



**Energy Transformation
Taskforce**

Foundation settings for market settlement

Information paper

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Energy Transformation Taskforce

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Contents

1. Purpose	1
1.1 The Energy Transformation Strategy	1
1.2 The purpose of this paper	2
2. Introduction to settlement	3
2.1 Market settlement	3
2.2 The case for change to settlement arrangements	3
2.2.1 Consequential changes.....	4
2.2.2 Opportunities for improvement	5
3. Settlement interval	6
3.1 Alignment of dispatch and settlement intervals	6
3.2 Five-minute settlement implementation considerations	7
3.3 Taskforce design decision – Settlement interval	8
4. Settlement timeline	9
4.1 Weekly settlement	9
4.2 Weekly settlement implementation	10
4.3 Taskforce design decisions – Weekly settlement.....	11
5. Settlement residues	12
5.1 Allocation of settlement residues to the Notional Wholesale Meter	12
5.2 Alternative approaches to allocate loss residues	14
5.3 Taskforce design decisions – Allocation of settlement residues.....	15

1. Purpose

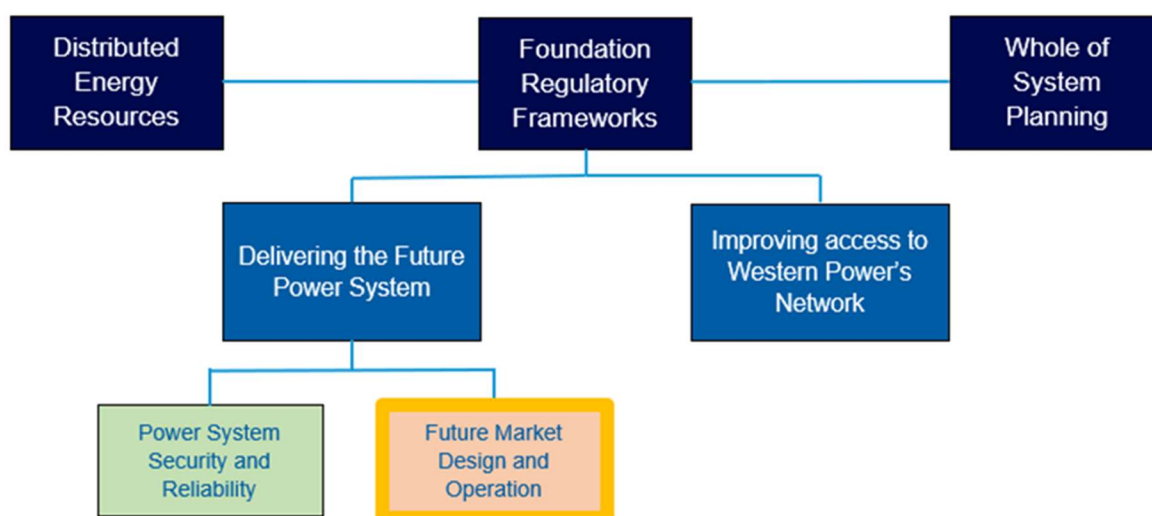
1.1 The Energy Transformation Strategy

This paper forms part of the work to deliver the Energy Transformation Strategy. This is the Western Australian Government's strategy to respond to the energy transformation underway and to plan for the future of our power system. The delivery of the Energy Transformation Strategy is being overseen by the Energy Transformation Taskforce (Taskforce), which was established on 20 May 2019. The Taskforce is being supported by the Energy Transformation Implementation Unit (ETIU), a dedicated unit within Energy Policy WA, a sub-department of the Department of Mines, Industry Regulation and Safety.

More information on the Energy Transformation Strategy, the Taskforce, and ETIU can be found on the Energy Policy WA website at www.energy.wa.gov.au

This paper is prepared as part of the Future Market Design and Operation project (highlighted in Figure 1) within the Foundation Regulatory Frameworks work stream of the Energy Transformation Strategy.

Figure 1: Energy Transformation Strategy work streams



The Future Market Design and Operation project is undertaking improvements to the design and functioning of the Wholesale Electricity Market (WEM). These include:

- modernising WEM arrangements to implement a security-constrained economic dispatch (SCED) market design that optimises the benefits of the introduction of constrained network access for Western Power's network; and
- implementing a new framework for acquiring and providing Essential System Services (ESS).

