AEMC

AUSTRALIAN ENERGY MARKET COMMISSION

RULE

Consultation paper

National Electricity Amendment (Inter-regional settlements residue arrangements for transmission loops) Rule 2025

Proponent

Australian Energy Market Operator (AEMO)

8 August 2024

Inquiries

Australian Energy Market Commission
Level 15, 60 Castlereagh Street
Sydney NSW 2000

E aemc@aemc.gov.au
T (02) 8296 7800

Reference: ERC0386

About the AEMC

The AEMC reports to the energy ministers. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the energy ministers.

Acknowledgement of Country

The AEMC acknowledges and shows respect for the traditional custodians of the many different lands across Australia on which we all live and work. We pay respect to all Elders past and present and the continuing connection of Aboriginal and Torres Strait Islander peoples to Country. The AEMC office is located on the land traditionally owned by the Gadigal people of the Eora nation.

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Summary

1 We are seeking your views on a proposed new method for allocating inter-regional settlements residue (IRSR) in transmission loops. IRSR is a surplus or deficit in the settlement outcomes of the electricity market, and it arises when electricity flows across regions with difference prices.

2 The Australian Energy Market Operator (AEMO) submitted this rule change request in February 2024. The rule change request stems from AEMO's market integration activities for Project EnergyConnect (PEC).

3 PEC will be a new interconnector linking South Australia and NSW, which will be fully operational in early 2027. Transmission infrastructure is a critical enabler of new low-cost generation and for the transition to net zero. PEC will help facilitate the transition by enabling future renewable projects to connect to the grid and supply energy into the network.

4 PEC will create the first inter-regional transmission loop in the National Electricity Market (NEM), along with the existing Heywood (VIC-SA) and VNI (NSW-VIC) interconnectors. In inter-regional transmission loops, IRSR is expected to arise more frequently than it does across 'radial' interconnectors (that is, the current regulated interconnectors that link two regions without forming part of an inter-regional transmission loop). This is due to the way that power flows in a transmission loop, and how this interacts with the NEM's regional pricing model.

5 AEMO's rule change request aims to create market arrangements for IRSR in transmission loops that help realise the benefits of PEC for consumers, while also aligning the costs of loop flows with the beneficiaries.

6 The Australian Energy Market Commission (AEMC or the Commission) has commenced its consideration of the request and this consultation paper is the first stage.

7 We are seeking your feedback on:

- the problem raised in the rule change request
- the solution proposed in the rule change request and alternative solutions, and
- our proposed assessment criteria for this rule change request.

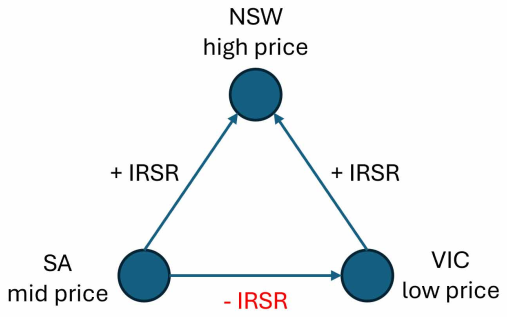
We are seeking your views on whether the current method for allocating IRSR would result in misalignment of costs and beneficiaries if applied to transmission loops

8 The NER contains a framework for managing and allocating IRSR. IRSR is positive if the flow is from a low-priced region to a high-priced region, and negative if the flow is from a high-priced region to a low-priced region. IRSR is allocated to the importing region, with different arrangements applying for positive and negative IRSR:

- Positive IRSR is distributed via an auction, with auction proceeds allocated to the importing transmission network service provider (TNSP) and passed through to consumers via reduced TUOS charges.
- Negative IRSR is allocated directly to the importing TNSP and passed through to consumers via increased TUOS charges. To manage the magnitude of negative IRSR, AEMO 'clamps' interconnectors (restricts the flow of electricity over the interconnector) when the magnitude of negative IRSR is forecast to reach $100,000.

9 AEMO considers that the current arrangements for managing negative IRSR are not suitable for inter-regional transmission loops, because negative IRSR will arise more frequently than it does

now. This is a result of the normal operation of loop flows, where flows on one 'arm' (interconnector) will affect flows on the other arms, which in turn affects prices in all three regions. This outcome is associated with a pricing phenomenon called the 'spring washer effect', where a constraint in a transmission loop leads to a large price separation across the constraint and increasing prices around the loop. An example of the spring washer effect and resulting IRSR is illustrated below.



If the sum of the positive IRSR on the SA-NSW and NSW-VIC arms is greater than the negative IRSR on SA-VIC, then the net IRSR for the loop is positive.

Note: This is an illustrative example only and negative IRSR can occur on any arm of the loop.

10 In a single dispatch interval, we expect that it will be a relatively common outcome that some arms of the loop will generate positive IRSR while others generate negative IRSR. As a result, sometimes the overall 'net IRSR' (the sum of all IRSRs on all arms) of the loop will be positive, and at other times negative. AEMO has commissioned modelling for the new inter-regional loop completed by PEC which forecasts this result.

11 There are two parts of the arrangements that give rise to how the problem is considered: clamping (managed under AEMO procedures and not necessitating a rule change) and the allocation of IRSR (managed pursuant to the rules).

12 AEMO considers that the current approach to clamping negative residues on individual arms of the loop would reduce the consumer benefits of PEC when there is net positive IRSR on the loop. This is because net positive IRSR is more likely to be an outcome of the most efficient dispatch in the presence of constraints. If AEMO were to clamp negative IRSR when the net IRSR for the loop is positive, this could reduce flows on the loop in circumstances when dispatch is efficient - and therefore reduce benefits for consumers of the new transmission infrastructure. AEMO considers that, in these circumstances, the negative IRSR on some arms is supporting positive IRSR on other arms of the loop and a net efficient overall dispatch outcome. In other words, the 'cost' of negative IRSR on some arms of the transmission loop allows the 'benefit' of inter-regional power flows to arise.

13 However, if AEMO does not clamp negative residues in these circumstances, this may lead to higher overall magnitudes of negative residues.

14 Under the current allocation approach, all negative IRSR would be allocated to the importing region(s) in the relevant dispatch interval. AEMO considers that this allocation approach would result in an unfair distribution of IRSR (and, therefore wealth) if applied to transmission loops because it would assign all costs (i.e. negative IRSR) to some regions, which does not reflect the broader benefits of the loop flow (i.e. the positive IRSR). AEMO therefore considers that negative IRSR should be reallocated when the net IRSR of the loop is positive.

15 The Commission considers that it is relevant to consider wholesale price outcomes around the loop, as well as the resulting IRSR, in defining the problem raised in this rule change request.

Prices between the arms on a transmission loop, like IRSR outcomes, are interdependent because of the physics of loop flows. Consumers pay not only for the cost of IRSR (passed through via TUOS charges) but also the outcomes of wholesale prices (passed on by their retailer).

16 When we consider wholesale price outcomes, it is not as clear that the current allocation of IRSR to importing TNSPs results in a misalignment between costs and benefits of the loop flow. Our analysis finds that in an inter-regional transmission loop, the price separation caused by the spring washer effect is essentially offset by allocating the IRSR to the importing region. This means that consumers who are paying lower wholesale prices for their electricity are generally assigned the negative IRSR, increasing their TUOS charge. Conversely, positive IRSR is generally being allocated to consumers who have paid more for their electricity, reducing their TUOS charge. We seek your feedback on this alternative approach to considering the problem.

We are seeking your views on whether, and how, to reallocate negative IRSR in transmission loops

17 To address the issue that AEMO identifies, AEMO proposes to adjust both its clamping approach and also the way that the rules allocate negative IRSR in transmission loops.

18 AEMO proposes not to clamp negative IRSR in an inter-regional transmission loop when net IRSR around the loop is positive. We agree that this approach is likely to help realise the benefits of the loop interconnectors for consumers.

19 AEMO then proposes to reallocate in the loop IRSR when net IRSR is positive. AEMO's proposed rule would allocate negative IRSR arising on one or more directional interconnectors of the loop to directional interconnectors that are receiving positive residues. AEMO considers that this approach would best align cost with beneficiaries of the loop flow. Where overall IRSR is net negative, AEMO proposes to apply the current approach. That is, AEMO would continue to 'clamp' individual arms when they reach a negative IRSR threshold, and IRSR would flow to the importing TNSP.

20 Under the proposed rule:

- When net residue for the loop is positive, any negative IRSR on individual arms of the loop would be reallocated to the other arms in proportion to the positive IRSR they have accrued in the same dispatch interval, and assigned to the importing TNSPs for those arms.
- When net residue for the loop is negative, negative IRSR accruing on any individual arm would be allocated directly to the importing TNSP as per the current rules.
- In both cases, positive IRSR would be distributed via settlements residue distribution (SRD) units, with the proceeds of settlements residue auctions (SRAs) being assigned to the respective importing TNSPs, as per the current arrangements.
- There would be no change to SRAs, except that AEMO would introduce new SA-NSW and NSW-SA SRD units to allow auctioning of the positive IRSR arising on PEC.
- The interconnectors forming the loop would only be subject to clamping when the net residue for the loop is negative.

21 The intention of AEMO's proposed rule is to allocate positive and negative residues for a dispatch interval to the same region so that they can offset each other. This is intended to reflect that the positive and negative residues arise out of how the whole loop is dispatched to create the lowest cost solution for all customers.

22 Our consultation paper presents three possible alternative options for allocating IRSR to address

the problem raised in the rule change request:

- Option 1 is to apply the existing arrangements to transmission loops, so negative and positive IRSR would continue to be allocated to the importing region in which it accrues.
- Option 2 is to reallocate negative IRSR, but using a different method or metric than AEMO's proposal (e.g. pooling negative residues accruing on all three arms and then dividing amongst TNSPs in proportion to their average load, or by the number of customers).
- Option 3 is to change the separation of positive and negative IRSR (e.g. subtracting negative residue from positive residue for each arm individually, over some defined period such as weekly).

23 The Commission is seeking stakeholder feedback on the proposed solution, the three alternative options, and any further options.

We propose three assessment criteria for this rule change request

24 Considering the National Electricity Objective (NEO)[1] and the issues raised in the rule change request, the Commission proposes to assess the rule change request against three assessment criteria.

- **Outcomes for consumers:** We selected outcomes for consumers because the design of the arrangements to manage and allocate IRSR in a transmission loop will affect the distribution of costs to consumers in different regions. Transmission loops will also affect underlying electricity pricing due to the interdependent nature of loop flows. Under this criterion, we will consider how the rule change would affect outcomes for consumers (particularly its effects on electricity pricing) and which approach for managing and allocating IRSR is in the best interests of consumers.
- **Principles of market efficiency:** Principles of efficiency are relevant because the market arrangements for transmission loops will affect the extent to which some of the benefits of PEC are realised. Specifically, clamping arrangements will influence loop flows and benefits to consumers for PEC. It will also be important to ensure that settlements residue is allocated in the most efficient way to ensure that risks are managed and benefits flow through to consumers. Under this criterion, we will consider questions relating to concepts of efficiency and risk allocation.
- **Principles of good regulatory practice:** It is important to create clear, stable, and predictable market arrangements for allocation of residues and inter-regional trading, so that the incentives for market participants and investors lead to efficient outcomes. Under this criterion, we will consider whether the rule change will promote predictability and stable outcomes for consumers.

1 Section 7 of the NEL.

Full list of consultation questions

Question 1: The problem identified in the rule change request

Do stakeholders consider that there is a problem with applying the current rules for managing IRSR to transmission loops, specifically with respect to:

- clamping negative residues at the current threshold of $100,000
- allocating negative residues to importing regions
- allocating positive residues to importing regions (via settlement residue auctions)?

Question 2: Will the proposed solution address the issue raised by the proponent?

What do you consider success would look like if the issue identified by the proponent was solved? Do you consider that the proposed changes to the rules will solve the problem raised or are there other factors that would have a greater impact?

Question 3: What are your views of the benefits and drawbacks of the proposed solution?

What do you consider will be the benefits and drawbacks, or costs, of the proposed solution? If there are costs, will these be one-off or ongoing? Is there anything the Commission could do in designing the rule that would help to minimise the costs and maximise the benefits?

Question 4: What are your views on these and other alternative solutions?

Are any of the alternative options outlined above, including a continuation of the current arrangements, preferable to the proposed solution in section 3.1? Can you share any other alternative solutions that you think would be preferable and more aligned with the long-term interests of consumers?

Question 5: Assessment framework

Do you agree with the proposed assessment criteria? Are there additional criteria that the Commission should consider or criteria included here that are not relevant?

How to make a submission

We encourage you to make a submission

Stakeholders can help shape the solutions by participating in the rule change process. Engaging with stakeholders helps us understand the potential impacts of our decisions and, in so doing, contributes to well-informed, high quality rule changes.

We have included questions in each chapter to guide feedback, and the full list of questions is above. However, you are welcome to provide feedback on any additional matters that may assist the Commission in making its decision.

Submissions are due by 5 September 2024 with other engagement opportunities to follow

Due date: Written submissions responding to this consultation paper must be lodged with Commission by **Thursday, 5 September 2024**.

How to make a submission: Go to the Commission's website, www.aemc.gov.au, find the "lodge a submission" function under the "Contact Us" tab, and select the project reference code ERC0386.[2]

You may, but are not required to, use the stakeholder submission form published with this consultation paper.

Tips for making submissions are available on our website.[3]

Publication: The Commission publishes submissions on its website. However, we will not publish parts of a submission that we agree are confidential, or that we consider inappropriate (for example offensive or defamatory content, or content that is likely to infringe intellectual property rights).[4]

Other opportunities for engagement

There are other opportunities for you to engage with us, such as one-on-one discussions or industry briefing sessions. See below for contact details for the project leader.

For more information, you can contact us

Please contact the project leader with questions or feedback at any stage.

Project leader:	Madeleine Hartley
Email:	madeleine.hartley@aemc.gov.au
Telephone:	02 8296 7816

2 If you are not able to lodge a submission online, please contact us and we will provide instructions for alternative methods to lodge the submission.

3 See: https://www.aemc.gov.au/our-work/changing-energy-rules-unique-process/making-rule-change-request/submission-tips

4 Further information is available here: https://www.aemc.gov.au/contact-us/lodge-submission

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Figures

1 The context for this rule change request

This consultation paper seeks stakeholder feedback on a rule change request submitted by the Australian Energy Market Operator (AEMO) in February 2024, proposing new arrangements for inter-regional settlements residue (IRSR) for transmission loops (which AEMO refers to as 'parallel transmission configurations').[5] This chapter provides context for the rule change request and information on the rule change process:

- Section 1.1 provides an overview of AEMO's rule change request and the relevant context and background.
- Section 1.2 highlights that AEMO has undertaken prior consultation on integrating Project EnergyConnect (PEC)[6] into the National Electricity Market Dispatch Engine (NEMDE).
- Section 1.3 provides our proposed timeline for this rule change.

1.1 AEMO has proposed a new method for allocating inter-regional settlements residue in a transmission loop

AEMO considers that the current rules for allocating inter-regional settlements residue (IRSR) need to be modified for transmission loops to better reflect the beneficiaries of inter-regional power flow. AEMO's rule change request states:[7]

> "[T]he current process of assigning costs to importing TNSPs [transmission network service providers] is not equivalent to assigning costs to beneficiaries of inter-regional power flow. Current process may therefore result in (unfair) significant wealth transfer between consumers in the different NEM regions."

1.1.1 PEC will connect NSW and SA to form a transmission loop

Project EnergyConnect (PEC) is a new 330kV electricity interconnector between South Australia and New South Wales that will add approximately 800MW of further transfer capacity between these two states. PEC facilitates the transition to net zero by enabling future renewable projects to connect to the grid and supply energy into the network. AEMO's Integrated System Plan has identified PEC as a committed interconnector project relevant to its optimal development path for the transmission system.

PEC is being constructed by ElectraNet and Transgrid and is due to be fully operational in Q1 2027, with a capacity of 500MW being released from Q4 2026. Further information on the PEC project can be found at https://www.projectenergyconnect.com.au/.

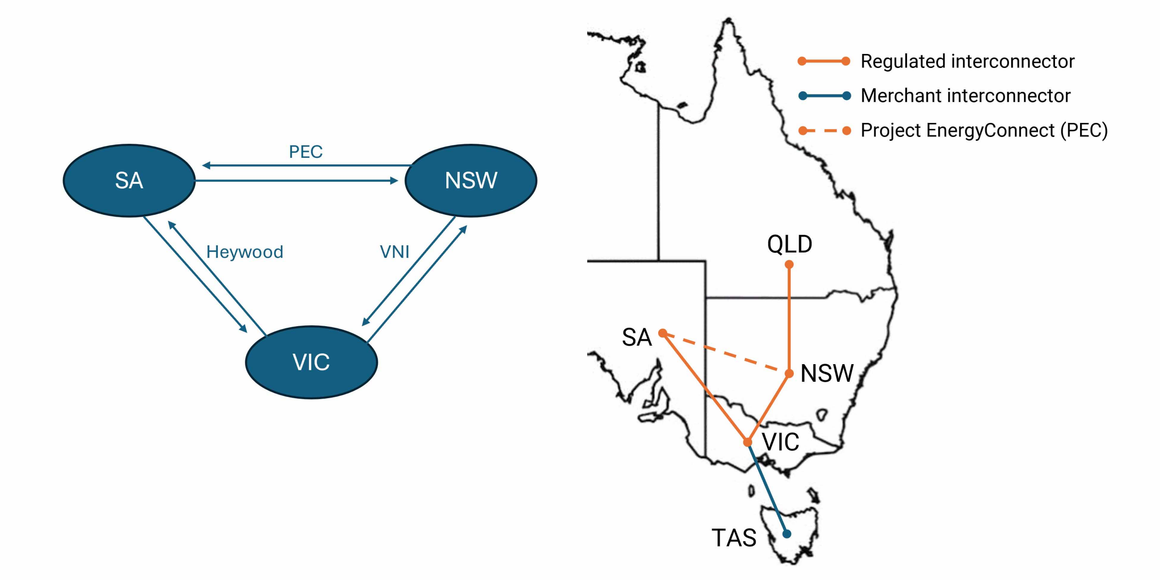
PEC, along with the Heywood (VIC-SA) and VNI (NSW-VIC) interconnectors, will create the first inter-regional transmission loop in the National Electricity Market (NEM) (Figure 1.1).

