RACE for 2030

RELIABLE
AFFORDABLE
CLEAN
ENERGY

IMPACT REPORT FY2021/22

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

Annual Impact Report

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Project team

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What is RACE for 2030?

Reliable, Affordable, Clean Energy for 2030 (RACE for 2030) is a Cooperative Research Centre (CRC) for energy and carbon transition.

Established in July 2020 with $68.5 million of Commonwealth funds, and commitments of $280 million of cash and in-kind contributions from our partners, we have some $300 million of total resources to invest in research, commercialisation, capacity building, market transformation and CRC operations through to 2030.

Our aim is to deliver over $3.8 billion of cumulative energy productivity benefits and 20Mt of cumulative carbon emission savings by 2030.

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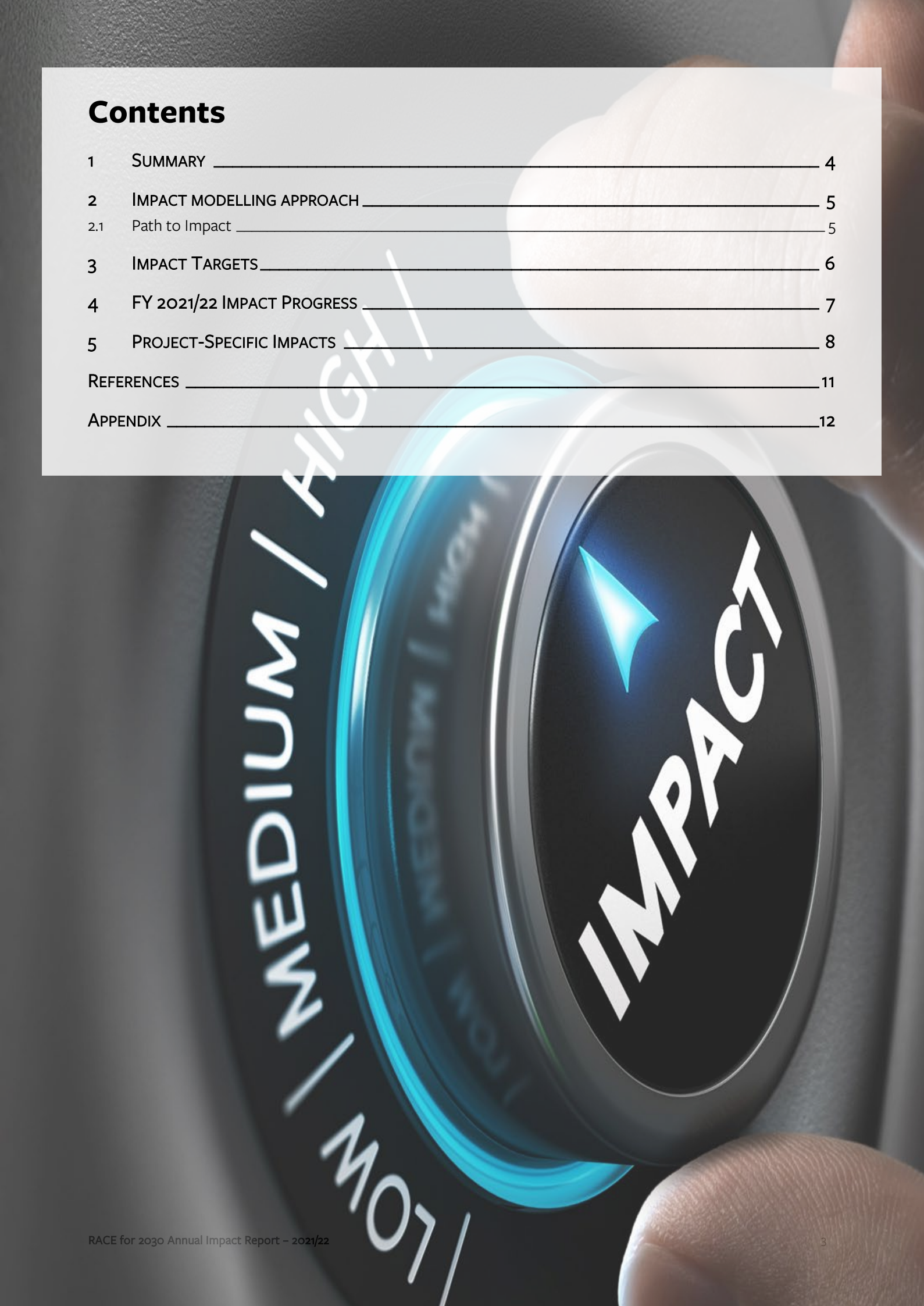


1 Summary

RACE for 2030 was created with an objective of driving innovation and accelerating the shift to a reliable, affordable, and clean energy transition.

