# **Input-Output tables and household effects of pricing carbon in Australia**

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**Abstract**

The Australian Bureau of Statistics (ABS) Input-Output tables have been used by the Australian Treasury to analyse the impact of policy changes.  This paper discusses recent analysis of the impact of introducing a price on carbon (and associated reforms to the tax and transfer system) on prices and the distributional effects on households using the Australian Treasury’s Price Revenue Incidence Simulation Model. In order to meet the data needs of the Australian Treasury, the ABS developed new editing strategies for the 2004-05 and subsequent Input-Output tables. The paper also explores recent challenges faced by the ABS while undertaking a major review of its energy estimates.

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# Introduction

The ABS Input-Output (I-O) tables provide a framework for the supply and use of products in the Australian economy and the structure of inter-relationships between Australian industries at a highly disaggregated level. The I-O framework enables changes in one sector to be traced through the economy. This is done by traditional I-O analysis using the standard *Leontief inverse* formula, including variations and extensions, and by computable general equilibrium (CGE) modelling, the core of which is usually a set of I-O tables.

In Australia, the national I-O tables are used for a broad range of analytical purposes including both I-O multiplier analysis and CGE modelling (see for example the studies by Gretton, 2005 and Gretton *et al.,* 2004). These have been used to perform state policy analysis, environmental studies and impact analysis. Box 1 provides an overview of the use of Australian I-O tables for analytical purposes.

The purpose of this paper is to briefly outline how the ABS and Australian Treasury have worked on a number of issues to ensure that high quality I-O tables can be used to assist with the provision of sound policy advice to the Australian Government. The paper discusses the ABS quality assurance procedures for the I-O tables and the recent Treasury analysis of the impact of the Australian Government’s carbon pricing policy on consumer prices and the distributional implications for households. The latter is of particular interest as countries implement policies to address climate change. Recent ABS work on the Energy Hybrid Accounts is also discussed.

**Box 1: Major uses of ABS national I-O tables for analytical purposes**

The ABS I-O tables are used by both public and private institutions in Australia and overseas. In Australia, some users include the Productivity Commission (PC), the Australian Treasury and other federal and state government departments.

I-O tables have also been used to examine a wide range of issues in Australia. This includes the introduction of the Goods and Services Tax (GST) (which is the Australian version of a value added tax) and related changes to the tax system in 2000‑01. The Australian Treasury modelling of the GST reforms was based on the I-O multiplier framework (Costello, 1998) developed in the Treasury’s Price Revenue Incidence Simulation Model (PRISMOD) which will be explored further in this paper. The PC has used I-O data to provide information about the structure of industry for the measurement and evaluation of industry assistance (see Productivity Commission, 2003) and to analyse the impact of assistance in the Australian-New Zealand Closer Economic Relations Agreement (Productivity Commission, 2004).

The ABS produces I-O tables for Australia at the national level. These tables are typically used by other organisations (see South Australian Centre for Economic Studies, 2005) as a basis for constructing state I-O tables.

Australian I-O tables have also been used to study the implications of changes in infrastructure costs on the competitiveness of Australian agriculture and food sectors (Bureau of Industry Economics, 1996), micro-economic reforms by State Governments and the research on the introduction of genetically modified (GM) crops (see Acworth, Yainshet and Curtotti, 2008).

At the international level, the Australian I-O tables contribute to the Global Trade Analysis Project (GTAP), aglobal economic database and model based on national I-O tables; the OECD I-O tables database; as well as other international projects requiring I-O data at the national level. GTAP has been used to analyse international trade policy (see for example Mai *et al.*,2005).

Australian institutions contribute to global research in I-O related analyses by contracting their expertise to international clients and providing software designed for CGE modelling purposes. Examples of these are the Centre of Policy Studies (CoPS) based at Monash University, with its MONASH and Monash Multi-Regional Forecasting (MMRF) models (Adams *et al.*, 2011), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Centre for Integrated Sustainability Analysis based at the University of Sydney.

