Accounting for greenhouse gas emissions embedded in electricity consumption in Australia

Webinar:Renewable Energy Certificates and Grid Emission Factors in Corporate and National Emissions Accounting.

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How are the emissions embedded in electricity consumption measured for liable facilities in Australia ?

- In principle, straight-forward calculation: work out average emission intensity of grid-supplied electricity, plus self-produced electricity. But many complications:
  - Mandatory renewable electricity target (RECs)
  - Producers can voluntarily surrender (or buy) RECs
  - Some (energy intensive) customers are partly exempt from RECs
  - Some customers self-consume REC-eligible generation on-site
  - One jurisdiction has set a much higher renewable obligation than established in national policy
- Australia's National Greenhouse Accounts allows two methods:
  - Location-based method (applicable in most cases)
  - Market-based method (applicable if voluntary REC trade/partially REC exempt/self-consumption of REC-eligible production)

The calculation is easy conceptually but complicated in practice. Let's focus on the concepts, starting with the objective.

- Objective: facility-level calculation of Scope 2 and Scope 3 (electricity) emissions that takes account of:
  - actual average electricity emissions intensity of grid-supplied electricity; and
  - actual emissions from self-supplied electricity adjusted for any production of renewable electricity that does not receive a (mandatory) REC; and
  - the voluntary surrender of RECs; and
  - any production of renewable electricity that does receive a (mandatory) REC that is self-consumed.

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What does this objective mean in practice for facility-level reporting?

A. Measure average actual average annual emission intensity of (locationally-adjusted) grid-supplied electricity multiplied by the annual quantity of grid-supplied electricity.

B. If applicable, exclude electricity consumed that is exempt from renewable electricity obligations.

C. If applicable, exclude grid-average emissions per unit of REC-eligible generation that is voluntarily surrendered.

D. If applicable, add back grid-average emissions per unit of REC-eligible generation that is self-consumed.

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What does this accounting system achieve?

1. If a facility buys electricity from the grid they pay their share of actual (annual) average grid emissions.
2. If a facility has a PPA with a renewable generator it makes no difference to their reported scope2+3 electricity emissions.
3. If a facility self-consumes electricity from a renewable generator that earns RECs, their reported emissions are as if that self-consumed electricity was purchased from grid-connected fossil-fuel and renewable generation that is not REC eligible.
4. If a facility hands back ("surrenders") RECs that it is eligible to receive for REC-eligible generation (or surrenders RECs voluntarily) this reduces their reported emissions (calculated at the average emission intensity of grid-connected fossil-fuel and renewable generation that is not REC eligible).

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The critical thing is a mandatory REC registry

1. There is a renewable electricity certificate (REC) scheme that:
    a) Mandates the measurement of REC creation from eligible sources;
    b) Mandates reporting of the voluntary surrender of RECs;
    c) Mandates reporting of self-consumption of REC-eligible generation; and
    d) Mandates the calculation of average annual emission intensity of grid-supplied electricity (other than from REC-eligible sources).

2. If South African authorities wish to develop arrangements that take account of the grid-emission impacts from the trade of renewable electricity, this architecture (mandatory measurement, reporting and calculation of average annual emission intensity of grid-supplied electricity other than from REC-eligible sources) is needed. There are many ways to skin a cat, and policy will need to be adapted to South African circumstances, but architecture that is essentially like this, will be needed.

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Australian Scope 2 + Scope 3 emissions accounting documentation

Relevant laws. Available at:

https://www.legislation.gov.au/F2008L02309/asmade/text

Australia's National Greenhouse Gas Accounts Factors. Available at:

https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors-2025

Reporting to Clean Energy Regulator. Available at:

https://cer.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme

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Scope 2 and 3 electricity emissions: location-based method

Calculating emissions from electricity purchased or acquired using the location-based method

The following method is used for estimating scope 2 and scope 3 emissions released from electricity purchased or acquired and consumed using the location-based method:

$$t\ CO_2\text{-}e = \frac{Q \times (EF2 + EF3)}{1{,}000}$$

Where:

t CO_2-e is the emissions measured in CO_2-e tonnes.

Q is the quantity of electricity purchased or acquired and consumed from the operation of the facility during the year measured in kilowatt hours.

EF2 is the scope 2 emission factor, in kilograms of CO_2-e emissions per kilowatt hour, as per Table 1.

EF3 is the scope 3 emission factor, in kilograms of CO_2-e emissions per kilowatt hour, as per Table 1.

Note: As the emission factors are given in kg CO_2-e, the division by 1,000 is necessary when reporting in t CO_2-e.

Example 1 Calculation of scope 2 and 3 emissions (t CO_2-e) from purchased electricity (kWh) using the location-based method

A company has operations in New South Wales and Victoria. A component of the company's energy use is electricity purchased from the National Electricity Market grid. During the year the NSW operations consumed 11,300,000 kWh of electricity, while the Victoria operations consumed 14,600,000 kWh. Emissions are estimated using the equation below:

$t\ CO_2\text{-}e = \frac{Q \times (EF2 + EF3)}{1{,}000}$
Where: NSW Q = 11,300,000 kWh EF2 = 0.66 kg CO_2-e /kWh EF3 = 0.04 kg CO_2-e /kWh Victoria Q = 14,600,000 kWh EF2 = 0.77 kg CO_2-e /kWh