5 The rule change proposal can be found at AEMC, 'Inter-regional settlements residue arrangements for transmission loops', https://www.aemc.gov.au/rule-changes/inter-regional-settlement-residue-arrangements-transmission-loops (AEMO rule change request). For the purposes of this paper, 'transmission loops' refers to inter-regional transmission loops.

6 Although Project EnergyConnect has two stages, it is stage 2 that specifically creates the transmission loop. For the purposes of this paper, references to PEC are predominantly references to the stage 2 infrastructure unless it is discussing PEC in relation to broader concepts like net zero.

7 AEMO, Electricity Rule Change Proposal, Integration of Project EnergyConnect (PEC) into the National Electricity Market (NEM), February 2024, p. 11 (AEMO rule change request).

Figure 1.1: Stylised representation of the transmission loop that PEC will create



1.1.2 Inter-regional transmission loops are likely to cause more frequent negative IRSR

The National Electricity Rules (NER) contains a framework for managing and allocating IRSR. IRSR is the surplus or deficit arising in settlement when there are different prices in two regions, and energy is flowing between them. IRSR can be positive or negative, depending on the price differential and direction of flow of electricity. IRSR is allocated to the importing region, with different arrangements applying for positive and negative IRSR:

- Positive IRSR is distributed through an auction system to provide an inter-regional hedging instrument,[8] and auction proceeds are allocated to the importing TNSP and passed through to consumers via reduced TUOS charges.
- Negative IRSR is allocated directly to the importing TNSP and passed through to consumers via increased TUOS charges. To manage the magnitude of negative IRSR, AEMO 'clamps' interconnectors (restricts the flow of electricity over the interconnector) when the magnitude of negative IRSR is forecast to reach $100,000.[9]

When the arrangements were put in place, negative IRSR was expected to be infrequent. However, negative IRSR is likely to arise much more frequently in the transmission loop created by PEC, compared with negative IRSR arising under current 'radial' transmission configurations.[10] This is because of how power flows in a transmission loop, where flows on one 'arm' (interconnector) affect flows on the other arms within the loop. When there are binding constraints, the changes in flows can give rise to the 'spring washer pricing effect' (explained in section 2.2.1). This involves large price separation across a constraint and produces more frequent negative IRSR, even when overall IRSR outcomes around the loop are net positive. AEMO has recently commissioned modelling which forecasts this result.[11]

8 For completeness, IRSR is technically used to back an auctioned instrument called a settlements residue distribution (SRD) unit, but for brevity this paper refers to positive IRSR as being auctioned.

9 The $100,000 threshold applies per instance rather than over a defined time window. It is reset to zero after each application of clamping, and negative residues can accumulate from that point onwards.

10 For the purposes of this consultation paper, 'radial' refers to the traditional NEM network transmission configuration, where regions are connected through regulated interconnectors but do not form an inter-regional transmission loop.

AEMO's current approach to 'clamping' interconnectors reflects that large negative IRSR is often currently caused by inefficient dispatch. However, AEMO considers that clamping may not always be efficient under the new loop configuration. This is because negative IRSR will arise more frequently as a natural consequence of the loop and will likely be part of efficient dispatch. As a result, AEMO considers that clamping in line with its current procedures would reduce the consumer benefits of PEC, because it would reduce the flow of electricity in the loop in circumstances where dispatch is efficient - and therefore reduce the benefits of trade.

If AEMO were to decide to relax its clamping approach to allow these efficient outcomes to arise,[12] AEMO considers that the current allocation of negative IRSR to importing regions would not align costs of the loop flow with beneficiaries. AEMO considers that the 'cost' of the negative IRSR on some arms of the loop supports positive IRSR on other arms of the loop and a net efficient overall outcome. AEMO considers that allocating IRSR to importing regions in these circumstances would cause significant unfair wealth transfers between consumers in different regions. Chapter 2 provides further details on the current IRSR framework, and investigates the problem that AEMO has identified.

1.1.3 AEMO has proposed a rule change to reallocate negative IRSR between regions within a transmission loop

To address the problem it has identified, AEMO proposes a rule change to reallocate the negative IRSR to directional interconnectors which are receiving positive residues when overall loop IRSR is net positive.

In other circumstances – where the overall loop IRSR is net negative – AEMO proposes the current approaches would apply. That is, AEMO would continue to clamp individual arms when they reach a negative IRSR threshold of $100,000, and the negative IRSR would flow to the importing TNSP.

AEMO considers that reallocating IRSR like this would best reflect the way that power flows in the loop by aligning costs with beneficiaries.[13]

The proposed rule change is designed to integrate PEC into the NEM. However, the rule's application would not be limited to PEC and would apply to any future inter-regional transmission loop. AEMO has indicated that no further such configurations are planned for the NEM at this stage. Chapter 3 provides further detail on AEMO's proposed solution and possible alternative options.

1.1.4 Transmission access reform issues are outside the scope of this rule change

The Australian Energy Market Commission (AEMC or the Commission) is conducting a review on transmission access reform (TAR), which seeks to ensure efficient use of the transmission network and drive efficient long-term investments to decarbonise the power system at lowest cost for consumers. The review further develops the Energy Security Board's work on TAR, which is relevant broader context but outside the scope of this rule change.

11 ACIL Allen, 'Modelling the settlement effects of Project Energy Connect', July 2023, https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper (ACIL Allen, 'Modelling the settlement effects of PEC').

12 The NER does not specify detailed requirements for AEMO's clamping procedures - NER, 3.8.1(b)(11) and 3.8.10(5).

13 AEMO rule change request, p. 11.

The AEMC has published a consultation paper outlining options for a transmission access reform hybrid model.[14] The hybrid model has two primary components:

- priority access would promote long term investment efficiency by encouraging investment in regions that are not already congested, and
- a congestion relief market (CRM) would improve operational efficiency by incentivising cost-reflective bidding and the deployment of batteries to absorb excess energy in congested areas.

There are potential interactions between these hybrid models and inter-regional settlements residue.

Regardless, we consider that the issue of allocating IRSR in transmission loops should be addressed now. PEC is due to be fully operational in January 2027 and AEMO needs sufficient implementation time in advance to ensure certainty of residue treatment and a smooth transition to any new auction approaches.

1.2 AEMO has consulted stakeholders on integrating PEC into the NEM

Since 2022, AEMO has undertaken significant stakeholder consultation on the market integration of PEC into the NEM, which has informed this rule change request.[15] AEMO received submissions from gentailers, retailers, TNSPs and industry peak bodies, including (but not limited to) AFMA, AGL, Delta, Electranet, EUAA, Shell Energy and Snowy Hydro. Stakeholders broadly accepted AEMO's proposed approach to clamping and negative residue reallocation, with no changes to the settlements residue auction (SRA) process. Many stakeholders emphasised the importance of maintaining the hedging value of settlements residue distribution (SRD) units sold through the SRA process, and therefore opposed any options that involved deducting negative residues from SRD unit payouts.

Appendix A provides a summary of AEMO consultation papers to date.

1.3 We have started the rule change process

This paper is the first stage of the AEMC's consultation process. This will be a longer-than-standard process due to the complexity of issues in this rule change proposal and the Commission has extended the time for making the draft determination and final determination. Our draft determination is due on 12 December 2024 and our final determination is due on 27 March 2025. We understand that this timing meets AEMO's requirement to undertake any required system implementation projects ahead of PEC going live.

14 AEMC, Transmission Access Reform, Consultation paper, April 2024, https://www.aemc.gov.au/market-reviews-advice/transmission-access-reform ('Transmission Access Reform').

15 AEMO, Project EnergyConnect Market Integration Papers, https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper ('PEC Market Integration papers').

Figure 1.2: Timeline for rule change

A standard rule change request includes the following formal stages:

- a proponent submits a rule change request
- the Commission commences the rule change process by publishing a consultation paper and seeking stakeholder feedback
- stakeholders lodge submissions on the consultation paper and engage through other channels to make their views known to the AEMC project team
- the Commission publishes a draft determination and draft rule (if relevant)
- stakeholders lodge submissions on the draft rule determination and engage through other channels to make their views known to the AEMC project team
- the Commission publishes a final determination and final rule (if relevant).

Information on how to provide your submission and other opportunities for engagement is set out at the front of this document.

You can find more information on the rule change process on our website.

To make a decision on this proposal, we seek stakeholder feedback on:

- the problem raised in the rule change request (Chapter 2)
- the proposed solution and our alternative options (Chapter 3), and
- our proposed assessment criteria (Chapter 4).

2 The problem raised in the rule change request

The NER contains a framework for managing and allocating IRSR. This framework was developed for the current configuration of transmission infrastructure in the NEM, which consists of radial interconnectors between regions. However, PEC will introduce a new 'loop' configuration connecting three NEM regions. This will affect flows, pricing and IRSR between the three regions. The arrangements for IRSR may therefore need to be amended to accommodate this change in inter-regional transmission.

This chapter examines the current rules for IRSR and the problem identified by AEMO in their rule change request.

- Section 2.1 outlines the current arrangements for the management and allocation of positive and negative IRSR.
- Section 2.2 explains how IRSR is expected to change with the introduction of a transmission loop, and the issues that AEMO identifies with the current rules for managing negative IRSR.

2.1 The current rules for allocating IRSR were designed for radial interconnectors

2.1.1 IRSR arises when prices separate between regions

Electricity markets need arrangements for managing 'settlements residue.' This is any surplus or deficit of funds when the price that load pays for energy is different to what generators are paid.[16] There are two types of settlements residue in the NEM:

- **Inter-regional** settlements residue (IRSR) occurs when prices between regions in the NEM differ, or separate, and energy is flowing across an interconnector between those regions. This happens frequently. Prices can differ between regions due to both transmission losses and the effect of constraints - and the resulting congestion - on the transmission lines within and between regions.
- **Intra-regional** settlements residue is related to physical losses from transmitting electricity within a region.

This rule change is concerned with inter-regional settlements residue.

AEMO calculates IRSR for each dispatch interval by multiplying:

- the difference in the regional reference price between the two NEM regions, and
- the amount of energy flowing between those two regions.[17]

IRSR can be positive or negative.

- **Positive IRSR** occurs when electricity flows from a lower-priced region to a higher-priced region. There is a settlement surplus – the amount of money received from energy consumers in the importing region is greater than the amount paid to generators in the exporting region for the energy that flows across the interconnector.
- **Negative IRSR** occurs when electricity flows from a higher-priced to a lower-priced region (known as counter-price flows). There is a settlement deficit – energy consumers in the importing region pay less than the amount paid to generators in the exporting region for the energy that flows across the interconnector.

16 See NER definition, 'settlements residue'. A 'settlement' is the activity of producing bills and credits for market participants.

17 There is also an adjustment for losses.

AEMO notes that counter-price flows and negative IRSR are usually caused by pricing interventions, errors, or what AEMO terms 'dispatch process issues'.[18] Dispatch process issues are where a counter-price flow is required to achieve the lowest cost dispatch while meeting power system operational requirements, such as ancillary service requirements.[19] An example is intra-regional network security constraints causing counter-price flows to or from an adjacent region. A small amount of counter-price flow is expected to arise in the NEM due to these reasons.[20]

However, large or frequent counter-price flows are currently more likely to be caused by disorderly bidding. This is a generator bidding behaviour where generators that are likely to be 'constrained off' have an incentive to bid at the market floor price of -$1000/MWh, which may be much lower than their short-run marginal cost (SRMC), to increase the prospect that they are dispatched. These generators anticipate that their low offers will not affect their regional reference price (RRP) due to a constraint in the network between their location and the regional reference node (RRN) where the RRP is set. When this occurs near an interconnector, NEMDE will preferentially dispatch these apparently low-cost generators, and their output will flow across the interconnector due to the constraint. This occurs regardless of the actual RRPs in both regions, and will result in a counter-price flow if the RRP in the adjacent (importing) region is lower.[21]

Disorderly bidding is a result of the NEM's regional pricing design. This rule change is primarily concerned with negative IRSR that arises from price separation between regions as a result of congestion, but not disorderly bidding. (This is because negative IRSR may frequently accrue on one or more arms of a transmission loop as part of efficient dispatch - see section 2.2.1 and section 2.2.2.)

2.1.2 Positive and negative IRSR are both passed through to consumers in the importing region

The current rules specify different methods for managing positive and negative IRSR. However, both types of residue are ultimately passed through to consumers in the region that is importing the electricity, as shown in Figure 2.1.

Negative IRSR is allocated directly to the TNSP in the importing region.[22] TNSPs recoup the resulting costs by increasing the transmission use of service (TUOS) charges levied on customers. However, AEMO limits the magnitude of negative IRSR passed through to customers by applying negative residue management constraints. See section 2.1.3 for more detail on the arrangements for negative IRSR, including negative residue management (clamping).

Positive IRSR is distributed through an auction system to auction participants. Instead of receiving positive IRSR directly, the importing TNSP receives the proceeds of the auction.[23] TNSPs pass this revenue through to customers via reduced TUOS charges. See section 2.1.4 for more detail on how auctions are conducted for positive IRSR and the role of these auctions in inter-regional hedging.

18 AEMO, Guide to the Settlements Residue Auction, v4, October 2019, p. 7, https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/settlements-and-payments/settlements/settlements-residue-auction/guide-to-settlements-residue-auction ('Guide to the Settlements Residue Auction'). AEMO notes that dispatch process *errors* can include SCADA input failures or manual processing errors, for example.

19 Ibid. Strictly speaking, the dispatch process aims to maximise the value of spot market trading, rather than minimise cost (NER clause 3.8.1(b)). These two objectives are slightly different when there is scheduled load.

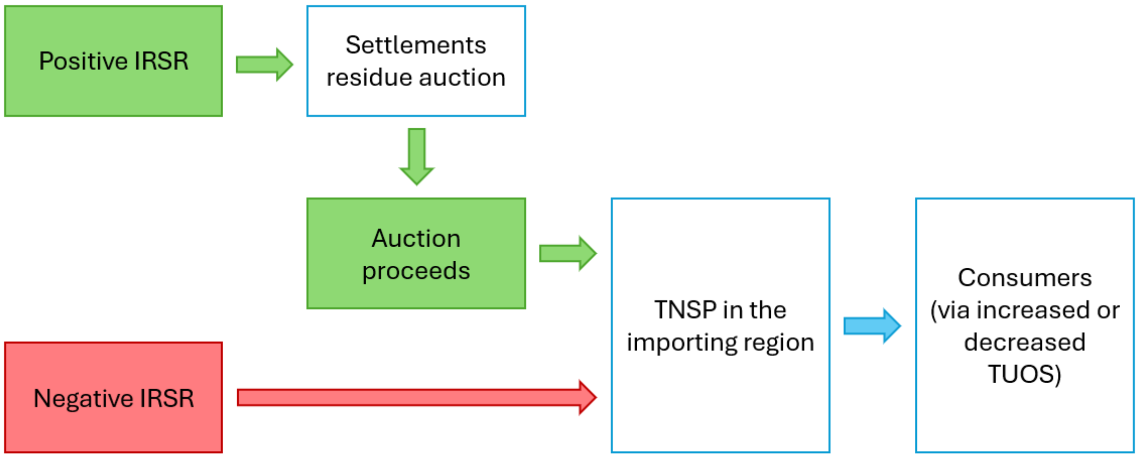
20 AEMO rule change request, p. 7.

21 For a more detailed explanation of disorderly bidding, see Australian Energy Regulator (AER), 'Special report - The impact of congestion on bidding and inter-regional trade in the NEM', https://www.aer.gov.au/publications/reports/performance/special-report-impact-congestion-bidding-and-inter-regional-trade-nem.

22 NER clause 3.6.5(a).

23 NER rule 3.18.

Figure 2.1: Stylised illustration of positive and negative IRSR allocation



The rationale for allocating IRSR (whether directly or via an auction process) to importing TNSPs recognises that TNSPs provide the infrastructure that enables electricity imports.[24] Interconnectors enable electricity to be transported between different NEM regions and facilitate inter-regional trade and competition between electricity suppliers. IRSR can be considered a form of 'congestion rent' provided by the interconnector asset – analogous to a profit or loss that flows from investment in, and operation of, an interconnector.

If we consider IRSR as congestion rent flowing from the asset, it should flow to the party that invested in or 'owns' the asset – ultimately, the consumers in the region that paid for the interconnector. Allocating IRSR to the importing TNSP recognises their investment in the infrastructure that generates the congestion rent. Note that allocating all IRSR to the importing TNSP is a simplification of reality, as it assumes that the importing TNSP has entirely paid for the infrastructure, whereas in reality both TNSPs will have invested in the interconnector.

Another rationale that has been previously discussed considers that it is reasonable for consumers to pay the same price for the energy they consume as the relevant generator receives for producing that energy. If negative IRSR accrues, this means consumers in Region A are importing electricity for a lower price than an exporting generator in Region B is receiving. Equally, positive IRSR means that consumers are paying a higher price for the imported energy than generators are receiving. Allocating IRSR to the importing region means that consumers' energy prices are ultimately adjusted to reflect the price paid to the generator. In 2008 the AEMC noted that:[25]

> It appears reasonable…for negative settlement residue to be recovered from the importing region's TNSP. This is because loads in an importing region can benefit from the counter-price flow that led to the negative settlement residues in the first place, in that the counter-price flows may have led to a lower RRP in the importing region than would otherwise have been the case.

