MONASH University

MONASH ENERGY INSTITUTE

Monash University's Response to the Department of Industry, Science, Energy and Resources

Technology Investment Roadmap Discussion Paper

A framework to accelerate low emissions technologies

Context The Australian Government's Department of Industry, Science, Energy and Resources released the Technology Investment Roadmap for public consultation in May 2020. The Technology Investment Roadmap is expected to help inform Australia's Low Emissions Technology Statement and support Australia's Long-Term Emissions Reduction Strategy.

Response

This paper presents a response by members of the Monash Energy Institute and other Monash University researchers to questions embedded in the *Technology Investment Roadmap Discussion Paper*.[1]

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

Challenges

- The right balance must be struck between investment in technologies and innovative market designs to reduce emissions in Australia at the lowest cost possible.
- Investment is required to establish an ecosystem that is able to translate early stage and applied R&D into demonstration and commercialisation stages. For example, outcomes arising from ARC-funded Centres of Excellences in energy (ACEx, ACES, FLEET) have huge potential but lack a clear pathway towards commercialisation and lack resources to do so (capital, institutional support etc.).

[1] Section titles throughout this submission reflect the language and order of items in the Government's call for stakeholder input.

- The talent pipeline must be supported to accelerate the collaboration of appropriately skilled graduates and doctoral students in research and development. Such talent is also needed to support the capability enhancements that will drive adoption of sustainable behaviours in organisations.
- There are not yet available the decision support software tools and operational controls and optimisation systems for planning and operating a high renewables grid (both transmission connected and DER). We have elements but standardised integration methodologies and components (hardware and software) do not exist locally or globally.
- Stakeholder buy-in can be difficult to secure. Transitions have both social and technological elements. The assumption that a technology-led process of change will be sufficient to bring about the desired effects can inadvertently become a barrier to change.
- The hydrogen future for Australia is uncertain, with the majority of planned R&D and production investments arising from China, US, EU and Norway [IEA].

Global trends

- Government investment in R&D (energy) has grown steadily since 2016 to around $30b after a period of decline. Low carbon energy technologies[2] make up a rising majority (80%) of the R&D investment with China, US, EU contributing over 80% of the energy R&D investments [IEA].
- Corporate R&D energy investment has been steadily increasing to around $85b (2019) since 2010. Automotive (efficiency, reduced emissions, electric vehicles) and electricity (generation, networks) have observed steady growth [IEA].
- Electrolysers to produce hydrogen are being installed at a rapid rate from around 25 MWe (2019) to planned[3] 140 MWe (2020) with the majority to be used for vehicles and industrial application. This planned growth is primarily observed in China and the EU [IEA].

Competitive advantages

- With Australia leading globally on the penetration of wind and solar in some regions (SA and WA) and roof PV penetration, we can trial existing innovations and develop and test new methods and technologies (such as new smart inverter algorithms). These can then form the basis of new export industries for technology and know-how.
- Excellent research and innovation in areas including solar, hydrogen (and hydrogen carriers including ammonia) is well under way. Moreover, we are strongly growing digital energy technologies based on machine learning and artificial intelligence from the academic sector (and Energy focus from Data61 and CSIRO) and commercial start-ups with a global track record e.g. GreenSync, Energy Exemplar, Solcast.
- Ease of business, multiple universities in the top 100 globally, and immigration policies attract and retain world class talent at all levels.
- Geographically, we are close to emerging economies in the Asian region.
- Australia has vast amounts of underutilised land and natural resources.

[2] Energy efficiency, carbon capture and storage, renewables, nuclear, hydrogen, energy storage and cross-cutting (smart grids).

[3] Although planned installations are likely to be delayed due to COVID impacts, the trend towards a rapid expansion is clear.

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

- Pumped hydro energy storage (drawing on existing surveys for off-river sites and repurposing disused mine sites)
- Digital technology enablers (artificial intelligence, digital twins, etc.)
- Grid simulation, planning and operation (for system security) technology (including remote and microgrids)
- DER control and orchestration hardware and software
- Advanced solar photovoltaics (including transparent tiles and windows)
- Concentrating Solar Technologies
- Carbon capture and storage
- Hydrogen (and hydrogen carriers including ammonia)
- Hydrogen fuel cell heavy vehicles conversion
- Waste to energy (and other elements of the National Waste Policy and Action Plan)
- Passive design (buildings)
- Glazings
- Insulation and thermal materials
- Thermal storage
- Phase change materials
- New refrigerants
- Smart communication technologies
- High energy density battery technologies from earth-abundant Australian resources

c) Goals for leveraging private investment.