Amid growing risks of climate change and frequent extreme weather events, ongoing net zero pledges by organisations and Australia's legislated commitment of reducing 43% emissions by 2030, there is a heavy burden on the energy sector to decarbonise quickly. This requires new solutions, new collaborations, new and diverse workforce, and a whole of system-level change, both locally and internationally.

Despite the challenges of COVID-19 and energy market volatility, this FY 2021/22 Impact Report shows that we, along with our partners have made significant progress this financial year.

Highlights for RACE for 2030 as of 30 June 2022 include-

- 74 partners- 14 research partners and 60 business and organisations
- $16.7 million committed to projects
- 12 PhD projects initiated this financial year, taking our total to 18
- 119 organisations in addition to RACE partners have participated in projects, via industry reference groups
- 52 projects contracted and completed
- A forecast committed cumulative energy savings of $248M and 1.1Mt CO_2e emission reduction by 2035 (monthly progress shown in Figure 1).

For more highlights, see RACE for 2030 Annual Report 2021/22[1].

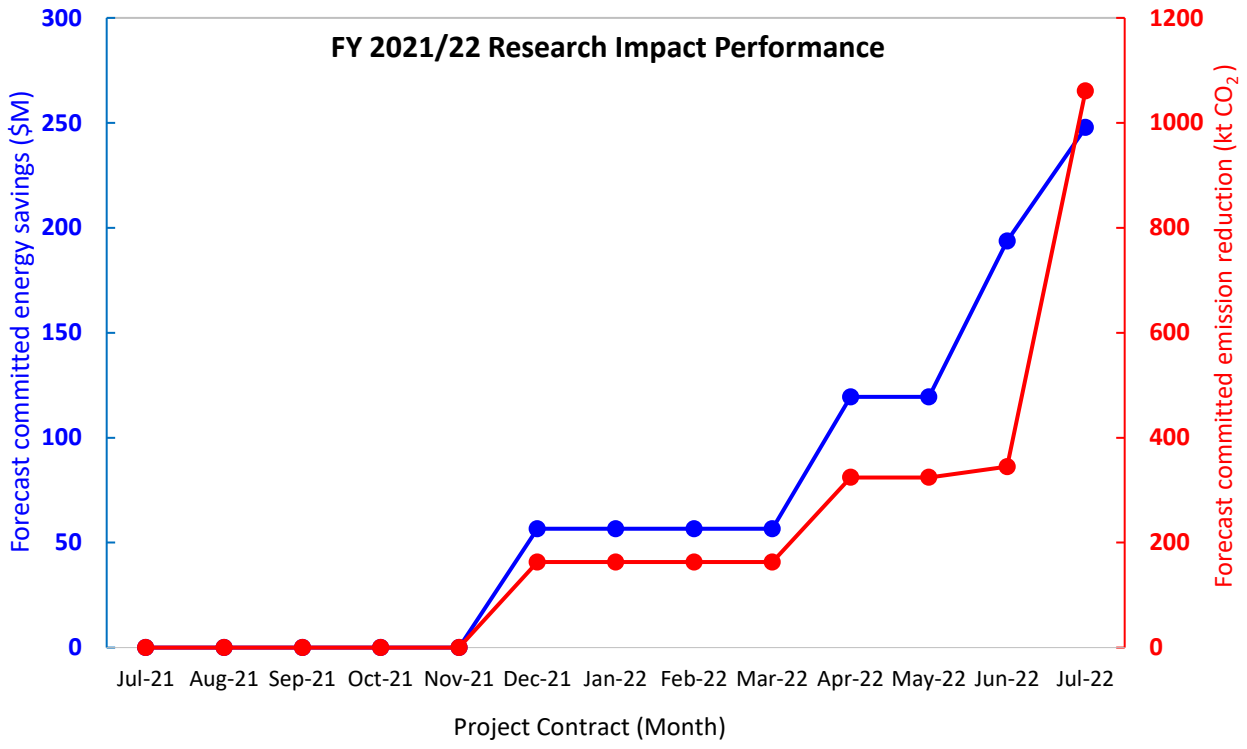


Figure 1 RACE for 2030 FY 2021/22 impact progress on energy savings and CO_2e emission reduction

2 Impact modelling approach

With a strong focus on funding high-quality research projects, RACE for 2030 concentrates on making a long-lasting impact in the real world. While it is still early days of our 10-year long journey, our customer-focused impact approach would lead to positive outcomes not only for our stakeholders, and the planet, but to the people, their lives, and livelihoods. RACE for 2030 measures its impact in terms of six performance metrics as:

Primary performance indicators:

a) reduced energy bills for Australian homes ($)
b) reduced energy bills for Australian businesses ($) and
c) reduced Australia's carbon emissions (tCO_2e).

Secondary performance indicators:

i. increased energy productivity- defined as the $ value added per GJ primary energy used.
ii. enhanced energy reliability- defined as $value of reduced unserved energy and energy at risk
iii. 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 energy exports.

