



THE UNIVERSITY
OF AUCKLAND
BUSINESS SCHOOL

The Energy Centre Annual Report 2014

To the Energy Education Trust of New Zealand



THE ENERGY CENTRE ANNUAL REPORT

TO THE ENERGY EDUCATION TRUST OF NEW ZEALAND MAY 2014



Professor Basil Sharp

Energy Education Trust Chair in Energy and Resource Economics

Director, The Energy Centre

May 2014

The Energy Centre's mission is to provide research, policy analysis and educational programmes to help business and Government confront energy issues of national significance to New Zealand.

The Centre aligned its programmes in support of the following strategy:

1. Undertake independent research and business and policy analysis on energy-related issues important to New Zealand's future
2. Research that is cross-disciplinary, drawing upon as appropriate, economics, engineering, and the physical, environmental and social sciences

3. Act as a bridge for open and informed dialogue between the energy industry, government and the community

4. Provide energy-related education that creates future leaders for academia, business and government

Key performance indicators (KPIs) are set around the strategy and activity outcomes are reported against key result areas.

1. INTRODUCTION

Cross-disciplinary research is an overarching theme and we acknowledge the following sustained contributions during the 2013/14 period:

- Dr Steve Poletti (Economics)
Dr Golbon Zakeri (Engineering Science)
Dr Tony Downward (Engineering Science)
Dr Rob Kirkpatrick (Engineering)
Dr Kiti Suomalainen (Postdoctoral Fellow)
Dr Geoff Pritchard (Statistics)
Selena Sheng (Research Associate)
Bart van Campen (Engineering Science)
Dr Sam Malafeh (Associate)
Professor Mark Greer (Dowling College, USA)
Frank Duffield (Honorary Fellow)

In addition to supporting the Chair in Energy and Resource Economics, the trust funds the postdoctoral position held by Dr Kiti Suomalainen and three PhD scholarships for students in Business and Economics. Funding to support research also came from the Business School's Faculty Research Development Fund, MBIE, Genesis Energy and the New Zealand Royal Society.

Translating research into value-adding outcomes is a central strategy. In this respect, the University of Auckland Business School's Advancement team played a pivotal role in the translational pathway raising the Centre's public profile and level of engagement with stakeholders and the community.

2. RESEARCH

Electricity markets

Renewable energy

The Centre's grant from the Faculty Research Development Fund "Economics of Change: Towards a Renewable Energy Future" provided a foundation for continuing research in renewables. A statistical model based on wind speed data and electricity generated by the Tararua Wind Farm was used to quantify relationships between water inflows and electricity generating potential at different sites throughout New Zealand. The models revealed a low positive correlation between wind and water inflows in major catchment areas (viz. Waitaki and Waikato catchments). This research is now being extended to examine the optimal location of wind farms and the impact of wind generated electricity on nodal prices.

Published results (Byrd et al. 2013) from a cross faculty research team involving Hugh Byrd (Architecture and Planning), Nirmal Nair (Engineering) and Basil Sharp (Economics) attracted widespread community interest and provided a platform for commercial involvement in future research. Auckland Council has expressed interest in the Centre using its LIDAR data to complete a comprehensive assessment of the solar potential in Auckland and the CEO of Vector has

indicated a potential project based on the roll-out of its solar products.

Industrial demand

A joint bid with the Faculty of Engineering's Light Metals Research Centre (LRMC) to MBIE to examine the technical and economic feasibility of using a shell heat exchanger to manage demand at the New Zealand Aluminium Smelter's (NZAS) plant at Tiwai was successful. The plant uses about 15 percent of New Zealand's electricity. Dynamic load management offers significant potential benefit to the company through avoiding high prices and to the economy by releasing electricity to the grid. NZAS will co-fund the \$1.9 million research project. Dr Poletti and Professor Sharp will lead the economic analysis. A PhD scholarship in energy economics is funded by the project.

