Minor Energy Flow (Small Load) Metering Briefing : Progress and Next Steps

A report for the Commonwealth Department of Industry, Science, Energy & Resources

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Acknowledgements

Next Energy Lighting has prepared this document for the Commonwealth Department of Industry, Science, Energy & Resources. Next Energy Lighting gratefully acknowledges the input of the Department, the Australian Energy Market Operator, the National Measurement Institute and a range of suppliers of smart street lighting controls in consultations for this project. Their input included participation in meetings, submissions by suppliers about how their systems performed metering functions and their experience in having such systems recognised overseas, and consultation on draft materials. Some of the material submitted by suppliers about the capabilities and approach taken to metering by their systems may be viewed as commercially confidential and has been treated as such. None of this material from suppliers is included in this document but the material has proven vital in presenting an informed view of the market.

About Next Energy Lighting

Next Energy Lighting is a specialist advisory firm focusing on LED street lighting, smart lighting controls, multi-function poles and inter-related smart city devices and technologies. Next Energy Lighting and its directors, Paul Gowans and Graham Mawer, have excellent relationships across the public lighting industry but are completely independent of all lighting equipment suppliers, controls/smart city suppliers and specialist lighting service providers. This allows Next Energy Lighting to deliver impartial strategic advice to the end-users of public lighting and a variety of associations and government bodies with an interest in public lighting and smart city issues.

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Executive Summary

Smart street lighting controls can deliver a range of road and public safety, asset management, energy reduction, environmental and overall cost benefits.

The current Type 7 metering approach that is widely used to assess street lighting energy consumption in the National Electricity Market (NEM) was not designed for the variable energy consumption that smart street lighting controls often entail (e.g. by using dimming, trimming and enabling constant light output controls or when smart city sensors are attached to lights). The Type 7 approach therefore creates an inadvertent barrier to the adoption of smart street lighting controls with consequent low adoption rates in Australia as compared to other jurisdictions.

In support of the National Energy Productivity Plan, the Department of Industry, Science, Energy and Resources (DISER), the Institute of Public Works Engineering Australasia (IPWEA), Lighting Council Australia (LCA) and a range of smart controls and street lighting suppliers have engaged with the Australian Energy Market Operator (AEMO) to help progress an effective, efficient, technology-neutral and optional metering regime for minor energy flows such as smart street lighting.

AEMO is currently examining options for the proposal of a NEM Rule change that would recognise such metering systems, potentially as an extension of proposals to progress initiatives suggested by the Energy Security Board (ESB).

In mid-2021, the ESB called for recognition of non-traditional metering types and locations in its Post-2025 Market Design papers (see Part C – Appendix, Page 40). This has been subsequently reflected in a September 2021 Australian Energy Market Commission (AEMC) directions paper with recommendations and options for the reform of smart metering in the NEM. Importantly, the directions paper recognises the potential for smart meters to provide, “*Better street lighting management for councils”* (Table 2.1).

In addition to a NEM Rule change, each individual smart street lighting control metering system will need to be verified under the *National Measurement Act 1960* (Cth). A prerequisite of verification is that the metering system must be of an approved pattern. Importantly, the National Measurement Institute’s (NMI) requirements for pattern approval, NMI M 6-1, was updated in July 2020 in a manner that may help facilitate the approval of smart street lighting control systems for metering purposes.

The changes to NMI M 6-1 give applicants a second pathway to pattern approval based on Australian Standards and some increased flexibility on the part of NMI to, *“….vary or interpret requirements, under either pathway, if it is deemed appropriate to support new or different technologies or applications.”*

This paper outlines next steps and key approval information for stakeholders:

- Section 4 - NEM rule change process, including consultation.
- Section 5 - smart meter pattern approval and verification - information for suppliers.
- Section 6 - information on the accreditation of metering data providers.

1) Benefits of Smart Street Lighting Controls

As identified in the 2016 Street Lighting and Smart Controls Programme Roadmap, a 2016 IPWEA discussion paper prepared for the then Department of Energy & the Environment and the E3 Committee, and in a previous paper by the LCA[1], smart street lighting controls have a range of road and public safety, asset management, energy reduction, environmental and overall cost benefits.

