COAG Energy Council

ENERGY SECURITY BOARD

National Energy Guarantee

TECHNICAL WORKING PAPER

Market Customer Load for the Emissions Reduction Requirement

June 2018

Contents

Executive Summary

The emissions reduction obligation of the Guarantee is designed to deliver the target reduction in emissions intensity of market customers operating in the National Electricity Market (NEM). The scheme requires the allocation of NEM generation at the corresponding National Greenhouse and Energy Reporting scheme (NGER) emissions intensity to market customers so that their emissions intensity can be determined. This process is enabled through the implementation of an emissions registry. This technical working paper discusses the definition of the key generation and market customer load inputs. The term "volume" is used to refer to load or energy.

Consideration has been given to the objectives of the Guarantee and the appropriate balance between verifiability of inputs and avoiding unnecessary complexity.

The preferred approach is mostly aligned with the mechanics of the Renewable Energy Target (RET) except where deviations are required to accommodate the requirements of the design:

- Generation and retail volumes will be recorded in the registry at the node by applying distribution and transmission losses to meter readings.
- Embedded generation and rooftop solar photovoltaic output (PV) will be treated similarly to the approach used in the Renewable Energy Target (RET). The net exports will be grossed up by adding the exports to both the total generation volumes available to the market customer and to the total market customer's volumes.
- Non-market embedded generation above a defined threshold will be required to be included in the calculation of a market customer's emissions intensity.
- Where a generator imports energy it will be netted against the generator's exports.
- Metering revisions will be addressed by setting the compliance date at 3 months after the end of the compliance year when the vast majority of metering revisions have been received.
- Metering associated with eligible GreenPower will be grossed up to the node and excluded prior to calculation of a market customer's final emissions intensity.

1 Introduction

On 20 April 2018, the Energy Security Board (ESB) presented the COAG Energy Council with a high-level design proposal for the National Energy Guarantee (the Guarantee). The COAG Energy Council agreed that the ESB progress the detailed design of the Guarantee for determination by the Council at its August 2018 meeting.

As part of the development process, the ESB convened Technical Working Groups to advise on certain detailed design elements of the Guarantee. The Technical Working Groups were comprised of a broad range of stakeholders with relevant expertise from more than 30 organisations.

The purpose of this paper is to outline options and preferred approaches relating to the following considerations of the emissions reduction requirement under the Guarantee, in particular:

- how retail load is determined
- the treatment of embedded generation and rooftop solar PV
- handling of meter data revisions, and
- treatment of GreenPower and related schemes.

These detailed design issues were considered by the Retail Technical Working Group.

This paper provides additional detail and context to the Draft Detailed Design Consultation Paper. Interested parties are encouraged to lodge a submission to the consultation by **13 July 2018** for consideration by the ESB prior to the publication of the final design of the Guarantee.

2 Overview of High-Level Design

The High-Level Design Document outlined the proposed approach to determine a market customer's load based on:

- wholesale purchases from AEMO, plus
- non-market embedded generation and behind the meter generation e.g. rooftop solar PV (with consideration given as to how to accurately measure this).

The Commonwealth Government has indicated that it intends to exempt EITE activities. Therefore, EITE load will not be included in the market customer's determination of its emissions intensity.

Load associated with GreenPower will need to be reported so that additional allocations can be made by the market customer in the registry.

3 Definition of volumes

3.1 Pool purchases and pool generation

The key inputs into the emissions registry are market customer purchase volumes (MWh) and generation volumes (MWh) with their associated emissions intensity sourced from NGER. The purpose of the registry is to record the allocation of volumes from generators to market customers so that market customers can calculate their overall emissions intensity for compliance purposes.

As discussed in the *Technical Working Paper on the Emissions Registry*, the design of the registry requires that all generation volumes are allocated to all market customers such that there are no unallocated emissions. This requires generation volumes to match market customer volumes, which can be achieved by scaling of market customer load to equal the generation volume.

AEMO settles a market customer's wholesale pool purchases on the following basis:

Pool Purchases = Metered Energy * DLF * TLF * RRP

Where:

- DLF = Distribution Loss Factor
- TLF = Intra-regional Transmission Loss Factor (also known as Marginal Loss Factor (MLF))
- RRP = Regional Reference or Pool Price

AEMO's settlements statements specify wholesale load as Metered Energy * DLF and then apply the TLF adjusted price (TLF * RRP) to calculate the total pool purchases. This definition of wholesale load excludes transmission losses and is sometimes referred to as **Energy at the TNI** (Transmission Node Identifier). A market customer's obligation under the RET scheme is determined on this basis.