Residential demand

The Centre completed its involvement in Genesis Energy's Tomorrow St project. Using data from the experiment we reported an average saving of 17 percent in electricity compared to the same period in 2011. Our results were presented to the public and the Genesis Board. The team at Genesis were very complimentary about the quality of analysis provided by the Centre and see the experience gained from the experiment providing a platform for rolling out other conservation products.

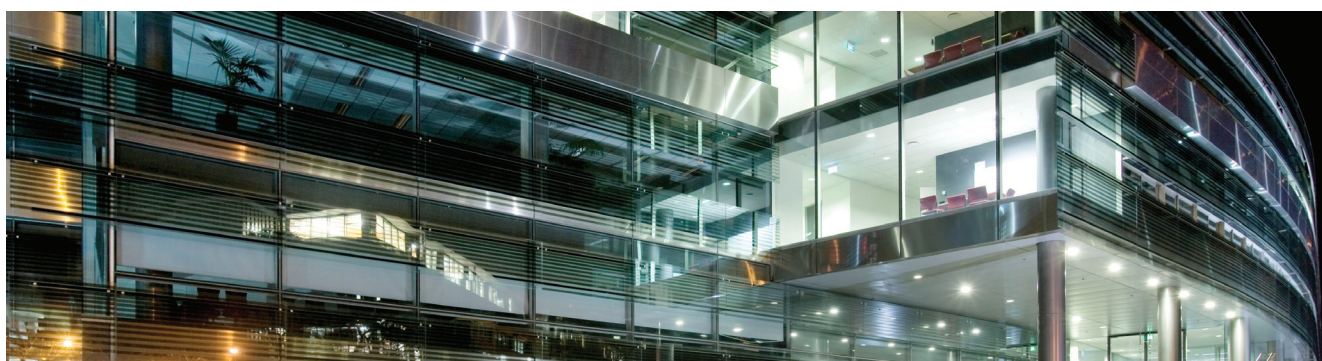
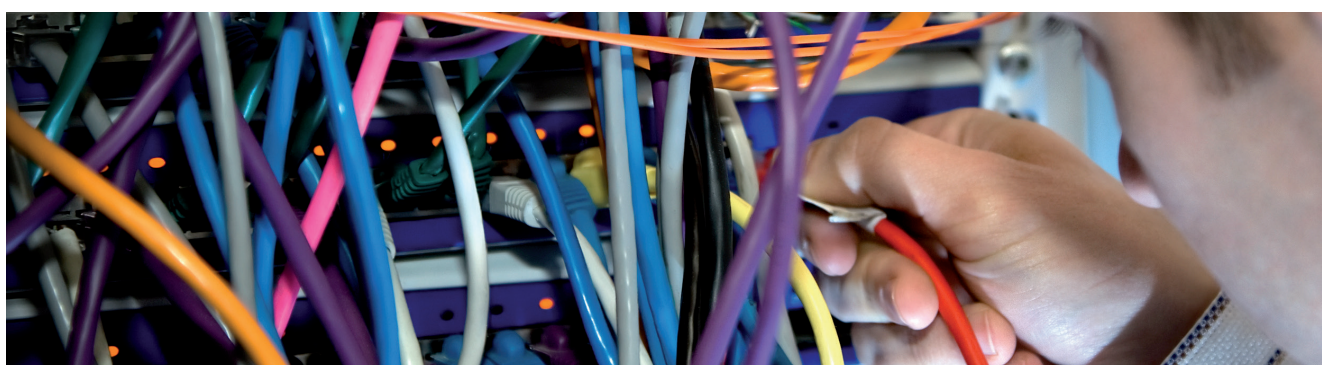
Oil and gas

Energy Matters was designed to capture the public's attention on the importance of this topic and provide a backdrop for our research in 2014. We have made contact with MBIE with the view to gaining access to energy and confidential financial data held by StatsNZ. If an agreement can be reached, we aim to undertake detailed econometric analysis of energy, including liquid fuels, in New Zealand's primary sectors.