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

2.1 Path to Impact

RACE for 2030 CRC is entering in its third year. In the early days of our research, it is challenging to measure the actual impact, as the research activities are not complete, and the real-world impact is yet to occur. Accordingly, our focus at this stage is on forecasting the impacts of research projects we are funding. For the detailed understanding of our impact methodology and pathways to impact, please refer RACE for 2030 Impact Framework[2].

Modelling the impact of projects that aim to transform the energy ecosystem of the future is difficult. However, early estimation of the scale of impact from our projects helps us contemplate the pathways and barriers to delivering those impacts. In addition, it also helps us compare the return on investment on our research projects and ensure we keep our focus on the best value for money paths to the highest impact.

Our impact estimation approach is based on the guidelines prescribed by the Commonwealth for CRCs[3]. A crucial factor while estimating the potential impacts is to ensure that the calculations don't overestimate the plausible impacts. To do this, an important element of the impact tool is confidence factor(s). This is important in determining the likelihood of achieving success associated with research outputs, outcomes, usage, and the overall impact of the research projects. For calculation purposes, the total confidence factor is the product of output confidence factor, and usage 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.

3 Impact Targets

In addition to achieving the Commonwealth milestones, RACE for 2030 has set ambitious impact targets as shown in Figure 2. During the development of CRCs, the commonwealth government requires the proponents to estimate the expected impact over a 15-year period (i.e., 2035 for RACE for 2030). As per our initial estimates, we aim to deliver energy-related economic benefits of at least $8.8B and committed CO_2e emission reduction of 20 Mt by 2034-35 for a research cash investment of $109M between 2020-2030. To achieve these targets, RACE for 2030 develops and funds projects in collaboration with our research and industry partners across 17 research themes[4].

No specific impact targets were set for our first year of operation (2020/21). For FY 2021/22, RACE for 2030 set the impact goals as 400kt CO_2e emission reduction and energy savings worth $75M. We adopted smaller impact targets for this year as we were still in the scaling up phase, while primarily focusing on the Opportunity Assessment projects[5] that deliver the ten-year research roadmaps for research themes. Figure 2 depicts the annual impact targets for 2021/22 and the years going forward to achieve the overall targets by 2030. The impact targets for the years beginning 2022/23 were calculated as the average yearly target required to meet our overall impact goals (i.e. ($8.8B-$75M)/8 years= $100M and (20Mt-400kt)/8 years= 2625kt) by 2030. Figure 3 shows the estimated share of this target impact divided into our four research programs across the years.

