

23 October 2015

METERING ARRANGEMENTS TO SUPPORT MULTIPLE TRADING ARRANGEMENTS

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1. Introduction

This paper addresses the following topics:

- What are the typical metering arrangements currently used to support premium feed in tariffs ('FIT')?
 - In particular, explain the difference between net and gross premium FITs.
- Describe the different data streams produced by different meters, including the orientation of 'import' and 'export' flows, real and reactive power. How do these relate to different arrangements of elements and registers?
 - Who is responsible for preparing and packaging the data, and who do they provide it to?

- Include a description of how this information is 'accessed' in a meter.
- What are the interactions between these physical metering arrangements and the particular model proposed by Craig Memery ('the single net meter' model)?
 - How can Craig's model be achieved in practice?
 - The extent of changes to AEMO, DNSP and retailer systems necessary to support this model.
 - Whether and how the competition in metering rules regarding the appointment of the Metering Coordinator by the retailer may impact on this model.

The information in the report has been oriented towards the overarching topic of Multiple Trading Relationships ('MTR') for a consumer who is connected to the NEM. The consumer may find it economical to purchase or sell electricity to more than one 'retailer'.

The report is specifically focused on the impact of metering on the opportunity for a consumer to engage with more than one retailer at the consumer's site.

For the purpose of this paper, the term:

- 'Metering Coordinator' will be used where the term 'responsible person' may be factually correct at the current date. This arrangement will not affect the intent of the description or explanation.
- 'retailer' will be used instead of the term financially responsible Market Participant, or Market Customer.
- The terms 'small customer' and 'consumer' will be used interchangeably, depending on the market context of the paragraph and the emphasis required to convey the best meaning.

2. Small customer FiT metering arrangements

Background:

Metering arrangements for the use of solar generation by small customers has been a focus of discussion over the last five or so years.

Initially jurisdictional governments had specified generous feed in tariffs ('FiT') that were to apply to solar generation as part of their policy to incentivise a consumer led deployment of small scale solar technology. The policy was initially based on FiT prices that were well in excess of the cost of that electricity when purchased from the NEM via a retailer.

Over the last five years, as the deployment of solar generation expanded beyond the critical mass targeted by the jurisdictional governments, annual policy reviews of the scheme reduced the FiT prices to the point where FiT prices are today on par with wholesale generation prices and well below the cost of electricity purchased from the NEM via a retailer.

The arrangements for metering of solar generation play a significant part in the application of FiT prices and consequently the attractiveness of solar generation to a small customer.

Types of metering arrangements:

There are two basic metering arrangements available to the consumer when solar generation is installed: gross metering and net metering.

Gross metering is deployed where the total quantity of electricity produced by the solar generator is measured and recorded by a meter prior to that generation being used by anyone. This arrangement is shown in Figure 1.

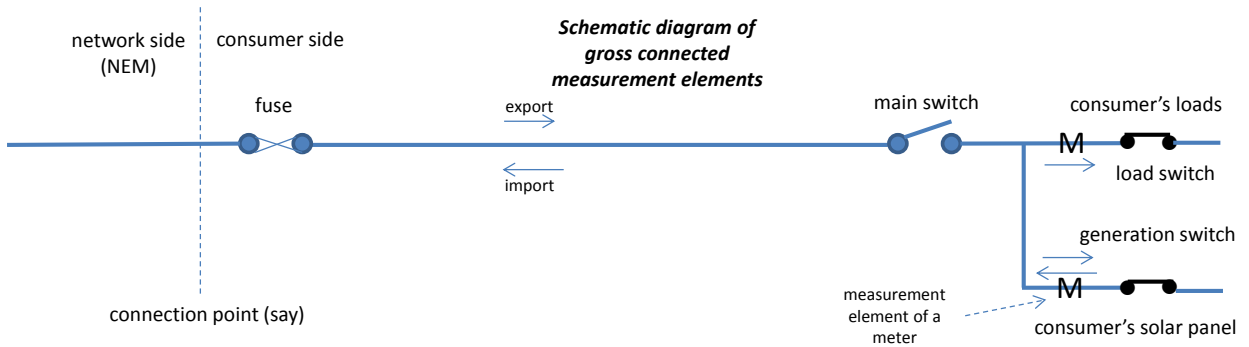


Figure 1: The metering arrangement that supports gross generation

Two measurement elements are required, as shown in the figure 1. There is one measurement element in each of the circuits, one for the solar generation, and one for the consumer's load. Both measurement elements can be in one meter, or they can be in separate meters. The solar generation measurement element must be capable of providing bi-directional data (import and export), with that data being sorted in separate registers. The load measurement element technically only requires a single register for export flows.

Net metering is deployed where the total quantity of electricity produced by the solar generator is not measured or recorded by a meter in any manner. Only the balance of the electricity that is surplus to consumer is measured and recorded. This arrangement is shown in Figure 2.

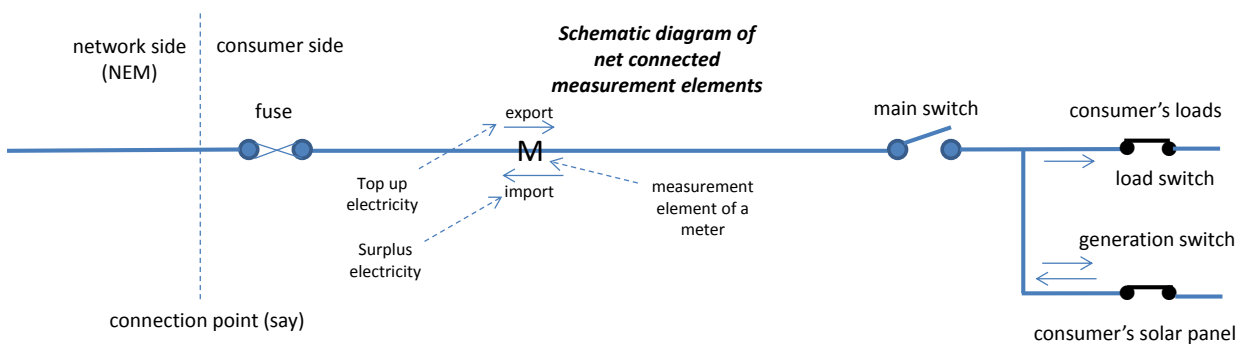


Figure 2: The metering arrangement that supports net generation

In this arrangement only one measurement element is needed (saving on the cost of the measurement element and its installation when compared to a gross metering arrangement). This measurement element would be housed within a meter. For the purpose of this explanation, other components within the meter (such as a register) are not shown. The measurement element must be capable of reading export and import flows, with the measurement stored in appropriate registers. In this arrangement, solar generation is first used by the consumer's load, with the balance (if any) sent to the network (NEM). The advantage is that when there is no solar generation, this arrangement defaults to an export only metering arrangement. The disadvantage is that the total output of the solar generation is not measured (for statistical purpose if nothing else).

