Energy and resources markets entered a challenging period in 2014. The world oil price halved, while iron ore and coal both experienced significant falls in prices, following gold and other metals to lows not seen since the global financial crisis (GFC) of 2008.

At UCL’s Australia campus, the changing conditions in resources markets posed new challenges and opportunities for the university’s first international department. We continued to grow enrolment numbers at the five-year-old campus, despite industry sectors which support the UCL School of Energy and Resources, Australia, dealing with their own commercial tightening.

In March we welcomed the Hon Martin Ferguson AM, the former Federal Minister for Resources and Energy, as the new chairman of the UCL Australia Board. Mr Ferguson retired at the September 2013 Election, after 17 years in Parliament.

The challenging market conditions opened up new research opportunities as our academic staff continued to develop projects around the six themes:

1. Adding value to resources
2. Shale and other unconventional gas
3. Environmental and resource monitoring
4. The low carbon economy
5. Community engagement and governance
6. Electricity markets, transmissions and renewables

Continuing UCL’s determination to provide real impact from its research, Profesor Stefaan Simons, the BHP Billiton Chair of Energy Policy, told February’s Australian Domestic Gas Outlook in Sydney, that the disparity of state regulations in Australia is one of the key causes of community concerns over unconventional gas development.

Dr Navinda de Silva attended the 2nd International Conference of the Research Centre for Energy Management in Greece in May, telling the conference that Australia should consider a 100% first-year depreciation of shale exploration and development costs, to stimulate unconventional gas jobs and activity, a policy later adopted by government.

On a more technical level, Dr Ady James presented, on behalf of colleagues, an ‘Assessment of existing satellite capacity for methane gas seep detection from orbit’ at the 14th Australian Space Research Conference, in Adelaide in September.

Meanwhile, Dr Craig Styan and Dr Laura Falkenberg produced a compelling article: ‘Too much data is never enough: a review of the mismatch between scales of water quality data collection and reporting from recent marine dredging programmes’ in Ecological Indicators, while Carmen Wouters, one of our PhD students, won a Distinguished Scholarly Award from the International Confederation of Energy Regulators for her paper, with Dr Katelijn Van Hende, entitled ‘The role of Microgrids within Future Regional Electricity Markets’ that will be presented at the World Forum of Energy Regulation (WFER) in Istanbul, Turkey, in May next year.

In December we graduated 32 students, the largest ever number in Australia, and farewelled Emeritus Professor Alan Robson AO, the former Vice Chancellor of the University of Western Australia, who retired as chairman of the UCL Australia Academic Board.

2014 brings challenges to energy and resources

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It was a busy year.

Finally, in addition to recognising the effort of staff, I add my thanks to the key industry supporters of UCL’s Australia campus, particularly major financial sponsors Santos, BHP Billiton and the South Australian Government, plus Beach Energy and Chevron.
Research goals

UCL has set itself the task of drawing on its full range of expertise to provide solutions to the world’s major problems. It is doing so by delivering a ‘culture of wisdom’, applying knowledge for the good of humanity arising out of a spirit of collaboration and openness. To deliver this culture of wisdom, UCL has defined overarching Grand Challenges as vehicles for cross-disciplinary research. These challenges are: Global Health, Sustainable Cities, Intercultural Interaction and Human Wellbeing.

UCL Australia, the university’s first overseas campus, delivers on this vision through multi-disciplinary research and teaching of energy and resources. Energy security and climate change are among the defining challenges of our time and are central to all four of the Grand Challenges themes. Hence, UCL Australia, through its three components - the International Energy Policy Institute (IEPI), the UCL School of Energy and Resources, Australia (SERAus) and the Mullard Space Science Laboratory (MSSL) aims to:

- Expand its distinctive brand of cross-disciplinary research through collaboration and partnerships, both within UCL and beyond;
- Provide leadership on issues related to the management and governance of energy and resources, both nationally and internationally;
- Engage with communities – local, regional, national and international – to foster open innovation and collaboration towards the transition to sustainable energy futures;
- Become a source of evidence-based policy solutions; and
- Communicate its findings widely through traditional and new forms of media.

UCL Australia applies a systems approach to natural resources research across sectors and disciplines (technology, natural and social sciences, economics, law) with particular focus on:

- Systems modeling (process optimisation, project organisation and management);
- Impact assessment (environment, society, economy);
- Decision support (governance, business models);
- Policy analysis and assessment (energy security, climate change, regional and national priorities); and
- Innovation opportunities and impacts (disruptive technologies, open and social innovation, incentives and barriers)

What follows is a review of the research conducted at UCL Australia over the past year. It reflects the broad spectrum of issues relating to energy and resources, from extraction through to renewables, and the range of expertise within the department. Where projects have been conducted within the IEPI, this is indicated against the names of staff involved. The research work of the student body is also included, with both PhD and MSc projects highlighted. The impressive list of publications, conference papers and other outputs emphasises just what a successful year of research 2014 has been.