24 ACCC Applications for Authorisation – National Electricity Code Determination, December 1997, p. 87, https://www.accc.gov.au/public-registers/authorisations-and-notifications-registers/authorisations-register/national-electricity-code-mark-i ('ACCC NEC Determination').

25 AEMC, Congestion Management Review, Final report, June 2008, p. 165, https://www.aemc.gov.au/markets-reviews-advice/congestion-management-review ('Congestion Management Review Final Report').

Appendix D summarises how IRSR allocation has been considered in the past.

2.1.3 Negative IRSR is managed through clamping and allocated to importing TNSPs

To manage inefficient counter-price flows and limit the impact of large negative IRSR on consumers and TNSPs, AEMO applies negative residue management (NRM) constraints, also known as 'clamping' constraints.[26]

In AEMO's current procedure, clamping constraints are applied when the negative residue on a given interconnector reaches a threshold of $100,000.[27] The constraints are removed when system conditions have changed such that negative residue is no longer likely to occur.[28] System security and adequacy of supply are always prioritised over clamping, by assigning clamping constraints a low constraint violation penalty (CVP).[29]

The clamping procedure is not designed to prevent negative IRSR completely, but to keep it at a manageable level. Clamping is applied because excessive negative IRSR is often the inefficient result of disorderly bidding and unnecessarily increases costs for consumers. However, intervening in dispatch to stop inter-regional counter-price flows may also be inefficient, if the cause of the counter-price flows is not disorderly bidding.[30] The process of clamping also has limitations since it is partially manually implemented and must come second to system security. The clamping threshold and low CVPs help to achieve an appropriate balance.[31]

Any negative residues that accrue before an interconnector is 'clamped' are allocated to the importing TNSP. That is, the TNSP must pay the settlements deficit back to AEMO.[32] As a regulated entity, TNSPs recover the cost of negative residues from transmission customers via TUOS charges. TUOS charges are paid by transmission-connected customers that include distribution network service providers (DNSPs) and some large industrial customers. DNSPs in turn recover their costs from end customers (via retail tariffs). This means that end users in the importing region, including households and small businesses, will ultimately bear the cost of negative IRSR.

Figure 2.2 below shows a simplified example of the allocation of negative IRSR. Region 2 is importing 200 MW from the higher-priced Region 1. Since the RRPs differ by $30/MWh, there is a negative residue of $6000 (per hour) which will ultimately be paid by consumers in Region 2. If the interconnector was not available, Region 2 may have to supply this last 200 MW of demand using a more expensive local generator, or might face other outcomes such as system security risks (depending on the reason for the counter-price flow). Including the residues, Region 2 is paying an average price of approximately $29/MWh while Region 1 is paying $50/MWh.

26 NER clause 3.8.10(c)(5) requires AEMO to set out its approach to clamping in its network constraint formulation guidelines. See AEMO, Constraint Formulation Guidelines, v12, June 2023, p. 24, https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource. See AEMO, SO_OP_3705 Dispatch procedure, v94, June 2024, pp. 37-38, https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/power-system-operating-procedures ('AEMO dispatch procedure').

27 AEMO, Automation of Negative Residue Management, v.30., July 2021, https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/policy-and-process-documentation ('Automation of Negative Residue Management').

28 AEMO dispatch procedure, pp. 37-38.

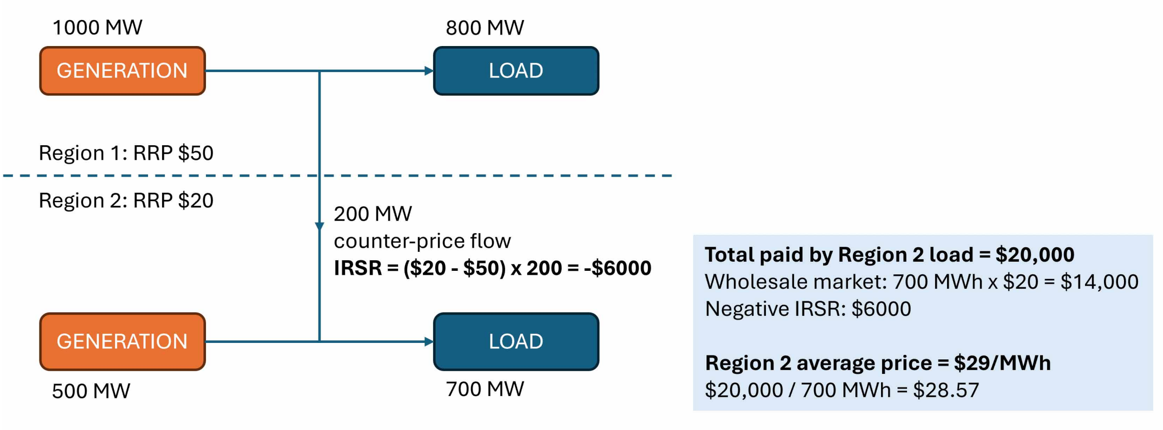
29 AEMO, Schedule of constraint violation penalty factors, v6.0, June 2024, p. 31, https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource.

30 See AEMC, Management of Negative Inter-regional Settlements Residues, February 2014, https://www.aemc.gov.au/markets-reviews-advice/management-of-negative-inter-regional-settlements ('Clamping review').

31 See AEMO, Automation of Negative Residue Management.

32 NER clause 3.6.5(a).

Figure 2.2: Simplified example of the allocation of negative IRSR



2.1.4 The rights to positive IRSR are auctioned to support inter-regional hedging

AEMO conducts SRAs for positive IRSR, in which auction participants bid for the right to receive portions (units) of future positive IRSR. SRAs are held quarterly. SRAs allow auction participants to purchase the rights to positive IRSR accruing up to three years in the future.[33]

Note that AEMO does not limit or 'clamp' the amount of positive IRSR that accumulates like it does for negative IRSR. This is because positive IRSR is more likely to be an outcome of the most efficient dispatch in the presence of constraints. Efficient dispatch benefits consumers by providing electricity at lowest cost.

AEMO administers the settlements residue auction according to the auction rules set out in the Settlements Residue Auction Rules.[34] NER Rule 3.18 provides the principles and core requirements for SRAs and requires AEMO to develop the auction rules and amend them as required, with the approval of the settlements residue committee.[35]

Parties eligible to participate in the auctions include retailers, generators, traders, and Integrated Resource Providers.[36] TNSPs are specifically excluded by the NER due to the potential for them to influence interconnector flows.[37]

In the auctions, SRD units are auctioned for each 'directional interconnector'. There are two directional interconnectors for each pair of regions that are connected, one for each direction of flow regardless of the number of physical interconnections. Directional interconnector notation indicates the direction of flow. For example, the NSW-VIC directional interconnector is considered to carry all flows from New South Wales to Victoria, and the VIC-NSW directional interconnector carries all flows in the other direction.[38]

33 AEMO, Settlements Residue Auction Rules, June 2024, p. 11, https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/settlements-and-payments/settlements/settlements-residue-auction/settlements-residue-auction-rules ('Settlements Residue Auction Rules').

34 Ibid.

35 NER clause 3.18.3.

36 Integrated Resource Provider is a NER participant registration category covering owners or operators of bidirectional units (batteries), among other things. AEMC, Integrating energy storage systems into the NEM, Final determination, pp. 89-91, December 2021, https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem.

37 NER clause 3.18.2(b); AEMO, Settlements Residue Auction Rules, pp. 8-9.

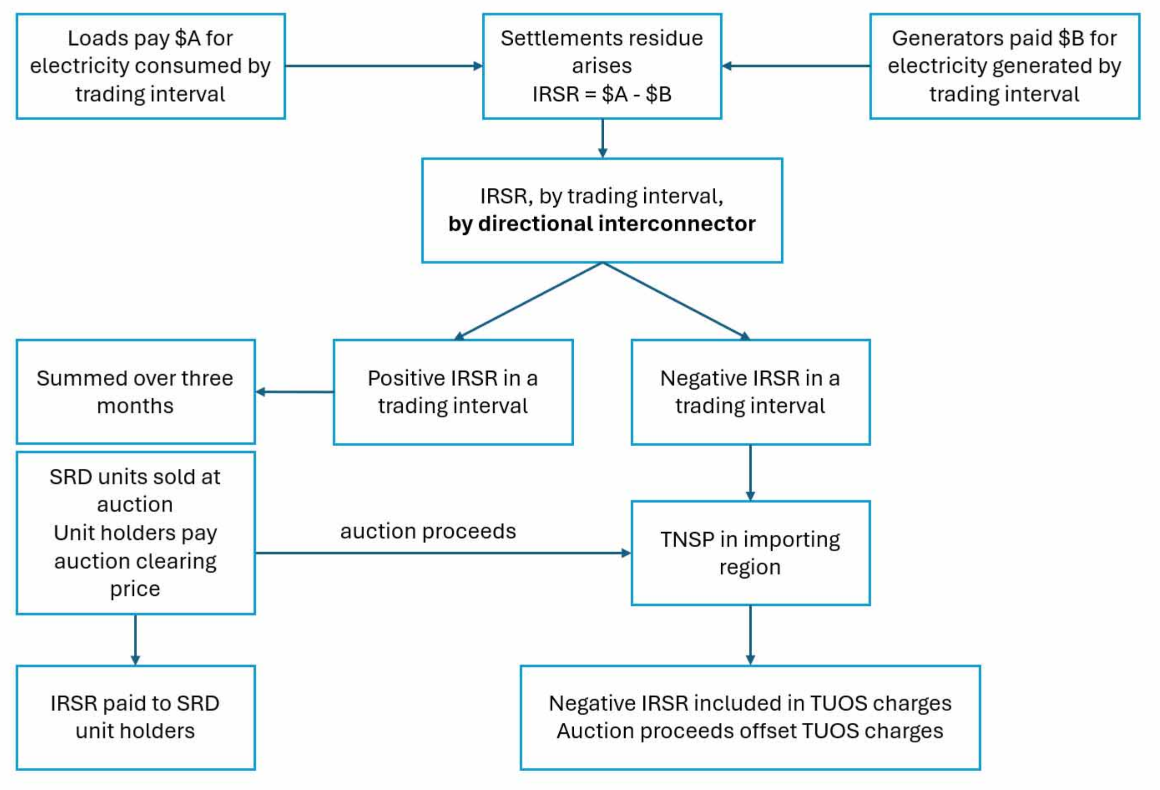
38 AEMO, Guide to the Settlements Residue Auction, p. 7.

The actual positive residues are paid out to the respective unit holders when they materialise, in the quarterly period to which the SRD units relate. Negative residues are excluded and are not netted off against positive residues – that is, in relation to any dispatch interval where the IRSR is negative, the SRD unit pays out zero. There is a minimum payout of $10 per SRD unit, and AEMO deducts auction expense fees from positive residue payouts.[39]

The auction proceeds are distributed to the relevant importing TNSPs, and passed through to consumers via reduced TUOS charges. The importing TNSP also receives, and passes through, the positive residues from any SRD units that are not sold at auction.[40] For example, the proceeds from selling VIC-NSW units, and the IRSR from any unsold SRD units, would go to the New South Wales TNSP, TransGrid.

Figure 2.3 illustrates the processes for allocating both positive and negative IRSR under the current rules.

Figure 2.3: Flowchart for IRSR allocation



39 Ibid., p. 14; AEMO, Settlements Residue Auction Rules, pp. 31-32.

40 NER clauses 3.6.5 and 3.18.4.

SRAs provide an opportunity to hedge against inter-regional price differences

The interconnection of the five NEM regions is designed to enable the inter-regional trade of electricity. Robust inter-regional trade can benefit consumers by:

- providing access to cheaper electricity generated in other regions,
- giving clear incentives for generators and large loads to locate in appropriate places, without being biased towards a particular region, and
- supporting retail competition by helping retailers and gentailers manage the risks of serving customers in multiple regions.

Sufficient opportunities for inter-regional hedging are needed to give retailers and generators the confidence to engage in inter-regional trade. This is because a party operating in multiple regions (including contracting across multiple regions) needs to be able to manage their inter-regional price risk. Parties are exposed to inter-regional price risk when they have contracts for load or generation that reference the spot price in other regions, or when they own generation assets and serve retail customers across different NEM regions.

SRAs were introduced to enable SRA participants to hedge against inter-regional price risk.[41] (For the purposes of this consultation paper, the term 'SRA participant' is being used to describe those persons eligible to participate in SRAs.[42]) Purchasing SRD units is one of several ways to hedge inter-regional price risk.

For example, consider a vertically integrated energy company that operates generation in Victoria and also serves retail customers in New South Wales. If the New South Wales RRP is higher than the Victorian RRP, the business is purchasing electricity at a high price for its retail customers and selling its generation at a low price, so it is experiencing inter-regional price risk. In this example, if the business owns SRD units on the VIC-NSW interconnector and Victoria is exporting to New South Wales at the time, these units will pay out an amount proportional to the price difference, which will help to compensate for that loss.

More generally, inter-regional price risk impacts retailers and generators through contracts that reference the spot price in other regions, whether or not they are vertically integrated.

SRD units are potentially a good hedge because, by definition, they are correlated with the price difference between regions. However, SRD units do not provide a perfect or completely 'firm' hedge, because SRD unit holders receive a share of positive IRSR, which is equal to the price difference multiplied by the interconnector flow. If the interconnector flow is constrained, the payout of SRD units is reduced.[43] The AEMC has discussed the limitations of SRAs in previous work.[44] Nevertheless, inter-regional hedging remains one of the motivations for SRA participants to purchase SRD units.[45]

41 NECA, Code Change Panel – Settlements Residue Auction, report submitted to the NECA board and subsequently authorised by the ACCC, May 1999, p. 2, archived at https://web.archive.org/web/20050615202232/http://www.neca.com.au/TheCode/.

42 See NER clause 3.18.2(b) and AEMO, Settlements Residue Auction Rules, pp. 8-9.

43 Often, the flow on an interconnector can be constrained to well below its nominal capacity due to factors such as intra-regional constraints. Times of limited interconnector flow are generally the times when price separation occurs – because the prices in the two regions would equalise if the interconnector was not constrained. Therefore, SRD unit holders may find that at the times of high price separation, the flow on the interconnector is reduced and thus their SRD units do not pay out the amount needed to completely cover the inter-regional price risk.

44 AEMC, Coordination of generation and transmission investment, Final Stage 1 report: 'Reporting on drivers of change that impact transmission frameworks', July 2017, pp. 46-47, https://www.aemc.gov.au/markets-reviews-advice/reporting-on-drivers-of-change-that-impact-transmi; AEMC, Transmission Frameworks Review, Final report, April 2013, pp. 102-103, https://www.aemc.gov.au/markets-reviews-advice/transmission-frameworks-review.

45 AEMO, PEC Market Integration Final Report, February 2024, pp. 31-33, https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper ('PEC Market Integration Final Report').

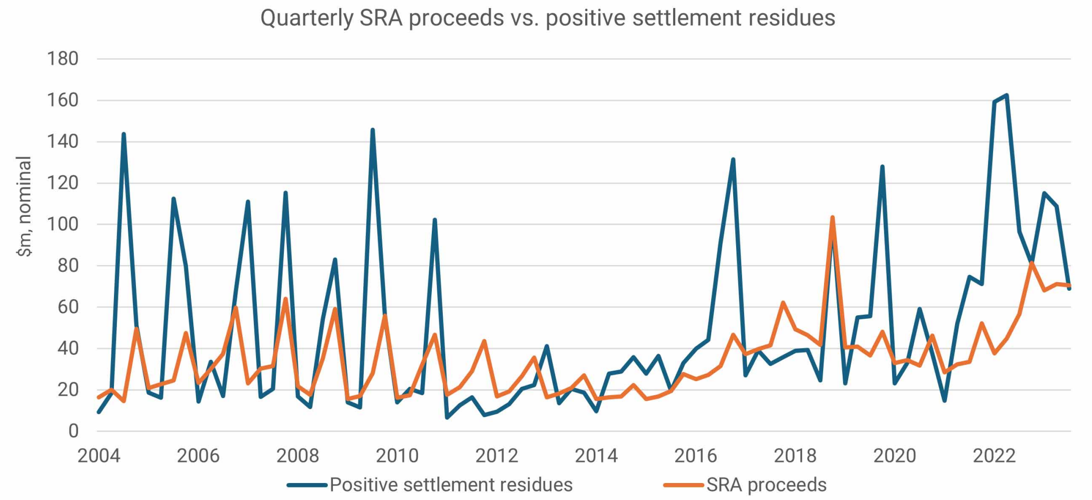
SRAs can benefit consumers by providing another tool for parties to manage the risk of inter-regional price separation (at least in theory).[46] To the extent that such inter-regional hedging is effective, it should reduce the amount of risk priced into customer offers. In theory, this should allow consumers to access lower and more consistent electricity prices in the long term. The Commission understands that the SRA clearing price has been lower on average than the eventual payout over a sustained period. As outlined in Box 1, this suggests that the SRA process is either not competitive, and/or that they are not an effective hedging instrument. Consistent with this, we also understand that there are relatively few parties participating regularly in SRAs, and that SRD units are sometimes used as a speculative instrument rather than a hedging instrument.

Box 1: A comparison of historic settlement residues and SRA proceeds

As noted above, electricity consumers do not receive the actual positive settlement residues. Rather, they receive the settlement auction proceeds paid by SRA participants. However, the two should be related if the auction process is competitive: the auction proceeds should reflect the expected value of settlement residues, plus the value of the residues as a risk management tool.

Figure 2.4 compares the amount of settlement residues accrued each quarter against the proceeds of settlements residue auctions.

Figure 2.4: SRA proceeds are persistently lower than actual positive residues



Source: AER data, 'Quarterly settlement residues and settlement residue auction proceeds', https://www.aer.gov.au/industry/registers/charts/quarterly-settlement-residues-and-settlement-residue-auction-proceeds.

