



ACT OCSE Investigation into Scope 3 Greenhouse Gas Emissions

Report on Scope 3 Greenhouse Gas Emissions of the Australian Capital Territory
by UNSW Sydney, the University of Sydney and CSIRO Land and Water.

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Executive Summary

As centres for economic and population growth, cities play a major role in the increase of anthropogenic greenhouse gas (GHG) emissions. Their ever-increasing consumption of natural resources and fossil fuels links cities to 70% of global GHG emissions. Some regional governments are taking a leading role in reducing GHG emissions. The Australian Capital Territory (ACT) is one such city, demonstrating climate leadership through their commitment to achieve net zero emissions by 2045. However, while territorial or direct emissions (Scope 1 and Scope 2) of cities are well understood, the full out-of-boundary (Scope 3) emissions embodied in consumption are not comprehensively reported or understood. Assessing Scope 3 emissions uses data on the consumption of goods and services that are provided inside and imported from outside of a city's or region's territorial boundary to calculate a carbon footprint (CF). Recent studies of CFs have highlighted the significant contribution of embodied Scope 3 emissions. As such, it is critical that these emissions are assessed and understood and included in emissions reduction targets and responses. This can ensure that claims of carbon neutrality are complete and credible.

This study applies an environmentally extended, nested, multi-region input-output (MRIO) database to investigate the ACT's Scope 3 GHG emissions by undertaking a full CF assessment of both direct and embodied emissions. The study determines the current sources of Scope 3 emissions, provides details of sectoral composition and geographical sources and cross border flows of ACT Scope 3 emissions, and provides a time series of projected Scope 3 emissions to 2050 following a high-ambition mitigation scenario.

The results (Section 3) reveal that Scope 3 embodied emissions made up 83% of the ACT's total CF in 2018. The magnitude of embodied emissions confirms that the Territory is a consumer city which relies on imported emissions - from Australia and the world - to satisfy private, public and corporate consumption and investments. Households make up the largest share of consumption-based emissions (59%), followed by government (33%) and businesses (8.2%). When broken down by main product group, the main hotspots for embodied emissions are: transport, postal and warehousing (16.8% of the total CF), food (9.9%, including all food items), retail trade (9.2%), construction (7.4%), public administration and safety (7.3%), and manufacturing (7.2%).

Household emissions are overwhelmingly related to transport (direct emissions, as well as imported from the rest of Australia and the world), retail trade (mostly imported from the rest of the world) and food (mainly imported from the rest of Australia). By contrast, government

embodied emissions are largely derived from services provided by the rest of Australia, with secondary priorities of healthcare, construction and education within Australia, retail trade outside Australia, and transport from the rest of Australia and the world. Overall, international imports (29%) and imports from Queensland (19%), NSW (18%) and Victoria (13%) make up over three quarters of embodied emissions. This reflects the extent of trade networks that the ACT relies upon and is useful in framing current and future supply chain relationships to reduce Scope 3 emissions.

In 2018, the ACT's per capita CF was 34.7 t CO₂-eq, which has declined marginally since 2009 but is still well above global averages and vastly exceeds estimates from global analysis of what is needed to keep global warming within 1.5° C (i.e. 2 to 2.5 t CO₂-eq per capita by 2030). Future projections show that the ACT's per-capita CF could decline to approximately 3.7 t CO₂-eq per capita by 2050 with ambitious mitigation trajectories in Australia and globally.

The study finds that the ACT's action on Scope 2 emissions is a good start but will not generate enough emissions reductions to achieve a net zero carbon footprint. Including Scope 3 emissions in the ACT's target to achieve net zero opens new opportunities for emissions reduction, targeting both consumers and producers. The key to reducing Scope 3 emissions lies in bringing both sides together to find common or joint solutions for mitigation. This study provides a first step in this direction as the CF results reveal the sources of Scope 3 emissions, in terms of the location of producers, the amount of emissions produced, and the main products in which these emissions become embodied.

Various options exist to address consumption-based emissions by impacting upon how goods and services are produced and consumed. Key areas for action include the emissions hotspots identified in this report, corresponding to food, transport, construction and infrastructure, services, and manufactured goods. The ACT Government can play a leadership role by influencing decisions and practices of producers outside and consumers inside the ACT. Apart from legislative, financial and regulatory instruments, the government can enter into partnerships and networks with the private and public sector elsewhere in Australia and even abroad. It can promote and support behaviour and lifestyle changes as well as a paradigm shift towards a wellbeing economy.

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Acronyms & Abbreviations

ABS	Australian Bureau of Statistics
AGEIS	Australian Greenhouse Emissions Information System
AFOLU	Agriculture, Forestry and Other Land Use
CF	Carbon Footprint
CH ₄	Methane
CO ₂	Carbon Dioxide
CO ₂ -eq	Carbon Dioxide Equivalent
DIM	Direct Impact Multiplier
EEE	Emissions Embodied in Exports
EEl	Emissions Embodied in Imports
EEIOA	Environmentally Extended Input Output Analysis
GHG	Greenhouse Gas
Gt	Gigatonne
IELab	Industrial Ecology Virtual Laboratory
IO	Input-Output
IOA/IOT	Input-Output Analysis / Table
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
kt	Kilotonne
LCA	Life Cycle Assessment
MFA	Material Flow Analysis
MRIOA / MRIOT	Multiregional Input-Output Analysis / Table
Mt	Megatonne
t CO ₂ -eq/cap	Tonnes of Carbon Dioxide Equivalence Per Capita
RoA	Rest of Australia
RoW	Rest of World
TIM	Total Impact Multiplier

1 INTRODUCTION

1.1 Consumption-based emissions of cities

Cities are intrinsic to the growth and development of human society as centres of knowledge, governance and technology. Economic growth and urban population growth in cities are ever-increasing drivers for the consumption of natural resources and fossil fuels, and they contribute to 70% of global greenhouse gas (GHG) emissions (Hoornweg et al., 2011, IPCC, 2014). As such, cities are increasingly recognized as central to the endeavour of limiting global warming to 2°C or below (Watts, 2017). As the world continues to urbanise and more cities are developed, an opportunity presents itself for cities to take the lead in terms of climate responses and sustainable development (United Nations, 2019, C40 Cities, 2018). In an effort to slow climate impacts, global governing bodies such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) are drawing attention to the need to limit all sources of emissions, including direct emissions from energy use within a city's boundaries, as well indirect or embodied emissions associated with urban consumption.

Cities have an opportunity to integrate sustainability and urban lifestyles through the consolidation of human populations, technological advancement and local political leadership. The collective impact of cities in reducing GHG emissions is significant only if they address all sources of emissions. This includes direct emissions from sources located within city boundaries (Scope 1), indirect emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling (Scope 2), and all other indirect emissions that occur outside the city boundary as a result of activities taking place within the city (Scope 3) (Wiedmann et al., 2020a). In order to implement effective emission reduction strategies, it is important that reporting of GHG emissions from cities includes these direct and indirect emissions (Wiedmann et al., 2016).

Territorial or direct emissions (Scope 1 and Scope 2) of cities are well understood, and so are those from infrastructure supply chains as well as energy and material requirements of infrastructure (Chen et al., 2016a). However, the full out-of-boundary (Scope 3) emissions, which refer to a city's emissions embodied in imports (EEI) and emissions embodied in exports (EEE), are not comprehensively reported or understood (Chen et al., 2016a), (Lenzen and Peters, 2010). Recent studies have highlighted the significant contribution of embodied

emissions (Fry et al., 2018). Wiedmann et al. (2020a) find that by only accounting for territorial emissions excluding Scope 3 emissions, 79 cities under-report 4% of global annual GHG emissions. Minx et al. (2013) find that in the UK, consumption-based emissions are approximately double that of production-based emissions, such that overall emissions increased despite a reduction in production-based emissions (Barrett et al., 2013, Millward-Hopkins et al., 2017). Furthermore, the share of climate impacts arising from embodied emissions is likely to increase in the future, largely due to the comparative ease in which cities can reduce their direct emissions. For these reasons, it is critical that embodied emissions are included in environmental assessments (Sharp et al., 2016).

There are standardized GHG accounting frameworks to assist cities in this process. However, their methodologies lack a complete understanding of embodied emissions – thus making a city’s claim to carbon neutrality difficult to track and lacking credibility. While the frameworks often consider direct sources of emissions (Scope 1) and emissions from energy (Scope 2), the option to include indirect emissions (Scope 3) is usually at the discretion of those conducting the analysis.

The process for assessing Scope 3 emissions requires data collection on the consumption of goods and services provided inside and imported from outside of the territorial boundary to determine a city’s carbon footprint (CF). The calculation of CF using consumption-based accounting (CBA) provides a clear methodology that enables a complete understanding of carbon neutrality and climate change implications of a city.

1.2 Carbon Neutrality in the ACT

The Australian Capital Territory (ACT, ‘the Territory’) has demonstrated leadership on climate action by setting world-leading emission reduction targets that are legislated under the *Climate Change and Greenhouse Gas Reduction Act 2010*. This includes targets of 100% renewables by 2020 and ‘net zero emissions’ by 2045, as well as interim targets that plot the course to achieving this long-term objective (ACT Government, 2019a). The ACT recently achieved their 2020 interim target of reducing GHG emissions by 40% and has fully transitioned to providing 100% of electricity from renewable sources (ACT Government, 2020). To realise their 2025 ambition of reducing emissions from 1990 levels by 50-60%, priorities are placed on mitigating GHG emissions from gas and transport which account for over 80% of the Territory’s remaining direct emissions (ACT Government, 2019a). This objective is supported by the ACT Climate Change Strategy 2019-2025 (ACT Government,

2019a) and initiatives such as the Government's Zero Emissions Vehicles Action Plan 2018-2021 (ACT Government, 2018). The ACT Government is also committed to achieving its emissions reduction targets and net zero emissions goal without the purchase of carbon offsets.

These efforts are rightly focused on reducing direct sources of emissions from transport and gas (i.e. Scope-1 emissions) and eliminating indirect emissions from electricity (i.e. Scope-2 emissions). However, the ACT is well-placed to achieve even more substantial emission reductions. In particular, the Territory can analyse and reduce indirect Scope 3 emissions so that GHG accounting is complete and consistent to support emission reduction targets, and to develop additional policies supported by quantifiable evidence. Consumption-based accounting processes using environmentally-extended multi-region input-output (MRIO) models are recognised as the most appropriate tool for the calculation of a city's total CF as they include all direct and indirect emissions (Chen et al., 2019, Wiedmann et al., 2016). Such an analysis can be used to inform mitigation policies and potentially support the generation of a pathway for the ACT to achieve true net zero emissions by 2045.

1.3 Aims & Scope of this study

This study aims to investigate the ACT's Scope 3 greenhouse gas emissions by undertaking a full carbon footprint assessment for future climate change policies. The carbon footprint analysis evaluates the ACT's direct (territorial) emissions and indirect (out-of-boundary or embodied) emissions, analyses the composition of Scope 3 emissions, determines current sources of Scope 3 emissions, provides details of sectoral composition and geographical sources and cross border flows of ACT Scope 3 emissions, and provides a time series of projected Scope 3 emissions to 2050.

The evaluation uses an environmentally extended, nested, multi-region input-output (MRIO) database developed by the project team (Fry et al., 2021), based on the latest available input-output data (2017/18) and GHG emissions data (2018). This MRIO database is used to identify emissions 'hotspots' in the ACT. These results are then assessed against existing climate strategies adopted by the ACT to facilitate the development of a pathway to carbon neutrality in the ACT.

2 METHODOLOGY and DATA

Total city carbon footprints (CFs) use a consumption-based accounting (CBA) approach to combine territorial emissions produced by human activities within a city and embodied emissions which originate from outside the city boundary (Lin et al., 2015, Minx et al., 2013). Unlike production-based approaches, CBA captures direct and lifecycle GHG emissions, such as emissions from raw material extraction, manufacturing, distribution, retail and disposal and allocates them to the final consumers, rather than the original producers (C40 Cities, 2018).

It is widely recognised that the environmental assessment of a city is complex (Andrade et al., 2017, Athanassiadis et al., 2018, Lombardi et al., 2017). Ultimately, the CBA method of choice will depend on the expected outcomes of the enquiry and the availability of data and resources (Wiedmann and Minx, 2008). Presently, the environmentally-extended input-output (EEIO) or global MRIO approaches are considered to be the most comprehensive forms of CBA as they provide the most rigorous CF estimate.

This Chapter introduces the concepts and methodologies used and provides an overview of the technical approach taken to assess the ACT's consumption-based GHG emissions.

2.1 Concepts and Methodology

2.1.1 Carbon Accounting, Carbon Footprints and Carbon Neutrality

In the context of global GHG reduction it is crucial that governing authorities, and consumers more broadly, understand the complex linkages between cities and the rest of the world through the global supply chain network. After all, cities are the nodes of a complex global network of trade and resource consumption. They receive and distribute information, goods, services, energy, water, and waste (Athanassiadis et al., 2018); all of which generate significant direct and embodied GHG emissions. To assess the sustainability of a city it is therefore necessary to measure and monitor resource use and pollution of GHG emissions, understand their flows, and allocate responsibility (Athanassiadis et al., 2018, Lin et al., 2015, Millward-Hopkins et al., 2017, Mi et al., 2016, Wiedmann et al., 2016, Pichler et al., 2017).

The CF has been recognized as a powerful tool for GHG emissions management (Lombardi et al., 2017, Lin et al., 2015); it provides a holistic understanding of total GHG-emitting processes, their origins and their composition and amounts (Franchetti and Apul, 2012). Carbon footprint is synonymous with the phrase 'GHG inventory' and relates to the amount of GHG emissions which directly or indirectly result from the activities of a person, the supply chain of an

organization, or the total emissions of a city, event, product or service along its supply chain (Franchetti and Apul, 2012, Lombardi et al., 2017, Wiedmann and Minx, 2008). CF takes its name from carbon dioxide (CO₂), the most dominant anthropogenic GHG emission. However, other GHG emissions – methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) – also significantly contribute to global warming. To ensure ease of comparability in reporting, results of the CF are reported in terms of carbon dioxide equivalent (CO₂-eq) and all emissions from the other gases are normalized to the mass of CO₂ by their Global Warming Potential (GWP); a measure of the potential climate change effect per kg of a GHG over a fixed period (100 years) (Lombardi et al., 2017).

The completeness of a CF is reliant on the extent of emissions data included in the GHG inventory; the 'spatial boundary' for which the city emissions occur (Lombardi et al., 2017). These emissions can take place within the city (direct) or outside (indirect) the city boundaries (Wiedmann et al., 2020a), and fall under three scopes as classified by the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) (WRI et al., 2014).

- Scope 1: GHG emissions from sources located within the city boundary (e.g. stationary energy, transportation, waste IPPU, AFOLU) called territorial emissions, produced within the geographic boundary.
- Scope 2: GHG emissions occurring as a consequence of the use of grid-supplied electricity, heating, and/or cooling within the city boundary.
- Scope 3: All other GHG emissions that occur outside the city boundary as a result of activities within the city boundary.

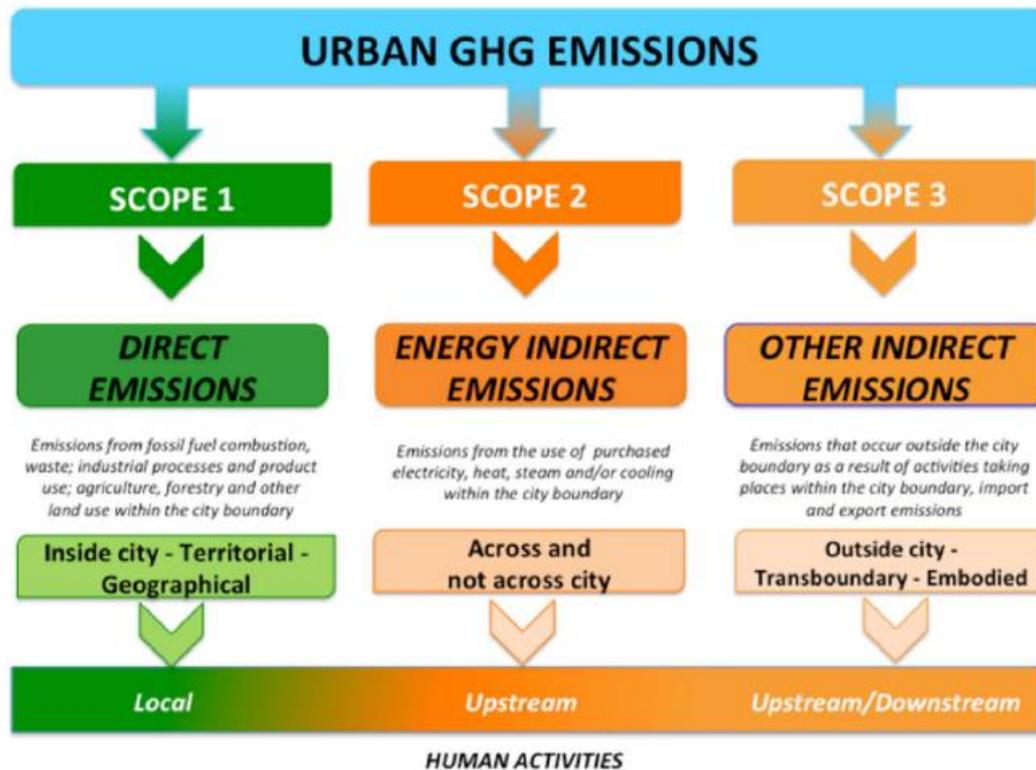


Figure 2-1: Scope classification of city-wide GHG emissions (Lombardi et al. 2017)

Total city CFs can assist policymakers and governing authorities to understand the driving forces behind consumption patterns of a city’s residents. They can also challenge the credibility of a city’s claim to carbon neutrality. Carbon neutrality is the balancing of GHG emissions so that the net emissions of an activity are zero (Climate Active, 2020). To achieve carbon neutrality, a product, service, city or organisation must first measure their CF and demonstrate that they have reduced emissions where possible; offset units are then purchased to compensate for the remaining tonnes of carbon dioxide equivalent (t CO₂-eq) which may be more difficult to eliminate.

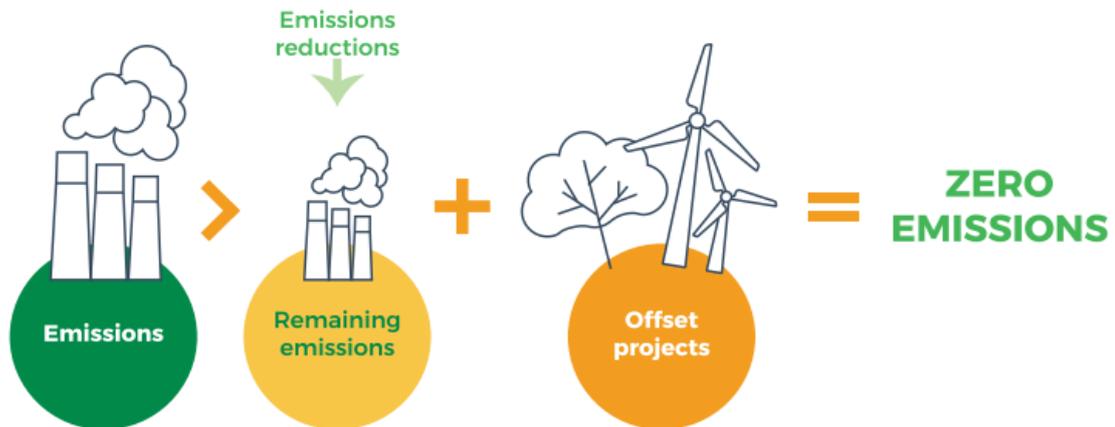


Figure 2-2: The process of carbon neutrality as proposed by the National Carbon Offset Standard (Climate Active, 2020)

This study reports the ACT’s carbon footprint in standard emission scopes according to the definitions provided by Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) (WRI et al., 2014).

2.1.2 Environmentally-Extended MRIO Analysis

Input-output analysis (IOA) is a top-down approach of CBA (Wiedmann and Minx, 2008). IOA has been recognised as a comprehensive and robust tool for calculating the direct and indirect linkages between consumption and emissions associated with production and trade at an international, national and sub-national level (C40 Cities, 2018, Wiebe et al., 2016, Wiedmann and Lenzen, 2018).

IO tables can be extended to include environmental account data related to industry sectors, e.g. the direct use of energy or resources or the direct emissions of GHGs or pollutants in production (C40 Cities, 2018, Wiedmann, 2009). The IO calculus is then applied to trace these environmental impacts from production by different industries to the final consumption of goods and services, using financial flow data from the IO tables. This method is called environmentally-extended input-output analysis (EEIOA). It has been widely recognised as a useful tool for estimating consumption-based impacts (footprints) of nations, regions, cities, companies, populations or individuals (Andrade et al., 2018, Wiedmann and Lenzen, 2018, Wiedmann, 2009).

Cities, or territories with relatively small populations, are more open economies even than nations, because they trade with both national and well as international regions. Therefore,

their exposure to trans-boundary emissions (Scope 3) is usually higher than that of countries (Chen et al., 2016b);

Deriving input-output tables (IOTs) for cities, however, is notoriously difficult, because in most cases neither city-level IO data nor detailed trade data across system boundaries exist (Lombardi et al., 2017, Ramaswami et al., 2011). This highlights the need for inter-regional trade analysis using what is referred to as multi-regional input-output tables (MRIOTs) (Lenzen et al., 2012, Tukker and Dietzenbacher, 2013). These are IOTs that distinguish several regions, each with their own structure for domestic (within-region) trade as well as inter-regional trade (Isard, 1951, Leontief and Strout, 1963). Imports and exports from and to all regions is explicitly described with a full industry sector breakdown, i.e. transactions from any sector in any region to any sector in any region are all included. The MRIOT used in this project is shown in Figure 2-3 below.

Using an MRIO framework further extends the EEIOA methodology such that results are sensitive to the sub-national region. National and regional statistics are used to produce balanced sub-national MRIOTs joined with environmental and/or social accounts (Lenzen et al., 2012). Issues with double counting of GHG emissions are avoided by integrating the trade relationships of different regions within a country (Lombardi et al., 2017, Wiedmann and Lenzen, 2018).

Over time, collaborations between input-output and sustainability researchers across the globe prompted a further extension of EEIOA to include global multi-regional input-output databases (Lenzen et al., 2017a). The combination of sub-national (city) with international IOTs by way of 'nested' global MRIO models is able to provide the most rigorous CBA estimate and therefore the greatest opportunity for households and local authorities to drastically reduce consumption habits and redirect purchasing towards less GHG-intensive sectors (Wiedmann and Lenzen, 2018, Ramaswami et al., 2011, Wang et al., 2017, Bachmann et al., 2015). This project takes advantage of newly developed method to nest Australian sub-national MRIOTs within global MRIOTs, see Section 2.1.3 below.

Environmentally-extended MRIO frameworks provide a consistent way of simultaneously reporting territorial and embodied emissions from urban consumption. This methodology is therefore an ideal accounting framework for analysing the ACT's total CF. This study uses MRIO computational infrastructure of the Australian Industrial Ecology Virtual Laboratory (IELab) (Lenzen et al., 2014).

2.1.3 MRIOT data created with the Australian IELab

The Australian IELab uses the underlying methodology of EEIO analysis. The high-performance computing (HPC) platform takes information from IO tables (IOTs) which summarise all financial transactions between all industry sectors in an economy (Wiedmann, 2018). IELab then links the IOTs to environmental and social statistics (e.g. GHG emissions, wages & salaries, employment) for use in detailed environmental footprint analyses (Lenzen et al., 2017a). This process can be extended to trace the environmental impacts through complex inter-regional trade and supply chain networks (Wiedmann, 2018, Lenzen et al., 2012). MRIO tables have the capacity for CBA at the sub-national scale and are therefore recognised as effective tools for calculating the total CF of cities (Lenzen et al., 2014). The resulting IOTs are flexible and have the ability to harmonise conflicting data (Lenzen et al., 2017a).

The MRIO table for this study was derived from IELab and was based on economic supply and use tables (SUTs). The SUT framework “represents a complete picture of the Australian economy showing all inputs (domestically produced goods and imports) and all outputs (domestic final consumption and exports) in monetary terms” (Wiedmann et al., 2006); see also Eurostat (2008). A SUT is considered more valuable than a symmetric IOT (industry-by-industry) as it retains more information on the structure of transactions between industries and products (Wiedmann, 2017). We refer to the table used in this project as a MRIOT in SUT format.

Regional input-output tables generated via survey-based methods are not available from the Australian Bureau of Statistics (ABS) due to lack of industry data and methodological issues (Lenzen et al., 2017a). Instead, initial estimates for inter-regional transactions are created by using non-survey methods (Bonfiglio and Chelli, 2008, McMenamin and Haring, 1974, Round, 1983, Sargento et al., 2012); the aim being that the most meaningful trade regionalisation approach is selected for the construction of the MRIOT (Lenzen et al., 2017a).

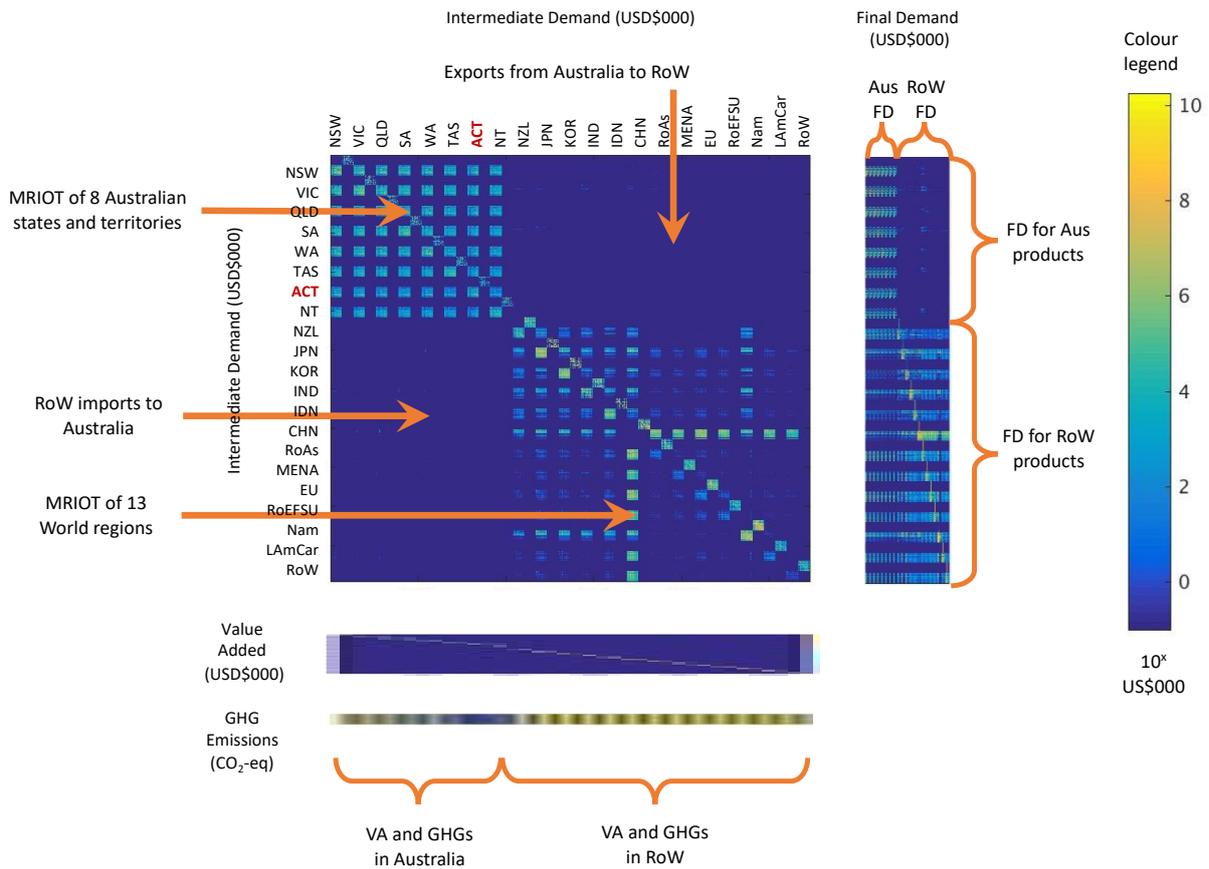


Figure 2-3: Format of the nested MRIOT structure used in this study (not to scale). The colouring of cells indicates the magnitude of cell value. Intermediate demand has dimensions 1092×1092 , FD 1092×126 , value added 105×1092 , and GHG emissions 1×1092 . Australian states are represented in the first 416 rows/columns of the MRIOT

The regions considered as part of this study comprised of all States and Territories in Australia with populations published by the ABS in June 2020 (ABS, 2020b). These spatial units include people living within the area of the State or Territory as well as people who regularly socialise, shop or work within the region, but who live in areas surrounding the region. The eight states and territories are ‘nested’ within the Rest of World (RoW), which is here represented by 13 countries and regions considered to be important trading partners of Australia. This results in a globally closed, 21-region MRIO framework in supply and use table format. The MRIOT structure is shown in the form of a ‘heat map’ in Figure 2-3, see also (Chen et al., 2016b). Note that in this novel nested MRIO framework all Australian states and territories have explicit trade links to all RoW countries (Fry et al., 2021). For example, the intersection of row TAS and

column CHN represents intermediate and final exports from Tasmania to China in the intermediate and final demand tables, respectively.

The *Intermediate demand* element in the top left of the MRIOT is called the transaction matrix (T) and it represents the financial transactions between 26 industry sectors for the 21 regions. The columns give the inputs to each sector, the rows give the outputs to each sector, and the off-diagonal areas represent trade between regions.

The final demand (FD, or **Y**) represents money spent by final consumers, broken down into households (HH), government and business (gross fixed capital formation).

Value added (VA) is the value that each industry generates (in US\$*k* for the current year) through wages and salaries, taxes and profits.

Finally, GHG emissions (**E**) represents the environmental impacts (in kt CO₂-eq) associated with the production of activities, goods and services in each sector for the current year.

2.1.4 Leontief Demand-Pull Model

Underlying calculations for the total CF followed the standard Leontief-inverse demand-pull input-output model (Miller and Blair, 2009, Leontief, 1936, Leontief, 1966), where emissions from industry sectors are allocated to final demand of products (Miller and Blair, 2009).

To begin an EEIO analysis using the Leontief demand-pull model, two pieces of raw data are required: the direct environmental impacts associated with each industry sector (*e*), and an input-output table which has been balanced such that total inputs for each sector equal total outputs (Kitzes, 2013).

Then, the technical coefficient matrix (**A**) is created. **A** is made up of coefficients *a_{ij}* representing the input coefficient for sector *i* required to produce one unit of input of sector *j* (Kitzes, 2013):

$$a_{ij} = \frac{x_{ij}}{x_j} \text{ for } i = 1, \dots, n \text{ and } j = 1, \dots, n,$$

where *x_{ij}* is the input from sector *i* to sector *j* and *x_j* is the total of industry inputs. For a sector *i*, the equilibrium between total supply and total demand can then be written as:

$$x_i = \sum_{j=1}^n a_{ij} x_j + y_i \text{ for } i = 1, \dots, n$$

The overall supply and demand equation can also be expressed as:

$$\mathbf{x} = \mathbf{Ax} + \mathbf{y},$$

where \mathbf{x} is a vector of total inputs (size $1 \times n$), \mathbf{y} is a vector of final demand (size $1 \times n$), and \mathbf{A} is a matrix of technical coefficients (a_{ij}) of size $n \times n$ (Miller and Blair, 2009).

By solving for \mathbf{x} , the Leontief inverse matrix, denoted by \mathbf{L} can be found:

$$\mathbf{y} = \mathbf{x} - \mathbf{Ax}$$

$$(\mathbf{I} - \mathbf{A}) \times \mathbf{x} = \mathbf{y}$$

$$(\mathbf{I} - \mathbf{A})^{-1} \times (\mathbf{I} - \mathbf{A}) \times \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \times \mathbf{y}$$

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \times \mathbf{y}$$

$$\mathbf{x} = \mathbf{Ly} \quad (1)$$

The Leontief inverse matrix can then be used to link the economy and the environment via the direct 'pollution' coefficient f_j (also called the Direct Intensity Multiplier, DIM) (Wiedmann, 2017):

$$f_j = \frac{e_j}{x_j}$$

where f_j is the amount of pollutant emitted (e_j) per total input x_j for each industry j .

Given a vector of total inputs \mathbf{x} , the total economy-wide industry emissions (\mathbf{E}) for all regions are:

$$\mathbf{CF} = \mathbf{fx} \quad (2)$$

Finally, the Leontief inverse matrix and DIMs are used to generate the Total Impact Multipliers (TIMs) of each industry in all regions; which, when multiplied by the final demand, give the full vector of total CF for all regions and industry sectors (Chen et al., 2016b).

By substituting (1) and (2):

$$\mathbf{CF} = \mathbf{fx} = \mathbf{fLy} \quad (3)$$

where \mathbf{fL} represents the vector of TIMs and \mathbf{CF} is the modelled CF for all regions.

2.1.5 City Carbon Map Concept

The City Carbon Map (CCM) concept proposed by Wiedmann et al. (2016) is an accounting framework based on environmentally-extended input-output analysis. CCM provides a consistent way of reporting territorial and embodied emissions simultaneously, is able to identify emissions from industries (origin) and emissions to products (final destination), and is able to categorise standard emission scopes. An advantage of the CCM is that it clearly defines emissions by sector and it also has the capacity to represent multiple spatial scales (e.g. city, regional, national, global) due to its consistency with global emission accounting frameworks (Lombardi et al., 2017). The carbon map was previously applied to the city of Melbourne using the EEIOA method and shows products consumed in the city; their type, Scope (i.e. 1, 2, or 3), origin and destination (Wiedmann et al., 2016). Based on the CCM concept, this study analyses the carbon footprint of ACT by emissions scope (1, 2 and 3), by sector, by region of origin and destination and by year (2008 to 2050).

Based on standard Leontief-inverse demand-pull input-output calculus, the carbon map is a two-dimensional decomposition of the carbon footprint of a city's final demand (Wiedmann et al., 2016). It splits up the total carbon footprint into the industry sectors from which the GHG emissions originate (rows) as well as into the product groups in which the emissions become embodied (columns). A third dimension can be introduced by splitting up final demand into its constituents. In aggregated form the calculations can be denoted as follows.

$$C = E\hat{x}^{-1}(I - A)^{-1}\hat{y}$$

where:

- **C** is a carbon map of dimensions $n \times n$.
- **$E\hat{x}^{-1}$** is the diagonalized vector ($n \times n$) of direct industry emission intensities, calculated as the product of a vector ($1 \times n$) of industry emissions **E** and the inverse matrix x^{-1} of diagonalized total industry output ($n \times n$). The hat symbol (^) indicates that the resulting $1 \times n$ vector has been placed onto the diagonal of a $n \times n$ matrix with all off-diagonal matrix elements being zero.
- **I** is an $n \times n$ identity matrix with ones on the diagonal and zeroes elsewhere.

- **A** is the technology coefficient matrix ($n \times n$), calculated as the product of the input-output transaction matrix **T** ($n \times n$) and the inverse matrix \mathbf{x}^{-1} of diagonalized total industry output ($n \times n$).
- $\hat{\mathbf{y}}$ is a $n \times 1$ vector of final demand which has been diagonalized.

