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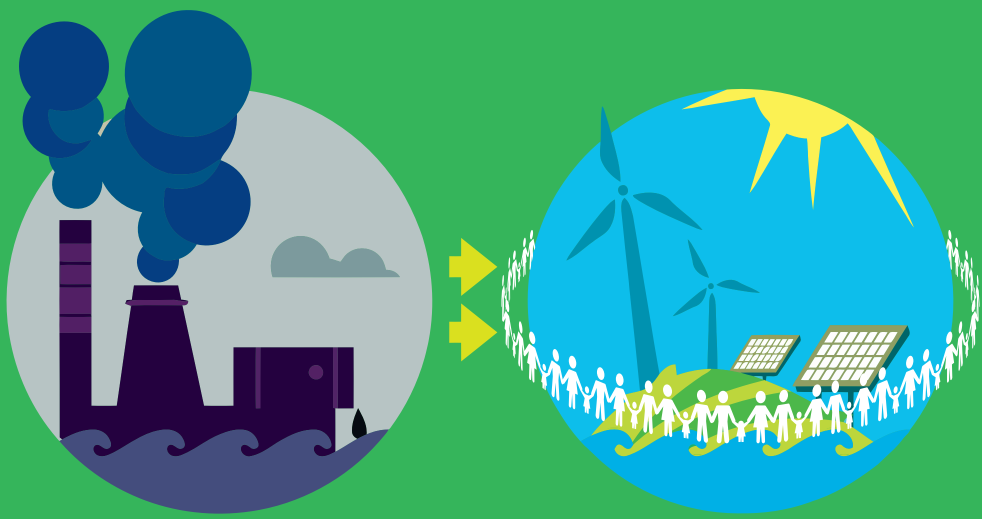
International Conference: New Pathways for a Just and Inclusive Energy Transition

Connecting Multiple Stakeholders and Levels

20-21 June 2023

Energy Academy | Groningen | The Netherlands



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Preface

Welcome to Groningen for the Second International Conference on New Pathways for a Just and Inclusive Energy Transition!

We are happy to welcome you on June 20th and 21st 2023 to the Second International Conference on New Pathways for Energy Transition: connecting Multiple Stakeholders and Levels, University of Groningen, the Netherlands. This conference is organized by the Integrated Research on Energy, Environment & Society Group and the Wubbo Ockels School of Energy & Climate of the University of Groningen, the Hanze University of Applied Sciences and the New Energy Coalition.

It is a multi-disciplinary conference with a special focus on socio-technical aspects of energy transition that aims for an energy system that is predominantly based on renewable sources. It imagines a future where most households are prosumers, technologies of renewable sources operate at a market competitive price, most industries are flexible in their power demand, power storage and its operation are cheap and a significant part of all power production capacity is owned by citizens, while the municipal, provincial, and national governments work in harmony towards a more sustainable energy agenda.

But how to come to this future? Which technological evolutions at the supply and demand end took will take place? How will the public be involved in this transition? How were the preferences and support of citizens acquired? What mechanisms will lead to such a coherence between people, municipalities, provinces, regions and nations? And not only in the Western World but also in the Global South? How can local solutions be connected to the national targets? How to align local initiatives and the conventional energy incumbents? These and related questions are what we will discuss during this conference.

To stimulate discussion we organize workshops, round tables, panels and more. The program includes two excursions to witness the practice of energy transition in our region.

We hope you will enjoy the conference, will be inspired by the sessions, key note speakers, panels and excursions and will meet new people to cooperate in future.

The Organizing Committee,
Kim van Dam, Anouk Goossens, Lineke Koops, Samie Maqbool, Anja Robbeson, Lorenzo Squintani, Aamina Teladia, Sander Vanca & Henny van der Windt

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Practical Information

Conference Locations

International Conference on New Pathways 2023
Energy Academy Europe
Address: Nijenborgh 6, Groningen

Informal Reception
House of Connections
Address: Grote Markt 21, Groningen
Second floor

Dinner
The Market Hotel Groningen
Address: Grote Markt 31, Groningen

Website
rug.nl/wubbo-ockels-school/calendar/2023/new-pathways

Contact
icnp2023@rug.nl

Internet Access
The WiFi network is called ‘Eduroam’.
Login details are available at the registrations desk.

Organizing Committee

- Dr. H.J. (Henny) van der Windt |Faculty of Science and Engineering, University of Groningen
- Prof. Mr. Dr. L. (Lorenzo) Squintani | Faculty of Law, University of Groningen
- Dr. K.I.M. (Kim) van Dam | Hanze University of Applied Sciences
- Dr. A.S. (Amtul Samie) Maqbool |Faculty of Science and Engineering, University of Groningen
- A. (Aamina) Teladia, MSc | Faculty of Science and Engineering, University of Groningen
- A.H. (Anouk) Goossens, BSc | Faculty of Science and Engineering, University of Groningen
- S.R.J. (Sander) Vanca, BSc | Faculty of Science and Engineering, University of Groningen
- R. (Lineke) Koops | Faculty of Science and Engineering, University of Groningen
- A. (Anja) Robbeson, BA | University Services, University of Groningen

Scientific Committee

- Dr. H.J. (Henny) van der Windt | Faculty of Science and Engineering, University of Groningen
- Prof. Mr. Dr. L. (Lorenzo) Squintani | Faculty of Law, University of Groningen
- Prof. Dr. C. (Christian) Zuidema | Faculty of Spatial Sciences, University of Groningen
- Dr. C. (Tineke) van der Schoor | Hanze University of Applied Sciences
- Dr. P.J. (Paul) Upham | Faculty of Science and Engineering, University of Groningen
- Prof. Dr. Ir. M.A. (Machteld) van den Broek | Faculty of Science and Engineering, University of Groningen
- Dr. K.I.M. (Kim) van Dam | Hanze University of Applied Sciences
- Dr. A.S. (Amtul Samie) Maqbool |Faculty of Science and Engineering, University of Groningen

Informal Reception

The informal reception will take place on June 19th at the Wubbo Ockels School for Energy & Climate in the city centre of Groningen.

17.00-17.45	Walk-in
17.45-18.00	Opening by Cisca Wijmenga (Rector UG)
18.00-18.10	Welcome to the city of Groningen by Phillip Broeksma (Alderman city of Groningen)
18.10-18.20	A word by Henny van der Windt and Lorenzo Squintani (UG Professors)
18.20-19.30	Drinks and snacks

Programme | Day 1

08.00-09.00	Registration (Atrium of the Energy Academy)	
09.00-09.15	Welcome and Opening by Melissa van Hoorn, Province of Groningen (Room 5159.0029)	
09.15-10.15	Keynote: Jerzy Jendrośka (Room 5159.0029)	
10.15-10.45	Break	
10.45-12.15	Parallel sessions 1	
12.15-13.15	Lunch (Atrium of the Energy Academy)	
13.15-14.15	Keynote (online): Benjamin K. Sovacool (Room 5159.0029)	
14.15-14.45	Break	14.30-16.30 Virtual Reality Session
14.45-16.15	Parallel sessions 2	
16.15-17.00	Break	
17.00-18.00	Keynote: Monica Maduekwe (Room 5159.0029)	
18.00-19.00		
19.00-22.00	Conference Dinner	

10.45- 12.15 Parallel sessions 1

Integrated urban and regional energy planning Room 5159.0291: Spatial dimensions

Chair: Van Dam, Zuidema, Van Geet

Bang	Strategic energy planning at the regional level for integrated energy systems
Vieveen/Van der Schoor	Laypersons as a driving force in heritage inclusive energy transition in the Netherlands
Van Dam/Van Spyk	Mapping the spatial and landscape consequences of the Hydrogen economy
Pons	The role of socio-spatial dimension in the pathway to electric vehicle adoption

Energy systems and (business) modelling Room 5159.0062: Business models

Chair: Van den Broek

Behrendt	Identifying transaction costs within the formal institutional framework to unlock the potential of microgrids in the EU.
Dam	Home batteries in the Netherlands. A model for smart control, potential financial yield and increase in self-consumption.
Mertins	Drivers and barriers for the development of cooperative business models in the biogas sector for the transformation of the energy system.

Global south Room 5159.0010: Finance, economic growth, inequality and poverty

Chair: Teladia, Van Huyssteen, Béres

Wang et al	Analysis of global household energy inequality by using Gini Coefficients.
Mkombe-Mpando	The impacts of renewable energy on economic growth. A scoping review
Pan & Dong	The impacts of energy finance policies and renewable energy subsidy on energy vulnerability under carbon peaking scenarios. Taking China as an example.
Ahimsa	A way to achieve energy transition inclusivity: a case study of Indonesia's readiness based on the economic inequality.

Citizens, community and bottom up initiatives Room 5159.0110: Substantial factors in energy transition

Chair: Van der Windt

Germes	The potential impact and the development of the local energy initiative sector in the North of the Netherlands
Boostani/ Pellegrini Masini	A systematic review of community energy schemes through a feminist perspective on the energy transition
Pellegrini et al.	A missed opportunity? Power unbalances and predominant narratives in the emergence of energy communities in Italy
Taminiau et al.	Beyond the impasse: polycentric rebellion and the transformation of American climate policy

Just energy transition, governance, and policy Room 5159.0105: Policy and governance concepts

Chair: Ruzzenenti

Scheer	Pathways towards problem solving – a conceptual approach for transition governance.
Spijkerboer/Turhan	Assemblages out of steam: the discourses surrounding geothermal energy as part of energy transition in Turkey
De Bont et al.	Are the deep transitions and deep incumbency frameworks reconcilable?
Rielli	Claiming sustainable development outcomes in decentralised renewable energy results from a systematic review

14.45- 16.15 Parallel sessions 2

Integrated urban and regional energy planning Room 5159.0291: Panel discussion: Overcoming challenges in local green H2 economies

Organizer:	Beata Kviatek
Panel members:	Jan-jaap Aué, Lorenzo Squintani, Kim van Dam, et al.

Energy systems and (business) modelling Room 5159.0062: Session: Multi-commodity energy systems

Chair: Vos

Vos	Multi-commodity energy systems
Dhondt et al.	Trilate: energy transport infrastructure for industrial clusters in the pursuit of climate neutrality.
Boucher/Matthews	Scotland’s net zero by 2045: modelling metabolic potentials and scenarios toward emission reductions.
Sareen	Examining the role of hydropower in green hydrogen production

Global south Room 5159.0010: Nexus, energy planning and access

Chair: Teladia, Van Huyssteen, Béres

Louw	Feasibility assessment of biogas fuelled refrigeration to curb spoilage in food value chains in Sub-Saharan Africa

Van der Veen et al. Inclusive decision making for new sustainable value chains for marine biofuels. A case study on encroacher bush in Namibia

Come Zebra Scaling up the electricity access and addressing best strategies for a sustainable operation of an existing solar PV mini-grid

Nunoo/Muchapondwa Energy poverty and fuel stacking. The role of charging ahead electricity systems in South Africa

Citizens, community and bottom up initiatives Room 5159.0110: Citizen perspectives and bottom up processes

Chair: Upham

V**an Dijk/Goedegebure** Biomass: will we get it?

Paustian et al. Ready, set, rollout? The role of actor collaboration in the delay of the smart meter rollout in Germany.

Diestelmeier et al. Developing an empirical legal methodology for exploring the concept of community benefits in the context of energy communities under EU law

Grasso et al. Community action in the energy and socio-ecological transition: theory, research, and perspectives

Just energy transition, governance, and policy Room 5159.0105: Energy poverty and inclusion

Chair: Zuidema

Dubois Addressing the energy-poverty-health nexus in France: narratives on causal relations and obstacles at the local level.

Taminiau/Byrne Community clean energy: A transformative approach to equitable and supply in California and Massachusetts

Mahoney et al. Mapping perspectives on the policy agendas of climate change, the energy transition and energy poverty in Portugal-the route to a just transition

Vasseur et al. Should energy poverty in Europe be saved by energy citizens' initiatives?

Keynote Speakers | Day 1

Jerzy Jendrośka

A quest towards sustainability in Europe: just and inclusive energy transition and its interplay with environmental law

Jerzy Jendrośka is the President of the Environmental Law Center. Mr. Jendrośka has represented the Government of Poland in various EU and international processes, including serving as a Vice-chair of the UNECE Aarhus Convention negotiations (1996-1998) and of the UNECE SEA Protocol negotiations (2000-2002) as well as a member (2000-2006) and the Chair (2002-2003) of the Aarhus Convention Bureau.

Benjamin K. Sovacool

Gaps and promising fields of research in energy social science

Benjamin K. Sovacool is director of the Institute for Global Sustainability as well as Professor of Earth and Environment at Boston University. He is also professor of energy policy at the University of Sussex, where he formerly directed the Center on Innovation and Energy Demand and the Sussex Energy Group. He has written on energy policy, environmental issues, and science and technology policy. Sovacool is also the editor-in-chief of Energy Research & Social Science.

