Making AEMC dumb meters smart

Dr Martin Gill

Meters mandated by the Australian Energy Market Commission (AEMC) are so sadly lacking in both functionality and features the meters can only be referred to as dumb. Managing the impact of increasing numbers of solar, and soon battery storage systems, requires measurements, however the dumb AEMC meters are not required, nor capable of, making the necessary measurements. The following discusses cost effective enhancements to the AEMC meters so they can assist our clean energy future.

Introduction

South Australia leads the world in the uptake of renewable sources of generation. This is not without its challenges. Managing high levels of both solar and wind requires measurements to identify and control the various network impacts. These measurements are made by meters.

There is an additional challenge when consumers are installing large numbers of solar and battery storage systems. This is the significant cost of installing 100,000's of meters at domestic sites. Fortunately the Australian Energy Market Commission (AEMC) has mandated the rollout of remotely read meters. As such consumers are already paying for meters fitted with communications. But there is a problem.

The AEMC made retailers responsible for the provision of consumer meters. The AEMC only requires the meters provide two functions (intended to benefit retailers).

- Remote reading of 5 minute interval data
- Remote disconnection and reconnection

Multiple Cost Benefit Assessments show the societal benefits delivered by these two functions will not recover the cost of the meter rollout. These same Cost Benefit Assessments show specifying additional functionality can increase societal benefits, without significantly increasing meter costs.

For example there is virtually no additional cost if the AEMC meters were required to make meaningful measurements of network voltage and frequency[1]. Knowing the maximum and minimum voltage and when they occur, can quickly identify areas where distributed generation is impacting the network.

[1] The AEMC meters are only required to measure average voltage which is not a benefit because these values are of little assistance to network management

Summary of Article

The addition of several functions to the AEMC meters will address major deficiencies in the current specification. These minor modifications ensure data and methods are available to efficiently manage consumer installed distributed energy resources.

- Add specifications for two element meters with switched and unswitched load control terminals
- Specify an export capacity limit (monitoring energy flow to the network)
- Specify 2 Amp voltage free relay(s) so meters can control inverters
- Specify meaningful measurements of network voltage

A decade ago these features were readily available from smart meters being offered in Australia. Importantly industry consultation found the additional features did not significantly increase meter costs.

South Australian Proposals

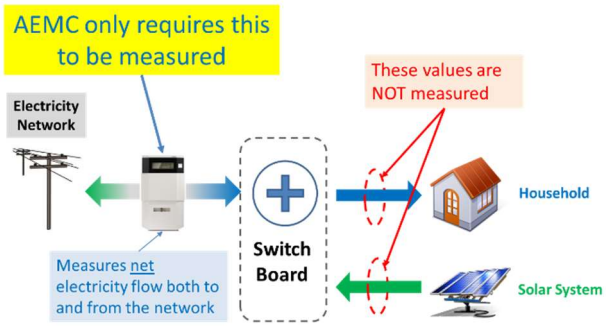
The South Australian Government has released a number of Consultation Papers. The two discussed here are:

- Proposed Smart Meter Minimum Technical Standards [Ref 1]
- Proposed Export Limit Requirements for Distributed Solar Generating Plants [Ref 2]

Jointly considering smart meters and Export Limits for inverter systems offers faster implementation at a significantly lower cost. The major savings come from utilisation of the remote meter communications avoiding unnecessary duplication. Also ensuring the AEMC meters can *and do* support network benefits, provides major savings.

Two element metering

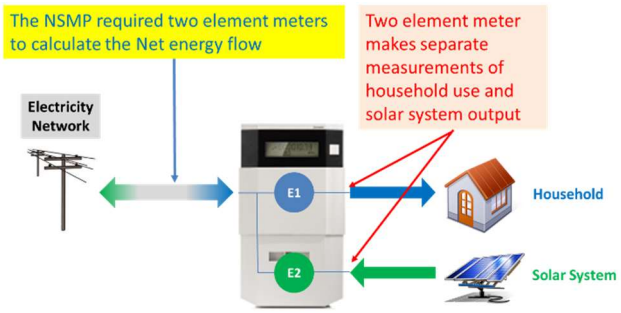
After investing in a solar system most consumers are then forced to install an AEMC meter (under the AEMC's mandatory replacement policy). Many are then surprised to find the new meter does not measure the output of their solar system. Instead it only measures the difference between solar system output and household use, so called net metering.