1.2 The purpose of this paper

The purpose of this paper is to outline foundational settings for market settlement under the new SCED market design. Specifically, this paper outlines the positions approved by the Taskforce regarding settlement interval, settlement timeline, and how residual electricity quantities (for example, due to losses) are allocated across market participants.

This paper is intended to be read in conjunction with the Taskforce paper *Foundation Market Parameters*,¹ which describes the five-minute dispatch interval that will be implemented in the new WEM from 1 October 2022. This paper highlighted that the adoption of five-minute dispatch intervals warrants further consideration of five-minute settlement.

A subsequent paper will outline further settlement items related to energy generation and consumption, including how:

- a change in settlement interval may best be implemented;
- generators are paid when they are required to generate when their offer price is greater than the market clearing price at the reference node (uplift payments); and
- costs are recovered for ESS and other consequential changes.

¹ Energy Transformation Taskforce, *Foundation Market Parameters – Information Paper*, August 2019, available at <https://www.wa.gov.au/sites/default/files/2019-08/Information-Paper-Foundation-Market-Parameters.pdf>

2. Introduction to settlement

2.1 Market settlement

Market settlement is the system and processes that enable payments to facilities for the services (such as energy and ESS) they provide to the WEM, and charge participants for the energy and other services they use.

There are six main components to current market settlement in the WEM.

1. Short-Term Energy Market (STEM) settlement, covering the day-ahead net pool market.
2. Balancing Market settlement, covering the real-time gross pool energy market.
3. ESS settlement, covering the Load Following Ancillary Services (LFAS) markets and other contractually-procured ESS (Spinning Reserve, Load Rejection Reserve, Dispatch Support Services and System Restart).
4. Reserve Capacity Mechanism (RCM) settlement, which covers capacity payments to generators and demand-side resources, capacity cost recovery from loads, and refunds from capacity providers who have failed to meet their availability requirements.
5. Market Fees, which are allocated to market participants.
6. Reconciliation of payments not covered above, including constraint payments and compensation of demand-side resource dispatch.

Other aspects of the current WEM settlement arrangements include:

- the use of a NWM to represent the consumption of Synergy's non-contestable customers;²
- two separate settlement cycles:
 - weekly settlement for STEM; and
 - monthly settlement for Non-STEM (currently the Balancing Market, ESS, RCM, Market Fees and Reconciliation Settlement); and
- net settlement, where a market participant's metered schedule is adjusted to reflect their bilateral contract and STEM positions (net contract position) during Balancing Market settlement.

2.2 The case for change to settlement arrangements

There are two main drivers for change to current settlement arrangements.

1. Consequential changes: Some changes to settlement warrant consideration as a consequence of the foundation market parameters adopted by the Taskforce.

² The NWM is the residual of total generation in the WEM, less generation charged to interval-metered loads. It includes load charged to Synergy customers, unmetered loads and residues (for example, energy theft, errors and calculation residues).

2. Opportunities for improvement: Other changes to settlement that will improve the operational and dynamic efficiency of the market.

2.2.1 Consequential changes

The Taskforce's decision to adopt a five-minute interval for dispatch means that the dispatch interval will no longer be aligned with the existing 30-minute interval for settlement. A misalignment between the dispatch and settlement intervals may lead to undesirable economic consequences.

