

The Contribution of the Antarctic and Southern Ocean Sector to the Tasmanian Economy 2017-18



**A Report to the Department of State Growth
November 2018**

Wells Economic Analysis

This report is commissioned by the Department of State Growth. It undertakes an analysis of the economic contribution of work Antarctica and the Southern Ocean to the Tasmanian economy, in terms of gross value added and employment.

The Tasmanian Polar Network (the TPN) is a group of businesses and scientific organisations based in Tasmania that have a common focus on serving commercial and scientific activity in the Antarctic, sub-Antarctic and Southern Ocean.

The TPN is supported by the Tasmanian State Government through Antarctic Tasmania in the Department of State Growth.

Thanks to Karen Rees and Jane Eldershaw, Department of State Growth, and Richard Fader, Chair of the Tasmanian Polar Network, for their assistance with this project. The cooperation and assistance provided by the institutions and firms whose activities are summarised in this report, especially those who gave their time for interviews, is also gratefully acknowledged.

Wells Economic Analysis

PO Box 3091 West Hobart

Tasmania 7000

ABN 22 345 940 518

Tel 0400642839

lahuwell@bigpond.net.au

Executive Summary

Hobart is the centre for Australia's research effort in Antarctica, the sub-Antarctic islands and Southern Ocean.

The Antarctic and Southern Ocean (ASO) sector is likely to expand over the next five years as a result of infrastructure spending with consequent flow-on to Tasmanian activity. Reflecting growing international interest in Antarctica, there is also potential for Tasmanian suppliers to increase their involvement with provisioning and supply of equipment and services to international programs.

Since the last analysis of the ASO contribution to the Tasmanian economy (2015/16), there has been modest growth in the sector, with employment rising slightly in public-sector institutions. This survey differs from 2015/16 in that it offers a more comprehensive picture of the private-sector employment generated by public-sector ASO activity – at 223 full-time equivalents, the current estimate of employment generated by first-round suppliers is 65% larger than previously estimated.

2017/18 Results

Expenditure

- Public-sector ASO activity in Tasmania is almost all supported by out-of-state finance – grants from the Commonwealth government and international organisations. Spending by this sector comprises \$185.9m, or 2.5% of the General Government consumption spending in Tasmania. Alternatively, it comprises 0.64% of 2016/17 Gross State Product.
- Non-wage expenditure (excluding large capital items such as the RV *Nuyina*) in 2017/18 was \$120.2m, of which it is estimated that \$51.5m was spent in Tasmania.
- Spending by expeditioners and conference delegates make a significant contribution to the local economy, estimated to be \$6.5m in 2017/18.

Employment

The ASO sector is a major employer; in 2017/18 it employed 855 full-time equivalents, comprising 0.42% of the Tasmanian total; in 2015/16 it employed 0.38% of the Tasmanian total.

Wages

Employees in the ASO sector have relatively high incomes. In 2017/18 average compensation of FTE employees in the public ASO sector was \$130,814, 107% higher than the Tasmanian average.

Value Added

- Gross Value Added in public-sector ASO organisations was, in 2017/18, \$79.51m, or 11% of GVA in the Professional, Scientific and Technical Services sector in Tasmania. In 2015/16, it comprised 9% of GVA in this sector.
- Including GVA in the secondary sector which supplies public-sector organisations, ASO GVA is \$110.4m, or 0.38% of Tasmania's Gross State Product.

Contents

| | |
|--|----|
| 1. Antarctica and Tasmania | 4 |
| 2. Objective and limitations | 6 |
| 3. Comparison with earlier analyses | 11 |
| 4. ASO Employment, Wages and Value Added | 12 |
| 5. ASO Expenditure | 22 |
| 6. Variation Analysis | 23 |
| 7. References | 25 |
| 8. Sample questionnaires | 27 |

Tables

| | |
|--|----|
| 2.1 Public Sector ASO Institutions | 9 |
| 4.1.1 Sectoral Allocation of Tasmanian activity | 13 |
| 4.1.2 ASO Employment | 17 |
| 4.2.1 ASO Wages | 19 |
| 4.3.1 Gross Value Added in the ASO Public Sector | 20 |
| 5.1 Public Sector ASO Expenditures | 22 |

Figures

| | |
|-----------------------------------|----|
| 1.1 Real ASO Expenditure | 5 |
| 4.1.1 Employment: TPN and Non-TPN | 17 |

1. Antarctica and Tasmania

In recent years activity generated by research in the Antarctic and Southern Ocean (ASO) has become an important part of the Tasmanian economy. Many research institutions are based in southern Tasmania, while Hobart has become the base for Antarctic and ocean research vessels from Australia and France, and a provedore for Korean, Italian, American, Russian and Chinese Antarctic ships. Tasmanian companies also undertake longline fishing in sub-Antarctic waters.

ASO research has generated a diverse range of private-sector expertise in specialized manufacturing, maintenance and technical services which supply not only the Australian research effort but also that of other countries.

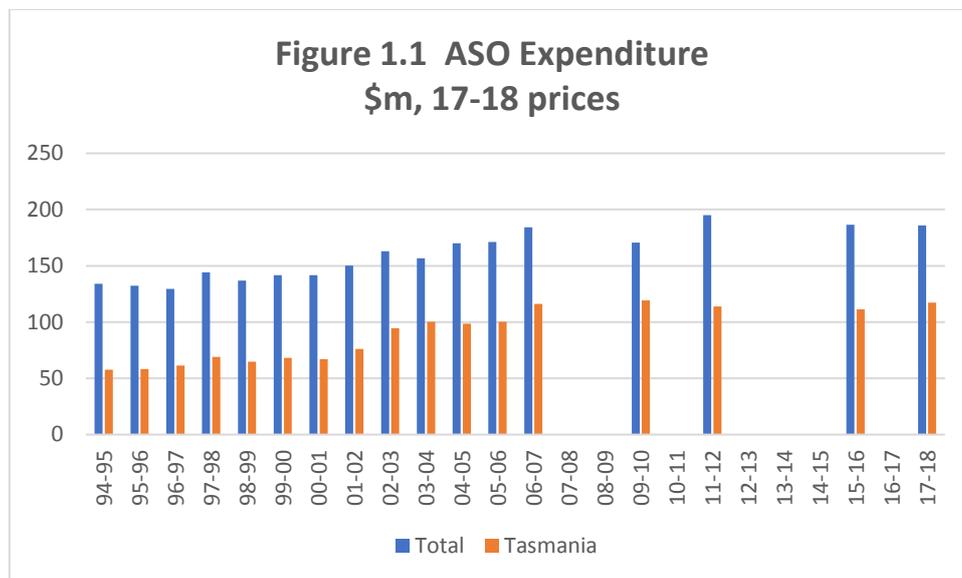
Physical infrastructure underpinning logistics support is provided by the Australian government, TasPorts, and the Hobart International Airport. Significant developments to cater for ASO activity have been, or are, underway:

