



Otago Energy Research Centre Energy & Climate Change Symposium

12th Symposium 2018

Abstract Booklet



CONTENTS

Keynote bios (<i>Surname order</i>)	4
1. KEYNOTE: Energy and climate change – councils making the connection	6
2. Flaxroots’ energy innovation in New Zealand: A baseline study and research agenda.....	6
3 Energy Resilience in Nepal: Response and Future Directions for Nepal after the 2015 Earthquake and Blockade ...	7
4. Green economy developments in South Africa's Cape Floristic Region	7
5. Climate Safe Housing: action on adaptation	8
6. KEYNOTE : GWP*: An improvement in how we compare greenhouse gases	9
7. Energy, climate change, and sea ice: what are the linkages?.....	9
8. Climate-Adaptive Communities	9
9. KEYNOTE: "Saving energy in the smart home: Opportunities and challenges".....	10
10. Has there been a difference? Data from the student measurement of rental housing accommodation standards in Dunedin	10
11. Matching solar photovoltaic electricity generation to demand profiles	11
12. Low emission food system insights for NZ from a global farm tour and EROI review.....	11
13. Demand Response Potential on Irrigated Dairy Farms.....	12
14. Locally-resonant wave energy converter	13
15. Hydrogen production on MoS ₂ electrocatalysts: The effect of applied potential and catalyst support.....	13
16. Thermochemical materials for thermochemical heat storage systems	14
17. Waste minimisation and energy sustainability: The utilisation of spent coffee grounds.....	14
18. Techno-economic consideration of a scaled-up meat waste biorefinery system: a simulation study.....	15
19. Predicting Corporate Carbon Footprint for Climate Risk Analyses– A Machine Learning Approach	16
20. KEYNOTE: The challenge of a low carbon economy	16
21. KEYNOTE: 1.5C global warming: can we still get there? insights from the IPCC's recently published special report.....	17
22. Electric Vehicle Charging, NZ’s Next Hot Water Cylinder?	17
23. Demand-driven domestic battery sizing for load smoothing and peak shaving	18

24. Optimal Sizing of an Islanded Micro-grid Using Meta-Heuristic Optimization Algorithms Considering Demand-Side Management.....	19
25. The effects of LED light bulb installation on electricity demand in UK households: results of a large n randomised control trial.....	19
26. Estimating the Technical Potential for Residential Demand Response in New Zealand	20
27. A Cooperative Model for Renewable Energy Prosumer in Smart-Grids -- A pathway to be a City of 100% Renewable Energy	21
28. Smart Control Scenarios for Domestic Water Heaters in New Zealand	21
29. The Diversity Plug	22
30. KEYNOTE: Some of the Challenges for NZ’s Energy Sector: an Industrial/Sectoral Perspective.....	22
31. KEYNOTE: Achieving an environmentally-sustainable, high-value economy	23
33. “We have the power”: addressing the challenges of energy poverty and climate change through sound energy policy and law	23
34. Quantifying barriers to more effective private sector involvement in the transition to low carbon energy system	24
35. Adolescents’ Travel to School Patterns in Urban, Semi-Urban and Rural Settings: Insights from the BEATS Research Programme	25
36. Updating estimates of international transport greenhouse gas emissions for New Zealand	26
37. Adolescents’ Perceptions of the School Neighbourhood Environment in Small-to-Medium Urban Areas versus Rural Settlements	26
38. Nudged into the Car: How Cultural Settings Trap Us.....	27

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KEYNOTE BIOS (*SURNAME ORDER*)

John Clark

General Manager Operations and Innovation, Transpower



Manager Grid Development which he held from 2008. Previously John spent ten years in senior roles within Transpower's System Operator division. His earlier career in the New Zealand electricity sector has included roles in distribution and electrical engineering consulting. John holds a BE in Electrical Engineering.

Responsibilities include System operations: the real-time co-ordination of supply and demand for the New Zealand power system and other security-related functions.

Dave Cull

Mayor of Dunedin



Dave was born in Invercargill in 1950 and attended Southland Boys' High School before moving to Dunedin. He completed a BA in Political Science at the University of Otago and worked part-time as a teacher and in the building industry. Dave's focus in his second term as Mayor of Dunedin is on strengthening the community and the economic capacity of the city. He anticipates the DCC's suite of strategies, including those still in development, will enable the Council to optimise the wonderful assets the city has – from its parks and gardens to facilities such as the Forsyth Barr Stadium, Edgar Centre and the city's theatres, galleries and museums for the long-term benefit of the city.

Dave Frame

Director, New Zealand Climate Change Research Institute



Dave Frame has a background in physics, policy, and philosophy. He has many years' research experience in climate research, publishing in the world's leading scientific journals as well as the specialist climate literature. Dave also has real world policy experience in a core government policy agency, having worked in the New Zealand Treasury's Policy Coordination and Development group. Prior to joining the NZ CCRI as Director and Professor of Climate Change, Dave was Senior Research fellow at the Smith School of Enterprise and the Environment at the University of Oxford, where he was also Hugh price Fellow in Geography at Jesus College. Before these roles Dave worked as James Martin Fellow in the Environmental Change Institute, and in the Climate Dynamics Group in the Department of Physics as coordinator of the highly successful climateprediction.net project.

Brigid McArthur

Partner Greenwood Roche chair of the Energy Law Association Inc



Brigid McArthur, a Partner at Greenwood Roche, is a highly regarded senior corporate/commercial lawyer specialising in energy and resources and acts for New Zealand and international petroleum, minerals and coal entities, and some of New Zealand's largest industrial concerns.

Brigid is also chair of the Energy Law Association Inc (ELA) which is an incorporated society with members from across New Zealand's energy and resource sectors. Its objectives are to foster and promote interest, learning and debate around the legal and commercial issues affecting the wider energy and resources sectors.

With over 28 years' experience, Brigid also works closely with institutions in the tertiary education and scientific research sectors.

Hon David Parker

Minister for the Environment



Hon David Parker grew up and studied in Dunedin, graduating with a BCom/LLB from the University of Otago. He had a long career in business and law before being elected to Parliament as Labour Member of Parliament in the former electorate of Otago in 2002.

In his earlier years, David was a managing and litigation partner in South Island law firm Anderson Lloyd. He was also involved in many businesses, including innovative bio-tech export start-ups A2 Corporation, BLIS Technologies, Botryzen and Pharmazen, as well as in more traditional industries. He is an experienced CEO and company director.

David was appointed to Cabinet in 2005, and served as Minister of Energy, Climate Change, Transport, State Services, Attorney-General, and Land Information under Helen Clark's Government. In Opposition, he served as Deputy Leader, Shadow Attorney General, and in Finance, Economic Development and various other roles.

Yolande Strengers

Associate Professor, co-leader Beyond Behaviour Research Program, RMIT University



Yolande Strengers is a sociologist, Associate Professor in Sustainability and Urban Planning, and researcher at the Centre for Urban Research, RMIT University, where she co-leads the Beyond Behaviour Research Program. Yolande's research is clustered around a series of applied projects concerned with the emergence and role of new smart technologies in everyday life, and their energy, gender and sustainability implications.