It shows that, over the past 20 years, settlement residues have exceeded auction proceeds. On average, the settlement residues accrued were $49 million per quarter, while auction proceeds were $35 million, a difference of 40%. Note that these numbers have not been adjusted for inflation.

On a quarterly basis, settlement residues exceeded auction proceeds in roughly half of all periods. But the risks have been skewed:

- In periods where residues exceeded auction proceeds, the average difference was about $40 million in favour of auction participants.
- In periods where auction proceeds exceeded residues, the average difference was less than $10 million in favour of consumers.

46 Ibid.

As SRD units are auctioned over the three years prior to the quarter that the residues accrue, it is reasonable that expected residues may not align to actual flows in any given quarter. However, over a 20-year timespan, auction proceeds are persistently below actual residues accrued. This result is somewhat surprising because SRD units ostensibly provide valuable risk management benefits to SRA participants.

These insights may have implications for this rule change, which is considering the allocation of settlement residues for transmission loops.

The price flows generated by PEC may mean that settlement residues on directional interconnectors become more difficult to predict and less well correlated to the hedging requirements of holders, given the proposal that SRA arrangements continue to separate positive and negative flows. To the extent that SRA participants are exposed to more uncertainty in the auction process, this could ultimately lower the price received by consumers.

2.1.5 How IRSR is managed affects a range of stakeholders

The management of inter-regional settlements residue impacts four main groups of stakeholders: consumers, SRA participants, TNSPs, and AEMO.

- **Consumers** in the importing region ultimately pay the cost of negative IRSR, and receive the benefits of positive IRSR via SRA proceeds. The amount of negative IRSR that consumers pay is impacted by AEMO's application of clamping. Consumers may also benefit from their retailer's inter-regional price hedging, through lower or more consistent electricity bills.
- **SRA participants** can use SRD units to hedge their risks related to price separation (or for speculative purposes). SRD unit holders receive any upside from positive residue payouts, but the downside risk of SRD units is limited because negative residues are not allocated through the auction process and there is a minimum payout of $10 per unit.[47] Also, AEMO's application of clamping can affect market prices to which auction participants may be exposed.
- **TNSPs** need to manage IRSR costs and revenues and pass them on to transmission customers through TUOS charges. Costs (negative residues) are incurred on a weekly basis, revenue (SRA proceeds) is received quarterly, and TUOS charges are set annually, so IRSRs can create cashflow challenges for TNSPs. The magnitude of negative IRSRs which TNSPs need to pay is impacted by AEMO's application of clamping. If IRSR is larger or smaller than expected, TNSPs must recover the difference from (or return the difference to) customers as part of their regulated cost recovery.
- **AEMO** is responsible for applying clamping constraints, conducting settlements and distributing IRSR in the manner specified by the NER and subordinate procedures, including by holding SRAs.

47 AEMO, Guide to the Settlements Residue Auction, p. 10.

2.2 The transmission loop created by PEC will change inter-regional power flows and settlements residue

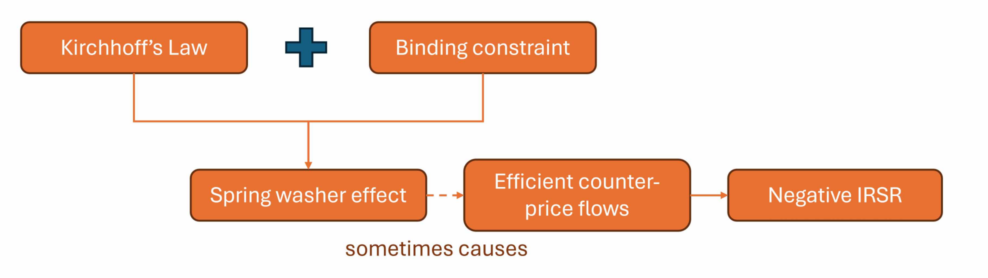
2.2.1 Negative IRSR can be part of efficient dispatch on a transmission loop due to the spring washer effect

Power flows differently in a transmission loop compared with a radial configuration. This can lead to different wholesale pricing outcomes – and different resulting IRSR – in a loop than we expect to see in radial configurations.

Power flows around a loop are governed by Kirchhoff's Law (Appendix C), a law of physics which states that power will flow along all network paths from a generator to a load. In other words, the power flow will be 'shared' between the paths. This is a physical law that cannot be overridden in dispatch.

When a binding constraint is present in a transmission loop, counter-price flows can be normal and necessary to support overall efficient dispatch outcomes. This is due to the 'spring washer effect' – a pricing phenomenon which arises when the loop is affected by a binding constraint (see Figure 2.5 and Box 2). It is so named because it involves a large price separation across the constraint with prices gradually increasing from the lowest to the highest price around the loop, which resembles the shape of a spring washer as shown in Figure 2.6. In certain circumstances, this can lead to efficient counter-price flow (Figure 2.5), as explained below. Constraining this flow would reduce the overall efficiency of dispatch.

Figure 2.5: How negative IRSR can arise in a transmission loop



Box 2 presents a simple example of the spring washer effect and the general principles are summarised below.

In the case of PEC, AEMO will represent PEC in NEMDE as an interconnector linking the New South Wales and South Australia regions, which are treated separately by the dispatch engine's hub-and-spoke model.[48] AEMO will then introduce a 'loop flow constraint' to represent the way that power physically flows around the loop (i.e. implementing Kirchhoff's Law in NEMDE).[49] This representation of the loop in NEMDE is an approximation of physical power flows, since the current hub-and-spoke formulation is a greater approximation of physical reality than if NEMDE were based on a network model.

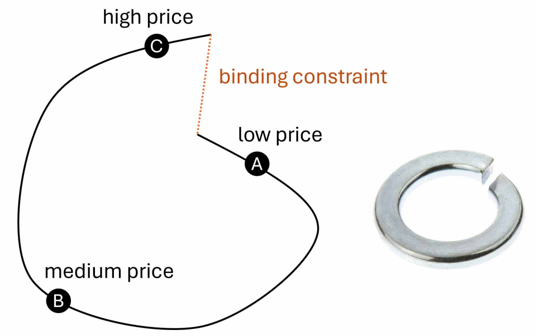
48 For an explanation of the hub-and-spoke model, see Appendix B. For AEMO's decision on how to represent PEC in NEMDE and its reasoning, see AEMO, PEC Market Integration Paper, November 2022, https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper, p. 12 ('PEC Market Integration Paper').
AEMO considered two options for reflecting the new physical transmission link in the dispatch model:
(1) the 'interconnector' model, where PEC is considered as a separate line linking New South Wales and South Australia for the purposes of dispatch.
(2) the 'micro-slice' model, which inserts a small Victoria region interfaced between the New South Wales and South Australia regions. This maintains the current topology of the NEM for the purposes of dispatch.

49 A loop flow constraint (also called a 'mesh constraint') is an equality constraint that governs dispatch and flows around a loop.

Box 2: Simple example of the spring washer effect and counter-price flows

The spring washer pricing pattern is illustrated in Figure 2.6. In this simple example, energy is generated at nodes A and B and the majority of the load is at node C. There is a constraint binding between nodes A and C.

Figure 2.6: Prices around a loop form a spring washer pattern when a constraint binds



Generators at node A will send most of the electricity they generate along the shortest route to C, due to Kirchhoff's Law. This route passes through the constrained line. As a result, generators at node A strongly contribute to congestion in the local area. This means the electricity they generate is less 'useful' (considering the largest load is at C), so the local price at A is low.

Moving away from the constraint, a higher proportion of the energy generated at node B goes directly to C, without crossing the constraint. A small proportion of electricity generated at B also flows via A due to Kirchhoff's Law. Generation at node B has a weaker impact on the constraint and therefore a higher local price. The highest local price occurs just downstream of the constraint, at node C.

The resulting prices around the loop resemble a spring washer as shown in Figure 2.6. Prices are very high immediately one side of the constraint (C), very low on the immediate other side of the constraint (A), and gradually change as we progress around the loop in between (B).

Depending on the dispatch conditions, the spring washer effect can sometimes lead to efficient counter-price flows. These flows travel from node B to node C via node A, creating a counter-price component of flow from B to A. This flow is netted off against the flow in the other direction (electricity generated at A).If the conditions are right, the power flow from generators at B can exceed the power flow coming from A. Then the total flow in the B-A arm will be in the counter-price direction, towards A.

Negative settlements residue would then accrue on the B-A arm, since energy is flowing to the lower-priced node A. Node A acts as a 'transition node' since power flows from node B through node A to supply node C.

Source: Lu F, Energy Market Company, 'Spring Washer Effect – A Market Clearing Engine Study of the NEMS', October 2004, https://www.home.emcsg.com/publications?q=&sort=date-asc&year=0&filter1=-1&filter2=-1&filter3=-1&page=0; Chin YC, Nair NC and Chakrabarti BB, 'Impacts of Loop Flow on Electricity Market Design', November 2006, https://www.researchgate.net/publication/224060669_Impacts_of_Loop_Flow_on_Electricity_Market_Design; TranspowerNZ, 'The Spring Washer Effect', video playlist, October 2013, https://www.youtube.com/watch?v=pezUSbI9OUY&list=PLXUccGn4ptEO5e0-MV37_vWPWerhB8yak.

If constraints are introduced on the loop (additional to the loop flow constraint), NEMDE needs to balance the electricity generated in different locations around the loop to keep the power flows within the constraints. This is complex because generators send power in both directions around the loop, as noted above. The need to balance generation around the loop can impact local prices quite significantly as the dispatch engine needs to adjust different combinations of generators up or down to meet the next MW of demand while not violating the constraints.[50]

When there is a binding constraint in a transmission loop, the spring washer pricing pattern emerges as explained in Box 2.

The spring washer effect can sometimes – but does not always – lead to counter-price flows. These flows can be thought of as taking a longer route to the load, as required by Kirchhoff's Law, via a 'transition node' that may have a different price.

Counter-price flows within a loop will translate to negative inter-regional settlements residue when the loop passes through more than two NEM regions.[51] Loops are currently quite common in the transmission and distribution networks within regions. However, these loops do not create negative IRSR since they do not cross region boundaries and the same regional price is applied to all generators and loads within the region.[52]

2.2.2 AEMO expects that negative residues will occur frequently in the PEC loop

AEMO commissioned modelling by ACIL Allen to investigate how PEC will impact IRSR and explore methods to reallocate IRSR amongst the regions in the loop.[53]

The modelling results suggest that, as expected, counter-price flows and negative IRSR will occur much more frequently in the PEC loop than they do in the existing radial interconnector configurations. Based on ACIL Allen's results, negative IRSR is expected to accrue on at least one of the three interconnectors around one-third to half of the time.[54] This is consistent with the spring washer effect.

ACIL Allen's modelling also considers the outcomes in terms of the net IRSR for the transmission loop. The 'net residue' or 'net IRSR' for a dispatch interval is the sum of the residues on each interconnector in the loop.[55]

The net residue can indicate whether dispatch in the loop is distributing energy between regions for the benefit of consumers.[56] Net positive residue arises when the loop is transporting energy from lower-priced regions to higher-priced regions overall, even if there are counter-price flows on some individual arms. This is consistent with – although not a guarantee of – an efficient dispatch solution that supplies energy to consumers at the lowest cost. Net positive residue is analogous to pro-price flows and positive IRSR in a radial network.

On the other hand, net negative residues for the loop would generally be associated with intra-regional constraints and sometimes disorderly bidding. In some cases, even a *net* negative residue can be part of efficient dispatch if it is simply due to congestion, but disorderly bidding

50 The local price is the marginal cost of electricity at a specific node (point on the network), taking into account generation, load, and constraints. Although NEM settlement uses regional prices (the same for an entire region except for marginal loss factors), NEMDE calculates local prices (ignoring the effect of losses) and uses them in dispatch.

51 There are cases where transmission loops pass through two regions – for example the two interconnectors Heywood and Murraylink between Victoria and South Australia. However, loops crossing only two regions don't lead to larger or more frequent negative IRSR because IRSR is based on the *net flow* between the two regions. The net IRSR is usually positive, notwithstanding factors such as disorderly bidding that may cause inefficient counter-price flows.

52 Intra-regional settlements residue does occur but this is a result of electrical losses rather than differences in local prices as such. Intra-regional settlements residue is not the subject of this rule change.

53 ACIL Allen, 'Modelling the settlement effects of PEC'.

54 Ibid., p. 20.
Results quoted in this consultation paper are based on ACIL Allen's Stage Two: NEM Model.

55 Note that AEMO's rule change request uses the term aggregate residue or aggregate IRSR, instead of net residue.

56 For markets that use local prices, the net residue for any network configuration (radial, loops or a combination of both) is guaranteed to be positive or zero. Net negative residue is a possible outcome in the NEM because of regional pricing.

could increase the magnitude of net negative residues. This is analogous to counter-price flows and negative IRSR in a radial network.

Because net positive residue is consistent with an efficient dispatch solution, AEMO considers that any negative IRSR that accrues on individual arms while the net residue is positive is 'supporting' that net positive residue and an overall efficient outcome.

ACIL Allen's modelling suggests that this outcome will happen frequently in the PEC transmission loop:[57]

- *Net negative* IRSR is only expected approximately 5% of the time.
- *Net positive* IRSR is expected approximately 45% of the time, despite counter-price flows often occurring on one or two arms.
- There would be zero net IRSR another 40% of the time (which is only possible since the modelling does not include losses, as noted below).

It is important to note that these results are based on simplified, stylised models of the NEM. We understand that the modelling was primarily intended to produce plausible examples of IRSR outcomes against which to test reallocation methods, and is not necessarily an accurate projection of future market outcomes. Pricing, flow and residue outcomes will also change over time with generator entry and exit, and other transmission upgrades.

In particular, the modelling did not account for transmission losses. Therefore, many cases of zero net IRSR in the modelling results likely represent instances where constraints do not bind and prices equalise across the three regions. In reality, there would most likely be a small, positive net residue due to losses.

Also, the modelling did not include any clamping constraints.[58] This means the results are indicative of the frequency of the net negative IRSR, but its actual magnitude may be lower as a result of clamping.[59] AEMO's intended approach to clamping for the loop is described in section 2.2.3 below.

2.2.3 AEMO proposes to clamp the loop interconnectors only when there is net negative residue

AEMO's existing negative residue management (clamping) procedure will be neither efficient nor practical for inter-regional transmission loops, if negative IRSR will arise commonly as part of normal dispatch and support overall efficient outcomes. Therefore, AEMO has proposed a new approach to clamping for the loop as part of its PEC market integration work.

The current clamping procedure would apply clamping constraints to any directional interconnector that is projected to accrue negative IRSR greater than $100,000. Since negative residues are expected to accrue frequently on individual arms, as shown by the ACIL Allen modelling, applying the current procedure to the PEC transmission loop would lead to very frequent clamping. However, the power flows on each arm are not independent and cannot be clamped independently. If a clamping constraint is applied to one arm, it would likely impact the flows on the other arms as well, due to Kirchhoff's Law.[60]

57 Ibid., p. i-ii.

58 AEMO, PEC Market Integration Final Report, p. 25.

59 We also understand that ACIL Allen's Stage Two: NEM Model did not account for disorderly bidding (i.e. generators bidding below SRMC to improve their chance of being dispatched). In reality, disorderly bidding could potentially create more instances of net negative IRSR, but AEMO's proposed clamping approach should limit the magnitude of the resulting negative IRSR.

60 AEMO, PEC Market Integration Directions Paper, p. 30.

Because of this effect, clamping the transmission loop according to the current procedure would be inefficient. It would significantly reduce the benefits of building new inter-regional transmission, and also reduce the benefits of the existing interconnectors that will form part of the loop.

For this reason, AEMO proposes a different approach to clamping for transmission loops. Under this approach, AEMO would not clamp the interconnectors in the loop when the net residue is positive. When the net residue is negative, any individual loop interconnector would be clamped when its negative residue is projected to exceed the threshold of $100,000. This approach would enable better utilisation of the transmission loop so that consumers can benefit from inter-regional trade, acknowledging that counter-price flows on individual arms can often be part of efficient dispatch. However, it would still prevent excessive negative IRSR from accumulating in cases of net negative residue (that is, where the positive IRSR does not exceed the negative).

AEMO has also noted that attempting to clamp individual interconnectors in the loop could have unintended effects, such as:

- ‘cycling’ where clamping constraints are repeatedly applied and removed
- causing or increasing negative IRSR on other arms of the loop
- NEMDE being unable to find a solution that satisfies all constraints including the loop flow constraints, causing one or more clamping constraints (which have low CVPs) to violate.

These effects mean that applying frequent clamping to the transmission loop would be impractical and possibly infeasible. AEMO’s proposed approach would help to avoid these outcomes, by removing clamping requirements when the net residue is positive.[61]

2.2.4 AEMO considers the current approach to allocating negative IRSR would cause misalignment of costs and beneficiaries if applied to transmission loops

Under the current rules, all inter-regional settlements residues are assigned to the respective importing TNSP and ultimately passed through to consumers via adjusted TUOS charges.[62] AEMO submits that a problem arises because transmission loops create more frequent, but efficient, counter-price flows and negative IRSR.

Given its proposed clamping procedure, AEMO submits that negative IRSR will accrue more quickly and more often on individual arms whenever the net residue is positive. The ACIL Allen modelling commissioned by AEMO shows that in almost half of all dispatch intervals, overall net positive IRSR around the loop will accrue when there is negative IRSR on some arms and positive IRSR on other arms. AEMO considers that in these circumstances, the cost of negative IRSR on some arms of the transmission loop allows the benefit of inter-regional power flows to arise. In other words, the negative IRSR on some arms supports positive IRSR on other arms of the loop, and a net efficient overall outcome.