- Two larger, purpose-built ships, the *Nuyina* and the *Investigator* have been purchased for, respectively, Antarctic supply and research, and for oceanographic research.
- TasPorts has recently upgraded the Macquarie No.2 berth to house the Australian Antarctic Division's provedoring centre. Strengthening of No. 5 and 6 berths is planned, in time for the arrival of the new supply and research ship, the *Nuyina*.
- In the medium term, it is proposed to consolidate Hobart's research and logistic support in an Antarctic precinct based at Macquarie Point.
- The Australian government has provided partial funding for a runway extension at the Hobart International Airport with capacity for larger aircraft such as RAAF C-17s to service Antarctica.
- The Australian Maritime College has completed a major research development for the design of underwater autonomous vehicles (UAVs) as part of the Antarctic Gateway Program.
- The Australian government has announced a \$50m upgrade to the Macquarie Island research station to be completed by 2021/22, much of which will impact on Tasmanian business.
- The Australian Antarctic Division plans to spend \$45m from 2017/18 to 2020/21 in establishing a traverse capability with mobile research stations in Antarctica.
- Development of a paved all-weather runway at Davis station is in the initial planning stage.

Support from all levels of government and the University of Tasmania has also played a crucial role in developing Hobart's endowment of globally significant research and teaching

infrastructure¹. This differentiates Hobart from other gateway cities such as Punta Arenas (Chile) and Ushuaia (Argentina), where the primary focus is on tourism.

As shown in Figure 1.1, real ASO spending by the public-sector institutions has remained unchanged in the two years since the 2015-16 survey, \$186m in real terms in both years. Real spending in Tasmania has, however, increased slightly, from \$111m to \$117m².



¹ The Australian Antarctic Division headquarters were established at Kingston, on the southern outskirts of greater Hobart, in 1981. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) established its permanent secretariat in 1982; The CSIRO Marine laboratories occupied their site on the Hobart waterfront in 1985; and the University’s Institute of Marine and Antarctic Studies was established in 2010.

² Sources for data in Figure 1.1. Data in the first half of the Figure refer to all ASO expenditure; from 2009-10 it only includes public-sector institutions. ASO data 1994/95 to 2006/07, (Tasmanian Polar Network and Tasmania Maritime Network (2008)), ASO data [public institutions only] 2009/10 to 2017/18, (surveys by Antarctic Tasmania, Blacklow Economic Consulting (2013) Table 2.9, Wells Economic Analysis (2017) and present report. Expenditure data are deflated by the ABS State Final Demand deflator.

2. Objectives and limitations

This report is intended to throw light on the following issues:

- (i) How much Tasmanian economic activity is associated with work in Antarctica, sub-Antarctica, and the Southern Ocean (ASO)?
- (ii) How much employment is generated by this activity?
- (iii) How do ASO productivity and incomes compare to their Tasmania-wide counterparts?
- (iv) How has ASO activity in Tasmania changed over time?

Measures of Activity

The focus is on two groups of activity measures for 2017/18.

The first group captures ASO activity in terms on National Accounting concepts. Gross Value Added (GVA), is a standard measure which corresponds to the production approach to measuring Gross State Product in the Australian Bureau of Statistics' National Accounts. This measure has several advantages. It is additive; summing GVA across all industries gives the more familiar measure of Gross State Product, or, at the national level, GDP.

The sum of expenditures provides an alternative approach to estimating Gross State Product. Symbolically,

$$C + I + G + X - M = \text{Sum of GVA in all industries} = \text{Gross State Product}$$

where the symbols have the following meaning:

| | |
|----------|------------------------------------|
| <i>C</i> | consumption spending by households |
| <i>I</i> | investment on new capital goods |
| <i>G</i> | spending by government |
| <i>X</i> | exports |
| <i>M</i> | imports |

Public-sector ASO spending is included in the 'G' component of expenditure – it captures a different aspect of the ASO sector than does GVA. The GVA approach provides a measure of productive activity, while the expenditure approach estimates the way in which the ASO sector adds to the demand for goods and services in the economy.

The second group of measures relate to the ASO workforce. Data for full time equivalent (FTE) employment, and the corresponding wage and salary bill, are estimated. As a measure of economic activity, employment has the advantage over value-added and expenditure measures that comparisons over time are unaffected by factors such as changes in prices or substantial changes in exchange rates.

Data Collection

Survey data for 2017/18, or for the 2017 calendar year, were collected from a number of sources. Although respondents were given the choice of reporting period, in accord with their respective accounting practices, all data in this report are reported as pertaining to the 2017/18 financial year.

(i) Public-sector primary organisations, listed in Table 2.1, were provided with a one-page questionnaire asking for details of revenue, expenditure and employment, along with an additional request to provide supplier lists so as to check the allocation of spending between Tasmanian and interstate/overseas purchases. The survey form, and requests for further information, was supplemented with face-to-face interviews. A sample of the survey form is provided on p.27 below.

The various components of CSIRO (Oceans and Atmosphere and MNF) provided only complete wage and employment data. Requests for disaggregated expenditure data were declined because the information was difficult to obtain or was regarded as commercial in confidence. Where possible, disaggregated data were imputed from public reports and telephone enquiries.

All other public-sector organisations provided detailed expenditure information.

(ii) Apart from the CSIRO, public-sector primary organisations provided comprehensive supplier lists for 2017/18. For most, these were consolidated and coded into two-sector ANZSIC categories by the author; IMAS performed this analysis in-house. Where necessary postcodes were obtained from an internet search and other information; these codes were used to classify expenditures into Tasmanian/Other and, as detailed later in this report, to estimate employment in non-TPN suppliers.

