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ANU ENERGY CHANGE INSTITUTE
ANNUAL REPORT
2015

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MESSAGE FROM THE DIRECTOR



This past year has seen some important developments for the ANU Energy Change Institute (ECI), not the least of which has been the announcement of five year funding certainty for the ECI from 2016 – 2020.

This confirms the appointment of the ECI Director for the same period in parallel with the new Director of the Climate Change Institute, and enables the two Institutes to move forward together by sharing a joint Secretariat that underpins our teaching, research and outreach activities.

A major highlight of the past year was undoubtedly the hosting of The Optical Society Congress on Light, Energy and the Environment in December 2014, where we were privileged to welcome plenary speaker Professor Steven Chu, former Energy Secretary to US President Barack Obama.

Professor Chu spent an entire week with us at the ECI contributing a series of major public presentations, and culminating with an address to the National Press Club.

Another highlight was the announcement of the outcome of the ACT Government 200MW wind reverse auction. A key outcome was the commitment of Windlab Limited to establish a new ANU course in Wind Energy as part of their investment in local education and research. 2016 will see the introduction of the new course for both undergraduate students and for students participating in the Master of Energy Change degree.

As a result, a new Wind Energy research cluster has been established in the ECI which includes the appointment of Dr Nathan Steggel of Windlab as an adjunct fellow, joining other ANU wind energy researchers. Another highlight of this research cluster was the establishment of a new SODAR and LIDAR wind profiler facility at the ANU Spring Valley Farm, initiated by Professor Michael Shats (Research School of Physics and Engineering).

A second research cluster has also been established in the area of Energy and Security which forms links with the ANU National Security College, the Strategic and Defence Studies Centre and the Crawford School of Public Policy. It includes researchers on energy supply chains, the security and resilience of electricity supply systems, the implications of climate change for environmental and human security, the interaction between decarbonisation of the electricity grid and security of energy supplies, and the relationship between geopolitics, energy and security. The formation of both the Energy and Security and the Wind Energy clusters brings to 18 the number of research clusters in the ECI.

Our existing research strengths have been recognised by a series of awards this past year. These include ACT Scientist of the year Colin Jackson, Bruce Chapman AM recognised as Distinguished Fellow of the Economic Society of Australia, Chennupati Jagadish who won the 2015 IEEE Pioneer in Nanotechnology Award and Engineering Achievement Award, Andrés Cuevas who won the 2015 Becquerel Prize for Outstanding Merits in Photovoltaics, and Graham Farquhar who won the 2015 Prime Minister's Prize for Science.

A full description of their achievements is contained in the awards section of this Report.

These and other achievements have made 2015 an outstanding year for the ECI, and we look forward to more success in the future.

A handwritten signature in black ink, appearing to read 'Ken Baldwin', written over a horizontal line.

Professor Ken Baldwin
ECI Director

HIGHLIGHTS

Events from ECI Open Day 1st December 2014 to ECI Open Day 7th December 2015

December 2014: Energy Open Day

The ECI Open Day serves as a platform for exchanging ideas and networking for ANU researchers and key ECI stakeholders working in the field of energy change. The event comprised of presentations by ECI participants on the latest research, education and policy highlights followed by a tour of the world-class energy change research facilities at the ANU.

December 2014: ANU Energy Update 2014

The annual ANU ECI Energy Update brought together Australian researchers, policymakers, industry and members of the public to provide an update on the latest world energy trends. Mr Ian Cronshaw of the International Energy Agency presented the IEA's perspective on the World Energy Outlook (WEO) for 2014. Panels of expert speakers also presented their perspectives on two key WEO themes: nuclear energy and energy sector investment.



Photo: Dr Adi Paterson (Australian Nuclear Science and Technology Organisation), Professor Barry Brook (University of Tasmania), Professor Ian Lowe (Griffith University) and Professor Steve Cowley (UK Atomic Energy Authority) take part in panel discussion at Energy Update 2014

February 2015: Wind Auction announcement

As part of its successful bid for the ACT Government's 200MW wind energy auction, Windlab Limited is partnering with the Energy Change Institute to develop and deliver a new Masters and undergraduate course in Wind Energy. Windlab Limited's Coonooer Bridge Wind Farm will produce around 10 per cent of the 200MW that will be provided through the ACT government's wind energy auction. The project aims to help the capital territory meet its ambitious 90 per cent renewable energy target for 2020, with first generation expected in March 2016.



Photo: ACT Minister Simon Corbell with Roger Price, Windlab CEO at the ground breaking ceremony for the Coonooer Bridge wind farm July 2015.

December 2014: ECI hosted Steven Chu's visit to Canberra

The ECI hosted Nobel Laureate and former US Energy Secretary Steven Chu for a hectic week of presentations and meetings including:

- > A public lecture and the opening address, Solar Energy in a Sustainable World, to the OSA Light, Energy and Environment Congress, on 5 December 2014. Professor Chu shared his thoughts on the current status and future prospects of photovoltaics and solar thermal energy, as well as biofuels and the conversion of sunlight/electricity to fuel.
- > ANU Energy Update 2014 on 9 December 2014. Professor Chu gave a keynote address on energy and climate change.
- > Televised National Press Club Address, 10 December 2014. Professor Chu's talk discussed the rapidly changing energy landscape involving fossil, nuclear and renewable energy, and how one can incorporate prudent management of risks of climate change with continued economic growth.



Photo: Former US Energy Secretary, Professor Steven Chu, received an honorary degree from ANU in December 2014

April 2015: Energy White Paper Forum

A panel of experts drawn from academia, government, NGOs and the private sector dissected the Government's Energy White Paper (EWP) at a public forum attended by over 130 people at ANU on 28 April.

The head of the EWP Task Force, Margaret Sewell, opened the proceedings and was followed by general observations from ECI Director, Professor Ken Baldwin, and an industry perspective from Mark Schneider of Megawatt Capital. Sessions on energy markets, energy productivity, energy technology and transport energy culminated in a panel discussion session with questions from the audience.

HIGHLIGHTS

April 2015: Energy Conversations Smart Grids

At this Australian Institute of Energy event, ECI members gave short presentations on various aspects of smart grids, stimulating discussion and providing a forum for conversations between different parts of the local energy sector about emerging research and technology.



Photo: Dr Hassan Hijazi, Paul Scott, Dr Nicholas Engerer and Dr Igor Skyrabin at the AIE event on Smart Grids.

July 2015: Tony Haymet Roundtable

Tony Haymet, former Director of the Scripps Institute, presented an ECI roundtable discussion with key local stakeholders on the advances in microgrid technology undertaken by the University of California San Diego in partnership with Cleantech San Diego.

Coming Up

7 December 2015 Energy Open Day

The annual Energy Open Day will this year feature a live cross to hear about the progress of the Paris climate talks.

ACT Solar Oration: Solar PV – Changing the Energy Landscape

Dr Pierre J Verlinden, Chief Scientist at Trina Solar, the world's largest solar PV manufacturer, will give the 2015 Solar Oration as part of the ECI Open Day. Solar photovoltaic (PV) systems are rapidly transforming the energy landscape. PV and wind generators are being installed at a greater rate than new coal, gas, oil and nuclear capacity combined.

August 2015: Roundtable with the Intergovernmental Panel on Climate Change (IPCC)

ECI members, including Professor Ken Baldwin, Associate Professor Frank Jotzo, Professor David Stern, Dr Matthew Hole, Professor Warwick McKibbin, Dr James Prest, Professor Dipesh Chakrabarty, Admiral (ret) Chris Barrie and Dr Michael Smith joined members of the Climate Change Institute as they hosted a roundtable discussion with visiting members of the IPCC.

September 2015: AIC Energy Cluster Workshop

The ECI facilitated and hosted the first AIC Energy Cluster workshop, attended by both Australian and Indonesian energy researchers. The workshop formulated the Cluster's \$2.1M research strategy. This is currently being implemented through the Cluster's collaborative strategic research projects.



Photo: The Australia Indonesia Centre Energy Cluster hosted by the ECI in September 2015

8 December 2015 Energy Update

The ECI is delighted to welcome back Mr Ian Cronshaw from the International Energy Agency (IEA), co-author of the World Energy Outlook (WEO) reports. Ian Cronshaw will present the IEA perspective on the WEO 2015, which provides a snapshot of international energy trends.

The ECI will also host Mr Byron Washom, University of California San Diego, as keynote speaker with a presentation on "UC San Diego's Microgrid: The World's Largest, Most Diversified Portfolio of Distributed Energy Resources". Expert speakers will also present on two key WEO 2015 themes: Renewables and Energy Efficiency and Unconventional Gas.

Energy Water Nexus

ANU researchers from the ECI Energy-Water Nexus research theme are now hosting the secretariat for the global Food, Energy, Environment and Water Network (FE2W network), which was launched in 2014.

