

Metering arrangements for Electric Vehicles

Overview of issues

29 February 2012

1. Key metering concepts
2. Separate metering
3. Parent – child metering
4. Roaming NMI
5. No EV dedicated metering and profiling
6. Glossary

The overview is a walk-through of pages 37 to 42 of the AEMC Issues Paper

The overview only considers metering issues related to electric vehicles

'kW' & 'kWh' are examples of an 'Australian unit of measurement'

1. Key characteristics of the National Measurement Act (NMA) are as follows:
 - a. It permits two commercial arrangements:
 - i. Sale of electricity with no reference to 'Australian Units of measurement'
 - ii. Sale of electricity with reference to 'Australian Units of measurement'
 - b. The National Measurements Institute is responsible for compliance with the NMA.
 - c. Chapter 7 of the NEM is a delegation of responsibility from the National Measurements Institute to the NEM (rule 7.15)
2. The NMI (National Metering Identifier) uniquely defines a 'metering installation' for the purpose of NEM settlements:
 - a. A metering installation may consist of none, one or more meters, depending on the configuration of the network connection to the load.
 - b. At present, the Metering Register requires a metering installation to be fixed **geographically** [agreed locations and reference details (eg: drawing numbers); site identification names; loss compensation calculation details]. This introduces the concept of a 'fixed NMI' and a 'fixed meter'.
 - c. If the load is not fixed geographically then the load can be considered as 'mobile'.
 - d. A mobile load may have a mobile meter.
 - e. A mobile meter requires a unique identifier (eg: 'mobile meter identifier' – MMI).
 - f. Will a mobile meter be involved in NEM settlements?

A fixed NMI is conceptually different to a roaming NMI

3. 'Responsible person' is defined by the NER as:

“The *responsible person* is the person responsible for in accordance with this Chapter 7, the *metrology procedure* and procedures authorised under the *Rules*, the (1) provision, installation and maintenance of a *metering installation*; and (2) collection of *metering data* from each *metering installation* for which it is responsible, the processing of that data and the delivery of the processed data to the *metering database* and to parties entitled to that data under rule 7.7(a), except as otherwise specified in clause 7.2.1A(a)”

Important principles underlying this definition:

- a. The role is technical (ie, technology) in nature, not financial.
- b. The role allows the accountability for meter error and meter security (where the meter is used for NEM settlements) to be traceable to a NEM 'participant' (identified in Chapter 2), rather than a *Rules* accredited 'service provider'.
- c. The role plays a fundamental part in the registration of a NMI for each metering installation used in NEM settlements (rules 7.3.1(d) and 7.3.1(f)).
- d. The role plays a fundamental part in ensuring the integrity of the metering installation (from a NEM settlements perspective) when a party wishes to add additional features to a metering installation, or to use the metering installation of operational purposes in addition to revenue purposes (rules 7.3.1(c) and 7.3.1(g) respectively).

4. 'metering installation' is defined by the Rules as:

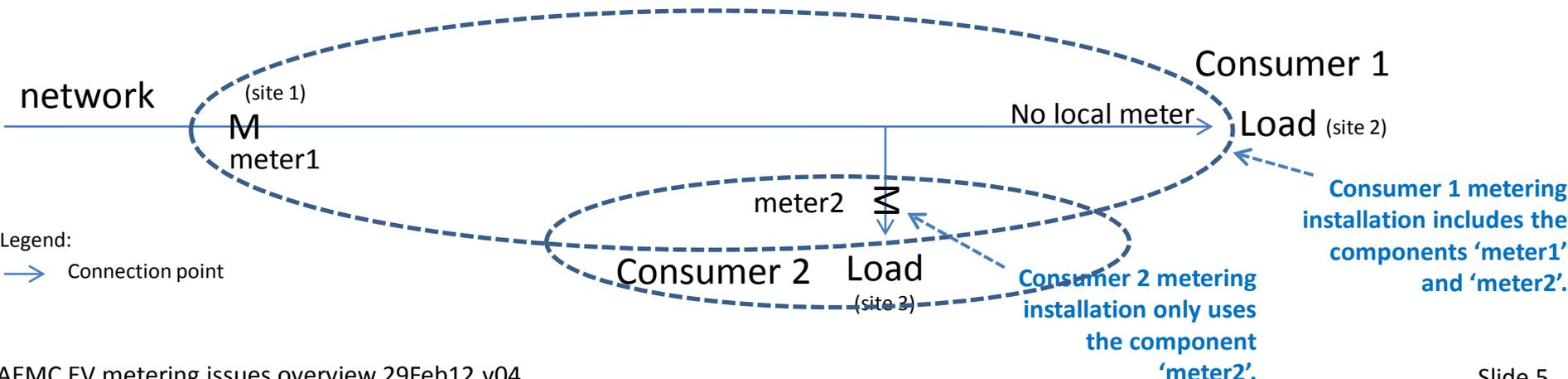
“The assembly of components including the *instrument transformer*, if any, measurement element(s) and processes, if any, recording and display equipment, *communications interface*, if any, that are controlled for the purpose of metrology and which lie between the *metering point(s)* and the point at or near the *metering point(s)* where the *energy data* is made available for collection.

