Australian Bureau of Statistics

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ENERGY ACCOUNT

AUSTRALIA

EMBARGO: 11.30AM (CANBERRA TIME) THURS 25 JUN 2009

CONTENTS

INQUIRIES

For further information about these and related statistics, contact the National Information and Referral Service on 1300 135 070 or Andrew Cadogan-Cowper on Canberra (02) 6252 7472.

NOTES

ABOUT THIS PUBLICATION

This publication represents the third edition of the ABS *Energy Account*, and responds to ongoing demand for information about energy products within Australia's economy. In particular, it contains estimates of the physical supply and use of energy products in Australia over the period 2001–02 to 2006–07, and introduces experimental monetary use estimates in respect of 2004–05.

It also provides a time series of energy intensity measures for selected Australian industries. Finally, it includes energy resource stock estimates for the calendar years 2002 to 2007 in both physical and monetary terms.

The outputs contained in this publication follow the general principles outlined within the *Handbook of National Accounting: Integrated Environmental and Economic Accounting (SEEA)* - a satellite system of the *International System of National Accounts 1993 (SNA)*. They serve to integrate environmental and economic data in order to overcome the tendency to analyse economic and environmental issues independently of each other.

Suggestions or comments on this publication would be appreciated and should be sent to the Director, Environmental Accounts and Water, Australian Bureau of Statistics, Locked Bag 10, Belconnen, ACT 2616.

Brian Pink
Australian Statistician

ABBREVIATIONS

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACS	Australian Customs Service
AGO	Australian Greenhouse Office
ANZSIC	Australian and New Zealand Standard Industrial Classification
ASNA	Australian System of National Accounts
ATO	Australian Taxation Office
DITR	Australian Government Department of Industry, Tourism and Resources
EAS	Economic Activity Survey
EDR	economic demonstrated resources
GDP	gross domestic product
GJ	gigajoule
HES	Household Expenditure Survey
HFCE	household final consumption expenditure
IEA	International Energy Agency
IFR	inferred resources
IGVA	industry gross value added
LNG	liquefied natural gas
LPG	liquefied petroleum gas
NPV	net present value
NRMA	National Road and Motorists Association
OVC	other volume change
PC	Productivity Commission
PJ	petajoule
QDME	Queensland Department of Mines and Energy
RACQ	Royal Automobile Club of Queensland
SDR	sub-economic demonstrated resources
SEEA	System of Integrated Environmental and Economic Accounting
SEEA-E	System of Integrated Environmental and Economic Accounting - Energy
SMVU	ABS Survey of Motor Vehicle Use
SNA	System of National Accounts
SNA93	System of National Accounts 1993
UN	United Nations

INTRODUCTION

There has been considerable interest in recent years, both in Australia and internationally, in the supply and use of energy products such as oil, gas, coal, uranium and electricity. Energy products are of vital importance and interest to policy makers in both the economic and environmental spheres. Energy is used either directly or indirectly in virtually all economic production and it is therefore a key factor in determining levels of economic production and the price of produced output.

In recent years, global demand for energy products has been rising strongly, at least partly driven by the strong growth in energy use within the emerging economies in our region and elsewhere. Increases in energy prices over the past few years have caused concern for many economies, while energy security is an increasing concern for many countries.

Energy use gives rise to a range of environmental concerns, including those related to the emission of greenhouse gases and other pollutants. As is the case in many other countries, most energy consumed in Australia is derived from non-renewable energy products, which raises questions about the sustainability of current production methods. Thus, there is increasing concern related to energy products from both economic and environmental perspectives and there is a clear need for consolidated statistics on energy in order to better monitor and respond to changes in monetary and physical supply and demand for energy within Australia.

The outputs contained in this publication fall under the heading of integrated environmental and economic accounts and follow general principles outlined within the *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003* (SEEA)— a satellite system of the *International System of National Accounts 1993* (SNA93). Satellite accounts, as articulated in the SNA93, allow for an expansion of the national accounts for selected areas of interest while maintaining links to the basic concepts and structures of the core national accounts. Integrated environmental and economic accounts have an important feature distinguishing them from other information systems related to energy and the environment. The integrated accounts are able to directly link data on natural resources, environment, energy and emissions, to the economic accounts through a shared structure, set of definitions and classifications. This serves to integrate environmental-economic analyses and to overcome the tendency to divide issues along disciplinary lines, in which analyses of economic, energy and environmental issues are carried out independently of each other.

Satellite accounts typically use a set of recommended classifications and frameworks developed from international research and discussion over a number of years, with international agencies usually taking the lead. The United Nations Statistical Division is in the process of coordinating an energy-specific module of SEEA, called SEEA-Energy (or SEEA-E). Consequently, guidelines for producing an energy account are continuing to develop; and work in this publication has proceeded without comprehensive guidance from international standards or guidelines. Appendix 1 describes the range of products in scope of this energy account, and the industry and product classifications used.

This publication utilises a number of data sources, both ABS and non-ABS. Data on the physical supply and use of energy products are derived from table A1 of the Australian Bureau of Agricultural and Resource Economics' (ABARE) *Australian Energy Statistics*. Geoscience Australia has provided information on physical stocks of energy assets. The

INTRODUCTION *continued*

Australian System of National Accounts (ASNA), including Input Output tables, is the principal source of economic information. A range of other ABS data have been used including: the business Economic Activity Survey (EAS); the Household Expenditure Survey (HES); the Survey of Motor Vehicle Use (SMVU); and the Balance of Payments and International Trade systems. A fuller description of data sources used in this publication is contained in Appendix 2.

The fundamental compilation framework for the energy account is the national accounts 'supply and use' system, which, in this case, has been adapted to focus on energy products. This framework allows various data to be brought together and integrated for the entire economy. In essence, the system consists of a table of supply estimates, representing the supply of energy products from imports and from Australian producers, and a use table that shows the use of those products by industries, households, government and for export. It aims to be comprehensive in its coverage, and as noted above, a range of statistical data sources are used to populate the supply and use tables.

In order to satisfy the identity that supply and use of products must be equal, discrepancies due to deficiencies in the source data must be identified and resolved. A great strength of this framework is that it facilitates this confrontation process and provides a basis for optimising the quality of the overall estimates in the face of data deficiencies and gaps in data coverage. Appendix 3 provides a more complete description of the frameworks and concepts used in producing the energy account.

The supply and use framework can be used to develop greater coherence in monetary measures of energy supply and use. It can similarly be used for corresponding physical measures. However, by juxtaposing monetary and physical measures of supply and use of energy products, a further degree of data confrontation is created, potentially leading to greater levels of data coherence. This desire to establish coherence between economic (monetary) and environmental (physical) data has required efforts to further integrate existing monetary and physical measures of supply and use of energy products. Note, that in order to ensure comparability with monetary data, the physical supply and use tables in this publication have been developed under a gross basis. See Appendix 3 for further discussion on gross energy flow accounts.

In this publication considerable effort has been devoted to reconfiguring data from ABARE's *Australian Energy Statistics* to ensure use of consistent classifications, concepts and scope between these data and data from the ASNA and other economic collections. The type of adjustments made to data contained in *Australian Energy Statistics* include: attributing unallocated energy conversions to energy products and using industries, as appropriate, to create a full picture of gross supply and use of energy products in Australia; developing a fuller articulation of service industries using various energy products; and converting certain data on industry use from an 'activity' basis to an industry of ownership basis, consistent with classification principles outlined in the *Australian and New Zealand Standard Industrial Classification* (ANZSIC). Appendix 4 describes the range of methodological issues addressed in producing this publication.

As noted earlier, this publication derives estimates of physical supply and use of energy products from the energy balances in table A1 of ABARE's *Australian Energy Statistics*. Unlike other tables within *Australian Energy Statistics*, table A1 is only presented for the latest year. While table A1 does not constitute a consistent time series, it provides

INTRODUCTION *continued*

information on conversions that is critical in compiling physical supply and use tables that are capable of being confronted with monetary data (refer to 'gross'/'net' discussion in Appendix 3 for further information). Therefore, estimates based on table A1 will not necessarily remain completely consistent with estimates based on other tables from *Australian Energy Statistics* which have also been used in this publication (notably table F: Australian energy consumption by industry and fuel type, used in the energy intensity chapter).

This edition of *Energy Account, Australia* introduces experimental monetary estimates of use of various energy products, alongside the corresponding estimates of physical use. Monetary data in this publication are produced in respect of 2004–05, while physical estimates relate to the period 2001–02 to 2006–07. The full analytical utility of monetary data is realised when a time series is achieved. These estimates provide a sample of the type of integrated environmental-economic information achievable from available data.

The economic value of energy products is already included in the ASNA in key economic aggregates such as Gross Domestic Product (GDP), industry gross value added (IGVA) and household final consumption expenditure (HFCE). However, the classifications and data sources used in the national accounts are generally not designed to systematically isolate energy products, or the industries that produce or distribute these products. Similarly, the national accounts do not systematically isolate the use of energy products by industries, government and households, although some important aggregates such as household final expenditure on electricity, gas and other fuels are already available.

Monetary data contained in this publication are largely coherent with the corresponding series published in ABS Input-Output tables (cat. no. 5209.0.55.001). However, in some instances, estimates differ between the two publications. Monetary data contained in this publication are considered experimental and data contained in the Input-Output tables remain the official estimates.

Data contained in this publication have utilised different estimation methodologies to those used in the ABS Input-Output tables. In particular, this publication has taken a closer consideration of relevant physical use of energy products by industries and by households.

Within the ABS, environmental-economic accountants are continuing to work closely with national accountants to improve estimates in both systems. In this respect, the upcoming ABS Energy, Water and Environment Survey, to be conducted in respect of 2008–09, is expected to deliver a rich vein of information to carry these initial investigations forward. It is anticipated that surveys of this type will in future deliver improved and consistent estimates within the energy account and the ASNA for these important data series.

MAIN FINDINGS

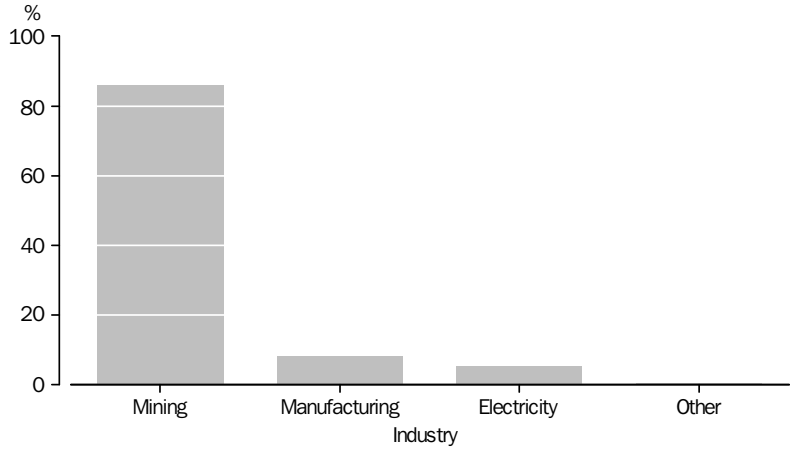
Australian energy supply

In 2006–07, Australia's total supply of energy products was 21,359 PJ, a 15% increase from 2001–02 (18,536 PJ). The largest contributors to this increase were black coal (7,282 PJ to 8,650 PJ, or 19%), uranium concentrates (3,782 PJ to 4,509 PJ, or 19%), natural gas (1,394 PJ to 2,007 PJ, or 44%) and refined products (1,618 PJ to 1,923 PJ, or 19%). While the supply of most energy products increased over this period, there was a decline of 14% in the supply of crude oil (from 2,393 PJ to 2,050 PJ) and 10% for hydro electricity (from 58 PJ to 52 PJ).

There was an increase in the supply of refined products despite a decline in Australian production, and this was driven by increased imports (from 150 PJ in 2001–02 to 642 PJ in 2006–07).

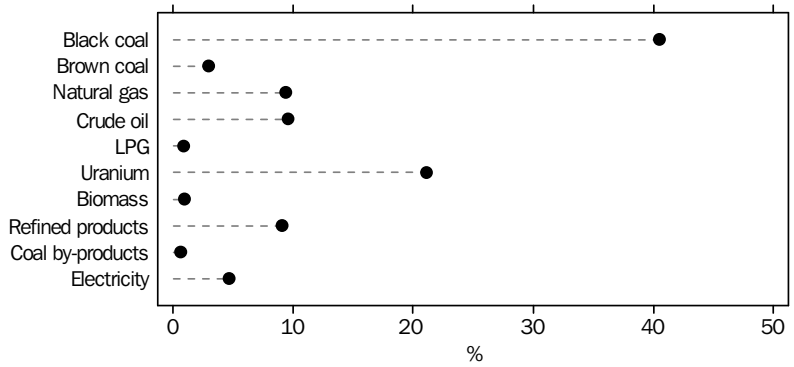
The mining industry dominates energy supply in Australia (86% of total supply), followed by manufacturing (8%) and the electricity supply industry (5%) (see graph 1.1).

1.1 PHYSICAL ENERGY SUPPLY, By industry, 2006–07



Coal comprised 44% of energy supply in 2006–07 with uranium contributing a further 21%. Other important contributors were refined products and LPG (combined) which comprised 10%, crude oil (10%) and natural gas (9%) (see graph 1.2).

1.2 DISTRIBUTION OF ENERGY SUPPLY, By type of energy, 2006–07



Notes: 'Biomass' includes biomass wood and bagasse.
'Refined products' include petrol, diesel, aviation fuel, liquid gas biofuel etc..
'Coal by-products' include metallurgical coke.

Australian energy supply continued

For all years between 2001–02 and 2006–07 over half of Australia's supply of energy products was exported. In 2006–07, out of a total 21,359 PJ of Australian energy supply, 13,055 PJ (or 61%) was exported.

Australian energy use

In 2006–07 domestic energy users consumed 8,308 PJ of energy products. The largest domestic users of energy products were: manufacturing (36%); electricity supply (31%); households (12%); transport (6%) and mining (5%).

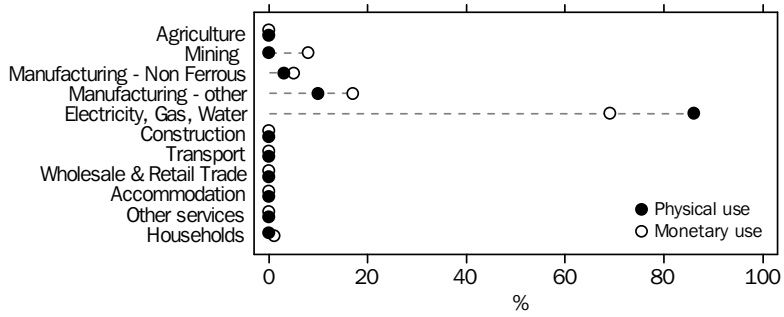
In Manufacturing, around half of energy use is the input of crude oil and other refinery feedstock to produce refined energy products (1,516 PJ out of the 2,990 PJ in 2006–07). Coal products made up 78% of energy products used by electricity producers in 2006–07. Household use of energy in 2006–07 was dominated by refined products (57%), while electricity (23%) and natural gas (13%) were also important.

Hybrid energy use

Hybrid energy use tables juxtapose monetary and physical measures, allowing direct comparison of these measures and, therefore, provide an indicator of relative implied prices paid by different energy users for various energy products. For domestic users of coal, crude oil and natural gas, refined products and electricity, graphs 1.3 to 1.6 show the distribution of energy use by key industries and households in both monetary and physical terms. Note that the monetary estimates presented here are considered experimental.

In most instances, proportional physical consumption of energy and the associated monetary expenditure are very closely related, indicating relatively uniform prices paid by consumers (whether industries or households). There are some exceptions to this, with some large industries paying lower unit prices than smaller industries or households. Examples include, coal used by the electricity industry (graph 1.3) and electricity used by non-ferrous metal manufacturers (graph 1.6). Reasons for these differences are discussed in Chapter 3.

1.3 DISTRIBUTION OF COAL USE (a), Monetary & physical, 2004–05

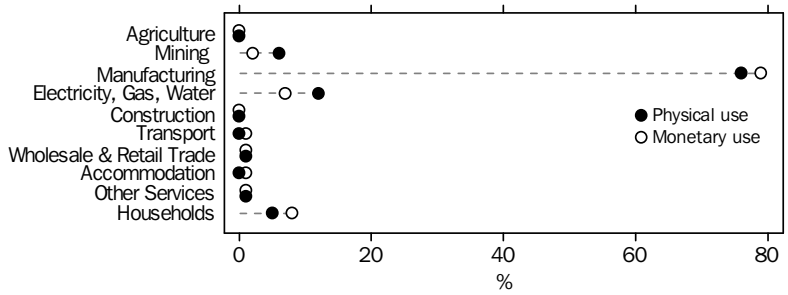


(a) 'Coal' includes black coal, brown coal and briquettes.

Notes: 1. 'Accommodation' includes Accommodation, Cafes & Restaurants.
2. 'Other Services' include Communication Services, Finance & Insurance, Property & Business Services, Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services.

Hybrid energy use continued

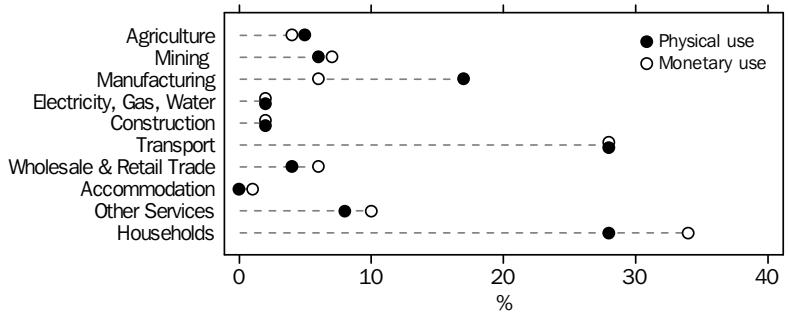
1.4 DISTRIBUTION OF OIL AND GAS USE(a), Monetary & physical, 2004–05



(a) 'Oil and gas' include natural gas and crude oil.

Notes: 1. 'Accommodation' includes Accommodation, Cafes & Restaurants.
2. 'Other Services' include Communication Services, Finance & Insurance, Property & Business Services, Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services.

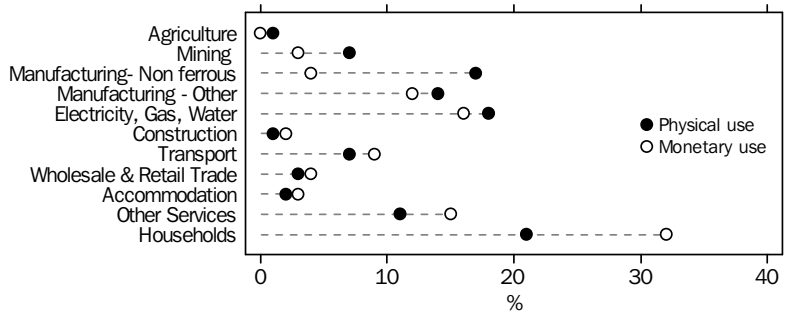
1.5 DISTRIBUTION OF PETROLEUM AND COAL PRODUCTS USE(a), Monetary & physical, 2004–05



(a) 'Petroleum and Coal Products' include propane, butane, LPG, refined petroleum products, coke.

Notes: 1. 'Accommodation' includes Accommodation, Cafes & Restaurants.
2. 'Other Services' include Communication Services, Finance & Insurance, Property & Business Services, Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services.

1.6 DISTRIBUTION OF ELECTRICITY USE(a), Monetary & physical use, 2004–05



(a) 'Electricity' includes solar, wind, hydro, solar hot water and other electricity.

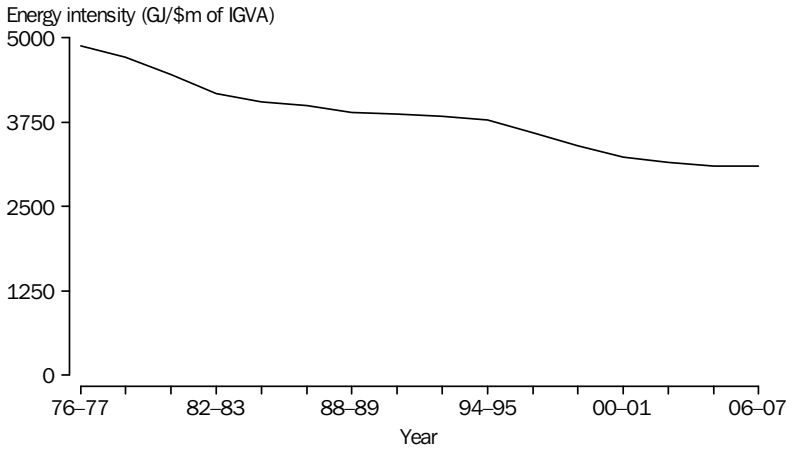
Notes: 1. 'Accommodation' includes Accommodation, Cafes & Restaurants.
2. 'Other Services' include Communication Services, Finance & Insurance, Property & Business Services, Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services.