Diana Ürge-Vorsatz

Vice Chair of Working Group III of the IPCC,

Director, Centre for Climate Change & Sustainable Energy Policy Central European University



Professor Diana Ürge-Vorsatz is Director at the Centre for Climate Change and Sustainable Energy Policy, Vice Chair of Working Group III of the Intergovernmental Panel on Climate Change (IPCC), member of Academia Europa and Professor and Director of Environmental Sciences and Policy at the Central European University. Her work focuses on integration of climate change mitigation and sustainable development objectives, energy efficient and sustainable buildings, and climate change mitigation in cities.

1. KEYNOTE: ENERGY AND CLIMATE CHANGE – COUNCILS MAKING THE CONNECTION

Author: Mayor Dave Cull

Authors Affiliations: Mayor of Dunedin

Climate change is a global issue. But it is at the local level where the impacts are most tangibly felt, and are being felt now. Dunedin is no exception – increased flooding events and rising sea levels are among the biggest challenges our city faces in the 21st century. The wide-ranging impacts of climate change are one of the key reasons why councils, including Dunedin City Council, are now taking a more proactive approach to planning for and mitigating against climate change. Transitioning to cleaner, smarter energy use is at the core of those mitigation efforts. In this presentation, Mayor of Dunedin Dave Cull outlines the city’s Energy Plan and how it aims to help reduce Dunedin’s climate change and environmental effects. As well environmental benefits, smarter energy use will improve our city’s economic, health and social outcomes.

2. FLAXROOTS’ ENERGY INNOVATION IN NEW ZEALAND: A BASELINE STUDY AND RESEARCH AGENDA

Author: Julie MacArthur^{1,2}, Anna Berka¹ and Claudia Gonnelli³

Authors Affiliations: ¹Energy Centre, University of Auckland ² Politics and International Relations, School of Social Sciences, University of Auckland ³ School of Environment, University of Auckland

International literature on civic and community energy has grown exponentially, but its role in meeting New Zealand’s decarbonisation goals remains understudied, reflecting the lack of data, the limited development and policy discourse around this energy subsector. This paper presents

the results of a newly compiled dataset, comparing and contrasting community energy in New Zealand to community energy definitions and typologies internationally. The analysis characterises the sector in relation to socio-political context, motivation, local embeddedness and functional energy activity. Our findings confirm a sizeable and unique local and community energy sector, dominated by consumer-owned trusts in electricity distribution and indigenous organisations in large-scale geothermal generation. We ask whether there is a role for civic energy in the implementation of New Zealand's climate and energy targets going forward, and explore whether and how such activities might address locally pertinent socio-economic and environmental needs.

3 ENERGY RESILIENCE IN NEPAL: RESPONSE AND FUTURE DIRECTIONS FOR NEPAL AFTER THE 2015 EARTHQUAKE AND BLOCKADE

Authors: Greg Underwood and Douglas Hill

Authors affiliations: Department of Geography, University of Otago

Resilience of energy systems within developing countries is not well considered in existing literature. This study seeks to inform this issue by investigating the response to the shocks which the energy systems of Nepal have faced recently. In April and May 2015 major earthquakes devastated parts of central Nepal, and from September of the same year until February 2016 a trade blockade greatly restricted the import of goods from India, including petroleum fuels. Drawing upon extensive fieldwork amongst a range of stakeholders, the study analyses the experiences of different actors in the sector during and after these two key events. This allows for an analysis of possible future energy scenarios for Nepal, which form along three distinct axes. These are the regionalisation versus nationalisation of energy systems, the use of fossil fuels versus renewable energy, and the centralisation versus non-centralisation of generation. This provides for two important sets of results, the first being the varied ability of government, private and community actors to demonstrate adaptive resilience in Nepal's energy systems following the earthquake and blockade, and the second being the implications for adaptive resilience of the possible future energy scenarios in Nepal.

4. GREEN ECONOMY DEVELOPMENTS IN SOUTH AFRICA'S CAPE FLORISTIC REGION

*Author: Daniel Basubas, Tony Binns, Etienne Nel and David Bek**

*Author affiliations: Department of Geography, University of Otago (*Centre for Business in Society, Coventry University)*

The threat of food, fuel and financial crises has increased global pressure on governments to transition from a 'business as usual' economy to a green economy that strives to curtail greenhouse gas emissions, reduce inequality and alleviate poverty. It is essential that this transition is inclusive of marginalized communities if a more socially equitable society is to be achieved. This research takes place in South

Africa, which has faced serious developmental challenges since the end of apartheid. South Africa has an advanced but small economy that does not incorporate or provide for all its citizens, with the black majority remaining the most marginalized group. National and local governments, international agencies, and local organizations have all demonstrated strong commitments towards achieving a green economy transition, however these efforts often do not translate to positive achievements on the ground. Much of the green economy research in South Africa to date has focused on quantitative measures (e.g. number of jobs created, improving resource efficiency, reducing waste and pollution) rather than qualitative measures that can provide insight as to how institutions and organizations engage with the green economy. This research examines South Africa's current green economy development approaches in the Cape Floristic Region, an ecologically significant area in the Western Cape province. The findings of this research can help provide a greater understanding of how national legislation and strategic frameworks for the green economy work on the ground in a developing country with extreme inequalities and the outcomes, both positive and negative.

5. CLIMATE SAFE HOUSING: ACTION ON ADAPTATION

Authors: Scott Willis, Martin Kean and Camilla Cox

Authors affiliations: Blueskin Resilient Communities Trust, Otago Polytechnic

The tension between long term adaptive planning and immediate need as the climate changes is acute. As a response to community feedback through adaptation workshops, and in response to direct community need we have been seeking partners to collaborate on Climate Safe Housing, one of the most critical needs that emerged from public meetings and from the community. The Climate Safe House project is our flax-roots community project, managed by BRCT to develop housing in areas vulnerable to climate impacts. The project is about making changes to prepare for managed retreat. Right now we are working with a vulnerable homeowner who is prepared to give up equity in the existing home in return for a warm, safe, efficient transportable eco-home with a low rental. We will transfer private risk to a collective solution of Climate Safe Housing. The Climate Safe House project aims to develop housing for coastal areas vulnerable to climate change and aims to implement adaptation planning in practice while presenting combined climate and housing solutions. We acknowledge the expectation both in the community and at local government level that 'others will pay for this', however we also believe that short term investment decisions must be made to avoid the growth of climate ghettos, as long as options for the future remain open.

6. KEYNOTE : GWP*: AN IMPROVEMENT IN HOW WE COMPARE GREENHOUSE GASES

Authors: Dave Frame

Authors affiliations: Professor of Climate Change, Victoria University of Wellington

Recent research has given us a more accurate way of comparing of how long-lived and short-lived greenhouse gases contribute to global warming. Potentially, this gives us a better way of comparing gases in the context of global temperature targets, such as those articulated in the Paris Agreement. The lecture will summarise the research findings and explore related policy issues, including possible interpretations of "net zero" targets.