To address the gap consumers are opting to pay for additional metering. This additional metering measures the actual output of the solar system and energy sent to the network. Forcing consumers to pay for this additional metering is wasteful when in most cases their (useless) AEMC meter could easily make these measurements.

There is another reason for adding this functionality to the AEMC meter specification. The Australian Energy Market Operator (AEMO) has stated their load forecasts are becoming increasingly inaccurate due to their inability to monitor domestic solar output. AEMO forecasts still rely on lessons from the meters installed to support the NSW Solar Bonus scheme. The NSW meters did separately measure solar system output and household electricity use (so called gross measurements).

The National Smart Metering Program (NSMP) foresaw the advantages of a single meter providing both net and gross solar measurements. The Smart Metering Infrastructure Functional Specification (SMI FS) [Ref 3] described a two element meter.

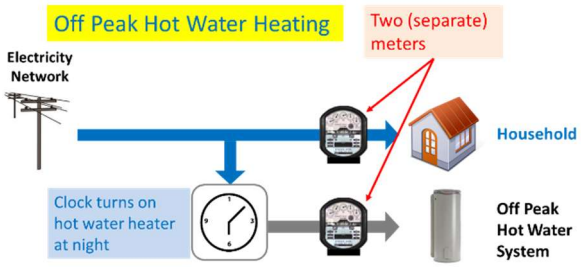


Importantly the SMI FS requires two element meters internally calculate the net flow of energy from the separate (gross) measurements. The separate measurements provide direct consumer and AEMO benefits. The cost of the additional metering element was around $10.

Three element metering – Why?

Two element meters are not new. They were first developed to support off-peak hot water heaters. Since the 1960's electricity distributors have offered lower energy prices to consumers prepared to only run their storage hot water heater at night.

In South Australia the hot water heaters were controlled using a time switch. Overnight the time switch turned on to heat water. Lower prices could be offered for hot water heating because it kept the coal fired power stations burning.



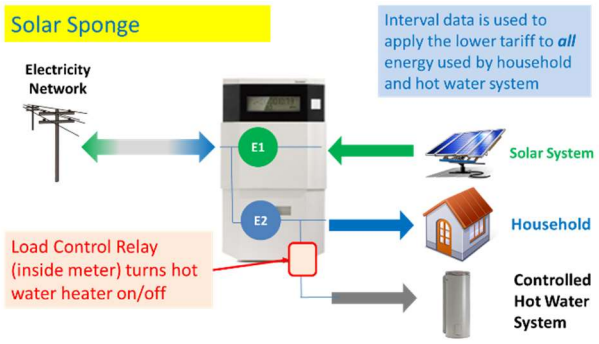
With high levels of renewable generation it is no longer valid to assume electricity prices are lowest at night. Evidence shows abundant supply in the middle of the day is resulting in lower prices in the middle of the day.

Indeed South Australia is currently offering a Solar Sponge tariff to encourage people to shift their electricity use to the middle of the day. The Solar Sponge offers low prices for electricity used in the middle of the day.

The above are important considerations when challenging the assumed need for three element meters. Solutions using existing two element meters are possible.

Should cheaper tariffs only apply to water heating?

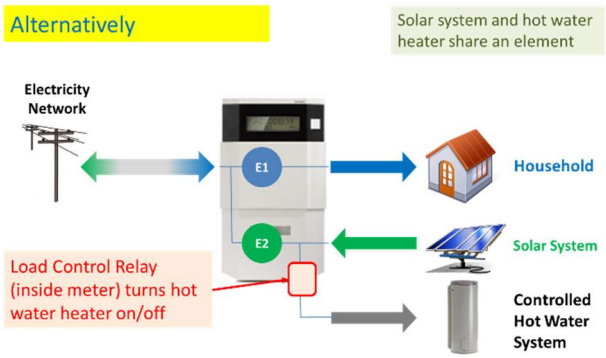
The following shows household electricity use and the hot water heater sharing one element. Bills are calculated using the 5 minute interval data. Specifically during the off-peak period both household use and hot water use are charged at the lower price.



While historically cheap electricity was only offered for controlled hot water heaters, this restriction no longer seems appropriate.