Energy Intensity

In this publication, energy intensity refers to the relationship between energy use and economic activity. Common measures of energy supply (consumption) versus economic activity include Total Primary Energy Supply per unit of GDP (TPES/GDP) or Total Final Energy Consumption per unit of GDP (TFC/GDP). Population based ratios are expressed in terms of energy supply (consumption) per capita, for example TPES/capita or TFC/capita.

In this publication, energy intensity for major industries has been calculated and expressed in gigajoules of energy consumed per million dollars of Industry Gross Value Added (GJ/$m IGVA), where IGVA is expressed in chain volume measures with reference year 2006–07. Australia's energy intensity fell 36% over the 30 years from 1976–77 to 2006–07, from 4,880 to 3,100 GJ/$m IGVA (see graph 1.7).

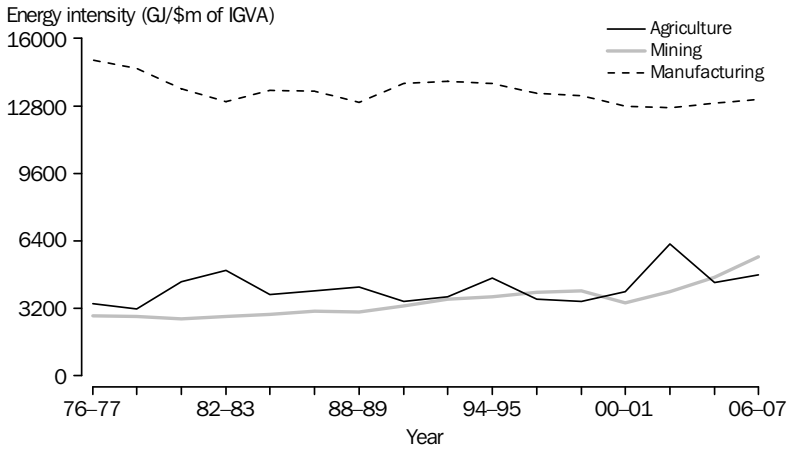
1.7 ENERGY INTENSITY, All industries, 1976–77 to 2006–07



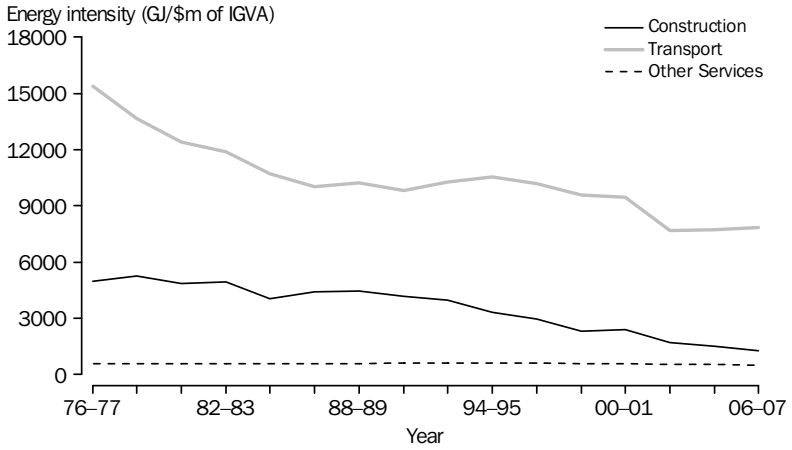
Energy intensity levels and trends vary considerably across the major industries. Graphs 1.8 and 1.9 show the energy intensity for the major industry divisions over the last three decades. Graph 1.8 shows Agriculture, Mining, and Manufacturing and graph 1.9 shows Construction, Transport, and Other Services. Energy intensity is greatest for Manufacturing and Transport while Other Services is very low. Whilst most industries' energy intensity levels fell over the 30 year period, Mining and Agriculture increased. Transport and Construction experienced large reductions in energy intensity (49% and 74%, respectively), while Other Services fell only 13%. Other Services includes the following industries: Wholesale Trade; Retail Trade; Accommodation, Cafes and Restaurants; Communication Services; Finance and Insurance; Property and Business Services; Government Administration and Defence; Education; Health and Community Services; Cultural and Recreational Services; and Personal and Other Services.

Energy Intensity continued

1.8 ENERGY INTENSITY, Agriculture, Mining & Manufacturing, 1976–77 to 2006–07



1.9 ENERGY INTENSITY, Construction, Transport & Other Services, 1976–77 to 2006–07

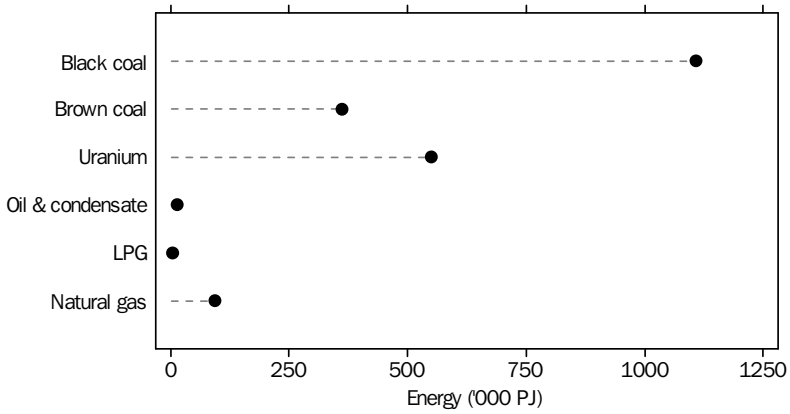


Energy Stocks

Stock data on available mineral resources are derived from the publication *Australia's Identified Mineral Resources*, while oil and gas resources are derived from *Oil and Gas Resources, Australia*, both of which are produced by Geoscience Australia. Economic demonstrated resources (EDR) are those resources that are established, analytically demonstrated, or assumed with reasonable certainty, to be profitable for extraction under defined investment assumptions. As at December 2007, Australia's EDR of energy was dominated by black coal (52%), uranium (26%) and brown coal (17%). In comparison, Australia's oil and condensate resources are relatively small (1% of total EDR) (see graph 1.10). Over the period 2002 to 2007, Australia's EDR of energy resources increased from 2,007,115 PJ to 2,134,401 PJ. This change reflects a rise in uranium reserves due to geological reassessments and economic reclassifications of previously sub-economic reserves. EDR of all other categories of energy reserves fell during this period.

Energy Stocks continued

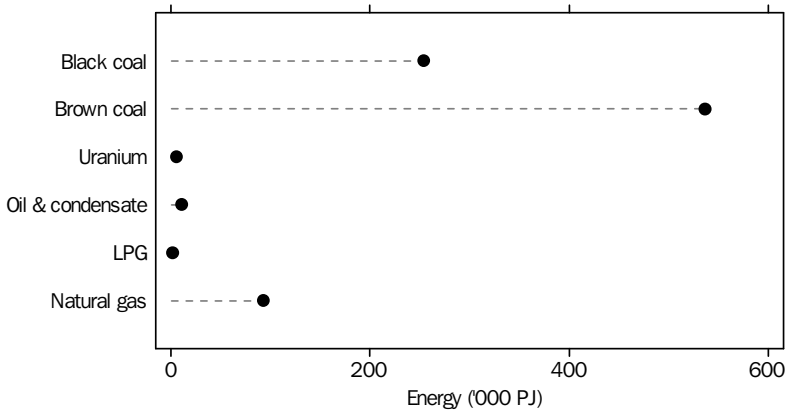
1.10 ECONOMIC DEMONSTRATED ENERGY RESOURCES—as at 31 December 2007



Source: Geoscience Australia

Subeconomic demonstrated resources (SDR) are similar to EDR in terms of certainty of occurrence but are not considered to be economic at present. In Australia, SDR of energy resources is dominated by coal, in particular brown coal (60% of all SDR in 2007) (see graph 1.11). Total Australian SDR of energy resources decreased from 1,027,683 PJ in 2002 to 900,943 PJ in 2007. This fall is mainly attributable to a fall in black coal SDR (from 396,150 PJ in 2002 to 253,650 PJ in 2007), though a sharp decline in SDR of uranium (from 25,760 PJ in 2002 to 5,600 PJ in 2007) was also significant. SDR of natural gas increased from 60,720 PJ in 2002 to 92,560 PJ in 2007.

1.11 SUBECONOMIC DEMONSTRATED ENERGY RESOURCES—as at 31 December 2007



Source: Geoscience Australia

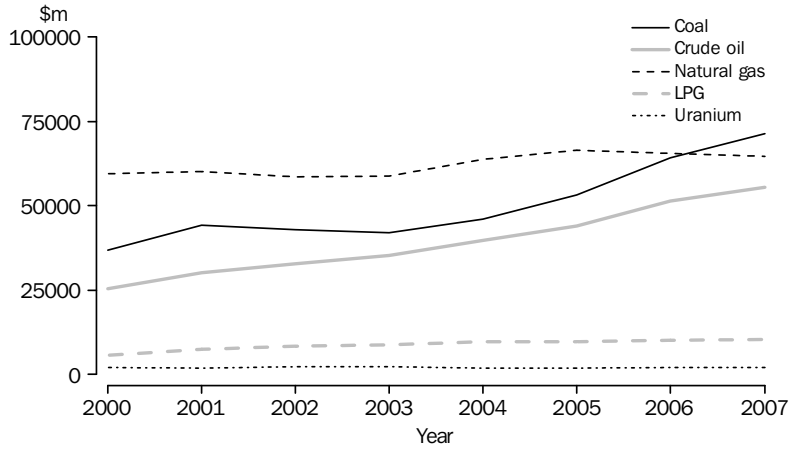
The ABS includes estimates of the monetary value of economic demonstrated energy assets in the balance sheet of the *Australian National Accounts* (cat. no. 5204.0). Australia's energy assets were valued at $204.2 billion at 30 June 2007; or 2.7% of the value of all assets on the national balance sheet. At 30 June 2007 the energy assets of highest monetary value were: black coal ($70.7 billion); natural gas ($64.7 billion); and crude oil and condensate ($55.5 billion; see graph 1.12). Crude oil and condensate, though making up just over 1% of Australia's economically demonstrated physical

Energy Stocks continued

reserves of energy assets, amount to 27% of the monetary value of energy assets in 2007. This reflects both the higher price of crude oil and condensate per unit of contained energy (especially in comparison to coal) and the shorter expected asset life of crude oil and condensate reserves. Shorter expected asset lives tend to raise derived net present values (NPVs) in comparison to assets with lengthy expected extraction lives.

The value of energy assets rose 57% over the period 2000 to 2007 (from $129.7 billion to $204.2 billion) which coincides with increases in energy prices. Graph 1.12 shows that the energy assets contributing most to the rise in values were: black coal (from $36.3 billion to $70.7 billion); and crude oil and condensate (from $25.4 billion to $55.5 billion).

1.12 NET PRESENT VALUE OF ENERGY ASSETS—as at 30 June



AUSTRALIA'S SUPPLY OF ENERGY

Over the period 2001–02 to 2006–07, Australia's total energy supply grew by 2,823 PJ (from 18,536 PJ to 21,359 PJ) or 15%. Tables 2.1 and 2.2 record details for supply and production of primary and secondary energy by product, industry and components of supply.

Black coal production remained the largest contributor to Australia's energy supply, growing from 7,282 PJ in 2001–02 to 8,650 PJ in 2006–07, an increase of 19%. Natural gas also experienced strong growth over the period, with production rising by 399 PJ or 29%.

Uranium production peaked in 2004–05 at 5,207 PJ, constituting nearly a third of total primary energy supply at that time, before contracting 698 PJ or 13% by 2006–07.

Australia's crude oil production fell by 271 PJ (from 1,336 PJ to 1,065 PJ) or 20% over the period between 2001–02 and 2006–07. Crude oil imports were also down 7% over the period (from 1,057 PJ to 985 PJ). This reduction in primary supply of petroleum was compensated by a 492 PJ (328%) increase in refined products imports over the period. Imports therefore constituted 33% of Australia's supply of refined products in 2006–07.

Electricity production grew steadily over the period between 2001–02 and 2006–07, with an overall increase of 131 PJ (from 868 PJ to 999 PJ) or 15%.

The supply of a number of renewable energy products experienced growth between 2001–02 and 2006–07. In particular, production of biomass wood and bagasse grew by 10%, while production of liquid gas biofuels increased by 30% over the period, but from a low base. Conversely, hydro electricity production fell by 10% over the period (from 58 PJ to 52 PJ), reflecting drought conditions during this time (between 2001–02 and 2006–07).

While production of solar energy increased from 3 PJ to 28 PJ between 2000–01 and 2006–07, the largest increase was from 9 PJ in 2005–06 to 28 PJ in 2006–07. Also, from 2004–05 solar photovoltaic and wind power were included in this measurement. Prior to that time, the data on solar represents solar hot water only.

2.1 AUSTRALIAN ENERGY SUPPLY, by components of supply—2001–02 to 2006–07

	2001–02	*2002–03*	*2003–04*	*2004–05*	*2005–06*	*2006–07*
	PJ	PJ	PJ	PJ	PJ	PJ
AUSTRALIAN PRODUCTION						
Primary						
Black coal	7 282	7 331	7 615	8 074	8 194	8 650
Brown coal(a)	670	654	659	668	706	644
Natural gas	1 394	1 449	1 473	1 622	1 672	1 793
Crude oil	1 336	1 233	1 031	1 049	915	1 065
Propane, LPG etc.	171	167	150	157	154	164
Uranium	3 782	4 399	4 529	5 207	4 666	4 509
Biomass wood & bagasse	187	194	194	200	191	205
Solar(b)	3	3	3	6	9	28
Total primary	*14 825*	*15 430*	*15 654*	*16 983*	*16 507*	*17 058*
Secondary						
Refined products	1 468	1 427	1 304	1 366	1 208	1 281
Liquid gas biofuel	10	11	11	10	12	13
Coal by-products incl. metallurgical coke	143	146	156	141	135	148
Electricity						
Hydro	*58*	*59*	*58*	*56*	*58*	*52*
Other	*810*	*837*	*861*	*906*	*915*	*947*
Total electricity	868	896	919	962	973	999
Total secondary	*2 489*	*2 480*	*2 390*	*2 479*	*2 328*	*2 441*
Total production	**17 314**	**17 910**	**18 044**	**19 462**	**18 835**	**19 499**
IMPORTS						
Primary						
Black coal	—	—	—	—	—	—
Brown coal(a)	—	—	—	—	—	—
Natural gas	—	—	—	—	52	214
Crude oil	1 057	1 082	909	1 042	977	985
Propane, LPG etc.	15	8	20	14	15	19
Uranium	—	—	—	—	—	—
Biomass wood & bagasse	—	—	—	—	—	—
Solar(b)	—	—	—	—	—	—
Total primary	*1 072*	*1 090*	*929*	*1 056*	*1 044*	*1 218*
Secondary						
Refined products	150	192	361	409	554	642
Liquid gas biofuel	—	—	—	—	—	—
Coal by-products incl. metallurgical coke	—	—	—	—	—	—
Electricity						
Hydro	—	—	—	—	—	—
Other	—	—	—	—	—	—
Total electricity	—	—	—	—	—	—
Total secondary	*150*	*192*	*361*	*409*	*554*	*642*
Total imports	**1 222**	**1 282**	**1 290**	**1 465**	**1 598**	**1 860**

— nil or rounded to zero (including null cells)

(a) Includes briquettes

(b) Includes solar and wind energy from 2004–05 onwards

2.1 AUSTRALIAN ENERGY SUPPLY, by components of supply—2001–02 to 2006–07 *continued*

	2001–02	*2002–03*	*2003–04*	*2004–05*	*2005–06*	*2006–07*
	PJ	PJ	PJ	PJ	PJ	PJ
	TOTAL SUPPLY					
Primary						
Black coal	7 282	7 331	7 615	8 074	8 194	8 650
Brown coal(a)	670	654	659	668	706	644
Natural gas	1 394	1 449	1 473	1 622	1 724	2 007
Crude oil	2 393	2 315	1 940	2 091	1 892	2 050
Propane, LPG etc.	186	175	170	171	169	183
Uranium	3 782	4 399	4 529	5 207	4 666	4 509
Biomass wood & bagasse	187	194	194	200	191	205
Solar(b)	3	3	3	6	9	28
Total primary	*15 897*	*16 520*	*16 583*	*18 039*	*17 551*	*18 276*
Secondary						
Refined products	1 618	1 619	1 665	1 775	1 762	1 923
Liquid gas biofuel	10	11	11	10	12	13
Coal by-products incl. metallurgical coke	143	146	156	141	135	148
Electricity						
Hydro	*58*	*59*	*58*	*56*	*58*	*52*
Other	*810*	*837*	*861*	*906*	*915*	*947*
Total electricity	868	896	919	962	973	999
Total secondary	*2 639*	*2 672*	*2 751*	*2 888*	*2 882*	*3 083*
Total energy supply(c)	**18 536**	**19 192**	**19 334**	**20 927**	**20 433**	**21 359**

(a) Includes briquettes

(b) Includes solar and wind energy from 2004–05 onwards

(c) These figures differ slightly from total energy use (table 2.3) due to rounding.

AUSTRALIA'S SUPPLY OF ENERGY *continued*

Table 2.2 shows Mining accounting for almost all of Australia's primary energy production (16,771 PJ or 98% in 2006–07). Most of the remainder comes from Manufacturing (184 PJ or 1.1%). Household's contribution to primary energy production was 0.2% in 2000–07, most of which was from biomass wood (31 PJ). However, Household solar energy production (solar hot water and photovoltaics) doubled in 2006–07 (from 3 PJ to 6 PJ) as a result of growing community concern over greenhouse gas emissions and State and Federal Government green energy incentives.

Secondary production is dominated by Manufacturing (59% in 2006–07), mostly from Chemical Manufacturing (refined petroleum products) and some contribution from Iron and Steel Manufacturing (coal by-products). The Electricity industry accounts for the remaining 41% of secondary energy production.