- Targeted pathways and incentives that make it easy for global companies and investors to partner with Australian Universities and/or deployment partners.
- Accelerating industry-R&D partnerships and innovation through the provision of targeted funding and supporting ecosystems for application/commercialisation.
- Enabling novel public-private partnerships to de-risk scaleup and commercialisation activities.

d) What broader issues, including infrastructure, skills, regulation or planning need to be worked through to enable priority technologies to be adopted at scale in Australia.

- An overarching policy framework to drive significant transition to a rapid uptake of low emission technologies is required.
- Social, behavioural and design research to understand human and societal needs as they will realistically evolve and translate into meaningful knowledge that will inform technology investment.
- Economics research to ascertain the impact and opportunities to increase the efficiency of our current energy market. Holistic economic understanding of increased renewables, demand side management, and carbon pricing is important to set correct incentives for transitioning to a low-carbon economy.
- Evaluation of energy technologies within the context of sustainability and how they contribute to circular economies and recycling opportunities.
- Significant reform for the R&D Tax credit and directed incentives (potentially linked to state level payroll tax discounts) to expand the talent pipeline that will drive future research and development and the adoption of sustainable behaviours in organisations.

e) Where Australia is well-placed to take advantage of future demand for low emissions technologies, and support global emissions reductions by helping to deepen trade, markets and global supply chains.

- Generation, ownership and commercialisation of new Intellectual Property (IP) through excellence in R&D and strong partnerships with companies that have a global presence for mass deployment.
- Partnerships with global companies to commercialise Australian IP offering products and services into countries with emerging markets and relatively high emissions. E.g. India.
- Strong partnerships with countries and companies that are "first movers" in making significant investments towards future low emission solutions with a view to establishing new industries.

f) Suggestions for economic stretch goals that could help establish pathways for the cost-effective deployment of priority technologies.

- Doubling energy productivity by 2030 - i.e. twice the economic output for the same amount of energy use, or half the energy use for the same amount of economic output.
- Net zero emissions by or before 2050.
- Lithium Ion Battery Cell: $50 per kWh cost by 2030 (currently at around $130/kWh), 500Wh/kg energy density, >10k cycle life, 30-year calendar life, charge rate of less than 10min and high safety record.
- Off-river pumped hydro that is cost equivalent with Snowy 2.0.

The Government is interested in partnering with industry, research institutions and others with relevant commercial or technical expertise to develop these economic stretch goals, which should be ambitious but achievable.

Monash University is a national leader in promoting research and industry engagement. The Monash Industry Council of Advisers (MICA) brings together a diverse and highly experienced group of chairpersons and CEOs from leading national and international corporations to support Monash University's industry engagement strategy. Council members provide our research teams with essential advice and counsel that is critical to ensuring effective collaborations between researchers and their industry counterparts.

Monash University is well positioned to make significant contributions by:

- Providing coordinated, university-wide input and response towards the initial development and iterated updates of the Road Map and stretch goals.
- Taking on a role to coordinate key aspects of the R&D vision, for instance being involved in and leading identified working groups.
- Enabling a broader reach to public funded major energy research programs in which Monash University is participating.
- Conducting interdisciplinary research that advances understanding of the social and behavioural changes that enable rapid and effective implementation of technological transitions.

The Monash energy research community comprises over 160 leading academics working in areas spanning from consumers' response to emerging technologies through to energy market economics and fundamentals of new fuels.

Flagship energy activities that Monash researchers are currently engaged in include the three Australian Research Council funded fundamental research Centres of Excellence (FLEET, ACES, and ACEx) and impactful industry partnerships including the Woodside Monash Energy Partnership and the Reliable Affordable Clean Energy CRC.

Monash is Australia's first university to announce a Net Zero by 2030 target and received the 2018 United Nations Momentum for Change Award for its innovative approach to integrate deployment, research, education and translation towards reaching its Net Zero goal.

We would welcome future opportunities to engage with the Department of Industry, Science, Energy and Resources as work progresses on the Technology Investment Roadmap and its implementation. Contributors to this submission are listed below.

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