The FE2W Network works with decision-makers to improve the understanding of systemic risks and how to manage shocks across these systems. The approach is founded on collaboration and an emphasis on poverty reduction, sustainable livelihoods, and the need to maintain critical ecosystem services. The network engages with the people who make the decisions from farmers to policy makers to consumers, and enabling actions that result in improved long-term outcomes.

MISSION



A key to addressing the many challenges the world is facing today is a world-wide change to carbon-free forms of energy production.

Energy change will offer broader benefits to society by:

- > driving the transformation to a clean economy in response to climate change
- > increasing economic productivity to help ensure long-term growth
- > improving energy access and security.

The ECI aims to provide authoritative leadership in energy research and education through a broad portfolio ranging from the science and engineering of energy generation and energy efficiency, to energy regulation, economics, sociology and policy. A defining feature of the ECI is that we are technology and policy neutral. The ECI undertakes research and education in critical areas of energy technology and energy policy without favouring one particular area over another. This can and should create an open forum for effective ideas leading to energy change.

GOVERNANCE

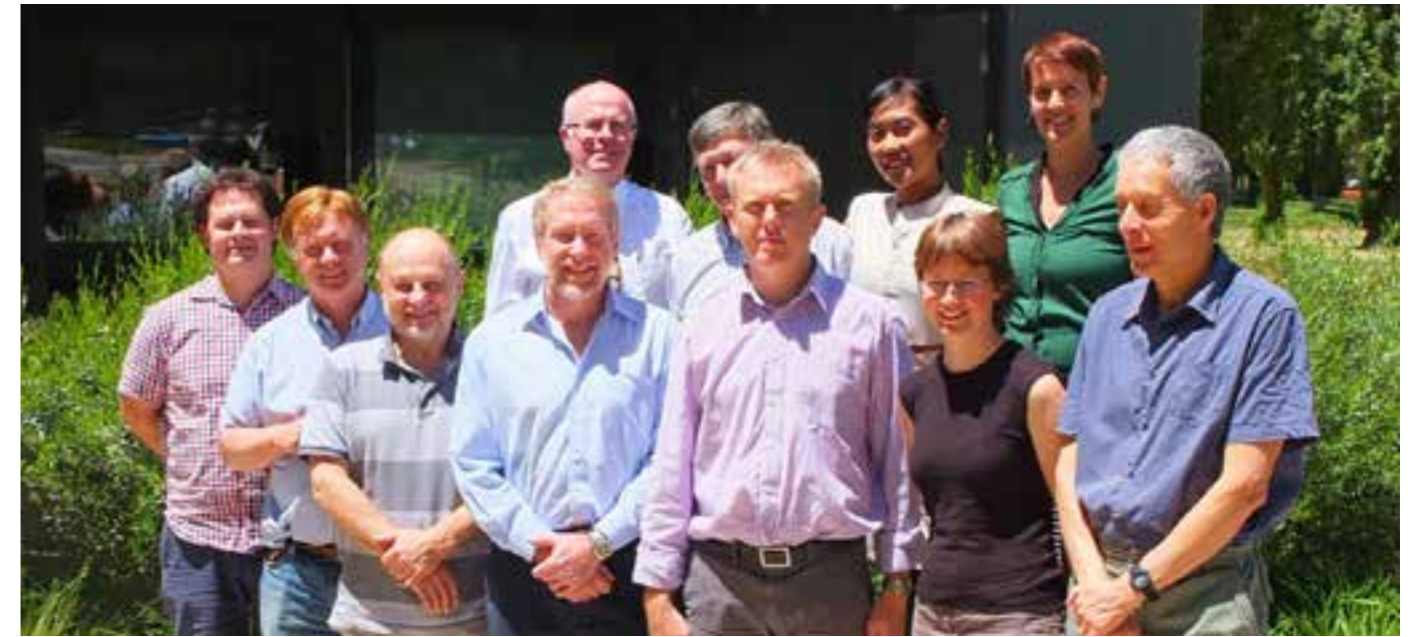


Photo: Members of the ECI Executive Adam Edwards/ECI

The ECI currently comprises of 137 academic staff and their postgraduate research students from all ANU Colleges, bringing the total complement to well over 200 researchers.

The wider ECI membership meets twice a year: at the Annual Business Meeting that establishes the activity for the coming year; and at the ECI Open Day which presents research highlights to the ECI stakeholder community.

Operationally, the ECI is governed by an Executive comprising representatives from most ANU Colleges:

ECI Executive

Professor Ken Baldwin – Director
ANU College of Physical & Mathematical Sciences

Professor Andrew Blakers
ANU College of Engineering & Computer Science

Professor Elmars Krausz (vice Dr Colin Jackson)
ANU College of Physical & Mathematical Sciences

Professor David Stern (vice Dr Paul Burke)
ANU College of Asia and The Pacific

Dr Kylie Catchpole – Education Convenor
ANU College of Engineering and Computer Science

Dr James Prest (vice Professor Tom Faunce)
ANU College of Law

Dr Igor Skryabin – Business Development Manager
ANU College of Engineering & Computer Science

Dr Michael Smith (vice Dr Mike Dennis)
ANU College of Medicine, Biology & Environment

The Executive meets regularly throughout the year as required. The strategic directions of the ECI are reviewed each year when the Executive meets with the ECI Advisory Board.

ECI Advisory Board

Professor Armin Aberle
CEO, Solar Energy Research Institute of Singapore

Ms Glenys Beauchamp PSM
Secretary, Department of Industry, Innovation and Science

Mr Stephen Devlin
General Manager Assets Division, ActewAGL

Ms Dorte Ekelund
Director General of Environment and Sustainable Development, ACT Government

Mr Ian Farrar
Board Member, Centre for Sustainable Energy Systems; former Chair and CEO of the Joint Coal Board

Professor John Poate
Colorado School of Mines; Member of the US National Renewable Energy Laboratory Advisory Board

Professor Mark Howden
Acting Director, ANU Climate Change Institute

EDUCATION

Master of Energy Change



Jeremy Gleeson graduating in 2015, with ECI Director, Professor Ken Baldwin

A major key to addressing climate change is the pressing need for a world-wide change to carbon-free forms of energy production.

There are also other drivers of energy change, including improvements to energy access, energy security and energy productivity. This need for energy change is well established, yet there are at present relatively few people who have an effective overview of the many factors involved or the multidisciplinary skills needed to effectively contribute to this complex and important issue.

The Masters of Energy Change (MEnCh) degree is structured to meet the needs and aspirations of professionals, and equips them to engage with the broad spectrum of challenges in energy change. It is a multidisciplinary degree that's available either through coursework or as a coursework plus dissertation research degree. Whilst it provides a strong basis in the fundamentals of economics, governance, policy and technology related to energy change, it also allows students to undertake advanced courses and research in areas of energy change suited to their individual needs, interests and skills.

The program brings together the wide-ranging energy expertise present at ANU. It covers policy, economics, environmental and regulatory aspects of energy change and is underpinned by fundamental scientific and technological training. The degree comprises two foundational and 41 elective courses.

The foundation courses are:

- > Principles of Energy Generation and Transformation
- > World Energy Resources and Renewable Technologies

These courses are aimed at providing students who do not have a technical background with an understanding of the principles underpinning energy technologies.

The course "Principles of Energy Generation" was specifically developed for this degree. The program now involves almost all ANU Colleges.

The remaining subjects are grouped into the key discipline areas of:

- > Energy regulation and governance
- > Energy economics
- > Climate change
- > Environmental sustainability
- > Specific energy technologies (solar, nuclear etc.)
- > Energy sociology and risk

In 2016, new undergraduate and postgraduate courses on Wind Energy will be added – see box.

In addition to the formal coursework, MEnCh students can participate in the wider activities of the ECI, which include seminars presented at ANU, conferences and workshops engaging with government and industry and other outreach programs with the wider community. Carefully targeted promotion of the Master of Energy Change remains the key to advancing this program.



New Wind Energy Course for 2016

In 2016, new undergraduate and postgraduate courses on Wind Energy will be added, an outcome of the ACT Government 200MW wind reverse auction. As part of its successful bid, auction-winning company Windlab Limited has collaborated with ANU energy academics to develop the new courses. This forms a part of their commitment to invest in local education and research.

While solar energy generation is taught via a number of ANU courses, to date there has been no specific wind energy course offered at the ANU, despite accelerated growth in wind energy generation worldwide, in Australia and especially in the ACT. In addition to meeting the demand for up-to-date, structured knowledge about wind energy, the course will cement scientific collaboration between ANU and Windlab. It will also open up prospects for students to undertake research internships with Windlab as part of their degree.