Professor Stefaan Simons
Director of Research, UCL Australia
Director, International Energy Policy Institute

20 December 2014
Current research projects

How does environmental regulation impact innovation and competitiveness? A meta-analysis of the Porter Hypothesis

Prof Mark Cohen (Vanderbilt University) and Dr Adeline Tubb

Twenty years ago, Michael Porter and Claas van der Linde challenged conventional wisdom by suggesting well-designed environmental regulation could actually enhance competitiveness. Traditional economic orthodoxy at the time maintained environmental regulation imposed an additional cost on firms which necessarily eroded their global competitiveness. Porter and van der Linde showed, via case studies, that regulation may enhance firm competitiveness by generating ‘innovation offsets’ which not only improve economic performance, but which potentially offset the costs of compliance. By suggesting environmental regulation might generate a ‘win-win’ situation for both environmental sustainability and firm profitability, the so-called Porter hypothesis has generated intense research among policy makers and academics alike over the past 20 years. Despite this depth of research, however, there is little consensus on the extent to which (if at all) such environmental regulation might spur technological innovation and ultimately improve profitability.

To date, we have identified more than 100 potentially relevant empirical publications examining the relationship between environmental regulation, innovation, and competitiveness and are currently coding each publication to extract relevant quantitative and qualitative data. Statistical analysis of this data will shed light not only on direction and strength of the underlying relationship between environmental regulation and competitiveness, but also on the extent to which this relationship depends on factors such as the data and methodology used in the empirical analysis, the regulatory approach, the firm’s sector and market conditions, the environmental problem being addressed and the firm’s government and management approach.

Our findings are still preliminary; however, it appears that studies are more likely to find environmental regulation has a negative impact on competitiveness than a positive impact. Moreover, studies are more likely to find a negative relationship when the study is at the firm or facility level as opposed to a state or country level. In other words, while environmental regulation might hurt individual firms (presumably those that are older or less efficient), they are less likely to hurt entire economies.

Assessing the impacts of resources developments in the sea

Dr Laura Falkenberg and Dr Craig Styan

As an island nation dependent on trade in energy and resources, Australia is putting ever-increasing pressure on its coastal resources and needs to monitor and manage these carefully. As part of this project we are looking for better ways to monitor activities associated with offshore oil and gas development, desalination, ports and other coastal developments associated with resources extraction. One of our main areas of research is in developing cost-efficient, yet statistically powerful, monitoring programme designs, which take into account natural environmental variability and the logistical realities of monitoring offshore, yet provide the critical information needed by managers. So far we have produced two review papers on large scale water quality and coral monitoring programmes; along with statistical consultancy advice on monitoring to manage dredging impacts and the effectiveness of aerial surveys for whales potentially affected by LNG port developments.

We are also developing new experimental tools for monitoring and managing impacts, such as new (rapid) toxicological methods. We have submitted a review of (eco)toxicology approaches previously used in permitting desalination developments and refined a new, general protocol for assessing the toxicity of substances that might be released into the sea. This protocol is potentially adaptable for use across a wide range of marine plants and animals.

Also, the interaction between monitoring, policy and governance, which is critical for managing impacts, is an important area of future research. Along with assessing the potential roles of biodiversity offsetting policies in the sea and understanding the role of a ‘social licence to operate’ in both offshore and onshore resources developments.
Concerns and challenges have arisen from the governance of unconventional gas development and its impact and risks to existing land users. Our research is analysing the regulatory approaches that have emerged to improve the management of these risks. Based on case studies in two jurisdictions (New South Wales, Australia, and the Province of Alberta, Canada), the regulator’s approach to the development of new frameworks, intended to support a ‘more responsible’ development of resources, will be considered and critiqued. In particular, the research is investigating and providing insights into:

(a) stakeholder participation in regulatory and policy development; the nature of its integration into the proposed new regimes and the correlation between stakeholder participation in land–use planning and community acceptance of the industry; and

(b) collaborative governance models. Cross-sector partnerships have emerged in response to the complexity and interdependence of issues related to unconventional gas development. These will be investigated to provide insights into the context, governance structure, actors, objectives and benefits. The research is ongoing, outcomes will help assemble a framework of analysis to investigate the correlation between governance systems, the sustainable development of resources and acceptance by the community (social licence).

Managing risks and coexistence: A cross-jurisdictional perspective on effective governance models for the unconventional gas sector

Christine Trenorden and Dr Cristelle Maurin, IEPI

A series of projects are underway, analysing how legal frameworks and regulation across the energy and resources sector impact on the environment and the development of a low carbon economy. Ongoing projects include:

- Offshore wind energy and rational use of sea space: This research is considering how to develop legal frameworks which can more rationally manage available sea space, while respecting economic and environmental objectives. It looks at different management approaches towards managing sea space and resources, in particular in the EU, Australia and New Zealand.