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EF3 = 0.09 kg CO_2-e /kWh
Calculation of Total Greenhouse Gas Emissions (t CO_2-e)
For NSW operations $= \frac{11{,}300{,}000 \times (0.66+0.04)}{1000}$ = 7,910 t CO_2-e
For Victoria operations $= \frac{14{,}600{,}000 \times (0.77+0.09)}{1000}$ = 12,556 t CO_2-e
Combined total greenhouse gas emissions (t CO_2-e) = 20,466 t CO_2-e

Table 1 Indirect (scope 2 and scope 3) emission factors from consumption of purchased or acquired electricity

State, Territory or grid description	Scope 2 Emission Factors (kg CO_2-e/kWh)	Scope 3 Emission Factors (kg CO_2-e/kWh)
New South Wales and Australian Capital Territory	0.66	0.04
Victoria	0.77	0.09

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Queensland	0.71	0.10
South Australia	0.23	0.05
Western Australia - South West Interconnected System (SWIS)	0.51	0.06
Western Australia - North Western Interconnected System (NWIS)	0.61	0.09
Tasmania	0.15	0.03
Northern territory - Darwin Katherine Interconnected System (DKIS)	0.56	0.07
National	0.63	0.07

Sources: Primary data sources comprise National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1), Australian Energy Statistics, Clean Energy Regulator, and AEMO data and Department of Climate Change, Energy, the Environment and Water.

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Scope 2 and 3 electricity emissions: market-based method

Calculating emissions from electricity purchased or acquired using the market-based method

The following method may be used for estimating scope 2 and scope 3 emissions released from electricity purchased or acquired and consumed using the market-based method:

$$t\ CO_2\text{-}e = \Big(\big((Q - Q_{exempt}) \times (1 - (RPP + JRPP)) + \big(Q_{exempt} \times (1 - JRPP)\big) - (REC_{surr} - REC_{onsite}) \times 1{,}000\Big) \times \frac{RMF1 + RMF2}{1{,}000}$$

Where:

t CO_2-e is the emissions measured in CO_2-e tonnes.

Q is the quantity of electricity purchased or acquired and consumed from the operation of the facility during the year measured in kilowatt hours.

Qexempt is the quantity of electricity exempt from Renewable Energy Target (RET) liability, measured in kilowatt hours.

RPP is the RET Renewable Power Percentage for the applicable period as published by the Clean Energy Regulator, averaged across the previous and current calendar years. For example, calendar years 2023 and 2024 are used for the calculation of the financial year 2024 RPP.

JRPP is the jurisdictional renewable power percentage for the applicable period and activity state. It is calculated as the number of eligible Renewable Energy Certificates surrendered by or on behalf of the jurisdictional authority divided by total electricity consumption in the jurisdiction.

RECsurr is the number of eligible Renewable Energy Certificates voluntarily surrendered in the reporting year equivalent to megawatt hours.

REConsite is the number of eligible Renewable Energy Certificates that have been or will be issued for electricity produced on-site during the year and consumed from the operation of the facility equivalent to megawatt hours.

RMF1 is the scope 2 residual mix factor, in kilograms of CO_2-e emissions per kilowatt hour, as per Table 2.

RMF2 is the scope 3 residual mix factor, in kilograms of CO_2-e emissions per kilowatt hour, as per Table 2.

Example 2 Calculation of scope 2 and 3 emissions (t CO_2-e) from purchased or acquired electricity (kWh) using the market-based method

A company has operations in New South Wales. A component of the company's energy use is electricity purchased from the National Electricity Market grid. During the year the NSW operations consumed 11,300,000 kWh of electricity from the grid. The company generated and consumed 500,000 kWh of electricity from onsite renewable electricity sources, for which LGCs were created. 200,000 kWh of these LGCs were surrendered to meet the company's RET liability, while the remaining 300,000 kWh were voluntarily surrendered. The company's activities are not in a jurisdiction whose jurisdictional authority voluntarily surrenders Renewable Energy Certificates. The company purchased and voluntarily surrendered 1,000 LGCs in the same period. Emissions are estimated using the equation below:

$$t\ CO_2\text{-}e = \Big(\big((Q - Q_{exempt}) \times (1 - (RPP + JRPP)) + \big(Q_{exempt} \times (1 - JRPP)\big) - (REC_{surr} - REC_{onsite}) \times 1{,}000\Big) \times \frac{RMF1 + RMF2}{1{,}000}$$

Where:

Q	= 11,300,000 kWh
Qexempt	= 0.0
RPP	= 0.1872 (value for average of published RPP for 2023 and 2024 calendar years)
JRPP	= 0.0
RECsurr	= 1,000 + 300 MWh
REConsite	= 500 MWh of LGC creations
RMF1	= 0.81 kg CO_2-e/kWh
RMF2	= 0.11 kg CO_2-e/kWh

Calculation of Total Greenhouse Gas Emissions (t CO_2-e)

$$= \Big((11{,}300{,}000 - 0.0) \times (1 - (0.1872 + 0.0)) + (0.0 \times (1 - 0.0)) - (1{,}300 - 500) \times 1{,}000\Big) \times \frac{0.81 + 0.11}{1{,}000}$$

Combined total greenhouse gas emissions (t CO_2-e) = 7,254 t CO2-e

Table 2 Indirect (scope 2 and scope 3) emission factors from consumption of purchased or acquired electricity: market-based factors

Residual Mix Factor for the market-based method	Scope 2 Emission Factors (kg CO_2-e/kWh)	Scope 3 Emission Factors (kg CO_2-e/kWh)
National	0.81	0.11

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