Another definition of load that is widely used is **Energy at the Node** which is calculated as Metered Energy * DLF * TLF. This definition of load is used by participants to manage their exposure to pool prices and to determine the volume of contracts required for hedging purposes. It is also used in the RET for the creation of LGCs by generators.

There are pros and cons to choosing either definition of volumes.

Energy at the TNI is already calculated for the RET and there would be benefits to market customers in aligning RET compliance with the Guarantee. However, alignment will be difficult to achieve in practice given that the RET compliance year is a calendar year whereas the Guarantee will use a financial year that is aligned to NGER and MLF changes.

The advantage of using Energy at the Node is that pool generation and pool purchases are closely aligned and require minimal scaling to match (around 1 per cent difference). Use of Energy at the TNI would require more scaling up of retail load to match the generation volumes which adds some additional uncertainty for market customers in managing their position.

Consideration should also be given to which party should bear responsibility for transmission losses and creating the right incentives for investment decisions. The Energy at the Node approach (which is used in the RET) puts the responsibility for losses on generation such that a renewable generator that invests in a location with a poor MLF will have a lower generation volume and so would have less impact on lowering a market customer's emissions intensity. The alternative of using Energy at the TNI would effectively spread transmission losses across all market customers and would mean that a new generator would be indifferent to where it was located.

On balance, taking these factors on board, the preferred approach is to use **Energy at the Node**. This is aligned with the market's approach to management of contract positions, aligned to treatment of generation in the RET, reduces the impact of scaling and creates the right locational incentive for investment.

Preferred approach

- The volumes in the registry will be defined **at the node** by applying DLF and TLF to the metered volumes.

3.2 Volumes used in calculation of generator emissions intensities

The emissions registry requires that the emissions intensity of a generator be recorded against the volume of energy generated at the node. This means that the definition of emissions intensity must align with the definition of volumes used in the registry.

NGER is the official source of emissions data for a reporting period but it uses a definition of generation volumes (i.e. "as generated" which is prior to auxiliary load) that is inconsistent with the proposed definition for the registry. This means that the NGER emissions intensity for the relevant reference year will need to be restated so it can be used in the registry.

However, another factor to consider is that the MLFs can change from year to year and this could lead to a generator's historical emissions intensity being defined using a different MLF to its volume at the node. To address this issue it is recommended that the emissions intensity for a generator be calculated as follows:

$$\textbf{Emissions Intensity}_T = * \textbf{ Total Emissions}_R \ / \ \{\textbf{MLF}_T * \textbf{Energy at the TNI}_R\}$$

Where:

Emissions Intensity_T = Generator emissions intensity at the node in compliance year T

MLF_T = Marginal Loss Factor applicable to generator in compliance year T

Total Emissions_R = Total NGER emissions from generator in historical reference year R

Energy at the TNI_R = Total pool generation at the generator TNI in historical reference year R. Note that pool generation at the TNI is the same as "sent-out" generation except for large generators embedded in the distribution area which have a DLF applied to their sent-out.

With these units:

Emissions intensity is in tCO_2-e/MWh, emissions are in tCO_2-e, energy is in MWh

3.3 Auxiliary load and metering channels

Most generators have some form of auxiliary or in-station usage for powering the operation of conveyor belts, milling, lighting etc. When a unit is generating the in-station load for the most part will be self-supplied but at other times, such as when a unit is on an outage, the generator will import from the grid. Pumped storage can provide a special case of in-station usage if imports from the grid are used to pump water for later release to generate electricity.

Whilst AEMO has most SCADA data for managing dispatch it does not have the ability to measure auxiliary load that is consistent with settlement data. Instead the settlements metering records only the exports to the grid (B channel) and imports from the grid (E channel).

This raises two questions:

1. Which entity is responsible for emissions associated with a generator's imports?
2. How should metering channels be used for calculating emissions intensity?

3.3.1 Responsibility for imports in the registry

There are a number of potential ways of addressing this. The first option is to just exclude them given the total amount of generator imports in 2017 was only around 1.5 TWh or 0.8 per cent of NEM volumes. However, this approach could lead to unanticipated issues and does not allow for the expected increase in pumped storage volumes.

Another option is to explicitly assign responsibility for the imports to an associated market customer or to the generator itself. The drawback to this approach is that the emissions reduction obligation is to apply to market customers only and generators are not explicitly included.