(iii) Fifty secondary organisations, members of the Tasmanian Polar Network, were provided with a less-detailed one-page questionnaire. A sample of this survey form is provided on p.28. Forms were initially circulated with a reply-paid envelope, subsequently via email, together with follow-up phone calls where necessary. The initial requests were, in some cases, supplemented with face to face interviews or interviews by telephone. In some cases, up to six follow-up approaches were made.

- 39 completed returns were received.
- Two respondents declined to provide information.
- Only one of the nine other non-respondents was likely to involve more than a single employee. In that case, the relevant value for sales could be retrieved from the supplier lists provided by the public-sector ASO organisations; the employment data for this firm was imputed by assuming the same employment/sales ratio as a TPN respondent in a very similar activity.

- A number of the respondents should be classified as primary organisations as they export their sales. However, to preserve confidentiality they have been included in data for the secondary organisations.

Table 2.1 Public Sector ASO Institutions

Antarctic Climate and Ecosystems Co-operative Research Centre (ACE CRC)

The ACE CRC is one of the world's leading climate research centres. Established in 1991, it has collaborative arrangements with a large number of Australian and international research agencies.

Australian Antarctic Division (AAD)

The AAD, a division of the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, leads Australia's Antarctic program. It undertakes major ASO research projects and provides logistical support for Australia's Antarctic and sub-Antarctic activities.

Antarctic Tasmania

Located in the Department of State Growth, this provides a capacity for co-ordination and policy development for ASO activities in Tasmania.

Australian Bureau of Meteorology (BoM)

The Bureau of Meteorology has an Antarctic office in Hobart providing specialised forecasting services, climate data, weather forecasts, warnings and observations for the Antarctic region.

Agreement on the Conservation of Albatrosses and Petrels (ACAP)

The secretariat for ACAP is located in Hobart; its function is to coordinate international activity to mitigate known threats to populations of albatrosses and petrels.

Australian Maritime College

Located in Launceston, the AMC is a specialist institute of the University of Tasmania. It is a participant in the Antarctic Gateway Partnership, with its primary role being the development of autonomous underwater vehicles for use in Antarctic research.

CSIRO Oceans and Atmosphere (O&A)

O&A undertakes research into sustainable marine resources and industries, climate, weather and ocean prediction and integrated coastal and oceans management. O&A houses Australia's leading regional climate change modelling research teams.

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

CCAMLR was established by international convention in 1982 and has its headquarters in Hobart. CCAMLR undertakes programs of research, monitoring and the application of conservation measures in the ASO.

Integrated Marine Observing System (IMOS)

The IMOS program observes coastal and deep-ocean waters around Australia using the latest technology to provide data to support research on many critical marine issues.

Institute for Marine and Antarctic Studies (IMAS)

IMAS is specialist institute within the University of Tasmania, created in 2010 to provide a focus on marine, Antarctic and climate change research and teaching.

National Marine Facility

The Marine National Facility, which is managed by the CSIRO, operates the *Investigator*, a large, modern, blue-water research vessel based in Hobart.

(iv) In the previous report³, more than 1000 non-TPN firms were identified as suppliers to primary organisations. Of these, 150 with supplies greater than \$5000 were selected for inclusion in a survey using the same questionnaire as for private-sector TPN members. An internet and telephone search by the author was used to establish postal addresses. These questionnaires were circulated together with a reply-paid envelope. The response rate was less than 10%, making it infeasible to include non-TPN respondents' employment data.

Rather than using a survey, the present report imputes non-TPN employment from supplier data. As detailed in section 4.1.1 below, more than 250 non-TPN Tasmanian firms with supplies greater than \$5000 were allocated to two-digit ANZSIC sectors. Associated employment numbers were imputed from these aggregates using sectoral employment and sales data provided by the Australian Bureau of Statistics. For some institutions not providing supplier lists, the major components of their local expenditures were allocated to ANZSIC sectors by the author. These allocations comprised approximately 5% of total Tasmanian supplies to public-sector ASO institutions.

Data quality

Employment and aggregate expenditure data from public sector organisations are judged to be of reasonably high quality. Where estimation rather than direct enumeration was required these estimates were made by scientists familiar with ASO activity.

In order to ease the burden on TPN survey respondents, their questionnaire offered the option of choosing between several whole-number percentages so as to identify the proportion of FTE employment involved in ASO activity. Most respondents took advantage of this option rather than the 'Other' option with which they could provide an alternative. Where possible, reported information on sales was checked against information from supplier lists – the correspondence was usually quite good, supporting the robustness of the survey responses.

As mentioned earlier, non-TPN employment has been derived from supplier lists and other imputations. The method for generating employment data from sectoral expenditure aggregates relies on an assumption often made in modelling exercises – that the employment/sales ratio in each Tasmania-wide industry sector is the same as the employment/sales ratio for the corresponding non-TPN suppliers. In effect, the assumption is that the *marginal* sales/employment ratio is the same as for the sector *average*. The extent to which this biases the overall results is not known.

³ Wells Economic Analysis (2017).

3. Comparison with Earlier Analyses

Surveys of Tasmania's Antarctic sector have been conducted by Antarctic Tasmania and the Tasmanian Polar Network since 1994/95. For the most part, the surveys focus on the nominal value of ASO-related expenditure, with data disaggregated into expenditure on goods, services and salaries within Tasmania and elsewhere. While these earlier data provide an overview of nominal expenditure growth, it is more informative to adjust for changes in prices, as in this report, where the deflator for State Final Demand is used to convert expenditures into a constant-price series.

Earlier data on full-time employment are provided by Wells Economic Analysis (2017). These data, adjusted to exclude non-TPN responses, are the basis for the comparisons of employment in this report.

As indicated in the previous section this report enumerates ASO activity, placing it in the context of the broader Tasmanian economy. Activity is estimated in terms of value added and employment, for public-sector ASO organisations. For secondary firms and organisations, activity is measured by FTE employment.

This approach is simpler and has a narrower focus than other recent analyses of the impact of ASO activity on the host economy – Blacklow (2013) for Tasmania, and Saunders *et al.* (2016) for New Zealand. These analyses use input-output models to assess economic impact.