Notes:

- (1) The assembly of components may include the combination of several metering points to derive the metering data for a connection point.
- (2) The metering installation must be classified as being for revenue purposes and/or as a check metering installation.
- (3) An unmetered connection point in accordance with schedule 7.2 does not require a meter; it is nevertheless considered as having a metering installation.”

Important principles underlying this definition:

- a. The device called a 'meter' is only one of the components of a metering installation.
- b. The metering installation may include two meters in order to determine the quantity of electricity flowing at a connection point.
- c. The two meters may be at the same site, or at different sites.
- d. A simple visualisation of this definition is shown in the following diagram:



5. 'role of the Metering Data Provider (MDP)':

By definition: "A person who meets the requirements listed in schedule 7.6 and has been accredited and registered by *AEMO* as a Metering Data Provider"

Important principles underlying this definition:

- a. The MDP is the only person authorised to:
 - i. collect metering data from a metering installation;
 - ii. validate, substitute and estimate metering data; and
 - iii. Deliver that metering data to Registered Participants and AEMO, for the purpose of NEM settlements, retail billing and DNSP billing.
- b. The MDP must demonstrate skills in:
 - i. Data transfers across various application interfaces;
 - ii. Database management for metering data and its associated 'standing data';
 - iii. Data confidentiality, data security and historical data availability;
 - iv. Data processing integrity (accuracy and repeatability)
 - v. Achieving data extraction and data delivery timelines.

6. 'current framework for metering in the Rules' (including type 4/5):

Rule 7.3.4(a): “The type of *metering installation* and the accuracy requirements for a *metering installation* which must be installed in respect of each *connection point* are to be determined in accordance with schedule 7.2”

Schedule 7.2.3: “Accuracy requirements for metering installations”.

Statement: The volume of electricity flowing through a connection point is graded in size from highest value to zero for the purpose of determining the accuracy of the components of the metering installation to be applied to that connection point.

Important principles underlying this statement:

- a. There are four sizes covering the total spectrum of that volume. These are:
 - i. Greater than 1,000GWh → known as type 1 metering installation;
 - ii. Between 1,000GWh and 100 GWh → known as type 2 metering installation
 - iii. Between 100 GWh and 750 MWh → known as type 3 metering installation
 - iv. Between 750 MWh and zero MWh → known as type 4 metering installation
- b. All of these metering installations must have the attributes specified in rule 7.3.1(a), three key points being:
 - i. Measurement in packets of 30 minute (or less);
 - ii. Capability to measure electricity flow in both directions;
 - iii. Remote extraction of metering data to a central database.

6. 'current framework for metering in the Rules' (cont'd):

Important principles (cont'd):

- c. To accommodate past technology and practice limitations, some additional metering installation types were identified. These are:
 - i. Between 160 MWh and zero MWh with only remote extraction of metering data not available → type 5 metering installation (this is known as 'manually read interval meter')
 - ii. Between 160* MWh and zero MWh with both interval measurement and remote extraction of metering data not available → type 6 metering installation (this is known as 'accumulation meter')
 - iii. Prescribed miniscule loads of known and acceptable characteristics and only where there is no meter → type 7 metering installation

6. 'Smart meters':

Statement: In Australia, it is proposed that smart meters will be devices that are compliant with rule 7.3.1(a) and have (at least) the additional features specified in the draft National Minimum Functionality for Smart Meters being considered by the Standing Council on Energy and Resources.

