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AIBE Industry Research Series

Australia's evolving energy future:

preparing business through systems modelling, organisational capabilities and stable energy policy

Dr Belinda Wade, Lecturer UQ Business School
Dr Ian MacKenzie, Senior Lecturer, School of Economics
Dr Scott Agnew, Post-doctoral Research Fellow UQ Business School
Cristyn Meath, Lecturer & Post-doctoral Research Fellow, UQBS & Australian Institute for Business & Economics

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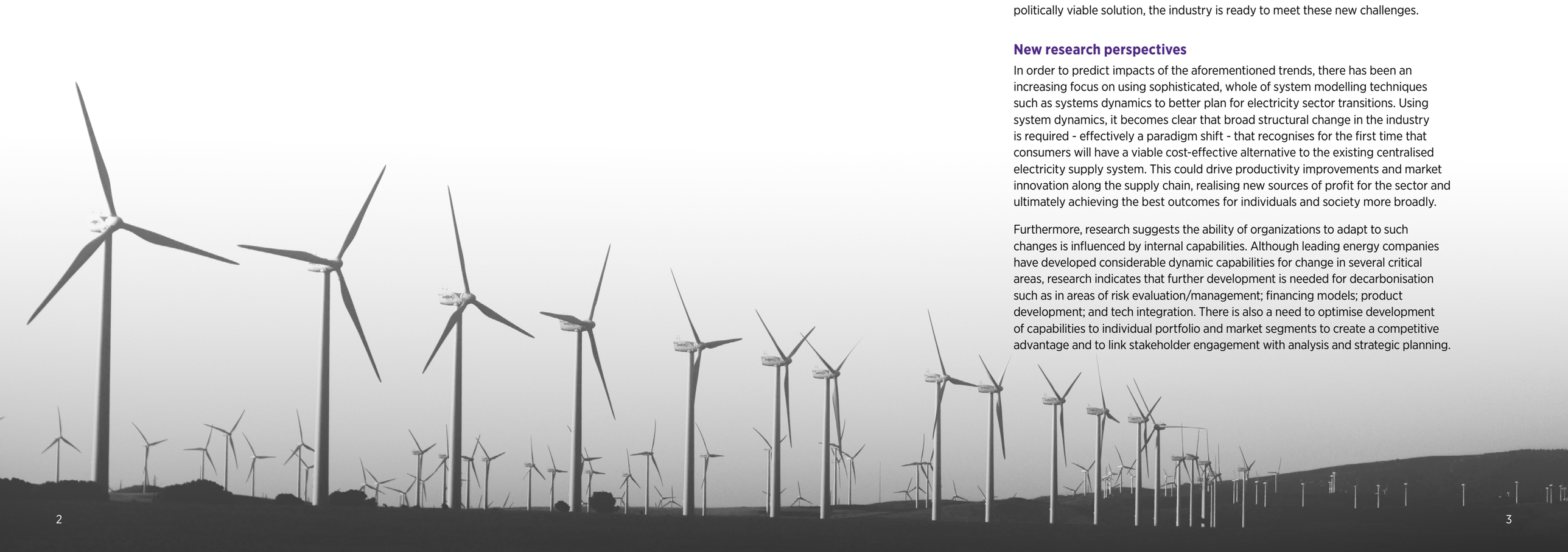


Executive Summary

Disruption to centralised electricity supply systems is accelerating as governments, industry and communities grapple with the so-called 'energy trilemma' – the challenge of providing secure, equitable and environmentally sustainable energy to an ever-growing global population. For Australia, resolution of these issues is becoming increasingly elusive with the energy sector facing unprecedented politicisation and policy inertia. Significant trends are also emerging in the market, including supply and storage developments and changing policy dynamics, with the associated impacts becoming more complex and difficult to predict. In this Industry Research Report the Australian Institute for Business & Economics (AIBE) contributes to the debate, providing a summary of the latest developments in Australia's energy market, expert insights as to future implications of such trends and importantly, profiles leading research which outlines how organizations and the industry can adapt to yet further changes.

Despite the many attempts by both sides of Australian politics, Federal Government policy remains ineffective at addressing both the increase in renewable energy supply to the grid and the reduction of greenhouse gas emissions from the electricity sector. With frequent announcements of new commercial scale renewables projects and unrelenting interest from residential customers to invest in solar panels and more recently battery storage, the industry needs to address the associated network issues and broader implications. Furthermore, the industry must factor in the cost of carbon to ensure that when carbon pricing becomes a politically viable solution, the industry is ready to meet these new challenges.

New research perspectives

In order to predict impacts of the aforementioned trends, there has been an increasing focus on using sophisticated, whole of system modelling techniques such as systems dynamics to better plan for electricity sector transitions. Using system dynamics, it becomes clear that broad structural change in the industry is required - effectively a paradigm shift - that recognises for the first time that consumers will have a viable cost-effective alternative to the existing centralised electricity supply system. This could drive productivity improvements and market innovation along the supply chain, realising new sources of profit for the sector and ultimately achieving the best outcomes for individuals and society more broadly.

