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ENERGIZING FUTURES

Sustainable Development and Energy in Transition

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Welcome to the 19th Futures Conference 'Energizing Futures – Sustainable Development and Energy in Transition'

To understand the challenges of transition, we need multidisciplinary, multi-level and time-variant analysis of various issues: renewable and non-renewable energy (re)sources, transforming primary energy into energy carriers (fuels, electricity, heat), energy technologies, impacts (environmental, social, economic, institutional, cultural, etc.) of energy use, energy exports and imports, energy markets and energy price, energy end-use patterns and consumer behavior, energy and resource efficiencies, energy policies, and energy governance.

- What are the main challenges of sustainable energy futures in an era of increasing uncertainty?
- How to create sustainable energy policies in Europe, and elsewhere in the World?
- What is the role of futures studies in identifying opportunities for a fair, efficient and resilient energy system?

“Energizing Futures” aims to generate multidisciplinary, stimulating and critical discussions that promote networking between people interested in energy issues from different backgrounds.

The conference is supported by the European Commission via the Horizon 2020 research project “European futures of energy efficiency (EUFORIE)”, coordinated by the University of Turku. The project outcomes will be widely disseminated in the conference.

Jarmo Vehmas

Adjunct Professor, Chair for the Conference Scientific Committee
University of Turku, Finland Futures Research Centre



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PROGRAMME

Wednesday, 13th of June

- 08:30 Registration & Coffee
- 09:30 **Opening of the Conference**
Adjunct Professor *Jyrki Luukkanen*
Finland Futures Research Centre, University of Turku
- Introduction to the Conference Theme**
Adjunct Professor *Jarmo Vehmas*
Finland Futures Research Centre, University of Turku
- 10:00 **KEYNOTE SPEECH: "Energy transition between acceptance and "nimbyism". The case of wind energy in Germany"**
Senior Researcher *Maria Rosaria Di Nucci*, Environmental Policy Research Centre of the Freie Universität Berlin, Germany
- 10:30 **Comment speech and discussion**
Adjunct Professor *Jarmo Vehmas*
Finland Futures Research Centre, University of Turku
- 11:00 Break
- 11:30 **KEYNOTE SPEECH: "Energy Foresight using Artificially Intelligence Futures"**
Dr. *Michael Jackson*, Shaping Tomorrow, United Kingdom
- 12:00 **Comment speech and discussion**
Professor *Sirkka Heinonen*,
Finland Futures Research Centre, University of Turku
- 12:30 Lunch
- 13:30 **Workshop session I**
- 15:00 Coffee break
- 15:30 **Workshop session II**
- 17:30

FOR PRE-REGISTERED

19:00–23
Conference Dinner
Museum restaurant Valssi

Thursday, 14th of June

- 08:30 Morning coffee
- 09:00 **KEYNOTE SPEECH: "100% Renewable Europe"**
Professor *Olav Hohmeyer*
Europa-Universität Flensburg, Germany
- 09:30 **Comment speech and discussion**
Adjunct Professor *Jyrki Luukkanen*
Finland Futures Research Centre, University of Turku
- 10:00 Short break
- 10:15 **Workshop session III**
- 12:00 Lunch
- 13:00 **Workshop session IV**
- 14:30 Coffee break
- 15:00 **Chaired Poster session**
- 15:45 **KEYNOTE SPEECH: "Can Citizens' Practices Change Energy Systems?"**
Professor *Eva Heiskanen*, University of Helsinki
- 16:15 **Comment speech and discussion**
Director *Sylvia Lorek*, SERI, Sustainable Europe Research Institute
Germany e.V
- 16:45 **Closing of the Conference**
- 17:00 Director *Juha Kaskinen*
Finland Futures Research Centre, University of Turku

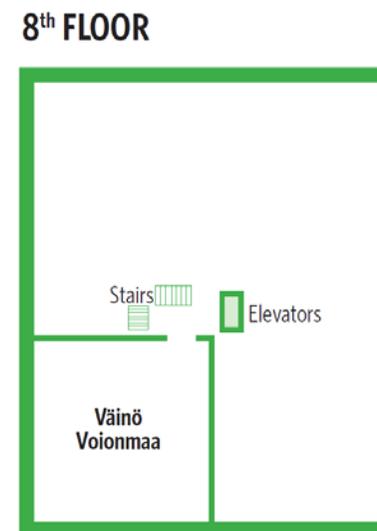
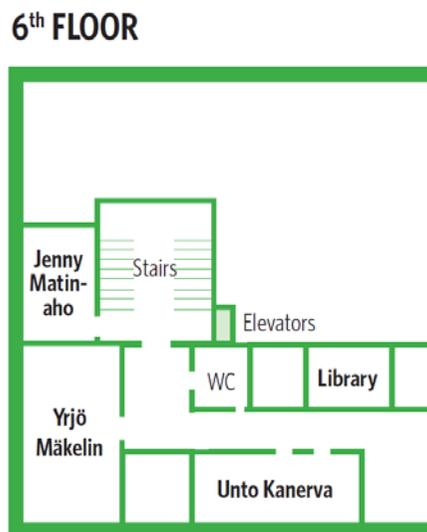
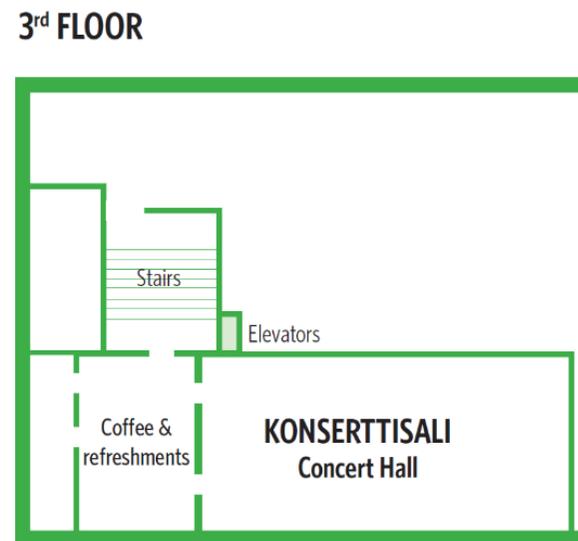
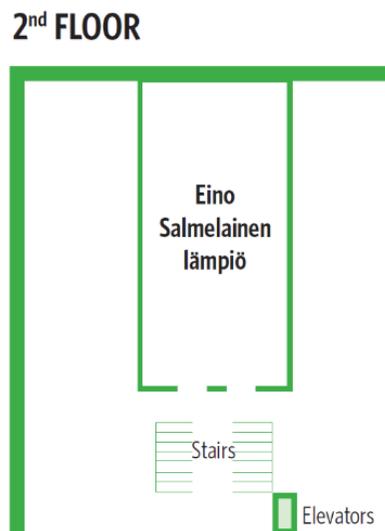
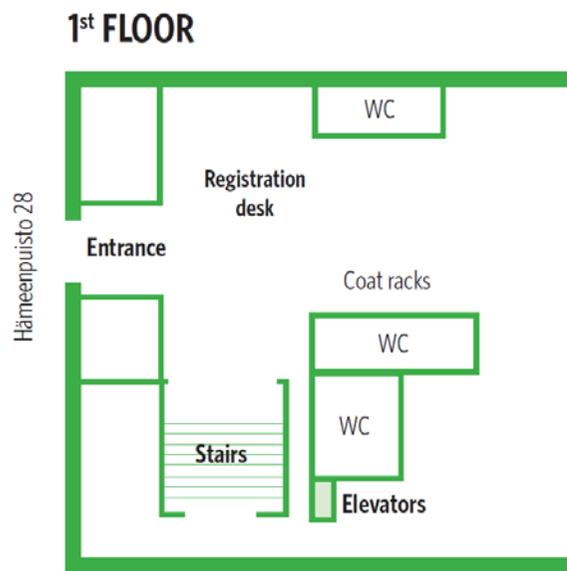
SESSION CHART

Session	Venue	Konserttisali	Väinö Voionmaa	Yrjö Mäkelin	Unto Kanerva	Kirjasto	Jenny Matin-aho	Eino Salmelaisen lämpiö
13:30–15:00 SESSION I		Theory and practice of energy and resource efficiency and sufficiency	Methods and methodology of futures research and sustainability	Renewable energy policies and sustainability in Europe and the World	Future prospects of carbon-neutral economy and its production structure and consumption patterns	Challenges and opportunities for future energy governance	Energy “fantasies” and socio-technical imaginaries	Interactive Workshop: Energy Landscapes
15:30–17:30 SESSION II		Theory and practice of energy and resource efficiency and sufficiency	Renewable energy policies and sustainability in Europe and the World	Future prospects of carbon-neutral economy and its production structure and consumption patterns	Challenges and opportunities for future energy governance	Energy sufficiency: Establishing a new guiding principle to reduce total energy consumption	Energy “fantasies” and socio-technical imaginaries	The Future Reinvented: Radical Energy Solutions – An Interactive Scenario and Storytelling Workshop

Session	Venue	Konserttisali	Väinö Voionmaa	Yrjö Mäkelin	Unto Kanerva	Kirjasto	Jenny Matinaho	Eino Salmelaisen lämpiö
10:15–12:00 SESSION III		Special Millennium Project Session with a Keynote Speech by Jerome C. Glenn	Theory and practice of energy and resource efficiency and sufficiency	Future prospects of carbon-neutral economy and its production structure and consumption patterns	Technology foresight of sustainable energy systems	Challenges and opportunities for future energy governance	Methods and methodology of futures research and sustainability	Interactive Workshop: Futures people/crafting persona in four different urban futures
13:00–14:30 SESSION IV		Theory and practice of energy and resource efficiency and sufficiency	Future prospects of carbon-neutral economy and its production structure and consumption patterns	Challenges and opportunities for future energy governance	Energy transitions in the Global South	Energy foresight as a cognitive tool for action: a discussion on the design processes of scenarios and on their performativity in the political arena		Workshop on the seeds of transformation and disruption related to carbon-neutral energy systems

CONFERENCE FLOOR CHARTS

Tampere Congress & Culture Centre Puistotorni



KEYNOTE SPEAKERS AND ABSTRACTS

Energy Transition between Acceptance and “Nimbyism”

– the Case of Wind Energy in Germany

Maria Rosaria Di Nucci

Environmental Policy Research Centre, Freie Universität Berlin, Germany

Germany is currently undergoing a profound process of change in its energy system, a change that has been particularly epitomized by the extraordinary growth of renewables and the phase out of nuclear power plants. Implementation of local energy projects has played an important role in this transformation, yet this process is faced with conflicts. Large energy and infrastructure projects not only lack broad support, they also provoke considerable local opposition. Negative attitudes, especially vis-a-vis wind energy, are now increasing. The effects of these projects can be perceived as positive or negative and are assessed in different ways according to attitudes and responses, which often depend on the context, project-specific factors and personal attitudes.

Sometimes local opposition has been labelled too quickly as Nimbyism, a practice that has been criticized by many studies. Social acceptance of wind energy has become a contested issue due to the visual impact on landscapes, noise pollution (including infrasound), the public’s perception of associated environmental and health risks, disruption harming local fauna and flora, negative impacts on tourism, and loss of land and real property value.

Often it has been purported that local acceptance is mainly influenced by factors such as distributional justice (fair allocation of costs and benefits), procedural justice (fair and participative decision-making processes) and trust (in information and intentions of investors and actors). However, participatory processes have proven not be a panacea and do not necessarily imply acceptance. Barriers and drivers for social acceptance vary significantly across countries, regions and communities.

This presentation focuses on the case of wind energy projects in selected German regions and discusses a number of factors affecting acceptance in a positive or negative sense. The presentation is based on the preliminary outcomes of the Horizon 2020 project WinWind, which analyzes acceptance factors, barriers and drivers within regions of six European countries where wind energy penetration rates have been comparatively low to date.

100% Renewable Europe

Olav Hohmeyer

Europa-Universität Flensburg, Germany

In order to stay within the 2° temperature limit set for global climate change by COP 21 in Paris in November 2015 all CO₂ emissions from the global use of energy need to stop before the year 2050. The most sustainable solution is a global shift to a 100% renewable energy (RE) supply. During the last ten years the discussion on the possibilities of a 100% RE supply has evolved in Germany, other European countries and the U.S. By now first studies on possible 100% RE power supplies have been conducted for more than 50 countries worldwide.

In 2011, just before the Fukushima accident, the German Council of Environmental Advisors published its ground breaking study on a 100% RE power supply for Germany, Europe and North Africa. It has set the pace for the expansion of renewables in Germany as well as for the connection of Norwegian storage hydro-power to the German electricity system.

Based on hourly system simulations the study showed that 100% RE power supply is possible for Germany as well as for Europe and North Africa and that such power supply will be in the cost range of present power costs. From the hourly simulation it can be seen that base load power plants cannot be operated economically together with the necessary high level penetration of wind and solar energy.

The presentation reports on the key results of the study and puts these into the context of the present climate policy.

Energy Foresight using Artificially Intelligence Futures

Michael Jackson

Shaping Tomorrow, UK

This keynote presentation will present the future of energy using AI and systems thinking to determine how the sector will likely evolve over the next decade towards a more sustainable future.

Using a unique, web-based and social media forecasting system, the presenter will show how energy sources and uses are likely to evolve, which sectors will likely be winners and losers, when we might expect the tipping point between traditional and emerging alternative energy sources and what are the key challenges facing decision-makers now, and in the future.

The presentation will describe the future of energy through simple, real-time and instantly created narrative reports and generate create key questions, radar charts, heat maps, tipping point, geographical and sectoral analysis on the fly.

He will also demonstrate how anyone can use the same system to quickly draw their own conclusions, on sustainable energy futures (or any other topic of interest), and respond in time as the future unfolds, with a dynamic display of the systems capabilities.

Finally, the presenter will describe his own strategic views on where AI can take the future of foresight and sustainable energy futures.

Can Citizens' Practices Change Energy Systems?

Eva Heiskanen

Consumer Society Research Centre, University of Helsinki, Finland

There is intense debate on the role of individual consumers in changing unsustainable systems of production and consumption. Methodologically individualist notions of changing systems by influencing consumers' behavior in the market have been – in my view, very validly – criticized. It is argued that we should change structures rather than attempt to influence individual behavior. Yet how and when do structures change and what roles do individuals have in this process?

My presentation illustrates how citizen groups and their innovations-in-practice have been important originators of several sustainability-supporting initiatives. Many of these date back to the 1970s and have been mainstream and institutionalized in recent years. In these examples, citizens have not only been consumers in markets, but rather early adopters, adapters or developers of innovative technologies or techniques, as well as promoters, multipliers and social movement organizers.

I draw on two integrative reviews for this: the first one focusing on relevant literatures investigating the mainstreaming of sociotechnical or institutional innovations, and the second one on published cases of the mainstreaming of solar power. Through an analysis of the conditions under which such initiatives were mainstreamed, I consider the role of citizen initiatives and contextual factors in changing practices on a large scale and across several countries. My contribution is to identify a set of propositions concerning (a) processes of social mobilization and (b) environmental conditions that have contributed to mainstreaming.

I also aim to contribute to how social practice theory is used in discussions on more sustainable lifestyles, where the question is usually: how might social structures support more sustainable household practices? One can also invert the question: How might individuals and their new practices modify or even subvert social structures?

Future Self-Actualization Economy for Sustainable and Energy Efficient Society

Jerome C. Glenn

The Millennium Project, US

Future synergies among AI, robotics, synthetic biology, computational science, cloud & big data analytics, artificial & augmented reality, nanotechnology, IoT & Tele-Everything, semantic web, quantum computing, tele-presence & holographic communications, intelligence augmentation, collective intelligence, blockchain, 3D/4D printing materials and biology, driverless and other driverless vehicles, conscious-technology will greatly improve energy efficiencies and what we think is possible for the future of civilization. It is widely understood that the applications of artificial narrow intelligence (ANI) to all elements of the industrial production processes and service industries (The Fourth Industrial Revolution) will have a great impact on energy, employment, and the economy. But it is less well understood, that the applications of artificial general intelligence (AGI) and synergies among next technologies will change make far more change than ANI and could create the Self-Actualization Economy and Culture. There alternative future work/tech 2050 global scenarios will be discussed and provide input to the small group discussions.

After the special keynote by Jerome Glenn, the Director of the Millennium Project, the participants will break out in small groups to work co-creatively and to deepen the key related questions emerging from the topic. The participants will report back to the session, and will get feedback and comments from their analysis from Jerome Glenn.

SESSION I

Wednesday, 13th of June at 13:30–15:00

Theory and practice of energy and resource efficiency and sufficiency

Time: Wednesday 13 June at 13:30–15:00

Room: Konserttisali

Chair: Adjunct Professor Jarmo Vehmas

Energy efficiency as a driver of CO2 emissions in the EU

Jarmo Vehmas, Jyrki Luukkanen & Jari Kaivo-oja

Finland Futures Research Centre, University of Turku, Finland

This paper presents results from a decomposition analysis of carbon dioxide emissions from fuel combustion in the EU-28 and its Member States between the years 1990 and 2015. The effects of drivers such as carbon intensity of the energy mix, efficiency of the energy transformation system, energy intensity, economic activity and population are calculated and analysed.

The analysis applies an incremental decomposition analysis, which focuses on annual changes between the years 1990 and 2015. Longer time periods can be easily looked at by just summing up the annual changes of all drivers.

The results show a large variety in the role of energy efficiency in the change of CO2 emissions over time.

Keywords: CO2 emissions, decomposition analysis, European Union, energy efficiency

Energy efficiency trends in the European Union: Decomposition analysis and policy implications

Gianluca Trotta

Energy Economics, University of Vaasa, Finland and Sustainable Europe Research Institute, Germany

The European Commission's 'Clean Energy for All Europeans' package sets 'Energy efficiency first' as guiding principle in future energy policy making as well as a binding 30% energy efficiency target for 2030. The achievement of this target will determine the success of EU Member States' actions and policy measures to improve energy efficiency, which in turn contributes to reduce energy dependence and CO2 emissions. However, the way the 30% target is set presents several limitations and it is not based on absolute energy savings, but on a hypothetical percentage cut of future primary energy use.

Thus, the objectives of this study are to provide new insights on: (i) the levels of energy efficiency improvements achieved by the EU over the period 1995–2015 by employing decomposition analysis approach – Logarithm Mean Divisia Index – and using disaggregated final energy consumption data; (ii) the progress of the EU towards the energy efficiency target set for 2030; and (iii) the energy security and climate benefits associated with energy efficiency improvements.

Results show that from 1995 to 2015 efficiency allowed the EU to save approximately 235 Mtoe, an amount equal to the final energy consumption of the United Kingdom, Spain, and Austria in 2015 combined. Additionally, energy efficiency improvements reduced the EU dependence on energy imports at the average rate of 1% per year, and saved 530 MtCO2. Most importantly, energy efficiency improvements between 2005 and 2015 contributed to achieve 61.8% of the energy efficiency target set for 2030.

Energy and material efficiency in chemical processes

Gabriella Fiorentino^a, A. Zucaro^a & Sergio Ulgiati^{a,b}

^aDepartment of Science and Technology, Parthenope University of Naples, Italy;

^bSchool of Environment, Beijing Normal University, China

Despite an essential role in our everyday life, chemical industries (especially petrochemicals, pulp and paper, basic chemicals, refining, nonferrous metals, iron and steel, nonmetallic minerals and food) are well known to be energy intensive manufacturing units and the production processes are often charged with the negative effects generated on human health and climate change. According to the IEA (2017), the chemical and petrochemical sectors result to be the largest industrial energy users, accounting for 28% of the total industrial energy demand worldwide and for approximately 10% of the global energy demand and, as a consequence, generating 5.5% of CO₂ emissions (7% of global GHG emissions) and 17% of industrial CO₂ emissions (20% of the industrial GHG emissions) (data updated at 2014). At present, energy demand and emissions' release by chemical processes are a serious concern and an increasing pressure is calling for a more sustainable and "green" chemical production. To this aim, the "green chemistry" concept was introduced in the early 1990s by the US Environmental Protection Agency (www.epa.gov/), in order 'to promote chemical technologies that reduce or eliminate the use or generation of hazardous substances in the design, manufacture and use of chemical products', and it is currently associated with the 12 principles formulated by Anastas and Warner, which advocate a decrease in the environmental impact of a chemical product by considering aspects of its entire life cycle – from raw material to product use and fate. Guiding principles of green chemistry include design for energy efficiency and use of renewable feedstock. Ongoing measures to implement energy efficiency promote incremental improvements that reflect relatively small and anticipated technological advances in the "normal course of business", as well as best practice technologies (BPT), i.e. the most advanced technologies currently in use at industrial scale. Conversely, "game changer" technologies (including the use of biomass as feedstock for chemical products) are potentially more decisive, since they re-invent the way some large-volume chemicals are made, although at the moment they are still far from commercial maturity and energy efficiency. The goal of this study is to quan-

tify the potential savings in energy consumption and the GHG emissions reductions that can be achieved by means of implementation of energy efficiency practices and of fuel and feedstock switching. In particular, the options of using biomass as a fuel to generate energy or as a substrate to generate chemical derivatives are assessed in a Life Cycle Thinking perspective and the impact on the sustainability of the chemical industry is envisaged.

Resource efficiency and circular economy – the search for appropriate indicators

A. Zucaro^a, R. Santagata^a, G. Fiorentino^a, F. Corcelli^a, S. Ulgiati^{a,b}

^a Department of Science and Technology, Parthenope University of Naples, Italy;

^b School of Environment, Beijing Normal University, China

In ecosystems products and residues from one component or compartment are always a useful resource for another component or compartment. This supports and at the same time limits a species or system's growth. Human societies are still driven by the illusion of unlimited growth. Unlimited or exponential growth on a limited planet is impossible, since it demands ever-increasing energy and resource inputs, in turn causing pollution and ecosystem degradation. The traditional linear production patterns "take, make, dispose" has become unsustainable in this particular moment of human history, where instead a complex and network-oriented production and consumption mode is needed, through which resources can continuously be exchanged and recycled. Optimized use of resources would make human-dominated technological systems more similar to fully natural systems, characterized by lower human loading, in so increasing success probability in a limited-world. Circular Economy (CE) frameworks are getting increasing attention with regard to their implementation in agricultural, urban and industrial sectors as an innovative business model to optimize resource use, process performances and development policies. Similar to the ability of ecosystems to self-organize for Maximum Empower, Circular Economy concepts (CE) may indicate a way for Maximum Empower implementation in human societies. Though, CE policies, prior to their implementation, need to be carefully assessed and progresses monitored. Conventional mono-dimensional indicators, still useful for specific purposes, only provide a partial understanding of CE features. A new set of indicators is needed when approaching to Circular Economy systems.

These indicators have to be capable of accounting for the complex, closed-loop, CE framework, taking into account and promoting both environment and human wellbeing.

Renewable energy policies and sustainability in Europe and the World

Time: Wednesday 13 June at 13:30–15:00

Room: Yrjö Mäkelin

Chair: Dr. Ville Luttamäki

Developing a collective vision for community led energy transition

Rosemary Byrne, Susan Byrne, Anne Bennett & Bernadette O'Regan

University of Limerick, Ireland

The Irish Government has pledged to transition to a low-carbon society by 2050, yet it is widely acknowledged that Ireland will fail to meet its EU 2020 GHG emission reduction targets. Failure to meet these targets leads to even greater challenges in meeting 2030 targets and beyond. Literature increasingly points towards the importance of action at the local level in meeting sustainability objectives. Developing a sustainable vision for the future requires finding solutions involving a collective effort from all levels of government, business, and citizens. Building on previous work examining motivations and barriers to action experienced by voluntary sustainable action community groups, this study applies a participatory backcasting scenario approach to construct the necessary steps to achieve necessary transformative societal change. Results of this research form the basis for reasoned policy recommendations to enable effective community level climate change action.

This study is part of a wider on-going research project that aims to develop a decision support tool and accompanying manual to incentivise and facilitate Irish communities in implementing sustainable urban development (SUD) programmes. The primary objective of this study is in developing strategies and recommendations to enhance and enable widespread community led actions that contribute to national GHG emission reduction efforts. This is achieved through:

- establishing participants' current understanding of sustainable communities and current levels of engagement or otherwise,
- aligning future emission reduction targets and the preferred future vision of citizens (desired end-point),
- allowing participants the opportunity to express their own visions of a desirable future, and learn the consequences and trade-offs associated with those preferences, and
- demonstrating how this can build capacity for a community led agenda on sustainable actions.

Following on from a recently completed study using the Q-method to determine motivation and barriers to voluntary community sustainability action, this study involves a Participatory Backcasting Scenario approach. Using both explorative scenarios, which show what could happen, and normative scenarios, which show how a solution to a particular problem might look, participants took part in visionary and problem-solving activities in two sessions:

Firstly, participants developed future scenarios that result in achieving at least an 80% reduction in GHG emissions through widespread citizen and community involvement.

Secondly, participants chose their preferred scenario and backcast from there as to what strategies, policies, and supports are necessary to make this happen. Participants were asked to think beyond 'usual' ideas and propose ambitious, novel and even controversial ideas. These included disruptive actions, system changers, adaptation to new and possibly unfavourable condition.

This study provides for a more informed set of preferences than can be obtained by traditional questionnaires and opinion survey methods. Results provide a link between international and national targets on one side and a range of local actions and options on the other. Using a participative process designed to involve stakeholders in visionary and problem-solving activities related to SUD, participants are encouraged to go beyond usual 'silo-thinking' and instead consider requirements for an improved process for building both awareness and capacity in developing climate change solutions at local level.

A set of reasoned and plausible recommendations are developed building on existing policies and practices by removing anomalies and demonstrating prece-

dence. Policy relevance primarily focuses on sectors (i) within the control of communities, and (ii) significant in climate protection policy. A major aim of these recommendations is providing user-friendly dissemination for communities.

The consequences of failure to meet GHG emission reduction targets will result in a situation where Ireland will need to borrow to pay fines and as yet unknown damage to the economy and international reputation. In addition, damage to infrastructure, coastal and river defences, business, agriculture, and society are uncertain. Many climate change studies address action at global and national levels, with limited potential for local level public involvement. Literature points to the involvement of local stakeholders in activities aimed at bringing their community into line with SUD as a critical element in achieving long-term sustainability goals and climate change action as adopted by many nations. Transitioning to greater sustainability requires appropriate participatory governance in planning and decision-making processes. This study contributes in aligning long-term climate change policy to the preferred future vision of communities in bringing about a low-carbon society transition.

Keywords: Participatory governance, Scenario analysis, Backcasting, Community, Climate action

Public values for a low material future

Catherine Cherry & Nick Pidgeon

Cardiff University, UK

A step change in the production and consumption of materials and products will be needed to transition towards a more sustainable, low carbon society, requiring us to identify new ways of designing, using, and delivering products, materials and services. This may include: designing for increased product longevity, durability, reparability; providing new services - extended warranties, incentivised return and upgradability; shifting from ownership to service provision; and promoting peer to peer trading, sharing or renting. Attempts to mainstream these strategies will require radical shifts in policy and business models, as well as social norms, values and practices, raising profound societal challenges. However, such strategies make implicit assumptions about the role of citizens, both in relation to the extent to which people are prepared to adopt new forms of provision and

in the novel relationships that they will require between businesses and consumers, or between peers.

Innovative ways of producing and consuming materials, products and services are therefore unlikely to be adopted successfully without a thorough consideration of wider citizen discourses, perspectives and values surrounding them. However, as yet few attempts have been made to assess the extent to which people are prepared to adopt new forms of consumption. Before recommendations can be made to decision-makers regarding the feasibility of new products and material strategies, a fundamental set of research questions will need to be addressed. As such, the aim of this research is to investigate:

- pinpoint points of public agreement/contestation regarding material demand reduction,
- elicit public perspectives on the implications of material demand reduction on everyday life,
- identify values underpinning public attitudes towards material demand reduction.

Our research explores the social acceptability of a range of different strategies for reducing consumption based energy use (ranging from lean production to a wholesale shift in consumption patterns) with members of the public. In a series of four two-day workshops, we utilised deliberative and narrative techniques to explore the possibilities for a low material future, making use of a range of scenarios, each describing one of six key areas of everyday life that might require rethinking, including: products, business, ownership, community, waste and lifestyles. In total 51 participants took part, split into four groups based on location (Cardiff and Bristol) and socio-economic status (high and low income). All workshops were audio-recorded and transcribed, and then anonymised. The dataset was coded within NVivo, using a grounded approach to analysis derived from grounded theory, and then analysed for key values and conditions that may influence public acceptability.

Public acceptability of different resource efficiency strategies varied, with participants very positive towards certain strategies (such as reduced packaging, repair schemes, extended producer responsibility, and peer-to-peer sharing/trading), whilst others (such as product-service systems and carbon taxes) proved much more controversial. Underlying these responses, a range of social values influenced the conditions under which strategies were deemed (un)acceptable. Values of fairness, trust, affordability, convenience, autonomy, community and

safety were embedded within discourse surrounding all scenarios (to varying degrees), highlighting key public concerns and desires for a low material future. Three meta-values were also identified. Concern for the environment (ensuring sustainable resource use), the economy (supporting a strong, ethical economy and jobs), and products (that are quality, long-lasting and repairable) were seen as an essential part of any low material transition.

With the discourse surrounding the circular economy and resource efficient business models echoing many of the essential values people want to see within system level changes, there is hope that in many cases they may be embraced by the wider public. However, for any new business model to succeed, it will need to align with a public vision of a desirable future. Our research highlights core values that need to be met if this future is to become a reality, and will need careful consideration if material demand reduction strategies are to be successfully introduced. Continuing analysis aims to explore how these visions can shift from imagined to plausible futures. In addition, these findings are now being used to design and implement a nationally representative online survey (n=1500) that will explore the prevalence of these values and concerns with a wider section of the UK public.

Keywords: Public perceptions, Circular economy, Sustainable consumption

Sustainability regionalized? Arctic, energy and the elusive social

Hanna Lempinen

Aleksanteri Institute, University of Helsinki, Finland

In political, popular and scholarly debates, the Arctic has become all but the world's new energy province: increasing consumption, dwindling reserves, warming climate and developing technologies are expected to push energy-related activities further and further to the previously inaccessible north. In these framings, energy in the Arctic is mostly understood as synonymous with oil and gas production for international exports: meanwhile, any societal aspects associated with energy-related developments remain largely neglected or reduced to regional socioeconomic concerns.

This presentation, based on a doctoral dissertation and an ongoing book project, is a conceptually informed critique of these narrow understandings of energy and its social dimensions, their blind spots and the consequences they have for the ways in which we think about what Arctic energy means for (northern) communities and societies.

A series of assessments and reports focusing on energy, the social dimension and/or both produced under the auspices the Arctic Council are investigated with the aim to demonstrate how energy, the social and their interface are constructed and advocated in the documents of an influential, science-based, policy-shaping intergovernmental pan-Arctic entity.

The presentation draws attention to the "regionalized" articulations of sustainability that are characteristic to the assessments and reports where social sustainability is reduced to mediating social impacts within the Arctic region, with little attention to the global implications of regional energy development.

Keywords: Arctic, Energy, Social sustainability, Sustainable development

The external dimension of renewable energy policy – analysing perceptions of EU-Maghreb renewable energy cooperation between 2007–2015

Sarah Kilpeläinen

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Regional renewable energy cooperation with the Maghreb has been an important aspect of EU energy policy making for the past two decades. However, developments lag behind expectations. In this study main obstacles in further developing EU-Maghreb renewable energy relations are being examined through a focus on perceptions of the EU's external renewable energy policy among stakeholders from the EU and the Maghreb. It is argued that differences in approaches to international renewable energy development account for some difficulties encountered in developing energy relations.

A multidimensional theoretical model is used to highlight the complex dimensions involved in policymaking, with a special focus on their interconnections. Furthermore, the model pays special attention to moving beyond a too strong

focus on technical and financial questions alone instead arguing for a holistic approach to policy analysis including a strong social dimension.

Understanding the multidimensional components of energy policy and their interconnections is vital, if we are to develop a functioning energy policy system able to support realising energy transitions. Questions of policy coherence and the external image of the EU go hand in hand in this analysis of energy policymaking, arguing that both are needed to better understand past policy challenges and to develop solutions on how to address these challenges in policy making in the future.