Professional Short Courses

The Energy Change Institute regularly runs short courses and briefings for government departments, corporates and NGOs. Short courses are designed to provide updates on recent advances in the science & technology of energy generation, and the social, policy, economic and governance aspects of energy change for policy makers and professionals. They can be tailored to meet the needs of a specific audience, and scheduled over consecutive days or spread over weeks.

In June 2015, the ECI ran a short course on "Energy Literacy" for the Department of Defence, which included sessions on Energy Fundamentals, Energy Systems, Economics of Decarbonisation, Energy and Economic Growth, Solar and Pumped Hydro, Nuclear Energy, Electricity Grids, International Energy and Climate, Solar Thermal, Wind Energy, Energy Efficiency Opportunities and Energy and IT.



Photo: Department of Defence staff attend a short course on Energy Literacy run by the ECI in June 2015

RESEARCH

Collaboration with Tianjin University

The Masters of Energy Change program is becoming increasingly popular among international students and the ECI sees potential for further growth via enrolments from Asia, particularly China and Indonesia.

In 2015 ECI facilitated a Memorandum of Understanding (MOU) between ANU and Tianjin University, China. The MOU provides opportunities for joint teaching programs between Tianjin University and ANU in the MEnCh and also in undergraduate Physics and Photonics. A delegation from Tianjin University headed by Professor Wang Yan, Vice President of the university, also visited ANU on 12 November 2015. Broad joint education programs in MEnCh, Physics and Engineering, including internships for ANU students, will follow.



Photo: ECI Business Development Manager, Dr Igor Skryabin, at an Asia Pacific Sustainable Energy Centre workshop, Tianjin University, September 2015



Megan Ward is currently undertaking a Masters of Energy Change

Megan Ward was an Energy Policy Officer with the ACT Government when she heard about the Masters of Energy Change (MEnCh) programme at ANU. Here she outlines her perspectives on the MEnCh:

“The Masters of Energy Change just seemed like a great fit with what I was doing. The issues affecting energy policy are highly complex and the MEnCh recognises this—drawing on law, economics, policy, engineering and beyond. Policy Officers like me need to be equipped with that sort of breadth. Most courses are very flexible in terms of projects, so you can choose what’s interesting and relevant to you and concentrate on that in assignments.”

The energy sector is on the precipice of change—and there are exciting opportunities for people who understand the range of issues impacting the sector, and its complex relationship with the built, human and natural environments.

This course really gives you the breadth and understanding to make that happen. I would highly recommend it to anyone with an interest in the future of energy.”

Personally, I have focussed on issues that we don’t have the time or resources to devote ourselves to in detail at work. For example I focussed on battery storage – the costs, the benefits, how to apply it in Canberra. It’s work that’s now informing how we’re looking at things—and I’ve recently taken on the temporary role of Manager, Solar Storage Policy. Without the work undertaken as part of the MEnCh, I wouldn’t have the knowledge to do this role. It’s a concrete example of career progression.”

Find out more about the Masters of Energy Change degree:

**Associate Professor Kylie Catchpole
(MEnCh Program Convenor)**

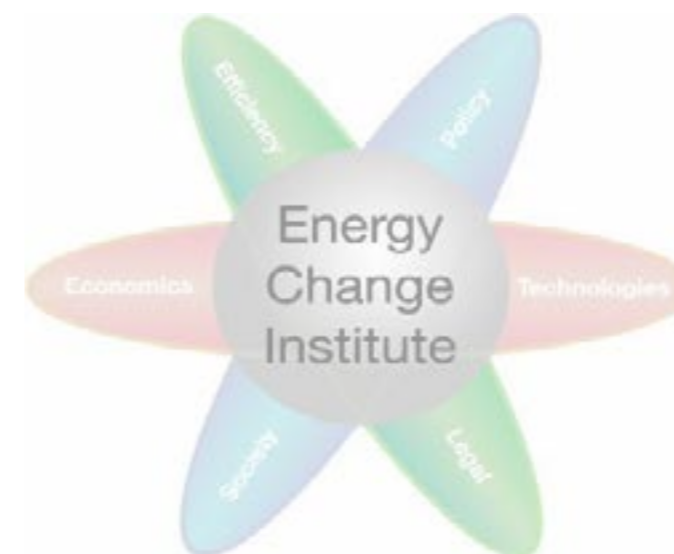
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This year’s Annual Report focusses on new areas of energy research that have developed in the ECI in 2015, as well as some highlights from the year.

There is a large amount of other research activity that has not been covered in detail in this report – to find out more visit energy.anu.edu.au/research.



The expanded research programme of the ECI covers a complete spectrum from energy science, engineering, efficiency and technology, to implementation expertise in the economic, legal, security, sociological and policy issues surrounding Energy Change. This broad portfolio of research activity is unique in the country.

The list below outlines the ANU Energy Change research clusters, many of which bring together researchers from several Colleges of the University:

- > **Artificial Photosynthesis**
- > **Biofuels**
- > **Carbon Capture & Storage**
- > **Energy & Security**
- > **Energy Economics & Policy**
- > **Energy Productivity, Energy Efficiency & Demand Management**
- > **Energy Regulation & Governance**
- > **Energy Sociology & Risk**
- > **Energy Storage & Recovery**
- > **Energy-Water Nexus**
- > **Enhanced Oil & Gas Extraction**
- > **Fusion Power**
- > **Nanostructure Photovoltaics**
- > **Nuclear Science**
- > **Smart Grid**
- > **Solar Photovoltaics**
- > **Solar Thermal**
- > **Wind Energy**

To find out more, go to energy.anu.edu.au/research.

RESEARCH



Energy and Security Research Cluster

The relationship between Energy and Security, originating from supply chain risks in the delivery of energy products, now incorporates a broader set of issues.

These include the security and resilience of electricity supply systems, the implications of climate change for environmental and human security, the interaction of decarbonisation of the electricity grid and security of energy supplies, and the relationship between geopolitics, energy and security.

Australia is at the centre of many of these policy issues as a major energy supplier located in the Asia-Pacific, which has the fastest growing demand for energy globally.

The Energy and Security research cluster at the Energy Change Institute aims to lead the conversation on the complex interactions between energy supply and demand and security in Australia and in the Asia-Pacific. The cluster is interdisciplinary with membership across a number of colleges of the University who actively collaborate with colleagues and partners from industry, government, policy and academia, within Australia, the region, and globally.

Research Topics

- > Fossil fuel supply chain resilience and energy security of supply
- > The security and resilience of electricity supply systems
- > Climate change mitigation, and human and environmental security
- > Decarbonisation and energy security
- > Geopolitics, energy and security in the Asia Pacific

Wind Energy Research Cluster

Commercial scale wind farms, capable of producing the equivalent energy needs of a town or small city have become commonplace since the turn of the millennium.

This exceptional growth in the proportion of wind generated electricity means that wind is no longer a token source of 'green' electricity. Wind is a proven technology; an established and important source of electricity generation; wind can be deployed rapidly in new markets; engineers and financiers view wind as a mature technology and a low risk investment.

Wind energy already provides substantial portions of the electricity demand across a diverse number of locations. States, provinces and countries where wind generation exceeds 15% of total electrical requirements include: the US states of Iowa, Kansas, Oklahoma, North and South Dakota, Minnesota, and Idaho; Denmark; Portugal; Ireland; Spain; Tamil Nadu (India); and Inner Mongolia (China). The State of South Australia generates over 30% of its electricity from wind.

Research in the Wind Energy research cluster in the Energy Change Institute and its partner organisation the WindScape Institute covers a wide range of wind assessment, wind development and renewables integration topics.

Example research topics include:

- > Remote sensing for wind and turbulence measurements (Professor Michael Shats, RSPE)
- > Development and application of CFD modelling for stratified flows in complex terrain (Dr Keith Ayotte, WindScape Institute)
- > Legal aspects of wind energy development including internationally and regionally comparative review of planning law, approvals and EIA law, litigation, project incentives and electricity law (Dr James Prest, ANU College of Law)
- > Development of a Hybrid Deterministic Statistical Model for wind energy assessment (Dr Keith Ayotte)
- > Community concerns and health impacts of wind farms (Dr Elizabeth Hanna, National Centre for Epidemiology & Population Health)
- > Turbulence generation and propagation from complex topographic features (Dr Keith Ayotte, supported by Coonooer Bridge Wind Farm and Ararat Wind Farm and in conjunction with turbine manufacturer Vestas)
- > Wind prospecting in sub-Saharan Africa and Indonesia (Dr Nathan Steggel, WindScape Institute)
- > Renewables integration of hybrid wind, solar and storage projects (Dr David Osmond, WindScape Institute)

The research is complemented by a new course in Wind Energy available to students in the Master of Energy Change and Master of Climate Change programs and to undergraduate students.