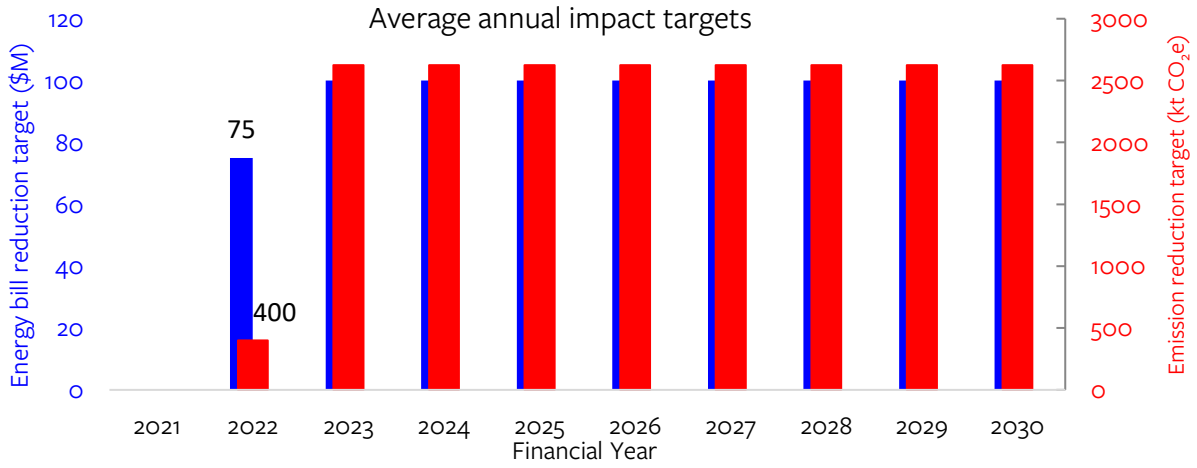


Figure 2 RACE for 2030 annual impact targets

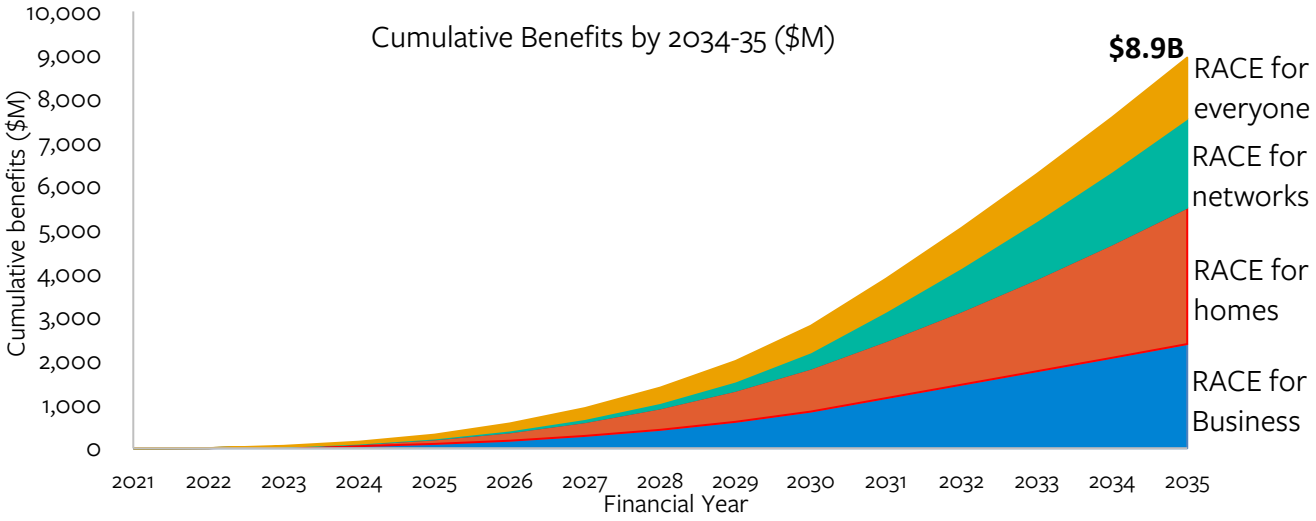


Figure 3 RACE for 2030 impact targets for our four research programs

4 FY 2021/22 Impact Progress

Working towards our targets for 2021/22 (Figure 2), this year, we contracted 5 standard track projects and 13 fast track projects. The cumulative (by 2035) forecasted impacts for these projects is estimated to be worth $248M in energy savings and 1.1Mt CO_2e emissions reduction as shown in Figure 4 and Figure 5. It should be noted that these are expected impacts when projects are contracted and the actual energy bill and CO_2e emission reductions will either be lower or higher than these values.

We acknowledge the crucial role of research and industry partners in disseminating the research outputs of our projects. We believe that we play an important role in dissipating the knowledge from our research efforts, to overcome the market barriers and modify current practices. RACE for 2030 is working with a range of government, business, and community stakeholders to accelerate the uptake of new technologies, products, and knowledge in the market through our market transformation activities. This is being ramped up over the coming year with the development of a market transformation plan together with our partners, as part of our 3-year research strategy, to leverage the outcomes to a broader market to deliver RACE for 2030's impact targets.

Figure 4 shows the potential forecasted impacts of the projects in terms of energy savings (in $M). The 2021/22 progress (solid lines) started with our first standard track project initiated in Dec'21. Our overall estimated energy savings from the projects exceeded our target (dotted lines). Similarly, Figure 5 shows the impact trajectory in terms of potential carbon emissions reductions corresponding our target in FY 2021/22.

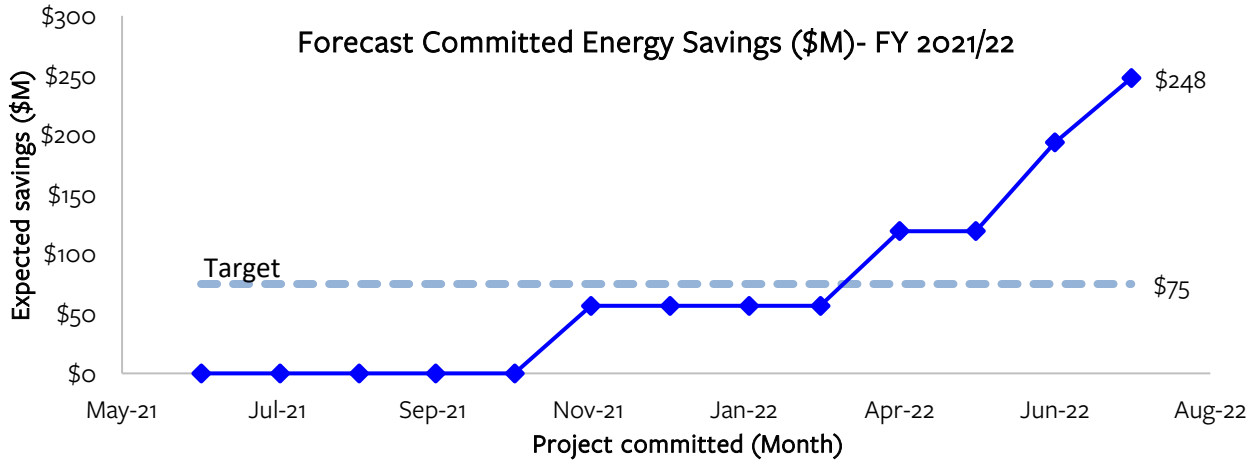


Figure 4 RACE for 2030 Impact Progress- FY 2021/22 in terms of expected energy savings/bill reductions