Focusing on the timeframe 2007–2015, the paper uses policy document analysis and Q methodology to trace policy developments and highlight differing stakeholder perceptions and their possible influence on both, the policy making process and the policy making context.

The paper will highlight past challenges and connect these to current activities in the region highlighting the extent to which past policy lessons can be applied to current challenges in the field of external energy policy. This will contribute to widening our understanding of the role the EU takes in external renewable policy making, how it relates to its partners and how these policy relationships can be developed to create a mutually beneficial energy cooperation.

Keywords: Renewables, Maghreb, EU

Future prospects of carbon-neutral economy and its production structure and consumption patterns

Time: Wednesday 13 June at 13:30–15:00

Room: Unto Kanerva

Chair: Dr. Sari Puustinen

CO2 reduction costs and benefits in transport: socio-technical scenarios

Heikki Liimatainen, Markus Pöllänen & Riku Viri

Transport Research Centre Verne, Tampere University of Technology, Finland

Transport sector produces 23% of greenhouse gas (GHG) emissions globally (Sims et al. 2014). While the mitigation of climate change requires GHG emissions to be drastically reduced, the emissions from transport sector are expected to grow (Sims et al. 2014). In Finland, transport emitted 12.1 Mt of CO₂-ekv, 19% of total GHG emissions in 2013. As an EU member state, Finland is committed to reduce GHG emissions by at least 40% by 2030 while the long-term target is at least 80% decrease by 2050, compared to 1990 emissions (European Commission 2015, MINTC 2014).

Achieving the necessary reduction in GHG emissions from transport sector is challenging and it requires aggressive and sustained mitigation policies. The policies promoting both behavioural change and uptake of improved technology offer together high mitigation potential. (Sims et al. 2014)

The purpose of this study is to produce alternative scenarios which meet the target of 80% CO₂ emissions reduction by 2050 for Finnish transport sector and to analyse the carbon abatement potentials, costs and benefits of the required behavioural and technical measures. The research question is, how can the CO₂ reduction targets in transport sector be met cost-effectively? The analysis is done on a national level using Finnish data.

There is a widely accepted framework for analysing the relationships between the economy, road freight transport demand, energy consumption and CO₂ emissions (see e.g. Liimatainen et al. 2014). For this study, the framework was replenished and applied to analyse also the passenger car transport. Other modes of passenger and freight transport are also analysed but with a lower level of detail. For the analysis, data from Statistics Finland regarding the regional accounts, road freight transport and current and forecasted population was adopted together with Finnish national travel survey data from Finnish Transport Agency as well as economic forecast from VATT Institute for Economic Research. Additionally, vehicles' emission data was adopted from VTT and NTM to construct scenarios up to 2050 on the most effective and cost efficient alternative to reach the 2050 GHG goals. For comparison, a scenario was constructed in which emission reductions are achieved only by technological measures.

The most cost efficient measure for the society is to support a shift from private car use to social car use through increasing car-sharing and ride-sharing. Ride-sharing increases the energy efficiency of car use barely without any additional costs and car-sharing decreases the size of the car fleet thus reducing the purchase costs and fixed costs of cars. Such transformation towards mobility services

requires both technological innovations and changes to legislation and market regulation.

Aiming to reach the emission reduction targets solely through technological measures would require a rapid uptake of alternative energies and the society would not receive the possible benefits, including health benefits, energy savings and fixed car cost savings. In addition, the technological measures shift emissions from transport sector to the energy sector, and in which the emissions can almost double due to the vehicles using alternative energy sources.

The aim of this study was to explore the cost effective ways to achieve the target of 80% reduction in transport GHG emissions by 2050. However, the target may be even greater than this in transport sector because emission reductions may be more difficult to achieve in other non-emissions trading sectors, for example in agriculture sector. Hence, there is a need to explore the measures, costs and benefits for even greater emission reductions in transport sector. Additionally, there may be a need to reach a great reduction well before 2050, which means that certain measures are more valid than others as the timeframe for the reductions may be shorter. There is a need for more analysis in the level of the effects and timing of individual measures as well as sensitivity analysis related to for example energy costs.

Keywords: CO2 emissions, Scenarios, Transport, Cost-benefit analysis

Electric Vehicle – Prosumer policy mix for sustainable mobility – a case study in Finland

Kirsi Kotilainen^a, Matti Kojo^a, Pami Aalto^a, Jussi Valta^b & Antti Rautiainen^b

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Climate change is pushing us to think of new ways of producing and consuming energy, moving goods and people, and building houses and cities. For example, energy systems are becoming more and more based on decentralized renewable energy sources. The smart grids enable two-way energy and data flows between producers and consumers of energy opening up novel opportunities for new services and business models. Consumers are becoming important new actors as prosumers i.e. producers and consumers of energy. At the same time, transportation sector is moving towards electrification. It is common to argue that electric

vehicles have pro-environmental advantages compared to traditional vehicles and hybrids: they can reduce pollution and noise levels locally, and greenhouse gas emissions globally. This paper introduces Finnish policy mix related to self-generation, EVs and demand response as a case study and analyses the how well the policies support sustainability.

Our research objective is to evaluate how Finnish policies related to microgeneration, electric mobility and demand response encourage small-scale energy production, use of electric vehicle with grid connection (V2G) and participation in demand response programmes and thus support the overall sustainability of electric mobility.

We are using earlier proposed sustainable Prosumer – EV policy framework as basis for documentary review on Finnish policies related to the above-mentioned areas. We complement the documentary review by economic analysis. We also conduct a comparative review with other states' policy mixes.

We argue that a more integrated policy mix is required to ensure sustainable electric mobility solutions in Finland. Based on our research, self-generation of energy by small scale producers is challenging in Finland due to the Northern geographical location. In addition, there are few economic incentives for consumers to evolve into prosumers. The policy mix today lacks subsidies for house-holds to invest in e.g. solar photo voltaic (PV). Demand response schemes for house-holds are in the early planning phase in Finland. The main focus on DR has been on tariff structure debate and design. Policy support for EVs has been almost non-existent to date in Finland. Based on the analysis we suggest a future policy mix that can support the combination of sustainable energy production by small scale producers and EVs. Our findings suggest that there are a lot of opportunities to take a more systemic approach to future ways of energy generation, consumption, electric mobility and energy efficiency. We argue that more integrated policy mixes can fast-track us to achieving sustainable future. EVs require similar kind of dedicated grid connection requirements than the solar PV. A non-discriminatory access to electricity network is needed and standards and communication protocols for charging stations have to be defined. Charging station deployment targets and building codes with minimum charging station mandates ensure that enough EV parking spaces are built. Property laws should be changed so that especially housing companies can easier deploy charging stations. Demand response need to be encouraged by means that attract consumers to participate.

Keywords: Electric vehicle, Prosumer, Demand response, Policy, Sustainability

The role of H2 by woody biomass gasification on reaching the Finnish Gov. renewable transport fuel targets for 2030

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The Finnish Government has suggested that 300 000 toe of transport fuels will be forest based by 2030. Currently several technologies exist for converting forest based biomass into liquid transport fuels, including ethanol production and Fischer-Tropsch synthesis. However, these technologies are complicated and expensive, and thus the possibility of meeting the Government transport fuel targets with these technologies seems challenging. Recently there has been a lot of interest in CH₄ production via biomass gasification coupled with catalytic methanation. The product methane can be used directly as a substitute for natural gas and the overall efficiency is rather high (0.57). Some commercial projects have been built, such as CoBiGas in Sweden and GAYA in France. Alternatively, biomass gasification could be utilized to produce H₂ (40-50% of dry product gas is H₂), which can be directly used as a transportation fuel.

The main objective of this study is to evaluate what share of the Finnish government's goals for renewable transport fuels could be reached with H₂ production by woody biomass gasification. As mentioned in Government report on the National Energy and Climate Strategy for 2030, current transactions are not enough in order to reach the goals. The amount of required production sites, and investments are discussed as well as the availability of woody biomass for H₂ production. Possible challenges for reaching the goals with H₂/CH₄ production is the lack of Gaseous fuel distribution infrastructure and historically relative old motor vehicle fleet. This work is part of the Transition to a resource efficient and climate neutral electricity system (EL-TRAN) consortium research funded by the Strategic Research Council.

The evaluation is based on information of real gasification processes available in the literature, such as the GoBiGas project in Gothenburg, Sweden. It has been estimated in The Finnish Government report on the National Energy and Climate Strategy for 2030, that 3-4Mm³ of woody biomass would be available for transport fuels. The amount of available H₂/CH₄ from the 4Mm³ of woody biomass for transport fuels is calculated and the possibilities of reaching the goals

are evaluated based on Gasification technology. The production costs of H₂/CH₄ are based on detailed material and energy balances and costs of each production step including biomass, biomass grinding, product gas purification, H₂ pressurization, as well methanation of H₂ and CO₂. Additionally, evaluation of overall economics includes investment costs for the facility with information on recent projects available in the literature.

Preliminary results show, that wood gasification technically could be used for woody biomass based fuel production. The results show that the Finnish government's goal of utilizing 300 000 toe of biofuels in the transport sector by 2030 with 3-4 Mm³ of woody biomass is challenging. The gasification product gas is rich in H₂, which could be utilized as transport fuel after purification and pressurizing. However, this would require major changes in the motor vehicle fleet, as well as the fuel distribution network. Alternatively, the H₂ could be further reacted with CO₂ to produce CH₄. The total amount of CH₄ that could be produced from 4Mm³ of woody biomass would theoretically cover 38% of the wood based renewable transport fuel goal. The advantage of CH₄ compared to H₂ is that it can be distributed through the existing natural gas infrastructure and the fuel technology for CH₄ fueled vehicles is an established technology.

The study showed that theoretically the Finnish Government's suggestion for wood based renewable transport fuel share of 300 000toe by 2030 could be reached by gasification of woody biomass. However, this could only be possible with H₂ as the primary product, and that it would require over 40 000 H₂ fueled vehicles as well as a major contribution to H₂ distribution infrastructure. If the H₂ is further converted to CH₄, the produced CH₄ could cover 38% of the wood based renewable transport fuel goal. This also seems more realistic option since the distribution infrastructure for CH₄ already exists and is growing. However, this option would require over 400 000 CH₄ fueled vehicles.

Keywords: Renewable transport fuels, Woody biomass upgrading, Finnish targets

The application of a national imaginary in local contexts – a comparative case study of public transportation in Linköping and Malmö

Amelia Mutter

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Transport solutions play a central role in the journey to fossil fuel freedom as highlighted in the Swedish context through a national goal of achieving a fossil fuel free vehicle fleet by 2030. Multiple technological solutions compete for the dominant role in the fossil fuel free imaginary, especially in the public transport sector where regional and municipal policy contribute to the choice of renewable fuel alternative.

While historically, the dominant national imaginary has hinged on biogas as the biggest hope for the future, now electric city busses are most often favored. Although this electric sociotechnical imaginary has become dominant on the national and even international scale, local actors still struggle to accommodate this future within their socio-material realities. This paper will consider how these interactions play out in two Swedish municipalities, with a focus on how local context influences the mobilization of the imaginary and public transport decision making.

Using interviews and document studies, the mobilization of and relation to the electric future imaginary is considered in Linköping and Malmö municipal bus systems.

While the dialogue in Linköping still works to acclimate the electric future imaginary with a biogas-based bus infrastructure, in Malmö they have been more willing to align local plans with the nationally accepted future imaginary. In Linköping, actors mobilize elements of the electricity imaginary alongside the local biogas imaginary. In Malmö, in contrast, more actors have accepted the national imaginary and hope to see a shift to electricity.

In each case, however, there are complexities in how the imaginary is utilized and how it influences the developing system. These complexities are nuanced by the local contexts of each system and the actors at the center.

Keywords: Sociotechnical Imaginaries, Local contexts, Public transportation, Electric vehicles, Biogas, Renewable fuels

Challenges and opportunities for future energy governance

Time: Wednesday 13 June at 13:30–15:00

Room: Kirjasto

Chair: Adjunct Professor Osmo Kuusi

The future of political globalisation and the nation state, and its impact on sustainable development/energy, based on an assessment of macro patterns in change

Michiel Jonker

Grant Thornton, South Africa

When Futurists design the preferred future of energy, it is important to consider the bigger contextual environment; e.g. what would be the impact of globalisation, but, more specifically, political globalisation (i.e. global governance), and the nation state on energy futures? A Futurist deals with three time dimensions in the Futures Triangle. The weight of history; the pushes of the present; and the pull of the future image. According to Inayatullah the weight of history represents the “deep patterns that are resistant to change (patriarchy, feudal structures, silos, macrohistory)”. The presentation will focus on macrohistory – the deep social, historical patterns in change, shaping the future of political globalisation and the nation state, and, ipso facto, the future of energy. Macrohistory (timing the future) is formally known as the third pillar in the Six Pillar Futures Theoretical Framework; but seldom used by Futurists to gain insight into the deeper patterns shaping society.

The objective is to provide research findings on how macrohistory, as part of the weight of history as a time dimension, shape the future of political globalisation (i.e. global governance), and the nation state, and what it means for sustainable energy and the future of planet Earth (Gaia); based on an analyses of four macro patterns in change – with the final objective to illustrate the: a) probable shape of the future of global governance and the nation state; and b) possible escape routes out of these identified patterns, via the human agency.

The Six Pillar Futures Theoretical Framework has been applied to achieve the research objectives; with a strong focus on the third pillar – i.e. Macrohistory (timing the future). Four macrohistorians' macrohistory patterns were assessed and these patterns were used to perform scenario planning and a CLA analysis too. The four macrohistory patterns were: a) Pierre Teilhard de Chardin (pattern: "Universal Personalization"); b) Riane Eisler (pattern: "Dominator and Partnership Shifts"); c) Arnold Toynbee (pattern: "Challenge and Response"); and d) Prabhat Sarkar (pattern: "Agency, Structure, and Transcendence"). These patterns were also used as input to a normative scenario and back-casting exercise to conclude on the macro requirements for true political globalisation and the survival of planet Earth.

Humanity and planet Earth are at a critical juncture. Survival needs, and not national identity, will determine the future of political globalisation and the nation state (and, eventually, sustainable development). If there is one pattern that will force humanity to work together, then it is Gaia's needs. However, the other macro patterns' messages are: a) Teilhard – although the world is on a very long trajectory of ever increasing complexity and unification, the opposite is multiplicity and a move away from that; b) Eisler – true world union is only possible if the world embraces a true partnership model; c) Toynbee – in order to achieve true political globalisation, the world would need an extremely creative minority who does not only respond to the environment's challenges in an appropriate manner, but who also enjoys the support of the majority; and d) Sarkar – without a true compromise between the four castes, true success on sustainable efforts would not be possible.

According to Inayatullah "macrohistory does not predict the future per se but questions patterns..." Macrohistory can be applied to contextualise events and trends. By understanding these patterns, a strategist is in a better position to understand the long term trajectory of the subject matter and can therefore be in better position to invent creative alternatives or to even escape a pattern's mechanisms; in other words, macrohistory does not insinuate that history is deterministic. Many macrohistorians did allow for an 'escape clause', from their identified patterns, via the human agency, and can therefore not be accused of deterministic views on the future. Macrohistory, should not be seen as constraining strategists, but should alert them of the given weight it carries, and how it could impact on their preferred images of the future (and in this case, how the future of political globalisation and the nation state can impact on the preferred future of sustainable energy).

Keywords: Macrohistory, Macro patterns in change, Timing the future, Political Globalization, Nation state, Energy

Competing sets of citizen visions for European futures – Implications and further potential

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Citizens across Europe have systematically been involved in articulating visions on desirable and sustainable futures in recent years. These visions have been a first step in identifying citizen induced agendas for European research and innovation. A total of 298 such visions were co-authored by citizens in three major projects funded by the European Commission (Civisti 2009, Casi 2014 and Cimulact 2016). As the citizen involvement methodology was uniform across the projects, these sets of visions provide a comprehensive look on European citizen sentiments and values concerning the future. The coverage of the citizen visions ranges from 7 countries in the Civisti project to 12 in Casi and 30 countries in Cimulact. This paper examines topics emerging in citizen visions across the projects in order to analyse whether outcomes depend on the project setting.

While considerable European-wide efforts have been made to scan citizen sentiments on desirable and sustainable futures, the particular contributions of each exercise remain unclear as do the potential benefits of conducting more such exercises. This paper represents the first attempt to assess these concerns through a joint analysis. Previously conducted content analyses of the visions have not been not comparable as Civisti's 69 visions were analyzed through 37 topics, Casi's 50 visions were expressed in 8 topic clusters and Cimulact's 179 visions in 12 domains representing 29 underlying social needs. Not having analyzed these visions jointly together further represents a missed analytical opportunity, which this paper addresses.

The citizen visions are analyzed by means of topic modelling, which is a methodology suitable for large sets of unlabeled texts. Topic modelling identifies probabilistic collocations of words, i.e. topics, across documents. The MALLET toolkit for statistical natural language processing is used to apply Latent Dirichlet Allocation (LDA) in the conducted topic modelling. The methodology is used to identify

the relative weights of the topics in the visionary corpus as well as their distribution across the three projects. Modelling is conducted with four topics and ten sampling iterations.

The results of the topic modelling show that there is one major topic which is covered in all three citizen involvement exercises: societal development that accounts for energy, environment and health (the citizen visions from each project relate to this topic to degrees ranging from 61% to 81%). The secondary topics of the visions further characterize the outcomes: the innovation oriented Casi project contributed to citizen visions relating to production (32%), the biotechnically inclined Civisti to questions of life and death (36%), and the more generally positioned Cimulact to collectives of people (15%). The results indicate that the aims and characters of each project influence the topical outcomes of the inclusive citizen engagement.

The study identified shared and particular topics in visions on sustainable futures, which were co-authored by citizens in connection to three European projects. It can be considered that a major topical body of contemporary citizen visions on desirable and sustainable futures has been established and that organisers of citizen engagement should also be aware of the effects of their project aims to the outcomes of the engagement. At the same time, the results show that there is room for more specifically targeted visionary citizen engagement activities. The study, furthermore, shows that topic modelling as a methodology suits well the analysis of comparable citizen generated and forward-looking texts.

Keywords: Citizen visions, Topic modelling, Sustainability, Social, Engagement

Conceptualizations of Energy Community based on Place, Social Groups and Social Imaginings

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University of Central Lancashire, UK

Citizens and communities are increasingly aware of energy system transformations and of their potential impacts, increasingly demanding to participate in and influence energy policy (Devine-Wright, 2014). Despite this, and whilst ac-

knowledging that future socio-energy systems should be envisioned and designed through energy industry and community collaborations, Miller et al. (2015) identify challenges surrounding developing new methodologies to devise “future energy pathways on multiple scales and temporalities” (p. 37). Miller et al. (2015) suggest four strategic directions to transform energy policy into processes for socio-energy system design. One of these avenues - socializing energy policy - proposes the need for new strategies to integrate human and social dimensions into “processes of energy design, planning, and policy-making”, requiring “understanding, acknowledging, and incorporating the ways in which people inhabit energy systems” (p. 36).

The importance of and need for further research into understanding the perceptions, priorities, involvement and support of local residents regarding large-scale energy infrastructure is evident, and Walker, Wiersma and Bailey (2014) echo this in the following statement: “How to ensure fair processes and just outcomes for local communities, and how to enhance the acceptability of energy generation facilities amongst local populations remain important areas of human-energy research. [p. 46]

We have previously stated that existing community / social groups are adequate to represent ‘the community’ in a particular locality – a convenient distinction when conducting research (Whitton, et al, 2015). In this paper, we reflect upon a deeper meaning of what and who the community are, where they reside and how community can alternatively be conceptualized when considering large-scale energy infrastructure development. We also consider the impact on energy governance of such conceptualisations.

We first carry out an analysis of the recent social science academic literature on energy infrastructure research to investigate and consider how others have conceptualized or assumed the term ‘community’. Community health research on the conceptualisation of community by Jamal (2015) provides a range of meta-narratives, representing a diversity of disciplines, comprising Anthropology, Political Theory and Sociology or a combination of these with associated sub-disciplines. We categorise this based on the following broad conceptualizations from the literature: Globally orientated approaches (Place); Public sphere and formation of community (Groups); Symbolic representations (Imaginings).

Our analysis of the energy and social science literature has highlighted that from the broad categories above, the research traditions of anthropology and sociology that encompass place based and social and community groupings research

two are common within the literature. We provide a summary table of our findings, with associated references to the literature.

We then explore the theory of social imaginings to re-conceptualize community and propose a conceptual framework that takes into account variation in energy communities that are impacted by both static (generation) and mobile (transmission) forms of infrastructure. We propose these to support social science researchers to for their own community based research when seeking new insights into how communities are represented and respond to large-scale energy system developments. We also consider the impacts on energy governance of a community based on social imaginings.

We have used the materiality of energy infrastructure to reflect on the static and mobile influence that this infrastructure has on conceptualizations of community. This has led us to consider various conceptualizations of community and to produce a conceptual framework based on our experience at energy infrastructure engagement events such as the UK nuclear Generic Design Assessment and the specific requirements of those energy communities that live adjacent or close to energy infrastructure. In this process and others, we have seen an imbalance between the [national] requirements of the convenor and those of participants regarding [local] priority issues for discussion. Our proposal of imagined energy communities provides an alternative conceptualization to those currently represented within the energy and social science literature and we hope will support academic researchers when grappling with what an energy community is, where it resides and how it can be conceptualized.

Keywords: Energy, Sustainability, Social Imaginings, Community, Participation

Review of alternative future approaches to sustainable electricity/energy access for rural communities in Lesotho

Leboli Z. Thamae, Moeketsi Mpholo and Molibeli B. Taele

Energy Research Centre, Department of Physics & Electronics, National University of Lesotho, Roma, Lesotho

The Lesotho government's commitment to provide clean energy access to predominantly low-income rural communities through electricity grid extension is posing technical and financial challenges to all relevant stakeholders due to remote and hostile terrain, dispersed households, low population densities, over-dependence on subsidies, user affordability and declining revenue collection, among other complications. Policy interventions anchored on universal access fund and fiscal support to facilitate rural access to electricity have achieved an almost 10-fold increase in household customer base from ~25,000 in 2002 to ~220,000 in 2017. However, during the same period, average annual household electricity consumption has rapidly decreased by about 65% from 3,400 kWh to 1,154 kWh due to newly connected low-consumption households, using electricity mainly for lighting. Another off-grid approach based on stand-alone solar photovoltaic home systems in the country's three highlands districts suffered a major challenge of social attitude, reliability and ease of use due to lack of local capacity and maintenance programme. This article therefore seeks to review alternative solutions for sustainable future provision of electricity/energy to rural communities in Lesotho based on the outputs of two national studies (electricity cost of service and electrification master plan) undertaken in 2017. The former study recommends introduction of lifeline tariffs at M0.65/kWh for the first 30 kWh/month for basic electricity needs of the poorest households and the accompanying cross-subsidization mechanism by higher income consumers. The latter study proposes a blended approach of grid extension (with low-cost dual or single-phase rural networks) and off-grid systems (based on stand-alone solar systems, fuel-efficient cook-stoves and hybrid renewable mini/micro-grids). For either approach, households in rural areas will be able to show improved affordability if "electricity market activation support mechanisms" do accompany electrification drives for productive use of electricity in activities generating income for rural communities and creating self-sustained local jobs.

Keywords: Lesotho, rural communities, grid extension, off-grid solutions

Energy “fantasies” and socio-technical imaginaries

Time: Wednesday 13 June at 13:30–15:00

Room: Jenny Matinaho

Chair: Dr. Riel Miller

Anticipating the energy transition: Hotspots and blindspots

Christopher Groves^a, Karen Henwood^a, Fiona Shirani^a, Erin Roberts^a & Nick Pidgeon^b

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In this paper, I want to focus on some research results relating to how the transition towards a sustainable energy system is being imagined by experts in a UK context, and to compare this with dominant framings in energy policy. I want in particular to look at the imaginaries through which the future of heating is understood, and at some methods being used by the social science team on the Flexis project at Cardiff University to increase opportunities for experts involved in energy engineering projects to reflect on the imaginaries and key assumptions about the future that structure their approaches to the energy transition problem. In particular, we are interested in hotspots (aspects of imaginaries that are widely shared, even if highly contested) and blindspots (concerns and uncertainties that are treated as less significant within dominant imaginaries or even ignored), and how enhancing reflexivity can invite different perspectives on both.

- To map and analyse socio-technical imaginaries of the energy system, including key uncertainties and the contribution of different drivers of change.
- Use innovative multimodal methods to engage aesthetic and cognitive reflexivity towards assumptions
- Show where hotspots and blindspots in imaginaries may be located and how these may create obstacles for energy policy

20 semi-structured but open-ended interviews with experts involved in the Flexis project, including engineering academics but also policy and SME actors involved in project delivery.

Interviews also featured a postcard task (drawing on Gaver et al (1999)’s ‘cultural probes’ approach) to explore affective dimensions of imagined futures. To this end, interviewees were given six postcards, three themed as ‘hope’ and three as ‘anxiety’. They were invited to fill these out before the interviews, including on each an example of a recent experience or event which had made them feel hopeful or anxious about the future. Eleven interviewees filled out at least one of these. Within the interview, once questions about future visions had been explored, the postcards were used to refocus the interview. The use of this method was intended to interrupt discussion of futures from a ‘professionalised’ perspective, provoking a more reflexive response to assumptions about how the future might turn out.

Examples are provided which show how the use of the postcard task and its evocation of personal experiences enabled participants to reflect on the meaning of concepts like ‘energy security’ and ‘affordability’ which act as hotspots within dominant imaginaries, being associated with fixed meanings that often exclude other meanings (for example: energy security as a concern for energy producers means something very different to how energy security is understood by end-users).

The resulting discussions of concepts like energy security enlarged and complicated the meaning of these ideas and the role they play in future imaginaries.

The importance of encouraging reflexivity towards future imaginaries (and hotspots/blindspots) is widely attested to within science and technology studies. This research demonstrates the value of using multimodal methods, and cultural probes in particular, to enhance traditional interviewing methods with the aim of encouraging aesthetic reflexivity. In particular, this kind of approach can evoke emotional responses to imagined futures which open up questions about dominant assumptions regarding the future, and thus allow blindspots within them to be explored.

Keywords: Future imaginaries, Energy system transitions, Expectations, Futures, Oblique methods

Japan's pursuit of a hydrogen society: Tensions and divergences between national and regional socio-technical imaginaries

Gregory Trencher

Tohoku University, Japan

Japan is a global leader in hydrogen and fuel cell (FC) technologies. It is aggressively rolling out residential co-generation FC units, FC vehicles and fuelling stations while preparing the 2020 Tokyo Olympics to demonstrate diverse societal applications of hydrogen in transport, energy storage and district co-generation. Guiding these efforts is the shared vision of a hydrogen society that emerged through tight collaboration across national government agencies, large energy producers and national automobile or electronics manufacturers. In addition to several national policy documents, Japan's nationwide pursuit of a hydrogen society is also institutionalized into a national roadmap. Consisting of three phases leading to 2040 and beyond, this calls for widespread usage of hydrogen in transport, co-generation and electricity generation and involves large-scale production from both international fossil fuel supply chains and domestic renewables.

The national vision of a hydrogen society is driven by a collective socio-technical imaginary consisting of particular assumptions, narratives, expectations and framings of a desirable future. While this highly influential national vision has inspired copy-cat visions of a hydrogen society at the prefectural level, in the case of Fukushima Prefecture, it has collided with a pre-existing and equally institutionalised vision of an alternative energy future. To accelerate the socio-economic restoration after the 2011 tsunami and nuclear disaster this calls for

at least 100% of Fukushima's energy needs to be met with renewables by 2040, paving a transition from a centralised energy exporting paradigm to a democratic model of local production and consumption. While the national hydrogen vision has significantly influenced Fukushima's imaginary around renewables, it has also bumped into several divergent framings around the most desirable energy future. So what happens when two divergent socio-technical imaginaries from differing geographical scales collide in this way? What tensions, contradictions and synergies might occur? To date, literature on this precise question is lacking, although there is growing interest in the field of energy transitions around how socio-technical imaginaries can differ across geographies.

Responding to these cues, this study aims to understand how imaginaries at two different geographical scales might interact and the consequences of this in the context of a low-carbon energy transition. By focusing on Japan's national vision of a hydrogen society and Fukushima's post-nuclear imaginary around a 100% renewables future, my principle research question is: "In what way does the national imaginary interact with and appropriate into the local imaginary in Fukushima, and specifically, what kind of concurrences complementarities are occurring on the one hand, and what kind of contestations and contradictions are occurring on the other hand?" Secondary data came from various government and industry documents while primary data was collected via ten semi-structured interviews with experts in government, industry and academic organizations and by attending academic, industry and government conferences.

This study thus identifies areas of either contradiction or complementariness with regard to the appropriation of the national hydrogen imaginary into Fukushima. This is explored through three key themes: 1) the necessity of hydrogen for widespread renewables diffusion, 2) expectations around using hydrogen and renewables to accelerate socio-economic recovery after the 2011 tsunami and nuclear disaster, and 3) the starting point, end goal and objective of the energy transition. The empirics demonstrate an underappreciated point in literature to date. That is, regardless of their limitations regarding wider relevance and transferability, nationally formed visions can in some cases complement independently formulated localised imaginaries. So while the appropriation of a national socio-technical imaginary around hydrogen into a divergent local imaginary in Fukushima generates friction, contestations and contradictions, it also create synergies and open doors for new possibilities that the local energy future alone could not accomplish.

Keywords: Contrasting socio-technical imaginaries, Different geographic scales, Energy visions, Energy futures, Hydrogen, Renewables

Shaping smart energy futures through the mobilization of demonstration projects

Fredrik Envall

Linköping University, Sweden

Smart grids are ascribed great importance in the transition to a sustainable future energy system. Currently in Sweden, several large smart grid demonstration projects are carried out and an emerging policy formation around smart grids can be

observed. Several scholars in urban studies, energy humanities and other fields have called for empirical research into what “smart” (grids, cities, urbanism) does in different contexts, e.g. how it impacts on and shapes our understanding of sustainability. This becomes a pressing issue in relation to sought-after sustainability transitions and future energy system configurations, since smart grids are expected to play a key role.

This paper follows three Swedish smart grid demonstration projects through different contexts, to try and discern whether and how they are mobilized to influence governance in the present and imaginaries of the future energy system. The studied contexts include the state agency responsible for financing and evaluating the projects, the policy network emerging around smart grids (state actors, firms, non-state actors), international institutions, the specific locations where the projects are carried out (e.g. with municipal actors), and the actors who executed the projects.

A combination of interviews and document analysis constitutes the main method, also supplemented by site visits and observations.

A dominant imaginary can be discerned, where smart grids are imagined to require very little actual change of the socio-technical energy system configuration. Several tensions threaten to destabilize this imaginary. Some actors claim that the projects’ actual significance amounts to Sweden gaining a favorable position in international organizations, and possibly future economic benefits in terms of export incomes. These actors also say that: “it’s still the same old actors with the same old technologies”, i.e. nothing new in terms of technologies tested or organizational structure was achieved. Another tension concerns responsibility, since there are many diverging views on for whom the demonstration projects are actually important. Also, actors in one project claim that their smart grid enables world class sustainable city development, whilst simultaneously claiming that they can “only do so much” and actually problematize the sustainability implications of their own project.

Different actors appear to mobilize and attempt to use the projects in different ways and for different purposes, while the influence at the policy level at first glance appears virtually non-existent. It seems to be the case however that the demonstration projects exert influence, e.g. in relation to policy, albeit not very visibly. This is evident when observing discursive shifts over time in relation to smart grids in the studied contexts, for example in relation to how electricity us-

ers are presented in policy documents and consequently how “flexibility” is interpreted in policy. It can be seen as well in the fact that the funding agencies have recently drastically changed their research financing strategy. It also becomes evident since certain actors appear to be using the projects to gain favorable positions in relation to (possibly altered) future energy system configurations.