- If dispatch and settlement intervals are not aligned, a 30-minute price for settlement would need to be created from the market prices across the six dispatch intervals. This could, for example, be an average of the six prices. A settlement price that is lower than the market-clearing price determined during the dispatch interval dilutes the price signal for investment in fast-responding technologies such as storage, gas peaking generators and demand-response. These technologies, which will increasingly be required by the power system due to the changing nature of energy supply fleet and demand profile, would be disincentivised to participate in the market. Loads may also be reluctant to participate in providing services due to the likelihood that the settlement price may be lower than the price needed to curtail load.³
- Misalignment between dispatch and settlement intervals may also encourage disorderly bidding. This is because generators would bid into the energy market on the basis of their expectation of the half-hourly settlement price, as opposed to the five-minute spot price. For example, if prices are high early in a 30-minute interval, generators may adjust their bids later in the interval to increase the quantity of their generation dispatched so they can capture the high price. Similarly, with late price spikes, generators may move quantity to higher-price tranches to increase the settlement price. This disorderly bidding behaviour increases the likelihood of inefficient market outcomes.
- Accurate calculation of constrained-on payments would be compromised. The foundation market parameters endorsed by the Taskforce⁴ included a decision to retain constrained-on payments. These payments are now being referred to as 'uplift payments' to more accurately reflect their purpose. Accurate calculation of uplift payments is difficult with misaligned dispatch and settlement intervals because the quantity generated will be calculated for a given five-minute dispatch interval, but the price applied would be calculated based on the 30-minute settlement interval. Where there is a material deviation between the 30-minute settlement price and the five-minute market price, uplift payments will not reflect the value needed to 'make the generator whole'. To avoid the risk of not recovering their costs when they are constrained-on, generators may price their quantities at higher-priced tranches in an attempt to recover as much of their costs as possible.

³ Energy price limits in the WEM may potentially mitigate the extent of the impact of an inconsistency between dispatch and settlement intervals, but may not entirely remove the disincentives for desirable technologies to participate in the market.

⁴ Energy Transformation Taskforce, *Foundation Market Parameters – Information Paper*, August 2019, available at <https://www.wa.gov.au/sites/default/files/2019-08/Information-Paper-Foundation-Market-Parameters.pdf>

- Cost-recovery for ESS on a causer-pays basis would also be compromised because the settlement quantity would need to be calculated over a settlement interval that is greater than the dispatch interval, resulting in under- or over-charging generators for their contribution to ESS costs in any given interval. This dilutes the price signal to facilities to improve their performance in maintaining power system security.

2.2.2 Opportunities for improvement

There is opportunity to consider efficiency improvements to the settlement process, including whether the market could be settled more frequently than monthly, and whether settlement residues can be explicitly calculated and allocated to retailers based on their load.

These changes are not consequential to other market design decisions, but may offer benefit in terms of reduced administrative burden and more efficient processes.

3. Settlement interval

The settlement interval is the period (i.e. temporal interval) Market Participants are settled for energy, ESS and Reserve Capacity.

3.1 Alignment of dispatch and settlement intervals

The Taskforce has endorsed the adoption of a five-minute dispatch interval with a single market-clearing price for energy and ESS (separate prices for each market), in every dispatch interval. If the existing 30-minute settlement interval is retained, there will be a misalignment between the dispatch and settlement intervals. This means that different prices must be used for dispatch and settlement, and the price for a 30-minute settlement interval must be calculated based on the spot price for six five-minute dispatch intervals, for example a time-weighted average as is done in the National Electricity Market (NEM).

Section 2.2.1 outlines the potential adverse consequences of misaligned dispatch and settlement intervals. The benefits of the new market design may not be fully realised if the dispatch and settlement intervals are not aligned. This includes the provision of an efficient price signal for new technologies to participate in the WEM, for facilities to improve their performance and decrease their contribution to ESS costs, and for overall costs to be minimised. For these reasons, dispatch and settlement intervals should be aligned to enable market settlement to take place at the same temporal granularity and price used for dispatch.

This approach is also consistent with other jurisdictions, including the NEM, which is implementing five-minute settlement by 2021 to address the current inefficiencies caused by the misalignment between the dispatch and settlement intervals.^{5,6}

Internationally, many markets that previously had misaligned settlement and dispatch intervals have also moved (or are in the process of moving) to align dispatch and settlement intervals. For example, the Federal Energy Regulatory Commission (FERC) Order 825 (July 2016) required all US Regional Transmission Operators to align settlement intervals with trading intervals for energy and ESS. All US markets now have five-minute energy dispatch and settlement intervals.⁷

⁵ Australian Energy Market Commission, *Rule Determination: National Electricity Amendment (Five Minute Settlement) Rule 2017*, available at: www.aemc.gov.au/sites/default/files/content/97d09813-a07c-49c3-9c55-288baf8936af/ERC0201-Five-Minute-Settlement-Final-Determination.PDF