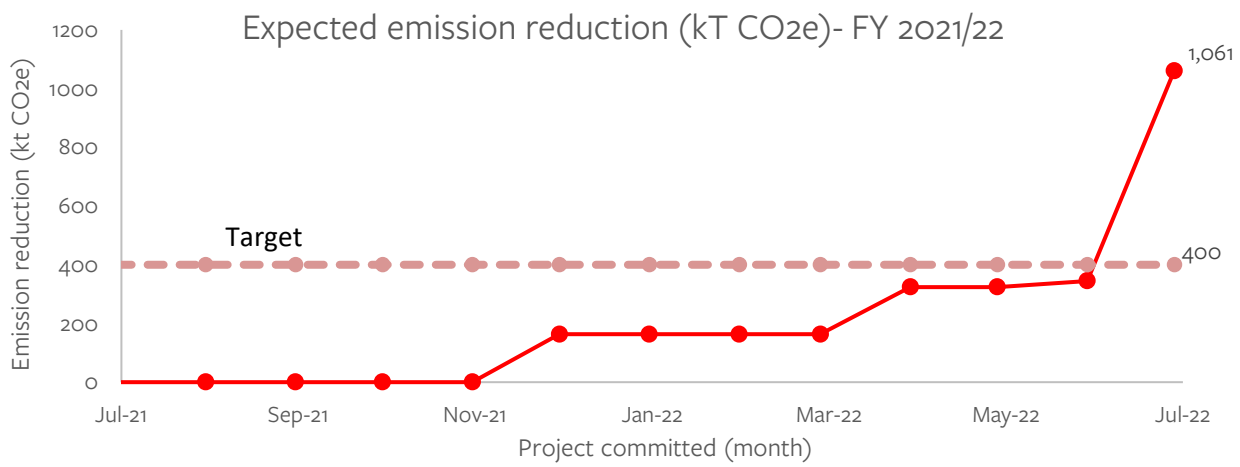


Figure 5 RACE for 2030 Impact Progress- FY 2021/22 in terms of CO_2e emission reduction

5 Project-Specific Impacts

This section describes the work and impacts of some of our most significant projects in FY 2021/22 that made the largest share of the forecasted impacts shown in Figure 4 and Figure 5. The list of all the projects that had quantitative impacts this financial year are listed in Table 1. For a detailed inventory of our projects funded (and completed) in this financial year, please refer to the Appendix.

Table 1 Forecasted Impacts of key RACE for 2030 funded projects in FY 2022

Project Title	RACE Program	Forecast bill savings ($M)	Forecast emission reduction (kt-CO_2e)	Project Contract	Expected first year of real impact	Project budget ($ cash)
Efficient supermarket Refrigeration- Testing and monitoring of an energy efficient indirect evaporative CO_2 refrigeration system at a Coles supermarket (21.B1.S.0233)	RACE for Business	57	163	Dec' 21	2023	$608,332
Building trust for smart inverters- Identification, Key Management and Trust for Inverters for Distributed Energy Resources (21.N2.F.0347)	RACE for Networks	49	151	April' 22	2025	$150,014
Incentivising smarter home energy use- Incentivising within-day shifting of household electricity use (21.H4.F.0239)	RACE for Homes	14	10	April'22	2025	$114,980
Carseldine Village Living Laboratory- A subtropical test centre for end users/prosumers, housing industry and electricity networks (21.H4.S.0240)	RACE for Homes	74	20	Jun' 22	2023	$317,536
24/7 Renewables: Solutions for Matching, Tracking and Enhancing Corporate Renewables Purchasing (21.B4.S.0250)	RACE for Business	54	716	July' 22	2023	$447,498
Total		248	1,060			