2.2 AUSTRALIAN ENERGY PRODUCTION, by energy product—2001–02 to 2006–07

			MANUFACTURING						
	Agriculture	*Mining*	*Food*(a)	*Wood*(b)	*Chem.*(c)	*Iron*(d)	*Electricity*	*Households*	*Total*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
2006–07									
Primary									
Black coal	—	8 650	—	—	—	—	—	—	8 650
Brown coal(e)	—	642	—	—	2	—	—	—	644
Natural gas	—	1 793	—	—	—	—	—	—	1 793
Crude oil	—	1 056	—	—	9	—	—	—	1 065
Propane, LPG etc.	—	121	—	—	43	—	—	—	164
Uranium	—	4 509	—	—	—	—	—	—	4 509
Biomass wood(f)	44	—	111	19	—	—	—	31	205
Solar(g)	—	—	—	—	—	—	22	6	28
Total primary	*44*	*16 771*	*111*	*19*	*54*	—	*22*	*37*	*17 058*
Secondary									
Refined products	—	—	—	—	1 281	—	—	—	1 281
Liquid gas biofuel	—	—	—	—	13	—	—	—	13
Coal by-products(h)	—	—	—	—	—	148	—	—	148
Electricity									
Hydro	—	—	—	—	—	—	*52*	—	*52*
Other	—	—	—	—	—	—	*947*	—	*947*
Total electricity	—	—	—	—	—	—	999	—	999
Total secondary	—	—	—	—	*1 294*	*148*	*999*	—	*2 441*
Total energy production	**44**	**16 771**	**111**	**19**	**1 348**	**148**	**1 021**	**37**	**19 499**
2005–06									
Primary									
Black coal	—	8 194	—	—	—	—	—	—	8 194
Brown coal(e)	—	697	—	—	9	—	—	—	706
Natural gas	—	1 672	—	—	—	—	—	—	1 672
Crude oil	—	900	—	—	15	—	—	—	915
Propane, LPG etc.	—	125	—	—	29	—	—	—	154
Uranium	—	4 666	—	—	—	—	—	—	4 666
Biomass wood(f)	39	—	109	17	—	—	—	26	191
Solar(g)	—	—	—	—	—	—	6	3	9
Total primary	*39*	*16 254*	*109*	*17*	*53*	—	*6*	*29*	*16 507*
Secondary									
Refined products	—	—	—	—	1 208	—	—	—	1 208
Liquid gas biofuel	—	—	—	—	12	—	—	—	12
Coal by-products(h)	—	—	—	—	—	135	—	—	135
Electricity									
Hydro	—	—	—	—	—	—	*58*	—	*58*
Other	—	—	—	—	—	—	*915*	—	*915*
Total electricity	—	—	—	—	—	—	973	—	973
Total secondary	—	—	—	—	*1 220*	*135*	*973*	—	*2 328*
Total energy production	**39**	**16 254**	**109**	**17**	**1 273**	**135**	**979**	**29**	**18 835**

— nil or rounded to zero (including null cells)
(a) Includes food, beverages and textiles
(b) Includes wood, paper and printing
(c) Chemicals
(d) Includes iron and steel
(e) Includes briquettes
(f) Includes biomass wood and bagasse
(g) Includes solar and wind energy from 2004–05 onwards
(h) Includes coal by-products and metallurgical coke

2.2 AUSTRALIAN ENERGY PRODUCTION, by energy product—2001–02 to 2006–07 *continued*

			MANUFACTURING						
	Agriculture	*Mining*	*Food*(a)	*Wood*(b)	*Chem.*(c)	*Iron*(d)	*Electricity*	*Households*	*Total*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
2004–05									
Primary									
Black coal	—	8 074	—	—	—	—	—	—	8 074
Brown coal(e)	—	658	—	—	10	—	—	—	668
Natural gas	—	1 622	—	—	—	—	—	—	1 622
Crude oil	—	1 039	—	—	10	—	—	—	1 049
Propane, LPG etc.	—	122	—	—	35	—	—	—	157
Uranium	—	5 207	—	—	—	—	—	—	5 207
Biomass wood(f)	44	—	108	18	—	—	—	30	200
Solar(g)	—	—	—	—	—	—	3	3	6
Total primary	*44*	*16 722*	*108*	*18*	*55*	—	*3*	*33*	*16 983*
Secondary									
Refined products	—	—	—	—	1 366	—	—	—	1 366
Liquid gas biofuel	—	—	—	—	10	—	—	—	10
Coal by-products(h)	—	—	—	—	—	141	—	—	141
Electricity									
Hydro	—	—	—	—	—	—	*56*	—	*56*
Other	—	—	—	—	—	—	*906*	—	*906*
Total electricity	—	—	—	—	—	—	962	—	962
Total secondary	—	—	—	—	*1 376*	*141*	*962*	—	*2 479*
Total energy production	**44**	**16 722**	**108**	**18**	**1 431**	**141**	**965**	**33**	**19 462**
2003–04									
Primary									
Black coal	—	7 615	—	—	—	—	—	—	7 615
Brown coal(e)	—	659	—	—	—	—	—	—	659
Natural gas	—	1 468	—	—	—	5	—	—	1 473
Crude oil	—	1 031	—	—	—	—	—	—	1 031
Propane, LPG etc.	—	123	—	—	27	—	—	—	150
Uranium	—	4 529	—	—	—	—	—	—	4 529
Biomass wood(f)	45	—	98	18	—	—	—	33	194
Solar(g)	—	—	—	—	—	—	—	3	3
Total primary	*45*	*15 425*	*98*	*18*	*27*	*5*	—	*36*	*15 654*
Secondary									
Refined products	—	—	—	—	1 304	—	—	—	1 304
Liquid gas biofuel	—	—	—	—	11	—	—	—	11
Coal by-products(h)	—	—	—	—	—	156	—	—	156
Electricity									
Hydro	—	—	—	—	—	—	*58*	—	*58*
Other	—	—	—	—	—	—	*861*	—	*861*
Total electricity	—	—	—	—	—	—	919	—	919
Total secondary	—	—	—	—	*1 315*	*156*	*919*	—	*2 390*
Total energy production	**45**	**15 425**	**98**	**18**	**1 342**	**161**	**919**	**36**	**18 044**

— nil or rounded to zero (including null cells)
(a) Includes food, beverages and textiles
(b) Includes wood, paper and printing
(c) Chemicals
(d) Includes iron and steel
(e) Includes briquettes
(f) Includes biomass wood and bagasse
(g) Includes solar and wind energy from 2004–05 onwards
(h) Includes coal by-products and metallurgical coke

2.2 AUSTRALIAN ENERGY PRODUCTION, by energy product—2001–02 to 2006–07 *continued*

			MANUFACTURING						
	Agriculture	*Mining*	*Food*(a)	*Wood*(b)	*Chem.*(c)	*Iron*(d)	*Electricity*	*Households*	*Total*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
2002–03									
Primary									
Black coal	—	7 331	—	—	—	—	—	—	7 331
Brown coal(e)	—	654	—	—	—	—	—	—	654
Natural gas	—	1 444	—	—	5	—	—	—	1 449
Crude oil	—	1 233	—	—	—	—	—	—	1 233
Propane, LPG etc.	—	124	—	—	43	—	—	—	167
Uranium	—	4 399	—	—	—	—	—	—	4 399
Biomass wood(f)	45	—	96	18	—	—	—	35	194
Solar(g)	—	—	—	—	—	—	—	3	3
Total primary	*45*	*15 185*	*96*	*18*	*48*	—	—	*38*	*15 430*
Secondary									
Refined products	—	—	—	—	1 427	—	—	—	1 427
Liquid gas biofuel	—	—	—	—	11	—	—	—	11
Coal by-products(h)	—	—	—	—	—	146	—	—	146
Electricity									
Hydro	—	—	—	—	—	—	*59*	—	*59*
Other	—	—	—	—	—	—	*837*	—	*837*
Total electricity	—	—	—	—	—	—	896	—	896
Total secondary	—	—	—	—	*1 438*	*146*	*896*	—	*2 480*
Total energy production	**45**	**15 185**	**96**	**18**	**1 486**	**146**	**896**	**38**	**17 910**
2001–02									
Primary									
Black coal	—	7 282	—	—	—	—	—	—	7 282
Brown coal(e)	—	670	—	—	—	—	—	—	670
Natural gas	—	1 389	—	—	5	—	—	—	1 394
Crude oil	—	1 336	—	—	—	—	—	—	1 336
Propane, LPG etc.	—	122	—	—	49	—	—	—	171
Uranium	—	3 782	—	—	—	—	—	—	3 782
Biomass wood(f)	44	—	92	18	—	—	—	33	187
Solar(g)	—	—	—	—	—	—	—	3	3
Total primary	*44*	*14 581*	*92*	*18*	*54*	—	—	*36*	*14 825*
Secondary									
Refined products	—	—	—	—	1 468	—	—	—	1 468
Liquid gas biofuel	—	—	—	—	10	—	—	—	10
Coal by-products(h)	—	—	—	—	—	143	—	—	143
Electricity									
Hydro	—	—	—	—	—	—	*58*	—	*58*
Other	—	—	—	—	—	—	*810*	—	*810*
Total electricity	—	—	—	—	—	—	868	—	868
Total secondary	—	—	—	—	*1 478*	*143*	*868*	—	*2 489*
Total energy production	**44**	**14 581**	**92**	**18**	**1 532**	**143**	**868**	**36**	**17 314**

— nil or rounded to zero (including null cells)
(a) Includes food, beverages and textiles
(b) Includes wood, paper and printing
(c) Chemicals
(d) Includes iron and steel
(e) Includes briquettes
(f) Includes biomass wood and bagasse
(g) Includes solar and wind energy from 2004–05 onwards
(h) Includes coal by-products and metallurgical coke

AUSTRALIA'S USE OF ENERGY

Australia's total energy use increased by 2,825 PJ or 15% over the period 2001–02 to 2006–07. Tables 2.3 to 2.7 record details of use of primary and secondary energy by product and industry.

The export market was the single largest consumer of Australian energy products, accounting for 13,055 PJ or 61% of total gross energy use in 2006–07. In particular, exports of primary energy grew from 10,392 PJ in 2001–02 to 12,838 PJ in 2006–07 (a 24% increase), to account for 98% of total energy exports in 2006–07.

Exports of black coal rose by 23% (5,630 PJ in 2001–02 to 6,943 PJ in 2006–07), while exports of uranium rose by 29% (3,463 PJ in 2001–02 to 4,474 PJ in 2006–07). Together, black coal and uranium made up the vast majority of energy products exported in 2006–07.

Exports of natural gas in the form of liquified natural gas (LNG) doubled from 413 PJ in 2001–02, to 827 PJ in 2006–07. This result reflects increased gas production from Western Australia and the Northern Territory.

Crude oil exports fell from 886 PJ in 2001–02 to 594 PJ in 2006–07 (a fall of 33%), reflecting decreasing domestic oil production. This result was accompanied by a 26% decline in exports of refined products, down from 292 PJ in 2001–02 to 217 PJ in 2006–07.

Total domestic use of energy products showed a small increase from 7,852 PJ to 8,308 PJ, (or 6%) between 2001–02 and 2006–07.

Household use of primary energy was dominated by natural gas, which made up 68% of total household use of primary energy in 2006–07. Overall, primary energy use by households has been quite stable over the period (194 PJ in 2001–02 to 198 PJ in 2006–07). Household use of secondary energy predominantly relates to use of refined products (71% of secondary energy in 2006–07), with the remainder being electricity usage. Secondary energy use by households grew by 15% between 2001–02 and 2006–07.

Primary energy use by the mining industry grew by 84% over the period 2001–02 to 2006–07, predominantly due to large increases in natural gas use (from 128 PJ in 2001–02 to 242 PJ in 2006–07). Increases in the use of refined products and electricity led to a 13% increase in secondary energy use.

Domestic use of refined products rose by 25% from 1,513 PJ in 2001–02 to 1,887 PJ in 2006–07. Electricity use was up by 15% to 999 PJ. Refined products (notably petrol and diesel) and electricity constitute around 95% of total domestic secondary energy use. Domestic use of refined products increased by 25% over the period. This included a 9% increase in use by the agriculture industry and an 18% increase in use by the transport industry. Within transport, road transport use of refined products rose by 10% over the period, rail transport rose 7%, air transport by 26% and water transport by 24%.

Conversion losses occur in the production of refined products from crude oil and the generation of electricity from fossil fuels (coal and natural gas). Nearly all crude oil production that is not exported is consumed in the manufacture of refined products. Of the 1,514 PJ of crude oil used by Chemicals manufacturing (essentially petroleum refiners), 1,281 PJ of refined products were produced.

AUSTRALIA'S USE OF ENERGY *continued*

Conversion losses in electricity generation are significant. The Electricity industry used 2,353 PJ of black and brown coal and natural gas in 2006–07, from which 947 PJ of electricity was generated (excluding hydroelectricity). Consumption of solar energy by the electricity industry grew significantly, but it should be noted that from 2004–05, solar photovoltaic and wind power were included in this measurement.

In respect of manufacturing energy use, it must be noted that energy use by the food, beverages and textiles, wood, paper and printing and non-ferrous metals industries for 2001–02 to 2003–04 were not identified in the source data. This explains the increase from 2004–05 for those industries, and also the decrease from 2004–05 onwards for other manufacturing.

AUSTRALIA'S USE OF ENERGY *continued*

2.3 AUSTRALIAN TOTAL ENERGY USE: 2001–02 to 2006–07

	2001–02	*2002–03*	*2003–04*	*2004–05*	*2005–06*	*2006–07*
	PJ	PJ	PJ	PJ	PJ	PJ
Agriculture	94	94	96	100	103	102
Mining	309	324	340	358	369	446
Manufacturing						
Food, Beverages, Textiles(a)	—	—	—	*203*	*206*	*221*
Wood, Paper, Printing(a)	—	—	—	*81*	*83*	*84*
Chemicals	*1 900*	*1 886*	*1 723*	*1 843*	*1 682*	*1 752*
Iron & Steel	*310*	*328*	*342*	*333*	*311*	*319*
Non-ferrous metals(a)	—	—	—	*448*	*444*	*460*
Other Manufacturing	*818*	*832*	*838*	*166*	*161*	*154*
Total Manufacturing	3 028	3 046	2 903	3 074	2 887	2 990
Electricity, Gas, Water	2 341	2 373	2 479	2 509	2 578	2 608
Construction	39	40	41	49	43	43
Transport						
Road	*180*	*181*	*186*	*203*	*201*	*201*
Rail	*36*	*36*	*38*	*39*	*40*	*39*
Air	*174*	*161*	*163*	*182*	*203*	*219*
Water	*55*	*54*	*55*	*55*	*60*	*68*
Total Transport	445	432	442	479	504	527
Other Services						
Wholesale & Retail Trade	*120*	*120*	*122*	*124*	*127*	*128*
Accommodation(b)	*40*	*40*	*40*	*39*	*40*	*42*
Communication(c)	*171*	*171*	*174*	*176*	*183*	*186*
Other(d)	*120*	*120*	*120*	*121*	*121*	*128*
Total Other Services	451	451	456	460	471	484
Total intermediate use	*6 707*	*6 760*	*6 757*	*7 029*	*6 955*	*7 200*
Inventory changes	254	–389	–177	–310	–287	106
Households	891	920	944	967	993	1 002
Total domestic use	*7 852*	*7 291*	*7 524*	*7 686*	*7 661*	*8 308*
Exports	10 686	11 906	11 811	13 237	12 770	13 055
Total energy use(e)	**18 538**	**19 197**	**19 335**	**20 923**	**20 431**	**21 363**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

(e) These figures differ slightly from total energy supply (table 2.1) due to rounding.

AUSTRALIA'S USE OF ENERGY *continued*

2.4 AUSTRALIAN PRIMARY ENERGY USE—2001–02 to 2006–07

	2001–02	*2002–03*	*2003–04*	*2004–05*	*2005–06*	*2006–07*
	PJ	PJ	PJ	PJ	PJ	PJ
Agriculture	—	—	—	—	—	—
Mining	136	146	156	163	170	250
Manufacturing						
Food, beverages, textiles	—	—	—	*154*	*154*	*167*
Wood, paper, printing	—	—	—	*50*	*51*	*52*
Chemicals	*1 813*	*1 797*	*1 633*	*1 697*	*1 535*	*1 638*
Iron & Steel	*185*	*206*	*214*	*200*	*182*	*185*
Non-ferrous metals	—	—	—	*213*	*205*	*214*
Other manufacturing	*456*	*464*	*467*	*106*	*101*	*111*
Total manufacturing	2 454	2 467	2 314	2 420	2 228	2 367
Electricity, gas,water	2 146	2 170	2 269	2 289	2 357	2 381
Construction	2	3	3	3	3	3
Transport						
Road	*1*	*1*	*1*	*3*	*2*	*2*
Rail	—	—	—	—	—	—
Air	—	—	—	—	—	—
Water	*4*	*4*	*4*	*6*	*5*	*5*
Total transport	5	5	5	9	7	7
Other services						
Wholesale & retail trade	*15*	*15*	*15*	*15*	*15*	*15*
Accommodation, cafes..(a)	*9*	*9*	*9*	*9*	*9*	*10*
Communication, Finan..(b)	*13*	*13*	*13*	*13*	*13*	*13*
Other(c)	*11*	*11*	*11*	*11*	*10*	*14*
Total other services	48	48	48	48	47	52
Total intermediate use	*4 791*	*4 839*	*4 795*	*4 932*	*4 812*	*5 060*
Inventory changes	336	–317	–146	–275	–159	1
Households	194	207	200	192	188	198
Total domestic use	*5 321*	*4 729*	*4 849*	*4 849*	*4 841*	*5 259*
Exports	10 392	11 619	11 563	13 013	12 541	12 838
Total primary energy use	**15 713**	**16 348**	**16 412**	**17 862**	**17 382**	**18 097**

— nil or rounded to zero (including null cells)

(a) Includes accommodation, cafes & restaurants

(b) Includes Communication Services, Finance & Insurance, Property & Business Services

(c) Includes Government Admin & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

AUSTRALIA'S USE OF ENERGY *continued*

2.5 AUSTRALIAN SECONDARY ENERGY USE—2001–02 to 2006–07

	2001–02	*2002–03*	*2003–04*	*2004–05*	*2005–06*	*2006–07*
	PJ	PJ	PJ	PJ	PJ	PJ
Agriculture	94	94	96	100	103	102
Mining	173	178	184	195	199	196
Manufacturing						
Food, Beverages, Textiles(a)	—	—	—	*49*	*52*	*54*
Wood, Paper, Printing(a)	—	—	—	*31*	*32*	*32*
Chemicals	*87*	*89*	*90*	*146*	*147*	*114*
Iron & Steel	*125*	*122*	*128*	*133*	*129*	*134*
Non-ferrous metals(a)	—	—	—	*235*	*239*	*246*
Other Manufacturing	*362*	*368*	*371*	*60*	*60*	*43*
Total Manufacturing	574	579	589	654	659	623
Electricity, Gas, Water	195	203	210	220	221	227
Construction	37	37	38	46	40	40
Transport						
Road	*179*	*180*	*185*	*200*	*199*	*199*
Rail	*36*	*36*	*38*	*39*	*40*	*39*
Air	*174*	*161*	*163*	*182*	*203*	*219*
Water	*51*	*50*	*51*	*49*	*55*	*63*
Total Transport	440	427	437	470	497	520
Other Services						
Wholesale & Retail Trade	*105*	*105*	*107*	*109*	*112*	*113*
Accommodation(b)	*31*	*31*	*31*	*30*	*31*	*32*
Communication(c)	*158*	*158*	*161*	*163*	*170*	*173*
Other(d)	*109*	*109*	*109*	*110*	*111*	*114*
Total Other Services	403	403	408	412	424	432
Total intermediate use	*1 916*	*1 921*	*1 962*	*2 097*	*2 143*	*2 140*
Inventory changes	–82	–72	–31	–35	–128	105
Households	697	713	744	775	805	804
Total domestic use	*2 531*	*2 562*	*2 675*	*2 837*	*2 820*	*3 049*
Exports	294	287	248	224	229	217
Total secondary energy use	**2 825**	**2 849**	**2 923**	**3 061**	**3 049**	**3 266**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.6 AUSTRALIAN PRIMARY ENERGY USE, by energy products—2001–02 to 2006–07

