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Australian microgrids: Catalysing the regional energy transition

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Visible impacts of a changing climate across the nation, spiralling energy prices, and international political pressure have prompted a renewed focus by State and Federal Governments on the decarbonisation of the Australian economy, bringing vigour and momentum to the country's renewable energy transition. This potential reallocation of energy resources away from a centralised model of generation to a more distributed approach has increased the interest in local energy solutions, bolstered by continuing reductions in the cost of renewable energy generation and storage. Microgrids and standalone power systems are attracting attention from regional and remote communities as a potential solution to their woes of energy insecurity and unreliability.

Using the lens of strategic niche management and viewing each initiative as a protected space of innovation, this research analyses 20 microgrid feasibility projects across regional and remote Australia funded by the Federal Government's Regional and Remote Communities Reliability Fund (RRCRF). This funding supported feasibility studies investigating microgrid technologies to replace, upgrade or supplement existing electricity supply arrangements in off-grid and fringe-of-grid communities in regional and remote areas. Using semi-structured interviews with a range of key stakeholders, this research explored key characteristics of these projects encompassing drivers, stakeholder engagement, ownership, and business models, all of which we previously identified as key challenges in developing local grids. Additionally, this research explores the key barriers and opportunities confronting the projects.

The findings confirm that the development of microgrids in Australia remains at a nascent stage, with projects in differing locations grappling with similar opportunities and challenges. Ownership and business models continue to evolve, complicated by legacy regulation and entrenched market players within and between the states and territories. Surprisingly, technology appears to be an enabler rather than an obstacle, while social and cultural drivers often take precedence over economic and environmental issues, particularly in remote areas.

The research suggests that much work remains to be undertaken in the regulatory, financial, and governance realms if the benefits of microgrids are to be fully realised for all stakeholders. The role of government remains critical in providing early-stage support for innovation, development, and implementation of microgrids through funding, policy, and regulatory change, and facilitating knowledge exchange. In addition, a key problem to be tackled is the need for a regulatory framework to permit microgrids to fit more easily within the national energy market (NEM).

Electricity tariffs and total cost of ownership of corporate electric vehicles

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Flexible demand is considered a key component of the energy transition. This includes existing as well as emerging loads such as charging electric vehicles (EVs). This study presents an in-depth investigation into the role that corporate BEVs can play in providing load flexibility services and generating alternative financial benefits under a variety of electricity tariffs. These include the flat tariff, Time of Use (TOU) tariff, and simulated dynamic tariff, also known as Real Time Pricing (RTP). We use Total Cost of Ownership model that factors such as impact of bi-directional charging, battery degradation cost, tax impacts and compare fleet vehicles under varying tariff structures. The findings of this study support that the integration of bi-directional load flexibility services in BEVs can result in enhanced financial outcomes, even when factoring in the costs related to battery degradation. Furthermore, this study found that introduction of dynamic RTP like tariffs may boost the financial appeal of investing in corporate-owned BEVs.

Are lands sufficient for solar and onshore wind in the Group of Twenty (G20) and Australia to supply 2050 electricity demands?

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Australia is a member state of the Group of Twenty (G20). In September 2023, G20 leaders endorsed accelerating the transition to renewable energy at the G20 New Delhi summit. G20 members account for 62% of the world's population, 85% of the global economy, 86% of global final electricity demand and 87% of global energy-related CO2 emissions. Thus, the success of the Paris Climate Agreement is heavily dependent upon G20 members successfully transitioning their energy supply towards sustainable sources of electricity, such as onshore wind and solar.

Our study is the first comparative geospatial analysis of solar energy and wind energy potentials across the G20 member states, including Australia. Here, we calculated geographical potential areas and capacity for solar and onshore wind energy using GIS-based spatial analysis across the G20.

Our results confirmed that there are sufficient solar and onshore wind energy resources available to enable a transition towards a decarbonised energy supply by 2050, while also considering the potential electrical demand increase caused by electrification and fuel switching. Our spatial analysis identified that a total of 33.6 million square kilometres (km2) of land has potential for solar energy production within G20 member countries, which could provide 965,291 TWh/ year of solar electricity generation potential. Our results also indicated that 31.1 million km2 of land is suitable for onshore wind, which has the potential generate 466,925 TWh/year of wind electricity. These solar and wind potential areas in the G20 are sufficient to generate over 43 times (solar) or 21 times (wind) the global electricity demand in 2020, or 14 times (solar) and 7 times (wind) the projected global demand in 2050.

Of all the G20 countries, our analysis highlighted Australia as having the largest comparative potential for solar energy and onshore wind energy in terms of the 2050 national electricity demand. This is largely due to its abundant solar, wind and land resources, with a small national population and relatively small energy demand. Our results indicated that the use of only 0.4% of the solar potential area or 0.8% of the wind potential area in Australia, would be sufficient to supply the country’s electricity demand in 2050. In addition to decarbonisation benefits, the renewable energy can also offer many more advantages to broader society through community projects, such as strengthening of energy security, equity and resilience, and local socio-economic benefits for remote and rural communities in the context of Australia.

Is renewable energy sustainable? Relationships between renewable energy production and sustainable development goals

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Achieving net zero carbon emissions has become the holy grail of energy supply. This is driven by the urgent need to decarbonise to avert the climate crisis and has resulted in the proliferation of renewable energy systems. However, the focus on using renewables for mitigating climate change has the potential to result in carbon tunnel vision, where the ability to achieve broader sustainability goals could fall victim to the myopic pursuit of achieving net zero emissions. Consequently, there is a need to better understand the potential positive and negative impacts of renewable energy systems on sustainability.

In order to meet this need, we present a high-level overview of the potential enabling (positive) and inhibiting (negative) relationships between renewable energy systems (RES) and the United Nation's Sustainable Development Goals (SDGs) based on a review of the literature. We pay particular attention to how these relationships vary for different types of renewable energy systems (biomass, hydropower, solar, geothermal, wind, wave & tidal) and how different aspects of the renewable energy production process affect the environmental, social and economic aspects of sustainability. This enables us to obtain a better understanding of (i) the degree of sustainability of renewable energy systems, (ii) the impacts of adopting carbon tunnel vision, and (iii) what we need to do to broaden our vision to achieve more sustainable outcomes.

Mapping Australia's home energy upgrade ecosystem and unpacking the elusive one-stop shop

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Recent years have seen a dramatic increase in public and industry interest in upgrading our residential building stock, as the electrification imperative begins to take hold. It is increasingly recognised that to meet our climate commitments, high performing buildings are needed alongside electrification and decarbonisation of the grid. State-based certificate schemes have helped to encourage efficiency upgrades on a measure-by-measure basis, to differing degrees by jurisdiction. Yet, at least until recently, the holy grail of a simple one-stop-shop delivery model – through which householders can have all of their needs met by a single, trusted delivery entity – has remained elusive. This presentation will examine the state of Australia's home energy upgrade delivery ecosystem to identify key roles of the active players, apparent gaps, and where the most promising developments towards the one-stop-shop are emerging. It will begin to sketch out the barriers and opportunities for achieving residential transformation at scale, and introduce a research program for understanding the delivery models of a decarbonised residential market.

This presentation will showcase early work on the RACE for 2023 Energy Upgrades for Australian Homes project, launched as a three-year collaboration between seven research partners.