61 AEMO also notes that these unintended effects of clamping could also result from their proposed approach to clamping when the net residue is negative, but to a lesser extent. AEMO explains these are “possible and likely outcomes from loop flow topology and the negative residue management regardless of the exact process to do so. The proposed approach seeks to limit the extent to which intervention via clamping constraints is required”.
AEMO, PEC Market Integration Directions Paper, p. 30.

62 Positive residues are ‘assigned’ to the importing TNSP via an auction process from which the TNSP receives the proceeds – see section 2.1.4.

Under the current allocation approach, all negative IRSR would be allocated to the importing region(s) in the relevant dispatch interval. AEMO considers that this allocation approach would result in an unfair distribution of IRSR (and, therefore wealth) if applied to transmission loops because it would assign all costs to some regions, which does not reflect the broader benefits of the loop flow:[63]

> the current process of assigning costs [i.e. negative IRSR] to importing TNSPs is not equivalent to assigning costs to beneficiaries of inter-regional power flow. Current process may therefore result in (unfair) significant wealth transfer between consumers in the different NEM regions.

To remedy this, AEMO submits that the costs of the negative IRSR should be distributed proportionately between consumers in those regions that received the auction proceeds for the corresponding positive IRSR. Negative IRSR would not be netted off from positive IRSR, so the allocation of positive IRSR would be unaffected. The rule change request does not raise any wealth reallocation issues with respect to positive IRSR.

2.2.5 We can also consider wholesale pricing outcomes in assessing whether there is a problem with IRSR allocation in a loop

AEMO is concerned that allocating costs (negative IRSR) to the importing TNSP, as per the current approach, would not adequately align the costs with the beneficiaries of the inter-regional power flow. This is because the costs of the negative IRSR are borne entirely by some region(s) and the benefits of the positive IRSR are entirely allocated to other region(s).

However, we consider that it is also relevant to consider wholesale pricing outcomes around the loop, as well as the resulting IRSR, in looking at whether costs of the loop flow align with the beneficiaries.

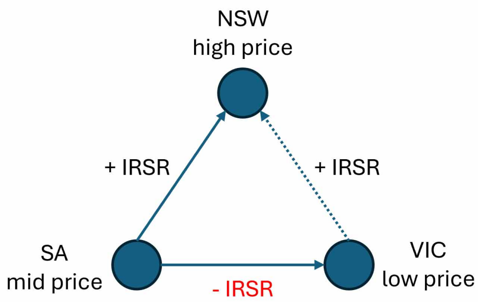
Consumers pay not only for the cost of IRSR (passed through via TUOS charges) but also the outcomes of wholesale prices (passed on by their retailer). Prices between the arms on a transmission loop are interdependent. When the spring washer effect occurs (see section 2.2.1), consumers in some regions on the loop will pay a higher RRP, while others will pay a lower RRP. This is analogous to the rule change request's description of negative IRSR on some arms of the loop 'supporting' positive IRSR elsewhere. Recalling that IRSR is a direct *result* of price differences around the loop, it follows that it does not arise in isolation of pricing outcomes.

Therefore, looking at both wholesale prices and IRSR can give a more accurate picture of how the loop flow impacts consumers in different regions. This provides a more comprehensive method to assess who is paying the costs and who is receiving the benefits of the loop flow.

To understand how wholesale prices and IRSR interact on a loop, we considered all possible configurations of flows and pricing between the three NEM regions. We analysed the impacts of allocating IRSR according to the current rules for one key example shown in Figure 2.7 below.

63 AEMO rule change request, p. 9.

Figure 2.7: Example configuration of power flows and wholesale prices in the PEC loop



Note: The location of the constraint and choice of price in each region are for example purposes only, and should not be taken as indicative of actual expected outcomes. We would expect that the configuration with a counter-price flow from the medium-priced region to the lowest-priced region is fairly common, but the lowest and highest wholesale prices could occur in any region. See Appendix E for more detail.

In this example, New South Wales has the highest wholesale price of the three regions and Victoria has the lowest price. There is a binding constraint on the VIC-NSW interconnector (flowing north) and a counter-priced flow on the SA-VIC interconnector (flowing east). This is consistent with the spring washer effect, with a binding constraint between the highest and lowest priced nodes (indicated by the dotted arrow), and a counter-price flow enabling generation in South Australia to supply New South Wales via Victoria.

Under the current rules, the negative IRSR on SA-VIC would be allocated to Victoria, the lowest-priced region. This would be passed on to consumers, offsetting their lower wholesale price with higher TUOS charges. The amounts of positive IRSR would both be allocated to New South Wales, which is the highest-priced region. This revenue would be passed on to New South Wales consumers, offsetting their higher wholesale price with lower TUOS charges.

In other words, the price separation caused by the spring washer effect in a transmission loop is essentially 'dampened' by allocating the IRSR to the importing region.

Appendix E steps through the other expected pricing and flow configurations to show that there are similar results in all possible cases if IRSR were to be allocated per the existing method. Appendix E also compares the existing IRSR allocation with AEMO's proposed rule. This is discussed further in section 3.2.1.

Our analysis does not show any obvious misalignment of costs and beneficiaries if negative residues in a transmission loop were to be allocated to importing TNSPs. Therefore, the Commission has not found there to be a clear problem in applying the current arrangements to a loop.

Question 1: The problem identified in the rule change request

Do stakeholders consider that there is a problem with applying the current rules for managing IRSR to transmission loops, specifically with respect to:

- clamping negative residues at the current threshold of $100,000
- allocating negative residues to importing regions
- allocating positive residues to importing regions (via settlement residue auctions)?

3 The proposed solution and implementation

This chapter considers the solution that AEMO has proposed in the rule change request and potential alternative solutions.

- Section 3.1 provides a description of the proposed rule.
- Section 3.2 discusses the key costs and benefits.
- Section 3.3 outlines the options that the Commission proposes to consider, including the option of maintaining the current arrangements.

3.1 AEMO has proposed changes to the allocation of negative IRSR in a transmission loop

AEMO's rule change request proposes that negative IRSR in a transmission loop should be reallocated amongst the interconnectors in the loop when the net residue for the loop is positive.

Under the proposed rule:

- When net residue for the loop is positive, any negative IRSR on individual arms of the loop would be reallocated to the other arms in proportion to the positive IRSR they have accrued in the same dispatch interval, and assigned to the importing TNSPs for those arms.
- When net residue for the loop is negative, negative IRSR accruing on any individual arm would be allocated directly to the importing TNSP as per the current rules (noting the negative IRSR allocated to an arm which has positive IRSR would not be deducted from the positive IRSR, which is allocated to SRD unit holders).
- In both cases, positive IRSR would be distributed to SRD unit holders, with the proceeds of SRAs being assigned to the respective importing TNSPs, as per the current arrangements.[64]
- There would be no change to SRAs, except that AEMO would introduce new SA-NSW and NSW-SA SRD units to allow auctioning of the positive IRSR arising on PEC.
- The interconnectors forming the loop would only be subject to clamping when the net residue for the loop is negative.

The change to clamping would be implemented by an AEMO procedure change, rather than a rule change. In AEMO's proposed new approach to clamping, no clamping would be applied to interconnectors in the loop when the net residue is positive. When the net residue is negative, clamping constraints would be applied on a directional interconnector when its negative residue is projected to exceed the threshold of $100,000, as in the current procedure.[65] Although no rule change would be required to implement this clamping approach, we include it in the definition of the proposed solution because clamping is a key part of the overall approach to IRSR management.

3.1.1 Negative IRSR would be reallocated when net residue is positive

Positive net IRSR for the transmission loop is associated with efficient dispatch, as outlined in Chapter 2. If there is a counter-price flow on one arm, AEMO considers that this is likely supporting efficient overall outcomes.[66] Therefore, AEMO has proposed a method for reallocating any negative residues to other arms of the transmission loop when the net residue is positive.

64 AEMO rule change request, pp. 14-17.

65 AEMO Final report, p. 41.

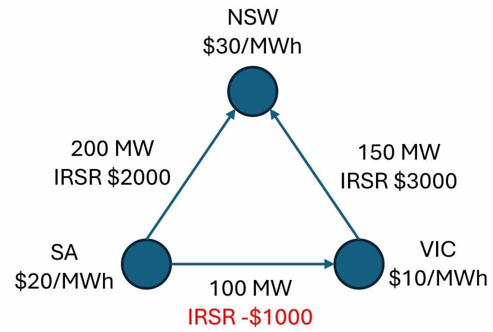
66 AEMO rule change request, p. 9.

Specifically, the negative IRSR would be redistributed amongst those arms accruing positive IRSR in the same proportion as the total positive IRSR accrued for the loop. The importing TNSP for each arm would be assigned that proportion of negative IRSR, in addition to receiving SRA proceeds as per the current arrangements.[67]

Figure 3.1 below shows how this proposed rule would operate. In this example, there is a counter-price flow on SA-VIC[68] with pro-price flows on the other two arms. NSW has the highest spot price at $30/MWh and VIC has the lowest price at $10/MWh. (This is consistent with the spring washer effect given a binding constraint on the VIC-NSW arm.) As shown in the figure, the following residues are accrued (per hour):[69]

- $3000 on VIC-NSW (positive IRSR)
- $2000 on SA-NSW (positive IRSR)
- -$1000 on SA-VIC (negative IRSR)

Figure 3.1: Example of the proposed reallocation with negative IRSR on one arm



Note: This is an illustrative example which does not reflect actual prices, flows, constraints, or interconnector capacities. Also, the rule would be applied on a dispatch interval basis rather than an hourly basis.

The net residue for the loop is $4000 (positive). In this scenario the proposed rule would reallocate the negative IRSR accruing on SA-VIC as follows.

The proportion of negative IRSR assigned to VIC-NSW would be:

$$R^{-}_{VICNSW} = \left(\frac{\$3000}{\$3000 + \$2000}\right) \times \$1000 = \$600$$

The proportion of negative IRSR assigned to SA-NSW would be:

$$R^{-}_{SANSW} = \left(\frac{\$2000}{\$3000 + \$2000}\right) \times \$1000 = \$400$$

This calculation would be applied in each dispatch interval.[70]

67 AEMO rule change request, p. 15.

68 Note we use the notation SA-VIC to indicate the directional interconnector importing from South Australia into Victoria.

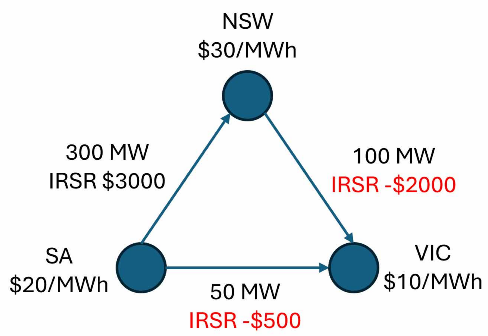
69 We use residues per hour here for simplicity. This is equivalent to assuming that the flows and prices are constant for one hour.

70 AEMO rule change request, p. 15.

These reallocated negative residues would be payable by the respective importing TNSPs, and then recovered from consumers in the TNSPs' regions. In this example, the importing TNSP for both arms with positive IRSR is the NSW TNSP. If the current allocation method were applied, the negative IRSR of $1000 would be payable by the Victorian TNSP instead (the importing TNSP for SA-VIC).

The proposed rule also accounts for cases where there are negative residues on two arms of the loop, but with net positive residue. Figure 3.2 below shows an example of this scenario.

Figure 3.2: Example of the proposed reallocation with negative IRSR on two arms



Note: This is a simplified illustrative example - see Figure 3.1 note.

In Figure 3.2, there are counter-price flows on both NSW-VIC and SA-VIC, accruing negative residues of $2000 and $500 respectively. SA-NSW is importing energy to NSW and generating $3000 in positive residues. The net residue is still positive ($500). Since there are two interconnectors accruing negative IRSR, both residues would be reallocated to SA-NSW.

$$R^{-}_{SANSW} = \$2000 + \$500 = \$2500$$

This negative residue would be allocated to the NSW TNSP. Note that the NSW TNSP would still receive proceeds from the sale of SRD units corresponding to flow on SA-NSW.

The net residue can also be positive when none of the arms have counter-price flows. In this case, the new rule would have no impact as there would be no negative residues to allocate.

When the net residue for the loop is negative, the proposed rule would allocate negative residues in the same way as the current arrangements. That is, negative IRSR on any individual arm would be allocated directly to the importing TNSP.

The rule change request does not account for cases where the net residue for the loop is exactly zero. This scenario would occur infrequently, if ever, and either the net positive or net negative allocation method could feasibly be applied. The Commission welcomes stakeholder views on how to treat the zero net residue case.

3.1.2 Positive IRSR on PEC would be distributed through SRAs, maintaining the current auction design

The method for allocating positive residues would not be impacted by the proposed rule. Positive residues on all of the interconnectors forming the loop would be distributed via SRAs.[71]

In the Figure 3.1 example, SRD units for VIC-NSW and SA-NSW would pay out. The proceeds for these units would have already been passed on to the NSW TNSP. Note that other TNSPs would have also received auction proceeds for their respective importing units for the quarter, even though they are not paying out in this dispatch interval.

In the Figure 3.2 example, SRD units for SA-NSW would pay out.

Note that the design of settlements residue auctions is largely AEMO's responsibility. The NER simply allows AEMO to hold settlements residue auctions, and sets basic requirements around eligibility, information provision, auction fees, and the role of the settlements residue committee.[72] AEMO would need to make changes to the auction rules to create SRD units for PEC, and any transitional provisions it may consider necessary.[73] However, the Commission understands that AEMO intends to maintain the current auction design.

Question 2: Will the proposed solution address the issue raised by the proponent?

What do you consider success would look like if the issue identified by the proponent was solved? Do you consider that the proposed changes to the rules will solve the problem raised or are there other factors that would have a greater impact?

3.2 Benefits and drawbacks of the proposed solution compared to current IRSR allocation

3.2.1 Appropriate allocation of negative IRSR amongst regions

AEMO considers that the reallocation of negative IRSR under the proposed rule would best reflect the way that power flows in the loop by aligning costs with beneficiaries. The rule change request states that the proposed rule would:[74]

> align the cost of negative IRSR with regions that receive increased positive IRSR from the occurrence of negative residues around the parallel transmission configuration

and[75]

> [spread] the impact of expected increases in negative IRSR resulting from the creation of the parallel transmission configuration.

As explained in section 2.2.4, AEMO considers the current arrangements are not appropriate for negative IRSR accruing in a transmission loop, due to a potential unfair wealth transfer.[76] This is because negative residues on some arms of a transmission loop can support simultaneous positive residues on other arms and efficient outcomes overall, as explained in section 2.2.1. The intention of AEMO's proposed rule is to allocate positive and negative residues for a dispatch

71 AEMO rule change request, pp. 9-10.

72 NER rule 3.18.

73 The SRD unit categories are specified in AEMO, Settlements Residue Auction Rules, p. 10.

74 AEMO rule change request, p. 10.

75 Ibid., p. 11.

76 Ibid., p. 10.

interval to the same region so that they can offset each other (while not changing SRA arrangements). This is intended to reflect that the positive and negative residues arise out of how the whole loop is dispatched to create the lowest cost solution for all customers.[77] In the example in Figure 3.1, customers in New South Wales would be allocated all of the negative IRSR and all of the SRA proceeds for that dispatch interval.

The proposed rule is designed to achieve this without changing any of the SRA arrangements, given stakeholder feedback on the importance of maintaining SRD unit hedging value.[78] AEMO notes that whenever the net residue is positive, the positive IRSR accrued on one or two arms is by definition sufficient to cover the negative IRSR on the other arm(s). If SRA proceeds reflect the expected amount of positive IRSR on each arm, then the SRA proceeds received by a TNSP should be sufficient to cover the reallocated negative residues in the long term.

However, as discussed in section 2.2.5 and Appendix E, we can also consider this proposed reallocation in light of the pricing impacts of the loop. In the Figure 3.1 example, New South Wales has the highest wholesale price as a direct result of the spring washer effect. The proposed rule would reallocate the negative residue from consumers paying a low price for wholesale electricity (Victoria) to those paying a high price (New South Wales). This reallocation method appears to worsen the impact of price separation associated with the transmission loop.

Appendix E generalises this analysis by looking at all possible combinations of flows between the three NEM regions, and the resulting impact on both wholesale pricing outcomes and resulting IRSR. Table E.1 compares pricing and IRSR outcomes under the status quo (that is, allocating negative IRSR to the importing region) with AEMO's proposal for reallocating negative residues.

The overall pattern is that the status quo allocates benefits (SRA proceeds) to regions where the wholesale price is higher, while allocating costs (negative IRSR) to regions where the wholesale price is lower. By contrast, AEMO's proposed rule allocates benefits (SRA proceeds) in the same way – where the price is higher – but would also recover costs from higher-priced regions. This would appear to be a drawback of AEMO's proposed reallocation method. The Commission welcomes stakeholder views on this point.

3.2.2 Relationship to clamping changes

As discussed in section 2.2.3, the existing clamping procedures would clearly be inefficient if applied to an inter-regional transmission loop. Since negative residues on individual limbs are expected to occur frequently, the current procedure would lead to frequent and repeated clamping which would limit utilisation of the interconnectors and reduce their benefits.[79]

AEMO proposes not to clamp the loop interconnectors where the net residue is positive. It considers that the proposed approach to clamping:[80]

> allows the parallel transmission configuration to maximise market outcomes and limit the extent to which intervention by clamping is required.

77 Ibid., pp. 9-10; AEMO, PEC Market Integration Directions Paper, p. 32.

78 AEMO, PEC Market Integration Final Report, p. 42. See also Appendix A of this consultation paper.

79 AEMO rule change request, p. 9.

80 Ibid., p. 11.

Specifically, AEMO's proposed clamping approach would have the following benefits (see section 2.2.3):

- enabling the loop to work effectively, including when counter-price flows are a part of efficient dispatch,
- preventing excessive negative residue (by continuing to clamp when net residue is negative), and
- more practical implementation and more predictable results, compared to applying the current procedures in a transmission loop.