Finally, the imports could be netted against the exports, which is equivalent to assuming that the generator is self-supplying its own imports. Given the relatively small scale of imports this approach is the simplest to implement and is also consistent with the RET treatment of generation where LGCs are only created for the net of a generator's exports and imports at the node.

3.3.2 Metering channels for emissions intensity

Calculation of the emissions intensity requires restatement as described in section 3.2. Given the preferred approach is to net generation imports against exports in the registry this means that the same approach is required in the restatement of historical volumes for calculation of the intensity.

Hence, in section 3.2:

$$\text{Energy at the } TNI_R = \text{Exported Energy at the } TNI_R - \text{Imported Energy at the } TNI_R$$

Preferred approach

- To calculate generator volumes, imports are netted against exports.
- Use the same approach for determining the volumes in the definition of emissions intensity in the registry.

4 Treatment of non-market generation

4.1 Embedded generation

For the purposes of the emissions registry consideration must be given to "embedded" generation. This is defined as generation that is not explicitly part of the NEM (i.e. is non-market) and is *embedded* within a local retailer's host region. This is different to generation that is embedded behind the meter at a site.

Non-market generation that is embedded within a local retailer's region has the impact of reducing the local retailer's purchase of energy through its boundary meters. The local retailer pays for this energy through the settlement of energy directly with the embedded generator according to its PPA. In some cases the embedded generator will have a contract with a market customer who is not the local retailer requiring arrangements to be made for energy payments between the local retailer and the embedded generator's market customer.

Embedded generators need to be incorporated into the measurement of emissions intensity because they can be significant in size, contribute to total emissions (e.g. landfill gas sites) and are a growing portion of total generation in the NEM.

The RET includes embedded generation by adding the exports (B channel) to the market customer's liable volumes. A similar approach is recommended for the emissions registry with the additional requirement that the embedded generator's volumes be recorded as a generator in the registry with its associated NGER intensity, i.e:

Total Generation Volumes in Registry = Pool Generation + Embedded Generation

Total Retail Volumes in Registry = Pool Purchases + Embedded Generation

Hence, the embedded generation grosses up both the generation volumes and retail volumes recorded in the registry. Consistent with section 3.1 the volumes would be grossed up to the node by applying the DLF and TLF. This is aligned with the treatment of the embedded generator if it were part of the market and ensures that there is integrity in the treatment of all volumes.

There is an argument that embedded generation does not need to be recorded in the registry and instead should be left to the market customer to include when calculating their emissions intensity for compliance. This would be similar to the approach used in the RET and effectively means that embedded generation is not visible to the market.

Given the objective of increasing market transparency there is a case to be made that it should be visible in the registry and would potentially provide embedded generators with more options for how they contract their output. Having said this there are challenges in sourcing metering data for embedded generators and the registry could become inundated with hundreds of small generators.

This issue could be alleviated by setting a threshold of 5 MW under which embedded generation does not have to be included, taking account incentives for low emissions generation and minimising compliance costs. To avoid capturing back-up plant that rarely runs, an additional threshold of exported generator output for non-renewable plant is proposed which could be aligned with the NGER threshold of 25,000 tCO_2-e.

Preferred approach

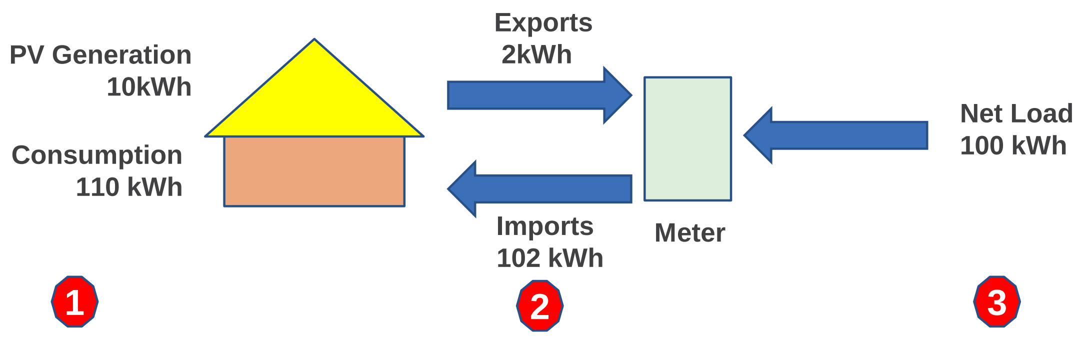
- Only non-market embedded generation above a 5 MW size and, for non-renewable plant, 25,000 tCO_2-e, should be included in the emissions reduction requirement.
- Embedded generation exports should be included in determining total NEM emissions and generation in the same way as for non-embedded generators.
- Embedded generation exports should be added back in determining market customer volumes consistent with the RET.

