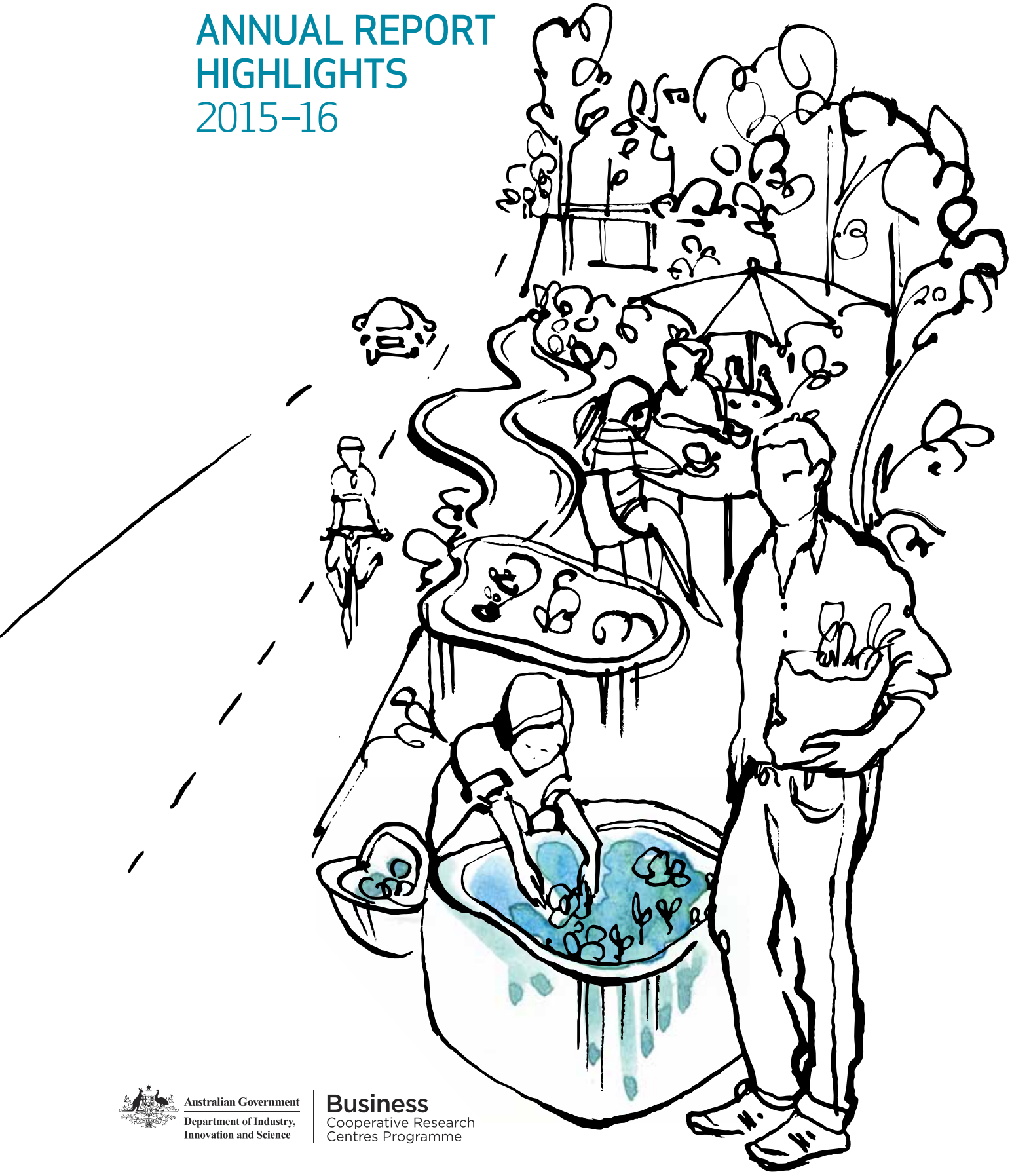
LOW CARBON LIVING CRC

ANNUAL REPORT HIGHLIGHTS 2015–16



Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

LOW CARBON LIVING CRC

2015/16 PARTICIPANTS

BLUESCOPE

Brookfield MULTIPLEX BM

AECOM

CSIRO

Sydney WATER

SWINBURNE UNIVERSITY OF TECHNOLOGY

THE UNIVERSITY OF MELBOURNE

Curtin University

UNSW AUSTRALIA

University of South Australia

Ash Development Association of Australia

HIA

HASSELL

green building council australia

UNIVERSITY OF WOLLONGONG AUSTRALIA

CSR

STANDARDS Australia

Australian Government
Department of Infrastructure and Regional Development

Australian Government
Department of Industry, Innovation and Science

Government of South Australia
Department of State Development

MASTER BUILDERS AUSTRALIA

ISCA Infrastructure Sustainability Council of Australia

UrbanGrowth NSW

VBA VICTORIAN BUILDING AUTHORITY

asa australasian (iron & steel) slag association

CONSULT AUSTRALIA

RenewalSA
people partnerships progress

Government of South Australia

UNEP

KTH VETENSKAP OCH KONST

SYDNEY COASTAL COUNCILS

buildingSMART AUSTRALASIA

ametalin
raising the standard

Australian Institute of Architects

The Centre for Liveability Real Estate
Real estate training, research, strategy and communications

Government of South Australia

SA Water

CITY OF MELBOURNE

CITY OF SYDNEY 2030

NSERC Smart Net-Zero Energy Buildings Strategic Research Network

aurecon

AWA
AUSTRALIAN WINDOW ASSOCIATION

City of Fremantle

Sydney TAFE

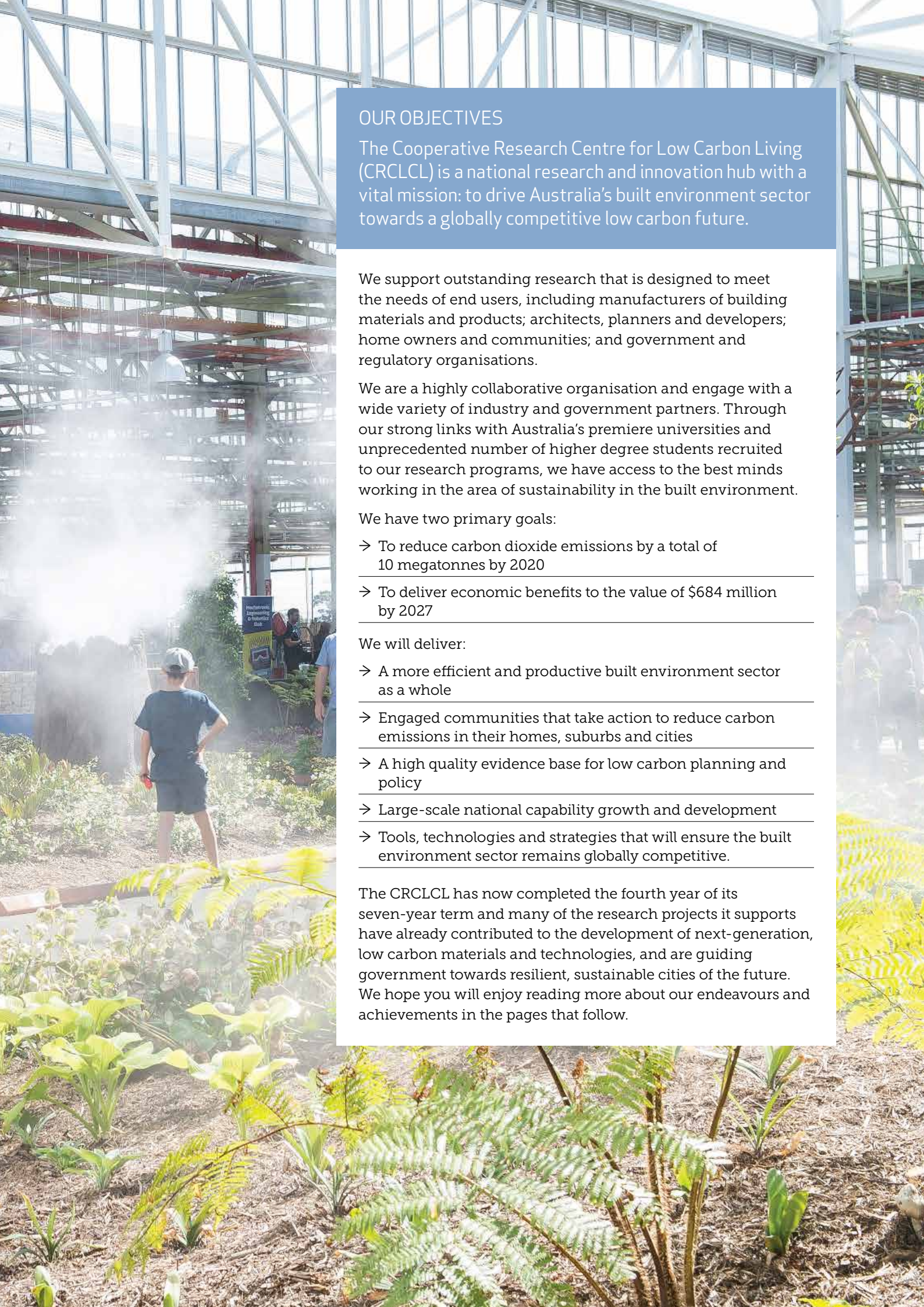
NSW GOVERNMENT Planning & Infrastructure

NSW GOVERNMENT Office of Environment & Heritage

BCI MEDIA GROUP

CONTENTS

Tonsley Central Forest
Photo: Renewal SA



OUR OBJECTIVES

The Cooperative Research Centre for Low Carbon Living (CRCLCL) is a national research and innovation hub with a vital mission: to drive Australia's built environment sector towards a globally competitive low carbon future.

We support outstanding research that is designed to meet the needs of end users, including manufacturers of building materials and products; architects, planners and developers; home owners and communities; and government and regulatory organisations.

We are a highly collaborative organisation and engage with a wide variety of industry and government partners. Through our strong links with Australia's premiere universities and unprecedented number of higher degree students recruited to our research programs, we have access to the best minds working in the area of sustainability in the built environment.

We have two primary goals:

- To reduce carbon dioxide emissions by a total of 10 megatonnes by 2020
- To deliver economic benefits to the value of $684 million by 2027

We will deliver:

- A more efficient and productive built environment sector as a whole
- Engaged communities that take action to reduce carbon emissions in their homes, suburbs and cities
- A high quality evidence base for low carbon planning and policy
- Large-scale national capability growth and development
- Tools, technologies and strategies that will ensure the built environment sector remains globally competitive.

The CRCLCL has now completed the fourth year of its seven-year term and many of the research projects it supports have already contributed to the development of next-generation, low carbon materials and technologies, and are guiding government towards resilient, sustainable cities of the future. We hope you will enjoy reading more about our endeavours and achievements in the pages that follow.