AEMO's suggested clamping approach appears reasonable, but it would necessarily allow large negative IRSR to accrue on individual limbs. AEMO's view is that the allocation method for negative IRSR should be changed to account for these large negative residues that are expected to accrue on individual limbs.

However, the Commission notes that the changes to clamping could be applied without changing the IRSR allocation rules – or along with a different IRSR allocation than that proposed.

3.2.3 Impact of negative residues on TNSPs and customers

The proposed rule change and clamping procedure would still allow large negative IRSR to accrue on individual arms of the loop, as noted above. Although this appears to be an inevitable effect of an inter-regional transmission loop in a constrained network, we note that the new interconnector is expected to provide significant net benefits for consumers.[81] However, large negative IRSR could still present problems for some stakeholders.

First, negative IRSR allocated to TNSPs can create cash flow challenges if it is both large in magnitude and unpredictable. ElectraNet noted these challenges in a submission to AEMO's PEC Market Integration process (see Appendix A).[82] The Commission will assess the materiality of this issue as part of the rule change process.

Secondly, negative IRSR is ultimately a cost to consumers. Greater quantities of negative IRSR are expected to accrue with PEC in operation and with AEMO's proposed clamping approach, although this should be offset by greater utilisation of the transmission infrastructure bringing lower wholesale prices and improved reliability, as well as increased positive IRSR and hence increased SRA proceeds. Given that positive and negative IRSR are treated differently, the Commission is considering whether AEMO's proposed rule is the best way to manage and allocate negative IRSR in a transmission loop.

3.2.4 Appropriate allocation of positive IRSR

A key theme in AEMO's consultation process for PEC market integration was maintaining the value of SRD units for inter-regional hedging (see Appendix A). These units are intended to support inter-regional trade. The Commission considers inter-regional trade is essential for the NEM to function efficiently, to continue encouraging investment, and to maintain retail competition.

AEMO's proposed rule, informed by stakeholder feedback, does not include any changes to SRAs or the allocation of positive IRSR, in order to maintain the value of SRD units to the extent

81 ElectraNet, 'Project EnergyConnect Updated Cost Benefit Analysis', September 2020, p. 4, https://www.electranet.com.au/projects/south-australian-energy-transformation/.

82 ElectraNet submission to AEMO PEC Market Integration paper, January 2023, pp. 1-2, https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper.

possible.[83] AEMO submits that the proposed rule would "protect the value of SRA units by keeping the positive and negative settlement residues separate in regards to inter-regional hedging."[84] (The Commission notes that positive residues and SRA clearing prices will inevitably be affected by the introduction of a new interconnector, regardless of the rule change.)

While SRD units are an important tool for inter-regional hedging, they do have significant limitations as discussed in section 2.1.4. Maintaining the current approach may not necessarily be the best way to maximise benefits for consumers in the context of a transmission loop. The Commission is interested in stakeholders' views on how SRAs and SRDs benefit consumers and how this is affected by the creation of an inter-regional transmission loop.

3.2.5 Alignment with previous AEMC decisions

AEMO submits that the proposal is consistent with past regulatory decisions on IRSR, citing past AEMC determinations such as:[85]

- The *Recovery of negative inter-regional settlements residue* rule (2006) which required negative IRSR to be deducted from auction proceeds rather than auction fees. This effectively meant that negative IRSR was allocated to TNSPs instead of SRD unit holders. The key reason for this rule change was to reduce the need for AEMO to carry negative residue debt, as there was a significant delay before AEMO could fully recover negative IRSR through auction fees.[86] The rule change proponent, the National Electricity Market Management Company (NEMMCO), also considered that the rule change would improve the efficiency of the SRA process and by reducing auction fees and hence encouraging greater participation.[87]
- The *Negative Inter-regional Settlements Residue Amounts* rule (2009) which removed the netting-off of positive and negative residue in the weekly billing period.[88] This came out of the *Congestion Management Review*. The key reasons were to improve the firmness of SRD units and create one consistent method for recovery of all negative IRSR.[89]
- The *Management of Negative Inter-Regional Settlements Residues* review (2014), also known as the clamping review, which broadly affirmed AEMO's existing clamping procedure including the $100,000 threshold.[90]

Appendix D provides more detail on the regulatory background to the current IRSR arrangements.

The Commission notes that although some previous decisions have aimed to maintain the firmness of SRD units, any future decisions on SRD units and the use of settlement residue auctions would consider whether the performance of this hedging mechanism provides benefits to consumers.

83 AEMO rule change request, p. 9; AEMO, PEC Market Integration Final Report, p. 42.

84 AEMO rule change request, p. 10.

85 AEMO, PEC Market Integration Directions Paper, pp. 14-16.

86 AEMC, Recovery of negative inter-regional settlements residue rule change, March 2006, Final determination, p. 8, https://www.aemc.gov.au/rule-changes/recovery-of-negative-inter-regional-settlements-re.

87 NEMMCO, rule change request, 'Proposed Change to Settlement Residue Auction Clause 3.6.5', February 2005, p. 2, https://www.aemc.gov.au/rule-changes/recovery-of-negative-inter-regional-settlements-re.

88 AEMC, Arrangements for Managing Risks Associated with Transmission Network Congestion – Rule 16, August 2009, Final determination, pp. 17-25, https://www.aemc.gov.au/rule-changes/arrangements-for-managing-risks-associated-with-tr (AEMC, Arrangements for Managing Risks Associated with Transmission Network Congestion rule change).

89 AEMC, Congestion Management Review, Final report, pp. 27-28.

90 AEMC, Management of Negative Inter-Regional Settlements Residues, Final report, p. i.

3.2.6 Implementation costs

The proposed rule is designed to address the problem identified by the proponent while making minimal changes to the current rules.[91]

This means that the rule change would be relatively simple to implement. Limiting the disruption to the rules may also help limit any flow-on effects to the market and consumers.

AEMO would need to update its settlement systems and some procedures and guidelines to implement and comply with the new rule. AEMO estimates that settlement system updates would take 6-9 months while procedure and guideline updates would take approximately 6 months.[92]

AEMO may also need to consider transitional implementation issues for SRAs for the new interconnector. For example, it is likely that AEMO will not be able to begin auctioning PEC SRC units three years in advance of PEC becoming operational, as PEC capacity is expected to be released in 2026-2027. Therefore, new units may initially need to be auctioned over a shorter time period. Any resulting changes to the auction rules would be implemented by AEMO with the approval of the settlements residue committee.[93]

This is in addition to the implementation of the new PEC interconnector in AEMO's systems, including NEMDE, which will be necessary regardless of the outcome of this rule change process.[94]

Question 3: What are your views of the benefits and drawbacks of the proposed solution?

What do you consider will be the benefits and drawbacks, or costs, of the proposed solution? If there are costs, will these be one-off or ongoing? Is there anything the Commission could do in designing the rule that would help to minimise the costs and maximise the benefits?

3.3 Alternative options

In this section, we present three possible alternative options to address the problem raised in the rule change request. Option 1 is to apply the existing IRSR arrangements to transmission loops. Options 2 and 3 are potential alternatives which are not fully developed at this stage. Note this discussion is intended as a starting point for assessing options in the lead-up to the draft determination. The Commission is seeking stakeholder feedback on these and any further alternative options.

All options listed below are assumed to operate alongside AEMO's proposed clamping approach for the transmission loop. Changes to the clamping procedure fall under AEMO's remit and do not require a rule change.[95] AEMO's proposed approach to clamping in the loop appears sensible and it would be technically feasible with or without a change to how IRSR is allocated.

Further, the options listed below primarily consider the case of net positive residue for the loop. AEMO does not consider there is a need to reallocate IRSR in the case of net negative residue.[96] Therefore, negative IRSR would be assigned to the importing TNSP if the net residue is negative under all options – noting that the magnitude of this IRSR is assumed to be limited by clamping.

91 AEMO rule change request, p. 10.

92 Ibid., p. 14.

93 NER clause 3.18.3(d).

94 For more information on technical implementation issues, see AEMO's series of PEC Market Integration papers.

95 NER clause 3.8.10(c)(5) requires AEMO to develop a procedure for negative settlements residue management.

96 AEMO rule change request, p. 15.

The options also do not consider methods for reallocating positive residues. The Commission is interested in feedback if stakeholders have a different view.

3.3.1 Option 1: Apply the current IRSR arrangements to transmission loops

The current method for IRSR allocation could be applied to transmission loops, along with AEMO's proposed changes to the clamping procedure. This would mean that positive IRSR would be distributed through SRAs, with proceeds allocated to the importing TNSP, and negative IRSR would be allocated to the importing TNSP.

This option would be the simplest to implement and would likely not require significant changes to the rules.

As discussed in section 2.2.5 and section 3.2.1, maintaining the current allocation method for negative IRSR may not have a significant adverse impact on consumers with the introduction of a transmission loop, owing to the effect that transmission constraints and loop flows also have on wholesale prices. If so, then there may not be a need for different negative IRSR allocation arrangements for transmission loops.

This option would also maintain the current arrangements for positive IRSR including SRA design. The SRAs would continue to enable inter-regional hedging, subject to their existing limitations, and also subject to how PEC may affect the quantities of IRSR that accrue.

3.3.2 Option 2: Reallocate IRSR according to a different metric or method, while keeping negative and positive IRSR separate

The rule change request proposes one method for reallocating negative IRSR between regions to address the issue of "(unfair) significant wealth transfer".[97] However, an alternative method for allocating negative and/or positive IRSR amongst the three regions may have greater net benefits for consumers.

AEMO considered two main variations to its eventual proposed reallocation method. We outline these below (Options 2a and 2b) along with an additional method (Option 2c). AEMO ultimately considered that reallocating in proportion to positive IRSR for a dispatch interval would best "reflect congestion and pricing dynamics between regions" and therefore best align costs with beneficiaries.[98]

Any of these methods would apply only to dispatch intervals with net positive IRSR.

Option 2a - Reallocate both positive and negative IRSR

Under one alternative method, both positive and negative IRSR would be reallocated in proportion to the total magnitude of IRSR accrued (both positive and negative). Negative IRSR would continue to be kept separate from SRD unit payouts. AEMO decided against this approach because it would result in allocating some (net) positive residue to interconnectors that had originally accrued negative residue.[99]

97 Ibid., p. 9.

98 AEMO, PEC Market Integration Directions Paper p. 33.

99 Ibid., pp. 33-34.

Option 2b – Reallocate negative IRSR to positive limbs using a different metric

AEMO also considered reallocating negative IRSR based on other metrics, including:

- interconnector power flows (MW),
- coefficients for each interconnector in the loop flow constraint equation,[100] or
- IRSR aggregated on a weekly, monthly, or quarterly basis, rather than in a single dispatch interval.[101]

Option 2c – Reallocate negative IRSR amongst all limbs

Another possible method, not previously considered, is for negative residues accruing on all three limbs to be pooled and then divided amongst TNSPs in proportion to their average load. By sharing the costs of negative IRSR amongst all three regions, this would recognise how the limbs of the loop operate together to benefit consumers in all regions. Other metrics could also be used to distribute IRSR amongst TNSPs, such as metrics based on number of customers, net imports from other regions, or wholesale prices.

With any of these reallocation methods (2a, 2b or 2c), AEMO could still change its clamping procedure so that clamping would be applied on individual limbs only when the net residue for the loop is negative. When the net residue is negative, negative IRSR would be allocated directly to the importing TNSP.

3.3.3 Option 3: Change the separation of positive and negative IRSR

We explained in Chapter 2 how the flows on all interconnectors in a loop work together to create efficient outcomes and benefits for consumers. Since positive and negative residues in the loop are parts of the whole, there is a view – different to AEMO's view – that the negative residue should be deducted from the positive. This leads us to consider options that involve netting off residues. There are potentially multiple ways to implement this and it is not obvious how to assign the remaining net residue amongst TNSPs or SRD unit categories.

The simplest approach would be to subtract negative residue from positive residue for each arm individually, over some defined period, such as weekly. Negative settlements residue was managed in this way until 2009. The AEMC removed this netting-off in 2009 largely because it was considered to reduce the usefulness of SRAs for inter-regional hedging.[102] However, it may be worth assessing whether this approach is suited to transmission loops in today's NEM.

Alternatively, a different netting-off method could better take into account the nature of the loop. AEMO considered some such methods in its consultation process.

Under one such approach, negative IRSR would be reallocated to interconnectors accruing positive residue when the net residue is positive, but then deducted from the SRA payouts on those interconnectors instead of being recovered from TNSPs.[103] For the example in Figure 3.1, this would mean that the proportion of negative IRSR reallocated to VIC-NSW would be deducted from the payouts for SRD units on VIC-NSW. Similarly, the proportion reallocated to SA-NSW would be deducted from SA-NSW SRD unit payouts. Effectively, the negative IRSR would be recovered

100 The loop flow constraint equation is a constraint that AEMO will apply in NEMDE to ensure that the dispatch solution accounts for the physics of loop flows. See section 2.2.1.

101 Ibid., pp. 32-35.

102 AEMC, Arrangements for Managing Risks Associated with Transmission Network Congestion rule change, Final determination, pp. 17-25. See Appendix D for more information.

103 AEMO, PEC Market Integration Directions Paper, p. 36.

from SRD unit holders instead of TNSPs. This is a form of netting off, since negative residues would be subtracted from positive residues that accrued on a different interconnector.

In AEMO's consultation process, stakeholders were generally opposed to this option due to its likely impact on SRD unit payouts. Stakeholders were concerned that any reduction in SRD unit payouts would reduce the effectiveness of SRDs for inter-regional hedging, hence impacting inter-regional trade and efficient market operation and investment. In addition, reducing SRD unit payouts would be expected to reduce the SRA clearing price, in turn reducing the proceeds that are returned to customers.

Early in its process, AEMO also raised an 'SRA bundling' approach where new SRA unit categories would be defined for the loop, such that the payout for each unit would always be positive provided the net residue is positive.[104] While AEMO did not develop this option in detail, we understand that each new SRD unit would be defined as a weighted sum of the residues (including negative residues) on different directional interconnectors. Where the net residue for the loop is negative, these SRD units could either have negative payouts or the excess negative residue could be allocated to TNSPs. As a result, smaller amounts of IRSR (or even no IRSR) would be allocated directly to TNSPs and ultimately to consumers.

AEMO noted two key drawbacks of this option:

- SRA participants can already 'bundle' SRD units in practice by purchasing combinations of units that suit their risk profile. A specific AEMO-prescribed bundling approach may be less flexible for SRA participants.
- Since the bundled SRD unit payout would include both positive and negative residues, the overall payouts would be "diluted".[105]

Under any of these approaches, AEMO could change its clamping procedure so that clamping would be applied on individual arms only when the net residue for the loop is negative. This would minimise the amount of negative IRSR accruing in cases of net negative residue.

Question 4: What are your views on these and other alternative solutions?

Are any of the alternative options outlined above, including a continuation of the current arrangements, preferable to the proposed solution in section 3.1? Can you share any other alternative solutions that you think would be preferable and more aligned with the long-term interests of consumers?

104 AEMO, PEC Market Integration Paper, pp. 17-18.

105 Ibid.

3.3.4 Options not being considered at this stage

We do not intend to consider the following options:

- **Allocation of IRSR to parties other than TNSPs or SRD unit holders.** The Australian Competition & Consumer Commission (ACCC) decided against allocating IRSR to market participants in 1997, and the AEMC decided against recovering negative IRSR through a market levy in 2006.[106]
- **Direct allocation of all negative IRSR or SRA proceeds to the exporting TNSP.** Allocating IRSR to the exporting TNSP would not address the problem raised in the rule change request.
- **Changes to IRSR or SRA arrangements that apply beyond inter-regional transmission loops.** We consider that any changes to IRSR or the SRA process for non-loop interconnectors are out of scope.
- **Any changes to the Modified Load Export Charge (MLEC) framework.** We consider the MLEC framework to be important context for the existing IRSR allocation provisions (see Appendix D). However, MLEC is a broader framework and the scope of this rule change is limited to IRSR allocation in transmission loops.
- **Recovery of negative residues from auction fees.** This recovery method was previously removed by the AEMC for reasons including increasing the value of SRD units and maintaining competition in settlements residue auctions.[107]

In addition, broader congestion management issues are out of scope for this rule change and are being considered through the Commission's review on transmission access reform, as discussed in section 1.1.4.[108]

106 ACCC NEC Determination, December 1997, p. 89; AEMC, Recovery of negative IRSR rule change, Final determination, p. 8.

107 Ibid.

108 AEMC, Transmission Access Reform.

4 Making our decision

When considering a rule change proposal, the Commission considers a range of factors.

This chapter outlines:

- issues the Commission must take into account
- the proposed assessment framework
- decisions the Commission can make
- rule-making for the Northern Territory.

We would like your feedback on the proposed assessment framework.

4.1 The Commission must act in the long-term interests of consumers

The Commission is bound by the National Electricity Law (NEL) to only make a rule if it is satisfied that the rule will, or is likely to, contribute to the achievement of the National Electricity Objective (NEO).[109]

The NEO is:[110]

> to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system; and
>
> (c) the achievement of targets set by a participating jurisdiction—
>
> (i) for reducing Australia's greenhouse gas emissions; or
>
> (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions.

The AEMC targets statement lists the emissions reduction targets to be considered, as a minimum, in having regard to the NEO.[111] The statement is available on the AEMC website: https://www.aemc.gov.au/regulation/targets-statement-emissions.

4.2 We propose to assess the rule change using three criteria

4.2.1 Our regulatory impact analysis methodology

Considering the NEO and the issues raised in the rule change request, the Commission proposes to assess this rule change request against the set of criteria outlined below. These assessment criteria reflect the key potential impacts – costs and benefits – of the rule change request. We consider these impacts within the framework of the NEO.