Commercial outcomes of solar PV research

(i) PERC solar cells

PERC silicon solar cells are capable of high cell efficiency at moderate cost. Professor Andrew Blakers led the high efficiency silicon solar cell program at UNSW whilst a Research Fellow during the 1980s, and developed the PERC cell in 1988. PERC cells have well-passivated surfaces on both the front and rear surface, and a rear surface mirror, which reduces electronic and optical losses, leading to higher cell efficiency. For many years the PERC cell design remained in the laboratory, and screen printed silicon solar cells reigned supreme in photovoltaics (PV). In recent years, however, the need for higher cell efficiencies, coupled with technical developments, has led to rapid adoption of PERC cells by manufacturers around the world. Current sales of PERC PV modules are in the range of \$4 billion per year, and growing rapidly. Industry roadmaps suggest that the PERC design will dominate the PV industry over the next decade. Some ideas, developed in a University laboratory, take decades to bear commercial fruit!

(ii) Sliver solar cells

In 2000, Associate Professor Klaus Weber and Professor Andrew Blakers attended a PV conference in Glasgow. On the train on the way there they conceived the Sliver solar cell design. This is a radically different way of fabricating silicon solar cells, and allows very high utilisation of silicon. Sliver cells are long (50-100mm), narrow (1-2mm) and thin (0.04mm). Origin Energy and Micron formed Transform Solar to develop the technology by agreement with ANU in 2009. About \$11 million in licensing and royalty payments have since been received by ANU.



Photo: Professor Andrew Blakers and Associate Professor Klaus Weber with a sliver solar cell



Climate, Energy and Water: Managing Trade-Offs, Seizing Opportunities

A landmark paper and a book from the ANU Energy Water Nexus research cluster and other collaborators were published this year. The paper - 'The water impacts of climate change mitigation measures' - presents the first systematic method for managing the climate mitigation – water nexus, and highlights which greenhouse gas mitigation measures conserve or consume water, to inform policy choices. The book 'Climate, energy and water' moves beyond theory and describes current best practices globally for managing the nexus to maximise benefits for people and the environment while minimizing perverse impacts.

Wallis, PJ, Ward, MB, Pittock, J, Hussey, K, Bamsey, H, Denis, A, Kenway, SJ, King, CW, Mushtaq, S, Retamal, ML, Spies, BR (2014), The water impacts of climate change mitigation measures, Climatic Change, July 2014, Vol 125, Issue 2, pp209-220.

Pittock, J, Hussey, K & Dovers S (eds), 2015, Climate, Energy and Water: Managing Trade-Offs, Seizing Opportunities, Cambridge University Press, Cambridge, UK, March 2015.



Nanotechnology Toward the Sustainocene

A new book 'Nanotechnology Toward the Sustainocene', edited by Professor Tom Faunce with chapters by leading ANU energy experts, was published in December 2014. Its goal is to lay out the scientific and policy hurdles that need to be understood and mastered if humanity is to reach the 'Sustainocene' – a unique period of history when human civilisation is in some form of dynamic equilibrium with its natural environment.

Tom Faunce (ed), 2015, Nanotechnology Toward the Sustainocene, Pan Stanford, Dec 2014

This year Prof Faunce also edited a special edition of the Royal Society's 'Interface Focus' journal - a collection of papers from the conference 'Do We Need a Global Project' on Artificial Photosynthesis.



Australia-Indonesia Centre Research Projects

Through its leading role in the Energy Cluster of the Australia-Indonesia Centre, the ECI has facilitated three Cluster-funded strategic research projects that will commence at ANU and other AIC participating universities in 2015.

Microgrid development, design and operation decision support

Widespread adoption of renewable and distributed generation is disrupting the top-down structure of electricity grids. This paradigm shift requires the development of reliable decision support tools. In this project, state-of-the-art models and algorithms will be developed at ANU School of Computer Science to create a decision support tool for optimal microgrid design and operations. This research will be supported in the ANU College of Law by examining the socio-legal and politico-economic barriers / drivers which affect the ability of micro-grids to become part of Indonesia's future energy mix.

Indonesian Energy Technology Assessment

This project will translate and validate its Australian counterpart project, the Australian Energy Technology Assessment, in which energy technology costs were modelled and compared on a consistent basis. This will enable the rigorous development of technology trajectories. The project will also test the generality of the Australian state-of-the-art methodology for technology cost assessment, as well as the appropriateness of the Levelised cost of Energy approach (LCOE). The project will be led by ANU and will be supported by University of Melbourne to develop enhanced technology cost assessment models.

Energy System Transformation Modelling for Microgrids

This project led by Monash University will develop a model that identifies requirements for the staged transformation of the Australian and Indonesian electricity systems to accommodate future energy needs.

It will cover trade-offs between technologies, deployment locations, and centralised versus microgrid solutions. An ANU project team will explore options for pumped hydro storage and implications for an Australia-Indonesia Supergrid.

Pumped Hydro Energy Storage

A substantial new ANU energy research program is investigating off-river pumped hydro energy storage as a way of stabilising a 50 – 100% renewables contribution to the electricity system.

Short-term energy storage is becoming increasingly important to smooth out peaks of high energy demand and low energy supply. Whilst much of the focus has been on battery storage, Pumped Hydro Energy Storage (PHES) actually constitutes 99% of all existing energy storage around the world, primarily using conventional hydro-electric dams, because it is cheap compared with alternatives such as batteries.

This year Professor Andrew Blakers and his team have investigated the potential for energy storage via off-river PHES using relatively small reservoirs which are much easier and cheaper to construct than large hydro-electric dams. This approach brings multiple benefits including its lower capital costs, reduced transmission costs, plentiful sites, avoidance of community conflict, and reduced environmental impacts. Their research has focussed on identifying and evaluating suitable sites around Australia.

The research is highly relevant for both policy makers and the electricity industry as decisions are made about increasing the penetration of renewables throughout the network. Nearly all new generation capacity in Australia is in photovoltaics and wind energy which are variable energy sources. PHES can help to stabilise the grid when PV and wind reach 50% or more of electricity generation. For example, South Australia is expected to reach this level within a few years.



Photo: Old mining sites are ideal for PHES. For example Genex Power has issued a prospectus for a 330MW PHES system at a former gold mine in North Qld.



Photo: Solar panels in situ at ANU

The ECI has an opportunity to use our energy expertise to make the ANU an energy efficient, low-carbon campus while maintaining a productive working and learning environment.

This includes our expertise in the ECI research clusters on Solar Photovoltaics, Solar Thermal, Nanostructured Photovoltaics, Smart Grids, and Energy Efficiency and Demand Management, to name but a few.

To this end, the ECI has partnered with the ANU Facilities and Services (F&S) Division to develop an ANU Energy Master Plan aimed at:

- > Reducing total electricity demand by 10% p.a. by 2020
- > Evening out peaks in electricity demand
- > Maximising use of thermal energy for heating and cooling
- > Exploring opportunities for rooftop PV generation
- > Exploring opportunities for co/tri generation
- > Exploring opportunities for electricity storage
- > Examining the role of electric vehicles to reduce greenhouse gas emissions and provide complementary electricity storage
- > Combining all the above to create cohesive ANU electricity microgrid
- > Altering our role as solely an electricity consumer, to providing demand management capability for our electricity provider.

As a first step, the ECI and F&S Division launched the Campaign to Reduce Energy and Water (CREW). In order to make smart energy choices we need knowledge about our energy usage, so an energy and water dashboard has been established to monitor consumption in many of our buildings. This information is collected centrally and can then be used to target reductions and monitor behavioural and structural changes.

F&S has had considerable success in several targeted projects focusing on energy efficiency, for example electricity consumption reductions at School of Music (37%), School of Art

(8%), College of Business and Economics (14%), Central Plant (16%). These results indicate that there is potential to achieve further reductions across other areas on campus.

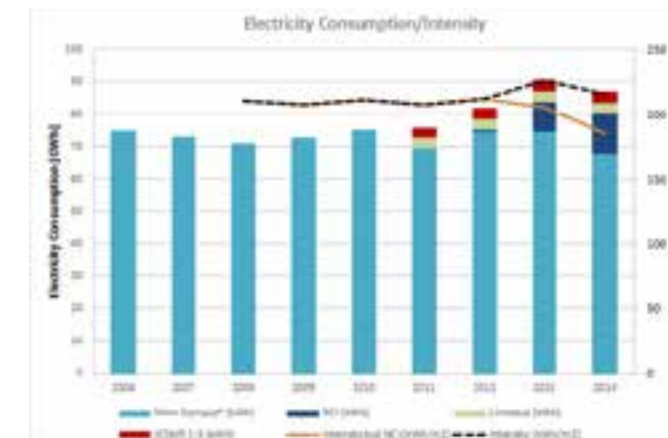
The University has recently installed a high level interface electrical meter replacement program. The new system will provide more accurate data, enabling review of energy consumption within other potential sites prior to and post energy efficiency works being implemented. These works will include building management system tune up programs, lighting upgrade projects and the replacement of major plant and equipment where appropriate. The F&S Division is also installing meter data loggers on the major gas meters on site to enable evaluation of consumption, along with the investigation of suitable metering technology for the main water meters on site as well.