MESSAGE FROM THE CHAIR

The CRCLCL is now in its prime and moving at an impressive pace towards its goals. We have enjoyed another productive year, signing up new projects, partners and students, and watching with pride as established projects come to fruition.

A valuable amendment to the constitution was approved by our participant members at our 2015 Annual General Meeting. The amendment allows the Board to recruit an additional, expert board member to oversee the next and arguably most important stage of the CRCLCL's lifespan: uptake and utilisation of our research outputs. The Board considered and approved 12 new research proposals over the course of the year. The CRCLCL has now funded a total of 83 projects.

Ensuring that the CRCLCL remains on track to fulfil its mission within its agreed timeline is one of the Board's key responsibilities. During the last year, the Board commissioned thorough independent reviews of the CRCLCL's governance processes, carbon reduction targets, economic benefit projections and progress towards its goals. The review process has been rigorous and the Board is delighted to report that the results have been extremely positive.

> "The CRCLCL is on track to meet all of its targets and all indications are we will in fact surpass them."

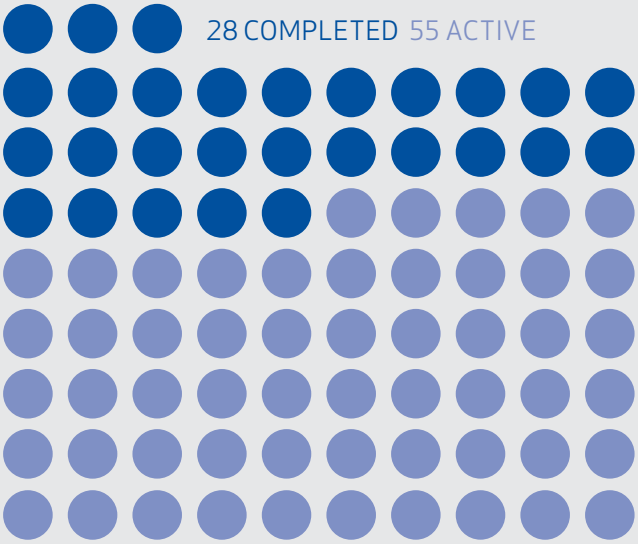
HIGHLIGHTS

$684m

expected benefit to Australian economy by 2027

83 APPROVED PROJECTS TO DATE

28 COMPLETED 55 ACTIVE



124

TOTAL MILESTONES DUE TO DATE

includes 26 utilisation milestones

ENABLING SIGNIFICANT CARBON REDUCTIONS

10Mt target by 2020 = the annual greenhouse gas emissions from 2.1 million passenger vehicles*

*Source: USA EPA Greenhouse Gas Equivalencies Calculator

- Our governance structures and processes have been affirmed as strong and effective by independent experts, FAL Lawyers.
- Analyses of the CRC's research portfolio by experts at the University of New South Wales confirmed that the CRCLCL is on course to deliver a cumulative reduction of 10 megatonnes of CO_2 emissions by 2020.
- PricewaterhouseCoopers (PwC) reviewed our original benefit estimates, confirming their soundness, and went on to assess the CRCLCL's performance towards its targets by assessing a range of current projects. PwC has reported that the CRCLCL is likely to exceed its economic benefit target of $684 million by 2027.

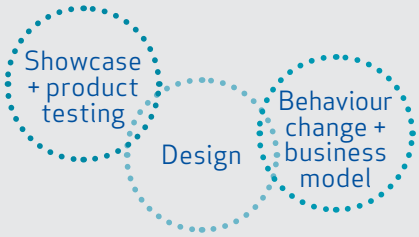
The Board is satisfied that the CRCLCL is on track to meet all of its targets and all indications are we will in fact surpass them.

The CRCLCL's current activities are set to leave an enduring legacy that will continue to deliver additional carbon reductions and economic benefits for decades to come.

The Hon Robert Hill AC
Chair, Board of Directors

8 IMPACT PATHWAYS

11 LIVING LABORATORY PROJECTS



45 PARTICIPANTS

20 Industry
17 Government
8 Research

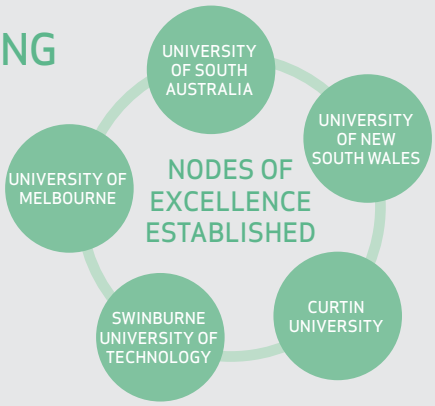
17 PROJECTS IN COMMERCIALISATION/ UTILISATION STAGES

ONCE IN A GENERATION CAPACITY BUILDING
FOR THE BUILT ENVIRONMENT SECTOR

HDRs ENROLLED
92

FORECAST INVESTMENT
$9m
in student scholarships over life of CRCLCL

PREPARING INDUSTRY-READY GRADUATES



MESSAGE FROM THE CEO

The CRCLCL is entering an exciting new stage of its life. Our research projects are maturing, some are complete, and we are increasingly focused on putting the results of our labours to work out in the world of business and industry. We are, as our Chair Robert Hill has stated, extremely well placed to achieve all of our goals.

We are also putting into place strategies and structures to ensure the CRCLCL's achievements continue to yield benefits well beyond its seven-year lifespan and to provide a platform for ongoing capacity building and education.

Much has been achieved over the past year, particularly in the areas of education and capacity building. We have now enrolled a total of 92 Higher Degree by Research students, surpassing our formal targets.

Our five new Nodes of Excellence, which are the pillars of our legacy plans and located at five universities around the country, have been launched and are undertaking a range of initiatives to fulfil their roles as exemplary centres for low carbon research, collaboration and training.

Our research projects continue to produce new products, tools and insights. Two of our projects, one promoting low carbon tourism, the other low carbon practices in local communities, have published guidelines to help others follow their lead. Our geopolymer concrete researchers have completed a comprehensive specifications handbook that will ensure the low carbon material becomes a mainstream choice. Our Program 2 researchers have furthered their work on a shared platform that predicts demand for energy, water, waste and transport, trialling it at one of our Living Laboratories. And our Program 3 researchers have developed scenario modelling software aimed at improving the energy efficiency of commercial buildings and it is attracting active industry interest.

Our Annual Participants Forum is always a highlight and the 2015 Forum was no exception, with plenty of productive discussion between our researchers, participants and others who share our vision of a built environment sector that is both sustainable and competitive.

The CRCLCL's research, particularly our Living Laboratories such as Josh's House and White Gum Valley in Western Australia, has continued to attract media interest. Both our students and program leaders have presented their ideas on Radio National's venerable Science Show and CRCLCL's headquarters staff have also taken to the road, in collaboration with our industry partners, to showcase some of our exemplar projects to significant industry organisations, including Mirvac, City of Melbourne and the NSW Department of Planning and Environment.

> "Much has been achieved over the past year, particularly in the areas of education and capacity building."

One of my personal highlights was signing a memorandum of understanding with the Global Alliance for Buildings and Construction, a United Nations initiative officially launched at the 2015 UN Climate Change Conference. Joining the Alliance is a significant honour for the CRCLCL as we were the only Australian organisation to do so and we plan to share our public domain knowledge, tools and techniques globally. We are also supporting the work of APEC's International Energy Policy and Program Evaluation, (IEPPEC) Asia-Pacific.

Scientia Professor Deo Prasad AO
Chief Executive Officer

Australian Taxation Office, Brisbane, by CRCLCL participant HASSELL
Photo: Christopher Frederick Jones

RESEARCH ACTIVITIES

The CRCLCL's research projects are organised under three Programs and eight Impact Pathways, which together set out a strategy for achieving a low carbon, economically viable built environment.

Integrated Building Systems

1 Harnessing the Australian sun

2 Lowering the embodied carbon in buildings

3 Mainstreaming low carbon buildings

Low Carbon Precincts

4 Designing integrated low carbon precincts

Engaged Communities

5 Evidence base for low carbon living policy

6 Enhancing community engagement

7 Living laboratories as low carbon lifestyle narratives

8 Enhance education and capacity building

Program 1 Integrated Building Systems

Developing new low carbon embodied products and services, and finding ways to communicate best practice design through rating tools, standards and display homes.

Program 2 Low Carbon Precincts

Creating planning techniques and data for delivering low carbon developments at a precinct level. Communicating best practice in sustainable city planning through exemplar precinct developments and tools.

Program 3 Engaged Communities

Capturing a new community appetite for low carbon living. Through research, communicating to business and government the vision of a prosperous, liveable and sustainable society.

The following pages provide research project highlights for each impact pathway from Year 4.

HARNESSING THE AUSTRALIAN SUN

The research associated with this pathway aims to make active solar products the default choice for roofing in Australia. The vast amount of sunlight landing on our rooftops could be used to heat, power and even cool entire cities, but instead it overheats buildings in summer, increases demand for conventional air-conditioning or simply goes unused.

THE ROOF THAT HEATS, COOLS AND GENERATES POWER

The CRCLCL and BlueScope investigated the behaviour and performance of a commercially oriented photovoltaic and thermal (PVT) roof system that not only generates electricity but also provides heating, cooling and fresh air ventilation. A prototype of the integrated system has been installed in a residential building in Glebe and monitoring over the past year has shown that the system has the potential to not only improve thermal comfort for residents, but also increase the flow of fresh air into the home. The researchers involved in this project have found that the depth of the PVT collector can influence the system performance for particular weather conditions and building types.

A second, more recent part of the project is focused on expanding the functions of PVT roofing systems to include desiccant cooling. A prototype is under construction and its performance will be monitored intensively once installed. These prototypes are not currently available for commercial purchase.

RP1001: Air handling solutions, integration approaches and building design considerations for PVT roofing

RP1015: Combining a building integrated PVT system with a low temperature desiccant cooler to drive affordable solar cooling

NSW GOVERNMENT SET TO UTILISE NEW ENERGY PERFORMANCE STANDARD

Other researchers in Program 1 (Integrated Building Systems Program) are working to remove barriers to industry uptake of renewable heating and cooling technologies. These barriers include outdated regulatory requirements and higher costs. CRCLCL researchers, in collaboration with Standards Australia, have devised the world's first technical standard for solar heating and cooling (AS5389). The standard sets out a method for evaluating the annual energy performance of solar cooling and heating systems which can then be compared to that of conventional systems. The draft standard has been released for public comment and work is underway to embed it in the next amendment to the NSW government's Energy Savings Scheme Rule (ESS). The ESS creates financial incentives for organisations to invest in energy savings projects.