	Black coal	*Brown coal*	*Natural gas*	*Crude oil*	*Uranium*	*Biomass wood & bagasse*	*Solar*	*Total primary*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
	2006–07							
Agriculture	—	—	—	—	—	—	—	—
Mining	6	1	242	1	—	—	—	250
Manufacturing								
Food, Beverages, Textiles(a)	*10*	*1*	*39*	*1*	—	*116*	—	*167*
Wood, Paper, Printing(a)	*12*	—	*21*	—	—	*19*	—	*52*
Chemicals	*2*	*8*	*114*	*1 514*	—	—	—	*1 638*
Iron & Steel	*159*	—	*26*	—	—	—	—	*185*
Non-ferrous metals(a)	*66*	—	*145*	*1*	—	*2*	—	*214*
Other Manufacturing	*30*	—	*80*	—	—	*1*	—	*111*
Total Manufacturing	279	9	425	1 516	—	138	—	2 367
Electricity, Gas, Water	1 373	671	309	—	—	5	23	2 381
Construction	—	—	3	—	—	—	—	3
Transport								
Road	—	—	*2*	—	—	—	—	*2*
Rail	—	—	—	—	—	—	—	—
Air	—	—	—	—	—	—	—	—
Water	*5*	—	—	—	—	—	—	*5*
Total Transport	5	—	2	—	—	—	—	7
Other Services								
Wholesale & Retail Trade	—	—	*15*	—	—	—	—	*15*
Accommodation(b)	—	—	*9*	—	—	—	*1*	*10*
Communication(c)	*1*	*2*	*10*	—	—	—	—	*13*
Other(d)	—	*1*	*10*	—	—	—	*3*	*14*
Total Other Services	1	3	44	—	—	—	4	52
Total intermediate use	*1 664*	*684*	*1 025*	*1 517*	—	*143*	*27*	*5 060*
Inventory changes	43	–39	22	–60	35	—	—	1
Households	—	—	134	—	—	62	2	198
Total domestic use	*1 707*	*645*	*1 181*	*1 457*	*35*	*205*	*29*	*5 259*
Exports	6 943	—	827	594	4 474	—	—	12 838
Total primary energy use	**8 650**	**645**	**2 008**	**2 051**	**4 509**	**205**	**29**	**18 097**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.6 AUSTRALIAN PRIMARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Black coal	*Brown coal*	*Natural gas*	*Crude oil*	*Uranium*	*Biomass wood & bagasse*	*Solar*	*Total primary*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
				2005–06				
Agriculture	—	—	—	—	—	—	—	—
Mining	7	—	162	1	—	—	—	170
Manufacturing								
Food, Beverages, Textiles(a)	*9*	—	*32*	—	—	*113*	—	*154*
Wood, Paper, Printing(a)	*13*	—	*20*	—	—	*18*	—	*51*
Chemicals	*2*	*9*	*123*	*1 401*	—	—	—	*1 535*
Iron & Steel	*158*	—	*24*	—	—	—	—	*182*
Non-ferrous metals(a)	*63*	—	*139*	*1*	—	*2*	—	*205*
Other Manufacturing	*30*	*1*	*68*	*1*	—	*1*	—	*101*
Total Manufacturing	275	10	406	1 403	—	134	—	2 228
Electricity, Gas, Water	1 352	701	293	—	—	5	6	2 357
Construction	—	—	3	—	—	—	—	3
Transport								
Road	—	—	*2*	—	—	—	—	*2*
Rail	—	—	—	—	—	—	—	—
Air	—	—	—	—	—	—	—	—
Water	*5*	—	—	—	—	—	—	*5*
Total Transport	5	—	2	—	—	—	—	7
Other Services								
Wholesale & Retail Trade	—	—	*15*	—	—	—	—	*15*
Accommodation(b)	—	—	*9*	—	—	—	—	*9*
Communication(c)	*1*	*2*	*10*	—	—	—	—	*13*
Other(d)	—	*1*	*9*	—	—	—	—	*10*
Total Other Services	1	3	43	—	—	—	—	47
Total intermediate use	*1 640*	*714*	*909*	*1 404*	—	*139*	*6*	*4 812*
Inventory changes	–27	–7	—	28	–153	—	—	–159
Households	—	—	134	—	—	52	2	188
Total domestic use	*1 613*	*707*	*1 043*	*1 432*	*–153*	*191*	*8*	*4 841*
Exports	6 582	—	680	460	4 819	—	—	12 541
Total primary energy use	**8 195**	**707**	**1 723**	**1 892**	**4 666**	**191**	**8**	**17 382**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.6 AUSTRALIAN PRIMARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Black coal	*Brown coal*	*Natural gas*	*Crude oil*	*Uranium*	*Biomass wood & bagasse*	*Solar*	*Total primary*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
				2004–05				
Agriculture	—	—	—	—	—	—	—	—
Mining	7	—	154	2	—	—	—	163
Manufacturing								
Food, Beverages, Textiles(a)	*9*	—	*33*	—	—	*112*	—	*154*
Wood, Paper, Printing(a)	*12*	—	*20*	—	—	*18*	—	*50*
Chemicals	*2*	*11*	*120*	*1 564*	—	—	—	*1 697*
Iron & Steel	*175*	—	*25*	—	—	—	—	*200*
Non-ferrous metals(a)	*64*	—	*145*	*2*	—	*2*	—	*213*
Other Manufacturing	*30*	*1*	*73*	*1*	—	*1*	—	*106*
Total Manufacturing	292	12	416	1 567	—	133	—	2 420
Electricity, Gas, Water	1 292	683	306	—	—	5	3	2 289
Construction	—	—	3	—	—	—	—	3
Transport								
Road	—	—	*3*	—	—	—	—	*3*
Rail	—	—	—	—	—	—	—	—
Air	—	—	—	—	—	—	—	—
Water	*6*	—	—	—	—	—	—	*6*
Total Transport	6	—	3	—	—	—	—	9
Other Services								
Wholesale & Retail Trade	—	—	*15*	—	—	—	—	*15*
Accommodation(b)	—	—	*9*	—	—	—	—	*9*
Communication(c)	—	—	*10*	—	—	—	—	*10*
Other(d)	*1*	*3*	*10*	—	—	—	—	*14*
Total Other Services	1	3	44	—	—	—	—	48
Total intermediate use	*1 598*	*698*	*926*	*1 569*	—	*138*	*3*	*4 932*
Inventory changes	–122	–29	–12	–32	–80	—	—	–275
Households	—	1	128	—	—	60	3	192
Total domestic use	*1 476*	*670*	*1 042*	*1 537*	*–80*	*198*	*6*	*4 849*
Exports	6 595	—	576	555	5 287	—	—	13 013
Total primary energy use	**8 071**	**670**	**1 618**	**2 092**	**5 207**	**198**	**6**	**17 862**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.6 AUSTRALIAN PRIMARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Black coal	*Brown coal*	*Natural gas*	*Crude oil*	*Uranium*	*Biomass wood & bagasse*	*Solar*	*Total primary*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
				2003–04				
Agriculture	—	—	—	—	—	—	—	—
Mining	7	—	148	1	—	—	—	156
Manufacturing								
Food, Beverages, Textiles(a)	—	—	—	—	—	—	—	—
Wood, Paper, Printing(a)	—	—	—	—	—	—	—	—
Chemicals	*2*	*14*	*129*	*1 488*	—	—	—	*1 633*
Iron & Steel	*157*	—	*57*	—	—	—	—	*214*
Non-ferrous metals(a)	—	—	—	—	—	—	—	—
Other Manufacturing	*101*	*1*	*243*	—	—	*122*	—	*467*
Total Manufacturing	260	15	429	1 488	—	122	—	2 314
Electricity, Gas, Water	1 299	679	287	—	—	4	—	2 269
Construction	—	—	3	—	—	—	—	3
Transport								
Road	—	—	*1*	—	—	—	—	*1*
Rail	—	—	—	—	—	—	—	—
Air	—	—	—	—	—	—	—	—
Water	*4*	—	—	—	—	—	—	*4*
Total Transport	4	—	1	—	—	—	—	5
Other services								
Wholesale & Retail Trade	—	—	*15*	—	—	—	—	*15*
Accommodation(b)	—	—	*9*	—	—	—	—	*9*
Communication(c)	*1*	*2*	*10*	—	—	—	—	*13*
Other(d)	—	*1*	*10*	—	—	—	—	*11*
Total Other Services	1	3	44	—	—	—	—	48
Total intermediate use	*1 571*	*697*	*912*	*1 489*	—	*126*	—	*4 795*
Inventory changes	–164	–38	—	–197	253	—	—	–146
Households	—	—	131	—	—	66	3	200
Total domestic use	*1 407*	*659*	*1 043*	*1 292*	*253*	*192*	*3*	*4 849*
Exports	6 208	—	430	648	4 277	—	—	11 563
Total primary energy use	**7 615**	**659**	**1 473**	**1 940**	**4 530**	**192**	**3**	**16 412**

— nil or rounded to zero (including null cells)

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(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.6 AUSTRALIAN PRIMARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Black coal	*Brown coal*	*Natural gas*	*Crude oil*	*Uranium*	*Biomass wood & bagasse*	*Solar*	*Total primary*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
				2002–03				
Agriculture	—	—	—	—	—	—	—	—
Mining	7	—	138	1	—	—	—	146
Manufacturing								
Food, Beverages, Textiles(a)	—	—	—	—	—	—	—	—
Wood, Paper, Printing(a)	—	—	—	—	—	—	—	—
Chemicals	*2*	*15*	*125*	*1 655*	—	—	—	*1 797*
Iron & Steel	*146*	—	*60*	—	—	—	—	*206*
Non-ferrous metals(a)	—	—	—	—	—	—	—	—
Other Manufacturing	*100*	*1*	*242*	—	—	*121*	—	*464*
Total Manufacturing	248	16	427	1 655	—	121	—	2 467
Electricity, Gas, Water	1 223	666	277	—	—	4	—	2 170
Construction	—	—	3	—	—	—	—	3
Transport								
Road	—	—	*1*	—	—	—	—	*1*
Rail	—	—	—	—	—	—	—	—
Air	—	—	—	—	—	—	—	—
Water	*4*	—	—	—	—	—	—	*4*
Total Transport	4	—	1	—	—	—	—	5
Other Services								
Wholesale & Retail Trade	—	—	*15*	—	—	—	—	*15*
Accommodation(b)	—	—	*9*	—	—	—	—	*9*
Communication(c)	*1*	*2*	*10*	—	—	—	—	*13*
Other(d)	—	*1*	*10*	—	—	—	—	*11*
Total Other Services	1	3	44	—	—	—	—	48
Total intermediate use	*1 483*	*685*	*890*	*1 656*	—	*125*	—	*4 839*
Inventory changes	–61	–30	—	–116	–110	—	—	–317
Households	—	—	134	—	—	70	3	207
Total domestic use	*1 422*	*655*	*1 024*	*1 540*	*–110*	*195*	*3*	*4 729*
Exports	5 909	—	426	775	4 509	—	—	11 619
Total primary energy use	**7 331**	**655**	**1 450**	**2 315**	**4 399**	**195**	**3**	**16 348**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.6 AUSTRALIAN PRIMARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Black coal	*Brown coal*	*Natural gas*	*Crude oil*	*Uranium*	*Biomass wood & bagasse*	*Solar*	*Total primary*
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
				2001–02				
Agriculture	—	—	—	—	—	—	—	—
Mining	7	—	128	1	—	—	—	136
Manufacturing								
Food, Beverages, Textiles(a)	—	—	—	—	—	—	—	—
Wood, Paper, Printing(a)	—	—	—	—	—	—	—	—
Chemicals	*2*	*15*	*117*	*1 679*	—	—	—	*1 813*
Iron & Steel	*135*	—	*50*	—	—	—	—	*185*
Non-ferrous metals(a)	—	—	—	—	—	—	—	—
Other Manufacturing	*95*	*1*	*242*	—	—	*118*	—	*456*
Total Manufacturing	232	16	409	1 679	—	118	—	2 454
Electricity, Gas, Water	1 209	665	268	—	—	4	—	2 146
Construction	—	—	2	—	—	—	—	2
Transport								
Road	—	—	*1*	—	—	—	—	*1*
Rail	—	—	—	—	—	—	—	—
Air	—	—	—	—	—	—	—	—
Water	*4*	—	—	—	—	—	—	*4*
Total Transport	4	—	1	—	—	—	—	5
Other Services								
Wholesale & Retail Trade	—	—	*15*	—	—	—	—	*15*
Accommodation(b)	—	—	*9*	—	—	—	—	*9*
Communication(c)	*1*	*2*	*10*	—	—	—	—	*13*
Other(d)	—	*1*	*10*	—	—	—	—	*11*
Total Other Services	1	3	44	—	—	—	—	48
Total intermediate use	*1 453*	*684*	*852*	*1 680*	—	*122*	—	*4 791*
Inventory changes	200	–13	2	–173	320	—	—	336
Households	—	—	126	—	—	65	3	194
Total domestic use	*1 653*	*671*	*980*	*1 507*	*320*	*187*	*3*	*5 321*
Exports	5 630	—	413	886	3 463	—	—	10 392
Total primary energy use	**7 283**	**671**	**1 393**	**2 393**	**3 783**	**187**	**3**	**15 713**

— nil or rounded to zero (including null cells)

(a) Prior to 2004–05, this was included in 'Other Manufacturing'

(b) Includes Accommodation, Cafes & Restaurants

(c) Includes Communication Services, Finance & Insurance, Property & Business Services

(d) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.7 AUSTRALIAN SECONDARY ENERGY USE, by energy products—2001–02 to 2006–07

	Refined products	*Liquid gas biofuel*	*Coal by-products*(a)	*Electricity*	*Total secondary*
	PJ	PJ	PJ	PJ	PJ
			2006–07		
Agriculture	95	—	—	7	102
Mining	125	—	2	69	196
Manufacturing					
Food, Beverages, Textiles(b)	*20*	*2*	*3*	*29*	*54*
Wood, Paper, Printing(b)	*11*	—	—	*21*	*32*
Chemicals	*75*	—	*9*	*30*	*114*
Iron & Steel	*6*	—	*101*	*27*	*134*
Non-ferrous metals(b)	*54*	—	*7*	*185*	*246*
Other Manufacturing	*14*	*2*	*1*	*26*	*43*
Total Manufacturing	180	4	121	318	623
Electricity, Gas, Water	27	7	6	187	227
Construction	39	—	—	1	40
Transport					
Road	*197*	*2*	—	—	*199*
Rail	*31*	—	—	*8*	*39*
Air	*219*	—	—	—	*219*
Water	*63*	—	—	—	*63*
Total Transport	510	2	—	8	520
Other Services					
Wholesale & Retail Trade	*80*	—	—	*33*	*113*
Accommodation(c)	*10*	—	—	*22*	*32*
Communication(d)	*109*	—	—	*64*	*173*
Other(e)	*55*	—	—	*59*	*114*
Total Other Services	254	—	—	178	432
Total intermediate use	*1 230*	*13*	*129*	*768*	*2 140*
Inventory changes	84	—	21	—	105
Households	573	—	—	231	804
Total domestic use	*1 887*	*13*	*150*	*999*	*3 049*
Exports	217	—	—	—	217
Total secondary energy use	**2 104**	**13**	**150**	**999**	**3 266**

— nil or rounded to zero (including null cells)
(a) Includes coal by-products and metallurgical coke
(b) Prior to 2004–05, this was included in 'Other Manufacturing'
(c) Includes Accommodation, Cafes & Restaurants
(d) Includes Communication Services, Finance & Insurance, Property & Business Services
(e) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.7 AUSTRALIAN SECONDARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Refined products	*Liquid gas biofuel*	*Coal by-products*(a)	*Electricity*	*Total secondary*
	PJ	PJ	PJ	PJ	PJ
			2005–06		
Agriculture	96	—	—	7	103
Mining	126	—	2	71	199
Manufacturing					
Food, Beverages, Textiles(b)	*21*	*2*	*3*	*26*	*52*
Wood, Paper, Printing(b)	*12*	—	—	*20*	*32*
Chemicals	*115*	—	*9*	*23*	*147*
Iron & Steel	*4*	—	*98*	*27*	*129*
Non-ferrous metals(b)	*55*	—	*7*	*177*	*239*
Other Manufacturing	*16*	*2*	*1*	*41*	*60*
Total Manufacturing	223	4	118	314	659
Electricity, Gas, Water	26	7	6	182	221
Construction	39	—	—	1	40
Transport					
Road	*198*	*1*	—	—	*199*
Rail	*32*	—	—	*8*	*40*
Air	*203*	—	—	—	*203*
Water	*55*	—	—	—	*55*
Total Transport	488	1	—	8	497
Other Services					
Wholesale & Retail Trade	*81*	—	—	*31*	*112*
Accommodation(c)	*10*	—	—	*21*	*31*
Communication(d)	*110*	—	—	*60*	*170*
Other(e)	*55*	—	—	*56*	*111*
Total Other Services	256	—	—	168	424
Total intermediate use	*1 254*	*12*	*126*	*751*	*2 143*
Inventory changes	–137	—	9	—	–128
Households	581	—	—	224	805
Total domestic use	*1 698*	*12*	*135*	*975*	*2 820*
Exports	229	—	—	—	229
Total secondary energy use	**1 927**	**12**	**135**	**975**	**3 049**

— nil or rounded to zero (including null cells)
(a) Includes coal by-products and metallurgical coke
(b) Prior to 2004–05, this was included in 'Other Manufacturing'
(c) Includes Accommodation, Cafes & Restaurants
(d) Includes Communication Services, Finance & Insurance, Property & Business Services
(e) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.7 AUSTRALIAN SECONDARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Refined products	*Liquid gas biofuel*	*Coal by-products*(a)	*Electricity*	*Total secondary*
	PJ	PJ	PJ	PJ	PJ
			2004–05		
Agriculture	94	—	—	6	100
Mining	124	—	2	69	195
Manufacturing					
Food, Beverages, Textiles(b)	*20*	*1*	*3*	*25*	*49*
Wood, Paper, Printing(b)	*11*	—	—	*20*	*31*
Chemicals	*114*	—	*10*	*22*	*146*
Iron & Steel	*5*	—	*100*	*28*	*133*
Non-ferrous metals(b)	*53*	—	*7*	*175*	*235*
Other Manufacturing	*14*	*2*	*1*	*43*	*60*
Total Manufacturing	217	3	121	313	654
Electricity, Gas, Water	29	7	5	179	220
Construction	39	—	—	7	46
Transport					
Road	*195*	*1*	—	*4*	*200*
Rail	*31*	—	—	*8*	*39*
Air	*182*	—	—	—	*182*
Water	*49*	—	—	—	*49*
Total Transport	457	1	—	12	470
Other Services					
Wholesale & Retail Trade	*80*	—	—	*29*	*109*
Accommodation(c)	*10*	—	—	*20*	*30*
Communication(d)	*108*	—	—	*55*	*163*
Other(e)	*55*	—	—	*55*	*110*
Total Other Services	253	—	—	159	412
Total intermediate use	*1 213*	*11*	*128*	*745*	*2 097*
Inventory changes	–49	—	14	—	–35
Households	560	—	—	215	775
Total domestic use	*1 724*	*11*	*142*	*960*	*2 837*
Exports	222	—	—	2	224
Total secondary energy use	**1 946**	**11**	**142**	**962**	**3 061**

— nil or rounded to zero (including null cells)
(a) Includes coal by-products and metallurgical coke
(b) Prior to 2004–05, this was included in 'Other Manufacturing'
(c) Includes Accommodation, Cafes & Restaurants
(d) Includes Communication Services, Finance & Insurance, Property & Business Services
(e) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.7 AUSTRALIAN SECONDARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Refined products	*Liquid gas biofuel*	*Coal by-products*(a)	*Electricity*	*Total secondary*
	PJ	PJ	PJ	PJ	PJ
			2003–04		
Agriculture	89	—	—	7	96
Mining	118	—	2	64	184
Manufacturing					
Food, Beverages, Textiles(b)	—	—	—	—	—
Wood, Paper, Printing(b)	—	—	—	—	—
Chemicals	*58*	—	*10*	*22*	*90*
Iron & Steel	*2*	—	*103*	*23*	*128*
Non-ferrous metals(b)	—	—	—	—	—
Other Manufacturing	*96*	*2*	*23*	*250*	*371*
Total Manufacturing	156	2	136	295	589
Electricity, Gas, Water	22	9	5	174	210
Construction	37	—	—	1	38
Transport					
Road	*185*	—	—	—	*185*
Rail	*30*	—	—	*8*	*38*
Air	*163*	—	—	—	*163*
Water	*51*	—	—	—	*51*
Total Transport	429	—	—	8	437
Other Services					
Wholesale & Retail Trade	*76*	—	—	*31*	*107*
Accommodation(c)	*10*	—	—	*21*	*31*
Communication(d)	*103*	—	—	*58*	*161*
Other(e)	*52*	—	—	*57*	*109*
Total Other Services	241	—	—	167	408
Total intermediate use	*1 092*	*11*	*143*	*716*	*1 962*
Inventory changes	–44	—	13	—	–31
Households	539	—	—	205	744
Total domestic use	*1 587*	*11*	*156*	*921*	*2 675*
Exports	248	—	—	—	248
Total secondary energy use	**1 835**	**11**	**156**	**921**	**2 923**

— nil or rounded to zero (including null cells)
(a) Includes coal by-products and metallurgical coke
(b) Prior to 2004–05, this was included in 'Other Manufacturing'
(c) Includes Accommodation, Cafes & Restaurants
(d) Includes Communication Services, Finance & Insurance, Property & Business Services
(e) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.7 AUSTRALIAN SECONDARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Refined products	*Liquid gas biofuel*	*Coal by-products*(a)	*Electricity*	*Total secondary*
	PJ	PJ	PJ	PJ	PJ
			2002–03		
Agriculture	87	—	—	7	94
Mining	115	—	2	61	178
Manufacturing					
Food, Beverages, Textiles(b)	—	—	—	—	—
Wood, Paper, Printing(b)	—	—	—	—	—
Chemicals	*58*	—	*9*	*22*	*89*
Iron & Steel	*2*	—	*95*	*25*	*122*
Non-ferrous metals(b)	—	—	—	—	—
Other Manufacturing	*95*	*3*	*23*	*247*	*368*
Total Manufacturing	155	3	127	294	579
Electricity, Gas, Water	20	8	5	170	203
Construction	36	—	—	1	37
Transport					
Road	*180*	—	—	—	*180*
Rail	*29*	—	—	*7*	*36*
Air	*161*	—	—	—	*161*
Water	*50*	—	—	—	*50*
Total Transport	420	—	—	7	427
Other Services					
Wholesale & Retail Trade	*74*	—	—	*31*	*105*
Accommodation(c)	*10*	—	—	*21*	*31*
Communication(d)	*100*	—	—	*58*	*158*
Other(e)	*52*	—	—	*57*	*109*
Total Other Services	236	—	—	167	403
Total intermediate use	*1 069*	*11*	*134*	*707*	*1 921*
Inventory changes	–78	—	6	—	–72
Households	522	—	—	191	713
Total domestic use	*1 513*	*11*	*140*	*898*	*2 562*
Exports	280	—	7	—	287
Total secondary energy use	**1 793**	**11**	**147**	**898**	**2 849**

— nil or rounded to zero (including null cells)
(a) Includes coal by-products and metallurgical coke
(b) Prior to 2004–05, this was included in 'Other Manufacturing'
(c) Includes Accommodation, Cafes & Restaurants
(d) Includes Communication Services, Finance & Insurance, Property & Business Services
(e) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

2.7 AUSTRALIAN SECONDARY ENERGY USE, by energy products—2001–02 to 2006–07 *continued*

	Refined products	*Liquid gas biofuel*	*Coal by-products*(a)	*Electricity*	*Total secondary*
	PJ	PJ	PJ	PJ	PJ
			2001–02		
Agriculture	87	—	—	7	94
Mining	115	—	1	57	173
Manufacturing					
Food, Beverages, Textiles(b)	—	—	—	—	—
Wood, Paper, Printing(b)	—	—	—	—	—
Chemicals	*57*	—	*8*	*22*	*87*
Iron & Steel	*2*	—	*101*	*22*	*125*
Non-ferrous metals(b)	—	—	—	—	—
Other Manufacturing	*95*	*2*	*23*	*242*	*362*
Total Manufacturing	154	2	132	286	574
Electricity, Gas, Water	19	8	6	162	195
Construction	36	—	—	1	37
Transport					
Road	*179*	—	—	—	*179*
Rail	*29*	—	—	*7*	*36*
Air	*174*	—	—	—	*174*
Water	*51*	—	—	—	*51*
Total Transport	433	—	—	7	440
Other Services					
Wholesale & Retail Trade	*74*	—	—	*31*	*105*
Accommodation(c)	*10*	—	—	*21*	*31*
Communication(d)	*100*	—	—	*58*	*158*
Other(e)	*52*	—	—	*57*	*109*
Total Other Services	236	—	—	167	403
Total intermediate use	*1 080*	*10*	*139*	*687*	*1 916*
Inventory changes	–84	—	2	—	–82
Households	517	—	—	180	697
Total domestic use	*1 513*	*10*	*141*	*867*	*2 531*
Exports	292	—	2	—	294
Total secondary energy use	**1 805**	**10**	**143**	**867**	**2 825**

— nil or rounded to zero (including null cells)
(a) Includes coal by-products and metallurgical coke
(b) Prior to 2004–05, this was included in 'Other Manufacturing'
(c) Includes Accommodation, Cafes & Restaurants
(d) Includes Communication Services, Finance & Insurance, Property & Business Services
(e) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

INTRODUCTION

This chapter introduces an experimental hybrid (combined monetary and physical) energy use account for the Australian economy. A hybrid account records physical flows consistent with monetary transactions of the national accounts. The linkages presented here relate to the Australian economy, to specific industries and across defined energy products.

