Classifying and Recording the Production of Electricity by Households in the National Accounts – Australian Experience

ESCAP SD, SIAP, and SPC : Webinar series on the 2025 SNA implementation

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Outline Presentation

- Background –Household generation of Electricity
- 2025 System of National Accounts (SNA) Treatment –most of the presentation
- Data Sources and Methods – Used for the Australian National Accounts
- Preliminary Results and Next Steps

The Australian Context

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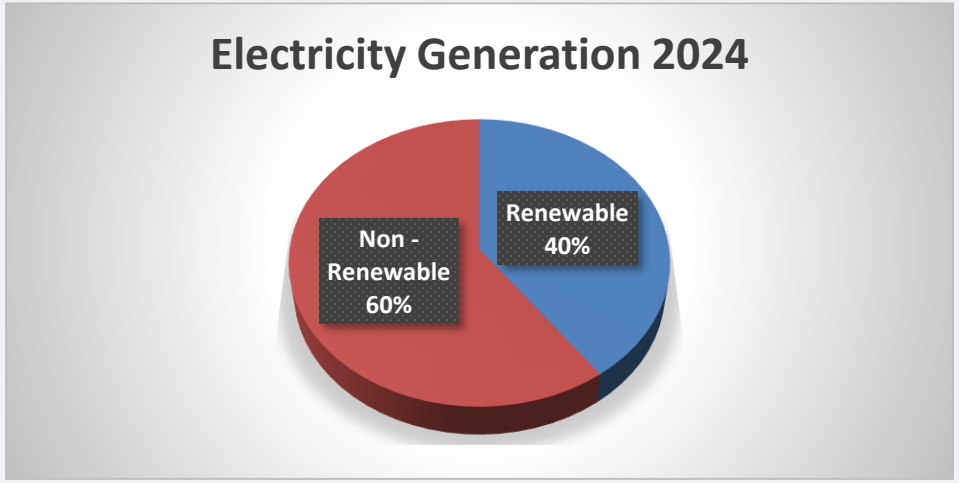
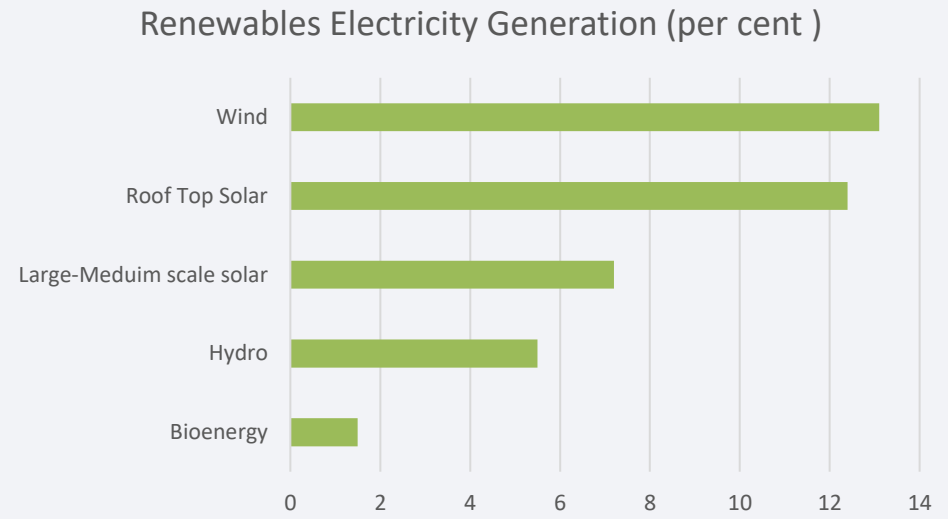
Solar Electricity

Australian Government Renewable Energy Target: an extra 33,000 gigawatt-hours from renewable sources every year from 2020 to 2030.

Rooftop solar continues to be a key driver of the clean energy transition.

Eligible installations of rooftop solar are entitled to small-scale technology certificates (STCs). STCs, creating a subsidy for households and businesses that install these renewable energy technologies. These schemes started 2011.





Rooftop solar was 12.4% of total electricity generation in 2024.

Households

- Australia has one of the highest household rooftop solar penetration rates in the world.
- 32% of renewable energy (mainly through rooftop solar) was generated by households in 2024.

- The Australian Renewable Energy Agency estimates that household generation of renewable energy could rise to 45% by 2050.

Rooftop Solar Electricity Measurement by Electricity Retailers

Electricity providers measure rooftop solar electricity generated in two ways (1) Gross metering or (2) Net metering

(1) Gross metering : all electricity produced by the solar panels are exported to the electricity grid.