4.2 Small-scale solar PV

Rooftop and other small-scale solar PV presents similar issues to larger non-market embedded generation except that there are many more individual sites involved.

The diagram below illustrates three options for incorporating solar PV into the scheme and the table considers the pros and cons of each approach.

Figure 1: Options for inclusion of solar PV



Option 1 uses the gross output from the solar installation, Option 2 considers only the exports and Option 3 only incorporates solar indirectly through its impact on reducing a market customer's load sourced from the grid.

Option	Example	Benefits	Issues
1 **Gross**	Generation 10 kWh Consumption 110 kWh	Counts all output from solar generation so market customers with high solar penetration can lower their intensity.	Solar PV output is not directly measured and would require estimation or metering changes. Solar PV is already incentivised under SRES.
2 **RET Model**	Generation 2 kWh Consumption 102 kWh	Counts only exports which is consistent with RET.	More complicated for AEMO to forecast exports for setting emissions targets then either gross or net approach.
3 **Net**	Consumption 100 kWh	Simplest approach, reduces steps required for market customer compliance.	Disadvantages market customers with high solar penetrations. Inconsistent with treatment of embedded generation above 5 MW threshold.

The key challenge with the gross approach is that solar PV output is not directly metered and would need to be estimated. AEMO uses a methodology to estimate total solar PV in the NEM which could be allocated to market customers according to their share of energy but this would have the effect of giving all market customers the same proportion of solar PV and so there would be no benefit to market customers who actually have higher penetrations of solar PV.

Whilst the CER has information on solar installations at the time they were installed, it does not know which market customers are associated with which installations at any time. Similarly, market customers do not have information about the size of the installation or its deemed output used to create STCs. There are also solar PV installations that do not receive STCs but still generate electricity. The alternative of letting market customers make their own assessments would likely lead to inconsistent approaches. A gross metered approach would have benefits for the system in providing visibility of what is now the NEM’s largest generator but would involve wiring changes and additional costs.

The RET approach, on the other hand, uses metering and billing data that is available to market customers and ensures all exports of solar PV into the NEM are included. Market customers will benefit from solar exports from their customers and thus be able to reward customers through feed in tariffs.

Whilst the Option 3 (net) approach does not explicitly include solar PV, it does have an effect through the overall trend of increasing solar PV displacing grid-scale generation and lowering overall intensity.

From an overall scheme point of view, there is little difference in including or not including solar PV, provided the solar PV forecast that was used to determine the original intensity targets is accurate. The only impact is to change the denominator on both the target and the actual calculation of intensity. If the forecast is not accurate a net approach is largely unaffected whereas a gross approach would either show a more favourable or less favourable emissions intensity depending on whether actuals are higher or lower than the solar PV forecast. The impact of the RET approach using net exports only would be somewhere in between these two extremes.

On balance, the approach used by the RET (Option 2) is favoured given it is measurable, rewards solar PV and leverages existing compliance processes. The one modification required for the emissions reduction obligation is that the same volume of zero emissions is added to the available generation for that market customer. Hence, similar to embedded generation, the inclusion of net-solar exports grosses up both the generation and retail volumes.

Preferred approach

- Apply approach used by the RET to inclusion of solar PV i.e. add net exports from solar installations to both generation and retail load.

4.3 Batteries

From an emissions point of view, a battery is a source of net consumption due to losses incurred in charging and discharging. Hence, grid-connected batteries that are registered as both a scheduled load and scheduled generator should allow for the netting of the generation against the load such that only the net load is subject to the emissions reduction obligation.

Large-scale behind the meter batteries require some additional consideration. There is the potential for a battery co-located with a wind farm to import energy from the grid, store it and then export it to the grid as if the energy was coming from the zero emissions wind farm. As discussed in section 3.3 this is handled by the netting of imports against exports.

Preferred approach

- Grid-connected batteries to require netting of generation against load.
- Behind the meter batteries collocated with grid-connected generation is included through the netting of imports and exports at the generator.

5 Other issues

5.1 AEMO metering revisions

AEMO's settlement of the NEM uses a cycle that revises meter readings at both 20 weeks and 30 weeks after the billing week. This allows for the flow through of actual readings for quarterly read meters.

This means that the meter readings for a compliance year are not fully known until more than 6 months after the end of the year. Given that market customers will need to know their final load before they can complete their reallocations and other compliance obligations this delay in receiving final revisions could mean that compliance takes most of a year to finalise.