In the situation of a net metering arrangement, when no electricity is imported to the NEM, any electricity used by the small customer to top up the solar generation will be exported from the NEM. The net meter will measure and record the NEM electricity used by the small consumer. No record of the solar electricity generated will be available from the net metering arrangement.

The expression 'gross generation' refers to generated electricity that is imported (in total) to the NEM (the distribution network) independently of the electricity consumed by the small customer. The expression 'net generation' refers to electricity that is surplus of the small customer's needs and by default is imported to the NEM.

The gross metering arrangement is commercially attractive to a consumer when the FiT tariff is higher than the price of electricity used by the consumer (one jurisdiction refers to this condition as a 'premium tariff' arrangement). When the solar generation is being used by the consumer, the consumer

doesn't have to pay the retailer for that electricity and in addition the consumer gets paid for the total amount of electricity generated, irrespective of whether it is used by the consumer or sent to the NEM. In this situation, the cost of the two measurement elements (and two meters) is totally offset by the generous payment from the solar generation.

The net metering arrangement is commercially attractive to a consumer when the FiT tariff is lower than the price of electricity used by the consumer. When the solar generation is being used by the consumer, the consumer doesn't have to pay the retailer for that electricity and in addition the consumer gets paid for the balance of electricity it sends to the NEM.

Extent of gross and net metering installations:

The extent of deployment of the gross and net metering arrangements can be readily summarised in the following way.

The gross metering arrangement is commercially attractive if the FiT is substantially higher than the cost of purchase of that electricity from a retailer. Once the FiT is approximately equal to or lower than the cost of purchase of that electricity from the retailer, the net metering arrangements become commercially attractive.

All jurisdictional governments whose initial policy was based on a gross metering arrangement have closed that policy. The policy has been replaced by recommended FiT prices that are payable by a retailer, should the retailer wish to offer a solar generation purchase product. The retailer can determine the basis of the FiT offer (gross or net generation). All retailers currently only offer FiTs for net generation. Consequently, net metering arrangements are deployed for new solar generation installations as the default arrangement.

Because of the significant drop in FiT price, it can be predicted that any gross metering arrangement currently deployed due to policy legacy will be converted to net metering arrangements at the time of current contract termination.

Summary:

Due to the low FiT prices offered by retailers, net metering arrangements for solar generation will eventually replace any legacy gross metering arrangements.

Consequently, from a policy perspective, the net metering arrangement should feature as the sole driver of MTR arrangements. This view is explained further in Section 4 'Single Net Meter' model'.

3. Meter data streams

This Section covers the request to describe the different data streams produced by different meters, including the orientation of 'import' and 'export' flows, real and reactive power. Specifically, it answers the questions:

- How do the data streams relate to different arrangements of elements and registers?
- Who is responsible for preparing and packing these data streams and who do they provide it to?
- How is the meter accessed in order to obtain these data streams?

These matters are explained below.

a. Meter data stream

For the purpose of this paper, there are only two designs of meter that are used for small customer billing: the 'accumulation' design and the 'interval' design.

An accumulation designed meter is when the device can only display an instantaneous reading in kWh. The meter does not attempt to package the measurement records into time periods. Rather the measurements are one continuous increasing number. The meter reading over a time period must be performed by a person who obtains the instantaneous quantity at time A and again at later time B and then subtracts quantity A from quantity B. Whilst the expression 'meter data stream' has been applied to the accumulation designed meter in the AEMO NMI Procedure, the data stream obtained from the meter consists of only the B quantity. For the purpose of this

paper, and to emphasise the relative merits of the interval meter over the accumulation meter, the quantity obtained from an accumulation meter will be referred to as an 'accumulation quantity', rather than as a 'datastream'.

An interval designed meter is when the device constantly packages the measurements in pre-determined time periods (say 30 minutes, but can be shorter – for example 15 minutes). The packages are stored in the meter for a specified duration (for example, 200 days). Any one package can be retrieved from the meter within 200 days, after that it is deleted and replaced by a new (and latest) measurement. The expression 'meter data stream' more intuitively applies to the interval designed meter because the quantities extracted from the meter are represented by a large number (or stream) of data packages. The following points also apply to this design of meter:

- The interval data can be extracted remotely via a communications network, or locally via a 'storage' device (either a mobile mini hand-held device or a local 'computer') from each of the meter's registers. The extraction software will look for the last package that was previously extracted by the device and only extract from that point up to the latest package. The set of packages in this extracted file from any one register is referred to as a 'data stream', irrespective of whether the extraction was performed remotely or locally. Consequently there would be a kWh and kVAh data stream for both the export direction and the import direction of flow (meaning four data streams are possible from a bidirectional single element meter).
- Locally, the meter must have a display that produces values in kWh. It is usual for the display to show the instantaneous value, as it would be impractical to show the package quantities. Because the meter can also produce the accumulated instantaneous quantity, it does not detract from the meter's underlying interval design.
- Whilst the accumulated instantaneous quantity can be extracted remotely from the meter in addition to the packages, it does not form part of the 'data stream' referred to in this paper.
- Meters in a type 5 metering installation are interval designed meters with local readings. The data streams are extracted using the local storage device. The data streams are manually transported to a MDP office where they are uploaded to a database for storage. Some DNSPs under their 'responsible person's role, have installed 'interval' meters without remote communication capability and only asked for the accumulated instantaneous quantity to be extracted from the meter's display. They then register the meter as a component of a type 6 metering installation. For the purpose of this paper, this arrangement is not referred to as producing a 'data stream' – rather it is simply referred to as producing an 'accumulation quantity'.
- The NMI can be assigned to an interval data stream or an accumulation quantity. The last two characters in the NMI character chain (known as the NMI suffix) are changed to suit the type of data represented by the NMI. For example:
 - An export interval data stream might be represented as: 1234567899 E1, where the first 10 characters are the NMI, 'E' in the suffix means an export interval quantity, and '1' means the first register in the meter (or the first meter).
 - An export accumulation quantity might be represented as: 1234567899 12, where the first 10 characters are the NMI, '1' in the suffix means accumulation quantity, and '2' means the second meter.

Note that meter designers have produced hybrid versions of the accumulation designed meter to make it perform 'like' an interval designed meter. These hybrid versions do not detract from the above two fundamental designs for the purpose of developing an MTR policy. If the hybrid version produces packets of data in short intervals, the set of packages would be referred to as a 'data stream'.

Note also that meter designers add 'bells and whistles' to produce many versions of the interval designed meter to suit specific customer requirements. The 'smart meter' is a good example of the 'bells and whistles' added to an interval meter. These additional versions do not detract from the above two fundamental designs for the purpose of developing an MTR policy.

b. Import and Export

Briefly:

- 'import' is assigned to a meter quantity¹ when applying the NMI if that quantity is entering the NEM at a site.
- 'export' is assigned to a meter quantity when applying the NMI if that quantity is leaving the NEM at a site.

