

# RESEARCH IMPACT FRAMEWORK



## **Research impact Framework**

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### **What is RACE for 2030?**

The Reliable Affordable Clean Energy for 2030 Cooperative Research Centre (RACE for 2030 CRC) is a 10-year, \$350 million Australian research collaboration involving industry, research, government, and other stakeholders. Its mission is to drive innovation for a secure, affordable, clean energy future.

<https://www.racefor2030.com.au>

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## INTRODUCTION

The energy sector is undergoing a rapid transition in the way energy has been generated, transmitted, and used. The trends towards decarbonisation, decentralisation, digitalisation, and democratisation are affecting electricity grids, businesses, and people (consumers to prosumers) and their households. In 2020, despite being one of the largest carbon emitters (1.3% of global carbon emissions<sup>1</sup>) per capita, Australia generated nearly 27.7% of its electricity from renewable sources, aided by the addition of over 3 GW of small-scale solar capacity and 76 large-scale wind and solar projects under construction<sup>2</sup>.

RACE for 2030 CRC initiated operations in July 2020 with a mission to drive innovation for a secure, affordable, and clean energy future. With more than 70 industry and research partners, we are an independent and focused collaboration platform that brings together research and industry experts to solve Australia's key challenges in the energy transition.

Early-stage analysis of our programs led us to set impact targets of \$3.9B and \$8.8B in cumulative energy savings by 2030-31 and 2034-35 respectively. We are also committed to reducing the emissions by at least a cumulative 20 Mt CO<sub>2</sub>e by 2034-35. Our other long-term objectives include increasing energy productivity and reliability and creating more clean energy jobs. We are also developing industry-focused educational and training initiatives like an industry PhD program and a carbon manager program to build cross-sectoral capacity and capability. Our work in taking clean and affordable energy innovation to market is also underway with our market transformation and commercialisation activities. These together recognise that the full potential of RACE for 2030's work will be realised well beyond 2030.

As a research organisation focused on affordable clean energy, the work undertaken by RACE for 2030 will play a significant role in achieving Australia's target of reducing GHG emissions by 26–28% below 2005 levels by 2030 (under the Paris agreement)<sup>3</sup>. RACE for 2030 sees itself as a crucial enabler for achieving these clean energy targets for Australia. With a customer-focused research outlook, we aim to make a positive real-world impact on Australian businesses and people's livelihoods.

The purpose of this document is to communicate to our partners and stakeholders our strong focus on making an impact and how we will deliver it through our programs. This document will be a living document to be reviewed and updated from time to time. The impact from the research will be delivered by a “path to impact” for every project, connecting research outputs with outcomes corresponding our impact goals reflecting end-user priorities. Planning and project development facilitates stakeholder opportunities, communication priorities and translation from research to those who use it. The process of estimating impact, guided by the Commonwealth Government's impact principles, is also reflected in this impact framework. This provides a basis for designing projects and will guide activities to be delivered by RACE for 2030.

## IMPACT—DEFINITIONS AND METRICS

The Australian Research Council (ARC) defines research impact as “the contribution that research makes to the economy, society, environment or culture, beyond the contribution to academic research.”<sup>4</sup> This indicates that in the Australian context, “research excellence” is in-line, but not identical with impact. According to the Excellence in Research for Australia 2018 handbook (ERA), research excellence indicators include journal articles, book chapters, conference publications, patents, and citations.<sup>5</sup> On the other hand, impact is broadly about the engagement of end-users in the research process. Impact has

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also been an integral part of ARC’s Engagement and Impact reports since 2018 with objectives of promoting engagement, making informed decisions, enabling comparisons, and measuring impacts to demonstrate success.<sup>6</sup> Overall, there is a growing focus on measurable and demonstrable impact worldwide, as it helps to keep the focus on the overall purpose, rather than the process of research. At a global level, the United Nations Sustainable Development Goals (UN SDGs) are a living example of that approach.

With a strong focus on high-quality research, RACE for 2030 is broadly focused on making real-time direct and long-lasting impact in the real world. The impact for RACE for 2030 implies the positive changes in the real-life processes that are of importance, not only to the stakeholders, and environment, but also to the people, their businesses, lives, and livelihoods.

A survey of RACE for 2030 partners’ priorities was conducted in Aug 2020 to understand the relevant focus areas of greatest importance to our partners. The survey was taken by approximately 90 industry and research partners. The consultations with stakeholders and partners’ priority survey (Figure 1) emphasised the importance of impact. This led to us setting priorities and impact metrics for program-specific and overall impact goals.