# Ensuring high quality I-O tables

The key to sound policy analysis based on the I-O framework is the quality of the I-O tables. Compiling high quality I-O tables is a significant challenge due to their size – 7.7 million data points for the 2007-08 I-O tables – and the resulting need to develop a strategy to monitor the data quality efficiently.

An important part of maintaining qualities is the use of “Quality Gates”. The ABS implemented Quality Gates into the production of the 2004-05 I‑O tables, which were released in 2008. Quality Gates are tools designed to improve the early detection of errors or flaws in a compilation process. At every strategic point in both the compilation and dissemination process, the data are assessed against a set of objective measures.

The concept of Quality Gates has contributed to the development of a formal strategy to ensure data quality in the I-O tables. It is an important component of progress monitoring, risk management and quality assurance in the tables. Quality Gates also ensure accountability and responsibility for each stage of processing, and formalise documentation of processes for future reference.

The Quality Gates have proven to be a valuable tool in maintaining data quality, especially with a large, complicated data set like the I-O tables. They affect the compilation process by setting the quality objectives to attain. Box 2 provides more detailed information on the implementation process of Quality Gates.

**Box 2: Quality Gates to ensure high quality I-O tables**

The introduction of Quality Gates required the mapping of the entire I-O process. Such mapping ensured the inclusion of Quality Gates at each of the following stages: input data, pre-balancing investigation, compilation and balancing, release of preliminary and final tables, release of alternative view tables for modellers, release of product details (commodity cards) and process review.

Each gate includes a series of manual checks or measures which have been progressively improved using experience from previous cycles and user feedback. One measure, for example, ensures that all three measures of Gross Domestic Product (GDP) match published estimates from the Australian National Accounts. Each measure has a different tolerance level. For example, there is nil tolerance for I‑O aggregates misaligning with published National Accounts estimates whilst the tolerance level for the coverage and specialisation ratios is higher. Importantly, the majority of the Quality Measures are assessed at every quality gate. The measures include:

* all three measures of GDP equal;
* Supply-Use tables are balanced in both rows and columns;
* there are no negative values in Supply, Intermediate Use and
 Final Demand (excluding change in Inventories, second hand Gross Fixed Capital Formation (GFCF) and
 imports of non-margin transport products);
* aggregate data matches the relevant release of the Australian
 National Accounts;
* all known issues from previous tables have been resolved;
* the cost insurance freight–free on board (cif-fob) adjustment has been
 applied;
* Services at I-O Product Category (IOPC) level do not have inventories or margins;
* GST and retail margins are consistent with HFCE data;
* Exports do not exceed Australian Production;
* Re-exports do not exceed imports (unless Inventories are
 drawn down);
* Coverage and Specialisation ratios are plausible;
* Supply and Use are plausible for the top 50 products;
* Compensation of Employees and Intermediate Use and Gross Operating Surplus and Intermediate Use ratios are plausible; and
* industry division growth rates are comparable with the
 Australian National Accounts.

# Public policy use of I-O tables: carbon price modelling

## Background on the modelling of carbon price policy

In July 2011, the Australian Government announced the “Clean Energy Future” package (CEFP) to commence from 1 July 2012 (Australian Government, 2011a). A major component of the CEFP is the introduction of a fixed carbon price at $23 AUD per tonne of carbon dioxide equivalent (CO2-e) starting on 1 July 2012, transitioning to a flexible market-based price from 1 July 2015.

The modelling of the impacts of the introduction of a $23 carbon price on prices was based on an I-O framework which models the flow through of the carbon price to different industry sectors, and calculates how this will impact consumer prices. These price impacts, combined with the government assistance estimated from a micro simulation model of the Australian tax and transfer system, provided estimates of the effects of the Government’s overall assistance to households by household types at difference income levels.