The hybrid table combines physical data commonly used by energy specialists or scientists, with the monetary data used by economists. It therefore has the potential to merge these two schools of thought about the environment.

The juxtaposition of related monetary and physical series potentially yields great benefits by supporting analyses in which monetary and physical series are directly confronted, supporting the possibility of greater data integrity for both sets of information. For example, the direct comparison of physical use of energy products (in PJ) by an institutional unit with corresponding monetary transactions implies a certain price paid by that unit per PJ of the energy product. When comparing energy use between industries, households and exports, and across energy products, this information provides a potentially powerful tool for assessing the quality and cohesiveness of data. One strength of the hybrid accounting technique is that it supports integration of monetary and physical data without impacting on any SNA accounting conventions. For many analysts, it is highly desirable to analyse environmental phenomena within the context of the national accounts as conventionally understood and measured.

While the hybrid account shows both monetary and physical information, monetary flows can only be meaningfully juxtaposed against gross physical energy flow data. For gross physical energy flows the supply of energy equals its use for each energy product type - this is not the case for net physical energy accounts. Appendix 3: Frameworks and concepts provides a fuller description of gross and net energy flow accounts. Note also that the product detail in the table below is less than the physical flow information available in other tables. In this publication it has been necessary to collapse this detail in order to support a direct correspondence between monetary and physical data.

RESULTS AND ANALYSIS

While monetary data contained in the table below are substantially based on official ABS data contained in *Australian National Accounts: Input-Output Tables* (cat. no. 5209.0.55.001), in some cases they differ. Data contained in this publication have utilised different estimation methodologies to those used in the ABS Input-Output tables. In particular, this publication has taken a closer consideration of relevant physical use of energy products by industries and by households. Monetary data contained here must be considered experimental in nature and figures contained in the national accounts remain the official estimates. Within the ABS, environmental-economic accountants are continuing to work closely with national accountants to improve estimates in both systems. In this respect, the upcoming ABS Energy, Water and Environment Survey, to be produced in respect of 2008–09, is expected to deliver a rich vein of information to carry these initial investigations forward. It is strongly anticipated that surveys of this type will in future deliver improved and consistent estimates within the energy account and the ASNA for these important data series.

3.1 AUSTRALIAN ENERGY USE, Experimental hybrid physical & monetary values—by selected energy products—2004–05

	COAL(a)		OIL & GAS(b)		PETROLEUM & COAL PRODUCTS(c)		URANIUM		ELECTRICITY(d)	
	Energy	*Monetary value*	*Energy*	*Monetary value*	*Energy*	*Monetary value*	*Energy*	*Monetary value*	*Energy*	*Monetary value*
	PJ	$m	PJ	$m	PJ	$m	PJ	$m	PJ	$m
Agriculture	—	—	—	29	94	2 071	—	—	6	95
Mining	7	259	156	577	126	3 122	—	—	69	800
Manufacturing										
Food, Beverages, Textiles	*9*	*30*	*33*	*488*	*24*	*298*	—	—	*25*	*645*
Wood, Paper, Printing	*12*	*36*	*20*	*210*	*11*	*261*	—	—	*20*	*351*
Chemicals	*13*	*37*	*1 684*	*16 240*	*124*	*1 551*	—	—	*22*	*536*
Iron & Steel	*175*	*402*	*25*	*257*	*105*	*205*	—	—	*28*	*434*
Non-ferrous metals	*64*	*147*	*147*	*845*	*60*	*75*	—	—	*175*	*736*
Other Manufacturing	*31*	*70*	*74*	*1 115*	*17*	*416*	—	—	*43*	*883*
Total Manufacturing	304	722	1 983	19 155	341	2 806	—	—	313	3 585
Electricity, Gas, Water	1 975	2 268	306	1 758	41	866	—	—	179	3 939
Construction	—	—	3	34	39	1 101	—	—	7	464
Transport										
Road	—	—	*3*	*43*	*196*	*5 049*	—	—	*4*	*120*
Rail	—	—	—	*12*	*31*	*575*	—	—	*8*	*238*
Air	—	—	—	*2*	*182*	*3 598*	—	—	—	*13*
Water	*6*	*12*	—	—	*49*	*467*	—	—	—	*3*
Total Transport	6	12	3	57	458	9 689	—	—	12	374
Other services										
Wholesale & Retail Trade	—	*1*	*15*	*393*	*80*	*2 898*	—	—	*29*	*987*
Accommodation(e)	—	—	*9*	*159*	*10*	*284*	—	—	*20*	*699*
Communication(f)	—	—	*10*	*166*	*108*	*3 080*	—	—	*55*	*1 898*
Other(g)	*4*	*4*	*10*	*170*	*55*	*1 436*	—	—	*55*	*1 869*
Total Other Services	4	5	44	888	253	7 698	—	—	159	5 453
Total intermediate use	*2 296*	*3 266*	*2 495*	*22 498*	*1 352*	*27 353*	—	—	*745*	*14 710*
Inventory changes	–151	–244	–44	–12	–35	–610	–80	–3	—	—
Households	1	26	128	2 078	560	15 975	—	—	215	7 818
Total domestic use	*2 146*	*3 048*	*2 579*	*24 564*	*1 877*	*42 718*	*–80*	*–3*	*960*	*22 528*
Exports	6 595	17 193	1 131	9 347	222	3 293	5 287	476	2	54
Total energy use	**8 741**	**20 241**	**3 710**	**33 911**	**2 099**	**46 011**	**5 207**	**473**	**962**	**22 582**

— nil or rounded to zero (including null cells)
(a) Includes black and brown coal and briquettes
(b) Includes crude oil and natural gas
(c) Includes propane, butane, LPG, refined petroleum products, liquid gas biofuels and coke
(d) Includes solar, wind, hydro, solar hot water and other electricity
(e) Includes Accommodation, Cafes & Restaurants
(f) Includes Communication Services, Finance & Insurance, Property & Business Services
(g) Includes Government Administration & Defence, Education, Health & Community Services, Cultural & Recreational Services, Personal & Other Services

Table 3.1 above shows that the great majority of coal produced in Australia in 2004–05 was exported and that implied prices for export coal were higher than for coal typically used in domestic industry applications. To a large extent this reflects the generally superior quality of exported coal, particularly in comparison to much of the coal used by Australian electricity producers (Owen, 2008). However, it should also be noted that significant quantities of coal used in Australia do not involve an explicit monetary

RESULTS AND ANALYSIS
continued

transfer, as there is no transaction between institutional units. For example, an electricity producer using coal deposits which it owns will typically not make an explicit payment for the coal used.

The use of oil and gas as described in the table above, combines two distinct energy products, namely: crude oil as an input to the production of refined products; and natural gas. However, domestic use of crude oil relates almost wholly to the chemical manufacturing industry. Table 3.1 shows that the very large physical users of gas have generally been able to secure lower implied prices for the supply of gas in comparison to household and service industries. The relatively low implied price paid by the mining industry mainly reflects the fact that significant quantities of natural gas are used within mining operations in the process of gas liquefaction.

'Petroleum and coal products' relates to combined petroleum products, diesel, LPG and coal products (principally coke) and, therefore, represents a somewhat heterogeneous grouping. It is, nevertheless, heavily dominated by petroleum and diesel and shows a strong degree of consistency in implied prices per PJ on energy product. This is expected, given the standard nature of these two products, their high energy-to-weight ratio and their relatively easy transportability and saleability.

In contrast, implied prices paid for electricity vary significantly between industries; most noticeably some manufacturing industries with large physical use, have considerably lower implied prices for this use. To a large extent, this result is explainable by the lower cost of supplying electricity to these large users, for example electricity is typically delivered to these customers at very high voltages; often the distance between the electricity generation plant and the manufacturing operation is (deliberately) small; and there are distinct advantages in supplying electricity to large customers with stable and predictable electricity requirements. Implied prices paid for electricity by households and by the service industries are relatively uniform.

Note that the electricity industry appears to be a significant user of its own output. This result must be interpreted with caution and is largely explained by the inclusion of electricity distribution margins within this industry under the 1993 edition of *ANZSIC*. This issue is discussed more fully in Appendix 1: Classifications and scope.

ENERGY INTENSITY

The energy intensity of an industry is a measure of the energy consumed to produce one unit of economic output. The principal unit used in the following graphs and commentary for each industry is gigajoules of energy consumed per million dollars of industry gross value added (GJ/$m IGVA). A high energy intensity figure does not necessarily imply that an industry is using energy inefficiently. By their nature, most industries engaged in physical transformation of raw materials will use more energy than service industries. Generally, energy intensity levels have fallen over time.

Falls in energy intensity in an economy or industry may be attributable to factors other than more efficient use of energy arising from technological improvements and/or energy price rises. It may indicate structural shifts in the economy as a whole or within industries, for example an economy moving from predominantly manufacturing activities to predominantly services. Within industries, a shift in emphasis from, say, light manufacturing to heavy industry, such as from fabrication to basic metals manufacturing, may increase energy intensity.

This chapter examines the energy intensity over 30 years to 2006–07 of the following industries:

- Agriculture, Forestry and Fishing
- Mining
- Manufacturing
- Construction
- Transport and Storage; and
- Other Services

Other Services corresponds to a broad grouping of eleven ANZSIC division level service industries. These industries have been grouped together because the energy consumption of each individually is relatively small and ABARE statistical coverage is not as detailed as for the other industries. Other Services corresponds to the grouping 'Commercial and Services' used in ABARE's *Australian Energy Statistics* and consists of the following ANZSIC divisions:

- Wholesale Trade
- Retail Trade
- Accommodation, Cafes and Restaurants
- Communication Services
- Finance and Insurance
- Property and Business Services
- Government Administration and Defence
- Education
- Health and Community Services
- Cultural and Recreational Services
- Personal and Other Services

Throughout this chapter, reference to a particular industry is by its abbreviated name; so for example, Agriculture, Forestry and Fishing is referred to simply as Agriculture.

The following analysis is based on the ratios of physical energy consumption statistics compiled by ABARE to industry gross value added (IGVA) data compiled by the ABS. Consumption data are based on Table F of ABARE's *Australian Energy Statistics*. ABS industry gross value added is from the *Australian System of National Accounts*

ENERGY INTENSITY *continued*

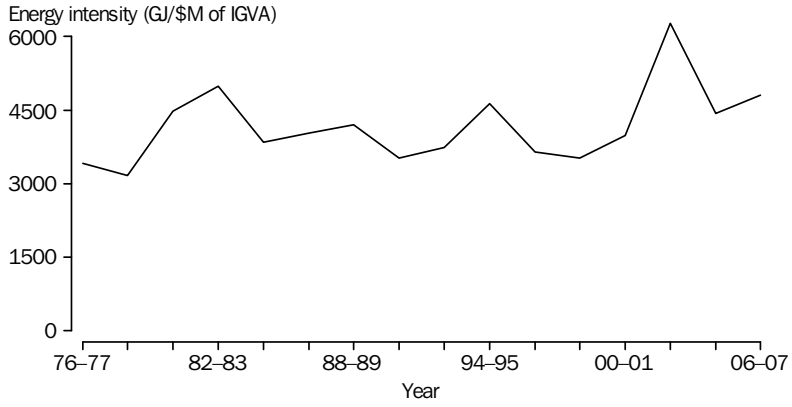
(cat. no. 5204.0) and are classified according to the *Australian and New Zealand Standard Industrial Classification (ANZSIC 1993)*.

Whilst ABARE's physical use statistics follow a similar classification system, consumption of transport fuels (petroleum, diesel and LPG) is assigned on the basis of activity, as opposed to industry of ownership. An important aspect of the energy account has been the reallocation of transport fuel use onto an industry of ownership basis. The energy consumption data used in this section has been adjusted in this way and has resulted in a significantly different view of physical fuel use by industry and households. For a fuller explanation of the methodology, refer to Appendix 4: Methodological Issues.

The principal unit used in this analysis is gigajoules (GJ) of energy. A gigajoule is roughly equivalent to the energy content of 29 litres of petrol or 280 kilowatt hours of electricity. The energy supply and use data presented in earlier chapters is in petajoules (PJ), which equates to one million gigajoules, and is typically used to measure national or industry energy production and consumption.

Agriculture

4.1 ENERGY INTENSITY, Agriculture, 1976–77 to 2006–07



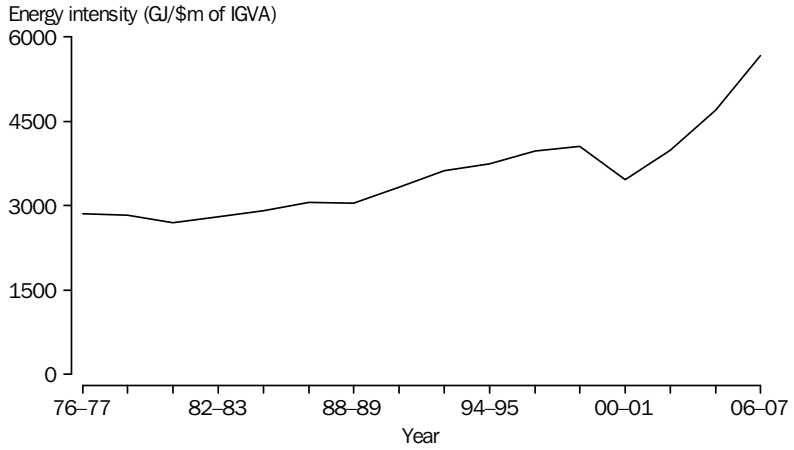
IGVA: Industry Gross Value Added

Energy consumption in Agriculture grew from 49 PJ in 1976–77 to 111 PJ in 2006–07, an increase of 125%. Over the same period, IGVA for Agriculture grew from $14.5 billion to $23.2 billion, or 60 per cent. This resulted in an overall increase in Agriculture energy intensity of 41% over the period (see graph 4.1).

The increase in energy intensity in 2002–03 coincided with severe drought conditions which caused a major decline in the volume of grain crops production (ABARE 2008a). Agriculture IGVA in that year fell almost 25% while farm costs were constant and energy consumption actually increased slightly (ABARE 2008a). Unlike some industries, agricultural energy consumption and output are not closely coupled. Major shifts in weather conditions and prices can impact significantly on Agriculture IGVA, obscuring long term trends in energy intensity.

Mining

4.2 ENERGY INTENSITY, Mining, 1976–77 to 2006–07



In contrast to other industries, energy intensity in Mining increased in most years and, overall, doubled to 5,633 GJ/$m IGVA (graph 4.2) in 2006–07. Energy consumption in mining grew very strongly from 74 PJ in 1976–77 to 461 PJ in 2006–07, an increase of 523% (see graph 4.3). Over the same period, IGVA grew 212% from $26.1 billion to $81.4 billion.

A number of factors contribute to the increase in energy intensity in Mining. Firstly, Australia's mining industry is increasingly dominated by coal, iron ore and bauxite. Together they now constitute 98% of tonnage extracted by the mining industry (excluding petroleum, gas and construction materials) (ABS 2009c). All three are relatively low value (dollar per tonne) commodities and require relatively high energy intensity because the energy required for extraction and beneficiation represents a higher proportion of the value of sales.

Coal production rose rapidly from 1987, coinciding with increased energy intensity for Mining. Coupled with this was the increasing proportion of production from open cut mines, which require the removal of huge quantities of overburden to expose the coal. Open cuts accounted for only 55% of production in 1980, but rose to 71% in 1997(PC 1998) and 77% in 2006–07 (ABARE 2008d). Also, the ratio of overburden removed to saleable coal production in Queensland (the state with the largest open cut producers) has increased in recent years (from 8:1 in 2002–03 to 9.2:1 in 2006–07) (QDME 2008), compounding the effect on energy intensity.

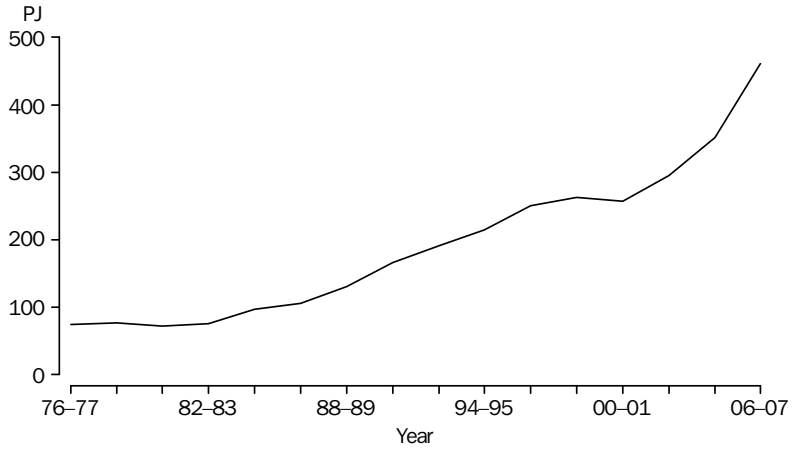
Iron ore production (which is all open cut) increased 78% between 2000–01 and 2006–07 (ABARE 2008a), the period of the largest increase in Mining energy intensity. With iron ore and coal production forecast to experience continued strong growth over the medium term, energy intensity in Mining is likely to continue increasing, albeit at a slower rate.

Other factors contributing to higher energy intensity are higher prices for base metals, gold, oil and natural gas and rapid growth in LNG production. From 2004 to the latter half of 2008, historically high prices for most mineral and energy commodities encouraged the mining of lower grade, less accessible deposits which require more energy to extract (ABARE 2008a). Also, Australian LNG exports almost doubled from

Mining continued

7.8 Mt in 2002–03 to 15.2 Mt in 2006–07 (ABARE 2008a). The liquefaction of natural gas to LNG requires significant amounts of energy. Whilst representing only a very small proportion of total mining production (by tonnage), increased LNG production has contributed to increased energy intensity.