Keywords: Smart energy, Energy futures, Demonstration projects

Futures literacy and socio-technical imaginaries: Integrating novelty and not-doing

Riel Miller

Social and Human Sciences Sector, UNESCO, France

Transforming the Future: Anticipation in the 21st Century provides key elements for understanding and changing why and how people ‘use-the-future’. The book explores three dimensions of Futures Literacy as a fundamental human capability. Part 1 elaborates a comprehensive framework for defining Futures Literacy (Chapter 1), constructed on the foundations of the Discipline of Anticipation (Chapter 2) and an examination – by applying mathematical formalisation – of the potential of collective intelligence knowledge creation processes that ‘use-the-future’ to generate novelty (Chapter 3).

Part 2 presents the design principles of one specialised tool for conducting research into the anticipatory assumptions that shape Futures Literacy, called Futures Literacy Laboratories (Chapter 4), and 14 case studies (Chapter 5) that offer tangible proof-of-concept evidence that FLL can enhance participant’s understanding of their anticipatory assumptions and that knowing why and how the future is used changes what people see and do.

Part 3, consistent with the open and comprehensive premises of the Futures Literacy Framework, offers insights into: a specific game based tool for revealing anticipatory assumptions (Chapter 6), a customised collective intelligence knowledge creation process aimed at understanding well-being (Chapter 7), and the critical role of reframing the future for sensing and making-sense of gender and power (Chapter 8).

The core hypothesis of this book is that advances in our understanding and use of anticipatory systems and processes in the 21st century could generate a change

in the conditions of change. This transformation has the potential to alter a set of distorted and damaging relationships between human agency and complexity, uncertainty and hope. Generalised Futures Literacy holds the promise of turning uncertainty from a liability into an asset by enabling people to overcome the anxieties induced by 'poverty-of-the-imagination' and the disappointments generated by vain efforts to colonize the future. Futures Literacy offers no certainties other than enhancing humanity's capacity to understand the world around us.

Methods and methodology of futures research and sustainability

Time: Wednesday 13 June at 13:30–15:00

Room: Väinö Voionmaa

Chair: Professor Rafael Popper

Common Framework for the Assessment and Management of Sustainable Innovations (CASI-F): A methodology of futures research on sustainability

Rafael Popper^a, Monika Popper^b & Guillermo Velasco^c

^aVTT Technical Research Centre of Finland, Finland, ^bFutures Diamond, UK; ^cUniversity of Manchester, UK

The aim of this paper is to introduce the methodology of futures research on sustainability, which resulted in the development of the Common Framework for the Assessment and Management of Sustainable Innovations (CASI-F). With this in mind, the paper begins with the explanation of why, what and how did CASI-F develop. What follows is the introduction of the CASI-F five step methodological approach to assessment and management of sustainable innovation, including an example of its application to a product innovation. A brief overview of how CASI-F was applied to 500+ innovations, 100+ policy briefs and 100+ citizen visions is also provided, alongside the benefits of CASI-F to four groups of SI stakeholders (i.e. government, business, civil society and research and education actors).

The objective of the paper is to promote a more effective and holistic assessment of sustainable innovation (SI). To do so, the paper shows the importance of the

seven types of sustainable innovation researched, mapped and analysed (product, service, social, organisational, governance, system and marketing) in the EU funded CASI project. In addition the paper discusses five systems (economic, social, environmental, government and infrastructure) that should be taken into account when assessing sustainable transformations and four types of critical issues or shapers of SI, namely: barriers, drivers, opportunities and threats.

The CASI-F methodology has been successfully applied to support the sustainability assessment and management of 43 innovations of the 7 different types: Social innovations (12 cases), Service innovations (11 cases), Organisational innovations (7 cases), Product innovations (5 cases), Governance innovations (4 cases), Marketing innovations (2 cases) and System innovations (2 cases). In terms of geographical scope, around 50% of the innovations were national, 30% local and 20% international. The most common sectors addressed by the innovations were education, energy, water, agriculture, ICT and health/social services. A dedicated SI Pilots web space (<http://www.casi2020.eu/casipedia/si-pilots/>) has been created to feature these 43 SI cases in the CASI Portal; however, the growing interest that different stakeholders have in future applications of CASI-F means that additional cases will be implementing the full CASI-F methodology before and potentially after the end of the CASI project.

The journey towards the finalisation of CASI-F is a good example of a collective mobilisation and mutual learning process, where CASI partners in 12 EU countries (AT, BE, BG, CZ, DE, DK, FI, IT, PL, PT, SI, UK), together with country correspondents in the other 16 Member States and a network of 40+ innovators were engaged in the co-creation and crowdsourcing of solutions to critical issues raised by the Societal Challenge on Climate Action, Environment, Resource Efficiency and Raw Materials. The CASI-F methodology helped to promote the incorporation of science in society by integrating multiple knowledge sources and multi-stakeholder perspectives (including those of citizens and sustainability experts) into the assessment of critical issues and the better management of sustainable innovations that embrace societal concerns and needs.

Both the CASI-F methodology and its 'by-products' (including CASIPEDIA, Ideas Bank, Actions Bank, Visions Bank and the supporting CASI Tutorial and other web-based Policy Watch-related modules, such as the CASI Blog and CASI Library of Documents and Policy Briefs) can be seen as state-of-the-art e-infrastructures capable of fostering Europe's innovation potential and human capital. They do this by: (1) introducing forward-looking approaches to address critical issues (potentially hampering or boosting the sustainability of SI, and (2) promoting a multi-

stakeholder and bottom-up approach to the development of the right set of aptitudes and attitudes among innovators, sponsors, brokers and beneficiaries of SI. In this sense, the widespread use of CASI-F in the assessment and management of SI will almost certainly help the EU R&I system to become more competitive on a global scale.

Keywords: Sustainable innovation, Assessment, Management, Roadmapping, Futures

Hungary 2050 – Horizon Scanning Methodology in Practice

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In 2016 and 2017 an interdisciplinary research group consisting of professional futurists and ecologists carried out horizon scanning (HS) researches with the involvement of academic experts and professional futurists under the umbrella of the Ecological Research Centre of the Hungarian Academy of Sciences (MTA), for the first time in Hungary.

Its purpose was (1) to map the possible changes in natural and human ecological systems until 2050 in the country in a multi-disciplinary way and (2) to show possible interactions between the changes to enable formulation of research tasks useful for practice from them. To this end, the research group further developed the participative phase of the HS procedure known from literature.

Based on the brainstorming results of the academic experts, a questionnaire procedure estimating impacts and probabilities with the involvement of professional futurists was organised, and then at the workshop of the research group – organising the HS – formulated the cross-cutting issues of the changes in the local ecological systems and their relation to international forecasts. The methodological experiences are presented in accordance with the phases of the developed HS practice and participating groups.

The process and methodological experiences of the first HS in Hungary show that this way of addressing the issues of the future by involvement of a wide range of experts and professional futurists and carried out with their personal presence

does not often occur in Hungary. That is why this HS process organised fundamentally for participative attendance was seen as a novelty and aroused the involved participants' interest and appreciation. Our task in the future is to maintain and increase this interest, involvement and engagement by extending the scope of participants too.

It is desired to open towards the participation of experts of the government, municipality governance systems as well as NGOs, civil and business organisations, artist so that the long term approach of the HS and its connections of possible shaping of the future of ecology should become a part of the everyday future shaping practice.

Keywords: Horizon scanning, Foresight, Brainstorming, Questionnaire, Participation, Estimation of impacts and probabilities.

Constructing comprehensive scenarios – The GHH framework for a comprehensive approach and its application in futures research

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Studying complex systems and their possible, probable and preferred futures fruitfully requires a balanced combination of comprehensive and differentiative approaches. Comprehensive approach is characterized by a broad scope of study, emphasis on interconnections and integration of knowledge from multiple disciplines and viewpoints. Differentiative approach favours specialization and analysis with a narrower focus. Combining these approaches allows us to study the big picture and simultaneously mind the details – an essential skill in interdisciplinary futures research in general and especially in constructing robust scenarios. As academic research and education are currently dominated by differentiative approaches and specialization, a stronger emphasis on comprehensive thinking skills is needed. Tending this imbalance is especially important when studying

sustainable futures, as dealing with sustainability challenges is seldom possible using knowledge developed within one discipline.

In order to integrate and apply comprehensive thinking in futures research, it is necessary to understand what comprehensive thinking actually is. In our latest research (Willamo et al. 2018), we have developed a conceptual framework for a comprehensive approach, called the GHH framework. By describing three general elements of comprehensive approach, the framework contributes to understanding comprehensiveness. The objective of this paper is to introduce the GHH framework in the context of futures research. The paper first explains the GHH framework, and then some tentative ideas of its application in futures research and especially in scenario construction are presented.

This paper is mainly theoretical as it focuses on introducing a conceptual framework for comprehensive thinking in the context of futures research. There are multiple different variants of comprehensive thinking. The GHH framework represents an approach that has been developed in the Department of Environmental Sciences in the University of Helsinki. This approach has drawn influences from (soft) systems thinking, complexity thinking, chaos thinking and dialectics. As an epistemological and heuristic instrument, the GHH framework is a tool for examining and understanding different kinds of complex systems and phenomena. The framework has been used successfully in university education of interdisciplinary environmental sciences (e.g. as a tool for creating a curriculum and writing/supervising theses) but it can be applied in academic research and university education in other relevant disciplines too. This is our first attempt to combine it with a futures perspective.

The GHH framework consists of three dimensions: 1) Generalism refers to the inclusion of multiple objects in a study and examining them from many perspectives. 2) Holism emphasizes the interactions between different parts of the system studied, and between the parts and the whole. 3) Holarchism refers to distinguishing the parts and wholes of the system by arranging them in many systemic levels and recognizing emergence between the levels. To summarize, the framework can be described as a system structure, consisting of multiple objects, perspectives, interconnections and levels. We suggest that the GHH framework can be utilised in analysing a system's change through time systematically and constructing scenarios: exploring both the future evolution of objects, perspectives, interconnections and levels and the overall shape of the resulting system. In future, we hope to test this idea in practice and reflect on the methodological implications of using this epistemological framework.

An ideal way to study the future of complex systems and to deal with sustainability issues is a dialectical and balanced combination of differentiative and comprehensive approaches. Both approaches are necessary, but a disproportionate domination of either approach can lead to problems. In the case of futures research, the excessive domination of one or the other results in a too narrow/broad scope of study and, thus, in non-functional research design. Thus, a key challenge of futures research is to find the right balance between the approaches in varying contexts and continuously evolving situations. In the academia and contemporary societies in general, the current domination of differentiative approaches impedes our ability to understand and deal with pressing sustainability challenges. This calls for a stronger emphasis on comprehensive approaches. Here, we argue that the GHH framework could act as a tool that enables us to teach and learn comprehensive thinking more effectively.

Reference:

*Willamo et al.2018: Learning how to understand complexity and deal with sustainability challenges – a framework for a comprehensive approach and its application in university education Ecological Modelling.

Keywords: Comprehensive approach, Complexity, Sustainability, Generalism, Holism, Holarchism

Four local scripts based on four alternative images of the future

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This is a proposal for the presentation of a case study: Four Scripts for Ghent 2040 (4SG2040), a project that ran in the Belgian City of Ghent from 2016 through to 2017. Our paper will describe:

A technical chronology of the 4SG2040 program, starting from its conception parallel to the broader Ghent On toMorrow (GOM) program initiated by the city of Ghent, bringing together over 350 civil servants for forward policy preparation work, to the presentation of the endproduct of the 4SG2040 effort.

The main differences and parallels between the two programs of GOM and 4SG2040, which used the same time horizon (2040) but in their implementation focused differently on actual images of the future and their uses.

The nine themes chosen for discussion with the civil servants and the technology and sustainability related ideas that were put forward by the participants, as well as how they were used in the four resulting scripts. The place of sustainability and energy topics in relation to these themes.

The methods used in the first (consultation) and second (scripting) parts of the 4SG2040 trajectory to learn about the civil servant's technology related images of the future and about their visions, including the role of expert consultation and of gatherings (including a locally held dedicated conference) herein, as well as the results of these activities.

The approaches and techniques used for the interpretation of the gathered data after more than a year of activities, the selection of building blocks for the scripts and the translation of the collected inputs into a policy supporting document in a collaboration (for the final scripting) between the in-house foresight team of the intra-communal Digipolis and the external centre of expertise of the Erasmus University College Brussels, Applied Futures Research – Open Time.

The main characteristics of the images of the future that were created in the final scripts and policy document; the compasses and layered representations of building blocks and how they were conceived.

How the combination of different methods (from horizon scanning, over trend analysis, through to Manoa alternative images of the futures, causal layered analysis and genius forecasting) was fruitful in this project, what the pitfalls and main bottle necks were.

The paper is primarily geared at presenting the results of the 4SG2040 effort and how they were achieved. In addition, it seeks to draw conclusions on applying specialized foresight methods with a technology related focus in service of local policy, paying specific attention to the benefits of bringing together a variety of approaches and actors for strengthening action towards sustainable energy and ecology.

Interactive Workshop: Energy Landscapes

Time: Wednesday 13 June at 13:30–15:00

Room: Eino Salmelaisen lämpiö

ChairS: Dr. **Josefin Wangel** (Swedish University of Agricultural Sciences, Sweden) & **Maja Frögård** (Konstfack University of Arts, Crafts and Design, Sweden)

Energy Landscapes

The aim of this workshop is to explore energy 'fantasies' or imaginaries from a timescapes and landscapes perspective. Through crafting alternative narratives and creating tools for sensitivities the workshop also provide a short-version-test of how research-through-design might contribute to understanding different energyscapes.

Energy production (conversion) and consumption (conversion) is intimately connected to 'scapes' of various types and scales. Two fundamental 'scapes' in relation to the transition to a more sustainable energy system relates to time and space, respectively. *Timescapes* helps pointing our attention to temporal dis/connectednesses, and to perceptions and practices of historical, contemporary and future energy systems. Similarly, through the concept of *landscapes*, spatial-material dimensions of the energy system can be addressed in a way that acknowledges a relational understanding of space.

This workshop invites to an intense and playful exploration of energy 'fantasies' from a timescapes and landscapes perspective, i.e. exploring energy systems as temporally, spatially, materially and socially situated energyscapes. Through crafting alternative narratives the workshop also provides a short-version-test of how research-through-design might contribute to understanding different energyscapes.

The workshop serves four purposes: 1) To jointly explore the concept of energyscapes and what that brings to the understanding of energy systems; 2) To provide a short-version-test of how research-through-design can be carried out; 3) To prototype a workshop design that will later be used in the research project Beyond Efficiency; 4) To start building a network for future collaborations for e.g. Nordic or EU proposals.

Keywords: Energyscapes, Socio-material imaginaries, Research through design

Session II

Wednesday, 13th of June at 15:30–17:30

Theory and practice of energy and resource efficiency and sufficiency

Time: Wednesday 13 June at 15:30–17:30

Room: Konserttisali

Chair: Professor Petri Tapio

How innovation in advanced power electronics can make distributed energy storage attractive?

Iliana Ilieva^a, Sanket Puranik^a & Andreas Sumper^b

^aSmart Innovation Norway, Norway; ^bUniversitat Politècnica de Catalunya, Spain

With an increasing number of distributed renewable energy sources installed at various ends of the low-voltage grid challenges arise with respect to ensuring security and quality of supply. Combining local renewable generation with local energy storage capacities can mitigate those challenges. Yet, an increasing market with dropping costs of energy storage solution of various types can be demanding, as batteries with different schedules of charging and discharging must be managed simultaneously. However, technological innovation can well respond to that issue.

Within the H2020 Project RESOLVD (2017-2020) an innovative advanced power electronics device with integrated storage management capabilities is to be developed. The device will be capable of optimizing on the co-joint charging and discharging schedules of different storage technologies. In this way the device will allow for improved grid-to-storage interactions and will contribute for better grid and flexibility control.

The advanced power electronics device is to facilitate interactions with legacy systems which makes it suitable for integration at various low-voltage grid levels

and for the benefit of various stakeholders. Thus, a diverse set of new business models can be envisioned to provide for an optimal utilization of energy storage capacities located at the relevant stakeholders' premises. The objective of this paper is to describe various stakeholders that can effectively implement the RESOLVD advanced power electronics solution and propose use cases validating the business models to be applied. In addition, the paper is to reflect on the benefits associated with the introduction of the specific technology solution.

The device to be produced in the H2020 project RESOLVD embraces a variety of new technology - a power conversion system, a battery management system and an intelligent local energy manager to cater for communications and the implementation of overall device control logic. These new technologies will be supported by a decision support toolkit, a distributed software platform and a wide area monitoring system to comprise an overall solution that successfully supports the low-voltage grid. A basic understanding of the technology is an important prerequisite for evaluating stakeholders' capability of taking it in use and making references to relevant use cases.

As a next step, the specific methods taken in use are: stakeholder analysis (with mapping of relevant stakeholders), analysis of potential market size and pricing policy, definition of new business models and specific use cases.

Our analysis suggests that the power electronics device with storage management capabilities can be attractive for various low-voltage grid users, besides for its primer users – the distribution system operators. Among the most eminent ones are considered energy communities owning storage of various types, neighborhood/block managers, industrial facilities and commercial buildings of larger-scale. The specific use-cases indicate a profitable business environment for the RESOLVD solution. However, possibilities for high degree of customization are needed and the overall applicability of the solution will depend on the market developments within the energy storage field.

This paper described an advanced power electronic device that could significantly improve grid-to-storage interactions, potentially resulting in flattening the demand curve at the substation level, loss reduction, improved voltage control and supply quality. The solution proves to be attractive for a variety of stakeholders who possess storage technology of various types, and may serve as an excellent instrument for solving low-voltage grid challenges by the distribution system operator. Having discussed the stakeholders' interest in the solution and possible use cases, the paper contributes for solving the pending distributed generation-

related challenges of the low-voltage grid. We recognize the vast potential of the RESOLVD power electronics device and are grateful for being given the possibility to work on this interesting topic within the RESOLVD project funded by the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 773715.

Keywords: Advanced power electronics, Distributed energy storage management, Business model innovation, Stakeholder use cases

Energy and matter optimization. A prototype tool for optimization of costs and benefits

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The strategic goal of the EUFORIE project is to provide useful and accurate information and knowledge in the field of energy and material resource efficiency for the EU Commission, policy makers and stakeholders in the Member States. Maximizing energy efficiency may not always be the best strategy. Other resources are crucial and sometimes limiting, such as water and rare earths. In order to fully evaluate a complex system, the account of all flows is needed.

Mono-dimensional or scale-limited energy assessments were proven to be not very telling in the presence of economic complex systems and multi-input/multi-output processes. Trade-offs are the most frequent case, where achieving an improvement of energy efficiency may require to decrease the material or the environmental or the sustainability performance of a system. As a consequence, optimization strategies capable to identify at the same time the best balance of resource investment, products and emissions, are needed, even if they not necessarily entail the maximization of energy efficiency in thermodynamic sense. Synergic integration of different (and more comprehensive than just energy-based) assessment methods resulted to be essential to deeply understand the analyzed systems. For this reason, we present an assessment tool that integrates and optimizes different evaluation approaches (such as Cumulative Material Demand, Cumulative Energy Demand, Cumulative Emissions Accounting and EMergy Accounting), resource use and emissions, in order to allow a minimization

of impacts and a comprehensive assessment of key environmental and resource issues.

The proposed user-friendly tool allows the application of standardized optimization procedures by means of transparent use of all process data and information in order to: (i) provide a full understanding of the options at stake, the performance drops and the potential improvements and (ii) support the evaluation by policy makers.

Implementation of case studies, representative of different levels (process, activity sector and economic/social system), will be carried out in order to assess potential improvements in the energy and material efficiencies and to ensure appropriate optimization solutions.

Coherent organizational transformation: A case study in energy conservation behavior change in the department of defense and department of education in Hawaii

Tyler W. Mongan

HAKU.global, USA

One of the lowest hanging fruit in reducing energy consumption is through human behavior change. Small individual changes in behavior can have huge impact over time as we strive for a sustainable energy transition. However, behavior change is also one of the most challenging pursuits within an organization culture due to engrained mental and social habits. Key insights from neuroscience and cognitive social behavior research can help to develop new approaches to coherent organization transformation. By developing an All-Around behavior change context, infusing the culture with new and relevant information, and providing an integration and mentorship framework, we were able to transform organizational cultures within the Hawaii State Department of Defense and Department of Education, resulting in the identification of over \$8 million on no-to-low cost savings for the State of Hawaii.

1. Learn why individual behavior change primes organizations for implementation high-cost efficiency and renewable technologies.
2. Explain the neuroscience and cognitive social behavior challenges to behavior change

3. Share the three components of a coherent energy conservation behavior change program: (1) All-Around Context, (2) Knowledge-Based Experience, and (3) Mentorship Motivation.
4. Discuss results from a 9-month energy conservation behavior change program implemented at the Hawaii State Department of Defense and the Department of Education
5. Explore additional opportunities to develop transition to a sustainable future using neuroscience, cardioneurology, and cognitive social behavior to inform coherent organizational transformation.

By applying the latest in neuroscience and cognitive social behavior research, a hands-on energy education and auditing experience was developed. We utilized an all-around context, knowledge-based experience, and mentoring program to discover no-cost energy saving opportunities and set goals for energy-saving projects within the Hawaii State Department of Defense and the Department of Education. Programs include a full day building energy auditing workshop, a 30-day building energy audit mentoring program, a follow-up event to present energy auditing results and participant certification ceremony.

- Developed a successful, repeatable energy audit education and behavior change program that helps organizations achieve their energy conservation goals.
- Trained 75% of the Hawaii National Guard, identifying \$100,000 per year, per base in no-to-low cost energy savings
- Trained Department of Education schools, identifying \$10,000 per year, per building in no-to-low cost energy savings
- One training saved BY University \$1.4M in energy costs from 2011-2013.
- Identified over \$8 Million in no-to-low cost energy savings for the State of Hawaii

Our work proves that energy education and auditing programs provide opportunities for changing behavior around energy consumption. Coherent organization transformational programs that use an all-around context, knowledge-based experiences, and mentoring can result in measurable and impactful changes that foster a systemic shift within a culture. By understanding individual behavior from a neuroscience and cognitive social behavior perspective, organizations can save money and improve the work environment as they transition into a sustainable future.

Keywords: Behavior, Transformation, Coherence, Neuroscience, Change, Organizational

Developing a Decision Support Tool (DST) to facilitate community led energy saving strategies in Irish urban areas

Anne Bennett, Rosemary Byrne & Bernadette O'Regan

University of Limerick, Ireland

Previous studies have stressed the need to involve communities at local level in implementation of energy saving actions in meeting national and EU targets for reduction of greenhouse gas emissions. This work focuses on the implementation of energy saving strategies by Irish urban based voluntary communities. Of EU states, Ireland currently has one of the poorest records in GHG reduction therefore urgent improvement is necessary to meet these targets. The Centre for Environmental Research in the University of Limerick, in partnership with Irish communities, undertook a study to identify reasons for the poor take-up of energy saving actions. Previously published results show that a lack of information, technical, legal and financial, was a major barrier. The work reported here relates to the provision of an online guide, in the form of a customised Decision Support Tool (DST), to aid these communities in embarking on energy saving strategies.

Objectives are:

- Find and collate relevant and up-to-date financial and legal information
- Identify and employ the most appropriate platform for the DST
- Organise content in a cascade from easily accessible introductions to more complex technical information
- Provide full references for sites providing additional technical information
- Ensure the DST is easily updated and with error recovery
- Trial the DST with Irish voluntary communities
- Launch the DST with free access.

Development of the DST comprises four phases: planning, designing, construction and evaluation. Literature review provided information on best practice in development of DSTs focusing on environmental issues, current DST technology,

database driven DSTs, web based DSTs and the user-driven design process. A comparative analysis was undertaken of database driven and web based platforms. Examination of targets as set out by the Irish Environmental Protection Agency and government documents provide a guide to the level of ambition required to affect adequate change, and the range of topics to be included. Structuring of content within the DST was informed by the need to provide full and updated information and to maintain accessibility in language and structuring for non-technical readership. The construction phase entails populating the DST with financial and legal information. Evaluation is achieved through participation of communities which agreed to trial the DST.

This is work in progress, therefore the final DST is not yet online. It was found that the internet was the most suitable platform for DST delivery due to its ease of use and wide accessibility, on a WordPress platform. The decision was made that the DST would be structured in two primary sections, 'Community Group Development' and 'Community Projects'. Community Group Development comprises aids for initial establishment of a sustainable group, while Community Projects categorises the technical, financial and legal content into seven clearly defined sectoral themes. Once the DST is fully populated with legal and financial information, it will be piloted in cooperating communities and evaluated based on usefulness and human computer interaction. The DST will then be reviewed and finalised based on feedback, and uploaded for free access. There is a distinct need for action to be taken if Ireland is to meet future EU 2030 and 2050 emission reduction targets. If transition does not occur there will be severe negative impacts on the economy and society as a whole, which could result in fines at a cost to the Irish taxpayer. Previous studies have highlighted the importance of community involvement at a local level in the transition to an energy efficient world, however Ireland is struggling to achieve this due to deficient technical, financial and legal information. This research will contribute by providing the relevant information, in relation to achieving energy saving strategies to Irish urban communities, and therefore promote knowledge transfer and incentivise change. The information will be available online in the form of a web based DST, ensuring free access to a non-technical readership.

Keywords: urban community, barriers to activism, web-based decision support tool, local level action.

Renewable energy policies and sustainability in Europe and the World

Time: Wednesday 13 June at 15:30–17:30

Room: Väinö Voionmaa

Chair: Dr. Juha Kaskinen

The policy robustness and resilience profiles of renewable energy leaders – analysing the promotion of solar power in Germany, wind energy in Denmark, and bioenergy in Finland

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Increasing the share of renewable energy in the energy palette has been seen as one of the key measures to combat climate change and to promote energy security, self-sufficiency and environmental health among other things. Long-term, forceful policy efforts to drive change towards renewables seem to be among the common denominators for European renewable energy technology leaders (Lipp 2017; Mickwitz et al. 2008). The three recent European renewable energy technology leaders are 1) Germany, that has been championing in solar power inventions; 2) Denmark, the wind energy leader; and 3) Finland, that has been one of the leading countries in bioenergy patents. In this article, we analyse the renewable energy policy mixes applied by the technology leaders. In particular, we are interested in the adaptive capacities of the policy mixes, their robustness and resilience profiles that may have helped the policies to cope over time.

Robustness and resilience are concepts that are widely applied in the realms of climate change adaptation studies and also in many other fields such as ecology, economy, and computational methods (Anderies et al. 2013; Capano & Woo 2017). Robustness and resilience refer to the ability of systems – or policies – to persist over time by overcoming both external shocks and internal perturbations (Capano & Woo, 2017). The claim of this article is that they could be more frequently applied in climate and energy policy studies that analyse attempts to actively change the system. In energy policy studies, robustness and resilience could

be useful concepts to analyse the persistence of certain policy objectives or measures e.g. in times of transitions or abrupt changes. We build our work on the adaptive policy literature (Swanson et al 2010) and contribute to the unaddressed question on how to develop a suitable mix of adaptive policy tools (Nair & Howlett, 2016). The study builds on a meta-analysis of articles on renewable energy technology leaders, Germany, Denmark and Finland. The analysis framework was built on the basis of principles for intervening in complex adaptive systems (Swanson et al. 2010). The list is based on broad theoretical and empirical work on adaptive policies. However, the principles of intervention found from the literature were grouped into five mechanisms that reflect the rate and style of policy robustness and resilience. Of the mechanisms, the three first ones - 1) rooting, 2) broadening social capital, and 3) diversifying action and information - reflect the basis and potential created for policy robustness and resilience. Meanwhile, the two latter ones - 4) creating adaptive policy mechanisms and 5) navigating strategically - deal more directly with the actual conduct of policy.

The article is still work-in-progress, and the results will be ready only early 2018. The hypotheses steering the work are that a) Germany, Denmark and Finland may have certain common robustness and resilience features in their renewable energy policy mixes and that b) analysing these three countries and their policy mixes may render some important lessons also for other countries seeking to promote renewable energy. Thus, the goal is to develop a tool to analyse the policy robustness and resilience profiles of different countries. Further, the target is to find the common and different robustness and resilience features of the European renewable energy leaders and to derive policy lessons from the cases. Conclusions will be drawn once the results of the study are ready.

Keywords: Renewable energy, Policy mix, Robustness, Germany, Denmark, Finland

Redesigning transition arenas for mid-range governance and country context specificities

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Transition management is one of the governance methodologies that can be used to catalyse vision building, experimentation and pathway construction for sustainable transitions. Its adoption in new country contexts may, however, require redesign. Finnish energy and climate policy already features wide experimentation, visioning and long-term roadmaps. Yet transition arenas could connect these existing instruments in a new way, particularly if adapted to mid-range. We redesigned the transition arena process and particularly its path creation toolsets and procedures to better serve mid-range pathway creation that features more specific pathway-steps and analysis of interrelations than long-range pathway creation conducted thus far. Our solution was to create a new set of procedures for transition arena processes paired with codesign tools to make the multiparty deliberation more efficient. The main path creation tool was based on magnetic elements that could be easily moved around a large physical metal board, set of procedures and a digitalized counterpart of the board for off-workshop commentary and reporting. The toolset was used to create eight mid-range transition pathways within a short time-frame.

We ran an eight month transition arena process with 23 experts who came widely from different energy related fields in Finnish society including four ministries, several industries, NGOs, Finnish parliament, cities and municipalities and citizens. The outcome processes were published as a report that was well received by Finnish MPs and minister to whom it was delivered. It has featured in headline news of virtually all Finnish media. Participants reported that the process helped them to envision transition goals and pathways with new accuracy and that the process facilitated and anchored well discussions with cross sectoral backgrounds.

Transition arena processes tailored to specific national context with improved codesign tools appear a promising addition to Finnish governance instruments targeted at deliberating climate and energy futures and strategies.

Keywords: Transition arena, Pathway Creation, Energy transition, Transition governance

Low carbon transition: Synergies, trade-offs, and barriers for the State of Qatar

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There is broad consensus that the current emission-intensive economic activities are not compatible with the climate system. Transition to sustainable, steady-state economy is crucial to keep the temperature well below 2°C and avoid crossing the thresholds of planetary boundaries. Each country faces a unique set of challenges, barriers, and opportunities towards low carbon society. Various domestic, regional and international drivers underpin the transition process. The Gulf Cooperation Council (GCC) is home to 29 per cent and 22 per cent of world's oil and gas reserves. The regional bloc accounts for 23 per cent and 11 per cent of global crude and natural gas production. On average, 45 per cent of the GDP, 79 per cent of fiscal revenues and 67 per cent of exports were from oil and natural gas. For countries that are extremely dependent on hydrocarbon export revenues, low carbon transition is extremely challenging. Although, many domestic and international factors such as a global rise in adoption of renewables, international climate agreement, domestic consumption of energy are forcing GCC member states to exploit renewables and stringent energy efficiency targets.

Much of the previous studies by academics and consultants in the region were limited to understand the potential of low carbon transition from a technological perspective (renewables/energy-efficiency). This study aims to address the low carbon transition in Qatar from a sociopolitical perspective. Three main focus of this study is to identify external and domestic drivers influencing low carbon transitions and explore various scenarios and pathways of transition. Investigate political and economic limitations and opportunities to transition to a low carbon economy and evaluate how institutional arrangements and policy alternatives could foster a low carbon transition.

The study adopts a three-pronged approach to understand the political economy of transition: scenario workshops, Delphi survey and semi-structured interviews with policymakers.

The findings of the scenario workshop will be presented at this conference. The participants of the workshop will be policy officials, academics, and public alike. The focus of the workshop is to understand low carbon transition from a local

perspective, structural challenges and barriers towards the transition and explore global and regional factors that will facilitate a low-carbon society. The findings of the workshop will be used in the successive stages of research in synthesizing and validating through Delphi survey and interviews with senior policymakers.

Keywords: Qatar, Economic diversification, Low carbon economy

Uncertainty analysis about the potentials of renewable energy sources in a simulation model

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According to most organizations like IEA or IIASA and oil companies like BP, the primary energy consumption will continue to increase in the next years from the current value 570 EJ until reaching in 2050 values around 800–1175 EJ.

In turn, the global energy system is facing a historic moment of constant change. The fossil resources, according to several reports, have already reached its peak or they are close to reach it. All this, added to the increasing international concern about the energy security and the climate change has implied every prospect to be established in the renewable production, in order to achieve the demand increase for the next decades.