In relation to a small customer, these terms can be shown diagrammatically in the following way:

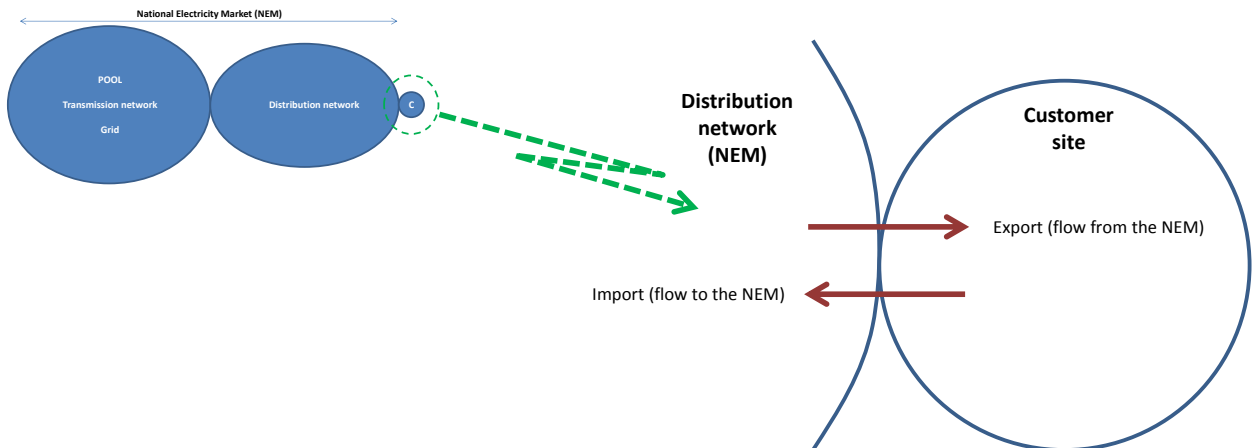


Figure 3: Import and export in the NEM

A more detailed explanation is presented in Appendix A. The explanation is recorded in Section 15 of the NMI Procedure published by AEMO.

c. Real and Reactive Power

In the NEM, the term 'real power' is given the name 'active power' and is defined in the NEM Glossary as "The rate at which *active energy* is transferred". The term 'active energy' is defined as "A measure of electrical energy flow, being the time integral of the product of *voltage* and the in-phase component of current flow across a *connection point*, expressed in watthour (Wh)".

However, the term 'reactive power' is directly applied in the NEM. It is defined in terms of 'reactive energy'. The term reactive energy is "A measure, in varhour (VARh), of the alternating exchange of stored energy in inductors and capacitors, which is the time-integral of the product of *voltage* and the out-of-phase component of current flow across a *connection point*".

A 'simple' explanation of the physical meaning of these terms is as follows:

Background: The electricity obtained from a distribution network is classified as 'alternating', meaning its value changes at every instant in time, from zero to a maximum value. One feature of alternating electricity is that the voltage and the current can be fully aligned (that is, these two components reach their maximum value at the same time, known as being in synchronism) or they can be out of synchronism (the worst case is when one component is at its maximum value and the other component is at zero value at the same instant of time), as shown in Figure 4².

¹ The quantity referred to here can be one of more packages in a data stream, or the difference between accumulation quantities over a nominated duration.

² Note that the Figure 2 and the description is orientated to the 'export' flow of energy. If the voltage and current were oriented to the 'import' flow of electricity, the diagram would point the voltage and current waves to the bottom registers in the meter.

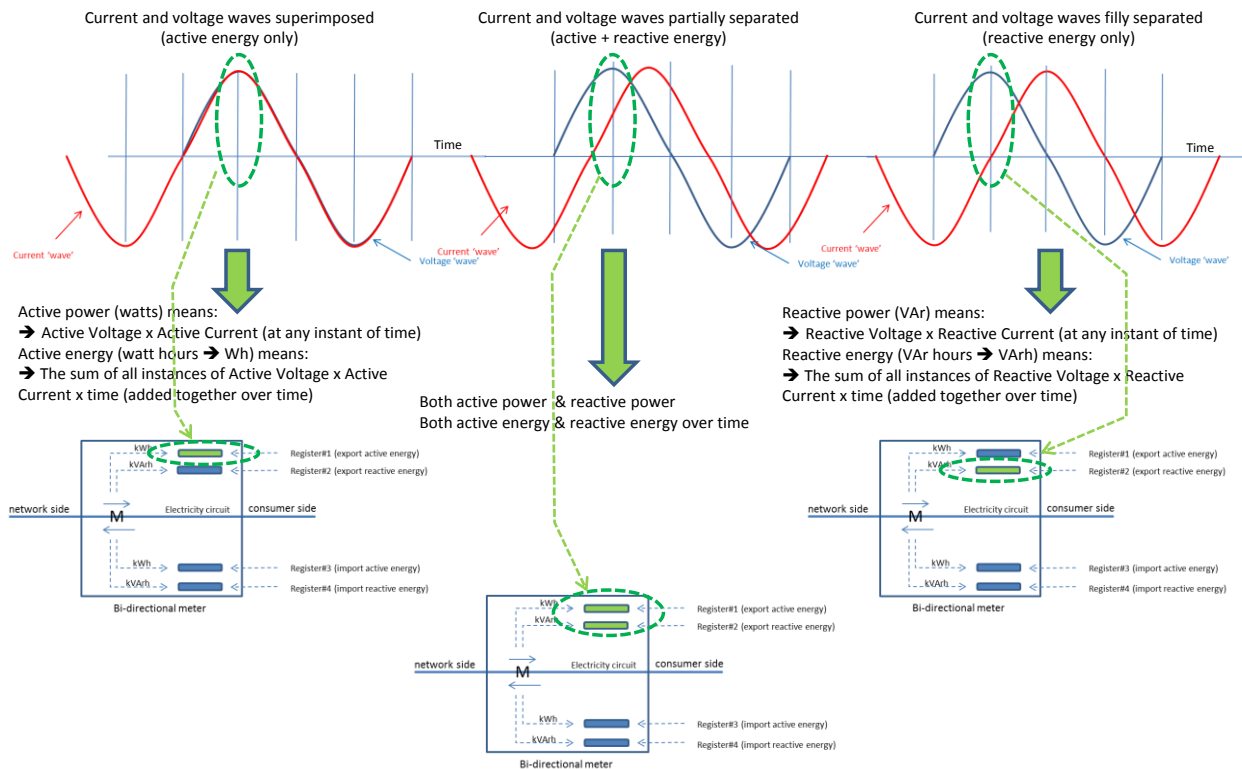


Figure 4: Active and reactive energy shown as mathematical concepts

The figure shows three situations where the peaks and troughs of voltage and current vary in time from each other. In the left hand situation, the measurement is stored only in the active energy register. In the middle situation, the measurement is stored in both the active and reactive energy registers, according to the proportion of the measurement they represent. In the right hand situation, the measurement is stored only in the reactive energy register.