Recent evaluation of the main campus electricity consumption has revealed that the ANU has reduced consumption compared with the same period last year, despite the expansion of the University and the establishment of new facilities such as the National Computing Infrastructure (see graph). This demonstrates that we have been able to target sustainable reductions through energy efficiency programs.

The University is not only the largest single institutional electricity customer in the ACT, but it also has the potential to be one of the largest institutional electricity generators by installing solar panels on its vast roof space. This, combined with the ability to control our real-time electricity demand through smart microgrid technology, will allow us to work together with our electricity provider to mitigate peak electricity demand in the ACT, and contribute to greenhouse gas reduction.

The ECI has invited the architect of the University of California San Diego microgrid, Byron Washom, to the ANU to present their microgrid concept at this year's annual Energy Update on Tuesday 8th December. The UC San Diego microgrid encompasses the world's largest, most diversified portfolio of distributed energy, generating 92% of the university's electricity needs.

With the ACT aiming to derive 90% of its electricity from renewable energy sources by 2020, and 100% by 2025, the development of a low-carbon ANU microgrid provides the University with a great opportunity to realize a near-zero carbon footprint.



Overall Electricity Consumption / Intensity at ANU

AUSTRALIA-INDONESIA CENTRE ENERGY CLUSTER



The Energy Cluster was established by the Australia Indonesia Centre (AIC) (australiaindonesiacentre.org), a \$25 million collaboration, funded by the Department of Foreign Affairs and Trade (DFAT), four Australian universities and CSIRO in 2015.

The Cluster's objective is to develop a collaboration between both countries' energy researchers and industry in designing an innovation pipeline for the integrated deployment of new technologies. These must be appropriate for a mixture of centralised and decentralised or remote area energy provision modes.

ECI Director Professor Ken Baldwin chairs the Energy Cluster, along with institutional co-leads Dr Ariel Liebman (Monash University) and Dr Igor Skryabin (ANU). The Energy Cluster brings together energy researchers from:

Australia	Indonesia
ANU	Institut Teknologi Bandung
CSIRO	Institut Pertanian Bogor
Monash University	Universitas Gadjah Mada
University of Sydney	Universitas Indonesia
University of Melbourne	Institut Teknologi Sepuluh Nopember
	Universitas Airlangga
	Universitas Hasanuddin

In 2015 the Energy Cluster identified its three key research themes:

- > Local Area Microgrids
- > Energy System Transformation Pathways
- > Technology Assessment

In April 2015, ECI Director Professor Ken Baldwin met the Minister for Energy and Mineral Resources (MEMR), Sudirman Said, in Jakarta, together with senior AIC representatives. This led to the establishment of a collaborative program to develop an Indonesian Energy Resource Assessment (IERA) and Energy Technology Assessment (IETA). Through discussions with the Department of Foreign Affairs, Professor Baldwin was able to enlist the support of Geoscience Australia (who developed the Australian equivalent – AERA) and the Department of Industry, Innovation and Science (AETA – for which he served on the Project Steering Committee). The result was the creation of an MOU between the AIC and MEMR to develop these Indonesian assessment projects over the next year.



Photo: Professor Ken Baldwin with the Indonesian Minister for Energy and Mineral Resources (on his right) and members of the AIC

The Energy Cluster researchers also met in April at the Institute of Technology Bandung, and again when the ECI hosted the cluster research workshop at ANU from 14 – 15 September. These meetings established the research collaborations that will move the agreed cluster program forward across the three research themes, with a total budget of AUD\$2.1 million over the three-year term of the AIC. The projects will involve a range of ECI researcher clusters including Smart Grids, Solar PV, Solar Thermal, Energy Regulation and Governance, Energy Sociology and Risk, and Energy Economics and Policy.



EVENTS

In 2015, the ECI organised and hosted a range of public events, ranging from public lectures by eminent speakers of global standing, to seminars and discussions of a technical nature, engaging experts and practitioners in the field of energy change in discussions around science, technology and policy. More information can be found at energy.anu.edu.au/news-events

Flagship events

The 2014 Solar Oration: Greg Bourne 17 November 2014

Greg Bourne, Chair of the Australian Renewable Energy Agency (ARENA), shared his views on the opportunities and challenges for renewable energy from both a technological and commercial perspective.



Photo: Greg Bourne, ARENA Chair, outlined his perspectives on the future of renewables in the 2014 Solar Oration

ANU Energy Change Institute Open Day 2014 1 December 2014

The Open Day showcased the latest in energy change research at ANU to key stakeholders, with ECI participants giving oral and poster presentations on their work.

ANU Energy Update 2014 9 December 2014

The annual ANU ECI Energy Update brought together Australian researchers, policymakers, industry and members of the public to provide an update on the latest world energy trends. Professor Steven Chu, former Energy Secretary of President Obama, was the keynote speaker.

Conferences

2014 OSA Light, Energy and the Environment Congress 2–5 December 2014

The ECI hosted the OSA "Light, Energy and the Environment Congress" on optical technologies for use in energy and the environment at ANU.



Photo: Associate Professor Wojciech Lipinski and Professor Ken Baldwin (2nd and 3rd left) with other researchers at the 2015 OSA Congress on Light, Energy and Environment in Suzhou, China

2015 OSA Light, Energy and Environment Congress 2–5 November 2015

ECI Director Ken Baldwin chaired the OSA Congress on Light, Energy and Environment in Suzhou, China, attended by 225 researchers from around the world, including a number of ECI solar researchers.

Meetings

The 2015 Solar Retreat

The annual solar retreat, organised by Professor Andrew Blakers, took place over 3 days from 15 February and combined the three ECI solar research clusters, Solar PV, Solar Thermal and Nanostructure Photovoltaics.

Energy White Paper Forum 2015

Speakers included Margaret Sewell, Professor Ken Baldwin, John Blackburn, Colonel (ret) Neil Greet, Jonathan Jutsen, Professor Iain McGill, Dr Michael Smith, Tony Wood, Professor Andrew Blakers, Dr Keith Ayotte - 28 April 2015

ECI Annual Business Meeting 8 May 2015

Ivor Frischnecht, CEO of the Australian Renewable Energy Agency, provided the keynote address at the annual ECI Business Meeting. Mr Frischnecht gave an overview of Australia's renewable energy sector, and discussed initiatives that would be important for the development of renewables in this country.

EVENTS



Photo: ANU Vice Chancellor Professor Ian Young and ACT Deputy Chief Minister Simon Corbell at the ECI Annual Business meeting with ECI Director Professor Ken Baldwin

The Australian Indonesian Centre Energy Cluster Workshop 15–16 September 2015

The ECI hosted the Energy Cluster workshop of the AIC to develop the collaborative research program of the Cluster. ECI Director Professor Ken Baldwin is the Energy Cluster chair, and Dr Igor Skryabin (ECI Business Development Manager) is a cluster co-lead.

ECI Public Lectures and Seminars

Solar Energy in a Sustainable World

Dr Stephen Chu, 5 December 2014

Innovation in Stationary Electricity Storage

Professor Donald Sadoway, 22 January 2015

Greening of the Hydropower Sector? What Difference does a Voluntary Sustainability Assessment Tool Make?

Helen Locher, 2 March 2015

City-wide simulations of distributed photovoltaic power production

Dr Nicholas Engerer, 2 April 2015

Energy Conversations: Smart Grids

Paul Scott, Nicholas Engerer and Hassan Hijazi, 8 April 2015

Globalising Solar: Industry Segmentation and Firm Demand for Trade Protection

Dr Llewelyn Hughes, 20 August 2015

Electricity demand and Australia's renewable energy targets: where to?

Dr Hugh Saddler and Mr Tristan Edis, 26 August 2015

Managing the growing energy cost of the Internet

Professor Rod Tucker, University of Melbourne, 29 September 2015



Photo: Professor Rod Tucker gave a seminar on "Managing the Growing Energy Cost of the Internet"

ANU Climate and Energy Student Expo Prize

The ANU Climate and Energy Student Expo 2015, held on 6 August 2015, showcased postgraduate research in the fields of climate change and energy change. The Expo aims to foster an interactive community of researchers and promote the exchange of knowledge in the field of climate change and energy change. This year the winners were:

- > Xiaolin Wang for her presentation on "CO₂ semi-clathrate hydrates for air conditioning applications"
- > Jeremy Hall for his presentation on "Light energy capture in natural photosynthesis"
- > Rani Yesudas was the winner of the poster prize.

Each winner received a \$500 prize, sponsored by Union Fenosa Wind Australia.



