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Battery Storage and
Grid Integration
Program

An initiative of The Australian National University

The ANU Battery Storage and Grid Integration Program submission to the Department of Industry, Science, Energy and Resources Technology Investment Roadmap Discussion Paper.

Established in 2018 the Battery Storage and Grid Integration Program (<https://bsgip.com/>) is a research, development and demonstration program supported by industry, state and federal government. The Program has a strong focus on an interdisciplinary, socio-techno-economic approach to the delivery of real-world energy projects.

We welcome the Government's Technology Investment Roadmap (The Roadmap) and in this submission we propose **three principles and three metrics** to underpin the future refinement of The Roadmap. The key principles of our submission are :

- **Electrification across all sectors**
- **Local activities and investments**
- **Providing global leadership**

We believe the **assessment of technology priorities within the roadmap should be measured against technical, social and economic metrics**. We would be happy to provide further information or details upon request.

a) The challenges, global trends and competitive advantages that should be considered in setting Australia's technology priorities.

The world is in the midst of century defining changes. The existential threats of human-induced climate change and the emergent impacts of COVID-19 have materially altered the world's economic, social, and technological systems. The prosperity of nations in the 21st century will be determined by how we mitigate and respond to the threats and impacts of human-induced climate change and COVID-19. The extent of the impact of COVID-19 was not foreseen during the preparation of The Roadmap but now demands that these two challenges be addressed with an integrated strategy.

Australia is uniquely exposed to the threats of human-induced climate change, leaving many key economic sectors, such as agriculture, tourism and energy, extremely vulnerable. However, Australia has important competitive advantages with our strong track record in research and development and ideal wind and solar resources for the generation of abundant renewable energy. These factors position Australia well for a future technology roadmap that will address the threats of human-induced climate change and underpin economic growth and social wellbeing.

In responding to the threats of climate change we should learn from our ongoing success in responding to the COVID-19 crisis: the value of the leadership of experts; the importance of the collective and aligned actions of government, research organisations, academia and industry, and; the significant opportunity for Australia to contribute to solutions for the world.

We detail the three principles and three metrics that we believe will most effectively underpin the future development of The Roadmap.

Principle 1. Electrification across all sectors

Electrifying as much as possible, as quickly as possible, should be a key factor when considering Australia's technology priorities. To date, Australia has had most success in reducing carbon emissions through the electricity generation sector, due to the rapid uptake of renewable energy generation technologies. Building economy-wide carbon reduction on top of deep and broad electrification in all sectors is thus a sensible approach to technology prioritisation in The Roadmap.

Principle 2. Local activities and investments

The second principle is to direct activities and investments to local communities across Australia. Such an approach will provide more effective economic stimulus; achieve more efficient whole of economy decarbonisation; and more equitably create opportunities for jobs, upskilling, and improved living conditions. Local investments and activities stand to better transition the economy to a low-carbon future whilst enhancing local resilience against both climate-change and energy transition risks. Local investments also have a higher economic multiplier effect, creating greater economic activity than the direct investment amount^{1,2}.

Principle 3. Providing global leadership

Australia can and should provide global leadership in the development and deployment of technologies that achieve deep carbon reduction. As an example, the International Renewable Energy Agency (IRENA) recently singled out Australia as a potential new energy leader. IRENA highlighted our opportunity to enhance our global influence and reach, through our ability to take advantage of renewable energy technologies.

Australia has additional global leadership opportunities in areas including the grid integration of renewables and smart grid technologies. Australia is well placed to further develop these technology capabilities, business models and know-how to lead the global response to climate change. Embracing this opportunity will not only enhance our global stature and influence but it will generate significant economic opportunities and rewards for all Australians.

In setting Australia's technology priorities, we believe candidate technologies need to be assessed against the following three metrics, based on the best available evidence. This evidence, and the assessment based upon it, needs to be published transparently to ensure an informed and productive process that builds upon the wealth of knowledge among both experts and the public at large.

Metric 1. Technical

Carbon intensity, and carbon emissions (and abatements) need to be a key metric in assessing technology priorities in The Roadmap. Scope 3 emissions must be accounted for and represent global best practice for such low-carbon technology assessments.

¹Auerbach, A. J., and Y. Gorodnichenko, 2012: Fiscal multipliers in recession and expansion. Fiscal policy after the financial crisis, University of Chicago Press, 63–98.

²Baum, M. A., M. M. Poplawski-Ribeiro, and A. Weber, 2012: Fiscal Multipliers and the State of the Economy. International Monetary Fund,.

Metric 2. Social

We wish to emphasise that prioritisation within The Roadmap must consider social acceptance of technologies and the broader socio-technical implications of different technologies such as the rural/urban, skilled/unskilled, and gender divides. We would welcome adoption of an equivalent framework to the European Union Responsible Research and Innovation (RRI) which requires that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together to better align both the processes and outcomes with the values, needs and expectations of society.

Metric 3. Economic

Economic metrics should aim to quantify the economic impacts achieved throughout the community, not solely the quantum of (public and private) capital invested. The assessment framework should not only measure the number and skill level of new jobs created, but should also quantify the future prospects of these jobs in a low-carbon economy.

b) The shortlist of technologies that Australia could prioritise for achieving scale in deployment through its technology investments.

In assessing technologies against the principles and metrics outlined above, there are **four** technology areas that Australia should prioritise:

1. Grid integration & modernisation - including automation, orchestration and co-ordination.
2. Renewable energy generation - primarily wind and solar generation and including behind-the-meter Distributed Energy Resources (DER).
3. Energy storage - including behind-the-meter and community batteries.
4. Electric vehicles - including vehicle-to-grid (V2G) capabilities.

