Business models and the energy transition

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Business models and the energy transition

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What is RACE for 2030?

RACE for 2030 CRC is a 10-year co-operative research program with AUD350 million of resources to fund research towards a reliable, affordable, and clean energy future.
https://www.racefor2030.com.au

Project Partners

Curtin University · DevelopmentWA · Government of Western Australia Energy Policy WA · Griffith University Queensland, Australia · REDGRID · RMIT University · Planet Ark Power · Starling Energy Group · westernpower

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Executive summary

The Australian and global electricity system is undergoing a massive transition towards a clean and more decentralised model. For technological, economic and policy reasons, this shift is happening fast. The national policy agenda on greenhouse gas reductions of 45% by 2030 and 'net zero' carbon by 2050 is going to drive this transaction even more quickly. In this context, there is a need to guide the transition processes so that investments in the public and private spheres can be optimised.

This report documents an exploration of business models in the electricity system as a way to identify opportunities to accelerate this transition. Simply put, a business model is about how the money is made and the stories and processes that explain how an enterprise works. The core question posed by the industry partners involved in this project was *What business models are emerging for all system participants in high distributed energy resources* (*DER*) *world*?

The research process used to explore this question involved obtaining industry insights from three industry reference group (IRG) workshops and interviewing selected stakeholders to draw out their professional and organisational insights on the state of the energy transitions. The industry participants where 'elite informants' with elevated levels of knowledge of the energy sector. We undertook a review of relevant literature and the policy environment and an analysis of recently published energy market and financial data to identify the shift in value pools as increased electrification and increased DER penetration occurs.

Participants in this process had diverse perspectives and no one view emerged on how the transition will unfold. However, there is strong recognition that increasing DER penetration provides significant opportunities for customers and investors (both public and private). Although the transition is unfolding fast in both in technical and institutional responses, as with all socio-technical systems, inertia and embedded practice are constraining the transition.

Overcoming embedded business practices can be achieved by supporting 'communities of practice' to foster champions and create enabling environments that support the clean energy transition. This will require leaders experienced in dynamic systems change that can test new ways of doing business in a 'safe–fail' rather than 'fail–safe' mind set through processes of co-design and co-creation.

Analysis of current and potential 'value pools' in the Western Australian integrated systems highlighted potential for lower energy costs and a need for increased investment in distribution over transmission to support a low emission energy system. This was based on a number of assumed scenarios of electrification penetration DER in 2030. This assessment strengthens the argument for increased attention to the creation and definition of distribution system operators (DSOs) and distribution market operators (DMOs) as important role changes for existing incumbents.

The highest value models during a DER transition which needed the most support and further testing were identified as:

- Energy as a service
- System stability, reliability, and security (ancillary services)
- Matching supply and demand
- Aggregator services (includes VPPs)
- Microgrid managers/providers

Ancillary services were seen as important to maintain system stability during the transition to DER and need to be appropriately valued. Further, a marketplace of aggregators needs to be created to help enhance the overall performance of high levels of DER, a model closely linked to VPPs and microgrid management and provision.

The following actions were suggested by stakeholders:

- Targeting large energy users
- Testing opportunities for aggregators
- Developing processes to shift organisational culture and
- Exploring the whole value
- Private funding
- Focusing on customers (positive outcome).

The research indicated that the policy and regulatory environment needs to move away from prescriptive elements within the existing energy systems towards an outcome or performance-based approach with a 'light touch'. Success metrics have been provided to help guide policy and regulatory frameworks and decision-making.

Using the lens of business models has highlighted the dynamic nature of the energy transition that is already underway. For the opportunities to be realised and a low emissions network to be established, significant changes to energy markets and network infrastructure are required. This must be supported by policy and regulatory reforms to urgently support emerging business models that will support the transition and provide reliable, affordable, clean energy for Australians.

Contents

1 Introduction—the Australian energy industry challenge

Australia's and the world's energy sectors are in the midst of a fundamental transition towards clean and decentralised electricity. Greenhouse gas emissions reduction targets and advances in technology are creating new distributed energy resources (DERs) that are straining centralised energy models. The recently announced climate bill by the Australian Government will enshrine into law two national greenhouse gas emissions targets: A 43% cut below 2005 levels by 2030, and a reduction to 'net zero' by 2050. This policy position will accelerate the uptake of DER systems, which play a significant part in achieving these targets.

The move away from centralised energy models is creating new business models, business types, regulatory controls, finance models, and the need for new skills and training. Previous revenue models based on direct sales to customers are likely to make way for an array of new models, which will require a comprehensive review and reform of the energy regulatory ecosystem. As of yet, it is not entirely clear what rules are needed, who should decide on them, and who should set and enforce them. The continued innovation of energy technologies is presenting new revenue opportunities that are both a disruption to the status quo and a major opportunity for early movers. For the existing incumbents, it presents both challenges and opportunities.

This report sets out to answer the question *"What are the business models and industry conditions for market participants in a high distributed energy resources (DER) penetration energy system?"* It identifies opportunities for different types of business models for all system participants as the transition in the energy sector unfolds. It sets out business models[1] that are emerging in the DER space and opportunities arising for the existing system participants, and it recommends pathways to help guide and accelerate the transition process already underway.

In addition to the push towards net zero, the convergence of alternative technology opportunities and the decreasing cost of the new technology, the transition is also being fuelled by factors such as:

- The high penetration of PV (with rooftop solar on one in three homes in Perth, Western Australia) and renewables, which appear to be the first wave of this technological shift
- The 'electrification of everything' and especially the predicted growth in electric vehicles (EVs), which will create more pressure on the energy system
- The technological shift from a system dominated by electro-mechanical technologies such as coal-fired steam turbines turning large generators towards solid state technologies such as PVS and smart inverters'
- The notion of energy as a service (EaaS) rather than a commodity, where we no longer pay for energy usage but for the service provided by access to energy (as the cost of energy from

[1] The term 'business model' has a range of implications that include the generation of revenue, assumptions about the services that will be remunerated, and the 'stories' that explain how enterprises work. Business models have two parts: activities associated with production and activities associated with sales.
Source: What Is a Business Model? by Andrea Ovans, January 23, 2015. Harvard Business Review. https://hbr.org/2015/01/what-is-a-business-model)

renewables is marginal).

These factors are all set in a context of significant technical challenges within the energy system (referred to as the 'reality of the physics of the grid') as the existing distribution and transmission system was not designed to accommodate a large amount of distributed and variable generation.

The institutional, technological and regulatory challenges for the transitioning energy system are substantial. For over a decade, it has been argued that traditional, centralised electricity systems in Australia could be experiencing 'death spiral dynamics'[2] or at least be characterised as a 'network in decline'.[3] Other perspectives on the transition process are not as radical.