The Australian Treasury modelling of carbon price impacts was based on a suite of models which include two top down CGE models developed in Australia – the Global Trade and Environment Model (GTEM) and the Monash Multi-Regional Forecasting (MMRF) model, the Treasury’s Price Revenue Incidence Simulation Model (PRISMOD) and the Static Incomes Model (STINMOD).[[1]](#footnote-1) This paper focuses on the household price impact analysis of carbon pricing.

## Price and Household Modelling

Modelling of the impact of the Australian Government’s carbon price policy on consumer prices and household income distributions was undertaken with the Australian Treasury’s PRISMOD. (For an overview of the modelling approach see Figure 1.) PRISMOD consists of two major modules – industry level PRISMOD.IO and household level PRISMOD.DIST.[[2]](#footnote-2)

**Figure 1: Overview of the modelling approach**

Changes in consumer prices and household income distribution

Changes in industry costs and price impact on household consumption expenditure

**Output**

PRISMOD.IO is a large-scale, highly disaggregated model of the Australian economy which captures the flows of goods between industries and final consumers, and was used to examine the inter‑industry transmission of price changes due to carbon pricing.

PRISMOD.DIST is a static micro simulation model which can be used to examine the impact on consumer prices and the distributional effects of government policies on spending by different households. The price changes by industry output are mapped to the Household Expenditure Survey (HES) expenditure categories to determine the impact of the industry level price effects on consumer prices.

Finally, the Australian Treasury version of STINMOD[[3]](#footnote-3) was used to model the household assistance package using the price impacts by household type and income quintile from PRISMOD.DIST.

The analytical framework assumes no behavioural changes in response to carbon pricing. This results in the modelling presenting conservative estimates of the price impacts, ensuring the government’s assistance (which is based on the modelling) fully compensates the most vulnerable household on average.

## PRISMOD.IO

PRISMOD.IO was used to examine the inter-industry transmission of price changes (also called second round effects) in addition to the direct effects of policy change. In the context of carbon price modelling, it tracks, for example, how pricing carbon affects the cost of producing electricity, the downstream effect of the change in the price of electricity on the output prices of industries that purchase electricity, and on all industries that purchase from those industries, and on all purchasers of those industries, and so forth.

The 2011 version of PRISMOD.IO used for the carbon price modelling disaggregates the economy into 109 industry categories and seven final expenditure categories and is based on data from the 2005-06 ABS I-O tables and 2005-06 emissions data from the 2009 National Greenhouse Gas Inventory Report (DCCEE, 2011) published by the Australian Department of Climate Change and Energy Efficiency (DCCEE).

PRISMOD.IO assumes businesses continue to operate with the same production techniques and that business and consumer behaviour remain fixed after the policy change. In other words, it assumes there is no supply or demand response to policy changes. All price impacts are assumed to be passed on fully to final purchasers (governments and households).

This may overestimate costs as behaviour effects by households and businesses in the economy are not taken into account. This approach ensures that the government assistance to low-income households will, on average, fully compensate for the average expected cost of carbon pricing, even if households and businesses do not change their behaviour. Further, the assistance package will also support incentives for households to adopt energy saving measures and, therefore, realise additional benefits to households than what was modelled.

The I-O analysis in PRISMOD.IO models how a carbon price flows through to different sectors of the economy and estimates a highly disaggregated set of industry and product price impacts arising from the imposition of carbon pricing. These estimates are then aggregated and incorporated into PRISMOD.DIST to estimate the impact on consumer prices and the distributional implications for households.

## Treasury analysis of the impact of carbon pricing

To capture the full price effect of a carbon price, the total emissions embodied in the production of a commodity need to be taken into account. This includes both the emissions that arise directly from the production of the commodity and the indirect emissions from the production of inputs that go into the commodity.

The direct impact of a carbon price on an industry depends on the industry’s emission intensity (its level of emissions relative to its level of production which can be measured as megatonne of CO2-e per dollar of Australian production). The analysis used emissions data from the National Greenhouse Gas Inventory (NGGI) produced by the DCCEE.