RP1008: Industry support mechanisms for renewable heating and cooling

PARTICIPANTS

BlueScope Steel
CSIRO
CSR
NSW Office of Environment and Heritage
Standards Australia
Suntech R&D
University of New South Wales
University of South Australia

Solar Analytics Dashboard
Image: Solar Analytics

SMARTER MANAGEMENT OF SOLAR ENERGY

The CRCLCL is supporting Solar Analytics to develop algorithms that accurately predict solar energy supply and demand in residential and small commercial buildings. The project will lead to smarter battery-charging systems and intelligent, responsive PVT management systems that can analyse power production, storage and consumption, take weather conditions into account and shift appliance loads to periods when energy is more readily available.

RP1023: Forecasting and home energy analysis in residential energy management solutions

LOWERING THE EMBODIED CARBON IN BUILDINGS

Conventional building materials embody significant quantities of energy and carbon. The CRCLCL aims to support the development of new, more environmentally friendly materials, and generate confidence in and support for their transition to mainstream use.

Geopolymer Concrete Bridge at Toowoomba, QLD in September 2014 Photo: Wagners

PROMOTING CONFIDENCE IN LOW CARBON CONCRETE

Geopolymer concrete makes use of industrial waste and its carbon footprint is 80 per cent smaller than that of conventional Portland cement. The CRCLCL is keen to encourage the widespread use of geopolymer concrete and, to that end, a team of its researchers has been collaborating with Standards Australia to produce a comprehensive specifications handbook based on data from real-world projects that have utilised the low carbon product. The first draft of the handbook is now complete and has been released for industry and public comment.

RP1020: Reducing barriers for commercial adaptation of construction materials with low embodied carbon

USING WASTE TO MAKE SUSTAINABLE ENGINEERED TIMBERS

CRCLCL researchers have been investigating the potential of readily available, low-cost waste materials (such as non-degradable plastics and agricultural by-products) as alternative fillers and binders to create sustainable particle board. The properties and processing conditions required to make next-generation boards have now been identified and the project is moving towards utilisation. A large Australian building-products company may take up the manufacture of the next-generation boards or with simplification of the production processes, smaller enterprises may be able to manufacture them close to their source materials.

RP1022: Investigation of innovative sustainable low carbon products from waste materials for built environments

Urban wood waste stream (left) and wood-plastic engineered wood sample.
Photo: Claudia Echeverria Encina

PARTICIPANTS

AECOM
Ametalin
Ash Development Association of Australia
Aurecon
Australasian Slag Association
Australian Steel Mills Services
Engineered Material Services
Millliken Infrastructure Solutions
Roads and Maritime Services
Standards Australia
VicRoads
Wagners
Swinburne University of Technology
Sydney Water
UNSW

MAINSTREAMING LOW CARBON BUILDINGS

CRCLCL researchers are gathering, analysing and promoting evidence that demonstrates the many merits of low carbon products, materials and designs. Their findings aim to instil confidence in low carbon buildings and drive up demand. It will also support smart policy and decision-making, and facilitate accurate comparisons between designs and materials.

A MODEL OF EIGHT-STAR ENERGY EFFICIENCY

CSR Low Energy House is a two-storey home in the western Sydney suburb of Schofields that boasts an eight-star energy-efficiency rating. The building's orientation and insulation, the way it is sealed and ventilated, and the materials used in its construction all contribute to its sustainability. It is an excellent, real world example of the sorts of energy efficiencies that can be achieved at relatively low cost and an important means of showcasing low carbon buildings to the public and industry. CRCLCL researchers are using a system comprised of more than 100 sensors to monitor and validate the actual thermal efficiency of the house and compare it to simulated models. Accurate models will help to determine how the building's design would perform in different climates and conditions.

RP1010: Monitoring and modelling the CSR Low Energy House

FINE-TUNING ENERGY EFFICIENCY ASSESSMENTS

The NSW Building Sustainability Index (BASIX) assesses the energy and water efficiency of proposed dwellings against a series of sustainability targets. CRCLCL researchers are collecting in-depth data about actual electricity and gas usage, as well as building design and occupant behaviour, across a range of new dwelling types, and comparing it to BASIX predictions in order to improve the accuracy of the assessment system.

RP1017: Validating the NSW BASIX energy assessment tool for low carbon dwellings

GETTING THE RIGHT INFORMATION TO THE RIGHT PEOPLE

CRCLCL researchers are developing processes to help decision makers understand and assess the evidence in support of low carbon buildings. They are also analysing how commercial building projects typically unfold in their earliest stages so as to devise strategies that ensure information about low carbon design reaches the right people in the right form at the right time to have the greatest impact.

RP1009: Closing the loop on evidence-based low carbon design of non-residential buildings

WARMING WATER WHILE LOWERING COSTS

CRCLCL researchers are investigating novel ways to improve the energy efficiency of solar pool heating systems. Their research to-date has shown that solar pumps that circulate water more slowly are effective and can generate energy savings of up to 70 per cent, without requiring significant changes to existing plumbing.

RP1014: Impact of energy efficient pool pumps on peak demand, energy costs and carbon reduction

PARTICIPANTS

AECOM
Ausgrid
Brookfield Multiplex
City of Sydney
Commonwealth Department of Industry, Innovation and Science
CSR
Curtin University
HASSELL
NSW Department of Planning and Infrastructure
NSW Office of Environment and Heritage
World Green Building Council
University of Melbourne
UNSW
University of South Australia

The BASIX team

DESIGNING INTEGRATED LOW CARBON PRECINCTS

CRCLCL research is contributing to the design of entire low carbon neighbourhoods, from individual buildings to transport, infrastructure, land use and waste management. Impact Pathway 4 recognises not only the environmental benefits of low carbon precincts but also their potential to promote human wellbeing. One of our researchers' key areas of focus is the development of highly-functional precinct design and assessment tools that will make it easier for industry and government to make low carbon choices.

Aerial view of the Lochiel Park development in Adelaide.

FORECASTING DEMAND FOR ENERGY, TRANSPORT, WASTE AND WATER

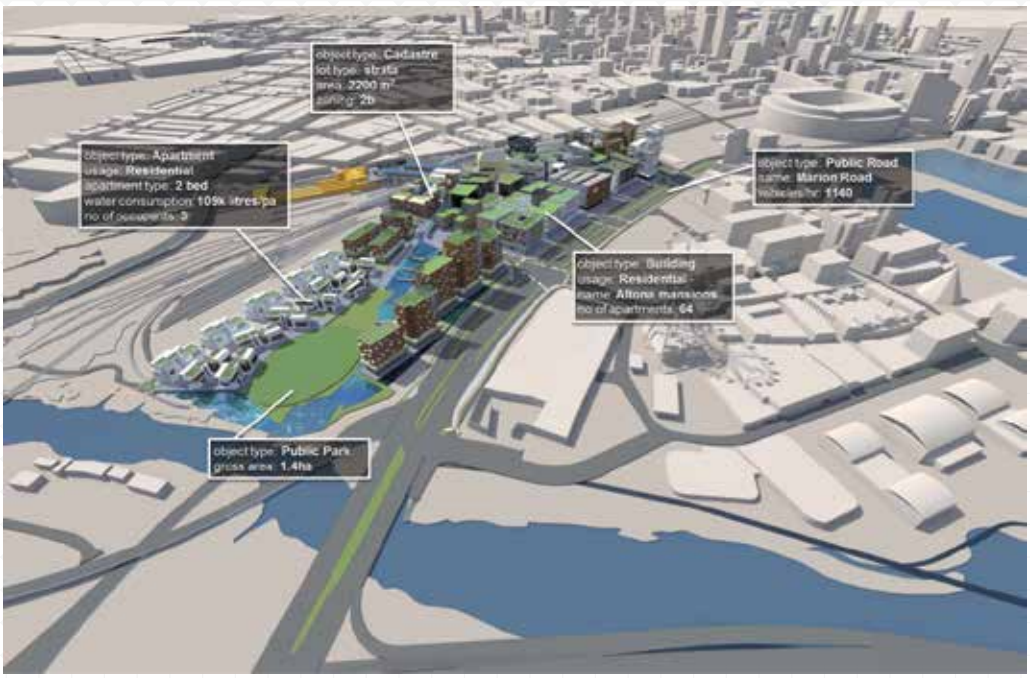
CRCLCL researchers are well along the path to developing a shared platform to forecast, in an integrated way, energy, transport, waste and water (ETWW) demand in different types of built environments. The tool will allow effective, efficient assessment of the overall carbon impacts of urban developments or redevelopments. A foundation version of the model has now been completed, trialled around the Lochiel Park development in Adelaide and the focus of a series of workshops. Refinement and development of the platform continues.

RP2002: Integrated ETWW demand forecasting and scenario planning for precincts

KEEPING URBAN TEMPERATURES TOLERABLE

CRCLCL researchers are examining the Urban Heat Island (UHI) effect in three of our state capitals. The project is building and sharing a vital body of information about the way people use public spaces, to support the planning and design of green and sustainable cites. CRCLCL researchers involved with this project took part in a shared workshop in March 2015 with the CRC for Water Sensitive Cities to identify the emerging evidence and tools for policy and practice related to potential urban planning and design interventions for greening and cooling Australian cities.

RP2005: Urban micro climates: Comparative study of major contributors to the Urban Heat Island (UHI) effect in three Australian cities (Sydney, Melbourne, Adelaide)



Example of Precinct Information Model (PIM)

TRACKING CARBON OVER TIME

The CRCLCL is developing software tools and databases to track the carbon embodied in and emitted by building materials over their entire lifecycle, from processing to distribution to use. The tools are designed for use on a range of scales, including entire precincts. Activity related to this project over the past year has included: commencement of work on a tool for balancing and optimising the carbon emissions and costs of buildings over their lifecycle, further development of a database of Australia-specific embodied carbon for construction materials and scenario modelling in two areas of Adelaide.

RP2007: Integrated Carbon Metrics: A multi-scale lifecycle approach to assessing, mapping and tracking carbon outcomes for the built environment

ENSURING GOVERNMENT CONSIDERS CARBON

The CRCLCL is working closely with UrbanGrowth NSW and its industry providers to reduce carbon in land development projects by embedding sustainability ratings, such as the Infrastructure Sustainability Council of Australia's IS Rating Tool, in NSW government procurement systems. Design of a methodology for doing so is underway.

RP2010: Informing and trialling low carbon inclusions in State Government Built Environment sector tenders

SHARING LARGE-SCALE, IN-DEPTH MODELS OF HUMAN ACTIVITY AND CARBON

The CRCLCL is developing a series of PIMs, or Precinct Information Models. PIM's three-dimensional virtual models include factors such as land use, flows of people, building materials, water, energy, waste and carbon performance within an entire precinct. The project has continued its development of an open platform for sharing precinct-scale information across all activities that lead to low carbon outcomes.