This research is framed by the view that at the very least a significant discontinuity occurring in the transition process due to change dynamics between incremental and radical innovation (Figure 1). Equally, the inertia within the system may cause lock-ins and backlash to key elements of a system, creating resistance to change or stifling innovation. This highlights the needs for active 'steering' over time of the transition dynamics.[4]

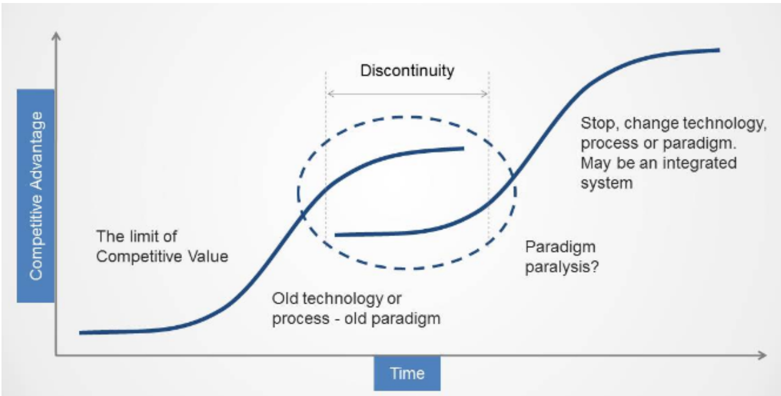

Figure 1. Significant disruption may occur in the socio-technological paradigm, i.e. the change dynamics between incremental innovation (the first curve) and radical innovation (the second curve)
Source: Ian Morrison, J. 1998.[5]

The literature on socio-technological transitions highlights the need to accelerate system level transitions in responses to climate change[6], highlighting that transitions are:

"...transformative sector-level changes in the methods of producing, selling, transporting, and using goods and services. They are multi-actor processes involving interactions between a wide array of actors, including firms, consumers, policy-makers, innovators and civil society groups."[7]

[2] Energy Networks Australia—www.energynetworks.com.au/news/energy-insider/the-death-spiral/ cited 5 July 2022
[3] Simshauser, P. & Akimov, A. (2019). Regulated electricity networks, investment mistakes in retrospect and stranded assets under uncertainty. *Energy Economics*, 81 (2019), 117-133, and James Giblin, PhD candidate, Curtin University, pers. comm. July 2022.
[4] See, for example, the Transitions Dynamics Framework developed by the CRC for Water Sensitive Cities, which has significant potential to be applied in the energy sector. watersensitivecities.org.au/transition-dynamics-framework-tool/
[5] Ian Morrison, J. (1998). The second curve: Managing the velocity of change. *Strategy & Leadership*, 26(1), pp. 7-11.
[6] Geels, F.W., Sovacool, B.K., Schwanen, T., & Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. Sep 22, 357(6357), 1242-1244.
[7] Victor, D.G., Geels, F.W. & Sharpe, S. (2019). Accelerating the Low Carbon Transition: The Case for Stronger, More Targeted and Coordinated International Action. brookings.edu/research/accelerating-the-low-carbon-transition/

The complexity of these socio-technological systems makes them subject to considerable inertia and resistant to change. Using existing and emerging business models as a lens provides a useful way of looking at how energy services are offered and where the money is made, and it also provides insights into how the industry might restructure to meet the contemporary challenges.

Western Australia's South–West Integrated System (SWIS), as the world's largest isolated grid with very high penetration of renewables, is experiencing many problems ahead of the rest of the world. As one participant quipped: "It's like WA is a postcard from the future."

The research in this report has focused on the SWIS as a case study, while also referencing the National Energy Market (NEM) of the east coast of Australia. The findings presented here are based on an analysis drawn from a combination of modelled projections and insights from interviews and workshops with industry practitioners[8] and also draw on the insights of the research team and the wider literature in this field.

[8] The industry practitioners came from a diverse mix of policy, public and private sectors, and academics within the energy policy arena. The organisations represented in the industry reference group and the interview process are presented in Appendix 1.

2 How was this industry challenge tackled in WA?

This research focused on the Western Australia as it is well advanced in its transition to renewable, distributed energy systems. This is due to its world-leading rooftop PV uptake and large number of remote communities which are either not connected to the grid or have long, often damaged, connections to the grid. Distributed, renewable energy solutions are ideal for these situations and are being deployed rapidly. Consequently, this study concentrated on engaging with industry practitioners that are familiar with this state, as well as other practitioners that are at the forefront of this transition, to provide insight into the business models that make sense.

2.1 Research methodology

Our research involved a mixed-method approach that aimed to understand the relevant DER energy market and policy contexts and to canvas key stakeholder perspectives on the key enablers, constraints and conditions of a high DER energy system in Australia.

The overall research methodology is presented in Figure 2. The first step involved exploring the topic by reviewing both academic and grey industry literature and analysing recently published energy market and financial data. The second step consisted of the research team hosting three facilitated industry reference group (IRG) workshops which explored different perspectives on business model value and opportunities. The third and final step was to go deeper with our selected stakeholders by drawing out their organisational insights on the state of the energy transitions and the possible pathways for DER into the future. The participants in this process were considered to be 'elite informants'[9] with detailed knowledge about energy infrastructure, markets, organisational dynamics and organisational policy agendas, and thus able to provide valuable insights.

[9] Aguinis, H., & Solarino, A. M. (2019). Transparency and replicability in qualitative research: The case of interviews with elite informants. *Strategic Management Journal*, *40*(8), 1291-1315.

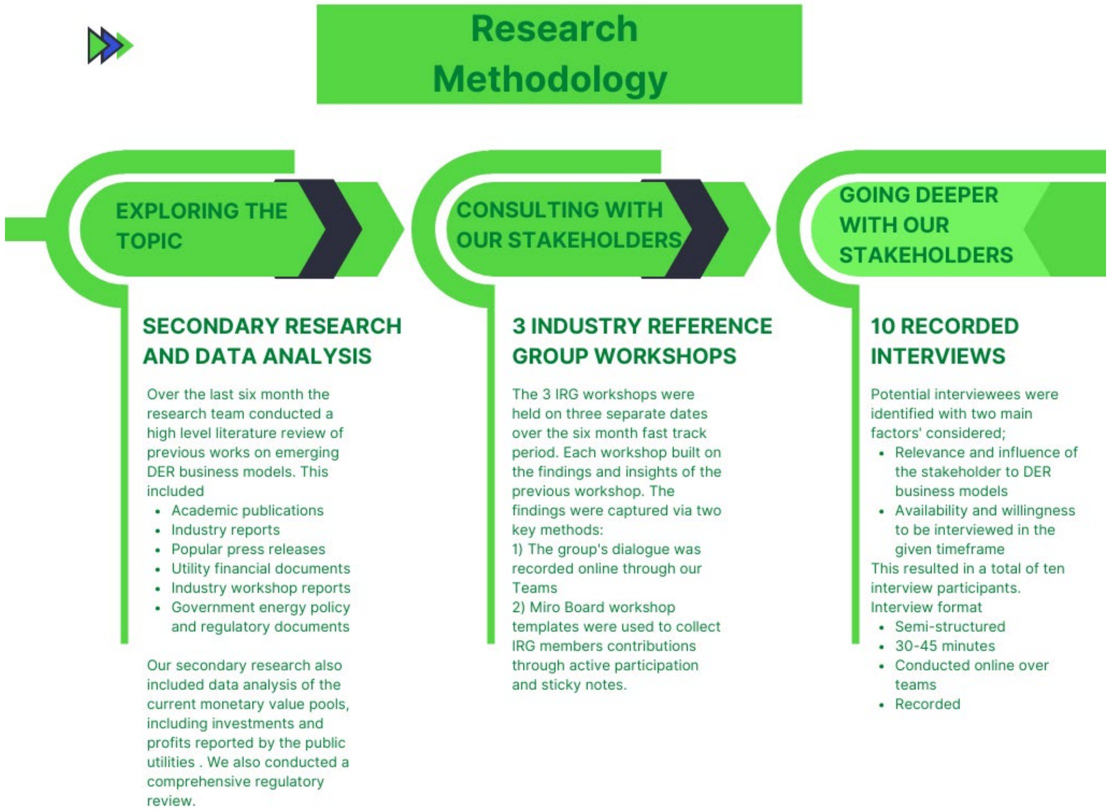

Figure 2. Research Methodology

The workshop and interview process (which provided the opportunity for deeper questioning) posed the following questions:

- What does a high-penetration DER world look like?
- What new and emerging business models are evident?
- What are the pathways for both new energy companies and existing systems participants in high penetration DER world?