PhD students

The following students are enrolled in doctoral research, supervised by faculty associated with the Centre:

- Mina Bahrami Gholami, Solar Electricity
- Milad Maralani, General Equilibrium Model with an electricity sector and a large industrial user (EETNZ, Scholar)
- Sina Mashinci, Renewable Sources of Electricity (EETNZ, Scholar)
- Masha Moshrefi, Energy Efficiency in OECD Countries and New Zealand (EETNZ, Scholar)
- Kai Tang, Low Carbon Economy, (CSC Scholar from China)
- Peter Wilson, Transitional Assistance in the Emissions Trading Scheme



Postgraduate research completions

Sam Malafeh, Sustainable Development of Geothermal Resources. Sam defended his thesis in November, revisions were completed in December and he graduated in May 2014.

Selena Sheng. Commuter's Journey to Work Travel Behaviour: A Spatial Econometric Analysis. Selena's submission is out for examination and results are not available.

Quiunan Liang. Estimating Electricity Consumption in New Zealand, BCom Hons Dissertation.

3. TEACHING

Apart from the decline in international students enrolled in the Master of Energy, interest in energy and resource economics continues to be high. Students enrolled in the following courses directly benefit from research at the Centre:

Econ 373 Environmental Economics: Coverage includes policy approaches to climate change, 60 enrolments in 2014.

Econ 372 Energy and Resource economics: Covers development and optimal utilisation natural resources and resource markets, 62 enrolments in 2014.

Energy 721 Resources: Economics, electricity and gas markets. Enrolments dropped off from last year's high of 45 to 26 in 2014; attributed largely to decline in international students.

Econ 783 Energy economics: Postgraduate course focusing on energy markets, 7 enrolments in 2014.

4. EXTENSION

Summer School

The Centre's week-long Summer School in Energy Economics ran from 24-28 February. More than 60 participants registered. Presentations of topical interest included:

- The Labour Party's single electricity buyer model arguments both for/against were canvassed
- Shale oil/gas development in Pennsylvania
- Māori participation in geothermal energy development. The programme appears in Appendix A.

Energy Matters 2013

Public interest in Energy Matters held up throughout the series; a testament to both interest and relevance. The Wellington presentations were extremely valuable; increasing stakeholder awareness of the Centre and contributing to discussions around energy policy, and in the case of Shell, community engagement. The benefits of Energy Matters are now becoming obvious as the following issues are now being raised by Government:

- Social Licence – importance of community engagement when proposing large scale development of oil and gas
- Sovereign Fund – possible use of resource royalties to create a fund for investing in projects that provide durable benefits for the community
- "Energy supply – geopolitics or geology?" 11 June 2013
Harvey Weake, Senior Vice President, Asia Pacific, Methanex Corporation, Managing Director, Methanex New Zealand Ltd
- "Existing paradox or new paradigm – fossil fuels and sustainability"
3 October 2013
Mike Bennetts, CEO, Z Energy, New Zealand



- “From the ‘seven sisters’ to the ‘six brothers’: Changing global oil markets and what it might mean for New Zealand” 28 October 2013
Professor Paul Stevens, Senior Research Fellow, Energy, Environment and Resources, Chatham House, UK
- “Resource Companies – transformation from isolated actor to regional development partner” 5 November 2013
Peter Bryant, CEO, Clarea Partners and Senior Fellow Kellogg Innovation Network

Presentations to stakeholders in Wellington:

Paul Alexander, Director Policy, Resources, Energy and Communications, MBIE

Melody Guy, Manager, Natural Resources, The Treasury

David Robinson, PEPANZ

Robert Jager, Chairman and Senior Management, Shell Companies in New Zealand

The British High Commissioner

Sophie Howard, MFAT, Middle East and Africa, Economics and Strategy

Energy Matters 2014

Building on last year’s success, Energy Matters 2014 will continue to focus on oil and gas development, bringing US experience with shale, and the Norwegian sovereign fund built up over the years from oil royalties.

February 2014

Professor Tom Murphy, Pennsylvania State University, an Extension Educator and Co-Director of the Penn State Marcellus Center for Outreach and Research.