RP2011: Precinct Information Model (PIM): An open digital information standard throughout the urban development lifecycle

RP2007 Industry Utilisation workshop

PARTICIPANTS

AECOM
AURECON
BlueScope Steel
Brookfield Multiplex
BuildingSMART
City of Adelaide
City of Melbourne
City of Sydney
CSIRO
Curtin University
Department of State Development South Australia (DSSD)
ETH Singapore
HASSELL
NSW Office of Environment and Heritage
Nursery and Garden Industry Australia
Renewal SA
SA Water
Sustainable Built Environment National Research Centre
Sydney Water
UrbanGrowth NSW
Swinburne University of Technology
UNSW
University of South Australia
University of Melbourne

EVIDENCE BASE FOR LOW CARBON LIVING POLICY

The CRCLCL is working with all levels of government to promote understanding of the benefits of low carbon policy and action. An evidence base for the high social, environmental and financial returns of carbon mitigation policy for Australia will encourage government uptake.

DESIGNING THE FUTURE

CRCLCL researchers are working to envision and articulate resilient, low carbon cities of the future and possible ways to support their reality. It relies on both research and creative engagement strategies, and its research team is engaging with councils, government and industry stakeholders to distil a wide range of perspectives. The project adheres to the adage that in times of great uncertainty, the only way to predict the future is to design it.

RP3008: Visions and Pathways 2040

MODELLING AND MEASURING POLICY EFFICACY

The CRCLCL has developed a unique software tool for analysing the cost benefits of energy policies, particularly around low carbon retrofitting. The research team has undertaken a number of modelling and evaluation exercises in 2016 at the request of CRCLCL participants and for the NSW government, including an assessment of the sensitivity of the market to the Energy Savings Certificate Price and an investigation of the potential for improving Environmental Upgrade Agreements. The latter analysis has shown how a new "one-stop shop" implementation model can increase uptake by a factor of up to 13.5. Alternative energy efficiency policy interventions were also modelled for the City of Melbourne and identified that capability assistance will generally have more impact on uptake than financial assistance alone.

RP3002: A framework for low carbon living community policy & program development

IDENTIFYING INFLUENCES ON CONSUMER CHOICES

The CRCLCL has developed a novel Agent Based Modelling tool to predict the future uptake of energy-efficient technologies and practices in the 'household and business product and service' markets, using different non-financial interventions. An initial investigation looked at the impact of the Energy Savings Scheme on the uptake of energy efficient fridges for vulnerable households in the Cronulla local government area. The researchers have found that uptake could be increased by 35% if the government provided zero interest loans.

RP3028: A 'virtual market' for analysing the uptake of energy efficiency measures in the residential sector

ENCOURAGING PUBLIC TRANSPORT USE

One of the CRCLCL's newest projects and is in its very earliest stages, RP2021 is aimed at encouraging public transport use and will entail, among other things, an investigation into current public transport usage, including why some people don't use it.

RP2021: Greening suburban travel

BREAKING DOWN BARRIERS

The CRCLCL is working to identify the barriers that low-income households face in reducing their carbon consumption. The research will help provide an evidence base for policy makers. Focus groups have been conducted with a range of vulnerable, low-income groups in both urban and regional areas around Australia. A range of service providers, peak bodies, advocacy groups, social landlords and state agencies have also been interviewed. The research team has identified a need to raise awareness about and uptake of existing assistance programs for low-income households.

RP3038: Lower income barriers to low carbon living

PARTICIPANTS

AECOM
AURECON
Brookfield Multiplex
City of Melbourne
City of Sydney
Commonwealth Department of Industry, Innovation and Science
CSIRO
Department of State Development South Australia (DSSD)
HASSELL
NSW Office of Environment and Heritage
Renewal SA
Sustainability Victoria
Swinburne University
Sydney Water
University of Melbourne
University of South Australia
UNSW

RP3008 project visualisation

RP3008 project visualisation

ENHANCING COMMUNITY ENGAGEMENT

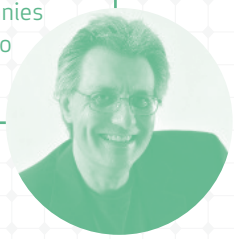
The CRCLCL promotes productive collaboration between developers and communities that stimulates demand for low carbon infrastructure and services. Our research will develop community engagement and consultation processes to facilitate rich dialogue about community aspirations for low carbon living. Councils, property developers and utility companies will be able to use these processes to create better developments and enable faster approvals.

LOWERING CARBON AND LIVING WELL

The Livewell Clusters are part of the CRCLCL's Living Laboratories program; a community and personal carbon reduction initiative comprising of groups of local individuals interested in reducing their carbon footprints and improving their wellbeing. Ten Livewell Groups have now been initiated in Melbourne's City of Yarra, resulting in the development of a website with a variety of resources on carbon reduction. The project recently expanded its outreach by producing an e-guide for dissemination by local councils and community groups outside of Melbourne.

RP3011: Community carbon reduction and wellbeing enhancement

"The Low Carbon Living Blue Mountains website is a win/win for not only business, large and small and their customers, but for our region as a whole. Businesses want to reduce their running costs, and this website allows them to do that while at the same time contributing to a cleaner low carbon environment for the Blue Mountains. It's a no-brainer. This CRCLCL initiative provides a synergy that makes business sense, as well as environmental sense and we need this to maintain a healthy, sustainable business economy and environment in the Greater Blue Mountains World Heritage area. I would encourage all businesses from single operators to large companies to become part of this movement that's helping to improve the planet – and increase sales. "



VENT THOMAS
President, Blue Mountains
Regional Business Chamber

PROMOTING LOW CARBON TOURISM

As one of Australia's top tourism destinations, the Upper Blue Mountains was chosen for a pilot project focused on helping tourism businesses reduce their carbon footprint. The project developed and launched a website to promote low carbon tourism and business practices, encourage visitors to the area to choose low carbon services and to provide a carbon accounting system for participating businesses. A survey conducted as part of this project has shown that 81% of visitors would choose to support businesses making an effort to reduce their carbon footprint over businesses that are not doing so. The project team has also produced a brochure to show how the website's carbon assessment tools can be adapted for use in other regions.

RP3010e1: Building low carbon communities

DEVELOPING COMMUNITY-ORIENTED RENEWABLE ENERGY INITIATIVES

RP3007 and RP3023 are investigating community-owned renewable energy (CRE) projects: a form of development where communities are integrally involved in the initiation, development, decision making, management and benefit of the facility. Project results will support industry and community groups seeking to develop community-oriented renewable energy initiatives.

RP3007: Opportunities and challenges for community-scale renewable energy projects

RP3023: The contribution of community-owned renewable energy to regional development and resilience in the face of climate change

IDENTIFYING STRONG COLLABORATIVE PLANNING PROCESSES

The CRCLCL has identified collaborative, community-engaged decision-making as a core pathway to more liveable and sustainable neighbourhoods with a low carbon footprint. This project aims to identify the strengths and weaknesses of collaborative urban planning processes.

RP3020 Low Carbon Schools launch, July 2016 Photo: Jean-Paul Horré

PARTICIPANTS

BCI Media Group
City of Freemantle
Curtin Univeristy
Yarra Council
Yarra Energy Foundation
Blue Mountains City Council
Blue Mountains, Lithgow & Oberon Tourism
Blue Mountains World Heritage Institute
Gridstone
NSW Office of Environment and Heritage
Renewal SA
SA Department of State Development
Swinburne University of Technology
UNSW
University of South Australia

RP3017 has identified specific techniques for facilitating engagement and Renewal SA is applying these resources at our Bowden and Tonsley Living Laboratories (See page Impact Pathway 7).

RP3019: Pathways to achieve low carbon living outcomes through collaborative urban development planning in Australia

RP3017: Adelaide Living Laboratory co-creation toolkit

GENERATING CHANGE VIA SCHOOL PROGRAMS

This project is examining the efficacy of a pilot Low Carbon Schools Program in Perth supporting 15 schools to reduce their operating carbon emissions by 20% by 2017. Researchers will also examine whether the schools and their students also influence broader community awareness, knowledge and action on climate change and decarbonisation.

RP3020: Influencing change through a low carbon schools community program)

ENABLING CO-DESIGN OF SUSTAINABLE PRECINCTS

Intense re-development in established inner and middle-ring suburbs is a major challenge for our fast-growing cities. Done well, urban regeneration on this scale has the potential to reduce carbon emissions and urban sprawl, and improve housing affordability and urban liveability. This project, which is being undertaken in collaboration with the CRC for Spatial Information will deliver new processes, standards and certification procedures to enable community groups to work with local governments, state agencies and property developers, to co-design more sustainable, medium density, low carbon housing precincts.

RP3034: Community co-design of low carbon precincts for urban regeneration in established suburbs

"We believe that this program will have far reaching impacts, not only on the schools currently participating, but for future participant schools who are already showing interest in signing up for the program. And if an entity as complex, as time poor and as financially constrained as our schools can reduce emissions – then surely there is a covert teaching opportunity that exists here as a challenge to the broader business community … if schools can, then you can! Given the aggregated potential of this program across the state, and the country, we feel that the funds that the City of Fremantle contributed to initially subsidising schools in the program, and supporting this valuable research project, were immensely well spent, and we hope the program continues to grow and develop into the future."

MELANIE BAINBRIDGE
Sustainability Officer,
City of Fremantle

LIVING LABORATORIES AS LOW CARBON LIFESTYLE NARRATIVES

The CRCLCL has helped to establish 11 Living Laboratories around Australia that are helping to generate demand for low carbon living. Living Laboratories are 'learn-by-doing' community developments, ranging from individual homes to entire precincts, through which the CRCLCL, its researchers and partners can integrate, test and evaluate low carbon living solutions. They also help to focus CRCLCL engagement with the public via the culturally appealing topics of home renovation and real estate.

MEASURING ATTITUDES, CHANGING BEHAVIOUR

Human attitudes and behaviour are key to building a low carbon future. We need to understand how people live now, what they could be doing to reduce their carbon footprint and what sorts of psychological, societal and cultural processes need to be activated to close the gap between the two. CRCLCL researchers are developing a reliable, practical survey that can be used to measure attitudes to low carbon living, with the aim of identifying the factors that drive adoption of low carbon practices.

RP3012: Environmental attitudes: low carbon behavioural practice

ENHANCING THE MARKET FOR ENERGY EFFICIENT HOMES

This project has been looking for the best ways to deliver information about energy efficiency at the point of sale or lease and has examined both public and industry preferences. Buyers and renters want energy-efficient homes and research has shown that energy efficiency increases property value. Industry and government are looking to develop a voluntary, national system of energy efficiency disclosure and this project is proving highly influential as discussions about policy design progress.

RP3016: The EnergyFit homes initiative: Enhancing the market for low carbon homes at point of sale

SPREADING THE WORD TO KEEN RENOVATORS

Australia is home to a lot of enthusiastic renovators. CRCLCL researchers working on this project have been working to identify the best ways to reach renovators with information about low carbon products and practices. Online platforms and social media which address the combined need for visualisation, story-telling and trusted advice show considerable potential. RP3029 researchers have developed a social media product design and branding concept, and initial surveys have shown it has considerable public appeal. Industry is highly interested in using the model and planning is well underway to construct the initial platform.