In addition to seeking answers to these questions, we analysed the regulatory environment and the barriers within the regulatory and governance frameworks to highlight where reform might be focused in a high DER penetration future. We also looked at the existing and future possible value pools[10] within the electrical energy systems in the SW of Western Australia (the SWIS). This involved evaluating general trends and factors impacting electricity costs in the SWIS and modelling specific forecast scenarios where DER growth is assumed to be highly distributed (and the market operational capacity remains relatively unchanged) to understand where incumbents, government and the private sector might invest.

The insights from the interviews and analysis were shared with the IRG at the workshops to inform a deeper dialogue about the state of the transition. Through both of these stages, this process provides a contemporary and unique picture of the opportunities for both existing incumbents and new players

[10] A value pool calculates the available potential in the market for new revenues and avoided costs and can provide insight into industry structure by visualising the economic and competitive forces driving the distribution of profits.

and identifies key enablers, constraints and conditions that determine how a high DER energy system in Australia might evolve.

3 What did we learn?

Outlined below are the key outcomes for the project. They include:

- Perspectives on the shape and trajectory of the energy transition
- Perspectives on the status and direction of the policy and regulatory reform process
- Insights gained from an assessment of the existing and prospective value pools in the SWIS
- An assessment of business models (both well-known and emerging), highlighting those that need more support for their full value to be realized
- A summary of the barriers and challenges to a more rapid transition
- A framework of success metrics that should become part of national policy and regulatory framework
- A set of policy and innovation processes that highlight the range of mechanisms to help fast track the transition.

3.1 What does a high DER penetration world look like?

While stakeholders agreed that an energy transition is indeed underway, there was no consensus on exactly how this transition process is likely to play out. Some viewed it as a 'steady as she goes' process of incremental change, others saw a future involving a 'completely and radically reshaped energy system in technological and institutional terms', while yet others held a range of perspectives in between. An overwhelmingly shared view, however, was that "the transformation of the energy system offers enormous opportunity for all parts of the sector and its customers."[11]

During interviews and workshops, participants raised the point that discussion about energy transition must account for residential customers having lost trust in the existing utilities, as evidenced by the amount of roof top PV. Given the option of cheaper batteries, many would most likely leave the system altogether. The study highlighted that the evolution of the energy system presents an ongoing challenge for incumbents (i.e. existing utilities and retailers), who posed questions as fundamental as:

- Do we need to enhance the transmission systems?
- Do we need to enhance the distribution systems?
- How are these changes paid for in a world where the production cost of energy is approaching zero?
- What are the new tariffs/pricing/charging frameworks?
- How are these changes communicated to consumers?

[11] Energy Networks Australia—energynetworks.com.au/news/energy-insider/the-death-spiral/ cited 5 July 2022

- Is the example provided by the local community energy systems of Yackandandah[12] a model for a local energy/community grid and possible model for the future across both rural and urban settings?

The interview process highlighted the significant value of many of the business models discussed in Section 3.4 following, with particular attention paid to the important role of aggregators and ancillary services. It was suggested that not every household with a PV system wants to put time and energy into optimising the performance and return of their asset. One view, held by an industry participant, is that households don't want to become prosumers but rather outsource that service in a similar way that superannuation funds look after retirement investments. Over time, consumers will look at the different levels of performance that aggregators can provide to enhance their return on investment.

Ancillary services were considered to be important as they optimise the performance of the system that is coping with the growth of renewables and high levels of local and distributed energy generation. These services are vital in maintaining grid stability and help to mitigate the effect of local generation and demand variability using tools such as controlled loads, short and long-term battery storage and virtual machines. There is, however, a need for clarity on how these services are valued and therefore rewarded to allow business models in this space to mature.

While DER penetration is generally lower on the east coast than in WA, the market and regulatory frameworks available in the NEM offer more opportunities for third parties to emerge. Coordination of pilot projects and behind-the-meter projects were considered critical to showcase innovations. In this context an interviewee suggested: "The changes in WA energy system should be recognised as an opportunity to lead the transition globally, but there is so much inertia in the system holding the transition back".

The theme of 'inertia' came through repeatedly; overcoming institutional mind sets resistant to change were considered to require as much, if not more, effort than dealing with the technical challenges. Many participants supported processes that would encourage the testing of new ways of doing business in a 'safe–fail' rather than 'fail–safe' mind set, and the importance of co-design and co-creation processes between existing incumbents and new players was often stressed as an important part of the journey moving forward. The need for these processes is discussed further in Sections 3.4 and 3.5.

3.2 How should the policy and regulatory environment evolve?

The project reviewed the existing regulatory environment and highlighted that the regulatory framework in Australia is highly complex as it covers multiple jurisdictions and has different state and national agendas potentially at play. The lack of clear national energy policy and ongoing political debate in the space has hampered a clear reform agenda. That said, reform *is* underway. Many policy and regulatory initiatives aim to enhance DER penetration, but the interview and workshop process highlighted that there is no overall framework of agreed key outcomes or success metrics to guide the transition. An example of a desirable outcome and design goal for Australia's new regulatory framework is the creation of new jobs and economic activities as the 'electrification of everything' (with renewable

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[12] totallyrenewableyack.org.au/

energy) accelerates to combat climate change. While this is often talked about as part of the transition process, there is currently no national framework or success metrics for these outcomes.

An important insight is that the policy and regulatory environment needs to move away from a framework with many prescriptive elements towards an outcome or performance-based framework. There is some evidence that performance-based regulation is already having positive benefits in some jurisdictions.[13] Ideally, a lighter touch is being sought, but in a way that ensures that lobby groups (in all their forms) should not be able dominate and drive an agenda as this may stifle innovation and slow down change. There are a multitude of regulatory issues within the industry that have still to be resolved, including tariffs, environmental issues, the visibility and manageability of DER in low-voltage networks, DER curtailment, network support services, network access, and competition and electric utility regulations, to name but a few. One issue that has been raised by industry participants across all Australian states as a serious barrier to development of DER models is a meter ownership and access by third parties. Innovative new service providers (including the so-called ancillary services) have the potential to contribute to maintaining reliability and cost effectiveness during a time of transition. At present, however, there is limited transparency and clarity on how these services are valued and therefore rewarded. Further, new models of community ownership and management of energy and storage systems need to be supported.

