CURRICULUM VITAE

Name: Christopher Greig

Present Position:

2011 – Current	Professor in Chemical Engineering, and Director, Dow Centre for Sustainable Engineering Innovation
2018 – 2020	Gerhard R. Andlinger Visiting Fellow in Energy and the Environment, Princeton University

Qualifications: BE(Hons), Chem. Eng., University of Queensland (1982)
ME St., Chemical Eng., University of Queensland (1984)
PhD Chemical Eng., University of Queensland (1995)

Prior Positions held

Full time Executive Roles

- CEO and Project Director, ZeroGen Limited (a CCS Company) (2007 -2011)
- Executive General Manager Projects & Development, Ensham Resources Ltd - subsidiary of Idemitsu Kosan (2004 – 2007)
- Managing Director and Chairman, McDonald Group (2000 – 2004)
- Founder and Managing Director, STG Pty Ltd, STG-FCB Group (1986 – 1999)

Non-Executive Roles

- ATSE – New Fellows Selection Committee - Resources and Energy Sector (2013 -current)
- ATSE - Clunies Ross Awards for Innovation, Commercialisation and Entrepreneurship Selection Committee (2014-2019)
- Director, The Energy Policy Institute of Australia (2014 - 2018) (Chairman 2017-2018)
- Non-Executive Director, Seymour Whyte Limited, ASX-listed engineering contractor (2013 – 2017)
- Non-Executive Director & Deputy Chairman, Gladstone Ports Corporation (2012 - 2016)
- Non-Executive Director, Golding Group Limited (2009 - 2014)
- Non-Executive Chairman of Western Metals Limited (2008 – 2013)
- Non-Executive Director, LogiCamms Limited, (2008 - 2012).

Awards:

- Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE), 2012
- Fluor Chemeca Award for Excellence in Engineering Management, 2001
- Engineers Australia (Queensland Division), - Engineering Product Design of the year, 1996
- Engineers Australia (Queensland Division), Engineering Project Management of the year, 1996
- Premier's New Queensland Exporter Award, 1996
- President's Medal, Australian Society of Sugarcane Technologists, 1990

Overview:

Chris is using the final stage of his career to create an impact in Academia, leveraging his professional career as an entrepreneur, executive and director, with extensive experience in general management, technology development and commercialisation, and the leadership of complex industrial projects. His impact is felt in the classroom, where he created a new professional practice course for final year engineers which is now taught to over 600 students per year at the University of Queensland; in research, where he has helped establish significant new interdisciplinary research efforts in Energy Transitions, Energy & Poverty, Unconventional Gas & CCS, Sustainable Process Innovation, Printed Energy Devices and Electric

Mobility; and in advancement where he has helped raise over A$40 M for new research and teaching initiatives from a mix of industry, government and philanthropic sources.

More recently he conceived the Rapid Switch Initiative, a major new international, interdisciplinary research effort which aims to accelerate progress on climate change by identifying and resolving the critical bottlenecks that slow our progress towards deep decarbonisation. He has spent the past 18 months leading this initiative as the Gerhard R. Andlinger Visiting Fellow in Energy and the Environment at Princeton University in the United States, raising US$13 M to date, and as a CI on two major programs focused on the US and India.

His professional career began during his PhD, as cofounder of a successful start-up company which grew under his leadership, into a globally recognised supplier of specialised sugar equipment and turnkey process plants, focused in developing countries. Following the sale and exit from that venture after 14 years as CEO, Chris went on to hold senior corporate and project roles with privately owned and listed companies in the resources and energy sector, covering engineering, construction and operations for a further 12 years. During his career, Chris worked extensively throughout Asia-Pacific, the Americas, Europe and Africa. His high-level technical qualifications coupled with broad commercial and interdisciplinary experience, and strong interpersonal skills, provide a sound platform for leadership roles in both the business and academic sectors.