While the input-output approach can be used to provide a detailed picture of the interaction between the various sectors of the Tasmanian economy, it has a number of disadvantages. The calculation is data-intensive and requires a large number of estimates and assumptions which, in the end, mean that the estimated effects are subject to a wide range of uncertainty. Also, if the intention is to estimate the total impact of an industry on the Tasmanian economy, it is generally recognised that the so-called 'multipliers' overstate the degree to which an actual change in the level of economic activity in, say, the ASO sector would lead to a change in the Tasmanian economy⁴.

Accordingly, this report applies the same methods as in Wells Economic Analysis (2017). It is limited to providing data for the employment and direct expenditures of ASO primary institutions (and corresponding value added), and for the employment generated in the 'first round' of suppliers to the primary institutions.

⁴ The limitations of input-output analysis are elaborated in, for example, Gretton (2013) or Wells Economic Analysis (2015).

4. ASO Employment, Wages and Value Added

4.1 Employment

An overview of the structure of the Tasmanian economy is provided in Table 4.1.1. The ABS provides yearly estimates of gross value added for 20 Tasmania industry groups, and GSP is their sum⁵. Employment data for the same industry groups are also provided. Note that the last industry in the Table, 'Ownership of Dwellings' does not engage any employees – it simply records the value of services delivered by the stock of dwellings in Tasmania.

In this report, all public-sector employment, except that associated with operation of the *Investigator*, is allocated to Sector M (Professional, Scientific and Professional Services). Although this sector generates 5% of Tasmanian FTE, it generates just 2.7% of Tasmanian value added, implying that the sector is labour intensive.

⁵ At the time of writing, data for 2017-18 State GSP were not available. Data for 2016-17 have been used.

Table 4.1.1
Sectoral Allocation of Tasmanian Activity
percentages

| | FTE | GVA Real |
|--|---------------|---------------|
| A Agriculture, Forestry & Fishing | 5.60 | 9.61 |
| B Mining | 1.99 | 3.51 |
| C Manufacturing | 7.84 | 6.04 |
| D Electricity, Gas & Waste services | 1.86 | 2.96 |
| E Construction | 10.59 | 5.34 |
| F Wholesale Trade | 2.14 | 3.39 |
| G Retail Trade | 9.97 | 4.78 |
| H Accommodation & Food Services | 6.22 | 2.56 |
| I Transport, Postal & Warehousing | 4.82 | 3.82 |
| J Information Media & Telecommunications | 1.44 | 3.61 |
| K Financial & Insurance Services | 2.42 | 6.27 |
| L Rental Hiring & Real Estate | 1.60 | 1.65 |
| M Professional Scientific & Technical Services | 5.01 | 2.66 |
| N Administrative & Support Services | 2.31 | 1.61 |
| O Public Administration & Safety | 7.09 | 6.33 |
| P Education & Training | 7.77 | 6.23 |
| Q Health Care & Social Assistance | 14.23 | 12.53 |
| R Arts & Recreation Services | 2.68 | 0.95 |
| S Other Services | 4.40 | 1.56 |
| T Ownership of Dwellings | | 8.52 |
| Taxes & Subsidies | | 6.33 |
| Total | 100.00 | 100.00 |

Note: Gross Value Added (GVA) are for 2016-7; Employment data are for 2017-18

Source: Australian Bureau of Statistics (2018a, 2018b).

4.1.1 Private-sector employment in secondary organisations

TPN Members

50 secondary organisations (almost all in the private sector) were surveyed. 36 responses were received⁶. In two cases, relevant sales data were obtained from supplier lists, and FTE data were derived by applying the same employment/sales ratio as applied to similar firms. An inspection of the 2017/18 supplier lists also indicated that none of the other non-respondents were likely to have an impact on the overall results. Hence the ‘relevant’ response rate is high. Based on the responses received, recorded employment of 105 is less than the 135 reported in the previous survey. However, some of the difference is due to the changing composition of the TPN membership list; suppliers who have left the membership would be included in the imputation for non-TPN suppliers described below.

Conference delegates and expeditioners

Conferences

The spending by visiting delegates and observers to ASO-related conferences can be viewed as a ‘secondary organisation’ in terms of the framework adopted in this report. The cost of hosting conferences and workshops is included in the relevant purchasing lists supplied by primary organisations. However, spending by the delegates themselves on accommodation and the like is not counted elsewhere. Significant conferences include

- Australia-China Workshop on Astrophysics, 18-20 September 2017
- Taking the Temperature of the Antarctic Continent (TACTical Workshop), 21-23 March 2018
- HASSEG Conference: Understanding the Antarctic region through the Humanities and Social Sciences, July 5-7 2017
- Marine Ecosystem Assessment for the Southern Ocean, April 9-13 2018
- 18th Meeting of the International Ice Charting Working Group, September 25-29 2017
- CCAMLR: Working Group on Fish Stock Assessment, 8-19 October 2017
- CCAMLR: Thirty Seventh Meeting of the Commission, 22 October – 2 November 2017
- CCAMLR: Thirty Sixth Meeting of the Scientific Committee, 16-20 October, 2017
- Symposium on Kerguelen Plateau Marine Ecosystem and Fisheries, 13-15 November 2017

⁶ The TPN membership includes a number of hotels. These were not surveyed, as the experience of the previous report was that hotels provided ‘nil’ returns. Instead, expenditure by conference delegates and expeditioners was estimated directly using the disaggregated approach described overleaf.

Expeditioners

Most expeditioners do not reside in Tasmania, and their wages and salaries while 'on the ice' do not contribute to Tasmanian economic activity. However, it is estimated that the Australian Antarctic Division and the Bureau of Meteorology expeditioners spend an aggregate of 7000 nights in Hobart in training and debriefing.

Total delegate/expeditioner expenditure was estimated by the product of visitor nights and an average daily spend; for conference delegates the latter figure was obtained from Business Events Tasmania (2017); for expeditioners this was scaled down by 50%. This calculation yielded an estimate of delegate/expeditioner expenditure of \$6,474,180.00 which, if it were included in Tasmania's GSP national accounting framework, would be included in the State's exports (X). For the purposes of calculating the employment impact of this expenditure, it was assumed that half the amount was spent in sector H (Accommodation and Food Services) and half in sector R (Arts and Recreation Services).