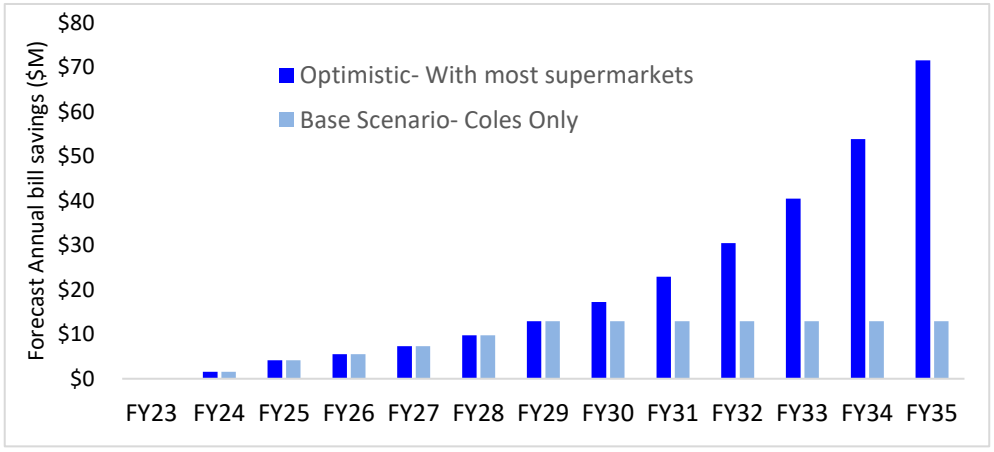
Case Study 1- Testing and monitoring of an energy efficient indirect evaporative CO_2 refrigeration system at a Coles supermarket (Project Id- 21.B1.S.0233)

Partners- University of South Australia (UniSA), Queensland University of Technology (QUT), Glaciem Cooling Technologies, Australian Alliance of Energy Productivity (A2EP) and Seeley.

Objective- This project focuses on monitoring and validating a new-generation energy efficient refrigeration system. The system incorporates an indirect evaporative cooling system to a refrigerant system that utilises natural refrigerants, potentially delivering up to 16% improvement in system efficiency and 24% reduction in peak demand. This project will also test its performance at scale by installing a first-of-a-kind system at a Coles supermarket in South Australia in 2023.

Impact- With the goal of setting up a pilot demonstration of a newly developed cooling system at a Coles supermarket in 2023, and with output and usage confidence factors as 95% and 50% respectively, two impact scenarios were established. A base case scenario where 50% of all Coles supermarkets (~1300 stores[6]) in the country would implement the new system by 2030 and an optimistic scenario where after 2030, other supermarkets and grocery stores follow the suite and implement this new system by 2035 as shown in Figure 6. The confidence factor adjusted forecasted impacts in base-case and optimistic scenarios were an estimated cumulative (2024-2035) energy bill savings of $56.6M and $132M, and a potential CO_2e emission reduction of 163Kt and 340Kt respectively as shown in Figure 6. To be conservative in our impact estimates, the base case scenario was used in our impact tracking (Figure 4 and Figure 5).

(a)



(b)

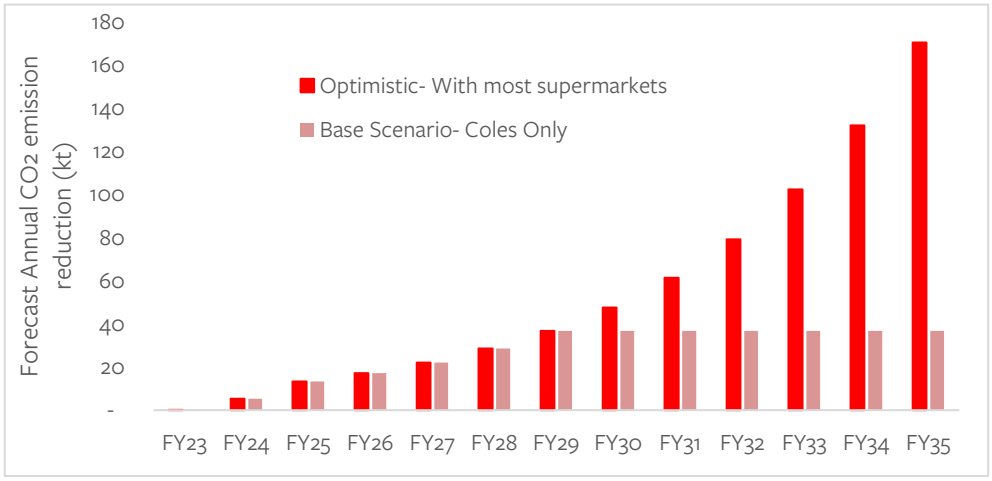


Figure 6 Forecast impacts for "Testing and monitoring of an energy efficient indirect evaporative CO_2 refrigeration system at a Coles supermarket" project.

Case Study 2- Carseldine Village Living Laboratory- a subtropical test centre for end users/prosumers, housing industry and electricity networks (Project Id- 21.H4. S. 0240)

Partners- Queensland University of Technology (QUT), University of New South Wales (UNSW), Economic Development Queensland (EDQ), Department of natural resources, mines, and energy (QLD), Department of environment (QLD), Powerlink, Energy Queensland, Evergen, Vantage homes, Thompson sustainable homes and an AC manufacturer (confidential).

Objective- The aim of this project is to implement and study the home energy management system (HEMS) in CVLL dwellings (~110 homes) with rooftop solar, batteries, EV circuits, and an overall 7-star NatHERS rating. This living laboratory would test the demand response strategies such as solar precooling, load shifting, cost-reflective tariffs, and dynamic operating envelopes. In addition, it will also enhance the understanding of motivations, needs and barriers experienced by Australian households, technology providers, builders, and the electricity network.