Experience:

July 2018 – June 2020 Princeton University

- Gerhard R. Andlinger Visiting Fellow in Energy and the Environment. Awarded a two-year Visiting Fellowship to lead a new international, interdisciplinary research network known as Rapid Switch to explore bottlenecks associated with rapid, deep decarbonisation of the global energy economy. By identifying, anticipating and resolving bottlenecks, the project seeks to create more robust transition scenarios and to identify opportunities to accelerate the decarbonisation pathways. Assisting with fundraising efforts that to date have yielded ~US$13 M (targeting US$50 M for research from industrial companies, foundations and private donors.
- Led the formation of a successful grant application from Princeton Institute for International & Regional Energy Studies to undertake multi-year, cross-disciplinary analysis of decarbonisation transitions in India. (US$0.8 M)
- Joint Principal Investigator on a major study on an industry-funded, infrastructure plan to take the US economy to net-zero emissions by 2050. (US$1 M – initial phase)
- Led the organisation of the 2018 Andlinger Center Annual Retreat and inaugural Rapid Switch International Conference, including raising funds to cover all conference costs and travel for 40 invited international guests). Attended by more a mix of more than 100 industry, government and academic leaders.
- Delivered a number of keynote presentations to various organisations inside and outside Princeton University, in the US, UK, Switzerland, Germany, Italy and Australia.
- Conceived, developed and delivered a new interdisciplinary undergraduate course on energy transitions (Rapid Switch). First offered in 2019, this course is fully subscribed to the enrolment cap in 2020 with enrolments across various engineering disciplines, mathematics, geosciences, computer science, religion, politics, and history.
- Advisor / co-advisor for four undergraduate senior theses.

September 2011 – Current University of Queensland

- Professor in the School of Chemical Engineering, Dow Chair & Director of the Dow Centre for Sustainable Engineering Innovation. The Dow Centre was established with a US$10 M gift from the Dow Chemical Company Foundation. The Centre is hosted within the School of Chemical Engineering but has a University-wide mandate to pursue strategies to *move the needle* in the sustainable production and utilisation of energy and materials. Played a limited supporting role in helping secure the first gift in 2012 and a significant role in securing a further gift of US$3.5 M in 2018. Core programs have included low-CO_2 iron production, low-CO_2 hydrogen and fuels production, Rapid Switch, Circular Economy, Next Generation Fertilisers, and Fighting Food Waste. Currently

working with academics in multiple schools to develop a major new A$9 M Plastics Circular Economy program - negotiating with philanthropists and industrial companies to support research across UQ, UWA and several South and Southeast Asian universities.

- Director of the UQ Energy Initiative. Established and led the University-wide initiative to lead the energy research strategy across all faculties and institutes. The role provided strategic context, techno-economic assessment and engagement with government, industry, NGO's, and research funders, as well as public outreach. The initiative emphasised a whole-of-system, transdisciplinary approach incorporating primary energy extraction to processing, conversion, distribution and utilisation of fossil and renewable energy systems for power, fuel and industrial applications. Played a significant role in establishing, and fundraising over A$25 M for new research centres covering unconventional gas, CCS and energy poverty. (Stepped down in December 2017).
- Co-Chief Investigator on A$4 M Printed Energy Cooperative Research Centre (Projects) grant and A$3 M Electric Mobility grant (both current) which are both co-funded by Industry.
- Current universities' nominee on the Advisory Board of Australian Solar Thermal Research Initiative, a formal research collaboration encompassing the Australian Renewable Energy Agency, CSIRO and six Australian Universities including UQ.
- Former chair or member of Advisory Boards for the UQ Centre for Coal Seam Gas, UQ Geothermal Energy Centre of Excellence and UQ School of Chemical Engineering.
- Established and co-led the UQ Energy Poverty Research Group – a cross-disciplinary research program looking at energy and livelihoods in the developing world.
- Advising / Co-Advising 7 (graduated) PhD scholars and 3 current PhD students.
- Conceived, developed, coordinated and lectured a new interdisciplinary course for final year undergraduate and Masters Engineering students, "Professional Practice in the Business Environment". This course started in 2013 with 55 students and grew to become a compulsory capstone course for over 700 students in 2018.
- Member of the Advisory Board for the International Energy Centre (IEC), a joint venture between UQ, UWA and U Newcastle offering postgraduate courses in Energy Studies. The IEC was not attracting quality students and was loss-making. Recommended its closure and transitioned the program to UQ, raised the start-up funding and led the program until a program leader was recruited. The rebadged UQ Masters of Sustainable Engineering program currently attracts 35 domestic and international students per year. Within the program, I developed, coordinated and lectured the course, "Energy Investment and Finance".
- Guest lecturer in various Engineering courses around Energy Policy & Economics, Innovation & Strategic Management.

