

N4 Opportunity Assessment

Distribution System Operator and Beyond: Optimising Planning and Regulation for Demand Management and Distributed Energy Resources

Final Summary Report



RACE for Networks

Research Theme N4: DSO and beyond: Optimising Planning and Regulation for DM and DER

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Acknowledgement of Country

The authors of this report would like to respectfully acknowledge the Traditional Owners of the ancestral lands throughout Australia and their connection to land, sea and community. We recognise their continuing connection to the land, waters and culture and pay our respects to them, their cultures and to their Elders past, present and emerging.

What is RACE for 2030?

RACE for 2030 CRC is a 10-year cooperative research centre with AUD350 million of resources to fund research towards a reliable, affordable and clean energy future. racefor2030.com.au

Disclaimer

The authors have used all due care and skill to ensure the material is accurate as at the date of this report. The authors do not accept any responsibility for any loss that may arise by anyone relying upon its contents.

GLOSSARY

ACCC	Australian Competition and Consumer Commission
ADR	Automated demand response
AEM	Australian Energy Market
AEMA	Australian Energy Market Agreement
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AES	Autonomous energy systems
ARENA	Australian Renewable Energy Agency
BEV	Battery electric vehicles
C-CEM	Consumer energy market
CER	Consumer energy resources
CRC	Cooperative Research Centre
DEIP	Distributed Energy Integration Program
DER	Distributed energy resource
DER-AO	Distributed energy resource asset owner
DM	Demand management
DMIS	Demand management incentive scheme
DNSP	Distribution Network Service Provider
DRSP	Demand response service provider
DSM	Demand-side management
DSP	Demand-side participation
DSR	Demand-side response
DUoS	Distribution use of System
ECA	Energy Consumers Australia
Energy Ministers	Forum for Australia's Energy Ministers (replaced COAG)
ERF	Emissions Reduction Fund
ESB	Energy Security Board
ESS	Energy storage system
EV	Electric vehicle
FCAS	Frequency Control Ancillary Service
FCEV	Fuel-cell electric vehicles
G2V	Grid to vehicle
ICE	Internal combustion engine
IEA	International Energy Agency
IRG	Industry reference group
ISP	Integrated system plan
KPI	Key performance indicator

LV	Low voltage
MV	Medium voltage
NECF	National Energy Customer Framework
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Energy Objective
NERL	National Electricity Retail Law
NERO	National Energy Retail Objective
NERR	National Electricity Retail Rules
NREL	National Renewable Energy Laboratory
NUoS	Network use of System
OA	Opportunity assessment
OEM	Original equipment manufacturer
PDRS	Peak Demand Reduction Scheme
PHEV	Plug-in hybrid vehicle
PV	Photovoltaics
RACE	Reliable Affordable Clean Energy CRC
RERT	Reliability and emergency trader
REZ	Renewable energy zone
RIT-D	Regulatory investment test distribution
RIT-T	Regulatory investment test transmission
RTPV	Rooftop photovoltaic
STPIS	Service target performance incentive scheme
TMIS	Transmission management incentive scheme
ToU	Time of use
TUoS	Transmission use of System
V2G	Vehicle to grid
V2H	Vehicle to home
V2X	Vehicle to “x-“ generic term for vehicle to grid, to home, to premises, etc.
VGI	Vehicle grid integration
VRP	Voltage stability, reliability and power loss
WDRM	Wholesale demand response mechanism
WEM/SWIS	Western Australian Wholesale Electricity Market/South West Interconnected System
ZLEV	Zero and low carbon electric vehicles

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1 INTRODUCTION

As a member of the international community and official party to the Paris Agreement and other international climate change treaties, Australia is working towards achieving national net zero emissions by 2050. Like many other countries around the world, Australia's ability to achieve its international climate change commitments is intrinsically linked to how it approaches and secures the decarbonisation of its energy sector. A central feature of this is a regulatory framework that operates as a critical enabler of Australia's transformative decarbonisation transition and net zero objectives by 2030 and beyond.

The Reliable, Affordable Clean Energy for 2030 Cooperative Research Centre (RACE for 2030) was established as a collaborative mechanism to address the multifaceted nature of this undertaking. Australia needs to understand its current position so it can develop the pathways needed to meet targets for 2030 and 2050, while ensuring beneficial outcomes are achieved for all energy end-users, market participants, and the wider economy.

Like the global electricity system, decentralisation and high levels of distributed energy resources (DER) are key drivers of the decarbonisation transition that is currently transforming Australia's energy sector. The growth in uptake of rooftop solar PV continues to escalate throughout Australia. Individual, community, industry and government interest and investment in batteries, EVs and other forms of DER is also rapidly rising.

While decentralisation of Australia's energy systems is a critical part of transformative decarbonisation and net zero pathways, it is now widely recognised that fully centralised control of planning, investment, operation and dispatch is unlikely to be effective or efficient in energy markets with high penetration of DER. Decentralised energy systems facilitate optimal production, storage, deployment and use of renewable energy at or close to source. In addition to providing greater access to clean energy services to more end-users, energy system decentralisation can reduce network inefficiencies, as well as environmental and economic costs (e.g. avoid expensive large-scale generation and additional network infrastructure). At the same time, networks are no longer simply providers of electricity from the wholesale market to end-users (consumers). Likewise, many consumers are no longer simply passive end users. These and related changes all present as significant challenges to the existing regulatory framework governing the energy sector, including policies, laws, regulations, rules, codes, etc. As of 2023, few would suggest that the existing regulatory framework is fit-for-purpose. On the contrary, it is a major barrier to decarbonising the Australian energy sector and achieving net zero emissions.

Experiences from international and several Australian jurisdictions confirm that a decentralised, high DER net zero energy future is achievable. Australia's energy future can be one in which safety, security, and reliability of electricity services and power systems, energy efficiency, emissions reductions, and value and benefits to consumers and the national economy are all fully recognised.

Australia's energy markets are undergoing a profound transformation. The national electricity market (NEM) is moving from a centralised system of large fossil fuel (coal and gas) generation towards an array of smaller scale, widely dispersed wind and solar generators, hydroelectric generation, grid-scale batteries and demand response. Over the last 12 months, we have observed that this transition continues to accelerate.