⁶ Some of the drivers for implementing five-minute settlement in the WEM and the NEM are different. For example, in the NEM, the incentives for disorderly bidding are greater given the price cap is much higher than in the WEM, meaning the potential payoff, and therefore inefficiency, of adjusting bids is often higher. The non-existence of uplift (or constraint) payments in the NEM mean that the existing misalignment of settlement and dispatch intervals has not created problems for calculation of these payments. However, in the WEM, the planned uplift payments (make-whole payment when a generator is required to operate when its offer price is greater than the reference node price) may be less accurate than they might be if the dispatch and settlement intervals were aligned.

⁷ FERC, *Energy Price Formation*, accessible at: www.ferc.gov/industries/electric/indus-act/rto/energy-price-formation.asp

3.2 Five-minute settlement implementation considerations

To enable five-minute settlement, five-minute generation and consumption data for each contestable metering installation (or a suitable proxy) will need to be available to AEMO for settlement calculations. Non-contestable loads are generally measured by accumulation meters. These do not have interval reading capability and are allocated to the Notional Wholesale Meter. This approach will not change when five-minute settlement is adopted.

Ideally, five-minute data would be available from meters with five-minute reading capability.

In the WEM, there are currently 60 metering installations for generators and 30,206 metering installations for contestable loads. Some of these installations provide Supervisory Control and Data Acquisition (SCADA) data,⁸ which is permitted to be used for financial settlement purposes under the Electricity Industry (Metering) Code 2012 (Metering Code).

Of these 30,266 metering installations, 5,067 can be reconfigured to provide five-minute readings, with the remaining 25,199 being unable to provide five-minute readings. Table 1 shows the breakdown of these meters by type defined in the Metering Code.

Table 1: Number of metering installations (generator and contestable load) by type and interval metering capability

Installation type	Megawatt hour (MWh) threshold (Annual throughput) ⁹	Interval metered (30 mins)	# of meter installations	# of meter configurable to five-minutes
1	Throughput >= 1000 GWh	Y	14	0
2	100 GWh <= throughput < 1000 GWh	Y	114	32
3	750 MWh <= throughput < 100 GWh	Y	1,584	387
4	300 MWh <= throughput < 750 MWh	Y	21,254	3,868
5	50 MWh <= throughput < 300 MWh	Y	7,300	780
Total interval metering (Types 1-5)			30,266	5,067

Source: Western Power

There are two options identified to enable five-minute generation and consumption data to be available to AEMO for settlement calculations.

1. Mandating five-minute meters to be operational for commencement of new market settlement arrangements. This would require Western Power to replace 25,199 meters that are not capable of providing five-minute readings and enabling the five-minute capability on meters where this is currently available.

⁸ SCADA is a software program used to collect data in real time from remote locations to control equipment.

⁹ Electricity Industry (Metering) Code 2012, Appendix 1.

2. Using SCADA or other data to profile 30-minute meter data into five-minute intervals for a meter that does not have five-minute capability. Five-minute meter data would be used where this is available.

These implementation options were presented to stakeholders at the Transformation Design and Operation Working Group meeting on 9 September 2019. Stakeholders supported the design decision in principle however, concerns were raised about the timing of implementation. Stakeholders indicated that implementation should be delayed to:

- provide enough time for market participants to design, develop and test new systems;
- learn from the implementation of five-minute settlement in the NEM; and
- allow time for meters to be upgraded to have five-minute capability.

AEMO and Western Power have also identified challenges to upgrade their systems in the time available.

For these reasons, five-minute settlement will not be implemented at commencement of new market arrangements. Additional work will be undertaken to inform a Taskforce decision on the timing and form of implementation. Implementation options will be developed in consultation with stakeholders and be assessed against WEM objectives.

3.3 Taskforce design decision – Settlement interval

The Taskforce has endorsed the following design decision.

Dispatch and settlement intervals will be aligned to both be five-minutes. Timing of implementation will be at a future date following commencement of new market arrangements.