Monica Maduekwe

What's wrong with the carrots? Global politics influences on African energy/climate agenda

Monica Maduekwe is a sustainable energy specialist with rich experience in renewable energy, energy efficiency, gender mainstreaming, resource mobilisation and project development. She is at the forefront of those influencing the design and development of the sustainable energy industry in West Africa.

Abstracts of Parallel Sessions | Day 1

Parallel Session | Integrated urban and regional planning: Spatial dimensions

Strategic energy planning at the regional level for integrated energy systems

Aksel Bang | Supervisor: Henrik Lund & Karl Sperling, Aalborg University

The grand challenge of tackling climate change requires every possible stakeholder to participate in reducing greenhouse gas emissions. With the overarching Paris agreement, various plans and strategies towards a net-zero emission society are plentiful today at both national, regional and local levels. These are all reaching towards a net-zero emission society in the future but have separate pathways and target years.

Despite striving for the same end goal various plans, strategies and targets can have an unintended negative impact on each other and the overall smart energy system if these are viewed as part of an integrated and holistic energy system. The transition towards a 100% renewable energy system Is highly complex since analysis of adequate conversion, efficiency improvements, storage technologies and different smart grids must be included and utilized via sector integration, optimized biomass utilization and balance technologies. Misalignment of plans and strategies can as such lead to untapped potential off synergies for the overall system while specific regions or areas are at risk of being decoupled from certain development pathways in the future. These pitfalls can be further enhanced if local government directly adopt national targets into the local planning since this adoption prioritize to only pursuit national targets rather than the overall collective objective of transitioning towards an integrated 100% renewable energy system. Strategic energy planning can be a powerful tool to identify and then minimize the risk of misalignment of plans and strategies between different planning levels and consequently help to focus the transition towards a holistic and integrated energy system. This identification can be done through investigations of different energy scenarios outlining the transition pathways of the energy systems. Investigations of various pathways can aid and scope different transition pathways at both the national, regional or local level and be understood in coherent context.

In the current Danish paradigm, the national target is to quadruple the amount of land-based wind- and solar power while municipalities must plan to eliminate gas fired areas, and industry must decarbonize to avoid additional costs caused by a new national CO2 taxation. At the local level, 96 of 98 municipalities in Denmark have developed local climate actions plans, through the DK2020 initiative, where the overall aim is to reach a net-zero emission future. All these targets and plans are formed in a period where uncertainty regarding Power-to-X end products and the carbon capture storage or utilization discussion is ongoing. Uncertainty is a prerequisite of the future, but national plans and strategies are plentiful, and an extensive acceleration of the transition is demanded from the national side. The role of strategic energy planning will as such be important in this new paradigm below the national level, but the role and output from strategic energy planning is however not clearly defined. This can also be seen as a result of strategic energy planning not being a mandatory task for the local level in the municipalities and the regions. The extensive acceleration from national targets potentially enhances the focus on short-term result orientated solutions which risk to be sub-optimizations in the medium- and long-term perspective for the integrated energy system.

A mean to ensure the long-term perspective and avoid suboptimization within the Danish energy system is to activate and utilize strategic energy planning at a regional scope. The regional perspective can help to create an overall alignment of underlying local plans or provide valuable insights to the local level if strategic energy planning is lacking in specific local areas.

The strategic energy planning at the regional level can strengthen the link between strategic energy planning at national and local level in Denmark and provide insights to the discussion on renewable energy capacities and infrastructure. Subsequently creating more alignment of plans between the planning levels, and help to improve and favor discussion within the region across administrative borders on how to participate, utilize and operationalize the renewable energy transition as part of a smart integrated energy system.

The methodology and tool applied must be action oriented and not overly complex why EnergyPLAN is an adequate modelling environment. This can potentially be linked to MUSEgrids to help novice energy planners to comprehend and understand the model. Ensuring a broader audience in modelling and design of the scenarios will be essential to enhance cooperation and collaboration across planning levels and administrative borders to make discussions including rather than excluding.

Investigating this will be done under the following research question:
How can strategic energy planning at municipality and national level benefit from technical energy system scenarios at the regional level to ensure a just and adequate development towards a more robust and resilient energy system?

Laypersons as a driving force in a heritage inclusive energy transition in the Netherlands M.C.

Vieveen, T. van der Schoor; Research Centre for Built Environment NoorderRuimte, Hanze University of Applied Sciences (HUAS), Groningen, The Netherlands

The Netherlands is committed to the European Union (EU) targets on becoming climate neutral by 2050. However, The Netherlands is one of the worst performing EU countries regarding renewable energy. To accelerate the energy transition, the Dutch government, enterprises and NGOs developed a Climate Pact to reduce 95% of CO2-emissions and ending the extraction of natural gas in 2050.

Climate targets will have a major impact on buildings and landscapes in the Netherlands. To prevent the loss of spatial qualities, it is important to include spatial qualities, such as heritage values, in spatial development projects. Furthermore, the Climate pact addresses two elements that are important for decision-making on heritage assets, firstly, a tailored approach for listed building to assure the preservation of heritage values, and secondly, a major role of local stakeholders in energy generation projects.

Theoretically, we rely on the ‘heritage as vector’-approach. In this approach, heritage is used as a source of inspiration to enhance the spatial quality of towns and regions. The heritage as a vector approach requires new instruments to enable stakeholders to deal with a multiplicity of demands. We aim to identify and evaluate instruments that enable laypersons, such as building owners and local energy collectives, to develop heritage inclusive energy plans that both include energy reduction and production in historical buildings, areas and landscapes?

Our empirical findings are derived from two research projects: Living Lab Heritage in Energy Transition (in Dutch: Erfgoed in Energietransitie) and People’s heritage as inspiration for village energy plans (in Dutch: Erfgoed van mensen als inspiratie voor energiedorpsvisies).

We published our findings in the form of a practical Handbook We do it! (in Dutch: Handboek Wij doen het!) for local communities. In the second project we applied the Handbook to support eight villages to develop energy transition visions and plans for their villages.

We first collected an inventory of existing practical instruments regarding energy landscapes, sustainable historical buildings and layperson participation.
We found 72 instruments or approaches, mainly in Dutch. These instruments could be contained in academic articles, reports, websites, manuals or otherwise. The 72 instruments were assessed on their relevance as instrument for laypersons, such as building owners and energy collectives. Of these 72 instruments, only 18 can be classified as practical instruments of which 12 are specifically designed to be used by laypersons. Most of these instruments are developed for the building scale, a limited number of instruments was developed for area scale (village, neighbourhood) and none for the scale of landscapes.

We translated various expert tools into practical instruments for laypersons and included these in the Handbook.

Furthermore, practical examples of bottom-up initiatives were described in a comparative case study approach, in which we interviewed local initiatives. New identified activities that local communities undertake were added to the practical instruments. The combined result was the Handbook We do it! that describes six main themes that can be included in energy plans. The first theme is about Storylines focusing on the historical layers of societal and spatial development of their project. The second theme is Energy challenge, focusing on the current and future need of the project. Thirdly, the theme Heritage strategy, which is about the extent to which they want to cope with spatial qualities such as heritage. Fourthly, a Supported vision, including consider advantages and disadvantages of needs and ambitions. Fifthly, a Concept plan is developed, a schematic idea about energy reduction and production. Lastly, it is important to regard the type of Organisation that is appropriate to realise an energy plan.

In the second project, eight local communities in the National Park Drentsche Aa – protected for its natural and cultural historical values –joined a project about the energy transition. This allowed us to study how the instruments and the Handbook were used in practice.

The progress of these communities were monitored via a tracking system. We found that the majority of the communities use the Handbook indirectly. These communities already had started various activities before the Handbook was introduced to them, therefore they've only selected some instruments to improve current activities.

With our research we show that there is a limited number of instruments available for laypersons that include energy and heritage related content. And more specifically, only instruments for laypersons at the building scale include heritage related topics. Furthermore, the described gap in the practical instruments for laypersons may enclose a risk for heritage preservation. For example, by filling the gap with practical instruments for laypersons, heritage valuation by laypersons can be used to create awareness about spatial qualities and thus strengthen heritage preservation. We therefore conclude that the Handbook We do it! can be used in collaborative design processes and as such contribute to heritage inclusive plans. Lastly, our findings of the local community initiatives in the national park Drentsche Aa indicate that the role of local stakeholders can be strengthened with the further development of instruments based on a heritage as vector approach. As a result, we expect that laypersons can take up an even more important role – and function as a driving force – in a heritage inclusive energy transition.

Mapping the Spatial and Landscape Consequences of the Hydrogen Economy

Dr. K.I.M. van Dam, Alex van Spyk MA, Hanze University of Applied Studies Groningen, Netherlands.

“In Dutch society, there is now general consensus that in order to sufficiently reduce CO_2 emissions, a transition to more sustainable forms of energy is necessary. As a way forward, the North of the Netherlands is fully committed to hydrogen, and related to this, the development of a hydrogen economy. This receives a lot of attention and support, for example from the government and the business community. However, there are also a number of concerns that seem to be underexposed so far. For example, it is unclear what the spatial and landscape consequences of this hydrogen economy are, and how its development relates to other spatial claims and landscape impact. In the political (North Netherlands) arena, the development of a hydrogen economy is fully supported, however, there are other stakeholder groups that fear the impact on the northern natural and cultural landscape. Related to that are issues of how much control local and regional communities have in the planning and decision-making processes. More insight is needed in the expected landscape impact of the hydrogen economy, and in the related spatial planning and decision-making processes. The central aim of this paper therefore is to investigate and analyze the landscape and spatial consequences of the northern hydrogen economy; to deconstruct the planning and decision-making so far; and to assess how impact of the hydrogen economy can be minimalized. In this paper we present the preliminary results of exploratory research into the spatial and landscape consequences of this transition to the hydrogen economy. Together with students and stakeholders, we have undertaken three related case studies: 1) the Reconstruction of the implementation a 380 kV powerline in Groningen 2) a Landscape scenario study in Oostpolder and 3) and a Multi-stakeholder analysis in Matsloot-Westpoort. Overall we have used a methodology of mostly qualitative practice based research, including experimenting with methods such as landscape analysis, stakeholder analysis, and scenario development. In the future, we plan to further investigate this issue with research activities such as charrette or design workshop with which different groups of stakeholders.

The Role of the Socio-Spatial Dimension in the Pathway to Electric Vehicle Adoption

Maria Caballero Pons - Master student at Wageningen University & Research - MSc Urban Environmental Management

The socio-spatial dimension plays a key role in the transition to an electromobility system. However, research on electric vehicle (EV) adoption is often limited to a techno-economic paradigm that neglects socio-spatial elements and multi-scalar connections involved in the energy transition (Chen et al., 2020; Sovacool, 2017). This paradigm fails to recognise the significance of socio-spatial components, like scale, territory, landscape, location and networks, in EV adoption (Bridge et al., 2013). Consequently, the existing knowledge on how socio-spatial components influence EV adoption is limited and fragmented.

To address this gap, this study aims to conduct a systematic literature review to map which socio-spatial components are considered in empirical models of EV adoption over the last decade and how they influence the EV adoption process. Specifically, this research will answer the following question: “”To what extent does the empirical literature on EV adoption incorporate the socio-spatial dimension, and how does this dimension influence the adoption process as portrayed in peer-reviewed journal articles?"" By providing an extensive analysis of the socio-spatial components affecting EV adoption, this study aims to contribute a more comprehensive understanding of the transition towards electromobility.

Bringing the socio-spatial dimension into dialogue with the EV adoption allows unpacking the socio-spatiality of the transition to an electromobility system. This process entails a simultaneously creative and destructive process that is changing the socio-economic, political, and cultural relationships between different places and people (Bridge & Gailing, 2020). This literature review contributes to the field of energy studies by identifying the socio-spatial components incorporated in empirical research on EV adoption, as well as the patterns of relationships between these components and adoption. In doing so, it provides guidance for future research on EV adoption that incorporates the “”spatial turn”” of energy studies.

Using a systematic approach and narrative analysis, we categorise the socio-spatial dimension components used in EV adoption empirical models of peer-reviewed journal articles. To minimise author bias and produce results based on scientific methodology, we followed the PSALSAR methodology proposed by Mengist et al. (2020). Our research process consisted of three phases: 1) designing the search protocol, where we defined the keywords, search engines, and time frame; 2) quality assessment, where we established inclusion and exclusion criteria for the articles to be analysed in-depth; and 3) synthesis and analysis, using the systematic literature review software Nested Knowledge to identify and classify the socio-spatial components used in the empirical models of EV. In total, we analysed a sample of 110 articles (n=110).