Important principles underlying this statement:

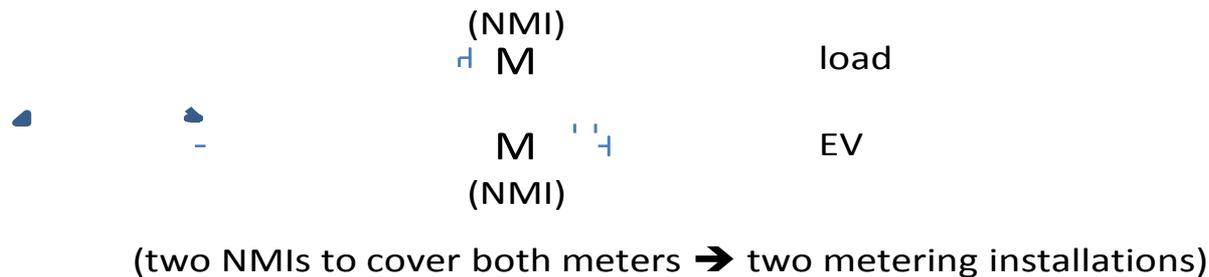
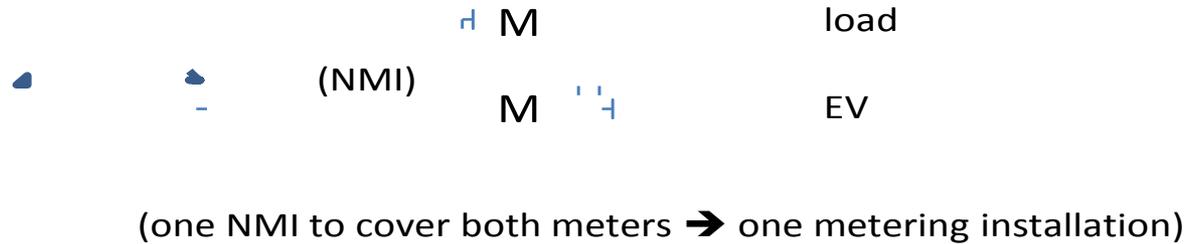
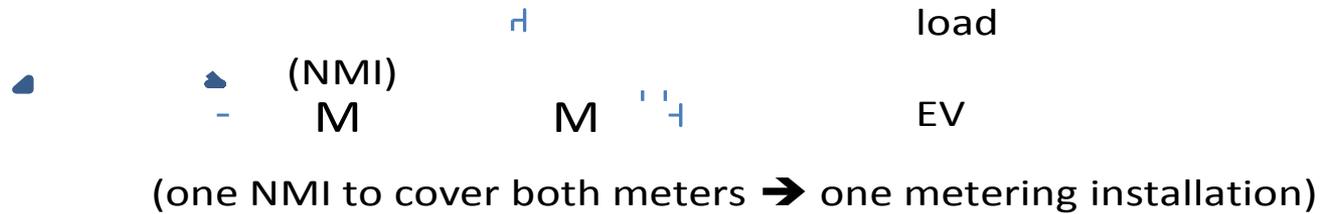
- a. A 'smart meter' is a device that contains additional control related features not required by a NEM compliant meter. Examples of these control features include:
 - a. Remote operated circuit switches within the meter to turn ON and OFF known loads.
 - i. This feature can include the cycling of a load between ON and OFF, such as a pool pump, at pre-set periods during a day or week.
 - b. Demand monitoring and automatic interruption when pre-set limits are exceeded.
 - c. Wireless control of premise loads.
 - d. Wireless transfer of knowledge or action related information to display screens located within the premise.
- b. The smart meter is currently accommodated within Chapter 7 by virtue of rule 7.3.1(c).
- c. Consequently, the proposed Australian smart meter is a NEM compliant meter.