July 2014

Dr Roland Williams has a chemical

engineering degree (Honours) and a doctorate of philosophy from the University of Birmingham. Former Chairman and CEO of Shell Australia and President of Shell Coal International; and Rio Tinto’s Chief Executive of Energy and non-executive Director of Origin.

November 2014

Willy Olsen is the former Senior Advisor to the President and CEO of Statoil. He joined Statoil in 1980 after 15 years in journalism.

Press releases and TV

- “Frank Duffield: Compelling reasons to search for untapped resources”

http://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=10895349

- “Farflung ‘Burbs’ future producers of energy for Auckland’s CBD”, press release based on the Byrd et al. (2013 paper). Basil Sharp was interviewed on TVNZ.
- “Using more natural gas will offset our carbon footprint”, Opinion, by Frank Duffield, *The Dominion Post*, 25 April 2014
- “Fracking: Is it good for New Zealand?” by Basil Sharp, www.ingenio-magazine.com

5. PUBLICATIONS AND PRESENTATIONS

Byrd, H., A. Ho, **B. Sharp** and N. Kumar-Nair. 2013. Measuring the solar potential of a city and its implications for energy policy, *Energy Policy*.

Croft, A., J. Boys, G. Covic, A. Downward. Benchmarking optimal utilisation of residential distributed generation with load control, ICRERA 2013 Madrid, Spain. October, 2013.

Khazaei, J., **G. Zakeri**, S. Oren, Market Clearing Mechanisms Under Demand Uncertainty, under review for *Operations Research* (submitted June 2013).

Khazaei, J., **G. Zakeri**, G. Pritchard, (accepted – to appear). The effects of stochastic market clearing on the cost of wind integration: a case of New Zealand electricity market, to appear in *Energy Systems*.

Khazaei, J., A. Downward, **G. Zakeri**, (accepted – to appear). Modelling counter-intuitive effects on cost and air pollution from intermittent generation, to appear in *Annals of Operations Research*.

Khazaei, J., **G. Zakeri**, S. and S. Oren. Market Clearing Mechanisms under Demand Uncertainty”, under review, *Operations Research*.

Khazaei, J., **G. Zakeri**, and G. Pritchard. The effects of stochastic market clearing on the cost of wind integration: a case of New Zealand electricity market”, under review, *Energy Systems*.

Poletti, S. International Energy Workshop, Paris. June 19–21, 2013. Presentation “Does Wind Kill Energy Only Markets”. Paper available on-line http://www.internationalenergyworkshop.org/docs/IEW%202013_1E4Poletti.pdf

Yang, M.M. and **B.M.H. Sharp**. Electricity Consumption Savings at Tomorrow Street, Report Prepared for Genesis Energy Ltd, November 2013, P52.

Suomalainen, Kiti, et al. Correlation analysis on wind and hydro resources with electricity demand and prices in New Zealand, submitted to *Applied Energy*.

Zakeri, G., D. Craigie, A. Philpott, and M. J. Todd Optimization of Demand Response Through Peak Shaving, *OR Letters*, Volume 42, issue 1, 2014, pp 97-101.



Presentations

Poletti, S. "Green Growth and Poverty Reduction in NZ", Sustainability Conference, Massey University, Albany Campus, presentation and panel discussion for session "Poverty and sustainability", 13-15 November 2013.

Sharp, Basil. Extractive Sector in the New Zealand Economy, presented to Talking Science, 4 December 2013.

Suomalainen, Kiti, et al. Wind power in New Zealand – Renewable energy resource dynamics in a hydro-based power system, poster presented at U21 Conference, Mexico City, December 2013.