Australian Energy Regulator, *State of the Energy Market 2022*

For Australia to fully realise the opportunities offered by the rapid rise of DER and the associated shift in how electricity is generated, supplied, sold and used requires a change in the management and regulation of the electricity system from both a technical and economic perspective. It also requires new thinking on the changing nature of DER asset ownership, new DM technologies, new entities such as distribution system operators (DSOs) and/or demand management operators (DMOs), and the related changing roles and functions of distribution networks, distribution network service providers, and related stakeholders such as retailers, end users, market institutions, and recently reformed state-owned electricity corporate entities. Australia's ability to harness the significant economic, environmental, and societal rewards can be enhanced in several ways, including –

- Effective and efficient integration of the nationwide rising levels of DER—rooftop PV solar, batteries, controllable devices (air conditioners, heat/water pumps, EVs) and microgrids into existing energy systems
- Cost effective DM technologies, regulatory market mechanisms and related opportunities for energy consumers and networks and
- Localised DSOs with roles and consumer-facing business models that complement the centralised market institution system operator (AEMO) and support and facilitate the orchestration and participation of DER and DM technologies and mechanisms throughout the national electricity market (NEM) and national energy retail market (NERM).

Reconceiving the regulatory framework to place the interests and benefits of Australian energy consumers at its centre lies at the heart of achieving a successful net zero transition to a nationwide clean energy sector in coming years. Ensuring that the opportunities associated with the decarbonisation transition are realised for the benefit of consumers requires a holistic review of the increasing complexification of the policy and legal framework that is regulating this essential services sector. For instance, new thinking is required on how best to overcome the regulatory constraints on market participation and transactional markets for DER, uncertainties surrounding DER ownership, access use and liability, and the persistent absence of transparency on costs and pricing. Ensuring that any future regulatory framework safeguards secure, reliable, resilient and affordable supply is also paramount to achieving positive outcomes from the decarbonisation transition.

A key enabler of decarbonisation pathways to net zero emissions

The Australian energy market's regulatory framework comprises an array of regulations (e.g. legislation, rules, mandatory and voluntary industry codes and standards) and policies within which regulation is developed and implemented across constituent markets: the national electricity market, national gas market, and national energy retail market. The regulatory framework can encourage or hinder the development of DM, DER and DSO, influencing their respective roles as enablers of the Australian energy market's decarbonisation transition and constraining or enhancing the maximisation of consumer benefits and value associated with such changes.

International, national and sub-national experiences demonstrate that regulatory frameworks are key enablers of change. This is evident in the impact of regulation-induced changes that underpin decarbonisation transitions across global, regional and national energy markets. At the same time, regulatory frameworks present considerable obstacles to achieving effective transitional outcomes. This is clearly evident in the tightly controlled regulatory framework of the Australian energy market. But while regulation is vital, given the essential nature of energy services, a failure to more closely consider the broad reach and inherently interconnected nature of the regulatory framework of electricity markets is a serious and considerable challenge to decarbonising the sector. This, in turn, threatens Australia's ability to achieve net zero emissions and transition to a clean, affordable, reliable, resilient and secure renewable energy sector.

The rapid pace of the energy system decentralisation and growth in DER throughout Australia has highlighted the need to address a growing dissonance in the functionality of the current NEM and NERM regulatory framework. Different approaches and active re-engagement of governments and public authorities are evident across Australian states and territories. A key finding of this opportunity assessment is the clear role for a distribution system operator and/or manager with DER orchestration, participation and aggregator roles, functions, and responsibilities, and the need for comprehensive regulatory support to ensure that decentralised energy systems can contribute to decarbonisation and net zero. Despite a DSO definition forming part of the national electricity rules (NER) since their inception in 2003, the existing national regulatory DSO definition is not suited to current and emergent high levels of DER or reflective of the changing nature of DER asset ownership across the energy system. Likewise, key regulatory definitions for energy efficiency, DM, DER and DSOs are not sufficiently provided in the current regulatory framework. In the absence of suitable, harmonised national policies and laws governing the important role and responsibilities of a DSOs and/or DMOs, Australian states and territories are pursuing their own sub-national approaches. While not ideal, from the point of supporting the existing national regulatory framework of the NEM and NERM, these developments can be seen as opportunities—experiences that can inform and guide the creation of a nationally agreed approach to the decentralisation of the energy system for the benefit of all consumers and stakeholders.

Addressing regulatory challenges, such as the misalignment between the aspirational uptake of new and innovative decarbonisation technologies and business models and the prevailing regulatory framework, is also central to the success of a rapid decarbonisation transition. Addressing current failings of the existing regulatory framework (policies, laws, and other instruments) governing the NEM and NERM to ensure it is fit for current and future purposes is fundamental to achieving these outcomes. As a critical enabler, a fit-for-purpose, harmonised national regulatory framework is central to Australia's energy sector decarbonisation and transition to net zero.

This opportunity assessment addresses these issues by exploring new approaches to the management and regulation of the electricity system from both a technical and regulatory perspective. It also presents new thinking on the role and functions of distribution networks, DER asset ownership, value of DER services, customer-facing business models, end-use energy efficiency and DM technologies. Recognising the important enabling role of a harmonised, consumer-focused, fit-for-purpose regulatory framework, a range of projects have been identified to facilitate Australia's decarbonisation transition and the realisation of net zero emissions. Individually and collectively, these opportunities can be used to address Australia's clean energy transition.

Post-final report note: The new objective discussed in this opportunity assessment has not yet passed into law. As such, the wide-reaching ramifications of these legislative changes do not form part of the findings.

2 BACKGROUND

The RACE for 2030 Networks research program is concerned with optimising Australia’s electricity grid through customer distributed energy resources and network integration. This opportunity assessment—*Distribution system operator and beyond: Optimising planning and regulation for demand management & distributed energy resources*—investigates how to maximise the benefits of rising levels of DER and value from existing DM regulatory incentives for electricity consumers (end-users). This includes the role of a distribution system operator. It also addresses a number of fundamental issues impacting the Australian electricity sector’s decarbonisation pathway to net zero and the imperative to ensure beneficial outcomes for all consumers throughout this transformation.

This opportunity assessment explores regulatory and technical aspects of the growth in distributed energy resources throughout Australia, the potential value from demand management regulatory incentives, and the role and functions of a distribution system operator and customer-centred reform opportunities for regulation of DER, DM and related networks services.

This work is separated into **four work packages**:

1. **Distributed energy resources—high DER future energy markets, new services, regulatory reforms, taxation and technical matters**
2. **Demand management—maximising customer value from existing demand management regulatory incentives**
3. **Distribution system operators—distribution system operator’s role and functions to enhance customer outcomes**
4. **Over the horizon—decarbonisation pathways supporting a just transition to net zero**

3 KEY FINDINGS AND DISCUSSION

Work Package 1: DER—high DER future energy markets, new services, regulatory reforms, taxation and technical matters

Work Package 1 focused on the emergence of high levels of DER throughout all jurisdictions of the Australian energy market (AEM). Against the backdrop of the regulatory framework, this discussion highlights regulatory and other reforms needed to support this transformative decarbonisation pathway. We explore a range of governance, legal, technical, and operational issues associated with the nationwide growth in DER, with a particular focus on EVs.