1. 'separate metering' at a premise means the installation of a dedicated meter to separately measure the EV load. This implies:
 - a. Only one NMI and one metering installation where an upstream meter is installed (diagram 1B). See 'sub-metering' if it was intended to establish a parent metering installation & a child metering installation relationship;
 - b. The dedicated EV meter (as well as any upstream meter) must be a NEM compliant meter;
 - c. This arrangement will support the EV operating as a generator;
 - d. There could be one or two NMIs at the site (diagram 1D and 1E):
 - i. Two NMIs at a site means separate metering installations;
 - e. There could be two responsible persons if a second metering installation was established;
 - f. A suitable electrical outlet must be installed at the premise.



**This applies to
each scenario**

2. Diagram 1B, 1D and 1 E apply



Separate metering:

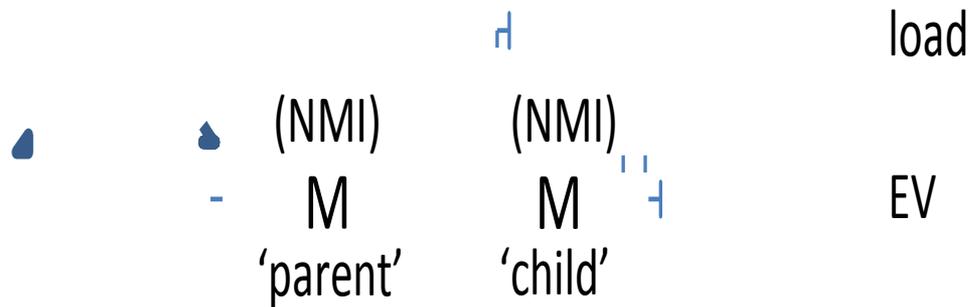
- Enables an EV user to retain its own retailer or EV services provider to supply its EV load. This enables tariffs to be applied to the EV load.
- Increases flexibility for offering EV load products. For example:
 - can arrange for the retailer/ EV services provider to supply energy from renewable generation for zero emission motoring
 - TOU pricing to provide incentives for EV charging at times of low spot price and low network utilisation;
- Enables V2G capability.
- Costs for separate metering may be substantial (claimed to be \$1000-\$8000 per site) and difficulties in implementation.
 - Will require changing the upstream meter to a NEM compliant meter if it is not already a NEM compliant meter.

1. 'Parent-child' metering or subtractive metering. This arrangement implies:
 - a. An upstream meter (parent) must be installed (new or existing):
 - i. If the existing parent meter is an accumulation meter, it must be changed for a NEM compliant meter.
 - ii. An interruption of supply will be required to change the meter.
 - b. A NEM compliant meter must be installed as the child meter;
 - c. This arrangement will support the EV operating as a generator;
 - d. There will be two metering installations at the site and hence two NMI's;
 - e. There could be one or two responsible persons for this configuration.
2. Operation of parent-child metering:
 - a. Parent-child metering would work in a way similar to the AEMO guideline for embedded networks, as follows:
 - b. The owner of the premise is the Embedded Network Operator (ENO) who [currently] would need to obtain an 'exemption' from registering as a NSP.
 - c. The parent metering point would be where the upstream meter was installed.
 - d. The child metering point would be where the downstream meter was installed.
 - e. The parent and child loads could be supplied by different *Registered Participants*

2. Operation of parent-child metering (cont'd):

- f. The parent metering installation would embrace the child metering point.
 - i. The parent metering installation would be a 'subtractive metering installation'.
- g. The EV load (and/or generation) is via the child metering installation.
- h. The responsible person for the EV load would be determined in accordance with Chapter 7 of the *Rules*, which may not be the same as the responsible person for the parent metering installation.
- i. The metering provider and the metering data provider for the parent and child metering installations would be determined by the respective responsible person.
- j. NEM settlements would distinguish between the Registered Participants for the parent and the child metering installations for purposes of billing arrangements.
 - i. The data entered into MSATS for the parent and child metering installations would be sufficient to perform the NEM settlements process for each Registered Participant.