Currently, most Australian street lighting is controlled by photoelectric cells that slot into a standard NEMA/ANSI C136 base mounted on the top or bottom of each street light. These contain a photo-sensitive element that measures the ambient light level, switching the light on when it is getting dark and off when it is getting light.

Figure 1: Smart Street Lighting Control Device

As per the adjacent Figure 1, illustrating a smart street lighting control device, smart street lighting controls typically slot into the same NEMA/ANSI C136 base. They can be programmed to perform basic switching from a Central Management System (CMS) as with traditional photocells, however, they possess many other capabilities because of their internal intelligence and communications systems. For example, they can implement dimming or brightening regimes, collect asset management data from the power supply of the luminaire, identify the GIS location, convey fault reports and relay metering data from an internal metering chip. In all, there are at least 23 areas of potential benefits from smart street lighting controls as summarised in the table below.

The deployment of smart street lighting controls also entails a number of challenges and risks. These include a range of technical, integration, security and training issues that must be addressed and are common to most large IT and communications implementations.

The energy-related benefits arising from items 19-23 in the table below are all enabled by being able to properly measure and bill for the energy consumption of the luminaire. Overall, the additional energy savings delivered by smart street lighting controls can range from 10-30% with figures of 20-25% being widely cited as typical in large international deployments. As such, the energy savings benefits of smart controls form a key component of the overall business case for their deployment and building a positive business case without being able to secure energy savings benefits appears challenging.

Securing energy-related benefits from smart controls is inherently reliant on having a metering regime that recognises the energy savings, allowing the end-customer to benefit from activities that reduce consumption such as dimming, trimming and enabling constant light output controls. As summarised in the next section, the current Type 7 metering approach that is widely used to assess street lighting energy consumption in the NEM was not designed for variable energy consumption that dimming, trimming and enabling constant light output controls entail.

[1] Discussion Paper – Smart street lighting in Australia July 2016, Lighting Council Australia

Table 1: Business Case Benefits of Smart Street Lighting Controls

Road Authority & Societal Benefits	Operator Benefits	Energy-Related Benefits
1) Improved Road Safety / Safer Communities	10) Automated Fault & Performance Reporting	19) **Dimming / Brightening** Generally off-peak dimming or shut-off but also brightening at peak times or in response to adverse weather, events or emergencies
2) Higher Service Levels	11) Automated Day-Burner Detection	20) **Trimming** Optimising on and off times / Permanently trimming excess lighting above compliance requirements
3) Installation Time Savings	12) Maintenance Optimisation	21) **Constant Light Output** Holding lighting output at compliance levels throughout life by gradually ramping up power to compensate for lumen depreciation
4) Offset Traditional Photocell Cost	13) Asset Management Benefits	22) **Smart City Device Support** Ability to properly measure energy consumption by smart city sensors added to street lights (e.g. traffic counters, environmental sensors, noise-level sensors)
5) Lower Failure Rates than Photocells	14) Billing / Inventory Accuracy Improvements	23) **Ability to Claim Environmental Credits** Provide evidence of energy savings where environmental credit schemes recognise smart lighting controls
6) Offset Night Patrol Costs	15) Insight into Network Performance	
7) Longer Luminaire Life	16) Reduced Call Handling from Fault Reports	
8) Ability to Support Smart City Functionality	17) Greater Certainty in Litigation	
9) Reduced Environmental Impact	18) GIS location	

Based on the range of business case benefits identified above, the volume of smart controls deployments internationally is understood to be rising at almost 25% per year and projected to reach 30 million deployments by 2023. The United Kingdom is understood to have connected over 29% of all street lights with smart controls[2] and, in New Zealand some 70% of street lights now have or are committed to have smart controls[3].

[2] Telensa 2020
[3] Strategic Lighting Partners 2020

In Australia, IPWEA estimates that total deployments of smart street lighting controls sit at less than 3% of all street lights with most of these being on lighting directly controlled by municipalities in the Australian Capital Territory and in the Northern Territory or on those directly managed by main road authorities. There has been little deployment by Australian electricity distributors to date. And, while almost all smart street lighting controls being deployed internationally are being co-deployed with big LED rollouts, this opportunity has been to date largely missed here in Australia in the absence of energy savings being able to support the business case for smart controls.

2) Current Approach to Street Lighting Metering in the NEM

The electricity consumption of most of the 2.5 million utility-owned street lights in Australia is currently billed for based on a calculated methodology. In the NEM this is referred to as Type 7 metering.