Note that only one column of final demand ($n \times 1$) can be turned into a carbon map at a time.

The carbon map shows the allocation of emissions from industries (vertical labels on the left side) to products (horizontal labels along the top). Industries can be thought of as the origin of emissions and products as the final destination, in terms of cradle-to-shelf embodied emissions. Direct household emissions, e.g. from heating homes or driving cars, are not included in the map.

2.1.6 Calculating the total carbon footprint (CF)

The CBA approach to carbon accounting allocates GHG emissions to the final consumers of goods and services, rather than to the producers of those GHG emissions (C40 Cities, 2018). The total carbon footprint is therefore defined as a consumption-based account of industry-related territorial emissions (Scope 1) plus emissions embodied in imports and excluding emissions embodied in exports.

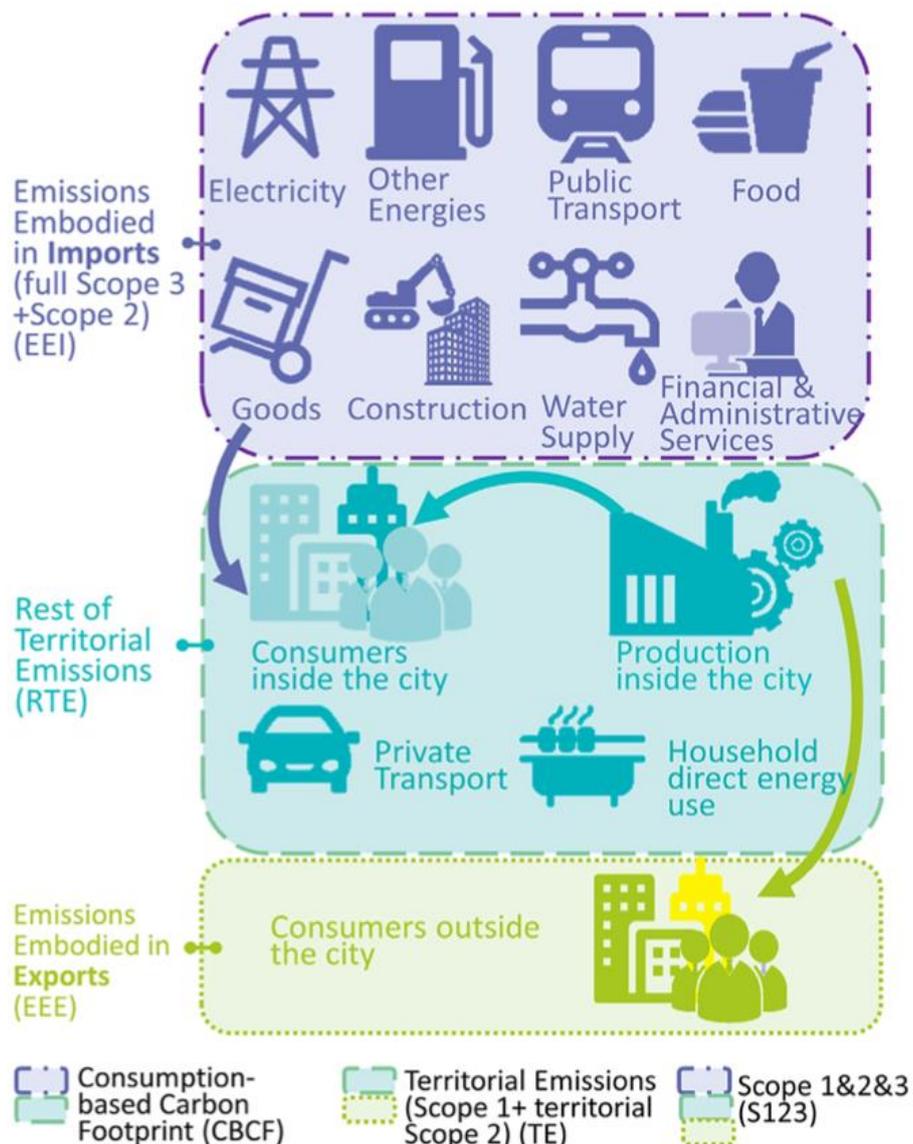


Figure 2-4: This study takes a Consumption-Based Carbon Footprint perspective (CBCF). The CBCF combines Remaining Territorial Emissions (RTE) with Emissions Embodied in Imports (EEI). RTE are the territorial emissions minus Emissions Embodied in Exports (EEE) (figure from Wiedmann et al. (2020a))

Total CF – Breakdown by emission Scopes

Calculating emissions embodied in final demand of the Territory with EEIOA, results in Scope 3 emissions, modelled Scope 2 emissions and some of Scope 1 being allocated to ACT consumers ($S1_{\text{territorial}}$) and some to consumers outside the ACT ($S1_{\text{exported}}$). The modelled CF does not, however, include direct residential emissions (DRE), which need to be added separately. To increase consistency, the modelled Scope 2 emissions were replaced with those

reported in the ACT Greenhouse Gas Inventory 2019-20 (Strategy. Policy. Research, 2020). The final consumption-based CF breaks down into Scopes as follows (Figure 2-5):

$$CF_{\text{Total}} = S1_{\text{territorial}} + \text{DRE} + S2 + S3$$

Scope 3	Scope 3 emissions are all indirect emissions associated with the final consumption of goods and services in the ACT. Except for the consumption of electricity which creates Scope 2 emissions and emissions originating in the ACT, which belong to Scope 1.
Scope 2	Scope 2 values were adopted from the ACT Greenhouse Gas Inventory 2019-20 (Strategy. Policy. Research, 2020).
Direct residential emissions	These are part of Scope 1 (territorial) emissions in the ACT, see Section 2.2.2.
Scope 1_{territorial}	Scope 1 (territorial) emissions of industries in the ACT were derived from AGEIS (Section 2.2.2). Under consumption-based accounting, some of these emissions are linked to consumption outside the ACT and are therefore subtracted from the ACT carbon footprint.
Scope 1_{exported}	These are territorial industry emissions from the ACT that are embodied in exports of goods and services from the ACT. Since exported Scope 1 emissions are not part of the consumption-based carbon footprint, they are shown as negative emissions in the graphs.

Figure 2-5: Explanation of the composition of the ACT’s carbon footprint by emission scopes. Scope 1, direct residential and Scope 2 emissions are taken from various data sources, whereas Scope 3 emissions are calculated with input-output analysis. The thick border line indicates components of the consumption-based carbon footprint. Note that this is illustrative only and the size of the sections does not represent actual values for the ACT.

To summarise, total Scope 1 emissions, including direct residential emissions, as well as Scope 2 emissions were taken from published data sources, whereas Scope 3 emissions, as well as the ratio of territorial vs exported Scope 1 emissions were modelled, using EEIOA.

Total CF – Breakdown by emitting regions and by consumed product groups

Once the full carbon map has been calculated, Scope 3 emissions can conveniently be identified by industry and/or region of origin by summing up the rows and by consumed product groups by summing up the columns. An illustration is provided in Figure 3-3. The rows indicate the industry and the region from which GHG emissions originate that become embodied in goods and services consumed by ACT residents (shown in columns).

Summing up whole blocks of a region results in the total emissions originating in that region, which can also be called ‘emissions embodied in imports from region x’. All regions outside the ACT contribute to Scope 3 emissions. Emissions from ACT industries are classified as Scope 1 emissions. Results of the regional breakdown of the ACT’s CF are presented in Figure 3-6.

It is also possible to sum up all rows belonging to one industry, e.g. construction, which results in the total contribution of this industry to the carbon footprint. In other words, it provides a breakdown of the CF by the ultimate source of emissions. Such an analysis was undertaken to create Figure 3-7 and Figure 3-8.

More importantly perhaps, a breakdown by consumed product group was also provided as follows. Summing up columns in the carbon map that belong to one product group (e.g. Food) results in all the total of all emissions from any region or industry that become embodied in that product group. Effectively, it is the total carbon footprint of that good or service that is consumed in the ACT. Such a breakdown is presented in Figure 3-2.

The 26 economic sectors used in the EEIOA model of this study represent both industry sectors (where emissions come from) as well as broad product groups (wherein emissions become embodied). The names are shown in Table 2-1 (see also Figure 3-2) and Section 7.3 in the Appendix provides detail on which individual products are included in the broad product groups.

Table 2-1: 26 economic sectors used in the underlying EEIOA model; these represent both industries as well as product groups.

Sector number	Name of sector (industry / product group)
1	A = Agriculture, Forestry and Fishing
2	B = Mining
3	Food = Manufactured food products
4	Bev = Alcoholic beverages and tobacco
5	Cloth = Clothing and footwear

6	Rent = Rent and other dwelling services
7	Fuels = Liquid fuels
8	Furn = Furnishings and household equipment
9	C = Manufacturing
10	D1 = Electricity Services
11	D2 = Gas, Water and Waste Services
12	E = Construction
13	F = Wholesale Trade
14	G = Retail Trade
15	H = Accommod. & Food Serv. (restaurants, take-away)
16	I = Transport, Postal and Warehousing
17	J = Information Media and Telecommunications
18	K = Financial and Insurance Services
19	L = Rental, Hiring and Real Estate Services
20	M = Professional, Scientific and Technical Services
21	N = Administrative and Support Services
22	O = Public Administration and Safety
23	P = Education and Training
24	Q = Health Care and Social Assistance
25	R = Arts and Recreation Services
26	S = Other Services

Sector A (#1) includes agricultural products directly bought by ACT residents, e.g. on farmers' markets. Food (#3) includes all food bought in supermarkets and prepared at home. Take-away food and meals consumed in restaurants fall under category H (#15).

Total CF – Breakdown by final demand categories

The modelled results allow for a breakdown of the total CF by final demand categories, representing broad groups of final consumers. These are defined in the following way:

- a) **Households:** CF related to “Final Consumption Expenditure – Households” plus direct residential emissions.
- b) **Government:** CF related to the sum of “Final Consumption Expenditure – Government”, “Gross Fixed Capital Formation – General Government” and “Gross fixed capital formation –Public corporations”.

- c) **Businesses:** CF related to the sum of “Gross Fixed Capital Formation – Private” and “Changes in inventories”.

Final demand categories as defined by the Australian System of National Accounts (ABS, 2021g) are mutually exclusive, therefore no double counting occurs between household expenditure and other forms of final demand (Chen et al., 2016a);(ABS, 2021c)

2.1.7 Calculating future projections of the total CF through to 2050

The scenario-based IO table timeseries projections through to 2050 are based on the general approach described in Li et al. (2019). Calculating future projections requires assumptions relating to the direct emissions intensities of each sector per unit of output (DIMs), final demand (Y) and the structure of the economy (L). The DIMs associated with each sector will vary over time as a result of GHG mitigation and decarbonisation as well as growth in economic output, and future values can be estimated based on projections of future GHG emissions trajectories and economic growth. These trajectories vary substantively depending on assumptions relating to the level of ambition and the scale and pace of decarbonisation. Of particular interest for this study is the potential to reach net zero emissions in the ACT by 2050 and to pursue a highly ambitious global pathway that restrains warming to 1.5°C. In line with this objective, we base our future assumptions on existing scenario modelling studies and projections, both in Australia and globally.

Assumptions regarding GHG emissions trajectories for Australia for electricity, transport, agriculture and land, buildings, extractive sectors and manufacturing are based on the ‘1.5°C All-in’ scenario from ClimateWorks Australia (2020). This scenario models an emissions outcome for Australia that is compatible with limiting the global temperature increase to 1.5°C. The decarbonisation of the electricity sector is a precondition for decarbonisation throughout other sectors, enabling a shift away from fossil fuels in buildings, transport and other sectors. However, some residual emissions remain in hard-to-abate sectors such as agriculture and manufacturing which are compensated for with carbon forestry. The modelling includes carbon capture and storage (CCS) but excludes sustainable bioenergy with CCS (BECCS) which is a negative emissions solution. Changes in GHG emissions for each sector are provided for 2030 and 2050, and for this study the annual values are interpolated using a compound annual growth rate.

For other countries and regions, assumptions regarding GHG emissions trajectories are taken from the International Energy Agency (IEA, 2017) based on their most ambitious Beyond 2°C Scenario (B2DS). This scenario explores an energy system consistent with limiting average

future temperature increases to 1.75°C by 2100, which delivers global net zero emissions by 2060. Direct CO₂ emissions trajectories are modelled for industry, transport, power, transformation, and buildings/agriculture/other as well as 11 countries or regions (OECD, non-OECD, ASEAN, China, Brazil, EU, India, Mexico, Russia, South Africa and US). For consistency with the Australian projection, BECCS is excluded from the IEA trajectories. Projections are provided in five-yearly intervals, and for this study the annual values are estimated using linear interpolation. Non-energy GHG emissions associated with agriculture are not modelled in the IEA scenarios. Instead, we used projections from the science-based GHG emissions targets for agriculture, including for livestock and crops (Smith et al., 2016).

We assume that the final demand (y) of each country or region will increase in line with annual GDP growth projections, which are taken from the International Monetary Fund for the medium-term until 2030 (IMF, 2021) as well as long-term global projections through until 2050 (PwC, 2017, Li et al., 2019, IEA, 2017). For the purposes of this study, we assume that the structure of the economy (L) remains the same, with annual growth projections applied equally across sectors. This presents a limitation to the study method. However, the future structure of the global economy remains highly uncertain and an analysis of the implications of potential changes are beyond the scope of this study.

For both the national (ClimateWorks Australia, 2020) and global (IEA, 2017) GHG projections, sectoral projections are more aggregated than the 26 sectors used in the IO tables. To align these, a sectoral concordance matrix was used to apply relative changes for the aggregated sectors to the corresponding 26 industry sectors. Similarly, the global countries and regions used in the IO analysis differed somewhat to those used by the IEA (2017), and some alignment was necessary by assigning the best-fit regional grouping (e.g. OECD, non-OECD).

The projected emissions intensities and final demand were applied to the underlying economic structure defined by the 2018 input-output tables to generate carbon footprint projections. Per capita results were calculated based on ABS mid-range population forecasts for the ACT through until 2050 (ABS, 2017c).

2.2 Underlying Data Used in the Analysis

2.2.1 Input-Output Data

Data on the supply and use of products in the Australian economy and financial inter-relationships between Australian producers and consumers was sourced from the Australian

System of National Accounts, published by the Australian Bureau of Statistics (ABS, 2016, ABS, 2021h). Key data include the national Input-Output Tables, the national Supply Use Tables and the State Accounts, see Table 2-2 below. The other data sources in the table are used to refine the MRIOTs which are created by the optimisation routine of the IELab (Lenzen et al., 2014, Lenzen et al., 2017b)). Further information can be found in (Kenway and Joske, 2017).

The latest year for which the national IO tables are available is the financial year of 2017-18 (referred to in the report as 2018), which is why the most recent results presented in this report is 2018, even though some data sets in Table 2-2 are available for more recent years. The time series going back to 2008 uses previous releases of the same datasets.

The Australian System of National Accounts also outlines final demand categories which have been adopted in the Australian IELab (Lenzen et al., 2014).

Table 2-2: Summary of input-output data sources used for creating the MRIOTs for the analysis of the ACT's total carbon footprint

Title	Source	Latest release / year used	Reference
Australian Data			
Australian System of National Accounts	ABS Catalogue Number 5204.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/national-accounts/australian-system-national-accounts	2019-20	(ABS, 2021h)
Australian National Accounts: National Income, Expenditure and Product	ABS Catalogue Number 5206.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-national-income-expenditure-and-product	2020	(ABS, 2021d)
Australian National Accounts: Input-Output Tables	ABS Catalogue Number 5209.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-input-output-tables	2017-18	(ABS, 2021c)
Australian National Accounts, Input-Output Tables (Product Details)	ABS Catalogue Number 5215.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-input-output-tables-product-details	2017-18	(ABS, 2021b)
Australian System of National Accounts: Concepts, Sources and Methods, 2015	ABS Catalogue Number 5216.0, Australian Bureau of Statistics. https://www.abs.gov.au/ausstats/abs@.nsf/mf/5216.0	2016	(ABS, 2016)

Title	Source	Latest release / year used	Reference
Australian National Accounts: Supply Use Tables	ABS Catalogue Number 5217.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-supply-use-tables	2018-19	(ABS, 2021f)
Australian National Accounts: State Accounts	ABS Catalogue Number 5220.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-state-accounts	2019-20	(ABS, 2021e)
Household Expenditure Survey, Australia	ABS Catalogue Number 6530.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/economy/finance/household-expenditure-survey-australia-summary-results	2015-16	(ABS, 2017a)
Value of Agricultural Commodities Produced, Australia	ABS Catalogue Number 7503.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia	2018-19	(ABS, 2021i)
Australian Industry	ABS Catalogue Number 8155.0, Australian Bureau of Statistics. https://www.abs.gov.au/statistics/industry/industry-overview/australian-industry	2018-19	(ABS, 2021a)
Census of Population and Housing 2016	Australian Bureau of Statistics. http://www.abs.gov.au/census	2016	(ABS, 2019)
Global Data			
FishStatJ - Fishery and Aquaculture Statistical Time Series	Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. http://www.fao.org/fishery/statistics/en	2018	(FAO, 2020)
Value of Agricultural Production	Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. http://www.fao.org/faostat/en/#data/QV	2018	(FAOSTAT, 2018)
Industrial Commodity Production Statistics Database	United Nations, New York, USA. http://www.unido.org/resources/statistics/statistical-databases.html	2018	(UNIDO, 2019a)
Industrial Statistics Database at the 4-digit level of ISIC (INDSTAT4)	United Nations, New York, USA. http://www.unido.org/resources/statistics/statistical-databases.html	2018	(UNIDO, 2019b)
National Accounts Official Data	United Nations Statistics Division, New York, USA. http://data.un.org/Browse.aspx?d=SNA	2018	(UNSD, 2019a)
UN comtrade - United Nations Commodity Trade Statistics Database	United Nations Statistics Division, UNSD, New York, USA. http://comtrade.un.org	2018	(UNSD, 2019b)

Title	Source	Latest release / year used	Reference
UN ServiceTrade	United Nations Statistics Division, UNSD, New York, USA. https://unstats.un.org/unsd/servicetrade/default.aspx	2018	(UNSD, 2019c)
National Accounts Main Aggregates Database	United Nations Statistics Division, New York, USA. https://unstats.un.org/unsd/snaama	2018	(UNSD, 2020)

For the global part of the MRIOT created in this project, multiple sources for input-output-related data were used, mostly from United Nations statistics. See Table 2-2 for details. Further information on the estimation of global MRIO tables can be found in Lenzen et al. (2012).

2.2.2 GHG Emissions Data

Data on greenhouse gas emissions from the Australian Greenhouse Emissions Information System (AGEIS) include the National Inventory by Economic Sector (ANZSIC), the Australian National Greenhouse Gas Inventory (NGGI) and the State and Territory Greenhouse Gas Inventories.

- **Australian Greenhouse Emissions Information System:** The AGEIS is an online database that provides detailed greenhouse gas emissions data from the National Greenhouse Accounts (DISER, 2021a). It includes the National Greenhouse Gas Inventory (NGGI) by UNFCCC classification (DISER, 2021c), by Kyoto Protocol classification (DISER, 2021b), as well as the two following inventories:
- **National Inventory by Economic Sector:** The National Inventory by Economic Sector (DISER, 2021d, DISER, 2021f) provides greenhouse gas emission estimates by economic sector (Australia-New Zealand Standard Industry Classifications (ANZSIC)) rather than by International Panel on Climate Change sector, provided in the NGGI.
- **State and Territory Greenhouse Gas Inventories:** The State and Territory Greenhouse Gas Inventories (DISER, 2021e, DISER, 2021h) provide an overview of annual greenhouse gas emission estimates for each Australian state and territory. These inventories are a disaggregation of the data contained in the National Inventory Report submitted to the UNFCCC each year.

The Australian National Inventory by Economic Sector (ANZSIC) data are more aggregated than the 26 sectors used in the input-output model for this study; whereas the Australian National Greenhouse Gas Inventory (NGGI) data provides more detail by source of emissions but with some gaps (i.e. data confidentiality and data not available).

Hence, a process of aggregation and disaggregation was adopted in the IELab to match the industry sector breakdown. The process for updating GHG data in the IELab can be summarised in 3 steps:

- 1) IELab's 2009 MRIOT solution (26 industry sectors or 'input-output product groups', IOPG) is used as the initial estimate, as an unusually large amount of disaggregated primary data was available for that year;
- 2) Primary data from ANZSIC and NGGI is aligned with blocks of data from the IOPG sectors. For example, Division B in ANZSIC aligns with the following 6 IOPG sectors:
 - a. Coal mining;
 - b. Oil and Gas Extraction;
 - c. Iron Ore Mining;
 - d. Non-Ferrous Metal Ore Mining;
 - e. Non-Metallic Mineral Mining; and,
 - f. Exploration and Mining Support Services.
- 3) Finally, the IELab data is calibrated using best available data from ANZSIC and NGGI, such that total IELab direct emissions for 2008 to 2018 match the combined AGEIS and state inventory totals.

The process of 'feeding' greenhouse gas emissions data into the IELab and combining it with economic (IO) data is called a 'datafeed'. This is a Matlab script that reads original GHG emissions data from Australia and globally from the data sources provided in Section 2.2.2. It then cleans the raw data by replacing non-readable or non-available entries with [NaN] and maps them from their original classification to the root classification of the IELab, using total industry output as proxy to attribute emission totals pro-rata to sub-sectors. The final step aggregates emissions from detailed root sectors to the target classification of the final EE-MRIO table (based on the root-to-target concordance).

The EEIOA model calculates Scope 2 emissions as those embodied in the purchase of electricity by ACT residents. However, these calculations are based on financial transactions which do not necessarily reflect the exact amount of kWh or electricity consumed and the location of electricity generation is modelled top-down (see Section 2.3.5), rather than derived from bottom-up data. For increased accuracy and consistency with published sources, the Scope 2 estimates from the ACT Greenhouse Gas Inventory 2019-20 (Strategy. Policy. Research, 2020) were used directly to replace the modelled values.

Direct CO₂-eq emissions from residential households are not related to industries and are therefore not covered under the standard *industrial* classifications (ANZSIC). Instead, AGEIS classes these emissions as “Residential” and includes them at the bottom of the inventory with a resolution of “Non-transport” and “Transport” (DISER, 2021g). As these emissions are never embodied in the supply chain of goods and services in the economy, the direct residential emissions are simply added separately to the total CF (see Chen et al. (2016a) and Wiedmann et al. (2006)).

This same procedure is used for Australian data as well as GHG emissions for all other countries and world regions in the model. International GHG emissions data were sourced from the EDGAR database (Janssens-Maenhout et al., 2017). All GHG emissions were considered for the analysis. Totals are expressed in kilotonnes of CO₂ equivalent emissions (kt CO₂-eq) or in tonnes of CO₂ equivalent emissions per person (t CO₂-eq/cap). The 100-year time horizon global warming potentials (GWP) relative to CO₂ were adapted from the IPCC Fifth Assessment Report, 2014 (IPCC, 2014).

2.3 Limitations, Assumptions and Uncertainty

2.3.1 Aggregation of Model Sectors

The primary weakness of IOA is the way in which individual activities (financial transactions) are aggregated into a limited number of economic sectors (Wiedmann, 2010). The IO data used in this study has a resolution of 26 sectors for each of the eight Australian and 13 countries / world regions, which is a simplification of the actual composition of the Australian and global economy. The breakdown of a city’s CF is therefore limited to an understanding of the consumption patterns at an aggregated sector level (e.g. manufacturing) rather than a product level (e.g. fridges).

Furthermore, the aggregation of industry sectors assumes homogeneity of products or organisations within that sector. Any change in emissions or spending by one organisation is therefore assumed to have the same impact as a change made by another organisation within the same industry. While this may not affect an understanding of the total city CF, such a limitation makes it difficult to quantify and track the impact of singular products or organisations; for example, if a city authority chose to target particular food types or brands as part of their emission reduction efforts. Wiedmann (2010) proposes that a hybrid LCA could resolve this issue as it combines top-down accounting processes with a bottom-up approach.

However, such a process is more labour intensive and is more difficult to update (Wiedmann, 2010).

2.3.2 Age and Timeframes of EEIO and GHG Data

National economic and environmental accounts are published annually by the ABS with a delay of about two years (Wiedmann, 2010). This study used underlying data from the Australian National Accounts input-output tables published by the ABS in 2021. The most recent IO tables use economic data from the 2017-18 financial year; GHG accounts were taken for the year 2018; the population for all regions was taken as at June 2020 (ABS 2020). While it is unlikely that the composition of the Australian economy and GHG emissions would have changed dramatically since 2018, issues in data availability meant that a more recent CF could not be calculated.

2.3.3 Land use, land-use change and forestry (LULUCF)

Direct industry emissions for Australia were taken from the AGEIS database (DISER, 2021a). Emissions relating to land use, land-use change and forestry (LULUCF) were removed from the data, as these emissions do not link clearly to production by specific industry sectors or specific household activities.

2.3.4 Assumption of Proportionality in Financial and Physical Flows

The MRIO model relies on economic data on transactional flows. These leads to two limitations in the model. First, different consumers may pay different prices for the same product. For example, large manufacturing industries will pay less for electricity and gas per unit than private households. The model assumes an average price for each product group which is homogeneous across intermediate and final demand. This basically means that proportionality between financial and physical flows is assumed, i.e. if a consumer pays twice the price they are assumed to consume twice the quantity of that product. Second, prices may also fluctuate of the period of one year (Wiedmann, 2010). In this case, monthly or seasonal variations were levelled out by taking economic data for the entire 2017-18 financial period.

2.3.5 Non-Survey Methods for Regionalisation

The ABS publishes national SUTs, however IO tables for individual States and Territories are not derived due to data availability and methodological issues. Unfortunately there are limited data available to generate regional SUTs or IOTs via survey-based methods, which need sub-national industry production data, inter-regional trade flows, and the origin and destination

data from international imports or exports to ensure the tables are balanced accurately (Lenzen et al., 2017a).

As data on the flow of trade between regions is rarely available at the sub-national level, initial estimates for sub-national MRIOTs have traditionally been constructed using non-survey methods (Lenzen et al., 2017a). Ultimately, it is the responsibility of the analyst to assess whether the inter-regional transactions give the most meaningful results. The Australian IELab offers ten different non-survey methods for the purpose of trialling different regionalisation approaches. Non-survey methods are presented in Lenzen et al. (2017a) and Lenzen et al. (2014).

Three non-survey methods were used to balance the multi-regional SUTs in this study. The three methods were selected from the ten location quotient methods available in IELab (Lenzen et al. (2014)). Selection was based on a closeness of the results to an 'average' value for the total CF. Two other methods were selected to represent values for the upper and lower boundaries to the total CF. Research shows that national carbon footprint estimates using MRIO models have a standard error of about +/- 5% (Wiedmann, 2010). A separate uncertainty analysis based on Monte-Carlo Analysis was conducted in this study, see the following section.

2.3.6 Modelling Uncertainty

Due to the non-linear nature of the EEIOA model, the uncertainty of footprint results cannot be obtained analytically. Instead the uncertainty of model results can be obtained by using Monte Carlo Analysis which calculates the results many times by varying input / source data based on their uncertainty (Lenzen, 2011, Bullard and Sebald, 1988, Bullard and Sebald, 1977, Hondo et al., 2002). Specifically, in this study, the uncertainty of the raw data is captured by perturbing the parameters **f**, **T** and **y** using the standard deviation sourced from the raw input-output data. Then, the perturbed footprint results are calculated with 1000 perturbation runs. The Monte-Carlo-based uncertainty analysis captures the following stochastic variations: 1) raw data; 2) MRIO table; 3) GHG multipliers.

The interquartile range (IQR) is a measure of uncertainty that covers the middle 50% of carbon footprint results. It can be obtained from the probability density distribution of the perturbations. In comparison the standard deviation (SD), the IQR reports the range where 50% of results are located, whereas the SD covers 68% of the results in the distribution (Figure 2-6).

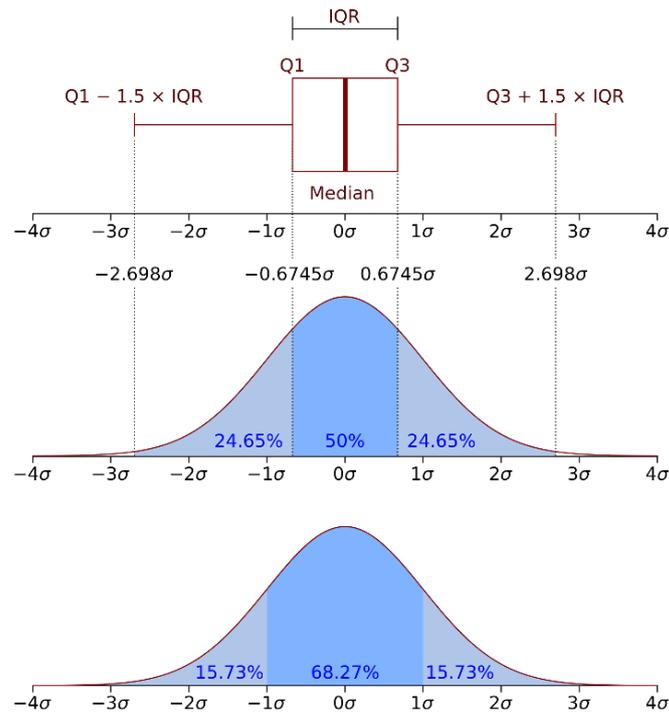


Figure 2-6: Comparison of interquartile range (IQR) and standard deviation (SD) as measures of uncertainty.

The difference between IQR and SD is that for data whose distribution is skewed (as in graph below), the standard deviation will be significantly affected by the outlier of the data, but IQR will have a better measure of central tendency by focusing on the median value.

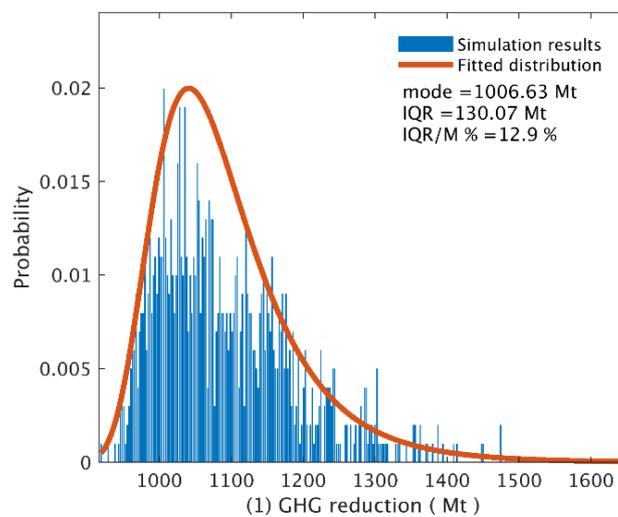


Figure 2-7: Example of a skewed (non-normal) distribution of data.

3 RESULTS and INTERPRETATION

This chapter presents the main findings of this study. The analysis has revealed interesting aspects of embodied emission flows related to consumption in the ACT. All carbon footprint results relate to final demand of goods and services within the ACT.

3.1 The ACT's total carbon footprint in 2018

3.1.1 Breakdown by Scope

The ACT's total carbon footprint (CF) in 2018 was 13,774 kt CO₂-eq, which equates to 34.7 t CO₂-eq/cap. Of this, 11,470 kt CO₂-eq (83.3%, 27.3 t CO₂-eq/cap) are Scope 3 emissions, making up the largest share of the total CF.

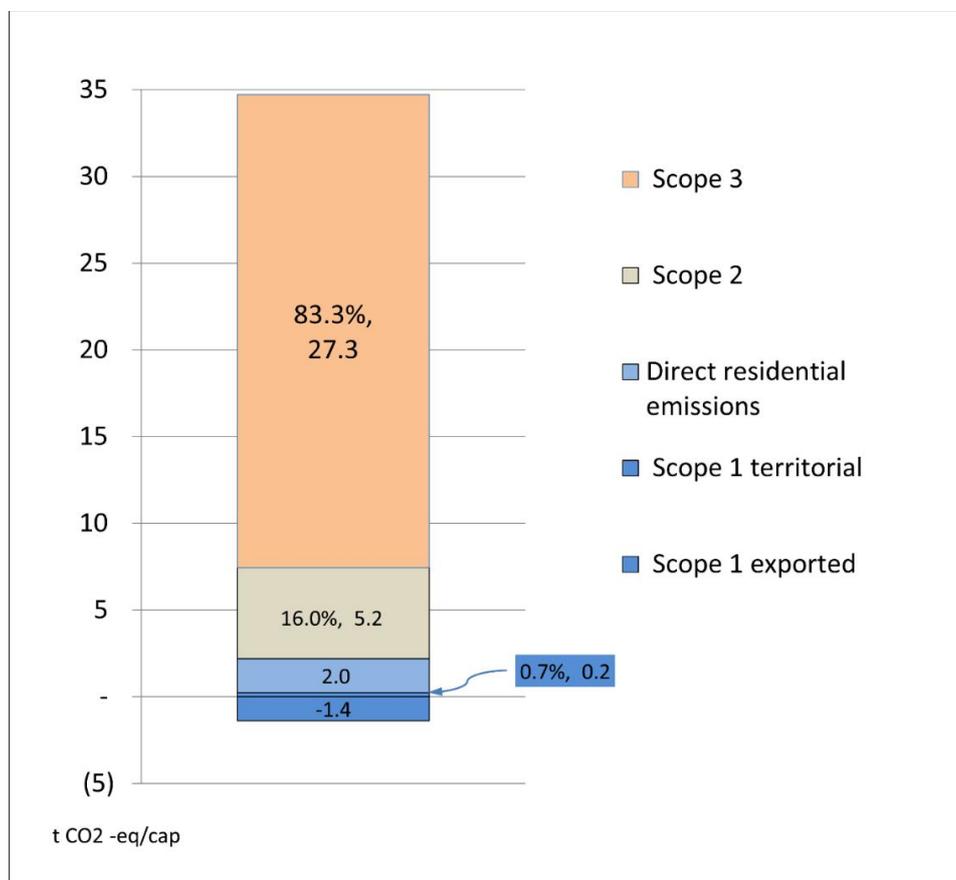


Figure 3-1: Total carbon footprint (CF) of the ACT including direct residential emissions. Exported Scope 1 emissions are shown as negative emissions, since they are not included in the CF because they become embodied in emissions consumed elsewhere and are thus the responsibility of the final demand regions outside the territory.

The results also show that 1.4 t CO₂-eq/cap of the territory's Scope 1 emissions become embodied in exports of goods and services that are produced in the ACT, but consumed elsewhere. This is 5.0 % of territorial emissions of the ACT.

The magnitude of embodied emissions associated with consumption in the ACT confirms that the Territory is a 'consumer city' as opposed to a 'producer city' (Sudmant et al., 2018, Lombardi et al., 2017). Similar assessments of Australian cities have also found that embodied GHG emissions are higher than the city's own direct territorial emissions (see Chen et al. (2016b)); for example, Greater Melbourne's CF is 43% embodied emissions (Wiedmann et al. 2016). This means that Australian cities rely on imported emissions - from Australia and the world - to satisfy their consumption habits. This is especially true for the ACT, where the Territory's size and geographical composition limits local production at a scale that meets the final demand of residents.

3.1.2 Breakdown of ACT CF by product group

A breakdown of the carbon footprint by product group, scope and origin helps to identify emission hotspots for the ACT. Figure 3-2 first identifies the contributions from the main product groups and to which emission scope they belong.