- The customer (e.g. household) earns the Feed in Tariff (FiT) rate for every kilowatt hour (kWh) exported to the electricity grid.
- The customer export the electricity and pay the normal fee for every kilowatt hour (kWh) they draw from the grid.
- From a measurement perspective in the National accounts – Gross metering would be quite simple.
- This type of measurement is very rare in Australia.

(2) Net metering: customer consumes the generated electricity and only exports to the electricity grid the excess of supply

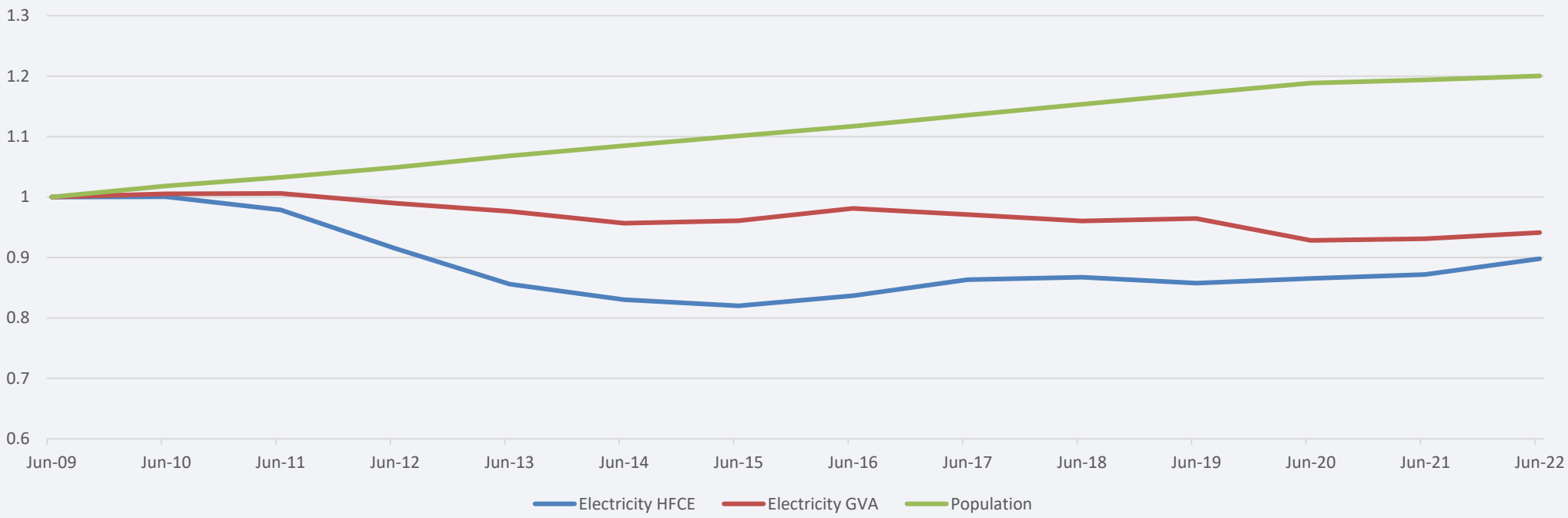
- The use of own generated electricity is known as **"behind the meter".**
- If customers needs more electricity, they draw it from the grid, incurring normal electricity fees.
- If the customer is consuming less electricity than their system is generating, then the surplus is exported to the grid and earns a FiT rate for each exported kWh.
- This type of measurement is very common in Australia but would create more complexities to measure in the National Accounts than Gross metering.

The Australian National Accounts: Current Treatment of Electricity

- Current estimates of electricity consumption and production are based on supply side measurement
  - **Production** estimates are based on generation (administrative data) from coal, gas and large-scale renewables (solar, wind, hydro).
    - Underestimated due to no estimate of household production of electricity
  - **Consumption** estimates are based on surveys of electricity retailers
    - Energy retailers report electricity consumption based on net billing to consumers. This results in household consumption **(HFCE) estimates being underestimated** as the estimate for electricity drawn from the grid by households is reduced by the electricity exported to the grid by household production.
    - **Further underestimation of HFCE** due to no estimate of consumption of own account household production of electricity