Under the Type 7 metering approach, the electricity consumption of street lighting is billed on a deemed basis determined by entries in a National Electricity Market Load Table for Unmetered Connection Points. This table of unmetered loads is maintained by AEMO. Entries in the unmetered load table are based on independent lab tests of each model of luminaire or other type of device.

Billing for each customer is determined through a calculation of the number of each type of luminaire multiplied by the corresponding unmetered load table entry for that particular type of luminaire and the estimated number of operating hours (as determined by sunset and sunrise times) over the billing period.

This approach inherently assumes that street lighting loads are constant, remain as first measured in lab tests and that lights turn on at full power at sunset and turn off at sunrise. Some of the inherent inaccuracies in the current Type 7 metering approach are that actual luminaire energy consumption changes over its lifetime, luminaires and photocells experience faults at typically 5-15% per year that can leave them off or on 24 hours a day until repaired, photocell switching times drift as dirt accumulates on their optical windows and street lighting inventories may not always have a high level of accuracy. There is therefore a reasonable case to be made that a metering regime for minor energy flows could materially improve the accuracy of street lighting energy billing.

The current Type 7 metering approach, which has also been widely used in other parts of the world, was entirely appropriate for the previous generations of lighting and the basic timers or photocell controls that switched them on and off. However, this approach has inadvertently created a barrier to the adoption of smart street lighting controls technology because it is unable to readily accommodate:

- variable loads in street lighting (e.g. that would result from constant light output controls being enabled, trimming and dimming / brightening); and
- additional small and often variable loads being connected to a street light such as smart city sensors in Zhaga receptacles (see Figure 2).

The Type 7 metering approach could accommodate a dimming regime (item 19 in the table above). However, this would need to be a fixed regime with unchanging dimming hours and levels and each combination of luminaire type and smart controls type would need to be independently tested under each fixed dimming regime. This approach is used in the assessing energy consumption of traffic signals but has not, to date, been taken up in public lighting most likely due to the cost and complexity of testing each different combination of luminaire, smart control and dimming regime. It would also not facilitate any changing approach to dimming or brightening (item 19) or other features entailing dynamic energy consumption (e.g. items 20-23 in the above table).

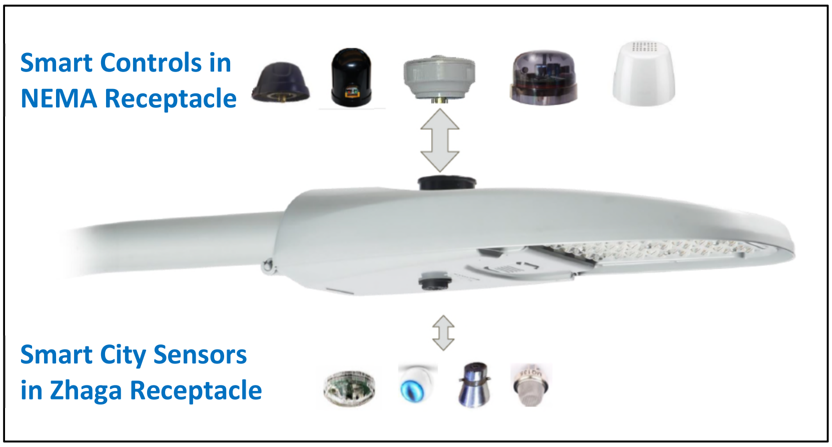

Figure 2: Luminaire with Smart Controls & Sensors

3) Consultation and Collaboration to Date

DISER, IPWEA, LCA and a range of smart controls and street lighting suppliers have engaged with AEMO over the past three years in an effort to help progress an effective, efficient, economical, technology-neutral and optional minor energy load metering regime on behalf of stakeholders in local government and main roads authorities. The goal of this work is to secure changes to the metering approach in the NEM that would recognise the metering capabilities of smart street lighting controls (and potentially other smart city devices and small loads in the public domain that are currently unmetered) to help facilitate the business case for their adoption.