However, there is a great uncertainty about the maximum potential that renewable energies sources (RES) could reach. Also, there are multiple potential definitions. The difference between authors lies in several orders of magnitude. Depending on which potential is considered, RES contribution to the future energy mix varies.

The main aim of this study is to carry out an uncertainty analysis about the potentials of RES. It will be used a simulation model in order to show its influence in the energy mix of world's energy demand and the limit and the circumstances under which the renewable energies will cover the world's energy demand by 2050.

To this effect, it will be necessary to study the existing renewable energies potentials in the literature. Due to the great uncertainty in the potentials, another aim

of this work is to classify them and suggest a method in which they can be processed to its later use in simulation models.

Finally, another important aim is to show the existing relation between the energy availability of the RES, through its potentials and its installation rate, and the variables in other disciplines. Due to having an integrated analysis model, it will be evaluated, among others, the land requirements due renewable energy sources and the CO₂ concentrations in the atmosphere.

First of all, it has been made a thorough study about the existing potentials in the literature for the main RES. More than 200 studies have been analysed.

As it exists a huge uncertainty between the potentials, it has been requested the expert opinion to classify these potentials in three different groups. In order to carry out the uncertainty analysis in the model, each group is considered as a different scenario. Within each group, they are given a probability range according to the existing data in the literature.

Once the probability ranges have been obtained, they are introduced in WOLIM model (<https://doi.org/10.1016/j.energy.2014.09.063>). The WOLIM model is a simulation model based on system dynamics in which the energy demand and the existing energy availability are compared. In this work, a new version of the model has been developed where there is much more disaggregation of RES and other improvements. In the model, all policies in favour renewable energies are considered.

In the electricity sector, if we run the model with the range of low potentials, RES will cover between 55-75% of the electricity demand in 2050. Also, the remaining potential will be less than 10%. In contrast, the simulation with the other two ranges of potentials would cover in 2050 all the electricity demand. Also, in these situations the possibility of continuing to grow exists due the remaining potential is still big.

The results change if we analyse the total primary energy demand. The influence of using different potentials is small, in none of the situations the renewable energies cover more than 50% of total energy demand in 2050, in the simulation with low potentials cover 33-38% while the other ranges cover near 45%. RES cannot reduce the consumption of fossil fuels; this dependence will continue in next years.

If we analyse other variables, for example land use, in the range of high potentials, the requirements of land surface for electric RES will be 265–280 MHa in 2050.

There are many studies that evaluate the maximum potentials of RES. According to most of them the potential is unlikely to be a limiting factor for RES deployment. However, there are some studies that make a very detailed analysis and they conclude that the limits in RES are much smaller than in other studies.

In high potentials range, the RES can cover the electricity demand in 2050. However, they require as land as currently urban surface, which could generate other problems like economics or a strong competition for land use. Also, due electricity covers a small part of total energy demand, the fossil fuel dependence will continue. A big change in our energy system will be necessary.

The simulation of the low range of potentials, show that in 2050 the limit in RES have appeared. In these case, the renewable production cannot cover the electricity demand in 2050. Using this potentials, a 100% RES system only would be possible with a reduction of energy consumption.

Keywords: Renewable energy sources, Potentials, Simulation model, Uncertainty analysis, System dynamics

Future prospects of carbon-neutral economy and its production structure and consumption patterns

Time: Wednesday 13 June at 15:30–17:30

Room: Yrjö Mäkelin

Chair: Adjunct Professor Jari Kaivo-oja

‘Sustainable Wellbeing’ in the EU of 2050: Consumption scenarios for transition

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As global material consumption and related GHG emissions continue to increase, the objective to avoid dangerous climate change is in increasing doubt. The Paris Agreement has established a policy framework that is pushing decarbonisation of energy through efficiency and renewables. While energy decarbonisation is necessary, it is now evident that it will not be sufficient for low-carbon transition. Increasing global consumption is overwhelming policy efforts to reduce emissions and a fundamental change in approach has become imperative.

The ‘over consumption’ of the affluent drives global GHG emissions, various environmental and economic damages and social inequality. It also has negative effects on the individual, including on health and other key life domains. It has become abundantly clear that high-growth/high-consumption development is destructive, yet policy steadfastly assumes that reducing material consumption involves cost and loss, an unpalatable political choice and an unpopular social one. This study explores ‘sustainable wellbeing’ in pathways of consumption that are more balanced and beneficial for human wellbeing and transition at the same time. Concepts such as the ‘double dividend’ have suggested that this is possible, but there has been little empirical work despite its great potential. The study develops wellbeing scenarios for the EU to 2050, and determines the emissions implications of these, quantified through the WIOD input-output framework.

Keywords: Consumption, Material, Greenhouse gas, Growth, Low carbon, Transition, Sustainable, Wellbeing

Effect of demographics on formulation and development of local economic and community plans for low carbon transitions

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GHG emissions from agriculture, transport, residential, commerce, industry and waste sectors are expanding faster than economic recovery. This presents a situation whereby Ireland is now on course to exceed its legally binding 2020 carbon budget by 12–14Mts carbon. Current policy measures account for just 4%–6% of agreed reductions, forcing Ireland to buy carbon credits from European countries, costing the Irish tax payer millions of euro. To ensure that Ireland can meet its carbon reduction commitments, new and innovative measures are needed to address the growing challenges, and the work needed to achieve these.

Rural communities have a significant role to play in the low carbon transition, however they rely heavily on external expertise and knowledge. Local Economic and Community Plans (LECP), developed by Local Authorities (LA) and public consultation are reflective of the needs of communities. LECP provides a mechanism for connecting knowledge and agency with community groups.

In order to support communities, local policy levers will be essential to creating the right circumstances for successful transitions. The Local Government Reform Act 2014 set the way for the expansion and strengthening of local authority functions and is a significant piece of legislation designed to advance the central purpose of local government. The Action Programme for Effective Local Government – Putting People First, highlights the importance of promoting quality of life and well-being for people and communities.

Therefore we aim to

- Gain an understanding of how demographics affect the Local Authority response to low carbon transition planning.
- Access the usefulness of the LECP in formulation of relevant objectives and actions.
- Determine how LECP can be used to improve LA support for community groups.

A review has been undertaken to determine the extent to which the LECP of each LA supports rural communities to become more sustainable and adapt to a low

carbon society. The review consisted of analysis and overview of the current approach taken by LA in providing support structures for low carbon community groups. High Level Goals (HLG) for each LECP were developed in response to the views of those who contributed to the consultation process. The resultant actions which support low carbon transitioning have been isolated and compared across all LA. This also provides an overview of the level of support that each LA delivers to its citizens in terms of actions relevant to low carbon transitioning and connecting communities with appropriate organisations and funding agencies.

There is a clear divide on concerns and priorities between urban LA areas and those that have a more rural aspect. The LA's located in the eastern part of Ireland are more focused on economic opportunities and social problems e.g. drugs and social exclusion. Predominately rural counties place their focus on rural isolation, transport, community engagement and increasing volunteering, localising consumption and services to maintain lifestyles in rural Ireland.

The LECP are consultation based, and it is clear that the issues, objectives and actions presented are reflective of the areas they represent. Initial analysis reveal that many challenges exist for LA and policy makers in developing pathways to low carbon transitions across diverse communities which have numerous societal issues.

An important aspect of the LECP is the mutual support of economic and community elements. Each with functions and challenges underpinning the end goal of building sustainable communities supported by strong local economies. This joined up approach results in a crossover of common action areas, such as, the economic benefits of supporting energy from renewables and energy efficiency and the community benefits of tackling fuel poverty. It also assists community groups become involved in renewable energy projects that can provide funding for other local initiatives. However, in a number of LECP the promotion of renewables and efficiency is formulated as an economic consideration. In contrast, LECP which inclusively embrace the environmental, social and economic aspects of sustainable development address sustainable or rural transport solutions, community participation, resource efficiency and social enterprise as a means to build thriving, resilient, sustainable and inclusive communities.

Keywords: Low Carbon Transition, Community actions, Sustainable, Rural

Towards sustainable household consumption? – Time-series analysis of carbon footprint household consumption in Finland

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The current consumption patterns cause severe pressure on the biosphere globally. Consumption is linked to the greenhouse gas (GHG) emissions via energy and material use – both being on an increasing trajectory. The household consumption, i.e. household consumption expenditure on housing, travel, food, and other goods and services, contributes substantial share of GHG emissions and raw material consumption (RMC) in affluent countries, such as Finland. In order to decrease the pressure from the household consumption, significant changes in consumption patterns are needed.

Our objective is to study how the carbon footprint and raw material consumption of Finnish household consumption has changed between 2000–2016 and which are the key drivers of that development. Furthermore, we want to analyze which product groups are the main contributors for GHG emissions and RMC and how the pressure from material consumption is spread between Finland and abroad.

We build a time-series of both carbon footprint and raw material consumption of Finnish household consumption between 2000–2016 by combining several data sources. We use household consumption data from national accounts (Statistics Finland) and GHG and RMC coefficients/intensities estimated with environmentally extended input-output model (EEIO). Our EEIO model is able to take account both direct and indirect emissions and material consumption. We use regression analysis to study and explain the changes in carbon footprint and RMC of household consumption.

Our hypothesis is that changes of household consumption expenditure and consumption patterns (“tastes”) contribute the changes in carbon footprint and RMC, among other drivers. We discuss our findings in the context of sustainable possible futures and relevant policy instruments in achieving those futures. We provide the forthcoming futures studies with important background information on the sustainability of Finnish household consumption.

The time-series of carbon footprint and raw material consumption of Finnish household consumption and the analysis of key drivers provide both scholars of future studies and policymakers with important background information. This study contributes to the analysis of the challenges of sustainable development in Finland from perspective of GHG emissions and raw material consumption, both being tightly linked to current and future energy use.

Keywords: Carbon footprint, Raw material consumption, Household consumption, Sustainability, Time-series analysis

An EU-28 Trends Evaluation of Sustainable Development Goal 7 and Goal 12 of Energy Policy: Final Energy Consumption in Households Per Capita, Greenhouse Gas Emissions Intensity of Energy Consumption, Primary Energy Consumption, Final Energy Consumption and Energy Productivity

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The study reports comparative benchmarking trend results of final energy consumption in households per capita, greenhouse gas emissions intensity of energy consumption, primary energy consumption, final energy consumption and energy productivity statistics of the EU-28 countries.

These energy policy variables are key variables of United Nations' sustainable development goals, SDG 7, Affordable and Clean Energy, with variables, (1) Final energy consumption in households per capita, (2) Greenhouse gas emissions intensity of energy consumption, SDG Goal 12, Responsible consumption and production with variables (3) primary energy consumption, (4) final energy consumption and (5) energy productivity.

These benchmarking results are based on Eurostat's database published in 2018. Energy SDG Database of the Eurostat is covering years 2000-2016. The benchmarking results are summaries of the Eurostat statistical observations in 2000-2016. In summary tables we apply traffic light symbols to visualise essential trend knowledge.

Challenges and opportunities for future energy governance

Time: Wednesday 13 June at 15:30–17:30

Room: Unto Kanerva

Chair: Dr. Burkhard Auffermann

Dynamics and structures for emergent building energy ecosystems in Finland?

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While there has been a lot of debate recently on business and innovation ecosystems (e.g. Adner & Kapoor, 2010; Autio & Thomas, 2013; Valkokari, 2015) as well as on shift towards renewable energy sources and systems (e.g. Airaksinen et al. 2017; Heiskanen et al. 2015; Apajalahti et al. 2015), with some exceptions (e.g. Kangas et al. 2018), less has been discussed on the dynamics of emerging energy ecosystems in construction. Even though being still a weak concept, ecosystem approach combined with multi-level perspective (MLP; e.g. Geels & Schot 2007) may provide, however, a framework to understand the change and dynamics of the emerging renewable and "smart" energy solutions systems in construction sector.

The paper is built on the hypothetical idea that so called multi-level perspective (MLP; e.g. Geels & Schot 2007; Geels 2013) and ecosystem approach may complement each. It has been suggested, that there are similarities between these two approaches on niche level, albeit the concept of innovation ecosystem should be treated critically (Oh et al. 2016). As in the transformation process relationships among actors in the regime and between regime and niche actors change and new interactions and dependencies are created (see Fischer & Newig 2016), these new emerging formations, which are not "system-wide" or singular "niches", can be called business or innovation "ecosystems". By following Moore's (1996) definition we understand a business ecosystem preliminary as "an economic community supported by a foundation of interacting organizations

and individuals". The paper tests the applicability of this framework in the empirical case of renewable and smart energy solutions in building.

The paper studies the change in Finland by using as empirical material secondary studies, documents (e.g. white papers, laws, company strategies), approximately 15 interviews of various actors (still going on) in the field of energy and construction (administration, companies and users) and workshop material. The data has been analyzed by using thematic content analysis (e.g. Greg 2012)

The preliminary analysis of the system dimensions by utilizing MLP, suggests that the current system is still highly regulated, industry-driven, in some respects oligopolistic, and characterized by vertical value-chains. There are, however, number of drivers pushing towards a profound change including e.g. policy targets, increasingly cheap renewable energy, digitalization and developing systems and services for controlling and adjusting energy use. The emerging new system seems to be based more on e.g. local hybrid solutions, users' increasingly active role, and data-driven business logic. Instead of vertical value-chains there now emerge horizontal systems based on mutual benefit of actors providing e.g. energy infrastructure and control services.

While the status of the ecosystem concept remains unclear, it may provide a useful metaphor of describing new emerging constellations and dynamics among actors in a system. As such, it is a conceptual "short-hand", rather than a robust theoretical concept that would add to e.g. previous notions of innovation systems and dynamics of change in technological systems. Despite this, we suggest that "ecosystem" might be a useful concept for describing business and innovation driven constellations based on actors' interdependencies and mutual benefits within a system (or a regime) as a distinction from hierarchical and less dynamic relationships. The concept seems to fit also to describe new emerging and complex actor relationships that are not yet institutionalized or otherwise stabilized on the system level.

Keywords: Energy system, Multi-level perspective, Eco-system

Representing disruption and discontinuity in energy models and scenarios

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Under the Paris Climate Change Accord in 2015, national governments have committed to large scale transformation of energy systems towards low carbon forms of supply and consumption. However, decarbonisation pathways might be disrupted in a number of areas, from dominant technologies and the scale of the energy system, to governance, politics, institutional arrangements and lifestyle changes. Energy systems models are often used to explore scenarios and pathways for future energy systems. In order to be credible, energy systems models and scenarios should present futures that are considered both plausible and at least reasonably probable at the time of their publication. Yet the key drivers behind energy system change, such as changes in institutional or governance structures, can often be unexpected, either due to them being considered to be of lesser importance at the time of scenario development or because they cannot be captured through the tools used.

The purpose of this study is to explore how different energy systems models and scenarios represent and assess the potential for discontinuous or disruptive change. One challenge is that there is a lack of agreement on how discontinuity and disruption should be defined and a wide variety of terms used to describe discontinuous and disruptive change (Mendonca et al., 2004, van Notten et al., 2005). The following research questions are addressed:

- To what extent have energy scenario and modelling exercises tried to represent and explore disruptive / discontinuous change in energy systems?
- How have scenario and modelling exercises distinguished between disruptive and more incremental change?
- Are particular models, approaches or techniques better suited to exploring disruptive change, or incremental change?
- Is the ability of models and scenarios to handle discontinuity / disruption dependent on the way they are structured or the way they are used in practice?

The method comprises a systematic review of academic and grey literature. The review has begun with a widely-scoped review of the scenario and modelling literature in order to provide an overview of the range of modelling approaches and scenario categories used in energy systems models and scenarios. This has been delivered through a review of reviews (search terms developed to reveal review papers) and meta-analyses over the last ten years. More focused searches have then sought data on the use of different models and scenarios to explore disruption and discontinuity. Search terms have been applied to Science Direct and Google Scholar, to include a wide range of journal paper databases such as Taylor & Francis, Wiley Online and IEEE Explore.

Interim and provisional findings are presented from a systematic review of academic and grey literature on how energy systems models and scenarios have been used to represent and analyse discontinuous changes and disruption in energy systems. An initial examination of this literature suggests that in the development of scenarios and futures analyses, thinking needs to be opened up to options or possibilities which may be hidden by mainstream or dominant views, such as potential shocks (van Notten et al., 2005; Volkery and Ribeiro, 2009). As a review of past scenario exercises by McDowell et al (2014) has shown, events and developments that were considered highly unlikely at the time a scenario was constructed, have happened. This is consistent with Mackenzie (2017), who presents evidence suggesting that IEA World Energy Outlook scenarios have frequently underestimated annual capacity increases in solar photovoltaics over the last decade.

Interim conclusions are pending and will follow further data collection and analysis. In the next phase of the project, the researcher will interview modelling and scenario practitioners, and gather unpublished data and assumptions used in scenario and modelling exercises that are relevant to disruption and discontinuity.

Keywords: Energy systems models, Scenarios, Disruption, Discontinuity, Futures

Envisioning low-carbon energy security

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Envisioning a secure low-carbon energy system is one of the key planetary challenges in the present, as the complex networked world remains heavily dependent on fossil fuels and tackling climate change is broadly acknowledged as an existential question for humanity. Finland is taken as a case study, as it on one hand has provided in traditional security of supply terms a versatile energy mix, that is, however, carbon-intensive. The country has a long history of heavy industry whose needs have shaped energy policy (Ruostetsaari, 2010). Domestically, Finland has only a limited number of energy resources, and therefore two thirds of energy has been imported. In terms of exports Nord Pool electricity market and energy trade with Russia have been the core of energy security arrangements.

Delina (2018) highlights that sociotechnical imaginaries in the context of energy are materialized into visions of transformation or continuity that is also intertwined with specific political economy. The former one, transition to a low-carbon energy system is often investigated through backcasting (e.g. Nilsson, Nilsson, Hildingsson, Stripple, & Eikeland, 2011; Quist & Vergragt, 2006), by mapping possible pathways such as in the approaches of multi-level perspective or arenas of development (Jørgensen, 2012). The latter one, continuity, is more closely associated with considerations of energy security that tend towards reactivity or conservatism regarding the future (Gruenig, Lombardi, & O'Donnell, 2016, p. 10) and the logic of war, zero-sum game or apocalyptic envisioning is common (Ciuța, 2010; Lempinen, 2013). This paper assesses how imaginaries, i.e. expressions of ways of knowing are framed in the processes of world-making (Delina, 2018) among Finnish energy sector actors in order to discover their implications for envisioning a secure low-carbon energy system.

We use as our data thematic interviews of Finnish energy sector and policy actors and document data consisting of policy documents including key strategies of Finnish government and firms, but also workshop results from our research consortium From Finland to Winland, as well as from other Finnish research consortiums. We will utilise the approach of sociotechnical imaginaries from the science and technology studies (STS) and develop it further with the framework of Ahvenharju et al. (forthcoming) that postulate five dimensions of futures consciousness that include time perspective, agency beliefs, openness to alternatives, systems perception and concern for others. This also links with the emerging literature of performative reading of energy security, i.e. our interest is not on what energy security means for a given actor, but rather how it is being made and materialized into certain visions.

Institutionalised orientations towards the future and ingrained anticipatory assumptions are expected to be one of the key challenges on the road to a secure and low-carbon energy system. They promote lock-in effects in an increasingly complex multi-actor system, preventing a clear consideration of necessary actions for energy transition. While a certain level of conservatism is inherent in energy security as a field of security, our preliminary results suggest that there is considerable room and potential for considering innovation and unforeseeable novelty in energy security thinking and practices. The challenge for future research and policy-making is how to unlock this potential in a responsible way.

Keywords: Energy security, Energy transition, Sociotechnical imaginaries, Futures consciousness, Anticipation

Can agile energy institutions mitigate for future shocks?

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Forecasting methods for conventional energy planning may work, if little future changes are expected. We may claim that the exact opposite is true for many African countries, few of whom have in the past had the capacity to anticipate what could happen in the energy sector in the next 5, 10 or 20 years. East African countries did not expect to discover oil or gas. More importantly, the rapid emergence, fall in the price, and a growing recognition of solar photovoltaics (PV), wind, storage technologies, and modern biomass options have been anticipated by only a few policy-makers.

Heinonen et al. (2017) claim that the emergence of renewables may be better understood as discontinuities built over time rather than as sudden “black swan” events (Taleb 2007). We address a research gap in analysing the institutional prerequisites to explore a growing uptake of renewable energy (Hancock et al. 2015). We examine this hypothesis by focusing on Kenya. We choose Kenya because it can be claimed to have introduced institutions that have successfully increased electricity access and expedited the uptake of renewable energy technologies.

Our work explores whether futures preparedness in the energy sector can be enhanced with institutional innovations. How could better futures preparedness shape Kenya’s institutional landscape?

Future-orientedness and foresight tools have been argued as means to reduce future uncertainty. It could also be argued that the uncertainty of the future calls for a different approach that focuses on establishing robust systems and institutions that can cope with future uncertainties and possibly identify any associated opportunities that may arise. Futures capacity needs to be embedded in institutions. Institutions can capture ideas, which serve as switches of interests or strategic constructions (Jabko 2006). Schmidt (2008) claims that ideas exist at three levels—policies, programs, and philosophies, and that their content can be cognitive or normative. As empirical data, we analyse Kenya’s Draft Energy Act (2015), which proposes a Renewable Energy Corporation to be established as a national authority. We draw on a futures workshop, organized in Nairobi in October 2017 with fifteen participants who worked in groups to discuss expectations about the new institution. To analyse future-orientedness and institutional change, we present the preliminary results of the workshop findings, which have been analysed by using qualitative content analysis. Our results suggest that futures-orientedness in institutions, seeking to govern and promote the uptake of renewable energy, could be an unexplored institutional factor. Additionally, we discuss how these institutions could be geared to anticipate the pressures of change in the energy sector for beneficial outcomes.

The paper presents a case study about institutions in energy transitions. With the paper, we open up room for further debate about their future-orientedness.

Keywords: Renewable energy, Futures preparedness, Institutional innovation, Discursive institutionalism, Institutional change, Kenya

Energy "Fantasies" and socio-technical imaginaries

Time: Wednesday 13 June at 15:30–17:30

Room: Jenny Matinaho

Chair: Adjunct Professor Katriina Siivonen

The art of letting go: the role of augmented reality in creating a post-consumption society

Monica Porteanu & Stan Ruecker

University of Illinois at Urbana-Champaign School of Fine and Applied Arts, Department of Art and Design, USA

Society wastes 24% of the food produced for human consumption. 28% of people overeat, but 28% of individuals are malnourished. The consumption problem also extends beyond food. We desire things, want money to buy them, but only need a fraction. Yet, in other contexts, "satisfying consumers [is] not a priority. Car buyers in East Germany had to order 15 years in advance. Ceausescu limited all [Romanians] to a low-calorie diet, lighting to one 40-watt bulb per room, heating to 14°C, and TV to two hours a day."

How do we stop such daunting extremes?

The study aims to uncover the switch of individual choice from consumerism to generativism, exploring symbioses among human, live and inanimate entities, across attributes such as complexity, malleability, continuity, serendipity, and empathy, as imagined in food experiences and beyond. Mr. Jaune creates food, biology, and instinct memory connections; Chef Monroe "eats like it's the end of food." [foam] transcends into worlds that "Grow.

How might we generate life instead of consuming it?" "M. Porter makes the case for a corporate augmented reality (AR) strategy based on its advantage of connecting the digital and physical worlds, as "a set of technologies that superimpose digital data and images on the physical world, promis[ing] to close this gap and release untapped and uniquely human capabilities. Spending on AR will hit \$60 billion in 2020.

Could AR also promote a generative society?

This paper proposes the study of augmented reality to reduce individual consumption by bringing to life the rigorous imagination of foresight scenarios through experience design and ethnography. The AR would overlay images or animations of personal preferences on the physical world. The AR world would be as rich as desired, while the physical world would be as simple as needed.

The study will iteratively adjust its scenarios, experience environments, and augmented reality settings to participant circumstances, interactions, and preferences, aiming to enable positive-sum situations. The results will be analyzed using decision trees. They will eventually be fed back into the augmented reality tool, empowering it to become a persuasive platform that increases future affordances and options.

Such platform could shape behaviours that shift fulfilling human desires from product consumption to experiences that delight the senses and raise moods such that the need for physical things diminishes. It would give individuals the agency to "access" things projected by the augmented reality, process these visual images and videos through their perceptory system, thus creating the comfort of having interacted with these desired objects, and reducing the want to own them in a concrete form.

Augmented reality seems to be developing in leaps and bounds, both in the corporate world and the service sector. As a result, it appears to present great opportunities at both the individual and societal level. In fact, it might be able to bridge the gaps between individual desires, needs, and wants, resulting in reduced consumerism and an increasingly generative reality. This study investigates and prototypes such scenarios, through sensory experiences enabled by augmented reality capabilities. By creating access to virtually any physical object, such a platform could promote social inclusion and create the capacity for humans to let go of the stuff most of the time they might not even need.

Keywords: Post-consumption generative society, Augmented reality

Transformation of everyday culture towards sustainability in museums

Katriina Siivonen, Satu Tuittila & Marjukka Parkkinen

Finland Futures Research Centre, University of Turku, Finland

Cultural changes in everyday life are needed in order to achieve ecologically more sustainable world. One example is a need of a new kind of food culture in order to reduce the heavy negative impact of Nitrogen fertilizers in climate change, water systems and soil. Increased production and consumption of crops producing Nitrogen in soil could be a solution and could be reached through revised food culture.

Currently, there are examples of curating processes where museums helps communities to change their everyday culture in order to adapt in e.g. climate change. We are asking: what are the possibilities of museums to co-create alternative futures on the base of traditions and cultural heritage in cooperation with their neighbouring communities and museum visitors? What kind of co-creation processes in museums can be defined as sustainable?

The research material consists of two futures processes. Firstly, we have produced material on alternative futures images of participatory curating processes in museums by utilizing futures workshops as methods. We have organized these workshops together with partners from different museums. Secondly, we have conducted futures workshops on reducing the negative impact of Nitrogen fertilizers in different communities.

In our analysis we will combine the results of both of these futures processes in order to answer our research questions. As a result we will have new conceptual insights to heritage futures, the combination of heritage and futures processes, based on our empirical futures workshops.

Our results will provide new knowledge for sustainability processes in everyday life in different communities and the potential role of museums in these processes.

Keywords: Heritage futures, Transformation, Everyday culture, Sustainability, Futures workshop, Museum

Magnetism will inaugurate the new era of humanity – analytical trilogy applied to the Keppe motor technology

Sari Koivukangas

Faculdades Trilógicas Keppe & Pacheco, Brazil

Civilization and science are based on postulates. Changing postulates changes civilization. According to Weinberg (2007), resolving current problems in physics would demand the emergence of radically new ideas. Dis-inverting Aristotelian Metaphysics has led Norberto Keppe to set a new basis for understanding energy, from which springs a revolutionary Keppe Motor (KM) technology. Having discovered the phenomena of inversion in 1977 Keppe saw that humanity is living upside down, seeing goodness as evil, love as dangerous, truth as aggression. His perception culminated in physics: “The fundamental mistake in physics is of the equation of energy with matter”, instead, matter is a sub-product of energy which can be tapped directly without destroying planet’s resources. The energy efficiency of KM is far ahead of conventional motors in all official tests. It is inexpensive to produce and use. It received patents in the U.S., China, Russia and Mexico, as well as several awards.

The objective of this paper is to analyze how the use of magnetism could possibly impact the futures, in case that humanity accepts the discoveries of a new science called Analytical Trilogy that is the unification of theology, philosophy and science. Based on Analytical Trilogy, it has been possible to develop efficient low cost electrical motors named Keppe Motor (KM). In addition to the possible futures scenario, this paper brings the official governmental studies of the energy efficiency of the Keppe Motor Technology and briefly transmits a few of Norberto Keppe’s hypotheses that have made this magnetic technology possible alongside other innovations.

In a way, combining research areas of Analytical Trilogy (theology, philosophy and science) under the umbrella of magnetism, this presentation brings forth some of the innovative areas of study and research at Faculdades Trilógicas Keppe & Pacheco in Cambuquira, Brazil, welcoming everyone to this New World.

Scenario method was used. Scenarios are narratives of the future, which describe plausible future paths and consider various factors. Their objective is to provoke thinking of decision makers and this way they also provide a base for strategic planning. The question was “What would the possible outcome be if Keppe’s

studies on magnetism, as well as resulting technologies, were widely applied in society?” However, it is understood that this occurrence faces several barriers deriving from individual and societal pathology. Also, the present and past of the Keppe Motor Technology were studied; the official documents of The National Program of Electrical Energy Conservation (PROCEL) where the efficiency of commercial models of the Keppe Motor technology is compared to other technologies were verified. From the past perspective, the reasons behind this efficiency were studied. What is the underlying theory? What is Keppe’s thesis on inversion applied to energetics and physics?

If Keppe’s studies on magnetism and the Keppe Motor technology were applied, it could mitigate Green House Gases and other pollutants, preserve ground, air and seas, hence reducing pulmonary and circulatory diseases. It eliminates the menace of energy crises, enables projects, earlier unfeasible, i. e. desalinization and transporting water to deserts, making them into fertile areas, thus reducing environmental migration. Gradual substitution of thermoelectric, hydroelectric and nuclear plants, avoiding the risk of nuclear catastrophes or other environmental hazards. Energy cost reduction, economic progress, ending economic slavery, independence of nations. Creating new markets. Achieving ISO 50.001 at low cost. Higher durability of motors. Contributing to the dematerialization of vehicles and airplanes. Eliminating conflicts caused by the search for domination of fossil fuel resources: World peace. Redirecting the technological philosophy of the world and simplifying technology.

The use of magnetism via the Keppe Motor Technology can inaugurate a new era for humanity, improving the energetic environment, decreasing pollution, providing better economic conditions, curtailing class struggles, domestic and urban violence, which directly affect people’s health and costs involved. However, the greatest challenge is how to make humanity, inverted as it is, to give up its materialistic view of reality, consolidated in Einstein’s theories that energy would derive from matter, and to accept new theories and forms of living, and consequently improving technologies to harness magnetism to serve humanity. The disinversion of physics may lead humanity to an abundant source of energy and consequent development, but this shift faces a great resistance, due to human pathology, and in particular the pathology of power.

Keywords: Energy efficiency, Keppe motor, Magnetism, Future, Analytical trilogy

Comparative analysis of the future-oriented educational practices in different regions: methodological issues

Tatiana Yakubovskaya

Scientific-Educational Center for Foresight-competence development, Nation Research Tomsk State University, Russia

In the paper we propose to consider and discuss the concept of “educational foresight event” (EFE) as an analytical model for a comparative analysis of the future-oriented educational practice in different regions.

The task to develop the analytical model for the comparative analysis came from the experience of projects “Open Foresight-laboratory for Students” in Russian regions. The educational technology “open foresight-laboratory” was developed for futures and foresight literacy programs by research and pedagogical teams in cooperation of Tomsk State University with high schools and colleges of West Siberia (Tomsk, 2012-2017) and Arctic area (Yamal, 2017).

The “open foresight-laboratory” as a futures and foresight literacy program goes beyond “futures” as isolated lessons. This is the critical and analytical, interpretive and creative and action learning modes which are realised as the series of regular educational events for students in cooperation with different groups of stakeholders including experts from research, business, culture, government and others type of institutes. This type of educational activities was named the “educational foresight event” (EFE).

The program’s content is developed according the basic principles and analytical logic of the foresight research for education and educational policy planning. In this way the Open Foresight-Lab moves participants’ thinking from an uncertain vision to more positive and constructive versions of their futures by analysis from a focus on new key technologies to the question about their effects and impacts on changes in economic, social-cultural, educational levels of social life. Participants are conducted analytical discussions about how these changes influence the exploration of worldviews and myths that underlie possible, probable and desirable futures. Finally, students are creating scenarios about futures of professions and skills and rethinking their own versions about personal educational and career scenarios.

During the implementation of this Open Foresight-Lab programs for different regions, was formulated a hypothesis about the dependence of future-oriented educational programs on regional and territorial features. This hypothesis is focused on the following main issues related to the Foresight methodology's world experience:

- on one hand, future- and foresight-literacy is based on normative principles, values, methods,
- but on the other hand, this methodology includes the regional content: economic and social-cultural particularities of region life as well as the circle of regional groups acting as participants of the educational foresight-events' programs (experts and stakeholders who are interested in territory development).