- Electricity markets: This research is looking at different aspects of electricity market design, predominantly the liberalization agendas of Asia and Europe and moving towards regional electricity markets. This project is multidisciplinary, involving laws and electrical engineering perspectives.

- Offshore oil pollution: This project is researching liability for pollution from global offshore oil rigs and seeks to identify a trend in the development of international principles of civil liability for oil spills. It compares oil mature regimes in Australia, United States, Europe (UK/ Norway).

Energy and resources law and regulation

Dr Katelijn Van Hende
The cost of electricity networks has increased by more than 50% in Australia over the past decade and this trend is particularly acute in states where network assets remain publicly-owned (i.e. New South Wales and Queensland). The prospect of privatisation reforms opens the possibility to write-down some of these stranded assets which have lost their economic value due to a fall in electricity demand. This project explores the expected consequences of such a decision and the ways in which it could be implemented. In particular, an important argument refers to the extent to which this reform may reduce costs of capital, reflecting investors’ view that current assets’ valuation do not reflect economic realities. In addition, we also stress the need for this reform to be part of broader regulatory change covering regulatory processes and tariff structures.

Nuclear fuel cycle strategies
Dr Michel Berthelemy and Dr Tim Stone, IEPI

Although Australia remains the only OECD nation which does not produce or consume electricity generated from nuclear power plants, Australia remains an important producer of uranium fuel for international nuclear power generators. This project is considering international strategies to manage the nuclear fuel cycle with a particular focus on international options to improve nuclear waste management. One of these options could include nuclear fuel leasing, whereby a uranium-producer country, such as Australia, could lease its uranium and recover spent fuel material at the end of the nuclear fuel cycle. We argue that such a proposal could present economic benefits and improve non-proliferation regime but, clearly, would be difficult to implement due to current laws and political opposition. In a second stage, we are focussing on the UK situation which has to manage its legacy wastes while delivering an ambitious new-build program and regenerating its domestic industry. In order to do so, we argue that the UK needs a holistic approach for its nuclear fuel cycle in order to understand the links between these conflicting policy objectives. In particular, the UK needs to capitalise on existing nuclear R&D capabilities in order to contribute actively to future nuclear fuel cycle options through the international Gen IV forum.
HypFex: development of hyperfine hyperspectral imaging instrument
Dr Ady James and Dale Potts

MSSL is pioneering an effort to develop a prototype laboratory and field-deployable very high spectral resolution imaging instrument to detect and map methane (CH4) seeps, for potential future high altitude exploration. The proposed technology aims to separate CH4 isotopologues and hence determine if the methane is from biogenic (flora and fauna) or abiogenic (geological, resource production or fugitive emission) sources. This capability will enable resource exploration, the accurate monitoring of any fugitive emissions for industry and the monitoring of natural methane seeps from areas such as environmentally sensitive wetlands.

In the completed first phase a desk-top study has determined the optimum technology for the proposed instrument. This research was based on existing satellite systems performance, and extensive modelling of the radiative transfer functions over multiple wave bands. In future stages a prototype instrument will be developed in the laboratory and, finally, a field-deployable system will be developed and field tested.

Shale gas in Australia: The policy options
Dr Navinda De Silva and Prof Paul Stevens, IEPI

Australia is currently engaged in a significant debate over the future of its gas resources, their availability and how they may be best used to benefit the country. A key question in this debate is about shale gas and whether Australia can (or in fact wants to) have the sort of ‘shale gas revolution’ which has occurred in the United States in recent years. Petroleum companies are also engaged in the debate in terms of how gas developments may fit into their investment portfolios. If shale gas was to make a major contribution to Australian gas supplies what impact would this have on both export and domestic market prices and government policy setting levers?

The aim of this research is to try and identify if conditions in Australia will encourage the development of shale gas and if conditions are not suitable, what policy options may be available to governments at Federal and State level to rectify the situation, if desirable. This is being evaluated by considering the central aspects of petrophysics, geology, markets, economics, regulations and infrastructure. Outputs to date include a policy green paper, several invited lectures, MSc research projects and publications in journals and conference proceedings.
Australia faces ongoing negative public opinion about the governance of unconventional gas developments in the burgeoning on-shore gas industry. The rapid development of the industry has raised concerns about regulatory capacity to manage the risks, while inhibiting a constructive dialogue with the community on the role natural gas plays in Australia’s energy mix. This project investigates public concerns and the regulatory approaches to the development of unconventional gas reserves. Drawing on case studies in Australia and overseas, the research provides a comparative analysis of emerging governance models and regulatory standards aimed at ensuring safe and sustainable development of the on-shore gas industry.

A scoping study, in collaboration with the University of Queensland’s Sustainable Minerals Institute, is assessing the gaps, as perceived by stakeholders, in the regulation of unconventional gas in several jurisdictions in Australia, North America and the UK.