4.3 ENERGY CONSUMPTION, Mining, 1976–77 to 2006–07

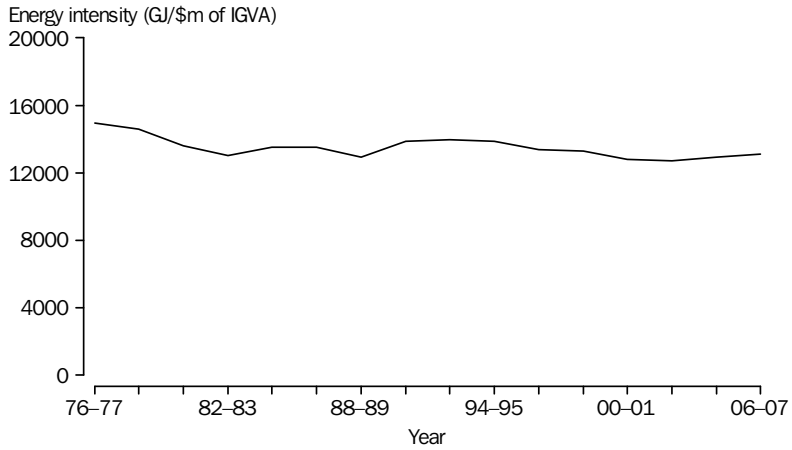


IMPLICATIONS OF A RAPIDLY EXPANDING MINING INDUSTRY

One of the potential consequences of the long-term depletion of Australia's mineral and energy reserves is that more energy will be required to produce a unit of physical output. In the case of crude oil, it is possible that future production will be at a higher real cost per unit of output, as oil is sourced from less accessible or smaller deposits. Even with further technological improvements in petroleum and minerals extraction and processing, mining of lower grade or less accessible deposits may entail increased energy input.

Manufacturing

4.4 ENERGY INTENSITY, Manufacturing, 1976–77 to 2006–07



Energy consumption in Manufacturing grew from 972 PJ in 1976–77 to 1,354 PJ in 2006–07, an increase of 39%. IGVA for the industry grew from $64.9 billion to $103.3 billion, a 59% increase over the period. As a result, energy intensity fell by 12% over the

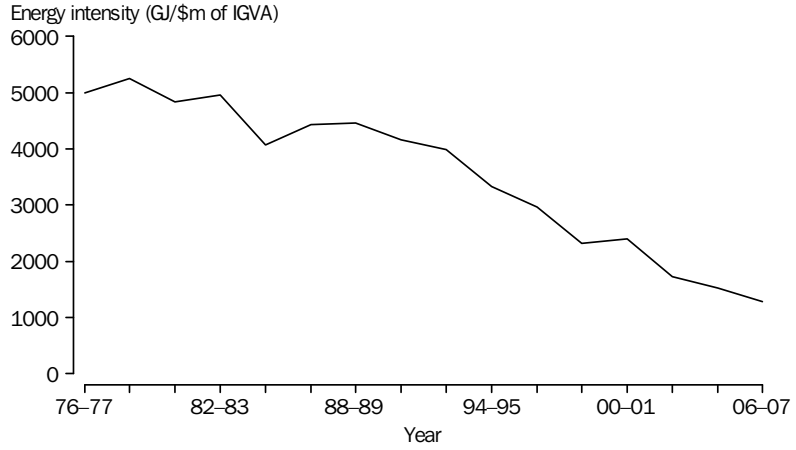
Manufacturing continued

30 year period. Figure 4.4 shows energy intensity falling most sharply in the late 1970s to early 1980s (Treasury 2006), which corresponds with a period of rapidly rising prices for petroleum products and resulting energy saving measures introduced by many manufacturers to contain costs.

In the last decade, energy intensity has trended downwards slightly, in line with an increasing proportion of manufacturing gross value added coming from machinery and equipment and other manufacturing. In the same period, the proportion of value added from the more energy-intensive subdivisions of petroleum and metal products fell slightly, from 34 to 32%, after increasing over the previous two decades (ABS 2008b).

Construction

4.5 ENERGY INTENSITY, Construction, 1976–77 to 2006–07



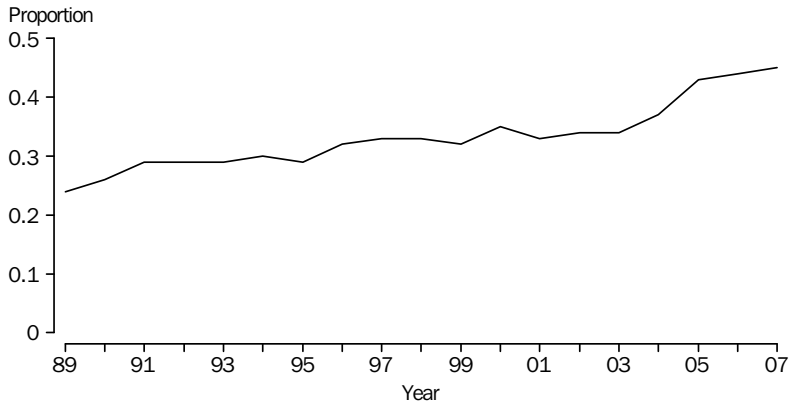
The Construction industry has experienced the largest proportional decline in energy intensity of all industries (see graph 4.5). Energy consumption declined by 32%, from 137 PJ in 1976–77 to 93 PJ in 2006–07. This reduction came notwithstanding a 165% increase in IGVA from $27.3 billion to $72.4 billion over the same period. Consequently, Construction industry energy intensity fell by 74%.

Construction industry energy intensity declined most noticeably from 1991–92 onwards, with a slight increase in 2000–01. This improvement coincided with significant increases in engineering construction's share of total construction IGVA (i.e. building and engineering construction). In the last 20 years engineering construction's share has risen from 30% to 44% of the total value of construction, largely driven by major growth in mining and minerals processing activity (ABS 2008c).

The slight increase in energy intensity in 2000–01 coincided with a stalling in engineering construction generally and a major downturn in new capital expenditure in mining and minerals products in 1999–00 and 2000–01 (ABARE 2008c). Since then, engineering construction has increased strongly each year (graph 4.6).

Construction continued

4.6 PROPORTION OF ENGINEERING CONSTRUCTION (a), 1989 to 2007



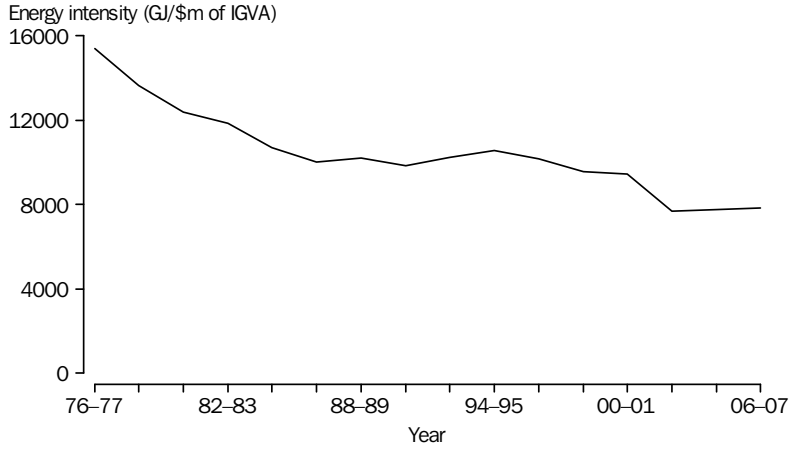
(a) of total Engineering and Building Construction IGVA

A possible explanation for the connection between engineering construction and lower energy intensity is that engineering construction relates to large, technically challenging projects utilising expensive componentry and techniques. The value added per unit of energy input could therefore be somewhat higher than for non-engineering construction.

A further explanation is that whilst ABS measurement of engineering construction activity endeavours to exclude the value of equipment being installed in construction (it should already be included in manufacturing or import activity), in large minerals and energy exploration, mining and processing projects, significant phases of construction would include the assembling of expensive components. Some of the cost of these components may, unavoidably, be included in construction activity statistics. If so, this would have the effect of inflating Construction industry gross value added, and deflating energy intensity figures.

Transport

4.7 ENERGY INTENSITY, Transport, 1976–77 to 2006–07



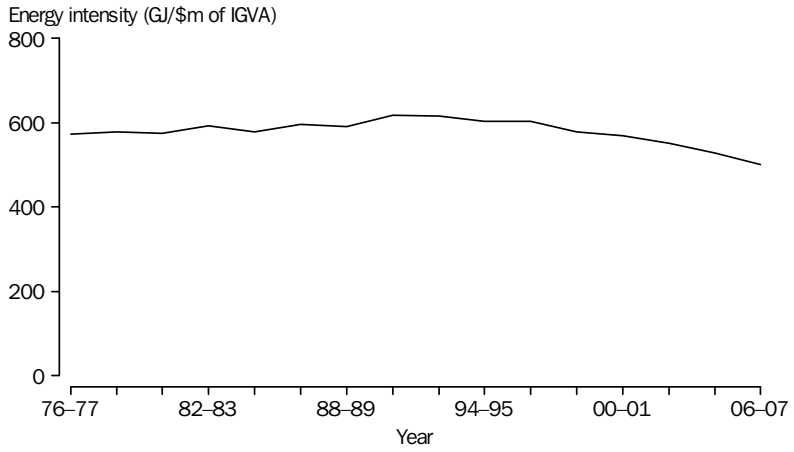
Energy consumption in the Transport industry increased 66% from 229 PJ in 1976–77 to 379 PJ in 2006–07. Over the same period, IGVA increased by 225% to $48.4 billion,

Transport continued

resulting in a decrease in energy intensity of 49% (graph 4.7). Most of the reduction in energy intensity was achieved in the first decade of the reference period, which coincides with a period of large increases in real fuel prices (Treasury 2006). From 1986–87 to 2000–01 energy intensity was relatively static, in line with flat real fuel prices. Between 2000–01 to 2002–03 energy intensity dropped again and then stabilised at just under 8,000 GJ/$m of IGVA. In absolute terms, Transport attained significantly greater declines in energy intensity than other industries. This result is expected given that transport operating costs are dominated by fuel costs. The end of very low fuel prices in Australia in the late 1970s provided the impetus for the adoption of more efficient engines which, in turn, contributed to lower fuel intensity.

Other Services

4.8 ENERGY INTENSITY, Other services, 1976–77 to 2006–07



Energy consumption in the 11 industries constituting Other Services increased 171% from 98 PJ in 1976–77 to 266 PJ in 2006–07. Over the same period, IGVA increased by 209% to $530.6 billion. This resulted in a decrease in energy intensity of 13%, most of which occurred from 1997–98 onwards when a consistent downward trend emerged (graph 4.8).

Other Services has the lowest energy intensity of any industry and is around 4% of Manufacturing, which has the highest energy intensity. This is expected as little physical production is involved and the vast bulk of energy consumed relates to lighting, heating, cooling, operation of office equipment and, in some industries, refrigeration and cooking. The very low GJ/$m IGVA indicates that energy constitutes a very small proportion of total costs for Other Services industries. Therefore, the financial incentive to use less energy is not as strong as for other industries. This raises the question of why energy intensity in these industries has fallen in the last decade. Possible reasons include the adoption of more energy efficient lighting, and heating/cooling and, possibly more importantly, outsourcing of labour intensive activities (e.g. call centres) and the reduction in the number of outlets such as banks branches and service stations. These cost cutting trends are not driven by an urgent need to reduce energy costs. However, because they reduce the need for office and building space they have the attendant effect of keeping energy consumption low.

INTRODUCTION

Australia is one of the world's leading producers of energy resources. It has the world's largest economic demonstrated resources of brown coal and uranium, is the world's largest exporter of black coal (IEA 2008a), and has significant petroleum reserves such as natural gas, LPG and coal seam methane. This chapter presents information about the physical stock and economic value of Australia's energy resources.

Energy is a vital input to all sectors of the economy. As well as supplying power on which industry and households depend, the production and supply of energy provides employment, investment and export opportunities, all of which contribute substantially to the welfare and standard of living of Australians. In 2007, the value of Australia's exports of mineral and energy commodities (excluding petroleum and gas) was $90.5 billion, which represented approximately 42% of the value of total exports of goods and services from Australia.

Energy resources can be divided into two groups - renewable (energy resources for which the supply is essentially considered inexhaustible) and non-renewable (energy resources with a finite supply). Renewable energy resources include solar, wind, hydroelectricity, geothermal and biomass. However, most of Australia's energy supply is derived from non-renewable fuels such as oil, natural gas, coal, and uranium.

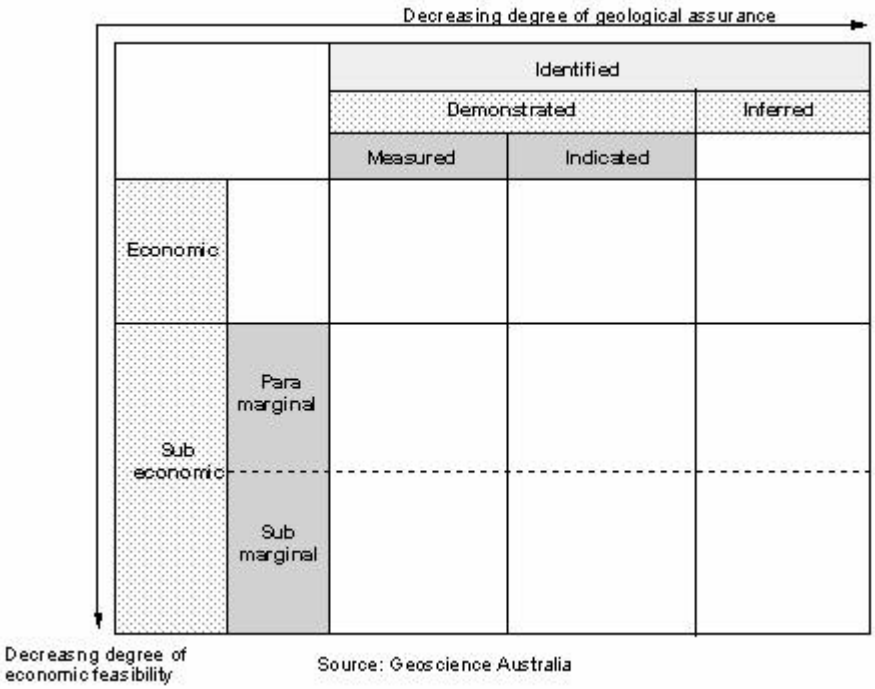
A number of factors will affect the rate of depletion of non-renewable energy stocks. Most significantly, the International Energy Agency predicts world primary energy demand could expand by 45% between 2006 and 2030. It also predicts that the demand for coal will rise faster than for any other fuel (IEA 2008b).

The ability of Australia's resources sector to meet this demand will be largely dependent on the discovery and development of new high yielding mineral and energy deposits, as well as technological advancements. It is likely that future oil and mineral production will be sourced from deeper, more remote or more difficult locations. This is likely to affect the cost of developing these resources, with economic viability dependent on prevailing world energy prices. It may also place greater stress on the natural environment in terms of overburden and mine tailings produced, and water and energy inputs required.

McKelvey Box

The ABS has adopted the same classification used by Geoscience Australia to assign a rating of economic feasibility and geological assurance to mineral and energy resources. Geoscience Australia uses an adapted version of the McKelvey Box which is illustrated in diagram 5.1.

5.1 MCKELVEY BOX AS ADAPTED BY GEOSCIENCE AUSTRALIA



Source: Geoscience Australia

The resource categories shown in diagram 5.1 are defined as follows:

Economic demonstrated resources (EDR) are resources judged to be economically extractable and for which the quantity and quality are computed partly from specific measurements, and partly from extrapolation for a reasonable physical distance on geological evidence.

Subeconomic demonstrated resources (SDR) are similar to economic demonstrated resources in terms of certainty of occurrence and, although considered to be potentially economic in the foreseeable future, these resources are judged to be sub-economic at present.

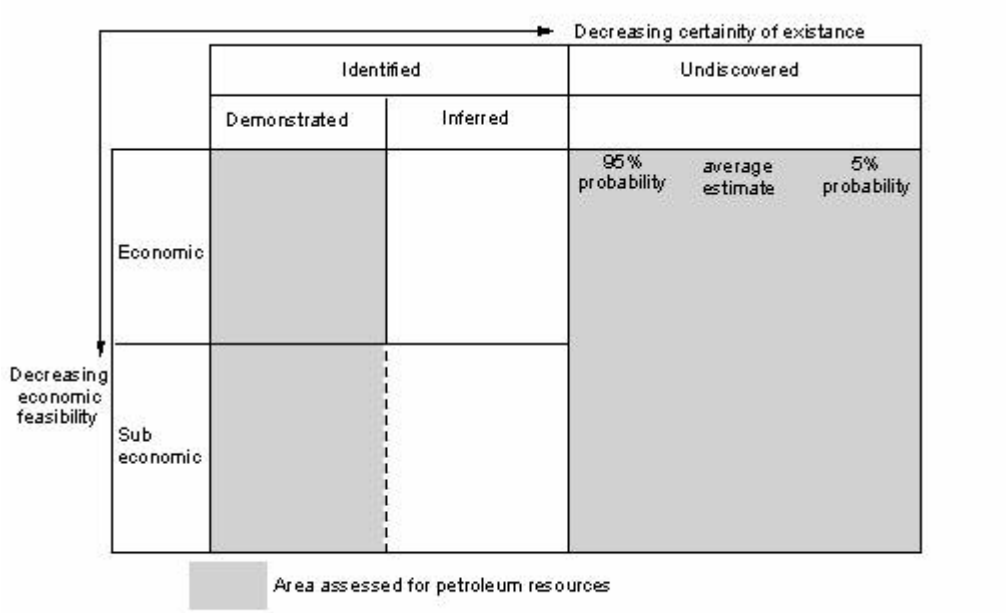
Inferred resources (IFR) are mineral resources for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition for which there is geological evidence. This evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geological evidence of their presence.

Petroleum resources are rated somewhat differently and are categorised using EDR, SDR and undiscovered resources (diagram 5.2). IFR are not used because this category relates to resources which have a low degree of geological assurance. Undiscovered

McKelvey Box continued

resources relate to the possibility of discovery in an area (and thus are presented with probabilities), independent of whether there are known accumulations in the area.

5.2 MCKELVEY BOX ADAPTED FOR PETROLEUM RESOURCES



Source: Geoscience Australia

CHANGE IN ENERGY RESOURCE

Table 5.3 uses the adapted McKelvey Box classification to present details of Australia's energy resources at a national level, for both energy bearing minerals and petroleum, for the calendar years 2002 to 2007. Data are sourced from Geoscience Australia and have been converted from their original units of quantity or volume to PJ using indicative conversion factors and advice provided by ABARE. Note that these conversion factors are averages only, since fuel quality can vary with location, air pressure and temperature. This should be taken into account when analysing the data.

CHANGE IN ENERGY RESOURCE *continued*

5.3 ENERGY RESOURCES, as at 31 December

	2002	*2003*	*2004*	*2005*	*2006*	*2007*
	PJ	PJ	PJ	PJ	PJ	PJ
BLACK COAL						
EDR	1 131 450	1 091 550	1 151 400	1 117 200	1 128 600	1 108 650
SDR	396 150	396 150	324 900	310 650	262 200	253 650
IFR	1 504 800	1 490 550	1 501 950	1 624 500	1 678 650	1 755 600
BROWN COAL						
EDR	364 720	363 750	363 750	362 780	361 810	361 810
SDR	536 410	536 410	536 410	536 410	536 410	536 410
IFR	998 130	977 760	977 760	977 760	977 760	977 760
URANIUM						
EDR	385 840	378 000	392 560	400 960	399 840	550 480
SDR	25 760	26 320	25 760	17 920	6 720	5 600
IFR	180 880	185 920	221 760	248 080	290 080	347 760
CRUDE OIL						
EDR	6 512	6 919	6 364	6 401	5 957	5 920
SDR	2 516	2 923	2 553	3 552	3 367	2 997
CONDENSATE						
EDR	10 212	10 508	9 805	9 546	8 843	8 399
SDR	4 033	4 181	4 329	5 402	5 550	7 659
LPG						
EDR	7 261	6 228	5 936	5 671	5 486	5 062
SDR	2 094	2 067	2 067	2 067	2 067	2 067
NATURAL GAS						
EDR	101 120	103 760	96 120	97 160	97 840	94 080
SDR	60 720	60 160	62 680	75 440	83 320	92 560
TOTAL ENERGY RESOURCES						
EDR	**2 007 115**	**1 960 715**	**2 025 935**	**1 999 718**	**2 008 376**	**2 134 401**
SDR	**1 027 683**	**1 028 211**	**958 699**	**951 441**	**899 634**	**900 943**

Black coal can be found in all states of Australia, however the majority of recoverable EDR are in Queensland and New South Wales. Black coal is commonly used as a fuel in electricity generation, as well as to produce coke for steel making. Australia's EDR of black coal remained relatively stable over the period 2002 to 2007, largely because annual production is comparatively small (8650 PJ in 2006–07) when compared to the vast reserves in existence.

Brown coal (also known as lignite) has a moisture content of around 60%, and is primarily mined in Victoria. Brown coal is commonly used in power generation, converted to liquid or gaseous fuels or formed into briquettes. Over the period 2002 to 2007, stocks of brown coal also remained relatively stable. Like black coal, this can be

CHANGE IN ENERGY RESOURCE *continued*

attributed to the extent of recoverable reserves relative to annual production (644 PJ in 2006–07).

