FOR REGIONAL IMPORTS
		(*Steps 4-14 apply to each region for which input-output tables are required*)
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
PHASE III		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
PHASE IV		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
PHASE V		DERIVATION OF FINAL TRANSACTIONS TABLES
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Bayne and West (1988).

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ATTACHMENT 2 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

1. "The *basic assumptions* in IO analysis include the following:

   - there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between IO tables for the same country over time have indicated that material input requirements tend to be stable and change but slowly; however, requirements for primary factors of production, that is labour and capital, are probably less constant);
   - all products of an industry are identical or are made in fixed proportions to each other;
   - each industry exhibits constant returns to scale in production;
   - unlimited labour and capital are available at fixed prices; that is, any change in the demand for productive factors will not induce any change in their cost (in reality, constraints such as limited skilled labour or investment funds lead to competition for resources among industries, which in turn raises the prices of these scarce factors of production and of industry output generally in the face of strong demand); and
   - there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.

2. The multipliers therefore describe *average effects, not marginal effects*, and thus do not take account of economies of scale, unused capacity or technological change. Generally, average effects are expected to be higher than the marginal effects.

3. The IO tables underlying multiplier analysis only take account of one form of *interdependence***,** namely the sales and purchase links between industries. Other interdependence such as collective competition for factors of production, changes in commodity prices which induce producers and consumers to alter the mix of their purchases and other constraints which operate on the economy as a whole are not generally taken into account.

4. The combination of the assumptions used and the excluded interdependence means that IO multipliers are higher than would realistically be the case. In other words, they tend to *overstate* the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered.

5. The multipliers also do not account for some important pre-existing conditions. This is especially true of Type II multipliers, in which employment generated and income earned induce further increases in demand. The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.

6. The most *appropriate interpretation* of multipliers is that they provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy which arises solely from purchases and sales of industry output based on estimates of transactions occurring over a (recent) historical period. Progressive departure from these conditions would progressively reduce the precision of multipliers as predictive device" (ABS 1995, p.24).

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (ABS, 1995). Conventional output, employment, value-added and income multipliers show the output, employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

Components of the conventional output multiplier are as follows:

Initial effect - which is the initial output stimulus, usually a $1 change in output from a particular industry (Powell and Chalmers, 1995; ABS, 1995).

First round effects - the amount of output from all intermediate sectors of the economy required to produce the initial $1 change in output from the particular industry (Powell and Chalmers, 1995; ABS, 1995).

Industrial support effects - the subsequent or induced extra output from intermediate sectors arising from the first round effects (Powell and Chalmers, 1995; ABS, 1995).

Production induced effects - the sum of the first round effects and industrial support effects (i.e. the total amount of output from all industries in the economy required to produce the initial $1 change in output) (Powell and Chalmers, 1995; ABS, 1995).

Consumption induced effects - the spending by households of the extra income they derive from the production of the extra $1 of output and production induced effects. This spending in turn generates further production by industries (Powell and Chalmers, 1995; ABS, 1995).

The *simple multiplier* is the initial effect plus the production induced effects.

The *total multiplier* is the sum of the initial effect plus the production-induced effect and consumption-induced effect.

Conventional employment, value-added and income multipliers have similar components to the output multiplier, however, through conversion using the respective coefficients show the employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

For employment, value-added and income, it is also possible to derive relationships between the initial or own sector effect and flow-on effects. For example, the flow-on income effects from an initial income effect or the flow-on employment effects from an initial employment effect, etc. These own sector relationships are referred to as ratio multipliers, although they are not technically multipliers because there is no direct line of causation between the elements of the multiplier. For instance, it is not the initial change in income that leads to income flow-on effects, both are the result of an output stimulus (Jensen and West, 1986).

A description of the different ratio multipliers is given below.

$$\text{Type 1A Ratio Multiplier} = \frac{\text{Initial + First Round Effects}}{\text{Initial Effects}}$$

$$\text{Type 1B Ratio Multiplier} = \frac{\text{Initial + Production Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11A Ratio Multiplier} = \frac{\text{Initial + Production Induced + Consumption Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11B Ratio Multiplier} = \frac{\text{Flow-on Effects}}{\text{Initial Effects}}$$

Source: Centre for Farm Planning and Land Management (1989).

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