There are significant opportunities for integrating high levels of DER into Australia's energy system. Such opportunities are directly dependent on a fit-for-purpose energy regulatory framework and supportive taxation incentives that facilitate widespread uptake of various sources of DER and related new technologies such as batteries, electric vehicles, smart chargers, etc. To date, there has been no nationally agreed regulatory framework for proactively planning and managing the integration of high levels of DER throughout the AEM. This gap includes –

- An absence of regulatory recognition of the growing levels of end-user investment in, and ownership of, DER assets
- The associated costs and value of the DER services provided and
- A lack of harmonised regulatory pathways to ensure that all energy consumers' protections and benefits are successfully realised in the net zero emissions transition.

Significant effort and collaborative action will be required to understand how continuous transformative pathways for high levels of DER can be supported by technical advancements and regulatory reforms, and ensure consumers benefit through the decarbonisation transition towards net zero. Developing a uniform, fit-for-purpose, consumer-focused regulatory DER framework and related taxation incentives to advance the integration of high levels of DER by 2030 and beyond, will place Australia in a strong position to measure the NEM and NERM's role in mitigating national greenhouse gas emissions and contributions to decarbonisation of the energy sector and the economy overall.

Work Package 2: DM—maximising customer value through existing and prospective demand management regulatory incentives

Work Package 2 recognises that DM is an enabler of emissions reductions. This work package also recognises that facilitating avoided or reduced final energy consumption with customer-focused regulatory design that incentivises end-users to reduce, change or shift how they use electricity can make significant contributions to Australia's successful transformative decarbonisation pathway to net zero emissions. The ongoing enhancement of energy efficiency response incentives for traditional end-users continues to be of enormous importance. Likewise, regulatory DM incentives can also be employed to manage and improve energy efficiencies, especially in electricity networks. This work package explores the advantages of making greater use of demand management/flexibility and related innovative technologies to access sizable untapped potential to improve the energy system's efficiency, security and reliability. Ensuring regulated electricity networks continue to remain both relevant and fit-for-purpose is critical to ensuring these beneficial outcomes are achieved in the global decarbonisation transition.

Work Package 3: DSOs—distribution system operator’s roles and functions to enhance customer outcomes

Work Package 3 focuses on how localised DSO roles can complement the centralised market institution system operator and facilitate the transition to a reliable, affordable clean energy future. This third work package explores the range of potential parties who may take on a DSO role, for instance, existing DNSPs, AEMO, new retail market institutions or new jurisdiction-based entities. There is a clear role for a DSO and/or DSM with DER orchestration, participation, and aggregator roles, functions, and responsibilities. Although a DSO has been part of the national electricity market since inception in 2003, the existing national regulatory definition does not adequately provide for the current and emergent high DER market paradigm. Resolving ongoing deliberations concerning a suitable regulatory DSO description and role and the design of DSO functions and associated regulatory constructs are critical aspects of the uniform, fit-for-purpose, consumer-focused regulatory DER framework identified in Work Package 1. Significant effort will also be required to understand and develop suitable consumer-facing business models that balance the range of competing needs and outcomes throughout the transition to net zero.

Work Package 4: Over the horizon—decarbonisation pathways supporting the transition to net zero

Ensuring that the rapid evolution of DER and distributed energy markets meets all energy customers’ needs is critical to the success in transitioning to a secure, affordable clean energy future. Drawing on Work Packages 1, 2, and 3, Work Package 4 focuses on understanding how transformative change pathways through regulatory reform and technical innovation can enable a clean energy transition that ensures full integration of consumer-owned resources within the energy system, and places all end users at the centre of the DER-driven energy transformation currently underway in the NEM. Due to the scale of the changes required to achieve decarbonisation in the energy sector and the extent of the disruption involved, Australia must accelerate and strengthen its energy innovation pathways. This work package explores how changes to the existing regulatory frameworks paradigm can be directed towards ensuring future beneficial customer-focused outcomes. This includes enhancing collaborations within and across jurisdictions, leveraging evidence-based public policy, strategic capacity-building, best practice participatory and engagement pathways, as well as diverse investments into innovative consumer-facing retail business models, network service models, asset and ownership diversity across the entire supply chain and fair distribution of benefits.

3.1 Further findings and discussion

These investigations are set against the backdrop of the existing regulatory framework of the NEM. International, national, and sub-national experiences demonstrate that regulatory frameworks (e.g. policies, law, and rules) are key enablers of transformative change. This is evident in the impact of regulation-induced changes underpinning decarbonisation transitions across global, regional and national energy markets. At the same time, regulatory frameworks present considerable obstacles to achieving effective transitional outcomes. This is particularly so in the heavily regulated Australian energy market. Key findings on regulatory barriers and opportunities are set out here.

3.2 Regulatory barriers: A regulatory framework no longer fit-for-purpose

It is becoming increasingly apparent that the existing energy regulatory framework is no longer fit-for-purpose with respect to the decarbonisation net zero transition and emergent high DER energy future. The accelerating uptake of DER and new DER and DM technologies is collectively challenging existing

energy market paradigms, pressing the AEM towards a regulatory precipice that cannot be comprehensively addressed by *ad hoc* delegated legislative responses such as discrete rule changes. Several principal regulatory barriers are identified and discussed subsequently in this opportunity assessment:

- An absence of regulatory definitions, roles and responsibilities relating to DER and DSO/DMO
- A lack of energy efficiency and DM regulatory definitions
- The growing pace of regulatory change, driving complexification and
- Growing jurisdictional regulatory divergences and impact on national regulatory cohesion.

3.3 An opportunity for transformative, comprehensive regulatory reforms

This opportunity assessment's clear message is that, while the current regulatory framework is a significant barrier, it can also be amended to become a critical enabler of Australia's decarbonisation transition and the realisation of net zero emissions. Consequently, the current uncertainties, risks and challenges resulting from the combined impacts of decentralisation of the energy system and markets, accelerating DER uptake, new DER and DM technologies, introduction of a DSO and/or DMO, and decarbonisation imperatives present a once-in-a-generation opportunity for pursuing coordinated and enduring regulatory reforms across the NEM and the NERM.