Indirect emissions from the production of inputs that are used to produce a commodity are also taken into account by using data on the amount of each intermediate input that is required by each particular industry. This information is obtained from the ABS I-O tables.

The information from the I-O tables can be used to derive the following formula to estimate the impact of carbon pricing on costs of production (see Henry and Wright, 1992, for a richer formula for the industry costs of production):

(1) $C=Cθ^{'}A^{\*}+E+Cθ^{'}G^{\*}+Cθ^{'}R+C^{\*}$

Equation 1 says that industry costs of production are affected by:

* costs of domestic non-margin inputs and their associated taxes - $Cθ^{'}A^{\*}$ ;
* costs from carbon pricing - E;
* domestically produced margins and their associated taxes - $Cθ^{'}G^{\*}$ ;
* domestically produced capital inputs and their associated taxes - $Cθ^{'}R$ ; and
* other costs - C\*;[[4]](#footnote-4)

Equation 1 can be rewritten as:

$$C=\left[C^{\*}+E\right]\left[I-θ^{'}(A^{\*}+G^{\*}+R)\right]^{-1}$$

where the last element is a type of Leontief inverse matrix and enables us to account for both the direct and indirect input requirements. By accounting for the indirect requirements, we recognise that the inputs directly required in the production of commodities may require inputs of other commodities.

### Incorporation of other policy measures in the PRISMOD.IO modelling

The modelling takes into account the specific features of the Australian Government’s carbon pricing policy, including the structure of assistance measures.

For example, the estimated costs of carbon pricing modelled are net of assistance to emission-intensive, trade-exposed industries through the Australian Government’s Jobs and Competitiveness Program. Eligible industries will receive a level of assistance based on a percentage of historical industry average carbon intensity of production. While the assistance will help shield emission-intensive trade-exposed industries from the full impact of the carbon price on profitability, it has been designed to ensure businesses retain the incentive to reduce their pollution.

The modelling also incorporates the cost impact on importers of synthetic greenhouse gases covered by the Kyoto Protocol. Importation (or manufacture) of these gases will be subject to an equivalent carbon price using existing import or manufacture levies.

Finally, the modelling reflects the exclusion of agriculture, fisheries and forestry from the scheme, as well as the initial exclusion of fuel use for on-road transport.[[5]](#footnote-5)

## PRISMOD.DIST

PRISMOD.DIST models the effects of price changes at the industry level, as described above, on household expenditure and consumer prices. It is a static model which assumes no behavioural effects by consumers in response to carbon pricing. In order to map the final consumption expenditure from PRISMOD.IO to the household level, the Australian Treasury drew on data from the ABS, including the Household Expenditure Survey (HES), the Survey of Income and Housing (SIH)[[6]](#footnote-6), the CPI[[7]](#footnote-7) and Average Weekly Earnings (AWE)[[8]](#footnote-8).

Information on price changes for expenditure classes underlying the CPI are published regularly by the ABS. These price changes were used to update expenditure estimates for each of the expenditure categories in the HES up to 2010‑11, assuming households continue to purchase constant quantities of goods and services over time. Household incomes and expenditure were projected forward to 2012‑13 price levels based on projected growth in the CPI for expenditure classes together with growth in wages and transfer payments and legislated tax rates and thresholds. As the number and composition of households also change over time, the modelling also incorporated projected movements in Australia’s demographic composition.[[9]](#footnote-9)

The price impacts of the carbon price estimated on an industry basis from PRISMOD.IO were applied to the price-updated expenditure data with the assistance of a concordance that matches product level classifications to the Household Expenditure Classifications (HECs) in the HES.

A concordance between the HECs and the CPI expenditure classes was used to map between the two classifications in order to ‘price update’ the HES data and estimate the impact of a carbon price on CPI. The price-updated HES data was normalised to the fifteenth series CPI weighting pattern to take account of under and over reporting of expenditure data in the HES.