PhD students

In many respects research students are likely to have a similar, though much smaller, impact on spending as delegates and expeditioners. In 2017/18, 63 PhD students were enrolled at the University of Tasmania in ASO areas of study. However, their activity has not been included in employment and expenditure estimates because

- Students fully supported by scholarships are not, technically, employees.
- An unknown number of students are non-resident in Tasmania.
- An unknown proportion of students are enrolled part-time while employed elsewhere.

Other non-TPN suppliers

In the 2015/16 report, the following approach was followed to obtain an estimate of FTE employment by Tasmanian suppliers as a whole. FTE employment for TPN suppliers was scaled up by the ratio $(TPN \text{ FTE}) \cdot \frac{Tas \text{ Sales to Primary ASO}}{TPN \text{ Sales to Primary ASO}}$. The denominator in this expression, *TPN Sales to Primary ASO*, was obtained from the survey sent to TPN members, while the numerator, *Tas Sales to Primary ASO*, was obtained from supplier lists provided by the primary ASO organisations. It emerged that the numerator and denominator were roughly equal, so that TPN FTE was taken to be a reasonable estimate of the FTE number for the secondary entities.

Further inspection of the 2015/16 data shows that total sales are dominated by a few large categories (sales of fuel, oil, and air transport, for example). With these categories included

in both the numerator and the denominator of the expression in the previous paragraph the sales ratio is necessarily close to unity. Together with the fact that these suppliers have only a very small number of local employees, this approach led to a downward bias in the estimate of employment in non-TPN secondary firms.

To overcome this bias, the present report follows a disaggregated approach.

- First, for each ANZSIC sector, sales and employment data were used to derive an estimate of the average number of employees per dollar of sales⁷. Data were averaged over the three years 2014/15, 2015/16 and 2016/17 so as to smooth out the effects of short-run sales variations. For sector M (Professional, Scientific and Technical Services) for instance, the employment ratio is obtained as $e_M = \frac{S_{M\ 14-15} + S_{M\ 15-16} + S_{M\ 16-17}}{E_{M\ 14-15} + E_{M\ 15-16} + E_{M\ 16-17}}$ where S_M and E_M refer, respectively to sales and employment by private-sector firms in sector M .
- The second step is to apply the employment ratio to purchases *by* primary ASO organisations *from* non-TPN private-sector suppliers. Purchases are derived from a sectoral allocation based on supplier lists and other information.
- Finally, these data are converted to FTE terms using the sectoral ratio of FTE to total employment, based on data in Australian Bureau of Statistics (2018b).

The resulting allocation of the 118 employees derived using this approach is shown in Figure 4.1.1, which also shows the distribution of employees indicated in returns by members of the Tasmanian Polar Network. An important feature of the results is that the disaggregated approach, together with a more complete estimate of the number of visiting delegates and expeditioners, leads to a much larger estimate of the number of non-TPN suppliers than in the 2015/16 data⁸.

The data also illustrate the difference in the distribution of employment generated by TPN and Non-TPN sales. Sector I (Transport, Postal and Warehousing) is clearly the most important sector for TPN supply. On the other hand, visitor nights associated with conferences and expeditioners show up in the importance of sectors H (Accommodation and Food Services) and R (Arts and Recreation Services) for non-TPN supply. There are also marked differences in the relative importance of Health Care (Q) and Other Services (S).

⁷ Australian Bureau of Statistics (2018c) provides sales and employment data for private-sector firms in each two-digit ANZSIC sector.

⁸ In the 2015/16 results, only 3.5 FTE employees were identified from non-TPN responses. It was not possible to re-work the present disaggregated approach for the 2015/16 data,

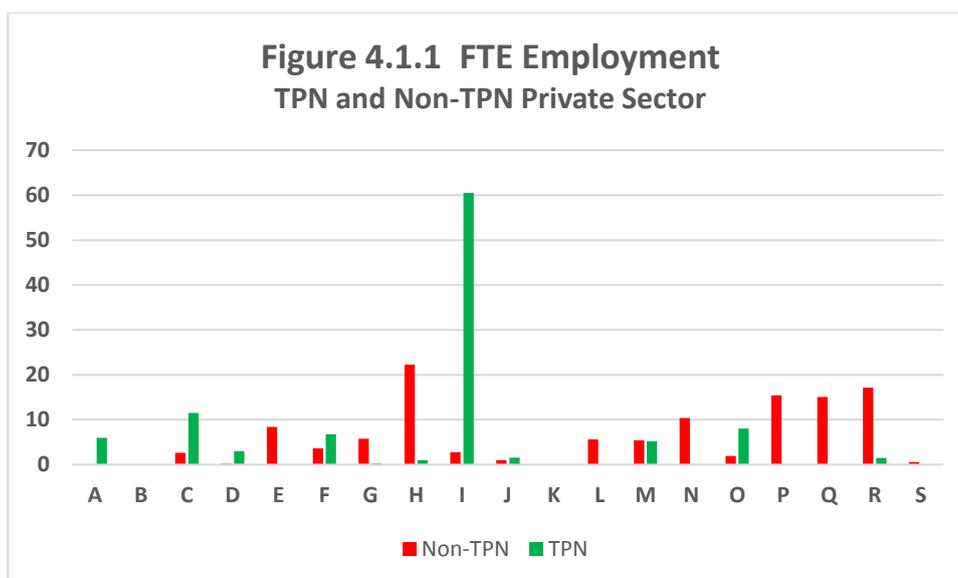


Table 4.1.2 ASO Employment

| | 2017/18 | | 2015/16 | |
|--|------------|-----------------|------------|-----------------|
| | FTE | % of M | FTE | % of M |
| Research | 244 | | 191 | |
| Technical, administration and other support | 215 | | 379 | |
| Policy | 24 | | 18 | |
| Other | 13 | | 34 | |
| Expeditioners | 129 | | | |
| Total | 631 | 6.2% | 622 | 5.8% |
| (Expeditioners and RHD students incl. 2015/16) | | | (133.5) | |
| Private Sector TPN | 105 | | 135 | |
| Private Sector Non-TPN | 118 | | N/A | |
| | | % of TAS | | % of TAS |
| Total | 855 | 0.42% | 756 | 0.38% |

Source: Wells Economic Analysis (2017) and author's calculations.