Uranium is predominantly used to fuel nuclear power reactors, but has medical and other applications. Australia's EDR of uranium rose 43% over the period 2002 to 2007, to 550,480 PJ. Within this period, the largest increase was from 2006 to 2007 (38%). This was predominantly due to large increases in resource estimates for the Olympic Dam deposit in South Australia.

Australia's petroleum resources include crude oil, LPG, condensate and natural gas. The majority of these resources are located in the Carnarvon and Bonaparte basins in Western Australia, and the Gippsland Basin in Victoria. Over the period 2002 to 2007 EDR of all these resources fell: crude oil by 9%, condensate by 18%, LPG by 35% and natural gas by 7%. Decreases in oil and gas reserves are typically due to production exceeding discoveries over the period.

National balance sheets

Where energy assets satisfy the conditions of an 'economic asset' (i.e. economic demonstrated resources), SNA requires that monetary estimates of these assets be included in the national balance sheet. Monetary estimates of energy and mineral resource assets are available as a complement to the physical resource information; the most recent ASNA provides relevant estimates. As well as providing an estimate of the monetary value of Australia's energy assets, these balance sheet estimates provide the basis for estimates of natural resource depletion arising from the physical extraction of energy assets.

National accounts include the value of goods and services produced and the income generated through the use of environmental assets, but do not reflect the economic cost of depleting these assets or the damage that arises from economic activity. There exists an asymmetry in the SNA between the treatment of produced assets, such as buildings, and environmental assets (such as energy resources). Depreciation of produced assets (termed consumption of fixed capital in the national accounts) is deducted to derive various 'net' income measures in the national accounts such as net domestic product (NDP), net operating surplus (NOS), net national income and net saving. No similar deduction is made for environmental assets when they are depleted up or degraded as a result of economic activity. SEEA recognises this asymmetry and outlines methods to present major national accounting aggregates on a basis that accounts for depletion of environmental assets, including energy assets.

Net Present Value

Table 5.4 shows the net present value (NPV) of economic demonstrated energy assets within Australia. The NPV is the expected value of the resource based on current resource prices, current extraction methods and costs, and on present physical rates of extraction. At 30 June 2007, total subsoil assets had a NPV of $345.8 billion of which 59% was attributed to the NPV of energy assets ($204.2 billion). In addition, the two most significant energy assets were black coal and natural gas which accounted for 35% and 32% of total NPV of energy assets, respectively.

Table 5.4 shows a 57% increase in the value of energy assets over the period 2000 to 2007. The increase in the value of energy resources was due largely to increases in the value of black coal and crude oil.

5.4 NET PRESENT VALUE OF ENERGY ASSETS, by resource type—as at 30 June

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
	$m	$m	$m	$m	$m	$m	$m	$m
Black coal	36 310	43 491	42 191	41 320	45 435	52 431	63 612	70 651
Brown coal	589	682	739	715	707	708	701	670
Uranium	2 210	1 991	2 263	2 256	1 811	1 919	2 012	2 168
Crude oil	14 860	18 980	20 323	21 811	22 854	26 134	31 891	35 811
Condensate	10 575	11 071	12 605	13 522	16 952	17 912	19 632	19 734
LPG	5 720	7 464	8 408	8 822	9 757	9 713	10 217	10 451
Natural gas	59 436	60 214	58 657	58 793	63 801	66 530	65 486	64 683
Total energy assets	**129 700**	**143 893**	**145 186**	**147 239**	**161 317**	**175 347**	**193 551**	**204 168**

Source: Australian System of National Accounts (cat. No. 5204.0) 2006–07, Table 84 (only available from web www.abs.gov.au)

APPENDIX 1 CLASSIFICATIONS AND SCOPE

ENERGY PRODUCTS

The scope of this publication is effectively determined by the range of products (goods and services) defined as 'energy products'. With minor exceptions, the product classification used in this publication for physical measures of energy products follows that used in ABARE's *Australian Energy Statistics*. The categories of energy product used in *Australian Energy Statistics* are:

- Black coal
- Brown coal
- Briquettes
- Metallurgical coke
- Coal by-products
- Natural gas
- Crude oil and other refinery feedstock
- Propane, butane, LPG
- Refined products (petrol, diesel, aviation fuel, etc.)
- Liquid / gas biofuels
- Biomass wood
- Biomass bagasse
- Electricity
  - solar/wind electricity
  - hydro-electricity
- Solar hot water
- Uranium

This publication excludes solvents, lubricants, grease and bitumen.

Physical energy products are not always accompanied by a monetary transaction, since in many such cases the economic unit supplying the energy is the same unit consuming the energy. For example, an electricity producer may own the coal deposit used to produce electricity at its power station. Use of bagasse and biomass wood are also typically not accompanied by monetary flows. Also, while there is a capital cost associated with solar hot water systems, there are no monetary flows related to solar energy captured by these systems.

INDUSTRY CLASSIFICATION

Industry classifications used in this publication generally follow the 1993 edition of the *Australian and New Zealand Standard Industrial Classification* (ANZSIC). However, ABARE's *Australian Energy Statistics* uses a different industry classification to present supply and use of energy products by Australian industry. The table below shows the industries used in Table A of *Australian Energy Statistics* alongside corresponding groups of ANZSIC industries.

INDUSTRY CLASSIFICATION *continued*

A1.1 CORRESPONDENCE BETWEEN INDUSTRY CLASSIFICATION USED, Australian Energy Statistics and ANZSIC93.

Australian Energy Statistics	*ANZSIC93 equivalent*
Agriculture	Division A (Agriculture)
Mining	Division B (Mining)
Manufacturing	
Food, Beverages & Textile	Sub Divisions 21 and 22
Wood, Paper & Printing	Sub Divisions 23 and 24
Chemicals	Sub Division 25
Iron & Steel	Group 271
Basic Non-ferrous Metal	Group 272
Other Industry	Sub Divisions, 26, 28 and 29 and groups 273, 274, 275 and 276
Construction	Division E (Construction)
Road Transport(a)	Sub Divisions 61 and 67 and Group 661
Rail Transport(a)	Sub Divisions 62 and 67
Air Transport(a)	Sub Divisions 64 and 67 and Group 663
Water Transport	Sub Divisions 63 and 67 and Group 662
Commercial & Services	Sub divisions F, G, H, J, K, L, M, N, O, P and Q.

(a) ABARE categories of transport (road, rail, air) include associated services to transport, including relevant storage services.

Note: ABARE industry classification used in Table A1 of *Australian Energy Statistics* varies over time. The classification attributed to ABARE here is based on the 2004-05 version of Table A1 of *Australian Energy Statistics*.

A challenging aspect for any statistical classification is to preserve continuity while remaining contemporary. This is especially true for the electricity and gas supply industries in Australia, which have undergone significant change in recent years. These industries are less vertically integrated than was previously the case; generation, transmission, distribution and retail operations are now often undertaken by separate business entities. In addition, considerable interest now attaches to the way in which electricity is generated and in particular to what degree renewable sources are being used in production.

Normally, distribution margins are listed in supply and use tables as service products in their own right, though they also form part of the value of the underlying good as far as the purchaser of the good is concerned. Supply and use tables typically distinguish between the 'basic price' and the 'purchasers' price' of products. The basic price is relevant to the producer or the importer of the product and represents the factory gate or landed value of a product. Trade and transport margins and taxes on products (such as GST) must be added to get to the value paid by the purchaser.

Margins for the electricity supply industry are set as zero, while the electricity industry also records very substantial usage levels of electricity. Some of the latter relates to consumption of electricity as part of electricity production processes, but most can be attributed to trading entities which simply purchase electricity from generating entities and on sell to consumers. This represents margin activity not separately identified as a margin. This asymmetry is due to all activities in the electricity industry (generation, transmission & distribution) falling within the one ANZSIC class, under the 1993 edition of ANZSIC. Under the 2006 edition of ANZSIC, these activities will be separately recorded, and a new 'electricity margin' table will be able to be created (in effect, shifting the margin out of basic prices into margin activity). This new treatment will resolve the asymmetry between electricity 'margins' and other margin activity in the accounts.

APPENDIX 2 DATA SOURCES

INTRODUCTION

Estimates contained in this publication are drawn from a wide range of data sources; both ABS and non-ABS. These sources have been used in a variety of ways, including: directly in the estimates of the Energy Account; forming part of validation processes; and in building methodologies to generate estimates on the required basis. An example of the latter would be the use of ABS Survey of Motor Vehicle Usage data to convert use of refined fuels from an activity basis (as recorded in ABARE's *Australian Energy Statistics*) to an ANZSIC industry basis.

In addition to survey data, various other forms of information were used to support estimation methodologies and to challenge various estimates and assumptions. This information was taken from a wide range of sources including research papers, annual reports, government reports and that information publicly available on reputable websites.

The following describes briefly the major data sources used in this publication.

Non-ABS sources

AUSTRALIAN ENERGY STATISTICS

Data on the physical supply and use of energy products are derived from the Australian Bureau of Agricultural and Resource Economics' (ABARE) *Australian Energy Statistics*. In particular, use has been made of the following tables in *Australian Energy Statistics*: Table F– Australian energy consumption by industry and fuel type; and Table A–Australian energy supply and disposal. Most tables within the *Australian Energy Statistics* present a lengthy time series of data.

Estimates of energy supply and use contained in *Australian Energy Statistics* are principally sourced from ABARE's 'Fuel and Electricity Survey', though a considerable amount of information is derived from other primary sources, such as industry associations, published company reports, and other government sources. Where appropriate, ABARE also makes use of information from secondary sources including research reports. To enable the balancing of energy supply and use, additional ABARE estimates underpin aspects of *Australian Energy Statistics*.

AUSTRALIA'S IDENTIFIED MINERAL RESOURCES

Geoscience Australia produces an annual nation-wide assessment of physical mineral resource stocks. In particular it takes a long term view of which mineral resources stocks are potentially economic and which stocks have an inferred economic value. In *Energy Account, Australia*, physical energy stock data for non-petroleum fuels are sourced from *Australia's Identified Mineral Resources*.

OIL AND GAS RESOURCES OF AUSTRALIA

This publication, also produced by Geoscience Australia, is a comprehensive assessment of exploration, development and production of Australia's petroleum resources. It contains data related to physical measures of production, exploration, reserves, undiscovered resources, coalbed methane resources, crude oil and shale oil. In *Energy Account, Australia* data relating to physical stocks of oil and gas is sourced from *Oil and Gas Resources of Australia*.

ABS sources

AUSTRALIA NATIONAL ACCOUNTS: INPUT-OUTPUT TABLES

Input-Output Tables are part of the *Australian System of National Accounts*. They are an important statistical product in their own right, but they also support and complement the quarterly and annual series of national income, expenditure and product aggregates. Input-Output Tables provide detailed monetary information about the supply and use of products in the Australian economy and about the structure of and interrelationships between Australian industries. Data from the most recent Input-Output Tables (2004–05) provide the degree of product detail needed to support work on integrating monetary and physical measures of supply and use of energy products. Input-Output information

ABS sources continued

used in *Energy Account, Australia*, include both published (cat. no. 5209.0.55.001) and unpublished data series.

AUSTRALIAN SYSTEM OF NATIONAL ACCOUNTS

The *Australian System of National Accounts* (ASNA - cat. no. 5204.0) provides a comprehensive, cohesive and integrated set of estimates for key aspects of the Australian economy. *Energy Account, Australia* uses estimates of gross value added by industry (in chain volume terms) to derive estimates of energy intensity by industry. Unpublished data from the ASNA on household expenditure on fuels have also been used - both directly in publication tables, and also as a basis to confront and validate other data.

The balance sheet of the ASNA produces monetary data on net present value (NPV) of economically demonstrated natural resource assets, including measures of various energy assets such as coal, uranium, oil and gas. These data have been included in *Energy Account, Australia*.

ABS ECONOMIC ACTIVITY SURVEY (EAS)

The ABS conducts an economy-wide annual business economic activity survey, EAS, covering most non-general government units. Data directly collected through the EAS are combined with income tax data provided by businesses to the Australian Taxation Office (ATO) to create a comprehensive data source. The EAS collects a range of data, including details on business income, expenses and capital formation. In particular, EAS collects some information on energy-related expenses of Australian business, which was used in this publication.

ABS HOUSEHOLD EXPENDITURE SURVEY (HES)

The *Household Expenditure Survey* (cat. no. 6535.0.55.001) presents detailed information about expenditure, income and characteristics of households resident in private dwellings throughout Australia, most recently in respect of 2003–04. HES is an input to various estimates of household final consumption expenditure in the national accounts. In *Energy Account, Australia*, HES data was used mainly in estimating and verifying household spending on certain energy products.

BALANCE OF PAYMENTS AND INTERNATIONAL TRADE

The ABS compiles statistics on the import and export of goods using information supplied by exporters and importers (or their agents) to the Australian Custom Service (ACS). Export and import data extracted from the Balance of Payments and International Trade systems forms the basis for estimates of imports and exports in the ASNA and also in *Energy Account, Australia*.

SURVEY OF MOTOR VEHICLE USE, AUSTRALIA (SMVU)

The *Survey of Motor Vehicle Use, Australia* (cat. no. 9208.0) presents data on use of passenger vehicles, motor cycles, trucks and buses for such variables as distance travelled, tonne-kilometres and fuel consumption. Most recent data relate to the period 1 November 2005 to 31 October 2006. In *Energy Account, Australia* information from SMVU was the primary basis for converting activity-based estimates of fuel use in ABARE's *Australian Energy Statistics* to an ANZSIC industry view of fuel use.

Other data sources

A range of other data was used in the *Energy Account, Australia* either; directly, for validation, or as an input to developing estimation methodologies.

The following additional ABS data sources were used: *Government Financial Statistics* (cat. no. 5512.0); *Government Financial Estimates, Australia* (cat. no. 5501.0.55.001); *Road Freight Transport Activity Survey* (cat. no. 9107.0); *Average Retail Prices of Selected Items* (cat. no. 6403.0); and *Consumer Price Index, Australia* (cat. no. 6401.0).

Other data sources continued

Other non-ABS data sources used include: Energy Use in Commonwealth Operations (Department of Industry, Tourism and Resources); Energy Use in the Australian Government's Operations (Australian Greenhouse Office); Energy grants credits scheme (Australian Taxation Office); FUELtrac (Independent Solutions); Australian Petroleum Statistics (Department of Resources, Energy & Tourism); National Road and Motorists Association (NRMA); and Royal Automobile Club of Queensland. Energy conversion factors used in the Energy Account are as published in *Australian Energy: National and State Projection to 2029-30* (ABARE).

APPENDIX 3 FRAMEWORKS AND CONCEPTS

ENVIRONMENTAL ACCOUNTING FRAMEWORK

The energy account integrates environmental and economic data following guidelines set out in the *System of Integrated Environmental Economic Accounting (SEEA)* which is a satellite system of the *System of National Accounts (SNA)*. Environmental accounts extend the boundaries of *SNA* accounting to include environmental stocks and flows not considered by conventional *SNA* accounting.

SUPPLY AND USE FRAMEWORK

The supply and use tables, which are a cornerstone of the *Australian System of National Accounts*, provide the data framework for the *Energy Account, Australia*. The supply table records the total supply of energy products within the economy (including imports) and the use table records the total use of energy products within the economy (including households) and for export. The supply and use tables can be compiled in both physical and monetary terms. In this publication,

Supply is composed of:

- Domestic production (by industry)
- Imports

Use is composed of:

- Household use
- Industry intermediate use
- Inventory changes
- Exports

The supply and use methodology is based on the fundamental economic identity that supply of products equals use. A feature of the supply and use system is that the supply and use of each product are, as far as possible, independently calculated. A systematic process of data confrontation is used to resolve discrepancies between supply and use. This generally involves making choices about which components are based on the most suitable and reliable data.

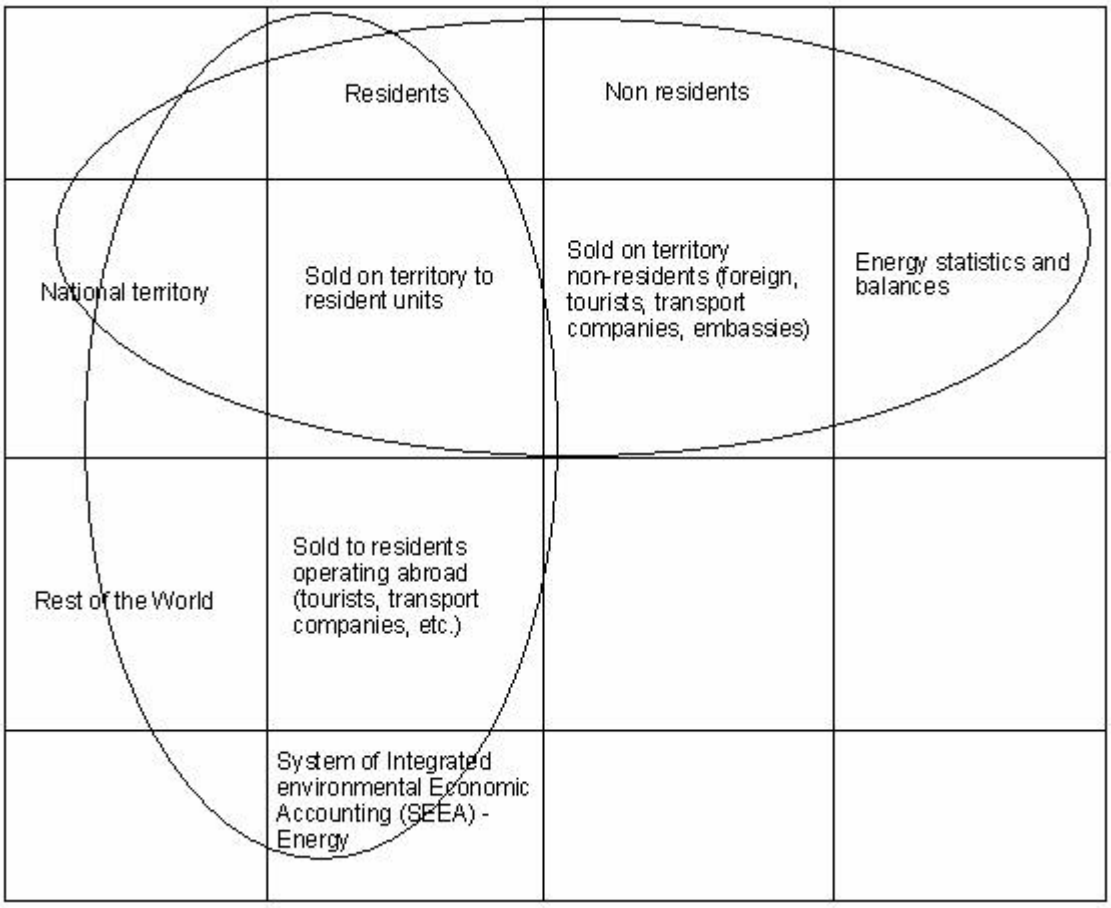
ENERGY BALANCES VERSUS ENERGY ACCOUNTS

Energy balances provide a complete overview of the physical production and consumption of energy on a national level. The ASNA records all monetary flows associated with energy (production of energy, intermediate use by industries, final use by households and by government, imports, exports, etc.). Ideally, data from the physical energy balances would be consistent with the monetary data from the national accounts. However, differences in classifications and definitions generally make a direct comparison between the two data sets very difficult. For example, source data information for these two sets of statistics usually originate from two distinct data environments and this has the potential to create a range of issues. Problems may arise, for example, by use of different product and industry classifications, differences in the sample size of underlying surveys, consistency procedures and so on. Another important difference is that energy balances are based on the territory principle, while national accounts are based on the residence principle. This is a key difference and is discussed in detail below.

In order to provide consistent physical and monetary statistics for energy, this publication uses a consistent framework in which energy data, in both monetary and physical terms, have been integrated into the national accounting framework. The supply and use tables provide an overall accounting structure for both monetary values and physical quantities of energy flows and stocks.

RESIDENCE PRINCIPLE

As mentioned above, the national accounts and the energy accounts are based on the residence principle, whereas energy balances are based on the territory principle. Accordingly, in energy accounts all economic units or entities of a country are included regardless of whether they are operating within the national territory or abroad. For example, energy purchased by Australian residents while operating abroad is taken into account - for example, bunkering of gasoline and fuel oil by ships and the purchase of motor fuels by tourists abroad are included. In the national accounts and the energy accounts, these types of purchases are recorded as imports. These types of transactions, where purchased by non-residents operating within Australia, are recorded as exports. Both imports and exports of energy are shown separately in the energy accounts.