The Australian Treasury sought assistance from the ABS to develop product concordances to match the classification of Household Final Consumption Expenditure (HFCE) from PRISMOD.IO to the expenditure classification in the HES. Specifically, the ABS provided a concordance for the Input-Output Product Groups (IOPGs) to the Input-Output Product Classification (IOPC) and the IOPC to the HEC. The concordances allow the Australian Treasury to create the required links between PRISMOD.IO and PRISMOD.DIST. Subsequent to the release of the carbon price modelling, Treasury requested a more direct concordance between the IOPG to the HEC from the ABS.[[10]](#footnote-10)

The development of correspondence tables is subject to a number of challenges including confidentiality, coverage and consistency of concepts. The HFCE and HES data, for example, differ in terms of scope. The HFCE data include expenditure by non‑profit institutions serving households (as recommended by the SNA) whereas the HES data exclude such expenditure. The treatment of imputed rent provides another example, being included in HFCE data and excluded from the HES data.

Such correspondence tables enable I-O data to be used in conjunction with other statistics. However, as illustrated in the above example, there are limitations involved when coverage and conceptual differences apply to the data sets being corresponded.

## Modelling results – price impacts

The modelling found that a $23 carbon price in 2012-13 will cause a modest one-off rise in the CPI of around 0.7 per cent. Table 1 shows the estimated average price impacts across all households following the introduction of a $23 carbon price in 2012-13 by CPI subgroup. The modelling estimates average price changes across household expenditure categories taking into account the different inputs involved in generating the goods and services that make up each CPI subgroup, such as energy use and transportation. While the modelling is intended to provide an accurate indication of how the price of different categories of goods will change on average, it is important to recognise that price impacts for specific items will depend on aspects particular to the product, such as degree of price pass through, the location, and the extent to which production processes and transportation required differ from the average across the CPI subgroup.

**Table 1: Price impacts on households for a $23 carbon price in 2012‑13\***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CPI subgroup[[11]](#footnote-11)** | *Average price impact ($ per week)* | *Price Impact (%)* | **CPI subgroup** | *Average price impact ($ per week)* | *Price Impact (%)* |
| **Dairy and related products** | < $0.10 | 0.4% | **Furniture and furnishings** | $0.10 | 0.4% |
| **Bread and cereal products** | < $0.10 | 0.4% | **Household appliances utensils and tools** | $0.20 | 0.8% |
| **Meat and seafoods** | $0.10 | 0.4% | **Household Supplies** | < $0.10 | 0.3% |
| **Fruit and vegetables** | $0.10 | 0.4% | **Household Services** | < $0.10 | 0.3% |
| **Non-alcoholic drinks and snack food** | $0.10 | 0.4% | **Health services** | $0.10 | 0.3% |
| **Meals out and takeaway foods** | $0.20 | 0.4% | **Pharmaceuticals** | < $0.10 | 0.3% |
| **Other food** | < $0.10 | 0.4% | **Private motoring** | $0.40 | 0.3% |
| **Alcoholic drinks** | $0.10 | 0.2% | **Urban transport fares** | < $0.10 | 0.5% |
| **Tobacco** | < $0.10 | 0.2% | **Communication** | $0.20 | 0.5% |
| **Men's clothing** | < $0.10 | 0.2% | **Audio, visual and computing** | < $0.10 | 0.4% |
| **Women's clothing** | < $0.10 | 0.2% | **Books, newspapers and magazines** | < $0.10 | 0.3% |
| **Children's and infants' clothing** | < $0.10 | 0.2% | **Sport and other recreation** | $0.20 | 0.3% |
| **Footwear** | < $0.10 | 0.2% | **Holiday travel and accommodation** | $0.30 | 0.5% |
| **Accessories and clothing services** | < $0.10 | 0.4% | **Education** | < $0.10 | 0.3% |
| **Rents** | $0.40 | 0.6% | **Insurance services** | < $0.10 | 0.3% |
| **Utilities** | $4.60 | 7.9% | **Other** | $0.90 | \*\* |
| **Other housing** | $0.90 | 0.6% | **Total Expenditure** | $9.90 | 0.7% |

\*Note: Estimating the impact on household goods and services has been undertaken across broad product categories and the estimates represent the average price impact across each category. Within each category there will be a range of goods with different levels of direct and indirect emission intensity, for instance due to the source of the electricity used in the production of a particular company or for a particular type of good.