Our study reveals notable differences in how the socio-spatial components of EV adoption are addressed across articles. While territory and scale serve as frameworks, location, landscape, and networks are examined as causal mechanisms. Most studies (n=65) focus on adoption at the state and individual levels. Only 32% explore other territorial frameworks, such as region (n=18), county (n=8), or municipality (n=24), and 20% conduct comparative studies between territories, mainly states. Furthermore, the literature on EV adoption lacks multi-scalar relationships between governance and geographical levels, with only a handful of studies (n=15) integrating regional, local, city, or neighbourhood levels with household and individual levels. Only four studies include variables from the regional, national, metropolitan, and local levels simultaneously, and only five use hierarchical empirical models. The remaining studies employ a linear model with variables from different scalar levels.

Less than half of the reviewed articles consider the location (n=23), landscape (n=31), and network (n=43) components in their empirical models, with mixed results on their impact on EV adoption. The charging infrastructure network is the only component with some consensus among the studies reviewed. The article's results reveal a significant positive effect at the beginning of the deployment of charging infrastructure, following a non-linear relationship, specifically for Plug-in Electric Vehicles (PEV). Regarding location and landscape, significant results are found in US studies on drivers'-built environment and place of residence, where factors such as house type and availability of parking at home explain adoption preferences and travel behaviour for PEVs. These results suggest that considering the type of EV has an impact on how these components influence adoption. Few studies differentiate between urban and rural landscapes; the reviewed articles suggest that EV adoption is not limited to urban areas. Suburban and rural landscapes present opportunities for niche adoption. However, how each type of landscape influences adoption is still unknown.

Based on the literature review, we observe that although EV adoption empirical models incorporate socio-spatial components, the approach remains entrenched in a techno-economic paradigm where technological opportunities for economic agents are unlimited and spatially uniform. Few studies extend their analysis beyond the state and individual levels. Likewise, how multi-scalar relationships between different territorial and geographical levels impact the transition is overlooked. In light of these findings, we suggest three avenues for future research: 1) Studying territory and scale as causal mechanisms that influence and interact with other socio-spatial components, 2) Exploring how landscape and built environment impact EV adoption, with particular attention to the needs of rural landscapes due to their high car dependency and low-income urban areas due to the limited space for charging infrastructure, and 3) and 3) Identifying socio-spatial development patterns of EV adoption to avoid spatial differentiation and transport poverty.

Integrating the socio-spatial dimension into the study of EV adoption enables a more comprehensive analysis of how the transition to an electromobility system alters existing spatial patterns of political power and socio-economic activity. The deployment of low-carbon technologies in the transportation sector has transformative potential in a society that heavily relies on automobiles. It has the potential to exacerbate disparities in access to transportation and energy. By incorporating a socio-spatial approach to the study of EV adoption, researchers and policymakers can better understand how the transition to an electromobility system is reshaping societies and work to ensure a just transition.

Parallel Session | Energy systems and (business) modelling: Business models

Identifying Transaction Costs within the Formal Institutional Framework to Unlock the Potential of Microgrids in the EU

Jamie Behrendt LL.M, PhD Researcher, University of Groningen, Groningen Centre of Energy Law and Sustainability

In the European Union (EU), the ageing infrastructure of the electricity transmission and distribution networks demand new approaches for electricity system development and operation to facilitate the energy transition towards a more sustainable energy mix. Technical and economic research confirms the potential of microgrids to contribute to this transition (Wallsgrove, 2021; Casaran et al 2021; Guibentif, Vuille 2022). However, high transaction costs limit the systems development. To ensure that interested parties have equal access to the development and operation of microgrids, transaction costs for the systems development and operation must be identified and subsequently reduced. This contribution aims to establish a methodology to identify transaction costs resulting from uncertainty and complexity in the formal institutional framework governing the development and operation of microgrids in the EU.

In essence, microgrids are decentralised electricity systems that can operate independently of the centralised electricity transmission and distribution network. Implementing microgrids has multiple benefits for the energy transition. Firstly, within a microgrid, energy security can be increased due to the system's ability to function islanded from the main electricity network. Secondly, implementing microgrids can incur economic benefits both for the centralised grid as well as the microgrid users due to infrastructure cost savings, fuel savings, and ancillary services that can be offered by the microgrid. Thirdly, microgrids can help to reduce greenhouse gas emissions by increasing the share of renewable energy sources in gross-final consumption as microgrids facilitate electricity generation and consumption on a local level. To that end, the development and operation of microgrids brings together multiple stakeholders, such as utility companies, local governments, technology developers, and consumers or prosumers who will gain access to reliable and affordable electricity.

Despite the system's benefits, microgrids are not widely adopted in the EU. From a theoretical perspective, a potential explanation is the fact that microgrids essentially defy the regulated and centralised approach to the production and distribution of electricity. Furthermore, EU law currently lacks a coherent formal institutional framework to regulate microgrids. From a law and economics perspective, the institutional framework is fundamental as law can mitigate externalities and reduce transaction costs. However, uncertainties and complexities in the institutional framework can also increase transaction costs, as more resources must be allocated to, for instance, search and information costs, monitoring and enforcement costs, and/or compliance costs (which are all types of transaction costs). This is confirmed in the academic literature (technical, economic, and legal) focusing on microgrids, where it is claimed that the uncertainty and complexity in the formal institutional framework is one of the main barriers to the development and operation of microgrids (Kojonsaari, Palm 2021; Soshinskaya et al 2014; Warneryd et at 2020). This discourages the development of microgrids and limits the system to unfold its full potential to contribute to the energy transition.

To advance the development of microgrids, transaction costs stemming from uncertainty and complexity in the formal institutional framework must be reduced. This first requires that those transaction costs are identified. Hence, the central research question of this contribution is: Which transaction costs resulting from uncertainty and complexity in the formal institutional framework governing the EU electricity sector limit the development and operation of microgrids? This contribution will lay a foundation to answer the question by establishing a methodology to identify transaction costs resulting from uncertainty and complexity in the formal institutional framework governing the development and operation of microgrids. This is needed as in the EU, there is little or no knowledge on how to identify transaction costs for the development and operation of microgrids. It will further be assessed who will bear the transaction costs resulting from uncertainty and complexity, considering that transaction costs will be experienced differently by relevant stakeholders (such as active electricity customers, system operators, or municipalities) involved in the development and operation of microgrids. To the best of the authors knowledge, such an analysis has not yet been conducted in the legal academic literature.

For the economic analysis, this contribution primarily builds upon the work of Oliver Williamson and Douglas North. Williamson's work will be used to explain the economic relationship of individuals or organizations involved in a transaction (Williamson 1981). North's research will be used as the basis for understanding the role of institutions in economic performance (North 1990). Concerning the law and policy perspective, the analysis builds upon the work of Warneryd et al. who review the role of institutions in the development of microgrids in the USA, EU, Asia, and Australia (Warneryd et at 2020). The added value to the academic literature will be an in-depth focus on the current legal framework of the EU. Contrary to Warneryd et al., this contribution (a) includes the latest Energy Package that entered into force in 2019, (b) makes a distinction between the different parties that will bear the transaction costs and (c) distinguishes between different types of transaction costs when developing and operating a microgrid.

Home batteries in the Netherlands: a model for smart control, potential financial yield and increase in self-consumption

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In the Netherlands, home batteries are not so common, mainly because of the netting arrangement (in Dutch: salderingsregeling) that is currently in place. Under this arrangement, households with solar panels may on an annual basis deduct the amount of electricity that they feed into the grid from their consumption from the grid. Hence, for households with fixed electricity prices, there is no financial incentive to increase self-consumption. According to current plans, as of 2025 this netting arrangement will be phased out, until it is completely removed in 2031.

Since recent years there is the possibility of getting a dynamic energy contract, meaning that a household pays and receives the EPEX day-ahead electricity prices for their electricity (consumption and feed-in). These are hourly prices. Especially since the last months of 2021, these prices can vary greatly and can even become negative at times.

The upcoming phasing out of the netting arrangement and the high and highly volatile electricity prices of recent years might create opportunities for households with a dynamic energy contract to profit from a home battery. As part of the Wattflex project, we created a model for smart control of a home battery considering these dynamic electricity prices, both for the current situation with the netting arrangement in place as well as the situation when it will be phased out. Furthermore, we study what this would mean for different households in terms of financial yield and increase in self-consumption.

Currently, households can control a home battery based on these hourly EPEX-day ahead electricity prices, by charging at low prices (generally during the night or the afternoon) and discharge at high prices (morning and evening). Using Linear Programming, we made a model that determines how to optimally control the battery to maximize the profit per day, taking into account the costs per cycle to determine how many cycles to use during a day. This model for controlling the battery under the netting arrangement is being tested on several home batteries.

For the situation without the netting arrangement, the Linear Programming model was expanded to also take into account the electricity usage and feed-in from the household, and prices in- and excluding energy taxes. Several options for how to control the battery are explored: the battery can be set to discharge for self-use only, or discharge to the grid as well. Similarly, a battery can be set to only charge from surplus electricity from solar panels, or charge from the grid as well. When netting is phased out, these choices impact the amount of taxes that must be paid.

By using the historical data of several households, the effect of a home battery on the self-consumption and potential yield for different households can be studied. For this, data from Energysense are used. Energysense is a large data collection project from the Hanze University where smart meter readings of hundreds of households in the Netherlands are collected. With these data, we studied the theoretical case what a home battery could have yielded in 2022 if there was no netting arrangement. This shows large differences between households: there is a clear relationship with the total electricity consumption and feed-in, but also on the trade-off between those two. Furthermore, without subsidies on a home battery, the payback period is still rather long.

Finally, to apply the latter model for battery control, the energy profile of a household for the next day must be predicted. We predict this using machine learning techniques, using amongst other weather predictions (such as predicted solar radiation) and then study how errors in prediction influence the financial yield of the battery.

Drivers and barriers for the development of cooperative business models in the biogas sector for the transformation of the energy system

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The energy transition involves various challenges. One key aspect is the decentralization of power generation, which requires new actors. In order to integrate these into the system in the best possible way, there are various approaches e.g. in cooperation in citizens' initiatives or cooperatives (Dorniok, 2016).

Cooperation in general can enable the implementation of certain business models or can increase profitability by the exploitation of economies of scale (Skovsgaard & Jacobsen, 2017; Theurl, 2010). Synergy effects result from the utilization of know-how, different technologies or resources of the partners involved to complement the own competencies and services (Eggers & Engelbrecht, 2005; Sander, 2009). Cooperation exists in various industries and enable the participating companies to compensate their size-related resource deficits (Glaister & Buckley, 1996; Todeva & Knoke, 2005). This creates the opportunity to develop innovations, open up new markets, exploit newly created economies of scale and share costs and risks (Franco & Haase, 2015). In agriculture, cooperation in the form of cooperatives have been of essential importance for a long time, especially with the aim of exploiting synergy effects (Bareille et al., 2017). In the field of renewable energy development, cooperation in form of citizen cooperatives make a significant contribution to the participation of citizens in political, social and financial aspects of the energy transition (Huybrechts & Mertens, 2014). Energy cooperatives are frequently discussed as a potential actor in the energy transition and are increasingly being established to advance the common interests of stakeholders. For example, the joint operation of decentralized power generation plants can involve new actors in the energy transition through regional cooperation (Walk, 2014).

Existing biogas plants in Germany need new business models after the 20-year Renewable Energy Sources Act feed-in tariff expires. For continued operation, a business model innovation is needed, which can be realized based on the the different technical utilization pathways. Cooperation can have a significant impact on the profitability of the different business models, especially by

exploiting synergy effects (Karlsson et al., 2019). In addition, cooperation can help to ensure that existing plants continue to operate at all.
Currently, the most widespread use of biogas in Germany is in the coupled generation of electricity and heat. Additionally, there is the possibility of upgrading biogas to biomethane or biogenic hydrogen path (Mertins & Wawer, 2022).

Different options for cooperative business models that exist in the biogas utilization pathways are presented. The focus is on explaining the advantages of a joint approach compared to single-farm business models and identifying the relevant actors. Subsequently, drivers and barriers for the different cooperative business models are identified and classified based on 20 semi-structured interviews with plant operators in the administrative district of Osnabrück. The aim is to identify drivers and barriers for cooperative post-EEG operation. As a result, political instruments are to be found that make it possible to involve relevant actors and thus stimulate the best possible continued operation from the point of view of the energy system. The results are structured according to the PESTEL analysis. This assigns drivers and barriers to the categories political, economic, sociocultural, technological, ecological and legal (Kaufmann, 2021). The analysis of the interviews is supplemented and validated by a literature review.

Drivers and barriers for cooperative business models are manifold and can vary mainly depending on the plant and the operator.