The variation in time difference between the voltage and current waves is due to the characteristic of the consumer load. In most situations the current 'lags' the voltage, meaning that the current peak occurs after (or to the RHS) of the voltage peak. In certain situations, the current 'leads' the voltage, meaning the current peaks before the voltage. The concepts of lead and lag are also expressed by another term known as 'power factor'.

Whilst active energy and reactive energy are mathematical representations of the physical condition of voltage and current as it occurs at different instances of time over a nominated period, it is these mathematical representations that are transcribed from the measurement element to the relevant register. From an MTR perspective, the only fact that is important is the formation of the data stream. If a retailer needs both an active and a reactive data stream from a meter at a settlements point, these two data streams can be associated with one metering installation and hence one NMI. No other fact is important.

Meaning: Active power and active energy are the terms applied when both the voltage and current are in synchronism. Reactive power and reactive energy are the terms used to describe the situation where the voltage and current are out of synchronism in the worst case.

Application: Active energy is the electricity that creates heat (radiators), light (globes) and motion (motors). Reactive energy is the electricity that provides the magnetic and electricity fields that surround all wires that transport alternating electricity. In some situations, the magnetic and electricity fields are detrimental to the transport of electricity. In other situations, the magnetic and electric fields are essential to electrical products (such as motors, transformers – a fridge for example). In general, the balance of active energy and reactive energy is important. Too much reactive energy relative to active energy is considered to be unproductive. A little bit of reactive energy and a very large amount of active energy is the ideal mix for the power system.

Usage: Generating units that use rotation to produce electricity can vary the mix of active and reactive energy. These units play an important part in managing the two components. In addition, the DNSP can control the mix by using special devices (reactors and capacitors). Large customers are generally required to limit their reactive energy requirements. The DNSP measures and in general bills large customers on reactive energy. This is in addition to the cost of active energy used by the customer. There is no known regulation (at the moment) that permits the DNSP to bill small customers for their reactive energy requirements. The NEM doesn't recognise reactive energy for the purpose of settlements – that is, NEM financial transactions are only based on active energy. It is for this reason that the type 4 metering installation has not specified (to date) the need for reactive energy measurement.

Metering: active and reactive energy are concepts that are mathematically related. Hence, the quantities (voltage and current) detected by a measurement element can be easily separated into active energy and reactive energy, with the value of each stored in memory (a 'register') within the meter. The export flow of electricity will have both active and reactive values, as will the import flow of electricity. Hence, a bi-directional meter will normally have four registers, two for export and two for import. Whilst these four registers are generally included in the meter as part of an accepted international standard design, the reactive energy registers are not used for small customers.

d. Elements and registers

An interval meter must have at least one measurement 'element' and one 'register'. The measurement element detects the flow of electricity in the circuit (it actually detects the components of electricity, being voltage and current) and passes that information to a 'calculator' for conversion into energy (active and reactive). The spinning disk in a meter was an early form of calculator. Software in electronic meters perform the calculation. The output of the 'calculator' is stored in a memory facility (register). The dials on a meter were an early form of register. Software 'memory' now provides the storage registers for an electronic meter. Figure 2 shows an electronic meter with a measurement element and four registers.

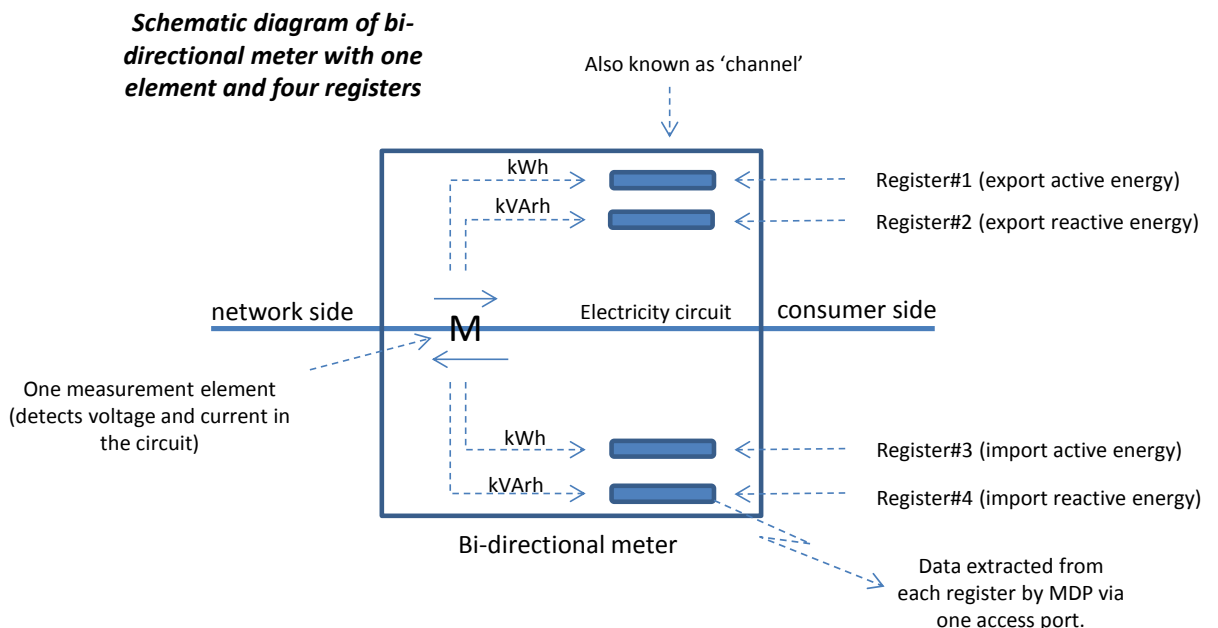


Figure 5: schematic of a meter's measurement element and meter register

The incoming supply to the premise (site) is shown to the left of the meter. The consumer's side is shown to the right of the meter. The meter is designated as bi-directional, meaning that the measurement will be calculated by the software as having a direction, towards the network (import) or away from the network (export).

The direction of electricity flow in the meter is detected by the measurement element (it is typical

for the meter to only have one measurement element). When the electricity is flowing to the LHS (export), the measurement is recorded in Registers#1 & 2. When the electricity is flowing to the RHS (import), the measurement is recorded in Registers#3 & 4.

Whilst the measurement element produces a continuum of data that is time independent, the software applies time intervals, forcing the measurement data to be separated into 30 minute packages. The total of the measurement for each 30 minute period is stored in one of the relevant register, be it active energy (kWh) or reactive energy (kVArh).

Note that the symbol for reactive energy makes use of the standard characters for volts (V) and current (A) to reflect that it is a measure of the separation of these two components.