3.3 How might the value pools shift?

The study assessed both existing value pools and models of prospective value pools within Western Australia's SWIS as examples of different growth scenarios of distributed energy resources and load demand (low, medium, high, accelerated, and business as usual). The findings of this study are generally also applicable to the east coast of Australia. The monetary value (in $ and %) for the existing WA market capacity of 18,304 GWh was calculated using public domain data such as AEMO-WEM data[14,15], Western Power network pricing information[16] and other reports.[17,18,19]

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[13] Rocky Mountains Institute. rmi.org/shining-a-light-on-utility-performance-in-hawaii/ 7 April 2022

[14]AEMO Capacity Credits Summary. (2018). Summary of capacity credits assigned by facility for the 2018 Reserve Capacity Cycle for the Capacity Year 1 October 2020 to 1 October 2021. aemo.com.au/-/media/files/electricity/wem/reserve_capacity_mechanism/assignment/2019/capacity-credits-assigned-for-the-2020-21-capacity-year.pdf?la=en

[15] AEMO WEM Market Data. (2020). AEMO-WEM Data Dashboard. aemo.com.au/energy-systems/electricity/wholesale-electricity-market-wem/data-wem

[16] Western Power. (2020). 2020/21 Price List. 25 May 2020. westernpower.com.au/media/4302/network-access-prices-2020-21-price-list-20200702.pdf

[17] Orme, S., & Robinson, T. (2021). Market Power Mitigation in the WEM. 30 March 2021. wa.gov.au/system/files/2021-03/Consultant%20Report%20-%20Sapere%20RBP%20WEM%20Market%20Power%20Mitigation.pdf

[18] Chin, I. (2020). Report on the Benchmarked Costs of Ancillary Services in Different Jurisdictions: By Economic Regulation Authority. February 2020. erawa.com.au/cproot/21417/2/Attachment-3 EMCA-report-on-the-benchmarking-of-ancillary-services-with-other-jurisdictions.PDF

[19] Graham, P., Hayward, J., Foster, J., & Havas, L. (2021). *GenCost 2020-21: Final report*, Australia. csiro.au/-/media/EF/Files/GenCost2020-21_FinalReport.pdf

The study considered the following five 2030 growth scenarios:

2020–21: ~1800 MW behind-the-meter DERs (Solar PV) with 0 MWh storage producing ~1008 MWh for self-consumption, and ~1k EVs with market operating capacity of 18,304 GWh and overall demand of 19,312 GWh

2030 (Low): ~4000 MW behind-the-meter DERs (solar PV) with 1200 MWh storage producing ~2800 MWh for self-consumption, and ~50k EVs with market operating capacity of 19,427 GWh and overall demand of 22,227 GWh

2030 (Medium; expected): ~4000 MW behind-the-meter DERs (solar PV) with 2700 MWh storage producing ~3920 MWh for self-consumption, and ~100k EVs with market operating capacity of 18,490 GWh and overall demand of 22,410 GWh

2030 (High): ~5000 MW behind-the-meter DERs (solar PV) with 4500 MWh storage producing ~5600 MWh for self-consumption and ~300k EVs with market operating capacity of 18,239 GWh and overall demand of 23,839 GWh

2030 (Accelerated): ~6000 MW behind-the-meter DERs (solar PV) with 9000 MWh storage producing ~7560 MWh for self-consumption, and ~650k EVs with market operating capacity of 17,555 GWh and overall demand of 25,115 GWh

2030 (Business as Usual—BaU): The BaU for fuel gen mix (the same % share as 2020–21) and accelerated EVs growth of ~650k EVs with a market operating capacity of 25,115 GWh

According to CSIRO/AEMO[20,21], the most likely scenario to occur by 2030 is the medium growth scenario (with 4000 MW behind-the-meter solar PV and 100k EVs), whereas private entities such as Starling Energy anticipate scenarios that include the relatively aggressive accelerated growth scenario of 6000 MW behind-the-meter solar PV and 650k EVs. While overall demand is different in these scenarios, the market operational capacity remains the same as in 2020, making it relatively easy to estimate the future electricity cost and trend.

The WA electricity market value pools (in $ and %) for 2030 accelerated growth and BaU scenarios are shown in the Mekko Chart[22] in Figure 3. The wholesale electricity price for the accelerated growth scenario is anticipated to be ~24 cents/kWh compared to 27cent/kWh today and 31cents/kWh with the BaU scenario. The electricity cost for the household solar PV system is estimated based on the forecast levelised cost of energy (LCOE) of residential solar PV and battery systems, which is ~24cent/kWh. This cost includes the battery storage system needed to achieve close to 100% self-consumption.

[20] Graham, P., Hayward, J., Foster, J., & Havas, L. (2021). *GenCost 2020-21: Final report*, Australia. csiro.au/-/media/EF/Files/GenCost2020-21_FinalReport.pdf

[21] Brinsmead, T.S., Hayward, J., & Graham, P. (2014). Australian Electricity Market Analysis Report to 2020 and 2030: By CSIRO. arena.gov.au/assets/2017/02/CSIRO-Electricity-market-analysis-for-IGEG.pdf

[22] slidescience.co/mekko-charts/

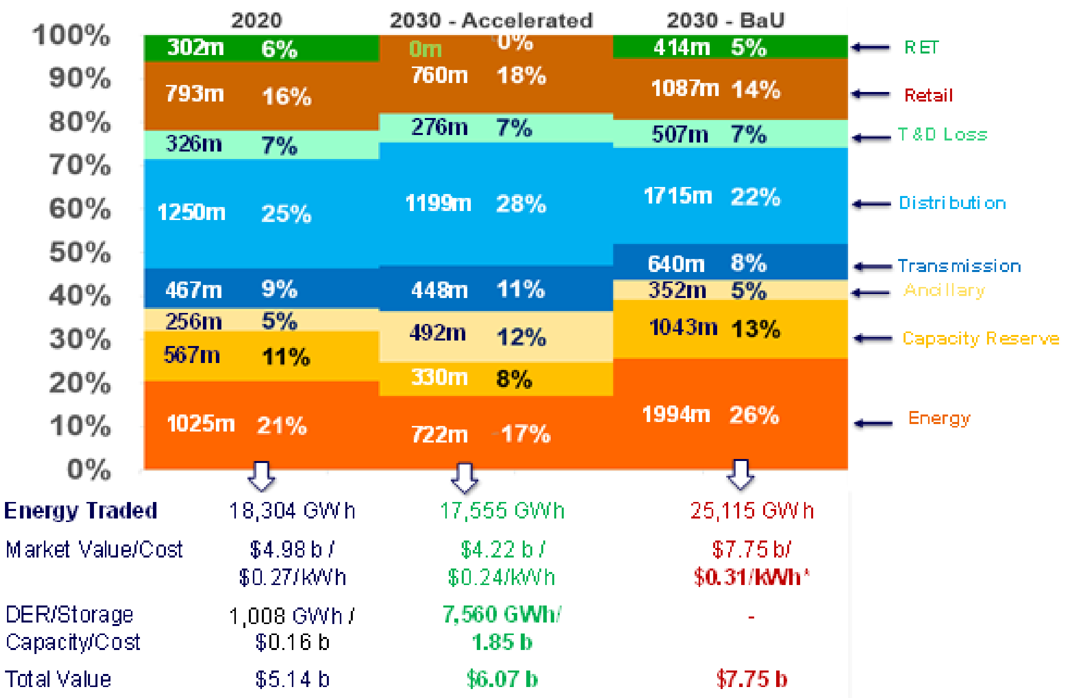

Figure 3. Mekko model showing WA electricity cost for 2030 Accelerated and BaU scenarios

Western Australia's market electricity cost for all considered growth scenarios is shown in Figure 4. The highly distributed energy resources and demand growth scenarios show lower electricity cost, mainly due to the lower cost of gen-fuel mix (renewable) in 2030. In addition, significant transmission network upgrade costs can be avoided if local demand is met locally and demand growth is matched by the distributed solar PV generations (i.e. mainly residential solar PVs and batteries). Moreover, the cost model presented above does not take into consideration the DERs' potential to provide grid support services, including capacity reserve. Therefore, the effective wholesale and residential solar PV system costs will reduce further if DERs are allowed to provide grid support services. This can be done through investment at the distribution level to allow network access and increased hosting capacity, and through regulatory changes to allow DERs and aggregators to participate in the electricity market.