Unlocking the value of such benefits for consumers, whilst also ensuring that the power system remains safe, secure and reliable, is critical to ensuring that the much-needed regulatory reforms are fit-for-purpose to bring about a consumer-focused, decentralised, decarbonised high DER future. Securing such outcomes requires further collaborative thinking on how best to reform the existing regulatory framework to avoid or minimise regulatory fragmentation across the nine jurisdictions of the AEM and to ensure that challenges are managed and transformed into opportunities and benefits.

4 METHODOLOGY

This opportunity assessment provides a holistic overview of transformative pathways to high DER efficient energy markets as part of the transition to net zero. Under each work package, researchers conducted rolling desktop reviews of the relevant literature as well as stakeholder consultations. Given the highly changeable nature of the regulatory framework, ongoing literature review and analysis was undertaken as part of the N4 OA team's drafting of the final report and roadmap. Within the background context and specific thematic focus on how such changes can benefit consumers, this necessarily included consideration of the existing governance, regulatory, compliance, and operational/planning roles, as well as the powers, functions, and obligations of market institutions and registered market participants in achieving the primary legislative objectives of the NEM and the NERM. Data collected through these reviews and stakeholder engagements were analysed and synthesised and incorporated into this report. The desktop reviews canvassed primary source regulatory materials such as policies, laws, rules, etc. as well as secondary source material from the relevant state, federal, and national electricity industry governance institutions, and the relevant academic literature and related grey literature.

Greater understanding of the practical influences of the existing and emergent regulatory framework applicable to DER, DM and DSOs, and the relationship between apposite regulatory constraints and enablers within a real-world context, was garnered through large group meetings and surveys with project and industry reference group (IRG) partners and small group consultations with other stakeholders. The latter comprised formal and informal consultations with parties from this opportunity assessments' project partners and key stakeholders, including consumer bodies and market institutions. A key objective of discussions at IRG meetings and small group consultations, was to identify issues to be included in the current research in order to develop project proposals that will garner strong industry, government and consumer support. Suggestions were distilled into a set of key additional issues that were incorporated into this project's research and report.

Throughout the project, meetings were also held with RACE representatives whose feedback was incorporated into the research activities of the opportunity assessment research team, the final report and research roadmap. The feedback set out in this report has been anonymised.

5 SUMMARY OF FINDINGS

This opportunity assessment outlines a range of opportunities for Australia to address the clean-energy transition through decentralisation of the energy system, integration of high levels of DER, cost-effective DM, the role for a DSO, and the regulatory reforms essential to enabling successful outcomes for all energy consumers and stakeholders and the wider economy.

Work Package 1: DER—high DER future energy markets, new services, regulatory reforms, taxation and technical matters

This work package identified the following opportunities –

- Further thinking on developing regulatory frameworks to facilitate DER participation and recognising the value of end-user provision of DER services
- More research on avoiding risks to power systems by developing nationally harmonised and planned regulatory reforms that aim to facilitate the integration of EVs and recognise the significant value and benefits to networks derived from large, mobile storage services (e.g. fleet EVs)
- Mapping out changes required in the regulatory framework to integrate grid, land-use and transport planning to accommodate the electrification of Australia’s transport sector and its growing integration with the NEM (e.g. individual and fleet EVs, public and industry transport)
- Investigating the regulatory drivers for a fast uptake of EVs from the perspective of EV owners, networks and retailers, and assessing regulatory arrangements to balance competing interest for a zero-carbon outcome
- Identifying pathways for ensuring consumer protections in a high DER future (e.g. consumer data and information protection regulations)
- Investigating the DER implications for selected residential and business activities across urban and regional settings such as caravan parks, residential developments, industrial parks, regional towns and local communities, and the range of DER and other energy system assets’ ownership in various jurisdictional locales
- Further research into the opportunities for creating a new DER market and market institution—Australian DER Market—with a harmonised, flexible regulatory framework that operates at sub-national and regional levels
- Additional research exploring cost-effective distribution network storage opportunities and tariff structure reforms to facilitate efficiency outcomes
- Regulatory amendment proposals that recognise the different types of end-users (passive/active) in the NERM, and regulatory recognition of the value provided through DER services by established and new DER asset owners in the NERM and to the NEM
- Developing methodology for monitoring and evaluating ongoing integration of new DER technologies and ownership and use of DER assets and
- Distributed energy resources definition needed that details the growing range of DERs and DER asset ownership.

Work Package 2: DM—maximising customer value through existing and prospective demand management regulatory incentives

- Further research into to the role of existing DM mechanisms in a high DER future—in particular the impacts on EV uptake trends—and regulatory reforms to enhance long term benefits across the retail-distribution-consumer interface

- Exploration of the role of technology (hard/soft/service) in transparently facilitating and maximising user-focused DM (considering access and control)
- Develop detailed energy efficiency and demand management definitions
- Investigate the DM implications for selected residential and business activities and networks across urban and regional settings and
- Establish methodology to monitor and evaluate the ongoing integration of new DM technologies and their contribution to the energy sector's decarbonisation transition to net zero.

Work Package 3: DSOs— distribution system operator's roles and functions to enhance customer outcomes

- Conduct a detailed investigation and analysis of the regulatory content and scope for the role and functions of localised DSOs and/or DMOS in a high DER future
- Investigate regulatory reforms and frameworks to consider legislative roles and functions for spot markets
- Develop KPI pathways for DSOs to help maximise consumers' benefits/values, including consumer, environmental, and financial outcomes, with further integration of DER
- Investigate additional methods for improving coordination and facilitating a fully harmonised approach across the different NEM jurisdictions for determining the regulatory role and functions of DSOs and/or DMOs in a high DER future
- Bring further thinking to the preferred responsible entity to assume the role and functions of a DSO/DMO (e.g. expanding the regulatory role of AEMO, similar to WA DER) or existing DNSPs in other jurisdictions
- Amendments to the existing regulatory DSO definition are needed to reflect new DER orchestration and participation roles and responsibilities
- Develop new regulatory definitions for DMO and DER aggregators, including roles and responsibilities, and
- Explore the mutually reinforcing relationship between DSO and DM, using air-conditioning as case study.