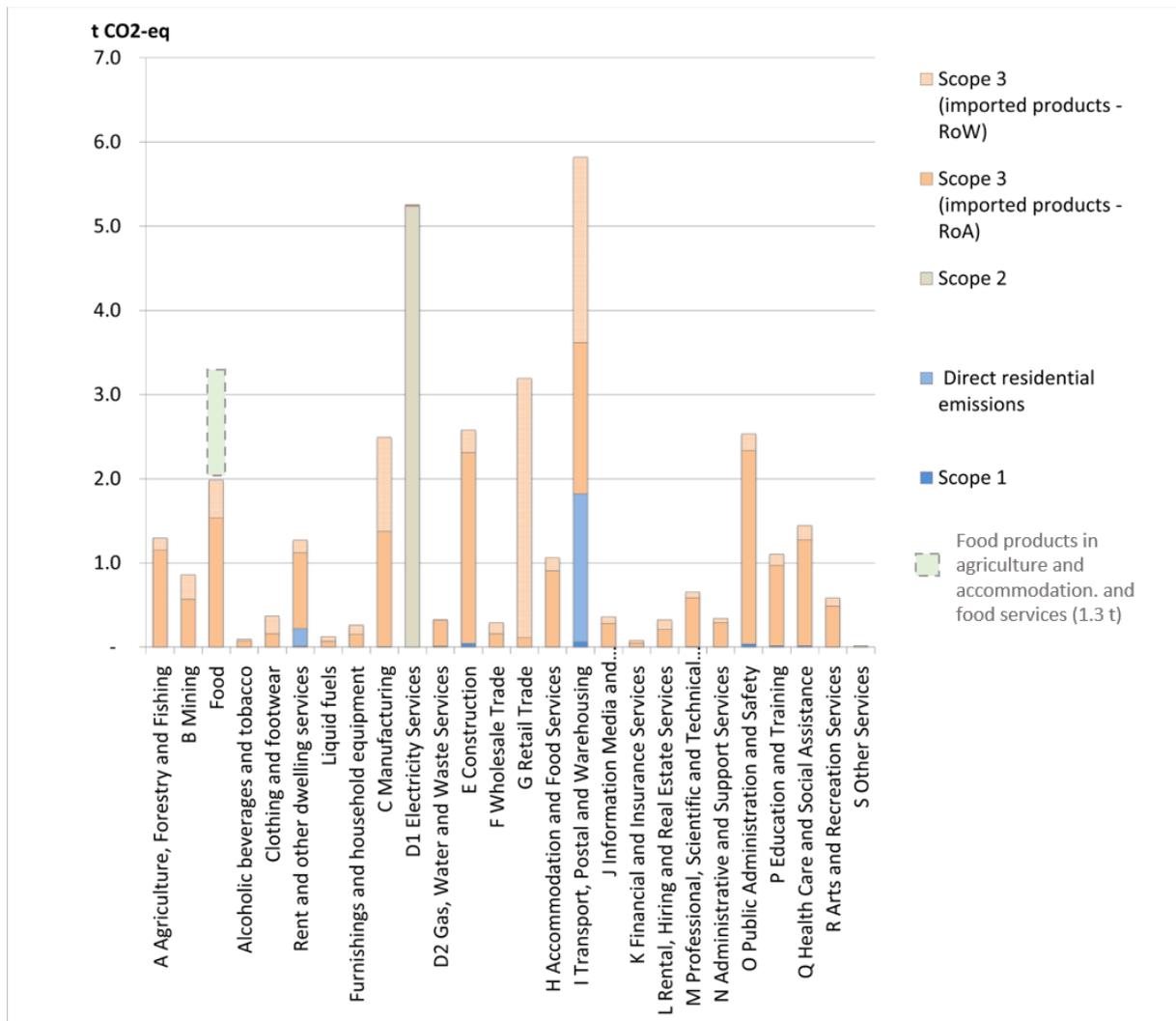


Figure 3-2 Total ACT CF with breakdown by main product group and emission scope. The green dotted bar above food shows the carbon footprint associated with food products sold to households from the agriculture, forestry and fishing sector (0.6 t CO₂-eq/capita) and accommodation and food services sector (0.7 t CO₂-eq/capita), representing around 65% of emissions from these two sectors.

The product groups that stand out are:

- 1) Transport, Postal and Warehousing (16.8%)
- 2) Electricity Services (15.1%)
- 3) Retail Trade (9.2%)
- 4) Construction (7.4%)
- 5) Public Administration and Safety (7.3%) – construction, buildings, equipment,
- 6) Manufacturing (7.2%), and

7) Food (5.7% or 9.9% including food items from other categories)¹

Transport, postal and warehousing, which includes public and private road, rail, air and marine transport, generates the highest carbon footprint. This footprint is notable for being high both within Canberra (due to direct residential emissions) and with a level of embodied emissions downstream from both the rest of Australia and internationally. This finding echoes the ACT Greenhouse Gas Inventory 2018–19 (reference) which found that transport was the highest contributing sector to ACT greenhouse gas emissions, represented over 40% of territorial emissions.

The model used does not further split transport, postage and warehousing into subcategories, however based on household expenditure data (ABS, 2017a) it is estimated that 13% of household expenditure in this category is air travel, approximately 0.37 t CO₂-eq per person per year. Additional footprint for government and business is also to be expected, although not estimated here.

Retail trade has a particularly high level of ‘scope 3-international imports’, particularly driven by international retail trade, manufacturing, and transport (see also Discussion section).

Construction, by contrast, is primarily driven by emissions in the rest of Australia, ultimately from manufacturing, electricity, gas, water and waste services, and the construction industry directly. Emissions reduction opportunities include reducing waste, increasing recycling and the use of low carbon materials (Yu et al., 2017).

Public administration includes such services as the police force, judicial and correctional system and defence force. The public administration carbon footprint is driven by electricity usage, and to a lesser extent agriculture, forestry and fishing, and gas, water and waste emissions in the rest of Australia.

The manufacturing industry footprint is largely self-created both within Australia and overseas, with a secondary driver of electricity usage. This is likely to reflect fuels burnt and

¹ Some food items are also included in the categories of agriculture, forestry and fishing (approx. 240 kt CO₂-eq) and accommodation and food services (approx. 294 kt CO₂-eq). If these food items were included in the food category above this would increase total food emissions to 1,367 kt CO₂-eq, which equates to 3.25 t CO₂-eq/cap or 9.9% of all emissions.

gases released in the manufacturing process. Manufacture of materials such as aluminium, steel and cement require significant amounts of energy.

The food carbon footprint is highly driven by agriculture, forestry and fishing within the rest of Australia, and is likely to include items such as methane from enteric fermentation in cattle and sheep, and greenhouse gases from manure management and fertilisers.

3.1.3 Breakdown of ACT CF by product group, scope and origin – The ACT’s Carbon Map

Using the ‘carbon map’ approach (Wiedmann et al., 2016), it is possible to show where the emissions were originally generated in the process of producing and providing the ACT with the goods and services it consumes. Figure 3-3 shows the ACT’s carbon map of 2018.

ORIGIN: Emissions from industries		DESTINATION: Emissions embodied in products																									
		GHG Emissions (kt CO2-eq per year)																									
		A	B	Food	Bev	Cloth	Rent	Fuels	Furn	C	D1	D2	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
RoW	A = Agriculture, Forestry and Fishing	32.2	4.2	65.6	1.9	11.1	4.9	0.9	3.0	43.0	0.1	0.3	9.3	2.2	32.5	13.1	46.3	1.7	0.6	2.3	3.1	2.1	10.9	6.0	7.0	4.1	0.5
RoW	B = Mining	2.4	20.7	9.3	0.9	7.3	7.3	5.5	8.1	68.3	0.5	0.3	12.9	4.2	80.1	6.4	75.6	2.5	1.3	6.4	3.1	1.8	7.9	6.2	9.5	4.1	0.4
RoW	Food = Manufactured food products	12.9	1.1	72.0	1.8	2.9	1.8	0.2	1.0	11.2	0.0	0.1	3.5	1.3	13.2	6.5	14.8	0.6	0.2	0.9	1.2	0.9	4.0	2.3	3.5	2.0	0.1
RoW	Bev = Alcoholic beverages and tobacco	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RoW	Cloth = Clothing and footwear	1.1	0.6	1.7	0.1	31.1	1.1	0.1	1.0	7.7	0.0	0.0	1.7	0.6	18.5	1.1	9.2	0.3	0.1	0.5	0.5	0.3	1.4	1.0	1.3	0.7	0.1
RoW	Rent = Rent and other dwelling services	0.0	0.1	0.1	0.0	0.1	1.3	0.0	0.0	0.7	0.0	0.0	0.2	0.0	0.9	0.1	1.1	0.0	0.9	1.8	0.1	0.0	0.1	0.1	0.1	0.1	0.0
RoW	Fuels = Liquid fuels	0.1	3.8	0.4	0.0	0.2	0.5	2.2	0.1	2.6	0.0	0.0	1.1	0.2	1.9	0.3	1.8	0.1	0.0	0.1	0.3	0.1	0.7	0.4	0.5	0.2	0.0
RoW	Furn = Furnishings and household equipment	0.3	0.9	0.8	0.1	2.4	0.8	0.2	6.1	9.2	0.0	0.0	1.5	0.4	7.5	0.6	7.5	0.4	0.1	0.4	0.4	0.2	1.1	0.7	0.9	0.6	0.0
RoW	C = Manufacturing	5.3	23.5	16.1	1.5	19.3	13.8	6.7	15.7	193	0.4	0.6	25.8	6.1	108	11.9	119	5.4	2.2	7.7	6.8	4.0	18.3	11.7	15.0	8.4	1.3
RoW	D1 = Electricity Services	3.3	58.1	10.9	0.9	5.5	15.7	5.7	5.6	75.4	38.1	1.2	31.2	4.6	51.7	11.7	210	4.9	1.3	5.2	8.6	4.5	23.0	14.0	19.5	8.6	0.4
RoW	D2 = Gas, Water and Waste Services	1.2	5.5	3.8	0.3	4.8	2.5	1.0	2.3	21.1	0.5	0.1	4.6	1.2	21.4	2.0	27.7	1.2	0.3	1.4	1.4	0.8	3.9	2.3	2.7	2.8	0.1
RoW	E = Construction	0.3	2.0	0.7	0.1	0.4	4.2	0.2	0.3	3.4	0.0	0.1	8.2	0.3	9.6	0.7	15.4	0.3	0.1	8.0	0.5	0.3	1.5	0.8	1.0	0.5	0.0
RoW	F = Wholesale Trade	0.1	0.0	0.3	0.1	0.1	0.1	0.0	0.1	0.5	0.0	0.0	0.1	11.6	19.7	0.1	1.7	0.1	0.0	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.0
RoW	G = Retail Trade	0.2	0.1	0.6	0.2	0.3	0.3	0.0	0.1	1.2	0.0	0.0	0.4	8.3	741	0.8	4.8	0.1	0.0	0.4	0.1	0.1	0.4	0.3	0.4	0.2	0.0
RoW	H = Accommod. & Food Serv. (restaurants, take-	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.6	2.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RoW	I = Transport, Postal and Warehousing	1.9	2.3	5.5	1.1	3.0	7.4	0.8	2.1	27.8	0.1	0.8	10.2	13.5	181	6.5	380	15.6	1.4	7.9	3.0	6.3	9.4	6.8	6.5	3.7	0.2
RoW	J = Information Media and Telecommunications	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.1	0.0	0.5	0.0	0.8	0.6	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.0
RoW	K = Financial and Insurance Services	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.4	0.0	0.6	0.0	3.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0
RoW	L = Rental, Hiring and Real Estate Services	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.2	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RoW	M = Professional, Scientific and Technical Services	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.7	0.0	0.0	0.1	0.0	0.8	0.1	0.7	0.2	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.2	0.0
RoW	N = Administrative and Support Services	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.5	0.1	1.1	0.2	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0
RoW	O = Public Administration and Safety	0.1	0.1	0.2	0.0	0.2	0.3	0.0	0.1	1.0	0.0	0.0	0.4	0.1	2.3	0.2	5.2	0.1	0.1	0.2	0.2	0.1	0.4	0.4	0.4	0.3	0.1
RoW	P = Education and Training	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.1	0.1	0.0
RoW	Q = Health Care and Social Assistance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.1	0.2	2.2	0.0	0.0
RoW	R = Arts and Recreation Services	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.5	0.0	0.0	0.1	0.0	1.5	0.1	0.5	0.2	0.2	0.2	0.1	0.0	0.1	0.5	0.1	3.3	0.0
RoW	S = Other Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	1.4	0.0

Figure 3-3: Aggregated version of the ACT's carbon map in 2018. The full size of the carbon map is 1092 rows and 1092 columns, showing all 21 regions and 26 sectors of the IO model. For illustration purposes, the full map was condensed into three regions: ACT, Rest of Australia (RoA) and Rest of World (RoW) (the figure stretches over two pages). The sum of all numbers in the carbon map adds up to the total CF of the ACT. Carbon hotspots in the map are highlighted. A detailed explanation of the map is provided in the main text. Sector labels are included in rows and abbreviated for columns.

How to Read the Carbon Map? The carbon map identifies the origin of emissions from industries (rows) and the destination of their embodiment in (allocation to) products (columns). The blue section shows Scope 1 emissions (those originating from industries in the Territory) that become embodied in products consumed in the ACT.

As an example, the first number in the map in the upper left corner shows GHG emissions (0.53 kt CO₂-eq) from ACT agriculture, forestry and fishing (most of these would be farming within the ACT) that are embodied in farming products that ACT residents buy (e.g. when residents buy directly from an ACT farmer at the farmer's market). The number under the column labelled "O" in the first row (1.14 kt CO₂-eq) are associated with goods and services that Public Administration require from ACT farmers, foresters and fishers. It is likely these are related to the maintenance of urban parks or food catering for events. At the intersection of the column/row labelled I / Transport, Postal and Warehousing is the largest number in the blue section (26.2 kt CO₂-eq). These are from companies of that sector selling transport and associated services to ACT residents. The majority of these emissions are likely to come from ACT taxi companies, public (fossil-fuelled) transport and couriers. ACT freight/delivery companies delivering transport services to construction in the ACT contribute 0.34 kt CO₂-eq (intersection of row ACT-I and column E). There are no emissions from power stations in the ACT, that is why all of row D1 is zero (Scope 2).

The orange sections show Scope 3 emissions from Australia outside the ACT (RoA rows) and from other countries (RoW rows) that have become embodied in products consumed by ACT residents (columns). As can be seen from the other figures, Scope 3 emissions constitute the majority of the ACT's carbon footprint. For example, the 27th row of the map shows emissions from the agriculture, forestry and fishing sector in Australia; mostly from farming in NSW, Victoria and other states. Most of these emissions become embodied in products sold directly by farms, e.g. at farmers' markets (450 kt CO₂-eq, first column), or they become embodied in processed food products that are sold in supermarkets and food shops (406 kt CO₂-eq, third columns). Note that these farms, supermarkets and food shops are not necessarily located within the ACT as ACT residents may buy some of their food products in NSW or other regions. In fact, about 66 kt CO₂-eq of the emissions embodied in food products bought by ACT residents come from overseas. This is shown at the intersection of the first row of the RoW section with the third column (row RoW-A, column Food).

A large amount of emissions (more than 1,863 kt CO₂-eq) comes from fossil-fuelled Australian power stations outside the ACT (row RoA-D1). These are not Scope 2 emissions but rather emissions from electricity required for the production of other products consumed by ACT residents, e.g. in manufactured products (column C, 152 kt CO₂-eq) or construction goods or services (column E, 260 kt CO₂-eq). ACT residents also consume transport, public, education and health services from outside the ACT that require electricity, leading to emissions of 129, 484, 127 and 148 kt CO₂-eq from non-ACT power stations, respectively (columns I, O, P and

Q). All of these are Scope 3 emissions as they are embodied in the supply chain of the production of non-electricity products. With one exception, which is electricity consumed in the ACT but coming from outside the ACT. The associated emissions fall under Scope 2 and are shown at the intersection of column RoA-D1 and column D1. There were still emissions in the year 2018, but as of the year 2020, these Scope 2 emissions have become zero, since all ACT electricity consumers receive power from renewable sources.

Construction activities in the ACT (column E) – most of which would be financed through public or private investment in infrastructure or building projects – create most of their emissions outside the ACT, more precisely through the use of electricity, gas and other construction services in the rest of Australia (260, 209 and 127 kt CO₂-eq, respectively, in rows RoA-D1, RoA-D2 and RoA-E). About 26 kt CO₂-eq are generated globally, outside of Australia, through the manufacturing of construction products used in ACT construction (row RoW-C).

Big hitters from overseas emissions include, for example, foreign retail trade (RoW-G, column G, 741 kt CO₂-eq), transport services (RoW-I, column I, 380 kt CO₂-eq), or manufacturing (RoW-C, column C, 193 kt CO₂-eq).

3.1.4 Breakdown of ACT CF by final demand group

Breaking down the total CF by final demand highlights responsibility for generating emissions through the level and pattern of consumption or investment. Figure 3-4 shows that household demand dominates; 2.0 kt CO₂-eq/cap comes from direct residential emissions – such as driving private cars and heating homes – and the rest come from emissions linked to industry-based products (14.6 kt CO₂-eq/cap).

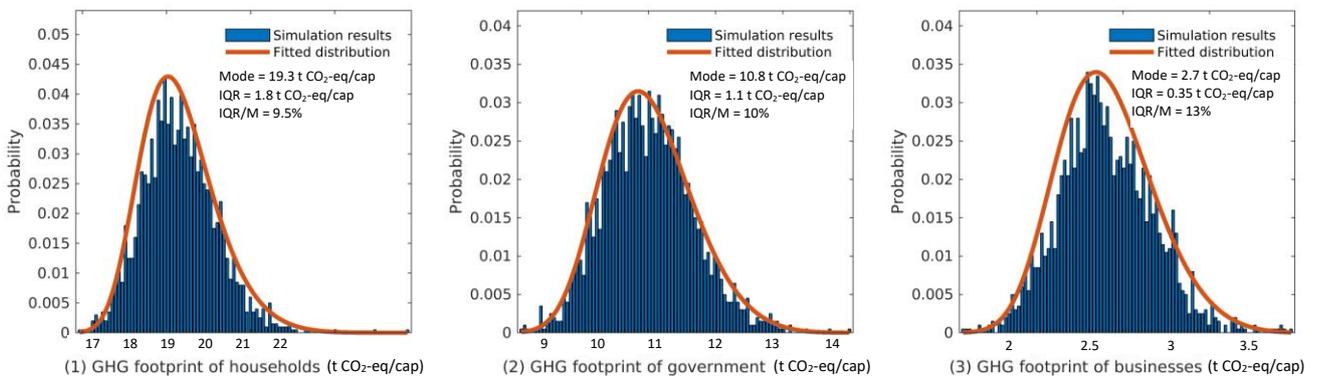
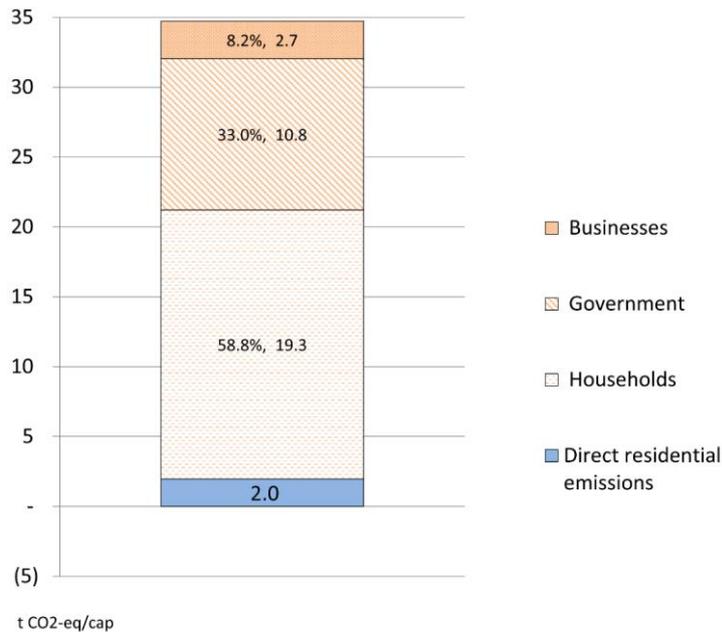


Figure 3-4: Breakdown of ACT CF by business, government and household consumption groups in t CO₂-eq/cap (upper graph). The lower row of figures show the uncertainty results for the three categories, with the interquartile range (IQR) covering 50% of the data observed with Monte-Carlo Analysis.

It is clear from Figure 3-4 that household consumption is the main driver of the ACT’s total carbon footprint, however, government also generates a significant proportion of emissions (33.0%). The majority of business costs are passed through the supply chain to other end-users, and accordingly the business sector (8.2 % of total ACT carbon footprint) mostly relates to the generation of assets held by businesses such as buildings and other machinery and equipment.

A further breakdown of sectors and consumption groups shows the drivers of carbon footprint in more detail (Figure 3-5).

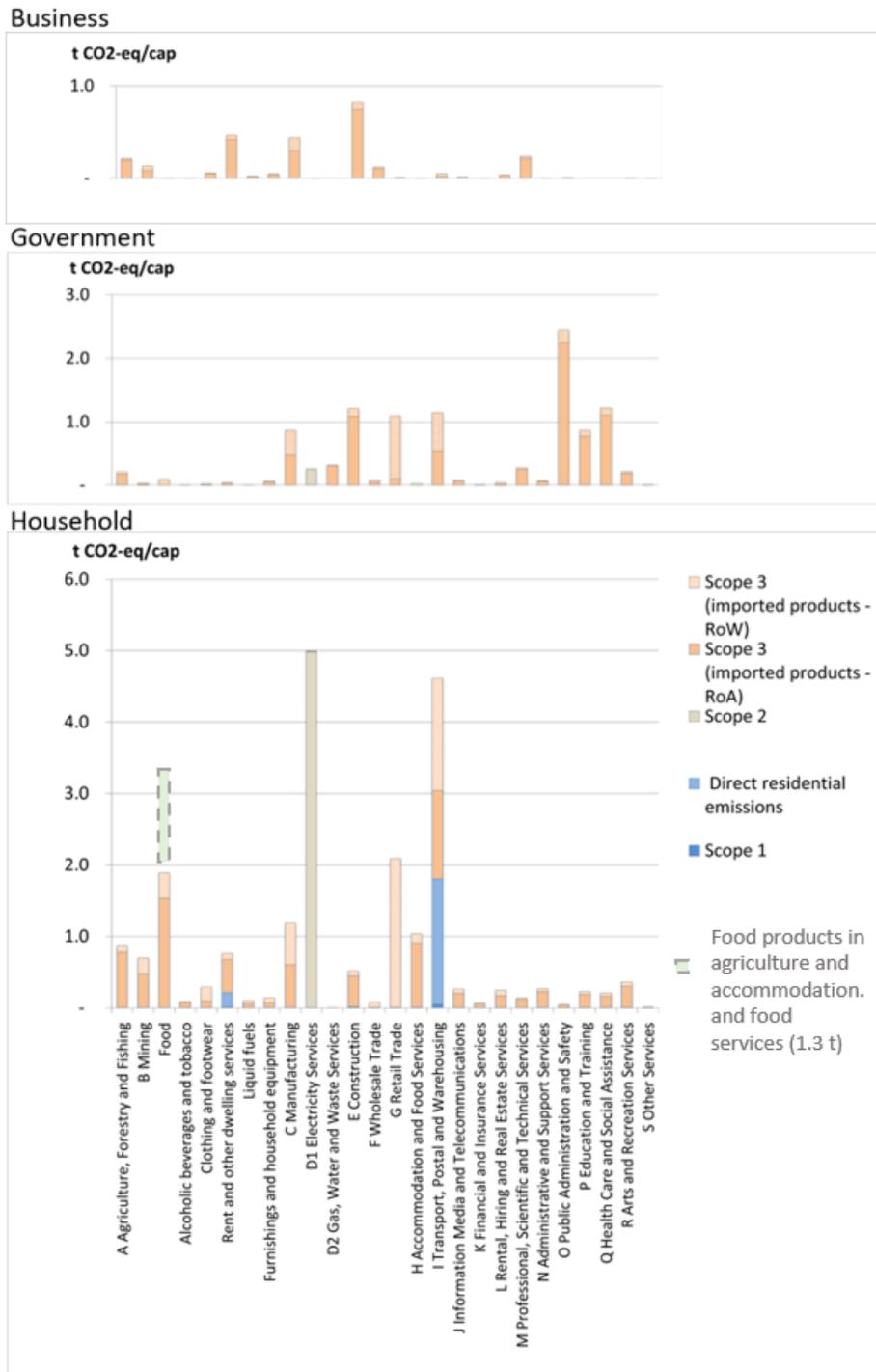


Figure 3-5: Total ACT CF with breakdown by emission scope and industry sectors for Business (top), Government (middle) and Household (bottom) final demand. The green dotted bar above food shows the carbon footprint associated with food products sold to households from the agriculture, forestry and fishing sector (0.6 t CO₂-eq/capita) and accommodation and food services sector (0.7 t CO₂-eq/capita), representing around 65% of emissions from these two sectors.

The impact of ACT businesses is dominated by embodied emissions related to construction activities.

Government embodied emissions are largely derived from government services provided by the rest of Australia, with secondary priorities of healthcare, construction and education within Australia, and retail trade outside Australia.

Household emissions, by contrast, are overwhelmingly related to transport sectors, with a further strong impact from international retail trade and Australian food. Some food items are also included in the categories of agriculture, forestry and fishing (approx. 240 kt CO₂-eq) and accommodation and food services (approx. 294 kt CO₂-eq). If these food items were included in the food category above this would increase total food emissions for households to 1,327 kt CO₂-eq, which equates to 3.16 t CO₂-eq/cap for households or 16.4% of all household emissions.

Scope 2 emissions have been allocated between households and sectors on the basis of financial data from the MRIO tables.

3.1.5 Breakdown of ACT CF by national and international regions (emissions embodied in imports)

The total CF can also be broken down to see where emissions are coming from. International imports (28.8%) and imports from Queensland (19.0%), NSW (17.8%) and Victoria (13.2%) make up over three quarters of embodied emissions (Figure below). This reflects the extent of trade networks that the ACT relies on.



Figure 3-6: Breakdown of ACT CF by Australian States and Territories and main international trading partners of Australia (in t CO₂-eq/cap)

Queensland, Victoria and New South Wales are dependent on black and brown coal-fired power (Global Roam (2018)). This means that any products originating from these regions will have significant embodied emissions which are passed through the supply chain.

This analysis will be useful for the ACT in framing current and future supply chain relationships. Partnerships with suppliers and supplying regions ('insetting') will be important to reduce Scope 3 emissions. They also have the added benefit of generating multiple positive sustainable impacts for all parties (Insetting Platform 2018).

Imports from other Australian states and territories

The following analysis shows emissions from the source, where the CF of the ACT ultimately originates. Based on the results of this analysis it is evident that *electricity, agriculture, forestry and fishing, and gas, water and waste* dominate the emissions embodied in imports (EEI) to the ACT from the RoA (Figure 3-7). Together the three sectors make up 69% of EEI from RoA, and 48% of the ACT's total CF.

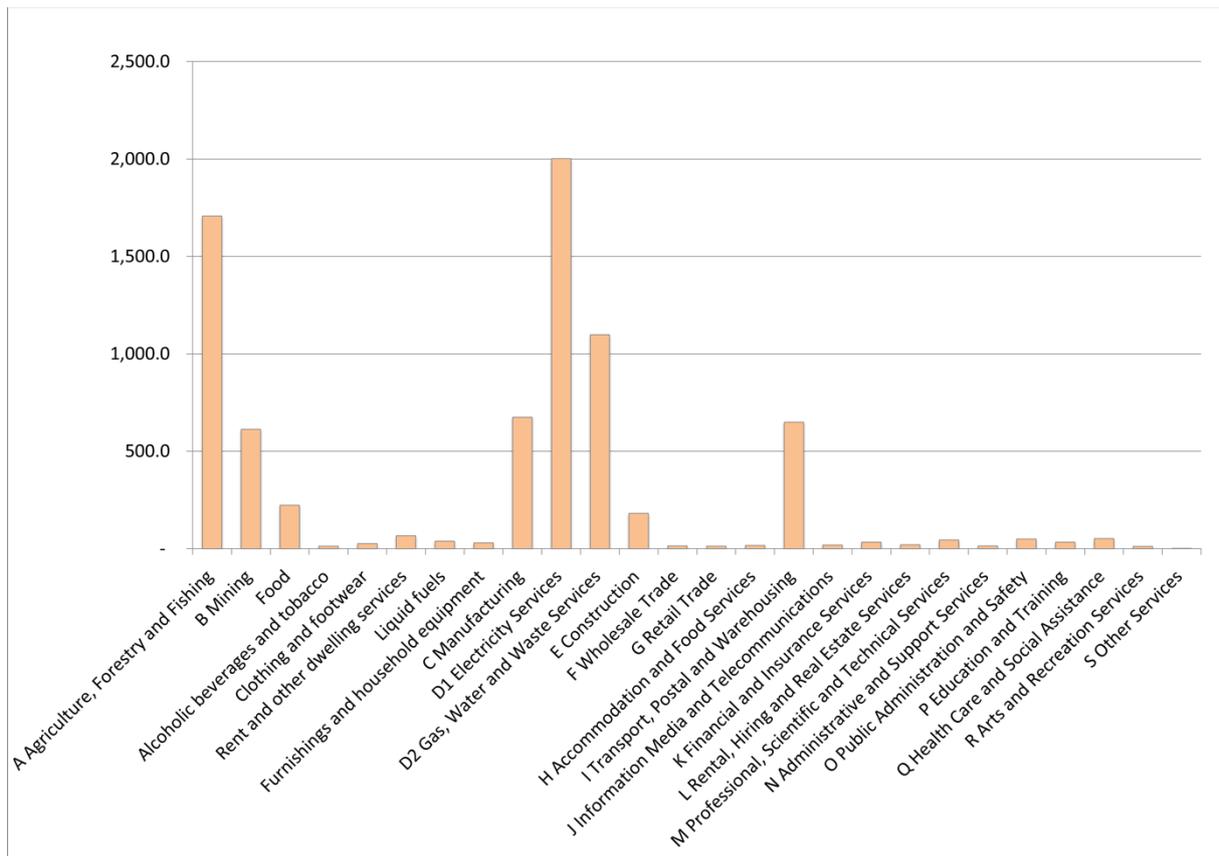


Figure 3-7: Industry emissions associated with imports from the rest of Australia (RoA) to final demand in the ACT in kt CO₂-eq (direct residential emissions not included).

International imports

Hotspots for EEI from RoW include retail trade, manufacturing, transport and electricity. Together the four sectors make up 71% of EEI from RoW, and 22% of the ACT’s total CF (Figure 3-8).

EEI are a growing issue for efforts to decarbonise. Around one quarter of global CO₂ emissions are embodied in imported goods. They are also difficult to reduce as it is much harder to effect change on products that are produced outside the Territory’s boundary. This is especially true as supply chains lengthen from expanding global trade flows.

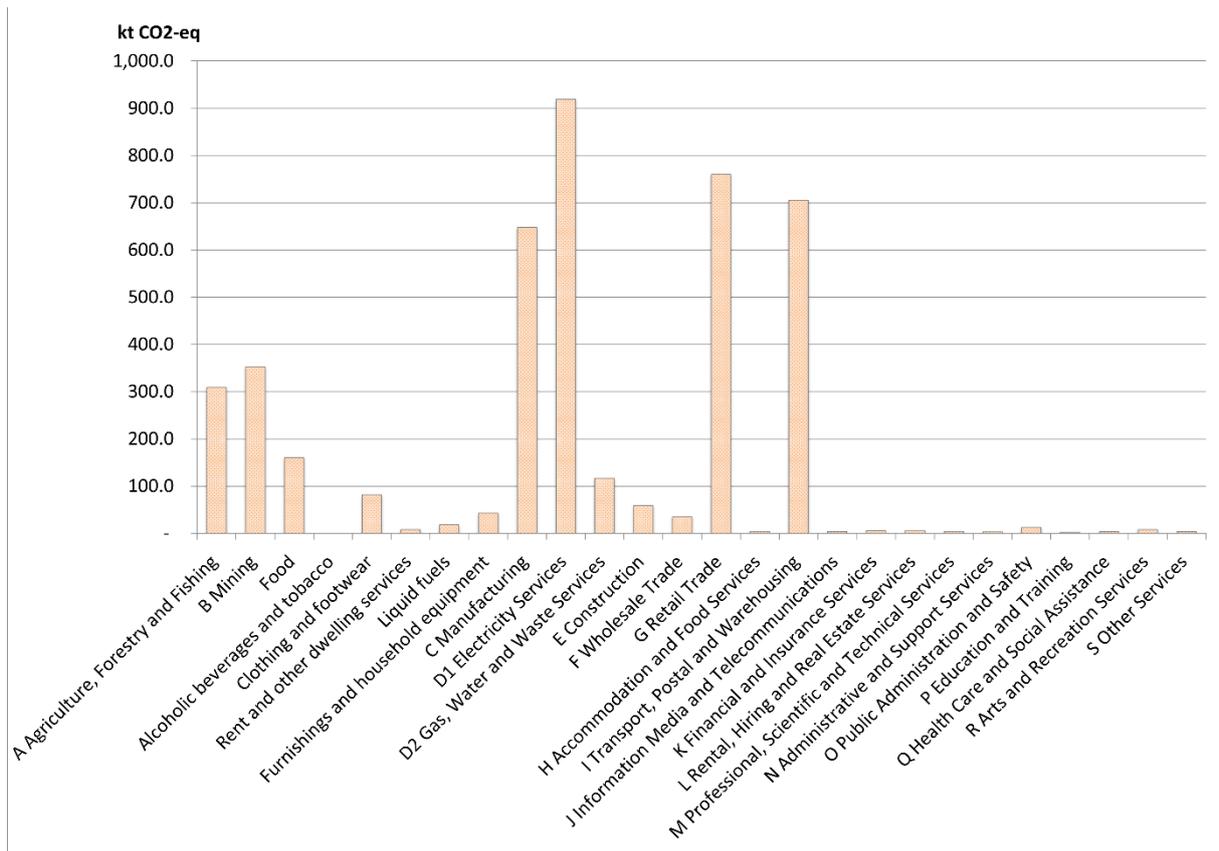


Figure 3-8: Industry emissions associated with international imports to final demand in the ACT (direct residential emissions not included).

3.2 ACT carbon footprint time series 2009-2018

Since 2009, the ACT carbon footprint has dropped from 14,900 kt CO₂-eq to 14,600 kt CO₂, or a reduction from 42.0 to 34.7 t CO₂-eq per person, with an increase in population from 355,785 to 420,379 people. Throughout this 10-year period, Scope 3 emissions made up the largest share, between 77 and 80%, of the total carbon footprint.