7. ENERGY, CLIMATE CHANGE, AND SEA ICE: WHAT ARE THE LINKAGES?

Authors: Inga Smith and Shona Mackie

Authors affiliations: Department of Physics, University of Otago

In winter, Antarctic sea ice is a closer neighbour to New Zealand than Tasmania. Changes in Antarctic sea ice can alter weather patterns over New Zealand, resulting in rainfall and temperature changes. Globally, Antarctic sea ice affects the global climate through its influence on the albedo (reflectivity) of the ocean, deep ocean transport, and surface exchanges. Energy use, through burning of fossil fuels and resulting greenhouse gas emissions, leads to changes in sea ice. We have been using the state-of-the-art Earth System Model HadGEM3-GC3.1 as part of the New Zealand Earth System Model activities, funding through a Deep South National Science Challenge funded project. The model is a fully coupled physical model that includes the atmosphere, land, ocean, and sea ice. Specifically, we have been looking at the influence of freshwater from icebergs and ice shelf basal melt on Antarctica sea ice. Like all modern Earth System Models, the model has a warm bias in the Southern Hemisphere, so our research aims to improve the model.

8. CLIMATE-ADAPTIVE COMMUNITIES

Authors: Janet Stephenson

Authors affiliations: Centre for Sustainability, University of Otago

In coming decades, many New Zealand families and businesses will be exposed to climate change impacts such as flooding and coastal erosion. Some will be resilient but others may be adversely affected physically, socially, financially and/or emotionally. To ensure successful adaptation in

the face of climate change, local authorities need new tools and ways of engaging with affected communities, and to support adaptation initiatives by iwi and communities.

The Climate-Adaptive Communities research programme of the Deep South National Science Challenge is undertaking research on how councils, iwi and communities are responding to the challenges of a climate-impacted future. This includes both how they are responding to climate-exacerbated events, and how they are planning for the future. The research has included a survey of councils, and case studies in Dunedin and Lower Hutt. This presentation will report on high-level findings from across the research programme, including how councils are seeing their changing roles and responsibilities in relation to their communities, and how communities and iwi are starting to develop their own responses.

9. KEYNOTE: "SAVING ENERGY IN THE SMART HOME: OPPORTUNITIES AND CHALLENGES"

Authors: Yolande Strengers

Authors affiliations: Associate Professor & co-leader Beyond Behaviour Research Program, RMIT University, Australia

Smart home technologies are intended to improve energy reduction and load shifting outcomes through better control, automation, algorithms and efficiency of household appliances and devices. However, these potential demand reduction benefits sit within a broader lifestyle vision for the smart home that promises enhanced 'comfort, romance and peace-of-mind'. In this talk, Strengers examines these competing and complementary visions for the smart home, showing how promoted lifestyle expectations, embodied in new smart devices and functionalities, can increase energy demand. Drawing on findings from several ethnographic research projects with Australian households conducted over the last 3 years, Strengers presents a series of challenges and opportunities for the smart home and its intended role as an instrument of energy demand management and climate change mitigation strategies.

10. HAS THERE BEEN A DIFFERENCE? DATA FROM THE STUDENT MEASUREMENT OF RENTAL HOUSING ACCOMMODATION STANDARDS IN DUNEDIN

Authors: Sara Walton

Authors affiliations: University of Otago

Challenging students to think about how change (for sustainability) can occur in organisations is an important part of teaching sustainability in a business school. MANT337 Organisations and Sustainability is a 300 level paper run at the Otago Business School attracting about 60-70

students per year. For the past four years an assignment called “Make a Difference” has been run that involves students considering how they could change their rental accommodation for the better. Using eco-innovation as a conceptual framework, students were required to consider market-based mechanisms for change, regulation to bring about change and examine their behaviour through the Energy Cultures Framework. This presentation will examine the data from the past four years and respond to the question – are we getting any improvement in rental housing standards in North Dunedin?

11. MATCHING SOLAR PHOTOVOLTAIC ELECTRICITY GENERATION TO DEMAND PROFILES

Authors: Tupuivao Vaiaso and Michael Jack

Author Affiliations: 1Department of Physics, University of Otago

A drawback for integrating renewable electricity technologies into existing energy systems is the temporal mismatch between non-dispatchable supply from these sources and variable demand. This means that electricity is often supplied when it is not in demand reducing its economic value and limiting technology uptake. There is, therefore, a need to find ways to better match supply with demand.

Rooftop solar photovoltaic (PV) installations, which have grown rapidly in the last few decades due to government subsidies and large reductions in the capital cost of PV panels, are good examples of this.

As subsidies are reduced, or in countries where they never existed, such as New Zealand, there is a need to improve self-consumption of generated electricity to improve economic viability. We explore two aspects of this in the New Zealand context.

First, we explore the self-consumption and economics of rooftop PV for a range of sites with different demand profiles, including a school and 17 households. This work shows that these demand profiles give rise to a wide range of self-consumption percentages and economic returns. A school profile in particular, has a high percentage of self-consumption due to its demand profile coinciding with solar availability. Second we explore the potential for different tilts and orientations of PV panels to improve self-consumption and economic returns. This work shows that, while self-consumption can be improved slightly by different orientations, the economics are dominated by total yearly production.

12. LOW EMISSION FOOD SYSTEM INSIGHTS FOR NZ FROM A GLOBAL FARM TOUR AND EROI REVIEW

Authors: Solis Norton

Author Affiliations : Nuffield International

New Zealand's proposed zero carbon bill is a bold step toward a society more in balance with the biophysical constraints of our planet. The pathway to its achievement is described in the New Zealand Productivity Commission's 'Low emissions economy final report' (2018).

Our primary food production systems (mainly agriculture and horticulture) contribute substantially to our prosperity, culture and social fabric. They will also play a role in global efforts to feed a projected nine billion people in 2050. The impact of this bill on them is critical.

Over the last year the author in undertaking a Nuffield International Farming Scholarship has made a global tour of primary food systems. From the Netherlands to the USA, Ukraine, Kenya, South Africa, Italy, UK, Ireland, Czech Republic and involving numerous meetings with farmers plus top level industry, banking, NGO, political and farming organisation representatives.

The full spectrum from local subsistence to regional specialty production, to mega-dairies, autonomous and robotically assisted farming, and a raft of other food systems were assessed.

Concurrently a review has been made of the latest research in the field of energy return on investment (EROI) and a presentation on food system assessment made to the International Society of Biophysical Economics.

13. DEMAND RESPONSE POTENTIAL ON IRRIGATED DAIRY FARMS

Authors: Jefferson Dew

Author Affiliations: Centre for Sustainability, University of Otago, Science for Technological Innovation.