Work Package 4: Over the horizon—decarbonisation pathways supporting the transition to net zero

- Further thinking on the nature and scope of beneficial regulatory changes required to build trust with consumers, ensure fair outcomes across different consumers (intra-end-users' equity), and enable greater uptake of automated demand response
- Regulatory reforms supporting fit-for-purpose distribution network planning
- Foresight future policy and regulatory changes to support ongoing integration of new DER, DM and DSO-related technologies and consumer-facing business models and network services including:
 - Developing DER, DM and DSO literacy pathways
 - Capacity building and knowledge sharing through the development and provision of industry and consumer education engagement programs in documented/online formats
 - Analysis of risks and financing characteristics of a future network utility
 - Drafting exemplar regulatory amendments that expressly recognise end-users' growing investment and ownership of DER assets and the value of end-users' flexible demand services to ensure value benefits flow to these DER market participants, and
 - Redesign and/or amend standard end-user contracts

5.1 Regulatory reform and impact across projects and RACE themes

A key finding of this opportunity assessment is the recommendation that RACE for 2030 engages with the holistic reform of the regulatory framework of electricity markets. Addressing regulatory challenges, such as a misfit of new and innovative technologies and business models with the regulatory framework, is central to the success of a rapid transition. Opportunities for focused regulatory reforms are included in the work package summaries (above) and the projects set out in the research roadmap (section 6). Moreover, a focus on regulatory reform is a key outcome across the research themes in the RACE for 2030 CRC and has been a major focus in a number of Commonwealth milestones. This N4 Opportunity Assessment provides key insights and impacts into regulatory reforms relating to other opportunity assessments (e.g. *N1: Electric vehicles and the grid*, Final Report, Nov 2021; *N2: Low voltage network visibility and optimising DER hosting capacity*, Final Report, Dec 2021; *N3: Local DER network solutions*, July 2023; and related projects from the RACE for Networks theme (e.g. *Curtailment and network voltage analysis study (CANVAS)* (Final Report 2021), *Low voltage network visibility and optimising DER hosting capacity* (Final Report, Nov 2021), and *Distributed energy business models: Comparing distributed energy business models within current and evolving institutional structures to identify key opportunities and leverage points for a clean, affordable and reliable electricity grid* (in progress). Further examples are set out in Figure 1.

5.2 Stakeholder feedback on findings and future research projects

Feedback on this opportunity assessment's findings and its research roadmap from the industry reference group, project partners, and other key stakeholders comprised strong support for and interest in several proposed future funded projects. The most positive responses were provided for the following research projects to be conducted within the next 2-5 years:

- Mapping out changes required in the regulatory framework to integrate grid and transport planning to accommodate electrification
- Investigating consumer-centric energy markets and consumer-focused DSO business models that support continual integration of DER and DM technologies, promote agile planning, ensure transparency and accountability, recognise and support CERs, flexible demand, and the transition to fully integrated high DER markets
- Establishing regulatory reforms (drafting, introducing, and enacting) that recognise and support an adopted DSO model, legislative provisions for DSO role/functions, agile planning, transparency and accountability measures
- Undertaking a comprehensive, comparative DER regulatory review across Australia (federal/states/territories), including regulatory reform mapping for behind the meter DER to ensure value and benefits for consumers
- Identifying opportunities for regulatory reform and redesign for a consumer-centric energy market that articulates how benefits of user-driven (passive/active) DER and DM can be understood, recognised and valued in order to increase uptake with aligned interests and consumer protections
- A review of DUoS/TUoS fees based on grid usage to encourage localised energy flows and to decouple DER utilisation from transmission network costs and
- Exploring beneficial regulatory changes required to build trust with consumers, ensure fair outcomes across different consumers, and enable greater uptake of automated demand response.

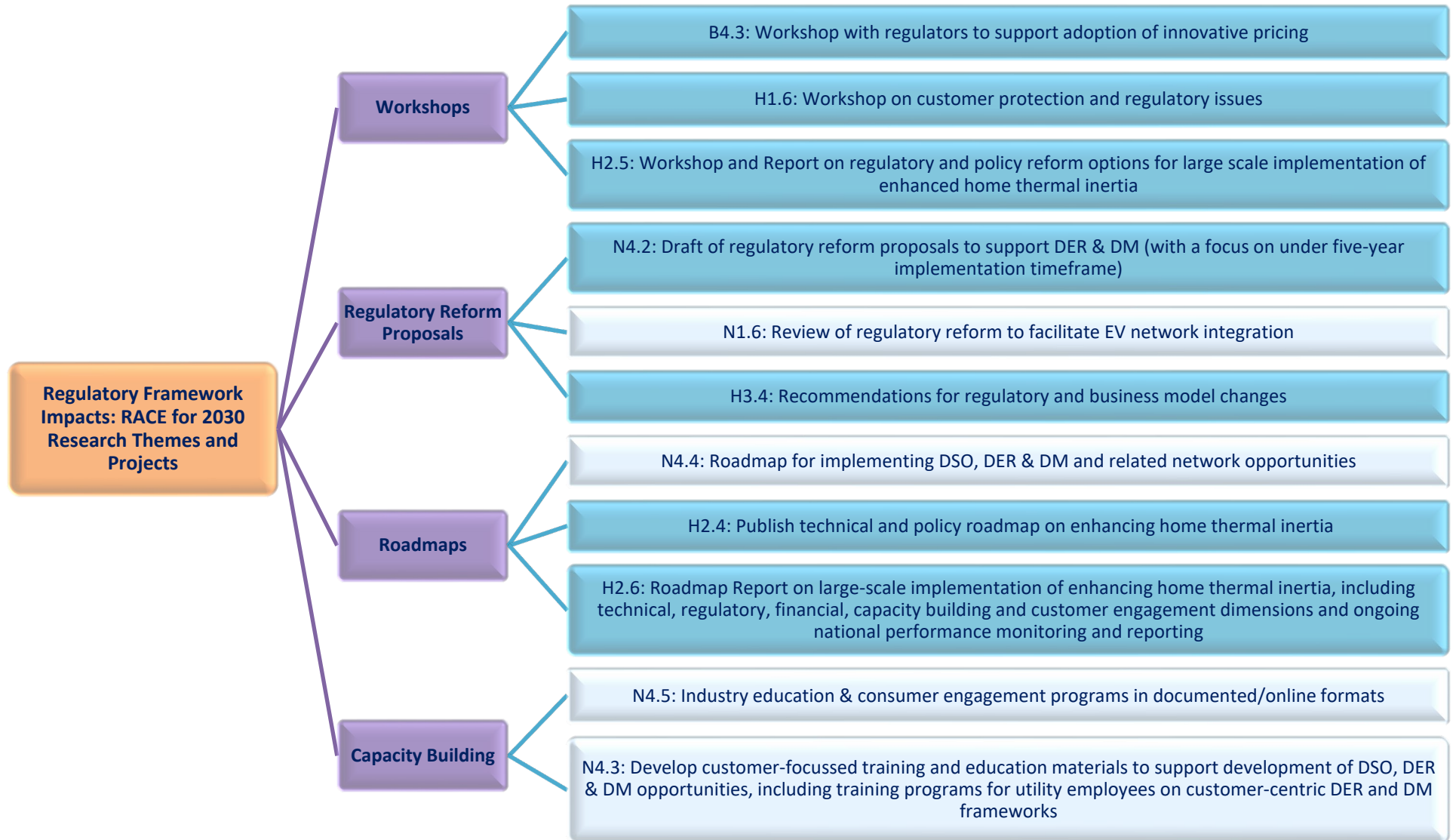
An important long-term project that received support entails investigating the role of DM mechanisms, such as the DMIS, in supporting DER integration and provision of DER services (e.g. EVs) in future energy markets.