Employment data for ASO primary organisations are provided in the first part of Table 4.1.2.

4.1.2 Public-sector employment

As indicated earlier, many expeditioners do not reside in Tasmania and spend only a part of the relevant fiscal year in Tasmania for training purposes⁹. In 2015/16, 109.5 of the 622- total shown in Table 4.1.2 are expeditioners associated with the Australian Antarctic Division (staff employed by the AAD are based in Tasmania and generally spend only one to two months in Antarctica). In 2017/18, there were 114 expeditioners with the Antarctic Division and 15 with the Bureau of Meteorology, and these are included in Table 4.1.2 for comparative purposes.

Although they fall into a similar category to expeditioners, no data are available for the number of interstate and international scientists joining the *Investigator* on its cruises out of Hobart. These personnel are not generally employees of Tasmanian public-sector ASOs.

As indicated in the Table, almost all the change in aggregate ASO employment is due to the change in the method of calculating employment by private sector suppliers. Within these aggregates, there has been a noticeable increase in the number of employees engaged in research, increasing from 191 FTE to 244 in 2017/18. Some, but not all, of the apparent decline in numbers of 'Technical, Administration and Other Support' can be explained by the inclusion of expeditioners in totals for 2015/16. It also appears that a number of casual employees were included in this category in 2015/16, but not in FTE terms.

4.2 Wages

Aggregate public-sector wages data are shown in Table 4.2.1. Turning first to the 2015/16 results, it can be seen that the average compensation per employees in the primary ASO organisations was \$130,814. This is 107% higher than the average figure for Tasmania as a whole¹⁰.

⁹ For purposes of comparability with 2011/12 data, Antarctic expeditioners and RHD students were included in the 2015/16 analysis as earlier data on expeditioners were not available. For 2017/18, expeditioners are recorded separately in Table 4.1.2. RHD students are not included in 2017/18 totals. It is estimated that expeditioners spend approximately 7,000 nights in Hobart for training, pre-departure and debriefing. Relevant expenditure data are included in the 'conferences' aggregate later in the report.

¹⁰ Note that the Australian Bureau of Statistics includes the compensation of the self-employed in the category 'Mixed Income' rather than employees; there is no 'mixed income' in the public sector. However, the 'compensation of employees' data used as the basis for the average Tasmanian Wage/FTE are roughly comparable (after allowing for superannuation contributions) with the figure provided for private-sector weekly earnings data in Australian Bureau of Statistics (2018d).

Table 4.2.1 ASO Wages

| | 2017/18 | | 2015/16 | |
|--|---------|--------------|---------|--------------|
| | FTE | Compensation | FTE | Compensation |
| Total Primary ASO (excl. expeditioners and RHD students) | 502.2 | \$65.7m | 489 | \$53.2m |
| Wage/FTE | | \$130,814 | | \$113,048 |
| % of Average Tasmanian Wage/FTE | | 207% | | 171% |

Sources: Wells Economic Analysis (2017), Australian Bureau of Statistics (2018a, 2018b) and author's calculations.

While every attempt has been made to ensure comparability between data for successive years, this has not always been possible. In the 2015/15 data, inclusion of a significant number of casual employees in the 'Technical, Administration and Other Support' category had the effect of lowering the average wage in that year. Casual employees have not been included in the 2017/18 employment or wage data.

Two other points should be borne in mind when interpreting the higher ratio of ASO to average Tasmanian wages. First, most of the growth in Tasmanian employment has been recorded in relatively low-wage sectors such as hospitality and accommodation services, depressing the denominator. On the other hand, the ASO sector has recorded an increase in the number of employees in the relatively highly paid 'research' category, raising the numerator.

4.3 Value Added

As a measure of productive activity, Gross State Product (GSP) is a measure of value added, or the difference between output and intermediate inputs. When the intermediate inputs are taken to include an allowance for the consumption (i.e. 'wear and tear') of fixed capital equipment, the term 'gross value added' is used, and GSP is then the sum of gross value added by all Tasmanian producer units. Were this 'wear and tear' allowance not included in the measure of value added, it would be referred to in 'net' rather than 'gross' terms.

Gross industry value added (GVA) (in 2016/17 prices) is derived using the income approach; for public-sector entities, this is the sum of Compensation of Employees and Depreciation

Allowances. Compensation of Employees includes wages and salaries actually paid, together with superannuation contributions by employees. Accrued annual leave is recorded in the ABS statistics at the time relevant wages and salaries are paid; the survey questionnaire is in line with this practice.

In some cases, primary ASO institutions provided estimates of depreciation allowances. Where estimates were not provided, or where the estimate clearly applied to facilities outside Tasmania, depreciation allowances were derived using the assumption of a common capital-labour ratio and a common depreciation rate across those ASO institutions¹¹. The resulting estimates of GVA can then be compared with comparable data for Tasmania as a whole.

Public Sector

Starting with the data in Table 4.2.1, and making the depreciation imputation noted above, this gives gross value-added figures as shown in Table 4.3.1. To ensure comparability, expeditioners have been excluded in both years. Public-sector GVA has increased by 15% over the two years since the previous report, and now accounts for 11% of value added in the Professional, Scientific and Technical Services sector.

Table 4.3.1 Gross Value Added in the Public ASO sector

| | Public ASO Sector | % of TAS GSP, Sector M |
|-------------|-------------------|------------------------|
| GVA 2017/18 | \$79.51m | 11.00 |
| GVA 2015/16 | \$69.09m | 9.00 |

Source: Australian Bureau of Statistics (2018a), Wells Economic Analysis (2017) and author's calculations.

Note: Percentages are based on the 2016/17 release of GSP data. Expeditioners excluded in both years.