\*\* The ‘other’ category is comprised of a range of household expenditures expected to increase in price by around a quarter of a per cent, which represents an average increase in prices for services across the general economy. Analysis of these products is difficult due to data limitations — many of these products are not included in the CPI basket of goods and services, for example — such that specific price increases cannot be determined. Examples of these products include life insurance premiums, fees for some financial services, gambling and outright purchases of dwellings.

**Source:** Australian Treasury[[12]](#footnote-12).

Electricity and gas are the most emission‑intensive goods that households consume so it would be expected that a carbon price would impact these items relatively more. On average, a $23 carbon price is estimated to increase weekly household electricity expenditure by around $3.30 and gas expenditure by around $1.50. In percentage terms, a $23 carbon price is estimated to increase retail electricity prices by 10 per cent and gas prices by 9 per cent.

The carbon price will have a different impact on each individual household according to what they purchase, as shown in Table 2. These estimates were published in SGLP (Australian Government (2011b)) and used as part of the design process of the household assistance package. It is impossible to examine each household’s circumstances, however certain trends exist between groups of households. For example, households in the lower income quintiles generally face a slightly higher proportional price impact. This is largely because electricity and gas expenditure form a higher proportion of lower income households’ total expenditure and both electricity and gas are highly emission intensive goods.

**Table 2: Estimated price impacts by household type of a $23 carbon price in 2012-13**

|  |  |
| --- | --- |
|  | **Household income quintile (a)** |
| **Household type and primary source of income** | **All** | **First quintile** | **Second quintile** | **Third quintile** | **Fourth quintile** | **Fifth quintile** |
|  | **Per cent** | **Per cent** | **Per cent** | **Per cent** | **Per cent** | **Per cent** |
| All | 0.7 | 0.9 | 0.9 | 0.7 | 0.7 | 0.7 |
| Two income household, no children (b) | 0.7 | \*\* | 1.0 | 0.8 | 0.7 | 0.7 |
| Two income household, with children (b) | 0.7 | \*\* | 0.8 | 0.8 | 0.7 | 0.7 |
| One income household, no children (b) | 0.7 | \*\* | 0.8 | 0.7 | 0.7 | 0.6 |
| One income household, with children (b) | 0.7 | \*\* | 0.8 | 0.8 | 0.7 | 0.7 |
| One income single person household | 0.7 | \*\* | 0.9 | 0.7 | 0.7 | 0.7 |
| Self-employed household | 0.8 | 0.9 | 0.8 | 0.8 | 0.7 | 0.7 |
| Household with primary income source from Commonwealth allowances (e.g. Newstart Allowance, Youth Allowance) | 0.9 | 0.8 | 0.9 | \*\* | \*\* | \*\* |
| Married pensioner household | 0.9 | 1.0 | 0.8 | \*\* | \*\* | \*\* |
| Single pensioner household | 1.0 | 1.0 | 1.0 | \*\* | \*\* | \*\* |
| Sole parent pensioner household | 1.0 | 1.1 | 1.0 | \*\* | \*\* | \*\* |
| Part-pension and self-funded retiree households | 0.7 | 0.8 | 0.9 | 0.7 | 0.7 | 0.7 |

\*\* indicates the sample size was too small to produce statistically reliable results.

Notes: These estimates assume that the carbon price costs are immediately passed through to consumers; that firms do not change their production processes; and that households do not change their consumption behaviour in response to the scheme. To the extent that households reduce their consumption of goods whose relative prices have risen, and increase their consumption of goods whose relative prices have decreased, the real impact on households would be expected to be lower.