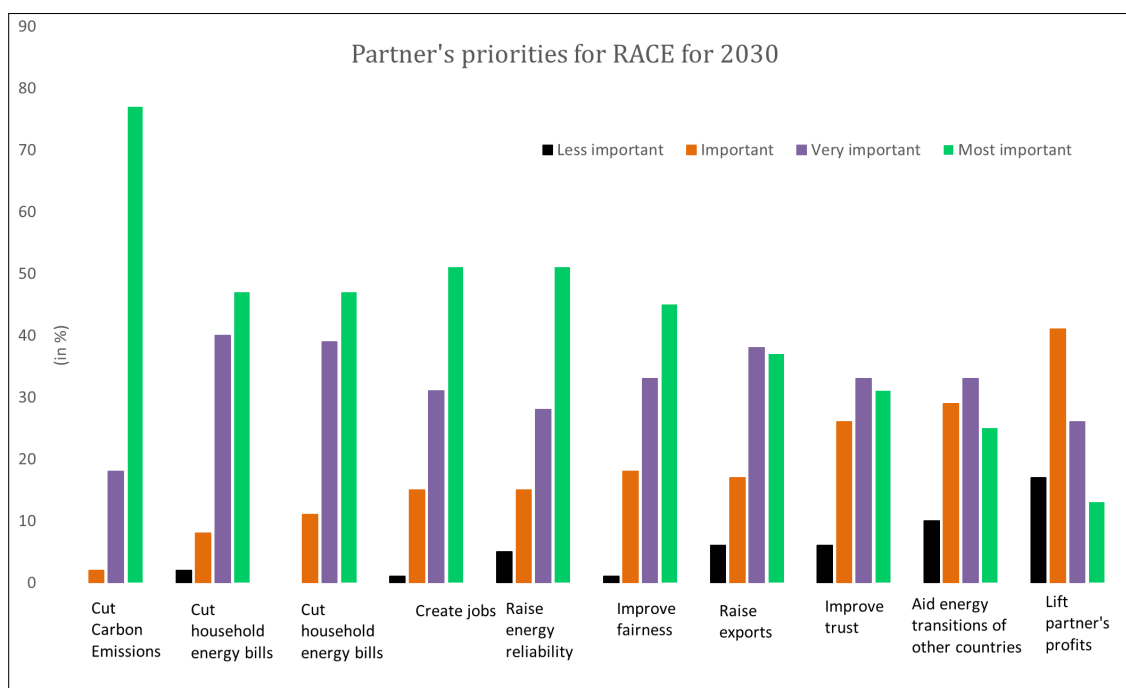


Figure 1 Outcomes of the partner’s priority survey (2020) showing partner’s (both research and industry) priorities on impact objectives.

Drawing on this feedback, RACE for 2030 adopted the following impact metrics:

*Primary performance indicators:*

- i. reduced energy costs for Australian homes (\$)
- ii. reduced energy costs for Australian businesses (\$) and
- iii. reduced Australia’s carbon emissions (tCO<sub>2</sub>e).

*Secondary performance indicators:* These are secondary metrics as individual projects might not be able to deliver these key impacts, however, cumulative impacts of multiple projects make them relevant to RACE for 2030 overall impact goals:

- iv. increased energy productivity- defined as the \$ value added per GJ primary energy used.
- v. enhanced energy reliability- defined as \$value of reduced unserved energy and energy at risk.
- vi. protecting and creating jobs (net positive change in employment).

It is also desirable that projects support the following objectives:

- protecting and improving fairness for energy customers, and
- encouraging Australian net exports.

In addition, crucial qualitative impacts of the projects may include health benefits for people, increased comfort, fairness in energy prices, greater flexibility and confidence in the use of energy technologies in everyday life, etc.

## PATH TO IMPACT

The process of making an impact typically involves a few crucial elements as shown in Figure 2. The journey begins with identifying the opportunities and examination of the industry problem along with the barriers that could obstruct the realisation of the full potential of a solution. This may be followed by the identification of cost-effective ways to maximise the impact of the solutions. The inputs of RACE for 2030 in terms of cash funding, infrastructure, and in-kind contributions would enable the research. Research activities include desktop and laboratory research, literature reviews, data collection and analysis, workshops, and stakeholder engagement. The outputs of the research include new knowledge, publications, intellectual property, technology, physical products, methods, tools, proof of concept, media reports, and business models, etc. These outputs would lead to outcomes such as change in practices or behaviours, commercial products, adoption of technologies, new businesses, increased investments, better policies, improved skills, and pricing. Finally, these outcomes will enable the *impact*, i.e., making a difference in real-world processes that are directly relevant to people, such as reduced electricity bills, lower carbon emissions, better energy reliability, more jobs, high-quality energy workforce, etc. This outline would be helpful in formulating research pipelines for the projects and facilitate the understanding of where each result sits on the path to impact. Note that the path from research to impact is typically not linear and requires working closely with industry and community for making a cross-sectoral transformation.

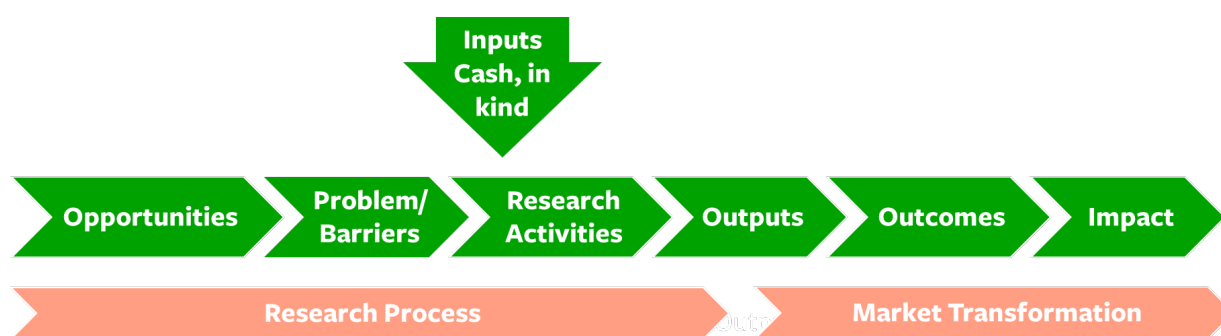


Figure 2. General outline of the key elements required to formulate a research impact pathway.

The relationships among the elements in Figure 2 is shown by way of an example in Figure 3. Here is an example of a research project focused on flexible energy demand leads to an outcome of reduced energy demand at peak times. This could help in increasing the capital productivity and lower electricity prices, leading to reduced energy bills for businesses and homes. Another example shown in Figure 3 could be for a project about reducing curtailment for distributed energy resources such as rooftop PV by

enhancing inverter flexibility. This could increase the power output of home inverters. The likely outcomes could be higher renewable generation, better integration of storage options such as EV batteries, reduced transport-related emissions, and reduced cost of firming. These outcomes would lead to substantial impacts including lower carbon emissions, reduced electricity bills, and more clean energy jobs.