Furthermore, research suggests the ability of organizations to adapt to such changes is influenced by internal capabilities. Although leading energy companies have developed considerable dynamic capabilities for change in several critical areas, research indicates that further development is needed for decarbonisation such as in areas of risk evaluation/management; financing models; product development; and tech integration. There is also a need to optimise development of capabilities to individual portfolio and market segments to create a competitive advantage and to link stakeholder engagement with analysis and strategic planning.

Introduction

Few topics have proven more divisive in the Australian policy landscape than that of energy and climate policy. The most recent toppling of a Prime Minister (Malcolm Turnbull) is just one in a growing line from both sides of Parliament related to attempts by consecutive governments to provide stability for the nation relating to the energy market. Yet Australia still has no sufficient Federal policy on the topic, with concerns of insufficient electricity supply in capital cities, and arguably a failure to address one of the greatest challenges of our time, climate change. Against this Federal policy vacillation, clear trends are emerging which will determine the future of Australia's energy market. The recent, public narrative focused on gold plating and green energy programs driving increases in electricity prices has subsided, replaced by an array of significant developments across energy supply and storage, and changing policy dynamics between the Federal and State Governments.

The changes characterising Australia's energy market in recent years are unprecedented and have significant consequences for the industry. Energy supply and storage changes, while still minimal as an overall percentage of national energy supply, are emerging as prominent disruptive forces. The result for the energy market includes a combination of challenging network stability issues and a shift in the traditional business model with the introduction of Virtual Power Plants (VPPs) and individual organisations becoming owners of grid-scale energy assets. Changes in policy dynamics are also occurring with the State Governments stepping in to legislate renewables target as a result of the failure of consecutive Federal Governments to do so, in addition to unprecedented changes by the Federal Government in relation to the Return on Investment (ROI) that network businesses are allowed to earn.

So how are organisations to make sense of the current energy market and significant emerging trends?

New research aimed at assisting organizations to navigate the transition to a decarbonised energy system outlines the need for sophisticated modelling such as systems dynamics and the development of internal dynamic capabilities. Integrating such strategies will assist in predicting impacts from the disruptive phenomena, and facilitate adaptation to such changes.

Energy supply & storage

Energy Supply

While black coal remains the dominant form of energy supply, Australia's energy production mix is becoming more diverse with the addition of solar, wind and bioenergy[1] (see Figures 1 & 2). The most recent AEMO figures and the current energy infrastructure pipeline suggest the coming years will see a continued increase in renewables through new solar and wind farms and a decrease in coal as ageing power stations are retired[2].

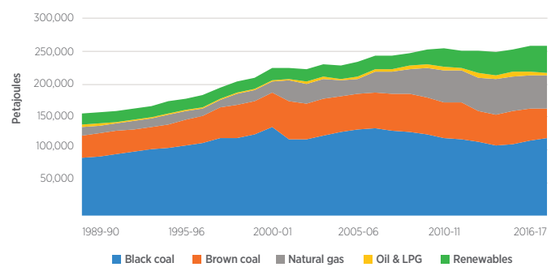


Figure 1. Australian energy production by fuel type[3 (p19)]

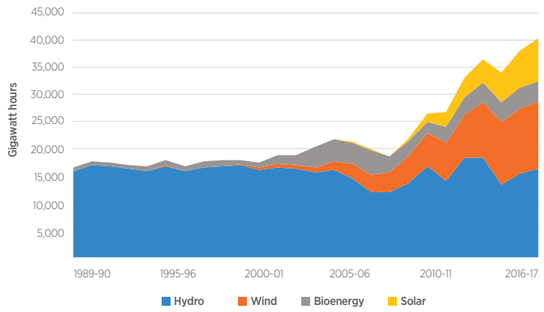


Figure 2. Australian electricity generation from renewable sources[3 (p24)]

Renewable energy increasing rapidly

Driving this change in the energy supply mix is dramatic reductions in the cost of solar and wind energy technology. While renewables remain a relatively small component of the total national energy supply, their development nonetheless is resulting in unprecedented changes and associated disruption to Australia's energy market. Significant investment in renewables is occurring across both commercial and residential levels.

Rooftop solar purchases increased by 19% or 669MW in the second quarter of 2018[4], reflecting the willingness of Australians to invest in renewable energy.

At the commercial scale the figures are even more noteworthy with average output from large-scale wind and solar increasing by 63% over the previous 12 months (wind 61% and solar 82% - see Figure 3)[5]. This increases the contribution of wind and solar to the total national energy supply to 7% up from 4% last year[6]. With much of the new capacity in wind and solar only recently connected to the grid and many new large-scale projects in development and construction phases this figure will continue to increase rapidly in the coming years[7]. The result to date has been a decrease in costs for both the spot market and futures market[8]. Given the cost-competitiveness of renewables at the commercial scale, interest in future renewable energy projects in Australia is indeed likely to remain[9].

Renewables and network curtailment

Despite such interest in future renewables projects, one aspect which may limit the growth of the industry is network constraints. This has affected project owners via unexpected ancillary services fees, higher than expected marginal loss factors (MLFs) and unexpected curtailment, meaning revenues are reduced below financial model forecasts.