(a) Income quintiles rank households from the lowest 20 per cent of disposable income to the highest 20 per cent. Modified OECD equivalence scales are applied to household disposable incomes to allow for comparisons across households of different sizes and compositions.

(b) Principal source of income is wages and salaries.

**Source:** Australian Government, 2011b, *Strong growth, low pollution: Modelling a carbon price* report

## Providing assistance to households

With the introduction of the carbon price, the government made a number of commitments relating to household assistance, including that:

* all low-income households will be eligible for assistance that at least offsets their expected average price impact from the carbon price; and
* middle-income households will be eligible for assistance that helps them meet their expected average price impact.

The estimated price impacts were then used to determine the necessary increase in payments and necessary tax changes to make sure that all low income and pensioner households are fully assisted given the estimated average price impact. While the policy is expected to induce behaviour change in the longer term, some households will not be able to respond immediately to higher electricity prices. For example, lower income households may not have the financial means to make energy efficient improvements around the house. The modelling presents a more conservative assumption to ensure that the assistance is sufficient to fully assist the most vulnerable households.

STINMOD, a static micro simulation model of the Australian tax and transfer system, was used to model the Government’s Household Assistance Package. The price impacts from PRISMOD.DIST were combined with the assistance estimated from STINMOD and used to generate overall estimates of the level of assistance received by households at various income levels. To ensure that these commitments will be achieved, the design of the Government assistance package was informed by the analysis using I-O tables. On average, households will see cost increases of $9.90 a week, while the average assistance provided will be $10.10 a week (see Australian Government, 2011b and 2011c).

# Recent development of the ABS Energy Hybrid Account

The ABS and DCCEE will continue to develop data on emissions and energy usage. One initiative includes the recent development of the ABS Energy Hybrid Account which is useful for monitoring the evolution of the Australian economy under carbon pricing.

The Energy Accounts are produced using the System of Environmental-Economic Accounts (SEEA) developed by the United Nations Statistical Commission, a satellite system to the System of National Accounts 2008 (SNA08). They encompass a set of supply and use tables showing how energy products are used and transacted between various industries and sectors of the economy. These energy data are presented in physical volume terms (Energy Account) and corresponding expenditure terms (Energy Hybrid Account).

The SEEA framework enables linkages to be made between physical information and economic data as presented in the Australian System of National Accounts (ABS cat. no. 5204.0). Although the Energy Hybrid Account and the I-O tables are compiled from different data sources, they are conceptually aligned via the SNA framework. There are likely to be some minor differences in estimates between the two accounts, due to differences in compilation timing, energy product classifications and conceptual frameworks. However, overall, data integration across different accounts improves the quality of the statistics by utilising additional data sources while applying a common conceptual framework.

|  |
| --- |
| **Box 3: Examples of data integration challenges**Monetary estimates in the Energy Hybrid Accounts are compiled using estimates of physical energy supply and consumption data[[13]](#footnote-13) that are used primarily for Australia’s official energy reporting obligations to the International Energy Agency. These estimates are not fully compliant with the SNA and have to be adjusted accordingly. Physical energy consumption and corresponding expenditures are collected separately from businesses in the economy[[14]](#footnote-14) allowing the inclusion of non-market transactions. In the compilation of the I-O tables, supply and use of energy products is a subset of a broader model in which various components of the tables are reconciled with the National Accounts framework. The I-O tables are compiled from a broad range of sources, the primary source being current values as reported by business.[[15]](#footnote-15) Whilst utilising such a broad range of sources, compilers need to ensure standards of data reliability and consistency with National Accounts are met at aggregate levels. The Energy Hybrid Account and the I-O tables both adopt the principals of Australian and New Zealand Standard Industrial Classification (ANZSIC06). The Hybrid Account bases its classification on the Standard International Energy Product Classification (SIEC) while I-O tables are based on the I-O Product Classification (IOPC09), which generally concords directly to the SIEC. However, there are some minor exceptions where the IOPC includes some aspects of service income not directly attributable to the production or consumption of specific energy products. This may result in small differences between the Energy Hybrid Account and the I-O tables. A specific example relates to the definition of liquefied natural gas (LNG). It is not differentiated from natural gas in the SIEC, whereas in the I-O product classifications natural gas and LNG are treated as two separate products. Lastly, estimates of physical energy supply and consumption data are collected on an activity basis and compiled on a ‘partial activity basis’ which is not fully consistent with the SNA. As a result, the compilation of the Hybrid Account requires reallocation of physical use data from an activity basis to an industry basis. Where possible, the energy use within vertically integrated businesses is imputed to the supply and use data by using modelling techniques to overcome the lack of reported financial transactions.  |