2007 – 2011 ZeroGen Pty Ltd

- CEO and Project Director for ZeroGen Ltd. ZeroGen was an SPV established by the Queensland Government which sought to develop a world-first, multi-billion-dollar, advanced coal-fired power project with carbon capture & sequestration. The project was a collaboration between the Australian and Queensland Governments, Australian Coal Association Low Emissions Technologies Ltd, Mitsubishi Heavy Industries and Shell Global Solutions.
- The scope of the project included designing and assessing the feasibility of coal supply, water and utilities supply, HV transmission infrastructure, integrated coal gasification with combined cycle power plant, syngas processing, CO_2 capture, transport and storage. The project also included the world's first major onshore exploration and appraisal program for storage of CO_2 in deep saline aquifers. ZeroGen invested A$128 million feasibility studies and exploration and appraisal activities.
- For the Feasibility Study, Chris played a leadership role in: working with key funders and stakeholders to frame the project; designing project delivery and contract structures; negotiating with key technology providers, contractors and engineering firms; assuring the integrity of capital and operating cost estimates; financial modelling; environmental impact assessment; stakeholder engagement planning; structuring the project finance (A$6.93 Billion); risk assessment and management plans; and the final Independent Expert Review.
- The final outcome was a five-volume, 150,000-word report and associated supporting materials to shareholders and financiers, which recommended cessation and closure of the project due to the lack of financial viability and

climate policy uncertainty. I co-wrote and published a book with two members of the team to disseminate the non-confidential learnings globally.

2004 – 2008 Ensham Resources Ltd

- Executive General Manager responsible for oversight and leadership of; all significant capital projects including open cut Expansion (from feasibility to implementation) and Feasibility Study for an underground development; negotiation of coal freight rail and port services contracts; supporting negotiation of coal sales agreements with customers in Japan, Korea, Taiwan, India and Malaysia.
- Project Director to initiate recovery of the mine and operations from a catastrophic flood; including development of cost estimates in circumstances of enormous uncertainty, interfacing with shareholders, banks and insurers for funding, and scoping, resourcing and project management of recovery capital works and operations. I subsequently recruited a successor to close-out this project, in order to take on the ZeroGen role.

2000 – 2004 JJ McDonald & Sons Group

- Managing Director and Chairman of a large family-owned group of companies, based in Townsville (North Queensland), with businesses in civil construction, agriculture and quarrying. Appointed at the request of shareholders and banks, a major restructuring and turn around task was successfully accomplished.

1986 – 1999 STG Group & STG-FCB SA

- Founder and Managing Director of a process technology and engineering start-up company formed during PhD studies. Developed and successfully commercialised patented technologies in sugar processing, mineral processing and hydrometallurgy (Exited in 1999 following sale to a listed French industrial engineering group).
- The company was a global leader in specific sugar processing technologies, especially continuous centrifuges – selling its proprietary equipment in all cane sugar producing countries of the world.
- Led several 'turnkey' sugar projects from concept through feasibility and from financing to construction and operation in South East Asia, and one in Australia (receiving the Queensland Government's award for New Exporter of the Year, and the Institution of Engineers Project Management Award, in 1996). This included raising finance, arranging all approvals and completing five major cane sugar projects in Vietnam between 1995 and 1999, at a time when the nation was early in its rebuilding phase after the war.
- The company was also contracted by Comalco Aluminium Ltd (now Rio Tinto) in 1989, to conceive and develop new dewatering technology for kaolin which was mined in a seam below the main bauxite resource. The process which was developed and patented, involved treating the kaolin slurry to maintain flowability even at 70% solids and dewatering using a novel, multiple effect evaporation system. I played a key role in the process conception (recognised as one of two inventors); bench scale demonstration; pilot plant design and operation; working with Japanese customers to assure product integrity; and scale-up to the first commercial plant at Comalco's Weipa operations.
- Between 1997 and 2000, the company led the process design, engineering and construction of a ~A$100 M demonstration plant for a first-of-a-kind Magnesium production process, and was heavily involved in the feasibility study for the $2 Billion commercial plant.