Impact- The impact of this project will be two-fold. First, by accelerating the HEMS uptake and secondly, the successful demonstration of this project will lead to more Carseldine-Village (CV) like homes beyond living lab research. The potential impacts were estimated based on the reduced daily energy use per household, the market dissemination of the whole-of-house approach, and the impact of the HEMS. The CV homes are modelled to reduce household annual electricity bills by $480 from the expected average QLD household consumption of $1100. This expected saving is due to the combined impact of a higher thermal performance of the building envelope (reducing the space cooling and heating need), high efficiency appliances, 3.5 kW PV system and 10.3 kW battery – resulting in a reduction of daily consumption of ~6kWh. The modelling on HEMS was based on an earlier small HEMS trial in QLD[7], and with an assumption of a 0.05% take-up rate per year. Overall, with the output and usage confidence factor of 95% and 50% respectively, the risk-adjusted forecasted impacts are the cumulative energy-related savings of $74M and CO_2e emissions reduction of 20 kt by 2035.

References

[1] Corporate documents - RACE for 2030

[2] Varshney, U. (2022) Research Impact Framework, RACE for 2030 CRC, Our impact - RACE for 2030

[3] Impact Tool User Guide, Cooperative Research Centres (CRC) Program, round 21

[4] Projects - RACE for 2030

[5] Opportunity Assessment Reports - RACE for 2030

[6] About us | Coles Group

[7] DMIA Project Market-Delivered Demand Response Pilot, Final Report January 2022. Energy Queensland

Appendix

Standard Track projects

Project Title	Research Theme	Contract Executed	Project ID	Status as of Aug '22
Carseldine Village Living Laboratory- a subtropical test centre for end users/prosumers, housing industry and electricity networks	H4: Rewarding flexible demand	Jun' 22	21.H4.S.0240	In Progress
My V2X EV - Informing Strategic EV Integration	N1: Electric Vehicles & the Grid	Apr' 22	21.N1.S.0344	In Progress
Renovate or Rebuild Full Series Evaluation Project	H2: Enhancing home thermal efficiency	Apr' 22	21.H2.S.0206	In Progress
Testing and monitoring of an energy efficient indirect evaporative CO_2 refrigeration system at a Coles supermarket	B1: Value chain optimisation	Dec' 21	21.B1.S.0233	In Progress
24/7 Renewables: Solutions for Matching, Tracking and Enhancing Corporate Renewables Purchasing	B4: Flexible demand	July' 22	21.B4.S.0250	In Progress

Fast Track projects

The Green Wave: Anchoring economic recovery through Net Zero Energy Strategy	E2: Energy foresighting and planning	Jun' 21	20.E2.F.0137	Completed
Decision Engine to Support the Path to Net Zero	E2: Energy foresighting and planning	Apr' 22	21.E2.F.0193	In Progress
Business Fleets and BEVs: Taxation changes to support home charging from the grid, and affordability	N1: Electric Vehicles & the Grid	Jun' 21	21.N1.F.0146	Completed
Identification, Key Management and Trust for Inverters for Distributed Energy Resources	N2: LV network & DER hosting capacity	Apr' 22	21.N2.F.0347	In Progress
Curtailment and network voltage analysis study (CANVAS)	N2: LV network & DER hosting capacity	Mar' 21	20.N2.F.0040	Completed
Optimised Zone Substation MV Voltage Management to Increase Distributed Energy Resource (DER) Hosting Capacity	N2: LV network & DER hosting capacity	May' 22	21.N2.F.0249	In Progress

Measuring and communicating network export service quality	N2: LV network & DER hosting capacity	Jan' 22	21.N2.F.0186	In Progress
Distributed Energy Business Models - Comparing distributed energy business models within current and evolving institutional structures to identify key	N4: Distribution System Operator	Jan' 22	21.N4.F.0151	In Progress
Demonstrating pathways for Urban Renewable Energy Zones-Barriers, opportunities, and impacts of establishing Urban REZ	N4: Distribution System Operator	Oct' 21	21.N4.F.0152	In Progress
Pathways to scale-Barriers to, opportunities from, and impacts of retrofitting one million+ homes	H2: Enhancing home thermal efficiency	Jun' 21	20.H2.F.0136	Completed
Incentivising within-day shifting of household electricity use	H4: Rewarding flexible demand	Apr' 22	21.H4.F.0239	In Progress
Decarbonisation Pathway for the Australian Cement and Concrete Sector	B1: Value chain optimisation	Sep' 21	21.B1.F.0237	Completed
Improving Energy Productivity Through the Electrification of Cold Chain Logistics: Phase 1: Concept Development	B1: Value chain optimisation	Jan' 22	21.B1.F.0203	In Progress
Phase change materials for flexible demand in refrigeration	B4: Flexible demand	Jun' 21	20.B4.F.0133	Completed
Load Flexing of Industrial Refrigeration Systems at Abattoirs	B4: Flexible demand	Nov' 21	21.B4.F.0153	Completed
Biogas from agricultural waste: a techno-economic evaluation	B5: Onsite anaerobic digestion	Aug' 21	21.B5.F.0149	In Progress
Techno-economic analysis on improving biogas from anaerobic digestion on pre-treated sewage sludge	B5: Onsite anaerobic digestion	March' 22	21.B5.F.0234	In Progress
Mapping organic waste in Sydney to advance anaerobic co-digestion for energy generation and GHG reduction	B5: Onsite anaerobic digestion	Dec' 21	21.B5.F.0195	In Progress