Many of the leading smart controls providers have been supporting this work, including:

1. **Dimonoff** (Distributed by NEC and ADLT)
2. **Sylvania-Schréder** (Distributor of Schréder, Cimcon, Urbana & other smart controls devices)
3. **Itron** (Network operator supporting a range of smart controls devices)
4. **LED Roadway Lighting** (Distributed by Pecan Lighting)
5. **NNNCo** (Network operator supporting Wellness Telecom devices)
6. **Signify** (formerly Philips)
7. **Telensa**
8. **Telematics** (Distributed by Connected Light Solutions)
9. **Thinxtra** (Network operator supporting Flashnet devices)
10. **Trilliant** (Network operator supporting a range of smart controls devices)

Key steps to date include:

- Publication by IPWEA in 2016 of the SLSC Roadmap explicitly calling for reform in this area after widespread consultation with local government, lighting industry suppliers, lighting consultants, a number of other associations and other stakeholders.
- Publication by LCA in 2016 of a Discussion Paper highlighting the potential benefits of smart controls and calling for reform to facilitate their adoption.
- IPWEA assistance with a series of Commonwealth-led, workshops in each State in 2017 with key stakeholders on possible approaches to addressing barriers to adoption of LEDs and smart controls.
- Publication by IPWEA in 2018 of discussion paper prepared for the then Department of Energy & the Environment and the E3 Committee.
- Submission by IPWEA to AEMO in 2018 of a proposal for them to consider adoption of a new minor energy load metering regime.
- Organisation of a supplier workshop by Next Energy on behalf of DISER with AEMO in Melbourne in March 2019 to assist AEMO with its consideration of a possible Rule change proposal and to assist suppliers in better understanding AEMO information needs.
- Submission to AEMO by Next Energy / DISER in January 2020 of Minor Energy Flow Metering Capability Statements from each supplier responding to a request for AEMO for more information on 26 metering-related aspects of their smart controls to a standard format agreed with AEMO.
- Submission to AEMO by Next Energy / DISER in July 2020 of updated Minor Energy Flow Metering Capability Statements from each supplier specifically responding to a request for AEMO for more information on areas such as cumulative energy measurement, data storage capacity, commissioning and standards compliance.
- Engagement with key stakeholders and securing submission to AEMO in Sep-Oct 2020 of sample metering data files from the UK, Georgia (USA) and New Zealand by Next Energy / DISER.
- Drafting of this summary document by Next Energy / DISER to apprise all key stakeholders of the status of discussions and next steps.

Of note in consultations was useful overseas precedent recognising the metering capabilities of smart street lighting controls systems cited by suppliers. This included systems in the United Kingdom, Georgia (USA) and New Zealand.

Overseas metering-related standards or parts of these standards that suppliers noted that they were being asked to comply with included ANSI C12.1/20, IEC 62052-11/21, IEC 62053-21/22/23, EN 50470-1/3 and UK BSCP520. Recently adopted changes to the New Zealand Electricity Authority's Approved Profiles for metering also now recognise CMS-monitoring street lighting installations. Suppliers also noted the very recently adopted ANSI C136.50 and ANSI C136.52 (US standards for metering-related performance requirements for smart street lighting controls and for LED drivers with integral energy measurement).

4) Rule Change Proposal

AEMO suggested a change to the National Electricity Rules was likely to be needed to facilitate the widespread use of smart street lighting controls (and other minor loads in the public domain). Such a Rule change would need to clarify the requirements for the installation, maintenance and operation of minor energy flow metering installations. This would enable distinction from the existing metering installation types primarily designed to support residential and small commercial and industrial connections, and from the current Type 7 calculation process used for most street lighting.

AEMO also indicated that a proposal to change might not be limited to smart street lighting control due to other factors that are causing AEMO to consider the need for greater flexibility in the NEM metering arrangements. These include metering other legacy unmetered electrical devices (e.g. bus shelter lighting, street telecommunication infrastructure), small footprint metering for customers within embedded networks and the enablement of flexible trading arrangements (currently being considered by the ESB). AEMO would be well positioned to initiate a Rule change proposal regarding these matters which would be sent to the AEMC for consideration.

AEMO has indicated that it is preparing a Rule change request in response to ESB recommendations for the development of flexible trading arrangements in the NEM, targeted for release in April 2022. This request would include proposals for metering minor energy flows (such as street lighting using smart control systems).

The AEMC would then need to consider the proposed Rule change, following its normal internal and external consultation processes as summarised below.