Electricity demand flexibility is an important component of a renewable and sustainable electricity system. As New Zealand strives to increase the use of renewable energy, consumers can play a part in shifting consumption patterns to match the available renewable generation. Dairy farms have unique potential as flexible electricity consumers. Being located in remote areas and having relatively large electricity consumption means the value of shifting demand is increased. By smoothing demand across the day, upgrades to long rural distribution networks can be avoided, providing cost savings to all consumers. This paper utilises smart meter data to assess the technical potential for demand shifting on timescales between 30 minutes to 48 hours. The modelled scenarios show a reduced peak demand and lower costs under a variety of electricity pricing regimes.

14. LOCALLY-RESONANT WAVE ENERGY CONVERTER

Authors: Fabien Montiel

Authors affiliations: University of Otago

We propose a new concept of wave energy converter (WEC), consisting of a hollow rigid cylinder extending throughout the ocean water column, and which is partially split along its vertical dimension. The small opening between the interior and exterior fluid domains allows for resonances to be excited in the cavity. Such a resonance behaviour is known as the Helmholtz resonance in Acoustics. We formulate a linear wave scattering problem to describe the response of the device to an arbitrary incident wave field. The idealised circular geometry of the device allows us to devise a semi-analytical solution technique for the scattering problem, based on the integral equation/Galerkin method. We perform efficient computations of the performance of the device for a large range of incident wave conditions and cylinder geometries. As predicted, a large resonance is excited in the cavity of the WEC for wavelengths one order of magnitude larger than the cylinder radius.

15. HYDROGEN PRODUCTION ON MOS₂ ELECTROCATALYSTS: THE EFFECT OF APPLIED POTENTIAL AND CATALYST SUPPORT

*Authors: Charlie Ruffman, Calum Gordon, *Egill Skulason and Anna Garden*

*Authors affiliations: Department of Chemistry, University of Otago, *Science Institute, University of Iceland.*

One solution to reduce fossil fuel consumption over the next 50 years is a shift towards a hydrogen economy where H₂ is used to store, transport, and release energy. To realise this shift, it must first be possible to produce H₂ via the electrocatalytic splitting of water. One of the half-cell reactions in this process is the hydrogen evolution reaction (HER).

The most efficient catalyst for the HER is Pt, however it is scarce and therefore undesirably expensive on an industrial scale. As a result, there has been significant interest in designing alternative catalysts from abundant and inexpensive materials.¹ Nanoscale MoS₂ catalysts are one promising option, as they are cheaply synthesised and have shown high catalytic activity towards H₂ production.² The mechanism for the HER on MoS₂ is not yet fully understood, and the novel catalyst must be optimised to perform as well as Pt.³

This presentation will explore results from first-principles calculations examining the Tafel and Heyrovsky mechanisms of hydrogen evolution on MoS₂. Specifically, I will focus on how the mechanism and rate of hydrogen evolution are affected by the applied potential and the use of different catalyst supports (e.g. gold and graphene). The results allow a more comprehensive understanding of the HER on MoS₂, and contribute to the optimisation of this key reaction for sustainable energy.

16. THERMOCHEMICAL MATERIALS FOR THERMOCHEMICAL HEAT STORAGE SYSTEMS

Authors: Cem Akcaoglu^{1,2}, Zhifa Sun¹ and Stephen Moratti²

Authors affiliations: ¹Department of Physics, ²Department of Chemistry, University of Otago

Thermochemical storage materials have the potential of reducing residential energy consumption for space heating and humidity control on an environment friendly basis. Given possible human interaction with the storage materials in terms of breathing or skin contact, it is important to utilize non-toxic and harmless materials. Apart from health considerations, proposed thermochemical materials must also have good heat and mass transfer rates, reaction kinetics, as well as an affordable price. Small size pellets (12 mm diameter, 5 mm thickness) were prepared by compressing expanded natural graphite, activated carbon, strontium bromide and magnesium sulfate at different mixing ratios under an applied pressure of 770 N/mm². Pellets were thermally characterized using thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) techniques. In order to further increase structural stability over the hydration and dehydration cyclic tests, the diameter and thickness of the pellets have been increased from 13 mm to 25 mm and from 2.5 mm to 25 mm respectively, and the applied compression pressure has been increased to between 1.30 kN/mm² and 5.20 kN/mm². The new pellets have been characterized using TGA and DSC and their permeability and thermal conductivity, and simulated theoretically. With the new pellets, structural stability is enhanced without a major change in the hydration and dehydration characteristics.

17. WASTE MINIMISATION AND ENERGY SUSTAINABILITY: THE UTILISATION OF SPENT COFFEE GROUNDS.

Authors: Alan Hayman

Authors affiliations: Chemistry Department, University of Otago

Our goal is to efficiently produce fuel pellets/briquettes from spent coffee grounds (SCGs). The utilisation of SCGs and waste cooking oil provides the primary feed-stock to produce a solid fuel with a calorific performance similar to a wood/coal mix. International studies have shown that coffee waste can be converted to solid fuels that have a higher calorific content than the equivalent wood products. Typically this requires extensive processing, thus we aim to develop a simple streamlined process that is more practicable, energy efficient and cost effective. SCGs have been collected and dried to produce feed material of varying moisture content. Waste cooking oil has also been collected. Numerous blends have been prepared in order to determine the optimal composition of feed material ie SCG moisture content, and the optimal mix of SCGs and cooking oil. This optimisation is imperative not only for the calorific properties but also the physical characteristics of the fuel. Key physical attributes include; the efficacy of the mechanical

processing ie compaction into a pellet or briquette, the density, and the hardness/brittleness of the solid fuel produced.

The calorific performance of these fuels is initially being evaluated in a modified domestic wood pellet burner. Unfortunately, due to the likely adoption of more stringent emission standards (that mirror EU regulations) for wood pellet burners, these fuels would probably be non-compliant due to their relatively high protein content. However, this can be mitigated through the incorporation of dried sawdust/woodchips with the coffee waste.

18. TECHNO-ECONOMIC CONSIDERATION OF A SCALED-UP MEAT WASTE BIOREFINERY SYSTEM: A SIMULATION STUDY

Author: Oseweuba Okoro¹, Zhifa Sun¹, John Birch² and Stephen Moratti³

Author affiliation: ¹Department of Physics, ²Department of Food Science, ³Department of Chemistry, University of Otago.