In addition, extra, often more costly requirements are being placed on new projects in order to get their Generator Performance Standard (GPS) approval from AEMO. “This situation of uncertainty with regard to costs and revenues related to network constraints makes investors uncomfortable and coupled with political pressures is not helping the potential growth of the renewables industry in Australia” says James Hunt from renewable energy consultant, RINA Consulting. While a lack of a co-ordinated approach to the development of renewables projects across the network has to date resulted in network challenges and inefficiencies, the release of the Integrates System Plan by AEMO in July 2018[10] is designed to address such issues.

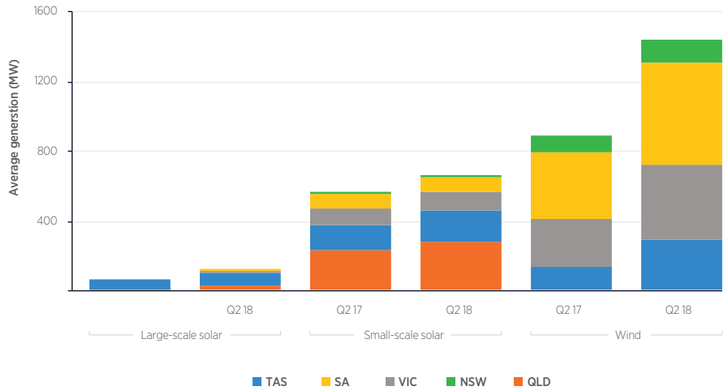


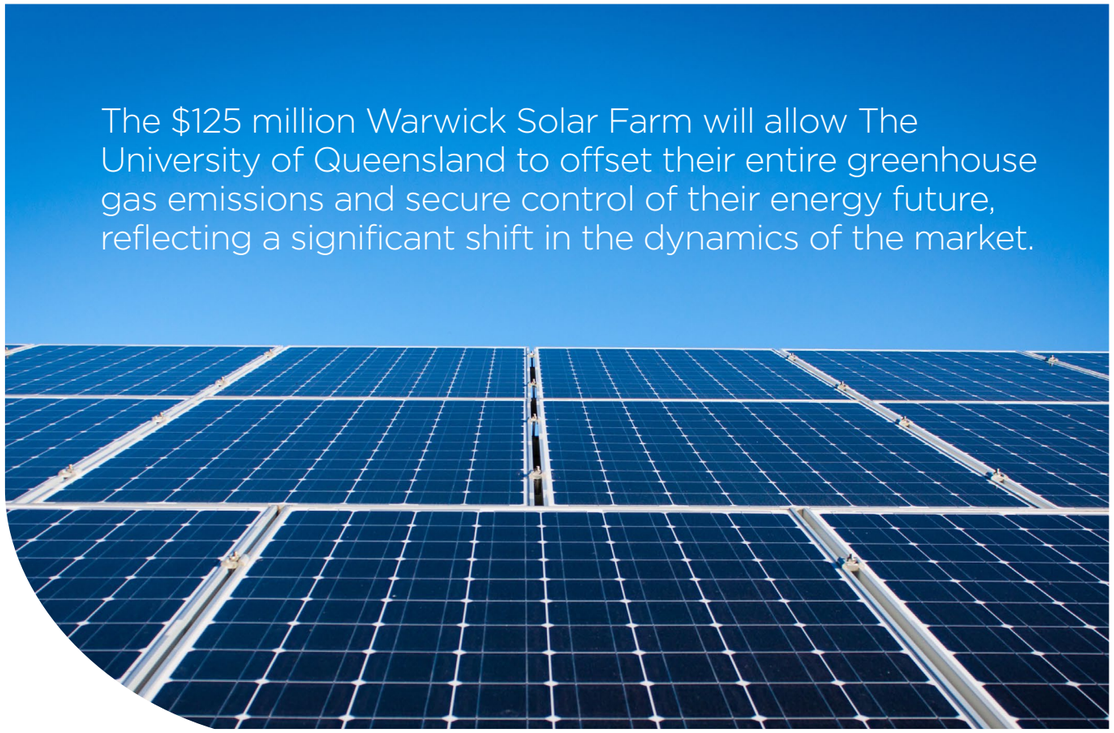
Figure 3. Average wind and solar generation by region[11 (p9)]

Energy storage to support network stability

Importantly, the aforementioned uptake of solar and wind energy production systems has been accompanied by increases in storage solutions by both commercial and residential customers. Until recently, energy storage was one of the largest constraints on the transition to a renewable energy system due to the aforementioned issues of grid stability. Although experts also warn of the limit of their ability to do so while market design issues remain[12]. The immense price reductions in battery storage, along with new product developments such as Tesla’s Powerwall for residential customers and the implementation of the first grid-scale battery in Australia, have spurred further investment in the technology.

Residential customers purchased more than 20,000 battery systems in 2017, a staggering three times the 2016 figure of 6,750 systems providing a total 170MW storage[13].