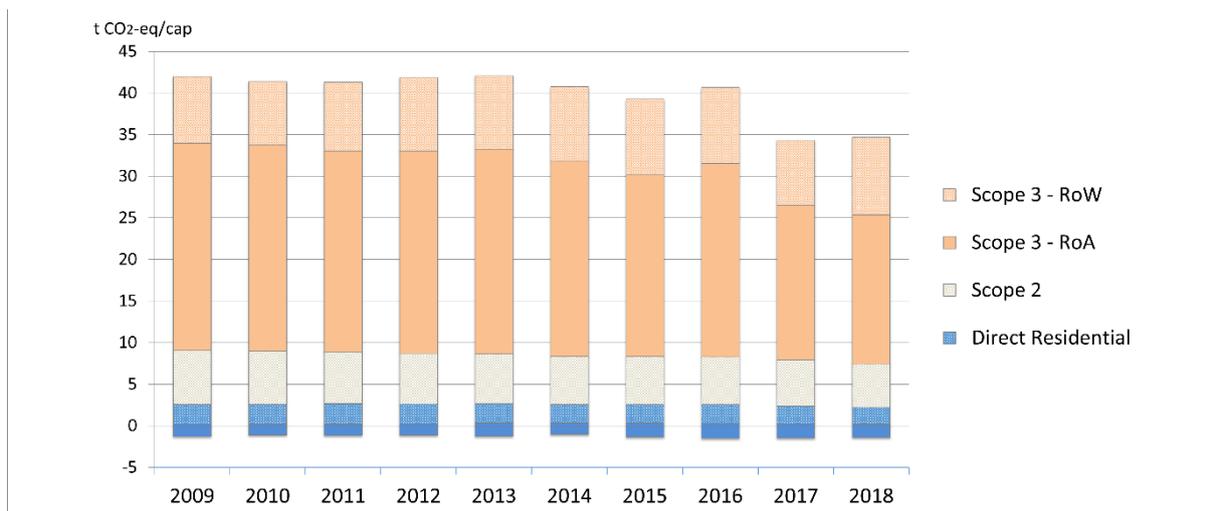


Figure 3-9: ACT carbon footprint per capita 2009-2018.

For comparison, C40 Cities (2018) reports that the average value of CFs for C40 cities is 10.7 t CO₂-eq/cap. This suggests that all Australian regions, including the ACT, are well above the global average. In their Emissions Gap Report for 2020, UNEP estimated that the global average CF needed to keep global warming within the 1.5°C goal of the Paris Agreement is 2-2.5 t CO₂-eq by 2030. Additionally, evidence indicates that for a 66% chance of staying within the ‘global budget’ for CO₂ emissions, global net emissions must be brought to zero by 2050 (Figueres et al., 2017).

3.3 ACT carbon footprint projections 2019-2050

The results for the future projections based on a 1.5°C or similar trajectory show a rapid decline in the per capita CF, falling to approximately 3.7 t CO₂-eq per capita by 2050 (Figure 3-10). The remaining CF is largely comprised of Scope 3-ROW emissions (2.4 t CO₂-eq per capita) and Scope 3-ROA emissions (1.1 t CO₂-eq per capita). The rapid decline in CF is driven by assumptions on ambitious future emissions mitigation trajectories modelled for Australia (ClimateWorks Australia, 2020) and globally (IEA, 2017), and could be considered ‘best case’ scenarios. While the reductions are significant, the trajectory fails to reach a net-zero CF outcome for the ACT by 2050, highlighting that such an outcome is closely tied to the decarbonisation of the economy in the whole of Australia and with our key global trading partners.

It is worth noting that the emissions modelling by (ClimateWorks Australia, 2020) for Australia achieves a net-zero outcome by 2050 through the inclusion of substantial offsetting through carbon forestry (~8 Mha of plantings, nationally). Similarly, the global modelling by IEA (2017) reaches a net zero outcome by 2060 through the inclusion of negative emissions technologies (BECCS). The projections in Figure 3-10 for the ACT exclude the use of offsets or negative emissions technologies, which would provide opportunities for reaching absolute carbon neutrality.

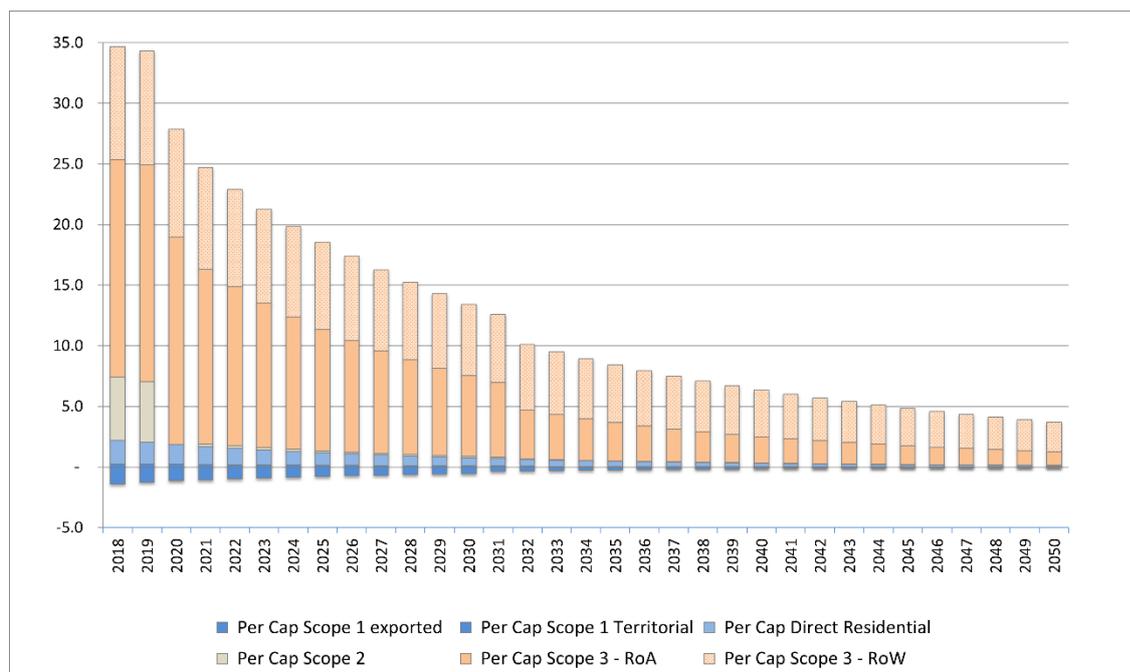


Figure 3-10: ACT carbon footprint projections to 2050 based on 1.5°C-compatible emission reduction pathways for Australia and other countries and world regions.

3.3.1 Snapshot of ACT CF reduction for households

Households are modelled to reduce their carbon footprint from 21.3 t CO₂-eq/capita in 2018 to 5.8 t CO₂-eq/capita in 2035 and then 2.4 t CO₂-eq/capita in 2050. A major drop in Scope 2 emissions of 5.0 t CO₂-eq/capita has already been achieved at the time of this report with the supply of 100% renewable electricity to the ACT from 2019-20 onwards. Sections forecast to make the biggest decreases by 2035 include:

- transport, postal and warehousing – Scope 3 1.69 t CO₂-eq/cap (59% decrease)
- transport, postal and warehousing – Direct residential transport 1.37 t CO₂-eq/cap (78% decrease)

- food 1.28 t CO₂-eq/cap (68% decrease)
- retail trade 1.11 t CO₂-eq/cap (53% decrease)
- accommodation and food services 0.74 t CO₂-eq/cap (71% decrease)
- agriculture 0.63 t CO₂-eq/cap (72% decrease)
- mining 0.58 t CO₂-eq/cap (83% decrease)

An example of key assumptions by 2030 to achieve this include 79% renewable energy in the Australian grid, 28% of the total Australian fleet are electric cars and a 69% decrease in Australian livestock emissions (ClimateWorks Australia, 2020).

Further decreases from 2035 – 2050 include:

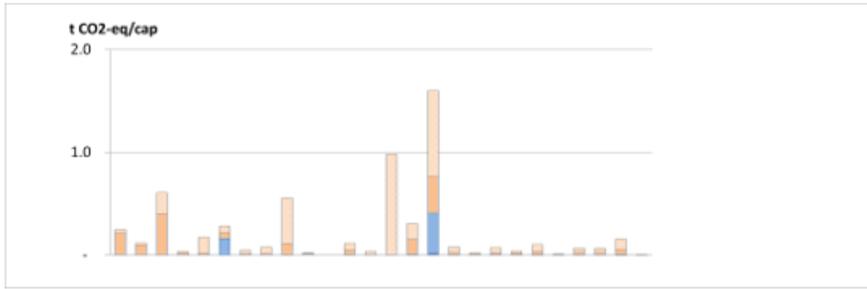
- transport, postal and warehousing (direct and scope 3) 1.00 t CO₂-eq/cap (a further 22% decrease)
- retail trade 0.47 t CO₂-eq/cap (a further 22% decrease)
- manufacturing 0.33 t CO₂-eq/cap (overall 81% decrease)
- food 0.31 t CO₂-eq/cap (a further 16% decrease)

The 2050 scenario includes 100% renewable electricity in Australia, full electrification of Australian residential and commercial buildings, and an overall reduction in Australian livestock emissions of 83% (ClimateWorks Australia, 2020).

2050



2035



2018

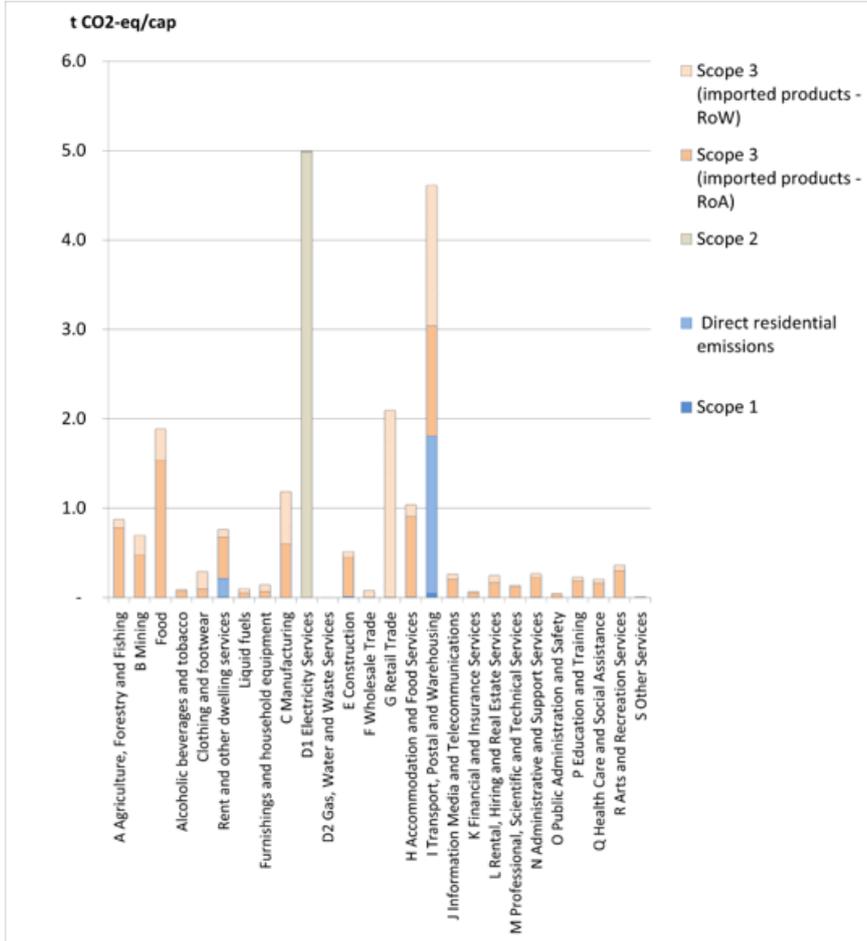


Figure 3-11: ACT carbon footprint projections for households for 2035 and 2050 by sector based on 1.5°C-compatible emission reduction pathways for Australia and other countries and world regions.

3.3.2 Snapshot of ACT CF reduction for government

The ACT Government is modelled to reduce its carbon footprint from 10.8 t CO₂-eq/capita in 2018 to 2.6 t CO₂-eq/capita in 2035 and then 1.1 t CO₂-eq/capita in 2050. Sections forecast to make the biggest decreases by 2035 include:

- Public administration and safety 2.1 t CO₂-eq/cap (86% decrease)
- Construction 1.1 t CO₂-eq/cap (86% decrease)
- Health care and social assistance 1.0 t CO₂-eq/cap (72% decrease)
- Transport, postal and warehousing 0.69 t CO₂-eq/cap (59% decrease)
- Education and training 0.72 t CO₂-eq/cap (82% decrease)
- Retail trade 0.58 t CO₂-eq/cap (53% decrease)

Further significant decreases from 2035 – 2050 include:

- Public administration and safety 0.21 t CO₂-eq/cap (a further 8% decrease)
- Transport, postal and warehousing 0.29 t CO₂-eq/cap (a further 25% decrease)
- Manufacturing 0.26 t CO₂-eq/cap (a further 24% decrease)

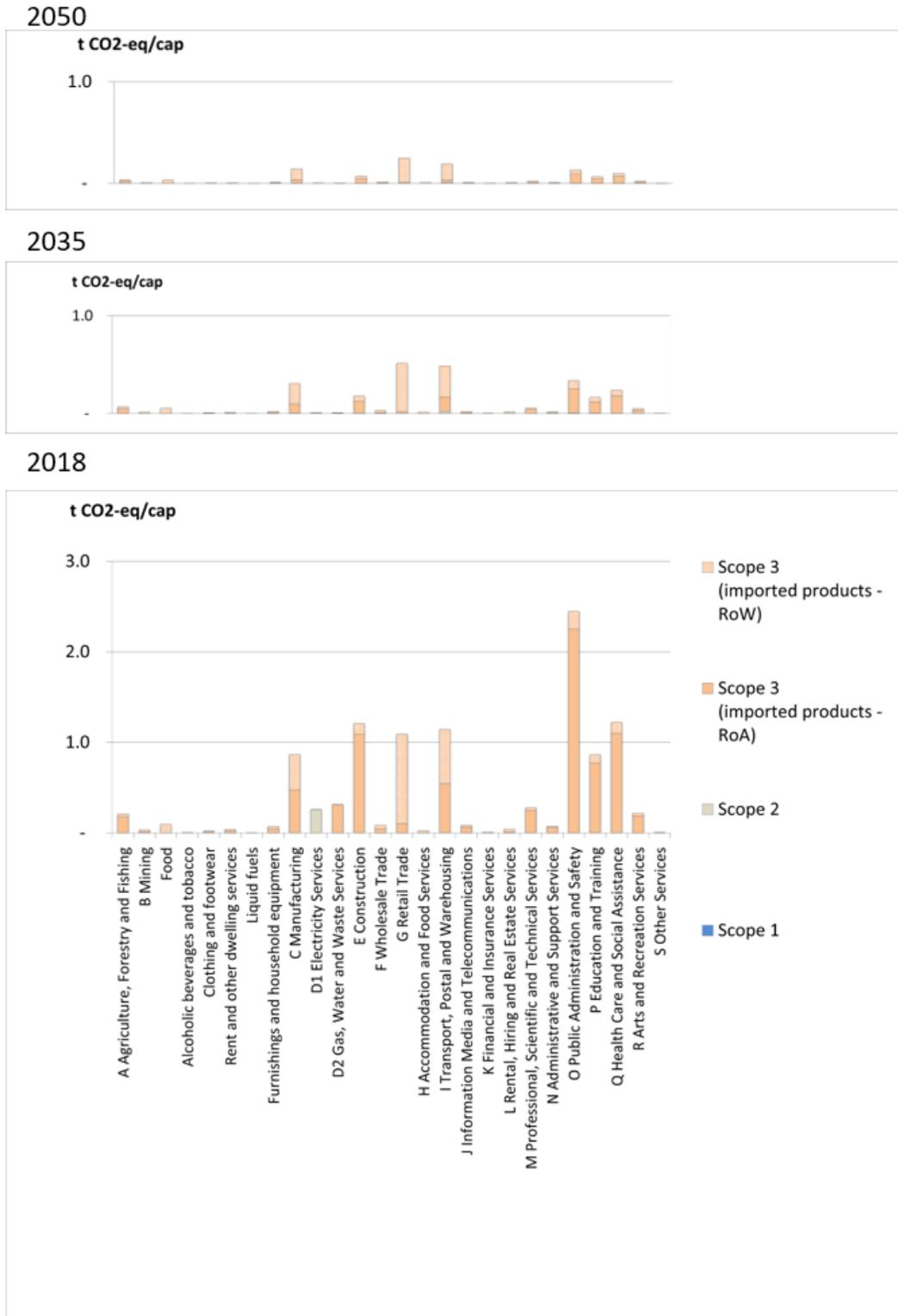


Figure 3-12: ACT carbon footprint projections for government for 2035 and 2050 by sector based on 1.5°C-compatible emission reduction pathways for Australia and other countries and world regions.

3.3.3 Snapshot of ACT CF reduction for businesses

ACT businesses are modelled to reduce their carbon footprint from 2.7 t CO₂-eq/capita in 2018 to 0.6 t CO₂-eq/capita in 2035 and then 0.2 t CO₂-eq/capita in 2050. This sector represents the creation of private sector assets.

Major sector reductions from 2018 to 2050 include

- Construction 0.79 t CO₂-eq/cap (94% decrease)
- Rent and other dwelling services 0.44 t CO₂-eq/cap (94% decrease)
- Manufacturing 0.39 t CO₂-eq/cap (88% decrease)

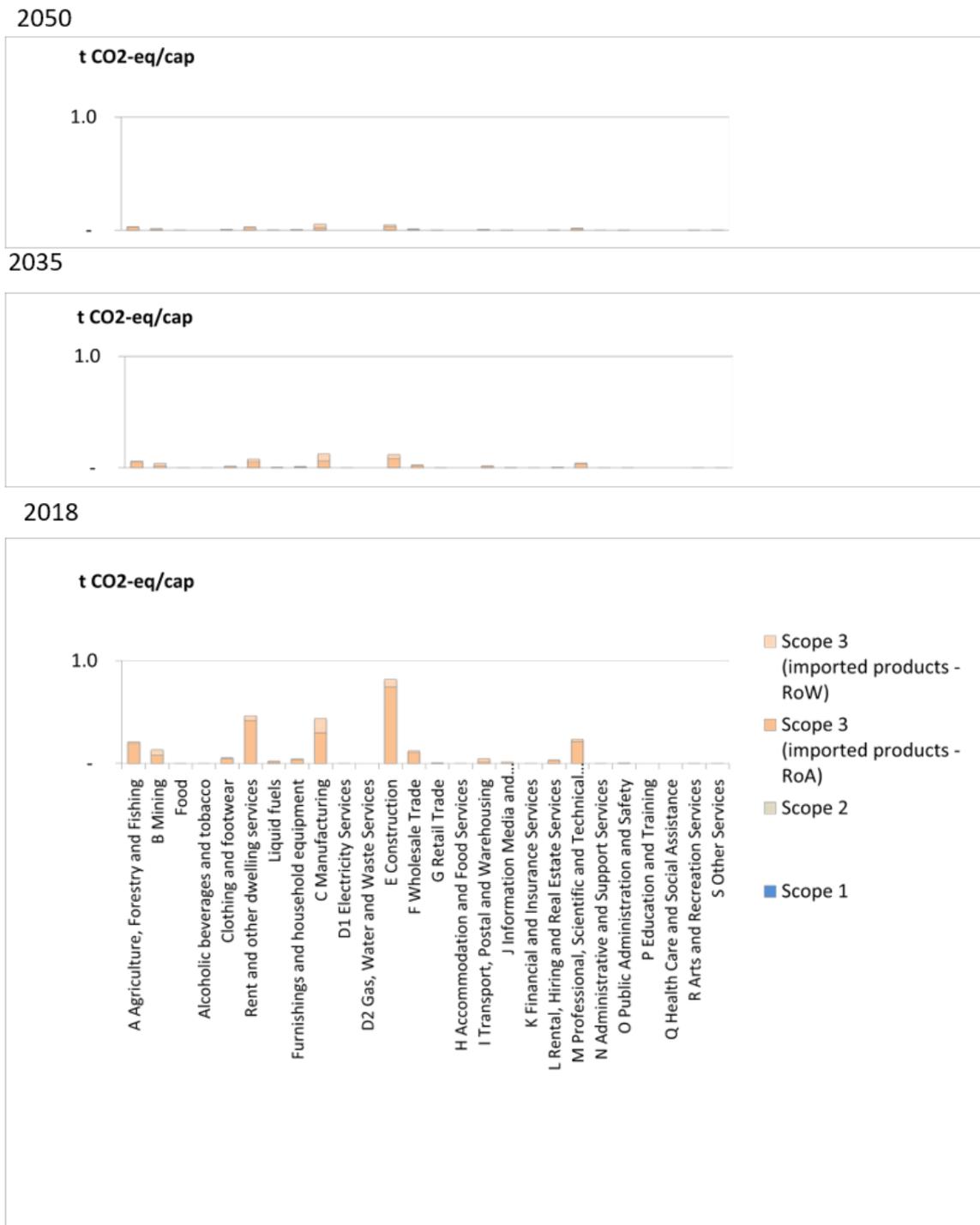


Figure 3-13: ACT carbon footprint projections for businesses for 2035 and 2050 by sector based on 1.5°C-compatible emission reduction pathways for Australia and other countries and world regions.

4 DISCUSSION

As the full carbon footprint analysis of this study clearly shows, targeting Scope 1 and 2 emissions alone only covers a small part of the ACT's shared carbon responsibility, as Scope 3 (indirect/outside/embodied) emissions make up most of the total carbon footprint (83.3% in 2018). While ACT's population only makes up for 1.6% of Australia's population, its carbon footprint accounts for 2.3% of Australia's total national footprint.

Attention therefore needs to be directed at where these Scope 3 emissions are coming from, how they are linked to consumption and investments in the ACT and how the ACT could contribute to their reduction. The responsibility for Scope 3 emissions is always shared (Lenzen et al., 2007). On one hand, these emissions only occur because ACT residents, government departments and businesses consume products and resources. If the ACT did not exist, these emissions would not occur. On the other hand, producers who provide the goods, services and resources the ACT consumes also bear responsibility for the way they produce these products. For example, they can decide whether they use renewable energy and resources in the production process or not.

The key to reducing Scope 3 emissions lies in bringing the two sides together to find common or joint solutions for mitigation. This study is a first step in this direction as the carbon footprint results reveal the sources of Scope 3 emissions, in terms of the location of producers, the amount of emissions they produce and the products in which these emissions become embodied. Most producers are located in large Australian states, but about 29% of Scope 3 emissions come from overseas; for some product groups even most of the producers are from other countries.

This section discusses the implications of Scope 3 emissions results and is organised by the main product groups that embody that largest shares of Scope 3. It lays out the changes that need to happen and highlights the options available to the ACT government and residents to achieve more sustainable consumption patterns and more rapid reductions in national and global emissions.

4.1 Food

ACT's carbon footprint associated with the consumption of food was identified as one of the hotspots for targeted emissions reduction efforts. The food sector accounted for 9.9% of the CF (Figure 3-2) including additional food-related emissions associated with food services and

agricultural food production. Most of these emissions are Scope 3 embodied emissions imported from other Australian States and Territories. Other similar studies undertaken for C40 cities have shown that emissions associated with food account for 13% of total consumption-based emissions, most of which (75%) stem from the consumption of animal-based foods and the remainder from plant-based foods (C40 Cities et al., 2019). Key emissions sources include non-energy emissions from livestock and crops, as well as emissions from electricity and fossil fuel energy, chemical production, and transport.

Energy-related emissions can be reduced through more energy efficient equipment, electrification of machinery, on-site solar, and precision agriculture. However, ClimateWorks Australia (2020) highlight that the majority of Australia's agriculture and land emissions come from livestock, which means that non-energy emissions solutions will be critical for this sector. In particular, reducing emissions from enteric fermentation which can be reduced through vaccinations, feed supplements and genetic improvements. This suite of solutions, if implemented successfully, could almost eliminate methane from livestock digestive processes, but will also depend on further research and development. Given that much of the ACT's food is sourced from other States and Territories, progress in reducing emissions from food will be partly dependent upon the acceleration of these measures within Australia.

Though producers are a vital part of the solution, their ability to reduce environmental impacts is limited, and dietary change can deliver environmental benefits on a scale not achievable by producers (Poore and Nemecek, 2018). Moving from current diets to one that excludes animal products has transformative potential, reducing food's land use by 76% and GHG emissions by 49%, amongst other benefits (Poore and Nemecek, 2018).

A range of demand-side measures are available which could be supported by the ACT Government. In particular, encouraging dietary change or red meat substitution and reducing food waste from households and supply chains. Increasing awareness of the environmental impacts associated with diets and meat consumption could influence eating habits, particularly reducing demand for emissions-intensive products such as beef and dairy. Plant-based meat substitutes are becoming more readily available and could be promoted. Substituting beef for kangaroo meat, poultry and pork also offer lower-emission alternatives. Studies estimate that emissions from food consumption in cities could be reduced by 50% through dietary change reducing meat consumption to 16kg per person per year and dairy consumption to 90kg per person per year while also halving food waste (C40 Cities et al., 2019).

Communicating average product impacts to consumers can aid consumer choice and the avoidance of high-impact products. Dietary shifts can also be supported by city or local governments by promoting low carbon food within organisations and public institutions (including catering), low carbon school meals and food education, and local sustainable food cultivation (Wendler and Blakey, 2021). Australia's National Food Waste Strategy also provides a framework to support collective action towards halving Australia's food waste by 2030 (Australian Government, 2017). The ACT sends around 26,000 tons of household food waste to landfill each year², so raising awareness about food waste and encouraging residents to find ways to avoid waste will also assist with reducing consumption-based emissions from food.

The projections of ACT's CF through until 2050 highlight some remaining emissions associated with food, mostly from imported products from the rest of Australia. This reflects that even under an ambitious future climate action scenario, some agricultural emissions will remain by 2050 (ClimateWorks Australia, 2020). However, these calculations exclude emissions from land use change, which are not included in consumption-based emissions inventories. Carbon forestry offers an additional option for reducing these remaining emissions to net zero.

4.2 Transport

The largest emissions hotspot for the ACT corresponded to 'transport, postal and warehousing' (16.8%) (Figure 3-2), with the majority likely associated with public and private transport. This sector includes road, rail, air and water transport and freight services, taxis and vehicle rental or hire services, airport operations and support services, amongst others. The vast majority of emissions from this sector resulted from households and, to a lesser degree, government and included both direct and embodied emissions from Australia and the rest of the world (Figure 3-4).

Transport is a significant emitter in Australia and globally and makes up a majority share of the ACT's direct emissions following the transition to 100% renewables, mostly from the use of private cars. Zero emissions vehicles offer a promising solution for reducing direct transport emissions, and the ACT Government has a range of measures already in place to promote zero emission car ownership including reduction in registration fees and zero stamp duty (ACT

² <https://www.cityservices.act.gov.au/recycling-and-waste/love-food-hate-waste/about>

Government, 2018). The Government also has a roadmap for transitioning public buses to zero emissions by 2040³.

However, the transition to net zero vehicles will likely also result in considerable embodied emissions associated with the production, maintenance and operation of the vehicle fleet. In addition, other sources of embodied emissions in the transport sector are those associated with the use of public transport, taxis, air transport, and freight transport. While it is difficult to determine the contribution of these different sources in the aggregated results, estimates of key contributors can be identified through expenditure data and other studies.

The Household and Expenditure Survey for the ACT (ABS, 2017b) indicates that the majority of household expenditure on transport in the ACT is associated with motor vehicle purchases (23%), the purchase of motor vehicle fuels, lubricants and additives (24%), vehicle registration and insurance (20%), vehicle charges including servicing, parking fees, and leasing (20%), and vehicle parts sold separately (5%). Remaining expenditure is mainly associated with public transport fares (1.6%), other fares including taxis/ride sharing and work-related air fares (1.7%) and delivery and freight charges (1.8%). Separate to this, expenditure is also reported on holiday airfares both in Australia and overseas as well as airfare inclusive package tours. Together, these airfare-related items equate to around an additional 20% of the total reported transport expenditure by households. However, these numbers exclude expenditure from government on work-related airfares which would be expected to be significant for the ACT with a large public sector.

Australia currently has one of the most energy- and emission-intensive road vehicle fleets in the world, and electric vehicles are the most significant and promising technology for reducing road transport emissions (ClimateWorks Australia, 2020). When combined with the ACT's renewable electricity supply, they offer the prospect of net zero direct emissions (Scope 1) for road transport. The transition to electric vehicles in the ACT would address not only the direct residential emissions from the transport sector, but also emissions embodied in vehicle fuels (e.g. from fossil fuel extraction). However, the breakdown in household expenditure suggests that broader measures to reduce embodied emissions associated with motor vehicle ownership will likely deliver the greatest benefits for reducing transport-related Scope 3

³ [Zero emissions transport - Environment, Planning and Sustainable Development Directorate - Environment \(act.gov.au\)](https://www.act.gov.au/zero-emissions-transport)

emissions. Embodied emissions associated with air travel are also likely to be significant, and opportunities to reduce these should also be pursued.

Other studies highlight that much of the embodied emissions associated with private transport relate to materials and processing, including electricity, chemicals and heat production used in vehicle manufacture (C40 Cities et al., 2019). Given that motor vehicles are largely imported from overseas, reducing these process emissions is highly dependent upon global action on climate change and the transition to renewable energy and material efficiency in our major trading partners (vehicle manufacturing countries). However, there are also several demand-side measures available to the ACT, which include reducing car ownership, increasing the lifetime of cars, and material efficiency and recycling. In terms of car ownership, the C40 Cities suggest a progressive target of 190 vehicles per 1000 people (C40 Cities et al., 2019). Achieving such a target would require a considerable reduction in the current 260,000 passenger vehicles registered in the ACT which equates to around 600 cars per 1000 residents (ABS, 2020a). Measures to support a reduction in car use and ownership and to support more active modes of transport such as walking and cycling include car-free commuting (e.g. electric bikes, public transport), congestion charges, deliberate urban design, extensive cycling infrastructure, ride sharing and transport-on-demand initiatives. The increase in teleworking and remote work arrangements can also reduce the demand for car ownership (IGES et al., 2019).

Overall, Scope 3 emissions associated specifically with air transport in the ACT are difficult to determine precisely due to the aggregation of sectors, however they are likely to be quite significant based on the household expenditure data. Other studies have shown that emissions associated with flights in cities made up 2% of total consumption-based emissions (C40 Cities et al., 2019). The dominant source of emissions relates to fuel consumed during flights as well as emissions embodied in the extraction of fossil fuels. Interventions to reduce consumption-based emissions associated with air travel include reducing the number of flights and adopting more sustainable aviation fuels. The C40 Cities suggest progressive 2030 targets of one short haul return flight (less than 1500 km) every two years per person, and 53% sustainable fuel adoption. Measures taken to respond to the COVID-19 pandemic have considerably reduced air travel since early 2020 and will likely continue for some time. This has accelerated the uptake of remote meetings and conferences and associated ICT infrastructure which provides an opportunity to reduce work-related travel in future. Encouraging consumers to take holidays closer to home and in Australia would also considerably reduce emissions associated with air travel.

The results show that both supply and demand-side measures will be needed to reach a net-zero CF in the transport sector. The future projections for ACT's CF in 2050 highlight that the largest share of remaining emissions are associated with the transport, postal and warehousing sector, much of which is from imported products from the rest of the world associated with household and government consumption. This suggests that ambitious action towards electric and net-zero vehicles as well as the replacement of vehicle fuels with alternative biofuels should also be complemented with demand-side measures targeting vehicle ownership and travel.

4.3 Construction, buildings and infrastructure

The results highlight that the construction, maintenance and refurbishment of buildings and infrastructure represents an important contributor to the ACT's CF (7.4%), see Figure 3-2. The majority of these emissions are associated with the government and business sectors and sourced from the rest of Australia (Figure 3-4), in particular from within the construction sector as well as the manufacturing, electricity, gas, water and waste services (Figure 3-3).

The industry sector in Australia comprises mining, manufacturing and construction operations and is responsible for around 40% of Australia's annual direct emissions when electricity use is included (ClimateWorks Australia, 2020). The construction sector makes up only a small proportion of these direct industry emissions (3%), however studies have shown that the sector accounts for over 18% of Australia's carbon footprint including embodied emissions based on final demand (Yu et al., 2017). The largest contributors to these embodied emissions are from electricity, gas and water as well as construction materials, primarily for residential and commercial building construction and heavy and civil engineering construction. In terms of materials, big hitters included cement, lime, plaster and concrete products, as well as iron and steel products (Teh et al., 2019, Yu et al., 2017).

Global studies of consumption-based emissions for cities have found that around 60% of construction emissions are associated with the production and delivery of building materials, namely minerals (dominated by cement), metals such as steel as well as a range of petrochemical-based and rubber materials that make their way into modern buildings and infrastructure (C40 Cities et al., 2019). Electricity emissions are a significant component in many industry subsectors, such as aluminium and manufacturing, and are heavily influenced by the emissions intensity of the grid. Reducing these emissions will be dependent on the pace of transition to renewables in Australia and globally. Non-energy emissions include

process emissions during the production and manufacturing of cement, heavy metals and materials.

With regard to reducing emissions from construction materials use, measures include replacing carbon-intensive materials, and reducing, reusing and recycling construction materials (Yu et al., 2017). New low-carbon materials, such as engineered wood products (EWPs) or geopolymers, have the potential to replace the traditional materials of steel and Portland cement, both of which are carbon-intensive. Several barriers, including perceptions of high cost, insufficient technical knowledge and skills, conservative industry culture and practices, and the limited availability of product and building-level data and tools for embodied carbon assessment need to be considered and overcome (Gieseck et al., 2016).

Promoting experiments in the construction sector that demonstrate low carbon construction, as well as setting a requirement for a certain percentage of low-carbon materials within a construction project can encourage companies to engage with new materials and processes and build new partnerships. Stricter standards for planning and procurement could include carbon indicators to promote zero carbon buildings. Such measures can help to create a local base of low-carbon skills, knowledge and resources. Experience in other cities also highlights that the reuse and recycling of construction materials can be encouraged through partnerships between demolition companies, recycling centres and cement factories, for example (Wendler and Blakey, 2021).

The ACT Infrastructure Plan (ACT Government, 2019b) and 2019-20 Budget outlines a \$3 billion pipeline of infrastructure projects over the next four years. This includes priorities such as health infrastructure, construction of public housing, building three new schools, extending the light rail network and footpaths and cycleways, and a new Canberra Theatre. This suggests opportunities for the ACT to reduce the CF of emerging infrastructure.

In this context, C40 Cities et al. (2019) propose five main interventions that could reduce consumption-based emissions from new buildings and infrastructure, with progressive targets through until 2030:

- Material efficiency: reduction in steel and cement use of 20% and 32% respectively
- Enhance building use: 10% reduction in demand for new buildings
- Material switching: 75% of residential and 50% of commercial buildings are timber buildings
- Low-carbon cement: 50% of cement replaced with low-carbon alternatives

- Reuse of building components: 11% reduction in virgin metal and petrochemical-based materials

Of these, the report shows that material efficiency has the highest emissions reduction impact, followed by enhancing building utilisation, material switching and low-carbon cement (C40 Cities et al., 2019). Other global studies highlight that strategies to reduce embodied emissions from a technological perspective include replacement of materials (with low carbon, natural or innovative materials), reuse and recycling of materials, better design and resource use, and reduction of end-of-life stage impacts (Pomponi and Moncaster, 2016, Birgisdottir et al., 2017, Malmqvist et al., 2018, Yu et al., 2020). Strategies such as replacement of materials can result in embodied carbon reductions of between 27% and 77% depending on the materials that are substituted (IEA, 2016, Malmqvist et al., 2018). The use of biomaterials in buildings, such as timber, bamboo and straw, has also been shown to reduce embodied carbon and provide long-term carbon storage, providing the potential for buildings to act as a 'carbon sink' (Pomponi et al., 2020). For example, Churkina et al. (2020) show a widescale global switch to timber materials for mid-rise buildings could store 0.01–0.68 GtC per year, which over 30 years would amount to up to 9% of the carbon stored in above ground tree stocks. New research on the transition to net zero direct and embodied emissions in the built environment in Australia highlights that it is possible to achieve a net-negative emissions outcome by 2050 through rapid decarbonisation of the energy system, material substitution (timber buildings) and rigorous resource management to avoid the loss of sequestered carbon at the end-of-life of buildings (Allen et al., 2021).