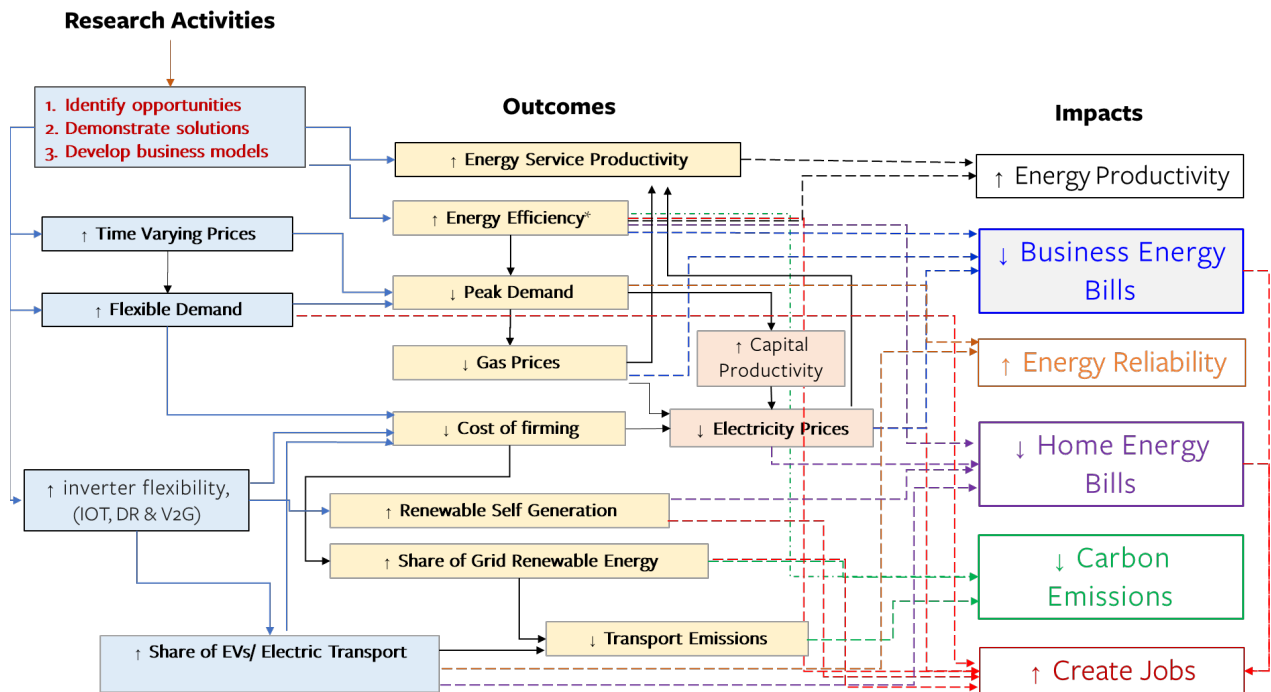


Figure 3. Schematic showing possible relationships between research activities, outcomes and impacts for future RACE for 2030 projects.

For improved understanding, Figure 4 shows an example of path to impact and its key elements for the residential solar pre-cooling (SPC) research theme (H1) under RACE for Homes. The research would likely involve the development, testing and facilitation of SPC in collaboration with heating, ventilation, and air conditioning (HVAC) suppliers. The outputs could include the publication of new data, reports, and a policy roadmap to support the adoption of SPC and solar pre-heating (SPH) in the future. The outcomes would be the adoption of SPC and SPH by households, particularly those with rooftop solar. This would in turn lead to reduced energy demand during peak times and therefore reduced electricity bills, improved system reliability and greater grid-penetration of renewables. This project can lead to financial and comfort benefits for consumers.