While exports from the meat industry in New Zealand constitute a valuable source of foreign exchange, the meat industry is also responsible for the generation of large masses of waste streams. These meat processing waste streams are largely biologically unstable and are capable of leading to unfavorable environmental outcomes if not properly managed. To enable the effective management and utilization of meat processing waste via value recovery, a scaled-up biorefinery system that facilitates the complete valorization of the meat processing waste biomass is proposed. For the first time therefore, a meat waste biorefinery configuration that integrates biomass conversion technologies of hydrolysis, esterification, anaerobic digestion and hydrothermal liquefaction was modelled, and optimized for improved environmental performance and economic performance. This study showed that when the mass feed rate of the waste processed by the biorefinery was increased beyond an optimal value, there was a deterioration of the environmental performance of the biorefinery system although economies of scale ensured that there was a sustained improvement in the economic performance of the biorefinery system. It was also demonstrated that for the different scenarios considered, the optimized meat waste biorefinery system facilitated a reduction in the unit production costs of target value-added products of biodiesel, biochar and biocrude compared the literature-obtained unit production costs of the respective abovementioned products. The unit production cost of biogas was however shown to be similar to the literature-obtained unit production cost of biogas. Finally, it was established that the optimized meat processing waste biorefinery could achieve enhanced economic performance while simultaneously maintaining environmental sustainability.

19. PREDICTING CORPORATE CARBON FOOTPRINT FOR CLIMATE RISK ANALYSES– A MACHINE LEARNING APPROACH

Authors: Quyen Nguyen

Authors Affiliations: University of Otago

While there is increased interest among investors about climate change, the existing reporting of corporate carbon emissions and climate transition risks is limited to voluntary disclosures or mandatory reporting by heavy carbon emitting plants. Thus, in assessing the relationship between carbon footprint and financial performance, the existing literature is either limited to studying disclosing firms only or utilizing carbon prediction models. The latter emission modeling approach is at an early stage, relying on simple mean calculations or ordinary least squares regressions with restricted sample and limited predictive ability. By way of contrast, this paper explores the application of standard machine learning algorithms and stacking generalization to predict corporate carbon emission (Scope 1 + Scope 2). Our proposed model, a meta linear learner that combines prediction from eight base learners (ordinary least squares, ridge, LASSO, elastic net, multilayer perceptron neural net, K nearest neighbours, random forest, extreme gradient boosting), generates considerably more accurate and stable prediction than existing statistical models on both log-transformed aggregate emission and isolated emission scopes. Its superior performance is proven via a set of out-of-sample validation scores (adjusted R2, mean absolute error, median absolute error, mean absolute percentage error, percentage of prediction within acceptance error range) and robustness tests (test of decile ranking, test of mean difference, test of bias). The high prediction error on untransformed emission, however, indicates that while explaining corporate carbon footprint with externally available data is possible, internal data is necessary to achieve better prediction accuracy.

20. KEYNOTE: THE CHALLENGE OF A LOW CARBON ECONOMY

Authors: John Clarke

Authors affiliations: General Manager Operations and Innovation, Transpower

New Zealand faces a unique challenge. Where many other countries are increasing their reliance on renewable electricity sources to meet climate change goals, our electricity supply is already 85% renewable. Among our other options, reducing emissions from agriculture will not be an easy task while we are still heavily dependent on imported carbon-based fuels for transport and industry.

Transpower's white paper, Te Mauri Hiko, draws on a range of future electricity supply and demand scenarios to identify how New Zealand can address the challenge of moving to a low carbon economy by 2050. These scenarios account for differing climate impacts as well as economic, societal and geopolitical factors that are likely to shape the future.

In Transpower's base case, our climate change goals are met through significant electrification in transport and industry by 2050. This results in the demand for electricity doubling while the need for energy in the economy reduces overall.

New Zealand has the options and resources available to deliver this future. However, in making this transformation a reality, we must address several important issues. They include factors such as reliability, affordability and sustainability to make sure expectations are met.

The Keynote will discuss these challenges including enabling investment, the role of distributed energy resources and how to address the electricity supply impact of dry winters.

21. KEYNOTE: 1.5C GLOBAL WARMING: CAN WE STILL GET THERE? INSIGHTS FROM THE IPCC'S RECENTLY PUBLISHED SPECIAL REPORT

Authors: Diana Ürge-Vorsatz

Authors affiliations: Vice Chair of Working Group III of the IPCC, Professor, Director at the Centre for Climate Change and Sustainable Energy Policy Central European University

The Special Report of the Intergovernmental Panel on Climate Change (IPCC) has broken many historic records, among these are the media coverage and public attention statistics indicating landslide success. The talk will provide the insights from this landmark report that are most relevant for the conference. The talk first answers: does half a degree climate change matter? Then, it decomposes the "is it still possible?" question into six feasibility criteria: geophysical, technological, economic, environmental-ecological, socio-cultural and institutional aspects. It discusses the feasibility of the four different key pathway families along these perspectives, and discusses the implications for (and from) an energy system transition. It concludes that there are pathways to 1.5C that simultaneously also help us achieve several sustainable development goals – i.e. help us closer to a healthier, cleaner, more equitable and happier future.

22. ELECTRIC VEHICLE CHARGING, NZ'S NEXT HOT WATER CYLINDER?

Author: Daniel Gnoth and Eric Pellicer

Affiliations: Powerco.

Electric vehicles have a key role to play in transitioning New Zealand's energy system away from fossil fuels. With ambitious goals to stimulate the uptake of electric vehicles to as many as 64,000 by 2021, the energy industry is rising to the challenge of maintaining a secure and safe energy supply.

One issue observed is the potential effectiveness of utilities to signal the impacts of charging on distribution infrastructure effectively. Electric vehicles are a special case as the new demand they create could bring a large amount of flexibility.

The ability to coordinate the rate and time of charging, as well as the potential to feed back into a home or network means that electric vehicles may be able to serve multiple markets, as well as benefit from them.

The interim findings of a number of ongoing case studies into electric vehicle charging will be presented, providing some insight into the potential needs of emerging customers as well as their ability to respond to varying pricing signals.

Whilst an established process of metering exists at a building level, it may not sufficiently capture the complexities of reconciliation between consumers who may wish to respond to multiple market signals in varying geographies.

23. DEMAND-DRIVEN DOMESTIC BATTERY SIZING FOR LOAD SMOOTHING AND PEAK SHAVING

Authors: Jason Mair, Kiti Suomalainen, David Eyers and Michael Jack

Authors Affiliations: University of Otago

Large infrequent peaks in residential electricity demand dictate much of the cost of supplying electricity. These peaks are likely to increase with increasing self-generation and adoption of new consumer technologies such as electric vehicles. Residential battery deployments provide a potential solution to these problems by storing electricity during periods of low use and discharging during peak periods. However, typical commodity solutions are often deployed in a one-size fits all scenario that neglects the large variation in demand profiles between individual households, potentially resulting in underutilised battery capacity. In addition, it is not clear whether residential or grid-level batteries will offer the optimum solution.

In this research, we take a demand-driven approach to determining residential battery capacity based on the individual household demand profiles. We consider two modes of battery operation: (i) load smoothing around the average and (ii) peak shaving, where the battery ensures grid power demand does not exceed a set threshold. We determine the battery capacity (in kWh) required for each mode of operation based on an individual household's demand patterns. The variation in battery size between households is quantified. The results also show a significant seasonal variation, such that in peak shaving mode the batteries are not required at all in summer. In addition, we also compare the battery capacity required for the individual houses with the aggregated demand of a collection of households. This shows that aggregation results in much smaller battery capacity requirements per house.