Use bi-directional energy flows

An alternative is to place the solar system on the same element as the hot water heater. This allows household electricity use during off-peak periods to be charged at a higher rate than electricity use by the hot water heater.



Technically it is still possible to separately measure household use, solar output and hot water system use. The restriction is the hot water heater must only be turned on when there is no solar output. If the hot water heater is turned on when the solar system is generating electricity the element will measure the net energy flow.

Two element meters are readily available from a number of vendors allowing both of the above solutions to be implemented immediately. By comparison vendors have offered three (and more) element meters but the incremental benefits may not justify limited availability and higher price.

Note the AEMC meter specification does not describe two element meters or load control relays. It also fails to describe meter configurations. South Australia will need to describe the required functionality and meter configuration, specifically the load control relay needs to provide both switched and unswitched outputs.

Export Limit Control

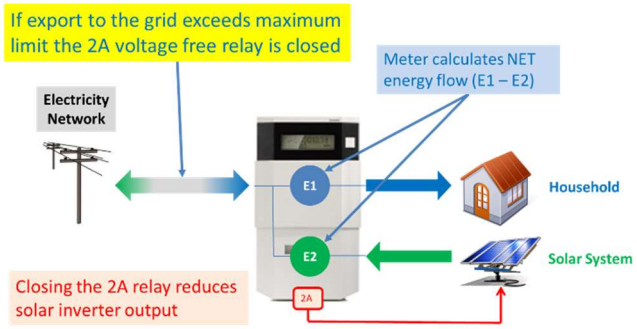
Only a few inverters currently support Export Limit Control [Ref 2]. Supporting this feature requires the installation of a separate additional sensor. The external sensor is easily tampered with to defeat the set Solar Export Limit.

There is no standard way to communicate with inverters. Different inverter manufacturers offer a range of incompatible interface standards (Canbus, USB, WiFi, etc). Even inverters offering the same interface then use incompatible command protocols. The result is it will take years to define a common interface standard and command protocol to support the desired Export Limit Control.

The NSMP considered a potential solution. The SMI FS described the inclusion of 2 Amp voltage free relays intended to control external equipment.

The reason this is significant is because all inverters described in Australian Standard AS/NZS 4777 [Ref 4] provide an interface compatible with the voltage free relays documented in the SMI FS. The interface can be used to reduce the output of solar inverters.

The following depicts a two element meter complying with the SMI FS. This meter calculates the net energy flow from the separate measurements and compares it to a programmed limit. If the limit is exceeded then the meter closes the 2 Amp relay.



As described there is the potential for undesirable (repeated) on/off switching of the inverter. When the 2 Amp relay is closed the inverter output is reduced and net energy flow falls below the Export Limit. The 2 Amp relay should remain closed for a suitable time period to avoid repeated rapid on/off switching.

Functionality to implement a demand limit and also to avoid rapid switching was included in the SMI FS. The appropriate section was “Supply Capacity Limiting”. The meter was required to calculate how long to close

the relay to achieve the (remotely) programmable demand limit.

So to summarise the proposed implementation of Export Limit Control.

- The solution is low cost, using the existing inverter interface and 2 Amp voltage free relays
- No changes to inverter software are required, instead using functionality already proposed for smart meters (not included in the AEMC meters)
- The demand limit is fully programmable using the existing meter communications, avoiding duplicating expensive remote communications

Importantly the proposed solution can even be applied to existing inverters, enabling its immediate implementation in areas where Export Limit Control can deliver societal benefits.

"But communications are cheap!"

There is a fallacy the Internet of Things (IoT) now allows free communications to connected devices. While prices may have reduced there remain significant challenges. Primary among them is the number of competing IoT standards (NB-IoT, LoRaWAN, etc). Picking the wrong standard may result in large numbers of stranded assets.

More significant is the lack of suitable standards to send commands to inverters. While there are currently a number of proposals to address this deficiency it will be years before inverters supporting any standard can be installed. More years will be required before there is a significant population of controlled inverters. It will be more than 10 years before this approach delivers any network benefits.

Addressing the desired functionality using smart meters presents a timely and significantly cheaper solution. A major impediment is the current dumb AEMC meter specification which fails to describe any of the required functionality.