Drivers
Political; Promotion of renewable energies: reduce dependence on fossil (Russian) fuels; Economic; Expectation of synergies (information sharing, shared risk, economies of scale); Planning security fixed supply or purchase contracts); Access to new markets (not accessible by single-farm business models); Cost savings by sharing infrastructure, technology; Positive return expectation; Sociocultural; Motivating, innovative environment; Lowers barriers to participation in new markets; Target-oriented partnerships; Better use of capacities and strengths; Strengthening regional value creation; Technological; Economies of scale (efficiency); Available, mature technology; Storable, transportable gas; Well-developed infrastructure; Ecological; Increase in plant plant efficiency; Reduction of greenhouse gas emissions; Promotion of the circular economy by utilization of organic waste and agricultural residues; Improving soil quality (fermentation residues as fertilizer)

Barriers

Political; Lack of political support; Competition to other renewable energies; Economic; Uncertainty about future development of energy markets; Disagreements between the cooperation partners; Lack of flexibility due to longer-term contractual obligations; Allocation of profits; Sociocultural; Cooperation with current competitor; Cultural differences and lack of trust; Acceptance by the general public (e.g. overproduction of maize); Technological; Different technology that is difficult to combine; Data protection; Ecological; Competition for agricultural land; Use of monocultures; Emissions from plant; Pollution from transport; Legal; Legal requirements and regulations; Unfavorable regulatory environment, e.g. long permitting process

One finding is that uncertainty is a major barrier for plant operators. This includes uncertainty about regulatory frameworks and political requirements, as well as about the general development of the energy markets. In addition, social factors such as lack of reliability and disagreement about revenue sharing are a potential barrier. A key driver for the implementation of cooperative business models is the expectation of synergy effects. In addition, operators are driven by a positive expectation of returns and the responsibility for securing the energy supply in times of crisis.

The drivers identified can now be used to develop strategies to advance cooperative business models. In particular, synergy effects should be exploited so that operators can benefit from cooperation. The advantages can also be highlighted and communicated to increase acceptance among the general public. Another important step is to reduce the barriers discussed above. In order to reduce social barriers in particular, it may be advisable to include an external partner in the cooperation, such as a municipal utility that operates an upgrading plant and concludes purchase agreements with the individual partners. In addition, it would be politically expedient to provide the operators with a clear framework for the future in order to reduce uncertainties. As a further aspect, knowledge transfer on new technologies and markets should take place.

Parallel Session | Global South: finance, economic growth, inequality, poverty

Analysis of global household energy inequality by using Gini coefficients

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Global wealth and income distribution is extremely unequal among countries and households. According to the World Bank's World Development Indicators (WDI), the per capita gross national income (GNI) of the richest countries is over 50 times higher than that of the poorest countries. Large inequality between countries and within a country can have profound impacts on social and economic development and would cause some social problems of unrest and turmoil. Addressing the inequality is an important goal for promoting a more just and equitable global society, and the 7th of United Nations Sustainable Development Goals is reduced inequalities. Therefore, the accurate measurement of inequality is important and help us gain deep understanding of the current condition of inequality.

There are wide studies about how to reduce inequalities, and the reasons and the impacts of inequality. The economic inequality also translates to energy inequality. Energy consumption is perceived as a better indicator of inequality as it captures the flow of durable goods and services which represent income and standard of living and are sustained by energy quantities . Households' direct energy consumption and energy footprints (or indirect energy use) are unequally distributed among countries and household groups due to differences in the size and patterns of household expenditure. Developed countries are more likely to consume and import more luxury consumer goods compared with less developed countries. By importing the products or cheap raw materials with low-value added from developing countries and then exporting the processed high-value added products to developing countries, developed countries gain the double economic revenues. And because the service and high value added industries are more profitable while more environmental-friendly, the developed countries also transferred more pollutant emissions and environmental burden to the less developed countries. And even within countries, higher-income people tend to have a more extravagant lifestyle and are less likely to be affected by the effects of extreme climate conditions than the vulnerable low-income people.

In order to achieve more equitable energy use worldwide, it is crucial to understand the current global distribution of energy consumption by household groups. However, previous studies about energy footprints and inequality seldom consider different energy types, economic sectors, and detailed household categories.

By using the latest GTAP v11 dataset (Multi-regional Input-Output table and energy data of 160 countries in 2017), global expenditure data for the year 2011 from World Bank Consumption Dataset (WBCD) (201 expenditure bins of 116 countries which almost consist of 90% of the global population), and population of countries in 2017 from world bank (used to downscale the aggregated regions and the calculation the Gini coefficients of different income groups in countries), we computed country- specific energy footprints by 201 household groups and 6 energy types (coal; oil; gas; petroleum, coal products; electricity; gas manufacture, distribution) using an environmental-extended multi-regional analysis and revealed the global household energy inequality by using Gini coefficients.

We find that the direct energy use of 116 countries were 1,787 Mtoe in 2017, while the indirect energy use induced by the household consumption of these countries were 9,390 Mtoe. A country's energy consumption is influenced by many factors, including economic and population factors, infrastructure, and technological level. More economically developed countries with mature industrial development have higher direct and indirect energy consumption, and their economic activities and living standards rely more on high-energy-consuming industries, transportation, agriculture, and other sectors. The sub-Saharan region has the lowest per capita direct and indirect energy consumption, while the United States has the highest per capita direct and indirect energy consumption. Coal accounts for the highest proportion in the energy structure of East Asia, while natural gas has a higher proportion in the Middle East, Europe, and Russia.

When comparing the direct and indirect Gini coefficients, the analysis shows that only the sub-Saharan and US regions have higher direct Gini coefficients than indirect ones, while all other regions show an increase in indirect Gini coefficients with increasing supply chain inequality.

Sub-Saharan Africa, the United States, and East Asia have highly unequal energy consumption patterns, with indirect Gini coefficients exceeding 0.4. When looking only at direct Gini coefficients, South Asia, Southeast Asia, and Latin America are close to perfect equality, while Northwest Europe and Southeast Europe are close to perfect equality. However, due to supply chain effects, these regions' Gini coefficients exceed perfect equality, with Latin America even exceeding 0.4, reaching a high level of inequality.

As for the inequality of indirect energy consumption of different energy types, natural gas has the highest inequality with a Gini coefficient of 0.75 globally. Many underdeveloped countries have yet to fully utilize natural gas, which is a clean energy source. The inequality in access to natural gas impedes global energy-saving and emission reduction efforts. Coal has the lowest Gini coefficient of 0.43 because of its relatively cheap price, but it still surpasses the 0.4 warning line for inequality. Electricity has a Gini coefficient of 0.63, and many African countries have yet to achieve access to electricity. As for the regions and economic sectors, in developed regions like Northern and Southern Europe, the inequality levels in water and food sectors are low while the transportation and service sectors have a high Gini coefficients, indicating that basic living and hygiene needs of people in developed countries are already met, but there is still significant inequality in lifestyle choices. Meanwhile, in Africa, the water sector has a high Gini coefficient of 0.6, and the transportation and service sectors have similar inequality levels as the water and food sectors. This reflects that basic needs in Africa are still not met, implies the Africa's low energy efficiency in water industriesm, and highlights the extreme inequality in global energy use.

Such detailed measures of global household energy consumption and energy inequalities could help us understand the current energy conditions among and within countries, inform policy interventions to promote energy transition, and achieve equitable energy access to more affordable energy while satisfying the basic needs and even improving the living standards of poor countries and poor households.

The impacts of Renewable Energy on Economic Growth: A Scoping Review

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In recognizing the benefits from the use of renewable energy which is believed to be a more sustainable energy system apart from being less carbon-intensive, this form of energy has gained popularity especially among advocates of clean environment as it reduces the adverse effects caused by greenhouse emissions and it has proved to be cost efficient. This is so because energy is necessary for an economy's growth and sustainability as such it is highly demanded. This high demand of energy as an important factor of growth has led to extensive research on the nexus between energy consumption and economic growth by many researchers which has resulted in inconclusive results. This has therefore motivated research in this discipline with different sets of methodologies, data sets, inclusions of heterogeneous characteristics and different set of variables, as these are believed to be the reason for the different set of results.

Researchers in this discipline mainly investigate four main hypotheses namely: the growth hypothesis which advocate for the important role energy has on output generation, since energy consumption is believed to boost economic growth; another hypothesis is the conservative hypothesis that believes energy is not an important factor for economic growth since the relationship is the other way round, where causality runs from economic growth to energy consumption; in addition, there is the feedback hypothesis that account for a bi-causal relationship and the dependence between these variables; finally, there is the neutrality hypothesis that indicates no causality of any form between energy consumption and economic growth. Understanding the extent to which empirical literature supports these four hypotheses becomes necessary as it guides policy formulation in the right direction. It is therefore against this background that this paper comes in a form of a scoping review of the literature on the impacts of energy consumption on economic growth specifically renewable energy which has gained popularity in recent years.

Research Question:

This paper tries to answer the research question: what is known from the existing literature about the impacts of renewable energy on economic growth?

Research Methodology:
A scoping review adopted from Arksey and O'Malley (2005) was carried out in February 2023. In line with this methodological framework, the review followed the five steps namely: identifying the research question; identifying relevant studies; study selection; charting the data; and finally collating, summarizing and reporting the results. A search for relevant literature published in English language from January 2010 to February 2023 was conducted. The review consisted of a wide range of literature from Peer reviewed articles, reviews and grey literature.

Results:
The review found that a large body of literature on the investigations into the renewable energy-growth nexus are in support of the growth hypothesis where renewable energy consumption was found to have a positive impact on economic growth. In addition, there was also evidence of bi-directional causality between renewable energy consumption and economic growth, that is the feedback hypothesis. Some studies also found the evidence of the neutrality hypothesis where there was no causality of any form between energy consumption and economic growth, while others found causality running from economic growth to renewable energy which is the conservative hypothesis. However, evidence of these last three hypotheses were not presented in many papers like the growth hypothesis.

In addition, the review also found emergence of non-linear relationship between renewable energy and economic growth where an inverted U-shaped relationship was reported by some researchers.

Furthermore, the review also found that there was some heterogeneity in the papers in terms of the methodologies that were used, sample size, mainly the number of countries in the study as well as the study period, data sets used, and variables used, to mention a few, which could be the reason for the variations in the results. However irrespective of the heterogeneity, most results were similar.

Conclusions and Recommendations:
This review has showed that there is a positive impact of renewable energy consumption on economic growth as the growth hypothesis has been dominant in most findings. Therefore, for countries to boost economic growth, there is need to address the gains from renewable energy consumption by developing and implementing energy sector specific policies that advocate for renewable

sources of energy, and this will not only boost economic growth but will also help to fully combat the global threat from the use of non-renewable sources of energy while in the long-term contributing to sustainable economic development.

The impacts of energy finance policies and renewable energy subsidy on energy vulnerability under carbon peaking scenarios: taking China as an example

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As the world's largest energy consumer and greenhouse gas emitter, China has been actively responding to the regulations of the Paris Agreement. After the dual carbon reduction targets were proposed, the Chinese provinces and cities responded by proposing the dual carbon strategy, such as high-quality development, energy dual control target. As an important financial tool for carbon peaking, energy finance can guide enterprises to optimize energy structure and change national energy vulnerability by reallocating resources in market, which helps the goals of environmental protection and sustainable development. Studying the impact mechanisms of energy finance policies on the energy system not only optimizes the design of energy policies, but also helps make plans for possible changes in energy vulnerability.

This paper explores the impact of two energy finance policies combined with renewable energy subsidy (RES) on energy vulnerability under different carbon peaking scenarios. To this end, this paper addresses three questions: (1) Investigating how different carbon peaking scenarios affect energy vulnerability. (2) Exploring how energy finance policies affect energy vulnerability under different carbon peaking scenarios. (3) Discussing the buffering effect of renewable energy subsidies on energy finance effects on energy vulnerability under different carbon peaking scenarios. This paper addresses the above issues by the following work: (1) The total fossil energy consumption and total renewable energy consumption are accounted for under different carbon peaking scenarios through the computable general equilibrium (CGE) model. (2) When allocating energy use rights to each sector, the game equity fixed cost allocation model (Game-EFCAM) that considers equity and efficient allocation is adopted to allocate initial fossil energy use quotas to each sector. Meanwhile, the renewable energy consumption threshold is set for each sector according to the Renewable Energy Quota System Policy. In addition, when designing the FET policy and RECT policy, this paper adopts the exogenous price for the in-quota part and endogenous price for the out-quota part to design the fossil energy and renewable energy prices. (3) Using the CGE model, this paper investigates the impact of carbon peaking, FET policy, FET policy and RECT policy combination, and FET policy-RECT policy and renewable energy subsidies on energy vulnerability under different carbon peaking scenarios, to discuss the effective policy combination design that can reduce energy vulnerability and make policy recommendations.