¹¹ Allowances were calculated using the expression,

$$\frac{\$mDepreciation}{FTE} = \frac{\$mDepreciation}{\$mCapital} \cdot \frac{\$mCapital}{FTE} = \$0.025m. \text{ See Wells Economic Analysis (2013).}$$

Private Sector

A rough estimate of value added can be obtained by using the formula:

$$(Pte\ Sector\ ASO\ GVA) = (Pte\ ASO\ FTE) \cdot \frac{TAS\ Pte \cdot Sector\ GVA}{TAS\ Pte\ Sector\ FTE} .$$

Wells (2015) reports that, in 2013/14, 20.45% of FTE employment was in the public sector, and 23.9% of GVA is generated by the public sector. Applying the corresponding private-sector proportions to 2015/16 data, along with the private-sector ASO FTE figure, gives private-sector ASO GVA in 2015/16 of \$18.4m.

For 2017/18, the required GSP data are not yet available. If, instead we use 2016/17 data, this gives an estimate of value added by TPN private-sector firms who are direct suppliers to public-sector ASO firms of \$14.6m. Adding the GVA by non-TPN suppliers increases this figure by a further \$16.3m, making \$30.9m in total.

As noted earlier, this increase in value added between the two surveys is largely due to the alternative method of imputing employment by private-sector suppliers. While this alternative method gives a conceptually better estimate of employment by private-sector suppliers the resulting estimate of value added, for both years, should be regarded as indicative:

- The *Pte ASO FTE* estimate in 2017/18 is, itself, subject to a number of simplifying assumptions
- It is assumed that the ratios of public to private employment, and public to private GVA, remain unchanged.
- It is assumed that the state-wide private-sector ratio of value added per employee can be applied to the ASO private sector.

Nevertheless, adding together the GVA of the public ASO organisations and their private-sector suppliers gives GVA of \$110.4m, which comprises 0.38% of GSP.

5. ASO Expenditure

An alternative approach to measuring Gross State Product is to add all the final expenditures within Tasmania. In theory this should give exactly the same answer as the measure obtained by summing industry value added. In practice, however, the ABS has difficulty in measuring interstate and international trade which means that a large balancing item (typically 25% of GSP) must be added to equalise the two measures. Government consumption expenditure is, however, likely to be measured accurately and so it is of some interest to compare expenditure by public-sector primary organisations to the ABS measure of government consumption expenditure.

As indicated in Table 5.1 nominal expenditure has increased, although it has fallen slightly as a proportion of General Government consumption expenditure in Tasmania¹². Alternatively, it comprises 0.64% of 2016/17 Gross State Product.

Table 5.1 Public Sector ASO Expenditures

| | ASO | Total Tas G | % |
|---------|----------|-------------|------|
| 2015/16 | \$180.6m | \$6,664m | 2.7% |
| 2017/18 | \$185.9m | \$7,320m | 2.5% |

Source: Wells Economic Analysis (2017), Australian Bureau of Statistics (2018e) and author's calculations.

If one were to apply the expenditure approach to secondary organisations, it needs to be borne in mind that the expenditure approach captures spending on *final* goods and services. Almost all relevant sales by secondary organisations are of intermediate (*non-final*) goods and services to primary organisations and so it is not meaningful to make comparisons with components of GSP.

Sales to interstate or international purchasers would be counted as exports (X), and analogously for imports (M). Such a comparison is not attempted here as State-wide measures of X and M are measured imprecisely, and in any event the survey questionnaire did not elicit the relevant information from respondents. However, there are a number of areas in which exports are significant and in which future growth can be expected. These include:

- providing for international ASO operations which are currently focussed on French and Italian programs, but which in the future may also include Chinese, Korean and American programs
- provision of specialised equipment such as igloos, sleds, tractors and mobile accommodation to international ASO programs.

¹² Reflecting the method of derivation, the sectoral pattern of ASO expenditures is very similar to the pattern of FTE employment illustrated in Figure 4.1.1.

6. Variation Analysis

There are a number of differences between the methods used in this report and its predecessor¹³, and these are now briefly outlined.

1. There are two categories of personnel who work in Antarctica and the Southern Ocean. The first is regular employees of the Bureau of Meteorology, the Australian Antarctic Division and possibly other ASO agencies based in Tasmania. These employees do not typically spend more than one or two months at a time located in the ASO. It is clear that ASO spending on their wages and salaries should be counted as “Tasmanian ASO spending”.

The other category of personnel is expeditioners who are not regular employees of public sector ASO institutions and who, mostly, do not normally live in Tasmania. Their salaries are, for the most part, spent in their normal place of residence. While in Antarctica they do not directly add to demand for goods and services in Tasmania, and their productive activity does not take place in Tasmania.

So as to ensure consistency, the 2015/16 report followed previous practice and included expeditioners’ wages and salaries as part of ASO Tasmanian spending and contribution to value added.

The present report has adopted an approach more closely aligned with National Accounting principles; expeditioners’ wages and salaries are excluded from GVA calculations. Had the present approach been followed in the 2015/16 report, GVA would have been recorded as \$69.09m, rather than \$81.87m; it is the former figure which is now shown in Table 4.3.1.

2. Expeditioners spend time in Tasmania in training and debriefing. During this time spending by expeditioners is included in private-sector spending. The spending associated with 7000 expeditioner nights is costed at 50% of the rate documented by Business Events Tasmania in relation to delegates at business conferences. The associated amount is included in ASO spending in Table 5.1. Additionally, this spending generates GVA in the private sector and the imputed amount is included in the non-TPN GVA of \$16.3m, as noted on p.21 above.
3. The previous report noted the difficulty of generating data for employment and GVA generated by non-TPN suppliers. The present report attempts to remedy this deficiency by using ASO supplier lists as a basis for, first, imputing non-TPN employment and second, to use these employment data to impute non-TPN GVA.

¹³ Wells Economic Analysis (2017).

The effect of these imputations is to add 118 FTE to the total, and \$16.3m to private-sector GVA.

Summary. Given available data, two comparisons are useful:

- Had the present report been prepared using the same approach in both periods as in 2015/16, there would have been little change in total ASO FTE employment over the past two years, rather than the increase from 756 to 855 shown in Table 4.1.2.
- Using the same approach as in 2017/18, present GVA would be slightly higher than the \$79.51m recorded in Table 4.3.1. The boost from expeditioners' GVA would be almost offset by the exclusion of non-TPN GVA. Measured on the same basis, the data would show a reasonably solid increase in GVA over the two years since 2015/16, rising from \$69.09m to over \$80m.