Other issues created by the AEMC

The AEMC meter specification fails to define a meter protocol. This is not a problem for retailers because they are only interested in the interval data for which a common market format has been defined. The lack of a common protocol is a problem for distributors wanting to obtain meaningful network voltage measurements.

The lack of a common meter protocol means Meter Data Providers (MDPs) can provide voltage data in any format they like. The problem then falls to SAPN who must develop software to convert each provided data format into something useful. It would be far simpler if a common format was specified.

There is conflicting advice about the availability of gross measurements made by two element meters. The AEMC advised they require MDPs provide the On Market data, or net measurements. Visibility of solar systems requires access to the separate (gross) measurements, referred to as Off Market data. There is no obligation MDPs provide Off Market data.

MDPs can choose to provide access to other meter measurements, including voltage measurements and Off-Market data and are free to charge for this access. SAPN acknowledges it intends to pay for access to voltage data, however they may also have to pay (more) to access the Off Market data, but this assumes the MDP is prepared to make it available. There should be a requirement MDPs will make the Off Market data from two element meters available and at a sensible price.

Another issue the SA Government may want to address has been created by the AEMC. An update allows consumers to request meter communications be turned off. The meter still collects the same data and can even be used to implement Export Limits, but data is only collected during manual meter reads. Any meter not fitted with communications is a dumb meter and ultimately fails to support the goals of improved network visibility and management. The SA Government may want to consider not allowing communications to be disabled.

Other issues

Metering standards do not specify or test the accuracy of voltage measurements. Voltage measurements should only be considered meaningful if they are tested, including influence factors. This was considered during the preparation of the SMI FS. The final specification referred to existing voltage measurement standards.

Testing shows meters can make unacceptably large measurement errors when harmonics are present. Internationally test waveforms have been defined intended to provide greater confidence meters are not adversely affected by harmonics. The SA

Government may want to consider including some of these waveforms in their enhanced specification.

Conclusion

The AEMC proposed the mandated rollout of meters under the banner of "Power of Choice". The AEMC promise was consumers would be able to choose the metering solutions they wanted. Instead the reforms have forced consumers to pay for meters incapable of delivering consumer or network benefits.

The lack of benefits was easily predicted. The National Smart Metering Program consulted extensively with all stakeholders. The consultation identified, discussed and addressed multiple smart metering needs. The final specification (SMI FS) delivered retailer, network and consumer benefits.

The lawyers and economists at the AEMC failed to understand the SMI FS. They instructed AEMO 'simplify it' so AEMO removed technical functions providing network and consumer benefits. The final AEMO/AEMC dumb meter specification [Ref 5] is so lacking in both features and functionality compliant meters do not support Australia's clean energy future.

The South Australian Government should be commended for challenging the lack of network benefits provided by the AEMO/AEMC dumb meters. Minor functionality enhancements can deliver significantly greater network benefits with minimal impact on meter costs.

References

1. Consultation on the Proposed Smart Meter Minimum Technical Standards in South Australia

2. Consultation on the Proposed Export Limit Requirements for Distributed Solar Generating Plants in South Australia

3. National Smart Metering Program (NSMP) Smart Metering Infrastructure Minimum Functional Specification (SMI FS).

4. Australian Standard AS/NZS 4777: Grid connection of energy systems via inverters

5. Minimum Functionality of Advanced Meters, prepared by AEMO November 2014

Citation

Please accurately attribute all quotes and references to this article including the title "Making AEMC dumb meters smart". It would be appreciated if references included the author's website drmartingill.com.au.

Comments or Questions?

The author is happy to receive comments or questions about this article. He can be contacted at martin@drmartingill.com.au

About Dr Martin Gill

Dr Martin Gill is an independent consultant specialising in the provision of consumer advice. This advice is based on a deep understanding of Australia's energy industry and strong analytical skills. As a consultant he has prepared advice for consumer advocates, government regulators, electricity distributors, electricity retailers, asset operators and equipment vendors.

Dr Gill is a metering expert. During the National Smart Metering Program he facilitated the development of a specification for Australian smart meters. Innovative metering products developed by his teams have been externally recognised with the Green Globe Award, NSW Government's Premier's Award and Best New Product by the Australian Electrical and Electronics Manufacturers Association.

He currently represents the interests of consumers on a range of Standards Australia working groups including metering, renewable power systems, battery storage and demand management.