To avoid this situation the RET allows revision volumes to roll over into subsequent compliance years. However, this approach creates issues for the emissions registry because all generation volumes need to be allocated to all retail volumes in the compliance year. The implication of an upwards metering revision is that one market customer has under-allocated generation to its load and one or more others have over-allocated. Hence, it is difficult to determine what the emissions intensity of the metering revision should be.

A carry-forward approach would also have problems in that it could make the registry unbalanced in the following year. Therefore, the preferred approach is to set the compliance date at a point in time such that most meter revisions have been received. The variation in meter readings for a billing week between the final statement and the 20 week revision can be in the order of 10 per cent depending on the time of year and the market customer's load mix. From 20 week to 30 week the revisions changes are much less significant at less than 0.5 per cent. Within 3 months of the end of the compliance year it is estimated that settlement volumes for the year are around 99 per cent accurate.

Preferred approach

- Metering revisions will be addressed by finalising them 3 months after the end of the compliance year i.e. end of September, with no further adjustments. These will locked down in the emissions registry.

5.2 GreenPower

The GreenPower scheme will be incorporated into the emissions reduction obligation and will allow consumers to make an *additional* contribution to emissions reduction beyond that required by the target.

Mechanically this can be achieved after the registry assignment process i.e. once a market customer has assigned all of its generation volumes to all of its purchase volumes it would then carve out the portion of its load that has the GreenPower obligation and fully assign the required type of GreenPower generation against that load. This would then be excluded from determination of the market customer's overall emissions intensity to meet the Guarantee obligation. This would have the effect of quarantining the low emissions generation and would raise the overall average intensity for the balance of the market customer's load.

Whilst GreenPower allows prior vintage LGCs (i.e. generation from previous years) to be surrendered, the emissions registry needs to balance in the current compliance year. Consequently, only renewable energy that has been generated in the compliance year can be used to meet energy that has been consumed in the compliance year. From a GreenPower perspective, surrendering older-vintage LGCs has still resulted in additional renewable energy having been procured by GreenPower customers. From the emissions reduction requirement under the Guarantee perspective, however, it makes sense for only the additional renewable generation that actually occurred in the compliance year under the GreenPower scheme to be matched to GreenPower sales in the registry.

From a volumes perspective the main requirement is that they are defined consistently with other scheme volumes at the node.

GreenPower arrangements were designed to allow for additionality to the RET, and have not anticipated the emissions reduction requirement under the Guarantee. The ESB intends to work with the GreenPower accrediting body to facilitate its treatment as additional within the registry arrangements.

Preferred approach

- Metering associated with GreenPower and related eligible schemes will be grossed up to the node and excluded prior to calculation of a market customer's final emissions intensity.

A Abbreviations and defined terms

AEMO	Australian Energy Market Operator
CER	Clean Energy Regulator
COAG	Council of Australian Governments
DLF	Distribution Loss Factor
EITE	Emissions-intensive trade-exposed
Embedded	A non-market generator that is embedded within the local retailer's region and has the effect of reducing their pool purchases.
Emissions intensity	The volume of greenhouse gas emissions produced for every unit of output. For the electricity sector, this is usually tonnes of emissions for every megawatt-hour of electricity produced.
ESB	Energy Security Board
Export	Energy sent to the grid by a generator
GreenPower	A program for purchasing renewable energy from government-accredited sources
Guarantee	National Energy Guarantee
Import	Energy sourced from the grid for consumption
LGC	Large-scale generation certificate under the RET
Load	Energy – usually for consumption
Local Retailer	A term used in the settlement of the NEM such that the local retailer is responsible for all of the energy that passes through the TNIs that make up the boundary in a region less any energy associated with NMIs that have transferred to another market customer.
MLF	Marginal Loss Factor
MW	Megawatt
MWh	Megawatt-hour
NEL	National Electricity Law
NEM	National Electricity Market
NGER	National Greenhouse and Energy Reporting scheme
PV	Photovoltaic – in relation to solar panels
RET	National large-scale renewable energy target currently in place under the *Renewable Energy (Electricity) Act* 2000 (Cth)
RRP	Regional Reference Price
STC	Small-scale technology certificate under the RET
tCO_2-e	Metric tonnes of carbon dioxide equivalent
TLF	Transmission Loss Factor
TNI	Transmission Node Identifier
Volume	Neutral way of describing energy – can be generation or retail.

Contact details:

Energy Security Board

E: info@esb.org.au

W: http://www.coagenergycouncil.gov.au/energy-security-board