5.3 Impact statement

Expected impacts of the research findings and future projects identified in this opportunity assessment include lower energy bills and higher reliability for energy users, accelerated adoption of network DM and DER solutions, and new business opportunities for energy users, start-ups, DER providers and network businesses. The findings of this opportunity assessment inform future research projects and improve the application of existing and planned regulatory reforms and facilitate future beneficial regulatory reforms across the NEM and NERM. By providing practical models for optimising DSO planning, deployment and dispatch, this project could facilitate rapid growth in cost-effective DM and DER, with significant benefits in costs savings, reliability, and emission reduction. The success of projects associated with this opportunity assessment can be assessed through various performance metrics, including –

- The reduction of consumers' electricity bills
- The reduction of electricity demand during peak hours
- Generation cost minimisation
- Demand curve flattening
- Consumer privacy
- Priority of consumer preferences and satisfaction and
- CO₂ emission reduction, and social welfare maximisation.

Figure 1. Regulatory reform impacts across RACE to 2030



6 RESEARCH ROADMAP

WORK PACKAGE 1: DER		
Recommended Research Projects	Potential Project Partners	Completion Dates
1. Comparative mapping of existing and emergent DER regulatory approaches across Australia		
<p>Undertake comparative mapping and review that includes –</p> <p>a. Identifying and defining range of existing and emergent DER asset owners, including residential and business consumers, communities, industry, the states/territories across Australian Energy Market</p> <p>b. Exploration of the ramifications of growing jurisdictional differences emerging throughout NEM</p> <p>c. Compiling a set of key lessons from a. and b. for future policy and regulatory reforms that support Australia’s decarbonisation transition to net zero</p> <p>d. Developing methods and pathways for monitoring and evaluating the impacts of regulatory changes and contributions to the energy sector decarbonisation transition and achievement of net zero</p> <p>e. Data collection through application of established methodology</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Market institutions, esp. AEMO • DNSPs • Consumer bodies • Federal/state/territory governments • Jurisdictional regulators • Energy Retailers, in particular those with aggregator roles or VPPs • DER businesses • Consumer bodies 	<p>June 2024 [a]</p> <p>Dec 2024 [b]</p> <p>June 2025 [c & d]</p> <p><i>Ongoing thereafter [e]</i></p>
2. Regulatory drivers for fast uptake of EVs		
<p>a. Investigating the regulatory drivers for a fast uptake of EVs from the perspective of EV owners, networks and retailers</p> <p>b. Assessing regulatory arrangements to balance competing interest for a zero-carbon outcome</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • EV industry • Market institutions • DNSPs • Retailers • Federal/state/territory governments • Consumer bodies 	<p>Dec 2023</p>
3. Scoping report: Comparative DER experiences		
<p>Case study scoping report—Investigating the DER implications for selected residential and business activities –</p> <p>a. Across urban and regional settings (e.g. caravan parks, residential developments, industrial parks, regional towns, local communities)</p> <p>b. Across the range of DER and other energy system assets’ ownership in the relevant locales</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Businesses grappling with impacts • Providers of innovative energy solutions • State/territory and local governments • Consumer bodies 	<p>Dec 2026</p>
4. Scoping report: Facilitating the transition to a specific DER market		
<p>Scoping report investigating –</p> <p>a. Development and introduction of a new separate market for DER</p> <p>b. Necessary regulatory requirements and frameworks supporting such a new market</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Market institutions, esp. AEMO • DNSPs 	<p>June 2026 [a-g]</p> <p><i>Ongoing thereafter [h]</i></p>

<p>c. The role of a potential new DER market institutional DSO</p> <p>d. Implications of different DER and energy system asset ownership across NEM jurisdictions</p> <p>e. Development of DER market specific consumer-facing retail business models and network</p> <p>f. Drafting proposals for regulatory amendments for the NEM and NERM to fully support transition to a consumer-focused DER market</p> <p>g. Developing methodology for monitoring and evaluating ongoing integration of new DER technologies and ownership and use of DER assets</p> <p>h. Data collection through application of established methodology</p>	<ul style="list-style-type: none"> • Consumer bodies • State/territory governments • Retailers, in particular those with aggregator roles or VPPs • DER businesses 	
<p>5. Electrification of the transport sector and DERs</p>		
<p>Mapping out changes required in the regulatory framework to integrate grid, land-use and transport planning to accommodate electrification of Australia's transport sector and its growing integration with the NEM, for example, individual and fleet EVs, public and industry transport</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Jurisdictional transmission planners (where they exist) • AEMO • DNSP • State/territory government transport departments • Transport peak bodies 	<p>June 2024</p>
<p>6. Review of DUoS/TUoS charges</p>		
<p>Review of DUoS/TUoS charges based on grid usage to encourage localised energy flows and to decouple DER utilisation from transmission network costs</p>	<ul style="list-style-type: none"> • Monash, UTS • AER • DNSP/TNSP • Other market institutions 	<p>June 2024</p>
<p>WORK PACKAGE 2: DM</p>		
<p>Recommended Research Projects</p>	<p>Potential Project Partners</p>	<p>Completion Dates</p>
<p>1. Promoting the relationship between DER and DM</p>		
<p>Assessing the application of DMIS in the context of current understandings of DER, with particular focus on –</p> <p>a. Impact on EV uptake trends</p> <p>b. Benefits to consumers from a minimal set of adjustments to DMIS and other incentive schemes (EBSS, CESS) that provide short-term improvement to consumer costs</p>	<ul style="list-style-type: none"> • Monash, UTS • AER • DNSPs • State/territory governments • EV industry 	<p>June 2024</p>
<p>2. Scoping reports: Comparative DM experiences</p>		
<p>Case study scoping reports on the DM implications for selected residential and business activities and networks across urban and regional settings (e.g. retirement and other large residential developments, industrial parks, local governments, regional towns and communities)</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • DNSPs • AEMO, AEMC, AER • State/territory & local governments • Energy retailers • Technology businesses 	<p>Dec 2026</p>