At the commercial scale a number of grid scale projects are planned at solar and wind farms around the country. In addition to the 100MW Hornsdale battery in South Australia which remains the world’s largest[14], new projects are set to add significant battery storage capacity across the country in addition to plans for pumped hydro and co-generation[15-17]. With the price of lithium-ion batteries falling by 80% since 2010 and set to continue to decrease substantially in the coming years[18], battery storage will continue to drive changes in the market. The potential of battery storage to overcome some of the critical issues relating to network stability is not limited to grid-scale batteries at wind and solar farms. Battery storage at the residential scale also offers potential to address such issues with Virtual Power



Plants (VPPs) currently being trialled in Brisbane by the CSIRO, in Adelaide by AGL, and more broadly in South Australia by Tesla and the South Australia Government through 50,000 rooftop solar and battery systems[19].

Decreased concentration of energy asset ownership

In addition to a change in the energy supply mix and storage capacity, another evolution is taking place, a change in the ownership of Australia’s energy production assets. While energy assets in Australia have experienced various forms of ownership over the previous decades, new owners are entering the market. Superannuation funds represent a logical investor for renewable energy assets as they require returns over many decades, unlike many other investors who favour short term returns. Although resulting in in a decrease in market concentration, ownership through entities such as superannuation funds may not seem dissimilar from the current situation of government owned or publicly owned investments. However, the new trend of individual corporations investing in energy producing assets such as solar and wind farms, often in combination with energy storage, is in stark contrast to the history of the system.

The well publicised project by billionaire entrepreneur Sanjeev Gupta in South Australia[20] might be considered by some as a unique case. On the contrary, a number of projects by individual organisations exist including multiple projects by The University of Queensland’s such as the $125 million Warwick Solar Farm[21]. The solar farm will allow UQ to offset their entire greenhouse gas emissions and secure control of their energy future, reflecting a significant shift in the dynamics of the market. If a University has the ability, will, and financial incentive to undertake such an unprecedented move into the energy market it is foreseeable that many private companies will seek to follow suit. The implications for the electricity market resulting from this change in ownership of assets will emerge over time, however, initial indications suggest co-ordinating the impact to the network is becoming more complex.

Changing policy dynamics

States taking the lead

Despite the attempts of both major political parties, the Federal Government has failed to provide policy certainty, regardless of the merits of the various proposed policies. Within this setting unprecedented changes in policy dynamics between State and Federal Governments have emerged. Who would have predicted the South Australian Government's move into the energy market, becoming a global leader with installation of the world's largest battery storage system? Bold policy moves have not been limited to South Australia with a number of States stepping in to legislate strong renewables targets in the absence of sufficient Federal policy.

Return on Investment rules and appeals abolished

Further complexity has emerged for the energy industry with the Federal Government recently taking the unprecedented step of removing the rules associated with setting the Return on Investment (ROI) that network businesses are allowed to earn, as well as removing the access to appeals through the Federal Court. Professor of Finance Stephen Gray from The University of Queensland explains that "one key plank of the governance and accountability framework for the National Electricity Market has always been the separation of powers between the Australian Energy Markets Commission (as the custodian of the National Electricity Rules) and the Australian Energy Regulator (who operates under those Rules). Another key plank has always been that network businesses and consumers have always had access to Limited Merits Review, whereby AER decisions could be challenged if it could be shown that the AER had made an error, the correction of which would result in a 'materially preferable' decision that is in the long-run interests of consumers.

In an extraordinary development last year, the Federal Government sought to obtain COAG agreement to abolish reviews of AER decisions. Failing to obtain that agreement, the Federal Government acted unilaterally, by banning the appeal body from hearing any appeals. Further changes mean that the AER is also no longer subject to the National Electricity Rules when setting the allowed return for network businesses. The full effect that these political interventions will have on investor confidence remains to be seen."

Federal Government policy – uncertain and ineffective

Although the Federal Government's most recent policy did not follow the Government's own Finkel review key[22] recommendation to establish a clean Energy Target, the government initially created two main driving obligations:

1. **Reliability: to ensure electricity is dispatched across the NEM; and**
2. **Emissions: to ensure an average emissions per MWH over a compliance period.**

Following internal party discussions emissions were removed (followed by the Prime Minister) and subsequently the NEG, and at the time of writing the primary focus of future energy policy is said to be reliability. Under "reliability", the government had previously planned to ensure retailers obtained electricity from a range of sources including batteries, hydro, and gas. Under this policy it was estimated that wholesale electricity prices would be on average 23 per cent lower than without the guarantee over 2020-2030[23].

"In an extraordinary development last year, the Federal Government devised a method to abolish reviews of AER decisions, alarming investors throughout the sector."

Professor Stephen Gray, Professor of Finance, The University of Queensland

The Renewable Energy Target does not support the energy industry

A key challenge for Australia's energy industry will continue to be the government's policy on renewables. The government does not plan to extend the Renewable Energy Target (RET) past 2020 and, the renewables sector has already generated sufficient levels of energy to meet the 2030 target. With legislation failing to provide incentives for investment in renewables, the industry needs to take a long-term perspective noting that, in the long run, the need for renewables will continue to increase.

Emissions reduction policies fail to secure effective impact in the largest emitting industry

Perhaps the most contentious aspect of energy policy in Australia relates to attempts to date to intertwine Australia's energy and climate policy.