- **Gross Fixed Capital Formation** (Investment) - Solar Panels
  - Installation of Solar panels on rooftops is included under category of alteration and additions for dwellings (Dwelling GFCF)
- 2008 SNA - doesn't provide explicit treatment for household generation of electricity generated by solar
  - Inconsistent with System of Environmental and Economic Accounts (SEEA) which does discuss solar electricity explicitly
    - "2.68. The activities of households are of potential interest in SEEA-Energy, for example, by virtue of the information they provide on household use of energy from a certain natural input (e.g., collected fuelwood) or on the use of solar panels situated atop houses. The energy produced by households is either consumed on own account or sold on the market (e.g., electricity by way of the grid"
- **User of the Australian National Accounts began to question our electricity estimates – See following charts**

The Australian National Accounts: Electricity



- The **missing estimates of household solar electricity production** are apparent in this graph, where Electricity Gross Value Added and Household electricity consumption is shown to grow at slower rate than annual population growth since June 2009.
- ABS plan to include these estimates in annual (2024-25) and quarterly (Q3) in 2025.

SNA 2025 – Conceptual Treatment

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2025 SNA Clarified Concepts to Enable Treatment of Household Energy Production

- The 2008 System of National Accounts (SNA) has little explicit guidance on the inclusion of household energy production.
- The ABS, Eurostat and the SNA 2025 editor jointly presented a paper in October 2023 to the Advisory Expert Group (AEG) of National Accounts on proposed conceptual treatment of household energy production, now included in the 2025 SNA.
- Overall, the proposed treatment did NOT propose major conceptual changes but provided clarity on relevant 2008 SNA principles/concepts to enable the correct conceptual treatment of household energy production.
- The clarification in 2025 SNA enable to following key questions to be answered:
  - Should own consumption of Solar Electricity be in the SNA Production boundary?
  - Are rooftop solar panels included in the asset boundary ?
  - What industry do we allocate household solar electricity production ?
    - Is it primary or secondary production of that industry?
  - Which industry are solar panels allocated to ?
  - What asset class are solar panels ?
  - What price should own account production and consumption be valued at?

Should own consumption of Solar electricity be in the SNA Production boundary?

SNA states that goods produced by households are within the production boundary of national accounts (2025 SNA§1.63).

- This generally also includes all goods produced by households retained for their own final consumption but excludes production of services own use (except for the services produced by employing paid domestic staff and the own-account production of housing services by owner-occupiers).

This leads to the key question as to whether electricity is a good or service ?

- Classifying electricity as a good is not straight forward - it cannot be handled or stored like “normal” goods.
- On the other hand, electricity is traded like a good and appears in existing product classification (CPA 2025) together with goods.
- It was recommended (AEG October 2023 meeting) that **electricity should be considered as a good** and as such should be included in the national accounts production boundary even when produced by households for own final consumption. In support of this recommendation the 2025 SNA 7.33 provides the following guidance:

  “The following types of production by households are included whether intended for own final consumption or not –

  - *the production of **electricity through the use of solar panels** and wind power plants and the production of heat through geothermal heat or heat pumps” **included in the production boundary** “*

Are rooftop solar panels part of the Asset Boundary?

To produce and use electricity, households need to acquire certain goods, like solar panels, batteries, power lines or pipes.

There are two options as to how this expenditure should be treated:

(1) Gross fixed capital formation (GFCF) linked to the production of energy, part of the asset boundary

(2) Household consumption as a consumer durable

Solar panels are a major expenditure added to the dwelling, 2025 SNA § 10.69 states,

"expenditures on major improvements (that is, reconstructions, renovations or enlargements) to dwellings are not classed in the same way as decoration, minor repairs and maintenance. They are ***excluded from household consumption expenditure and are treated as gross fixed capital formation*** *on the part of the owners of those dwellings, including owner-occupiers".*

SNA (2025 § 11.40) guidance indicates that household solar panels should be classified as **fixed assets (gross fixed capital formation)** and part of the asset boundary in line with the fact it is used in the **production of goods (electricity) by the household for more than one year**.

SNA § 11.41 states "Consumer durables are not treated as fixed assets. The services these durables produce are household services outside the production boundary of the SNA".

The guidance provided by SNA concludes that **solar panels are part of the asset boundary and the expenditure is treated as gross fixed capital formation.**

What Industry to allocate of household solar electricity production ? Is it primary or secondary production?

In Australia household production of rooftop solar electricity occurs on a small scale and on an informal basis.

2025 SNA § 6.15 – 6.19 recommends the creation of a separate establishment for the household production of energy for own final use or for sale if it is feasible to compile estimates for all inputs used in the production of the energy products. This enable allocation of homogenous activities into the same category.