Dr **Zakeri** was a keynote speaker at the CONICYT sponsored Energy Workshop held at the Energy Centre of the University of Chile, Santiago, where she presented three lectures on

- Demand side participation in electricity markets
- Strategies for integration of renewables into electricity markets
- Models for investment under renewable driven uncertainty

6. INTERNATIONAL COLLABORATIONS

The Energy Centre is a partner in the European Commission "Economic Modeling for Climate-Energy Policy" project. The project received funding (in excess of €800,000) to establish a network of 17 universities to undertake research focussed on renewable energy and policy. The consortium of researchers includes academics from a broad disciplinary base. Staff exchanges will enable reciprocal transfer of knowledge between members of the consortium including senior fellows, professors, early career academics and PhD students. The programme is funded for 48 months and will include exchanges to/from the EU with USA, Canada, New Zealand, Australia, Africa and Russia.

A total of seven work packages are involved. The Centre is contributing to two work packages: #1 *Coordination and Management* and #3 *Energy Resources*. Under *Energy Resources* we will contribute to work on: economic modelling of energy resources; energy-food-environment linkages; non-renewable energy markets; energy development and economic growth. Staff exchanges are planned with: Fondation Jean-Jacques Laffont, Toulouse Sciences, Economiques, France; University of Oxford, UK; Fondazione Eni Enrico, Italy; and the Univerzita Karlove v Prague, Czech Republic; over 2014-2015.

The Centre's network of collaboration increased with three additions.

- "Enhancing Renewable Energies and Strengthening Cooperation between New Zealand and Germany". Funded by the Federal Ministry of Education and Research and the NZ Royal Society (NZ\$13,000) and brings together the Energy Centre (the University of Auckland), the Centre for Sustainability (University of Otago), and two centres at the Technische Universität Dresden, Germany. Professor Sharp will visit Dresden in September 2014.
- Dr Kiti Suomalainen (EETNZ Postdoctoral Fellow) received a grant from the International Central Network Fund for support to develop strategic activities with network partners. The Early Career Researcher Workshop was held at the Tecnológico de Monterrey in Mexico in late 2013, and brought together postdoctoral researchers from across the U21 network to share knowledge and experiences on current projects which are at the cutting edge of research around the world.
- Co-operation project with the Centro de Energia, Universidad de Chile, and the Energy Centre. This continues the exchange of staff and students for research, publication, and run workshops.

Appendix D illustrates the network that has been developed. Exchanges will occur in 2014 and 15. We plan to consolidate the relationships with cooperative research and further explore opportunities in the Asian economies.

7. PLANS FOR 2014/2015

- Plans are in place to continue with the research themes, educational and extension activities mentioned above.
- Professor Sharp will be on research and study leave from June 2014 to June 2015. He will continue to lead the Centre and focus on:
 - advancing his research in renewable sources of electricity and role of oil and gas in the NZ economy
 - Developing collaborations with energy research centres in Asia



APPENDIX A

Summer School in Energy Economics, February 2014					
	Monday 24	Tuesday 25	Wednesday 26	Thursday 27	Friday 28
Room*	Case Room 4, OGGB	Case Room 5, OGGB	Case Room 3, OGGB	Case Room 3, OGGB	Case Room 2, OGGB
9-9.45am	Registration	Economics of Renewable Electricity	8.15am Field visit to Otara	Electricity Market Simulation Game (Tony Downward)	Geothermal Resource Development (Gina Rangi)
9.45-10.45am	Welcome & Introduction to Economics of Energy (Basil Sharp)	Introduction to Wind Energy (Kiti Suomalainen)			Industry Speaker on NZ Geothermal Geoff Smits-MRP
10.45-11am	Coffee break		Coffee break		
11-11.45am	World Oil Markets – Peak Oil (Steve Poletti)	Introduction to Solar Energy (Shay Brazier – Southern Perspectives)	Economics of Climate Change (Steve Poletti)	Energy & Environment (Frank Duffield)	Green Growth (Steve Poletti)
11.45am-12.30pm	World Gas Markets & Petroleum Policies (Bart van Campen)	Electricity market structure modelling (James Tipping Trust Power)		Green Growth (Rod Oram)	
12.30-1.30pm	Lunch – lvl 1 DeLucas	Lunch – lvl 1 DeLucas	Lunch – lvl 1 DeLucas	Lunch – 088	Lunch – 088
1.30-2.15pm	NZ Petroleum Markets (Dean Gilbert Chevron NZ)	Issues in Electricity market structure And models (James Tipping Trust Power)	Demand side management And smart metering (Nigel Williams Mercury)	Industry Speaker on NZ Emissions Trading Scheme (Lara Philips, Fonterra)	Group Presentations and Discussion with Industry Representatives Rob Kirkpatrick + COFFEE BREAK
2.15-2.30pm	Coffee break	Coffee break	Coffee break	Coffee break	
2.30-3.15pm	Land Use & Transport (Roger Dunn)	Single buyer electricity Model Geoff Bertram (University of Victoria)	Single buyer electricity Model Kieran Murray (Scapere)	Open Discussion on practical impact of low carbon policies (Rob Kirkpatrick)	
3.15-4pm		Preparation for field visit and Simulation Game (Tony Downward & Rob Kirkpatrick)	Introduction to Group Topics for Friday (Rob Kirkpatrick)	Shale oil/gas (Tom Murphy Pennsylvania State)	Drinks and nibbles with forum participants
			Drinks and nibbles with Energy PhDs and Energy Centre staff		