2000 – 2011 Other Ad-hoc Management Consulting and Directorships (Selection only)

- Project advisor to the Vietnamese government, Xstrata Coal, Sojitz and Kyushu Electric Power Company to scope the development of a new 4,400 MW pulverised coal fired power generation complex in southern Vietnam.
- Independent reviewer for BHP Billiton of the Business Case estimates for the Uranium recovery section of the proposed Olympic Dam Expansion project.
- Advisor for Enthalpy Pty Ltd on Capital Investment Systems and Project Delivery for major clients including BHP Billiton, Barrick Gold and Stanwell Corporation.
- Lead negotiator for UniQuest Pty Ltd (the commercialisation vehicle for the University of QLD) in major technology licensing deals with CSR Limited and OneSteel Limited.

Publications (since joining UQ in late 2011) Papers and significant reports

1. Heynen, A., Lant, P., Smart, S., Sridharan, S. & Greig, C. (2019). "Base of the Pyramid" engagement by India's large firms. South Asian Journal of Global Business Research. Under review.
2. Larson, E., Kreutz, T., Greig, C., William R., Rooney, T., Gray, E, Elsido C., Martelli E., and Meerman, H. (2020). Design and Analysis of a Low-Carbon Lignite/Biomass-to-Jet Fuel Demonstration Project. Applied Energy. https://doi.org/10.1016/j.apenergy.2019.114209.
3. Balinger, B., Schmeda-Lopez, D., Kefford, B., Parkinson, B., Stringer, M., Greig, C. & Smart, S. (2019). The vulnerability of electric vehicle deployment to critical mineral supply. Applied Energy. https://doi.org/10.1016/j.apenergy.2019.113844.
4. Heynen, A., Lant, P., Smart, S., Sridharan, S. & Greig, C. (2019) Off-grid opportunities and threats in the wake of India's electrification push. Energy Sustainability and Society, 9 (1).
5. Small, M., Wong-Parodi, G., Kefford, B., Stringer, M., Schmeda-Lopez, D., Greig, C., Ballinger, B., Wilson, S., and Smart, S. Generating Linked Technology-Socioeconomic Scenarios for Emerging Energy Transitions, (2019) Applied Energy.
6. Kefford, B., Ballinger, B., Schmeda-Lopez, D., Greig, C., Smart, (2018). The early retirement challenge for fossil fuel power plants in deep decarbonisation scenarios. Energy Policy.
7. Curran, F., Smart, S., Lacey, J., Greig, C. and Lant, P. (2018). Learning from experience in the water sector to improve access to energy services. Utilities Policy, https://doi.org/10.1016/j.jup.2018.01.005
8. Malakar, Y., Greig, C. & Van de Fliert, E. (2018). Structure, agency and capabilities: Conceptualising inertia in solid fuel-based cooking practices. Energy Research & Social Science. Vol 40.
9. Parkinson, B.; Tabatabaei, M.; Upham, D.C.; Ballinger, B.; Greig, C.; Smart, S and McFarland, E. (2018). "Hydrogen production using methane: Techno-economics of decarbonising fuels and chemicals", International Journal of Hydrogen Energy. DOI: 10.1016/j.ijhydene.2017.12.081.
10. Greig, C.R.: "Contemporary research in energy science and engineering", Engineering, 2017, 3(4): 436-438. http://engineering.org.cn/EN/Y2017/V3/I4/436.
11. C. R. Greig, T.G. Kreutz, E.D. Larson, J.C. Meerman, R.H. Williams, "Lignite-plus-Biomass to Synthetic Jet Fuel with CO2 Capture and Storage: Design, Cost, and Greenhouse Gas Emissions Analysis for a Near-Term First-of-a-Kind Demonstration Project and Prospective Future Commercial Plants," Final report to The National Energy Technology Laboratory, U.S. Department of Energy, 1 September 2017.
12. Parkinson, B., Greig, C, McFarland, E. and Smart, S. (2017) Techno-economic analysis of a process for CO_2-free coproduction of iron and hydrocarbon chemical products, Chemical Engineering Journal, 313 (2017).
13. Herington, M., Lant, P. Smart, S., Greig, C. and Van de Fliert, E. (2017). Defection, recruitment and social change in cooking practices: Energy poverty through a social practice lens. Energy Research & Social Science. Vol. 34.
14. Greig, C., Bongers, G., Stott, C. and Byrom, S. (2016) Energy Security and Prosperity in Australia: A Roadmap for CCS, The University of Queensland, Brisbane. ISBN 978-1-74272-175-0.
15. Greig, C., Baird, J. and Zervos, T. (2016) Financial Incentives for the Acceleration of CCS Projects, The University of Queensland, Brisbane. ISBN 978-1-74272-177-4.
16. Grove, J., Lant, P., Greig, C. and Smart, S. (2016). Can coal-derived DME reduce the dependence on solid cooking fuels in India? Energy for Sustainable Development, 546 (2016). Energy Research & Social Science 34.
17. Herington, M., Van de Fliert, M., Smart, S., Greig, C. and Lant, P. (2016). Rural energy planning remains out-of-step with contemporary paradigms of energy access and development. Accepted by Renewable & Sustainable Energy Reviews.
18. Larson, E., Baxley, S., Greig, C., Kreutz., T., Meerman, H., & Williams, R., (2015). Design and Commercialisation Analysis for Synthetic Jet Fuel Production from Lignite and Woody Biomass at a Mississippi Site with CO2 Capture and Storage via Enhanced Oil Recovery. 32nd Annual International Pittsburgh Coal Conference, USA.