3. Diagram 1C applies:



(two NMIs to cover both meters → two metering installations)

Parent-child metering:

- Claimed to be more cost effective and easier to implement than separate metering but there are costs/complexities with this approach.
- Facilitates business models: enables EV user to choose an EV services provider that differs from its host retailer. (ie. EV load (the child NMI) serviced by a EV service provider while non-EV load (the parent NMI) with host retailer)
 - The EV services provider will need to be a Registered Participant (is this acceptable?)
 - If yes, will the EV services provider have different characteristics to those currently imposed on Registered Participants?
- Enables V2G capability.
- Costs – perceived complexity of arrangements (including difficulties with embedded networks generally):
 - This raises the question of what rules exist for embedded networks
 - The *Rules* are currently silent on this arrangement
 - The existing embedded network rules are supported by an industry ‘guideline’ sponsored by AEMO

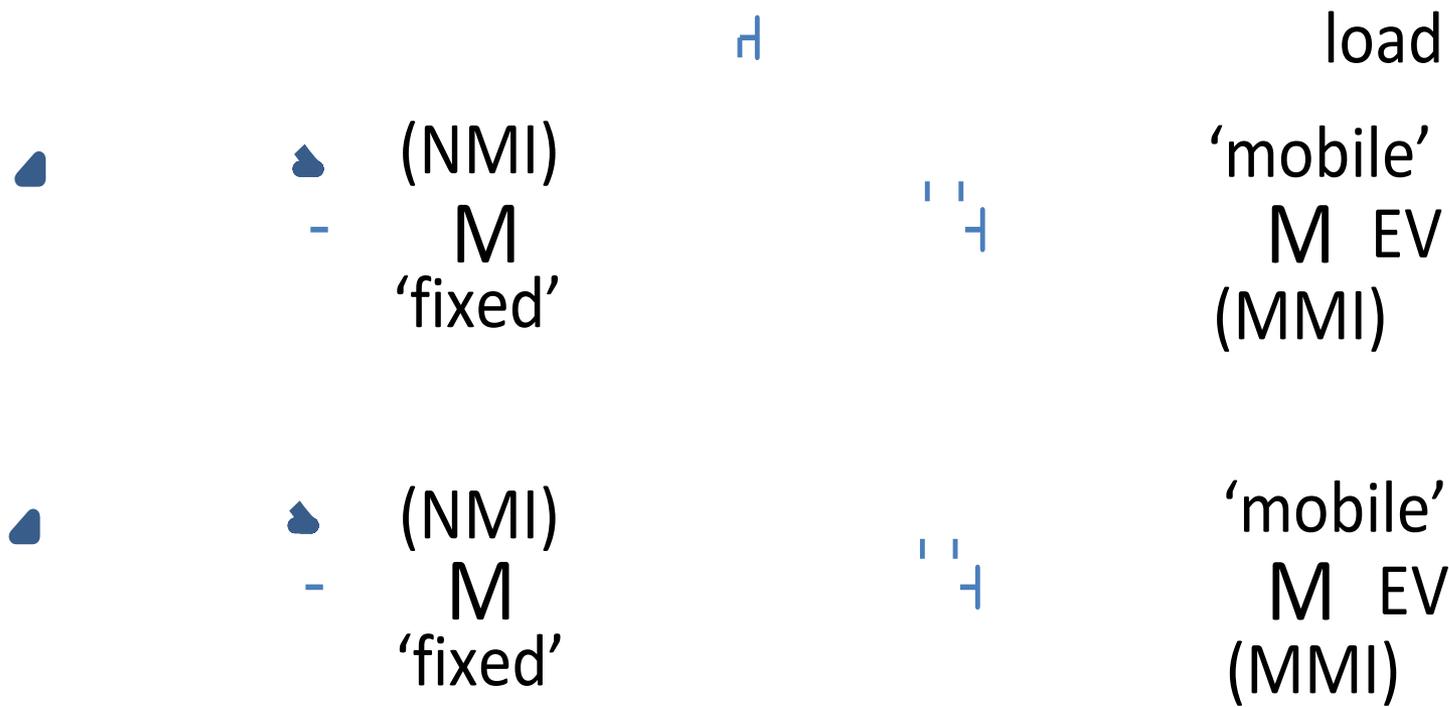
Parent-child metering (cont'd):

- Should the Responsible Person for the 'child' NMI be determined in accordance with the *Rules* (as per the AEMO guideline) or in some other way?
 - Is the AEMO guideline adequate to govern EV connections, or are there principles on embedded networks (including subtractive metering for EV loads) that should be located in the Rules?
 - If yes, what are these principles?
- Are there ROLR implications for the 'child' NMI?