Operational emissions associated with residential and commercial buildings are also important, comprising around one-fifth of Australia's total territorial emissions. With the ACT's transition to 100% renewables, remaining operational emissions are mainly associated with the use of gas for cooking and heating. Stationary energy from natural gas comprised around 20% of the ACT's direct greenhouse gas emissions in 2019/20 (Strategy. Policy. Research, 2020). At the national level, commercial buildings derive nearly 80% of energy from electricity, with the rest coming from gas, while residential buildings use electricity for nearly 50% of their energy emissions, gas for one-third and biomass for the remainder (ClimateWorks Australia, 2020). The full electrification of buildings combined with deep energy efficiency are additional measures that can deliver net zero emissions in the building sector. Reducing energy consumption will be important through the construction of buildings with reduced energy requirements for lighting, heating and cooling and efficient appliances. Both residential and commercial buildings can shift reliance on gas to electricity, by retrofitting existing buildings and the construction of new buildings with electricity as the sole power

source. Many electrical appliances are now more energy efficient and cost effective than their gas counterparts. These opportunities are already well recognised and supported by the ACT Government through its provisions for buildings and land use⁴ associated with the ACT Climate Change Strategy 2019-2025 (ACT Government, 2019a).

4.4 Services

Apart from transport, food and accommodation services, other services generally create a relatively smaller amount of Scope 3 emissions for ACT households (and also for businesses in general). Together the product groups I to S, which include media, financial, rental, technical, administrative, educational, health care and other services account for 31% of households' carbon footprint (see Figure 3-5). Compared to households' spending on services, this is comparatively low, since the specific Scope 3 impact per \$ spent is lower for services than for food or manufactured products. Education is one of the services that has amongst the lowest kg CO₂-eq/\$ intensities, which generally means that investing in education is a relatively low-carbon way of spending money, apart from the other benefits provided by secondary, tertiary and life-long education (Lenzen and Cummins, 2013).

Many services can be regarded as essential or important, since most households will need to pay rent or mortgages or require insurance and communication services. But even in the service sector there are low-carbon alternatives that consumers can choose. Some banks, for example, have committed to divest from fossil fuel projects and instead invest in renewable, ecological or ethical projects instead. Given that rent or mortgage payments are the single highest expenditure item for the vast majority of households, choosing how that money is used and invested by banks can make a profound difference to the wider carbon intensity of an economy.

One service provision that stands out from the Scope 3 results is retail trade (Figure 3-5), which makes up 10% of the household and 10% of the government carbon footprint. Consumers do not directly spend money on retail trade, but every time they buy a product – be it in the supermarket or online – a certain share of the price they pay is being used to pay for freight transport, wholesale, distribution and retail services. The EEIOA model used in this study identifies the GHG impacts of these services separately in sector G (see e.g. Figure 3-5). A very

⁴ [Buildings and land use - Environment, Planning and Sustainable Development Directorate - Environment \(act.gov.au\)](https://www.act.gov.au/buildings-land-use-environment-planning-and-sustainable-development-directorate-environment)

large infrastructure is necessary to create, maintain and operate trade services, including roads, railways, ports, airports, warehouses, freight transport, distribution centres, retail shops, etc. Accordingly, the associated Scope 3 emissions are substantial.

Interestingly, most of these trade-related emissions seem to come from outside Australia (Scope 3 RoW). A closer analysis was outside the scope of this study, but it is likely that this is related to the additional infrastructure needed to transport and distribute goods internationally (most importantly port and airport infrastructure, longer distances and more participants in the supply chain). Figure 3-7 and Figure 3-8 reveal that it is actually not so much the Scope 1 emissions of the trade companies themselves, but rather the supply of the products and materials that they need, e.g. from the electricity to provide cooling or heating in warehouses or from construction materials and activities.

For government, spending and investing on services makes up the majority of its carbon footprint, i.e. 60% for services I-S and 11% for the trade services F and G. This is to be expected since it is the government's remit to provide and support essential services for the community, such as schools, hospitals and other public services. Most of the Scope 3 emissions in these sectors come from other regions in Australia and are related to the production and supply chain of the equipment, the materials and the services needed indirectly to provide the local services. The most prominent and potent tools available to governments to influence these indirect carbon emissions include sustainable procurement and public tenders. Governments set up direct contracts with suppliers, manufacturers, contractors, construction companies and service providers, i.e. they have a direct leverage point to require or force the provision of low-carbon products or alternatives, which can be written into legally binding contracts.

4.5 Manufactured goods

Consumption of physical goods represents 8.7% of the total CF. This category represents manufactured products that households either consume within a year – e.g. paper, cleaning and toiletry products, partly even clothing – or buy for a longer period of time as durable household items, such as furniture, appliances, equipment or tools. Each of these items requires raw materials, energy, water, production facilities and associated infrastructure in its production, delivery and disposal, with GHG emissions occurring at each stage. This underlines the challenges associated with reducing Scope 3 emissions: for every participant from the producer to the consumer and to those dealing with waste, profound changes need to be

made at every step to achieve deep decarbonisation. Small, peripheral changes, such as recycling plastic waste – as necessary as they are – will no longer be sufficient.

The Household Expenditure Survey for the ACT (ABS, 2017a) identifies the product groups where most money is spent (and with an equivalent share of Scope 3 emissions in the category 'C Manufacturing') as Recreational and educational equipment (including home computer equipment, 30%), Household furnishings and equipment (26%), Clothing and footwear (19%), Tools and other household durables (12%), and Personal care products (10%). In contrast, Repair and maintenance of household durables is only 1% compared to the total spending on material goods and there is no spending at all on Hire of household durables (e.g. the hiring of tools).

Other studies on consumption-based emissions in cities highlight that clothing and textiles and electronics and household appliances comprise 7% of total consumption-based emissions, largely from electricity generation and fossil fuel extraction emissions consumed across supply chains as well as the production of primary natural materials (e.g. livestock rearing for animal-based products and fibre crops) (C40 Cities et al., 2019). Suggested actions that government could take to reduce consumption-based emissions, include (C40 Cities et al., 2019):

- for households:
 - Encourage and support the sharing and hiring of durable items, such as tools and equipment.
 - Encourage and support reducing the purchase of new clothing items per person per year, e.g. by supporting second-hand markets.
 - Inform consumers about low-carbon products, including consumables, durables and building materials.
- for government operations:
 - Sustainable procurement could support the longevity of equipment, e.g. the 7-year optimum lifetime of laptops and similar electronic devices.
 - Support circular economy solutions to reduce waste in the supply chain.

5 CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The science on climate change is clear: swift, ambitious and profound action is required to avoid the most severe outcomes of climate change (IPCC, 2018). A recent report on the future of urban consumption in a 1.5°C world spells out the massive challenge that cities in particular are facing: *“To avoid climate breakdown, emissions from global urban consumption must halve by 2030. For this to be achieved, emissions from consumption in high-income cities must decrease by two thirds within the next decade.”* (C40 Cities et al., 2019)

The ACT has already demonstrated climate leadership with a clear ambition for renewable energy. The Territory’s legislated emission reduction targets and renewable energy investment program has led to 100% of its electricity supply being sourced from renewable sources in 2020. Moreover, the ACT’s reverse auction feed-in tariff mechanism and broad support from community for renewable energy are further examples of progress on mitigating GHG emissions. Transitioning to renewable energy is an important step when considering the future of emissions reduction as the ACT looks to carbon neutrality by 2045.

This study aimed to assess the ACT’s full carbon footprint, with a focus on its indirect Scope 3 emissions that are embodied in the Territory’s final demand. This aim arose from the opportunity to inform policy processes in the ACT Government’s development of a roadmap to carbon neutrality by 2045. The research is clear that embodied emissions make up most of the Territory’s carbon footprint (83%). This was true for at least the last ten years and will be into the future until 2050. The magnitude of embodied emissions confirms that the Territory is a consumer city which relies on imported emissions - from Australia and the world - to satisfy private, public and corporate consumption and investments.

When observing the breakdown of the ACT’s carbon footprint by region, it was found that international imports (29%) and imports from Queensland (19%), NSW (18%) and Victoria (13%) make up over three quarters of embodied emissions. This reflects the extent of trade networks that the ACT relies upon. This knowledge will be useful for the ACT in framing current and future supply chain relationships to reduce Scope 3 emissions.

Household demand dominates the breakdown by consumer groups, highlighting that ACT residents must be educated on the impact of their consumption habits. Manufactured

products (12% of the total CF), car ownership, meat and dairy, eating out, imported clothing (including footwear) and travelling by air are all major sources of Scope 3 emissions in the Territory. The ACT Government already has various grants and schemes to support efficiencies in the home. However, these focus on energy and waste efficiencies, rather than the need to reduce demand for goods and services in the first instance (e.g. through sharing economies and sourcing sustainably).

Business and Government generate relatively less emissions through their consumption habits, however, they are significant procurers of goods and services. The public and private sectors' ability to affect reductions through planning and management make them highly influential in the decarbonization process. Strategies to address the impact of infrastructure and construction (16% of the total CF), food (14% of the total CF and significant emissions from CH₄ and N₂O footprints), and public and private transport are necessary.

This study has confirmed that the ACT's action on Scope 2 emissions is a good start but will obviously not generate enough emissions reductions to achieve a net zero carbon footprint. Looking beyond the Territory's sphere of influence to partnerships with suppliers and supplying regions will be important to reduce Scope 3 emissions. Likewise, a change in user behaviour to more sustainable consumption habits will be required. The ACT Government is still in the early stages of developing a pathway to carbon neutrality, so this quantitative analysis is a valuable tool which has the potential to influence deep decarbonisation in the Territory.

5.2 Recommendations for the ACT Government

Achieving a net zero CF by 2050 will depend upon the decarbonisation of Australia and the world, however the Territory does not have to wait for this to happen and can initiate, support and promote changes to behaviours and practices, both in the ACT and elsewhere. Different outcomes arise if the ACT's climate strategy assigns the burden of responsibility for emissions to the consumer or the producer. The findings of this report reveal that the ACT's target to achieve net zero emissions by 2045 must include Scope 3 emissions and that it is imperative that the Territory regularly assesses progress using consumption-based accounts.

Within the ACT's legislative power, various policy options exist to address consumption-based emissions, including product and procurement standards, policy for city and infrastructure planning, and other economic incentives to promote product longevity and a sharing

economy. Carbon accounting across regions or joint targets could also support the ACT and its trade partners to achieve emission reduction targets.

Public and private sectors are significant procurers of goods and services thus making them highly influential in the decarbonisation process. For example, the provision of new infrastructure (e.g. new homes or public transport options) is highly carbon and resource-intensive. Local authorities have the ability to influence impacts from sectors such as infrastructure through effective planning and management, including (Millward-Hopkins et al. 2017; Sudmant et al. 2018):

- Low-carbon building standards and improved building design;
- Supply chain efficiency and transparency measures;
- Influence urban form and function to promote durable infrastructure that is sustainable, adaptable and reusable (e.g. buildings, transport systems or infrastructure more broadly);
- Product and resource efficiency standards;
- Refundable recycling fees for goods;
- Incentives to reduce consumption and the generation of waste;
- Support for adaptive reuse and the sharing economy (e.g. car sharing, bike sharing, tool sharing, office sharing);
- Free public transport;
- Leading by example to shape user behaviours (e.g. travel patterns and lifestyles);
- Partnering with industry, organisations and other regional or national governments; and,
- Joint emission reduction targets.

While the ACT Government has limited direct influence of Scop 3 emissions, it can influence decisions and practices of producers in other regions and consumers in the ACT. Governments can mandate low-carbon supplies through legislation, not just for their own consumption and investments, but also for businesses and products. One prominent example is the Australian Modern Slavery Act (NSW Government, 2018, Parliament of Australia, 2018) that obliges companies to make an annual public statement declaring the risk of forced labour within their operations and supply chains as well as their efforts in addressing these risks of modern slavery. The same could be done with climate legislation with the aim to increase transparency of GHG emissions across companies' supply chains. This would improve the accountability of suppliers and encourage them to take responsibility for the embodied carbon emissions in their own operations and supply chains. This would extend the reach of climate legislation beyond own territory and lower supply chain carbon risk nationally and globally.

This analysis will be useful for the ACT in framing current and future supply chain relationships. Partnerships with suppliers and supplying regions ('insetting') will be important to reduce Scope 3 emissions. Such partnerships between the ACT Government and the private and public sector elsewhere will also be crucial to advance decarbonisation across supply chains. They also have the added benefit of generating multiple positive sustainable impacts for all parties (Insetting Platform 2018). The Government could target specific industry associations or stakeholders in areas of high Scope 3 emissions. Examples include national or regional farmers' associations, renewable energy providers, manufacturers of electric cars or other zero-carbon technologies, companies of the circular economy etc. Public procurement is an obvious leverage point but agreements with other governments to support financial or incentives or regulation as well as joint ventures and direct partnerships or investments in low-carbon businesses around the country are also conceivable.

Transnational networks such as C40 or the Covenant of Mayors for Climate and Energy have promoted information on best practices and knowledge sharing between subnational governments. Interagency organisations such as the Climate Action Network Australia⁵ can help facilitate coordination and learning across multiple jurisdictions and connect public, private and civil society actors.

Governments should clearly define long-term regulatory outcomes to enable the market and supply chains to adapt and build new capacity to deliver low-carbon outcomes. The following initiatives could also be adopted by the ACT to support a reduction in supply chain emissions:

- Advanced, regular monitoring of embodied carbon in trade;
- Grants and subsidies to promote local sustainable industry practices;
- Building government or institutional support for CBA;
- A formalised way to regularly update CBA results (Moran et al. 2018a);
- GHG accounting across boundaries to explore the effect of emission reduction in one region compared to other regions (e.g. between the ACT and QLD, NSW or VIC);
- Requirements for low carbon concrete and steel when tendering public construction contracts.

Apart from policies that affect the Government's Scope 3 emissions, it is also clear that significant behaviour change of the ACT's population is required. Households make up the largest share of Scope 3 emissions with 59%. Individual consumers ultimately decide how

⁵ <https://www.cana.net.au>

much they consume and which products they buy. The challenge laid out above will require profound and widespread lifestyle and consumption changes, which governments can support with policy and financial incentives as well as new business models.

Ultimately, a paradigm shift will be needed in the way economic systems and societies operate. Economic growth and affluence are the strongest driver of GHG emissions globally, leading to scientists calling for GDP to be replaced with more suitable indicators of wellbeing and sustainability and for new economic models to be explored (Wiedmann et al., 2020b). One example of initiatives that go in that direction is the Wellbeing Economy Alliance (WEAll), adopted by Wellbeing Economy Governments (WEGo), including New Zealand (Wellbeing Economy Alliance, 2021). The United Nations Sustainable Development Goals (SDGs) also provide new metrics for measuring progress towards sustainable wellbeing (UNGA, 2015), and are being applied in Australia to evaluate progress and explore sustainable future scenarios (MSDI, 2020, Allen et al., 2019b, Allen et al., 2019a).

To reach ambitions of net zero emissions the ACT Government can deliver a series of consumption interventions that could impact how goods and services are produced and consumed. For construction, this can include changes to the types of building and infrastructure that are built as well as the materials used. In transport, reducing private car ownership and promoting shared vehicles and net zero transport options are required. Residents of the ACT can also be encouraged to adopt plant-based diets, reduce or replace flying with less energy-intensive forms of transport, and reduce consumption of clothes and textiles, electronics and household appliances. Cutting consumption-based emissions will also deliver wider benefits, with individuals, businesses and city governments all standing to gain if changes are delivered in the right way (C40 Cities et al., 2019).

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7 APPENDIX

7.1 Comparison across Australia's states and territories

A comparison of per-capita carbon footprints across Australian states and territories is provided in the figure below.

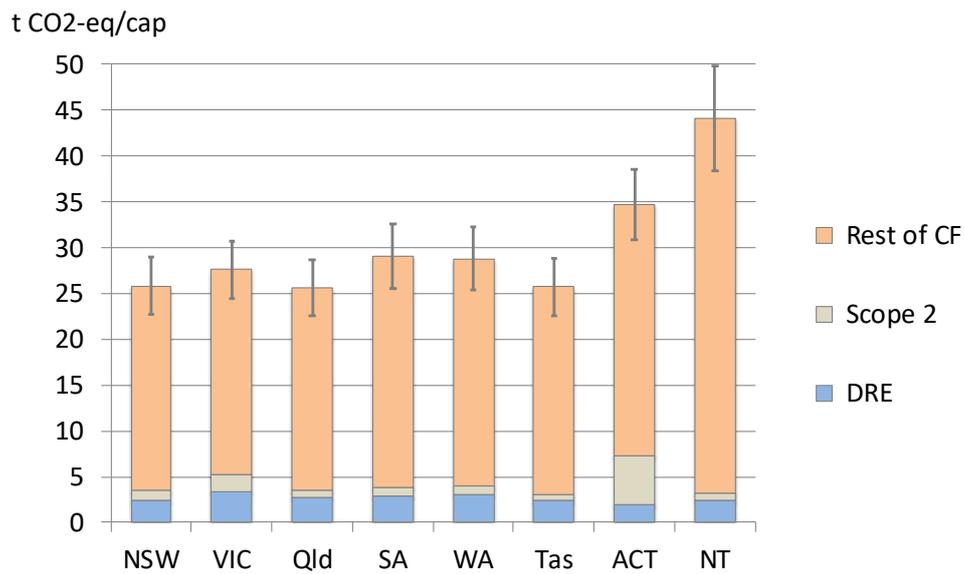


Figure 7-1: Per-capita carbon footprints of Australian states and territories in 2018 in t CO₂-eq/cap. Shown are direct residential emissions (DRE), Scope 2 emissions and the rest of the full carbon footprint, which includes mostly Scope 3 emissions and some remaining industrial Scope 1 emissions. Note that all Scope 2 values are modelled, except for Scope 2 emissions of the ACT, which were taken from the ACT Greenhouse Gas Inventory 2019-20 (Strategy. Policy. Research, 2020). From 2019 onwards, these ACT Scope 2 emissions are zero. Error bars indicate 14% relative standard deviation, equivalent to 10% interquartile range obtained in Monte-Carlo uncertainty analysis.

7.2 Questions about Input-Output Analysis

What is environmental Input-Output Analysis (EEIOA)?

Input-Output Analysis (or short IOA) is a method that tracks all financial transactions between industrial sectors and consumers within an economy. By adding environmental information, such as greenhouse gas emissions, to each sector it becomes possible to assign an environmental burden (a footprint) to these financial transactions. Similar to following the flow of money, or costs, from production to consumption, an environmentally extended Input-Output model allows following the flow of environmental footprints along supply and production chains. As each production step adds an environmental burden, the result is a life-cycle inventory of impacts of production and consumption, e.g. carbon, water or ecological footprints of companies, organisations, sectors, individuals, regions or countries.

How established is IOA? When was it first used?

Economic Input-Output analysis was first developed by Wassily Leontief in the 1930s to aid manufacturing planning and has been used ever since in countless applications addressing questions on economy, labour, social issues, trade, energy, ecology, resource use, industrial ecology and environmental science. The compilation of Input-Output tables of national and regional economies is a routine practice governed by a UN standard. Thousands of analysts and researchers use analytical Input-Output techniques. Environmental applications of IOA began in the early 1970s when it was widely used for energy analysis. In 1973, Leontief received the Nobel Prize for Economic Science for the development of the Input-Output methodology and its wide application.

What are the main advantages of IOA?

Due to its economy-wide approach, environmental IOA allows for the allocation of all impacts along the production and supply chain to the consuming sector or groups of final products. This has the advantage of being complete and avoiding boundary issues commonly associated with process analysis. Results from IOA are fully consistent with standard accounting, and a direct and valid comparison of environmental performance (e.g. carbon footprint intensity) is possible between companies/organisations, sectors or nations.

Environmental IOA is also a very efficient technique that saves time and money as it requires a minimum of data collection; the required financial information is in most cases readily available.

What are the main limitations of IOA?

Environmental Input-Output models work with data that are aggregated at the level of economic sectors rather than individual products. Input-Output tables are the sum of countless individual activities (financial transactions) and for practical reasons this wealth of data is grouped in a limited number of industries (e.g. 123 in the UK). For this reason, the results of an IOA show the impact of an industry or product group (e.g. 'dairy products') but not of a specific product type (e.g. 'cheese') or even individual products (e.g. 'Cheddar'). To achieve this level of detail, IOA needs to be combined with a bottom-up analysis of specific processes.

What are the data requirements of IOA?

Every country in the world holds statistics about the size and structure of its economy, for this is the basis of calculating the Gross Domestic Product (GDP) as an indicator of economic performance. Government's statistical offices in most countries compile these data in a standard format specified by the UN. These annual economic accounts are regularly published and form the basis of Input-Output tables. Some data manipulation by the Input-Output analyst might be necessary because tables in basic prices are necessary for environmental Input-Output models, but such tables might not be published every year by the statistical agency.

Environmental extensions are added to the Input-Output framework in the form of inputs or 'factors' of production by industrial sector, e.g. emissions of greenhouse gases or air pollutants, water use, land use or the extraction of raw materials. Much of this is covered by environmental accounts published annually by statistical offices; again often adhering to a UN standard. This means that all environmental variables are a direct satellite account to the national accounts and to economic activities of industries and that the same system boundaries, classifications and definitions are used. In some cases it might be necessary to obtain additional statistics in order to break down aggregated data to the desired level of sectoral detail.

What is an input-output table?

Input-Output tables provide a complete picture of the value of products and services sold and bought in an economy for a given year, illustrating the interdependencies of industries and the relationship between producers and consumers. In its general form an Input-Output table shows the purchases made by each sector of the economy in order to produce their own output, including purchases of imported commodities (inputs) as well as the consumption of

products and services by other sectors and final consumers, such as private households (outputs). The basic assumption is that what is produced by one industry must be consumed, either by other industries or by individual consumers. Input-Output tables are a central element of economic National Accounts which are produced by national statistical offices and are used to generate annual accounts of the Gross Domestic Product (GDP).

Are imports accounted for in IOA?

Yes. The value of imports is part of national economic accounting and therefore part of input-output tables. The degree of detail, however, can vary and it depends on the data available and the type of Input-Output model constructed by the analyst as to how many countries or world regions can be distinguished in the calculations. Large multi-region Input-Output models include data for more than 100 economies and assign environmental impacts associated with products imported from these countries depending on the foreign production technology and efficiency.

How old are the data used in IOA?

Supply and use tables, the basic building blocks for national economic accounts, as well as environmental accounts are published annually by most national statistical offices with a delay of about two years. These tables are usually sufficient to update all the information necessary to construct Input-Output models, including basic price tables or imports matrices etc. from previous years. Using GDP estimates and appropriate matrix balancing (updating) procedures, it is even possible to update the supply and use tables to the current financial year. Therefore, well maintained Input-Output models are capable of generating life-cycle conversion factors which are much more up-to-date than most secondary data from life-cycle inventories compiled with process analysis.

Is IOA complicated?

Not more complicated than the multiplication of numbers. For the construction of an Input-Output model, knowledge of linear and matrix algebra as well as national economic and environmental accounting is required; computational skills are useful. Once the model is completed, conversion factors (called 'Input-Output multipliers') for total impacts per financial unit can be extracted used further in simple spreadsheet calculations. Software tools using environmental IOA are available that perform more sophisticated analyses with a minimum of data input by the analyst.

What is the quality of input-output data? How reliable are input-output models?

The ideal data basis for an Input-Output model are either detailed supply and use tables or symmetric Input-Output tables in basic prices, all of which are regularly compiled by statistical offices. Not all of the information is published, however, and it therefore depends on the quality and date of available information as well as capacity of the modeller to update and handle missing or conflicting data, how well the model reflects the real-world economy.

The uncertainty of Input-Output data is routinely and well documented by the statistical authority compiling the national accounts; the standard errors of Input-Output data are published. A similar process of uncertainty calculation and error publication has been established by the process of compiling national greenhouse gas inventories under the UN Framework Convention on Climate Change – the data set underpinning the national environmental accounts of greenhouse gases. Recent research has shown that national carbon footprint estimates using a multi-region input-output model have a standard error of about $\pm 5\%$.

How accurate is IOA?

Input-Output analysis is generally correct and accurate but not particularly precise. Because of its economy-wide and consistent character, IOA correctly and accurately apportions indirect impacts from production to industry sectors, product groups or individual companies. If added up, results for all companies within an economy, for example, would add up to the total impact of this economy. Different individual products coming from the same industry sector, however, cannot be distinguished sufficiently with IOA alone, as the analysis refers to the whole sector comprised of several sub-sectors or product groups.

Process analysis, on the other hand, can be precise and specific to one particular product as it aims to calculate life-cycle impacts bottom-up by using original, primary data collected from individual processes. However, the necessity of establishing a system boundary for the analysis means that important higher-order processes might be excluded and the result, even if it is precise, might not be accurate (not correct).

To increase both accuracy AND precision of life-cycle assessments, Input-Output analysis has been combined with process analysis in various forms of hybrid analysis which are state of the art and now are routinely employed. It depends on the application what level of accuracy or precision is required.

Are physical data not superior to financial data? What about price fluctuations?

It is a common perception that physical data are more accurate than financial data. After all, the volume or mass of a commodity (e.g. one kilogram of steel) is a more accurate and stable description of a physical quantity than the value (e.g. £1000 of steel). This does not mean, however, that an environmental (life-cycle) analysis based on physical data is always and necessarily more accurate than one based on financial data. Undoubtedly, the most accurate way of attributing environmental impacts to a commodity is a primary analysis of all processes necessary for its production. In practice, it would be too time-consuming to analyse all but a few main processes, and it is unavoidable to use secondary data for the bulk of processes perceived to be lesser important. These secondary data, however, have a higher level of uncertainty, no matter whether they are based on physical or financial information. The decision for choosing secondary data derived from either physical or financial units should therefore be based on the quality and suitability for the specific purpose.

Price fluctuations and distortions are a concern for the Input-Output analyst and need to be taken into account. Usually, financial information for one whole year is used in the analysis, levelling out monthly or seasonal variation. It is good practice in IOA to remove the trade and tax margins to set up and operate the model in basic prices, rather than purchasers' prices. This eliminates another source of price distortion and aligns the financial flows in the model closer with the actual flows of physical quantities.

7.3 Details of industry/product classification

The underlying EEIO model of this study uses a configuration of 26 different sectors, which represent both industries (that produce GHG emissions) as well as product groups that are being consumed (by ACT residents and other final consumers). The sectors are mutually exclusive and collectively exhaustive, i.e. together they cover the whole economy. The table below provides more detail on which sub-industries / detailed product groups are included in the 26 sectors (ABS, 2021b).

Table 7-1: Details of the 26 sectors (industries / product groups) used in the model for this study.

26 #	26 Sector Name	1284 #	1284 Sector Name
1	A Agriculture, Forestry and Fishing	1110010	Plants grown undercover
1	A Agriculture, Forestry and Fishing	1120010	Plants grown outdoors
1	A Agriculture, Forestry and Fishing	1130010	Turf
1	A Agriculture, Forestry and Fishing	1140010	Flowers (incl cut flowers) and flower seeds grown undercover
1	A Agriculture, Forestry and Fishing	1150010	Flowers (incl cut flowers) and flower seeds grown outdoors
1	A Agriculture, Forestry and Fishing	1400010	Sheep and lambs
1	A Agriculture, Forestry and Fishing	1400020	Wool (shorn and dead)
1	A Agriculture, Forestry and Fishing	1400030	Sheep and lamb products nec
1	A Agriculture, Forestry and Fishing	1400040	Sheep and beef cattle agistment services
1	A Agriculture, Forestry and Fishing	1400050	Beef cattle and calves
1	A Agriculture, Forestry and Fishing	1400060	Beef cattle and calves products (excluding Milk) nec
1	A Agriculture, Forestry and Fishing	1400070	Rice, in the husk
1	A Agriculture, Forestry and Fishing	1400080	Wheat (incl spelt) and meslin, unmilled
1	A Agriculture, Forestry and Fishing	1400090	Barley, unmilled
1	A Agriculture, Forestry and Fishing	1400100	Oats, unmilled
1	A Agriculture, Forestry and Fishing	1400110	Grain, sorghum
1	A Agriculture, Forestry and Fishing	1400120	Lupins (white or yellow) for grain
1	A Agriculture, Forestry and Fishing	1400130	Oilseeds

1	A Agriculture, Forestry and Fishing	1400140	Legumes for grain nec
1	A Agriculture, Forestry and Fishing	1400150	Cereal grains nec
1	A Agriculture, Forestry and Fishing	1510010	Sugar cane (for planting or crushing)
1	A Agriculture, Forestry and Fishing	1520010	Cotton (excl ginned)
1	A Agriculture, Forestry and Fishing	1590010	Forage sorghum
1	A Agriculture, Forestry and Fishing	1590020	Forage products nec
1	A Agriculture, Forestry and Fishing	1590030	Tobacco
1	A Agriculture, Forestry and Fishing	1590040	Beverage and spice crops
1	A Agriculture, Forestry and Fishing	1590050	Grass, lucerne and clover seed
1	A Agriculture, Forestry and Fishing	1590060	Hay, cereal grasses and fodder
1	A Agriculture, Forestry and Fishing	1590090	Peanuts
1	A Agriculture, Forestry and Fishing	1590110	Natural rubber
1	A Agriculture, Forestry and Fishing	1590120	Crops nec
1	A Agriculture, Forestry and Fishing	1600010	Whole milk, chilled but otherwise untreated
1	A Agriculture, Forestry and Fishing	1600020	Dairy cattle
1	A Agriculture, Forestry and Fishing	1710010	Poultry, for slaughtering
1	A Agriculture, Forestry and Fishing	1720020	Egg laying hens
1	A Agriculture, Forestry and Fishing	1800010	Deer
1	A Agriculture, Forestry and Fishing	1910010	Thoroughbred horses
1	A Agriculture, Forestry and Fishing	1910020	Horse stud and breeding services; horses nec
1	A Agriculture, Forestry and Fishing	1910030	Horse Agistment Services
1	A Agriculture, Forestry and Fishing	1920010	Pigs
1	A Agriculture, Forestry and Fishing	1930010	Unblended honey and beeswax
1	A Agriculture, Forestry and Fishing	1990010	Pet breeding and live animals nec
1	A Agriculture, Forestry and Fishing	1990020	Livestock products nec
1	A Agriculture, Forestry and Fishing	3010010	Natural gums and resins (incl oleoresins)

1	A Agriculture, Forestry and Fishing	3010020	Softwoods (conifers) growing
1	A Agriculture, Forestry and Fishing	3010030	Hardwoods, brushwoods, scrubwoods - growing
1	A Agriculture, Forestry and Fishing	3010040	Forest products nec
1	A Agriculture, Forestry and Fishing	3020010	Softwoods (conifers) logs
1	A Agriculture, Forestry and Fishing	3020020	Hardwoods, brushwoods, scrubwoods - logs; hewn timber and timber nec (incl firewood)
1	A Agriculture, Forestry and Fishing	3021980	General government consumption of fixed capital (0301-0302)
1	A Agriculture, Forestry and Fishing	4200010	Skins and pieces, raw
1	A Agriculture, Forestry and Fishing	4200020	Wildlife culling services
1	A Agriculture, Forestry and Fishing	4200030	Hunting and trapping products nec
1	A Agriculture, Forestry and Fishing	4201980	General government consumption of fixed capital (0411-0420)
1	A Agriculture, Forestry and Fishing	5100010	Services to forestry nec
1	A Agriculture, Forestry and Fishing	5210010	Cotton (ginned), cotton seed, waste from cotton and cotton ginning services
1	A Agriculture, Forestry and Fishing	5220010	Sheep shearing services
1	A Agriculture, Forestry and Fishing	5290010	Aerial agricultural services
1	A Agriculture, Forestry and Fishing	5290020	Services to agriculture nec
1	A Agriculture, Forestry and Fishing	5290030	Services to fishing nec
1	A Agriculture, Forestry and Fishing	5290040	Wool classing services
1	A Agriculture, Forestry and Fishing	5291980	General government consumption of fixed capital (0510-0529)
2	B Mining	6000010	Black coal (all types incl briquettes)
2	B Mining	6000020	Brown coal-lignite (incl briquettes)
2	B Mining	7000010	Crude oil (incl. condensate)
2	B Mining	7000020	Liquefied natural gas
2	B Mining	7000030	Natural gas (in the gaseous state)
2	B Mining	7000040	Coal gas, water gas, producer gas and similar gases (excl petroleum gases and other gaseous hydrocarbons)
2	B Mining	8010010	Iron ore (incl treatment; excl pelletising)
2	B Mining	8010020	Agglomerated iron ores nec (incl iron ore pellets and sintered ores)
2	B Mining	8020010	Bauxite
2	B Mining	8030010	Copper concentrates, oxides and ores
2	B Mining	8040010	Gold bullion and ores
2	B Mining	8050010	Beneficiated ilmenite, ilmenite and leucoxene concentrates

2	B Mining	8050020	Rutile concentrates
2	B Mining	8050030	Monazite, xenotime and zircon concentrates; mineral sand ores nec
2	B Mining	8060010	Nickel ores and concentrates
2	B Mining	8070010	Lead ores and concentrates (excl silver-lead-zinc ores)
2	B Mining	8070020	Silver and zinc ores
2	B Mining	8090010	Tin, tin-copper and tin-tantalite concentrates
2	B Mining	8090020	Uranium concentrates
2	B Mining	8090030	Manganese ores
2	B Mining	8090040	Non-ferrous metallic ores and concentrates nec (incl tungsten)
2	B Mining	9110010	Gravel
2	B Mining	9110020	Sand
2	B Mining	9190010	Dimension stone
2	B Mining	9190020	Pebbles, broken or crushed stone, macadam, tarred macadam, granules, chippings and powder of stone
2	B Mining	9190030	Limestone (incl shell and coral)
2	B Mining	9190040	Clays nec (incl brick, pipe, tile and shale)
2	B Mining	9190050	Construction materials (mined) nec (incl decomposed rock, residues, etc) (excl crushed and broken stone and dimension stone)
2	B Mining	9900010	Salt
2	B Mining	9900020	Precious and semi-precious gemstones (incl garnet concentrate)
2	B Mining	9900030	Gypsum; anhydrite; calcareous stone of a kind used for the manufacture of lime or cement (excluding limestone)
2	B Mining	9900040	Silica
2	B Mining	9900050	Natural phosphates and Phosphate rock (unground)
2	B Mining	9900060	Chemical and fertilizer minerals nec
2	B Mining	9900070	Non-metallic minerals nec
2	B Mining	10110010	Petroleum exploration
2	B Mining	10120010	Mineral exploration
2	B Mining	10900010	Mining services nec
2	B Mining	10901980	General government consumption of fixed capital (1011-1090)
3	Food	1210010	Mushrooms, fresh or chilled
3	Food	1210020	Mushroom spawn
3	Food	1220010	Lettuces grown undercover
3	Food	1220020	Tomatoes grown undercover
3	Food	1220030	Other vegetables, fresh or chilled, grown undercover
3	Food	1230010	Lettuces grown outdoors
3	Food	1230020	Tomatoes grown outdoors
3	Food	1230030	Potatoes, sweet potatoes and edible roots and tubers nec grown outdoors
3	Food	1230040	Beans, french and runner; peas, green or blue grown outdoors
3	Food	1230050	Cabbages, brussels sprouts, cauliflowers and headed broccoli grown outdoors
3	Food	1230060	Carrots grown outdoors