RP3021: Media and communication strategies to achieve carbon reduction through renovation of Australia's existing housing

RP3029: Driving a national social media conversation on energy efficient housing

PARTICIPANTS

Australian Window Association
BlueScope Steel
Brookfield Multiplex
The Centre for Liveability Real Estate
CSIRO
CSR
Department of State Development South Australia (DSSD)
Housing Industry Association
Master Builders Australia
NSW Office of Environment & Heritage
Sustainability Victoria
Victorian Building Authority
Swinburne University of Technology
University of Melbourne
UNSW

"Build4Life is being developed to inform, inspire and engage consumers to demand sustainable homes. The companies that we work with in the residential sector are pushing hard to drive sustainable outcomes. If we can match that with demand from consumers then we can achieve the kind of transformation that is necessary to create liveable, healthy and resilient places for people."

ROMILLY MADEW
Chief Executive Officer, Green Building Council of Australia

ENHANCED EDUCATION AND CAPACITY BUILDING

The CRC for Low Carbon Living's mission relies on the creativity and energy of superlative researchers and we are proud to be supporting an unprecedented number of students undertaking higher degrees by research. Our students are making a valuable contribution to the CRCLCL's current research projects, will graduate with valuable skills in a field that is of global importance and will carry the CRC's legacy into the future.

In 2015, Emeritus Professor Denny McGeorge joined the CRCLCL as its Education Program Leader, charged with increasing student enrolments, supporting existing students and encouraging their engagement with the CRCLCL. The appointment has been a resounding success and the CRCLCL has now surpassed its student recruitment targets. We have enrolled 92 higher degree by research students (85 PhDs and 7 Masters), who are based at universities around Australia and are working on an extraordinary range of projects.

"It is a rare privilege to work with such talented researchers whose interests cover the full spectrum of physical and social sciences. The CRCLCL has brought together a critical mass of higher degree researchers, the largest ever assembled in the low carbon field, and it would be impossible not to be excited about the world-changing potential of this achievement. We are on an exhilarating journey of discovery that will benefit the entire global environment."

EMERITUS PROFESSOR
DENNY MCGEORGE
Education Program Leader, CRCLCL

OUR STUDENTS

TANYA BABAEFF
PhD candidate
CRCLCL Project RP3033

Thesis title:
Governance and community engagement for mainstreaming low carbon housing precincts

"I am researching the making of White Gum Valley (WGV), a new housing development in the City of Fremantle, Western Australia, aimed at changing the way we live. WGV brings together a range of sustainability initiatives such as rooftop solar panels on houses and apartments, battery storage for solar energy, dual plumbing for alternative water sources, rainwater tanks, a community bore for watering gardens, guidelines for sustainable house design and construction, spaces for community connection and much more. Importantly, it introduces medium-density housing into an established, low-density suburb and will offer a range of housing types from community housing for artists, to a Gen Y house, to apartments, to stand-alone houses.

The research asks: how did WGV achieve this breakaway from business as usual? What governance processes and systems supported, or hindered, its formation? And, if we want to do this again, what would it take to succeed?

It's inspiring to be part of an extensive community of people from diverse backgrounds all working toward a sustainable present and future."

CRCLCL 2015 Student Day Photo: Rob Largent

OUR STUDENTS

DAVID BENNETT
PhD candidate
CRCLCL Project RP3008

Thesis title: *Shaping Suburbia: towards the suburbs of the future.*

"What if we could achieve enough physical activity for good health simply from how and where we chose to live? My research reveals a new connection between physical activity and the built environment that supports citizen wellbeing by making walking to destinations the easy choice. In doing so it also delivers stronger local economies, connected communities and places that create car-light, low carbon environments.

The thing that excites me most about this project is that the findings indicate ways that our suburban, middle-ring suburbs could evolve with 'gentle density' delivering new forms of city growth without alienating existing residents, and in so doing unlock significant areas of our post-war growth cities."

ALEX JAIMES CASTILLO
PhD candidate
CRCLCL Project RP2019

Thesis title: *Carbon reductions from composting food waste for food production – fitting recycling models to urban forms*

"Landfill, much of which is made up of food waste, emits vast quantities of methane and is a significant contributor to climate change. The project I am involved with is exploring the most effective ways to divert food waste from landfill and turn it into compost instead, on a large scale, to mitigate methane production.

We are looking at onsite models for urban organic solid waste, such as in-vessel composters and vermiculture (worm farms), as well as offsite models, such as kerbside collection. We want to know which methods are most effective at reducing greenhouse gas emissions, while at the same time producing the best compost product free of pathogens and how to engage the public in the process."

Student posters display at CRCLCL 2015 Forum Photo: Rob Largent

CHRISTINE EON
PhD candidate
CRCLCL Project RP3009

Thesis title: *Challenges and synergies to low cost and low carbon housing*

"The research project I am undertaking is monitoring a mix of 10 year old and modern homes around Western Australia and looking at how occupant behaviour affects their energy use. We have so far discovered that the energy usage in houses of very similar design can vary up to 33 per cent. This is due to a combination of factors, including the way people keep warm in winter or cool in summer, different lifestyles and family configurations, the interactions between family members, habits and attitudes. So building a house that is actually energy efficient requires an understanding of all the complexities going on at the home level."

MEHRDAD FARSHCHIMONFARED
PhD candidate
CRCLCL Project RP1001

Thesis title: *Air Handling solutions, integration approaches and building design considerations for photovoltaic thermal roofing*

"The research project I am working on, with BlueScope Steel, is about developing an effective, aesthetically pleasing and commercially-viable photovoltaic roofing system that is capable of generating electricity as well as heating and cooling a home. It is very exciting and our results will be useful to anyone interested in using the BlueScope PVT roofing system."

JONATHAN FOX
PhD candidate
CRCLCL Project RP2005

Thesis title: *The Australian Urban Heat Island: a template for climate-sensitive design*

"More people live in cities now than ever before. While cities provide social and economic benefits they also increase health risks, including "lifestyle" diseases and extreme heat. More people die of extreme heat in Australian cities than from any other natural event. Extreme heat also limits opportunities for healthy

Scholarship holder Zichao Meng receives a prize at the CRCLCL 2015 Forum

outdoor activities and increases air-conditioning use, energy use and carbon emissions.

Cities can be designed to intentionally mitigate the impacts of extreme urban heat, however architects and building designers currently have little information on how to reduce the negative outdoor microclimate effects of their designs. My research explores how the design of buildings can reduce urban heat and improve outdoor thermal comfort by quantifying the effects of individual design decisions on microclimate.

This critical research will provide decision-makers with the tools and evidence-base needed to build healthy, sustainable, low-emissions cities for the future."

HERIYANTO
HERIYANTO
PhD candidate
CRCLCL Project RP1022

Thesis title: *Glass Recycling for Waste Reduction in Built Environments*

"The research I am involved with is looking for novel ways to use waste glass to make sustainable building materials. We have tested our prototype products and been really pleased to find they compare well with existing products such as granite and Caesarstone. These findings will hopefully reduce glass waste and create new business opportunities. Ultimately, I would like to see recycling help to support economic growth by maximising the economic value of waste materials."

KIRRILIE ROWE
PhD candidate
CRCLCL Project NP1003

Thesis title: *Maximising renewable energy in small community precincts*

"I am investigating how small community precincts can be designed and operated to maximise the use of renewable energy, with a focus on retirement villages. The combination of solar power, cunning low carbon building design and smart energy management systems has the potential to be a sustainable and cost effective solution. I'm keen to see retirement villages and similar sorts of communities powered entirely by renewable forms of energy and am working to identify the factors to make this possible."

CALLUM SLEEP
Masters candidate
CRCLCL Project RP2021

Thesis title: *Analysing public transport travel patterns using stated preference survey and smart card data*

The research project I am working on is all about the psychology of travel and encouraging people to make more environmentally-conscious travel choices. While walking and cycling are the modes that release the least carbon, they're just not practical in a lot of circumstances, and that is where public transport comes in. Low carbon alternatives need to be competitive with driving a car, in terms of speed and flexibility. I will be investigating current public transport usage and getting the perspective of non-users, too, to get as many people as possible making greater use of public transport for the least investment."

GERTRUD
HATVANI-KOVACS
PhD candidate
CRCLCL Project RP2005

Thesis title: *Urban Micro Climates: A comparative Study in Sydney, Melbourne and Adelaide*

"As heatwaves are becoming more common and persistent, keeping Australian homes cool without increasing demand for air-conditioning has become an extremely important issue. My research is looking at how we can increase our resilience to heat with better building design and adaptation, without using more energy. We need a combination of energy efficient *and* heat stress resistant design to build sustainable buildings for the future. Building users should be educated about building adaptation and retrofitting strategies to encourage them to use alternatives to air-conditioning. This could decrease energy use, peak demand and wellbeing issues during heatwaves."

OUR INDUSTRY NETWORK

SMEs

Aurecon Australia, BCI Media Group, HASSELL, Zimmerland

PEAK BODIES

Australian Institute of Architects, Australian Sustainable Built Environment Council, Consult Australia, Green Building Council of Australia, Housing Industry Association, Standards Australia

INDUSTRY ASSOCIATIONS

Ash Development Association of Australia, Australasian Slag Association, Australian Window Association, BuildingSMART Australasia, Master Builders Australia, Planning Institute of Australia

"This is an exciting time for the CRC for Low Carbon Living's Industry Network. Members of the Network are provided with the competitive advantage of regular exposure to the CRCLCL's ever-growing and innovative low carbon research outcomes, with their needs continuing to inform the CRCLCL's research directions. As the five Nodes of Excellence develop and mature, so will their related industry networks, to the benefit of all Network members."

PROFESSOR KEN MAHER
Industry Network Leader

Transurban headquarters, Melbourne, by CRCLCL participant HASSELL Photo: Nicole England

OUR LEGACY

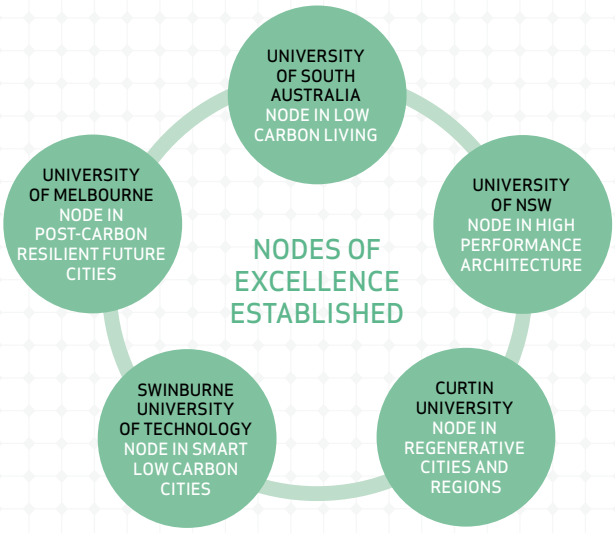
The CRCLCL is now in the latter half of its seven-year lifespan and has its legacy commitments firmly in its sights. Our student cohort represents a once-in-a-generation capacity building for the sector. Our portfolio of research projects are expected to have a significant impact on Australia's effort to reduce carbon emissions in the built environment.