Each register builds up a set of data packages. Once the register is full, the oldest package drops away and the newest package is added. Hence, the register contains a moving window of data at any point in time. Data needs to be extracted (read) from each register on a regular basis to ensure that an on-going set of data measurements is held in a separate location for historical reasons, including its use for billing. If the meter is read remotely, the moving window must have a minimum a capacity of 35 days in one direction for each register. If the meter is read locally, the moving window must have a minimum a capacity of 200 days in one direction for each register.

e. Preparing and packaging data extracted from the registers.

The appointed MDP is the party who is entitled to extract 'raw' data from the registers for the purpose of NEM settlements. This raw data is known as 'metering data'. The MDP is required to subject that metering data to a validation process.

If the validation process detects an error with the data, the MDP is authorised to apply metrology rules to correct that data error (using agreed substitution and/or estimation techniques). Rules for processing the data are contained in the metrology procedure (Part B) published by AEMO.

At the conclusion of the validation/substitution/estimation process, the MDP stores the 'processed' metering data for future access. The MDP is also required to store the raw metering data, so that a complete history of the metering data is available to a third party, should that be necessary.

The processed metering data is delivered to AEMO in accordance with the NEM delivery timeline. The data is also delivered to the relevant retailer and relevant DNSP/TNSP in accordance with the timeline agreed between the parties. The MDP may also provide the extracted data to a consumer (usually the consumer's retailer will facilitate this request). Rule 7.7 specifies which parties are entitled to receive metering data. The MDP usually is the source of this data for these parties, rather than direct access to the meter by the party).

f. Meter access security

Historically, meter access security was a relatively simple idea.

Local access: the meter contains a display which allows any person the ability to obtain a certain amount of meter data by reading the information displayed on the screen. In an interval meter, the display values usually rotate through a selected set of data, including accumulated kWh. In some displays the time of use (peak, off-peak, shoulder) are able to be displayed. Other information includes data such as: date and time of day, instantaneous voltage and current.

The meter also contains a 'port' which allows electronic access to the registers. The two main types of ports are optical and socket. The optical port is a wireless transfer facility. A hand held device is placed against the port to allow data to be transferred from the meter to a mobile storage device. The hand held device contains the meter's access code to initiate the data transfer. The socket permits a cable to be used between the meter and the storage device (could be a mobile hand held device or a local computer). It is usual for a meter code (like a user name) and password to be used with a socket.

Remote access: The socket is used for remote access. The meter's remote access communication modem could be within the meter or external to the meter. The communication network plugs into

the meter's communication modem and allows remote electronic transfer of information.

Passwords: meters using sockets for extraction of meter data were initially designed on two levels of access security, restricted and unrestricted. The restricted level is 'read only' access to the data registers. The unrestricted level is 'read/write' access to all parts of the meter. Currently, meters are designed with three levels: read only to the data registers, read/write to the clock, and read/write to all other parts of the meter. This design of access security was designed for multiple parties who were allowed direct access to the meter using a public telecommunication network. Chapter 7 was designed on this arrangement.

With the advent of IP networks (internet communication protocols and private internet style networks), meters are being access using IP addresses. This style of communication pushes the access security away from the meter and back to the third party's database. The notion of a gateway and gatekeeper will emerge as the key elements of meter access security in the future. This will lend itself naturally towards a single Metrology Coordinator for any one site. Retailers will compete for customers, whereas Metrology Coordinator's will compete for sites.

Note that whilst a meter manufacture can partition software components to provide individual access to one component and not to any other components (allowing multi parties to access the meter but only for their datastream), this level of security introduces a cost which has not been seen to date as justifying its adoption as a standard feature in mass produced meters.

Consequently, it is not practical in the NEM to design regulatory arrangements around the restriction of access to a unique data stream (say export kWh). Rather, the practical solution is to adopt a single Metering Coordinator who would manage the distribution of data streams to authorised parties.

MTR would be efficiently facilitated in the market place by the adoption of a single Metering Coordinator for declared 'MTR sites'.

g. Summary.

None of the above matters relating to meter data streams present a barrier to the introduction of multiple trading relationships at a declared MTR site if:

- (i) all data streams at a site are managed by the one Metering Coordinator (from a security perspective);
- (ii) each retailer at a site has its own metering installation (with one or more meter data streams); and
- (iii) each metering installation is allocated a NMI.

4. The Single Net Meter model

The Single Net Meter model is a specific situation where multiple data streams with one meter are assigned to multiple retailers (for example, one retailer per data stream). The Single Net Meter model is described in Appendix B.

The first matter, and key regulatory hurdle, to be addressed for the Single Net Meter model is the appointment of a single Metrology Coordinator for this type of meter.

The second matter (and further regulatory hurdle) is the confirmation that Chapter 7 as it stands supports the principle that a NMI can be assigned to a metering installation containing only a single data stream (say export kWh)³. The question boils down to what makes up a metering installation in the regulatory language used by Chapter 7⁴. That is, what are the components that are within the current Chapter 10 definition of

³ This example is not to preclude the possibility of also including the 'export kVArh' data stream into that metering installation which is covered by the one NMI, nor other data streams (say for voltage and/or current).

⁴ It is not a question of ambiguity, because ambiguity within a 'principle' fosters innovation. If after operational experience it is found that one stream of ambiguity produces unintended consequences, then that ambiguity should be removed to the extent necessary to achieve the desired consequences.

metering installation that relate to energy flow and can those components support a single data stream. The Chapter 10 definition of metering installation refers to 'energy data' rather than 'data stream'. Phacelift regards these two terms as largely synonymous, with 'energy data' describing the whole and 'data stream' describing the lowest form of energy data⁵. However, it would be appropriate for the AEMC to examine this matter from a regulatory perspective and consult with stakeholders on their findings. Confirmation that a single data stream (representing energy data) can be registered as a unique metering installation would clear this regulatory hurdle to the benefit of simplifying the MTR policy.

The third matter that is not a regulatory hurdle but rather a stakeholder hurdle is the alignment of a NMI with a meter data stream. This is not a regulatory hurdle, as the NMI is clearly aligned to a metering installation, not a connection point. However, some stakeholders hold a colloquial view that refutes this relationship. These stakeholders will need to be exposed to good consultation practices to dismantle this hurdle. In discussion with an AEMO representative Phacelift formed the view that AEMO regarded a NMI to be the unique identifier for a metering installation and not for a connection point. Phacelift understood that AEMO's databases (particularly MSATS) can accommodate multiple NMIs per connection point. That is, the databases can accommodate a growth in NMIs due to the onset of multiple data streams in a single meter.

This position is supported in AEMO's document "Multiple Trading Relationships & Embedded Networks – High Level Design"⁶. On page 14, it states "While NMIs are allocated to metering installations, generally each connection point has one NMI. But, there is no restriction on the number of metering installations per connection point or the number of meters per metering installation."