Source: System of Integrated Environmental Economic Accounting (SEEA) - Energy (draft, as at 2008)

BUNKERING

In the energy balances, bunkering refers to the supply of petroleum products to ships and aircraft engaged in international transport services. These are essentially purchases of jet fuel by airlines and of fuel oil and diesel by shipping operators. Bunkering is not recorded as a separate category in the energy account. Supply to national companies is part of the intermediate use by water transport and air transport, while supply to foreign companies (sea vessels, aircraft) is part of exports. Where Australian operators purchase fuel from overseas bunkers (for their aircraft or vessels), these purchases are treated as fuel imports in the energy account. This accords with the national accounts residence principle, described above. In contrast, energy balances make no distinction between supply of fuel from a bunker to resident companies or foreign companies.

RELATING PHYSICAL AND MONETARY FLOWS

Energy accounts show the physical flows of energy products bought and sold. This is not always the same as the quantities of energy produced and used within a business unit or an industry because internal use (i.e. energy produced and used within the same business unit) has no corresponding monetary transaction. For example, co-generation of energy, such as typically occurs in steel manufacturing, involves physical energy flows but no corresponding monetary flow. Also, in some cases, energy used in production is drawn from energy assets owned by the producer - again the physical flow of energy is not matched with an explicit monetary flow. This would be the case, for example, where an electricity producer uses its own coal reserves to produce electricity. This is thought to be particularly true for renewable energy sources as these are often first applied for own use, for example, with much of biomass wood and bagasse production and use.

GROSS ENERGY FLOW ACCOUNTS

Gross energy flow accounts provide a detailed overview of all energy flows occurring within the national economy. Physical data can be combined with price information to calculate monetary energy values, which can then be used to analyse differentials in unit prices paid by industry for various energy commodities and can be used to improve monetary data in the national accounts.

The gross energy flow accounts, however, have an important disadvantage. In any aggregation of data by industry/energy carrier, totals will be subject to double counting. When primary energy sources are converted into secondary energy sources (for example the conversion of coal into electricity) some energy products are double counted with respect to the total energy use or total energy production of industries or the whole economy. The total gross energy use by industry is therefore not equal to the total 'net' energy consumption, which is the energy that is consumed for 'final purposes' and can no longer be used for any other energy purposes. In practice, differences between gross and net flows tend to be significant only for that small number of industries undertaking significant energy conversion, such as suppliers of secondary energy products.

Like the monetary supply and use tables of the national accounts, the supply and use of each energy product is balanced. Thus, the main accounting identity underlying the gross flow accounts for energy is the following:

Imports + Domestic production = Exports + Intermediate use + Final use by consumers - Inventory changes

The energy flows are recorded in both physical and monetary terms. The gross energy accounts are thus hybrid accounts as described in chapter four of *SEEA-2003*. Gross energy accounts are fully consistent with national accounting principles and with relevant monetary measures from the national accounts.

NET ENERGY FLOW ACCOUNTS

Net energy flow accounts only record energy 'entering' the economy (imports and extraction) and energy “leaving” the economy (exports, energy used for final purposes and energy losses upon conversion processes). The supply table of the net energy flow accounts shows the different energy products extracted within a country, supplied from the rest of the world (imports), along with inventory changes. The use table shows the different energy products actually consumed for final purposes (final use of energy plus energy losses due to conversions) and supplied to the rest of the world (exports). In contrast to the gross energy accounts, there is no double counting. The main accounting identity underlying the net flow accounts for energy is the following:

Imports + Direct Extraction = Exports + Final use of energy + Energy losses due to conversions - Inventory changes

However, this accounting identity is only valid for the sum of all energy products in the economy and not for individual energy products.

Monetary transactions related to the supply and use of energy products are essentially 'gross' in nature. That is, monetary use of an energy product will reflect the full sequence

NET ENERGY FLOW ACCOUNTS *continued*

of monetary transactions involved in the supply of the product to its final user. For example, the final price paid for the electricity will reflect, at least in part, any coal, gas etc. purchased and used in generating the electricity for sale.

ACTIVITY VS. OWNERSHIP (ANZSIC) INDUSTRY BASES

ANZSIC is the industry classification system used by the ABS. It provides a standard framework under which units carrying out similar productive activities can be grouped together, with resultant groups being referred to as industries. The term industry is used in its widest context, covering the full range of economic activities undertaken to produce both goods and services. Each individual industry class is defined in terms of a specified range of activities.

It is common for a business unit to engage in a range of activities wider than those designated as belonging to a particular class, and when this occurs the unit is classified based on its predominant activity, that is, the activity with the highest value-added. Activities undertaken which belong to classes other than that to which the unit is classified, are described as its secondary activities. The secondary activities of the unit play no part in assigning the industry to which the unit is classified.

An important characteristic of *Energy Account, Australia* (and the ASNA) is that energy production and energy use are attributed to appropriate institutional units, classified to an ANZSIC industry (as presented in *Australian Energy Statistics*). ABARE energy balances assign fuel consumption on a different basis. Specifically, energy use related to transport activity is allocated to 'transport', whereas the national accounts attribute transport-related fuel consumption to the industry to which the predominant activity of the unit (and therefore the unit itself) belongs. This may not be the transport industry, especially in the case of road transport fuel use. For example, under ANZSIC, the fuel consumed by a truck owned by a construction company would be assigned to the construction industry, not road transport, because the predominant activity of that business entity is construction.

This approach has necessitated a methodology to re-allocate fuels from the transport industry, to the industry to which the predominant activity of the unit belongs. See Appendix 4: Methodological issues which describes the reallocation methodology in further detail.

It should also be noted that in the ABARE energy balances, service industries are recorded under one broad grouping. In this energy account, that grouping is disaggregated into relevant ANZSIC industry divisions (see appendix 4 for description of how this has been applied).

CONCEPT OF MARGINS - ELECTRICITY SUPPLY AND *ANZSIC 1993*

Normally, distribution margins are shown in supply and use tables as service products in their own right. The treatment of distribution margins related to electricity supply is somewhat atypical and is discussed in Appendix 1: Classifications and scope.

RELATIONSHIP WITH OTHER ABS STATISTICS

This publication provides estimates of supply and use of energy products in both physical and monetary terms - in some cases it suggests estimates of business spending on energy products that are at variance with the official ABS release in its Input-Output Tables (cat. no. 5209.0.55.001). The monetary data contained here are considered experimental and the figures contained in the national accounts remain the official estimates. Nevertheless, the results of this exercise (in particular, possible improvements to data sources and estimation methodology) are being considered within ABS process. It is expected that this will lead to improvements in other ABS data products.

APPENDIX 4 METHODOLOGICAL ISSUES

INTRODUCTION

One of the major challenges of this publication has been to adjust available physical measures of energy supply and use in order to reflect the conceptual structure as outlined in the SEEA, to ensure coherence with related economic data. In particular, this publication uses ABARE's *Australian Energy Statistics* as its primary source of information on physical supply and use of energy products. The majority of methodological issues encountered in proceeding this publication arise from a need to modify the concepts and classifications used in *Australian Energy Statistics* to allow the compilation of integrated environmental and economic accounts.

REALLOCATION OF PETROLEUM, DIESEL AND LPG USE BY INDUSTRY AND HOUSEHOLDS

In ABARE's *Australian Energy Statistics* physical use of refined fuels is assigned on the basis of activity type, rather than according to industry of ownership. For example, fuel used by a truck owned by a construction company would likely be treated as transport activity in *Australian Energy Statistics* but an industry-based view would assign this use to the construction industry. This section describes the methodology developed to reallocate activity-based fuel use data from *Australian Energy Statistics* to the ANZSIC industry basis used in this publication.

The ABS *Survey of Motor Vehicle Use, Australia* (SMVU) provides a breakdown of household and non-household use of petroleum, diesel and LPG in motor vehicles, while data on fuel used by Commonwealth Government vehicles were published in the Australian Greenhouse Office's *Energy Use in the Australian Government's Operations*. State and local government vehicle fuel use was apportioned on the basis of total operating expenses for different levels of government. The ABS business *Economic Activity Survey* (EAS) collects motor vehicle-related expenses for most non-general government businesses but not quantities of fuel used - and therefore a starting point to estimate fuel usage by industry. Although fuel use is a major component of motor vehicle-related expenses, it is not the only component and it is clear that the proportion related to fuel varies from industry to industry. This has been taken into consideration when using EAS motor vehicle-related expense data to contribute to the fuel use reallocation. Also taken into consideration is the need to adjust EAS data for scope differences, for example, to derive comparable estimates of motor vehicle-related expense for the finance and insurance industry (an industry not included in the EAS).

In practice, application of the fuel use reallocation methodology impacts significantly on derived estimates of fuel use. For example, the proportion of fuel use attributed to households ('residential') in *Australian Energy Statistics* is negligible, since an activity basis of reporting will attribute this fuel use to 'transport'. However, when usage is recorded on the basis of ownership, households are the most significant single user of refined fuels. The implications are also significant for industry-based measures of energy intensity. To date, published estimates of these measures have combined gross value added measures produced on an ANZSIC basis with activity-based 'industry' measures of physical energy use. This publication presents energy intensity measures utilising ANZSIC-based measures of physical energy use in combination with ANZSIC-based measures of Industry Gross Value Added- which is both conceptually appropriate, and for a number of industries, significantly different to estimates derived using a non-ANZSIC industry use of energy products.

USE OF ENERGY PRODUCTS BY SERVICE INDUSTRIES

ABARE's *Australian Energy Statistics* focuses on the larger users of energy products and therefore emphasises manufacturing, mining, agriculture, transport and similar industries. The energy use of service industries is essentially grouped into one category 'Commercial and services'. Although the individual service industries are of lesser importance in overall energy use, there is nevertheless considerable interest in the energy usage of these industries.

This publication provides a breakdown of energy use (in physical and monetary terms) of individual service industries for 2004–05. The breakdown was achieved after skirmish

USE OF ENERGY PRODUCTS BY SERVICE INDUSTRIES *continued*

investigations suggested that the price per unit of energy paid by the service industries fluctuated very little between various service industries. For example, while the price per Kilowatt hour (KWh) of electricity varies markedly across different manufacturing activities, prices paid by various service industries were relatively uniform. In addition, there were less complications in measuring physical energy use by the service industries, for example, service industries generally do not undertake significant energy transformations and generally do not undertake co-generation of energy. It was, therefore, considered appropriate to derive physical energy use for detailed service industries on the basis of their respective expenditures on energy products. Various sources of data were used to derive this breakdown, including: ABS EAS data; ABS Input Output tables and publicly available reports of companies and industry associations.

For years before and after 2004–05, ABARE physical energy use figures for total 'Commercial and services' were again used. But the energy use of individual service industries was derived by adjusting 2004–05 estimates according to changes in the total volume of production (Industry Gross Value Added, chain volume measure).

ALLOCATION OF ENERGY CONVERSIONS TO USING INDUSTRY AND TYPE OF ENERGY PRODUCT

In order to present a full picture of gross physical supply and use of energy products, it is necessary to allocate all energy conversions by type of energy product and by industry. ABARE's *Australian Energy Statistics* provides a comprehensive picture of physical supply and use across a detailed grouping of energy products and across various end users of energy. Key energy conversions, both gains and losses, are also described but not fully allocated.

For each type of energy product, this publication has allocated all energy conversions to the using industry. This ensures that monetary measures of supply and use of energy products are comparable to physical measures.

In most cases, this allocation has been relatively straightforward. For example, a large 'brown coal' loss of energy on conversion described as 'electricity generation' is a clear case of brown coal energy lost in conversion to electricity and is therefore attributed to the electricity supply industry. The larger energy conversions all proved relatively straightforward to assign. However, a number of the smaller energy conversions described in *Australian Energy Statistics* are less obvious and involved some degree of investigation of energy conversion types and of relevant industrial processes. ABARE analysts provided very good assistance in these inquires. Nevertheless, in some cases the nature of the conversion is inferred rather than unequivocally known. These cases are all small in scale and have a negligible impact on the analytical utility of the data.

DATA CONFRONTATION AND QUALITY IMPROVEMENTS

Broadly, the approach adopted in this publication has been to place data in a supply and use framework. This allows us to examine and confront data available from the various sources and, after investigation, make judgements about what data are likely to be of the highest quality. These data are given preference and are used as benchmarks to adjust data considered of lower quality or to derive some items as a residual. Generally, the estimates of supply into the economy have been used to benchmark the data for use of energy products.

The approach described above is a well practised technique in national accounting and in various satellite accounts. However, the process used in this publication has faced an added complication because of the need to ensure coherence between supply and use of each energy product across both monetary and physical measures. That is, by juxtaposing the derived estimates of household and industry use of energy, by type of energy product, it is possible to infer an implied price paid by each user for each energy product. This implied price must be plausible and differences in price paid by different users for different energy products must also be credible. These implied prices formed a potent indicator of potential data issues and ultimately a prime indication of the coherence of monetary and physical measures.

GLOSSARY

ANZSIC	The Australian and New Zealand Standard Industrial Classification (ANZSIC) is the standard classification used in Australia and New Zealand for the collection, compilation, and publication of industry statistics.
Bagasse	Residue of the sugar cane milling process which can be used as fuel.
Black coal	A sedimentary organic rock consisting of anthracite, bituminous and sub-bituminous rank coals. Black coal is primarily used as a solid fuel to raise steam to generate electricity and to produce coke for steel making.
Biofuels	Produced from renewable organic sources or 'feed stocks', biofuels include ethanol and biodiesel, and are commonly used as a fuel in transportation.
Biomass wood	Includes wood and wood waste used to produce energy, usually through burning.
Briquettes	Made from brown coal through a process of crushing, drying and the addition of a binding agent, to produce a compact, high energy fuel easily transported and commonly used for industrial and domestic heating.
Brown coal	Also known as lignite, is a low rank, brownish-black coal with a high moisture content of around 60%.
Butane	A gaseous hydrocarbon and the fourth member of the paraffin series (following methane, ethane and propane). If exposed to higher pressures or lower temperatures it can be converted to liquid form, and is a major component of LPG.
Chain Volume Measure	For certain types of economic analysis it is useful to examine estimates of the principal flows of goods and services in the economy revalued in such a way as to remove the direct effects of price change over the relevant period. These estimates are obtained by first weighting together the elemental volume indexes from the previous financial year to the current financial year, where the weights are calculated using the current price value shares of the previous financial year. Second, the resulting aggregate year-to-year volume indexes are linked together to form a time series. Third, the time series is referenced to the current price estimates of the reference year.
Condensate	A liquid mixture of pentanes and heavier hydrocarbons that form part of the vapour phase of natural gas in the reservoir and become liquid under standard field separation conditions.
Consumption of fixed capital	Decline in the current value of a fixed asset owned and used by a producer as a result of physical deterioration, normal obsolescence and normal damage.
Conversion loss	Energy lost in the transformation of a primary fuel to a derived (secondary) energy product.
Crude oil	A mixture of hydrocarbons, existing in the liquid state; both in natural underground reservoirs and at atmospheric pressure after passing through surface separating facilities.
Economic resource	This term implies that, at the time of determination, profitable extraction or production under defined investment assumptions has been established, analytically demonstrated or assumed with reasonable certainty.
EDR	Economic Demonstrated Resources are resources judged to be economically extractable and for which the quantity and quality are computed partly from specific measurements, and partly from extrapolation for a reasonable distance on geological evidence.
Electricity	The flow of electrical power or charge. It is a secondary energy source, meaning it is derived from the conversion of primary sources of energy such as coal, natural gas, oil and nuclear power.
Energy intensity	A measure of the energy consumed to produce one unit of output
Environmental account	An information system and framework that links the economic activities and uses of a

resource to changes in the natural resource base, thus linking resource use with the System of National Accounts. See also SEEA.

Exports The exports of goods represents the quantity or value of goods sent to other countries or for which ownership changes from residents to non-residents.

Final use Use that finally consumes a product, as opposed to an intermediate use. Final use includes: household final consumption; government final consumption; exports; and changes in inventories.

Flow accounts General term used for a framework presents information on the physical flows of resources throughout the economy. Flow accounts published for energy include supply and use tables.

Fossil fuel Non-renewable fuels, such as coal, crude oil and natural gas, formed in pre-historic times from the remains of living organisms.

Gross energy Total energy including that derived from primary as well as secondary energy sources. See also net energy.

Household final consumption Measures the consumption of goods by households and producers of non-profit services to households. It includes the consumption of durable and non-durable goods.

Hybrid flow account An environmental account that juxtaposes related monetary and physical flows.

Hydropower A process in which flowing water is used to spin a turbine connected to a generator.

Identified resources Specific bodies of energy-bearing material whose location, quantity, and quality are known from specific measurements or estimated from geological evidence. Identified resources include economic and sub-economic components. To reflect degrees of geological assurance, identified resources can be subdivided into the following categories: economic demonstrated resources (EDR), subeconomic demonstrated resources (SDR) and inferred resources (IFR).

IFR Inferred Resources. These are resources for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geological evidence.

Industry gross value added (IGVA) The value of an industry's output at basic prices, minus the value of goods and services consumed as inputs during the process of production. Basic prices valuation of output removes the distortion caused by variations in commodity taxes and subsidies across the output of individual industries.

Input–Output A compilation method which provides a description of the inter-industry flows of goods and services within the economy, and the structure and interrelationships of industries.

Intermediate use Intermediate use consists of goods and services consumed as inputs by a process of production, excluding fixed assets whose consumption is recorded as consumption of fixed capital. The goods or services may be either transformed or used up by the production process.

Liquefied natural gas (LNG) Natural gas which has been processed and then refrigerated to the very low temperatures needed to reach the liquid state.

Liquefied petroleum gas (LPG) Consists of propane, butane and isobutane and petroleum and is derived by processing through a low pressure gas separation plant the natural gas produced from either gas or oil reservoirs.

McKelvey box classification Used for classifying resources into categories based on the certainty that the resource exists and the best estimate of economic feasibility of producing them.

National accounts Systematic summary of national economic activity. At a detailed level it shows a statistical picture of the performance and structure of the economy.

Natural gas	A combustible mixture of hydrocarbon gases. While natural gas is formed primarily of methane, its composition can vary widely, commonly including ethane, propane, butane and pentane.
Net energy	Total net energy accounts for the transformation process of a primary energy product to a secondary energy product and related conversion losses. In this way, estimates for total net energy avoids double-counting the amount of converted primary energy. See also gross energy.
Net present value	A measure of the total present value of a time series of cash flows by using a discount rate (e.g the cost of capital).
Output	Consists of those goods and services produced within a business that become available for use outside that business, plus any goods and services produced for own final use.
Petroleum	Naturally occurring hydrocarbon or mixture of hydrocarbons as oil or gas, or in solution found in sedimentary rocks.
Primary energy source	Those forms of energy obtained directly from nature. They include both non-renewable and renewable energy. Primary energy sources include firewood, coal, crude oil, natural gas, liquefied natural petroleum gases, uranium, bagasse and solar energy. In this publication hydroelectricity is treated as a secondary energy product.
Propane	A gaseous hydrocarbon and the third member of the paraffin series (following methane and ethane). If exposed to higher pressures or lower temperatures it can be converted to liquid form, and is a major component of LPG.
Refined products	Includes automotive gasoline and diesel, aviation gasoline and turbine, kerosene and heating oil, industrial diesel and fuel oil, and others such as naphtha and petroleum coke used as fuel.
Resource	A concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust and in such form that its economic extraction is presently or potentially feasible. The definition does not intend to imply that exploitation of any such material will take place in that time span, but only that its possibility might reasonably be considered.
SDR	Sub-economic demonstrated resources are similar to economic demonstrated resources in terms of certainty of occurrence and, although considered to be potentially economic in the foreseeable future, these resources are judged to be sub-economic at present.
Secondary energy source	An energy product derived from a primary energy source. Includes refined petroleum products, coal by-products, coke, and electricity.
SEEA	The System of Integrated Economic and Environmental Accounting. It is a framework used to develop environmental accounts by integrating environmental information into an accounting framework. The SEEA handbook provides the conceptual basis for developing a framework to describe the interrelationship between the natural environment and the economy. See also Environmental account.
Solar power	Photovoltaic conversion generates electric power directly from sunlight in a photovoltaic (solar) cell. Solar thermal electric generators use the radiant energy from the sun to produce steam to drive turbines.
Stocks	Asset (or liability) holdings at a point in time.
Structural effect	The changes in energy consumption resulting from a change in the mix of industrial output, for example, a contraction in energy intensive sectors.
Supply-use framework	An accounting framework utilising the basic principle that the total supply of a product is equal to its total use.
System of National Accounts	The System of National Accounts (SNA) is an international framework which can be used to develop a comprehensive, consistent and flexible set of macroeconomic accounts.

Total supply Australian production plus imports.

Uranium Radioactive grey heavy metallic element, used as a source of nuclear energy.

Wind power The conversion of wind energy into electricity using wind turbines.

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