4. Settlement timeline

The settlement timeline refers to the cycle or frequency in which AEMO invoices, collects funds from, and pays funds to market participants for various WEM settlement components (energy, ESS, Reserve Capacity, Reconciliation Payments and Market Fees).

The implementation of the SCED model in the WEM does not require a consequential change to the settlement timeline. However, there is an opportunity to improve efficiencies in the WEM by shortening the settlement cycle. In consultation undertaken on this matter under the previous Government's reform processes, some Market Participants expressed a desire to explore this opportunity for improvement.

4.1 Weekly settlement

All components in the WEM are settled monthly, except the STEM, which is currently settled weekly.

Currently, there is a two-month lag between the end of a trading month and when settlement occurs. This requires AEMO to hold 70 days of credit support (approximately \$100 million) to account for the risk of non-payment. High prudential requirements can be a barrier to entry for new market participants and can affect the amount of working capital available to existing market participants.

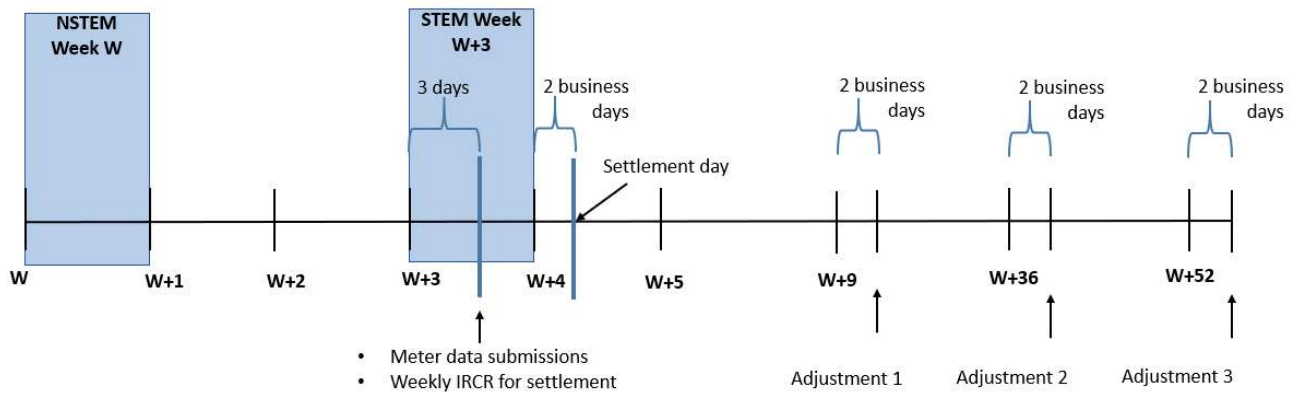
Weekly settlement will require the Individual Reserve Capacity Requirement (IRCR) for each market customer to be calculated and published weekly, instead of the current practice of publishing the IRCR monthly. This change is required as a monthly IRCR would not be available in time to enable weekly settlement with a short lag between the trading week and the settlement week. The method to calculate the IRCR will not change, however this calculation will be undertaken more frequently.

The number of days when AEMO undertakes settlement runs can also be reduced if settlement activities are aligned. Currently, settlement can occur on up to six days per month. This includes four STEM settlements, one initial Non-STEM settlement, and one adjustment settlement. This requires market participants to undertake administrative processes and have staff on call to address any queries from AEMO on up to six days per month.

Under weekly settlement, the number of settlement days can be reduced to four per month by aligning settlement for STEM, Non-STEM and adjustments. Settlement will only occur on one day per week, which will likely decrease administration costs for both AEMO and market participants.

Figure 2 illustrates the new weekly settlement cycle. It shows that on the settlement day indicated, settlement will occur for the STEM week immediately prior and the Non-STEM week three weeks prior. The delay in Non-STEM settlement is due to meter data needing to be provided by Western Power. This occurs in week W+3 as indicated.