24. OPTIMAL SIZING OF AN ISLANDED MICRO-GRID USING META-HEURISTIC OPTIMIZATION ALGORITHMS CONSIDERING DEMAND-SIDE MANAGEMENT

Authors: Soheil Mohseni, Alan Brent and Daniel Burmester

Authors Affiliations: School of Engineering & Computer Science, Victoria University of Wellington,

Distributed renewable energy systems that are located close to where electricity is finally consumed have been proposed as a viable solution to overcome many of the problems associated with large centralized fossil-based power plants (e.g. high power losses, high emissions, expensive capital infrastructure, etc.). One solution for dealing with the intermittent nature of renewable energy sources is the concept of a micro-grid that facilitates the use of demand response programs. Micro-grids are discrete, small power grids that provide a platform for the integration of distributed energy resources and loads that can be operated in both grid-connected and islanded modes. The purpose of this paper is to develop a model for optimal sizing of the components of an islanded micro-grid for remote communities. The proposed micro-grid incorporates PV arrays and wind turbines as power generation components as well as battery packs as storage units. It also contains residential loads as well as an electric vehicle charging station, which are coupled to the micro-grid network through DC/AC converters. In this regard, some meta-heuristic optimization algorithms are used to minimize the life-cycle cost of the micro-grid and their results are compared with each other in terms of convergence speed and optimality of the solution obtained. Also, a demand-side management (DSM) strategy is implemented that shifts a percentage of the loads from peak to off-peak consumption hours. According to the simulation results, integrating the proposed DSM strategy into the optimal sizing model decreases the optimal sizes of the micro-grid components and its life-cycle cost.

25. THE EFFECTS OF LED LIGHT BULB INSTALLATION ON ELECTRICITY DEMAND IN UK HOUSEHOLDS: RESULTS OF A LARGE N RANDOMISED CONTROL TRIAL

Authors: Tom Rusby, Ben Anderson, Patrick James and Abubakr Bahaj

Authors affiliations: University of Southampton

Improving the energy efficiency of appliance use in households represents an important approach to electricity demand reduction to reduce the need for expensive GHG-intensive peak-period (16:00 and 20:00) generation in the UK and elsewhere. This paper reports analysis of a large-scale randomised-controlled trial in the south of the UK which tested the effect of LED lightbulb installation on daily electricity consumption in winter evening peak periods.

Up to 10 LED lightbulbs were installed free-of-charge during the Autumn of 2017 (Oct-Nov in the UK) in approximately 800 randomly selected households from a representative sample of ~1,600. 15-minute electricity consumption data was continuously collected through Autumn/Winter/Spring for both the installation and the remaining control households. We

present analysis of the observed electricity demand for the intervention and control groups over the following six months using the electricity consumption data along with socio-demographic data collected from household surveys.

Overall, the reduction in electricity consumption due to LED installation and use was strongly seasonal with the greatest reduction (8%) achieved during the peak hours of the shortest day-length periods in December. This fits the hypothesis that lighting utilisation is driven by evening daylight availability. Our analysis also reveals correlations between observed changes in household consumption due to LED installations and household and dwelling characteristics. For example, savings vary according to household characteristics associated with daily household routines driven by employment status and the presence of children. The results suggest that considerable winter evening peak electricity demand reduction may be achievable via widespread LED installation and the electricity network benefits that accrue mean that local distribution network operators may have a role to play in this transition.

26. ESTIMATING THE TECHNICAL POTENTIAL FOR RESIDENTIAL DEMAND RESPONSE IN NEW ZEALAND

Authors: ¹Carsten Dortans, ¹Janet Stephenson, ²Ben Anderson and ³Michael Jack

Authors affiliations: ¹Centre for Sustainability, University of Otago, ²Faculty of Engineering and the Environment, University of Southampton ³Department of Physics, University of Otago

Electricity supply systems must be able to meet the variation in electricity demand at all times. Peaks in demand require that sufficient generation and transmission infrastructure is available, leading to high costs from maintaining energy assets with low operation hours. Increasing levels of variable renewable generation sources, such as water inflow for hydro electricity generation, and daily fluctuations in wind and solar will exasperate this issue and may raise the cost of integrating renewables.

In New Zealand energy consumption of hot water heaters, refrigerators, and heat pump appliances in households accounts for a large percentage of total electricity generation during peaks. Due to the ability of these appliances to store energy in the form of hot water, and cold/warm air, they can be utilised as a form of demand response (DR) to shift electricity demand out of these peak times.

In this paper we report the results of an assessment of the technical potential of residential DR with these three appliances. We combine data from the NZ GREEN Grid household electricity demand study with NZ appliance statistics to develop a model of national half-hourly electricity demand for these the three appliances.

Applying DR scenarios to this model we find that daily energy consumption can be reduced by ~5 GWh per day during winter peaks. This represents a reduction in total demand and thus required generation of 20 per-cent. Using spot market prices and congestion period demand charges, we estimate the economic value of this to be ~\$100 M NZD/year.

27. A COOPERATIVE MODEL FOR RENEWABLE ENERGY PROSUMER IN SMART-GRIDS -- A PATHWAY TO BE A CITY OF 100% RENEWABLE ENERGY

Authors: Sean Hsin-Shyuan Lee, Jeremiah D. Deng, Martin Purvis and Maryam Purvis

Authors affiliations: Department of Information Science, University of Otago

Because renewable energy sources, such as wind and solar power, have variable energy outputs across both space and time, it can be useful for them, the prosumers, to form temporary coalitions in order to share their energy. Within our model the members can exchange their energy with others in the coalition, which will reduce the cost for trading with power utilities. That way communities having excess energy (i.e. they are producing energy in excess of their local consumption) can give their unneeded energy to other members within their coalition who are facing an energy deficit. For a large collection of communities producing renewable energy, it then becomes an optimisation problem as to what coalition arrangement (i.e. which energy-producing communities should join together to form the various coalitions) will result in the optimal distribution of available power. Because weather conditions can change rapidly, a solution for this coalitional optimisation needs to be recalculated very often, say every hour. However, a straightforward algorithmic approach to reaching the coalitional optimization is time-consuming and so does not scale well with respect to increasing numbers of participating communities involved. Indeed, calculating coalitional optimisation using this straightforward approach for just two dozen agents in this connection is infeasible. In this study we explore more efficient ways to achieve near-optimal results that are more computationally tractable.

28. SMART CONTROL SCENARIOS FOR DOMESTIC WATER HEATERS IN NEW ZEALAND

Authors: Rafferty Parker and Michael Jack

Authors affiliations: University of Otago

Electricity demand by consumers has significant variation over time, which needs to be met by varying electricity supply, an inefficient and expensive process. Managing this variability in demand is exasperated by the variability in supply from growing supplies of renewable electricity generation, such as from solar photovoltaic (PV) and wind. Instead of altering electricity generation to meet demand, demand side management (DSM) seeks instead to shift electricity demand to meet supply.