Governance of unconventional gas operations
Dr Cristelle Maurin and Christine Trenorden, IEPI

Renewable Energy Strategy, Upper Spencer Gulf
Dr Darien Simon, IEPI

The IEPI is collaborating with the Upper Spencer Gulf Common Purpose Group (comprising three regional cities, State and Commonwealth Governments) to develop a renewable energy strategy. The research is based on an assessment of infrastructure capacity and constraints, the existing renewable energy industry in the region, current demand, regional emissions, key strategic plans, international trends and local community preferences. The project has recommended focussing on developing a broader base of community understanding of the issues and options and creatively navigating through the issues raised by different policy goals at different governmental levels to overcome knowledge gaps, infrastructure capacity issues (current and future) and policy matters.

The Upper Spencer Gulf partners have recently been made aware of a significant commercial development opportunity which could impact the strategic direction of regional renewable energy development. Hence, the final report for this project has switched focus from developing a strategy direction to providing the foundation for discussion and negotiations about the potential development opportunity.
Though the requirement for immediate and sustained investment in climate change mitigation is well understood, the impact of population ageing on government environmental expenditure has been virtually ignored. In an attempt to address this gap, this research considered two distinct – though interrelated aspects - of population ageing: increased longevity and a rise in the proportion of individuals aged over 65 years. An implication of the overlapping generations model presented in this research is that heightened preferences for expenditure on environmental care, among the young, dominates older generation’s preferences for higher transfer payments and lower environmental expenditure. To test this theoretical result, I employ a panel data set containing observations on a diverse set of 47 countries. Empirical results provide clear support for the theoretical hypothesis that the proportion of individuals over the age of 65 negatively impacts public spending on the environment, though this effect is overwhelmed by the statistically significant positive effect on environmental expenditure of both longevity and the proportion of the population aged between 15 and 64 years.

This project utilised an OECD survey of more than 4000 manufacturing facilities to explore whether environmental R&D expenditure enhances facility profitability and whether the profitability enhancing effect of environmental R&D is attributable to green innovation. Key among the empirical results is that the proportion of R&D expenditure that a facility devotes to environmental R&D positively and significantly impacts facility profitability. Intriguingly however, this result is not driven by contemporaneous environmental innovation. Rather, it may be that by enhancing the green credentials of a facility, environmental R&D serves to elicit preferential treatment from key stakeholders.
In 2013, UCL Australia partnered with SA Power Networks to assess the impact of a smart meter capacity tariff trial in North Adelaide, South Australia. Trial group households were provided with a smart meter and real time monitoring device. The trial included an incentive payment to households if they could decrease peak time demand (3-9 PM) to a level based on a reduction to previous demand for each household.

The project acquired quarter hourly data from trial and control households which was analysed for changes from the previous summer (2011-2012). In addition to general assessment of the changes for peak and near-peak time periods, weather impacts on demand were also compared.

A final report was completed in December 2013 documenting some demand reductions in both trial and control group households. The data suggests the incentive did have an impact; however, the trial group size was quite small (43 households) with a very high level of variation across the households. There was no evidence of a general shift in demand from peak to near-peak times, though there were some households in which peak demand declined while near-peak demand increased.

Low Carbon Prospectus Project, Yorke and Mid North, South Australia

Dr Darien Simon, IEPI

In 2013, Regional Development Australia Yorke and Mid North and 11 local government councils partnered with UCL Australia to investigate what the region could do to attract investment in low carbon energy generation and other low carbon industries.

The study concluded in December 2014 after a comparison of development planning and other pertinent documents to identify land areas appropriate for commercial-scale low carbon development. A survey of regional residents assessed community preferences for both resource type and strategy for development. Solar was the most agreeable option. Wind farms were acceptable in some areas but not in others. The least acceptable option was nuclear.

Workshops were conducted to develop a low carbon vision for the future in which a desire to focus on local self-sufficiency and regional energy generation rather than commercial scale development reinforced similar comments from the survey.

Another survey of renewable energy and community development professionals revealed a high level of investment uncertainty specific to Australia expected to last 2-5 years. In combination, the results indicated some additional work was required within the region: improved education in renewable energy and climate change issues, building community capacity for strategy discussions and clarifying the development requirements for renewable energy generation.
The value of natural capital includes an economy’s stocks of energy, water, natural habitats and minerals. Australia’s natural capital base drives the nation’s economy and provides significant social and health benefits for the population. Despite the crucial role played by natural capital in determining economic and social prosperity, there are many unanswered questions surrounding the relationship between natural capital, economic competitiveness and productivity growth. For example, how does a country’s natural capital stock and the rate of resource extraction impact productivity growth? To what extent does the failure to include core inputs and outputs in market transactions contribute to the sub-optimal exploitation of an economy’s energy and resources base? This research will shed light on these, and other, outstanding questions.