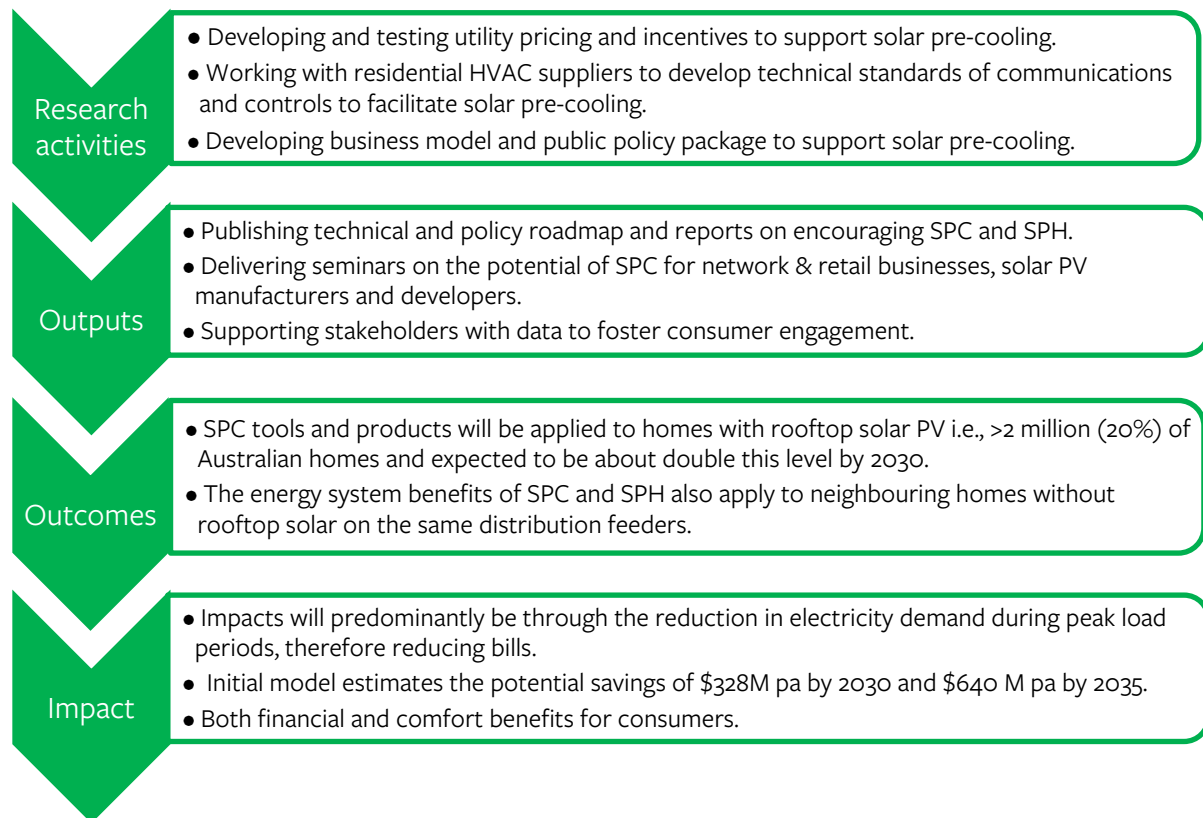


Figure 4. An example of path to impact for research Theme, H1 – Residential solar pre-cooling.

## IMPACT TARGETS

RACE for 2030 has ambitious goals to reduce energy bills (and costs) for homes and businesses, and reduce carbon emissions, without deteriorating supply reliability (ideally enhancing it). An initial estimate of the impact of RACE for 2030's activities was prepared for the Stage 2 funding application using the prescribed Commonwealth method<sup>7</sup>. This estimate found that the government could expect a benefit to cost ratio (BCR) for their investment of 36:1. RACE for 2030 aims to deliver a (risk adjusted) economic benefit of \$3.9B by 2030–31 and \$8.8B by 2034–35 for a cash investment of \$109M over next ten years. Figure 5 shows the distribution of these targets across our four research programs. These programs and their respective impacts will be discussed in the next section.



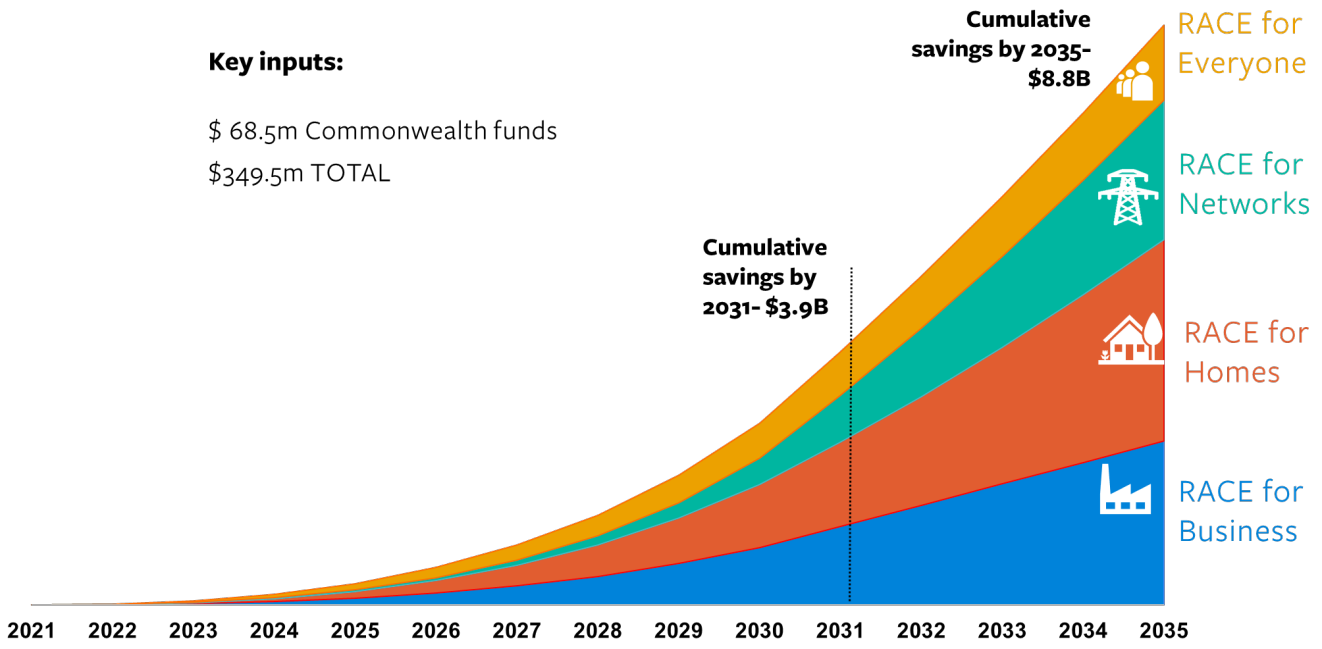


Figure 5. Cumulative initial impact targets (\$ in energy savings) for RACE for 2030.