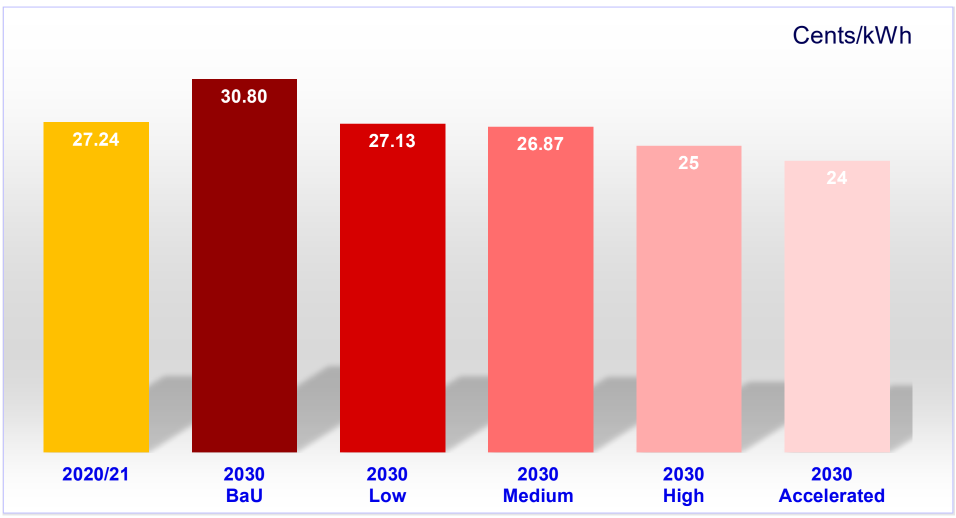

Figure 4. WA electricity cost for different growth scenarios

The cost model did not account for the infrastructure upgrade cost, but the assessment recognised that upgrading distribution networks is very likely to be much cheaper than upgrading the transmission network under the existing system model. This means that, overall, less capital will need to be spent on the transmission systems. The shift in this direction will require regulatory changes and a mechanism to determine the network cost and returns for DER owners—most likely through aggregators—as well as a shift in investment priorities. This finding illustrates the need for a significant rethink in the overall priorities for investment strategies within the sector. The assessment further highlights the opportunities created by existing incumbents to give focused attention to distribution system operator's (DSO) functions at a more local level. This will help to reduce complexity and risks in the transmission systems to deliver a more technically efficient, cost-efficient and cost-effective system as a whole.

This process illustrated that the value to be unlocked in facilitating higher levels of DER could be significant. As reported in the Project Symphony DER Services Report[23] on the economic value of better management of distribution and the uptake of aggregation services of virtual power plants' in the SWIS:

"All scenarios produce positive gross economic benefits. The maximum economic benefit that is produced in Scenario 0[24] is significant, at just over $1.4 billion over 15 years in present value terms based on a weighted cost of capital (WACC) of 4%."

3.4 What are the business models during the transition to a high DER environment?

Through a series of workshops and interviews with stakeholders in the energy space, we found three categories of business model opportunities, which are summarised in Table 1:

- Emerging models that are completely new and incompletely understood
- Evolving models that are variations on older business models but with new technologies or approaches
- Established models that are well understood technically and financially.

The dynamism of this space is exemplified by Mike Cannon-Brookes' play for AGL, which is a new spin on established financing business models. Cannon-Brookes identified a significant business opportunity for AGL, one of Australia oldest utilities (see Box 1 for summary), by recognising that accelerating the transition to renewables could create significant value that warrants investment. According to the letter he wrote with Biden White House expert, Saul Griffith, and sent to every federal politician earlier in the year:

[23] Oakley Greenwood (undated) Project Symphony: Our energy future, Work package 2.1., 10. The economic value of virtual power plants in the SWIS of Western Australia. arena.gov.au/assets/2022/03/project-symphony-der-services-report.pdf
[24] Scenario 0 assumes that all benefits are monetisable and the VPP flows all of the monetised benefits to customers. Because this maximises the financial benefit to participating customers, this scenario results in the highest level of customer participation in the VPP.

"When we electrify every Australian home, average energy and fuel bills will drop from about $5000 a year to just $800, and the savings pay for themselves."[25]

BOX 1. Atlassian founder Mike Cannon-Brookes is looking for a place at the AGL board table after routing the company's CEO and chairman and derailing the company's demerger plan

Cannon-Brookes spent around $650 million through his family venture capital firm, Grok Ventures, to take an 11.3% stake in AGL, launching a high-profile PR campaign against AGL's plan to separate the business into a distribution arm and Accel Energy, which would have owned the company's existing half dozen fossil fuel generators as well as its renewable energy plants.

"AGL's retail and institutional shareholders have sent an emphatic message to the Board and management of AGL that the company needs to be kept together to take advantage of the economic opportunity presented by decarbonisation," the statement (by Grok Ventures) said.

The underlying premise of the fight for control of AGL has been about a different vision for AGL's future—one that is very much framed by the notion of energy as service one where the service offering to customers will be about how they can part of a net zero world by getting access to finance to electrify and decarbonize their homes.

Source: Drawn from Startup Daily, 31 May 2022

Table 1. Business model summary from workshops and interviews (for more detail, see Appendix 2)

[25] As reported in news.com.au 16 February 2022

Categories	Business models
Emerging	**Energy as a service** (EaaS)*—Move from charging for energy to charging for access to infrastructure for energy and for reliability and security **Aggregator services** AGGs)*—An aggregator manages and controls multiple small DER systems, connecting multiple single nodes into a networked energy system for one connection to the grid; virtual power plants are an important example. **Microgrid managers/providers** (MICRO-MP)*—These can also be considered a kind of aggregator service, which can be islanded and grid-forming. **Peer-to-peer energy trading platforms** (P2P)—These allow prosumers the choice to decide from whom they purchase electricity, and who they sell their (DER) energy/storage to. As VPPs emerge, this model may make less sense.
Evolving	**System stability, reliability, and security services** (SSRS)*—These are ancillary services that provide energy reliability and security as the transition takes place. These services mitigate the effect of generation and demand-variability using tools such as controlled loads, short and long-term battery storage and virtual machines. **Matching supply and demand** (MSAD)—This can be achieved via a combination of controlling load, controlling generation and short and long-term storage. **Network intelligence** (NI)—Advisory services and services on DER optimisation, efficiency, simulation and network awareness that are evolving due to large amounts of new, fine-grained, near real-time data. **Building new infrastructure** (Build)—Businesses that install new infrastructure for the transition (residential, commercial, utility), with new technology and economics. **EV charging** (EV charge)—Charging is seen as a key evolving business by several IRG members due to V2G, the need for controllable loads, and demand for fast chargers. **Energy self-reliance** (ESR)—Beginning in remote areas far from the grid or when supply is not reliable, a market is developing for (renewable) stand-alone power systems to augment and eventually replace diesel systems. **Fully-integrated business models** (FIB)—These are evolving where an entity is active across the entire value chain. Tesla is an example of this model, covering PVs, batteries, charging and vehicles.
Established	**Financial business models** (Fin BS)—some business opportunities during the transition to renewables are financial plays from green funds, super funds, development funds, or high net-worth individuals. **New centralised renewable energy** (Central RE)—Large-scale solar and wind farms and grid-scale batteries that are connected to big transmission lines are seeing massive investment as we move from coal and gas to renewables.
	*Indicates requires prioritisation from IRG feedback and industry interviews