	<ul style="list-style-type: none"> Consumer bodies 	
3. Developing DM monitoring and evaluation methodology for future clean energy markets		
<p>a. Establishing methodology for monitoring and evaluating ongoing integration of new DM technologies and their contribution to the energy sector's decarbonisation transition to net zero</p> <p>b. Data collection through established methodology</p>	<ul style="list-style-type: none"> Monash, UTS DNSPs AEMO, AEMC, AER State/territory governments DM technology businesses 	<p>June 2024</p> <p><i>Ongoing thereafter</i></p>
4. Energy efficiency and demand management definitions		
<p>Provide greater regulatory and market certainty by –</p> <p>a. Determining an agreed, uniform regulatory definition for energy efficiency measures and mechanisms for end-users, market participants and networks</p> <p>b. Drafting proposals of regulatory energy efficiency definitions</p>	<ul style="list-style-type: none"> Curtin, Monash, RMIT, UTS AEMC, AER, jurisdictional regulators State/territory governments Market participants Networks DM technology business Consumer bodies 	<p>Dec 2023 [a]</p> <p>June 2024 [b]</p>
5. The future role for DM and energy efficiency market mechanisms		
<p>Exploring the role and application of existing and emergent efficiency technologies and mechanisms in transparently facilitating and maximising user-focused DM, and lowering emissions and costs, including –</p> <p>a. Exploring future opportunities for DMIS and new market mechanisms to support DER integration and provision of DER services (e.g. EVs)</p> <p>b. Identifying challenges and range of regulatory reforms to promote increased uptake of DM by networks</p>	<ul style="list-style-type: none"> Monash, UTS DNSPs AEMO, AEMC, AER State/territory governments DM technology businesses Consumers bodies 	<p>June 2024</p>
6. Tariff alignment and DM		
<p>Tariff-focused research into –</p> <p>a. Alignment of retail energy tariffs and demand tariffs to reflect costs from wholesale and network costs drivers (DUoS, TUoS) in DM context, for example, DMIS, efficiency benefit sharing scheme (EBSS) and capital expenditure sharing scheme (CESS)</p> <p>b. The benefits of harmonising tariffs and efficiency benefits across retail, network and incentive schemes</p> <p>c. Assessing regulatory solutions for resolving inefficiency of capacity charges for large clients</p>	<ul style="list-style-type: none"> Monash, UTS AER, AEMC DNSPs State/territory governments Consumer bodies Retailers 	<p>June 2024</p>
WORK PACKAGE 3: DSO		
Recommended Research Projects	Potential Project Partners	Completion Dates

1. Scoping Report: Consumer-facing DSO business models in high DER markets		
<p>Undertake review and gap analysis that –</p> <p>a. Identifies further existing and emerging different DER asset owners and the implications for consumer-facing DSO business models and network services, with a view to identifying best industry practice model for adoption in the AEM (e.g. market institution, state-owned or other DSO that accommodates ongoing integration of new DER and DM technologies, promotes agile planning, ensures transparency, accountability, and consumer benefits and protections)</p> <p>b. Identifies opportunities for regulatory reforms that reflect best practice consumer-facing DSO business model/s, including legislative provisions that articulate the nature and scope of future DSOs’ role and functions, agile planning, transparency, accountability, and consumer benefits and protections as well as identifying high leverage sandbox options to demonstrate DM and DER</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT and UTS • DNSPs • AEMO, AEMC, AER • Jurisdictional regulators • State and local governments • Energy retailers • Technology businesses • Consumer bodies 	Dec 2024
2. Distribution system operator regulatory definition		
<p>Provide regulatory and market certainty by –</p> <p>a. Determining an agreed, uniform DSO definition</p> <p>b. Identifying the nature and scope of necessary regulatory amendments required to give effect to new DSO entities (e.g. a new market institution or other)</p> <p>c. Drafting proposals on DSO definition, regulatory role and functions</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT and UTS • DNSPs • AEMO • AEMC • Jurisdictional regulators • State/territory governments 	<p>June 2024 [a]</p> <p>June 2025 [b]</p>
3. Model KPIs for DSO		
<p>a. Develop KPI pathways for DSOs to help maximise consumers’ benefits/values, including consumer, environmental, financial outcomes, with further integration of DERs</p> <p>b. Draft proposals for regulatory reforms mandating adoption and fulfilment of DSO KPIs as part of best practice DSO business models</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT and UTS • DNSPs • AEMO, AEMC, AER • Jurisdictional regulators • State/territory governments 	Dec 2024
4. Scoping Report: Comparative DSO experiences		
<p>Case study scoping reports: Investigating the ramifications of different consumer-facing DSO business models and network services for selected residential and business activities across urban and regional settings (e.g. caravan parks, residential developments, industrial parks, regional towns, local communities), and across the range of DER and other asset ownership across the energy system in the relevant locales</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • DNSPs • AEMO, AEMC, AER • Jurisdictional regulators • Industry/businesses • State/territory and local governments • Consumer bodies 	Dec 2026
5. The Role of a DSO in supporting DM (with air-conditioning case study)		
<p>Exploration of the mutually reinforcing relationship between DSO and DM –</p> <p>a. Identifying the benefit/s of a DSO in supporting DM</p> <p>b. Case study focusing on the benefit/s of a DSO in enabling air conditioning DM (incorporates comparative analysis of standalone DM incentives for air conditioning load reduction)</p>	<ul style="list-style-type: none"> • Monash • DNSPs • AEMO, AEMC, AER • Air conditioning industry • State/territory governments 	June 2025
6. Evaluating a DSO’s role in DER uptake and benefits to consumers		