The concept and analytical model of "educational foresight event" (EFE) for the comparative analyses future-oriented educational practice connected with three key regional factors:

- Visioning (V): What kind of visions of the future are there on this territory? How do the visions of the future in the region influence future-oriented educational practices?
- Communities (C): What kind of territory groups are there who are interested in future-oriented educational practices?
- Education (E): Who are agents and what kind of approaches, programs, projects for future-oriented educational practices do they need?

Based on this EFE -model the particularities of the future-oriented educational practice have conducted comparative analyse of different region types in Russia: West Siberia (Tomsk as Scientific-education centre and Siberian Technological-Innovation region) and Arctic area (Yamal as Russia's strategic oil and gas region).

Keywords: Comparative analysis; Future-oriented educational practice; Educational foresight event; Futures literacy; Foresight literacy.

Interactive Workshop: Energy sufficiency

Time: Wednesday 13 June at 15:30–17:30

Room: Kirjasto

Chair: Dr. Sylvia Lorek

Energy sufficiency: establishing a new guiding principle to reduce total energy consumption

Sylvia Lorek

SERI, Sustainable Europe Research Institute Germany e.V. & Horizon 2020 project "European Futures of Energy Efficiency (EUFORIE), Germany

In the last four decades, energy efficiency increased significantly in OECD countries. However, only recently, total energy consumption started to decrease a little, and much more slowly than energy efficiency potentials would suggest. Thus in addition to lowering energy intensity, increasing productivity and optimizing resource use, energy sufficiency has gained new attention as a way to limit and reduce total energy consumption of a household or a country.

Where eco-efficiency is concerned with production based on using fewer resources, eco-sufficiency follows the premise that we should limit what is produced or consumed in absolute terms. Sufficiency thus essentially implies being satisfied with less material goods than usually consumed today, and being satisfied means the no loss of quality of life is implied: needs are to be satisfied in a different way, and conspicuous consumption is to be avoided. Profound discussion on sufficiency and limits, however, are only in their beginning. The workshop starts with a short introduction into the sufficiency concept and its state of debate in research and policy. To inspire debate this is followed by the presentation of findings from the EUFORIE project concentrating on the possibilities for energy sufficiency in housing. The main share of the time, however, is devoted to collect sufficiency examples from the participants' (in their respective home countries) and to brainstorm about necessary and possible policy instruments to support energy sufficiency.

Keywords: Sufficiency, Energy consumption, Limits, Social innovations, EUFORIE

Acceptability of eco-sufficient policy measures among regime members in Finland

Sanna Ahvenharju

Finland Futures Research Centre, University of Turku, Finland

According to recent research, household natural resource consumption should be reduced roughly over 60–80% in Western European countries by 2050. The challenge is formidable, and it requires a transformation in the consumption patterns and habits of present day consumers. The transformation, however, should not solely rely on changing individual behaviour. Instead, systems and structures should be created to make it possible for individuals to lead lives that consume less than today. Therefore we would need more stringent policies, which would target reductions in consumption demand. Learning ways to cap this demand would enable us to block the rebound effects, which currently are undermining most efforts of saving resources. One way is to implement new kinds of policies that would set limits to household consumption through taxation, quotas, bonus systems or other alternatives. Such systems could ensure fair and equitable levels of consumption between and within nations.

Politicians often hesitate to implement environmental – or any other – policies that are known to be controversial and provoke resistance from the public. Therefore research on environmental policies typically focuses on the acceptability of different types of policies by the members of the public. This presentation, however, presents a case when the acceptability of new kinds of consumption policies is studied among politicians and other regime representatives of the Finnish society. Finding out the preferences of the current regime exposes the potential options and paths for sustainable consumption governance.

The presentation describes the results of a Delphi survey, which has included 15 Finnish policy experts on the first round and 23 Finnish regime members on the second round. The second round has been ongoing fall 2017. The regime members include policy makers, executives from government ministries, heads of trade unions and other interest groups and businesses. They represent persons in strategic positions from all influential sectors of society from parliament to interest groups. The policy experts have experience on the various aspects of consumption society from transport to economic impacts and represent researchers,

civil servants and activist groups. In the Delphi survey, the participants have been asked to express their personal opinions, despite perceived opinions of general public, and despite potential technical implementation costs, since these may change in the future.

The Delphi process is still ongoing at the moment, thus it is too early to report results. In the Delphi survey, the participants have been being asked to evaluate the acceptability and preferability of a set of potential future policy measures that could be used to radically reduce household consumption of natural resources. These policy measures can be divided into three categories: 1 – policies to reduce the attraction of harmful products, like banning advertisements or targeted taxation, 2 – policies to promote low-consumption, like personal footprints or urban planning codes, and 3 – policies to cap total consumption by introducing quotas or reducing wages.

The Delphi process is still ongoing at the moment, thus it is too early to predict conclusions. However, the hypothesis is that more acceptable policy measures are based on pull rather than push, they are financial and not regulatory, and they are targeted rather than generalised instruments. The data will be analysed by May 2017 and hence can be reported at the conference.

Keywords: Sustainable consumption, Consumption policy, Delphi survey, Sustainable consumption governance, Acceptability of policies, Future policies

Interactive Workshop: The future reinvented: Radical energy solutions – An interactive scenario storytelling workshop

Time: Wednesday 13 June at 15:30–17:30

Room: Eino Salmelaisen lämpiö

Chairs: Chief Operating Office **Steve Wells**, Foresight Director **Alexandra Whittington**, Researcher **April Koury** & Researcher **Helena Calle**, Fast Future, USA/UK

The future reinvented: Radical energy solutions - An interactive scenario and storytelling workshop

Description:

This workshop will explore disruptive energy trends and challenges, and participants develop scenarios based on radical ideas for how to improve the power system and harness renewable energy sources. The workshop will start with a short overview of ideas that could transform the world's power systems over the next thirty years or more. The main emphasis of the workshop will be to engage participants in a process to envision how to approach reinventing the future of energy using radical scenarios and stories.

Logistics:

The workshop will require small groups of 4-6 participants to be seated at tables arranged around the room. Ideally each table would have two flip charts and/or one flip chart per table and a room that could accommodate papers being placed on the wall with tape. Markers, pens, post it notes and other sizes of paper could be placed on the tables as well.

The process that will be used at the workshop combines elements of established scenario and group discussion techniques. Radical Scenario Development uses the method known as Backcasting (forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_backcasting.htm) with a group conversation style known as the World Café (www.theworldcafe.com/key-concepts-resources/world-cafe-method/).

Backcasting means that the future conditions are predetermined at the beginning of the activity. The World Café lends a conversation style that takes place in small groups over two rounds. The approach builds on interpersonal dynamics, individual reflection and organized discussions. The process concludes with shared observations among the larger group.

The process takes place in two rounds. Between rounds, the participants will do a Café Review, where they walk around the room and observe the scenarios and timelines created by groups at other tables. The participants will be asked to comment on at least three other scenarios during Café Review. Group facilitators will be in attendance to assist groups with the group discussions and provide supplies for the participants' use.

Keywords: Scenarios, Futures studies, Energy

Session III

Thursday, 14th of June at 10:15–12:00

Special Millennium Project session with keynote speech:

New great electrification as Cultural Revolution for post-oil era
- Everybody on board!

Time: Thursday, 14th of June 10:15–12:00

Room: Konserttisali

Chair: Professor Sirkka Heinonen

Provocation for peer-to-peer energy culture

Sirkka Heinonen & Joni Karjalainen

Finland Futures Research Centre, University of Turku, Finland

Future Self-Actualization Economy for sustainable and energy efficient society

Keynote Speech by **Jerome C. Glenn**, The Millennium Project, USA

Join this co-creative and electrifying Special Millennium Project Session to probe the concrete possibilities for making visionary change happen around the world!

By 2050 energy will be emission free, almost entirely renewable, and used much more efficiently than today. We will thereby have a wealth of inexpensive, clean energy in use. An internet of energy will empower an electrified, resilient and secure society, and inspire its networked and autonomous citizens.

The aim of the workshop is to probe the novel and innovative discoveries of the Neo-Carbon Energy research project (2014–2017). Transformative scenarios have been constructed with the aid of CLA and pioneer analysis, and tested with identification of black swans. These scenarios reflect a vision of renewable energy

transition, which will now be used to open up a space for future stakeholder actions and commitments. We will also explore how the identified policy recommendations can be put into action!

A Futures Provocation will open up a vision of a future powered by renewable energy technologies where citizens will act as energy producers in a peer-to-peer society. They upload their surplus energy into a smart grid and download energy when needed. Low-cost energy, cheap and renewable raw materials, artificial intelligences, and platforms that match supply and demand will emancipate citizens as responsible producers. They also produce their energy entirely autonomously.

Jerome Glenn, the Director of the Millennium Project, will give a **special keynote** about the **Future Self-Actualization Economy for sustainable and energy efficient society**, evolving in part from the emerging peer-to-peer society to shape more sustainable and energy efficient societies.

Future synergies among AI, robotics, synthetic biology, computational science, cloud & big data analytics, artificial & augmented reality, nanotechnology, IoT & Tele-Everything, semantic web, quantum computing, tele-presence & holographic communications, intelligence augmentation, collective intelligence, blockchain, 3D/4D printing materials and biology, drowns and other driverless vehicles, conscious-technology will greatly improve energy efficiencies and what we think is possible for the future of civilization. It is widely understood that the applications of artificial narrow intelligence (ANI) to all elements of the industrial production processes and service industries (The Fourth Industrial Revolution) will have a great impact on energy, employment, and the economy. But it is less well understood, that the applications of artificial general intelligence (AGI) and synergies among next technologies will change make far more change than ANI and could create the Self-Actualization Economy and Culture. There alternative future work/tech 2050 global scenarios will be discussed and provide input to the small group discussions.

Representatives from the Millennium project, FFRC summer school and anyone interested in the future changes in the global energy landscape are invited to actively contribute and debate! The workshop participants will break out and report back to the session, and will get feedback and comments from their ideas and analysis from Jerome Glenn.

The Special Session findings will contribute to the new science-communication project called Great Electrification in a Peer-to-Peer Society (<https://www.utu.fi/en/units/ffrc/research/projects/energy/Pages/savays.aspx>)

After the special keynote by Jerome Glenn, the Director of the Millennium Project, the participants will break out in small groups to work co-creatively and to deepen the key related questions emerging from the topic. The participants will report back to the session, and will get feedback and comments from their analysis from Jerome Glenn.

Keywords: Science-communication, renewable energy, Great Electrification, Peer-to-Peer Society, Self-Actualizing Economy

Theory and practice of energy and resource efficiency and sufficiency

Time: Thursday, 14th of June 10:15–12:00

Room: Väinö Voinmaa

Chair: Dr. Maria Höyssä

Saving cooperative energy: Key learnings from a cross-cutting European agro-food energy efficiency project with particular focus on Danish dairy SMVs

Mikkel Stein Knudsen^{a,b} & Kasper Bruun Knudsen^a

^aDanish Agriculture & Food Council, Denmark; ^bFinland Futures Research Centre, University of Turku, Finland

In 2015, a report from JRC showed that the amount of energy necessary to cultivate, process, pack and bring the food to citizens' tables in the EU is the equivalent of 17% of EU's gross energy consumption. Improving energy efficiency along the food value chain is therefore vital for decreasing total energy use, and it can simultaneously strengthen Europe's sectoral competitiveness.

SCOoPE – Saving Cooperative Energy – aims at finding cost-efficient energy efficiency solutions for SMV agri-food cooperatives. The project helps increasing

market uptake of innovative and effective solutions, but it also provides valuable results regarding current industrial energy performance, general barriers for energy efficiency improvements in SMV's, and of regulatory differences within the EU.

The Danish Agriculture & Food Council is a project partner, coordinating energy audits in 5 Danish dairies. The project is supported by the Horizon 2020-programme under the call H2020-EE-2015-3-MarketUptake"

The SCOoPE-Project's objective is to reduce energy consumption directly with between 10% and 15% by implementing cost-effective energy solutions in 81 businesses across seven countries in Europe in the agri-food sectors of crop drying, meat and poultry, dairy, and fruit and vegetables transformation.

The reduction in energy consumption shall be achieved without any decrease in the production capacity of the companies. The project therefore aims to promote the uptake of specific and cross-cutting innovative technologies and techniques.

On the basis of previous academic literature and practical findings a collection of 200 Key Performance Indicators (KPI's) was gathered with relevance for the agri-food sectors participating in the project. In addition to the KPI's Extended Value Stream Maps were created for each target sector of the project.

During the course of the SCOoPE-project energy audits are performed in each of the 81 involved businesses across the four agri-food sectors in the seven different countries, and the businesses are being each benchmarked against the KPI's developed in the project.

Simultaneously, the project directly involves key actors like equipment suppliers and financial actors in order to foster investment in those energy efficiency potentials identified in the energy audit.

In another stream of the project six pilot industrial clusters are run for one year using innovative methods of Collaborative Management Systems.

As the energy audits are performed during the fall of 2017, the results of the project are not yet available. It will, however, be possible to show the outcome of the energy audits at the conference in June 2018. Special focus will be put on the results of the energy audits in Denmark, but, to the degree this will be possible, the overall results from the European study will also be presented.

Preliminary results show that even for the most efficient operations, cost-effective energy efficiency potentials can still be identified, and that energy performance, and then the cost-efficient improvement potential, varies widely among European countries.

The project is not yet finalized, so it cannot yet be verified whether the ambitious targets for improved energy efficiency will be met. However, the project has already helped enable better understanding of the energy efficiency performance of the sectors examined than what was previously available in the literature.

Furthermore, the project illustrates barriers for energy efficiency improvement projects in small- and midsize companies. Even energy audits performed at no financial cost for the company has proven difficult to arrange, and it requires significant expertise and overviews to identify the most promising (but often difficult) energy efficiency solutions. Finally, the course of the project has illuminated significant cultural and regulatory differences across EU Member States, e.g. with different implementations of the EU Energy Efficiency Directive. These project results will also be communicated during the conference presentation.

Keywords: Energy efficiency, Energy audits, EU, Competitiveness, Food industry

Unlocking energy efficiency in the tea industry: An assessment of KTDA tea factories

Edward Mungai^a, Izael Da Silva^b & Geoffrey Ronoh^c

^aKenya, Climate Innovation Centre; ^bStrathmore University, Kenya; ^cStrathmore Energy Research Centre, Strathmore University, Kenya

Accelerating the transition to efficient and resilient energy systems in the industrial process-heat sector holds the potency of unlocking significant contribution towards keeping the global temperature rise below 2 degrees Celsius and achieving carbon-neutral energy economy in Kenya. The Kenyan tea industry consumes approximately 1.5 million cubic meters (stacked) of wood annually. Fuelwood provides 99% of the process heat required for drying tea at Kenya Tea Development Agencies' (KTDA) 67 tea factories. Systemic inefficiencies in the energy consumption of these facilities have economic and environmental costs which are a major barrier to achieving resource- and cost-efficient bioenergy systems. This paper introduces a new benchmarking metric, fuelwood energy costs, collected

at the boiler mouth after excluding boiler efficiency records and measured in KSh/MWh for identifying drivers of heat energy cost within KTDA facilities. The fuelwood supply chain, onsite logistics, and boiler efficiency are studied separately and then integrated in a larger analytical framework, eventually extended to steam production costs. Alternative fuels and fuelwood plantations are assessed individually. The objectives of this paper are: 1) review existing information, design an analytical framework covering – fuelwood, alternative biomass fuels supply chains, onsite fuel logistics, and boiler operations; 2) perform field surveys; 3) analyse result provide factory (bioenergy) rankings; and 4) identify information gaps. Results strongly suggest that using high-density fuelwood lowers fuelwood energy costs. In contrast, wood price (KSh/m³stacked), transport distance or fuelwood use efficiency as currently measured by KTDA factories do not provide a credible metric to measure fuelwood energy cost. This research constitutes a best-effort attempt to harmonize a bioenergy-specific database, capacity building tasks, and a high-level ranking of KTDA factories on their potential to serve as a bioenergy flagship factory. This bioenergy flagship factory will feature top of the line onsite bioenergy logistics, innovative sustainability, cost and risk monitoring of the supply chain, as well as a long-term biomass supply strategy.

Keywords: Low Carbon Transition, Energy Efficiency, Tea Manufacturing, Biomass Energy

The Futures and options of milk farming

Susanna Lahnamäki-Kivelä

JAMK University of Applied Sciences, Finland

The aim of this study is to take part to the discussion of the future foresight in milk production and farm-level decision making with concern of forecasting. The dairy farming in Finland has encountered strong structural change and the overall size of dairy farms has been growing. This development demands the dairy farmers to have focused analyze to the business environment, including understanding the effect of driving forces. Dairy farmers need strong management skills on daily basis and ability to scan the business environment on long-term strategical development planning. Since the structural change has enormous effect on farm-

level, it also effects on other operators on agriculture sector, including education and counseling.

For agricultural education and counseling, it is vital to learn how dairy farmers do forecasting. To have fully view of dairy farmers future forecasting the study will also research which channels the dairy farmers use to find weak signals, driving forces and other forecasting signals. It is also important to learn, if they do the environmental scanning at all. With this information education and advising sector can provide sufficient information for dairy farmers.

Keywords: Dairy farming, Forecasting, Environmental scanning, Decision making

Developing visionary concepts for the water sector

Jukka Laitinen & Tarja Meristö

Laurea University of Applied Sciences, Finland & FuturesLab CoFi, Finland

The consequences of the climate change, together with the depletion of fossil energy resources, have provoked the development of numerous national and multinational energy policies towards renewable energy sources (Mediavilla et al. 2013). In the transition towards renewable energy, all potential energy sources need to be exploited and new different solutions need to be considered. In this paper, the focus is on the new opportunities related to energy and nutrient recycling in the context of water sector and water reserves. The background of the paper will base on the project Circle financed by ERFD 2016–2018.

The main objective of the project is to create future-oriented concepts for the energy and nutrient recycling in the context of water supply services.

The research questions and the guiding principles in this context are as follows:

- What are the world/society needs? to create future-oriented solutions to resource scarcity and polarization at world level
- What are the branch needs? to find knowhow-intensive education modules for export
- What are the firm needs? to exploit new opportunities and visionary concepts based on scenario alternatives
- What are the individual/consumer needs? to provide easy solutions to everyday life concerning sustainable way of living

Our aim is to apply visionary concept design for all these research questions to find out new solutions in the form of hybrid product concept.

As a framework we apply hybrid product framework. The core elements of the product consist of physical, service and know-how element but also financial, customer and ecosystem elements are taken into consideration to form comprehensive solutions.

The main methods applied in the study are scenario planning combined to the visionary concept design. Visionary concept design starts from the future and its alternative development paths and focuses on needs and opportunities identified from alternative scenarios. Scenarios will serve as an ideation source to design visionary concepts, but also as wind tunnels to test ideas and concepts (Kokkonen et al. 2005).

The data has been collected from the participatory visionary design workshop consisting of various actors in the different fields in the water service supply ecosystem, including the enablers there." As a result, we will introduce the water sector scenarios on which the visionary concepts are based on. The visionary concepts created combine two different aspect: on the other hand they are related to the energy and nutrient recycling, but on the other hand they include also water sector aspect. In addition to scenarios and visionary concepts we introduce the methodological learnings from our visionary concept design process. Hybrid products will be presented for the water sector context. Hybrid product concept design for the new product development will cover the complete process from the visionary idea to the final phase of bringing new product to market, including different aspects: service element, knowhow element and physical element of the product. The future challenges related to energy, nutrients and water are so fundamental that they are relevant to many different levels including society, industry, business and consumers as well. In the context of water service supply and energy recycling the service element can come from the water treatment plant, know-how from the university and education and the product element from industry companies in different branches. As a hybrid solution, these aspects will be combined in a new way towards a visionary solution for the future. In order to create holistic future oriented solutions, the workshop participants consist of different groups presenting business, society, NGOs and individual citizens.

Keywords: Visionary concept design, Scenario planning, Energy, Nutrients, Future, Water

Future prospects of carbon-neutral economy and its production structure and consumption patterns

Time: Thursday, 14th of June 10:15–12:00

Room: Yrjö Mäkelin

Chair: Adjunct Professor Vilja Varho

Biogas enables the resource efficient use of raw materials in a circular economy

Erika Winquist, Pasi Rikkonen & Vilja Varho

Natural Resources Institute Finland - LUKE, Finland

Transition from a fossil-based economy towards a bio-based economy requires new perspectives. Although renewable, biomass resources are limited. Thus, resource efficient use of biomass is needed. The energy density of biomass is low, which creates challenges for centralized utilization and creates possibilities for decentralized utilization. On the other hand, biomass is rich in nutrients. The sustainable utilization of biomass includes nutrient recycling. All of these aspects can be taken into account with local biogas production.

The aim of this research was to study the future role of biogas in Finland in the production of renewable energy, biofuels, biochemicals and recycled nutrients.

15 forerunners, representing farm-scale (6), co-operative (2), and centralized biogas plants (7), were selected for interviews, which were carried out in 2017. The current strengths and weaknesses as well as the future possibilities and threats were discussed concerning political atmosphere, business models, economic feasibility, subsidies, the use of biogas, and the nutrient recycling.

Starting points for feasible biogas production in a farm-scale or a centralized biogas plant are somewhat different. In the farm-scale, important issues are energy self-sufficiency, manure treatment and nutrient recycling. The centralized biogas plants treat municipal biowaste and wastewater sludge. 80% of their revenues come from gate fees and 20% from energy. Recycled nutrients are produced in some plants, but their economic importance is minor. Both the farm-scale and centralized plants are struggling with the economic feasibility. The purification and selling of traffic fuel is seen as a promising business opportunity in the near

future. In the longer time span also nutrients and biochemicals are seen as potential products. In addition, the importance in energy production may increase, because biogas can be used to stabilize the energy production from other renewable sources, i.e. wind and solar energy, and energy can be also stored in the form of biomethane.

Currently the low energy prices, the underdeveloped organic fertilizer markets as well as the yet expensive technology for small-scale biorefineries limit the profitability and expansion potential of biogas production. The future potential is significant, however, and lies particularly in decentralized, small-scale, and flexible solutions. The political atmosphere in Finland and EU as well as research hopefully helps to tackle these barriers.

Keywords: Biogas, Forerunners, Business opportunities

The forerunners' business opportunities in the biogas business branch – new paths for the future?

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Distributed energy production and markets for renewable energy (RE) technologies are currently expanding. This is due to the greener policy goals within European Union and globally resulting from sustainability concerns. Bioenergy has been an asset for Finland as there is a significant potential of biomass available, particularly from forests. Better utilization of agricultural biomass has also raised attention and can on a farm-level even compete with the forest biomass. One growing energy form is currently biogas. Small-scale biogas companies are usually farm-driven and cooperation is built in raw material logistics as well as in spreading digestate nutrients back to agricultural fields.

In this study forerunners representing farm-scale, co-operative and centralized biogas plants were interviewed and their business models and current economic situation were evaluated in the light of future potential.

15 forerunners were interviewed. The background, framework and the business model components were defined according to relevant business model literature. The main business model components were defined here as 1) Product and/or

service innovation and offerings, 2) Infrastructure and resources, 3) Earning logics, and 4) Customers and distribution channels. The entrepreneur's business model approach is applied as an analytical tool to evaluate existing and future possibilities of the biogas businesses. The current and past economic situation of companies was analyzed through available financial ratios from public final accounts. The aim was a profitability, solidity and liquidity evaluation that represents overall profitability of the biogas companies.

According to the overall profitability evaluation it seems that small-scale companies struggle with achieving a solid profitability and also solidity. In general the return of investment (ROI, %) has decreased from 9% to 5% between 2011 and 2015, but in small-scale companies ROI is even lower. The debt ratio equals that of the larger scale companies. Short term liquidity is somewhat lower level than in larger companies. The traditional products of biogas plants are usually heat, electricity, and/or the digestate. Farms have built cooperation models and shared their resources in order to arrange the manure handling as optimally as possible. Large investment is required in a biogas plant, and resources are needed both financially and through new competencies. Competent and solid co-investors (e.g. local energy companies) can ease the investment process. The current state subsidy for investment has an important role.

Overall, a more self-sufficient energy production in distributed energy systems is hoped for and calls for new business models to be utilized within agriculture. Interesting new potential can be found in purifying biogas for traffic fuel, productizing the digestate as organic fertilizers, bio chemical production, and branding of products produced with biogas, e.g. local green electricity or GHG neutral food production. There may be room for a new type of GHG trading scheme for small-scale renewable energy production. The earning logics call for new income sources from new products or services, as the end product price in traditional heat and electricity is currently low. There is still potential unused in farm-scale biogas business. Increasing the self-sufficiency of energy production and improving nutrient recycling would benefit local agriculture, and create new job and business opportunities in rural communities.

Keywords: Biogas, Business model, Agriculture, Profitability

Waking sleeping giants; Engaging Futures of the bioeconomy

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There are *Sleeping Giants* that we are about to wake in the unfolding paradigm shift to a bio-based economy. That can be seen as a multifaceted diaspora of interconnected energy possibilities that traverse the fine balance between stored and collected carbon sinks and earths bio resources. This process can be seen as *Waking Sleeping Giants*, a term and constructed methodology utilised in our futures project *Bioeconomy and Justice* at the FFRC. We illustrate the industrial desire to unleash and wake an abundant beast from deep within nature and the ethical issues that involves. We explore the ramifications of 'waking' such various energy abundant giants, those successfully woken and those that should definitely best be left in deep sleep. Strange and wonderfully innovative methods are promising to be applied to wake these Giants of the Bioeconomy that offer many scenarios and alternative futures that reveal crucial decision points and causal consequences.

The Giant metaphor is very useful as a way to approach bio-based economies, especially connecting issues of nature and society, climate change and more radical transformative innovations. The hope is that this is a useful futures approach to make sense of the multiple future potentials and dangers that the next transformation suggests.

Presented in this paper is the exploration and construction of the Giant metaphor for our futures methodology, utilised to engage and construct scenarios for long range futures of the bio-based economy, especially to expose ethical confrontations and decision points. Literature review, horizon scanning and expert interviews have formed the content for this sense-making discourse. Three transformational giant metaphor scenarios are offered that engage bio-technology, bio-resource and bio-ecology perspectives.

Keywords: Bioeconomy, Giants, Futures, Scenarios, Sinks

Woodchips as an energy source in Finland – Potential Futures

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The wood-based fuels are currently the biggest energy source in Finland with 92 TWh in 2015 comprising about 80% of total consumption of the renewable energy, and about one fourth of the total energy consumption. Woodchips are solid wood-based fuel that is typically chipped from all parts of timber, including tops, branches, stumps and trunks. Typically they are produced from the timber that cannot be used in the forest industry production. Heat production plants use about one third of all the woodchips, and the rest is used for heat production in small units, such as agricultural facilities. Overall, the wood chips can be characterised as a mature regime-level energy source that has solid technological ground and well-established production chain, as well as institutionalised policy support. The use of wood-chips as an energy source has grown eightfold after the Millennium in Finland. The share of imports, mainly from Russia, has varied considerably.

The objective of this research is to investigate the future prospects of woodchip use as an energy source in Finland. We study perceptions, experiences and representations on woodchips use and how they have evolved after the Millennium. In addition, we seek alternative future images in public discussions and users' interviews. We employ media contents and interviews as research materials. The interview material consists of 18 semi-structured theme interviews with altogether 23 interviewees that either use woodchips as an energy source at their own home or farm, or are employed in woodchip related businesses, such as engineering offices, woodchip enterprises, or energy companies. The media study consists of a content analysis on the woodchips related articles in the newspaper *Maaseudun Tulevaisuus* ("The Rural Future") between 2000 and 2016 (N=296).

We describe how the woodchip use is represented in the media and how the interviewees perceive current and future woodchip use. Utilising the interview data as well as the most recent newspaper articles from *Maaseudun Tulevaisuus*, we construct four alternative future images on the woodchip use in Finland. The future images are built around two major driving forces identified from the research material. The first driving force is the international and national energy

and climate policy. The increasing use of renewable energy sources, such as woodchips, may be promoted, which could lead to increasing use of woodchips as an energy source. On the other hand, declining political support for the use of wood-based fuels is also possible, in order to safeguard the carbon sinks in forests. The second major driving force is the interplay between centralised use of woodchips in e.g. district heating and decentralized small-scale, prosumeristic use in farms and detached houses.

We conclude that although woodchip use today seems to be on a firm ground and an established energy source, the future use is uncertain and dependent on two major driving forces. Firstly, the development of international and national climate and energy policies, and secondly, the tendency towards either centralised or small-scale use. There seems to be several possible competing uses for wood and it is uncertain which of them will become more common. The use of woodchips may be strongly influenced by emergence of new energy technologies from niche level and landscape level changes such as changing priorities of international climate and energy policies.

Keywords: Renewable energy, Woodchip, Multi-level Perspective, Bioenergy, Media study, Interview

Technology foresight of sustainable energy systems

Time: Thursday, 14th of June 10:15–12:00

Room: Unto Kanerva

Chair: Professor Markku Wilenius

Scenarios for a sustainable Scottish energy system

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Several studies exist that show the increasing economic, social and environmental attractiveness of 100% renewable energy systems globally. In the Scottish context, a transition towards sustainability in the power system has been identified, but information is lacking related to the heat and mobility sectors. In order to both retain a competitive industrial sector and meet the needs of a future society, such a broader transition needs to be mapped. This will also enable further discourse on energy related issues at a national level. Scotland has a high potential for renewable energy generation, with wind resources amongst the best in the world, and could be in an excellent position to become a significant electricity exporter to surrounding regions, and to Europe as a whole.

The aim of this work is twofold. First, scenarios of the Scottish energy system for 2030 are developed which test the feasibility of Scotland to provide energy to the rest of the UK in sufficient quantities to displace the need for further development of the controversial Hinkley Point C nuclear power plant. Second, two scenarios are developed for 2050 in which Scotland is supplied by 75% or 100% renewable energy for the electricity, heating and mobility sectors. The costs of such scenarios are compared, so that both technological and economic feasibility can be determined. At the same time, these scenarios can evoke important social discourse on the future of energy in Scotland, a discourse that is not always in line for the UK as a whole.

Four representations of the future Scottish energy system are modelled with the EnergyPLAN tool for the electricity, heating and mobility sectors. These are compared to a reference scenario developed for 2015. Key energy resources are considered, in particular the overall excellent, domestic renewable resources found

in Scotland, primarily onshore and offshore wind. The mobility sector is modelled with increasing shares of electric vehicles, and with varying levels of vehicle-to-grid participation. A cost optimal solution is investigated for each scenario, and costs are compared between scenarios to determine economically preferable pathways.

The results suggest that a 100% renewable energy system is possible for Scotland in 2050, and represents a least cost and low risk option for the future. The 100% renewable scenario would be about 8 b€ annually, compared to about 9.5 b€ for a 2050 scenario featuring only 75% renewable energy. Wind power emerges as the main source of energy generation in the system, facilitated by solar PV, bioenergy, and hydropower. Bioenergy plays an important role in the heating sector. At the same time, sustainable use of biomass is assured. A combination of electricity and synthetic fuels can satisfy the future demands for mobility, with synthetic fuels derived from sustainable renewable electricity used mainly for marine transport and aviation.

For 2030, results show that Scotland could export sustainable baseload electricity to the rest of the UK for lower overall costs than those reported to be paid in the form of a subsidised price to the proposed Hinkley Point C nuclear power plant. Scotland can provide this electricity for about 71.6 €/MWh, a 36 % reduction in the subsidised price reported to be paid of 112 €/MWh.

The reliability and sustainability of a 100% renewable energy system can be assured at an hourly resolution for the power, heat and mobility sectors for Scotland by the year 2050. Several barriers exist related to a transition towards a fully sustainable energy system, but these can be overcome through effective policy, planning and education. This is one of several studies which indicate that 100% renewable energy systems will be resilient, low cost and low risk options for the future. Such systems will also help to achieve the targets set out in the Paris Agreement, and increase overall sustainability at a national level. The use of domestic, renewable energy resources can increase energy independence, improve the national trade balance and have positive impacts on employment. Further, Scotland could become a significant electricity exporter due to its excellent renewable energy resources. The transition pathway determined in this research can serve as a starting point for renewed national and UK discourse on energy related issues.