3	Food	1230070	Onions grown outdoors
3	Food	1230080	Vegetable seeds
3	Food	1230090	Other vegetables (incl. melons), fresh or chilled grown outdoors
3	Food	1310010	Grapes - table
3	Food	1310020	Grapes - wine
3	Food	1310030	Grapes sun-dried or for drying
3	Food	1320010	Kiwi fruit
3	Food	1330010	Strawberries
3	Food	1330020	Berries nec - fresh and sun-dried
3	Food	1340010	Apples - fresh and sun-dried
3	Food	1340020	Pears and quinces - fresh and sun-dried
3	Food	1350010	Stone fruit - fresh and sun-dried
3	Food	1360010	Citrus fruit - fresh and sun-dried
3	Food	1370010	Olives - fresh and sun-dried
3	Food	1390010	Bananas - fresh and sun-dried
3	Food	1390020	Orchard fruit nec - fresh and sun-dried
3	Food	1390030	Almonds and macadamias
3	Food	1390040	Edible nuts (excluding Peanuts) nec; Other fruit nec - fresh and sun-dried
3	Food	1720010	Eggs
3	Food	2000010	Farmed oysters (including Pearl), paua and molluscs nec
3	Food	2000020	Farmed seaweed
3	Food	2000030	Farmed fish and fish hatchery products
3	Food	2000040	Farmed prawns and crustaceans nec
3	Food	2031980	General government consumption of fixed capital (0201-0203)
3	Food	4110010	Rock lobster and crab
3	Food	4120010	Prawns
3	Food	4130010	Fish and squid (line fishing)
3	Food	4140010	Fish (trawling or netting)
3	Food	4190010	Oysters and other aquatic invertebrates nec, live, fresh or chilled
3	Food	4190020	Coral and similar, shells of molluscs; natural animal sponges; algae, fresh or dried
3	Food	4190030	Freshwater fish and aquatic animals nec
3	Food	11110010	Fresh meat, chilled or frozen (excl kangaroo or horse meat, other than for human consumption)
3	Food	11110020	Fresh kangaroo or horse meat, other than for human consumption
3	Food	11110040	Edible offals (excl poultry offals)
3	Food	11110050	Edible tallow (excl refined)
3	Food	11110080	Meat (excl fresh) for human consumption
3	Food	11110090	Blood meal (milled or screened dried blood) for use as stock or poultry feed
3	Food	11110100	Inedible meat or meat offal flours, meals and pellets; greaves

3	Food	11110110	Other animal products nec
3	Food	11120010	Poultry and poultry products (incl canned)
3	Food	11130010	Bacon and ham and other dried, salted or smoked pigmeat (incl canned)
3	Food	11130020	Smallgoods nec (incl crumbed lamb cutlets, cured meat (canned or uncanned), frankfurters, saveloys and salami)
3	Food	11200010	Fish, canned
3	Food	11200020	Frozen whole fish, fish fillets and fish meat; fish loaf, cake, balls and paste; smoked fish; fish fingers; caviar
3	Food	11200030	Rock lobster and crayfish (incl tails), chilled or frozen (incl boiled and frozen)
3	Food	11200040	Crustaceans, molluscs & aquatic invertebrates nec (chilled, frozen, preserved or otherwise prepared)
3	Food	11200050	Inedible flours, meals, pellets & other products nec of fish, crustaceans & molluscs or other aquatic invertebrates
3	Food	11310010	Processed liquid milk (incl whole milk and skim)
3	Food	11310020	Cream (incl thickened), not concentrated or sweetened
3	Food	11320010	Ice cream and frozen confections
3	Food	11330010	Flavoured whole milk drinks
3	Food	11330020	Sour cream, yoghurt and other cultured milk products
3	Food	11330030	Buttermilk
3	Food	11330040	Fats and oils derived from milk (incl butter oil); casein
3	Food	11330050	Butter
3	Food	11330060	Cheese and curd
3	Food	11330070	Milk based food preparations (excluding malt extracts) and dried milk based mixes
3	Food	11330080	Milk and cream, concentrated or sweetened; lactose and lactose syrup; products of natural milk constituents nec
3	Food	11400010	Jams
3	Food	11400020	Fruit juices, single strength or concentrated
3	Food	11400030	Dried fruit (excl sun-dried)
3	Food	11400040	Preserved fruit and fruit products nec
3	Food	11400050	Vegetables, frozen
3	Food	11400060	Vegetables, prepared or preserved (incl dried or shelled)(excl frozen); pickles and chutney
3	Food	11400070	Tomato pulp, puree and paste
3	Food	11400080	Mixed meat and vegetables, canned
3	Food	11400090	Vegetable juices (incl mixtures)(incl tomato); mixtures of vegetable and fruit juices
3	Food	11400100	Pasta products, canned
3	Food	11400110	Soup and homogenised food preparations including fruit, vegetables, meat or composites thereof
3	Food	11400120	Sauces (excl worcestershire and apple); vinegar (excl wine vinegar)
3	Food	11400130	Fresh vegetable salads, in plastic containers
3	Food	11400140	Fruit and vegetable based health, invalid or baby preparations

3	Food	11400150	Dried roots, tubers and vegetables; Flour and meal of vegetables nec.
3	Food	11500010	Crude soya bean, cotton seed, peanut, sunflower, safflower, rape seed, coconut and vegetable oils
3	Food	11500020	Refined and processed animal or vegetable oils and fats (incl tallow) (excl neatsfoot, wool grease and lanolin)
3	Food	11500030	Margarine
3	Food	11500040	Oil-cake, acid oils, cotton linters and other solid residues resulting from the extraction or refining of vegetable fats or oils
3	Food	11610010	Wheat and other cereal flours (incl self-raising)
3	Food	11610020	Flour mill products nec, for human consumption
3	Food	11610030	Wheat bran for human consumption (excl for breakfast food)
3	Food	11610040	Starch of wheat and corn
3	Food	11610050	Glucose, glucose syrup (incl dextrose) and modified starches (incl dextrans)
3	Food	11610060	Wheat gluten and tapioca
3	Food	11610070	Prepared baking powders
3	Food	11610080	Malt (excl malt extract)
3	Food	11610090	Malt extract
3	Food	11610100	Rice (husked, semi-milled or wholly milled)
3	Food	11610110	Rice groats, meals and pellets; other worked cereal grains and products nec;
3	Food	11620010	Cereal foods (incl breakfast foods)
3	Food	11620020	Mixes and doughs nec (incl custard powder) for preparation of bakers wares (excl frozen)
3	Food	11620030	Pasta
3	Food	11700010	Bread and bread rolls
3	Food	11700020	Biscuits and biscuit crumbs; rusks; ice cream cones and wafers; unleavened bread
3	Food	11700030	Cakes, pastries and crumpets
3	Food	11700040	Meat pies
3	Food	11700050	Biscuit and bread dough (incl frozen)
3	Food	11810010	Raw and refined sugar in solid form (incl brown sugar)(excl icing sugar)
3	Food	11810020	Icing sugar, molasses (incl treacle) and sugar nec
3	Food	11810030	Liquid refined sugar, golden syrup, artificial honey, starch and sugar products nec
3	Food	11820010	Chocolate confectionery (excl chocolate coated biscuits and white chocolate)
3	Food	11820020	Cocoa beans (roasted); cocoa paste, powder, butter, fat or oil
3	Food	11820030	Other food preparations containing cocoa (excl chocolate confectionery)
3	Food	11820040	Chewing gum, white chocolate and other confectionery not containing cocoa
3	Food	11820050	Crystallised, drained and glace fruit, nuts and peel
3	Food	11910010	Potato crisps and flakes
3	Food	11910020	Corn chips; taco, tortilla and tostada shells

3	Food	11920010	Dog and cat food (excl canned)
3	Food	11920020	Dog and cat food, canned
3	Food	11920030	Bran, sharps and other residues (excl rice, wheat and rye), for animal feed
3	Food	11920040	Prepared animal and bird feeds nec (incl poultry pellets, crumbles and mash)
3	Food	11990010	Coffee and tea, including substitutes
3	Food	11990020	Yeast and yeast extracts
3	Food	11990030	Nuts, roasted
3	Food	11990040	Spices
3	Food	11990050	Mustard; worcestershire sauce; mayonnaise and salad dressing
3	Food	11990060	Flavouring essences, industrial
3	Food	11990070	Prepared meals (incl TV dinners), of meat or meat offal
3	Food	11990080	Bakers' wares nec (incl pretzels and frozen pizza) (excl bread and pies)
3	Food	11990090	Peanut butter and other nut butters, pastes and purees; jams
3	Food	11990120	Food products nec (incl jelly crystals, meat pastes)
3	Food	12110010	Natural and artificial mineral waters and aerated waters (excl sweetened or flavoured)
3	Food	12110020	Natural water nec
3	Food	12110030	Mineral waters and aerated waters, sweetened or flavoured, canned
3	Food	12110040	Mineral waters and aerated waters, sweetened or flavoured, bottled
3	Food	12110050	Cordials and syrups; powder flavours for soft drinks; concentrated cordial extracts
3	Food	12110060	Sweetened or flavoured bulk pre-mix & post-mix concentrates for mineral & aerated waters; non-alcoholic beverages nec
3	Food	12110070	Ice
3	Food	12120010	Beer, ale and stout, bottled
3	Food	18420010	Animal feed supplements
4	Alcoholic beverages and tobacco	12120020	Beer, ale and stout, canned
4	Alcoholic beverages and tobacco	12120030	Beer, ale and stout, bulk
4	Alcoholic beverages and tobacco	12130010	Whisky, brandy, rum, gin and fortified spirits; other distilled alcoholic beverages (incl liqueurs and mixed drinks)
4	Alcoholic beverages and tobacco	12130020	Vermouth and distillation wine
4	Alcoholic beverages and tobacco	12140010	Wines (incl sparkling) of grapes and other fruit (excl vermouth)
4	Alcoholic beverages and tobacco	12140020	Cider, perry, mead and wine-based mixed drinks (coolers)
4	Alcoholic beverages and tobacco	12140030	Vinegar from wine
4	Alcoholic beverages and tobacco	12200010	Cigarettes, cigars, cheroots and tobacco
5	Clothing and footwear	13200010	Leather, vegetable or chrome tanned (incl re-tanned), dressed or finished; chamois leathers

5	Clothing and footwear	13200050	Handbags, suitcases, bags, travel sets for personal toilet articles, purses, key cases, wallets and billfolds (excl paper)
5	Clothing and footwear	13200060	Saddlery and harness, of any material; leather articles nec
5	Clothing and footwear	13200070	Rucksacks of leather or leather substitute
5	Clothing and footwear	13310010	Carpets and other textile floor coverings (incl mats and matting) (excl felt and underfelt)
5	Clothing and footwear	13320010	Rope and cable (excl wire), cordage (excl tyre cord yarn), twine or net products
5	Clothing and footwear	13330010	Textile interior furnishing articles (incl blankets (excl electric), wall coverings, curtains, bed and table linen nec)
5	Clothing and footwear	13330020	Towels (incl tea towels) and face washers of cotton terry towelling or similar cotton terry fabrics
5	Clothing and footwear	13330030	Baby napkins of textile fabrics
5	Clothing and footwear	13330040	Textile quilted prods, hose/tubing, nonwovens, (bonded & yarn fabrics)
5	Clothing and footwear	13330050	Curtains in the piece (incl continuous), knitted or crocheted
5	Clothing and footwear	13330060	Textile tarpaulins (incl canvas), sails, tents, annexes, pneumatic mattresses and motor vehicle covers
5	Clothing and footwear	13330070	Blinds and awnings of textile fabrics (incl canvas) and woven textile materials (incl cotton)
5	Clothing and footwear	13330080	Bags, sacks and packets of textile or canvas
5	Clothing and footwear	13330090	Textile motor vehicle seat covers
5	Clothing and footwear	13330100	Pillows, cushions, bolsters, bean bags and stuffed mattress protectors (excl those of or stuffed with rubber)
5	Clothing and footwear	13330110	Floor-cloths, dishcloths, dusters and similar cleaning cloths
5	Clothing and footwear	13330120	Textile life jackets, life-belts, sleeping bags, parachutes and other cut and sewn textile products nec
5	Clothing and footwear	13340010	Labels and badges with printed or woven lettering or design
5	Clothing and footwear	13340020	Textile finishing nec
5	Clothing and footwear	13340030	Felt floor coverings (exclude underfelt)
5	Clothing and footwear	13340040	Underfelt and other felt products (excl floor coverings, headwear or clothing)
5	Clothing and footwear	13340050	Textile fabrics (excl rubber or plastic coated) & articles (excl bags) of a kind commonly used in machinery or plant
5	Clothing and footwear	13340060	Wadding, powder puffs, pads, cotton wool, gauze and bandages
5	Clothing and footwear	13340080	Articles of bonded fibre or yarn fabrics (excl labels & badges); tapestries, textile sutures, transmission and conveyor belts, textile articles nec
5	Clothing and footwear	13340090	Braids, tassels, tulle; lace or embroidery, strips or motifs
5	Clothing and footwear	13340100	Special fabrics nec
5	Clothing and footwear	13400010	Hosiery (incl pantyhose, stockings, tights and socks)
5	Clothing and footwear	13400020	Pullovers, jumpers, sweaters and cardigans - knitted
5	Clothing and footwear	13400030	Knitted or crocheted pile fabrics (excl elastic or elastomeric)
5	Clothing and footwear	13400040	Knitted or crocheted fabric nec
5	Clothing and footwear	13400050	Knitted products nec
5	Clothing and footwear	13510010	Mens and boys trousers (excl suits), shorts, jeans, overalls and work shirts, dustcoats, textile (excl waterproof)

5	Clothing and footwear	13510020	Men's & boys' suits or uniforms (incl trousers for suits & uniforms), coats & jackets, textile (excl waterproof)
5	Clothing and footwear	13510030	Women's and girls' dresses, skirts, slacks, shorts, tunics, uniforms, jeans, overalls, leotards, coats, capes, suits and ensembles
5	Clothing and footwear	13510040	Shirts and blouses (with collars)
5	Clothing and footwear	13510050	T-shirts and tank tops
5	Clothing and footwear	13510060	Swimwear; sweatsuits, tracksuits, jogging suits, leisure suits and jumpsuits
5	Clothing and footwear	13510070	Foundation garments (incl brassieres, corsets and girdles)
5	Clothing and footwear	13510080	Underwear
5	Clothing and footwear	13510090	Outer nightwear (incl dressing gowns and robes) and sleepwear
5	Clothing and footwear	13510100	Waterproof, plastic or rubber trousers, overalls, coats and jackets
5	Clothing and footwear	13510110	Plastic (unsupported film) clothing other than waterproof
5	Clothing and footwear	13510130	Fur and sheepskin clothing and clothing accessories (excl headwear, footwear, handbags, purses and toys)
5	Clothing and footwear	13510140	Hats and other headgear (excl safety, rubber or plastic)
5	Clothing and footwear	13510150	Safety headgear; textile belts for clothing; plastic clothing accessories (excl belts and disposable gloves)
5	Clothing and footwear	13510160	Safety eyewear (industrial or sporting) (incl goggles)
5	Clothing and footwear	13510170	Clothing and clothing accessories nec
5	Clothing and footwear	13520010	Footwear with uppers and outer soles of rubber or plastic (incl waterproof footwear and thongs) (excl sports footwear)
5	Clothing and footwear	13520020	Footwear with uppers of leather and outer soles of rubber or plastic (excl sports footwear)
5	Clothing and footwear	13520030	Sports footwear
5	Clothing and footwear	13520040	Footwear with uppers of leather and outer soles of leather or composition leather (excl sports footwear)
5	Clothing and footwear	13520050	Footwear nec (incl steel capped footwear)
5	Clothing and footwear	13520060	Soles of or cut from rubber or rubber composition and parts of footwear nec (incl plastic heels)
5	Clothing and footwear	19110050	Textile fabrics (excl tyre cord) impregnated, coated, covered or laminated with plastics
5	Clothing and footwear	25130010	Mattresses, of, or stuffed with rubber
5	Clothing and footwear	25130030	Water mattresses
5	Clothing and footwear	25130040	Mattresses (excl water-mattresses and those of or stuffed with rubber)
5	Clothing and footwear	25130050	Mattress supports (excl unupholstered woven wire, link mesh, wire springs and those of or stuffed with rubber)
5	Clothing and footwear	94910010	Clothing and footwear repair
6	Rent and other dwelling services	14910010	Prefabricated or transportable wooden buildings
6	Rent and other dwelling services	30100010	Residential building construction
6	Rent and other dwelling services	30109010	Second hand residential buildings
6	Rent and other dwelling services	32000010	Trade services repair and maintenance
6	Rent and other dwelling services	62000020	Bank services nec

6	Rent and other dwelling services	63100010	Life insurance provision
6	Rent and other dwelling services	63210010	Health insurance provision
6	Rent and other dwelling services	63220010	Fire and industrial special risks insurance provision
6	Rent and other dwelling services	63220020	Houseowner and household insurance provision
6	Rent and other dwelling services	63220030	Motor vehicle comprehensive and compulsory third party insurance provision
6	Rent and other dwelling services	63220040	Public liability, product liability and professional indemnity insurance provision
6	Rent and other dwelling services	63300010	Superannuation fund services
6	Rent and other dwelling services	66190010	Other motor vehicle rental or hire (incl caravan & trailer) (excl financial leases) nec
6	Rent and other dwelling services	67110010	Ownership of dwellings
6	Rent and other dwelling services	94110010	Automotive electrical repair or replacement services
6	Rent and other dwelling services	94110020	Automotive electrical installation services
6	Rent and other dwelling services	94120020	Automotive body, paint and interior repair services
6	Rent and other dwelling services	94190010	Other automotive repair services
6	Rent and other dwelling services	94210010	Domestic appliance repair and maintenance
6	Rent and other dwelling services	94220010	Electronic and precision equipment repair and maintenance (excl domestic appliance)
6	Rent and other dwelling services	94290010	Other machinery and equipment repair and maintenance
6	Rent and other dwelling services	94990010	Other repair and maintenance nec
7	Liquid fuels	17010010	Automotive petrol; gasoline refining or blending; motor spirit (incl aviation spirit)
7	Liquid fuels	17010030	Gas oil or fuel oil (excl motor spirit and kerosene)
7	Liquid fuels	17090100	Brake and hydraulic fluid
7	Liquid fuels	17090110	Rust arresting compound
8	Furnishings and household equipment	24110010	Cameras, image projectors and parts
8	Furnishings and household equipment	24110020	Photographic goods nec (excl sensitised photographic film, paper, plates & chemicals)
8	Furnishings and household equipment	24110030	Objective lenses, filters and other mounted optical elements; microscopes (excl optical) and diffraction apparatus and parts nec
8	Furnishings and household equipment	24110050	Ophthalmic instruments and appliances
8	Furnishings and household equipment	24110060	Spectacle and contact lenses
8	Furnishings and household equipment	24110070	Spectacles, sunglasses and frames

8	Furnishings and household equipment	24120030	Hearing aids and parts or accessories
8	Furnishings and household equipment	24190040	Watches (incl metal watch straps), watch cases, clocks and parts
8	Furnishings and household equipment	24210030	Laptops, notebooks, personal digital assistants and other portable computers
8	Furnishings and household equipment	24210040	Desktop computers (PCs)
8	Furnishings and household equipment	24210050	Computer peripheral devices (incl monitors, keyboards, mice, joysticks, speakers, drives and burners)
8	Furnishings and household equipment	24210060	Printers and plotters
8	Furnishings and household equipment	24210070	Other computer hardware, computer peripherals and accessories nec
8	Furnishings and household equipment	24290010	Television receiving sets (excl parts)
8	Furnishings and household equipment	24290020	Radio receiving sets (incl car radios and clock radios) (excl parts)
8	Furnishings and household equipment	24290030	Sound and video recording and reproducing equipment (incl CD players, record players) (excl parts)
8	Furnishings and household equipment	24290040	Loudspeakers and audio-frequency electric amplifiers (excl hearing aids and parts)
8	Furnishings and household equipment	24290050	Electric or electronic alarm systems (excl remote monitoring alarm systems) and parts
8	Furnishings and household equipment	24390010	Dry cell batteries
8	Furnishings and household equipment	24390020	Automotive wet cell batteries
8	Furnishings and household equipment	24410010	Solid fuel or gas portable barbecues
8	Furnishings and household equipment	24410020	Domestic stoves, ovens and rangehoods (incl gas, electric, solid fuel, oil or spirit fired)
8	Furnishings and household equipment	24410030	Domestic refrigerators and freezers
8	Furnishings and household equipment	24410050	Clothes washing machines, drying cabinets, tumble driers and dishwashing machines
8	Furnishings and household equipment	24410060	Domestic food waste disposal units
8	Furnishings and household equipment	24490010	Domestic gas, electric, solid fuel, oil, spirit fired space heaters and non-electric warm air furnaces
8	Furnishings and household equipment	24490020	Domestic soil heating apparatus
8	Furnishings and household equipment	24490030	Domestic solar hot water collectors, systems and parts (incl systems with conventional backup sources)
8	Furnishings and household equipment	24490040	Domestic gas and other non-electric water heaters and hot water systems (excl solar) and parts
8	Furnishings and household equipment	24490050	Domestic electric water heaters or hot water systems and parts
8	Furnishings and household equipment	24490060	Domestic room air conditioners and coolers (excl fans)
8	Furnishings and household equipment	24490080	Domestic fans (incl table, floor, wall, window, ceiling or roof)

8	Furnishings and household equipment	24490100	Sewing machines, vacuum cleaners, food mixers and other domestic appliances and parts (nec)
8	Furnishings and household equipment	24491700	Domestic appliances - commission production (2441-2449)
8	Furnishings and household equipment	24610010	Lawn mowers
8	Furnishings and household equipment	24630020	Hand tools, power operated (incl portable electric hand tools) nec
8	Furnishings and household equipment	25190010	Other assembled domestic furniture nec (excl wooden, metal or plastic)
8	Furnishings and household equipment	25920010	Toys (excl fur or leather)
8	Furnishings and household equipment	25920020	Other articles for funfair or table games (incl billiards, snooker or pool, pintables articles and accessories)
8	Furnishings and household equipment	25920030	Sporting equipment and accessories (incl fishing gear and gloves specially designed for use in sport)
8	Furnishings and household equipment	25990010	Paint brushes or rollers, accessories and parts
8	Furnishings and household equipment	25990020	Hair brushes, nail brushes, toothbrushes (excl electric) and other brushes for personal use
8	Furnishings and household equipment	25990040	Pens, pencils and refills, crayons and chalk
8	Furnishings and household equipment	25990050	Typewriter ribbons and ink pads
8	Furnishings and household equipment	25990060	Umbrellas
8	Furnishings and household equipment	25990070	Musical instruments (incl parts and accessories)
8	Furnishings and household equipment	25990090	Metal (other than precious) statuettes and other ornaments
8	Furnishings and household equipment	25990100	Articles of precious metal (incl articles for technical or laboratory use)(excl jewellery)
8	Furnishings and household equipment	25990120	Manufacturing nec (incl non-textile based sutures)
9	C Manufacturing	11110030	Casings, bungs, weasands and runners (incl gut materials for further processing)
9	C Manufacturing	11110060	Inedible tallow (excl refined) and other unrefined animal oils and fats
9	C Manufacturing	11110070	Raw hides and skins
9	C Manufacturing	11131700	Meat and meat products - commission production (1111-1113)
9	C Manufacturing	11201700	Processed seafood - commission production
9	C Manufacturing	11201980	General government consumption of fixed capital (1120)
9	C Manufacturing	11331700	Dairy products - commission production (1131-1133)
9	C Manufacturing	11401700	Fruit and vegetable products - commission production
9	C Manufacturing	11501700	Oils and fats - commission production
9	C Manufacturing	11621700	Grain mill and cereal products - commission production (1161-1162)
9	C Manufacturing	11701700	Bakery products - commission production (1171-1174)
9	C Manufacturing	11821700	Sugar and confectionery - commission production (1181-1182)
9	C Manufacturing	11920050	Cereal groats, meals, pellets and other cereal products nec, other than for human consumption

9	C Manufacturing	11990100	Refined salt (cooking and table)
9	C Manufacturing	11990110	Gelatine
9	C Manufacturing	11991700	Other food products - commission production (1191-1199)
9	C Manufacturing	11991970	Waste from the manufacture of food, food products and beverages (excl alcohol) (1111-1211)
9	C Manufacturing	11991980	General government consumption of fixed capital (1191-1199)
9	C Manufacturing	12111700	Soft drinks, cordials and syrups - commission production
9	C Manufacturing	12121700	Beer - commission production
9	C Manufacturing	12141700	Wine, spirits and other alcoholic beverages - commission production (1213-1214)
9	C Manufacturing	12141970	Waste from the manufacture of alcohol (1212-1214)
9	C Manufacturing	12201700	Cigarette and tobacco products - commission production
9	C Manufacturing	12201970	Waste from the manufacture of tobacco products
9	C Manufacturing	13110010	Wool, scoured or carbonised (degreased but not carded or combed)
9	C Manufacturing	13110020	Wool tops; noils of wool or fine animal hair
9	C Manufacturing	13110030	Wool grease and fatty substances derived from wool grease (incl lanolin)
9	C Manufacturing	13120010	Yarn and thread (excl chenille, loop wale, elastic or elastomeric) of natural fibres (incl worsted) nec
9	C Manufacturing	13120020	Chenille, loop wale yarn and thread of natural fibres
9	C Manufacturing	13120030	Natural textile fibres prepared for spinning nec
9	C Manufacturing	13120040	Narrow woven textile fabrics (incl tape) (excl bias binding) of natural fibres; tyre cord fabric of high tenacity yarn of natural fibres
9	C Manufacturing	13120050	Woven and broadwoven pile, chenille and terry fabrics of cotton or other natural fibre (excl narrow fabrics)
9	C Manufacturing	13120060	Woven and broadwoven fabrics of natural fibres, other than cotton, nec (excl pile, chenille and terry)
9	C Manufacturing	13120070	Woven and broadwoven fabrics of cotton (excl pile, chenille and terry)
9	C Manufacturing	13130010	Textured, high tenacity, single, elastomeric, synthetic or artificial yarns and threads nec
9	C Manufacturing	13130020	Gimped yarn and strip; chenille and loop-wade yarn; woven or broadwoven fabrics of metal thread and metallised yarn nec
9	C Manufacturing	13130030	Elastomeric yarn of cotton, wool or fine animal hair (containing polyurethane or similar thread, excl rubber thread)
9	C Manufacturing	13130040	Yarn of glass fibre
9	C Manufacturing	13130050	Woven or broadwoven fabric of artificial or synthetic filaments and fibres (excl pile or chenille)
9	C Manufacturing	13130060	Woven pile fabrics and chenille fabrics (other than narrow fabrics) of man-made fibres
9	C Manufacturing	13130070	Narrow woven textile fabrics (incl tape) (excl bias binding) of synthetic fibres; tyre cord fabric of high tenacity yarn of synthetic fibres
9	C Manufacturing	13131700	Textiles - commission production (1311-1313)
9	C Manufacturing	13200020	Leather (excl dressed or finished)
9	C Manufacturing	13200030	Raw hides and skins, pickled or otherwise preserved
9	C Manufacturing	13200040	Tanned or dressed skins, with hair or wool retained (incl sheepskin rugs)

9	C Manufacturing	13201700	Tanned leather, dressed fur and leather products - commission production
9	C Manufacturing	13340110	Garment dyeing service
9	C Manufacturing	13341700	Textile products - commission production (1331-1334)
9	C Manufacturing	13341980	General government consumption of fixed capital (1331-1334)
9	C Manufacturing	13401700	Knitted products - commission production
9	C Manufacturing	13510120	Wetsuits and other rubber clothing and accessories nec (incl gloves, belts)(excl headgear)
9	C Manufacturing	13511700	Clothing - commission production
9	C Manufacturing	13521700	Footwear - commission production
9	C Manufacturing	13521970	Waste from the manufacture of textiles, clothing or footwear (1311-1352)
9	C Manufacturing	14110010	Undressed sawn timber from logs sawn at same establishment (incl treated (excl impregnated sleepers or resawn)); shooks
9	C Manufacturing	14110020	Treated wood in the rough (excl sawn timber, dressed or undressed); impregnated railway sleepers
9	C Manufacturing	14110030	Ground bark
9	C Manufacturing	14120010	Woodchips, softwood
9	C Manufacturing	14120020	Woodchips, hardwood
9	C Manufacturing	14130010	Resawn/seasoned timber (incl kiln dried)(excl sleepers, palings & shingles)
9	C Manufacturing	14130020	Dressed timber and mouldings of a thickness up to and including 6mm
9	C Manufacturing	14130030	Dressed timber and mouldings of a thickness exceeding 6mm
9	C Manufacturing	14130040	Chemically preserved re-sawn or dressed timber.
9	C Manufacturing	14131700	Drying, impregnation or chemical treatment - commission production (1411-1413)
9	C Manufacturing	14920010	Doors, wooden
9	C Manufacturing	14920020	Roof trusses, wooden
9	C Manufacturing	14920030	Wooden wall and window (incl complete with glass) frames
9	C Manufacturing	14920040	Custom made built-in wooden furniture
9	C Manufacturing	14920050	Other wooden builders joinery and carpentry
9	C Manufacturing	14930010	Veneers (incl laminated)
9	C Manufacturing	14930020	Plywood
9	C Manufacturing	14930030	Glued laminated lumber
9	C Manufacturing	14940010	Fibreboard (excl fibre paperboard and particle board)
9	C Manufacturing	14940020	Cellular wood panels
9	C Manufacturing	14940030	Particle board (incl laminated) and similar board of wood or other ligneous materials
9	C Manufacturing	14940040	Laminates of timber and non-timber materials
9	C Manufacturing	14940050	Other boards manufactured from wood nec (incl densified wood in block or other shape)
9	C Manufacturing	14990010	Parquetry strips etc., assembled into panels; shingles and shakes
9	C Manufacturing	14990020	Pallets, cases, boxes, crates, drums, casks and barrels, wooden
9	C Manufacturing	14990030	Frames, wooden (incl for paintings, photographs, mirrors, etc)

9	C Manufacturing	14990040	Boards & similar articles nec, of vegetable fibre agglomerated with mineral binders (excl wooden boards)
9	C Manufacturing	14990050	Moulding boxes, patterns, bases; moulds for metal (excl ingot), glass, mineral materials, rubber or plastics
9	C Manufacturing	14990060	Wooden tools, tool bodies & handles; cork articles (incl agglomerated)(excl gaskets for motor vehicles); other products of wood nec
9	C Manufacturing	14991700	Other wood products - commission production (1491-1499)
9	C Manufacturing	15100010	Mechanical, chemical and semi-chemical wood pulp and residual lyes from wood pulp (excl tall oil)
9	C Manufacturing	15100020	Newsprint
9	C Manufacturing	15100030	Paper stock (incl toilet, facial tissue and similar paper stock used for household or sanitary purposes)
9	C Manufacturing	15100040	Copying paper nec
9	C Manufacturing	15100050	Paper and paperboard, coated, impregnated, covered, surface-coloured, surface-decorated nec
9	C Manufacturing	15100060	Paper and paperboard, uncoated nec
9	C Manufacturing	15101700	Paper - commission production
9	C Manufacturing	15210010	Solid and corrugated paperboard containers
9	C Manufacturing	15210020	Corrugated paperboard sheeting
9	C Manufacturing	15220010	Paper bags, packets and sacks (incl paper multiwall bags) (excl bags of composite material)
9	C Manufacturing	15230010	Envelopes (paper), letter & correspondence cards (excl printed or illustrated); paper wallets & writing compendiums of paper
9	C Manufacturing	15230020	Exercise books, registers, account books, diaries, board games and other paper stationery (excl commission printing)
9	C Manufacturing	15240010	Toilet, tissues, serviettes, towels & similar paper for household & sanitary purposes, in sheets or perforated rolls
9	C Manufacturing	15240020	Baby napkins (excl textile), sanitary towels and tampons of paper or cellulose wadding
9	C Manufacturing	15290010	Paper and paperboard trays, dishes, plates, cups, cones, egg containers and box files
9	C Manufacturing	15290020	Paper festival, carnival or other entertainment articles (incl conjuring tricks, novelties, Christmas decorations)
9	C Manufacturing	15290030	Adhesive paper labels (excl printed)
9	C Manufacturing	15290040	Other paper, paper pulp or paperboard products (incl wallpaper and liquid activated gummed or adhesive paper)
9	C Manufacturing	15291700	Paper products - commission production (1521-1529)
9	C Manufacturing	15291970	Waste from manufacture of wood and paper products (1411-1529)
9	C Manufacturing	15291980	General government consumption of fixed capital (1521-1529)
9	C Manufacturing	16110010	Books (incl atlases & touring guides), maps, charts, plans, sheet music printed but not published by this business
9	C Manufacturing	16110020	Newspapers, journals and periodicals printed but not published by this business once a week or more
9	C Manufacturing	16110030	Newspapers, journals and periodicals printed but not published by this business less than weekly
9	C Manufacturing	16110040	Security printed material (incl stamps, cheque books, banknotes, share documents and airline tickets)
9	C Manufacturing	16110050	Paper labels, printed or imprinted (but not published)

9	C Manufacturing	16110060	Letter and correspondence cards (printed but not published), postcards
9	C Manufacturing	16110070	Trade advertising material or commercial catalogues printed but not published by this business; other printed matter nec
9	C Manufacturing	16120010	Composed type, prepared printing plates/cylinders, lithographic stones or other impressed media for use in printing
9	C Manufacturing	16120020	Printing trade services nec (excluding desktop publishing)
9	C Manufacturing	16200010	Pre-recorded Audio and Video tapes, manufactured but not published by this business
9	C Manufacturing	16200020	Reproduced computer software, manufactured but not published by this business
9	C Manufacturing	16200030	Pre-recorded Audio CD's and DVD's, manufactured but not published by this business
9	C Manufacturing	16200040	Other pre-recorded media (including records), manufactured but not published by this business
9	C Manufacturing	16201980	General government consumption of fixed capital (1611-1620)
9	C Manufacturing	17010020	Kerosene (incl kerosene type jet fuel)
9	C Manufacturing	17010040	Petroleum bitumen; residues of petroleum oils and bituminous minerals; petroleum coke
9	C Manufacturing	17010050	Liquefied petroleum gas produced at refineries
9	C Manufacturing	17010060	Lubricating, heavy petroleum & bituminous oils; solvents; topped/enriched crude, refinery products nec
9	C Manufacturing	17090010	Metallurgical coke, coke breeze, retort carbon and char (excl bone char)
9	C Manufacturing	17090020	Pitch and pitch coke obtained from mineral tars
9	C Manufacturing	17090030	Mineral turpentine
9	C Manufacturing	17090040	Petroleum jelly; paraffin wax and other mineral waxes
9	C Manufacturing	17090050	Toluol, xylol, not chemically or commercially pure; benzole and benzene from petroleum
9	C Manufacturing	17090060	Phenol
9	C Manufacturing	17090070	Styrene
9	C Manufacturing	17090080	Chloroform and other halomethanes
9	C Manufacturing	17090090	Carbon tetrachloride
9	C Manufacturing	17090120	Bituminous mixtures and other articles of asphalt
9	C Manufacturing	17090130	Petroleum and coal products nec.
9	C Manufacturing	17091700	Petroleum and coal products - commission production (1701-1709)
9	C Manufacturing	17091970	Waste from the manufacture of Petroleum and Coal products (1701-1709)
9	C Manufacturing	18110010	Acetylene gas
9	C Manufacturing	18110020	Hydrogen, rare gases, nitrogen, medicinal gases (incl nitrous oxide and oxygen), carbon dioxide (incl dry ice) and carbon monoxide
9	C Manufacturing	18110030	Ethylene gas
9	C Manufacturing	18110040	Liquefied natural gas (other than from the well head)
9	C Manufacturing	18110050	Hydrogen sulphide, Sulphur dioxide and other industrial organic and inorganic gases nec
9	C Manufacturing	18120010	Carbon black
9	C Manufacturing	18120020	Synthetic organic colouring agents & preparations (incl colour lakes, pigments & dyes of vegetable or animal origin)