It is clear that electricity production is the leading source of greenhouse gas emissions within Australia. In particular, electricity contributes about 35% of all emissions within Australia[24]. The bringing together of energy and climate policy, while a good decision in theory, will present the industry with fresh challenges within the next decade.

The period from 1990-2017 witnessed the most significant growth in emissions from the electricity sector increasing emissions by 42.6%.

Since 2008 the sector has started to reverse this trend[25]. AEMO's latest report for Q2 2018 shows emissions continuing to reduce from the electricity market for absolute emissions and emissions intensity. This is due to the closure of the Hazelwood brown-coal power station and increased renewables supply, however, the lack of stable and effective climate policy remains a major hurdle[26].

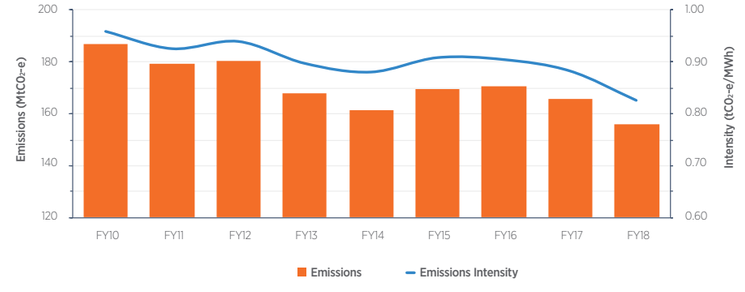


Figure 4. NEM annual emissions and emissions intensity [27 (p10)]

Currently the voluntary Direct Action Plan has reduced emissions from predominately non-electricity generation sources. In particular the process of savannah burning is the most significant pollution abater within the scheme. Another policy initiative to reduce emissions is the Emissions Reduction Fund's safeguard mechanism. While the aim of the mechanism is to limit total emissions to an agreed "baseline", calculated on the existing operations of organisations, the government has increased the baselines and therefore the allowable emissions.

With a recent consultation document released by the Federal Government indicating baselines could be increased further, simply to bring them in line with current circumstances, the potential benefit of this mechanism to reduce emissions, and the ERF itself is ultimately negated[28].

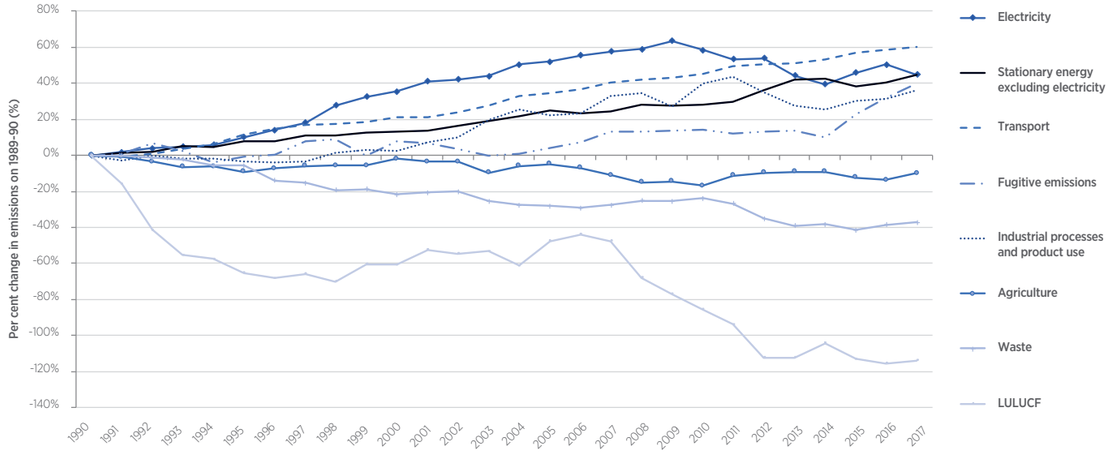


Figure 5. Percentage change in emissions by sector since 1990, Australia, financial years, 1990-2017 [29 (p9)]

Notably, there is little scope for the electricity sector to participate in the current climate policy. Given the prominence of electricity generation as an emitter of greenhouse gases this sector will continue to represent a key mitigation challenge in the future. Based on Australia's emissions pledge under the Paris Agreement, there will, over the next decade need to be innovative climate policy implemented, which may impact the industry.

Over the long term, industry needs to factor in the cost of carbon and ensure when carbon pricing becomes a politically viable solution, the industry is ready to meet these new challenges.

New research perspectives to support organisations and the energy industry

Systems Dynamics modelling of the energy network transition

As industry and governments struggle to develop cogent solutions to the energy challenge, it may be the emergence of a large and engaged residential consumer base that could provide the impetus for transformational change in the electricity sector.

The recent multi-billion dollar global boom in residential solar photovoltaics (PV) symbolises both the power of consumer-led transition and the challenge. In Australia, PV growth has exceeded all forecasts, increasing from approximately 40 megawatts in 2008 to more than 8 gigawatts in 2018. Despite its many benefits however, the rapid integration of PV into existing centralised electricity systems has not always been optimal. It has resulted in economic impacts for electricity sector participants, power quality and system stability issues, electricity price rises and negative social-equity outcomes.