Figure 2: New weekly settlement cycle

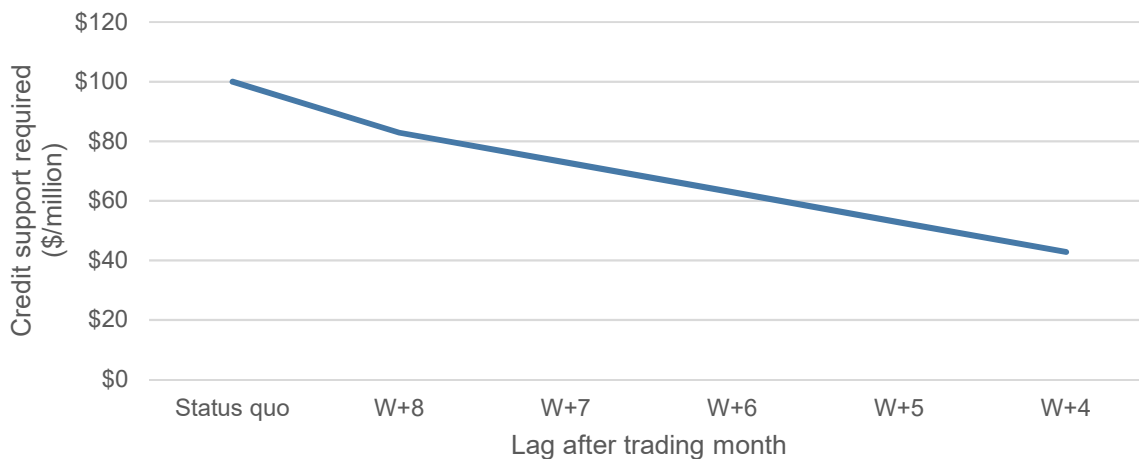


Source: ETIU and AEMO

Shortening the settlement cycle to weekly will decrease the lag between a billing period and settlement to four weeks. Analysis indicates that decreasing the time period between the settlement cycle and the billing period can reduce the prudential burden on market participants by more than half, to approximately \$43 million. The decrease in prudential requirements (approximately \$57 million) will be proportionally shared across market participants based on their invoiceable value.

Figure 3 shows the value of credit support needed for a given lag between the trading interval and settlement.

Figure 3: Relationship between settlement lag and credit support requirements



Source: ETIU and AEMO

4.2 Weekly settlement implementation

A weekly settlement cycle settles a week of trade on settlement day.

To enable weekly settlement, Western Power will be required to provide meter data to AEMO on a weekly basis. Currently, although Western Power has a month to submit the meter data for that trading month, it provides meter data as it becomes available (rather than waiting to provide it all on a single day each month). The current practice of providing this data as it is available (rather than on a single day per week) can continue.

Where meters have remote-reading capability, Western Power can provide weekly meter data using its current frequency of meter reading. However, there are 7,508 interval meters belonging to small contestable customers that cannot be remotely read. Western Power has advised that reading these meters weekly would be expensive. Instead, an estimation method can be developed to calculate weekly data for settlement, with adjustments taking place when more accurate data becomes available. This will require some changes to the Metering Code and associated instruments.

The adjustment process will also be amended to reflect the need to adjust estimated meter readings in a timely manner. Currently, the first adjustment occurs approximately four to five months after the trading month. Under weekly settlement, the first adjustment period will be brought forward to two months after the trading week to enable adjustments to estimates to be made closer to the trading week. There will be no changes to the second and third adjustment periods.

4.3 Taskforce design decisions – Weekly settlement

The Taskforce has endorsed the following design decision.

Settlement of all WEM components will occur on a weekly basis, with the first adjustment period to occur two months after the relevant trading week.

5. Settlement residues

Settlement residues are the difference between the total amount charged for electricity (to loads) and the total amount paid (to generators).

5.1 Allocation of settlement residues to the Notional Wholesale Meter

In the WEM, settlement residues are obscured and not explicitly calculated because they are incorporated into the NWM. The NWM represents the load of non-contestable customers and unmetered loads (both of which must be served by Synergy under the existing legislative framework). The value of the NWM is calculated as the difference between total loss-adjusted generation and the total loss-adjusted metered consumption of contestable (interval metered) loads. Contestable loads are loads greater than 50 MWh a year. A contestable load must be interval metered to transfer from Synergy to another retailer.

This method to calculate the NWM means that it also includes transmission residues and unaccounted-for energy (together, referred to as settlement residues). These are not explicitly calculated but are included in the NWM as it is the residual of total and interval metered load.