9	C Manufacturing	18120030	Hydrocarbons and derivatives (incl ethane, butane and benzene and benzene other than from petroleum and iron and steel)
9	C Manufacturing	18120040	Nitrogen-function compounds (excl saccharin)
9	C Manufacturing	18120050	Organo-inorganic compounds; heterocyclic compounds; nucleic acids
9	C Manufacturing	18120060	Carboxylic, monocarboxylic & polycarboxylic acids and derivatives (excl pharmaceutical goods)
9	C Manufacturing	18120070	Ethyl alcohol pure
9	C Manufacturing	18120080	Other alcohols, phenols (excl phenol), phenol-alcohols and derivatives, fatty acids (purity less than 90%)
9	C Manufacturing	18120090	Plasticiser; mixed alkylbenzenes and alkyl naphthalenes nec; other chemical products and preparations nec
9	C Manufacturing	18120100	Ethers, alcohol peroxides, ether peroxides, epoxides, acetals and hemiacetals and derivatives; organic chemicals nec
9	C Manufacturing	18130010	Hydrochloric, chlorosulphuric, sulphuric (incl oleum), diphosphorous pentoxide, phosphoric, and polyphosphoric acids
9	C Manufacturing	18130020	Nitric, sulphonitric and other inorganic acids; inorganic oxygen compounds of non-metals (excl industrial gases)
9	C Manufacturing	18130030	Synthetic inorganic colouring agents and preparations (incl inorganic pigments and chemical whites)
9	C Manufacturing	18130040	Refined salt other than cooking or table salt
9	C Manufacturing	18130050	Triammonium phosphate; ammonia (excl fertiliser); ammonium chloride & carbonates; potassium nitrate
9	C Manufacturing	18130060	Prepared pigments, opacifiers, colours, glazes used in ceramic, enamel, glass industry; glass powder, granules/flakes
9	C Manufacturing	18130070	Artificial graphite; colloidal or semi-colloidal graphite; preparations based on carbon in form of semi-manufactures
9	C Manufacturing	18130080	Radioactive elements, nuclear reactor fuel elements, isotopes and compounds; alloys, dispersions, ceramic products and mixtures
9	C Manufacturing	18130090	Other inorganic chemicals nec
9	C Manufacturing	18210010	Synthetic rubber
9	C Manufacturing	18210020	Polystyrene
9	C Manufacturing	18210030	Polyethylene
9	C Manufacturing	18210040	Polyvinyl chloride
9	C Manufacturing	18210050	Polypropylene
9	C Manufacturing	18210060	Polyvinyl acetate & synthetic resins nec (excl adhesives) in primary forms, not mixed/compounded (excl regranulated)
9	C Manufacturing	18210070	Rosin and resin acids, and derivatives thereof, rosin spirit and rosin oils; rosin gums
9	C Manufacturing	18210080	Plastics in primary forms, mixed/compounded with other substances; regranulated, single thermoplastic scrap material
9	C Manufacturing	18290010	Cellulose fibre or filament
9	C Manufacturing	18290020	Non-cellulose fibre or filament
9	C Manufacturing	18290030	Synthetic fibre or filament nec
9	C Manufacturing	18290040	Basic polymers nec
9	C Manufacturing	18310010	Ammonia aqua or urea, fertiliser grade; ammonium sulphate
9	C Manufacturing	18310020	Superphosphate and other phosphatic fertilisers
9	C Manufacturing	18310030	Ammonium nitrate (excl explosive)

9	C Manufacturing	18310040	Mixed fertilisers
9	C Manufacturing	18310050	Ground phosphate
9	C Manufacturing	18310060	Fertilisers nec
9	C Manufacturing	18320010	Insecticides, pesticides, fungicides, weedkillers and pest control chemicals nec
9	C Manufacturing	18321700	Basic Chemicals - commission production (1811-1832)
9	C Manufacturing	18321970	Waste from the manufacture of basic chemicals (1811-1832)
9	C Manufacturing	18410010	Pharmaceutical goods, for human use (excl wadding, gauze, bandages and surgical sutures)
9	C Manufacturing	18411700	Human Pharmaceutical and Medicinal Products - commission production
9	C Manufacturing	18420020	Pharmaceutical goods for veterinary use
9	C Manufacturing	18421700	Veterinary Pharmaceutical and Medicinal Products - commission production
9	C Manufacturing	18421970	Waste from the manufacture of pharmaceutical goods for human or veterinary use (1841-1842)
9	C Manufacturing	18510010	Glycerol (glycerine), glycerol waters and lyes
9	C Manufacturing	18510020	Candles and tapers
9	C Manufacturing	18510030	Soap and soap based products
9	C Manufacturing	18510040	Toothpaste and other dentifrices
9	C Manufacturing	18510050	Laundry bleach
9	C Manufacturing	18510060	Disinfectants (incl phenyl)
9	C Manufacturing	18510070	Anionic, cationic and other organic surface active agents (excl soap)
9	C Manufacturing	18510080	Scouring preparations and abrasive cleaners
9	C Manufacturing	18510090	Surface cleaning, washing and degreasing preparations nec (incl oven and stove cleaners)
9	C Manufacturing	18510100	Other cleaning polishes, creams and waxes nec
9	C Manufacturing	18520010	Barrier creams and toilet lanolin; suncreening preparations
9	C Manufacturing	18520020	Hair shampoo, conditioner, sprays, colouring and other hairdressing preparations
9	C Manufacturing	18520030	Aftershave & shaving preparations; lipstick, eye makeup; beauty cream or lotions; face lotions & powders
9	C Manufacturing	18520040	Hand cream or lotions (excl barrier & medicated cream); nail polishes & other nail care preparations
9	C Manufacturing	18520050	Perfume, deodorants, bath salts, depilatories, talcum powder and other preparations nec
9	C Manufacturing	18521700	Cleaning Compounds and Toiletry Preparations - commission production (1851-1852)
9	C Manufacturing	18521970	Waste from the manufacture of cleaning compounds and toiletry preparations (1851 -1852)
9	C Manufacturing	18910010	Photographic, film, cloth, plates (sensitised), photographic chemicals and photographic paper (sensitised)
9	C Manufacturing	18920010	Safety fuses, detonating fuses or caps
9	C Manufacturing	18920020	Explosives and other pyrotechnic articles (incl Ammonium nitrate (explosive), nitrocellulose, gun cotton, signalling flares, fireworks and matches)
9	C Manufacturing	18990010	Eucalyptus, sandalwood and Tea-tree oil

9	C Manufacturing	18990020	Natural gums (processed or refined)
9	C Manufacturing	18990030	Fluxes and other preparations (incl pickling preparations, powders and pastes) for soldering, brazing or welding
9	C Manufacturing	18990040	Other chemical products nec
9	C Manufacturing	18991700	Other Basic Chemical Products - commission production (1891-1899)
9	C Manufacturing	18991970	Waste from the manufacture of other basic chemical products (1891-1899)
9	C Manufacturing	18991980	General government consumption of fixed capital (1891-1899)
9	C Manufacturing	19110010	Self-adhesive plastic plates, film, foil, tape, strip and other flat shapes
9	C Manufacturing	19110020	Flexible plastic strip, plates, film, foil, tape and sheet (excl self-adhesive)
9	C Manufacturing	19110030	Plastic-coated, pressure-sensitive, gummed or adhesive paper and paperboard
9	C Manufacturing	19110040	Plastic sacks, packets and bags (incl garbage bags)
9	C Manufacturing	19120010	Plastic bottles
9	C Manufacturing	19120020	Plastic table and kitchenware (incl disposable cups), other household (incl buckets) and toilet articles
9	C Manufacturing	19120030	Complete and assembled other domestic furniture (plastic only) not elsewhere specified
9	C Manufacturing	19120040	Other complete and assembled non-domestic furniture (plastic only) nec
9	C Manufacturing	19120050	Other medical, dental, surgical or veterinary furniture and parts (plastic only)
9	C Manufacturing	19120060	Unassembled or partly assembled domestic furniture and parts (plastic only) nec
9	C Manufacturing	19120070	Unassembled or partly assembled non-domestic furniture and parts (plastic only) nec
9	C Manufacturing	19120080	Plastic pipes
9	C Manufacturing	19120090	Plastic fittings for tubes, pipes and hoses (incl joints, elbows and flanges)
9	C Manufacturing	19120100	Plastic taps, cocks, valves and similar attachments
9	C Manufacturing	19120110	Plastic drums, drum linings, boxes, cases, crates & packaging accessories. (incl stoppers, lids, caps & seals)
9	C Manufacturing	19120120	Polycarbonate sheets
9	C Manufacturing	19120130	Plastic blow moulded products nec
9	C Manufacturing	19120140	Other rigid or semi-rigid plastic injection moulded products (excl toys, games and fibre reinforced products)
9	C Manufacturing	19120150	Rigid and semi-rigid polymer products nec (excl fibre reinforced plastic products)
9	C Manufacturing	19130010	Foam and sponge plastic sheets, plates and strip (incl foam insulation and padding)
9	C Manufacturing	19130020	Plastic foam products nec
9	C Manufacturing	19140010	New pneumatic, rubber tyres for motor cars and motor cycles
9	C Manufacturing	19140020	New pneumatic, rubber tyres for buses and lorries
9	C Manufacturing	19140030	Tyres (solid rubber)
9	C Manufacturing	19140040	Tyres, rubber nec (incl retreaded tyres)
9	C Manufacturing	19140050	Pneumatic rubber tubes

9	C Manufacturing	19140060	Camel-back and unvulcanised rubber strip for retreading rubber tyres
9	C Manufacturing	19150010	Adhesives (excl bituminous) and glues
9	C Manufacturing	19160010	Architectural & decorative paints (incl coatings for use on buildings), enamels & clears (excl heavy duty coatings)
9	C Manufacturing	19160020	Automotive paints (incl primer & undercoats), enamels, lacquers (excl heavy duty coatings & bituminous mastics)
9	C Manufacturing	19160030	Industrial paints (incl primer, undercoats, finishing coats and heavy duty coats), enamels and clears
9	C Manufacturing	19160040	Inks
9	C Manufacturing	19160050	Filler or putty, caulking compound
9	C Manufacturing	19160060	Other paints (incl marine coatings) and other allied products (incl thinners, wood stains, paint, rubbing compounds and varnish remover)
9	C Manufacturing	19190010	Plastic tubes and hoses
9	C Manufacturing	19190020	Plastic conveyor belting
9	C Manufacturing	19190030	Plastic wall or ceiling coverings (excl tiles)
9	C Manufacturing	19190040	Linoleum and other floor coverings with a textile base; plastic floor coverings (incl paper or paperboard base), wall or ceiling tiles
9	C Manufacturing	19190060	Rigid fibre reinforced plastic articles (incl swimming pool shells and tanks)
9	C Manufacturing	19190070	Other plastic injection moulded products nec (excl rigid or semi-rigid)
9	C Manufacturing	19190080	Artificial guts (sausage casing) of hardened protein or of cellulosic materials
9	C Manufacturing	19190090	Synthetic rubber products and other polymer products nec (excl rigid or semi-rigid)
9	C Manufacturing	19191700	Polymer Products - commission production (1911-1919)
9	C Manufacturing	19200010	Rubber gloves, mittens and mitts
9	C Manufacturing	19200020	Rubber belting (incl V belts)
9	C Manufacturing	19200030	Rubber tubes, pipes and hose
9	C Manufacturing	19200040	Rubber sheets, strips, plates, rods, profile shapes and primary forms (excl cellular)
9	C Manufacturing	19200050	Sponge and foam rubber
9	C Manufacturing	19200060	Other natural rubber products nec
9	C Manufacturing	19201700	Natural Rubber Products - commission production
9	C Manufacturing	19201970	Waste from manufacture of polymer products, rubber, natural rubber and rubber products (1911-1920)
9	C Manufacturing	20100010	Float, surface ground/polished glass, in sheets; cast & rolled glass, in sheets or profiles; but not otherwise worked
9	C Manufacturing	20100020	Safety glass (incl windscreens and laminated sheet glass)
9	C Manufacturing	20100030	Glass containers, bottles or jars; glass stoppers; glass inners for vacuum vessels
9	C Manufacturing	20100040	Rear-view mirrors for vehicles
9	C Manufacturing	20100050	Glassware nec
9	C Manufacturing	20101700	Glass and glass products - commission production
9	C Manufacturing	20210010	Clay bricks (excl refractory bricks)
9	C Manufacturing	20290010	Refractory products (incl bricks, cement and clay)

9	C Manufacturing	20290020	Ceramic roofing, flooring and wall tiles (incl terracotta) and ceramic construction goods nec
9	C Manufacturing	20290030	Ceramic wash basins and permanent fixture type sanitary ware
9	C Manufacturing	20290040	Tableware, ornamental pottery and domestic ware nec
9	C Manufacturing	20290050	Ceramic goods nec
9	C Manufacturing	20291700	Ceramic products - commission production (2021-2029)
9	C Manufacturing	20310010	Cement (incl hydraulic and portland) (excl adhesive or refractory)
9	C Manufacturing	20310020	Lime (incl hydraulic, quick, hydrated, slaked and agricultural)
9	C Manufacturing	20320010	Plaster boards, sheets, panels, tiles, cornices and other articles of plaster (excl ornamental)
9	C Manufacturing	20320020	Plasters (incl plaster of paris)(excl dental plasters)
9	C Manufacturing	20330010	Ready mixed concrete and mortar (incl dry mix concrete)
9	C Manufacturing	20331700	Cement, lime and ready-mixed concrete - commission production (2031, 2033)
9	C Manufacturing	20340010	Concrete, cement, fibrous-cement or artificial stone pipes; concrete box culverts
9	C Manufacturing	20340020	Concrete, cement and artificial stone bricks, blocks, building boards and tiles
9	C Manufacturing	20340030	Concrete or predominantly concrete prefabricated and transportable buildings
9	C Manufacturing	20341700	Plaster and concrete products - commission production (2032, 2034)
9	C Manufacturing	20900010	Worked monumental or building stone
9	C Manufacturing	20900020	Glass fibre and glass wool products
9	C Manufacturing	20900030	Ground limestone
9	C Manufacturing	20900040	Ground clays (excl colours); andalusite, kyanite & sillimanite; mullite; chamotte & dinas earths
9	C Manufacturing	20900050	Ground mica; feldspar; leucite; nepheline ; ground natural abrasives; crushed, powdered natural steatite and talc
9	C Manufacturing	20900060	Ground minerals & fluorspar (excl abrasives, dust & powders of natural & synthetic precious or semi-precious stones)
9	C Manufacturing	20900070	Non-refractory mortars and concretes other than ready mixed; articles of asbestos-cement and cellulose fibre-cement nec
9	C Manufacturing	20900080	Other non-metallic mineral products
9	C Manufacturing	20901700	Other non-metallic mineral products - commission production
9	C Manufacturing	20901970	Waste from the manufacture of non-metallic mineral products (2010-2090)
9	C Manufacturing	21100010	Basic iron, pig iron, sponge iron and spiegeleisen; iron or steel granules and powders
9	C Manufacturing	21100020	Ferro-alloys (incl manganese, silicon or chrome)
9	C Manufacturing	21100030	Iron or steel primary forms (incl ingots) and semi-finished products
9	C Manufacturing	21100040	Iron or non-alloy steel flat-rolled products (excl clad, plated or coated)
9	C Manufacturing	21100050	Clad, plated or coated iron or non-alloy steel flat-rolled products
9	C Manufacturing	21100060	Alloy steel flat-rolled products
9	C Manufacturing	21100070	Iron and steel bars, rods, angles, shapes and sections (incl sheet piling)
9	C Manufacturing	21100080	Iron or steel wire for further processing (excl fencing, stranded or barbed)

9	C Manufacturing	21100090	Painted, varnished or coated steel sheet, profile decking or cladding (incl steel sheeting for fencing)
9	C Manufacturing	21100100	Iron or steel rails, rail fastenings or other rail accessories
9	C Manufacturing	21100110	Iron or steel expanded metal
9	C Manufacturing	21100120	Light oils obtained as a by-product from metallurgical coke (excl grease oils, toluole and xylene); Benzole from iron and steel manufacturing
9	C Manufacturing	21100130	Crude tar
9	C Manufacturing	21100140	Gas from coke works or blast furnaces
9	C Manufacturing	21210010	Cast iron tubes, pipes and hollow profiles; cast iron or cast steel tube or pipe fittings
9	C Manufacturing	21210020	Cast iron or cast steel steam, gas and water fittings other than domestic (incl taps, cocks and valves)
9	C Manufacturing	21210030	Cast articles of iron or steel nec
9	C Manufacturing	21220010	Iron or steel seamless tubes or pipes (excl cast or forged)
9	C Manufacturing	21220020	Iron or steel tubes, pipes, hollow profiles and fittings (excl cast iron or seamless)
9	C Manufacturing	21220030	Steel steam, gas and water fittings other than domestic (incl taps, cocks and valves) (excl cast steel)
9	C Manufacturing	21221700	Iron and steel - commission production (2110-2122)
9	C Manufacturing	21221970	Waste from manufacture of iron and steel (incl slag, dross, sealings and scrap steel) (2110-2122)
9	C Manufacturing	21310010	Alumina
9	C Manufacturing	21320010	Aluminium and aluminium alloys (excl purchased scrap)
9	C Manufacturing	21320020	Aluminium secondary recovery from purchased scrap
9	C Manufacturing	21320030	Aluminium castings and diecastings
9	C Manufacturing	21321970	Aluminium scrap from the manufacture of alumina, aluminium and aluminium alloys (2131-2132)
9	C Manufacturing	21330010	Silver primary and secondary recovery (excl from purchased scrap)
9	C Manufacturing	21330020	Copper (including brass) primary and secondary recovery (excl from purchased scrap)
9	C Manufacturing	21330030	Lead primary and secondary recovery (excl from purchased scrap)
9	C Manufacturing	21330040	Zinc primary and secondary recovery (excl from purchased scrap)
9	C Manufacturing	21330050	Silver, copper (including brass), lead and zinc recovery from purchased scrap
9	C Manufacturing	21330060	Zinc alloys; copper matte; cement copper; unwrought copper and nickel
9	C Manufacturing	21330070	Sulphuric acid from the smelting of copper, silver, lead and zinc.
9	C Manufacturing	21390010	Platinum primary and secondary recovery (excl from purchased scrap)
9	C Manufacturing	21390020	Nickel and tin primary recovery and secondary recovery from drosses, ashes or other waste materials (excl from purchased scrap)
9	C Manufacturing	21390030	Nickel and tin recovery from purchased scrap
9	C Manufacturing	21390040	Gold - primary and secondary (excl from purchased scrap)
9	C Manufacturing	21390050	Antimony and other non-ferrous basic metals nec primary and secondary recovery
9	C Manufacturing	21390060	Basic precious metals (excl silver) secondary recovery from purchased scrap

9	C Manufacturing	21390070	Other non-ferrous metal alloys
9	C Manufacturing	21391700	Basic non-ferrous metals - commission production (2131-2139)
9	C Manufacturing	21391970	Wastes and scraps from the smelting and refining of non-ferrous metals (incl precious) (2133-2139)
9	C Manufacturing	21410010	Non-ferrous metal (excl aluminium) castings and diecastings
9	C Manufacturing	21420010	Aluminium and aluminium alloy bars, rods (incl wire rod) and profiles (incl decking and cladding)
9	C Manufacturing	21420020	Aluminium foil
9	C Manufacturing	21420030	Rolled, drawn or extruded aluminium pipes, tubes, plates, sheets, strip & wire products; aluminium powders & flakes
9	C Manufacturing	21490010	Copper, copper alloy, nickel, lead, zinc and tin rolled, extruded and semi-finished products
9	C Manufacturing	21490020	Silver and platinum rolled, drawn or extruded semi-finished products
9	C Manufacturing	21490030	Semi-manufactures of tungsten, molybdenum, tantalum, magnesium, cobalt, cadmium, titanium, zirconium and thallium
9	C Manufacturing	21490040	Non-ferrous (excl aluminium) metal powders and flakes
9	C Manufacturing	21491700	Basic non-ferrous metal products - commission production (2141-2149)
9	C Manufacturing	21491970	Wastes and scraps from the manufacture of non-ferrous metal products (incl precious) (2141-2149)
9	C Manufacturing	22100010	Iron or steel pieces roughly shaped by forging
9	C Manufacturing	22100020	Forged iron or steel tyres and wheels for railway or tramway locomotives and rolling stock
9	C Manufacturing	22100030	Iron or steel chain (other than articulated link chain) and other forged articles of iron or steel
9	C Manufacturing	22101700	Forged iron or steel products - commission production
9	C Manufacturing	22101900	Repairing and servicing (2210)
9	C Manufacturing	22210010	Fabricated & prefabricated construction steel (incl scaffolding, perforated plate & ready made parts for structures)
9	C Manufacturing	22210020	Reinforcing steel rods or bars
9	C Manufacturing	22210030	Reinforcing welded steel mesh
9	C Manufacturing	22220010	Prefabricated metal or metal framed buildings (excl aluminium) and other transportable buildings
9	C Manufacturing	22220020	Aluminium or aluminium framed prefabricated buildings
9	C Manufacturing	22230010	Aluminium/aluminium framed doors (incl roller/concertina) & windows (incl glass); door/window frames; roller grilles
9	C Manufacturing	22230020	Aluminium fire doors
9	C Manufacturing	22230030	Aluminium combined door-window units
9	C Manufacturing	22230040	Architectural aluminium products (excl sheet metal), for building nec
9	C Manufacturing	22230050	Aluminium roofing and guttering
9	C Manufacturing	22230060	Other articles of aluminium (excl ladders) nec
9	C Manufacturing	22240010	Metal roofing and guttering (excl aluminium)
9	C Manufacturing	22290010	Iron or steel window-frames; metal (excl aluminium) door or door frames
9	C Manufacturing	22290020	Wooden fire doors
9	C Manufacturing	22290030	Iron or steel fire doors; fabricated iron or steel stairs, balustrades and other architectural products (excl Aluminium)

9	C Manufacturing	22291700	Structural metal products - commission production (2221-2229)
9	C Manufacturing	22291970	Waste from the manufacture of ferrous metal products nec
9	C Manufacturing	22310010	Metal cylinders (incl aerosol containers) for compressed or liquified gas
9	C Manufacturing	22310020	Sheet metal reservoirs, vats, tanks and similar containers of a capacity exceeding 300 litres
9	C Manufacturing	22310030	Sheet metal vats and tanks of a capacity not exceeding 300 litres
9	C Manufacturing	22310040	Super heated water boilers & steam generators (incl parts) (excl central heating); condensers for vapour power units
9	C Manufacturing	22310050	Non-electric hot water or low pressure steam central heating boilers
9	C Manufacturing	22310060	Iron, steel or aluminium vats, tanks, capacity exc. 300 litres and containers for compressed or liquefied gas
9	C Manufacturing	22310070	Plate iron, steel and aluminium vats and tanks, capacity not exc. 300 litres (excl with mechanical or thermal equipment)
9	C Manufacturing	22310090	Metal freight containers (excl stock crates)
9	C Manufacturing	22390010	Metal containers nec
9	C Manufacturing	22390020	Sheet metal milk and cream cans of a capacity not exceeding 300 litres
9	C Manufacturing	22390030	Sheet metal household containers (excl sanitary ware)
9	C Manufacturing	22390040	Metal vacuum flasks
9	C Manufacturing	22400010	Sheet metal ducting
9	C Manufacturing	22400020	Sheet metal sanitary ware
9	C Manufacturing	22400030	Sheet metal stoppers, caps, lids, capsules for bottles, threaded bungs, bung covers, seals & packing accessories nec
9	C Manufacturing	22400040	Sheet metal non-electric tableware, kitchenware or other household articles and parts (excl containers and sanitary ware)
9	C Manufacturing	22400050	Sheet metal machine guards (not designed for use with a particular machine)
9	C Manufacturing	22400060	Sheet metal products nec
9	C Manufacturing	22401700	Metal container and sheet metal products - commission production (2231-2240)
9	C Manufacturing	22910010	Iron or steel fencing wire (excl stranded or barbed)
9	C Manufacturing	22910020	Wire stranded, cables, cordage, ropes, plaited bands and slings (excl electrically insulated slings)
9	C Manufacturing	22910030	Springs (incl leaves for springs)
9	C Manufacturing	22910040	Nails, tacks, staples, spiked cramps, studs, spikes & pins (incl drawing & cotter pins) (excl metallic dowel pins)
9	C Manufacturing	22910050	Woven or linked wire fabric (excl mattress supports)
9	C Manufacturing	22910060	Welded wire fabric (excl reinforcing)
9	C Manufacturing	22910070	Iron or steel wire gates (cross-sectional dimension of wire 16mm or less)
9	C Manufacturing	22910080	Iron or steel articulated link chain and parts
9	C Manufacturing	22910090	Domestic metal wire products; copper cloth, grill, netting and fencing; barbed wire; other wire products
9	C Manufacturing	22920010	Metal nuts, bolts (incl expansion), screws, rivets, washers, dowel pins, masonry anchors and turnbuckles
9	C Manufacturing	22930010	Metal coating and finishing
9	C Manufacturing	22990010	Metal hand tools (incl gardening; excl power operated or pneumatic)

9	C Manufacturing	22990030	Cutlery, kitchen ware and table ware (excl solid silver or gold) nec
9	C Manufacturing	22990050	Knives and cutting blades for metal or wood working tools and machines
9	C Manufacturing	22990060	Metal hand tool accessories & attachments (incl screwdriver & drill bits)(excl twist drills, taps, dies, chasers)
9	C Manufacturing	22990070	Non-ferrous metal steam, gas and water fittings other than domestic (incl taps, cocks and valves)
9	C Manufacturing	22990080	Tube or pipe fittings (excl valves) (eg couplings, elbows, sleeves), of copper or nickel (incl alloys) or aluminium
9	C Manufacturing	22990090	Munitions and ammunition (incl cartridges)
9	C Manufacturing	22990100	Aluminium venetian blinds (incl plastic coated)
9	C Manufacturing	22990110	Metal blinds and awnings (excl aluminium venetian blinds)
9	C Manufacturing	22990120	Locks (incl parts/padlocks); keys; metal fittings for windows or doors (incl hinges and hydraulic door closures)
9	C Manufacturing	22990140	Firearms (incl parts)
9	C Manufacturing	22990150	Fire extinguishers
9	C Manufacturing	22990160	Articles of tungsten, molybdenum, tantalum, magnesium, cobalt, cadmium, titanium, zirconium and thallium (incl wrought)
9	C Manufacturing	22990170	Non-electric lamps and lighting fittings (incl pressure and gas lanterns)
9	C Manufacturing	22990180	Woven wire, link mesh or wire spring mattress supports (excl upholstered)
9	C Manufacturing	22990190	Cigarette and other lighters
9	C Manufacturing	22990200	Fabricated metal products (incl ladders) nec
9	C Manufacturing	22991700	Other fabricated metal products - commission production (2291-2299)
9	C Manufacturing	22991900	Repairing and servicing (2291-2299)
9	C Manufacturing	23110010	Finished motor vehicles with less than 10 persons capacity
9	C Manufacturing	23110020	Finished motor vehicles with 10 or more person capacity
9	C Manufacturing	23110030	Finished trucks, truck type vehicles, utilities and panel vans
9	C Manufacturing	23110040	Unassembled motor vehicles nec
9	C Manufacturing	23110050	Chassis with engines for motor vehicles
9	C Manufacturing	23110060	Engines nec, for motor vehicles or tractors
9	C Manufacturing	23119000	Second hand motor vehicles
9	C Manufacturing	23120010	Motor vehicle and truck bodies (coachwork)
9	C Manufacturing	23120020	Caravans, camper trailers and similar vehicles
9	C Manufacturing	23120030	Agricultural self loading and unloading semi-trailers (incl tippers)
9	C Manufacturing	23120040	Other semi-trailers for the transport of goods & materials (incl tankers, vans, transporters, stock crates & jinkers)
9	C Manufacturing	23120050	Trailers for the transport of goods and materials (incl box trailers, boat trailers and horse floats)
9	C Manufacturing	23120060	Other trailers & semi-trailers nec (excl for the transport of goods & materials, & domestic type camper trailers)
9	C Manufacturing	23120070	Body panels for trucks and buses
9	C Manufacturing	23120080	Parts nec, for motor vehicle trailers and semi-trailers
9	C Manufacturing	23130010	Vehicle electric motors of an output not exceeding 37.5W; other DC motors and DC generators

9	C Manufacturing	23130020	Motor vehicle and truck air conditioners
9	C Manufacturing	23130030	Motor vehicle apparatus for making, breaking, protecting & making connections to/in electrical circuits (excl wiring)
9	C Manufacturing	23130040	Motor vehicle or motor cycle wiring harnesses
9	C Manufacturing	23130050	Motor vehicle, tractor or motor cycle starting, heaters, demisters, windscreen wipers; lighting/signalling equipment
9	C Manufacturing	23130060	Motor vehicle, tractor and motor cycle filament lamps and sealed beam lamps
9	C Manufacturing	23130070	Motor vehicle & tractor gauges, revolution & production counters, speed indicators, thermostats & similar instruments
9	C Manufacturing	23130080	Automotive insulated cable, wire or strip
9	C Manufacturing	23190010	Motor vehicle transmission assemblies
9	C Manufacturing	23190020	Cylinder blocks, pistons, connecting rods, valves
9	C Manufacturing	23190030	Fuel, lubricating or cooling medium pumps
9	C Manufacturing	23190040	Cranks, crank & cam shafts, gears and flywheels
9	C Manufacturing	23190050	Motor vehicle, tractor and truck gaskets
9	C Manufacturing	23190060	Motor vehicle body panels
9	C Manufacturing	23190070	Motor vehicle and tractor parts and equipment nec
9	C Manufacturing	23910010	Vessels of 50 tonnes gross and over (incl floating structures)
9	C Manufacturing	23920010	Small boats (incl rowing or sail), yachts and canoes under 5 tonnes displacement (incl inflatable vessels and canoes)
9	C Manufacturing	23920020	Boats and other vessels for pleasure or sport (over 5 but under 50 tonnes)
9	C Manufacturing	23920030	Cruise ships, ferry and excursion boats, and other vessels under 50 tonnes nec for the transport of persons and goods
9	C Manufacturing	23921700	Ships and boats - commission production (2391-2392)
9	C Manufacturing	23921900	Repairing and servicing (2391-2392)
9	C Manufacturing	23930010	Locomotives and trams (incl underframes); railway rolling stock
9	C Manufacturing	23931700	Railway rolling stock - commission production
9	C Manufacturing	23931900	Repairing and servicing (2393)
9	C Manufacturing	23940010	Aircraft and aircraft parts
9	C Manufacturing	23941700	Aircraft - commission production
9	C Manufacturing	23941900	Repairing and servicing (2394)
9	C Manufacturing	23990010	Motorised tanks and other armoured fighting vehicles and parts
9	C Manufacturing	23990020	Transport equipment, parts and accessories nec (incl motorcycles and motor scooters)
9	C Manufacturing	23990030	Repairing and servicing - (incl factory motor vehicle engine repair or replacements) (2311-2319, 2399)
9	C Manufacturing	23991700	Motor vehicles, other transport equipment and parts - commission production (2311-2319, 2399)
9	C Manufacturing	24120010	Surgical, medical equipment (excl X-ray) and appliances (incl artificial joints, limbs or eyes, pacemakers, mechanical dental chairs & needles or syringes)
9	C Manufacturing	24120020	X-ray medical equipment and parts or accessories
9	C Manufacturing	24190010	Gas or liquid meters (incl parts and accessories)
9	C Manufacturing	24190020	Parking meters, traffic signals and other signalling equipment

9	C Manufacturing	24190030	Taxi meters
9	C Manufacturing	24190050	X-ray equipment (excl medical) and parts or accessories
9	C Manufacturing	24190060	Professional or scientific instruments, apparatus or models for demonstrational purposes only
9	C Manufacturing	24190070	Surveying, physical or chemical analysis and other measuring, checking and testing instruments, appliances and parts
9	C Manufacturing	24190080	Radio and radar equipment, navigational aids, and radio remote control equipment
9	C Manufacturing	24190090	Optical fibres, fibre bundles and cables (excl insulated)
9	C Manufacturing	24190100	Professional and scientific equipment nec
9	C Manufacturing	24191700	Professional and scientific equipment - commission production (2411-2419)
9	C Manufacturing	24191980	General government consumption of fixed capital (2411-2419)
9	C Manufacturing	24210010	Mainframe and super-computers
9	C Manufacturing	24210020	Computer file servers and other multiple-user computer hardware
9	C Manufacturing	24210080	Photocopying machines and parts
9	C Manufacturing	24210090	Electronic machines with a calculating device (incl cash registers, postage-franking & ticket machines) & parts
9	C Manufacturing	24210100	Typewriters, word processors, addressing machines, EFTPOS machines, coin counting machines and other office machinery
9	C Manufacturing	24210110	Money-changing, cigarette, food, beverage and other automatic goods vending machines (excl refrigerated vending machines)
9	C Manufacturing	24210120	Office machines, parts and accessories nec
9	C Manufacturing	24220010	Line telephone and telegraph equipment (excl headphones and parts)
9	C Manufacturing	24220020	Radio and television studio equipment (incl cameras), transmitters, radio transceivers, mobile, cellular & car phones (excl parts)
9	C Manufacturing	24220030	Satellite receivers (excl parts)
9	C Manufacturing	24220040	Remote monitoring alarm systems
9	C Manufacturing	24220050	Intercom equipment
9	C Manufacturing	24220060	Parts for radio and television studio equipment, transmitters and radio transceivers
9	C Manufacturing	24220070	Television antennae parts
9	C Manufacturing	24220080	Telecommunication equipment parts (incl parts for mobile phones and satellite receivers)
9	C Manufacturing	24290060	Video games, poker machines and other coin or disc operated games
9	C Manufacturing	24290070	Prepared unrecorded media for sound or video recording (incl blank CDs, magnetic tapes)
9	C Manufacturing	24290080	Other audio and video equipment and accessories (excl parts)
9	C Manufacturing	24290090	Parts for television and radio receiving sets, sound and video recording and reproducing equipment, other audio and video equipment
9	C Manufacturing	24290100	Electronic equipment and parts nec
9	C Manufacturing	24291700	Computer and electronic equipment - commission production (2421-2429)
9	C Manufacturing	24291980	General government consumption of fixed capital (2421-2429)
9	C Manufacturing	24310010	Uninsulated copper and aluminium stranded wire, ropes, cables, plaited bands and slings
9	C Manufacturing	24310020	Co-axial cable and other co-axial electric conductors