Issues surrounding green technology diffusion from developed to developing countries have remained largely overlooked in the economic literature, where existing contributions do not explore the trade-offs between different policy mechanisms, and technological options and have been limited to mechanisms – such as the Clean Development Mechanism – that impact diffusion only indirectly. To address this significant gap in the literature, we aim to investigate three interrelated questions: (a) What are the impacts of command and control versus market based instruments on green innovation and technological diffusion?; (b) How does the choice of pollution control instruments impact the type of green technologies which are transferred?; and (c) How does green technology diffusion from developed to developing countries enable developing countries to engage in environmental technological innovation domestically?
This will investigate the conditions required to realise a sustainable energy system and emission planning, especially for holistic key load activities in South Australia. From the analysis and case modelling, it is expected that the discussions will be relevant to contemporary governmental policy and industrial strategic directions. The outcome of this research is expected to contribute to the wider strategy of sustainable development from energy and emissions planning perspective for South Australia.
Concerns about greenhouse gas emissions have drawn academic and industrial attention to high penetration renewable power systems as a more sustainable alternative. Given the abundance of wind and solar resources, development of transmission networks and placements of storage are crucial for high penetration renewable power systems.

My research focuses on the most economic combination of renewable technologies, storage devices and transmission infrastructure to meet the demand in the Australian National Electricity Market (NEM) regions. The research is also investigating the role of storage devices, transmission infrastructure and carbon policy in the future power systems.

The least cost combination of renewable generators, storage system and transmission system in an Australian Super Grid

Government and industry are rapidly adopting biodiversity offsetting approaches to account for the environmental impact of development and use of natural resources. Offsetting in the marine area presents challenges, as the knowledge of associated ecological systems is much more limited and uncertain when compared to terrestrial systems.

This research explores, firstly, the potential of offsets to represent an improvement to current environmental compensation approaches and whether they can contribute to the wide-ranging sustainability and conservation goals in the marine area. Secondly, it considers the social factors that influence marine governance and the management of competing economic, conservation and sustainability objectives.

Interdisciplinary optimisation of design, operation and regulation of residential microgrids

The focus of my research is the use of mathematical modelling to assess optimal design, operational and organisational parameters for residential microgrids.

The aim is to provide an interdisciplinary decision-making strategy to make recommendations for a conceptual regulatory framework aiding the widespread implementation of microgrids within future liberalised electricity markets.

Until now, a model was developed for optimal residential energy system design, minimising energy-related costs. This is extended to multiple-objectives to analyse the impact of different stakeholder preferences on chosen designs.

Biodiversity offsets and their potential in the marine environment

Until now, a model was developed for optimal residential energy system design, minimising energy-related costs. This is extended to multiple-objectives to analyse the impact of different stakeholder preferences on chosen designs.
Life cycle assessment of underground coal gasification

My research lies at the interface between environmental and social risk assessments and techno-economic analysis of gasification processes, particularly in relation to policy formation and the establishment of novel or emerging technologies such as underground coal gasification.

I have focused on looking at alternatives to the traditional combustion coal utilisation technologies. Underground coal gasification was identified among other clean coal technologies as one of the most promising, especially when combined with carbon capture and sequestration or enhanced oil recovery technologies to reduce environmental impact associated with coal utilisation and having a potential to become a bridging technology for sustainable energy future.

Synthesis of water purification processes

The primary goal of the project is the development of a methodology for selecting a technically, economically and environmentally superior system for the purification of any water source.

I am considering various inlet and outlet water qualities and the most common purification technologies to deliver a final product that meets regulatory standards.

The problem is formulated as a mathematical model and the aim is to test its applicability on a few case studies from surface water, tertiary wastewater or seawater projects. The results give the shortest purification pathway that will cost least throughout the plant lifetime at the lowest carbon footprint and waste disposal.

Using the Value of Lost Load (VOLL) dynamics to assess design scenarios for renewable energy integration

This research explores consumers’ valuation of electricity continuity in assessing technical and policy arrangements for renewable energy integration. The project is set in the context of the Philippines (a developing country) to determine how this demand-side valuation provides guidance on designing development plans for investment to achieve greater proportion of renewable energy technologies on the generation mix.

The aim is to elucidate the overlapping and conflicting concepts and theories about consumers’ valuation on power interruption and develop a methodological framework on how this valuation can be effectively integrated in the development planning.
Systematic best practice energy management for the mining industry: A case study for Olympic Dam (ODO) in South Australia

Energy is one of the most important cost drivers in a modern mining operation, typically accounting for 10-40% of the operations cost. My research applied a best practice methodology to evaluate the existing energy management systems (EnM), as well as analysis to determine the potential for improvement, at BHP Billiton’s Olympic Dam. The results showed EnM has the potential to deliver significant energy savings. Secondly, benchmark analysis shows that at ODO, measures of waste heat recovery, production energy optimization and renewable energy technologies present viable opportunities for energy improvement.