Keywords: Renewable energy, Sustainability, Power-to-X, Energy storage'

Future smart energy software houses

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Software is the key enabling technology as digitalization is cross-cutting future energy systems spanning the production sites, distribution networks, and consumers particularly in electricity smart grids. It follows that there will be more and more ‘software houses’ in the future smart energy systems. For example, if an electricity distribution company wants to serve their customers with online monitoring of the electricity distribution situation, the network equipment supplier must provide the smart grid software components, and the focal distribution company need to connect their control room software systems to the end-user software service (e.g., online web portal or a mobile device application). Furthermore, the electricity distribution company may want to open that data for its transmission network service partners with software APIs. In all, the role of software increases across the future energy systems and, consequently, new and improved software competencies are needed.

The purpose of this work is two-fold. First we identify systematically what particular software competencies are required in the future energy systems (end-to-end). Based on that holistic understanding we determine by inference what the consequent impacts for (incumbent) non-software organizations are, and compile plausible scenarios how they can advance towards becoming proficient at software working with software companies. Our overall premise is that in future smart energy houses the critical key capabilities will be distributed systems design and operations management with software-intensive digital automation and real-time information exchange. The realizations of that can then be mapped to specific software competencies such as defining and utilizing intercompatible data interfaces across the power production, distribution and consumption network elements (e.g., AMR) to achieve for instance new demand response (DR) services, and individual’s behavior in the loop.

Our overarching method is future mapping (Futures Map). The vision of future smart energy software houses is mapped with the already progressing scenarios of energy systems transitions (e.g., smart grids) on the one hand coupled with the technology foresight of trends of software on the other hand. A lot of software is already deeply embedded in those enabling and supporting them (e.g., SGAM).

The SOTA of software technology makes it possible to tackle many of the current challenges and developments of future energy systems. Moreover, the future development of software technology and applications will advance those threads even further (plausible scenario). In addition, we recognize the changing consumer behaviors and expectations (e.g., digital services, sustainability) acting as drivers to our software focus. Our working time horizon is the year 2030 which is typically used in many current energy systems studies and policies (e.g., EU energy strategy).

The key contribution of this work is a software key competence assessment and development grid to address our research objectives. The grid tabulates the distinguished software competencies and maps them to the different organizations – including customers/consumers – involved in future smart energy systems. The resulting grid can then be used to recognize and measure the necessary software competencies in order to be able to develop them in-house or for instance to partner with software companies. Consequently, each organization can then create and improve the key organizational capabilities to be competitive in the future energy system value networks. In the smart grid context this leads to future software development and application roadmap levels ranging from smart components (e.g., next-generation AMR) to digital service businesses (e.g., demand flexibility). In general, that demystifies what digital transformation entails in future electricity industry.

Digital transformations of energy systems are enabled by software. It follows that in future energy systems more software competencies to develop and utilize systems software, applications, data and communications across all the network houses (nodes) will be needed. Consequently, there are major needs for new and improved software capabilities in different organizations spanning the entire networks. Software-intensive systems development competence becomes one of the key success factors. On the other hand, lacks in the required competences and organizational capabilities slow down future energy system transitions and may cause new risks for sustainability (e.g., cybersecurity). We present how systematically foreseeing such needs and opportunities (e.g., customer preferences) makes it possible to build intelligently future large-scale smart and sustainable energy systems fostered by software. We also show pointers for future software organization research.

Keywords: Digitalization, Smart grid, Software competence, Systems thinking, Cyber-physical-social systems, Futures research

Sociotechnical scenarios of heating and the future of ground-source heat pumps in Finland

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Ground-source heat pumps (GSHPs) have become a widely used heating technology in Finland during the past two decades, especially in smaller buildings. Due to expected changes on the heating market in years to come, continuation this success is an interesting question. Heating regime, traditionally dominated by large centralised power plants, is being complemented by new, de-centralised small-scale heating solutions. The role of GSHP amid these changes is uncertain. This research views the future of GSHPs in Finland to year 2030 through sociotechnical scenarios. Scenarios are constructed in a theory-driven manner by using development paths identified in transition literature as frames for scenarios.

To map the dynamics and potential development paths of various ways of heating buildings in Finland until 2030. Special interest is devoted on viewing the role of GSHPs.

Scenarios, Delphi and qualitative content analysis. Scenarios are constructed using development paths identified in the MLP theory. Main method is 2-round Delphi, where 1st round is done by interviews. Interview material is analysed using qualitative content analysis. Scenario drafts are constructed combining insights from the theory with results of the analysis. 2nd round, where scenario drafts are commented and complemented, is done using a questionnaire.

Research material consists of 28 expert interviews, a questionnaire and supplementary literary material. Three scenarios of heating and the future of ground-source heat pumps in these futures in Finland 2030. Results show how various policy and strategy choices affecting the heating market will influence the future of GSHPs. Methodological result is a way of building scenarios combining ideas from sustainability transitions literature and futures studies.

Heating market in Finland is in an interesting phase. Heating regime, which is traditionally dominated by large centralised power plants, is being complemented by new, de-centralised small-scale heating solutions. In smaller buildings other heat pump types will replace GSHP's, but GSHPs will continue to be used in large buildings where, along with heating, there is a need for cooling. New emerging

business models are making GSHP more approachable option for large buildings are emerging.

Keywords: Ground-source heat pump, Scenario, heating, Finland, multi-level perspective

What does the future hold? Study on the perceptions of the opportunities and challenges for the Finnish energy sector

Jukka-Pekka Bergman, Päivi Karhu, Argyro Almpantopoulou & Kirsimarja Blomqvist

Lappeenranta University of Technology, Finland

The whole energy sector is undergoing a disruptive transformation. The electrical grids that rely on one-way power transmission from large centralized power generation units are transformed to electrical grids based on decentralized electricity generation and a two-way power flow. The interoperability and flexibility of such system will be guaranteed by novel services based on digitalization. This changes the rules of the game, and the energy consumers are taking a more proactive role. As the energy market undergoes a major shift, the managers and decision-makers of different organizations struggle to make sense of the changing regulations, norms and mindsets. At the same time, try to find their own niche in changing tenet by inventing new business models, earning logics and enhancing their technical, especially digital competences. This study aims to understand the perceptions of the digital disruption and its meaning for the future opportunities and challenges for the companies.

The purpose of the study is to discover the managers' and decision-makers' perceptions of the driving forces of the energy sector change: the technical, economic and business factors that empower and facilitate the energy transition, and those that hinder or slow down such transition. Our key aim is to understand the challenges and opportunities in the Finnish energy sector renewal towards more sustainable development the lens of managerial cognition. Our research question is twofold: 1) what are the possible future paths for the energy sector, and 2) how are those perceived by the different actors in the energy ecosystem? As an outcome of the study, we create meta-scenarios, which provide normative

descriptions of the future of energy technology development, economic and social factors as well as regulative and political actions.

In our study, we use the heuristic scenario method for continuous analysis of the context of digital disruption and energy sector transition. Meta-scenarios recognize the driving forces of the operative environment as well as the triggers behind the shared cognitive frames that the actors rely on when assessing the changes in future development paths. As an input for the meta-scenarios, we utilize secondary data on technological development, market and legal developments as well as the experts' insights, which we collected via 26 semi-structured interviews. The interviewees included a variety of experts: 6 leading energy-sector-related academics, 2 research institute representatives, 5 policy makers, 10 company representatives, 2 industry association representatives and 1 representative of a non-governmental organization. We conducted also a content analysis for our interview data, in which we use the text analytics techniques for the text extraction and coding of the textual content.

The results of this study provide state-of-the-art knowledge on the on the driving forces of the future developments of the Finnish energy sector. The results show, how the energy sector ecosystems (are likely to) emerge and develop in Finland, as different actors become more inter-dependent or find emerging business opportunities together across different fields such as traditional energy as well as other industries such as ICT. Furthermore, our study presents the future challenges and opportunities for the energy sector organizations in terms of energy technology, business and policy decisions. The study shows how managers perceive the transition differently, and engages in the discussion on the underlying reasons for energy sector in transition.

As the energy sector transition accelerates, not only challenges but also new opportunities emerge due to digitalization and fast developing energy technology. The changes have a larger impact, and those open up opportunities for new actors that can enter from various other industries and even disrupt the current businesses. Important for energy sector actors is how the challenges and opportunities in sustainable development and energy transition are perceived and translated into actions. Understanding the challenges and opportunities in sustainable development and energy in transition have implications for both incumbent firms and potential new actors. We hope that our study spurs up a vivid discussion among researchers and practitioners interested in the energy sector developments.

Keywords: Decision-making, Scenario method, Energy industry, Digital disruption, Managerial cognition, Challenges and opportunities

Challenges and opportunities for future energy governance

Time: Thursday, 14th of June 10:15–12:00

Room: Kirjasto

Chair: Dr. Burkhard Auffermann

Future governance of individual energy consumption behavior change – Challenges and opportunities of bottom-up approaches

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Putting energy transition into effect requires not only improvements at the supply side, but also substantial demand side reductions, through technological energy efficiency improvements but more importantly through behavioral changes to reduce individual energy consumption. So far, there are only marginal aggregated energy reductions. Thus, changes of individual energy consumption behavior (IECB) be expected to become an ever more important playing field for future energy governance.

A particular challenge to address IECB is that to some extent classical governmental policy instruments at higher levels are only suitable for limited use, as they mainly try to impose energy efficiency through technical improvements. The IECB, particularly usage behavior, is better addressed by smaller-scale, non-hierarchical interventions of other governance actors. Reasons for this are that interventions to change IECB may touch on many private areas that are out of reach of governmental regulations.

This points to the underlying thesis of this paper: Changing IECB calls for smaller-scale, "soft" interventions by a range of actors – what we conceive of as bottom up governance.

Despite the relevance of bottom-up governance for changing IECB and a constant reference to the term in practice and science, there appears to be no commonly accepted understanding nor a comprehensive approach to successful designs.

Therefore, the aims are: (1) Based on a literature review we develop a comprehensive conception of bottom-up governance in the field of IECB and thereby refine two governance frameworks. (2) The paper explores a number of features that empirically proved to be challenges or opportunities for bottom-up governance of IECB to set out possible pathways for best-practice designs.

Accordingly, the paper pursues two research questions: RQ1: What is bottom-up governance to change IECB? RQ2: What are important components of successful bottom-up governance designs to change IECB?

To answer these two research questions, we conduct a systematic literature review. The literature review focusses on scientific publications but also includes grey literature. The search strategy comprises platforms such as Web of Science, Google scholar, Scopus as well as Google Web for grey literature. Central keywords are “bottom-up”, “top-down” and “bottom-up governance”.

In addition, the relevant literature, including literature about CIECB governance is scanned for challenges and opportunities of bottom-up governance in general.

(Re RQ1) Based on these findings, we adjust two relevant frameworks and develop a comprehensive conception of bottom-up governance in the field of IECB.

(Re RQ2) Moreover, we collect empirical findings on challenges and opportunities for best-practice designs of bottom-up governance of IECB in order to extract features for successful bottom-up governance designs for IECB.

The systematic review and from that developed framework will take into account three constitutive elements of a bottom-up governance approach: a certain type of instrument (policy), certain governance actors (politics) and certain governance level (polity). Bottom-up governance in our understanding takes into account governance arrangements with all three dimensions as constitutive elements.

Given the review of empirical findings of challenges and opportunities for successful designs and the developed framework, features for best practice designs include the following:

- Group specific: Considering segmentation of bottom-up interventions
- Type specific: Considering spill-over effects between types of IECB

- Multi-factorial: Considering habitual behavior by addressing structural and individual determining factors
- Integrated: Considering interactions of various small-scale instrument and coherence of policy mixes
- Dynamic: Considering dynamics of grassroots and movements

The constitutive elements as well as features for best practice designs are explicated and critically discussed. However, this will not result in a checklist of an ever-fitting type of instrument for bottom-up governance. Instead, we stress that one size does not fit all, but instruments have to be designed according to the respective governance arrangements, taking into account the findings in successful governance designs. This paper, therefore, contributes to future governance.

Moreover, the paper explores to what extent bottom-up approaches can add to the very ambitious aggregated political targets of energy reductions, reflecting governance for the future.

Keywords: Governance, Bottom-up, Energy consumption, Behavior change, Governance designs, Challenges and opportunities

Future Energy Governance in Anglesey, North Wales: effective stakeholder dialogue, social priorities, and perceived social impacts of new nuclear build at the community-level

Ioan Charnley-Parry & John Whitton

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As new nuclear power developments are proposed for the UK over the coming decades, it is important that public engagement and decision-making processes for these developments are carried out as effectively and sustainably as possible to benefit both current and future generations and mitigate negative social impact and conflict, particularly at the local scale. Central to this is energy governance, an important and necessary consideration if future challenges are to be managed both strategically and democratically, and if future opportunities are to be identified and seized by affected communities. Understanding the context of

affected communities, and the heterogeneity of community-level needs, concerns and priorities, is critical here. The paper details empirical research which identifies diverse social priorities at the community-level in Anglesey, North Wales, in order to better understand future energy impacts and key 'conditional issues' for local sustainable energy governance.

The paper presents and explores unique empirical data on the social priorities of local stakeholder groups in Anglesey, and discusses how local energy governance may be enhanced by a more dialogic and deliberative approach to public stakeholder engagement.

The research entails three main objectives:

1. To engage with different social groups on Anglesey to understand which social issues are prioritised by each group - in a community context, and also in the context of a new nuclear energy development
2. To identify with different social groups which social issues should be measured into the future to assess the social sustainability of a new development, in order to inform energy governance practices at the local level
3. To identify, from social group engagement and dialogue, methods and approaches which contribute to more open, effective and positive engagement, to improve public stakeholder engagement strategies for future nuclear developments in Anglesey and beyond

A mixed method, Action Research-orientated approach was employed to engage with three different social groups in Anglesey: young people (secondary school students, aged 16-17); secondary school teachers; and farmers/agriculturists. A series of group sessions were held in 2014-2015, whereby a three round process was utilised to gather both questionnaire-based quantitative data (Round 1) and dialogue-based qualitative data (Round 2 and 3). Group sessions were conducted in both the English and Welsh language depending on group preference. Data was gathered by manual completion of questionnaires and audio recordings of group sessions, which was then processed and analysed using NVivo and SPSS data software. The Action Research-orientated aspect of the approach involved participant responses from the first group dialogue session dictating in-part topics of discussion during the proceeding dialogue session. As such, dialogue remained focused on community-level and group-relevant issues.

The study finds that each of the four groups prioritises social issues to varying degrees, but that there does appear to exist a core of social priority issues which

may impact upon local public support of energy developments, which the researcher terms 'conditional issues'. The findings of the study are in line with previous research that discusses factors affecting tentative and conditional support for nuclear energy (see Bickerstaff et al., 2008; Pidgeon et al., 2008). Stakeholder-determined social criteria are presented by group-specific indicator sets (GSISs), and can serve as sustainability assessment criteria as part of future nuclear governance in Anglesey. Welsh language is revealed to be viewed as important by all groups, as are physical health and development-related local employment opportunities in Anglesey but to a lesser extent. The results show that 'the public' are heterogeneous with regards to matters of social priority, and view future energy impacts differently.

With regards to social priorities, all four participant groups place great importance on maintaining and promoting Welsh language. This key 'conditional issue' has the potential to influence public stakeholder support for new nuclear build in Anglesey; local support is likely to be influenced by the prevalence of the impacts of future energy governance on the Welsh language. I argue that local conditional issues must be identified in order to ensure that local priorities inform local energy governance, such is their potential to impact upon public acceptability and support of future energy developments. The issues also represent important criteria for social sustainability at the local level, and public stakeholder engagement should acknowledge and reflect the heterogeneity of communities by being flexible and tailorable according to social group needs and priorities, whilst ensuring greater incorporation of public stakeholders and their priorities into governance processes.

Keywords: Social impacts; Nuclear Energy; Energy Governance; Stakeholder Dialogue; Community-level; Social priorities

Present and future challenges and opportunities for South Africa's energy governance

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This paper analyses current and future challenges and opportunities for South Africa's energy governance, with a focus on the role of new renewable energy

(RE) sources in transitions from coal, in the historical context of uneven access, distribution, and governance. Like many middle- and low-income countries, South Africa suffers from high unemployment, poverty, and inequality levels; it also suffers from high per-capita greenhouse gas (GHG) emissions levels and low GDP growth. An accelerated renewable energy (RE) transition could help reverse these trends. Although roughly 90 per cent of its electricity is currently generated from coal, South Africa enjoys an abundance of solar intensity as well as wind generating capacity, capable of reducing its coal dependence by more than two-thirds in less than a decade; yet its RE consumption lags OECD and African averages. Moreover, the cost of a 50%+ RE generation transition would be lower than that of its proposed nuclear power plan.

This paper first outlines three major challenges to this transition. First, there are the political challenges associated with 'state capture' and corrupt favoritism in the determination of energy-related contracts and priorities. Second, there is the related fiscal challenges concerning the parastatal Eskom's mounting infrastructure costs in the context of widespread poverty, unequal energy access, and sluggish growth. The third type of challenge concerns socio-technical aspects of governance at different scales, one that is heightened by the large-scale introduction of RE capacity. In the second half, the paper identifies three types of opportunity that arise in overcoming these challenges. Political opportunities: ending the dominance of national-level actors over major energy decisions; fiscal opportunities: re-thinking tariff policy as a means of promoting welfare and employment creating redistribution; and socio-technical opportunities: promoting decentralized energy governance.

The methods entail a mix of quantitative and qualitative data collection, interviews, and use of primary and secondary source materials.

Preliminary results suggest that energy justice claims are most successful when combined or articulated together with other broad social justice claims, by a coalition of movement actors.

The paper will conclude with a preliminary yet detailed assessment of advantages and disadvantages of current community-level participatory energy governance initiatives. Beyond specificities, these point to the tensions inherent in combining universal, national-level justice demands with specific and highly contextualised local conditions, cultures, and participatory requirements.

Keywords: Energy and climate justice, Participatory governance

Governance and/of practices? Towards a definition and outline of a practice-sensitive approach to sustainability governance

Mattijs Smits

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Sustainability governance is a contested term and field, based on different underlying concepts and theories. Practice-theoretical approaches have become a leading body of theory within the social science literature on sustainability, providing an important way to study the dynamics of social life and routines. The resulting insights in how such 'practices' develop and change over time and are implicated in the (un)sustainable activities – for example contributing to demand for energy – have the potential to provide important insights into the governance of these issues.

However, the link between practice theories and sustainability governance is underdeveloped, partly because of the tension between complexity, interlinkages and routinised character associated with practices, and governance as a way of (deliberate) steering of these practices. A challenge is thus to come up with a definition of sustainability governance that does justice to practices as contingent and context-dependent processes. This paper takes on these challenges by (1) discussing institutional, behavioural and transition perspectives to sustainability governance, (2) a review of attempts within practice theory to link to policy and governance, (3) conceptually linking key features of practice theory to governance principles, and (4) outlining a definition and practice-sensitive approach to sustainability governance.

Methods and methodology of futures research and sustainability

Time: Thursday, 14th of June 10:15–12:00

Room: Jenny Matinaho

Chair: Adjunct Professor Jyrki Luukkanen

Present and future of the electric energy consumption of the residential sector in Cuba: Some collective responses of its use

Reineris Montero Laurencio

Higher Metallurgical Mining Institute of Moa, Cuba

In Cuba, it is a priority to guarantee the energy carriers for economic and social activity. The country's energy base, characterized by its high dependence on imported fuel, requires the study of consumption behavior and the demand for electricity, laying out strategies to guarantee customer satisfaction to favor the continuous improvement of the energy matrix. One of the strategies is related to the generation of electric power to cover more efficiently the demands of the country. In the particular case of the residential sector, the service of the National Electric Power System reaches almost 99% of the population, however, studies of the collective responses of the use of the electricity energy carrier that allow, define actions in terms of policies are required energy and take technical decisions to make the best use of them for the sake of sustainable energy development.

Determine the particularities of the electric power consumption of the residential sector in Cuba, which allow an interpretation of its behavior through an analysis that includes technical aspects of the loads and distribution circuits, the energy policies for the sector and the elements of sustainable energy development.

The analysis of the data series of the electric energy consumption of the residential sector was used through the use of different graphics typologies. Mathematical modeling appears through the use of artificial neural networks to systematize the electricity demand of a primary distribution circuit from the measurements during a year with NULEC monitoring and protection equipment. Electrical measurements were made with a network analyzer to determine the behavior of these variables in a multi-family building. Linear regression models were defined that

relate percentage of the number of clients that are in the different levels of the billing and the interrelation between the monthly electricity consumption in correspondence with the number of clients connected to a secondary distribution circuit transformer. An analysis and synthesis of the energy policies of the residential sector is carried out.

The main results are related to the analysis of the country's electric power consumption, concatenating it with energy policies and presenting relevant aspects of the historical development of the electric power system. It is particularized in the characteristics of consumption in the residential sector as the most important from the quantitative point of view. For the study of active power demand, a primary distribution circuit is selected for the specific study of demand, in which residential loads have a high incidence. In this case, the behavior of the main electrical variables of the circuit is evidenced, the characteristic curves of the demand in the different days of the week, the difference between the behavior during the winter and summer periods, etc. Demand is modeled by the use of artificial intelligence techniques, particularly artificial neural networks. Finally, models of collective responses to the consumption of electrical energy are systematized.

Electricity has a significant weight among all carriers in the energy sector, its production throughout the world is mostly made through the use of fossil fuels, which is why the use of electric power requires strategic studies to be able to align the energy policies to the particularities of the behavior of demand and consumption. The use of tools for the modeling of these aspects and particularly in the residential sector, allow to properly formalize these behaviors in the different levels of distribution that are analyzed. The prediction of demand using modeling techniques based on artificial intelligence; the analysis of the electrical variables resulting from the exploitation of the distribution circuits and the formalization of expressions that systematize the collective responses of the level of utilization of electric power in the residential sector in Cuba, constitute tools for making technical and economic decisions.

Keywords: Electric power, Residential sector, Demand model, Collective responses

The future in sustainability transitions – Interlinkages between the multi-level perspective and futures studies

Noora Vähäkari, Ville Lauttamäki, Petri Tapio, Jarmo Vehmas & Marko Ahvenainen

Finland Futures Research Centre, University of Turku, Finland

Both sustainability transition studies and futures studies link to systems approach, aiming to increase understanding on complex forces that shape the development of socio-ecological systems in order to make better decisions paving the path towards preferred futures. In this work we focus on one dominant sustainability transition framework, the multi-level perspective (MLP). MLP portrays how factors on multiple levels can influence the development of a certain topic. MLP essentially does not touch upon the political debates that might or should take place in order to support the realization of the development in question. We suggest that the MLP should address more thoroughly potential future developments that might result from a varying set of decisions. We underline the synergies that futures thinking and the MLP have. Such work would enrich the analyses done using MLP by including also potential futures of sustainability transitions.

This work examines the interlinkages and new approaches of intertwining futures studies and MLP. We compare the key concepts of both fields in order to understand how the interlinkages can provide new approaches to detect and foresee development processes, and thereby support new sociotechnical innovations. We also outline the ways alternative futures and transition patterns are integrated in the MLP in a broader sense, and open up discussion on where and how wider scale societal transitions should be acknowledged related to the conventional understanding of the MLP approach. The research questions of this paper include: 1) what are the key interlinkages of the MLP and futures studies, 2) how to navigate these interlinkages to support sustainability transitions, and 3) can MLP support some well-known futures methodology in providing a preparative environment for suitable transition patterns. We explore previous academic writing on both fields and make elaborative comparison of concepts, as well as try to intertwine the theoretical underpinnings that have many similarities into a coherent synthesis that can be used to better evaluate sustainability transition patterns and steps to achieve preferable outcomes.

Futures studies and MLP both categorize phenomena relative to their scope. Traditionally in the first, new innovations start off as weak signals or emerging issues, growing into trends and further conglomerating into megatrends. In MLP, the same continuum grows from niche innovations to regime to landscape level. Multi-level interaction between systems is a key characteristic for both. Significant interruptions affecting the normalized state of a regime are called wild cards or black swans in futures studies, whereas in MLP they are labelled as specific shocks or avalanche changes. Scenarios represent a key concept in both futures studies and MLP studies. Scenarios are typically alternative hypothetical paths to a set of possible futures. Backcasting is a special case of backward-looking scenarios and well connected to MLP studies. However, we have to consider how and when MLP is a suitable framework to be applied in futures studies, specifically with regard to systemic transitions.

Established paradigms and theoretical approaches or academic futures studies merge with sustainability transition studies relatively much. Further shared elaboration of these fields can provide new insights and support for understanding and promoting holistic, sustainable global development. The rationale to investigate the relationship between MLP and future studies stems from the need to enhance interdisciplinary methodology within futures research, to detect and support positive innovation development and deter negative accumulative processes, to provide better foresight tools and capacities to business developers and policy makers, and to introduce sustainability transition studies as an integrative part of futures studies. More fundamentally, it is worth investigating if MLP can be applied in futures studies as a provider of a broader theoretical framework of societal change.

Keywords: Sustainability, Socio-technical transitions, Futures studies, Interdisciplinary research

Capacity Building for Renewable Energy Foresight in Cuban Electric Sector

Miguel Castro Fernández, Miriam Lourdes Filgueiras Sainz de Rozas, Miriam Vilaragut Llanes & Ariel Santos Fuentesfría

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Actually, the renewable energies have imposed in the entire world like an important energy source. There have a quick growth, particularly in the electric sector. Diverse factors triggered it. The international agencies reveal the emergence of transition in the electric power capacity with renewable energy. The Electric Union (Unión Eléctrica de Cuba) has the challenge to change Cuban energy matrix with the introduction of renewable energy, starting from the acquisition of technologies that allow them to satisfy the electric power demand with efficiency and effectiveness, with friendly to the environment. Therefore, Cuba need innovate by acquiring machinery and equipment from technology suppliers; then the increase of the absorptive capacity of technology, defined by Cohen and Levinthal on 1999, is required to develop renewable energy in Cuba at the electric sector.

This paper aims to propose a formation and training strategy designed to increase the absorptive capacity of technology (ACAP) to optimize and enriching the new technologies concerning to renewable energy development. The point of departure is the actual level of ACAP at the different levels of organization, in order to build, to operate and maintaining the new electrical power plant basis on renewable energy sources (RES) in Cuba.

The general procedure of the model for the process of creation and development of the ACAP proposed by Filgueiras (2013) until the third phase, conformed by four phases:

Phase I: Setting. To determine the innovation level, the development of organizational learning and the organizational climate.

Phase II: Diagnosis of the ACAP level. To determine the limiting components and the causal analysis on the influence of components on innovative process.

Phase III: Process to improve the existing ACAP. To establish the strategies and actions to solve the inadequacies and to improve the ACAP level, and the implementation of the concerning actions plan, with attention to University-Industry interaction and foreign supplier of technology as external sources of knowledge.

Phase IV: Monitoring and control of the process. To establish and deploy the control system over the effectiveness “ex dure” and “ex post” during the process to improve the ACAP level.

The diagnosis permitted to elaborate a formation and training strategy concerning to renewable energy development. Their basis was:

- Three level has structured for personnel at Electric Union: workers (1st, the most important), chief in each power plant (2nd) and national/region managers (3rd).
- An interdisciplinary approach in 3 stages: Leveling: to execute in the enterprise of UNE to incorporate people in the enterprise, and it looks to reinforce basic knowledge. Basic: to execute at the National Center of International Certification and it looks one general preparation about RES for personnel contracted. Specialization: it is an specific training for each technology, and it will be executed at the National Training Centre for RES and where the personnel will work, culminating with the certification by the adviser of the specific technology.
- To strengthen the qualification outline with alliances and all experiences of R+D+i.
- The action of managers became in a systematic training.

The ACAP level and her limiting components is determined. The path and culture to development new technology is adequate; but management’s levels of organization have a narrow view of innovation, combined with an incorrect organizational design limiting the existing knowledge integration and knowledge from the external sources, with a lack of attention to University-Industry interaction and foreign supplier of technology as external sources of knowledge. A poor organizational learning emerged which did not allow the absorptive capacity required by optimization and enrichment of the new technologies.

This paper shows the main strategies and actions to solve problems with ACAP; it is very important that 100% of personnel considered in the level of workers

should finish their specialization in a period not more than a 4 years and re-certification of this process was planned for each person annually, as an approach to maintain the result of strategies.

Keywords: Electric sector, Absorptive capacity, Renewable energy

AXIOM approach in high-level expert-elicited modeling of an energy system

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Finland Futures Research Centre, University of Turku, Finland

AXIOM is a novel, generic, expert informant based, graphical systems modeling approach. It is comparable to several cross-impact approaches, morphological analysis approaches, structural analysis approaches and decision support-oriented Bayesian network applications. In the study, a small model of the Finnish electricity system, described using the AXIOM modeling language, is presented. Analytical utilities of the AXIOM approach are illustrated with this model.

The paper aims to illustrate the use of AXIOM modeling language in modeling of a complex socio-techno-economic system, the modeling process, and the higher-order information that can be extracted from such models.

The study uses the AXIOM approach, a novel, generic, expert informant based, graphical technique for systems modeling. AXIOM has generally a high fitness for modeling complex systems and decision-making problems in foresight activities, as it is suitable for relying on expert elicited information in the modeling to a much greater extent than many other systems modeling approaches.

The results or contributions of the presentation are threefold.

1. The AXIOM modeling language and general approach are illustrated
2. An expert-elicited causal model of the electricity system is presented
3. The model is used in discovery of higher-order interactions between the system descriptors

Keywords: Expert elicitation, Systems modeling, Simulation, Cross-impact analysis, Structural analysis, Bayesian networks

Interactive Workshop: Futures people/Crafting persona in four different urban futures

Time: Thursday, 14th of June 10:15–12:00

Room: Eino Salmelaisen lämpiö

Chair: Foresight Specialist Joris Wauters

Joris Wauters^a, Martine Delannoy^a, Maya Van Leemput^b & Cornelia Daheim^c

^aDigipolis Ghent, Belgium; ^bApplied Futures Research Centre | Open Time, Belgium; ^cFuture Impacts Consulting, Germany

The *Digipolis Ghent Foresight team* and the *Applied Futures Research Centre | Open Time* developed four scripts on the future of the City of Ghent in 2040 in a one year co-creation program with over a hundred local civil servants. The topics sustainability, social cohesion, the impact of technology, and the government as a facilitator were given attention into every script (albeit in different forms); as they reflect our participants' visions of preferred futures.

These scripts will be the starting point for a creative workshop in Tampere, wherein participants together develop one or more persona in the different scripts. For the sake of usability, the references to Ghent have been replaced so the scripts become more generic. The added value of crafting persona is this: by imagining what people potentially do, feel, aspire, dream, fear... in different futures, futures can be understood differently when compared to the more quantitative facts used in dry descriptions (e.g. 'sea level will rise 102 cm' or 'the amount of NOx in the air will have tripled by 2040' etc.). We understand that the four futures are made more real and imaginable by adding a touch of fiction and allow for a deeper engagement with the possibilities outlined in the scripts.

Aligned with the topics of the conference, we highlight the driving forces Energy and Technology in every script: In a continued growth-script, there is sufficient energy available and technology is accelerating the further growth of cities and their economies. In a scenario of collapse, energy is scarce and technology is not being developed further. The third script of discipline/new equilibrium speaks of a limited availability of energy and a restricted access to technology. Finally, in

the transformation script energy is abundantly available and technology feeds a transformed 'post-human' society.

The workshop will split the participants into four groups. The authors of this abstract will each facilitate the crafting of persona in one of the four scripts with these groups, in cooperation with other members of the Foresight Europe Network (FEN) – a network of foresight practitioners from across Europe. Thereby, the workshop brings together a portfolio of approaches in working with scripts and with personas in the context of a scripting process for fostering urban development.