We want to ensure our achievements continue to yield benefits long after our organisation has closed its doors. To this end, the CRCLCL has set up Research Nodes of Excellence to ensure that the research we initiated will continue to contribute to the sustainability and economic prosperity of Australia beyond its own lifespan.

NODES OF EXCELLENCE

Last year, the CRCLCL established Nodes of Excellence at five Australian universities. They are charged with undertaking end-user-driven research projects, running vocational training programs, supervising higher degree by research students, widening engagement with low carbon living initiatives and ensuring industry involvement. They will continue the CRCLCL's low carbon mission well past the year 2020.

Each Node focuses on a distinct but complementary research strength in the low carbon built environment.



Over the past year, the Nodes have increased their activities and begun to raise their profiles and establish links with industry.

University of South Australia's Node of Excellence in Low Carbon Living has established a regular series of Node events and will next year host a national forum. In November 2015, the Node held its first Research Symposium, during which CRCLCL scholarship holders presented their research to a large audience comprised of industry and government representatives. The symposium showcased research funded by the CRCLCL and gave students valuable experience in presenting research findings to a non-academic audience. The University of South Australia Node has also established an 'Industry Friends of Low Carbon Living Forum Series' to facilitate industry engagement. The first of the series was held in May 2016 and featured presentations from industry and government leaders on the challenges and possibilities of creating low carbon buildings, precincts and organisations. All five Nodes will establish their own version of the CRCLCL Industry Network to ensure the end-user focus of future low carbon built environment research is maintained and developed.

The University of NSW's Node of Excellence in High Performance Architecture held its first event in June 2016. Well-attended and featuring a series of presentations from CRCLCL scholarship holders, the event gave (as with the University of South Australia Node) students an opportunity to present their research to industry and other members of the Node Steering Committee.

KNOWLEDGE HUB

The CRCLCL is also in the early stages of developing a comprehensive Knowledge Hub, which will be an essential part of its legacy. The Hub is envisioned as an online platform that will allow government and industry to access best practice information and low carbon toolkits, as well as academic publications. It can also be seen as a virtual sixth Node, providing a permanent home for CRCLCL research outputs and acting as a mechanism for collaborative activity between the Nodes and the wider built environment.

INDUSTRY NETWORK

The CRCLCL's Industry Network represents the interests and needs of small and medium enterprises (SMEs), which make up a large proportion of the low carbon built environment industry. The network formally connects SMEs with relevant peak bodies and industry associations to promote information sharing and engagement.

Membership in the Network is not limited to official CRCLCL Participants, as a varied membership helps inform the CRCLCL's research directions whilst keeping industry partners up to date with the latest innovations in research in the built environment. The Network's meeting agenda typically includes discussion of big, bold ideas; new CRCLCL research possibilities; presentations from exemplar projects and pathways to utilisation.

The Industry Network has continued to meet regularly throughout the year and taken steps to widen its membership. Currently NSW-based, the Network will connect to industry networks in other states as they develop under the auspices of the Nodes of Excellence.

COMMUNICATION, COLLABORATION & OUTREACH

Effective communication is critical to the CRCLCL's mission. Our key communication goals are about capturing and raising awareness of the CRCLCL's achievements and research projects, supporting and promoting collaboration, and transferring knowledge to end users. Communication also helps us to build a strong sense of community with our researchers, Participants other interested parties.

COMMUNICATION

The CRCLCL's website, which has recently been optimised for smart devices, is the foundation of its communications strategy. It features a comprehensive body of up-to-date information, including news alerts, key publications, videos and event invitations.

The CRCLCL maintains a strong social media presence and its Twitter audience has increased by a third over the past year. We also publish a quarterly newsletter that is attracting a growing number of online subscribers.

As our research projects mature, so the number of publications and presentations linked to the CRCLCL increases. Over the past year, our researchers have delivered and published more than 130 journal articles, conference papers and reports.

The CRCLCL has also continued to drive and attract strong interest from mainstream media. Over the past year, the CRCLCL generated more than 80 mentions across various media and our achievements, particularly those related to our vibrant Living Laboratories, earned significant write-ups in digital and print publications including *The Sydney Morning Herald*, *Architecture and Design*, *The Guardian (Australia)* and *Australian Design Review*.

We are proud to report that one of our PhD candidates, Gertrud Hatvani-Kovacs (see page 21), was interviewed about her research on heatwaves and heat-resistant homes on Radio National's venerable The Science Show. Professor Peter Newman, one of our project leaders, was also a guest of The Science Show. He spoke about the growing use of household solar panels for the centralised electricity grid.

COLLABORATION

The Annual Participants Forum is one of the CRCLCL's primary platforms for collaboration and communication, and one of our most lively and enjoyable events. It is an opportunity to showcase new research and developments, and to discuss avenues for utilisation.

Our 2015 forum took place at the Australian Maritime Museum and was attended by more than 170 delegates. Speakers included The Hon Ian Hunter MLC, South Australian Minister for Sustainability, the Environment and Conservation, Minister for Water and the River Murray, and Minister for Climate Change; The Hon John Alexander OAM, MP; Professor Nicole Woolsey Biggart, Research Professor and Dean Emerita of Management at the University of California Davis; and Michael Daddo, Managing Director of The Shannon Company.

A 'speed dating' session, in which researchers and industry representatives shared their ideas and priorities, was one of the event's highlights.

OUTREACH

In 2014, the CRCLC initiated its first series of targeted roadshows to showcase some of its exemplar projects to industry and government organisations. The roadshows were highly successful and this year we delivered a second, expanded series.

The roadshows are led by senior CRCLCL researchers, with support from some of our key partners, including Brookfield Multiplex, AECOM, Hassell and CSIRO. This year, we delivered presentations to organisations including Mirvac, Infrastructure Sustainability Council of Australia (ISCA), City of Melbourne, Pittwater Council, UrbanGrowth NSW and Department of Planning and Environment on topics ranging from innovative policy interventions and tackling urban heat islands to energy efficiency and energy storage.

The CRCLCL and its researchers have also hosted and/or taken part in more than 50 local and international lectures, seminars and workshops over the past 12 months. In total, more than 3500 people, including end users, government representatives, students and international researchers, attended these events and had the opportunity to learn about the CRCLCL's activities and achievements.

Top row: CRCLCL Forum 2015 keynotes: The Hon John Alexander OAM MP; The Hon Ian Hunter MLC
Middle row: Researcher 'speed-dating' session, CRCLCL Forum 2015
Bottom row: Professor Peter Graham and Scientia Professor Deo Prasad at the inaugural meeting of the Global Alliance for Buildings and Construction, April 2016; CRCLCL roadshow (Innovations for Infrastructure), February 2016

"We believe the CRCLCL is creating real change and awareness, particularly around the coming together of leading edge thinking from both academia and industry with a focus on practical solutions and ideas to current issues facing the community. We are delighted to have been involved in the CRCLCL over the past few years and are optimistic about the next few years where more of the projects will come to delivery milestones and capability building takes shape as the ongoing legacy of the CRCLCL."

KRISTON SYMONS
Managing Director – Buildings & Places,
AECOM Australia New Zealand

Bowden Rivergum 3-storey terrace on Sixth Street
Photo: Renewal SA

OUR PEOPLE

BOARD

The Hon Robert Hill AC
Independent Chair; Chair of Nominations Committee; member of Research Advisory Committee

Sandy Hollway AO
Independent Deputy Chair; Chair of Audit & Risk Committee

Professor Ken Maher
Additional Director; leads Industry Network

Professor Matthew Bailes
Research Sector Director

Dr Kevin Cullen
Research Sector Director; member of Nominations Committee and Audit & Risk Committee

Dr Dennis Else
Industry Sector Director; Chair of Research Advisory Committee

Mr Lester Partridge
Industry Sector Director; member of Nominations Committee

Ms Megan Antcliff
Government Sector Director

Dr Kate Wilson
Government Sector Director; member of Nominations Committee and Research Advisory Committee

INDUSTRY NETWORK | RESEARCH ADVISORY COMMITTEE | AUDIT & RISK COMMITTEE | NOMINATIONS COMMITTEE

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Scientia Professor Deo Prasad AO
CEO

Paul Hopkins
Business Manager and Company Secretary

Jillian Bywater
Research Project Coordinator

Chloe Woodgate
Communications Manager

Ross Flemons
Accountant

Sara Fagir
Office Manager

Emeritus Professor Denny McGeorge
Education Leader

PROGRAM AND NODE LEADERSHIP GROUP

Assoc. Prof. Alistair Sproul
Program Leader, Integrated Building Systems

Prof. Peter Newton
Program Leader, Low Carbon Precincts

Dr Stephen White
Program Leader, Engaged Communities

Prof. Peter Newman
Node Leader, Curtin University

Dr Lan Ding
Node Leader, University of NSW

Prof. Wasim Saman
Node Leader, University of South Australia

Prof. Peter Graham
Node Leader, Swinburne University of Technology

Prof. Chris Ryan
Node Leader, University of Melbourne

Medibank Place, 720 Bourke St, Melbourne by CRCLCL participant HASSELL
Photo: Earl Carter

FINANCIAL OVERVIEW

The CRC for Low Carbon Living continued to maintain a healthy financial position in the 2015-16 reporting period, carrying forward unspent funds to use in its research in year five. The financial statements for the CRC for Low Carbon Living Ltd have been independently audited by HLB Mann Judd (NSW) Pty Ltd and submitted to ASIC, ACNC and the Commonwealth CRC Programme. The Auditor's report contained no adverse, qualified or other matters of emphasis. Copies of the Annual Financial Report for the period ended 30 June 2016, are available on request.