The initial energy savings estimates found a cumulative carbon dioxide equivalent (CO<sub>2</sub>e) reduction of at least 9.3 Mt by 2030–31 and 24.3 Mt by 2034–35 was possible, as shown in Figure 6. The impact of RACE for 2030’s work would likely be evident for years beyond 2030 and 2034. It is worth noting that the RACE for Everyone program supports the carbon emission reductions in the other three research programs.

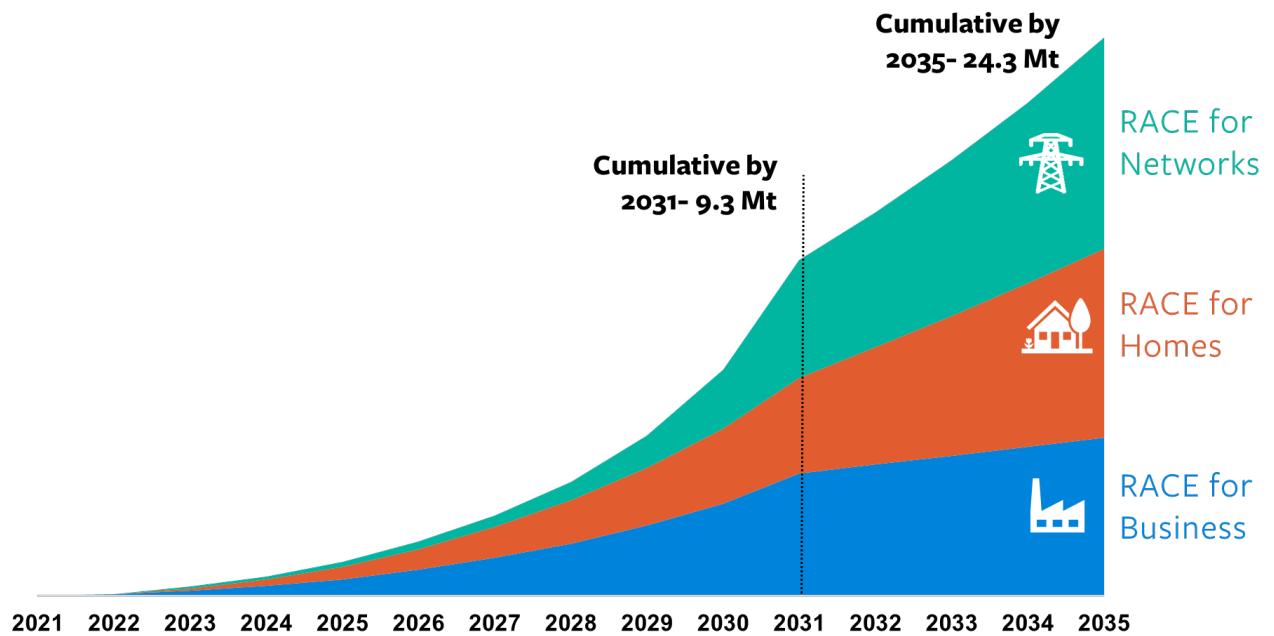


Figure 6. Cumulative initial impact targets for CO<sub>2</sub>e emission reductions for RACE for 2030.

## RACE FOR 2030 RESEARCH PROGRAMS

RACE for 2030 facilitates collaboration between industry and research institutions to accelerate the transition to reliable, affordable, and clean energy through innovation focused on end-users. Our research focuses on outcomes and impacts, which will also be driven into the market through our market

transformation, capacity building, and other commercialisation pathways.

The key impacts of RACE for 2030 will include but are not limited to:

- Enhanced energy productivity in businesses and energy efficiency in residences.
- Reduced commercial and residential energy bills.
- Reduced carbon emissions.
- Creation of the future energy workforce, including funding over 55 Industry PhD candidates.

RACE for 2030 will achieve these impacts through four research programs, namely:

**RACE for Business:** Reliable, affordable, and clean energy for Australian businesses by working on the research themes as outlined in Figure 7.

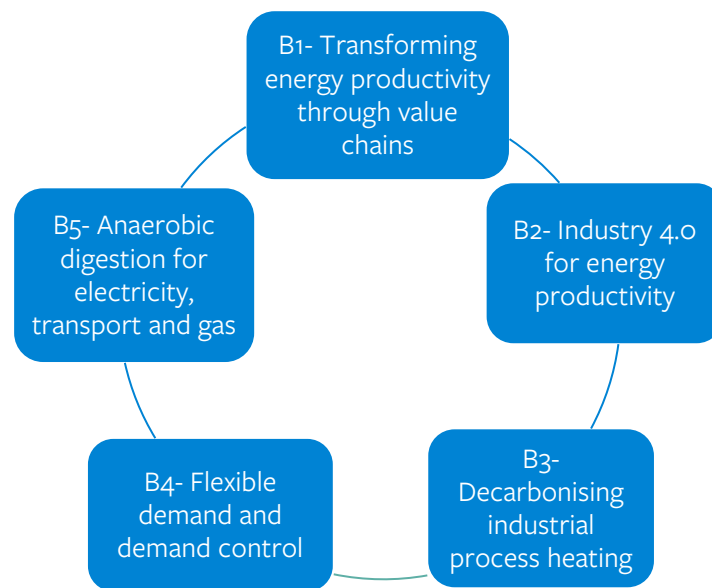


Figure 7. RACE for Business research themes

**Key Outcomes:**

- Installing load control systems in manufacturing, commercial and water facilities.
- Installing smart sensors and artificial intelligence (AI) on energy intensive plant, installing enhanced non-invasive metering and IOT for improved measurement of key variables.
- Reduced energy cost by developing the next generation demand control systems (using AI) by matching load flexibility with price signals.
- Utilisation of agricultural and animal wastes, a major underutilised ‘renewable’ energy source, and a significant cause of methane.