Phacelift also formed the view from the AEMO discussion that the rules 7.2.4 'Joint metering installations' and 7.2.4A 'Special site or technology related conditions' could be readily expanded to accommodate the use of a single Metering Coordinator for the single net meter model if that meter was to be used for allocating one data stream to one retailer (say export kWh) and another data stream (say import kWh) to another retailer. Further, and from the discussion, Phacelift found the logical conclusion to be that a single Metering Coordinator must manage the single net meter model as a result of the application of these two rules.

It is a very small expansion of that idea to form the view that it is not the meter that is declared the 'special technology site' but the site itself (once a single net meter model is deployed at that site and used for MTR).

Consequently, Phacelift formed the view that in general AEMO would experience little or no barriers with their systems or process from the introduction of MTR on the basis of the regulatory principles already deployed by Chapter 7.

On the topic of DUOS change, Phacelift consolidated its view during the AEMO discussion that the DUOS charge for a small customer is only billed on active energy (this calculation is currently made for each connection point and no change is required to accommodate MTR arrangements). On face value, there appears to be no substantive reason why the DUOS charge can't be apportioned to multiple retailers at a connection point by using the active energy measured from the retailer's data stream. This change will (may?) require an adjustment to a DNSP's billing system but the adjustment should be a low cost alteration and a simple trade-off against the benefits of MTR.

The appointment of a single Metering Coordinator for the Single Net Meter model is described at a high level in Appendix C. The specifics of the appointment of a single Metering Coordinator a small customer MTR site are described as follows for the purpose of providing a strawman:

1. The first Metrology Coordinator at a site (irrespective of how that party was introduced to the site) will have the option of being the single Metrology Coordinator for that site should the first retailer and customer together declare the site to be an MTR site.
2. The customer will have a right to appeal to AEMO (AER?) should the retailer not agree to support the declaration.

⁵ For example, 'export kWh' can be described as a subset of energy data and also a data stream.

⁶ This document was included in the Rule Change Proposal submitted by AEMO.

3. Should multiple Metering Coordinators perceive they have a right to be the Metering Coordinator at a declared MTR site, AEMO must choose the single Metering Coordinator in accordance with rule 7.2.4(e).
4. Should a Metering Coordinator who had the right to service a MTR site decide not to service that site (for any reason), AEMO must choose the single Metering Coordinator to service the site in accordance with rule 7.2.4(e).

5. Summary

The paper describes various features of metering that need to be understood when exploring the barriers that metering brings to multiple trading relationships for small customers.

The features described are:

- Metering for solar generation under different tariff arrangements.
 - When solar generation prices are higher than consumption prices, gross metering is commercially attractive to the small consumer (refer to Figure 1 for gross metering).
 - When solar generation prices are lower than consumption prices, net metering is commercially attractive to the small consumer (refer to Figure 2 for net metering).
 - Jurisdictions have closed their high priced generation schemes, with these schemes' contracts progressively terminating in the years ahead. As each contract terminates, the small customer will be motivated to change their metering from gross to net (if they are not already on a net metering scheme) to maximise their commercial advantage from the low solar generation prices.
 - MTR arrangements must be able to cater for the efficient use of net metering schemes.
- Meter data stream characteristics. These include:
 - Import and export directions of electricity flows, being into and out of the NEM respectively (refer to Figure 3 and Appendix A for a visual explanation).
 - Real and reactive power and energy measurements (refer to Figure 4 for a visual explanation).
 - Elements and registers, being components that respectively measure and store electricity flows within the meter (refer to Figure 5).
 - Preparing and packaging meter data streams (known as metering data).
 - Meter access security.
 - From the above characteristics, it can be concluded that MTR arrangements must be able to cater for one Metrology Coordinator per site (due to access restrictions), multiple metering installations at that site (due to multiple retailers) and multiple NMIs.
- Single Net Meter model. This model is a good example of how the MTR arrangements mentioned above can be effectively used to empower consumers and retailers.

The paper presents the view that Chapter 7 contains several of the necessary principles that are needed to support MTR arrangements. These are special technology site and NMI allocation principles.

The paper notes the adoption of MTR rules will need to include principles on (a) how the DUOS is to be allocated by DNSPs to more than one retailer at a site, and (b) how some stakeholder databases will need to migrate to a more flexible arrangement when the NMI is not the primary identifier of a connection point.

APPENDIX A – Import and Export definitions

The terms ‘import’ and ‘export’ are defined with the POOL as the reference point. Electricity exiting the Pool is exported from the Pool. Electricity entering the Pool is imported to the Pool.

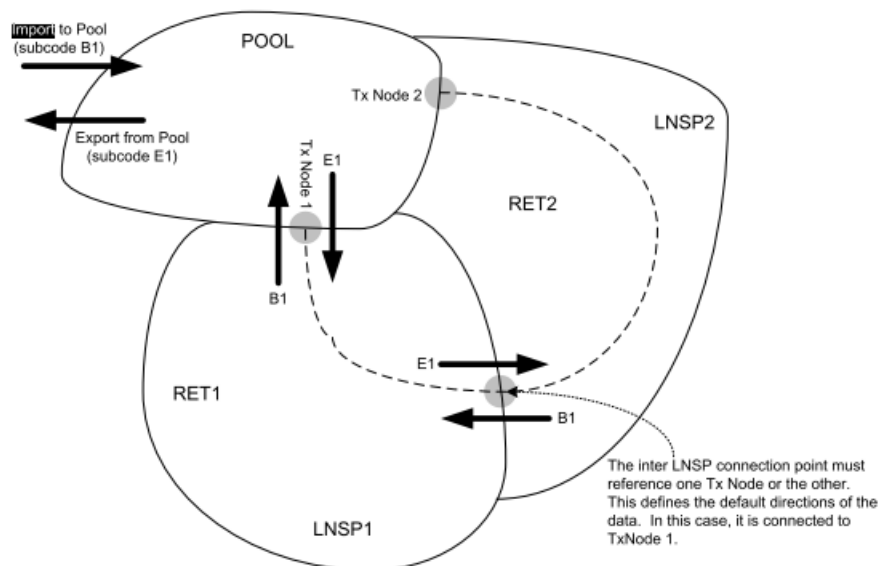
The following extract is from Section 15 (page 79) of the National Metering Identifier (NMI) Procedure, published by AEMO.

15. Energy Direction Flows

The following conventions are used in the National Electricity Market:

- (a) All flows are in relation to their direction to/from the pool. Hence:
 1. All energy from the pool is considered **export** (i.e. energy consumed by a customer is export).
 2. All energy into the pool is **import** (i.e. the energy generated into the pool is import).
- (b) For Interconnector flows, AEMO shall define the Import and Export energy flows on a case-by-case basis.
- (c) For MSATS, net energy is derived as:
Net = Export - Import

Hence the net energy for generation energy is negative (in a **net** quantity) and a customer’s energy is positive (in a **net** quantity).