The four sub-groups will work on crafting a presentation of one or two characters within their script. Exemplary questions guiding this effort will be:

- What will most people be doing? What are some of their everyday experiences?
- What makes them happy...sad...cry...laugh? – both on micro and macro level of one's existence.
- What social, technological, economic, environmental, political, health, energy etc. problems will people worry about?
 - What current problems will by then be gone or will have become relatively minor?
 - What new kinds of problems will people have that are absent (or still rather invisible) now?
- What are people's dreams in these futures?
- How do people communicate? What do they talk about?
- What does it feel like to be alive in these worlds?
- ... (to be developed further)

These questions closely resemble the Manoa School's 'Futures for XXX' exercise as related in: Dator, J. Alternative Futures at the Manoa School. In: Journal of Futures Studies, November 2009, 14(2): 1 – 18.

By discussing these questions, the workshop participants empathize with the realities of the developed scripts and in this way understand the scripts more from a bottom-up or 'lived' perspective; rather than via a more dry, top-down narrative of the futures. This is the primary intangible effect sought by the exercise, but we also seek to have usable deliverables that profile actual people living in the four worlds that are the starting point. Different forms of presentation of these characters will be suggested, from performed roll-play, to accounts of 'a-

day-in-the-life-of' and short stories that put a specific challenge to the characters. The authors hope to learn how form and content combine fruitfully in the development and presentation of future personas for future scripting within a condensed, cooperative co-creation session. Participants will benefit from learning about the scripts' contents, i.e. different perspectives of urban futures, as well as experiencing and thereby being introduced to the methodology of working with personas in the context of future scripting processes.

Keywords: Urban Futures, Persona, Daily life, Energy and Technology, 2040, Future Scripting

Session IV

Thursday, 14th of June at 13:00–14:30

Theory and practice of energy and resource efficiency and sufficiency

Time: Thursday, 14th of June 13:00–14:30

Room: Konserttisali

Chair: Adjunct Professor Jarmo Vehmas

Insights on the plan for the adaptation to the impacts of climate change

Miki Kuribayashi

National Institute of Science and Technology Policy (NISTEP), Japan

In Japan, "A plan for adaptation to the impacts of climate change" was approved in a cabinet meeting in November, 2015. The damages to life, property, economy, and natural environment caused by climate change can minimize by adjusting the society and nature system. For this, the influence of any climate change covered in this plan, which aims at building a sustainable society by providing it security and relief to help it recover quickly from any adverse impact.

However, only a few studies provide examples on the influence of climate change on energy supply and demand, commerce, construction industry, and medical field. Therefore, it is necessary to plan the accumulation of scientific knowledge and ensure that it promotes the development of adaptive action and technology through cooperation between the public and private sectors with reusable knowledge on the influence of climate change.

I investigated the policies of U.K., Australia, Germany, the United States, and Canada, which propelled the adaptation plan for the influence of climate change and the enforcement example in this study.

With that in mind, I show the direction of promotion of adaptive action in both a district and a company, especially with regard to how the technology is used and what co-operation is build there.

It has to point out that the efficiency methods and substantial issues of the adaptation not been realized, although the influence of climate change has already appeared and many SEM's and local governments entities believe that adaptation is necessary.

We need to present a model for the desirable spread of action, in both a district and a company, for the efficient utilization of energy and resources in the future, from the perspective of adaptation to climate change.

Keywords: Climate change, Adaptation, Sustainable society

The End-Use Matrix: An innovative tool for the analysis of the energy performance of the economy

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Energy governance in the context of climate change, peak oil and other raw resources requires multi-scale, multi-level and multi-dimensional analysis. Energy efficiency is one of the most recurrent strategies to confront these problems as for example the improvements of energy performance of buildings or energy optimization of industrial processes. Nonetheless, these targets are being defined one at the time and there is a lack of quantitative diagnostics interrelating their effects over the broader context. Therefore, the evaluation of policies should be based on the concept of multi-level energy performance. Additionally, the complexity of the metrics of energy accounting require the distinction between primary energy sources, energy carriers and energy end-uses; as well as the distinction between qualities of energy carriers as electricity, heat and fuels.

In this paper we will present the end-use matrix as a useful tool for characterizing the energy performance of a country economy from a multiscale approach. This tool will be used for the characterization of the metabolic pattern of 28 European

countries, focusing on energy, human activity, value added and material products. Additionally, we will characterize the openness of the economy illustrating the effects of externalization on local performance.

An application of the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) method is used for developing the end-use matrix. The main data used for the analysis are the energy balance and economic accounts from Eurostat.

We obtain the end-use matrix characterizing the energy metabolic pattern of 28 European countries and 16 subsectors, focusing on: energy, human activity, value added and material products.

1. Energy efficiency is a mono-criterial concept too simple to assess energy performance.
2. The energy end-use matrix is a tool to study national and sectoral energy performance
3. It combines qualitative and quantitative variables into a multi-scale assessment
4. It bridges top-down (national statistics) and bottom-up (technical) information
5. Its use is validated by comparing the industrial sectors of 28 EU countries
6. The end-use matrix readily identifies the major determinants of energy performance and the effects of externalization on local performance

Keywords: End-use matrix, MuSIASEM, Multi-scale analysis, Energy performance

A flexible sustainability indicator for companies

Jarmo Vehmas

Finland Futures Research Centre, University of Turku, Finland

This paper suggests an indicator of changing sustainability for the company level and presents a set of examples based on data collected from case companies. The flexibility of the indicator comes from the applicability with different parameters at different levels in the companies

The paper presents a set of examples to show the flexibility and capacity of the suggested sustainability indicator. The indicator is based on a two-factor decomposition analysis in the Advanced Sustainability Analysis approach. The results show a variation of sustainability over time and depending on the choice of parameters of the indicator.

Keywords: Sustainability indicator, Energy efficiency, Decomposition analysis, Company level

University – Industry interaction: Cuban study case at the electric sector

Miguel Castro Fernández, Miriam Vilaragut Llanes, Miriam Lourdes Filgueiras Sainz de Rozas & Ariel Santos Fuentes

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Internationally there is an extensive literature on university-industry linkage, and its impact on the innovative performance. It is recognized that universities and public research centers play an outstanding role in upgrading the National System of Innovation, as they train graduates, contribute to the stock of knowledge, and moreover they may make more direct contributions to the demands of knowledge from the society. The empiric evidence obtained through diverse regions of the planet suggests the multiplicity in the channels of interaction through which the knowledge is transferred.

In a Cuban economy, the studies about this linkage still received little attention. From experience, it has been possible to identify a set of inductors to which the link University-Industry has faced; these inductors must be analyzed to achieve greater contribution to socio-economic development and to design policies. This paper focuses on the experiences of linking the electric sector.

The objective is to analyze the nature of collaboration between one Research Center (the CIPEL) and Electrical Union, which groups Cuban electric industry. This research has been guided by the following questions: Which are the major mechanisms that act in the bond between CIPEL and the Electrical Union? Which are the similarities and differences of mechanisms reported on this interaction

between Latin American countries? With the investigation results, is it possible to extract lessons that can contribute to the policies formulation and, consequently, to the social and economic development of the country?

The methodology is based on a survey of managers and specialists of the Cuban electric sector and a group of professors/researchers from the University; they have been characterized by a high bond with the electric sector, providing solutions to the problems that arise there for more than 20 years of working together. The survey explores the perception of both actors on the channels of interactions, which can be grouped into the proposal given by Dutrénit et al (2010), and its differentiation from other Latin American countries. The case study focuses on the nature of the linkage between Research Center belonging to the Cuban Higher Education and Electrical Union grouping Cuban electric companies.

In this paper, a brief history and evolution of Cuban electric sector in parallel as the Cuban University facing the electric sector, as well as some topics of the literature on University-Industry linkages are reviewed.

- The CIPEL was officially created on 1987 with the fusion of two research centers: one belonging to the Higher Education and other of belonging to the Industry. The evolution has had a parallel path.
- The survey demonstrated a similarity with the perception between managers of Cuban electric sector and the academics about the channels used and the importance of the knowledge transferred. The value of the correlation coefficient r between both actors 0.98%. The managers consider about the frequency in that the interaction occurs, is still a low interaction and academics consider it is enough.
- In Cuban case the main channel for the academics is the graduates recruiting to industry, while the linking way through the projects of I+D among the university and industry is considered in a second place. The same as in the other four Latin American countries, the investigators spread to assign a bigger importance to any channel comparatively with the representatives of the productive sector.

The interaction mechanisms differ as for their importance and frequency according to the perception of both actors; among the most important for the electric sector in Cuba highlight: the traditional one, the bidirectional one and that of services.

The two more important interaction ways for the academics are the recruiting of graduate and the development of combined projects of I+D, and for the companies the recruiting of graduate and the informal contact among the personal.

In comparison with other countries of Latin America, they were similarities and differences with the Cuban case. These discoveries indicating that the linkage between universities and companies from the university shows high levels of agreement in those obtained results. The results reaffirm the third mission of Universities generating of knowledge, a role-play that is less recognized by the industrial sector in all the studied countries. It should be considered by the policies deciders.

Keywords: University industry linkage, Electric sector

Future prospects of carbon-neutral economy and its production structure and consumption patterns

Time: Thursday, 14th of June 13:00-14:30

Room: Väinö Voionmaa

Chair: Adjunct Professor Jari Kaivo-oja

Energy efficiency as an engine for development in countries characterized by energy poverty

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Energy drives everything, from knowledge to economic development, to life itself. But access to energy is a sensitive issue, function of many factors, among which history and geography play a fundamental role. Among all the continents of the world, Africa is probably experiencing the most paradoxical situation: despite Africa being very rich in energy resources (both fossil and renewable ones)

more than half of the African population does not have access to electricity. The situation is even worse in the Sub-Saharan region, where the percentage is 65% on average (WEO, 2016). Moreover, sometimes the energy available is wasted in severely obsolete appliances, and inefficient infrastructures and processes. The two levers on which to operate to face energy poverty of Africa are therefore the production from renewable sources and the promotion of energy efficiency. This process can trigger a virtuous circle with several positive repercussions, firstly the creation of local jobs and the blossom of a community-based and self-sufficient economy. The same applies to other worldwide areas where energy poverty and development are strictly linked and affect people wellbeing.

In this work, we do a review of practical initiatives, projects and studies that deal with this challenge, and try to investigate future scenarios.

Cuban electricity sector development. Challenges of increased intermittent renewable production

Jyrki Luukkanen^a, Anaely Saunders^b, Irina Salazar^c, Luis Vazquez^c, Yrjö Majanne^d, Ariel Santos^e, Mika Korkeakoski^a

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Cuban government has set targets to increase the share of renewable energy production in electricity generation. The target is to have 755 MW of bioenergy production capacity, 633 MW of wind capacity and 700 MW of solar capacity by the year 2030. The fast increase in the share of intermittent renewables poses challenges for the electricity system in controlling the electricity supply-demand balance. The paper presents scenarios constructed for Cuban energy system and analysis of the requirements of the electricity supply system to respond to changes in consumption and the intermittent supply. Future scenarios constructed with CubaLinda model till the year 2050 describe the potential energy demand changes in different sectors of the economy, changes in load curves of different consumer groups, and changes in the production side. Different potential economic development paths are constructed and their impacts on electricity demand are calculated. Hourly wind and solar radiation data is used to assess production from these sources and the ramping rates for producing the residual

load are calculated. Different future production options are analysed and the challenges of production balance are discussed.

What is a Green economy? Case study on Cambodia and Laos on the transition towards a greener future

Vuola, M.^a, Korkeakoski, M.^{a*}, Vähäkari, N.^a, Dwyer, M.^b, Hogarth, N.^c, Kaivo-oja, J.^a, Luukkanen, J.^a, Chea, E.^d & Nanthavong, K.^e

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A green economy that simultaneously promotes environmental sustainability, social inclusiveness, and economic growth is expected to benefit especially the heavily resource dependent least developed countries. Yet, internationally there is very little empirically based research on how the “green development” agenda translates into natural resource management policies in least-developed countries. This paper examines the implementation of “green economy” policies at the national level in the energy and forestry sectors in Lao PDR and Cambodia. Both countries have adopted green growth targets, however, in terms of natural resources management, two contradictory processes have taken place during the past decade. While there have been initiatives to decentralise natural resources management by enhancing the local communities’ role, the economies of Lao PDR and Cambodia have, on the other hand, opened up to large-scale resource investments by multinational enterprises. Large-scale hydropower projects and increasing deforestation from a variety of sources pose direct challenges to other, more sustainable natural resources management efforts. The analysis is based on interviews with experts representing a wide variety of different actors including the government, academia, civil society, private sector and international and national development organisations. The challenges and opportunities for the transition towards a greener economy are examined from the political, environmental, social, technological, economic and cultural aspects. Results show that green economic paths in energy and forest related sectors are possible but require a comprehensive approach to resolve the various challenges identified in the paper.

Challenges and opportunities for future energy governance

Time: Thursday, 14th of June 13:00–14:30

Room: Yrjö Mäkelin

Chair: Professor Petri Tapio

Big Picture of Energy Efficiency: Solving a Complex Puzzle of Green Economy and Sustainability

Jari Kaivo-oja, Jyrki Luukkanen & Jarmo Vehmas

Finland Futures Research Centre, University of Turku, Finland

This paper discussed key issues of energy efficiency research such as concepts, indicators and methodological issues. We can note that there is not one grand way to analyse energy efficiency. All dominant approaches have their advantages and weaknesses. Different levels of energy economy require tailored concepts, indicators and methodologies. For example, with regard to the energy intensity we can only provide indirect and delayed evidence of technological and engineering energy efficiency of energy conversion processes, which entails some shortcomings for management and policymaking in energy efficiency policies. Nowadays thermodynamic indicators describing energy efficiency at the physical, technological, enterprise, sub-sector, sectoral and national levels can be very important part of energy efficiency analysis. Because we need to have big picture of energy efficiency, we must calculate some detailed analyses with economic and financial attributes, but in the final stage need critical approach in interpreting the final results and energy policy implications. This is not an easy task for energy research professionals.

In this paper we discuss what is the big picture of energy efficiency and how we should analyse this scientific puzzle? We can identify many levels of energy demanding human activities such as global economy with its complex networks of export and import, macroeconomic energy systems, regional energy economies, sectoral energy systems, urban energy systems and micro-level organizational energy systems. The systemic boundaries of energy units and systems play an important role in this methodological and scientific discussion. In this paper we

frame out the big picture of energy efficiency and propose some promising research visions and questions. On the basis of our current scientific understanding, promising energy policy research approaches are: (1) System boundary analyses of energy efficiency, (2) detailed aggregation of energy systems, (3) synergy analyses of energy systems, (4) critical analysis of urban and industrial metabolism, (5) system dynamics of energy systems, (6) resilience analysis of energy systems, (7) comparative advantage analysis of energy systems and (8) rebound analyses of energy systems.

Urban energy futures: A comparative analysis

Graeme Lang

City University of Hong Kong, Canada

It can be argued that no contemporary major city is sustainable, with current population and levels of consumption, beyond the fossil fuels which have facilitated what has been called ‘high-energy modernity’ (Love and Isenhour, 2016). Unconventional sources of oil and gas such as from ‘fracking’ appear able to provide only a temporary boost to supply (Hughes, 2013; Inman, 2014). In most city-regions, there is no possibility of replacing more than a fraction of the energy from fossil fuels with renewable energy (eg. Clack, et al., 2017). Even in those cities which can get most of their electricity from renewables, there is still a heavy reliance on motorized transport of goods and food into and around the city; there does not appear to be a way to power these vehicles with renewable energy at the current scales of truck-based transportation in most major cities (Friedemann, 2016). But cities and regions vary greatly in sustainability (Day and Hall, 2016) depending on local renewable-energy sources (eg. Londoño, 2017), hinterland food production (e.g. Lang and Miao, 2013), population size and density, extent of urban sprawl (Kunstler, 2005), and access to a regional economy in which transportation is water-borne or uses renewable energy. This paper identifies the features of more sustainable versus less sustainable energy-supply for cities, with examples from Asia, the Americas, and Europe. Policy-implications are outlined, including initiatives with short-term benefits which would also ease the difficult longer-term transitions to the post-fossil-fuels urban futures of the late 21st century. The paper also notes some of the kinds of citizen-led initiatives (eg.

Dollinger, 2017; Eddy, 2017) which will be increasingly common and important during these transitions.

Comparative analysis, using both quantitative and qualitative factors. (quantitative: eg., proportion of electricity supply from hydro, nuclear, wind, or solar; proportion of renewable electricity supply which is sustainable beyond the fossil fuels industrial platform; ratio of population to surrounding agricultural land; qualitative: eg. dependence on vehicle-transport vs water-transport for imports of food; commuting culture and infrastructure for post-fossil fuels movement of people within the city)

Cities vary greatly on some energy-sustainability factors. Some major cities such as Hong Kong, New York City, and Los Angeles, are unsustainable beyond fossil fuels at more than a small fraction of their current populations. Other cities such as Toronto and Vancouver are close to sustainability in electricity supply, but will have to make major changes in land use and local economic activity to support a substantial proportion of their current populations. Finally, cities such as Amsterdam will be able to make the transition to sustainable urban life beyond fossil fuels with changes which are politically and technically feasible. For those major cities which are least sustainable, planning functions should include progressive adjustments in land use, building design, and support for local food production far beyond what is currently practiced. Political feasibility will be tied to promotion of short-term benefits.

Analysis of urban energy-sustainability beyond fossil fuels is much more important than has been generally recognized, and is also feasible using a small set of variables. Policy initiatives can be identified for both the most sustainable and least sustainable cities.

Keywords: Sustainability, Energy security, Urban planning, Post-fossil fuels economies

Resource adequacy in EU law – A delicate balance between market-driven solutions and State intervention

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Security of supply is one of the fundamental objectives of EU energy law. In terms of electricity, ensuring sufficient resources to meet electricity demand is a fundamental element of security of supply. It is addressed through a number of EU legal instruments, which emphasize the role of the market as the primary means through which to ensure security of supply. However, there are growing concerns among EU Member States on the ability of this market-based approach to guarantee the uninterrupted availability of affordable electricity. These concerns are reflected in the wide-spread adoption of State-driven capacity mechanisms by which Member States provide electricity producers with additional economic incentives to ensure that there is enough generation capacity to meet electricity demand at all times.

This paper will examine the EU legal framework for resource adequacy in the context of the energy transition and discuss how this framework addresses the uncoordinated State interventions adopted to guarantee resource adequacy in Member States.

The paper applies a systematic doctrinal analysis of EU law as means to identify and interpret the legal framework that governs the adoption and design of national legal instruments that aim to ensure resource adequacy in the electricity market.

The analysis demonstrates that EU law acknowledges Member States' need to intervene when the markets fail to deliver an adequate level of security of supply. However, EU law also aims to control the adoption of State-driven measures that distort the functioning of the internal market in electricity. Balancing the need to ensure uninterrupted availability of affordable electricity on the one hand and the EU goal to achieve efficiencies through market integration on the other requires a shared understanding of the respective roles of the State, the EU and market forces.

Under EU law, State interventions to ensure resource adequacy should be interpreted as the exception to the rule by which markets are expected to be the primary driver in favor of security of supply. In practice, this approach is conflicted with Member States' national security of supply concerns which are exacerbated within the energy transition.

Keywords: EU law, Resource adequacy, Security of supply, Energy transition

Citizens' views on the future of decentralized renewable energy

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Achieving success in sustainable energy transitions is crucial for tackling climate change. In Finland, distributed renewable energy forms could play a central role in the ongoing energy transition towards the decarbonization of the energy system. Citizens' engagement is important for the successful transition and therefore we need to understand citizens' views regarding future energy systems.

In this study, we explore citizen perspectives of transition dimensions and transition pathways, with a focus on the potential transition towards renewable decentralized energy forms in Finland.

This study investigates the data gathered with a citizen questionnaire of the adult population 17-75 years of age (n=1000) conducted in Finland during the fall 2017. The responses were analyzed with exploratory factor analysis.

Four dimensions of transition were identified: 1) market, 2) state, 3) niche and 4) consumer behavior. Transition was perceived as taking place through four pathways: 1) mainstreaming, 2) international actors' operations, 3) citizens' activeness, and 4) profound systemic change.

Citizens' views of the future of distributed renewable energy forms and the energy transition potential are multidimensional. Consumers' and citizens' roles in transition need to be included in legitimate national energy policies.

Keywords: Renewable energy, transition, Image of the future, Citizens, Survey, factor analysis

How have framing and discourse approaches contributed to analysing energy transitions? A critical review of empirical cases

Karoliina Isoaho & Kamilla Karhunmaa

University of Helsinki, Finland

This paper presents a critical review of the use of framing and discourse approaches in energy transition literature. The field examines socio-technical and political processes contributing to change, or the lack of change, in energy systems. Recently, especially since 2013, there has been a marked increase in studies that employ discursive approaches to examine empirical cases where energy transitions unfold. These studies address a wide range of questions with varying methodological depth as researchers are choosing different discursive methods, such as frame identification and discourse analysis, to analyse processes of change. We argue that there is a need to more thoroughly understand how these methods are both shaping transitions research and the processes of change themselves.

We are on one hand interested in seeing if, and in what ways, scholars position themselves with regards to the critical debates on discursive approaches. For example, do scholars defend their contribution against claims on lack of objectivity and robustness, or are they considering their work as a contribution to the 'language over matter' debates? Or are new conceptual developments made to further the relevance of discursive approaches to sustainable energy transitions and energy policy? On the other hand, we also explore the realities and constructions that researchers are enacting with their choice of methods. Our research questions are: In what ways have empirical studies used discursive approaches in sustainability transitions literature? How are (socio-technical) processes of change conceptualised through discursive approaches?

We conduct a critical survey of existing literature with the aim of uncovering, synthesizing and disseminating existing research findings. We base our analysis on a critical reading of previous empirical studies on energy transitions and politics. Our data set consists of 100 articles from 43 different journals extracted from the SCOPUS database, published between 2006 and 2016.

We will analyse the data with two different approaches. In this section, we will present results from a quantitative overview of the articles. This analysis will be guided by predetermined coding schemes that we have developed. These include

categories such as methodology, method of analysis, source of data, time frame and geographical scope of the analysis. New categories are likely to be included to complement the scheme as the coding proceeds. The aim of this analysis is to display synthesising information about existing literature to help position the analysed studies in a wider context to identify possible areas that have been understudied. The second part of this section presents our qualitative results.

The main question guiding the analysis is 'How are discursive approaches used to understand processes of change?'

Critically assessing how current scholarship is using discursive approaches not only helps identify gaps or methodological limitations. It also enables us to respond to recent calls for increased self-reflection from academics on how energy transitions are framed and communicated, and in this way contribute to the literature on the performativity of social scientific methods.

Keywords: Qualitative methodology, Research methods, Literature review, Socio-technical change

Energy transitions in the Global South

Time: Thursday, 14th of June 13:00–14:30

Room: Unto Kanerva

Chair: Dr. Juha Kaskinen

Assessing the impact of climate entrepreneurship programs in renewable energy transition: A case study of Kenya Climate Innovation Centre (KCIC)

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Climate change is a global phenomenon that has posed various threats to the globe. In Kenya, Climate Change has been manifest by the rises in temperatures across the years, irregular and unpredicted rains, increased frequency of intense

rain, melting and retreat of mountain glacier and increasing frequency of extreme climate events (droughts and floods) (Olago, 2013).

Africa has a weak adaptability capacity caused by low capital levels, poverty and the lack of political good will. Adaptation and mitigation strategies are no longer an option for Africa but a necessity. The level of environmental degradation and other environmental outcomes are evidence enough of the destruction caused by climate change. This thus calls for the African continent to develop practical solutions towards response to climate change (Boko, et al., 2007).

One of the solutions Kenya has been developing in response to climate change is building a business case for climate change solutions. One of the main responses to climate change is shifting from fossil fuels to renewable energy solutions. Clean tech solutions are being developed through support to enterprises to build businesses that offer clean and renewable energy solutions. The world bank has estimated that 70% of the global population without access to electricity are in Sub-Saharan Africa. What this thus shows is the increase in access to electricity can be coupled with ensuring there is an increase in investment in renewable energy solutions.

Energy transition is the de-carbonization of the energy system through structural changes of the energy systems. This is simply transitioning from non renewable energy options to renewable energy ranging from solar power, wind, hydro-power, geothermal and marine energy. The main sources of energy in Kenya average about 74.6% biomass, 19.1% Petroleum and 5.9% electricity. Renewable energy in Kenya has continued to gain popularity with an increase of 8.7% in the generation of electricity via wind power and geothermal by 6.1% in 2017 (KBS Kenya Bureau of Statistics, 2018).

The journey to renewable energy in Kenya has been a combination of the drive from the private sector that has created a business case for renewable energy and government policy that has acted as a catalyst for the growth of the sector. Climate entrepreneurship is part of social entrepreneurship where technical startups are used to come up with solutions for social, cultural and environmental challenges (Braunerhjelm, 2010). Climate entrepreneurship programs came into existence to bridge this gap by supporting climate entrepreneurs to build a business case and commercialize. Kenya Climate Innovation Center (KCIC) is one such institution that came into existence in 2012 with an interest to support businesses in three sectors renewable energy, water and agribusiness and so far over

150 enterprises have received support from KCIC. Of the 150 enterprises, 97 enterprises have been in renewable energy, which is the strongest sector in KCIC.

This paper assesses the impact the support to these enterprises in Renewable Energy has had in energy transition in Kenya and consequently assessing how the entrepreneurship programs are influencing energy transition.

The objectives of the study is to assess: the need for climate entrepreneurship in energy transition, looking into the gaps and opportunities that necessitated the existence of climate entrepreneurship programs in Kenya; the role of Kenya Climate Innovation Centre (KCIC) in renewable energy transition looking into the services provided by KCIC to support energy entrepreneurs and the impact of KCIC in renewable energy transition looking into the success stories and lessons from the energy entrepreneurs within the portfolio of KCIC. A case study research is being employed to conduct an in-depth assessment of the role of KCIC in facilitating renewable energy transition in Kenya. This will be followed by a sustainable impact assessment (SIA) to explore the combined economic, environmental and social impacts of KCIC's climate entrepreneurship programs for renewable energy transition.

Both qualitative and quantitative data is in use in conducting this study and drawing inferences.

Data for the study will be collected from both the end users to assess the penetration of renewable energy in the market and the entrepreneurs to assess the level of investment in renewable energy in Kenya.

The study focuses on the first four years of the implementation of the KCIC entrepreneurship support program from 2012 to 2016. The study assessed the main services that KCIC focuses on in supporting enterprises which include access to finance, business advisory, access to facilities, access to information and creation of an enabling environment.

Between 2012 and 2016 136 clients were incubated and out of this 77 of the clients were in renewable energy. The success rate of enterprises, from proving their concepts to commercialization is 50%. Of the 77 enterprise in renewable 40 of the enterprises are still in business at different levels of growth. Failure or lack of kick of enterprises is largely caused by failed concepts and unresponsive business models. From this enterprises 425 direct and indirect jobs and reached 11585 clients with renewable energy product solutions.

17 of the 77 clients were funded by KCIC through the Proof of concept financing to the tune of about 350,000USD. Beyond the funding from KCIC the clients were

able to raise 1,100,000USD of financing from other sources. The growth of the enterprises has been attributed to the support in business and financial modeling & analysis that the enterprises are offered by the organization. There also has been development in the policy, institution and legal framework around renewable energy that has accelerated the growth of the renewable energy. Energy is a technical sector that has traditionally been looked at as capital intensive and thus has had very minimal entrants in the market. Renewable energy makes it more technical and there has been minimal interest due to the slow returns associated with climate entrepreneurship. This study makes the case for climate entrepreneurship in transitioning to a carbon neutral and climate resilient economy. The steps required to move towards a carbon neutral and climate resilient economy are described. Examples of where KCIC is already catalyzing adaptation innovation to support this outcome are also presented.

Keywords: Renewable Energy Transition, Climate Entrepreneurship, Kenya Climate Change Innovation Center

Radical solar energy pioneers in Kenya and Tanzania

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Investment in solar PV into developing countries is growing (Baker and Sovacool 2017). Kenya and Tanzania have emerged as the main attractors of investment in off-grid renewables, solar PV in particular (REN21 2016, 21). The penetration of solar products (solar lighting, solar home systems and micro- and mini-grids) and services was slow for a long time in African countries. The global landscape of solar photovoltaics (PV) is rapidly changing. As the costs of solar photovoltaics have dramatically decreased, solar PV generation has expanded by 50% per year worldwide (Huang et al. 2016; Lazard 2016; IRENA 2016b, 2016a). Solar energy is a powerful sociotechnical imaginary for the Global South (Hancock 2015; Cloke, Mohr, and Brown 2017), but its implications and future trajectories have received limited attention. The research agenda should better understand transformations for sustainability (Wiek and Lang 2016), how they are enabled, why it

happens and by whom. The paper seeks to shed light on the role of solar entrepreneurs operating in the PV niche of Kenya and Tanzania. A growing number of 'heroic' entrepreneurs have begun to address energy poverty in African countries, which is re-enforcing a pre-existing market-led narrative. Owing to the uptake of ICT and mobile systems (Onsongo and Schot 2017), Kenya and Tanzania have become hyped as the "cradle" for mobile based pay-as-you-go deployments. In the whole of East Africa, over 80 million people could benefit from mobile-enabled energy services (Gauntlett, Nique, and Smertnik 2016). We discuss the implications and pre-requisites of this trend in critical fashion. To achieve our aim, we test a socio-cultural scenario called Radical Startups 2050, in which innovative startups are expected to 'transform innovation for sustainability' (Leach et al. 2012).

A study of two countries draws from a case study approach. The main theoretical lens applied is 'pioneer analysis' (Heinonen 2017). Within futures research, pioneering acts are claimed to provide early information and potential symptoms of future trajectories (Hiltunen 2008, Heinonen 2017). We complement our analysis by drawing on theories of global innovation networks, innovation and technological capabilities (Liu 2017, Bell and Figueiredo 2012). The paper uses complementary data: websites, grey literature, media coverage, and project documents. Interviews (n=38) in September-October 2015, and subsequently in 2016-2017, were analysed with directed content analysis. As limitations, we interacted only with a limited number of the pioneers.

We divide PV companies in Kenya and Tanzania into four groups. i) The first group comprises of those solar PV entrepreneurs and companies innovating in the 'innovation/technology frontier'. A small group of 'pioneering' actors who have harnessed 'radical innovation' and developed the solar PV niche with their innovative activities can be distinguished. ii) The second group epitomizes an evolving narrative: increasingly broad group of emerging companies incorporate PV-related innovations in their business model. They typically operate in the pay-as-you go (PAYG) space and are linked to global innovation networks. iii) The third group consists of emerging local entrepreneurs in the PV niche gradually incorporating innovation activities. iv) The fourth group consists of local actors who conduct business activity, supplying the industry. The pattern resembles Martin Bell and Paulo Figueiredo's (2012) typology to world leading, advanced, intermediate and basic.

The scenario-testing exercise sheds light on emerging practices and allowed exploring emerging trajectories in Kenya and Tanzania's solar PV niche. We find pioneering actors to have initially nurtured the niche, and socially-minded entrepreneurs who created the pay-as-you-go (PAYG) model. PAYG as a 'radical innovation' addresses energy poverty. It identified a social need, created a finance innovation to reduce the upfront cost of solar, and then harnessed multiple emerging technologies. The model is reaching popularity and incremental innovation. If 'heroic' entrepreneurs can solve wicked challenges, we must ask critically, who can become an innovative pioneer?

Keywords: Pioneer analysis, Radical innovation, Startup, Solar, Energy transition, Entrepreneurship

Towards energy security and the protection of consumers' right in Bangladesh

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Energy access is equally right and demands for all consumers living in Bangladesh, has little access for their daily life consumption. Energy security promises to ensure this fulfillment. Considering the right of the consumers, government has set a vision to ensure electricity for all by 2021 and goal for energy security by 2041. To achieve this vision and goal, government initiated to increase power generation from 5000 MW (2009) to 24000 MW (2021) and undertaken various projects (i.e. new power plant (fuel, coal based, nuclear, increasing efficiency), exploring new gas field, find renewable energy sources, installing new LNG, LPG plant/terminal; taken steps for the protection of consumers' right with justified tariff (for low-income citizen) and provides quality service. Government provides funds, subsidies, Bangladesh Energy Regulatory Commission also supports by BERC Energy Fund to run the plants. A revolutionary change in energy sector achieved in the recent years (2009-2017).