3.4.1 Prioritising business models

Beyond exploring the current and emerging business models within a high DER energy system, participants also discussed which business models should be prioritised. The matrix in Figure 5 below (adapted from IRG Workshop 3) shows how participants mapped some of the listed business models according to perceived value to the overall system and the current support or contestability of the model. The purpose of this process was to identify those business models that had the highest value and required the most support to be fully realised. This process helped to illustrate where policy and resources could be directed to better enable the high priority business model innovations in Quadrant 2.

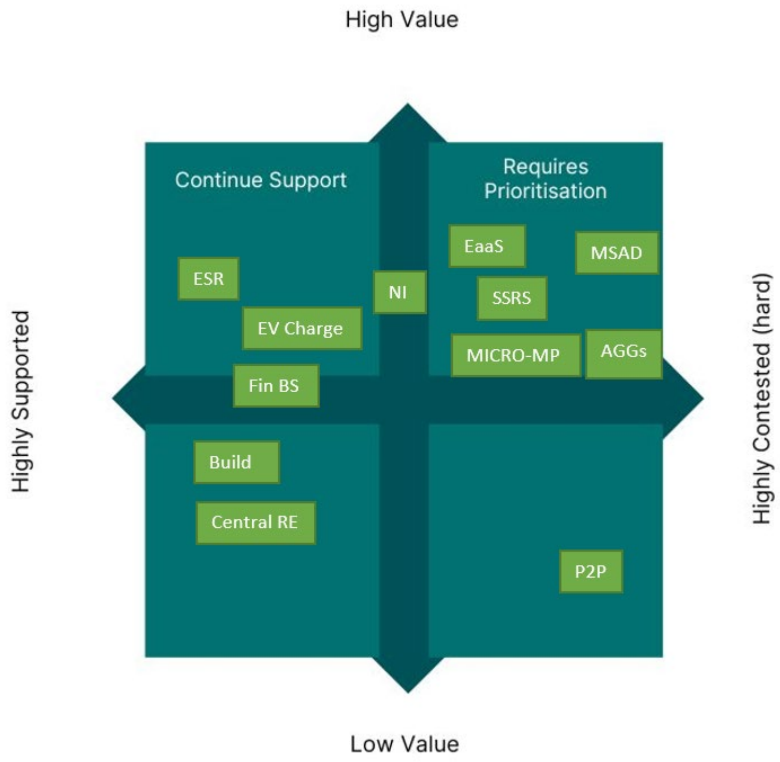

Figure 5. Business model value and support positioning matrix

All business models' quadrant positions are listed in Table 2. Models clustered in Quadrant 2 (top right, high value and highly contested) were considered to have the greatest potential value and should be prioritised for further support and testing.

Table 2. Business models and perceived value

Quadrant	Business model
Quadrant 1	**High value and highly supported—requiring continued support** • Network intelligence **(NI)** • Energy self-reliance **(ESR)** • Financial business models **(Fin BS)** • EV Charging **(EV Charge)**
Quadrant 2	**High value and highly contested (hard)—requiring prioritising for support and testing** • Energy as a Service **(EaaS)** • System stability, reliability, and security (or ancillary services) **(SSRS)** • Matching supply and demand **(MSAD)** • Aggregator services (includes VPPs) **(AGGs)** • Microgrid managers/providers **(MICRO-MP)**
Quadrant 3	**Low value and highly supported** • New centralised renewable energy **(Central RE)** • Building new infrastructure **(Build)**
Quadrant 4	**Low value and highly contested (hard)** • Peer-to-peer energy trading **(P2P)**
Not mapped	• Fully integrated business models **(FIB)** • Merged into matching supply and demand **(Urban Fringe Industrials)**

3.4.2 Key emerging and evolving business models

The process above identified five business models that were of the highest value but to date have received the least support.

Energy as a service—This represents a move from charging for energy usage to charging for access to infrastructure that delivers energy with reliability and security:

- Equipment is supplied; next level of evolution is getting comfortable with fungibility versus lease (i.e. not a specific piece of equipment)
- Need to define extra revenue streams, e.g. VPP
- Energy will evolve to where is it possible to decide how much capacity a customer wants and to ‘rent’ the infrastructure
- Ownership of the asset is sitting with someone else and may be cooperative (e.g. Plico, which provides equipment and owns a share of the equipment, while Plico/Starling manages the system. Customers can be rewarded with credits, discounts or cash).

System stability, reliability, and security services—These so-called ancillary services provide energy reliability and security during the transition. These services mitigate the effect of generation and demand-variability using tools such as controlled loads, short and long-term battery storage and virtual machines. Tariffs and export charges can be adjusted as mechanisms to ensure system stability, reliability and security services:

- DER exports to the grid can either be monetarily rewarded or penalised, depending on demand and supply. This can open revenue streams up for DER generators or for network utilities.
- Self-reliant (DER) systems also have a value proposition in providing service during faults and outages.
- Traditional mechanical 'spinning' generators are moving to solid-state 'clever things' and controllable loads.

Matching supply and demand—This can be done by a combination of controlling load, controlling generation and short and long-term storage. Ideas from the group:

- Businesses and services that provide, manage and aggregate controllable loads
- Businesses that absorb excess load
- EV charging control as a service
- Long-term energy storage to use across seasons and help stabilise the grid
- Battery back-up as a service
- Move from 'I build, you buy' to competing with new solutions and customers that have new options
- Generation and loads being matched at the street level, that is, transitioning from the transmission to the distribution system.
-

Industrial parks and large warehouses on the urban fringe have high controllable loads and significant potential for large solar and battery installations. These represent valuable opportunities for stabilising the grid. A third party may be needed to allow profitability and to overcome the current grid's one-way design which causes the inverter to shut off when there is too much solar.

Aggregator services—An aggregator manages and controls multiple small DER systems, connecting multiple single nodes into a networked energy system that can (and usually does) interface with the grid. We assume aggregation can occur across residential and commercial sites and would include aggregation models for

- Storage
- Generation
- Demand/loads
- VPP, which is needed as individual consumers are too small and cannot react fast enough to be manageable by traditional utilities at scale.

These aggregated services can now be sold into energy markets at a scale that is efficient/saleable.

Microgrid managers/providers—These can also be considered a kind of aggregator service. Identified areas of opportunity within the microgrid concept included

- Capable of being islanded to provide reliable power independently
- Grid forming: Can synchronise to grid frequency or create the frequency for the grid; Network business model evolving to allow this
- Strong intersection with VPPs
- In Western Australian the use of Stand-Alone Power Systems, have been found to be cheaper than the maintenance or provision of poles and wires, especially at the edge of the grid.