2025 SNA §5.24 *states "when the production units of households are not legal entities (and cannot be treated as such) they are described as unincorporated enterprises. They remain part of the same institutional unit as the household to which they belong."*

From this we can conclude that **rooftop solar production is treated as a *producing unit of the household institutional sector.***

While the sector classification of households producing units is clear, household sector, there are two possibilities for their industry classification:

(1) Electricity production as main activity of the producing unincorporated unit owned by a household. This activity is classified together with energy production by other industries in ISIC Division 35 'Electricity, gas, steam and air conditioning supply'.

(2) Classify households' electricity production as output of a secondary activity of the household unincorporated enterprise that produces dwelling services, as household's electricity production is likely to be on a small scale when compared to households' production of dwelling services (see 2025 SNA § 6.15). Classified to the same industry as dwelling services, ISIC 'Rental and operating of own or leased real estate'.

*Australian National Accounts will classify Rooftop solar electricity production to the **Electricity industry**, in line with SNA recommendation of allocating homogenous activities in the same category.*

Which industry are solar panels allocated to ?

Using guidance from SNA § 6.18 the following was concluded regarding the household rooftop solar electricity production:

- The only data that can meaningfully compiled for a producing unit relate to its production activities
- Gross fixed capital formation (GFCF)of solar panels are recorded and used by producing unit in the production process
- The household institutional units records the ownership of the solar panel assets.

2025 SNA § 7.122 states that GFCF is not recorded until the ownership of the fixed assets is transferred to the unit that intends to use them in production.

- This would infer that recording of GFCF will occur when the household institutional unit takes ownership of the solar panels, and when the notional producing unit begins to use these in the production process.

While not explicitly discussed by SNA, we have interpreted that the industry allocation of GFCF should follow industry allocation of solar electricity production.

- Allocation of production and related GFCF to the same industry ensures coherence across the sequence of accounts and especially for productivity estimates.

*Australian National Accounts will classify the solar panels to the **Electricity industry**, in line with industry of production of household production of electricity*

What Asset Class are Rooftop Solar panels ?

We have already concluded rooftop Solar panels are in the asset boundary and part of Gross Fixed Capital Formation and allocated to the electricity industry. SNA has seven categories of assets for gross fixed capital formation.

(1)Dwellings (2) Other building and structures (3)machinery and equipment (4) Weapon systems (5) Cultivated biological resources (6) Cost of ownership of transfer on non-produced assets (7) Intellectual property products

- Out of the seven categories, **solar panel could be categorized under either Dwelling or Machinery and Equipment**

2025 SNA §11.77 defines Dwelling as *"Dwellings are buildings, or designated parts of buildings, that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences."*

  - If solar panels are seen as "permanent fixtures customarily installed in residences" then solar panels could be seen as part of the dwelling.
  - Against this classification is the fact that the output of solar panels is not dwelling services, but electricity.

2025 SNA § 11.90 states that "*Machinery and equipment cover transport equipment, machinery for information, communication and telecommunications (ICT) equipment, and other machinery and equipment".*

  - 2025 SNA § 11.94 directly specifies under "other machinery and equipment, electrical machinery and apparatus, of which solar panels would be classified under.

Allocating Solar panels to Machinery and equipment (M&E)is consistent with a logical production function of electricity as opposed to dwellings. Further solar panels asset life of approximately 10 to 30 years is consistent with M&E opposed to dwellings, which will generally have a longer lifespan.

Australian National Accounts will classify the solar panels to the machinery and equipment asset class

What price should own account production and consumption be valued at?

The conceptual basis for valuation of own production electricity is well covered by 2025 SNA, §3.123 states:

"When exchange prices for transactions are not observable, valuation according to market-price-equivalents provides an approximation to exchange prices. Generally, exchange prices should be taken from the markets where the same or similar items are traded currently in sufficient numbers and in similar circumstances.'

Further, 2025 SNA § 7.136 states *that 'output for own final use should be valued at the basic price at which the goods or services could be sold on the market'* .It further states *" The expression 'on the market' means the price that would prevail between a willing buyer and willing seller at the time and place that the goods and service produced. "*

From these 2025 SNA principle:

- own account production of electricity **is valued at the price that applies at the moment of (day and hours) at which electricity is produced and consumed.**
- the price for valuing own account production and consumption directly from solar panels and batteries is the **feed in Tariff (FIT) rate paid for excess electricity not used in the household and sent back to the grid**
    - The FiT is a price offered to household on the "electricity" market
    - Aligns with the SNA definition of basic prices
    - captures additional economic benefits of consuming renewable energy.