1. These points continue on from the explanation of the NMI on slide 3.
2. 'roaming NMI' is a concept not available under the existing Chapter 7 rules:
 - a. It is not easily accommodated in the metering register under Chapter 7, because:
 - i. NEM settlements will require some form of reliable synchronisation arrangement to align the mobile meter with the fixed NMI.
 - ii. At present, NEM settlements relies on fixed geographic attributes to provide 100% synchronisation reliability.
 - b. Further, the language of Chapter 7 may not apply to the mobile meter. That is:
 - i. If the EV carries its own meter, then the following questions arise:
 - A. Does Chapter 7 of the *Rules* apply to the mobile meter?
 - B. Do the terms 'metering installation' and 'responsible person' apply to the mobile meter?
 - C. Does the EV socket/plug and flexible extension cord represent an embedded network?
 - D. Do NEM settlement arrangements apply to the mobile meter?
 - ii. If the answers are in the negative, should Chapter 7:
 - A. be changed to include governance of metrology in electric vehicles? or
 - B. Not be changed?
3. If Chapter 7 was not changed to accommodate a mobile meter, then billing arrangements for EV loads and generation would need to be 'off-market' (see comment on double accounting on next slide)

4. A 'mobile meter identifier' for mobile EV load/generation measurement devices introduces the following challenges:
 - a. This concept requires an approved meter (adequately sealed) to be installed in the vehicle, similar in many ways to a taxi:
 - i. Who would be accredited to install and service the meter, and what arrangements would apply?
 - ii. Who would be accredited to collect meter data from the mobile meter, and what arrangements would apply?
 - b. The possibility of double accounting for load measurement would need to be carefully considered, with a possible minor impact on the NEM settlements arrangements:
 - i. A problem occurs if an EV consumer plugs into its own premise. In this case the consumer would be billed for the same load by two entities.
 - ii. It may raise fundamental issues for the National Measurements Institute and policy makers, for example:
 - iii. Can a revenue meter be installed in a vehicle that is owned by a consumer?
5. In general, it would be expected that the installing and servicing of the meter in the EV would be performed by a different person to the person who is responsible for the metering installation at a premise.

6. Diagrams 2A & 2B apply:



Roaming NMI:

- Can the principles that apply to the parent and child metering installations apply to this arrangement?
- Will the design of NEM rules for the roaming NMI concept be so onerous as to make this arrangement unattractive from a practical perspective?
- Does 'off-market' arrangements provide the better balance for innovation and ease of application?
- Need to ensure that the metering data from the roaming child is subtracted from the correct parent meter data. How should this be achieved?
- Who is the responsible person for the child NMI given that it would not be uniquely associated with a single distribution network service provider?
 - Should the Registered Participant who supplies the EV load be the person who chooses the responsible person, as currently provided for in Chapter 7 for metering installations types 1 to 4?
- An EV may operate in different states and outside the NEM (ie. WA or NT) and so metering arrangements will need to be standardised.
 - Will this add to the regulatory complexity mentioned above?

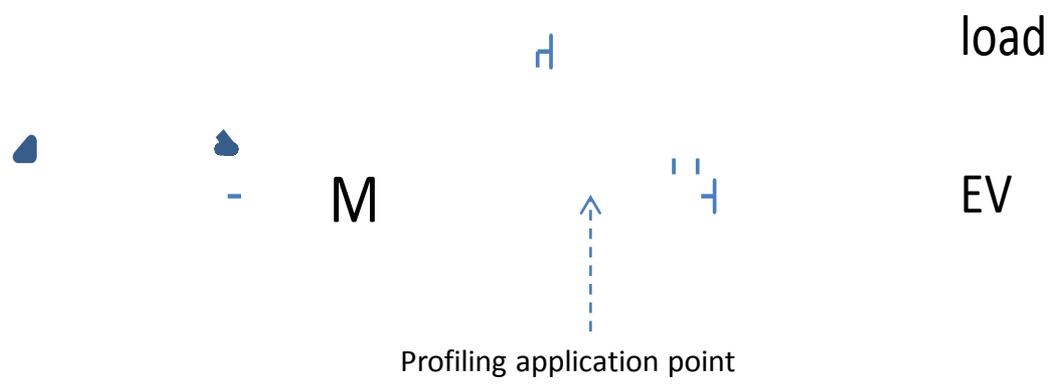
1. 'No dedicated EV metering' at a premise means that an EV would be treated like a normal appliance. This implies:
 - a. An upstream meter must be installed (new or existing);
 - b. No separation of the EV load from the other loads at the premise;
 - c. No segregation of the EV load measurement if more than one 'Registered Participant' wishes to be involved at the premise;
 - a. It is noted that the financial relationship between more than one 'Registered Participant' would need to be off-market;
 - d. If the meter is an accumulation type, it must be changed to a NEM compliant meter (to provide bi-directional metering capability);
 - e. No additional NMI is required;
 - f. No change to the appointed responsible person is required.