Even as industry attempts to address many of these issues, affordable residential battery systems have now begun to enter the market representing the next wave of disruptive change. When coupled with solar power, battery technology could enable millions of small-scale electricity end-users to participate in the market as both generators and consumers, reducing total system demand while challenging the business models of incumbent utilities. This development will not only amplify existing operational complexity in electricity markets, but if the technology is poorly integrated, impact the efficient provision of electricity.

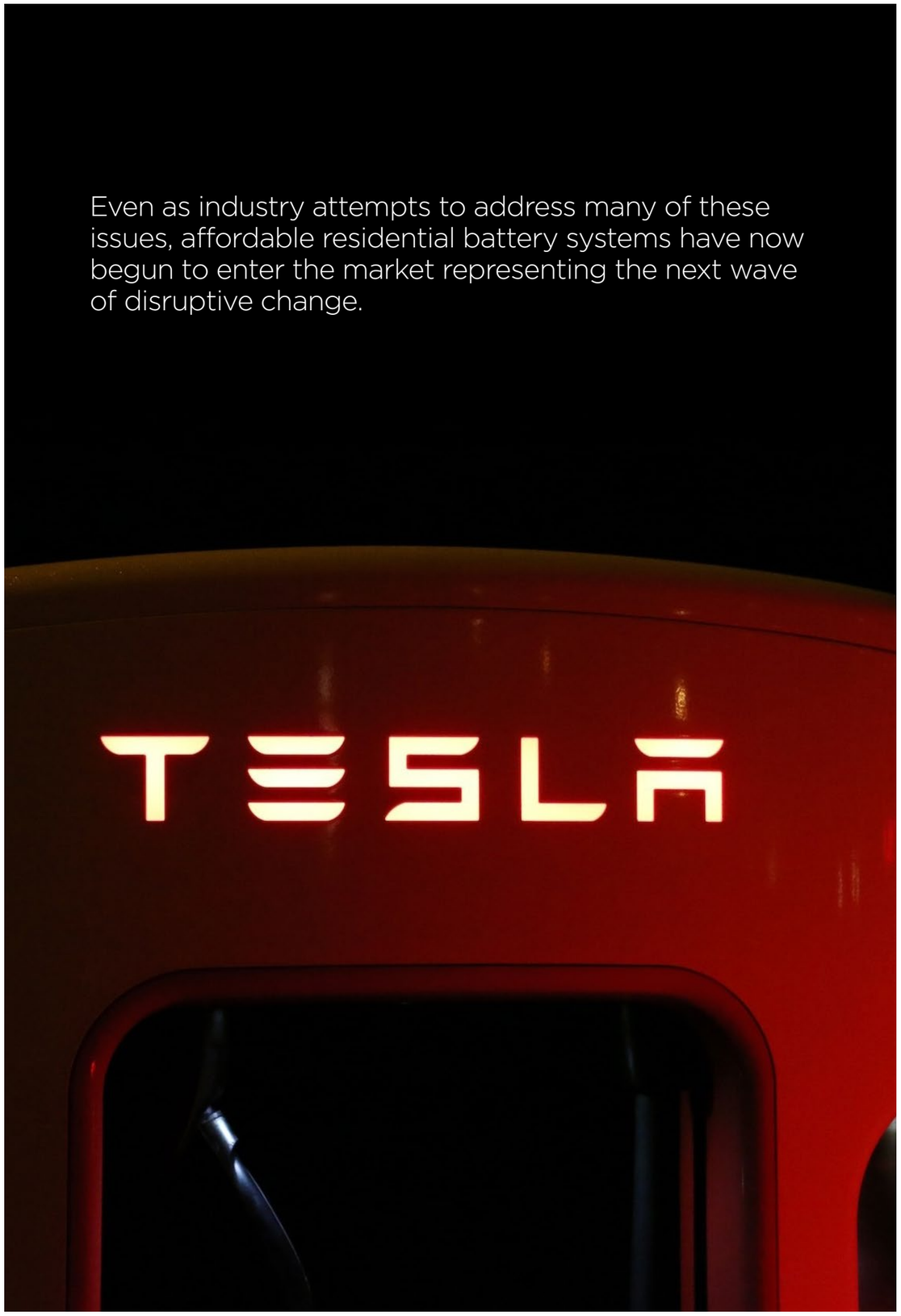
To enable optimal integration, government and industry must recognise and respond to the pervasive dynamics that are driving the transition. Indeed, these dynamics stem in part from the failure of the existing electricity sector to recognise and respond to the changing needs of the residential electricity consumer. Should these needs remain unmet, and consumers turn at-scale to grid alternatives such as PV and batteries, the probability of negative consequences along the supply chain increases dramatically. This could include a decline in asset utilisation, asset impairment, increasing costs and broader social and economic impacts.