*Australian National Accounts will use the **average Feed in Tariffs (FiT) rate as the basic price for electricity own account** production and consumption.*

Data Sources and Methods

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Data Sources

Household solar electricity production:

- Australian Energy Statistics (AES) –Table O- Electricity generation by fuel type.
  - Data modelled based on capacity and location of solar panels (does not separate electricity sold electricity retailers versus own consumption)
- Australian Energy Regulator (AER) –From the 30 Distribution Network Service Provider (DNSP) in Australia
  - Annual quantity of electricity flows
    - from electricity retailers to households
    - from households to electricity retailers

Price of Household Own Account Production and Consumption :

- State and Territory Governments – Minimum Feed in Tariffs (FiT) rates for each kilo Watt hour (kWh) for each State
- Supplementary data from electricity retailers of retail FiT rates.

Gross Fixed Capital Formation - Solar Panels :

- Clean Energy Regulator (CER) –Number of solar panel installed (and capacity) and average solar installation size.
  - Monthly post code data
- Solar Choice - State level price index data – price($) per kW
- Government Finance Statistics – Capital Transfer paid to household- Small scale technology certificates (STCs)

Methods

(1)Household Solar Electricity production

Total value of household solar electricity production (1) = Volume of electricity generated (GWh) × Feed-in-Tariff ($/GWH)

- *Volume of total quantities of electricity generated (GWh) (Australian Energy Statistics Table O)*
  - All non-household solar electricity generation is removed. *(Clean Energy Regulator (CER) –solar panel post code data)*
- *Feed-in-Tariff ($/GWH) – (State and Territory Governments and Electricity Retailers)*

Household solar electricity production for own consumption (2) =

*Total value of household solar electricity production **(1)** minus Electricity sold by households to electricity retailers (DNSP data)*

(2) Price of Own Account Production

- The average Feed in Tariff (FiT) rate is used as the basic price to value own account production of electricity by the household
  - Data on actual FIT rates by providers is difficult to source, therefore, an average FIT rate is used as an approximation.

Example	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
1. Solar Panel Electricity production							
A. Feed in $kWH	0.226	0.229	0.226	0.211	0.199	0.137	0.136
B. Feed in $GWH	225,500	228,900	225,600	210,800	199,215	137,230	135,704
C. Total rooftop solar electricity production (GWH) -Table O	6381	7399	8922	11116	13897	18079	22117
D -Value of solar electricity production ($M)=A*C	1442.1	1694.4	2016.4	2345.5	2765.5	2476.8	3007.9
E-Household share (%)	99.5	99.0	99.0	99.0	99.0	98.5	96.0
F-Total Household electricity production (GWH)=C*E	6349	7325	8833	11005	13758	17808	21232
G-Value of Household electricity Solar Production ($M)=A*F	1435	1677	1996	2322	2738	2440	2888
H-Household Grid Exports (AER Energy Imports)	3854	3975	4596	5539	7112	8695	10218
I-Value of Household Grid Exports =A*H	871	910	1039	1169	1415	1191	1390
J-Household Own Account Consumption (GWH)=F-H	2495	3350	4237	5466	6646	9113	11014
K-Value of Household Own Account Consumption ($M)= G-I	564	767	958	1153	1323	1248	1498

Methods

(3) Valuation of Gross Fixed Capital Formation of Solar Panels

- *GFCF of solar panels ($m) = (3) Direct costs to households ($m) + capital grants to households relating to solar panels ($m) (GFS data)*
  - *(3) Direct costs to households ($m) = Capacity of household solar panels installed (KW) x Price per KW ($/KW)*
    - Where: *Capacity of household solar panels installed (KW) = Number of household solar panels installed (CER Data) x Average household solar installation size (KW) (Solar Choice price index data)*

Example

	Jun-17	Jun-18	Jun-19	Jun-20	Jun-21	Jun-22
a - No. of Solar PV Installations	149,584	196,371	253,405	358,790	361,901	328,722
b - Average Solar PV Installation Size	5.9	6.8	7.4	7.2	9.0	8.9
C - Total Solar PV KW Installs = (a*b)	879,539	1,340,850	1,865,060	2,567,110	3,270,456	2,936,639
D - Price Per KW installation	1,584	1,372	1,184	1,058	964	937
E - TOTAL Expenditure ($M) = D * C	1,393	1,839	2,209	2,715	3,152	2,752
Imports of Solar panels			1,937	1,797	1,506	1,985