RESOURCES RECEIVED

TOTAL CASH AND IN-KIND CONTRIBUTIONS BY PARTNERS & GOVERNMENT

$14.34 MILLION

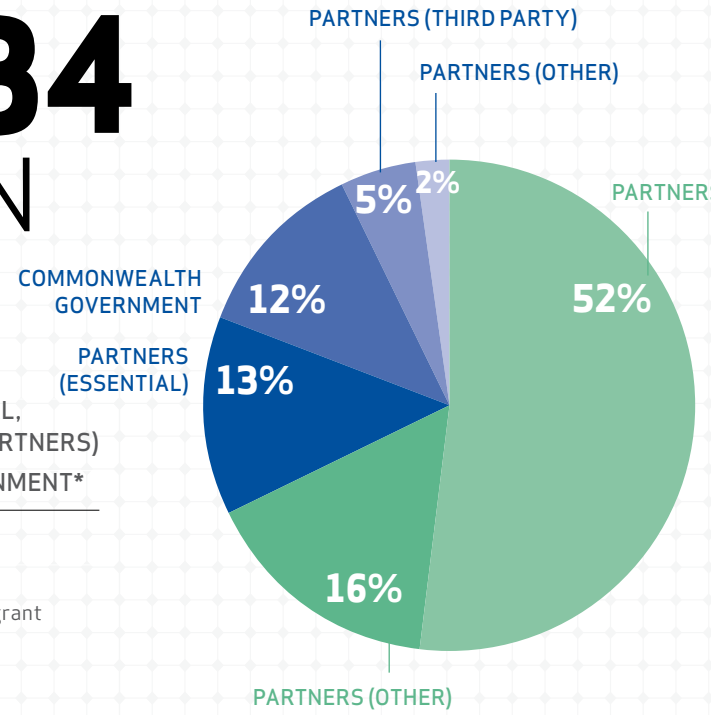
CASH

FROM TWO SOURCES:

1. CRC PARTNERS (ESSENTIAL, OTHER & THIRD-PARTY PARTNERS)
2. COMMONWEALTH GOVERNMENT*

TOTAL: $4.56 MILLION

* Excludes $2.7m Commonwealth grant prepayment received in FY3 to be applied in FY4.



IN-KIND

includes time provided by partner employees (equivalent to 30.6 full-time researchers valued at $8.8m) and other non-staff resources such as facilities, equipment and materials ($0.98m)

TOTAL: $9.78 MILLION

RESOURCES APPLIED

RESOURCES APPLIED ACROSS THE THREE RESEARCH PROGRAM AREAS IN THE FOURTH YEAR

$18.21 MILLION

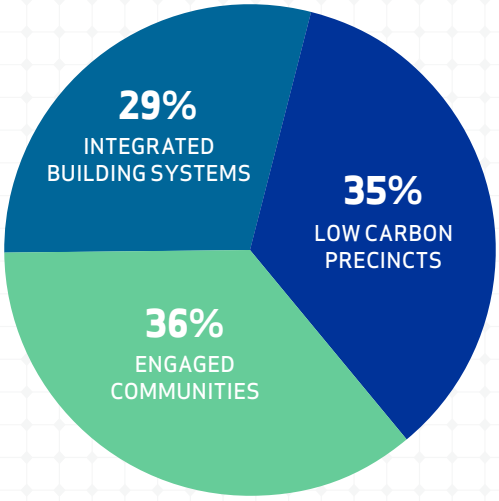
IN-KIND APPLIED $9.78m

CASH APPLIED $8.43m

This includes proportions of expenditure on:

- Governance and administration $1.6m (19%)
- Education (scholarships) $1.9m (23%)
- Research – Staff $3.5m (42%)
  – Non-staff $1.4m (16%)

No capital purchases made.



1 July 2015 – 30 June

YEAR 4 PROJECTS

	NO.	IMPACT PATHWAY	PROJECT TITLE	PROJECT PARTICIPANTS
PROGRAM 1 – INTEGRATED BUILDING SYSTEMS	RP1001	1. Harnessing Australian sun	Air handling solutions, integration approaches and building design considerations for Photovoltaic Thermal (PV-T) roofing.	BlueScope; UNSW; UniSA
	RP1002	1. Harnessing Australian sun	Concentrated solar thermal systems and absorption HVAC systems	UNSW; CSIRO
	RP1008	1. Harnessing Australian sun	Industry support mechanisms for renewable heating and cooling	CSIRO; UNSW; UniSA; NSW OEH; CSR; BlueScope; SA Dept of State Development; Seeley International; Standards Australia
	RP1009	3. Mainstream low carbon bldgs	Closing the Loop on evidence-based low carbon design of non-residential buildings	UNSW; UniMelb; Curtin; Brookfield; Hassell; AECOM
	RP1010	3. Mainstream low carbon bldgs	Monitoring and modelling the CSR Low Energy House	CSR; UniSA; UNSW
	RP1011	3. Mainstream low carbon bldgs	Sustainable and affordable living through modular, net zero energy, transportable, and self-reliant homes and communities	Nova Deko; UNSW
	RP1014	3. Mainstream low carbon bldgs	Impact of energy efficient pool pumps on peak demand, energy costs and carbon reduction	UNSW
	RP1015	1. Harnessing Australian sun	Combining a building integrated PVT system with a low temperature desiccant cooler to drive affordable solar cooling	UNSW; Bluescope; CSIRO
	RP1017	3. Mainstream low carbon bldgs	Validating and improving the BASIX energy assessment tool for low carbon dwellings	UNSW; NSW OEH; NSW Planning & Infrastructure; Dept of Industry; City of Sydney
	RP1020	2. Low carbon materials	Reducing barriers for commercial adaptation of construction materials with low-embodied-carbon	ASA; ADAA; AECOM; Sydney Water; UNSW; Swinburne; Standards Australia; Australian Steel Mills Services
	RP1021	3. Mainstream low carbon bldgs	Reframing building regulation: The role of building regulation as a policy instrument for the transition to low carbon built environment	Curtin; VBA; Australian Building Codes Board; Dept of Planning Transport and Local Infrastructure; Office of Energy Efficiency; GBCA; Aurecon
	RP1022	2. Low carbon materials	Investigation of innovative sustainable low carbon products for the built environment	UNSW; NSi
	RP1023	1. Harnessing Australian sun	Forecasting and home energy analysis in residential energy management solutions (Algorithms)	UNSW; Solar Analytics (Suntech)
	RP1024	3. Mainstream low carbon bldgs	Facilitating the transition to low carbon housing	CSIRO; UniSA; UNSW; CSR; Renewal SA; Dept of Industry and Science; Energy Inspection
	RP1026	3. Mainstream low carbon bldgs	Evaluation of next-generation automated fault detection and diagnostic tools for commercial building energy efficiency	CSIRO; City of Sydney ; Lend Lease; Charter Hall; Stockland; Brookfield
	RP1029	2. Low carbon materials	Integration of phase change storage	UniSA, Ametalin
	RP1031	3. Mainstream low carbon bldgs	Development and optimisation of low carbon, affordable, medium-rise modular structural system using innovative connections	Swinburne; UniMelb; Brookfield; Vic Building Authority; AECOM; BlueScope; Hassell
	RP1032	1. Harnessing Australian sun	Facilitating large energy user deployment of off-site renewable generation	UNSW; AECOM; Brookfield; AGL; Uni Sydney
PROGRAM 2 – LOW CARBON PRECINCTS	RP2002	4. Integrated low carbon precincts	Integrated ETWW demand forecasting and scenario planning for precincts	UniSA; CSIRO; UNSW; Sydney Water; SA Water; Renewal SA; SA Dept of Env, Water & Natural Resources; AECOM
	RP2003	4. Integrated low carbon precincts	A review of national and international low carbon precincts to identify pathways for mainstreaming sustainable urbanism in Australia	Curtin
	RP2005	4. Integrated low carbon precincts	Urban Micro Climates: Comparative study of major contributions to the Urban Heat Island effect in three Australian cities (Sydney, Melbourne, Adelaide).	UniSA; UNSW; UniMelb; NGIA; City of Adelaide; City of Sydney; SA Dept Env, Water & Natural Resources; Bluescope; Hassell; Renewal SA; NSW OEH; Commonwealth of Australia Dept of Infrastructure and Transport
	RP2006	7. Living laboratories	Action research to examine and demonstrate how to mainstream low-cost and low carbon housing in Western Australia. FredZED	Curtin; City of Fremantle; WA Housing Authority; The Next Practice; CSIRO
	RP2007	4. Integrated low carbon precincts	Integrated Carbon Metrics (ICM) – a multi-scale life cycle approach to assessing, mapping and tracking carbon outcomes for the built environment	UNSW; UniMelb; UniSA; AECOM; Aurecon; Sydney Water; BlueScope; CSIRO; Swinburne; Renewal SA; Urban Growth NSW
	RP2008	4. Integrated low carbon precincts	Beneficial reuse of solids from wastewater treatment operations	UNSW; UniSA; Sydney Water; SA Water; Prospect Water; Hunter Water; Suez Environment; Degremont
	RP2010	4. Integrated low carbon precincts	Informing and trialling the inclusion of low carbon requirements in state government built environment sector tenders	Curtin; Swinburne; UrbanGrowth NSW
	RP2011	4. Integrated low carbon precincts	PIM: An open digital information standard for the exchange of precinct information supporting carbon management throughout the urban development lifecycle	UNSW; UniMelb; Brookfield; Building SMART; ETH Singapore; Aurecon
	RP2014	4. Integrated low carbon precincts	Quantifying the contribution of green infrastructure to carbon and energy performance	UNSW; Brookfield; ISCA
	RP2016	4. Integrated low carbon precincts	Assessing the impact of solar PV, electricity prices and dwelling energy efficiency on domestic electricity consumption in Sydney: Exploring the prospect of rebound effects	Swinburne; Ausgrid; Dept of Industry; NSW OEH; Vic Building Authority
	RP2017	4. Integrated low carbon precincts	Energy benchmarking for efficient, low carbon water recycling operations	UniSA; SA Water; Sydney Water; UNSW
	RP2018	4. Integrated low carbon precincts	Retrofitting urban precincts to create low carbon communities - Broadway, AECOM	AECOM; Brookfield; Swinburne; UNSW; TAFE NSW - Sydney Institute; UTS; City of Sydney; Better Building Partnership (City of Sydney); Urban Growth NSW
	RP2019	4. Integrated low carbon precincts	Carbon reductions from composting food waste for food production – fitting recycling models to urban forms	Swinburne; UniSA; City of Melbourne; Sustainability Vic; Renewal SA; Melbourne Metropolitan Waste Management Group; Nillumbik Council; Moreland City Council; NAB; RACV; Veolia; Closed Loop Organics; Worm Lovers; Compost Victoria; East End Coordination Group (via City of Adelaide)