6. References

Antarctic Tasmania (2008), *Antarctic Expenditure, Tasmania 2006-07* (A report to the Department of Development and Tourism).

Australian Antarctic Division, *20 Year Australian Antarctic Strategic Plan*, (A report to the Department of Environment and Energy, Canberra). <http://www.antarctica.gov.au/about-us/publications/20-year-australian-antarctic-strategic-plan> (accessed 21 October 2016)

Australian Antarctic Division, *Australian Antarctic Strategy and 20 Year Action Plan*, (A report to the Department of Environment and Energy, Canberra). <http://www.antarctica.gov.au/about-us/antarctic-strategy-and-action-plan> (accessed 21 October 2016)

Australian Bureau of Statistics (2012), *Australian System of National Accounts. Concepts, Sources and Methods*, Edition 3, Canberra.

Australian Bureau of Statistics (2018a), *Australian National Accounts: State Accounts, Table 7. Expenditure, Income and Industry Components of Gross State Product, Tasmania, Chain volume measures and current prices*, cat no. 5220.0. (accessed 20 September 2018)

Australian Bureau of Statistics (2018b) *Labour Force, Australia, Detailed, Quarterly : Table 05. Employed persons by State and Industry. Cat. no. 6291.0.55.003* (accessed 17 September 2018)

Australian Bureau of Statistics (2018c), *Australian Industry, 2016-17*, cat. no. 81550DO001_201617 (accessed 12 October 2018)

Australian Bureau of Statistics (2018d), *Average Weekly Earnings*, cat. No. 6302.0 (accessed 12 October 2018)

Australian Bureau of Statistics (2018e), *Australian National Accounts: National Income, Expenditure and Product, Table 31. State Final Demand, Detailed Components*, cat. no. 5206.0 (accessed 30 October 2018).

Blacklow Economic Consulting (2013), 'A General Method to Estimate Direct and Indirect Contributions to the Tasmanian Economy With Application to the Antarctic, Sub-Antarctic and Southern Ocean Sector', A report for the Tasmanian Polar Network and the Department of Economic Development, Tourism and the Arts, Hobart.

Business Events Tasmania (2017), *How Conferences Benefit Tasmanian Businesses*, <https://www.screencast.com/t/OG8yryAYCqeT> (accessed 26 September 2018).

D'Hernoncourt, J., Cordier, M., and Hadley, D. (2011), *Input-Output Multipliers – Specification sheet and supporting material*, Spicosa Project Report, Université Libre de Bruxelles – CEESE, Brussels.

Gretton, P. (2013), *On input-output tables: uses and abuses*, Staff Research Note, Productivity Commission, Canberra.

Tasmanian Polar Network and Tasmania Maritime Network (2008), Response to the Hobart Railyards Urban Design Strategy. http://www.tmn.org.au/wp-content/uploads/2013/07/TPN-Submission_11aug08.pdf (accessed 28 November 2016)

Wells Economic Analysis (2013), *Public-Sector Science Research in Tasmania 2011-12*, (A report to the Department of Economic Development, Tourism and the Arts), July.

Wells Economic Analysis (2015), *Science in the Tasmanian Public and Private Sectors 2013-14*, (A report to the Department of Economic Development, Tourism and the Arts), July.

Wells Economic Analysis (2017), *The Contribution of the Antarctic and Southern Ocean Sector to the Tasmanian Economy 2015-16*, (A Report to the Tasmanian Polar Network), March.

Organisation Details

| | |
|---|--|
| Name of Organisation | |
| Address | |
| Name and telephone/email address for contact person | |

Survey Period

This information is for: financial year 2017/18 calendar year 2017

Workforce

3.1 How many employees does your organisation have in Tasmania?

| Number | Full Time Equivalents (FTE) | Total wage/salary bill (including on-costs such as superannuation contributions) |
|--------|-----------------------------|--|
| No. | FTE | \$ |

3.2 How many of your Tasmanian employees are involved in ASO activity? (Those directly involved in ASO activity, and those that support them). Please detail the activities they were undertaking.

| | Number | FTE | Total wage/salary bill (including superannuation contributions) |
|---|--------|-----|---|
| Research | | | \$ |
| Technical, administration and other support | | | \$ |
| Policy | | | \$ |
| Other | | | \$ |
| Total | | | \$ |

Financials

| | |
|---|----|
| 4.1 What was the value of your total expenditure last year (exclude wage and salary bill as detailed above, but include services such as council rates, electricity etc.) | \$ |
| 4.2 What was the value of your purchases of goods and services from all other organisations in Tasmania? | \$ |
| 4.3 What was your provision for maintenance/depreciation? | \$ |

Thanks for your help. Please return completed survey to Wells Economic Analysis, PO Box 3091, West Hobart, 7000, or to lahuwell@bigpond.net.au.

Organisation Details

| | |
|---|--|
| Name of Organisation | |
| Address | |
| Name and telephone/email address for contact person | |

Survey Period

| | | |
|--------------------------|---|---|
| This information is for: | <input type="checkbox"/> financial year 2017/18 | <input type="checkbox"/> calendar year 2017 |
|--------------------------|---|---|

Workforce

3.1 How many employees does your enterprise have in Tasmania?

| Number | Full Time Equivalents (FTE) | Total wage/salary bill (including superannuation but excluding payroll tax) |
|--------|-----------------------------|---|
| No. | FTE | \$ |

3.2 What percentage of your Tasmanian FTE workforce is engaged in activity related to the Antarctic and Southern Ocean – either directly or supplying organisations such as the Australian Antarctic Division, IMAS etc?

| | | | |
|-----------------------------|-----------------------------|-----------------------------|---|
| <input type="checkbox"/> 1% | <input type="checkbox"/> 2% | <input type="checkbox"/> 5% | <input type="checkbox"/> other (please specify %) |
|-----------------------------|-----------------------------|-----------------------------|---|

Financials

4.1 What was the value of your total sales related to activity in the Antarctic and Southern Ocean – either directly or supplying organisations such as the Australian Antarctic Division, IMAS etc?

Thanks for your help. Please return completed survey to Wells Economic Analysis, PO Box 3091, West Hobart, 7000, or to lahuwell@bigpond.net.au.

Results are strictly confidential to Wells Economic Analysis.