APPENDIX B

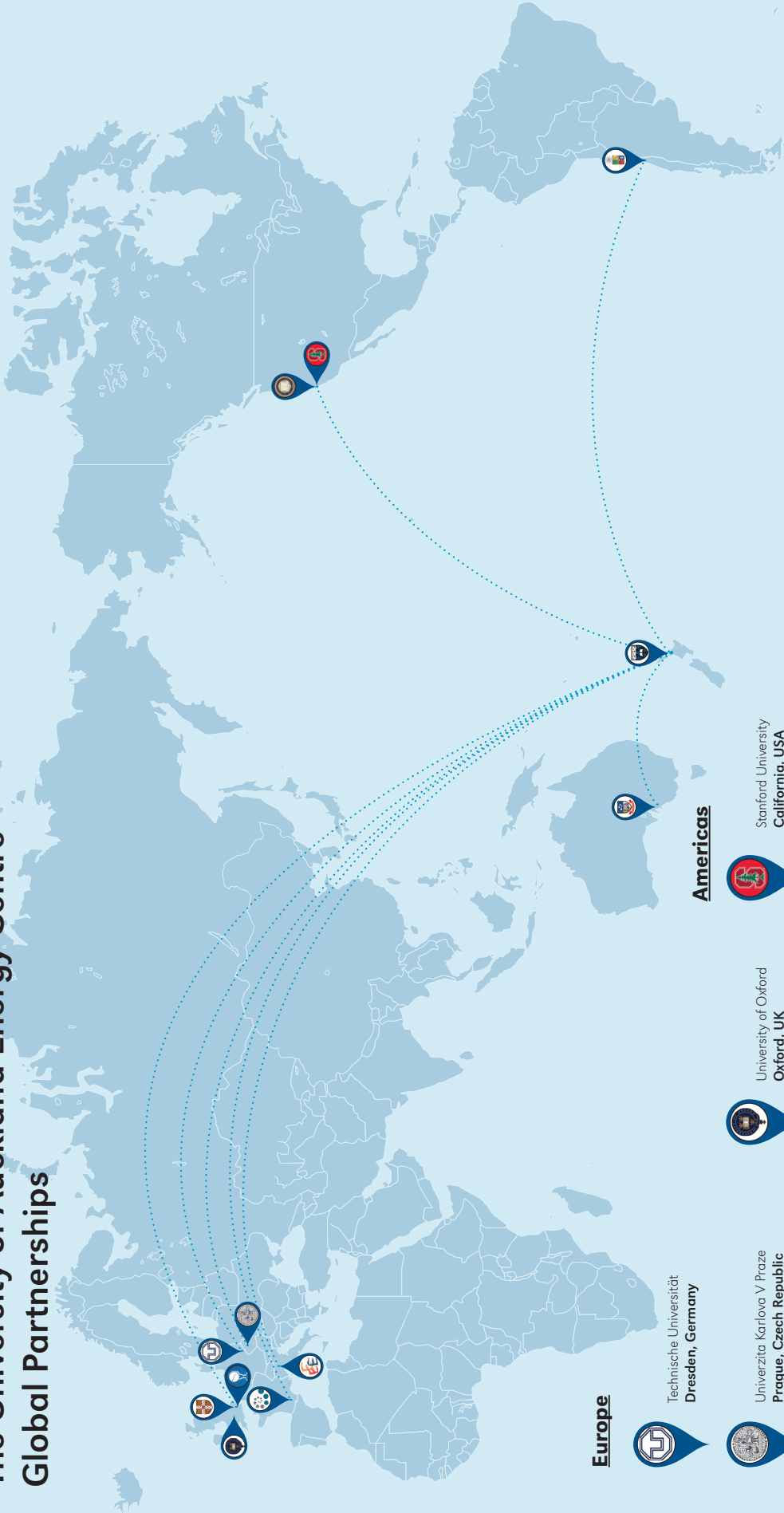
Energy Centre Programme

Critical Success Factors and Key Performance Indicators 2014

Programme	Critical Success Factors	KPI/Outputs
Research	<p>Applied research projects</p> <ol style="list-style-type: none"> 1. Programme focusing on oil and gas in NZ economy 2. Collaborative research with EU partners <p>External funding</p> <ol style="list-style-type: none"> 1. Continue to seek external research grants <p>Cross faculty engagement</p> <ol style="list-style-type: none"> 1. Faculties of engineering and science <p>Peer reviewed articles and reports</p> <p>Academic workshops</p> <p>Conference presentations</p> <p>Public forums</p>	<p>Project reports</p> <ol style="list-style-type: none"> 1. Factual account of oil and gas use in NZ 2. Developing New Zealand's oil and gas resources 3. Renewable energy: lessons from Europe <p>Funding</p> <ol style="list-style-type: none"> 1. Grant applications to MBIE, business and international sources <p>2 cross disciplinary projects</p> <ol style="list-style-type: none"> 1. Integrating wind into New Zealand's electricity market 2. Solar potential of Auckland City 3. Electricity savings at Tiwai Point smelter <p>2 papers in ranked journals</p> <p>2 workshops</p> <p>3 presentations, including 1 industry presentation</p> <p>2 public forums</p>