- "(i) to find out present energy situation and energy scenario of Bangladesh;
- (ii) to ensure availability (by production) of easy energy access for all by 2041;
- (iii) To implement energy vision 2021 and energy goal 2041 to ensure energy security;
- (iv) To ensure the protection of consumers right and interest by regulatory orders and tariffs, (especially for low-income citizens);
- (v) to create an atmosphere conducive to private investment in the generation of electricity, and transmission, transportation and marketing of gas resources;
- (vi) to ensure transparency in the management, operation and tariff determination in energy sectors;
- (vii) to promote the creation of a competitive market;
- (viii) to introduce energy efficiency mechanism through energy audit, the verification, monitoring, analysis and installation of efficient technologies.

The paper is based on the secondary data sources, field assessment, impact analysis and stakeholder consultation; comparative data analysis of energy situation (present and previous), future projection, analysis of tariff order 2015 and 2017; reviewing of regulatory act-rules, planning for energy security and implementation of energy vision 2021 and goal 20141.

Bangladesh is passing most critical energy transition with scarcity of electricity, natural gas, and fuel for daily life consumption. The climate change impact causes 25% more pressure on energy uses, increased demand of electricity. To achieve country's energy vision and goal, government already increased power generation from 5000 MW (2009) to 13500 MW (present 2017) with 30 power plants, and planning to increase 24000 MW to make availability of energy for all by 2021. Bangladesh is now importing 600 MW power from India and another 500 MW in 2018. About 27 power plants are under construction with 6427 MW and 18 new plants are under process with 5000 MW. New Power and Gas Sector Master Plan, hopes to reduce gas dependency for power generation, to increase power capacity of 39000 MW by 2030. The government is planning to import LNG due to declining gas reserve, and building a floating LNG terminal at Moheshkhal Island to facilitate LNG re-gasification (5 mln ton/yr and 1000mmcf).

Bangladesh aims to provide access to affordable electricity to each house-hold by 2021 and is planning power production 24,000 MW (2021), 40,000 MW (2030), 60,000 MW (2041), import power 6500 (2030), nuclear energy 4000 MW (2030), renewable energy sources 3100 MW (2021) and energy savings 15% by 2021 to ensure energy security for all by 2041. Government is implementing new Renewable Energy Policy (especially for solar energy). Bangladesh has already reached the mile stone of 4 million solar systems in off grid rural areas. BERC is mandate to protect consumer's right and interest by regulatory rules and orders (BERC Act-2003, Consumers Protection Act 2016), fix justified tariffs for life-line (low-income citizen), ensures energy justice, quality of service to end-consumers and different development sectors to facilitate economic activities. A detail research work with alternative solutions and strategies for energy sector are needed to ensure energy security in Bangladesh.

Keywords: Energy, Security, Generation, Tariff, Regulations

Off-grid power quality and its effects on commonly used appliances: A case study of Nepal

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Over one billion people worldwide lack access to energy, which hinders their socioeconomic development. The problem is most apparent in rural and developing regions where extending the national grid is strenuous and economically infeasible. Small off-grid power systems could provide affordable energy solution in these remote areas, and out of environmental considerations, such systems should preferably operate on renewable resources instead of kerosene or diesel. But renewable energy is intermittent and causes reliability issues often leading to low acceptance in poor communities. However, improving power quality may make the system prohibitively expensive, and thus a compromise between quality and cost must be found. This study provides the design starting point for reliable off-grid systems by determining the power quality in existing installations in developing areas and by analysing its effects on commonly used appliances. Nepal is chosen as the target country for this project.

This study determines the power quality within the national grid and off-grid installations in Nepal and compares the results with fully electrified nations and existing standards. Detected power quality problems due to user behaviour and insufficient system capacity are identified and organised according to duration and severity. Methods to avoid found problems within the design of power systems are discussed.

The impact of low power quality is studied on electrical appliances commonly used in Nepal, and the risk of increasing household expenditure due to loss of efficiency and electrical damage is estimated. Appliances most susceptible to power-system disturbances are determined. Based on the results, the design of off-grid systems may be adapted to the power quality requirements of end-user appliances.

The main objective of this study is to determine the minimum power quality needed for reliable power production to increase the acceptance of off-grid systems in rural communities.

The study is realised by analysing power quality data from on-grid and off-grid power systems in Nepal, and by conducting experiments on a range of common appliances. Nepal is chosen as focus due to its low rural electrification rate of 80% and high renewable-energy potential. The German national grid in Munich is used as comparison.

Power quality is determined by measuring the RMS value of single-phase voltage along with frequency and waveform to identify harmonic effects. A fleet of multimeters, oscilloscopes and a self-developed Arduino-based datalogger serve as equipment. The locations are Kathmandu for on-grid, and two microhydro off-grid systems in Manang District in the Annapurna region.

To test the impact of low power quality on appliances, their power consumption, input current waveform and external effects such as heating are measured under voltage and frequency fluctuations. Tested appliances include a range of lamps, TV set, mobile chargers and low-power rice/water cookers.

Near the centre of Kathmandu, the main-grid power quality is comparable to that of Germany, but disturbances increase with increasing distance from the central area. The grid conditions cannot thus be assumed rigid as is routinely done by electronics manufacturers.

The off-grid voltage is subject to substantial fluctuations in both measurement locations in Manang District, with daily scheduled power outages that limit energy access. Locals currently use LPG and firewood for cooking and space heating,

and electricity mainly for illumination and entertainment. Commonly used appliances include mobile phones, low-power rice cookers, light bulbs and televisions. Preliminary results suggest voltage sags are less harmful to appliances than swells. Lighting devices seem more susceptible to low power quality than chargers and other devices with inbuilt filters. Especially light sources may suffer damage under varying voltage conditions, although manufacturing quality also plays a role." "Power quality and the lack thereof is a major obstacle for rural electrification as poor communities prefer conventional fuels over unreliable off-grid connection. Due to health and environmental risks, improving the power quality of affordable renewable energy solutions is imperative.

This study establishes the status quo of power quality in Nepalese off-grid installations and compares it to the local main grid and that of fully electrified nations. Short-term effects of low power quality on commonly used appliances is also studied. These aspects provide one of the essential first steps in designing reliable and energy-efficient off-grid power systems. Finding a compromise between quality and price is key in providing energy access to developing areas and enabling socioeconomic growth.

Future work includes more vigorous long-term testing on the impact of power quality on the lifespan of common appliances, as well as similar power quality measurements in other developing regions.

Keywords: Rural electrification, energy access, Off-grid, Nepal, Power quality

Energy foresight as a cognitive tool for action: a discussion on the design processes of scenarios and their performativity in the political arena

Time: Thursday, 14th of June 13:00–14:30

Room: Kirjasto

Chair: Adjunct Professor Katriina Siivonen

Integrating social dimensions in energy scenarios

Grégoire Wallenborn

Université libre de Bruxelles, Center for Studies on Sustainable Development (IGEAT), Belgium

Most energy scenarios are characterised by a poor representation of social dimensions of energy demand. Although energy scenarios usually claim to explore future energy needs and tell how low carbon technologies will be used, they fail to describe the basic dynamics of demand. Many policy scenarios assess ways of delivering the same services with fewer resources but do not investigate the practices on which energy consumption depends. Technology is considered as the main driver of social change, but social practices are depicted as fixed and stable. This assumption of stability of current standards and expectations is obviously fundamentally flawed (Shove & Walker, 2014). Moreover, these dominant scenario approaches perform households as sites of technological intervention in which ‘smart technologies’ will be adopted. In this perspective, energy scenarios disclose how sociotechnical visions are imbued with ontological and normative predictions about how people should live (Strengers 2013). Many energy scenarios also assume an ‘average consumer’, disqualifying the issue of social inequalities. Therefore, energy poverty does not appear in foresight and planning activities.

The paper analyses a range of scenarios developed in Europe at regional and national levels. First, I show that quantitative scenarios and methods limit possible futures because they take ‘standard’ practices for granted. In quantitative back-casting studies, the socio-economic system is assumed to be stable, similar to the one we know today. The country's population is considered as an aggregate of average consumers. Interviews with scenario makers have revealed that these

assumptions are made to reduce the complexity of the quantitative model, but also because scenarios are usually realised by technicians who have a limited knowledge of demand dynamics and because stakeholders of these scenarios have little interest in social inequality issues. In a second part, I review alternatives to quantitative scenarios. For instance, some qualitative forecasting study leaves more room for differentiations of social groups and a diversity of social practices. These approaches are usually pluralistic and develop contrasted images of everyday life. However, they rarely engage with social inequalities. I conclude by discussing the implications of adopting different epistemological, axiological and ontological approaches towards energy futures.

Key words: Scenario, Demand, Practices, Social inequalities

Towards policy-relevant low-carbon scenarios: discourses analysis of the actors involved in the long-term policy process for mitigation in Wallonia (Belgium)

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The majority of low-carbon scenarios currently developed provide a high level of detail for the technical and economic issues, but do not or hardly address the governance issues (Schubert et al., 2015; Nilsson et al., 2011; Söderholm et al., 2011; Wangel, 2011; Hughes et Strachan, 2010). Yet, it is obvious that the policy process and its outputs (i.e. *policy*), the constellation of actors and their role in the policy process (i.e. *politics*) as well as the mode of political steering and the institutional arrangements (i.e. *polity*), have a significant influence on the configuration of the transition towards a low-carbon society. The limited consideration of socio-political hurdles in energy foresights studies could help to explain the implementation gap between scenarios-based research and public policy (Olsson, 2016; Banister et Hickman, 2013), which materializes at least partially through the non-use of scientific knowledge by politico-administrative authorities. Indeed, purely technical-economic scenarios are not necessarily politically feasible and don't effectively inform public actors about the way to steer the low-carbon transition (Schubert et al., 2015).

In this context, developing low-carbon scenarios that include governance issues as variables appears like a necessary next step in the design of supporting tools for the energy transition; and would it be only to increase policy-makers' perception of the relevance of foresight studies. With a view to designing policy-relevant supporting tools, two interconnected questions emerge: What kind of knowledge concerning the governance of the low-carbon transition do political actors need to devise long-term mitigation policies? Is foresight a suitable approach to provide this kind of knowledge?

The paper develops on an empirical study that analyses the discourse of the actors involved in the long-term policy process of GHG-emissions' mitigation in the Walloon Region (i.e.: producers and intended users of scenarios). The aim of this study is to apprehend and compare the perceptions of different actors of, on the one hand, what are the major uncertainties and challenges regarding the governance of the low-carbon transition that need to be addressed and, on the other hand, whether foresight is a suitable approach to address these social-political issues. To this end, I use the Q methodology, a qualitative, but statistic survey method that allows comprehending the variety of discourses around a given topic (see Barry et Proops, 1999). I will present a cognitive map to illustrate the diversity of perceptions among the Walloon actors.

Keywords: Foresight, Energy scenarios, Governance, Decision support, Science-policy interface, discourse qualification

Epistemic communities, foresight and change in energy policy: a case for two scenario-design processes in Wallonia

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Scenario-design processes in the field of energy remains strongly embedded in communities of technical experts able to deal with complex issues and systems. Enrolling non-technical stakeholders in the design of the scenarios proves to be a challenge that involves strong skills in knowledge transfer and abilities to keep the debate relevant to quantitative strategic objectives often predefined at supranational scale. In this context, leading scenario-design processes in the field

of energy for regions, municipalities or local communities encompasses a large set of variables that policy makers are not empowered to directly influence for technical, governing or cognitive reasons.

The paper develops a case study for two scenario design processes in the field of energy in the Belgian region of Wallonia.

It compares two methods for designing scenarios for the future of energy: a first one that is built upon a common reflection of a community of experts in energy and climate change that remains external to the issues and visions of the local administrations and stakeholders; and a second one that elaborates a common knowledge upon an epistemic community that links local administrations, technical experts and a set of other key stakeholders in the policy design process.

Such a comparison aims at characterizing strengths and weaknesses of both methods and at identifying opportunities for future effective and efficient scenario design processes able to further reinforce the link between technical aspects of energy and climate change and political dimensions of local governance. The paper will therefore open a discussion on how foresight studies in energy transition may affect local political agendas.

Keywords: Scenario design, Governance, Knowledge transfer, Energy policy, Science-policy interface

Interactive Workshop: The seeds of transformation and disruption related to carbon-neutral energy system

Time: Thursday, 14th of June 13:00–14:30

Room: Eino Salmelaisen lämpiö

Chair: Dr. Mikko Dufva

Dr. Mikko Dufva

Leading specialist, Foresight, Sitra, Finland

The urgency and need for transitioning to a sustainable energy system is widely acknowledged and even manifested in global climate agreements. The question

is now more about the timely implementation, which accounts for the unexpected or systemic effects such as the rebound effect. Solutions for going 100% renewable, reducing energy use and increasing the resilience of energy systems already exist and the task ahead is to deploy them. This requires clear and compelling narratives of the changes ahead and the anticipation of potential disruptions and their implications.

The main objective of this workshop is to explore and elaborate the implications of scaling up emerging solutions for carbon-neutral energy systems. What would the world look like if the solution would be adopted widely? This includes considering the hurdles of implementation as well as political, economic, social, technological, environmental and cultural aspects. The goal is to come up with compelling narratives of change, which also take into account possible disruptions and assess the resilience of the new system.

The workshop is inspired by the approach used in the "Seeds of the Good Anthropocene" project, but adapted to energy context and modified to pay closer attention to disruptions. The basic idea is to start with an existing or emerging solution and use futures wheel and the three horizons approach to explore what scaling the solution could mean. The solutions are based on specific, small scale examples, which have been identified in the Next Era project, Green to Scale project and other work done at Sitra. The outcomes of the workshop will be packaged into narratives describing the main implications of scaling up the solution.

The narratives of change are the main tangible result from the workshop. In addition the futures wheel and three horizons provide a more nuanced view of the change. Another expected result is a better understanding of pathways of transition and the implications of scaling of existing or emerging technologies and grass-root approaches.

The workshop is premised on the assumption that bottom-up and grass-root approaches can make a difference. Instead of describing the transition from the abstract and top-down view, the workshop produces images of futures based on narratives of scaling up existing and emerging solutions. These narratives are key for implementation. After all, the future is made together.

Keywords: Weak signals, Transition pathways, Narratives, Futures wheel, Sense-making

CHAired POSTER SESSION

Time: Thursday, 14th of June 15:00–15:45

Room: Konserttisali

Chair: Dr. Juha Kaskinen

Sustainable development – international framework – overview and analysis in the context of forests and forest products – sustainable approaches with the CSR in the markets

Annika Hyytiä

University of Helsinki, Finland

Forests and forest products play an important role taking into consideration the climate change mitigation framework. International approaches, strategies and agreements have a significant role in the sustainable development. Markets are linked to the sustainable development framework and green approaches and the bio-based economy. Climate change mitigation framework has a link with the CSR and Forest Law Enforcement, Governance and Trade, FLEGT, sustainable trade and investments globally. Innovations have an important role in the sustainable development. The Corporate Social Responsibility, CSR, provides nowadays an increasingly important framework with the sustainable development globally. Green Economy, Green Growth and Bioeconomy represent sustainable policies and international and national approaches in the sustainable development. This is a qualitative research based on literature. It is based on research articles and literature and organizational literature. Several academic sources are included, for example Proquest, Academic Search Complete (EBSCO), Agris, CAB Abstracts, SCOPUS (Elsevier), Web of Science (ISI) and Google Scholar and Internet sites.

Keywords: Forests and forest products, sustainable development, CSR

Enhancing public administration – Geoenergy permissions in Finnish municipalities

Pirjo Majuri & Timo Vuorisalo

University of Turku, Finland

Geoenergy is a rapidly growing renewable energy sector in Finland. Since 2011, the land use and building legislation in Finland has primarily required a permission (planning permission for minor construction) to build ground heat exchangers (GHEs) for retrofit geoenergy heating systems. However, each municipality may in its building code replace the permission procedure with a notification procedure.

This study was designed based on the results of an earlier questionnaire study, in which Finnish geoenergy practitioners pointed out certain issues relating to the permission practices. We studied the permission practices for GHEs in nine randomly selected municipalities of three size groups in south-west Finland. The objectives were to find out how the practices differ between municipalities, and to identify good practices. The data was collected from 1) GHE permission documents (applications and decisions), 2) GHE notification documents, and 3) interviews of the permission authorities.

Altogether more than 430 GHE permissions and more than 80 GHE notifications were analyzed. One municipality had ordained a notification procedure for its entire area, and one municipality had a notification procedure for areas outside the town plan zone. Otherwise a permission procedure was applied in all the municipalities. In two municipalities some permissions had been rejected. The results showed clear variation in for example the permission practices, specificity of permission conditions and the permission fees.

In Finland municipalities have a high degree of autonomy in land use decisions, and this will probably be the case also in the future. However, it seems that clearer instructions for designing the GHE permission procedure would benefit all stakeholders: The instructions would help the local authorities streamline their work and comply to legislation. More coherent permission practices would improve equitable treatment of house owners and simplify the work of geoenergy practitioners. When municipalities pay more attention to quality control of GHE systems, both the environment and customers probably benefit.

Key words: geoenergy; ground source heat pump; building control; planning permission; notification; municipal administration

Relation of selected classes of uncertainty to the types of the future in foresight methodological approach – the context of a sustainable economy

Andrzej Magruk

Bialystok University of Technology, Poland

In the literature there are many definitions of uncertainty, which should be perceived in a broad, quantitative and qualitative perspective. For the purpose of this publication, uncertainty is defined as a condition of lack of confidence for specific results of the analyzed event. The confidence level is conditioned by the assessment of information in terms of level: incompleteness, blurriness, inaccuracy, potential fake.

According to the author, in order to identify, analyze and reduce the level of uncertainty in sustainable development, prospective decision-making activities should be formulated based on the analysis of alternative futures, using selected foresight methods and classes.

The main purpose of the publication is an attempt to answer the following research questions: 1) What is the methodical relation of the types of the future in the systemic approach (on the example of a sustainable economy) to the study of the uncertainty phenomenon? 2) Which foresight research methods can be used to study different types of the future (which presents the future cone)?

In the author's opinion, from the methodical point of view of foresight research, it seems relevant to determine which classes of methods (and which methods) will be appropriate for the analysis of a specific type of future (possible, probable, preferable and others) in order to properly manage the uncertainty of a certain type (eg., scenario, qualitative, ignorance) in the selected complex system (such as sustainable economy).

The publication refers to the process of identifying, analyzing and minimizing the phenomenon of uncertainty using the foresight methodology (including author's types, classes, individual methods) for various types of future on the example of selected aspects of a sustainable economy. The study uses the results of the analysis and criticism of the literature as the main research method. On this basis was performed deductive reasoning.

Particular attention in the publication will be devoted to the presentation of author's concepts and solutions regarding the methodology at the interface between the theory of uncertainty, sustainable development analysis and future research. Despite several decades of foresight presence in science, it requires unambiguous formulation, especially in terms of methodological knowledge related to the management of uncertainty. In this context, foresight is not the only remedy, but it provides a valuable alternative to traditional prognostic and strategic approaches.

Uncertainty is one of the most important features of many areas of social and economic life (including sustainable economy), especially in the future context. In this publication, uncertainty is treated as a phenomenon that arises on self-knowledge regarding the information on the basis of which decisions are formulated. In the author's opinion, thanks to specific foresight methods (and/or their combinations) relating to selected types of the future (characteristic for future cone), it is possible to manage selected types of uncertainty by their identifying, analyzing and minimization, and not just treating uncertainty as the background of future research. The research were conducted within 2017/01/X/HS4/00985 project and were financed from National Science Centre (Poland) funds.

Keywords: Classes of uncertainty, Types of future, Futures cone, Foresight, Sustainable economy

Surface modification of carbon cloth electrodes for microbial fuel cells by coating candle soot

Shih-Hang Chang, Bor-Yann Chen, Yuan-Ting Tsao & Bo-Yen Huang

National I-Lan University, Taiwan

Microbial fuel cells (MFCs) are promising for the renewable and sustainable energy because they can generation of bioelectricity via the treatment of wastewater. MFCs are able to convert chemically-bound energy into biomass-based electricity generation through electrochemically active bacteria. It has been demonstrated that the surface characteristics of the anode electrodes are critical to the performance of MFCs. Carbonaceous electrodes, such as carbon

paper, graphite plate, carbon cloth, carbon mesh, granular graphite, granular activated carbon, carbon felt, reticulated vitrified carbon, carbon brush, nanoparticles and nanomaterials, are widely used in MFCs due to their high conductivity, good biocompatibility, excellent chemical stability, and relatively low cost.

The surface properties of these carbonaceous electrodes are critical to the performance of MFCs as bacterial attachment and electron transfer is necessary to overcome mass-transfer resistance. The undesirable hydrophobic property of the carbonaceous electrodes normally causes a poor electron transfer efficiency. Thus, surface modifications of the carbonaceous electrodes are needed to enhance the power performance of MFCs. Numerous methods for modifying the surface of carbonaceous electrodes have been proposed in order to improve the power-generating capabilities of MFCs. However, most of these surface modifications are normally time-consuming, relatively expensive, and potentially harmful to the environment. The main objective of this study is to propose a rapid, cost-effective, clean, non-toxic, and environmentally friendly method by coating candle soot on the surface of carbon cloth anode to enhance the power density of the MFCs.

Membrane-free air-cathode single-chamber MFCs were constructed in cylindrical tubes made of polymethyl methacrylate with an operating volume of 220 mL. A carbon cloth with a projected area of approximately 22.9 cm² on one side was used as the anode. The air cathode was nearly identical in size to the anode and consisted of a polytetrafluorethylene diffusion layer on the air-facing side. The microbe used in this study was *Aeromonas hydrophila*. The culture medium in the MFCs used in this study was Luria-Bertani (LB) broth medium. The candle soot was deposited from the candle flame for approximately 60 seconds.

Scanning electron microscope results demonstrate that there are abundant candle soot deposited on the surface of carbon cloth. Water contact angle measurement results show that the surface of the carbon cloth become highly hydrophilic after coating candle soot, which is promising for the biosorption on the anode electrodes of MFCs. X-ray photoelectron spectroscopy results reveal that the C1s characteristic peak of the untreated carbon cloth can be deconvoluted into a major sp³ C-C peak and a minor C-O peak. Except of the C-C and C-O peaks, the C1s characteristic peak of the carbon cloth coated with candle soot exhibited additional C=O and sp² C-C peaks. Electrochemical measurements show that the power density generated from the MFC configured with carbon cloth electrode coated with candle soot is approximately 6.77 mW m⁻², which is higher than that of the MFC configured with untreated carbon cloth electrode (4.44 mW m⁻²).

This study investigated the surface and electrochemical properties of carbon cloth electrodes surface-modified by coating candle soot for applications involving microbial fuel cells (MFCs). The carbon cloth became highly hydrophilic after coating candle soot. MFCs configured with carbon cloth electrode coating with candle soot exhibit a maximum power density of 6.77 mW m⁻², which is superior to that of MFCs configured with untreated carbon cloth electrode (4.44 mW m⁻²). Surface modification by candle soot is non-toxic, environmentally friendly, rapid, and cost-effective process, making it ideal for the fabrication of large-scale MFCs.

Keywords: Microbial fuel cells, Candle soot, Carbon cloth electrode, Surface modification

Collaborative foresight – Insights from a renewable energy cluster in Germany

Reimo Jahn, Hans Koller & Michael A. Zeng

Helmut Schmidt University, Germany

Today's energy markets are affected by converging industries, disruptive business models of energy supply and accelerating innovation cycles. As environmental uncertainties rise organizations need to stay ahead of current developments and adapt to ever-changing market demands (Von der Gracht & Stillings 2013). Foresight methods support organizations in detecting environmental change early and respond quickly in order to seize future opportunities and avoid threats (Rohrbeck 2012). But turbulent business contexts and hyper-competition call for a more networked foresight including various external sources of knowledge (Daheim & Uerz 2008). Some authors already give reference to foresight's participative and integrative functions (Könnölä et al. 2007; Wiener 2017). These collaborative approaches utilize a broad base of distributed expertise for creating future-related knowledge and may, thus, result in richer insights than internally conducted foresight activities (Ehls et al. 2016).

Since research on collaborative foresight is elaborate and remains largely conceptual in nature, insights gained from empirical investigations could provide valuable evidence for its practical potential. We examine this assumption empirically and report on the outcomes of a collaborative foresight workshop series with pre-

selected representatives from different organizations engaged in a German renewable energy cluster – Erneuerbare Energien Hansestadt Hamburg (EEHH)*. Some research questions may help to guide the investigation and focus the analysis:

- What is the potential of collaborative foresight in the field of renewable energy?
- What are future scenarios of the renewable energy ecosystem in 2040?
- What are relevant future issues in the field of renewable energy?
- What are early warning indicators and information sources for future monitoring?

Workshop design follows the idea of the communication and process-oriented approach (CPA) as outlined by Koller (2009). The workshops series comprised five sessions over a timespan of 18 months with 19 participants from 11 organizations. Workshop activity included environmental analysis (STEEP), scenario building with the help of Design Thinking (as described by Jahn et al. 2017) and a brainstorming session in order to carve out early warning indicators. In addition, we combined Netnography and a Delphi survey to examine the potential of integrating online communities in foresight ventures (as described by Zeng et al. 2017). All data were collected utilizing hand-written protocols, feedback questionnaires, workshop materials and a total of nine semi-structured interviews that were audio-recorded and transcribed. The future scenarios were visualized by a professional graphic designer.

In total, the workshop participants created four future scenarios depicting the energy ecosystem in 2040 (two dystopic and two utopic narratives), collected 122 future issues in five themes corresponding to STEEP-factors (Ecological Development, Energy Economy, Technology, Legal-political Development and Social Development) and came up with 98 information sources that work as early warning indicators for future monitoring. Furthermore, the combination of Netnography and a Delphi survey showed that online communities deliver a time and resource efficient solution to gather additional insights on the future. For instance, users of two online communities generated another 69 future issues.

Conclusion: This study enriches foresight research with empirical insights from a collaborative foresight practice on cluster level. Based on numerous environmental factors the participants created diverging future scenarios that are both impressive and stimulating. Moreover, the participants identified a good deal of

noteworthy information sources and relevant warning indicators. Due to its participative and integrative nature, the workshop series could pool a rich knowledge base provided by informants with diverse backgrounds. Integrating further external sources of information, e.g., two online communities, has proven to be a worthwhile means to enrich debate and stimulate creativity. The collaborative workshops spawn economic virtue for both SMEs and large corporations: SMEs participate in a professional foresight venture that usually demands vast resources while large corporations—even if already engaged in foresight – get the chance to integrate novel perspectives. Workshop evaluation showed major benefits in individual sensitization to future information and processing of inter-organizationally relevant topics. However, we recognize the pitfall that many participants have difficulties to transfer the workshop insights into their daily business routine.

Keywords: Collaborative Foresight, Open Foresight, Scenarios, Workshops, Renewable Energy

* The workshop series in EEHH is part of the larger research project ‘Open Foresight’ funded by the Hamburg Ministry of Science.

How Do We Explore Our Futures?

Osmo Kuusi, Sirkka Heinonen & Hazel Salminen

The Finnish Society for Futures Studies, Finland

We wish to present a recent book on futures studies methods, published by the Finnish Society for Futures Studies (FSFS). It comprises **21 leading Finnish futurists** revealing their **practical and theoretical knowledge of futures studies**. The texts are a cross-section of 20 years of futures research. Every method is described by an author who has used the method in their own practical project(s). (Various) interactions between futures research and other fields of science are also discussed.

The book samples a (large) variety of modern futures studies’ methodology, including (sections on) evolutionary and systems thinking, expert-based knowledge evaluation and time-series based methods like Delphi and Causal Layered Analysis (CLA). The book also presents communicative futures methods such as futures

workshops and scenario work. In addition, it includes sections on newer methods such as the anticipation of Weak Signals and Black Swans.

This book is a comprehensive reading for anyone interested in futures studies theory and its practical applications. As a fundamental publication of futures studies methods, this book is also suitable as lecture material for universities. The purpose of the book is to familiarize the reader with the idea of futures studies and the basic methods of futures as a scientific discipline. We hope that the readers will find this publication (and its discussions) a stimulating trigger, launching creative argumentation about our responsibility to imagine alternative futures.

This publication is an English edition based on the 3rd revised edition (2013) of the Finnish 1993 original *Miten tutkimme tulevaisuutta?*. The English version is an answer to increasing international demand for Finnish original contributions to the fields of Futures Studies and Foresight.

The EU project Radical Innovation Breakthrough Inquirer RIBRI

Osmo Kuusi & Marjukka Parkkinen

Finland Futures Research Centre, University of Turku, Finland

The main aim of the RIBRI project (2017–2018) is to collect and systematise up-to-date information on key future Radical Innovation Breakthroughs (RIBs) and to evaluate their potential as emerging trends or game-changers as well as their strategic importance for Europe with a set of Global Value Networks (GVNs). The partners of the project are Fraunhofer ISI Germany (lead), Institutul de Prospectiva Romania and Finland Futures Research Centre, University of Turku

The Finnish partner has a special role in the project because the project tries to generalise the ideas of the Finnish Radical Technology Inquire (RTI) on the European level. The RTI was developed in the Committee for the Future in the Parliament of Finland (Linturi et al. 2013, the English edition 2015: ty.fi/rti). In April 2018, the last update of the tool was published in Finnish in the report by Risto Linturi and Osmo Kuusi called “One Hundred New Possibilities for Finland 2018-2037”.

The two main elements of the RIBRI are the 100 Radical Innovation Breakthroughs (RIBs) and 20–25 Global Value Producing Networks (GVNs). The prospects of the RIBs are evaluated based on their anticipated impacts on the GVNs. The Romanian partner is developing a list and descriptions of 100 RIBs using the Artificial Intelligence. In the Poster table, the GVNs – still preliminary – of the RIBRI project are compared with the Linturi and Kuusi (2018) report GVNs.

Transforming the Future: Anticipation in the 21st Century

Riel Miller

Social and Human Sciences Sector, UNESCO, France

Transforming the Future: Anticipation in the 21st Century provides key elements for understanding and changing why and how people ‘use-the-future’. The book explores three dimensions of Futures Literacy as a fundamental human capability. Part 1 elaborates a comprehensive framework for defining Futures Literacy (Chapter 1), constructed on the foundations of the Discipline of Anticipation (Chapter 2) and an examination – by applying mathematical formalisation – of the potential of collective intelligence knowledge creation processes that ‘use-the-future’ to generate novelty (Chapter 3).

Part 2 presents the design principles of one specialised tool for conducting research into the anticipatory assumptions that shape Futures Literacy, called Futures Literacy Laboratories (Chapter 4), and 14 case studies (Chapter 5) that offer tangible proof-of-concept evidence that FLL can enhance participant’s understanding of their anticipatory assumptions and that knowing why and how the future is used changes what people see and do.

Part 3, consistent with the open and comprehensive premises of the Futures Literacy Framework, offers insights into: a specific game based tool for revealing anticipatory assumptions (Chapter 6), a customised collective intelligence knowledge creation process aimed at understanding well-being (Chapter 7), and the critical role of reframing the future for sensing and making-sense of gender and power (Chapter 8).

The core hypothesis of this book is that advances in our understanding and use of anticipatory systems and processes in the 21st century could generate a change

in the conditions of change. This transformation has the potential to alter a set of distorted and damaging relationships between human agency and complexity, uncertainty and hope. Generalised Futures Literacy holds the promise of turning uncertainty from a liability into an asset by enabling people to overcome the anxieties induced by ‘poverty-of-the-imagination’ and the disappointments generated by vain efforts to colonize the future.

Futures Literacy offers no certainties other than enhancing humanity’s capacity to understand the world around us understanding and use of anticipatory systems and processes in the 21st century could generate a change in the conditions of change. This transformation has the potential to alter a set of distorted and damaging relationships between human agency and complexity, uncertainty and hope. Generalised Futures Literacy holds the promise of turning uncertainty from a liability into an asset by enabling people to overcome the anxieties induced by ‘poverty-of-the-imagination’ and the disappointments generated by vain efforts to colonize the future. Futures Literacy offers no certainties other than enhancing humanity’s capacity to understand the world around us.

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