The Commission's regulatory impact analysis may use qualitative and/or quantitative methodologies. The depth of analysis will be commensurate with the potential impacts of the proposed rule change. We may refine the regulatory impact analysis methodology as this rule change progresses, including in response to stakeholder submissions.

109 Section 88 of the NEL.

110 Section 7 of the NEL.

111 Section 32A(5) of the NEL.

Consistent with good regulatory practice, we also assess other viable policy options - including not making the proposed rule (a business-as-usual scenario) and making a more preferable rule - using the same set of assessment criteria and impact analysis methodology where feasible.

4.2.2 Assessment criteria and rationale

The proposed assessment criteria and rationale for each is as follows:

- **Outcomes for consumers**

  We selected outcomes for consumers because the design of the arrangements to manage and allocate IRSR in a transmission loop will affect the distribution of costs to consumers in different regions. Transmission loops will also affect underlying electricity pricing due to the interdependent nature of loop flows. Under this criterion, we will consider how the rule change would affect outcomes for consumers (particularly its effects on electricity pricing) and which approach for managing and allocating IRSR is in the best interests of consumers.

- **Principles of market efficiency**

  Principles of efficiency are relevant because the market arrangements for transmission loops will affect the extent to which some of the benefits of PEC are realised. Specifically, clamping arrangements will influence loop flows and benefits to consumers for PEC. It will also be important to ensure that settlements residue is allocated in the most efficient way to ensure that risks are managed and benefits flow through to consumers. Under this criterion, we will consider the following questions:

  - **Concepts of efficiency -** What is the most efficient way to manage negative IRSR through clamping? What is the most efficient allocation of negative IRSR? Is the retention of existing positive IRSR through the SRA process the best and most efficient outcome for consumers?
  - **Risk allocation -** This rule change is looking at the distribution of positive and negative IRSR, initially to TNSPs who will manage the cashflows and then through to customers. We will consider whether the rule change would change support the allocation of risk to the parties best suited to manage it.

- **Principles of good regulatory practice**

  It is important to create clear, stable, and predictable market arrangements for allocation of residues and inter-regional trading, so that the incentives for market participants and investors lead to efficient outcomes. Under this criterion, we will consider whether the rule change will promote predictability and stable outcomes for consumers.

Question 5: Assessment framework

Do you agree with the proposed assessment criteria? Are there additional criteria that the Commission should consider or criteria included here that are not relevant?

4.3 We have three options when making our decision

After using the assessment framework to consider the rule change request, the Commission may decide:

- to make the rule as proposed by the proponent[112]
- to make a rule that is different to the proposed rule (a more preferable rule), as discussed below, or
- not to make a rule.

The Commission may make a more preferable rule (which may be materially different to the proposed rule) if it is satisfied that, having regard to the issue or issues raised in the rule change request, the more preferable rule is likely to better contribute to the achievement of the NEO.[113]

4.4 The proposed rule would not apply in the Northern Territory

Parts of the NER, as amended from time to time, apply in the Northern Territory, subject to modifications set out in regulations made under the Northern Territory legislation adopting the NEL.[114]

The proposed rule would not apply in the Northern Territory, as it amends provisions in NER chapter 3 that do not apply in the Northern Territory.[115] Consequently, the Commission will not assess the proposed rule against additional elements required by the Northern Territory legislation.

112 The proponent sets out its proposed rule in section 3.2 and Appendix A of the rule change request.

113 Section 91A of the NEL.

114 National Electricity (Northern Territory) (National Uniform Legislation) Act 2015 (**NT Act**). The regulations under the NT Act are the National Electricity (Northern Territory) (National Uniform Legislation) (Modification) Regulations 2016.

115 Under the NT Act and its regulations, only certain parts of the NER have been adopted in the Northern Territory. The version of the NER that applies in the Northern Territory is available on the AEMC website at: https://energy-rules.aemc.gov.au/ntner.

A Summary of submissions to AEMO's PEC Market Integration series of papers

A.1 Submissions to the initial PEC Market Integration Paper

AEMO published a PEC Market Integration Paper for consultation in November 2022 and received 11 submissions.[116] This paper considered how PEC should be implemented in NEMDE, the use of phase shifting transformers (PSTs), approach to clamping, and how both positive and negative IRSR should be managed. Note that the scope of AEMO's PEC Market Integration work is broader than the current rule change.

Stakeholders who made submissions included retailers and generators, energy traders, industry bodies, ElectraNet and the AER.[117] Most stakeholders requested more information before they could reach a firm position on how PEC should be integrated into the NEM.

AEMO proposed several broad options for the management of negative IRSR at this stage, including changes to clamping, residue allocation, and/or the definition of SRD units. The most popular option amongst stakeholders was to maintain the status quo except for removing clamping in the loop. A number of stakeholders were also interested in options where IRSR could be reallocated amongst the regions in the loop. However, many stakeholders did not have a strong position and were interested in further analysis of the options.

Consistent with feedback from some stakeholders, AEMO's final rule change proposal is a combination of some of the options raised in its initial consultation paper.

A.2 Submissions to the PEC Market Integration Directions Paper

AEMO published a PEC Market Integration Directions Paper in November 2023 and received 13 submissions.[118] The paper presented AEMO's preferred approach to IRSR management for the transmission loop, as well as some variant options and discussion of technical implementation matters.

Stakeholders who made submissions included retailers and generators, energy traders, industry bodies and ElectraNet.[119] Stakeholders broadly accepted AEMO's proposed approach to clamping and negative residue reallocation, with no proposed changes to the SRA process.

Many stakeholders emphasised the importance of maintaining the hedging value of SRD units. In the Directions Paper, AEMO asked stakeholders whether the negative residue (after some form of reallocation) should be recovered from TNSPs or deducted from SRD payouts. Due to their views about SRAs and hedging, most stakeholders strongly preferred the first option. On the other hand, ElectraNet considered that the larger quantities of negative IRSR expected with the transmission loop would create significant cash flow challenges for TNSPs. Its view was that negative residues should be deducted from the payments made to SRD unit holders instead.

Some stakeholders were interested in further information, such as modelling of the micro-slice approach (out of scope for this rule change), or waiting to see the real market impacts of PEC before making a final decision.

116 AEMO, PEC Market Integration Paper. AEMO's series of papers and all submissions are available at https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper.

117 AEC, AER, AGL, ElectraNet, EnergyAustralia, Engie, Haast Energy Trading, Origin Energy, Pacific Energy Trading, Shell Energy, and Snowy Hydro.

118 AEMO, PEC Market Integration Directions Paper.

119 AEC, AFMA, AGL, APA, Delta Electricity, ElectraNet, EnergyAustralia, Engie, EUAA, Hydro Tas, Origin Energy, Pacific Energy Trading, and Shell Energy.

B Integrating transmission loops into NEMDE's hub-and-spoke representation

NEMDE's current formulation is known as the 'hub-and-spoke' representation. Each region's non-scheduled demand and generation is a represented at a 'hub' with scheduled and semi-scheduled activities represented at the end of 'spokes'. Like generators, interconnectors are also represented as 'spokes' connecting the regional hubs (see Figure B.1).

Dispatch is determined such that energy balances in each region, inclusive of imports and exports to neighbouring regions, and electrical losses. AEMO determines constraint equations as an input to NEMDE. These constrain the dispatch in the spokes to be consistent with the capacity of the physical transmission and account for the fact that non-scheduled load and generation is – in reality – spread across the region.

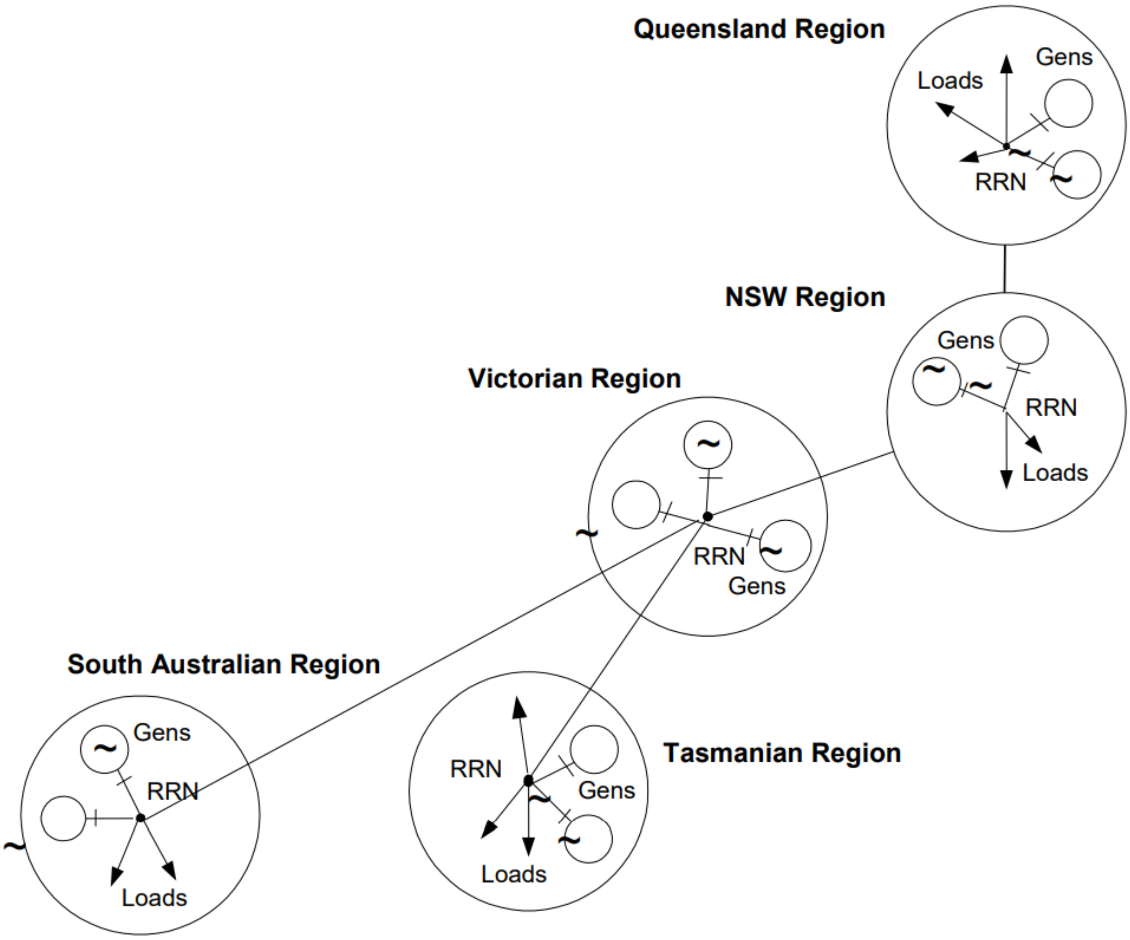
This approach contrasts with a 'full network model' used in some other jurisdictions. In a full network model, the physical characteristics of the transmission lines (for example their impedance, capacity, which nodes they connect to) are directly represented in the dispatch process. The dispatch engine determines the efficient dispatch such that energy balances at each node (not each region, as per the hub-and-spoke), inclusive of 'imports' and 'exports' to neighbouring nodes connected by transmission lines. The 'imports' and 'exports' on each transmission line are determined based on electrical circuit laws and are directly constrained to the physical limits of the lines.

Compared to a full network model, NEMDE's hub-and-spoke model is a greater approximation of physical reality. We understand it was chosen for pragmatic reasons (e.g., computing power in the 1990s, when it was introduced), noting that the approximation becomes weakest in highly meshed networks.[120]

The prospective looping of the New South Wales, Victoria and South Australia regions with PEC has required AEMO to introduce an additional 'loop flow constraint' (or 'equality constraint') to approximate the behaviour of the physical power system. The loop flow constraint will represent the relative flows across the interconnectors and the Phase Shifting Transformer (PST). AEMO notes that the representation of an inter-regional loop in NEMDE is a new concept. While AEMO has confirmed its intention to manage the loop in this way, the detailed constraint equations will be built in the lead up to PEC stage 2 commissioning.

120 A highly meshed network is a network that involves a large number of parallel transmission or distribution lines (loops).

Figure B.1: Hub and spoke representation of NEM regions



Source: AEMO, Treatment of Loss Factors in the NEM, July 2012, p. 19, https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries.

C Kirchhoff's Law for power systems

Kirchhoff's Law is a principle of physics which applies to electrical circuits. Strictly, there are two laws: Kirchhoff's Current Law and Kirchhoff's Voltage Law. However, for this purpose we will use one law stated in terms of electrical power, which is a consequence of both Kirchhoff's Laws and Ohm's Law. If there are two or more paths (transmission lines in parallel) between a generator and a load, the electricity will flow down both paths in inverse proportion to their impedance. Impedance is a measure of opposition to electrical flow (and is analogous to resistance in DC circuits). Long distances increase impedance; conversely, thick cables and high-quality materials decrease impedance. All else being equal, a longer transmission line has higher impedance than a short one.

This means that more power will flow through the shorter path to the load, but some power will always flow down both paths. For example, if line X is twice as long as line Y, then it will carry half as much power flow (and current) – so line X will carry one-third of the total power generated and line Y will carry the remaining two-thirds.

This is a physical law that cannot be overridden. Therefore, a dispatch engine such as NEMDE can only issue instructions to generators and scheduled loads to produce or use electricity, given the expected demand. The flows on transmission and distribution lines happen as a physical result of where energy is being generated and used.

D History of IRSR in the NEM

D.1 IRSR arrangements have evolved throughout the NEM's lifetime

Inter-regional settlements residue has existed since the NEM was established in 1998. The NEM converted what had previously been separate state grids into NEM regions. With regional prices came the potential for inter-regional settlements residue. A key piece of the NEM governance was the National Electricity Code (the Code).[121]

In approving the Code, the ACCC determined that both negative and positive residues should be allocated to the appropriate (i.e. importing) TNSP and passed through to consumers.[122] There are various comments in the literature about why the TNSP in the *importing* region receives both positive and negative IRSR. The 1997 ACCC Determination authorising the Code makes a congestion rent argument similar to that set out in section 2.1.2, albeit focussing on positive residue.[123]Neither this original authorisation nor the Code change introducing SRAs discuss negative residues in detail. However, the 2008 AEMC Congestion Management Review notes it 'appears reasonable' to recover negative IRSR from the importing TNSP, since consumers in the importing region benefit from the counter-price flow.[124]

Positive IRSR has been auctioned through settlements residue auctions (SRAs) since shortly after the NEM was established. The draft Code proposed that NEMMCO (the predecessor to AEMO) would use the IRSR it collected to make inter-regional hedging contracts available to market participants.[125] However, the ACCC removed these provisions in the process of authorising the Code, determining that a more minimal approach should be taken so as not to inhibit market-based initiatives. Instead, the National Electricity Code Authority (NECA) was required to develop a facilitated inter-regional hedging framework after the commencement of the NEM. In its Determination, the ACCC emphasised the importance of hedging in enabling inter-regional trade, enhancing competition, and ensuring the overall integrity and efficiency of the NEM.[126]In 1999, NECA completed a Code change giving NEMMCO the ability to hold settlements residue auctions. SRA design has evolved since then through rule changes and procedure changes.[127]

Negative IRSR has been treated in different ways throughout the history of the NEM. Under the first iteration of SRA arrangements in the Code, and unlike now, negative IRSR was deducted from positive IRSR in the same billing period (week) before the positive IRSR was paid out to SRD unit holders.[128] At the beginning of the NEM, negative IRSR was not expected to be large in magnitude, so it was considered adequate to net off residues during the billing week and then recover any outstanding amount from auction fees. The AEMC stated in 2006:[129]

121 Changes to the Code were managed by the National Electricity Code Authority (NECA), predecessor to the AEMC.

122 ACCC NEC Determination, p. 89.

123 Ibid pp. 87-89.

124 AEMC, Congestion Management Review, p. 165.

125 Draft National Electricity Code submitted by National Grid Management Council 1996, pp. 3.50-3.54, https://www.accc.gov.au/system/files/public-registers/documents/96%2B14793B.pdf?ref=0&download=y.

126 ACCC NEC Determination, pp. 87-89.

127 NECA, Code Change Panel – Settlements Residue Auction, report submitted to the NECA board and subsequently authorised by the ACCC, May 1999, https://aemo.com.au/en/consultations/current-and-closed-consultations/project-energy-connect-market-integration-paper ('NECA, Code Change Panel – Settlements Residue Auction').

128 Ibid, p. 24.

129 AEMC, Recovery of negative IRSR rule change.

> The process of recovering negative residues from auction fees was designed shortly after the NEM commenced and was based on the assumption that negative residues would not be significant. This has not necessarily been the case, particularly following the commissioning of the QNI interconnector [in 2001].

A number of rule changes have since adjusted the method for recovery of negative IRSR. As discussed in section 2.1.3 of this report, negative IRSR is now recovered directly from the TNSP in the importing region.[130]

The timeline in appendix D.3 provides a summary of how the relevant provisions in the NER have changed over time, as well as key changes to NEM regions and interconnections.[131]

D.2 The inter-regional transmission charging framework recognises that one region's network can benefit customers in other regions

Transporting electricity between regions uses transmission infrastructure in both regions to link customers with generation. Inter-regional settlements residues, as well as the overall benefits of interconnection, are therefore a result of both regions' transmission networks.

The NER originally provided for jurisdictions to negotiate payments between TNSPs, up to the value of the relevant settlements residue, to reflect the shared use of their network assets.[132] This was intended as a temporary arrangement until a national transmission pricing methodology could be developed.[133] The AEMC explained in the 2005 *Review of electricity transmission revenue and pricing rules* (emphasis added):[134]

> The National Electricity Code originally contained a moratorium on the payment of TUoS charges across regions until a national transmission pricing methodology was developed and implemented. Instead of inter-regional TUoS charges, clause 3.6.5 of the Code (now the Rules) provides the TNSP in the region importing electricity with the relevant inter-regional settlements residue **on the basis that** this TNSP makes negotiated payments to the exporting region for use of its network assets.