The same convention is used for kvarh's, i.e.:

Sub-codes B1 and E1 are used in the NMI as part of the suffix. For example:

The NMI is a 10 digit number: 12345678999

The suffix is added to the end of the number: 12345678999E1

When received by AEMO, the number is decoded to mean the export channel of the metering installation number 1234567899, which identifies a location (for the purpose of applying loss factors, and a retailer for the purpose of billing). That is, at this location, the quantity of electricity contained in the data stream is consumed by the end use customer. Hence, it is a quantity that can be invoiced to a retailer for the purpose of settlements.

The character B means ‘import’ channel, E means ‘export’ channel.

The digit 1 means either meter number 1, or the first measurement element in a dual element meter.

APPENDIX B – The Single Net Meter Model

The following description of the ‘Single Net Meter’ model was produced in discussion with Craig Memery on behalf of the Alternative Technology Association. The Single Net Meter model is a concept that will allow a consumer to engage more than one electricity retailer at their premise – one to sell energy to the consumer and the other to buy it.

For the purpose of this explanation, only a ‘small’ customer will be considered for the Single Net Meter model. It is noted that whilst the concept remains sound for ‘large’ customer, the economics of a large consumer may allow for alternative arrangements that are not available to the small customer. Because the large consumer has more commercial flexibility than the small customer, there is less (or no) need to justify the adoption of the Single Net Meter model by the large consumer.

The concept is best explained using a single meter (with a single measurement element) that has a bi-directional flow feature and is located upstream of the tee point where the consumer’s circuits meet. This feature has one register for recording the flow of electricity (active energy, kWh) in one direction and a second register for recording the flow of electricity (active energy, kWh) in the other direction. That is, the meter can produce two data streams (export kWh and import kWh). By treating these two data streams as commercially unique, the consumer has the opportunity to engage one electricity retailer A using the data stream from register number 1 and a second electricity retailer B using data stream from register number 2.

Diagrammatically, the concept would be presented as follows:

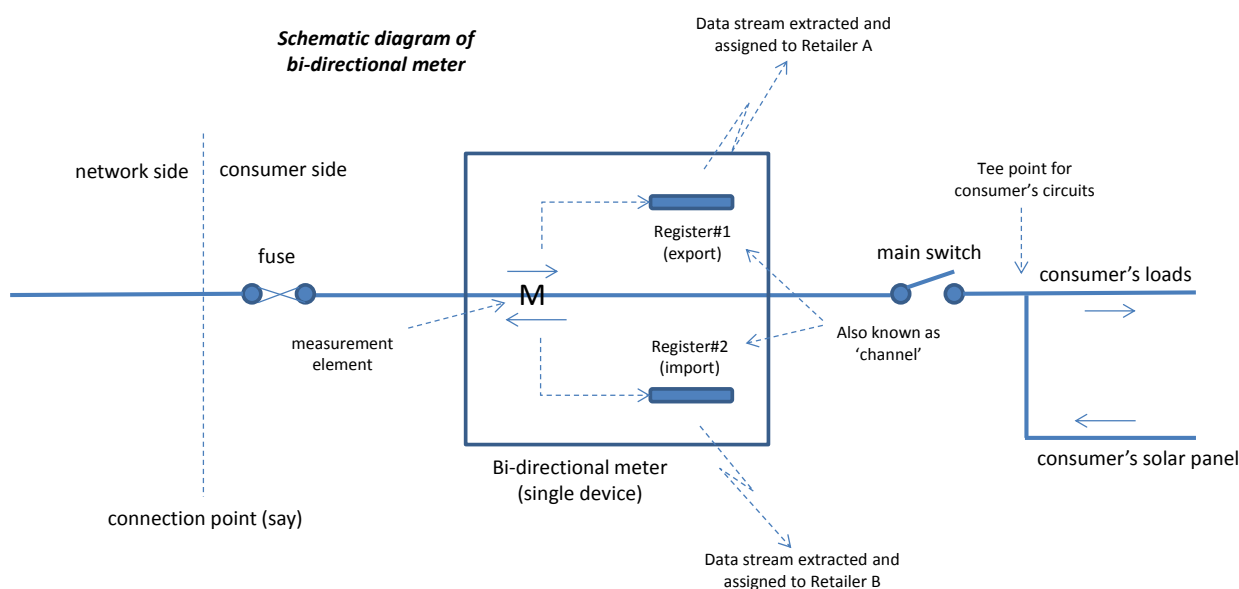


Figure B.1 – Single Net Meter model for Multiple Trading Relationships

Figure B.1 shows a device (meter) as the central attraction. The incoming supply to the premise (site) is shown to the left of the device. The consumer’s circuits are shown to the right of the device. There are two main circuits, one for the consumer’s load and one of the consumer’s generation (solar panels). The direction of electricity flow for each circuit is shown.

Such meters are in place now as for all homes in Victoria under the AMI program. At least one million homes in the rest of the NEM are installed as type 5 or 6 meters that operate in this way or can be logically converted to do so. These meters are installed as a standard when a customer installs solar panels.

The internal logistics of the device is explained in Section 3 of the paper.

Logistics of a single bi-directional meter: Rule 7.3.1(a)(7) in Chapter 7 of the NER requires a metering installation to have a bi-directional meter. Whilst a historical⁷ meter may not be bi-directional, it’s replacement is required to be

⁷ ‘Historical’ refers to a meter that was installed prior to the commencement of the NEM. Whilst this is a legacy condition, the historical meter is required to be upgraded to a bi-directional meter should an alteration be made

bi-directional. The consumer will automatically obtain a benefit from the upgrade in that the new meter can distinguish between import and export data streams, a necessary feature for sites with embedded generation. This benefit could be commercially attractive to the consumer, and should be available for the consumer to negotiate separate commercial outcomes with sellers and buyers of electricity. That is, the consumer should not have to incur an additional cost to replace the single device with two devices just for the purpose of physically separating the meter data streams in order to appoint separate parties to each of the import and export data streams for a single measurement element.

Logistics of data security: As explained in Section 3 of the paper, the standard bi-directional meter installed in a small customer's premise does not have a facility to partition access to one register to a unique party and not any other party. Consequently, any one party⁸ who is assigned responsibility for collecting the data streams from the meter will have access to both registers. This type of limitation is dealt with in principle in NER rule 7.2.4⁹. Where metering technology prevents separate Metering Coordinator's from co-existing at a site, a single Metering Coordinator is 'appointed' to manage that metering technology. The specifics of that appointment for a small customer site are explained in Section 4 of the paper.

Logistics of a metering installation: At the commencement of the NEM, the design of Chapter 7 was based on a 'metering installation' rather than a meter. The metering installation was a concept that covered one or more physical locations and one or more meters. For example, subtractive metering for a connection point could be achieved by meters at sites remote from the immediate connection point.