**Key Impacts:**

- Gross energy savings of \$1.1B by 2030-31 and \$2.4B by 2034-35 (after risk adjustments and a 5% discount on net present value, NPV).
- Emissions reductions of 5.9 Mt and 12.9 Mt CO<sub>2</sub>e by 2030-31 and 2034-35, respectively.
- Enhanced energy efficiency would also deliver other non-energy benefits, namely, more jobs, new markets and more competitive pricing and potential export opportunities.

**RACE for Homes:** Reliable, affordable, and clean energy for Australian residences by working on the research themes as outlined in Figure 8.

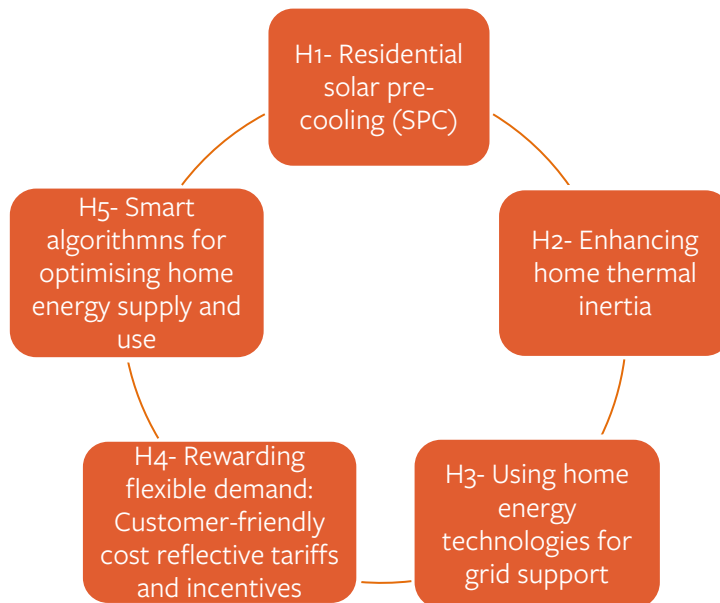


Figure 8. RACE for Homes research themes

**Key Outcomes:**

- Application of SPC and SPH tools and products on homes with rooftop solar PV.
- Changes to inverter and appliance standards and industry practices over time.
- Enhanced renewable energy consumption and reduced curtailment.
- Tools, apps, and resources to assist customers to better use their own home energy data.

**Key Impacts:**

- Gross energy savings of \$1.3B by 2030-31 and \$3.1B by 2034-35 (after risk adjustments and a 5% discount on NPV).
- Emissions reductions of 2.0 Mt and 5.5 Mt CO<sub>2</sub>e by 2030-31 and 2034-35, respectively.
- Other benefits could include reduction in residential energy bills, enhanced comfort, and increased network resilience.

**RACE for Networks:** Reliable, affordable, clean energy for electrical networks that support the energy flow by working on the research themes as outlined in Figure 9.

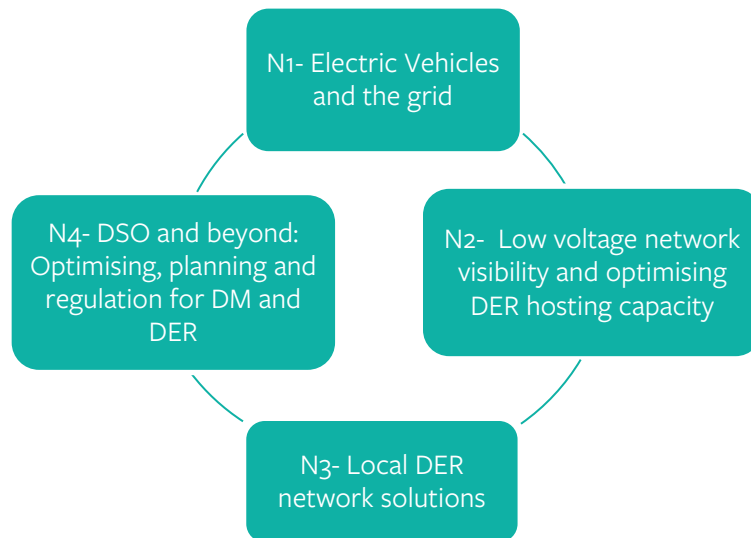


Figure 9. RACE for Networks research themes

**Key Outcomes:**

- Support stand-alone power systems (SPS) and microgrid implementation at lower cost, and higher reliability electricity supply.
- Expedited uptake of EVs to support distribution networks: Consumer participation in managed charging services, vehicle availability for grid support, incentives, and warranty implications.
- Demonstrations of EV smart charging architecture with vehicle-to-grid (V2G)/vehicle-to-home (V2H) trials.
- Improved operation of existing and planned regulatory reforms including: the DMIS, DMIA and WDRM, and facilitate future beneficial regulatory reform.

**Key Impacts:**

- Gross energy savings of \$675M by 2030-31 and \$2.0B by 2034-35 (after risk adjustments and a 5% discount on NPV).
- Emissions reductions of 1.4 Mt and 6.0 Mt CO<sub>2</sub>e by 2030-31 and 2034-35, respectively.
- Other benefits could include expedited uptake of EVs with better incentives, warranties, and demonstrations of smart charging with vehicle-to-grid (V2G)/vehicle-to-home (V2H) trials.

**RACE for Everyone:** Reliable, affordable clean energy for everyone to address the rapid transformation by working on the research themes as outlined in Figure 10.