Despite the magnitude of these risks, planning for and effectively implementing positive change in the electricity sector remains notoriously difficult. This is because energy systems are frequently defined and modelled as techno-economic phenomenon, when in fact they are socially driven systems characterised by ‘messy’ real-world complexity. This is especially true for residential PV and battery energy storage where the outcome of the impending sector transition could largely depend on the actions of the consumer, particularly the choice they make in regard to the type of battery they purchase and the way in which it is used.

To be most effective, government and industry must leverage trans-disciplinary techniques to better understand and plan for electricity system change.

Traditional linear approaches to modelling can be limited in understanding and anticipating impacts in complex systems over time.

Even as industry attempts to address many of these issues, affordable residential battery systems have now begun to enter the market representing the next wave of disruptive change.



If successful, PV and battery technology could act as a catalyst for a new era of consumer engagement and participation in the electricity market. This could drive productivity improvements and market innovation along the supply chain, realising new sources of profit for the sector and ultimately achieving the best outcomes for individuals and society more broadly.

Such approaches break a system into its component parts to investigate the linear impact of cause and effect while often ignoring the interactions from which the complexity and the behaviour of the system are derived.

To avoid these pitfalls, there has been an increasing focus on using sophisticated, whole of system modelling techniques such as systems dynamics to better plan for electricity sector transitions.

System dynamics can map and quantify multidimensional causal relationships, while incorporating the impacts of feedback loops and time delays. This is particularly relevant for consumer-led change in the electricity sector, where large numbers of small end-users with differing motivations have the ability to disrupt an essential service.

As the electricity supply system underpins the structure and function of modern economies it is becoming increasingly urgent to prepare for disruption stemming from the rise of solar and battery energy storage. Using system dynamics, it becomes clear that broad structural change in the industry is required - effectively a paradigm shift - that recognises for the first time that consumers will have a viable cost-effective alternative to the existing centralised electricity supply system. In this environment, government and industry will need to work with the community to identify and unlock shared value along the supply chain. If successful, PV and battery technology could act as a catalyst for a new era of consumer engagement and participation in the electricity market. This could drive productivity improvements and market innovation along the supply chain, realising new sources of profit for the sector and ultimately achieving the best outcomes for individuals and society more broadly.

Organizations need to prepare for changes and dynamic capabilities will be essential

Despite policy uncertainty there remains a surety that major change is coming. With ageing infrastructure and global trends towards reducing carbon dioxide emissions the need to replace existing infrastructure with lower carbon alternatives could not be more certain. From a top down perspective pressure on Australia as a nation to reduce its carbon dioxide emissions is likely to continue to increase necessitating an accelerated transition to a low carbon energy market. Pressure for decarbonisation and an altered energy mix is also mounting through demand changes and societal expectations within the Australian public.

Among the Australian population beliefs in climate change have now reached 70% with 90% believing the Federal Government holds the responsibility to act (Climate Council, 2016). When considering climate beliefs a generational influence has been reported to exist with 83% of people between the ages of 18 and 34 found to believe in climate change compared to 73% of respondents aged over 55 years as reported in the Climate Council Climate of the Nation 2016 report. The importance of this generational distinction in beliefs should not be underestimated.

Notable examples of younger global leaders include Jacinda Ardern (New Zealand), Justin Trudeau (Canada) and Emmanuel Macron (France). Consistent with the general demographic trends in climate change acceptance, the younger generation of leaders may be less likely to question the need to act on climate change. Further within Australia as recent generations progressively enter the market for energy products and develop their own investment portfolios, demand changes for new lower carbon products, ethical sourcing and comprehensive CSR reporting will also naturally increase.

So where do these trends leave managers from energy companies? The historic dominant view from energy executives has been that certainty is required for significant investments to be made. This view is understandable given the considerable number of energy policies which have been introduced, amended or removed over the last 20 years.

Firstly, through the retention of large stranded assets which have significant book values that will never be realised and secondly, by failing to maximise the opportunities presented through the changing market. These are both crucial factors in maintaining a long term competitive advantage. This section of the report examines how managers can act to prepare for market evolution and invest in the absence of policy certainty by considering the potential assistance of dynamic capability development.

Dynamic capabilities are core areas of strategic management research. Essentially, they provide the ability for companies to adapt and change along with changes in their market environment. Kathleen Eisenhardt and Jeffery Martin (2000) remarked "Dynamic capabilities consist of specific strategic and organizational processes like product development, alliancing, and strategic decision making that create value for firms within dynamic markets by manipulating resources into new value-creating strategies."

Recent research that has been conducted by the University of Queensland Business School in the energy sector has found that leading energy companies have developed considerable dynamic capabilities for change in several critical areas however research indicates that further development is needed for decarbonisation such as in areas of risk evaluation/management; financing models; product development; tech integration.

Within the sections below seven key areas of dynamic capability development for organisations looking to decarbonise will be presented and discussed.

1. **Stakeholder Engagement**

   Capabilities in the area of stakeholder engagement, promoting knowledge of both the internal and external firm environment, were shown to be a critical capability area of development in the energy companies studied. Stakeholder interactions have the ability to shape not only the internal decisions and processes within the firm but also the external operational environment highlighting the temporal and structural implications of meaningful stakeholder engagement. Internal engagement between staff within the company can promote a transparent knowledge of areas of strength and vulnerability to the decarbonisation process, critical for a successful transformation. Externally focused engagement may take the form of participation in industry bodies, customer forums, meetings with government, interactions with supplies, NGOs and new tech developers. Both direct face to face interactions and indirect formats such as reports, submissions or participation in the development of research and white papers can form part of the engagement process.