19. Greig, C. (2015). We need to get our energy policy right. Feature article in FOCUS. Published by The Australian Academy of Technological Sciences and Engineering (ATSE).
20. Lane, J., Smart, S., Lopez, D., Hoegh-Guldberg, O., Garnett, A., Greig, C, and McFarland, E. (2015). Understanding constraints to the transformation rate of global energy infrastructure. WIREs Energy Environment. Volume 3, 2015.
21. Greig, C, Garnett, A., Oesch, J., Smart, S. (2014). Guidelines for scoping & estimating early mover CCS projects. http://anlecrd.com.au/wp-content/uploads/2016/08/ANLEC-Project-1-0512-0205_Milestone-5_Final-Report.pdf.
22. Garnett A. and Greig C. (2014). Cost Reduction and Innovation Strategies for Carbon Storage. Published by the International Energy Agency.
23. Garnett A. and Greig C. (2014). Investing in CCS: Key project gateways. INSIGHTS 2014: What lies in store for CCS. International Energy Agency.
24. Greig C, et al, (2013). A Roadmap for the Development and Deployment of Carbon Capture and Storage in Australia. Report prepared on behalf of the National CCS Council for the Minister for Resources, Environment and Tourism, Australian Commonwealth Government.
25. Greig, C., Baird, J. and Zervos, T., (2013). Mobilising Investment to Accelerate CCS Deployment in Australia. Report prepared on behalf of the National CCS Council for the Minister for Resources, Environment and Tourism, Australian Commonwealth Government.
26. Greig C., (2013). Energy Innovation Policy and the need for a Portfolio Approach. Public Policy Paper 4/2013 prepared on behalf of The Energy Policy Institute of Australia.
27. Garnett A., Greig C. and Wheeler C. (2011). The ZeroGen project—Managing risk and uncertainty. Energy Procedia. Volume 4, Pages 5631–5638.