The economics of Residential Electricity Storage (RES) systems in Victoria, Australia

Residential electricity storage (RES) battery systems that complement solar PV are now being sold to grid connected consumers and many anticipate this technology could disrupt the electricity industry in the future. My research took a detailed modelling approach to analyse the economic viability of battery based RES for residential consumers today, and project the likely paybacks for such systems when investing over the next decade. Further analysis indicates how RES could impact the timing, volume and volatility of residential demand for grid delivered electricity.

Can You Measure a Social Licence to Operate? New multivariate approaches to analysis

Companies in the energy and resources sector often try to understand their social licence to operate by conducting community surveys. However the drivers of community acceptance are complex and interlinked and key insights are often missed using conventional univariate approaches. My research investigated the use of multivariate statistical techniques and the results used to generate a visual representation of the data that showed which impacts and attitudes were the most important drivers of community acceptance.
Third Party Access To Natural Gas Pipelines In Australia: Overcoming Barriers

Third party access (TPA) requires the owners of natural gas transmission networks to allow any producers to access these networks. By comparing Australian TPA frameworks, with the advanced regime in the EU, my research identified two major barriers hindering the functioning of TPA in Australia – vertical integration and the contract carriage model of pipeline capacity management. The experience of the EU in addressing the first barrier the form of unbundling rules is recommended to be a good example to consider.

Energy Transmission Expansion Planning in the Australian Context: an integrated solution for the gas and electricity markets

Australia is on the verge of an energy planning dilemma. Most of its electricity generation is from coal, resulting in enormous discharge of CO2. The country is confronted with the question ‘which future energy path must Australia follow’? Business as usual, where coal is the predominant fuel to generate electricity, or a shift into a low carbon economy? My research shows the power generation and transmission expansion planning of the electricity sector seeks an optimal answer to the following questions: when, what and where new generation and transmission assets will be built over a specific period of time.

An analysis of the relationship between Australian renewable energy policy, market forces and corporate finance; can the Large Scale Renewable Energy Target (LRET) be met under current market conditions?

Meeting Australia’s 41,000 gigawatt-hours (GWh) target for large-scale renewable electricity generation requires an almost threefold increase in existing onshore wind power capacity between now and 2020. My paper argues that current Australian environmental and energy policy objectives have been, and continue to be, eroded primarily by the fundamentals of supply and demand. A resulting inability to secure finance is also recognised showing Australian wind projects that secure finance, do so at a premium to other regions.

Evaluating South Australian Industry Practices with regard to the Environmental Risks of Hydraulic Fracturing in SA shale plays – in South Australia Case

To verify the effectiveness of the South Australian shale industry hydraulic fracturing mitigation practices, my research designed evaluation mechanisms, composite risk criteria and composite risk matrix. These mechanisms assess the severity of the residual environmental risks and differentiate the risks in terms of the level of risk severity. The results indicate that while the water contamination and GHG emission could not be mitigated into as low as reasonably practicable (ALARP) through current SA industry practices, the other environmental risks could be mitigated to acceptable levels.
A web site is one of the main channels for a company to communicate with its stakeholders. Communication is influenced by culture and so is web communication through a web site. Thus it has been presumed that countries classified into the same cultural context have the same communication method. It might have ignored possibilities of differences in web communication between the countries. This research presents the results of an investigation of 150 oil and gas corporate websites from three low-communication methods. Further, it contains a comparison between the results from low-context countries and a high-context country, South Korea, to figure out a difference of web communication from different cultures.

**Web Communications and Cultural Homogeneity in the Oil and Gas Industry**

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**Evaluation of Medium to Long-Term Shale Gas Production Costs in Australia**

Australia is catching up with shale gas development, as it embarks on a LNG export drive. However, the shale gas is still new and Australia has a long way to go before shale gas can be a major contributor to gas production. This project considers the financial viability of Australian shale gas development, from the well drilling and completion perspective as well as required investment of gas processing plant (GPP) and other infrastructure necessary to bring whatever shale gas to be produced, online. As expected, it was found that Australian shale gas is more expensive than the US, due to costs (capital, operational and fiscal). It also provides the investments required to bring the gas from extraction, process and distribution.

**A Study of Strategies and Options for Regional Low Carbon Investment - A Case of the Yorke Peninsula and Mid-North region**