2. Diagram 1A applies:



3. 'Profiling' of an EV load is identical to the concept of a type 7 metering installation, where an agreed methodology (a formula and its parameters) is used as the basis of the measurement;
4. It is noted that energy charged in units of kW or kWh on the basis of a profile would be contrary to the NMA, as there is no traceability back to a measurement standard. Note also:
 - a. the current type 7 metering installation arrangement in the NEM is a grandfathering of existing historical arrangements based on the implacability of installing a meter in past times – it is hard for this arrangement to support the application of a type 7 metering installation for electric vehicles.
 - b. Time synchronising between the NEM and the EV profile is required in the methodology. That is, a time-clock (or consumer regulation based on prohibited connection times) would be required if this arrangement were to be used.
5. Timing (in addition to quantity) would be a further difficulty when the EV is used as a generator;
6. An estimation of time of day for consumption (and generation) would be necessary with this approach;
7. A NMI would be required to cover this configuration if NEM settlements were to be involved;
8. No change to the appointed responsible person would be required.

9. Diagram 1A applies:



No dedicated EV metering:

- No special arrangements are required.
- A single retailer would be responsible for all electricity use at the premise.
- Cannot apply EV specific incentives to encourage EV users to charge at periods of low demand or network loading except if EV household was subject to a general TOU tariff.
- May prevent development of potential business models that provide packages (eg. energy and provision of an EV battery).
- Difficult to do V2G technology.

Profiling:

- Unlikely to be able to differentiate between the charging behaviour among EV users
- Cost reflective tariffs would be ineffective because consumers are not able to receive the benefit from changing their charging behaviour
- Not conducive to business models relying on accurate measurement of EV charging load:
 - That is, the billing on be basis of kW or kWh would not be permitted (NMA Act)
- Unlikely to effectively manage EV supply back into the network for V2G