Photo: Prize winners Jeremy Hall, Rani Yesudas and Xiaoling Wang with Warwick Foster of Expo sponsor, Union Fenosa Wind Australia

OUTREACH

Part of the ECI's mission is to disseminate information on energy change through outreach activities. The following list gives a sample of the types of activities ECI members have been involved in.

Community engagement

Dr Colin Jackson of the Biofuels research cluster organised the ANU International Genetically Engineered Machine (iGEM) team for the International Synthetic Biology Competition with the aim of creating less energy intensive biosynthetic ways to make chemicals. The iGEM team had a stall at National Science Week and also presented to students at Melrose High School - August 2015.



Photo: The ANU iGEM team at National Science Week

Professor Andrew Blakers gave a lecture to University of the 3rd Age on renewable energy - 3 March 2015

Dr Igor Skryabin represented ECI at the South East Region of Renewable Energy Excellence (SERREE) Renewable Energy Day - 30 October 2015

Public Fora

Professor Andrew Blakers gave a seminar for the US Australia Institute on security and PV - 20 May 2015

Professor Andrew Blakers spoke at a Grattan Institute forum on energy storage - 19 August 2015

Professor Ken Baldwin chaired a discussion panel on Innovation and Renewables at the La Camara Spain and Australia Renewable Energy Conference - 3 September 2015

Professor Ken Baldwin contributed to a discussion panel at the Australian Institute of Energy in Adelaide on the Nuclear Energy Fuel Cycle - 11 September 2015

Industry Engagement

ECI and the Australian Institute of Energy jointly presented an Energy Conversation to industrial members of the AIE - April 2015

Professor Andrew Blakers gave a talk at the Australian Solar Council annual conference on "Roadmap to Lower PV prices" - 14 May 2015

Dr Michael Smith launched a report on "Doubling Energy and Resource Productivity by 2030 - Boosting Global GDP by > \$25 Trillion" at the World Resources Forum for Asia Pacific International Conference - June 2015

Professor Matthew Hole and Professor Andrew Stuchbery gave talks at the Australian Nuclear Association in Sydney - 9 October 2015

Professor Andrew Blakers gave a presentation to Engineers Australia on Renewable Energy - 14 October 2015

Professor Ken Baldwin opened the second day of Microgrid 2015 with an address on "Microgrid research and innovation in Australia" - 15 October 2015

Dr Michael Smith is leading one of the ACT Government's main energy efficiency projects in partnership with the Canberra Business Chamber, to address barriers and thereby improve the uptake of energy efficiency opportunities by ACT businesses.

Dr Igor Skryabin is a Director of the Australia Photovoltaic Institute (APVI)

Professor Ken Baldwin is a member of the board for SERREE

Dr. Igor Skryabin is a member of the Research Advisory Board of the NSW Knowledge Innovation Hub

Other research and academic institutions

Professor Elmars Krausz presented on Artificial Photosynthesis at the Australian Deans of Science meeting - October 2015

MEDIA AND COMMUNICATIONS

Media

The media is a key partner helping the ECI to engage and educate the wider community on topics relevant to energy change.

ECI participants regularly provide expert commentaries on news relevant to energy technology and energy policy. This is often done via an "ANU experts alert" issued as news breaks. For example, media coverage generated by ANU on the Australia's emissions reduction targets reached an audience of over 2 million people.

Here are some examples of coverage listed by theme:

Growth of renewable energy

- > The Conversation, 22 April 2015, "Report calls for emissions cuts, but plays down the opportunities" Associate Professor Frank Jotzo and Adjunct Professor Howard Bamsey
- > The Conversation, 10 June 2015, "The G7 is right to call for fossil fuel phase-out, but it can happen sooner", Associate Professor Frank Jotzo
- > The Guardian, 23 June 2015, "Renewables will supply majority of Australia's electricity by 2040 – study", Commentary by Professor Andrew Blakers
- > Radio National's The Science Show, 13 June and 4 July, "Energy Futures", Interviews with Professor Andrew Blakers and Professor Ken Baldwin
- > Climate Spectator, 5 October 2015 "Coal and emissions stall as renewables rise", Dr Hugh Saddler

Renewable Energy Target

- > The Conversation, 27 May 2015 "Renewable energy deal gives no certainty over coming decades", Professor Ken Baldwin
- > 7.30 Report, ABC News, 22 July 2015, Interview about realism of Labour's 50% Renewable Energy Target with Professor Ken Baldwin
- > The Conversation, 22 July 2015, "How much would Labor's 50% renewable energy policy cost Australian households?" Dr Hugh Saddler

Australia's emissions reductions targets for the Paris Climate Talks (INDCs)

- > Sydney Morning Herald, 10 August 2015, "Abbott risks backlash over climate change", Commentary by Professor Ken Baldwin
- > ABC News 24, 11 August 2015, Interview with Associate Professor Frank Jotzo
- > The Australian Financial Review, Opinion, 31 August 2015 p39 (2015) "Emission Targets Put Us in Bulls Eye of Climate Fight", Professor Warwick McKibben.

Electric transport

- > ABC 666 radio, 10 March 2015, Interview on solar powered transport with Professor Andrew Blakers
- > The Conversation, 30 April 2015, "Teslas in Victoria aren't greener than diesels", Dr Niraj Lal

Energy storage

- > Energy News, March 2015, Article on pumped hydro storage, Professor Andrew Blakers
- > 2SER, 26 May 2015, Interview on batteries and PV with Professor Andrew Blakers

Nuclear energy

- > ABC, The World Today, 9 February 2015, "SA royal commission on nuclear energy sparks calls for discussion to go national", Commentary by Professor Ken Baldwin
- > ABC 666 radio, 7 May 2015, "ITER project: Australian physicists enlisted for fusion experiment to help clean energy research" Interview with Professor John Howard

Renewable energy in the ACT

- > Australian Quarterly, Oct-Dec 2015, "Race to Renewables: The Australian Capital Territory", Professor Ken Baldwin
- > Canberra Times, 10 Oct 2015, "Barr launches bid to attract Tesla research to city", Includes commentary by Dr Evan Franklin and Professor Ken Baldwin

Other energy policy articles

- > The Conversation, 13 November 2014 "Increasing fuel taxes could save thousands of lives worldwide", Dr Paul Burke
- > The Australian Financial Review, Opinion, 30 June 2015 "Cheap Reductions, not Binding Targets are the Best Bet", Professor Warwick McKibben

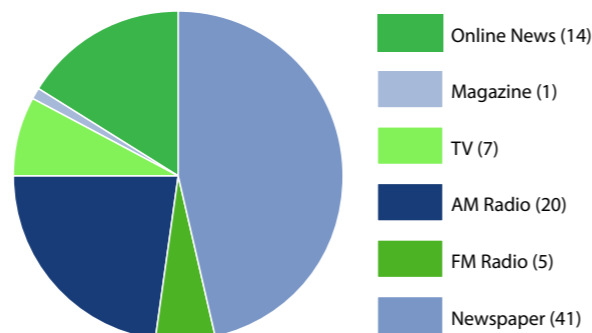
Communications

In May 2015, the Energy Change Institute and Climate Change Institute jointly appointed a new Communications Manager, Clare de Castella.

Key ECI communications initiatives in 2015 have been the instigation of a regular e-marketing programme to ECI stakeholders, social media (Twitter: @ANUEnergyChange), website upgrades and various media relations initiatives.

Media Type Breakdown (Volume)

*ASR is not available for social content



Media generated by ECI Executive and Public Policy Fellows for the 6 months to 6 November 2015 reached an audience of over 4.3 million people (Isentia Media Monitoring)

AWARDS



Dr Colin Jackson – Inaugural ACT Scientist of the Year

Dr Colin Jackson has been named the ACT Scientist of the Year for his work, which covers areas as diverse as biofuels, ageing, poisons, agriculture and disease. As part of the award, Dr Jackson will be a science ambassador for the ACT. He is a member of the ECI Biofuels research cluster.



Professor Bruce Chapman AM – Distinguished Fellow of the Economic Society of Australia

Professor Bruce Chapman has been made the 2015 Distinguished Fellow of the Economic Society of Australia in recognition of his contributions to the profession, the Society and the nation over more than three decades. Bruce is the architect of HECS and applies similar Income Contingent Loan principles to enhance the uptake of rooftop solar and other renewable energy systems. He is a member of the ECI Energy Economics & Policy research cluster.



Professor Andrés Cuevas – 2015 Becquerel Prize for Outstanding Merits in Photovoltaics

This award recognises Professor Cuevas's scientific merits in the development and characterisation of silicon solar cells, the most common type of solar cell technology. Professor Cuevas is one of the pioneers in the development of bifacial silicon solar cells and he contributed significantly to the development of high-efficiency silicon solar cells. Professor Cuevas is a member of the ECI Solar Photovoltaics research cluster.