In practice, only Victoria and South Australia negotiated such payments.[135]

However, inter-jurisdictional transmission charging arrangements were ultimately considered a broader issue than the allocation of IRSR. The AEMC highlighted the need for a whole-of-NEM inter-regional transmission charging arrangement in its 2008 National Transmission Planning Arrangements (NTP) Review.[136] Previous AEMC work had raised a number of options for inter-regional transmission charging including splitting IRSR equally between importing and exporting regions. This would recognise that IRSR arises from the shared use of transmission

130 Direct recovery is slightly different to deducting negative IRSR from auction proceeds, which was the approach for a portion of negative IRSR between 2006 and 2009. AEMC, Congestion Management Review, Final Report, pp. 165 -168. AEMC, Recovery of negative IRSR rule change.

131 The timeline includes the most important events but is not a complete list of rule changes, reviews and other events that relate to IRSR.

132 NER version 1 clause 3.6.5(a)(5) (since deleted), https://energy-rules.aemc.gov.au/ner/169.

133 AEMC, Review of electricity transmission revenue and pricing rules, Transmission Pricing: Issues Paper Transmission Requirements, November 2005, https://www.aemc.gov.au/sites/default/files/content/1e0b09d5-5498-479d-b801-695fcc5c4cb4/Issue-Paper-Transmission-Requirements.pdf, p. 67 ('Review of transmission pricing').

134 Ibid., p. 64.

135 Ibid., p. 65.

136 AEMC, National Transmission Planning Arrangements Review, Final Report to MCE, June 2008, pp. 67-69, https://www.aemc.gov.au/sites/default/files/content/6996f777-74b7-4937-bb49-9afc3b16e297/Final-Report.pdf ('NTP Review').

infrastructure.[137] However, the NTP Review determined that this would not be an adequate inter-regional charging mechanism and broader changes were required.[138]

Today, the Modified Load Export Charge (MLEC) framework provides a formal inter-regional transmission charging mechanism. The MLEC rule requires TNSPs to levy a charge on adjacent TNSPs to reflect each region's use of the other region's network.[139] The commencement of the MLEC rule in 2015 superseded the provisions in NER 3.6.5(a)(5).

D.3 Timeline of IRSR and interconnection in the NEM

This section provides a summary of key rule changes, reviews and other NEM milestones related to interconnection, IRSR, and how IRSR is managed.

- **1998:** The NEM commences operation as a wholesale spot market, comprising the regions of NSW (including the ACT), VIC, Snowy, SA and QLD.
  - All IRSR is allocated to the 'appropriate' (i.e. importing) TNSP, with NEMMCO to develop a calculation and distribution methodology. TNSPs pass through residues (positive and negative) to consumers.
  - Using IRSR to enable inter-regional hedging is discussed, but the ACCC delays this until after the NEM is established, to allow time to develop a suitable framework.
  - VIC and NSW are interconnected, with the largest link passing through the Snowy region. This creates a transmission loop which is initially implemented as a 'micro-slice' to avoid some of the challenges with loop flows.[140]
  - VIC and SA are also linked. QLD is not yet physically connected to the rest of the NEM.[141]
- **1999:** A National Electricity Code change establishes SRAs.
  - Key reason: to enable inter-regional hedging to support inter-regional trade.
  - Negative IRSR is netted off from positive within the billing period, with SRD unit holders receiving net IRSR for that billing period. If net IRSR for a billing period is negative, this further deficit is recovered by adding it onto future auction fees (AEMO charges SRA participants auction fees by deducting said fees from SRD unit payouts).
- **2001:** QNI is completed, creating a new source of IRSR and SRD units.[142]

137 AEMC, Pricing of Prescribed Transmission Services rule change, Final Determination, December 2006, https://www.aemc.gov.au/sites/default/files/content/dfd89237-4c6b-44ea-a251-c611dc715d21/Rule-Determination.pdf.

138 AEMC, NTP Review, Final Report to MCE, p.175.

139 Inter-regional Transmission Charging rule change, Final determination, February 2013, p. i, https://www.aemc.gov.au/rule-changes/inter-regional-transmission-charging.

140 This means the interconnectors were implemented in NEMDE such that all of the NSW-VIC flows passed through the Snowy region in NEMDE even if they did not do so physically. This contrasts with AEMO's proposed implementation for PEC. We understand the term 'micro-slice' was not used when the Snowy region existed but was introduced by AEMO in its PEC Market Integration work. AEMO considered a micro-slice implementation for PEC (i.e. adding a small slice of the VIC region between SA and NSW such that flows on PEC are represented in NEMDE to travel through VIC rather than from SA to NSW directly). However, AEMO's decision is to use a loop flow constraint implementation instead. See AEMO's PEC Market Integration Directions Paper and Final Report for more detail. See also Appendix B of this consultation paper.

141 KPMG and AEMC, 'National Electricity Market – A case study in successful microeconomic reform', 2013, p. 32, https://www.aemc.gov.au/sites/default/files/content/The-National-Electricity-Market-A-case-study-in-microeconomic-reform.pdf ('KPMG-AEMC NEM case study').

142 AEMO, 'Interconnector Capabilities', April 2024, p. 6, https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource/network-status-and-capability.
Note that the DirectLink (Terranora) interconnector had already connected New South Wales and Queensland in 1999, but was operated as a merchant interconnector until 2006. AER, Directlink Determination 2006-15, Directlink Joint Venturers' Application for Conversion and Revenue Cap Decision, March 2006, p. iv, https://www.aer.gov.au/industry/registers/determinations/directlink-determination-2006-15.

- **2005:** Basslink is completed and Tasmania joins the NEM, with Basslink becoming fully operational in April 2006.[143] (Note there is no SRA for Basslink residues since it is a merchant interconnector.[144])
- **2005:** The AEMC's *Review of the electricity transmission revenue and pricing rules* raises the issue of whether TUOS payments between jurisdictions are needed to reflect each region's use of networks in adjacent regions (in relation to IRSR specifically).[145]
- **2006:** The *Recovery of negative inter-regional settlements residue* rule change determines that negative IRSR is to be deducted from the auction proceeds paid to TNSPs, rather than recovered from future auction fees paid by SRA participants.
  - Key reason: to recover negative IRSR faster and reduce the need for NEMMCO to carry negative residue debt.
  - AEMC notes at the time that this should also increase the value of SRD units and hence increase SRA proceeds.
- **2006:** In the *Pricing of prescribed transmission services* rule determination, the AEMC briefly outlines options for improving the inter-regional TUOS arrangements, noting the existing arrangements are 'inadequate'. However, the final decision is to seek Ministerial Council on Energy (MCE) input rather than making a new rule, because inter-regional TUOS is considered to be a jurisdictional matter.
- **2008:** The AEMC's *Congestion Management Review* recommends that:
  - Negative residue should no longer be netted off from positive residue.
    - Key reason: to increase the firmness and value of SRD units.
  - NEMMCO should increase the clamping threshold from $6,000 to $100,000 (consistent with NEMMCO's own consultation on this issue).
    - Key reason: clamping too often restricts efficient dispatch – and the changes to negative IRSR recovery mean that NEMMCO can now manage a $100,000 threshold.
- **2008:** The AEMC's *National Transmission Planning Arrangements* review determines there is a need for a formal inter-regional transmission charging framework.
- **2008:** The Snowy NEM region is abolished (after a 2007 rule determination).
  - Key reason: to resolve issues with congestion and negative IRSR around the Snowy region.
  - This followed significant problems with intra-regional congestion in the Snowy region and with region boundaries. Prior to the abolition of the Snowy region, the Tumut Constraint Support Pricing/Constraint Support Contract trial had been in place aiming to improve these regional boundary issues, but did not fully resolve the problem.
- **2009:** The *Arrangements for Managing Risks Associated with Transmission Network Congestion – Rule 16* rule change removes netting-off of IRSR, as recommended by the Congestion Management Review.
- **2013:** The *Inter-regional transmission charging* rule change is completed, creating the MLEC framework. TNSPs are now required to levy a charge on neighbouring TNSPs for use of their network.

143 KPMG-AEMC NEM case study, p. 32; APA Group, Basslink Determination 2025-30 – Regulatory proposal, Attachment 7.2 - Control & Protection system Renewal, September 2023, p. 11, via AER website https://www.aer.gov.au/industry/registers/determinations/basslink-determination-2025-30/proposal.

144 AER, Basslink Determination 2025-30, Decision: Commencement and Process Paper, July 2023, p. iv, https://www.aer.gov.au/industry/registers/determinations/basslink-determination-2025-30/decision.

145 AEMC, Review of transmission pricing, Transmission Pricing: Issues Paper Transmission Requirements, pp. 64-68.

    - Key reason: to improve cost reflectivity of customer transmission charges, reflecting how customers in each region benefit from the use of adjacent regions' transmission networks.
    - The MCE submitted the rule change request based on the AEMC's earlier work.
- **2014:** The AEMC's *Management of Negative Inter-regional Settlements Residues* review finds that AEMO's clamping procedure, including the $100,000 threshold, is broadly appropriate, recommending minor changes.
- **2017:** The *Secondary trading of settlement residue distribution units* rule change allows SRA participants to re-offer their previously purchased SRD units for sale at subsequent auctions.
    - Key reason: to improve liquidity in the SRD unit market, hence supporting inter-regional trade, risk management, and competition.
- **2017:** The AEMC's *Coordination of generation and transmission investment* (COGATI) review Final Stage 1 Report reviews the drivers of change that impact transmission frameworks. Amongst many other issues, this report discusses the limitations of SRDs as a hedging tool and the difficulty of contracting across regions.
    - The report also outlines the recent (at the time) consideration of interconnection upgrades, including a 2017 TransGrid finding that a SA-NSW link would provide significant economic benefits.
- **2018:** The COGATI Final Report finds that the existing inter-regional TUOS arrangements are broadly adequate, but could be modified. The AEMC at the time recommends a broader review of TUOS charges.
- **2022:** Construction of PEC begins.[146]
- **2022:** AEMO begins work on PEC market integration.[147] Between 2022-24 AEMO has released a series of papers discussing the integration of PEC into dispatch, settlement, and IRSR allocation methodology, and completed two rounds of stakeholder consultation.

146 ElectraNet, 'Major construction work begins on electricity interconnector with New South Wales', February 2022, https://www.projectenergyconnect.com.au/article.php?id=71.

147 AEMO, PEC Market Integration Papers.

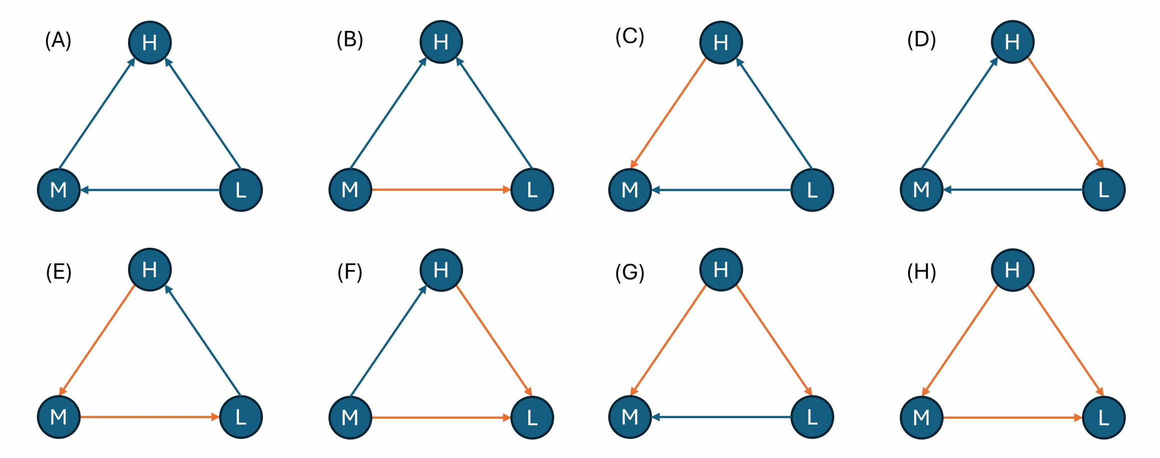
E Flow configurations in the transmission loop

To understand the outcomes of the proposed rule, we can consider all possible combinations of flows between the three NEM regions.

We use a simplified representation of the NEM with three nodes representing the three regions, and one transmission line between each pair of nodes. Without loss of generality we can assign one high-priced, one low-priced, and one medium-priced region. The results of the analysis will be the same regardless of which actual regions are experiencing high or low prices at a point in time.

In any dispatch interval, the flows on each of the three arms can be either pro-price (low to high) or counter-price (high to low).[148] Therefore there are $2^3 = 8$ possible flow configurations, as shown in Figure E.1. In Figure E.1, counter-price flows are shown in orange while pro-price flows are shown in blue. Blue flows accrue positive IRSR and orange flows accrue negative IRSR.

Figure E.1: There are eight possible flow configurations for a three-node transmission loop



Note: Configuration B is equivalent to the example in Figure 3.1, section 3.1.1 - which is fully worked with prices and flow values.

As outlined in section 3.1, the proposed rule would reallocate negative residues in cases where the net residue is positive. In configurations B-G above, it is possible (although not guaranteed) that the net residue is positive. In configuration A, the net residue is always positive, and in configuration H it is always negative. Table E.1 shows how both the current IRSR allocation (to the importing region) and the proposed rule would reallocate negative residues for each flow configuration, assuming that the net residue is positive. Where the net residue is negative, the allocation of residues would be the same as the status quo.

148 It may be possible for an individual arm to carry zero power flow (although this would seem unlikely in practice, for reasons including transmission losses). Zero flows can be considered a special case of pro-price flows in this analysis. Where the flow (or more specifically, the residue) is zero, SRD units would pay out zero to unit holders. However, the importing TNSP would still have received SRA proceeds for that interval since SRD units are sold in advance.

Table E.1: Operation of the proposed rule and status quo for all flow configurations

Configuration	Positive IRSR	Negative IRSR - status quo (i.e. allocate to importing region)	Negative IRSR - proposed rule (when net positive)
A	L-M: Proceeds to M region L-H and M-H: Proceeds to H region	N/A (see note)	N/A (no negative IRSR - see note)
B	L-H and M-H: Proceeds to H region	M-L: Recovered from L region	M-L: Recovered from H region
C	L-M: Proceeds to M region L-H: Proceeds to H region	H-M: Recovered from M region	H-M: Recovered from M and H regions
D	L-M: Proceeds to M region M-H: Proceeds to H region	H-L: Recovered from L region	H-L: Recovered from M and H regions
E	L-H: Proceeds to H region	M-L: Recovered from L region H-M: Recovered from M region	M-L and H-M: Recovered from H region
F	M-H: Proceeds to H region	M-L and H-L: Recovered from L region	M-L and H-L: Recovered from H region
G	L-M: Proceeds to M region	H-L: Recovered from L region H-M: Recovered from M region	H-L and H-M: Recovered from M region
H	N/A	M-L and H-L: Recovered from L region H-M: Recovered from M region	As per status quo (net IRSR not positive - see note)

Note: Since configuration A has positive IRSR accruing on all three limbs, there is no need to allocate or reallocate negative residues. Since configuration H has negative IRSR accruing on all three limbs, the net residue for the loop must be net negative, and there is also no reallocation of negative residues.

Note that this analysis does not consider which flow configurations are likely to occur in practice. For example, we would expect configuration B to be a fairly common outcome because of the spring washer effect (similar to Figure 3.1 in section 3.1.1). It is more difficult to see how configurations E-H would occur, although ACIL Allen's modelling does suggest it would be common for counter-price flows to occur on two arms at a time (i.e. intra-regional constraints can result in counter-intuitive flow patterns).

This is a qualitative analysis which considers the direction of flows and price differences. We do not consider the actual magnitude of flows or IRSR. In practice the actual prices and power flows would determine whether the net residue is positive or negative, and the amount of IRSR to be distributed. The magnitude of SRA proceeds also depends on SRA participants' bidding behaviour.

Still, Figure E.1 and Table E.1 cover all theoretically possible power flow configurations, so this analysis forms a complete description of how the proposed rule would operate.

Observations

The overall pattern is that the status quo allocates benefits (SRA proceeds) to regions where the price is higher, while allocating costs (negative IRSR) to regions where the price is lower.

By contrast, AEMO's proposed rule allocates benefits (SRA proceeds) in the same way – where the price is higher – but would also recover costs from higher-priced regions. Also, in some cases (C and G), the proposed rule appears to have a limited effect because it 'reallocates' a fraction of the negative residues back to the same region where it would be allocated in the status quo. This is because AEMO's proposed rule reallocates negative IRSR amongst the directional interconnectors, but two directional interconnectors may import energy into the same region. In configuration C, for example, the proposed rule reallocates some negative residues from the H-M to the L-M interconnector – but these residues would be paid by the TNSP in the M region regardless.

Abbreviations and defined terms

ACCC	Australian Competition & Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Commission	See AEMC
CRM	Congestion relief market
CVP	Constraint violation penalty
DNSP	Distribution network service provider
IRSR	Inter-regional settlements residue
MCE	Ministerial Council on Energy
MLEC	Modified load export charge
NECA	National Electricity Code Authority
NEL	National Electricity Law
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
NEMMCO	National Electricity Market Management Company
NEO	National Electricity Objective
NER	National Electricity Rules
NRM	Negative residue management (‘clamping’)
PEC	Project EnergyConnect Stage 2
Proponent	The proponent of the rule change request
PST	Phase shifting transformer
RRN	Regional reference node
RRP	Regional reference price
SRA	Settlements residue auction
SRD	Settlements residue distribution
SRMC	Short-run marginal cost
TAR	Transmission access reform
TNSP	Transmission network service provider
TUOS	Transmission Use of System