In detail, this research mainly fills the following gaps: (1) The realization of carbon peaking will cause shocks to the energy system, but little existing literature has studied the impact of carbon peaking on energy vulnerability. This paper considers the impact of different peaking scenarios on energy vulnerability based on the CGE model. (2) Past studies have often studied the energy finance policies by indicators or econometric methods, without revealing the mechanism design of energy finance policies and their impact paths on the energy system. When designing the energy finance policies, this paper allocates the fossil energy quotas with the principles of efficiency and equity. In addition, the prices of fossil energy and renewable energy inside the quotas are exogenous, and outside the quotas are endogenous. (3) Energy finance policies can change the energy system, but the existing literature rarely studies the impact of energy finance policy implementation. This paper integrates the impact of different combinations of energy finance policies on energy vulnerability and argues that RES can not only maximize the reduction of energy vulnerability, but also mitigate the impact of energy finance on economic development.

The main conclusions are as follows. (1) In the long run, the earlier the peaking time, the lower the energy intensity, the lower the energy import rate, the higher the share of renewable energy, the lower the carbon intensity, and the lower the energy vulnerability composite index. In other words, early peaking enables China's energy system more stable. . (2) Scenarios without energy finance policies implementation can minimize energy vulnerability before the peaking year. After the peaking year, the implementation of energy finance policies can reduce energy intensity and energy import rate, and increase the share of renewable energy more significantly. In particular, the earlier the peaking year, the more

significant the effect of energy finance policies on reducing energy vulnerability. (3) Among the three combinations of energy finance policies implemented, energy finance policies combined with RES can minimize the national energy vulnerability and buffer the negative impact of energy finance policies on GDP.

Keywords: carbon peaking; energy finance; energy vulnerability; renewable energy subsidy; computable general equilibrium; game equity fixed cost allocation.

A way to achieve energy transition inclusivity; A case study of Indonesia's readiness based on the economic inequality

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Climate change has appeared as one of the world's greatest concerns. The emergence of climate change has led many people to regard it as a crisis rather than a shift. The damage caused by the climate crisis has physically harmed not only the environment but also its living beings. 2023 is predicted to be among the hottest years ever because of this matter. It has also resulted in deadly flooding all over the world, food scarcity, drought, wildfire, and many more. Indonesia, despite its abundant natural resources, has become the world's fifth-largest polluter, with fossil fuel consumption largely responsible for it. To a surprise, the impact is not only on the use of fossil fuel that contributed to the climate crisis, but it is mainly due to the coal mining activities that results in water, soil, and air pollution, environmental damage, and even health and the life sustainability of the people living near the mines. Such cases occur in areas like Bengkulu, Satui Barat, Samarinda, and even North Jakarta, Indonesia's capital city. The damage is still ongoing, the leak of the company's waste disposal causing a decline in fish populations on the coast, acid rain causing skin diseases and coughs, damaged road access and land humidity resulting in the destruction of residents' houses, and so on. Although this issue has been ongoing for years but has yet to be resolved, it is due to a lack of monitoring and a weak legal framework. It reflects inequity because some people in the smaller region that does not rely on fossil fuel energy must bear the brunt of the impact.

Its effects are growing and spreading throughout the entire world, and will continue to occur as long as there is a demand for non-renewable energy. As a result, we required a green energy transition. The main goal of energy transition is to enhance energy efficiency by phasing out fossil fuels while also boosting production of renewable energies such as hydrogen, biomass, and geo-heat.

Even though there are many alternatives for Indonesia, it remains a huge challenge because Indonesia is still heavily reliant on fossil fuels to fulfil its energy demand. Other factors that hinder the process of transitioning to green energy are due to the lack of sufficient knowledge, funding to produce renewable energy, and the assurance that the transitions will not only cover the urban and metropolitan areas but can be felt by all levels of society. Aside from ensuring equal distribution, stakeholders should also ensure that the transition has no negative impact on the environment or its people like the previous mining activities did. As a result, this paper will try to answer the question, “How can Indonesia be assured of an inclusive green energy transition in which all individuals have access to green energy and none suffer the negative impact of the transition on the environment or the people?” It will examine Indonesia’s readiness to address these two potential issues, given that the country still has a huge gap in public access, and that there are still many problems arising from coal mining activity, with no guarantee that the problem will be mitigated if the country transitions to green energy.

This paper uses a longitudinal method to assess the problem, determining the transition progress and development in various areas in Indonesia over time. In addition to longitudinal studies, observational methods and in-depth interviews with the public and various stakeholders will be used to determine how much the transition affects the public’s life and what types of impacts benefit and what do not. Doing these mixed methods is important to optimize the projected outcome. It is hoped that this paper will result in seeing the reality and public perceptions of the impact before and after the transition. It is substantial because it will (1) help to determine what kind of action the government should take and what to prioritize, the distribution of green energy or reducing the transition’s overall impact. (2) What type of resource is best for Indonesia’s green energy that has the least negative environmental impact? (3) Due to the high risk of inequality, is Indonesia able to achieve the Paris Agreement targets to limit global warming well below 2 degrees Celsius as It will be a long journey for Indonesia not only to consistently produce renewable energy, but also to reach the point where they can meet their energy needs entirely through green energy. (4) It will also answer how various stakeholders can collaborate to address this issue. This paper is expected to result in policy innovation as well as a long-term vision and planning.

Parallel Session | Citizens, community and bottom up initiatives: Substantial factors in energy transition

The potential impact and the development of the local energy initiative sector in the North of the Netherlands

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Local energy initiatives (LEIs) may play an important role in the energy transition. However, their impact is still limited. Different scholars examined the development of LEIs in the context of Strategic Niche Management (SNM) and concluded that currently the local energy initiative sector is not a robust niche which is integrated within the current regime. In other words, LEIs do not have an high impact to cause a regime shift. Within SNM, different factors are mentioned which are important for the development of niches to become more robust, such as managing expectations, learning processes, and building social networks. Although, these factors are important for the development of LEIs, it gives not enough information where the local energy stands regarding a regime shift. So far, little is known about the developmental phases a local energy sector goes through from niche to eventually cause a regime shift. Only a few studies attempted to examine the developmental phases of LEIs. However, these phases where not sufficient enough and these studies only examined the development of the sector so far. The first aim of this study is to contribute to this knowledge gap by defining the different phases in the development of the local energy sector from the emergence of LEIs until they can cause a regime shift. The second aim is to examine in which phase the local energy sector is currently positioned. And the last aim is to explore what is needed to move to the next phase.

The first step was exploring whether there was a shared vision within the local energy sector. A shared vision is important for a successful development of a niche, as it gives input for the learning processes (i.e. what has to be learned to become a successful niche?) and it determines which actors should be included into the social network to accomplish the shared vision. Additionally, a shared vision presents the last phase of the development of LEIs. Therefore, this vision is used in the second step as a starting point to define the different phases the niche goes trough in order to reach the last phase. Additionally, the requirements of what is needed to move to the next phase is examined.

To examine the developmental phases of the local energy sector in the province of Groningen, semi-structured interviews are conducted with local energy initiatives, intermediary organisations and civil servants of municipalities from the province of Groningen. At the time of submission, 35 local initiatives were interviewed and the interviews with intermediaries and municipalities are scheduled in March. The results will be analysed in April. Based on the results of the interviews, an overview of the different developmental phases of the local energy sector will be presented and be discussed at the conference.

A Systematic Review of Community Energy Schemes through a Feminist Perspective on the Energy Transition

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Climate change leads to implementing different policies to deploy renewable energy and move toward energy transition. Energy transition should provide equal access to sustainable energy to all individuals. Meanwhile, community energy schemes could promote public participation in our communities.

The sustainable development goals (SDGs) agenda illustrates sustainable energy (SDG7) to follow three targets: affordable and global access to energy services, increasing the use of renewable energy and enhancing energy efficiency up to 2030, (Gielen et al., 2019). In order to achieve these targets, we need new policies and strategies for speeding up the energy transition, (Pellegrini□ Masini et al., 2020). Energy transition should empower low-income households and communities to move to a fair sustainable society (Biswas et al., 2022). In renewable energy projects, we need public participation both financially and in decision-making to innovate new energy models (Lowitzsch, 2019). Community energy schemes can help bring citizens, authorities, and organizations to follow new strategies to move toward energy transition.

This paper aims to analyze the role of feminist theories associated with energy transition in community energy schemes. As Wilson (2018, p.398) argued, “Energy transition is a feminist issue”. Decarbonizing the energy supply could bring individuals, including women and people of color, into communities and enhance social life (Wilson,2018). Feminists try to reach the equity goal, which means all women are as same as men and have the same natural rights.

In this paper, we explore to what extent are community energy schemes inclusive of women, and how they can be more inclusive to deliver a fair energy transition.

This analysis is based on a global systematic literature review of community energy schemes through a feminist perspective on energy transition. This systematic review is a process where existing scientific studies are the main source of data. The researchers used the guidelines of Higgins and colleagues (2019) in Cochrane Handbook for Systematic Reviews of Interventions, Booth and colleagues (2016) in their book Systematic Approaches to a Successful Literature Review and the Systematic Guidance on Conducting a Systematic Literature Review proposed by Xiao and Watson(2019). This systematic review aims to understand the role of women in community energy systems and evaluate each article based on its research subject and, more specifically, whether there is any attention to women. Google Scholar, Web of Science, NTNU library, and SCOPUS have been used to access these articles and books. Five topic areas have been identified to cover the concept of community energy schemes through a feminist lens: community energy initiatives, inclusion, community empowerment, community energy democracy, and ecofeminism. The selected references were identified carefully to extract helpful information related to the trends, environmental and social impacts, and the role of the feminist approach toward sustainable development. Finally, 80 articles have been selected for further analysis through this paper. NVivo has been used for analyzing and conducting the articles for systematic reviews and further analysis. In the end, a framework will be defined based on the linkage between ecofeminist and community energy schemes to help future researchers to demonstrate the importance of feminist theory on energy transition issues in communities.

A missed opportunity? Power unbalances and predominant narratives in the emergence of energy communities in Italy

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Energy communities (ECs) are emerging as a promising model for a transition to multi-governance structures in the process of deep decarbonization of energy systems. Decentralized and community-owned energy structures offer the potential to increase citizen inclusion in energy system governance, unlock private investment in renewable energy and improve just and fair distribution of benefits related to energy ownership (Hoicka et al., 2021).

However, this potential is limited by recurring narratives and perpetuating power structure that characterize centralized energy systems, which shows significant shortcomings in terms of justice (Sovacool et al., 2017). These refer to the object of injustices (distributional perspective), to the inclusion in decision-making processes (procedural aspects) and to the identification and consideration of neglected and vulnerable individuals and their needs (recognition implications). Thus, this study investigates (a) existing power dynamics in the emergence and establishment of ECs in Italy, (b) possible spaces for change to ensure a just transition and fair outcomes of deep decarbonization pathways. Specifically, we examined if and how existing power influences the strengthening of dominant narratives in shaping ECs, and whether inclusive spaces can be created along the transition process to involve less powerful actors in promoting just and inclusive deep decarbonization pathways.

This study refers to sustainability transition research that investigates how power is exercised in transition processes, as inherently political processes (Köhler et al., 2019). Specifically, Avelino (2021) proposes a meta-theoretical framework to study power in processes of social change and innovation, recognizing that the concept of power is more frequently used to explain a lack of change rather than change happening in socio-technical systems. Moreover, the socio-ecological transition perspective contributes to the discussion about power by looking at the central role attributed to defined narratives, underlying worldviews (e.g. on human-nature relationships), and value systems in enabling or constraining profound transformations and the shaping of power dynamics (Abson et al., 2017; Fischer et al., 2015), whether in relation to 'power over', 'power to' or 'power with' (Partzsch, 2017). Brisbois (2019 and 2020) develops a powershifts framework to study shifting political power in energy transitions, investigating the potential impact of ECs on political systems across comparative cases. Although her findings reveal that ECs are gaining capacities and influencing political power, they are challenged by pressures from incumbent players in the electricity sector to maintain central power and control. We build on Brisbois' recommendations to investigate the nascent expansion in ECs political power and to explore power dynamics and narratives in Italian deep decarbonization pathways.

To this end, we examined a case study in the Italian city of Trento that is currently exploring the EC model as a key solution for local deep decarbonization pathways. Qualitative data were collected during a workshop with stakeholders in Trento that was held on October 2022.

The workshop included 30 representatives of local ECs, energy companies, policymakers, research institutions and civil society associations with the intention of exploring key characteristics of two grand narratives ("energy as a commodity"" - i.e. aiming at production from renewable energy sources and enhancing energy efficiency, relying on the capacity of citizens to act as individuals and consumers, addressing the problem of energy poverty - , and "energy as a common good", - i.e. aiming at energy sufficiency and stability, relying on the capacity to act as part of a community, addressing energy opulence (Gantioler et al, 2023)), and working across the three dimensions (forms, spaces and levels) of the power cube. The "power cube" (Gaventa 2006) has been used as methodological approach for the design of the workshop and the analysis of information collected on the power implications of the shaping of ECs in Italy.