Logistics of the NMI assignment: By separating the metering installation from a meter, the allocation of the NMI was also separated from the meter. In actual fact, the NMI is the unique identifier of one or more data streams that are covered by a metering installation. This point is identified in Section 1 'Introduction' of the NMI Procedure published by AEMO, where it states "This document sets out the structure for ... NMIs and details metering data streams for each category of installation". The NMI also provides "a verifiable link between connection points and relevant metering data" (note the reference to metering data, not to a meter).

Consequently, the housing of two data streams within one meter does not restrict the application of the NMI. Each import and export data stream(s) from a single measurement element would be registered as a unique metering installation and accordingly assigned a unique NMI. Rather, this restriction only impacts on the appointment of a Metering Coordinator.

Logistics of the DUOS: The Distribution Use of System change ('DUOS') only applies to the export data stream(s)¹⁰. The DUOS is not applicable to the import data stream(s). Consequently, in this explanation of the Single Net Meter model, there should be no complication for the DNSP in applying the DUOS charge to the appropriate retailer.

Note however, that when an alternate single meter model (noted on P57 of the AEMC Consultation Paper) is used more broadly to cover only export loads that are assigned to two retailers (as a result of a dual element meter), it is understood that the separation of the DUOS at a connection point to more than one retailer surfaces as a problem for the DNSP when applying the existing pricing arrangements specified in Chapter 6.

On first pass of Chapter 6, there appears to be no reason why the existing arrangements for DUOS can't be adopted to accommodate its allocation to more than one retailer at a single connection point. For example, rule 6.20.1(b) requires the DNSP to bill the retailer for the DUOS and for the retailer to on-bill that DUOS to the consumer (Distribution Customer¹¹). There is nothing in this rule that prevents the DUOS being assigned proportionally to each retailer in accordance with the proportion of the load for which each retailer is financially responsible.

to the load at the consumer's site. For example, the connection of a solar panel to the connection point would trigger a meter upgrade.

⁸ Being the Metering Coordinator's appointed MDP.

⁹ The principle in rule 7.2.4 was initially constructed on metering installations deployed at the transmission / distribution interface of the NEM. The rule was later expanded to cover 'special technology sites. The introduction of MTR provides a further opportunity to utilise this concept.

¹⁰ Rule 6.1.4 of the NER specifically states this principle. Note that the term 'export' referenced in the rule is a colloquial use of the word and should not be confused with the definition of export applied to meter data streams.

¹¹ Note that the definition of a 'Distribution Customer' includes a franchise customer and a retail customer (being a small customer for the purpose of this paper) having a connection point with a distribution network.

APPENDIX C – The Single Metering Coordinator Model

A discussion on the practical arrangements for Multiple Trading Relationships (MTR) at a small customer's site was held with Marco Bogears from Metropolis Metering Services Pty Ltd.

The key points identified by Metropolis for MTR were:

- MTR was a good Power of Choice policy to include in the NEM. Consumers should have the ability to engage more than one retailer at a site to service its electricity needs. Competition between retailers for portions of the consumer's load would lead to improved outcomes for consumers, be it in choice of product, quality of service or price. MTR would encourage innovation and lead to many more products emerging in the market place.
- The key to a successful MTR policy was the recognition that there can only be one Metering Coordinator to service the site. That is, once a consumer decides (declares) the site to be an MTR site, the site must only be serviced by one Metering Coordinator. This is because: (a) one meter with multiple data streams will emerge as the cost effective facilitator of MTR¹², and (b) the meter box would quickly become a battle ground for space on the meter board if multiple Metering Coordinators were permitted to service a consumer's site¹³.
 - [Phacelift] It is noted that the application of MTR at a site has the potential to make that site a 'special technology site'. As such, rule 7.2.4A could be readily expanded to incorporate MTR arrangements, allowing the site to be serviced by one Metering Coordinator, who must work with all retailers engaged by the customer. Specifically, a new sub-paragraph could be added to rule 7.2.4A(a) to cater for MTR arrangements at a small customer's site.
- The choice of the single Metering Coordinator should be available to the retailer who has the primary load (the E1 or 'main' datastream) for the site. It is this retailer who will appoint the Metering Coordinator for the primary load. If the customer subsequently declares the site to be an MTR site, it would be natural for this Metering Coordinator to assume metrology responsibility for the whole site.
 - [Phacelift] AEMO would retain a decision making role should the retail, other retailers and/or the consumer not agree, as catered for in rules 7.2.4(d) and (e).
- Industry has the view that the NMI 'defines' a connection point. That is, there is only one NMI for a connection point. That NMI may identify more than one meter at that connection point, and each meter may identify more than one data stream. Whilst one NMI may be assigned multiple data streams, the connection point can only have the one NMI.
 - [Phacelift] It is noted that rule 7.1.2(a)(3) requires a NMI to be assigned to a metering installation, not a connection point. Rule 7.3.1(e) requires the LNSP to issue a unique NMI for each metering installation, not for a connection point.
 - [Phacelift] It is noted in the NER Glossary, the term connection point is defined as "...the agree point of supply between the NSP and ... a franchise customer". It is further noted in rule 7.1.2(a)(1) requires a retailer to ensure the connection point has 'a' metering installation. There is nothing preventing two retailers being responsible for parts of the supply at a connection point so long as each retailer 'ensures that the proportion of supply they are to be responsible for has a metering installation and that metering installation has

¹² In most cases it will be cost effective for a consumer to have multiple data streams contained within one meter.

¹³ Conflict between multiple Metering Coordinators over limited space on a meter board would be detrimental to a good policy outcome for the consumer.

- a NMI'. Further, there is nothing in the NER preventing each of those metering installations from containing only one meter data stream (within the meaning of 'energy data').
- [Phacelift] The NMI Procedure published by AEMO makes three contributions to this industry view (Section 1 'Introduction'):
 - First, the Procedure set outs the structure of the NMI in relation to a detailed set of meter data streams.
 - Second, the NMI provides a verifiable link between connection points and relevant metering data;
 - Third, the NMI provides a unique identifier for each connection point within the NEM.
 - [Phacelift] It is possible that the third point has contributed to (or is a practical reflection of) industry's view of the role of the NMI. Chapter 7 does not envisage that the NMI provides a unique identifier for a connection point. Quite the contrary, it requires the NMI to be a unique identifier of a metering installation. There is nothing in the NER preventing a connection point from having more than one metering installation, and hence more than one NMI.
 - [Metropolis] The above Phacelift views were noted. A shift in the definition of the NMI away from a connection point to only a metering installation would not impact on the Metropolis metering databases. However, it might impact on the databases of AEMO¹⁴ and other NEM stakeholders.
 - In summary, the allocation of a single Metering Coordinator for an MTR site and the partitioning of the consumer's total load into separate data streams that were uniquely identifiable by a NMI for NEM settlements, are essential elements in a sound MTR policy.

¹⁴ AEMO has subsequently advised that their databases cater for multiple NMIs at a connection point (see further comment in Section 4).