Many countries and regions such as the UK, Australia and Korea have promoted the investment in low carbon industries and technologies to achieve low carbon development for economic, social and environmental benefits. My research investigated the optimal strategies and options towards low carbon development. I chose the Yorke Peninsula and Mid-North region of South Australia as a case study. My results identify job creation and cost reduction as the important economic drivers, with high costs and long payback period the key barriers. From a social point of view, drivers were growing public perception and personal understanding, while barriers were distrust of public information and regional opposition.
Australia is a major player in the international uranium market, holding 29% of the world’s reserves in its role as the third largest nuclear fuel supplier globally. Many developing nations within Australia’s immediate region have either begun, or signalled their intent, to produce nuclear energy, including China, India, Indonesia, Malaysia, Thailand and Vietnam. An Australian ‘Nuclear Fuel Leasing’ scheme is believed to have positive implications including enhanced non-proliferation and safeguard network as well as economic, political, ethical and environmental advantages. My research addresses a lack of literature related to NFL’s legal implementation. Given the breadth of regulatory issues touched by such a scheme. My research dissertation studies the long-term Asian LNG market development in the context of Australian LNG exports through identifying some key factors including supply, demand, supply price, supply cost and Asian importers’ strategies for LNG procurement. These factors are likely to reveal uncertainties and dynamics of the Asian LNG market in the future and to consequently affect Australian LNG exports over the next decades.
The key objective of this research project was to determine the role and assess the current state of policy framework for development and adoption of alternative technologies, in particular coal to liquids. Coal to liquids is a technology to produce synthetic liquid hydrocarbons derived from coal. From an environmental point of view, well to wheel production of synthetic diesel from coal is twice CO2 intensive as conventional diesel production. Without adequate carbon management system integration, my research found it strongly doubtful that coal to liquids will go global.

Completed two short research projects in MSc year two.

Hyperspectral remote sensing – a review of the current technology, its application in the detection and monitoring of methane gas, and an examination of factors and trends which may influence the design of future sensor

Building climate change resilience – an examination of resilience building in the broader context of urbanization and climate change, and an assessment of measures undertaken in Kuala Lumpur

Coal To Liquids Technology Development Prospective In South Australia: Policy Barriers And Drivers

The key objective of this research project was to determine the role and assess the current state of policy framework for development and adoption of alternative technologies, in particular coal to liquids. Coal to liquids is a technology to produce synthetic liquid hydrocarbons derived from coal. From an environmental point of view, well to wheel production of synthetic diesel from coal is twice CO2 intensive as conventional diesel production. Without adequate carbon management system integration, my research found it strongly doubtful that coal to liquids will go global.
Students at UCL Australia enjoy unprecedented access to industry, in the classroom, in research – and popularly – during two major field trips each year. In 2014, students visited Port Bonython (Santos), wind farms, solar, gas and coal-fired power stations, Olympic Dam (BHPB), the Whyalla steelworks (Arrium), water desalination and interconnectors (ElectraNet).
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<td>Prof Brian Collins (STeAAPP)</td>
<td>Corporate briefing to Babcock</td>
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<td>Adelaide SA</td>
<td>Systems Thinking and Interdependency – a joined up world</td>
<td>Prof Brian Collins (STeAAPP)</td>
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<tr>
<td>Adelaide SA</td>
<td>Energy and environmental public policy. Joining the dots between public policy, economics and implementation</td>
<td>Jim Voss, Honorary Reader</td>
<td>Grote Lecture</td>
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<td>March</td>
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<td>UCL-Ian Wark Research Institute (UniSA)</td>
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<tr>
<td>Adelaide SA</td>
<td>3 Minute Thesis (3MT) Competition</td>
<td>Prof Paul Stevens, Prof Stefaan Simons</td>
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<td>April</td>
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<td>Adelaide SA</td>
<td>Private boardroom lunch, with Martin Ferguson</td>
<td>Hon Martin Ferguson AM</td>
<td>Santos</td>
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<td>Adelaide SA</td>
<td>Uranium Fuel Leasing</td>
<td>Hon Martin Ferguson AM</td>
<td>Confidential</td>
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<td>June</td>
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<td>Adelaide SA</td>
<td>Mining 2030 roundtable: “What would a mine look like in 2030?”</td>
<td>Key thinkers from UCL</td>
<td>Private roundtable BHP Billiton-UCL</td>
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<td>Adelaide SA</td>
<td>Application of Oil Dispersants by Sub-surface Injection: Deepwater Horizon</td>
<td>Dr Kenneth Lee (CSIRO)</td>
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<td>August</td>
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<tr>
<td>Adelaide SA</td>
<td>Showcasing remote sensing and hyperspectral imaging capability of MSSL</td>
<td>MSSL (Dr Ady James)</td>
<td>Confidential briefing</td>
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<td>Adelaide SA</td>
<td>Arbitrating Complex Energy Disputes: Gas/LNG Production &amp; Export</td>
<td>Dr Alejandro Escobar</td>
<td>Grote Lecture</td>
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<td>International arbitration and dispute resolution</td>
<td>Dr Alejandro Escobar</td>
<td>Corporate lecture at Finlaysons</td>
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<tr>
<td>Adelaide SA</td>
<td>Evidence, Parliaments and making good policy decisions</td>
<td>Chris Tyler (Director of the Parliamentary Office of Science and Technology, and UCL)</td>
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<tr>
<td>Adelaide SA</td>
<td>Economic prosperity: the risks and opportunities of public infrastructure investment</td>
<td>UCL Dept of Science, Technology, Engineering and Public Policy delegation (Professor Brian Collins CB, Professor Arthur Petersen, Dr Michael Acuto)</td>
<td>CEDA panel</td>
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<td>Hon Martin Hamilton-Smith MP</td>
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<td>Sydney NSW</td>
<td>World Oil Prices</td>
<td>Prof Christof Rühl</td>
<td>CBA clients</td>
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<td>October</td>
<td>The global energy implications of the shale technology revolution</td>
<td>Prof Paul Stevens</td>
<td>Boardroom lunch - ABCC</td>
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<td>Canberra ACT</td>
<td>Global fuel security</td>
<td>Prof Paul Stevens and David Travers</td>
<td>Secretary of Defence</td>
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<tr>
<td>November</td>
<td>Transforming health</td>
<td>Prof Sir Malcolm Grant CBE</td>
<td>Government workshop</td>
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<tr>
<td>Melbourne VIC</td>
<td>How health can beat at the heart of an economy</td>
<td>Prof Sir Malcolm Grant CBE</td>
<td>Boardroom lunch with ABCC</td>
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<tr>
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<td>How health can beat at the heart of an economy</td>
<td>Prof Sir Malcolm Grant CBE</td>
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Conference Papers