Preliminary findings show that "energy as a commodity" is the dominant narrative in discourses concerning ECs, which is in line with the emerging Italian and EU narrative on the topic. Conflicting sets of value systems exist among different types of stakeholders and latent conflicts on governance models and energy ownership became visible (e.g., 'one member – one vote' versus 'demand-response systems'). The decision-making processes on EC regulation appeared to be a closed space of participation. Strong discourse and political coalitions are forming around technical and (economic/legal) feasibility issues of ECs as communities of prosumers/consumers ('it's about numbers and costs'). Nonetheless, invited spaces are created by local governments, as discourse coalitions emerged around the need to consider social impact and value systems for ECs (e.g., environmental protection). The study has some methodological limitations. During the workshop, due to time constraints, the concept of power and the power cube analysis framework were implicitly used rather than explicitly presented to participants. Moreover, as researchers, we recognize we exercised some power in defining the agenda and the guiding questions of the workshops, hence creating claimed space.

This study has been conducted in the framework of the JPI Solstice-funded project ROLES, aimed at revealing just and inclusive deep decarbonization pathways in Italy, specifically related to smart electricity meters, a digital data infrastructure that can support EC operations.

Beyond the Impasse: Polycentric Rebellion and the Transformation of American Climate Policy

Presenter: Job Taminiau, Foundation for Renewable Energy and Environment (FREE, New York, USA) | Coauthor: John Byrne, Center for Energy and Environmental Policy (CEEP, University of Delaware, USA) | Coauthor: Joseph Nyangon, Center for Energy and Environmental Policy (CEEP, University of Delaware, USA)

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The presentation analyses the historic cycle of climate policy stagnation at the national level in the United States, characterized by alternating periods of Democratic policy creation and Republican policy dismissal. However, it posits that a new and potent actor has emerged in the form of a polycentric counterparty, a coalition led by state and local governments allied with social movements. The persistence of this counterparty has led to policies far exceeding national plans, showing resilience against political shifts. Their strategies have focused on social justice, moral responsibility, and environmental sustainability, effectively challenging the existing policy stalemate at the national level. We present a theory of American climate policy conflict, providing empirical evidence of the transformative power of the polycentric movement. This movement aims not only for a reduction in carbon emissions but also for a comprehensive change in the institutions of governance and the socio-political fabric of climate-society relations, displacing the ‘cornucopian political economy’ with one dedicated to ‘just sustainabilities’.

Parallel Session | Just energy transition, governance and policy: policy and governance concepts

Pathways towards problem-solving – a conceptual approach for transition governance

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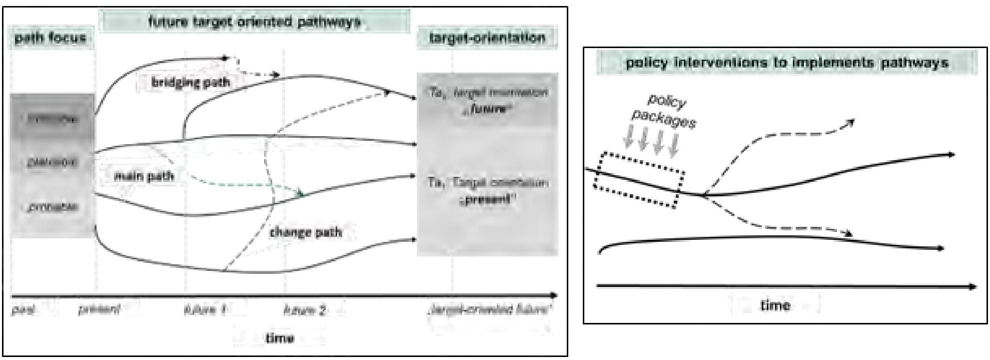
Pathways is an emerging concept for both analytical science and policy advice purposes on how to deal with upcoming and longterm problems that societies face. The pathway and policy formulation phase become relevant provided a long-term public problem was identified and entered successfully the agenda setting phase seeking relief through policy-makers and governmental action. What comes next, is to identify solution-oriented pathways which end up in solving the problem, and adequate policies that to a high degree will implement the considered pathways. Thus, within the phase of pathway and policy formulation, we identified pathway target specification and goal settings, and policy mixes for long-term pathways as key issues. The pathway framework consists of a phase model that comprises two core elements, namely: pathway identification and specification, and corresponding policy interventions for pathway implementation (cf. Figure 5).

Figure 5: A heuristic of pathway and policy formulation

Source: own elaboration



First, pathway identification, specification and target setting aim at exploring which pathways are promising to finally solve the problem. The options for strategically dealing with the grand and long-term challenges of our time can be described by different paths of action and their probable or assumed consequences. Pathway identification and target specification refers to linking the identified problem with a convincing solution through a target-oriented pathway. The problem-solving final status needs to be addressed. In case of climate change, target specification refers to, for instance, limiting the global average temperature rise to well below 2°C above pre-industrial levels. In the field of nuclear disposal, the final target can be specified to ensure the permanent protection of humankind and the environment from ionizing radiation and other harmful effects of such wastes for the future. From that end, several pathways can be identified and detailed which serve the long-term goal. To give an example, in the case of climate protection different pathways are reduction of greenhouse gases, and geoengineering activities. While the CO2-reduction pathway includes phasing out of fossil fuels and extension of renewable energies, geoengineering activities can be divided into two major categories: carbon dioxide removal (CDR) and solar radiation management (SRM). Carbon dioxide removal is linked to long-term sequestration of atmospheric carbon dioxide in forests, agricultural systems, or through direct air capture and geological storage. SRM technologies promise to increase the reflectivity of the Earth's atmosphere or surface, in an attempt to offset some of the effects of anthropogenic climate change. As the example shows, the two pathways follow their distinct solution roads and hence, request considerable different action.

The step of pathway identification, specification and target setting is conceptually illustrated in the left display of Figure 5. The focus here is on providing a consistent description of several pathways which are discussed among researchers, experts, stakeholders, and policy makers. The idea here is to comparatively illustrate the scope of different futures and alternatives for action. The concept of path heuristics uses various path types to structure the network of relationships between future paths in a goal-oriented transformation toward problem solving. A main pathway fully connects the present with the long-term future and contributes significantly, independently and complementarily to the set goal of transformation. A focus path is a component of a main path (or several) and details specific elements in the area of technology, organization, intervention, etc., from a specific different angle or focus. Third, an alternating path provides the option of turning off at a a junction or bifurcation in order to move from one path to another.

And finally, a bridging path is a time-limited future path that facilitates the transition to strong transformation pathways as a present-related, “most favorable” path but is foreseen as to end in a mid-term future due to the fact that in the future better solutions are strived for.

Second, policy formulation and packaging for pathway implementation is needed. At the heart of the approach is the design of adequate policy interventions and packages that are capable of triggering the preferred transformation pathways from a long-term perspective. Policy formulation is essential since pathway implementation does not occur autonomously and independently. The concept of “policy package” includes interventions or bundles of interventions in the sense of concrete policy measures and packages that seek to implement a specific target-oriented pathway (cf. right display in Figure 5). This is because target-oriented pathways need policy interventions in order to materialize. Or in other words: no decision, no transition. Policy interventions can be understood as deliberate steering processes to implement or realize a politically selected and desired pathway. The approach of “policy packages”, understood as a bundle of coordinated political options for action, analyzes expected intended and unintended effects and, through the bundled consideration of different measures and their interaction, aims to improve the effectiveness of individual measures in their control function, to minimize possible unintended effects and/or to strengthen the legitimacy of the measures or to facilitate their implementation. From a long-term perspective, pathway implementation through policy formulation specifies the fundamental building blocks, defines substantial interim targets, and designs policy options and interventions for fulfillment.

Assemblages out of steam: The discourses surrounding geothermal energy as part of energy transition in Turkey

Spijkerboer, R. C. - University of Groningen, Faculty of Spatial Sciences, Turhan, E. - University of Groningen, Faculty of Spatial Sciences

Geothermal energy is receiving increasing attention as a renewable source of heat and flexible baseload electrical capacity in the global south and north. However, geothermal energy is mainly perceived as a technological and geological issue. There is a clear lack of research employing social sciences perspectives to study geothermal energy as part of decarbonization strategies.

Hence, this paper aims to explore the divergent discourses on promises, pitfalls and spatializations of geothermal energy as part of a just and inclusive decarbonization strategy in Turkey.

Turkey has experienced a boom in geothermal development since 2008, which has catapulted the country to the fourth largest producer of geothermal electricity in the world. In little more than a decade, the installed capacity for power generation went from 30 MWe to 1676 MWe. Most of these projects have been geographically concentrated in the Büyük Menderes and Gediz River Basins in Western Anatolian, where geological circumstances are favorable for power generation from geothermal energy. However, many new geothermal projects in these regions are now facing resistance and are challenged in courts. This raises questions regarding the divergent discourses surrounding geothermal energy when taking into account both the material and social dimensions of geothermal energy.

This study draws on assemblage thinking to focus attention on the interlinkages between the material and the social dimensions of geothermal energy development and how this relates to issues of equity, access, and ownership of resources and processes. Using Q-methodology, this study explored the plurality of viewpoints among a variety of stakeholders involved in or affected by geothermal energy development in Turkey. Based on 4 preliminary online interviews and document analysis a concours was established which was reduced to a set of 30 statements. Q-sorts in combination with face-to-face interviews were organized with 21 participants from financial institutions, industry, policy-makers, community activists, environmental lawyers and universities. Results were analyzed using Ken-Q, resulting in 4 factors that show 4 distinct discourse coalitions surrounding geothermal energy development in Turkey.

Results demonstrate a highly polarized debate with four major coexisting discourses: (1) The sharing solution: These actors belief in further growth of geothermal energy where geographical concentration is inevitable and not necessarily problematic as long as investors are held liable and benefits are shared with local populations; (2) There is no solution: These actors do not think there is room for further development of geothermal energy in the regions that have experienced most growth so far, and that this development has definitely not been a success so far. Their focus lies mainly on minimizing future harm from existing projects. (3)

The technocratic solution: These actors are proud of the quick development of the geothermal sector and consider it a big success. Existing rules suffice as long as they are implemented well. Further (international) investments are considered necessary to maintain growth; (4) The regulatory solution: These actors see the high potential of geothermal energy in Turkey. They see that there are a few bad investors that ruin the reputation of the sector and these bad practices are enabled by gaps in the existing regulatory system. With a well-designed regulatory system and good scientific practice, there is definitely a future for geothermal energy in Turkey.

Despite this polarized debate there appears to be consensus on a number of statements. Across these four discourses, there was agreement on the need for timely and continuous community engagement, and on the need for social- and environmental impact assessments independent of the size or phase of projects. Moreover, none of these groups disagree with statements concerning the need for a central geothermal agency for integrated assessment of permits and the need for geothermal investors to also invest in local communities. While the underlying reasons for agreement with these statements might differ between these discourses, they provide a direction for potential measures to be taken for improving equity, access and ownership of geothermal energy. Moreover, none of these discourses necessarily shows a complete disregard of the potential for geothermal energy to be(come) part of decarbonization strategies, just widely different perspectives on how, where, and when it should be deployed. Thereby, this study also shows how Q-method can also help to find some bridging perspectives in a highly polarized debate, such as the one concerning geothermal energy development in Turkey.

Concluding, this paper shows how there are at least four different perspectives on how the material and social dimensions of geothermal energy are interrelated in the Turkish context, with a variety of implications for how actors experience issues of equity, access, and ownership of resources and processes. A just and inclusive energy transition needs to take into account this plurality of perspectives, with particular attention to how the material and social are intertwined in these various perspectives. Moreover, this study clearly illustrates how geothermal energy is more than just a geological and technological issue and reinforces the call for engagement with this topic by social scientists.

Are the Deep Transitions and Deep Incumbency frameworks reconcilable?

Rien de Bont, RUG | Gunter Bombaerts, Eindhoven University of Technology | Bonno Pel, Université Libre de Bruxelles | Erik Laes, VITO

One of the central characteristics of the field of sustainability transitions studies (STR) is the study of stability and change of socio-technical systems (Köhler, 2019). The notion of 'regime' as conceptualized in the MLP (Geels, 2005; Geels, 2011) remains the central theoretical orientation in this study of change. Aside more incremental proposals for refining perspectives (e.g., Fuenfschilling and Truffer, 2018), there have been various attempts at more radical theoretical advances, challenging the basic assumptions of the MLP. Two particularly explicit examples of those are the recently proposed frameworks of Deep Transitions (Schot & Kanger, 2019) and Deep Incumbency (Stirling, 2019) - hereafter referred to as DT and DI, respectively. The frameworks share the aim for foundational contributions to transitions theory, and fundamentally rethinking the MLP. More specifically, as the adjective 'deep' denotes, both DT and DI frameworks maintain that the MLP is insufficiently able to grasp the 'depth' that stabilizes entrenched socio-technical systems, implying that the MLP is not apt to inform/inspire that truly seeks to break from these entrenched socio-technical systems.