- Co-design of a distribution system operator (DSO) acting as a retailer and aggregator to support stable system operations and provide value to community (e.g. flexible tariffs and connections)
- DER microgrids at estate/facility development scale—Developers can either own the energy infrastructure or sell it to an operator. Enablers for this are data quality, leverage, data sharing regulations, and rules around green community title (in WA).
- Energy interaction as a service through VPP aggregation (perhaps using peer-to-peer platforms), which would be driven by market demand, real-time DNSP (Distribution Network Service Provider) constraints and DER availability
- Recovering DERMS/Microgrid operator revenue across all users, with a possible need for regulation
- There is also a need for suburb-to-suburb load matching across different managers/providers, which is a generalisation of the classic load and demand matching problem.

3.5 What are the challenges and accelerators to achieve a high-penetration DER world?

Accelerating the transition comes with a range of challenges, including but not limited to:

- cultural and operational changes that are required in existing incumbents to help overcome the inertia in the system
- the need to optimise the policy and regulatory system to facilitate DER uptake
- the technical challenges of the distribution network ability to deal with the amount distributed energy being pushed into the grid.

These point to the complex and intertwined nature of the cultural, institutional and technological challenges of a socio-technical system in transition.

An important part of understanding how to overcome these challenges and deploy accelerators will come from a 'learning-by-doing' approach of co-designing experiments that explore both business model opportunities for utilities and the use of private capital to facilitate an open process towards a 'stakeholder capitalism' approach.[26] This approach would help to foster processes where the value of existing systems and emerging opportunities can be optimised in a transparent process and could, for example, involve identifying a location(s) to test real system opportunities through creating a 'sandbox'[27] approach that explores the bigger range of potential solutions and experiments. The Australian Energy Regulator (AER) has released a position paper and draft trial projects guideline to support 'regulatory sandboxing.'[28] The focus of experiments that could explore overcoming the challenges could include:

[26] See weforum.org/agenda/2021/01/klaus-schwab-on-what-is-stakeholder-capitalism-history-relevance/

[27] What is a sandbox? techopedia.com/definition/27681/sandbox-software-testing. Note that the term 'sandbox' originated in software development environments but is now used more broadly.

[28] *AER is powering on to energise innovation in the energy market,* published in AER website, April 2022. aer.gov.au/communication/aer-is-powering-on-to-energise-innovation-in-the-energy-market

- **Targeting large energy users** for renewable energy in traceable ways to move faster and more profitably and accountably to reduce emissions (this is already being explored through a RACE for 2030 project titled 24/7 True Zero).
- **Testing opportunities for aggregators** to play a greater role. Exploring how the role of aggregators and data management can optimise the performance of high levels of DER penetration.
- **Developing processes to shift organisational culture and regulation** from a 'fail–safe' mindset to 'safe–fail' (i.e. safe to experiment), from a strong but brittle system to a resilient one that also shifts from the three to five-year planning cycles to rapid response approaches and find ways for procurement process to stimulate local innovation opportunities.
- **Exploring the whole value chain**–Business models need to be profitable for all players in the value chain, including incumbents, 'prosumers' and businesses in peer-to-peer platforms and selling.
- **Private funding**—The existing transmission and distribution system has been predominately publicly funded (in Australia) and there is a significant investment in that infrastructure. However, increasingly, private funding opportunities and sources are growing (green super funds, sustainable exchange-traded funds, interest of high-net-worth individuals). The value of these potential funding sources, and how to realise their potential benefits, has not been fully explored.
- **Focusing on customers**—Core to any experiment of this kind need to be questions such as *What do average energy users and/or homeowners think about these models? What is in it for them?*

Driving innovation in the energy sector means turning new concepts into real systems and deploying them at scale. The typical stages of such innovation (especially as expressed in the technology start-up space) move from ideation (often using design thinking to clarify the needed product or service features), to a proof-of-concept which validates that the concept is feasible (often expressed as a demonstration), to an early prototype and then to a minimum viable product29 ('the simplest thing that can be sold'). The minimum viable product allows for the product or service to be refined during a trial period with feedback from real customers before being finalised and scaled. These steps can be conducted within a lean canvas framework30 and also follow agile31 development processes.

Another part of accelerating the transition process is the need to build and support an ongoing 'community of practice' of innovators and leaders equipped with the skills and insights in dynamic systems change. This involves actively supporting the range of enabling factors necessary to guide the transition, such as identifying and supporting champions, establishing platforms for connecting, building process to share and accelerate the exchange of knowledge, implementing safe–fail experiments and demonstrations, building technical guidance and fostering policy and regulatory changes.32 There are

[29] *A Review of The Minimum Viable Product Approach*. Forbes, Dec. 2021. forbes.com/sites/theyec/2021/12/08/a-review-of-the-minimum-viable-product-approach

[30] *Lean Canvas: Communicate Your Idea Clearly and Concisely*. www.leanstack.com/lean-canvas [31] *The Agile Coach: Atlassian's no-nonsense guide to agile development.* atlassian.com/agile [32] See for example watersensitivecities.org.au/transition-dynamics-framework-tool/

also strong lessons to be learnt from the Collective Impact[33, 34] and Systems Leadership journeys about how best to foster integrated and aligned efforts across many stakeholders as "We face a host of systemic challenges beyond the reach of existing institutions and their hierarchical authority structures."[35] Fostering and supporting the organisational, cultural and people parts of the transition process was highlighted as equally critical throughout the engagement process as the technical innovations.

3.6 What success metrics should guide the energy transition?

A key part of the process was to determine what outcomes would indicate a successful energy transition in Australia. This translated into developing a set of success metrics that provides energy sector stakeholders with an Australia-wide framework of goal-oriented metrics. These metrics can be used to enhance policy and regulatory frameworks and decision-making as we need a new and consistent set of success metrics to guide the emerging energy system (Table 3).

Table 3. Success metrics for the energy transition

SUCCESS METRICS FOR THE ENERGY TRANSITION	
Resilient, equitable, clean	Electricity supply during and after the transition needs resilience and to be clean and equitable (note that the RACE acronym of Reliable, Affordable, Clean and Efficient is good starting point for a KPI framework).
Energy sovereignty	Ensuring long term security and reliability of supply, operation and maintenance
Equity	This is a recurring theme. We need to ensure affordability for DER (perhaps through creative finance) and avoid subsidising the wealthy.
Residential market appeal	Business models should appeal to households, and it is important that we understand the needs of this market as we transition. DER may have diminishing returns in the residential sector as PVs and storage may need to be over-dimensioned unless there is pooling across many residences.
Flexible, adaptable, agile	Business models need to be flexible during the transition, able to adapt to change quickly, i.e. be agile.
Jobs, economic growth and social good	These need to be an outcome of the transition, and there needs to be a 'just transition' as part of that process—for example, right now only well-off people can afford to take advantage of residential solar plus battery storage.
Technical performance characteristics	Deviation, reliability and the voltage profile of the electricity supply need to be maintained and be measurable during the transition. Related to this is an ability for real-time network awareness for DER.