Falkenberg, L.J., Papageorge...


Invited Presentations

James, A., “Greenhouse gas monitoring at the Mullard Space Science Laboratory (UCL, Australia)”. Roundtable for oil and gas projects, Adelaide, Australia, 23 October 2014.

James, A., “CubeSat instrumentation development for the QB50 project”. Workshop on utilising existing Australian space capability for future growth, Mt Stromlo Observatory, Canberra, Australia, 14 - 18 July 2014.


Reports


Interactions across UCL:

UCL (Australia) is an integral part of University College London. As such, it interacts with colleagues across UCL in a number of ways.

Co-supervision of PhD students

Nelson Enano Jr: Professor Brian Collins, STEaPP
Mariya Koleva: Professor Lazaros Papageorgiou, Department of Chemical Engineering
Holly Niner: Dr Peter Jones, Department of Geography
Sayara Saliyeva: Professor Paola Lettieri, Department of Chemical Engineering
Carmen Wouters: Professor Eric Fraga, Department of Chemical Engineering
Yunyang Wu: Dr Mark Barrett, UCL Energy Institute.

Lectures and seminars

Dr Mark Barrett presented a lecture, via video-conferencing, on the Energy Technologies Perspectives module in April 2013.

Collaboration on projects

In September 2014, a delegation of academic staff from STEaPP, led by the Head of Department, Professor Jason Blackstock, visited UCL Australia to discuss possible areas of collaboration.

In October and November 2014, UCL Australia staff engaged in Initial meetings with UCL London staff and students to discuss collaboration opportunities in community engagement and capacity building, citizen science, sustainability and low carbon energy generation especially as they relate to the UCL Grand Challenge of Resources and Sustainable Cities. London participants included Muki Haklay, Steve Pye, Raimund Bleischwitz, Michael Grubb, Michael Fell, Charlotte Johnson, and Joel Guilbaud. Additional discussions will be scheduled for mid-January 2015 to follow up and develop additional networking contacts.

The Principal Investigator for the HypFex project is Professor Jan-Peter Muller of the Mullard Space Science Laboratory. He has visited MSSL Australia on three occasions this year for discussions on the project and engagement with other stakeholders (CSIRO, DSTO, University of Adelaide, APA Flinders University, University of South Australia, Department of State Development (SA), Geoscience Australia).
University College London established the UCL International Energy Policy Institute (IEPI) in 2012, giving it a mission to consider global issues surrounding investment in power generation technologies, where liberalised power markets are operating under carbon constraints.

This focus includes the complex interactions and implications of technical, legal, financial and environmental effects on power generation. IEPI also examines the role of governments in energy technology investment and the positive and negative impacts on resource-rich nations – including the ‘resource curse’.

Value-adding to energy resources and assets, particularly global uranium production, the unconventional gas revolution and renewable energy are also focal points for the research programme – particularly the impact of policy setting on communities, the environment and energy transmission.

The IEPI was founded with major funding donations from Santos and BHP Billiton. It draws further funding from private and public programs, including a number of power and energy companies.

**Professor Stefaan Simons CEng FIChemE**

BHP Billiton Chair and Director
International Energy Policy Institute
Director of Research
UCL Australia
Founded in 1826 with a Global Reputation for Teaching and Research
Currently Ranked 5 in the QS World University Rankings Industry-specific education
29 Nobel Prize winners among former students and academics
Ranked No.1 university in the UK for research strength in the 2014 Research Excellence Framework
UCL’s founders and members of UCL’s first Council - Jeremy Bentham, Henry Brougham and George Grote - inspired the founding of colonies in South Australia

“University College London — An intellectual powerhouse with a world class reputation.
The Times, UK”

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CRICOS Provider Number: 03095G