Words in italics refer to the definitions found in Chapter 10 of the Rules

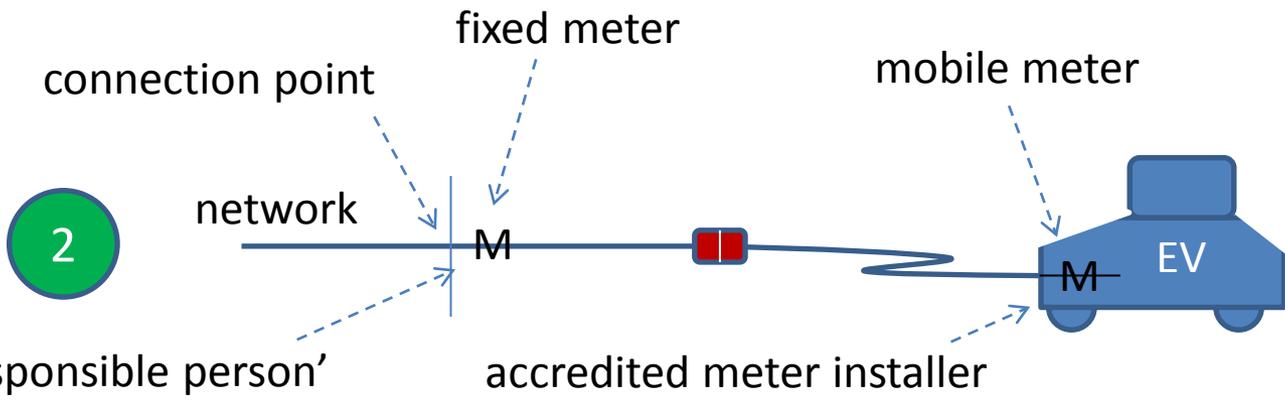
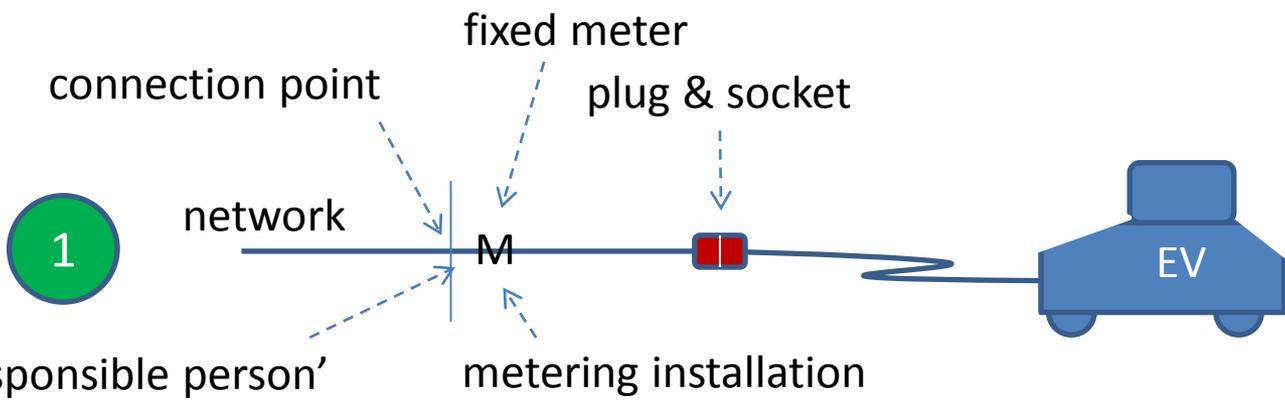
1. Accumulation meter means a device that measures electricity flow and records that flow as in a continuous manner so that the latest value is the only record of that measurement
 - a. For differentiation purpose, an accumulation meter is not a NEM compliant meter. It only becomes NEM compliant when used in conjunction with the AEMO profiling arrangements, but this level of compliance is not compatible with a NEM compliant meter.
2. DNSP means *Distribution Network Service Provider*
3. EV means electric vehicle
4. Interval meter means a device that measures electricity flow in 30 minute intervals in both directions and has remote data transmitting capability, which may not be deployed.
5. MMI means a mobile meter identifier used to identify meters installed in EVs
6. National Measurement Act (NMA) → found at www.comlaw.gov.au
7. National Measurements Institute → found at www.measurement.gov.au
8. NEM means the National Electricity Market

Words in italics refer to the definitions found in Chapter 10 of the Rules

9. NEM compliant meter means (for the purpose of the AEMC Issues Paper) a TOU meter, an interval meter or a smart meter (where that meter is operating as a device in a metering installation and meets the relevant requirements of rule 7.3.1(a))
 - a. The expression 'NEM compliant' meter has been used for consistency in these slides
10. NMI (National Metering Identifier) means the unique identifier given to a metering installation, as specified in rule 7.3.1(d)
11. *Profile/profiling* means the arrangement where *metering data* (or costs) for a period longer than a *trading interval* is allocated into *trading intervals*
12. *Rules* means the National Electricity Rules
13. Smart meter means an 'NEM compliant meter' that contains additional load control features, as discussed on slide 9
14. TOU meter means (for the purpose of the AEMC Issues Paper) an 'interval meter', where those interval measurements are aggregated into longer periods during a day (for example, 5.00 pm to 8.00pm)
15. The reference to 'accurate measurement' in the Issues Paper is a reference to a measurement device (meter) that is traceable back to an approved 'measurement standard'

2 conceptual diagrams can be used to examine the range of issues

Metering for Electric Vehicles



The following schematic diagrams can be used to examine the range of issues

Metering for Electric Vehicles