Opportunity Assessment

Trust building for collaborative win-win customer solutions	E1: Trust building	Apr' 22	20.E1.A.0122	Completed
Foresighting for Net Zero Energy Systems	E2: Energy foresighting and planning	Dec' 21	21.E2.A.0189	In Progress

Developing the future energy workforce	E3: Future energy workforce	Apr' 21	20.E3.A.0080	Completed
Electric Vehicles & the Grid	N1: Electric Vehicles & the Grid	March' 21	20.N1.A.0077	Completed
Low voltage network visibility and optimising DER hosting capacity	N2: LV network & DER hosting capacity	Mar' 21	20.N2.A.0126	Completed
Local DER network solutions	N3: Local DER network solutions	Jun' 22	21.N3.A.0212	In Progress
DSO and Beyond Opportunity Assessment	N4: Distribution System Operator	Apr' 22	21.N4.A.0242	In Progress
Residential solar pre-cooling	H1: Residential solar pre-cooling	Mar' 21	20.H1.A.0089	Completed
Enhancing home thermal efficiency - Turning up the HEET (Housing Energy Efficiency Transitions)	H2: Enhancing home thermal efficiency	May' 22	21.H2.A.0199	In Progress
Rewarding Flexible Demand	H4: Rewarding flexible demand	May' 21	21.H4.A.0150	Completed
Value chain optimisation to transform energy productivity	B1: Value chain optimisation	March' 21	20.B1.A.0130	Completed
Industry 4.0 for energy productivity	B2: Industry 4.0	Dec' 21	21.B2.A.0229	In Progress
Electrification and renewables to displace fossil fuel process heating	B3: Electrification & renewables	Feb' 21	20.B3.A.0121	Completed
Flexible demand and demand control technology and development	B4: Flexible demand	Mar' 21	20.B4.A.0132	Completed
Onsite anaerobic digestion	B5: Onsite anaerobic digestion	Jan' 22	21.B5.A.0187	In Progress

PhD Projects

Artificial Intelligence for management of electric vehicles and vehicle to grid (V2G) resources optimization	N1: Electric Vehicles & the Grid	Oct' 21	21.N1.P.0215	In Progress
Data Innovation for Zero Carbon Buildings	B4: Flexible demand	Oct' 21	21.B4.P.0219	In Progress
Prefabricated solutions for large-scale energy efficiency retrofitting of residential buildings	H2: Enhancing home thermal efficiency	Jun' 21	21.H2.P.0161	In Progress
Green small scale hydrogen solutions for household energy supplementation	H3: Home energy technologies	Jun' 21	21.H3.P.0162	In Progress

Optimal design of biogas power generation system in wastewater plants	B5: Onsite anaerobic digestion	Oct' 21	21.B5.P.0217	In Progress
Innovative tariffs and demand response potential for residential and industrial customers	H4: Rewarding flexible demand	May' 21	21.H4.P.0163	In Progress
Fast-track to Net Zero Carbon buildings	B4: Flexible demand	May' 21	21.B4.P.0164	In Progress
Smart Charging Strategies for Electric Vehicles in Smart Grids	N1: Electric Vehicles & the Grid	May' 21	21.N1.P.0165	In Progress
How can the "customer first" and iterative approaches of successful Australian and International start-ups be applied to help the energy transition?	E1: Trust building	May' 21	21.E1.P.0169	In Progress
Designing Distributed Renewable Micro-Grids for Reliability.	N3: Local DER network solutions	Jun' 21	21.N3.P.0166	In Progress
Developing appropriate and robust community management strategies to support successful renewable microgrid energy solutions for off-grid Indigenous communities	E1: Trust building	Jun' 21	21.E1.P.0168	In Progress
The Development of an Australian Energy Sector Trust Index	E1: Trust building	Jun' 21	21.E1.P.0167	In Progress

Non-research Projects

Ecosystem Mapping	N1: Electric Vehicles & the Grid	Jun' 22	22.N1.N.0416	In Progress
National Charge Link	N1: Electric Vehicles & the Grid	Apr' 22	22.N1.N.0414	In Progress

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