Domestic electric hot water cylinders are ubiquitous in many countries around the world, and as such may play a significant role in DSM. They provide a potential low-cost method of storing energy as they are able to heat during times when energy is plentiful and utilise stored heat at other times. In this work we analyse the DSM potential of a domestic hot water cylinder via a computer simulation consisting of a physical model of a hot water cylinder and a statistical model

of residential hot water usage patterns. A smart controller for the electrical element was used to suppress element operation according to various scenarios including: (i) maximising self-consumption of solar PV; (ii) minimising operating costs under time-of-use electricity pricing, and (iii) avoiding grid congestion charges. The results of the analysis show the potential for financial savings of hundreds of dollars per year for residential consumers as well as benefits for the wider electricity grid.

29. THE DIVERSITY PLUG

Authors: Dougal McQueen

Authors affiliations:

For a power system to operate efficiently frequency and voltage must be maintained within strict limits, requiring the fine balance between generation and demand to be kept. If the system goes out of balance then generators may trip, under protection settings, further disturbing system stability ultimately resulting blackout. It is particularly difficult to ensure generation and demand is balanced when black starting a power system or connecting a large load (such as connecting a feeder in a small system). The current drawn in these cases, termed Cold Load Pick Up, can be much greater than the otherwise maximum demand as power is drawn to energise components, start motors, and power appliances that are duty cycled on. In most power systems CLPU is not overly problematic as the required current is drawn from the inertia of synchronous machines, however in systems which have high penetrations of inverter connected generation there may be insufficient instantaneously available power. An effective way to limit the CLPU is to incrementally connected loads through manual or automatic switching. The switching can be performed at many locations within the power system with varying requirements for manual interventions and costs. To limit technical capability and keep costs low the Diversity Plug, which operates to delay individual appliance connections has been developed. The research and development pathway toward a compliant product will be presented.

30. KEYNOTE: SOME OF THE CHALLENGES FOR NZ'S ENERGY SECTOR: AN INDUSTRIAL/SECTORAL PERSPECTIVE

Authors: Brigid McArthur

Authors affiliations: Greenwood Roche partner, Chair of the Energy Law Association

Brigid will be presenting her perspective, informed by many years of practice at the coalface, on some of the challenges and opportunities facing the transformation of New Zealand's energy sector, and particularly the transition away from fossil fuels.

31. KEYNOTE: ACHIEVING AN ENVIRONMENTALLY-SUSTAINABLE, HIGH-VALUE ECONOMY

Authors: David Parker

Authors affiliations: Minister for the Environment

This Government’s vision is for economic growth within environmental limits. To quote former World Bank economist Herman Daly – ‘The economy is a wholly owned subsidiary of the environment, not the reverse’.

As Minister for the Environment, Economic Development and Trade, David Parker is at the centre of the Government’s work to achieve this vision. Drawing on his long history as an advocate for the environment, and his prior experience as Minister for Climate Change and Energy in the Clark Government, Minister Parker will share his views on what’s needed to protect and restore New Zealand’s natural capital.

Environment Minister David Parker will outline how the Government is knitting together a range of policies that will all contribute to an environmentally-sustainable, high-value economy that supports the well-being of New Zealanders.

Together these policies are intended to:

Halt further degradation and reverse damage to the environment

Transition to more sustainable, adaptable and innovative systems

Improve New Zealand’s environmental credentials

Minister Parker will discuss the Government’s agenda across climate change, freshwater, biodiversity and energy. In particular, the Minister will provide an update on climate change policy including the Zero Carbon Bill, improvements to the ETS, and planning for adaptation and mitigation.

He will also discuss New Zealand’s transition to a post fossil fuel economy

33. WE HAVE THE POWER’’: ADDRESSING THE CHALLENGES OF ENERGY POVERTY AND CLIMATE CHANGE THROUGH SOUND ENERGY POLICY AND LAW

Authors: Jennifer Campion

Authors affiliations: University of Waikato

Our planet faces two significant energy-related challenges for the twenty-first century: climate change and energy poverty. Both pose unique and related policy challenges. Addressing climate change frequently involves implementation of measures designed to reduce energy consumption. However, energy poverty arises in situations where there is already a recognizable lack of energy consumption – frequently this will be due to a lack of access to energy, although accessibility issues can, of course, include price barriers as well as availability issues. Both challenges should be able to be addressed in ways that complement each other; however, it has

been observed that some approaches to mitigating climate change may be increasing or exacerbating energy poverty.

Thus, energy poverty is becoming an increasingly important aspect of the climate change response. “Energy poverty” is a term that describes a lack of access to modern energy services, where these services are typically defined as household access to domestic energy needs, such as electricity and fuel. To an extent, mapping the problem has invited a consideration of energy poverty in particular areas of human activity, and on societal groups that are most affected by energy poverty. Although it is important to consider the impact of energy poverty on areas of energy use and groups of users, this approach may result in the development of policies that target those areas of the energy sector or groups, rather than addressing the causes and consequences of energy poverty more holistically and through cross-sectoral approaches.

There is a need for an integrated, cross-sectoral, and systematic approach to energy policy and to the regulatory measures supporting that. This presentation will consider the features of good law for the development and implementation of energy policy, in light of the particular challenges posed by climate change and energy poverty.

34. QUANTIFYING BARRIERS TO MORE EFFECTIVE PRIVATE SECTOR INVOLVEMENT IN THE TRANSITION TO LOW CARBON ENERGY SYSTEM

Authors: Tsani Fauziah Rakhmah

Authors affiliations: Department of Geography, University of Otago

The global energy system faces increasingly significant challenges that clearly require a greater use of low carbon energy. On the one hand, there is an increasing demand for energy by all sectors across the economy, especially in emerging countries of Asia. On the other hand, there is a need to reduce the historic dependence on fossil fuel and reduce emissions from the energy sector that contributes to climate change. Addressing how this transition to low carbon economies might be financed is yet to be determined in many countries. Indeed, in the emerging countries in Asia alone, meeting the climate targets under the Paris Agreement framework will require around US\$200 billion annually for low carbon energy supply and energy efficiency, which is beyond the capability of many cash-strapped governments in the region (Anbumozhi et al, 2018). As such, leveraging private finance for low carbon energy investment has become important to close this investment gap. However, despite the progress of private finance investment on low carbon energy, there remains a sizeable shortfall of investment flows due to the existing barriers from the policy, market and investment side. My research aims to identify barriers to more effective private sector involvement in the transition to low carbon energy system. In doing so, the research seeks to measure the direct effect of variables that influence low carbon investment, such as policy, market, and investment barriers from the private sector side.