Professor Graham Farquhar – 2015 Prime Minister's Prize for Science

In October 2015, Professor Graham Farquhar AO won the 2015 Prime Minister's Prize for Science for his work on water-efficient crops. His latest research looks at how plants will cope with climate change and higher levels of carbon dioxide in the atmosphere, and which plants will grow best in drier marginal farm lands. Professor Farquhar is a member of the ECI Biofuels energy cluster.



Professor Ken Baldwin – 2014 Vice-Chancellor's prize for Advancing the Reputation of the University

In December 2014, Professor Ken Baldwin, ECI Director, was recognised for his contribution to the University's profile in the energy arena and in particular for hosting a wide-ranging visit by former US Energy secretary Steven Chu, with the 2014 Vice-Chancellor's prize for Advancing the Reputation of the University.



Professor Chennupati Jagadish – 2015 IEEE Pioneer in Nanotechnology Award

2015 IEEE Photonics Society Engineering Achievement Award
 Professor Chennupati Jagadish received the IEEE Nanotechnology Council's Pioneer Award in Nanotechnology for pioneering and sustained contributions to compound semiconductor nanowire and quantum dot optoelectronics. Professor Jagadish has established a world-class research program on compound semiconductor optoelectronics and nanotechnology at ANU. He is a member of the ECI Nanostructure Photovoltaics research cluster.



Adjunct Professor Al Weimer – 2015 Research Excellence in Sustainable Engineering

In November 2015, Adjunct Professor Al Weimer won the American Institute of Chemical Engineers 2015 Award for Research Excellence in Sustainable Engineering. He also won the Nanoscale Science and Engineering Forum Award for his work in fluid-particle processing. He is a member of the Solar Thermal research cluster.

PUBLIC POLICY

The ECI continues to engage in the development of public policy through its extensive relationships with government departments and agencies.

This year's public policy highlights included:

Federal Government

- > Professor Andrew Blakers hosted Opposition Leader, Bill Shorten, Mark Butler and Andrew Leigh at the ANU Solar PV labs at ANU - 12 August 2015



Photo: Professor Andrew Blakers with Opposition leader Bill Shorten and Andrew Leigh MP at the ANU Solar labs

- > The signing of a MMOU with the Office of the Chief Economist, the Department of Industry, Innovation and Science, to undertake targeted research projects, initiated by a study of the factors behind declining electricity demand.
- > Briefings to the Chief of the Defence Force, and to the CDF Leadership Team, by Professor Ken Baldwin, following a Professional Short Course on Climate and Energy for the Defence Department organized by the ECI/CCI.
- > The holding of a public forum on the Energy White Paper (released in April 2015 by the Department of Industry, Innovation and Science) that provided feedback from key stakeholders in the energy sector.



Photo: Tony Wood (Grattan Institute), Ken Baldwin (ECI) and Margaret Sewell, leader of the Energy White Paper Task Force, Department of Industry

- > The ECI (Prof Ken Baldwin, Prof Andrew Blakers, Assoc Prof Kylie Catchpole and Prof Quentin Grafton) contributed to an ANU / Chifley Research Centre future leaders program, holding briefing discussions on energy with five Australian Labor parliamentarians.
- > In November 2015, the ANU hosted the annual workshop of the Office of the Chief Economist, the Department of Industry, Innovation and Science, where Professor Baldwin was a facilitator and presenter.

International

- > The ECI hosted a delegation from Trinidad and Tobago on energy in February 2015.



Photo: Members of the ECI with a delegation from Trinidad and Tobago

- > Professor Andrew Stuchbery participated in the Council for Security Cooperation in the Asia Pacific, Nuclear Energy Experts Group meeting in Singapore, which discussed the Nuclear Security Summit Process, Nuclear Governance, Radioactive Sources Management, and Nuclear Accident Response, including a Table-Top Exercise around a hypothetical nuclear power reactor accident in the ASEAN region – 15-16 October 2015.

ACT Government

Locally, the ECI plays an important role in the development of the ACT Government energy plan as a founding partner in the Renewable Energy Industry Development Strategy (REIDS). The ECI played a major role in the ACT Government reverse auction for 50MW Next Generation Solar and 200MW wind energy held this year, engaging with dozens of corporate bids that undertake to invest in renewable energy research and education. The new course in Wind Energy developed for the ECI by Windlab Limited is a result of the first 200MW wind reverse auction. The University and the ACT Government are now considering the establishment of a renewable energy precinct near the ANU campus with ECI involvement.

Individual contributions

Many ECI researchers contribute to public policy development through their individual research expertise as part of their everyday activities – particularly in the disciplines of economics, law, sociology and policy. Amongst many individual achievements throughout the year, ECI researchers contributed to the following areas of public policy:

Decarbonisation of the economy

- > Associate Professor Frank Jotzo is a member of the Australian committee for UN Deep Decarbonisation Pathways Project. He has also been appointed to the South Australian government's Low Carbon Economy expert panel and for a second term with the ACT Climate Change Council.
- > As Chair of the Emissions Reduction Assurance Committee, Associate Professor Andrew Macintosh has been involved on the preparation of energy related carbon offset methods. He is also a member of the ERF expert reference group and an Associate Member of the Climate Change Authority.
- > The ECI (represented by Dr Michael Smith and Professor Ken Baldwin) have partnered with Alliance to Save Energy, UTS and 20 peak industry groups. In 2015, they produced a comprehensive Federal Government policy submission on how to develop the COAG national energy productivity roadmap.
- > Complementing that initiative, Dr Michael Smith has collaborated with the peak energy efficiency NGO, the Alliance to Save Energy, on developing a series of reports to help business double energy productivity by 2030 funded by the Department of Industry (www.2xep.org.au).
- > Professor Warwick McKibbin prepared two reports for Department of Foreign Affairs and Trade: "Report 1: 2015 Economic Modelling of International Action Under a new Global Climate Change Agreement" and "Report 2: Economic Modelling of Australian Action Under a new Climate Agreement" – 20 August 2015.
- > Professor Neil Gunningham is co-convenor of the Australian Panel of Experts on Environmental Law and has written the Panel's Discussion Paper on Energy Law and Policy.
- > ANU academics Dr Michael Smith, Chris Browne, Dr Peter Stasinopoulos, Associate Professor Paul Compston and Dr Marina Lobastov have contributed to a range of government funded energy efficiency projects, most recently creating, an online educational resource to help university engineering departments create new courses in energy efficiency or embed energy efficiency topics into existing courses. This project was funded by the Department of Industry and is being launched at the Australian Association of Engineering Educators conference in December 2015.

Low carbon technologies

- > Dr James Prest gave evidence in person and written submission to Inquiry of Senate Select Committee on Wind Turbines, "Towards a Principled Approach to Federal Regulation of Wind Energy" – 19 June 2015

- > Professor Quentin Grafton and Professor Ken Baldwin were appointed as members of the Socio-Economic Modelling Advisory Committee to the South Australian Nuclear Fuel Cycle Royal Commission. Professor Andrew Stuchbery also provided expert advice to the Royal Commission.

Energy Policy in the ACT

- > Professor Andrew Blakers hosted Minister Corbell at ANU labs to announce the ACT renewable energy strategy – 30 April 2015
- > Professor Andrew Blakers spoke at the launch of the ACT Government's 40MW PV reverse auction – 6 May 2015

Public Policy Fellows

The University has a major role in providing expertise to government and the wider community through its Public Policy Fellows program in which the ECI is a major player, contributing 6 Public Policy Fellows:



Professor Ken Baldwin
ECI Director
Research School of Physics and Engineering



Professor Andrew Blakers
ECI Solar Photovoltaics
College of Engineering and Computer Science



Professor Quentin Grafton
ECI Energy Economics and Policy
Crawford School of Public Policy



Associate Professor Frank Jotzo
ECI Energy Economics and Policy
Crawford School of Public Policy



Professor Warwick McKibbin
ECI Energy Economics and Policy
Crawford School of Public Policy



Associate Professor Karen Hussey
ECI Energy-Water Nexus
Fenner School of Environment and Society



The ECI continues to contribute strongly to research and education, and now plays a key role in local, national and international policy.

Locally we contribute through the ACT Government's Renewable Energy Industry Development Strategy plan, while nationally energy was a key focus in the past year through, for example, the revision of the Renewable Energy Target. Internationally, increasing attention has been focused on the Intended Nationally Determined Contributions for the upcoming UNFCCC Conference of the Parties on climate change in Paris in December. The upcoming Federal election year will provide further opportunities for the ECI to contribute significantly towards debate on these key issues.

Our international engagement will increase as the Australia-Indonesia Centre – in which the ECI heads the Energy Cluster – expands its research programs further, with a key emphasis on microgrids and the development of energy technology assessments. We hope to create further linkages to the development of microgrids with the visit in December 2015 of Byron Washom, architect of the UC San Diego microgrid system, to help develop the ANU Energy Master Plan.