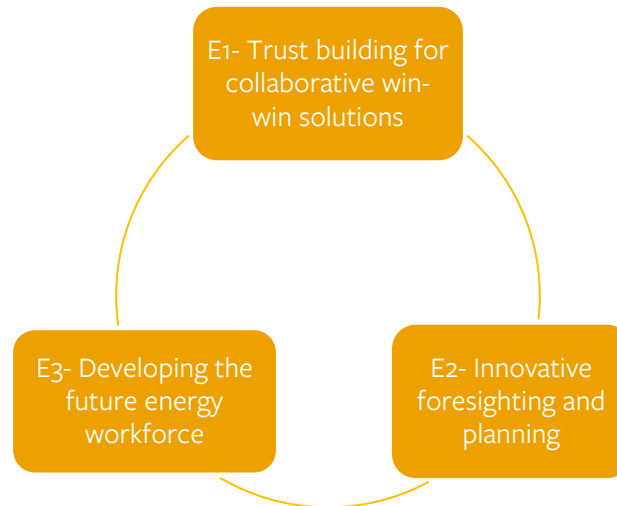


Figure 10. RACE for Everyone research themes

### Key Outcomes:

- Guiding the industry towards a lower cost and more customer-centred energy transition by building trust among multiple stakeholders.
- More accurate, flexible, and relevant electricity sector foresighting and planning processes would improve future investment decisions, allow better market operation, decrease costs, and increase reliability.
- Improved knowledge and skills in the industry to undertake demand management projects at lower cost, template development, procurement, reporting, monitoring and verification.

### Key Impacts:

- Gross energy savings of \$758M by 2030-31 and \$1.4B by 2034-35 (after risk adjustments and a 5% discount on NPV).
- Creation of a future energy workforce through capacity building program and funding 55 industry-focused PhD graduates across multiple universities participating in the CRC.
- Commercialisation and fostering the Australian clean energy start-up ecosystem.

## STRATEGIC CHALLENGES

Our research focus will predominantly be on the following challenges for the next financial year (FY22-23). However, we will continue to accept projects from partners in all our 17 themes.

1. Minimum demand- Optimising use of rooftop solar, while supporting grid security.
2. EV integration- Accelerating EV smart charging, Vehicle to Home (V2H) and two-way charging.
3. Million Homes- Retrofitting a million homes for increased comfort, lower energy bills and lower emissions.
4. Net zero business- Pathways to decarbonise businesses.

Note that the modelling to develop ambitious targets associated with these strategic challenges is underway and will be released in 2022.

## IMPACT ENABLERS

RACE for 2030 recognises that the translation of research activities to impact is often complex and requires a significant stakeholder engagement to work together with governments, industries, and communities. To facilitate this transition, we are investing in several channels, namely, market transformation, capacity building and commercialisation to foster the delivery of impacts.

### INDUSTRY PHD PROGRAM

RACE for 2030 initiated a PhD program in 2020 and aims to fund up to 55 PhD candidates, working on real-world industry problems. The successful candidates are awarded a scholarship of \$38,000 per year with an additional \$3,000 per year for research-related expenses for a 3-year project. The topics and projects (aligned with our research themes) are to be nominated by our industry partners corresponding a call for nominations issued twice a year. An industry reference group (IRG) is also formed to provide mentorship and guidance to the candidates. This program will not only help in making significant progress towards solving some key issues but also creating the Australian clean energy workforce.

### MARKET TRANSFORMATION

RACE for 2030 will catalyse change in targeted energy markets by working with industry, businesses, community, and consumer representatives and all tiers of government to drive the uptake of the innovations created by the RACE for 2030 research to decarbonize energy services. A market transformation strategy will be developed in FY 2021-22 to deliver on RACE for 2030's impact goals.

### CAPACITY BUILDING

Capacity building aims to support the Australian clean energy industry through the energy transition by helping organizations to grow their internal expertise. Being a subset of RACE for Everyone research theme E3-Developing the future energy workforce, it aims to identify significant skill gaps in the Australian workforce. Up-skilling the existing workforce and planning education for the future will enable companies and organisations to work on the strategies for decarbonisation. Within capacity building, the Carbon Manager Pilot Project is a new initiative where RACE for 2030 will co-fund embedded carbon managers who will focus on the decarbonisation of shortlisted government, non-government, and private sector organisations.

### COMMERCIALISATION

A commercialisation program is under preparation to support the application of technologies developed through RACE for 2030. This will also facilitate the development of start-ups to grow and thrive in Australia and internationally. A commercialisation committee will be also established in FY 2021-22. Membership of committees and forums will be open to partners and change on a periodic basis.

## IMPACT MODELLING

The initial impact model has been established to provide baseline values for each of the four programs and their respective research themes. The results of the opportunity assessments (OAs) will be used to refine this impact modelling. OAs are short-term investigations intended to guide where RACE for 2030 should focus its efforts on each research theme over the coming years. These review the state of the market and technology, the scale of potential benefits and the future research opportunities and priorities for research themes.

Estimating the impact of future research to be undertaken in the next decade is challenging. However, contemplating impact early stimulates conversations around the implementation of the research activities and outcomes, and leads to educated assumptions to design a high-level impact framework.

RACE for 2030's initial impact model was based on the guidelines prescribed by the Commonwealth for CRCs<sup>7</sup>. It is a tool that supports the articulation of research outputs, outcomes, and final impacts. It also helps in clearly defining the relationships between research programs, individual projects, and the path from research to impact.