The standard AEMC Rule Change Process:

- The Proponent submits a Rule change request
- The AEMC commences Rule change process and seeks submissions on the Rule change request and consultation paper
- Stakeholders (including the proponent, if they wish) lodge submissions on the Rule change proposal
- The AEMC publishes a draft Rule determination and seeks submissions on the draft determination
- Stakeholders (including the proponent, if they wish) lodge submission on draft Rule determination
- The AEMC publishes a final Rule determination.

In addition to the steps referred to above, the AEMC seeks to engage with stakeholders through discussions throughout the Rule change process which can take the form of informal one-on-one discussions, workshops, forums and technical working groups. More information about changing energy rules is available on the AEMC website.

5) Updated Metering Approval Process for Smart Meters

Under Australian trade measurement laws, electricity meters that are to be used for billing purposes must be pattern approved and verified. This would include smart street lighting control systems if the energy consumption data that they produce and deliver via a Central Management System is to be used as the basis of billing retail electricity and network distribution charges.

The requirements for pattern approval and verification of meters is overseen by the National Measurement Institute (NMI) within the Department of Industry, Science, Energy and Resources. Information about electricity metering pattern approval and verification can be found here.

This metering approval process is separate to and could potentially be run in parallel with an AEMO/AEMC Rule change process.

Pattern Approval

In summary, pattern approval refers to assessing the meter's design to ensure that it is fit for purpose and able to operate in the environment in which it is expected to be used. In the context of electricity meters, pattern approval is designed to determine the measurement accuracy of the meter and whether it retains its accuracy over a range of environmental and operating conditions.

Each type or model of meter must seek pattern approval which is assessed against the requirements of NMI M 6-1. NMI provides guidance on how to apply for pattern approval and the associated fees here.

Importantly, NMI M 6-1 was updated in July 2020 giving applicants a second pathway to pattern approval based on Australian Standards (in turn based on IEC standards) and some increased flexibility on the part of NMI to *"….vary or interpret requirements, under either pathway, if it is deemed appropriate to support new or different technologies or applications."*

The NMI does not conduct testing for pattern approval itself. Rather, NMI considers independent laboratory test results from approved laboratories in assessing compliance with NMI's pattern approval requirements. Further information about acceptance of test results in available in NMI P 106 available on the Pattern Approval website.

To obtain approval, an application must be made to NMI. If an applicant has existing test reports that contain relevant testing towards pattern approval, these may be considered by NMI. NMI can work with applicants to provide advice on the acceptance of test results and required testing. If an application and test results are satisfactory, NMI will issue a Certificate of Approval for the pattern (design) of meter/system.

Verification

Following pattern approval, individual meters/systems must be verified before they may be used for trade such as billing. NMI has appointed Utility Meter Verifiers (UMV) who can verify that the meter is operating within acceptable error limits. The UMV will use NITP 14: National Instrument Test Procedures for Utility Meters to assess each meter. Verified utility meters must then be either marked with a verification mark or referenced in a certificate of verification by serial number.

6) Metering data provider accreditation process

The collection, processing and delivery of metering data in the NEM can only be performed by an appropriately accredited Metering Data Provider. For each metering installation in the National electricity Market, Metering Data Provider responsibilities include:

- Collecting metering data,
- Validating and, where necessary, substituting metering data,
- Calculating metering data for type 7 metering installations,
- Where appropriate, producing metering data forward estimates, and
- Delivering metering data to AEMO and energy market participants.

The DNSP performs Metering Data Provider services for metering installations that are manually read (type 5 and 6 metering installations) or calculated type 7 metering installations, and in Victoria provides metering in accordance with the Victorian AMI requirements. For all other metering installations in the NEM, provision of metering services are contestable and any competent and capable party, except a Market Generator or Market Customer, can apply to perform the role of Metering Data Provider.

The National Electricity Rules require AEMO to establish a qualification process to facilitate the accreditation of Metering Data Providers. The Qualification Procedure and Accreditation Checklist can be found on AEMO's website at Accreditation and Registration.

The Accreditation Checklist contains questions the applicants are required to complete as part of the qualification process. They are intended to provide verification of what is required of an applicant through demonstration of systems, processes and procedures that allow AEMO to assess the applicant's suitability to perform in the role of a Metering Data Provider.