ECI researchers will expand their research, education and public policy contributions into new areas informed by the expanding breadth of the ECI research portfolio. These, together with our national and international initiatives, will provide the strong public profile that enables the ECI to be a significant contributor to energy policy. Through its annual flagship event Energy Update, the ECI will continue to promote informed discussion around the World Energy Outlook by the International Energy Agency.

As we engage with industry, government and the wider community, the ECI will increasingly contribute to the enormous changes that will occur in the world energy sector in the coming decades.

Please visit our website and subscribe to Twitter (@ANUEnergyChange) and/or our mailing list for the latest developments.



Professor Armin Aberle – Solar Energy Research Institute of Singapore

Armin Aberle is the CEO of the Solar Energy Research Institute of Singapore (SERIS) at the National University of Singapore (NUS) and a professor in the university's Department of Electrical and Computer Engineering. His research focus is on reducing the cost of solar electricity generated with silicon solar cells, both wafer based and thin-film based. His work has covered the full spectrum from fundamental materials research to the industrial evaluation of novel PV technologies at the pilot line level, including the development of novel solar cells, their fabrication in the laboratory, their characterisation, and their computer modeling. He has published extensively and his work has a high impact on the field.



Ms Glenys Beauchamp PSM – The Secretary, Department of Industry

On September 18 2013, Glenys Beauchamp was appointed Secretary of the Federal Department of Industry. Prior to this, she was appointed Secretary, Department of Regional Australia, Regional Development and Local Government in 2010 after acting in the position since the Department was created on September 2010. She has also worked as Deputy Secretary in the Department of the Prime Minister and Cabinet.



Mr Stephen Devlin – General Manager Assets Division, ActewAGL

Stephen Devlin is responsible for ActewAGL's energy networks asset strategy and planning functions. He is also responsible for the gas networks business, technical regulatory standards, major customer connections and smart networks developments. He has a breadth of experience in the energy, water and waste sectors, having worked across many facets of the electricity, water, gas and waste industries for 30 years. Stephen holds a Bachelor of Engineering (Electrical), a Master of Business Administration and a Master of Commercial Law.



Ms Dorte Ekelund – Director General of Environment and Sustainable Development, ACT Government

Dorte Ekelund is an urban planner and the Director-General of the Environment and Sustainable Development Directorate of the ACT Government. She was formerly the head of the Major Cities Unit, the Australian Government's think tank on urban policy issues. Prior to that, she held roles as the Deputy Director General, WA Department for Planning and Infrastructure, and Deputy Chief Planning Executive, ACT Planning and Land Authority. Dorte is experienced in urban development coordination, infrastructure planning, statutory planning, planning system reform and governance reform.



Mr Ian Farrar – Board Member, Centre for Sustainable Energy Systems; former Chair and CEO of the Joint Coal Board

Ian Farrar has a distinguished career in senior management in CSIRO and the coal industry. He has a Bachelor of Commerce from ANU. From 2002 until his retirement in 2005 he was Managing Director/CEO of Coal Services Pty Limited (CSPL), Coal Mines Insurance Pty Limited (CMI) and Mines Rescue Pty Limited, as well as Chairman of Coal Services Health and Safety Trust and Injury Prevention and Control Australia Limited. From 1964 to 1992 he held a range of senior management position within CSIRO, including General Manager (Corporate Resources) and Senior Principal Advisor (Special Projects).



Professor John Poate – Colorado School of Mines; Member of the National Renewable Energy Laboratory (US) Advisory Board

John M. Poate is Vice-President for Research and Technology Transfer at the Colorado School of Mines. He previously served as a Harwell Fellow of the UKAEA, Head of the Silicon Processing and Interface Physics Research Departments at Bell Laboratories, Dean of the New Jersey Institute of Technology and CTO of Axcelis Technologies. John has published extensively in several areas of nuclear physics, solid state physics, materials science and engineering. He is a Fellow of the American Physical Society and Materials Research Society, MRS Past-President and the John Bardeen award winner of the The Minerals, Metals and Materials Society (TMS).



Professor Mark Howden – Acting Director, The ANU Climate Change Institute

Mark was appointed Acting Director of the Climate Change Institute in February 2015. He is also a Chief Research Scientist with CSIRO Agriculture and an Honorary Professor at Melbourne University, School of Land and Food. Mark has worked on climate variability, climate change, innovation and adoption issues for over 27 years in partnership with farmers, farmer groups, catchment groups, industry bodies, agribusiness, urban utilities and various policy agencies via both research and science-policy roles. He has over 390 publications of different types. Mark has been a major contributor to past Intergovernmental Panel on Climate Change (IPCC) reports and is a Vice Chair of the IPCC Working Group 2, which addresses Climate Impacts and Adaptation. Recently Mark sat on the US Federal Advisory Committee for the 3rd National Climate Assessment and he participates in several other international science and policy advisory bodies.

EXECUTIVE MEMBERSHIP



Professor Ken Baldwin – ANU College of Physical & Mathematical Sciences

Ken Baldwin is the Director of the Energy Change Institute at The Australian National University, where he is also Deputy Director of the Research School of Physics & Engineering. He is also a Deputy Director of the ANU Climate Change Institute. Since 2011 he has been a member of the Project Steering Committee for the Australian Energy Technology Assessment.

Ken is an ANU Public Policy Fellow, and is a Fellow of the American Physical Society, the Institute of Physics (UK), the Optical Society of America and the Australian Institute of Physics.



Professor Andrew Blakers – ANU College of Engineering & Computer Science

Andrew Blakers is the Director of the Centre for Sustainable Energy Systems at the Australian National University. He was a Humboldt Fellow and has held Australian Research Council QEII and Senior Research Fellowships. He is a Fellow of the Academy of Technological Sciences & Engineering, the Australian Institute of Energy and the Institute of Physics. He has published approximately 200 papers and patents.

His research interests are in the areas of photovoltaic and solar energy systems; particularly advanced thin film silicon solar cell technology and solar concentrator solar cells, components and systems. He is also interested in sustainable energy policy, and is an ANU Public Policy Fellow.



Professor Elmars Krausz – ANU College of Physical & Mathematical Sciences

Elmars Krausz graduated with a PhD from the University of Sydney. He has since held research positions at The Australian National University (1971 – 1973, 1978), Oxford University (1974 – 1975), the University of Virginia (1976 – 1977), the University of Sydney (1979 – 1980) before being appointed as Research Fellow at the Research School of Chemistry.

He was awarded fellow of the Royal Australian Chemical Institute and was appointed Professor at the Research School of Chemistry in 2002.



Professor David Stern – ANU College of Asia and the Pacific

David Stern is an energy and environmental economist whose research focuses on understanding the relationship between resource use and economic growth and development. He has investigated both the role of energy and resources in economic growth and the determinants of environmental impacts, especially air pollution and climate change. He is also interested in research assessment using meta-analysis and bibliometric techniques.

David is an associate editor of Ecological Economics, a research associate in Centre for Applied Macroeconomics Analysis (CAMA) and Centre for Climate Economics and Policy (CCEP) at the ANU Crawford School of Public Policy.



Associate Professor Kylie Catchpole – ANU College of Engineering and Computer Science

Kylie Catchpole is the education convenor of the Master of Energy Change program. Her research interests are in nanotechnology for solar cell applications. She has a physics degree from the ANU, winning a University Medal, and a PhD from the ANU.

She was a Post-doctoral Fellow at the University of New South Wales and the FOM Institute for Atomic and Molecular Physics, Amsterdam. She has published over 70 papers, which have been cited over 2500 times to date. She currently leads the nanostructures for photovoltaics group at the College of Engineering and Computer Science.



Dr James Prest – ANU College of Law

James Prest is a lecturer in law at the ANU specialising in environmental law with interests in administrative law and litigation. He is a Member of the IUCN Commission on Environmental Law. James is currently working on renewable energy law (particularly feed-in tariffs and tradeable RE certificates law); and major projects legislation. His research interests are in the areas of energy and climate change.

After graduating from the University of Adelaide and the ANU and gaining admission to practise in the Supreme Court of the ACT in 1995 he worked for several years as a legal policy officer at the Department of Prime Minister and Cabinet. He has also held positions as a Research Officer at the Law and Bills Digest Group of the Parliamentary Library in Canberra and as an adviser at Parliament House.



Dr Igor Skryabin Business Development Manager – ANU College of Engineering & Computer Science

Igor Skryabin's career has spanned both industry and academia. His interests are in the areas of development and commercialisation of solar energy technologies and their integration into national electricity markets.

His major technical contribution has been in the industrialisation of nano-structured dye solar cells. Igor has published more than 100 research papers and is an inventor of more than 30 patents and industrial designs, granted in Australia and overseas.

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