Transmission residues arise due to the following.

- The treatment of transmission losses during energy dispatch, scheduling and pricing. Transmission Loss Factors (TLF) used during dispatch are marginal loss factors: Marginal losses are typically greater than average losses,¹⁰ and therefore basing market settlement on marginal losses generally leads to recovering more from customers than is owed to generators. Residues arising from this component are referred to as 'loss residues' and are typically positive. However, they can be negative if the marginal loss factors underestimate system losses leading to under-recovery of the cost of losses.
- 'Non-technical' losses, including metering errors, SCADA errors, errors in the TLF calculation or the inclusion of unmetered load in SCADA values used for settlement.

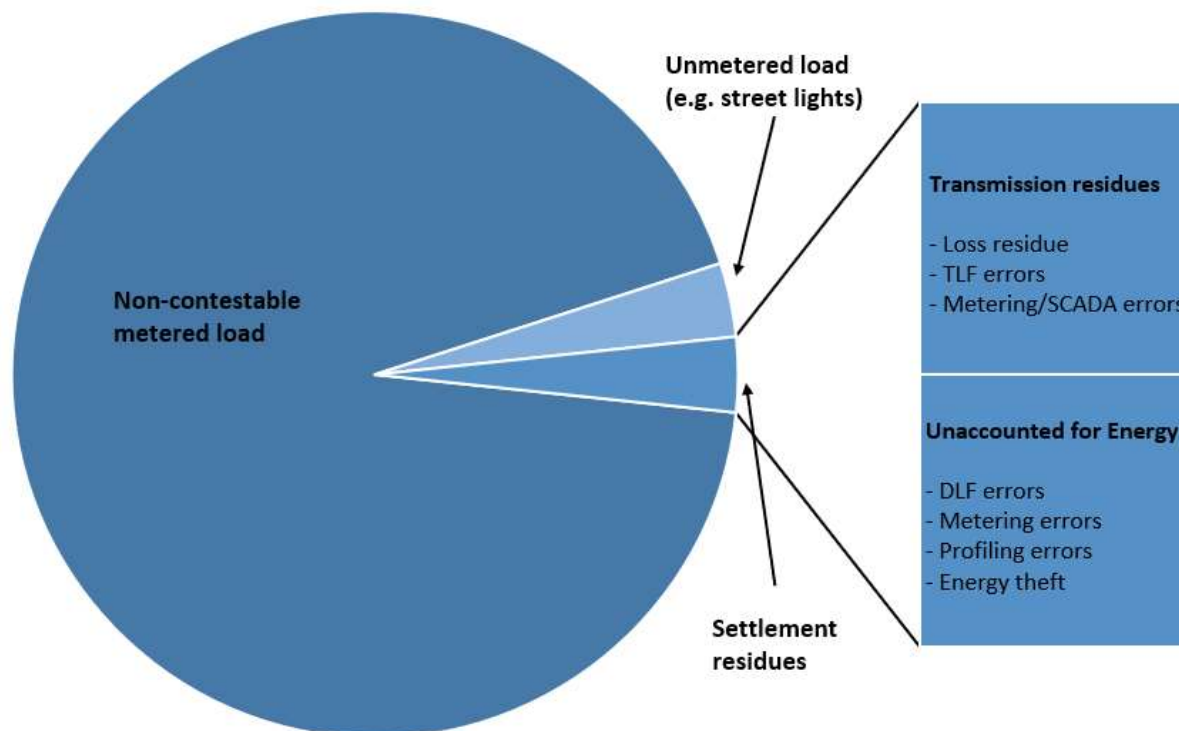
Unaccounted-for energy arises due to the following.

- The treatment of distribution losses during settlement: This results from the use of Distribution Loss Factors (DLF) to adjust metered values to represent consumption at the relevant transmission distribution boundary connection point. These residues occur due to errors or inaccuracies in the distribution loss factor estimations.
- 'Non-technical' losses include a combination of calculation errors and physical losses from the system.

Figure 4 illustrates the composition of the NWM.