Notwithstanding this similarity concerning 'depth', the two frameworks propose advances that seem strongly opposed: While Stirling (2019) presents his theoretical/methodological ideas on deep incumbency and diverse transformations as a move away from the more rigidity/systematic thinking underlying the MLP, the Deep Transitions framework rather appears to extend this same 'systematic' thinking. Seeking to make the best of these theoretical advances, this leaves us with a challenging question: Can the DT and DI frameworks be reconciled?

A first step in exploring a possible reconciliation of DI and DT is develop an understanding of what both frameworks refer to with the adjective 'deep'. The DT framework takes a very systematic approach to theorizing stability and change, meaning that it develops a large system with multiple levels and concepts, like the MLP. The system conceptualizes specific mechanisms/dynamic that came about during over 250 years of industrial development and is a part of western societies to its 'deepest' extend. The DT framework conceptualizes this 'depth' with their notion of industrial modernity, which describes a set of deeper rules orienting behavior in domains of (1) 'Resources, science and technology', (2) 'Economics, business and industry', (3) 'Policy, regulation and governance',

(4) ‘User practices, consumption and everyday life’, and (5) ‘Culture: general foundational assumptions and symbolic meanings’ (Kanger and Schot, 2019). The DT framework conceptualizes how ‘industrial modernity’ came about in a self-reinforcing/fulfilling manner: the more weight industrial modernity came to accumulate since start of the industrial revolution, the more industrial modernity started to push the direction of changes in directions biased towards certain features of industrial modernity (Kanger and Schot, 2019, p.13).

The Deep Incumbency framework (Stirling, 2019) explicitly takes a step away from systematic thinking and rather emphasizes disciplinary/methodological plurality. Important to understand is that the Deep Incumbency Framework is rather a collection of ideas or a ‘spirit’ which can only be explained by summing up several of its constitutive parts. One of those parts is Stirling’s argument that stability and change should be understood in irreducible terms of entire societies, cultures, economies and materialities. Also relevant is the intuition that knowledge and action are co-constituting, which implies that any knowledge formed on changing towards sustainability can itself create a type of stability of entrenched socio-technical systems, rather than challenge these systems. The understanding of ‘deep’ in the DI framework relates to how different axioms in the framework (e.g. ‘deep incumbency with open topology’) jointly make it challenging to change an entrenched socio-technical system – they make this stability ‘deep’.

After clarifying (the differences in) what both frameworks refer to as ‘deep’, the presentation continues with drawing on the history of 20th century philosophy to highlight how both frameworks are in fact not very different after all. The perspective argues that both frameworks revive a classic discussion on ‘structure’ in the style of critical theorists (e.g. Marx, Adorno) and specific French post-WWII theorists such as Louis Althusser or Michel Foucault. Just as these thinkers stress the difficulties in breaking with deep-rooted sexual norms or capitalist mechanisms (i.e., ‘structures’) that emerged (in the west) over centuries, both DT and DI are concerned to stress the difficulties in breaking with deep-rooted western structures concerning sustainability.

Placing DI and DT in longer traditions can help to contextualize the systematic (DT) and plurality/emergence based methods/accounts. DT’s system based approach can be argued to bear greatest resemblances with more ‘classical’ analyses of ‘structure’ in the line of Althusser or Foucault. That is, Althusser or Foucault still aim to develop some kind of systemic account of the dynamics of the functioning of ‘structure’. DI, on the contrary, is more in line with the break introduced by Gilles Deleuze and continued by STS scholars such as Bruno Latour. As in DI, Deleuze builds on the idea of refraining from any systematic philosophy, rather embracing theory as necessarily plural. If we focus on Deleuze’s conceptual innovation, we can see that ‘systematic’ and ‘plurality’ based perspectives on ‘structure’ can in co-exist in a creative tension. An example is how - after the death of Foucault in 1984 - Deleuze provided a very rich examination of Foucault’s work. We can imagine a similar productive dialogue between DI and DT.

Returning to the question of ‘Can the DT and DI frameworks be reconciled?’, we can say that a full-reconciliation might not be possible nor desirable, but the creative exchange of both frameworks in this shared question of breaking free from deep rooted (unsustainable) structures can be productive. Engaging in this constructive, critical dialogue can again reinvigorate the global/macro level reflection on ‘structure’ in STR.

Claiming sustainable development outcomes in decentralised renewable energy: results from a systematic review

Luiz Eduardo Rielli, Inês Campos | CE3C – Centre for Ecology, Evolution and Environmental Changes, Faculty of Science, University of Lisbon, Lisbon, Portugal

A fast energy transition requires new technologies such as soaring renewable energy solutions. Considering new electricity infrastructure development, it is relevant to understand how local environmental and social aspects affect local actors. It is commonly considered that decentralisation increases benefits at the local level, but the argument is under-researched, with limited evidence of the related positive outcomes. Therefore, this work pursued answering *what aspects or criteria must be considered to claim positive sustainable development outcomes in new electricity generation infrastructure?*

This research assessed conditions, factors, and criteria in decentralised and centralised new renewable electricity generation, indicating which ones contribute to claiming local-level sustainable development benefits. It relies on a comprehensive systematic review, as a solid common ground for further evaluations and analysis. From the literature assessment, the following analysis was raised.

In the last two years, there has been a significant increase in peer-reviewed scientific production regarding the local effects of the energy transition, especially the impacts of decentralization. The most relevant associated keywords were "decentralized energy"; "renewable energy communities"; "energy transition AND impact assessment". Other search entries such as "energy transition AND local benefits" and "Energy transition AND local development" showed less relevance.

The analysis approach of stakeholders' engagement in renewable electricity infrastructures is moving from "social acceptance" to "energy justice" perspectives. Energy justice needs to be added because it is a modern and very suitable approach to value effects on local communities (Mendieta-Vicuña & Esparcia, 2022).

In the Global North, the energy communities, with local-level participation and ownership, are being institutionalized in national-level policies, facilitating its spread and recognition as contributing model to the energy transition.
In the Global South, especially in middle and low-income countries, energy infrastructures are a binding constraint which may be a barrier or leverage of local transformations and development (Andreoni et al., 2022). Therefore, criteria and factors are necessary to assess how decentralization promotes benefits at the local level. It means considering the procedures and decision processes while deploying new energy technologies.

From the available literature Berka and Creamer (2018), offer a common ground for setting criteria to claim positive sustainable development positive outcomes. They provide several local impact categories and criteria: economic regeneration (i.e., local procurement, earnings allocations, and local capital investments source); capacity building and knowledge transfer; social capital development (i.e., interpersonal networks, and trust); social support (i.e., ownership, and acceptance); access to affordable energy; environmental literacy and ecological consciousness. These parameters comprise relevant socio-economic and environmental aspects and may be used as a basis for defining the proxies for local development assessment.

Other authors contribute with further perspectives, such as intergenerational justice, and political autonomy (Andreoni et al., 2022). While quantitative research is associated with economic parameters, qualitative approaches bring deeper understanding and complements aspects related to social and environmental outcomes.

Debate and Conclusions

Decentralisation is a defining feature of energy system transition, but local-level outcomes is under-researched and offers a clear scientific gap. There is not a consolidated literature or clear saturation of analysis and results. Although the systematic review indicates an increasing interest, it a research agenda that is not consolidated.

Finally, the fast energy transition must not take new infrastructures local positive benefits for granted. Therefore, there is space for further research on the parameters and conditions enabling new renewable electricity infrastructure to drive sustainable development.

Panel Discussion | Overcoming Challenges in Local Green H2 Economies

Overcoming Challenges in local green H2 economies

Organizer: Dr Beata Kviatek, Jean Monnet Chair in Sustainable EU Economy, Centre of Expertise Energy / International Business School / Hanze University of Applied Sciences Groningen, the Netherlands

One of the main pathways of the current energy transition includes development of regional green hydrogen economy, usually based in the so-called hydrogen valleys. The development of regional green hydrogen economies enables to green up regional industry and mobility, brings new business opportunities for local and regional businesses, redirects regional investments and financial streams, and proposes new avenues for regional education, knowledge, and research institutions. However, the complexity of regional transformation towards green hydrogen economy, poses challenges that require a close cooperation between different local and regional stakeholders at multiple levels, including national and European. What are these challenges in developing regional green hydrogen economies here, in the northern part of the Netherlands, and in other regions of Europe and what are the new pathways to overcome challenges in regional green hydrogen economies? – is the main question of the proposed panel discussion that will involve academics, policy makers, and practitioners from the northern part of the Netherlands as well as some European regions.

The members of the panel are:

- Dr Ir Jan-jaap Aué, Professor Application of Hydrogen within the Energy Transition, EnTranCe / Hanze University of Applied Sciences Groningen
- Prof Lorenzo Squintani, Professor of Energy Law, University of Groningen
- Dr Kim van Dam, Senior Researcher Spatial Transformation at EnTranCe / Hanze University of Applied Sciences Groningen
- Dr Beata Kviatek, Jean Monnet Chair in Sustainable EU Economy, EnTranCe / Hanze University of Applied Sciences Groningen
- Representative from the Province of Friesland
- Representative from the Province of Groningen
- Representative from the Province of Drenthe
- Representatives from regional business association

Parallel Session | Energy Systems and (Business) modelling: Multi-commodity energy systems

Multi-commodity energy systems

Ewoud Vos, Hanze School of Applied Sciences

The increasing share of renewable production like wind and PV poses new challenges to our energy system. The intermittent behavior and lack of controllability on these sources requires flexibility measures like storage and conversion. Production, consumption, transportation, storage and conversion systems become more intertwined. The increasing complexity of the system requires new control strategies to fulfill existing requirements.

The SynergyS project addresses the main question how to operate increasingly complex energy systems in a controllable, robust, safe, affordable, and reliable way. Goal of the project is to develop and test a smart control system for a multi-commodity energy system (MCES), with electricity, hydrogen and heat. In scope are an industrial cluster (Chemistry Park Delfzijl) and a residential cluster (Leeuwarden) and their mutual interaction. Results are experimentally tested in two real-life demo-sites scale models: Centre of Expertise Energy (EnTranCe) and The Green Village (TU Delft) represent respectively the industrial and residential cluster.

The result will be a market-driven control system to operate a multi-commodity energy system, integrating the industrial and residential cluster. The experimental setup is a combination of physical demo-site assets complemented with (digital) asset models. Experimental validation is based on a demo-scenario including real time data, simulated data and several stress tests.
In this session we'll elaborate more on the project and present (preliminary) results on the testing criteria, scenarios and experimental setup.

TRILATE: Energy transport infrastructure for industrial clusters in the pursuit of climate neutrality

Nienke Dhondt (UGent), Joannes Laveyne (UGent), Greet Van Eetvelde (UGent)

Enforced by the current energy crisis, the energy transition calls for reassessing the energy demands in all activities of our society, producer or consumer, industrial or residential sector alike.

Every player is in need for alternatives to lower the consumption of energy and in particular the dependency on fossil fuels. This challenge is reinforced by the net zero emissions target to reach climate neutrality by 2050. Key to reaching this goal is advancing renewable and alternative energy sources, but it is generally accepted that a broad set of abatement measures will be needed in a wide variety of economic and societal areas. A range of pathways can be identified that each set forward a series of technologies to serve the net zero purpose. Examples of direct abatement measures in industry are increasing overall process efficiency, switching to low or zero carbon fuels to operate plants, using circular feedstock or capturing carbon for either usage or storage. In residential areas, energy efficiency in buildings and electrification of heating or transport are important ways to reduce emissions, whether through own or joint renewable power projects. It will indeed be a combined set of measures, depending on time and place, type and size, drive and ability of the actor. Legal, economical, spatial, technical and social (LESTS) enablers or barriers will play a role in where and when measures are implemented and whether climate neutrality is reached through direct abatement or compensation mechanisms. Finding the optimal combination of measures is subject to many studies, typically performed for a specific sector. Ideally, though, the scope should cover the entire energy system, explore a number of scenarios and include interdisciplinary aspects like LESTS. The TRILATE project took up this challenge.

TRILATE investigates the need for energy transport infrastructure in order to guarantee the security of energy supply to industrial clusters. In the region that unites Belgian, Dutch and German industrial clusters, the density of energy demand is very high, while spatial options to deploy renewable energy technologies are limited. Hence, an analysis of the required energy transport infrastructure for industrial clusters is crucial in view of security of supply. TRILATE aims to develop scientific models at the level of processes, industrial clusters and cross-border energy systems, linked to an integrated energy infrastructure to the benefit of the society as a whole.

The project started from a manifold of unresolved questions related to the energy transition. How will demand and supply change per industry sector and per energy carrier? What alternative sources are available, affordable, accessible? Which new technologies or infrastructure needs are essential to stay on track for reaching the climate goals? At what pace must the transition take place? Indeed, there is a sense of urgency, from a societal but also industrial perspective.