9	C Manufacturing	24310040	Cable (excl co-axial or insulated optical fibre), wire and strip
9	C Manufacturing	24310050	Insulated optical fibre cable
9	C Manufacturing	24320010	Electric light or lamp bulbs or tubes (incl filament or fluorescent) (excl automotive)
9	C Manufacturing	24320020	Incandescent light fittings
9	C Manufacturing	24320030	Cold, discharge, arc, ultra violet, infra-red and other electric lights, torches and fittings nec
9	C Manufacturing	24320050	Illuminated signs, name-plates and sign-plates having a permanently fixed light source
9	C Manufacturing	24390030	Batteries nec and battery components
9	C Manufacturing	24390050	Transformers
9	C Manufacturing	24390060	Electric motors, generators, electric generating sets and rotary converters (incl parts) (excl automotive)
9	C Manufacturing	24390070	Electrical welding (incl arc) base metal wire, rods, tubes, plates and electrodes
9	C Manufacturing	24390090	Relays and relay sets for radio, telephones and telegraphic equipment
9	C Manufacturing	24390100	Electrical apparatus to switch, protect/connect circuits (incl boards & cabinets equipped with such) (excl inductors)
9	C Manufacturing	24390120	Inductors (incl chokes, ballasts used with lighting apparatus and current limiting regulators)
9	C Manufacturing	24390130	Electric soldering and welding (incl arc) irons, guns and other machines, apparatus and parts
9	C Manufacturing	24390140	Industrial or laboratory electric furnaces and ovens
9	C Manufacturing	24390150	Electric heating resistors (excl carbon)
9	C Manufacturing	24390160	Electrical insulators nec and other electrical equipment and parts nec
9	C Manufacturing	24391700	Electrical equipment - commission production (2431-2439)
9	C Manufacturing	24410040	Compressors for domestic refrigeration equipment
9	C Manufacturing	24490070	Compressors for domestic air conditioning equipment
9	C Manufacturing	24490090	Electro-thermic appliances nec
9	C Manufacturing	24510010	Pumps and pumping machinery (incl petrol bowsers and air or gas compressors)
9	C Manufacturing	24510020	Pump and compressor parts nec
9	C Manufacturing	24520010	Complete air conditioning units nec (incl ducting etc); air conditioning compressors or parts (commercial or industrial)
9	C Manufacturing	24520030	Refrigeration cabinets, coolrooms, beverage dispensing equipment (cooling), refrigerated vending machines and refrigeration equipment nec (commercial or industrial) (incl water coolers)
9	C Manufacturing	24520050	Water heaters (commercial or industrial) and parts
9	C Manufacturing	24520060	Space heating equipment (commercial or industrial) (incl parts) nec
9	C Manufacturing	24610020	Ploughing, seeding and planting equipment and parts (excl hand tools)
9	C Manufacturing	24610030	Harvesting, threshing and haymaking machinery (incl straw or fodder balers or agricultural mowers)
9	C Manufacturing	24610040	Agricultural wheeled tractors (excl crawler)
9	C Manufacturing	24610050	Mechanical appliances and parts for projecting, dispersing or spraying liquids or powders (excl industrial spray guns and steam blasting)
9	C Manufacturing	24610070	Dairy machinery
9	C Manufacturing	24610080	Agricultural and horticultural machinery and parts nec

9	C Manufacturing	24620010	Construction and earthmoving wheeled tractors
9	C Manufacturing	24620020	Front end shovel loaders; mechanical shovels, excavators & shovel loaders with a 360 degree revolving superstructure
9	C Manufacturing	24620030	Bulldozers & other moving, grading, scraping, excavating, compacting or extracting construction machinery nec
9	C Manufacturing	24620040	Buckets, shovels, grabs, grips, blades, bodies and cabs for construction vehicles and other construction and earthmoving machinery parts
9	C Manufacturing	24620060	Machinery for crushing, grinding, mixing or kneading earth, stones, ores or other mineral substances in solid form
9	C Manufacturing	24620070	Mineral substances sorting, screening, separating, washing, mixing or kneading machinery and parts
9	C Manufacturing	24620080	Mining or drilling machinery and parts (incl coal or rock cutters, boring, sinking or tunnelling machinery)
9	C Manufacturing	24630010	Gas welding and cutting equipment (excl filler welding rods)
9	C Manufacturing	24630030	Machine-tools for working materials other than metal, wood; laser machine tools; hand tools with self-contained motor
9	C Manufacturing	24630040	Converters, ingot moulds and ladles, casting machines, metal-rolling mills and rolls and parts
9	C Manufacturing	24630050	Machining centres & other wood & metal working machinery & parts nec (excl saw blades, metal moulds & dies)
9	C Manufacturing	24630060	Saw blades
9	C Manufacturing	24630070	Metal dies, die sets and moulds
9	C Manufacturing	24630080	Interchangeable tools for power-operated hand tools; sintered metal plates; rock drilling and earth boring tools
9	C Manufacturing	24630090	Parts for hand tools with self-contained non-electric motors
9	C Manufacturing	24630100	Metal work and tool holders, heads for machine tools, and other machine tool accessories and parts
9	C Manufacturing	24690010	Non-domestic cooking or heating machinery for food or drinks
9	C Manufacturing	24690020	Cream separators; bakery machinery (excl ovens) and other food and beverage processing machinery and parts
9	C Manufacturing	24690030	Distilling/rectifying plant; heat exchange units; centrifuges nec; gas liquefying or beverages filtering machinery
9	C Manufacturing	24690040	Machinery for can and bottle washing, packing, wrapping, canning, bottling and sealing of food and drink
9	C Manufacturing	24690050	Parts of machinery nec for cleaning food or drink cans or bottles, (incl parts of dishwashing machines nec), or for filling, closing, sealing, capsuling or labelling containers for food or drink
9	C Manufacturing	24690060	Other food and beverage processing machinery and parts nec
9	C Manufacturing	24690070	Industrial machinery and parts for textile manufacture and treatment industries (excl industrial sewing machines)
9	C Manufacturing	24690080	Office type sheet fed printing machinery, accessories and parts
9	C Manufacturing	24690090	Other textile, apparel and leather production machinery and parts nec (incl industrial sewing machines)
9	C Manufacturing	24690100	Printing machinery and parts
9	C Manufacturing	24690110	Tobacco machinery and parts; bakery and biscuit ovens; dryers for agricultural products
9	C Manufacturing	24690120	Machinery and parts for paper or book-binding
9	C Manufacturing	24690140	Special purpose machinery & parts nec

9	C Manufacturing	24691700	Specialised machinery and equipment - commission production (2461-2469)
9	C Manufacturing	24910010	Wheeled tractors (excl crawler, agricultural, construction and earthmoving)
9	C Manufacturing	24910020	Powered store trucks (incl those used on railway station platforms and forklifts)
9	C Manufacturing	24910030	Conveyors, continuous-action, for goods & materials
9	C Manufacturing	24910040	Hoists, cranes and other lifting, loading or unloading machinery
9	C Manufacturing	24910050	Elevators, continuous-action, for goods & materials; escalators & moving walkways
9	C Manufacturing	24910060	Materials handling equipment and parts nec
9	C Manufacturing	24990010	Hydraulic and pneumatic motors and parts
9	C Manufacturing	24990020	Rubber, plastics or hot glass working machines (incl parts)
9	C Manufacturing	24990030	Non-electric industrial and laboratory furnaces, ovens (other than bakery or biscuit) and incinerators and parts
9	C Manufacturing	24990040	Dishwashing machines other than household
9	C Manufacturing	24990050	Engines nec, turbines and water wheels and parts
9	C Manufacturing	24990060	Oil filters, petrol filters and air intake filters for internal combustion engines
9	C Manufacturing	24990070	Bearings (incl parts)
9	C Manufacturing	24990080	Parts for centrifuges (incl centrifugal dryers); parts for liquid or gas filtering or purifying machinery
9	C Manufacturing	24990100	Other machinery, equipment and parts nec
9	C Manufacturing	24991700	Other machinery and equipment - commission production (2451-2452, 2491-2499)
9	C Manufacturing	25110010	Assembled domestic wooden chairs, upholstered seating with wooden or metal frames, wooden or predominantly wooden domestic furniture nec
9	C Manufacturing	25110020	Assembled non-domestic wooden or predominantly wooden seating and furniture nec
9	C Manufacturing	25110030	Unassembled or partly assembled domestic wooden chairs, upholstered seating with wooden or metal frames, wooden or predominantly wooden furniture nec
9	C Manufacturing	25110040	Unassembled or partly assembled non-domestic wooden chairs, furniture and parts nec
9	C Manufacturing	25110050	Wooden or predominantly wooden medical, dental, surgical or veterinary furniture
9	C Manufacturing	25110060	Upholstered seats with frames of any material for transport equipment and parts of passenger transport seats
9	C Manufacturing	25120010	Cabinets (Audiovisual) - Metal framed
9	C Manufacturing	25120020	Assembled metal or predominantly metal domestic furniture (excl upholstered seating with metal frames)
9	C Manufacturing	25120040	Metal medical, dental (excl mechanical dental chairs), surgical or veterinary furniture
9	C Manufacturing	25120080	Unassembled large scale sheet metal or fabricated metal storage structures and shelving
9	C Manufacturing	25120090	Unassembled or partly assembled domestic metal furniture and parts nec (excl upholstered seats with metal frames)
9	C Manufacturing	25120100	Unassembled or partly assembled non-domestic metal furniture and parts nec (excl upholstered seats with metal frames)

9	C Manufacturing	25120110	Metal furniture fittings
9	C Manufacturing	25120120	Metal seating for entertainment and sporting venues (incl assembled and unassembled)
9	C Manufacturing	25120130	Assembled metal non-domestic furniture nec (excl upholstered seating with metal frames)
9	C Manufacturing	25190020	Other medical, dental, surgical or veterinary furniture (excl wooden, metal or plastic) and parts
9	C Manufacturing	25190030	Other assembled non-domestic furniture nec (excl metal, wood and plastic)
9	C Manufacturing	25190040	Unassembled or partly assembled domestic furniture and parts nec (excl metal, wood and plastic)
9	C Manufacturing	25190050	Unassembled or partly assembled non-domestic furniture and parts nec (excl metal, wood and plastic)
9	C Manufacturing	25191700	Furniture - commission production (2511-2513, 2519)
9	C Manufacturing	25910010	Badges, coins and medals, sheet metal
9	C Manufacturing	25910020	Jewellery and silverware
9	C Manufacturing	25910030	Imitation jewellery (excl incorporating precious metal except as plating or as minor constituents)(excl watch straps)
9	C Manufacturing	25990030	Advertising signs, name-plates and sign-plates (excl electric and metal)
9	C Manufacturing	25991700	Manufacturing products nec - commission production
9	C Manufacturing	62220020	Building society services nec
9	C Manufacturing	62230020	Credit union services nec
9	C Manufacturing	66190020	Transport equipment rental or hire (incl ship & boat) nec
9	C Manufacturing	73110010	Building and other industrial cleaning services nec (incl gutters, drains, roads, beaches, swimming pools and toilets)
9	C Manufacturing	73120010	Pest control services
9	C Manufacturing	94120010	Car wash and cleaning services
9	C Manufacturing	95400010	Religious services
9	C Manufacturing	95590020	Services to students at post-secondary institutions by their sports and student unions
10	D1 Electricity Services	26110010	Electricity generated from fossil fuels
10	D1 Electricity Services	26120010	Hydro-electricity
10	D1 Electricity Services	26190010	Electricity generation nec
10	D1 Electricity Services	26400010	Other electricity service income
10	D1 Electricity Services	26401500	Margin - Electricity transmission, distribution and on selling (2620-2640)
11	D2 Gas, Water and Waste Services	27001500	Margin - gas distribution
11	D2 Gas, Water and Waste Services	28100010	Water, sewerage and drainage services
11	D2 Gas, Water and Waste Services	28101980	General government consumption of fixed capital (2811, 2812)
11	D2 Gas, Water and Waste Services	29000010	Waste collection (incl skip and portable toilet hire), treatment disposal remediation and materials recovery services
11	D2 Gas, Water and Waste Services	29221980	General government consumption of fixed capital (2911-2922)
12	E Construction	30200010	Non-Residential building construction

12	E Construction	30201980	General government consumption of fixed capital (3020)
12	E Construction	30209010	Second hand non-residential buildings
12	E Construction	31010010	Road and bridge construction (excl repair and maintenance)
12	E Construction	31010020	Repair and maintenance - road and bridge
12	E Construction	31019010	Second hand roads and bridges
12	E Construction	31090010	Non-building construction nec
12	E Construction	31090020	Repair and maintenance - non-building construction nec
12	E Construction	31091980	General government consumption of fixed capital (3101-3109)
12	E Construction	31099010	Second hand non-building construction nec
12	E Construction	32000020	Other construction trade services
12	E Construction	32001980	General government consumption of fixed capital (3211-3299)
13	F Wholesale Trade	37000010	Non-margin - wholesaling services (excl repairing and servicing)
13	F Wholesale Trade	37001400	Margin on reexports - wholesaling services
13	F Wholesale Trade	37001500	Margin - wholesaling - services
13	F Wholesale Trade	38000020	Auction room operations; Electronic procurement brokering services
13	F Wholesale Trade	38001800	Wholesale commission on sales
13	F Wholesale Trade	38001980	General government consumption of fixed capital (3311-3800)
14	G Retail Trade	43000010	Non-Margin - retailing services (excl repairing and servicing)
14	G Retail Trade	43001500	Margin - retailing services
14	G Retail Trade	43001800	Retail commission on sales
14	G Retail Trade	43001980	General government consumption of fixed capital (3911-4320)
15	H Accommodation and Food Services	44000010	Accommodation services
15	H Accommodation and Food Services	45000010	Meal preparation and presentation
15	H Accommodation and Food Services	45000020	Beverage serving service
15	H Accommodation and Food Services	45000030	Takeaway food
15	H Accommodation and Food Services	45000040	Catering services
15	H Accommodation and Food Services	45000050	Net losses from gambling - Clubs, pubs, taverns and bars (Hospitality)
15	H Accommodation and Food Services	45001500	Margin - food and beverage services (4511-4530)
16	I Transport, Postal and Warehousing	46100020	Non-margin - road freight transport services (incl rental or hire of trucks with driver)
16	I Transport, Postal and Warehousing	46100030	Road vehicle towing services
16	I Transport, Postal and Warehousing	46101600	Margin - road freight transport services
16	I Transport, Postal and Warehousing	46210010	Interurban or non-metropolitan bus transport services (incl long distance, charter and rural)
16	I Transport, Postal and Warehousing	46220010	Urban or metropolitan bus and tramway transport services (incl short distance, airport and school)

16	I Transport, Postal and Warehousing	46230010	Taxi transport services
16	I Transport, Postal and Warehousing	46230020	Rental or hire of passenger car with driver
16	I Transport, Postal and Warehousing	46230030	Rental or hire of passenger road vehicle nec (incl buses and coaches) with driver
16	I Transport, Postal and Warehousing	46230040	Urban road passenger transport services nec
16	I Transport, Postal and Warehousing	46230050	Interurban road passenger transport services nec
16	I Transport, Postal and Warehousing	47100020	Non-margin - railway freight transport services nec
16	I Transport, Postal and Warehousing	47101600	Margin - railway freight transport services
16	I Transport, Postal and Warehousing	47200010	Urban railway (incl monorail) passenger transport services
16	I Transport, Postal and Warehousing	47200020	Interurban railway passenger transport services
16	I Transport, Postal and Warehousing	48100020	Non-margin - ocean and inland water freight transport services
16	I Transport, Postal and Warehousing	48101600	Margin - ocean and inland water freight transport services
16	I Transport, Postal and Warehousing	48200010	Local water transport services for passengers
16	I Transport, Postal and Warehousing	48200020	Long distance water transport services for passengers
16	I Transport, Postal and Warehousing	48200030	Rental or hire of water vessel with operator
16	I Transport, Postal and Warehousing	49000020	Non-margin - air and space freight transport services
16	I Transport, Postal and Warehousing	49000030	Air passenger transport services
16	I Transport, Postal and Warehousing	49000040	Rental or hire of aircraft with operator
16	I Transport, Postal and Warehousing	49001600	Margin - air and space freight transport services
16	I Transport, Postal and Warehousing	50100010	Scenic and sightseeing transport services
16	I Transport, Postal and Warehousing	50211600	Margin - pipeline transport services
16	I Transport, Postal and Warehousing	50290010	Transport services nec (incl ski lift operation)
16	I Transport, Postal and Warehousing	50291980	General government consumption of fixed capital (5010-5029)
16	I Transport, Postal and Warehousing	51010010	Postal services
16	I Transport, Postal and Warehousing	51020010	Courier pick-up and delivery services
16	I Transport, Postal and Warehousing	51021980	General government consumption of fixed capital (5101-5102)
16	I Transport, Postal and Warehousing	52100030	Non-margin - stevedoring and port handling services (5211-5219)

16	I Transport, Postal and Warehousing	52100040	Support services to water transport nec (5211-5219)
16	I Transport, Postal and Warehousing	52101400	Margin on reexports - services to water transport (5211-5219)
16	I Transport, Postal and Warehousing	52101600	Margin - services to water transport (5211-5219)
16	I Transport, Postal and Warehousing	52200010	Airport operations and other air transport support services nec
16	I Transport, Postal and Warehousing	52910010	Customs agency services
16	I Transport, Postal and Warehousing	52920010	Freight forwarding agency services
16	I Transport, Postal and Warehousing	52990010	Other transport support services nec
16	I Transport, Postal and Warehousing	52990020	Support services for road transport nec (incl taxi radio base and road vehicle driving service)
16	I Transport, Postal and Warehousing	52990030	Support services for railway transport nec (incl station and terminal operations)
16	I Transport, Postal and Warehousing	52991980	General government consumption of fixed capital (5211-5299)
16	I Transport, Postal and Warehousing	53010010	Grain storage services
16	I Transport, Postal and Warehousing	53090010	Warehousing and storage services nec
16	I Transport, Postal and Warehousing	53091980	General government consumption of fixed capital (5301-5309)
16	I Transport, Postal and Warehousing	66110010	Passenger car rental or hire (incl cars, minibuses) - (excl financial leases)
16	I Transport, Postal and Warehousing	95330010	Parking services
17	J Information Media and Telecommunications	54110010	Newspaper publishing (incl printed and published by the same business) published once a week or more
17	J Information Media and Telecommunications	54110020	Newspaper publishing (incl printed and published by the same business) published less than weekly
17	J Information Media and Telecommunications	54110030	Newspapers - advertising services
17	J Information Media and Telecommunications	54110040	Copyright leasing - newspapers
17	J Information Media and Telecommunications	54120010	Magazine and other periodical publishing (incl printed and published by the same business)
17	J Information Media and Telecommunications	54120030	Magazines and other periodicals - advertising services
17	J Information Media and Telecommunications	54120040	Copyright leasing - magazines and other periodicals
17	J Information Media and Telecommunications	54130010	Book publishing (incl textbooks, encyclopedias, travel guides and atlases) (incl printed and published by the same business)
17	J Information Media and Telecommunications	54130030	Books - advertising services
17	J Information Media and Telecommunications	54130040	Copyright leasing - books
17	J Information Media and Telecommunications	54140010	Directory, mailing list, collection or compilation publishing (incl printed and published by the same business)

17	J Information Media and Telecommunications	54140030	Directory, mailing list, collection or compilation - advertising services
17	J Information Media and Telecommunications	54190010	Other publishing nec (incl maps, greeting cards, postcards and calendars) (incl printed and published by the same business)
17	J Information Media and Telecommunications	54190030	Other publishing - advertising services
17	J Information Media and Telecommunications	54190040	Copyright leasing - other
17	J Information Media and Telecommunications	54200010	Software publishing services (non-customised)
17	J Information Media and Telecommunications	54200020	Copyright leasing - software (non-customised)
17	J Information Media and Telecommunications	54201980	General government consumption of fixed capital (5411-5420)
17	J Information Media and Telecommunications	55110010	Motion picture and video production
17	J Information Media and Telecommunications	55120010	Motion picture and video distribution services
17	J Information Media and Telecommunications	55120020	Copyright leasing - motion pictures and videos
17	J Information Media and Telecommunications	55130010	Motion picture theatre services
17	J Information Media and Telecommunications	55140010	Post-production services and other motion picture and video activities
17	J Information Media and Telecommunications	55210010	Music publishing nec (incl sheet music)
17	J Information Media and Telecommunications	55210030	Music copyrights (Acquiring, registering and selling)
17	J Information Media and Telecommunications	55220010	Music and other sound recording studios operation (incl pre-recorded radio programming services)
17	J Information Media and Telecommunications	55221980	General government consumption of fixed capital (5511-5522)
17	J Information Media and Telecommunications	56100010	Radio broadcasting services
17	J Information Media and Telecommunications	56210010	Free-to-air television broadcasting services
17	J Information Media and Telecommunications	56220010	Cable (Pay TV) and other subscription broadcasting services
17	J Information Media and Telecommunications	56221980	General government consumption of fixed capital (5610-5622)
17	J Information Media and Telecommunications	57000010	Internet publishing and broadcasting services (incl radio, television, books, newspapers and magazines)
17	J Information Media and Telecommunications	57000020	Internet publishing - advertising services
17	J Information Media and Telecommunications	57001980	General government consumption of fixed capital (5700)
17	J Information Media and Telecommunications	58010020	Wired telecommunications network services (incl International, long distance and local)
17	J Information Media and Telecommunications	58020010	Mobile and other telecommunication network services nec (incl wireless and satellite)
17	J Information Media and Telecommunications	58090010	Other telecommunications services nec

17	J Information Media and Telecommunications	58091980	General government consumption of fixed capital (5801-5809)
17	J Information Media and Telecommunications	59100010	Internet access (incl ISPs) and internet search services
17	J Information Media and Telecommunications	59210020	Data processing and web hosting services
17	J Information Media and Telecommunications	59220010	Information storage and retrieval services
17	J Information Media and Telecommunications	59221980	General government consumption of fixed capital (5910-5922)
17	J Information Media and Telecommunications	60100010	Library and archive services
17	J Information Media and Telecommunications	60200010	Other information services (incl radio and television new collection and telephone based recorded information services)
17	J Information Media and Telecommunications	60201980	General government consumption of fixed capital (6010-6020)
18	K Financial and Insurance Services	62000010	Bank services - Financial intermediation services indirectly measured
18	K Financial and Insurance Services	62290010	Other depository financial services (incl securitiser services) - Financial intermediation services indirectly measured
18	K Financial and Insurance Services	62290030	Other depository financial services nec (incl money market and securitiser services)
18	K Financial and Insurance Services	62300010	Non-depository finance services - Financial intermediation services indirectly measured
18	K Financial and Insurance Services	62300020	Non-depository finance services nec
18	K Financial and Insurance Services	62400010	Financial asset investors
18	K Financial and Insurance Services	63220060	Marine insurance provision (Non-margin); aviation hull/cargo insurance provision
18	K Financial and Insurance Services	63220070	Employers liability insurance provision
18	K Financial and Insurance Services	63220080	Insurance provision (incl travel insurance) nec.
18	K Financial and Insurance Services	63221500	Marine insurance provision (Margin)
18	K Financial and Insurance Services	63301980	General government consumption of fixed capital (6310-6330)
18	K Financial and Insurance Services	64110010	Financial asset broking services
18	K Financial and Insurance Services	64190010	Insurance fund management service
18	K Financial and Insurance Services	64190020	Auxiliary services to finance and investment nec
18	K Financial and Insurance Services	64200010	Services to insurance nec
19	L Rental, Hiring and Real Estate Services	66200010	Farm animal and bloodstock leasing
19	L Rental, Hiring and Real Estate Services	66310010	Heavy machinery and Scaffolding (excl erection) rental or hire (excl financial leases)
19	L Rental, Hiring and Real Estate Services	66320010	Video and other electronic media rental or hire

19	L Rental, Hiring and Real Estate Services	66390010	Other goods and equipment rental hire nec (incl art works, household goods and office machinery)
19	L Rental, Hiring and Real Estate Services	66400010	Non-financial intangible assets (excl copyrights) leasing
19	L Rental, Hiring and Real Estate Services	66401980	General government consumption of fixed capital (6611-6640)
19	L Rental, Hiring and Real Estate Services	67110020	Residential caravan park operation and residential property body corporate or strata corporation services
19	L Rental, Hiring and Real Estate Services	67111980	General government consumption of fixed capital (6711)
19	L Rental, Hiring and Real Estate Services	67120010	Non-residential property operator services (incl non-residential property body corporate or strata corporation services)
19	L Rental, Hiring and Real Estate Services	67200010	Real estate agent services
19	L Rental, Hiring and Real Estate Services	67200020	Agricultural or pastoral property broking, leasing, renting or valuing
19	L Rental, Hiring and Real Estate Services	67201980	General government consumption of fixed capital (6712-6720)
20	M Professional, Scientific and Technical Services	69000020	Architectural services
20	M Professional, Scientific and Technical Services	69000030	Surveying and mapping services
20	M Professional, Scientific and Technical Services	69000040	Quantity surveying services
20	M Professional, Scientific and Technical Services	69000050	Engineering design and consulting services
20	M Professional, Scientific and Technical Services	69000060	Commercial art and display services
20	M Professional, Scientific and Technical Services	69000070	Specialised design services nec (incl fashion, interior and jewellery design)
20	M Professional, Scientific and Technical Services	69000080	Scientific testing and analysis services
20	M Professional, Scientific and Technical Services	69000090	Legal services
20	M Professional, Scientific and Technical Services	69000100	Accounting services
20	M Professional, Scientific and Technical Services	69000110	Advertising services
20	M Professional, Scientific and Technical Services	69000120	Market research services

20	M Professional, Scientific and Technical Services	69000130	Statistical services
20	M Professional, Scientific and Technical Services	69000140	Corporate head office management
20	M Professional, Scientific and Technical Services	69000150	Management services (incl business, artists, entertainers and sporting professionals)
20	M Professional, Scientific and Technical Services	69000160	Management advice and consulting services nec (excl financial and computer consulting)
20	M Professional, Scientific and Technical Services	69000190	Meteorology services
20	M Professional, Scientific and Technical Services	69000200	Interpreting and translating services
20	M Professional, Scientific and Technical Services	69000210	Research and development services
20	M Professional, Scientific and Technical Services	69000220	Own account research and development
20	M Professional, Scientific and Technical Services	69000230	Professional, scientific or technical services nec
20	M Professional, Scientific and Technical Services	69001980	General government consumption of fixed capital (6910, 6921-6950, 6961-6999)
20	M Professional, Scientific and Technical Services	70000010	Computer systems, hardware and software design and development services
20	M Professional, Scientific and Technical Services	70000030	Computer support services
20	M Professional, Scientific and Technical Services	70001980	General government consumption of fixed capital (7000)
21	N Administrative and Support Services	72110010	Employment placement and recruitment services (incl casting agency service)
21	N Administrative and Support Services	72120010	Labour supply services
21	N Administrative and Support Services	72200010	Travel agency and tour arrangement services
21	N Administrative and Support Services	72910010	Periodical subscription service
21	N Administrative and Support Services	72910020	Office administration services nec (incl clerical, billing, record-keeping and payroll services)
21	N Administrative and Support Services	72920010	Document preparation services nec (incl word processing, stenography, typing, transcription and resume writing)
21	N Administrative and Support Services	72930010	Credit rating, credit investigation and collection agency services

21	N Administrative and Support Services	72940010	Call centre operation
21	N Administrative and Support Services	72990010	Tourist information centre operation
21	N Administrative and Support Services	72990020	Theatre, concert and sport ticketing and booking services
21	N Administrative and Support Services	72990030	Event management or promotion (incl sport, art or similar); fund raising services (fee based) or administration services nec
21	N Administrative and Support Services	72991980	General government consumption of fixed capital (7211-7299)
21	N Administrative and Support Services	73200010	Crating or packing services for transport
21	N Administrative and Support Services	73200020	Packaging of fresh produce, groceries; bottling or rebottling services and packaging services nec
21	N Administrative and Support Services	73201980	General government consumption of fixed capital (7311-7320)
22	O Public Administration and Safety	75000010	Government administration and regulatory services
22	O Public Administration and Safety	75400010	Judicial services
22	O Public Administration and Safety	75510010	Domestic government diplomatic and consular services
22	O Public Administration and Safety	75521980	General government consumption of fixed capital (7510-7552)
22	O Public Administration and Safety	76000010	Defence services
22	O Public Administration and Safety	76001980	General government consumption of fixed capital (7600)
22	O Public Administration and Safety	77110010	Police services
22	O Public Administration and Safety	77120010	Investigative and security services (incl locksmiths) (excl police)
22	O Public Administration and Safety	77130010	Fire brigade services (incl forest fire fighting)
22	O Public Administration and Safety	77140010	Correctional and detention centres (incl juvenile)
22	O Public Administration and Safety	77190010	Public order and safety services (incl coastwatch and country border) nec
22	O Public Administration and Safety	77201980	General government consumption of fixed capital (7711-7720)
23	P Education and Training	80100010	Preschool education services
23	P Education and Training	80200010	Primary education services
23	P Education and Training	80200020	Secondary education services
23	P Education and Training	80200030	Special school education services
23	P Education and Training	81010010	Technical, vocational and other non-tertiary education services
23	P Education and Training	81020010	Tertiary higher education services (incl undergraduate and postgraduate)

23	P Education and Training	82110010	Sports or physical recreation instruction services (incl ski or snowboard) nec
23	P Education and Training	82120010	Arts education services (excl vocational)
23	P Education and Training	82190010	NPISH-provided adult, community and other education services
23	P Education and Training	82190020	Other adult, community and other education services
23	P Education and Training	82200010	Educational support services
23	P Education and Training	82201980	General government consumption of fixed capital (8010-8220)
24	Q Health Care and Social Assistance	69000170	Veterinary services
24	Q Health Care and Social Assistance	84010010	Hospital services (except Psychiatric Hospitals)
24	Q Health Care and Social Assistance	84020010	Psychiatric Hospitals services
24	Q Health Care and Social Assistance	85110010	General practice medical services
24	Q Health Care and Social Assistance	85120010	Specialist medical services
24	Q Health Care and Social Assistance	85200010	Pathology and Diagnostic Imaging services
24	Q Health Care and Social Assistance	85310010	Dental services
24	Q Health Care and Social Assistance	85320010	Optometry and optical dispensing
24	Q Health Care and Social Assistance	85330010	Physiotherapy services
24	Q Health Care and Social Assistance	85340010	Chiropractic and Osteopathic Services
24	Q Health Care and Social Assistance	85390010	NPISH-provided other allied health services
24	Q Health Care and Social Assistance	85390020	Other allied health services n.e.c.
24	Q Health Care and Social Assistance	85910010	Ambulance services
24	Q Health Care and Social Assistance	85990010	Other health services nec
24	Q Health Care and Social Assistance	85991980	General government consumption of fixed capital (8401 - 8599)
24	Q Health Care and Social Assistance	86010010	Residential care services for the elderly (Aged care)
24	Q Health Care and Social Assistance	86010020	Residential care services for the disabled
24	Q Health Care and Social Assistance	86090010	Other residential care services (incl mental health illnesses or substance abuse) nec
24	Q Health Care and Social Assistance	87100010	Child care services
24	Q Health Care and Social Assistance	87900010	NPISH-provided other social assistance services n.e.c. (incl elderly, disabled, marriage and adoption services)

24	Q Health Care and Social Assistance	87900020	Other social assistance services n.e.c. (incl elderly, disabled, marriage and adoption services)
24	Q Health Care and Social Assistance	87901980	General government consumption of fixed capital (8601 - 8790)
25	R Arts and Recreation Services	69000180	Photography services nec (incl Video filming of Weddings etc)
25	R Arts and Recreation Services	73130010	Gardening services
25	R Arts and Recreation Services	89100010	Museum and art gallery services
25	R Arts and Recreation Services	89210010	Zoological and botanical services
25	R Arts and Recreation Services	89220010	Nature reserve and conservation park services
25	R Arts and Recreation Services	89221980	General government consumption of fixed capital (8910-8922)
25	R Arts and Recreation Services	90010010	Performing arts operation nec (incl theatre restaurants and circuses)
25	R Arts and Recreation Services	90020010	Services of independent creative artists, writers and performers
25	R Arts and Recreation Services	90020020	Theatre lighting, costume design and set design services
25	R Arts and Recreation Services	90030010	Performing arts venue operation
25	R Arts and Recreation Services	90031980	General government consumption of fixed capital (9001-9003)
25	R Arts and Recreation Services	91110010	Gymnasia or fitness centre operation
25	R Arts and Recreation Services	91120010	Sports professional services
25	R Arts and Recreation Services	91120020	NPISH-provided sport and physical recreation club operation
25	R Arts and Recreation Services	91120030	Other sport and physical recreation club operation
25	R Arts and Recreation Services	91130010	Sports grounds and similar recreational facilities operation nec (excl Gymnasia or fitness centre)
25	R Arts and Recreation Services	91140010	NPISH-provided sport and physical recreation administrative services
25	R Arts and Recreation Services	91140020	Other sport and physical recreation administrative services
25	R Arts and Recreation Services	91210010	Horse and dog racing, administration and track operation
25	R Arts and Recreation Services	91290010	racing horse or dog training and stable (kennel) operation
25	R Arts and Recreation Services	91310010	Amusement parks and centres operation
25	R Arts and Recreation Services	91390010	Amusement and other recreational activities nec
25	R Arts and Recreation Services	91391980	General government consumption of fixed capital (9111-9139)
25	R Arts and Recreation Services	92010010	Casinos operation

25	R Arts and Recreation Services	92020010	Lottery operation
25	R Arts and Recreation Services	92090010	Totalisator agency services
25	R Arts and Recreation Services	92090020	Gambling services nec
25	R Arts and Recreation Services	92091980	General government consumption of fixed capital (9201-9209)
25	R Arts and Recreation Services	95110010	Hairdressing and beauty services (incl massage services nec)
25	R Arts and Recreation Services	95200010	Funeral directing services
25	R Arts and Recreation Services	95200020	Crematoria and cemetery services
25	R Arts and Recreation Services	95300010	Personal services nec (incl weight reduction centres and prostitution services)
25	R Arts and Recreation Services	95310010	Laundry and dry-cleaning services
25	R Arts and Recreation Services	95320010	Photographic film processing
25	R Arts and Recreation Services	96000010	Domestic services of private household employees
26	S Other Services	94191980	General government consumption of fixed capital (9411-9419)
26	S Other Services	94991980	General government consumption of fixed capital (9421-9499)
26	S Other Services	95391980	General government consumption of fixed capital (9511-9539)
26	S Other Services	95510010	Business and professional association services
26	S Other Services	95520010	Labour association services
26	S Other Services	95590010	Interest groups nec (incl welfare fundraising services)
26	S Other Services	95591980	General government consumption of fixed capital (9540-9559)