	NO.	IMPACT PATHWAY	PROJECT TITLE	PROJECT PARTICIPANTS
	RP2021	4. Integrated low carbon precincts	Greening suburban travel	Swinburne; UniSA; CSIRO; UniMelb; SA DPTI; Renewal SA; Vic DTPLI; Transport NSW; Hassell
	RP2028	4. Integrated low carbon precincts	Development and trial of a co-benefits calculator	UniMelb; Swinburne; UNSW; NSW OEH
PROGRAM 3 – ENGAGED COMMUNITIES	RP3002	5. Evidence base for LCL policy	A framework for low carbon living community policy and program development	CSIRO; NSW OEH; Dept of Industry; Sustainability Vic
	RP3007	6. Community engagement	Opportunities and challenges for the development and implementation of community-scale renewable energy projects	UNSW; UniSA; BCI Media Group; NSW OEH
	RP3008	5. Evidence base for LCL policy	Visions & Pathways 2040	UniMelb; UNSW; Swinburne; Aurecon; AECOM; Hassell; Brookfield; City of Melbourne; City of Sydney; Sydney Water; ICLEI; SA Dept Env, Water & Natural Resources
	RP3009	7. Living laboratories	High performance housing: LL monitoring, evaluating and communicating (Josh's House)	Curtin; UniSA; Josh Byrne & Associates
	RP3010	6. Community engagement	Building low carbon communities	UNSW; Curtin; NSW OEH; BMLOT; BMWHI; Gridstone; BMCC
	RP3011	7. Living laboratories	Community carbon reduction and wellbeing enhancement	Curtin; Yarra Council; Yarra Energy Foundation
	RP3012	7. Living laboratories	Transformation to low carbon living: Social psychology of low carbon behavioural practice	UniMelb; CSIRO; Swinburne
	RP3015	8. Education and capacity building	Increasing knowledge and motivating collaborative action on low carbon living through team-based and game-based mobile learning.	Swinburne; UniMelb; Vic Building Authority; Masters Builders Australia; Syd Coastal Councils; BuildSmart; Centre for Liveability Real Estate; Loud & Clear
	RP3016	7. Living laboratories	Enhancing the market for low carbon homes at point of sale	CSIRO; Swinburne; CSR; NSW OEH; AGL; Aust Windows Assoc; Clean Energy Council; Energy Efficiency Council; Stockland; Fletcher Insulation; Knauf Insulation; Low Energy Supplies & Services Pty Ltd; Liveability
	RP3017	7. Living laboratories	Adelaide Living Laboratory Hub– Lochiel Park, Bowden and Tonsley	Renewal SA; UniSA; SA Dept Env, Water & Natural Resources; SA Dept of State Development; Campbelltown Council; Charles Sturt Council; Marion Council; SA Water; Hassell; Adelaide City Council; ENOLL
	RP3020	6. Community engagement	Carbon tools and frameworks for institutional precincts: Stage 1 – Low carbon schools scoping study and Stage 2 – Low carbon schools program	Curtin; City of Fremantle
	RP3021	7. Living laboratories	Media and communication strategies to achieve carbon reduction through renovation of Australia's existing housing	Swinburne; BlueScope; CSR; HIA; Masters Builders Australia; Sustainability Vic; Department of Manufacturing, Innovation, Trade, Resources & Energy (SA)
	RP3022	8. Education and capacity building	Policy impediments and incentives for effective education and training in LCL	Swinburne; BCI Media Group; Department of Manufacturing, Innovation, Trade, Resources & Energy (SA); Sydney Institute of Technology
	RP3023	6. Community engagement	The contribution of community-owned renewable energy to regional development and resilience in the face of climate change	UNSW; NSW OEH
	RP3025	8. Education and capacity building	Sydney TAFE carbon reduction website	TAFE NSW - Sydney Institute
	RP3028	5. Evidence base for LCL policy	A "virtual market" for analysing residential housing policy interventions	CSIRO; Swinburne; NSW OEH
	RP3029	6. Community engagement	Driving a national social media conversation on energy efficient housing- Stage 1	CSIRO; NSW OEH; NBNTV; Collabforge; LJ Hooker; Lend Lease; BlueScope; CSR; GBCA; Australand; Brookfield
	RP3031	5. Evidence base for LCL policy	Information, risk and retrofit: enabling energy/carbon disclosure at the building retrofit investor – user interface	UniMelb; Swinburne; UNSW; Brookfield
	RP3032	7. Living laboratories	Canning City Centre: A low carbon living laboratory	Curtin; City of Canning
	RP3033	7. Living laboratories	Mainstreaming low carbon housing precincts – the WGV living lab	Curtin; LandCorp; City of Fremantle; Josh Byrne & Associates
	RP3034	6. Community engagement	Community co-design of low carbon precincts for urban regeneration in established suburbs	Swinburne; UNSW; NSW OEH; CRC Spatial Information; Maroondah Council; AECOM; Consult Aust; Hassell; HIA; GBCA; Vic DELWP
	RP3038	5. Evidence base for LCL policy	Lower income barriers to low carbon living	UNSW; NSW OEH; Council of the Ageing; Salvation Army
	RP3039	8. Education and capacity building	Liveability Real Estate framework training and professional development	CSIRO; TAFE NSW - Sydney Institute
	SP0003	8. Education and capacity building	UNEP Beijing Guidelines for sustainable cities and communities	UNEP
	SP0006	3. Mainstream low carbon bldgs	Built environment impact framework and decision making tool	Brookfield; UNSW; KPMG; ASBEC; GBCA; Urban Growth NSW; Stockland; Mirvac; Hassell; AECOM; Westpac; GRESB; Republic of Everyone; GRI
	SP0007	8. Education and capacity building	Carbon accounting assessment of CRCLCL projects	UNSW
	SP0008	8. Education and capacity building	Built Environment Knowledge Hub	Swinburne; UNSW; UniMelb; Curtin; CSIRO; UniSA
	SP0009	5. Evidence base for LCL policy	Role of Regulation in driving low carbon outcomes in Built Environment	

PARTICIPANTS INDEX

	IMPACT PATHWAY							
	1	2	3	4	5	6	7	8
AECOM Australia Pty Ltd (AECOM)								
Ametalin								
Ash Development Association of Australia (ADAA)								
Aurecon Australia Pty Ltd (Aurecon)								
Australasian Slag Association (ASA)								
Australian Institute of Architects (AIA)								
Australian Window Association Inc (AWA)								
BCI Media Group Pty Ltd (BCI Media Group)								
BlueScope Steel Limited (BlueScope)								
Brookfield Multiplex Constructions Pty Limited (Brookfield)								
BuildingSMART Australasia Incorporated (BuildingSMART)								
Centre for Liveability Real Estate (CLRE)								
City of Fremantle								
City of Melbourne								
City of Sydney								
Commonwealth Department of Industry, Innovation and Science (DIID)								
Commonwealth Department of Infrastructure and Regional Development (DIRD)								
Concordia University, Canada, representing Smart Net-zero Energy Buildings Research Network (NSERC)								
Consult Australia								
CSIRO								
CSR Limited (CSR)								
Curtin University (Curtin)								
Department of State Development South Australia (DSSD)								
Green Building Council of Australia (GBCA)								
HASSELL								
Housing Industry Association Limited (HIA)								
Infrastructure Sustainability Council of Australia (ISCA)								
KTH, Royal Institute of Technology, Sweden								
Master Builders Australia Limited (MBA)								
NSW Department of Planning and Infrastructure (NSW DEPI)								
NSW Office of Environment and Heritage (NSW OEH)								
Renewal SA								
South Australia Water Corporation (SA Water)								
Standards Australia Limited								
Swinburne University of Technology (Swinburne)								
Sydney Coastal Councils Group Inc. (SCCG)								
Sydney Water Corporation (Sydney Water)								
TAFE NSW Sydney Institute (TAFE Sydney)								
Tongji University, China								
University of Melbourne (UoM)								
University of New South Wales (UNSW)								
University of South Australia (UniSA)								
University of Wollongong (UoW)								
Victorian Building Authority (VBA)								
United Nations Environment Program (UNEP)								
UrbanGrowth NSW								

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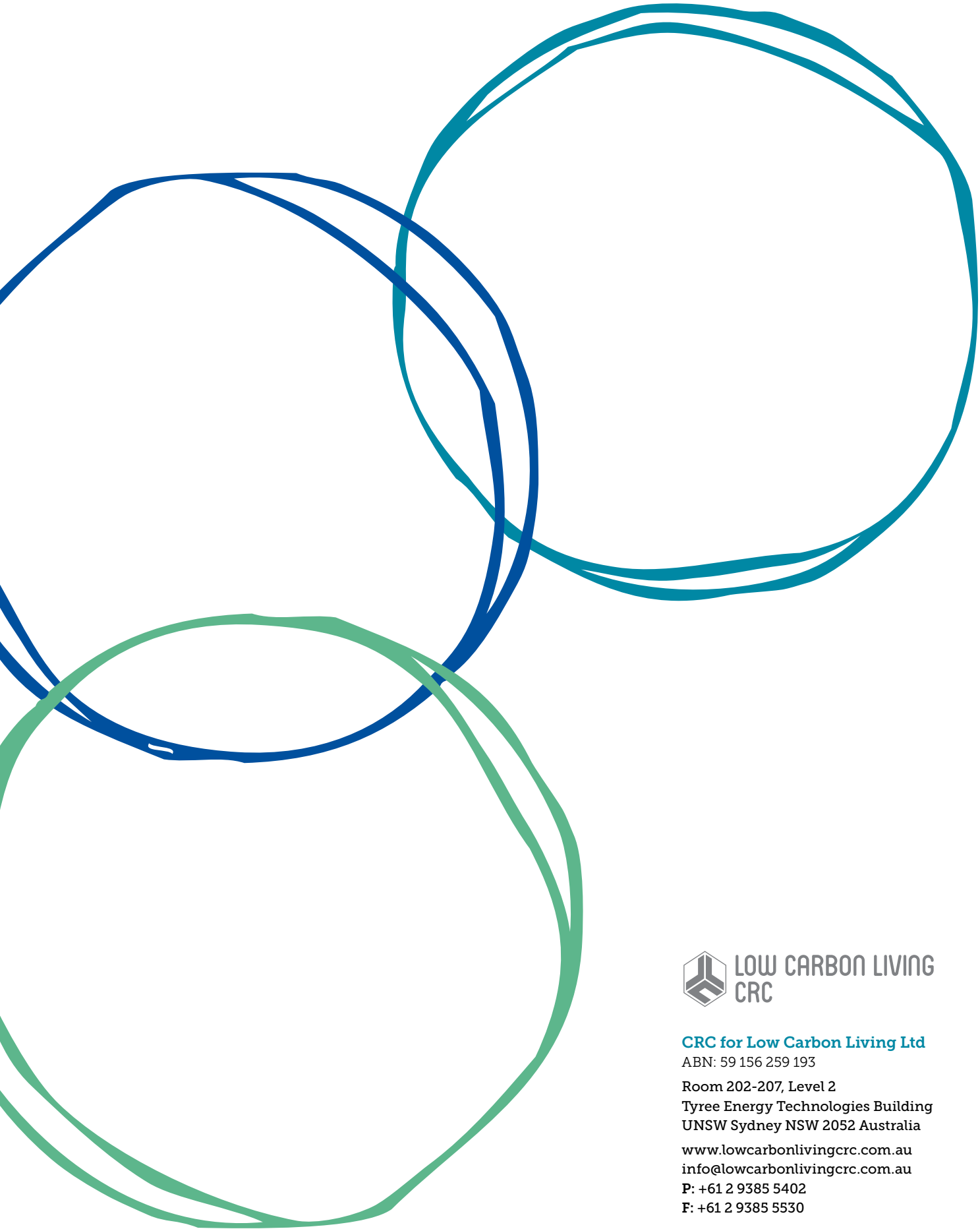

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