"Stakeholder engagement is critical to ensuring that companies are able to anticipate directional change within society. The concepts of materiality, responsiveness and inclusivity are critical in this context."

Dr Tim Nelson, Chief Economist, AGL Energy Ltd

If managers continue to wait for certainty in energy policy before investing they risk their own viability.

2. **Knowledge assimilation/transferal**

   Connected with the process of stakeholder engagement is the capability to assimilate and transfer knowledge. All markets are changing necessitating that managers become hyperaware of not only changes within their market place but also those of their counterparts. Distributed energy, battery storage and technological innovation in sectors outside the energy industry will have implications for the demand for traditional energy products. Knowledge of technology change, customer preferences, new competitor products and market changes are of little use if they don't reach the individuals impacted. Consideration of department structures and information flows within energy utilities are necessary to prevent silos of knowledge creation and decision making.

3. **Ambidextrous strategic planning**

   Ambidexterity as a dynamic capability was promoted in 2008 by O'Reilly and Tushman connecting the ability to simultaneously explore and exploit with long term success. Managing competing agenda's and simultaneous cognitive frames can be challenging requiring conscious decisions by management to promote ambidextrous planning. In addition to traditional forecasting the process of scenario planning is increasingly being included in the strategic planning tool kit of energy utilities.

Made popular by Shell in the 1970's scenario planning offers a process by which organisations can stress test their companies for potential revolutionary market change. Such change is possible and potentially probable for energy utilities. The question companies will increasingly need to consider is whether their core competency is still as electricity manufacturers or whether they are now predominantly a service based industry. Careful consideration must now be paid in vertically integrated utilities to how these conflicting identities are managed and the potential role new business models, such as those of the sharing economy, will play in their future operations.

4. Product development

The energy industry is brimming with new technology from renewable generation and batteries on the generation side, to smart meters and sensor activated control systems for energy consumers. These new technologies are increasingly reaching or approaching cost parity with traditional sources leaving the challenge in the area of deployment and system integration. This challenge can also be viewed as an opportunity for companies with capabilities in new product development. Services such as demand side management and leasing arrangements for distributed energy and batteries offer a new world of flexibility and freedom for energy users. The question is whether energy products can fill the growing market for experiential and personalised products and services. Competitive advantages lie in the ability to differentiate from rivals and lead in new market offerings.

5. Culture

Organisational culture is of key importance particularly in times of uncertainty when external messaging through media and social interactions can work against cohesive corporate decision making. Change requires not only strong leadership and innovation but a supportive corporate culture matched to strategy. The culture of the organisations set by the leadership team around core corporate values influences the internal messaging and adaptability of employees. Whether or not 'culture eats strategy for breakfast' as suggested in the famous quote attributed to Peter Drucker, culture is certainly the foundation on which cohesive strategic decision making is based.

6. Risk/return evaluation and alternate financing options

The evaluation of risk in an uncertain market is a major challenge when it comes to divesting and investing in large energy assets and managing altered consumer demands. Potential to spread the risk for example through different types of generation assets with contrasting production profiles, varying customer demographics, evolving retail products and novel financing arrangements are needed to avoid the potential to be left behind by market change. Consumer leasing arrangements on distributed generation, asset funding by superannuation or alternative financing arrangements should all be explored as ways to facilitate a transition to a low carbon economy. Companies can also consider whether there is a place for routinely including longer term secondary risks and benefits in the decision making process such as through consumer loyalty, marketing advantage and technological innovation.

There is a need to optimise development of capabilities to individual portfolio and market segments to create a competitive advantage and also to link stakeholder engagement with analysis and strategic planning. So it's not just the capabilities but the way they are co-created or developed which further enhances a company's competitive positioning.

Conclusion

While the Australian energy market may continue to face challenges associated with a lack of stable policy over the short term, organizations need to prepare for de-carbonisation of the energy system. Market disruption resulting from residential and commercial scale renewable energy and storage projects will continue to impose new challenges on the network which must be addressed.

Leading research by The University of Queensland into the unfolding evolution of the energy network provides clear evidence of strategies which can assist organisations to prepare for these continued changes. Sophisticated modelling such as systems dynamics has the ability to inform organisations of the 'reality' of drivers of disruptive technology and how the system will likely react. Furthermore, the development of dynamic capabilities within organisations will improve their ability to adapt to future changes in the market. These fresh perspectives offer the ability for organisations to embrace the uncertainty which has in some cases paralysed decision making, and to move the industry forward to its inevitable de-carbonised future.

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For more information, please contact

T: +61 7 3316 0628

E: enquiries@aibe.uq.edu.au

W: aibe.uq.edu.au

A: Level 3, GPN3 Building (39a)
Corner Campbell Road and Blair Drive
The University of Queensland
St Lucia QLD 4072, Australia

CRICOS Provider Number 00025B