35. ADOLESCENTS' TRAVEL TO SCHOOL PATTERNS IN URBAN, SEMI-URBAN AND RURAL SETTINGS: INSIGHTS FROM THE BEATS RESEARCH PROGRAMME

Authors: Sandra Mandic¹, Debbie Hopkins², Enrique García Bengoechea^{3,4}, Charlotte Flaherty¹, Antoni Moore¹, Susan Sandretto¹, Kirsten Coppell¹, Christina Ergler¹, Michael Keall⁵, Anna Rolleston⁶, Gordon Wilson⁷, Gavin Kidd⁷, Angela Findlay¹, Brittany White¹, Chris Tait¹, Jessica Calverley¹, Michael Jensen¹, Roman Keller¹, Tessa Porskamp¹, Judy Rodda¹, Long Chen¹, Kimberley King¹, John C. Spence⁸

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Transitioning from the car-dominated transport system towards more sustainable active transport (AT) is necessary to address climate change and prevalent non-communicable health concerns. Encouraging AT to school has the potential to develop into a life-long, environmentally sustainable, economical practice. How adolescents' travel to school has been studied extensively in urban centres, yet travel patterns in rural areas are less known. Travel to school is context-specific and differences between rural and urban environments are expected. This study compared adolescents' travel to school patterns in a main urban center (Urban), small-to-medium urban areas (Semi-Urban) and rural settlements (Rural) across the Otago region, New Zealand.

Methods: Data were collected as part of the BEATS Study (Dunedin; 2014/2015; 12 schools; 1,663 adolescents) and BEATS Rural Study (Otago; 2018; 10 schools; 993 adolescents). Adolescents (1,663 Urban; 814 Semi-Urban; 179 Rural) completed a questionnaire about school travel.

Results: Overall, school travel (55.0% motorised transport, 29.8% AT, 15.2% combined active-and-motorised transport; $p=0.686$) and average distance to school (Urban/Semi-Urban/Rural: $6.2\pm 7.4/7.9\pm 10.1/9.3\pm 9.8$ km; $p=0.386$) were not different across settings. Among adolescents who were ineligible for school bus transport, AT rates were significantly different across settings (Urban/Semi-Urban/Rural: 38.7%/47.9%/58.5%; $p<0.001$). Rates of walking (Urban/Semi-Urban/Rural: 27.4%/23.2%/29.7%; $p=0.013$) and cycling (Urban/Semi-Urban/Rural: 1.1%/12.2%/6.8%; $p<0.001$) were different across settings.

Conclusions: Motorised transport dominates adolescents' travel to school across Otago with differences in rates of walking and cycling to school across settings. Future interventions for promoting sustainable modes of transport in New Zealand should focus not only on urban centres but also semi-urban and rural settings.

36. UPDATING ESTIMATES OF INTERNATIONAL TRANSPORT GREENHOUSE GAS EMISSIONS FOR NEW ZEALAND

Authors: Anna Tarr and Inga Smith

Authors affiliations: Department of Physics, University of Otago

Earth's climate is impacted by greenhouse gas emissions from human activities such as the burning of fossil fuels by international transport of people and goods. However, quantifying international transport emissions is more difficult than might be initially assumed. If aviation were a country rather than a transport mode, it would be one of the ten highest CO₂ emitting countries, accounting for over 2% of global emissions; maritime transport accounts for 2.5%. Despite this significant contribution to global emissions, international aviation and maritime greenhouse gas emissions were not liable under the Kyoto Protocol. The issue of apportioning responsibility to individual countries for international transport emissions is vexed, and calculating emissions for countries is complicated. 2020 is a significant year for both industries emissions. The first voluntary phase of the Carbon Offsetting and Reduction Scheme for International Aviation begins, aiming to stabilise CO₂ emissions at the 2020 level. On January 1st 2020, the global limit on sulphur in marine fuels drops from 3.5% to 0.5%. The University of Otago international transportation energy and climate impacts research team calculated international transport greenhouse gas emissions for New Zealand, with papers published between 2009 and 2011. This summer, we will be updating this research, and in this talk present an overview of the changes that have occurred since that period, and what progress has been made towards the 2020 goals.

37. ADOLESCENTS' PERCEPTIONS OF THE SCHOOL NEIGHBOURHOOD ENVIRONMENT IN SMALL-TO-MEDIUM URBAN AREAS VERSUS RURAL SETTLEMENTS

Authors: Brittany White and Sandra Mandic

Authors affiliations: School of Physical Education, Sport and Exercise Sciences, University of Otago

Background: Active transport to school (ATS) is an easy and effective way to increase physical activity (PA) in adolescents. Perceptions of the school neighbourhood environment can influence an adolescents' transport to school behaviours. This cross-sectional study compared adolescents' perceptions of the school neighbourhood environment in small-to-medium urban areas (SMU) versus rural settlements (RS) in Otago, New Zealand.

Methods: Adolescents from 11 secondary schools (6 located in SMU and 5 in RS), living ≤ 4.8 km from school reported their perceptions of the school neighbourhood environment. All adolescents completed a survey ($n=471$; 56.9% female; age 15.29 ± 1.34 years) and a subgroup

completed the Neighbourhood Environment Walkability Scale for Youth questionnaire (NEWS-Y) (n=166; 53.7% female; age 15.26±1.37 years).

Results: Compared to RS, SMU adolescents expressed greater concerns about unsafe road crossings (SMU vs RS: 44.1% vs 28.9%; p=0.014), high traffic volume (37.2% vs 19.7%; p=0.003) and vehicles stopping and/or parking around school (40.3% vs 23.7%; p=0.006). SMU adolescents reported higher residential density (SMU vs RS: 64.81±21.81 vs 57.64±14.29; p= 0.014), land mix use access (3.18±0.34 vs 3.04±0.35; p= 0.008) and lower diversity of land use (2.94±0.64 vs 3.21±0.51; p=0.003) and recreation facility access (3.26 ± 0.77 vs 3.72±0.55; p=<0.001) compared to RS adolescents.

Conclusions: Compared to RS adolescents, SMU adolescents reported more traffic concern about their school neighbourhoods. RS adolescents had better access to recreation facilities and greater land use mix diversity in their school neighbourhoods compared to SMU adolescents. School neighbourhood environment should be considered when designing initiatives for promoting ATS among adolescents.

38. NUDGED INTO THE CAR: HOW CULTURAL SETTINGS TRAP US

Authors: Ben Wooliscroft and Alexandra Ganglmair-Wooliscroft

Authors affiliations: University of Otago

Nudging has been hailed as the solution to many of societies problems, from organ donor rates, to obesity and beyond. Nudging involves setting default behaviours – the easy path – to the desired behaviour. But the setting of default behaviours is not always planned, at least publicly planned.

We consider the case of New Zealanders' transport mode choice, in light of a mobility cultures model, and how cultural settings trap New Zealanders in their cars, in spite of stated desire to move more actively. Using the mobility cultures model, an extension of the energy cultures model, we diagnose the points during which New Zealanders are nudged into cars? Through identifying these default choice/ behaviour settings insights are gained into the barriers to and possibilities of shifting mode share to more sustainable transportation (walking, cycling and public transport) in line with New Zealand's requirements if it is to meet Paris Agreement commitments.

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