- An important element of the impact tool is confidence factors (which signify the likelihood of achieving success) associated with outcomes, usage, and impact of the research projects. For example, output confidence factor is a measure of the probability that a project will deliver the specified outputs. Usage confidence factor relates to the likelihood of successful uptake, application, or adoption of the project outputs by the industry or other end-users. The impact confidence factor is, if the project outputs are used, the likelihood of a project making specified impact. So, the total confidence factor is the product of output confidence factor, usage confidence factor and impact confidence factor. The suggested ratings are 5%, 25%, 50%, 75% and 95% for the probability of success from being very low to very high, respectively. The impact targets for RACE for 2030, as shown in Figure 5 and Figure 6 were set using conservative assumptions with the value of output and usage confidence factors as 50% in most cases.
- The resultant impact benefits and BCR also depend on input cost and usage cost for a project. For this purpose, the input costs include the funding provided by RACE for 2030 for a research project, whereas usage costs refer to any cost incurred outside the CRC for the adoption or uptake of the research outputs. Note that in some cases, the usage cost can be significantly higher than the input costs involved.
- For better savings estimates, net present value (NPV) was calculated to provide the current value of an amount that will be received or expensed in the future. As per the Commonwealth guidelines, a discount rate of 5% per annum was used for NPV calculation of input costs, usage costs, and impact benefits.

## IMPACT MEASUREMENT AND TRACKING

The measurement of both long- and short-term impacts is crucial in tracking the success of our projects, mitigating barriers, and applying learnings going forward. It will also help identify the areas to target investment for achieving our overall impact goals.

- Impact tracking for projects- The impact of each project will be monitored using an impact monitoring tool, currently via Salesforce and subsequently using surveys sent via an impact monitoring software (an example is shown in Figure 11). Impact tracking will be at full application stage and on an annual basis. Project teams would be requested to provide their impact estimates for energy savings (in \$) and CO<sub>2</sub>e emission reduction (in tonnes), including the input and usage costs and confidence factors for outcomes, usage, and impacts. RACE for 2030 could provide assistance (if requested) in making these estimates and quantify the potential impact. This will facilitate measuring the progress towards achieving RACE for 2030's targets in alignment with the Commonwealth milestones.
- Data collection- For automating the data collection from diverse industry and research partners for indicators mentioned above, we are working towards setting up an impact management software. This will organise our data management to aggregate impacts with real-time dashboards, along with a clear visualisation of impact from each project, theme, and program. It will also enhance our understanding of results and support streamlining the strategic deployment of funding to the areas of maximum impact. The dashboards enable data analytics to be viewed as per demographics, partners, research programs, funding allocated, etc as shown in Figure 11.

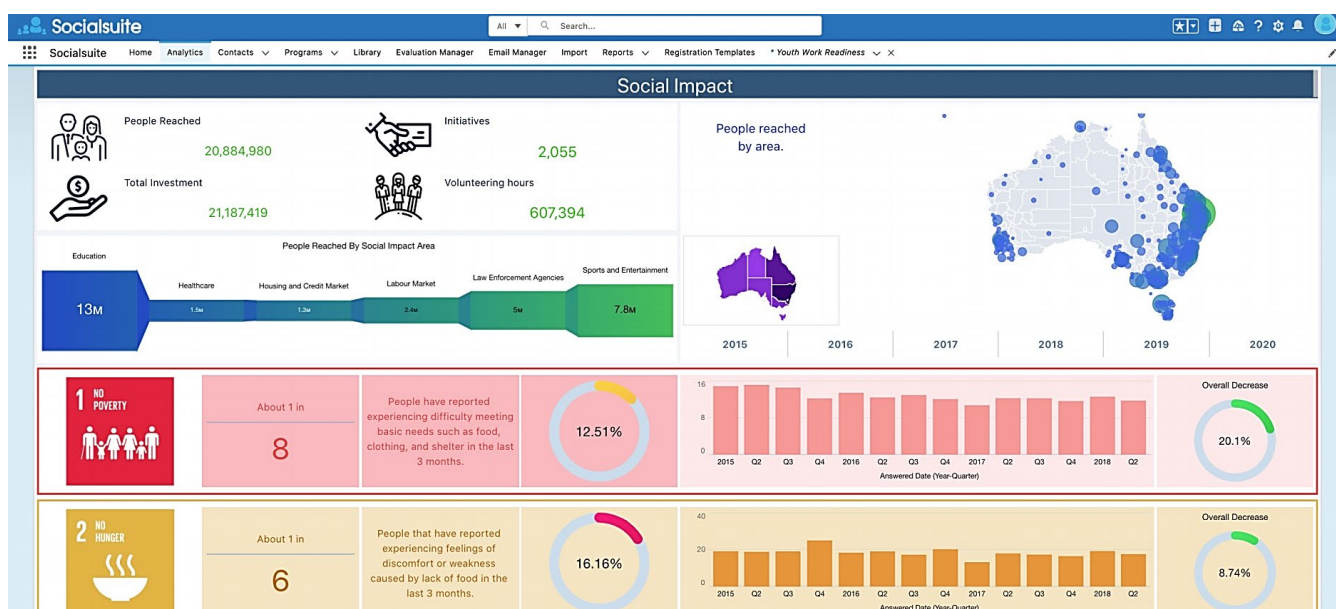


Figure 11. An example dashboard of social suite. The data visualisation reflects the results as per demographics, time of the year and impact corresponding to UN SDGs.

## REVIEW PROCESS

With a timeline of 10 years, we need to ensure that we have a robust review process. The intent is to have an internal tracking and review using quarterly reports on our status towards our impact targets. This will also keep us on track with progress and highlight the projects and programs that need work. There will also be an external review of impact strategy, processes, and performance periodically (more on this TBC).



## REFERENCES

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