<p>a. Determining how a DSO will make the uptake of DER more beneficial to consumers than a non-DSO based approach</p> <p>b. Analysis of whether and how this will be cheaper to the consumer</p>	<ul style="list-style-type: none"> • Monash, UTS • AEMO, AER • DNSPs • State/territory governments • Consumer bodies 	<p>June 2025</p>
<p>WORK PACKAGE 4: Over the horizon</p>		
<p>Recommended Research Projects</p>	<p>Potential Project Partners</p>	<p>Completion Dates</p>
<p>1. Regulating for energy consumers: Current and long-term interests</p>		
<p>Investigating integration and impacts of high DER, cost-effective DM, and localised DSOs in the achievement of energy consumers' current and long-term interests, including –</p> <p>a. Identifying regulatory and institutional reforms focusing on harnessing DM and DER through DSO to minimise costs while sustaining urban grids and islanding rural grids, end-users' flexible demand, tariffs, agile planning</p> <p>b. Evaluating impacts of regulatory and institutional reforms focusing on selected DM mechanisms and DERs - EVs, RT solar, batteries residential, business, neighbourhood, urban, edge of grid through DSO technologies and models</p> <p>c. Monitoring, review/evaluating regulatory changes</p> <p>d. Ongoing integration of new technologies and business models</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • AEMC, AER, AEMO • Federal/state/territory governments • DNSPs • Providers of innovative energy solutions, e.g. retailers, VPPs, aggregators, microgrids, community batteries • Relevant state government departments (e.g. partners for VIC Government Neighbourhood Battery Initiative) 	<p>Dec 2026</p>
<p>2. Stocktake of international frameworks for local application</p>		
<p>a. Comparative review of innovative regulatory frameworks from the UK, EU, USA and other jurisdictions</p> <p>b. Develop research frameworks that translates these experiences into the Australian context</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • AER, AEMC, AEMO • Federal/state/territory governments • Jurisdictional regulators • State governments 	<p>Dec 2027</p>
<p>3. Regulatory reforms supporting fit-for-purpose distribution network planning</p>		
<p>Conduct exploratory investigation into –</p> <p>a. Methods and pathways for supporting the planning process to be agile in the face of rapidly changing technology and market conditions</p> <p>b. Regulatory reforms and frameworks to consider legislative roles and functions for DER spot markets</p> <p>c. Draft proposals for amendments to the NEL and NERL and NGL to recognise and facilitate agile planning processes that take account of jurisdictional differences</p> <p>d. Pathways for monitoring and evaluating the impacts of regulatory changes, with a view to informing on contributions to net zero, and future policy and legislative amendments as required</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • DNSPs • AEMO, AEMC, AER • Jurisdictional network planners • Energy Retailers • Federal/state/territory governments 	<p>June 2024</p> <p><i>Ongoing thereafter</i></p>
<p>4. Scoping report for consumers: trust and automated demand response</p>		
<p>a. Explore beneficial regulatory changes required to build trust with consumers, ensure fair outcomes across different consumers, and enable greater uptake of automated demand response</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Consumer bodies 	<p>June 2024</p>

<p>b. Evaluate impacts of regulatory and institutional reforms relating to automated demand response and consumer trust</p> <p>c. Monitor, review/evaluating regulatory changes</p>	<ul style="list-style-type: none"> • Providers of automated demand response solutions, e.g. retailers, aggregators, VPP providers and similar • Federal/state/territory governments • AEMC 	<p><i>Ongoing thereafter</i></p>
<p>5. Transitioning to a consumer-focused best fit DER, DM and DSO regulatory framework</p>		
<p>Comprehensive Regulatory Reform Review: SWOT and gap analysis comprising</p> <p>a. In depth regulatory mapping across all participatory jurisdictions that identifies the growing fragmentation emerging throughout the national regulatory framework, and re-engagement and active role of the State in the energy sector, with specific focus on the retail-distribution interface with all consumers (passive/active)</p> <p>b. Drafting proposals for amendments to the NEL, NERL, NGL and related legal instruments to recognise the changing nature of end-users, including, definition of DERs, new market participant, DER asset owners, ownership and role and responsibilities of DER asset owners</p> <p>c. New definition that sets out different end-users, for example, traditional consumers v. prosumer v. fully active, DER asset-owner market participants</p> <p>d. Monitoring, review/evaluating regulatory changes</p> <p>e. Ongoing integration of new DER, DM, DSO technologies</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Federal/state/territory governments • Market institutions • Jurisdictional regulators • DNSPs • Retailers • Consumer bodies 	<p>June 2024 [a]</p> <p>June 2025 [b-d]</p> <p><i>Ongoing thereafter</i></p>
<p>6. Harnessing DER and DM value behind the meter. Regulatory reforms and consumer-facing business models</p>		
<p>Recognise consumers investment costs in distributed energy and energy efficiency resources via a focus on –</p> <p>a. Potential regulatory amendments that expressly recognise end-users growing investment and ownership of DER assets and the value of end users’ flexible demand services to ensure value benefits flow to these DER market participants</p> <p>b. Redesign and/or amendment of standard end user contracts</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Federal/state/territory governments • Market institutions • Jurisdictional regulators • DNSPs • Retailers • Consumer bodies • Providers of innovative energy solutions 	<p>June 2024 [a]</p> <p>Dec 2024 [b]</p>
<p>7. Future policy and regulatory changes and knowledge sharing</p>		
<p>Future policy and regulatory changes to support ongoing integration of new DER, DM and DSO related technologies and consumer-facing business models and network services including –</p> <p>a. Collate and analyse data from monitoring regulatory changes identified through this Theme’s various future projects</p> <p>b. Identify successes and barriers based on data obtained from a. above</p> <p>c. Identify opportunities for ongoing reforms through stakeholder engagement and consultations</p> <p>d. Draft recommendations for future regulatory transformations in support of the energy sector transition to net zero emissions</p> <p>e. Development and provision of industry and consumer education engagement programs in documented/online formats</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Federal/state/territory governments • Market institutions • Jurisdictional regulators • DNSPs • Consumer bodies • Retailers and other consumer-facing businesses in NERM 	<p>June 2028</p>

8. Develop DER, DM, and DSO literacy pathways		
<p>a. Identify pathways to improving energy literacy of all end-users residential and business consumers and other stakeholders</p> <p>b. Capacity building and knowledge sharing through the development and provision of industry and consumer education engagement programs in documented/online formats</p>	<ul style="list-style-type: none"> • Curtin, Monash, RMIT, UTS • Federal/state/territory governments • AEMC • Consumer bodies • DNSPs • Retailers and other consumer-facing businesses in NERM 	<p>June 2025</p> <p><i>Ongoing thereafter</i></p>
9. Future network utility: financial and risk analysis		
<p>Analysis of risks and financing characteristics of a future network utility with all new technologies accounted for and new consumer expectations accounted for (e.g. includes investor appetite analysis)</p>	<ul style="list-style-type: none"> • Monash, RMIT • Federal/state/territory governments • AEMC, AER • Consumer bodies • DNSPs, retailers and other consumer-facing businesses in NERM 	<p>Dec 2026</p>

RACE for 2030



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