Books

- Garnett A., Greig C. and Oettinger M. (2013) [Eds]. ZeroGen IGCC with CCS. A case history. UQ Press. ISBN: 978-0-646-91501-2.
- Foster, J., Froome, C., Greig, C., Hoegh-Guldberg, O., Meredith, P., Molyneaux, L., Saha, T., Wagner L. and Ball, B. (2013). Delivering a Competitive Australian Power System (3 Part series).

Reports to governments

Submissions to the Australian and State Governments made on behalf of the University of Queensland;

- Submission in response to the Commonwealth Chief Scientist's Report. "Independent Review of the Future Security of the National Electricity Market". 2017
- Submission to the NSW Department of Environment. "Response to Senate Enquiry on Australia's Transport Energy Resilience and Security. 2014. NSW Climate Change Policy Framework: Important considerations for taking the aspirational goal seriously - a public interest discussion paper". 2016
- Submission to 'Australia's transport energy resilience and sustainability' enquiry by the Senate Standing Committees on Rural and Regional Affairs and Transport. Also requested to appear before the committee. 2016
- Submission to Federal Minister for Resources and Energy. Response to the Energy White Paper 2015 "Australia is an Energy Superpower". 2015
- Submission to State Minister for Energy and Water Supply. Response to the Queensland Government's "POWERQ: A 3- year strategy for Queensland's electricity sector". 2013
- Submission to the Federal Minister for Resources and Energy. Response to the Energy White Paper 2012 "Australia's Energy Transformation". 2013

Submissions co-authored on behalf of the Australian Academy of Technology & Engineering.

- Deep reductions in emissions using CCS (Action Statement). 2017
- Advancing energy storage for Australia (Action Statement). 2015

- Enhancing Australia's solar photovoltaic advantage (Action Statement). 2015
- Doubling Australia's energy productivity (Action Statement). 2014
- Intelligent electricity networks for the future (Action Statement). 2014
- Low emission fuels for transport (Action Statement). 2014
- Nuclear energy is an option (Action Statement). 2014
- A sustainable energy future for Australia (Position Statement). 2014

Invited talks/papers at national and international conferences (selection only):

- European Union PEP 1.5^{o}C Conference – Pathways and Entry Points, Potsdam, Germany (2019)
- Electric Power Research Institute Annual Research Strategic Review – Keynote - Chicago (2019)
- Climate Change Authority – Private Board presentation – Canberra (2019)
- Princeton-BP Carbon Mitigation Initiative 2019 (London), 2017 (Princeton), 2016 (London)
- World Economic Forum - Young Global Leaders Forum, Princeton University (2018)
- Indian Conference on Advances in Energy Research 2017- Keynote (Mumbai)
- 9th Sino-US Joint Conference of Chemical Engineering 2017 (Beijing)
- Australian Engineering Conference 2016. Australia's Transition away from Fossil Fuels (Brisbane)
- McDonnell Alliance Global Energy & Environment Partnership 2016 (Brisbane), 2014 (St Louis) & 2012 (Mumbai)
- New Frontiers for Energy & Chemicals in a Carbon Constrained World 2015 & 2014 (Santa Barbara)
- EnerAsia 2014 (Ahmedabad, India).
- Energy State of the Nation. 2016 & 2013 (Sydney)
- America Australian Chamber of Commerce Energy Conference in Houston (2014)
- Bio-energy and CCS (BECCS): Options for Brazil – IEA Workshop Sao Paulo (2013)
- EPRI CCS Costs Workshop 2013 (USA)
- Australian Ambassadors Global Leadership Address in Washington DC (2012)
- International Energy Agency – Coal & CCS 2012 (Paris)
- International Conference on Clean Energy 2012 (Xian)
- APEC Expert Committee on Clean Fossil Energy 2012 (Gold Coast)
- International Energy Agency, Committee on Energy Research & Technology 2012 (Sydney)
- Various invited presentations to Engineers Australia and Society of Petroleum Engineers