

Appendix A — Data Sources, Adjustments and Calculation Methods

This appendix sets out the data sources, adjustments and assumptions used to construct the energy accounting and charts for *Battling Entropy* article 06: “Give me the oil, please...”.

The goal of the analysis is not to produce an official national energy balance (that work is already done by government agencies). Instead, the objective is to create a **consistent thermodynamic accounting of Australia’s energy use in petajoules (PJ)** that allows the relative importance of different energy sources and sectors to be visualised.

All calculations were performed using publicly available Australian Government statistics with several adjustments described below.

A1. Units and definitions

All energy quantities are expressed in **petajoules (PJ)**.

1 PJ = 10^{15} joules

Where fuel statistics were reported in tonnes, litres, gigawatt-hours (GWh) or other units they were converted to PJ using standard conversion factors.

Electricity:

1 GWh = **3.6 TJ = 0.0036 PJ**

Coal energy content used for illustrative examples:

Black steaming coal ≈ **24 GJ per tonne**

Electricity generation efficiency example:

Typical Australian coal generator ≈ **35–42% thermal efficiency**

The article uses **~40%** as a representative value.

A2. Core data sources

The core datasets used were:

Australian Energy Update (Department of Climate Change, Energy, the Environment and Water)

Latest available full year: **2023–24**

Australian Bureau of Statistics (ABS)

Energy Account, Australia

BITRE (Bureau of Infrastructure and Transport Research Economics)

Transport fuel consumption statistics

These sources provide the official national energy balances and sector consumption statistics used as the starting point for all calculations.

A3. Total Australian energy consumption

Official Australian final energy consumption in **2023–24** was:

4,035 PJ

This article uses an **adjusted analytical framework** to simplify sector comparisons and align the fuel accounting used later in the charts.

The adjusted totals used are:

Sector	PJ
Fixed energy use	2,276 PJ
Mobile energy use	1,959 PJ
Total	4,235 PJ

The adjustment primarily affects the **transport sector**, scaling mobility energy to align with detailed fuel consumption statistics used later in the analysis.

The purpose of this adjustment is purely analytical and does not alter the qualitative conclusions.

A4. Sector classification

Energy use is grouped into two broad categories:

Fixed energy use

Energy consumed in stationary activities:

- Residential households
- Commercial and services
- Manufacturing
- Construction
- Mining
- Agriculture, forestry and fishing

These correspond broadly to ABS industry energy consumption categories.

Off-road fuel consumption in mining and agriculture (e.g. haul trucks and tractors) is included within these sectors because this is how the ABS reports the data.

Total fixed energy:

2,276 PJ

Mobile energy use

Energy used to move people and goods:

- Road transport
- Aviation
- Shipping
- Rail
- Other transport

Total mobile energy:

1,959 PJ

Transport sector fuel consumption statistics are derived primarily from BITRE and Australian Energy Update fuel balances.

A5. Electricity treatment

Electricity is treated as an **intermediate energy carrier** rather than a primary energy source.

Electricity generation therefore does **not appear in the sector table** of end-use consumption.

Instead electricity is traced back to the fuels used to generate it in the Sankey diagrams.

Electricity generation in Australia is primarily supplied by:

- black coal
- brown coal
- gas
- hydro
- wind
- solar PV
- other renewables

The electricity component of sector energy use is therefore allocated back to the **original fuel sources** when constructing the fuel-mix charts.

A6. Electricity generation fuel mix

Electricity used in the charts is allocated back to generation fuels using approximate shares consistent with recent Australian electricity generation statistics.

Representative shares used:

- Coal (black + brown)
- Gas
- Renewables (hydro, wind, solar and others)

These shares are used to trace electricity consumption back to the underlying primary energy inputs in the Sankey diagrams.

A7. Rooftop solar self-consumption

Small-scale rooftop solar generation is included in official electricity generation statistics.

However a separate category labelled “**Rooftop solar self-consumption**” is included in the fixed-sector fuel mix chart to make distributed energy visible.

This represents solar generation consumed directly at the point of production rather than flowing through the grid.

The estimate used is based on national small-scale solar generation statistics.

A8. Transport fuel breakdown

Mobile sector fuel consumption is divided into the following categories:

Fuel	Typical uses
Petrol	Passenger vehicles
Diesel	Heavy vehicles, commercial fleets
Aviation turbine fuel	Air transport
Electricity	Rail and electric vehicles
Other fuels	Minor categories

The relative shares shown in the article are derived from national petroleum product consumption statistics.

A9. Import vs domestic energy sourcing

To estimate Australia's exposure to imported energy the following assumptions were used.

Coal

Effectively **100% domestically sourced**

Gas

Effectively **100% domestically sourced**

Renewable energy

Entirely **domestic**

Liquid hydrocarbons (oil products)

Australia imports approximately:

79% of refined petroleum products

This figure is based on Australian Government petroleum statistics.

Domestic production accounts for the remaining **~21%**.

A10. Fixed sector import exposure

The fixed sector fuel mix includes a significant oil component.

Applying the 79% import share to oil consumption produces an estimated fixed-sector import exposure of:

≈22% of total fixed energy

This aligns with the values shown in the fuel-mix charts.

A11. Mobile sector import exposure

Transport energy is overwhelmingly supplied by petroleum fuels.

Applying the same 79% import share to liquid fuels results in:

≈78% of transport energy being import-exposed

Only a small share of mobility energy is supplied by electricity generated domestically.

A12. Energy conversion efficiencies

The Sankey charts illustrate energy conversion losses.

Representative efficiencies used are:

Process	Efficiency
Thermal electricity generation	~35–40%
Internal combustion engines	~20–25%
Electric drivetrains	~70–80%

These efficiencies explain the large “loss” flows shown in the diagrams.

The losses are not wasted energy in a strict sense but represent heat dissipated to the environment due to thermodynamic limits.

A13. EV displacement scenarios

Two illustrative electrification scenarios are discussed in the article.

Transport energy:

≈ **1,759 PJ**

Liquid fuel component:

≈ **1,731 PJ**

Import-exposed portion:

$0.79 \times 1,731 \approx$ **1,370 PJ**

Illustrative scenarios:

EV fleet share	Approx energy displacement	Import reduction
20%	~15%	~200 PJ
50%	~40%	~550 PJ

These are not forecasts but simple illustrations of the scale of potential import reduction.

A14. Purpose of the analytical framework

The objective of this analysis is not precision to the last decimal place.

Instead it is to reveal the **structural features of Australia’s energy system**:

- fixed energy is mostly domestic
- transport energy is mostly imported
- electrification shifts energy demand from imported fuels to domestic energy sources

Expressing all energy flows in **PJ** allows these relationships to be visualised clearly.

All calculations were performed using publicly available data and simplified where necessary for clarity. The results are therefore best interpreted as **order-of-magnitude indicators rather than exact accounting values**.