It is clear from both of the recent AEMO Integrated Systems Plans and the most recent CSIRO GenCost Report³ that **renewable energy generation** (primarily wind and solar generation) already represent the cheapest form of new build generation. The economic advantage of renewable wind and solar generation over any other form of generation will increase over the decades to 2050. Renewable generation technologies will also create jobs nationally, including in rural and regional Australia⁴.

To support this broad transition to renewable energy generation, it will be necessary to satisfy the key technical criteria for operating a power system⁵. This amounts to jointly and simultaneously managing energy reliability, energy security, and access to network capacity (at both transmission and distribution level). To satisfy these technical criteria, Australia will rely on expanded transmission infrastructure and various forms of **energy storage including pumped hydro, and residential, community and utility battery storage**.

A portfolio of **energy storage** will provide the necessary balancing and firming capabilities to fill-in the gaps of renewable generation and ensure that current levels of energy reliability can be maintained. Battery storage will provide the necessary services to ensure that energy security is maintained and there is already ample

³ https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/Inputs-Assumptions-Methodologies/2019/CSIRO-GenCost2019-20_DraftforReview.pdf

⁴ <https://assets.cleanenergycouncil.org.au/documents/resources/reports/Clean-Energy-at-Work/The-Clean-Energy-Council-Clean-Energy-at-Work-2020.pdf>

⁵ https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power-system-requirements.pdf

evidence⁶ that battery storage can provide enhanced energy security services over existing fossil-fuel fired generators. From an economic perspective, renewable generation firming with energy storage is already cost competitive with fossil fuel fired generation. By 2030 renewable generation firming with energy storage will be the cheapest source of firm energy supply³.

At the same time, it is widely acknowledged that the percentage of **distributed energy resources** in Australia, including behind the meter solar PV, battery storage, and demand response is expected to increase dramatically over the decades to 2050. This will contribute to Australia leading the world in levels of decentralisation after 2025⁷.

Alongside, uptake of **distributed energy resources**, there is also significant forecast uptake of **electric vehicles** in Australia⁸. The growth in EVs will be driven over the coming decade by further reductions in price, enhanced range and the phasing out of internal combustion engines, making EVs the de facto new car choice by 2035⁸. When integrated effectively into the power systems through vehicle-to-grid (V2G) capabilities, **electric vehicles** will also provide an additional source of grid-connected energy storage to support energy reliability and energy security.

Linking these renewable generation, energy storage, DER, and electric vehicles together will be new sophisticated **grid integration capabilities** which include new functionality for both system and network operators. Australia already leads the world in the development of these capabilities whose development has been driven by the important recognition that operating a 21st century power system requires 21st century systems and operating paradigms. Australia has the potential to lead the world in all areas of grid integration and many Australian high growth technology companies are already considered leaders in this field.

Included in these newly developed **grid integration capabilities** will be technologies that underpin the operation of microgrids and stand-alone power systems. A recent report⁹ emphasised the significant opportunities for new jobs, particularly in regional areas, as well as export opportunities.

In contrast to the opportunities provided by the portfolio of technology capabilities outlined above, we believe that Gas, CCS, and Nuclear technologies should not be considered further for inclusion as priority areas in The Roadmap.

Gas generation is not needed to ensure long term energy reliability or energy security and will increasingly not be cost competitive when compared against storage firming renewable generation. Whilst gas-fired electricity generation may reduce carbon emissions when compared against coal-fired electricity generation it will still result in considerable carbon emissions at a time when deep cuts in emissions are necessary.

Both CCS and Nuclear technologies have low technology readiness levels and are not cost-competitive when compared with renewable energy generation alternatives. Nuclear generation is currently over five times more expensive than renewable generation and is not anticipated to have price reductions until after 2030. Given the emphasis on moving quickly to decarbonise our economy, we believe that neither technology should be prioritised in The Roadmap moving forward.

⁶ https://www.aemo.com.au/-/media/Files/Media_Centre/2018/Initial-operation-of-the-Hornsedale-Power-Reserve.pdf

⁷ <https://about.bnef.com/blog/neo-2017-presentation-csis/>

⁸ <https://arena.gov.au/assets/2018/06/australian-ev-market-study-report.pdf>

⁹ <https://www.horizonpower.com.au/media/4469/2018-wa-microgrids-inquiry.pdf>

c) Goals for leveraging private investment.

We believe that the most beneficial outcomes for Australia will arise from the co-ordinated efforts of government, industry, research organisations and academia.

Technologies with high technology and commercial readiness levels, like wind and solar generation, are already receiving substantial private investment. Further private investment in these areas will follow energy and environmental policy and regulatory certainty. Mandating more ambitious emission reduction targets at a federal level would also provide significant investment certainty to encourage private investment through reducing sovereign risk.

For technologies with medium technology or commercial readiness levels, we would strongly encourage the use of existing organisations and funding programs to encourage private co-investment. Such an approach would include the programs operated by both ARENA and the CEFC which have had considerable success in maturing technologies and supporting large scale deployment through encouraging private co-investment.

Where new research and development (R&D) activities are identified, we strongly encourage the government to support the involvement of local R&D partners including universities, and Australian-based high-growth technology companies and SMEs. This will create broader domestic capability and capacity but will also result in the generation of potentially valuable intellectual property that can underpin future businesses, industries and export opportunities.

Given that Government is likely to invest heavily in supporting the development of some technologies prioritised in The Roadmap, we would recommend that the Government structure any public support and investments so that the taxpayer benefits from any future commercial upside.