# Conclusion

The ABS and Australian Treasury have worked to ensure high quality I-O data is used to produce well-informed analysis of policy issues. This is illustrated by the PRISMOD modelling. It combines information about the Australian Government’s CEFP carbon price policy with ABS I-O data on inter-linkages across the economy and household data from the HES and CPI, to calculate the effect of carbon pricing on industry and household prices throughout the economy. Quality gates ensure that the I-O tables are of good quality and the ABS continues to innovate to produce fit for purpose statistics for users.

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1. The SGLP report and update (Australian Government, 2011b and 2011c) provide a detailed description of the carbon price modelling of the Australian economy and present the results of the modelling. [↑](#footnote-ref-1)
2. Detailed information on Treasury’s PRISMOD can be found in Henry and Wright (1992). [↑](#footnote-ref-2)
3. STINMOD (Static Incomes Model) is the National Centre for Social and Economic Modelling’s (NATSEM) static micro simulation model of Australia's income tax and transfer system. The model is mostly used to analyse the distributional and individual impacts of income tax and income support policies and to estimate the fiscal and distributional impacts of policy reform. [↑](#footnote-ref-3)
4. Henry and Wright (1992) explains much of the algebra in greater detail. [↑](#footnote-ref-4)
5. The Australian Government has stated that it intends to apply an effective carbon price on fuel used by heavy on‑road transport from 2014‑15, though this was not part of the legislated Clean Energy Future package. [↑](#footnote-ref-5)
6. *Household Expenditure Survey* and *Survey of Income and Housing 2003-04*, Cat. No. 6540.0, Australian Bureau of Statistics, Canberra. [↑](#footnote-ref-6)
7. *Consumer Price Index*, Cat. No. 6401.0, Australian Bureau of Statistics, Canberra. [↑](#footnote-ref-7)
8. *Average Weekly Earnings*, Cat. No. 6302.0, Australian Bureau of Statistics, Canberra. [↑](#footnote-ref-8)
9. For each surveyed household, all wages, transfer payments, tax rates and thresholds are updated to derive a 2012-13 household disposable income. The ‘weights’ assigned to the survey households are then adjusted to reflect demographic changes. The household ‘weights’ then allow aggregation of the sample survey data to estimate impacts for the Australian population in 2012-13. [↑](#footnote-ref-9)
10. The IOPG 09 to HEC 2009-10 concordance table is available on the ABS web site with a number of caveats relating to coverage differences between HFCE data in the I-O tables and HES data. [↑](#footnote-ref-10)
11. The CPI subgroup classification broadly aligns with the international standard Classification of Individual Consumption by Purpose*.* More information can be found in *Information Paper: Introduction of the 15th Series Australian Consumer Price Index Australia September 2009* (catalogue number 6470.0). [↑](#footnote-ref-11)
12. <http://www.treasury.gov.au/contentitem.asp?NavId=035&ContentID=2118> [↑](#footnote-ref-12)
13. *Australian Energy Statistics* (AES) produced by the Bureau of Resource and Energy Economics (BREE). [↑](#footnote-ref-13)
14. ABS *Energy, Water and Environment Management Survey* (EWES). [↑](#footnote-ref-14)
15. ABS Annual Integrated Collection (*Economic Activity Survey*). [↑](#footnote-ref-15)