¹⁰ Marginal loss factors represent the change in network losses that occur due to a small increase in load at a connection point(s). They are used for settlement purposes. Residues occur because the marginal loss factor does not represent actual network losses. The difference between the marginal and average loss factor forms part of the settlement residue.

Figure 4: Composition of Notional Wholesale Meter (not to scale)¹¹



Source: ETIU and AEMO

Settlement residues cannot be explicitly calculated as they are the residual from interval metered loads and other components of the NWM. There is no measurement of energy injection or offtake at the transmission-distribution boundary. This results in the following.

- There is no transparency with respect to the source of settlement residues: This impedes the ability to identify the source of residues and allocate them in a methodical manner to the party best able to mitigate them.
- (Implicit) settlement residues are allocated by default to Synergy by virtue of the calculation used to determine the consumption of the NWM: Settlement residues could be used to offset the cost billed to market customers. Hence, if the settlement residue were positive, this would mean contestable customers are being billed more than they otherwise would be. However, if the settlement residues are negative, then it means Synergy's customers may be bearing a cost that should be shared across all customers.¹²

¹¹ This diagram is for illustrative purposes only. The size of each component shown on the chart does not represent the actual size of that component.

¹² Analysis undertaken as part of the previous government's reform process in 2016 had estimated the transmission residue to be approximately a (negative) \$9 million (i.e. a cost) for the 2014-15 financial year. However, the analysis did not adjust for unmetered load included in the SCADA settlement values at some Synergy facilities, and noted that a 20 MW load at Muja could swing the residue from a negative (cost) to a positive (surplus) value.

The allocation of settlement residues by default to Synergy creates an inefficient cross-subsidy between Synergy and other market participants. This creates an inequity between customers which entrenches an economic inefficiency in the market.

5.2 Alternative approaches to allocate loss residues

The economic inefficiency created by the inequitable allocation of settlement residues can be reduced by more accurately calculating and allocating the residues. There are two alternative approaches to do this.

1. Global settlement: Transmission and distribution residues are explicitly calculated. This enables both transmission and distribution residues to be calculated explicitly rather than allocated by default to the NWM.
2. Settlement by difference: Only transmission residues are explicitly calculated. This enables transmission residues to be calculated explicitly. Distribution residues are allocated to Synergy.

Under both these arrangements, non-contestable and unmetered loads would continue to be allocated to Synergy through the NWM.

Global settlement is generally only of benefit in markets where most customers can choose their retailer. In the WEM, there are limitations on the choice of retailer for most customers. As such, global settlement would likely be too complex and costly to implement when compared with the anticipated benefit.

Settlement by difference would improve economic efficiency in the WEM by removing the inequitable allocation of residues. As such, it would – in principle – better achieve the WEM objectives. However, this approach should only be adopted if the economic benefits outweighs the cost of implementation.

Settlement by difference requires measuring energy flows at the boundary between the transmission and distribution networks. However, the exact boundary point between the two networks has never been formally defined. Currently, the majority of substations are not metered and instead rely on SCADA equipment. SCADA equipment in the absence of revenue metering is not sufficient for use in financial settlement.¹³

Implementation of settlement by difference would therefore require substantial investment in metering infrastructure at the transmission and distribution network boundary. Although exact costs for metering infrastructure upgrade are not available, it is anticipated to be a prohibitively expensive exercise and, in some cases, technically infeasible due to the physical design of some substations.

The benefits of settlement by difference would have to be sufficiently high to offset implementation costs. Due to data limitations a definitive value of the residues allocated to the NWM has not been estimated. However, the Taskforce's investigation indicates that this value is likely to be relatively small and will vary between being positive or negative from year to year.

As the net benefit of implementing settlement by difference is likely to be small or potentially negative, the current approach of allocating settlement residues to the NWM will continue at this time.

¹³ Under the *National Measurements Act 1960* (Cth), which requires the revenue meters (potentially in conjunction with – but not instead of – SCADA), be used for financial settlement or trade purposes, except in certain circumstances (for example, where grandfathering arrangements are in place)

5.3 Taskforce design decisions – Allocation of settlement residues

The Taskforce has endorsed the following design decision.

Settlement residues will continue to be allocated to the Notional Wholesale Meter.



Energy Transformation Taskforce