Results and Next Steps

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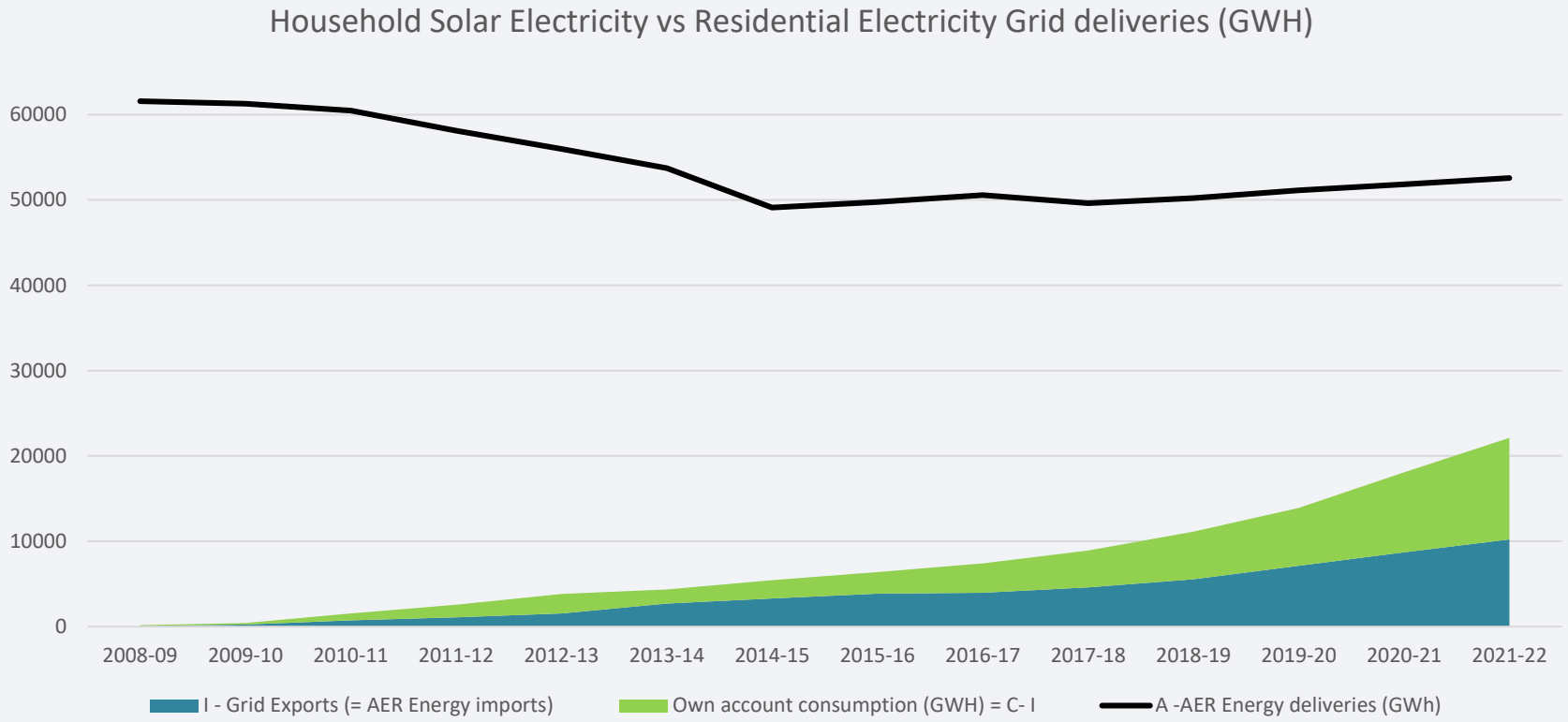
Growth in the Australian Household Solar Electricity



Australian National Accounts – Impacted Estimates

Additions of own account household solar production and consumption will impact:

- Output and GVA - Electricity Industry
- HFCE – Electricity (includes both own account consumption and consumption from electricity retailers – fix netting in reporting)
- Gross Mixed Income (Household electricity producing unit)
- GDP increase = GVA increase = Output increase
- Total GFCF will be unchanged as solar panel as GFCF already withing the Australian National Accounts, but allocated to incorrect industries
- Business own account consumption - no impact on GDP – increased output offset by intermediate consumption

Aim is to implement own account household solar production at end of 2025, to annual and quarterly Australian National Accounts. Time series will be back casted to 2005-06 when roof top solar panel investment started in Australia.

Questions