Education	<p>Courses in energy economics</p> <p>Summer School</p> <p>PG research completions</p> <p>Teaching into the Master of Energy programme</p>	<p>3 courses evaluated by participants</p> <p>At least 70 percent level of participant satisfaction</p> <p>2 honours completions and 1 PhD</p> <p>Enrolments in energy economics ENG 721</p>
Outreach	<p>International collaboration</p> <p>Public seminar series</p> <p>Herald opinion pieces</p> <p>Newsletter</p> <p>On line "contacts" data base</p>	<p>Participate in development of existing network</p> <ol style="list-style-type: none"> 1. Visit at least 2 network partners in 2014 2. Develop network in Asia <p>At least 4 presentations</p> <p>2 submissions</p> <p>4 newsletters</p> <p>Establish data base</p>
Administration	<p>Participation by Advisory Board in developing work programme</p> <p>Meeting with EETNZ</p>	<p>2 meetings</p> <p>4 meetings</p>



The University of Auckland Energy Centre Global Partnerships



Europe



Technische Universität
Dresden, Germany



Univerzita Karlova V Praze
Prague, Czech Republic



Fondation Jean-Jaques Laffont,
Toulouse Sciences Economiques (TSE)
Toulouse, France



Fondazione Eni Enrico Mattei (FEEM)
Milan, Italy



University of Oxford
Oxford, UK



University of Cambridge
Cambridge, UK



Chatham House
London, UK



Stanford University
California, USA



University of California • Berkeley • Davis
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Centro de Energia, Universidad de Chile
Santiago, Chile

Asia/Pacific



University of Auckland
Auckland, New Zealand



University of Adelaide
Adelaide, Australia

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