[33] ssir.org/articles/entry/collective_impact
[34] collectiveimpactforum.org/
[35] ssir.org/articles/entry/the_dawn_of_system_leadership#

Financial and system modelling	This is needed to support investment decisions in DER, especially from private sources. These models will help understand revenue potential across different asset types (storage, generation) and how demand-side management and PV curtailment may operate and interact with connection contracts.
Workforce skills	As the transition progresses, supply chain and skills shortage issues will need to be considered—Consumers and systems managers are looking for reliability, and factors like procurement and supply chains need to be designed to ensure we have the whole supply chain covered.
Transition design goal	What is the design of our energy system when the transition to renewables is complete? Do we have a design goal or vision of what it looks like and how to get there?
Technology stability	Rapidly evolving technology is one of the biggest challenges for DER/domestic PV situations and international and Australian standards are continually evolving. Many of the older domestic systems (inverters etc.) will need to be upgraded to link to aggregators.

4 Findings, policy and next steps

The shift from a large-scale centralised energy system to a medium and small-scale decentralised system (a DER-based system) is going to present many challenges. This transition is likely to bring with it a sector-wide replacement of many of the current practices and models, in effect creating a completely new energy paradigm. This offers significant opportunities for customers and investors (both public and private). If handled well, such a transition need not be inherently disruptive, but it will cause major disruption if long held views and assumptions are not rapidly reconsidered and renewed.

Findings

One of the significant barriers to realising the value created in the transition is system inertia (i.e. institutional mindsets), which requires as much, if not more, effort to change than dealing with the technical challenges. Emphasis was placed on setting up collaborative processes that test new ways of doing business in a 'safe–fail' rather than 'fail–safe' mindset through co-design and co-creation processes to test technical and institutional solutions.

Wherever possible, utilities need to shift from the current 3 to 5-year planning cycles to rapid response approaches and find ways for procurement processes to stimulate local innovation opportunities.

An analysis of potential shifts from the current centralised energy 'value pools' in the SWIS of WA to higher levels of electrification and high penetration DER in 2030 highlighted that there is potential for lower energy costs and a need for increasing investment in distribution over transmission to support a low emission energy system. This assessment strengthens the argument for increased attention to the creation and definition of Distributed System Operators (DSO) and DMOs as important role changes for existing incumbents.

Assessing and categorising different business models that are unfolding in the transition as either emerging, evolving or established identified the highest value business models (which needed the most support and testing):

- Energy as a service
- System stability, reliability, and security (ancillary services)
- Matching supply and demand
- Aggregator services (includes VPPs)
- Microgrid managers/providers.

Important points about these models included that the role of ancillary services is seen as critical as they optimise the performance of the system and need to be appropriately valued. Further, creating a marketplace of aggregators will help enhance the overall performance of high levels of DER.

Policy directions

The research indicated that the policy and regulatory environment needs to move away from prescriptive elements within the existing energy systems towards an outcome or performance-based approach. Success metrics have been provided in this report to enhance policy and regulatory frameworks and decision-making.

Using the lens of business models has highlighted the dynamic nature of the energy transition that is already underway. For the opportunities to be realised and low emission networks to be established, significant changes to energy markets and network infrastructure are going to be required. This will need to be supported by policy and regulatory reforms to enable the urgent development of emerging business models that will support the transition and provide reliable, affordable clean energy for Australians.

Next steps

As the electrification of everything unfolds and higher levels of DER seek to enter the systems, ongoing support is required to strengthen the 'community of practice' of innovators and leaders equipped with the skills and insights in dynamic systems change. This involves identifying and supporting champions, establishing platforms for connecting, building process to share and accelerate the exchange of knowledge, implementing safe fail experiments and demonstrations, building technical guidance and fostering policy and regulatory change.

Pathways towards higher DER system penetration involving 'sandbox' testing to accelerate the transition should focus on:

- Targeting large energy users
- Testing opportunities for aggregators
- Developing processes to shift organisational culture and regulation
- Exploring the whole value chain
- Leveraging private funding
- Focusing on customers
- Involve design of both technical and institutional innovations.

This project has highlighted the rapid process of translation that is underway in the Australian energy system. Importantly, it has highlighted the need for ongoing and active 'steering' of the transition. Supporting structures and processes will need to be swiftly put in place to enhance the opportunities to provide reliable, affordable, clean energy for all Australians and to illustrate to the world how to negotiate and accelerate the transition.

Appendix 1 IRG and interview participants

Energy Enterprise	**Government Agencies**
Starling Energy	Energy QLD
Planet Ark Power	AER
Essential Energy	AEMC
Horizon Power	Energy Policy WA
Ausgrid	AEMO
Western Power	
Synergy	**Other**
Elements 47	Conservation Council
Red Grid	Energy Consumer Australia
Hesperia	
Universities	
Curtin	
Griffith	
RMIT	
Adelaide	
ANU	

Appendix 2 Additional detailed business model descriptions

Network intelligence—Services with advisory roles and roles in DER optimisation, efficiency, simulation, network awareness (detailed temporal and geospatial generation, load, and storage data) and presentation of these services, evolving due to large amounts of new, fine-grained, near real-time data. As an example, deferring investment in new infrastructure can be considered as revenue if upgrading or maintenance can be reduced or delayed.

Building new infrastructure—Businesses are installing new infrastructure for the transition (residential, commercial, utility) with new technology and economics. These may include:

- Building new systems (OEMs, installers, equipment compliance managers)
- Investment in new DER (e.g. PVs, batteries)
- Upgrading older systems (e.g. domestic inverters)
- Businesses that build (and add intelligence to) new distribution (related to Distributed System Operators)

Financial business models—Some business opportunities during the transition are finance plays. Such business models are also supported by the growing interest from the financial sectors (green funds, super funds, development funds) and include

- Investing in obsolete businesses and updating the technology (e.g. Cannon-Brookes and AGL)
- Financing DER systems for affordability to lower income areas/people
- Financial models to amortise upfront costs for new renewable infrastructure (especially residential)
- Selling or leasing rooftop space
- Trillions of dollars waiting to be invested, e.g. SUSI fund www.eib.org/en/products/equity/funds/susi-renewable-energy-fund-ii
- Smart meter firms
- Divestment of coal resources
- Proxy for new business models

EV charging—Charging is seen as a key business by several IRG members as it is evolving due to V2G, V2Home and the need for controllable loads and demand for fast chargers. Variations may include EV manufacturers selling battery capacity tothe fleet they have already sold.

Energy self-reliance—In remote areas or where supply is not reliable, a market is evolving and expanding for (renewable) stand-alone power systems (SAPS) to augment, and eventually replace, diesel systems. Residential and commercial customers may choose SAPS as they may save money in the long term and SAPS could be included in a house and land package.

Peer-to-peer energy trading platforms—These allow prosumers to choose from whom they purchase electricity and who they sell their (DER) energy to. The concept could be extended to storage. However, as VPPs emerge, this model may make less sense.

New centralised renewable energy—Large-scale solar and wind farms, and grid-scale batteries that are connected to big transmission lines, are seeing massive investment from the move from coal and gas to renewables. These need to be coupled to controllable loads and storage so that no generation is wasted.

Fully integrated business models— These may emerge where an entity is active across the entire value chain. As markets and businesses mature, this evolution is a natural process. Tesla is an example of this model, and includes business units such as:

- Manufacture and sale of hardware and software (storage, EVs, etc.)
- Building and installation
- Aggregation
- Operations and maintenance
- Optimisation and data management
- Retail