Investment cycles towards 2050 are limited and implementing or developing the required technologies takes time. This affects all sections and actors in the energy supply chain and a dynamic roadmap benefits all players in the economy and society as a whole. A crucial role is taken by energy infrastructure. Grid operators are currently designing the energy infrastructure of the future, for electrons (green electricity) and molecules (hydrogen, methane, etc.). To provide the necessary connections between demand and supply in time and space, grid operators rely on projections of preferential pathways taken by different industry sectors, often in relation to regional communities. In return, it is crucial for industry clusters and regional planners to gain insight in (new) energy supply options to assess the business case of new project developments.

TRILATE focuses on the energy connection of industrial clusters in Belgium and their interaction with neighbouring clusters in the Netherlands and Germany. Starting from modelling the energy profiles (power, hydrogen, methane, etc.) of high-density clusters in the Flemish and Walloon region, the energy integration and needed infrastructure is determined. Within and between clusters that are often cross-sectorial, even urban-industrial, efficiency and optimisation tools are applied to exploit industrial symbiosis (IS) practices. The link with residential energy needs is for instance made through heat network opportunities and joint investments in renewable energy sources are explored. The results will provide guidance for new or repurposed energy infrastructure, both within and in between industrial clusters and residential areas.

The viability check of energy transition projects requires a multidisciplinary approach, adding a non-technical assessment of enablers and barriers. This is done by performing a LESTS survey. By evaluating all five dimensions, the scores provide insight on the feasibility of mutualising energy transition in and across industry clusters.

TRILATE aims at answering what pathways can be prioritised to achieve optimal use and integration of energy sources, depending on geographical but also techno-economic opportunities. Symbiosis as driver for energy clustering of industrial and residential areas is a key area of research, with a focus on Belgium but reaching out to interconnections with the Netherlands, Germany and in a later stage also France and even the UK. The project outcomes are considered to support and accelerate the energy transition and help reaching climate and resource neutrality targets.

Scotland's Net Zero by 2045: Modeling metabolic potentials and scenarios toward emissions reductions

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Research Question: From a multidimensional societal-metabolic view, how viable are the Scottish Government's plans for 'net zero by 2045'?
As humanity faces the complexities of a global ecological crisis, there is a great need to reconnect actors, levels of governance, institutions, and technical domains in creating new pathways toward energy transition. In this aim, societal metabolic analyses (SMA) offer a multidimensional and cross-scale method of understanding and examining sectoral and regional actors through material flows and other energetic accounts (Giampietro et al. 2014; Giampietro, Mayumi, and Sorman 2011). SMA define and integrate views of: industrial sectors; workforce capacities; land use patterns; energy carriers and end uses; gross value added, and other primary material flows. These metabolic analyses can provide useful insights into relations between multi-level actors and their accompanied material flows, the options for social, economic, and energy policy instruments, and tests of the coherence of instruments as plans toward the 'greening' of economies, 'green recoveries', net zero, and a more ecologically just world.

For instance, in assessing the technological replacement of fossil fuels with biofuels, Giampietro and Mayumi (2009) conducted metabolic analyses and found that biofuels created shortages of power and food while still contributing to climate change, stressing biodiversity, and pressuring traditional farm systems. In a cross-scale, metabolic case study of the nexus of energy, food, water, and land use of Mauritius, Serrano-Tovar et al. (2014)—conducting integrated socio-ecological analyses—found such analyses could not solely be accomplished from the comforts of a desk, but that local actors were required to define the semantics and grammars that framed and 'quality checked' the study's final 'knowledge claims.' In another multiscale, multidimensional metabolic study, Madrid-Lopez et al. (2014) found that international remittances and governmental subsidies were contributing to a higher per capita income that kept a metabolic pattern—of a rural area in Punjab, India—viable. This same study also found that electricity subsidies and governmental price supports contributed to soil degradation and the overdraft of aquifers (Madrid-Lopez et al. 2014). Additionally, for Giampietro et al. (2011), SMA can more viably and extensively detail the 'painful truth' of the biophysical limits on economic growth.

Scotland—and other nations for that matter—has expressed great ambitions for not only a post-covid ‘green recovery’ (SG 2020) but also a ‘net zero by 2045’with interim targets for 2030 and 2040 with, respectively, 75% and 90% lower emissions than the baseline net zero (SP 2019). Besides noting that these targets must be ensured by Scottish Ministers, there is also little material detail on how these targets will be met (SP 2019).
With this case of Scotland’s ‘net zero by 2045’, we use metabolic analyses to assess this challenge and its possible tradeoffs in maintaining stable household and paid-work sectors while transitioning to electricity, other low-carbon energy carriers and end uses, while also trying to activate greener activities in land use and other industrial sectors. This analysis will be operationalized through a number of different scenarios that include: status quo, net zero, progress to net zero, and degrowth.

Methodology. Although SMA can illustrate multiscale and multidimensional relations and complexities, it is also a very simple accounting method. Moreover, our approach to analyzing Scotland’s ‘net zero by 2045’ will be less a process of forecasting and more one of backcasting. For example, as the legislation requires, we will set the future emissions in particular Scottish industries and sub-sectors to ‘net zero’ and then examine the changes—socio-technological and otherwise—required to get there. The largest challenge of this study, though, will not be its goals, strategy, or method, but access to the pertinent data. Due to the excessive historical and disciplinary prominence of economics (its interests and measures), ecological and other more material metrics and measures of funds and flows are lacking. These include not only different fuel, energy carriers and end-use types—at different scales and dimensions—but also related water and land use, employment figures, and greenhouse gases. These data will primarily be governmentally sourced, but some may need to be created, raw, and some extrapolated.

Expected results and conclusion. We expect that a SMA of Scotland will reveal that Scotland will be hard-pressed to meet its net zero goals without a covid type—possibly degrowth—dramatic reduction in economic activity, even with green growth initiatives. Such findings also depend on the grammars of the study and the scope of what is to be considered ‘Scotland’s environmental impacts’.

Nevertheless, to accomplish what can only be considered an extremely rapid reduction of fossil fuel use, much strain will be placed on economic and employment activities related to transition, changes in material funds and flows, and degraded environmental sinks. Other societal metabolic constraints and tradeoffs will be discussed.

Examining the Role of Hydropower in Green Hydrogen production

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Integration of large-scale Renewable Energy Sources (RES) with the electrical grid is enhancing ecological harmony and reducing human effect on the environment, but it also presents new issues in terms of ramp-up/ ramp-down, forecasting, stability, and most importantly, the need for energy storage. Even while large-scale batteries offer some assistance in this area, batteries still have their own concerns, including a relatively short lifespan, high cost, problematic disposal, performance degradation and a constrained capacity for storage. The process of converting electrical energy generated from hydropower projects into hydrogen through the electrolysis process (where huge quantity of water requirement is full field through hydroelectric power projects) may convert a typical hydro plant to operate as a “pumped storage plant” which can be a game changer in the energy sector because it can addresses a number of issues, including the limitation of renewable energy, long-term energy storage, the use of heavy metals, carbon footprint, the need for fossil fuels, the need for hydrogen in other sectors, etc. The energy produced from hydro power plants, not having storage facility, can also be utilized in production of hydrogen production via electrolysis process and can be stored for its future use. In addition, the hydrogen having applications in various industries such agriculture / fertilizer, chemical, petroleum refining, etc. has huge demand. Green Hydrogen can also be converted to many derivatives e.g. green ammonia, green, methanol etc. It could directly substitute the feedstock or it can be used in place of the fossil fuels (like Natural gas). However, as per International Renewable Energy Agency (IRENA, 2019) report, only 4% of global hydrogen requirement is met from electrolysis process and the rest is from fossil fuel. In order to maintain the system reliability, the load and generation shall be balanced from time to time. The RES are available for limited period and generation is uncertain and unpredictable and not matching with pattern of demand. Thus, it necessitates for not only energy storage but also flexible operation of thermal power plants i.e. ramp up / down and operational lower plant load factor (PLF). In the monsoon season when hydro generation increases significantly, the thermal plants operate at lowest PLF. Therefore, the excess energy during the monsoon season from hydro generation may also be utilized for hydrogen production via electrolysis process which will also improve the PLF of the coal plants and minimize the spill over. Also, in Nations where there are substantial seasonal variances between power consumption and renewable energy production, long-term storage alternatives can aid in the grid integration of additional renewable energy. Germany's energy consumption, for instance, is 30% more in the winter than it is in the summer, yet RES produce around 50% less electricity during the winter than they do during the summer. In order to move the supply of renewable energy from seasons with low demand to seasons with high demand, it may be necessary to produce hydrogen. Further, the energy charges vary from time to time i.e. peak to off peak, the hydrogen may be produced at lower energy charges and reproduce electricity at higher energy charges. The same not only benefit the owner but also support the grid in balancing. Hydrogen might be used as a long-term storage medium since it can hold energy for several months. Further, standalone uses of fuel cell in remote areas is another option to electrify the pockets which so far are away from the conventional electricity grid.

Problem statement & Contribution of this study: Since, it is a well known fact that despite the many advantages of renewable energy, its intermittency and stochastic nature offers complexity in power generation and may impose stability issues on the electrical system leading to increase in the operational costs as well. With increased penetration of renewables, supply side will be lot more uncertain now. Different types of solutions such as battery technologies and pumped storage systems are being proposed and planned. And then lot of discussions and plans are being formulated for having sufficient share of dispatchable reliable clean sources like nuclear and large hydro in the energy mix. In such a scenario, integration of hydropower plants with green hydrogen production is proposed in this study that not only provides enough flexibility and ramp rates but can also prove to be one of the preferred options for energy storage applications as well. Further, this study will also contribute in developing various frameworks pertaining to energy transition scenario of achieving 100% renewable energy based systems where the entire focus of world community will be to shift on to clean energy transition and achieving net zero in the coming 2 to 4 decades. This necessitates a shift towards technologies that enable enhanced share of renewable sources in the energy mix, and progressively reduce the reliance on fossil fuels.

Green hydrogen produced using renewable energy, has the major potential to play a key role in low-carbon and self-reliant economic pathways of energy transition.

This study may also support the countries in achieving the United Nations Development Programme (UNDP) Sustainable Development Goal no. 7 (Ensure access to affordable, reliable, sustainable and modern energy for all), Goal no. 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) and Goal no. 13 (Take urgent action to combat climate change and its impacts).

Parallel Session | Global South: nexus, energy planning and access

Feasibility assessment of biogas-fuelled refrigeration to curb spoilage in food value chains in Sub-Saharan Africa

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The lack of access to refrigeration in Sub-Saharan Africa (SSA) due to deficient electrical grids is a major contributor to food loss, which exasperates food insecurity in the region. The use of biogas-fuelled refrigeration (BFR) could provide opportunities to leapfrog over environmentally harmful or outdated refrigeration methods while curbing food loss and treating organic waste. The main objective of this research was to evaluate the applicability and feasibility of BFR in SSA. This project compiled findings from value chain analyses (VCA) in literature of the beef, dairy, fish, and fruit and vegetable value chains in SSA to describe the nature and distribution of food loss and available feedstocks for anaerobic digestion. The analysis found that food loss is concentrated in the processing, agricultural production, distribution, and postharvest handling stages of the fruit and vegetable, meat, fish, and dairy value chains, respectively. However, regardless of the distribution of the losses, refrigeration intervention measures early in the value chain could mitigate downstream food losses. BFR could also only be implemented where there is sufficient feedstock and has limited impact on food loss mitigation in cases where other problems with food handling cause food loss regardless of access to refrigeration. Using these findings from the VCA, scenarios where waste would be readily available or where multiple stages in the value chain could be targeted were chosen as the foundations for BFR process models, namely a dairy farm, abattoir, and a community setting. The process models investigated were absorption dairy coolers for dairy smallholders, containerized compression-refrigerated cool rooms for small-scale actors in the fruit and vegetable value chain, industrial icemakers to supply ice to small-scale actors in the fish value chain, and combined heat and power (CHP) systems to cover the electrical requirements of refrigeration for modernised abattoirs. Four feedstocks associated with the value chains were selected for biomethane potential (BMP) testing: fruit and vegetable waste, tomato waste, abattoir waste, and cow manure. The BMP results were used as a basis for sizing the required biogas installations to meet the calculated energy requirements of the various refrigeration systems.

The capital (CAPEX) and operating costs were estimated using capacity-cost estimations based on collated data of existing biogas installations in SSA. When electricity generation was required to drive the refrigeration process, multivariate regression was used to develop a model that estimated the CAPEX of a plant based on the volume of the digester and its electrical output. Using discounted cashflow analysis of the scenarios at various scales, internal rates of return (IRRs) ranging from 15.13% to 28.16% (absorption cooler), -6.77% to -2.79% (CHP), 0.97% to 22.84% (cool room), and 0.74% to 24.05% (ice maker plants) were estimated. Issues arose with feedstock availability, particularly for the large-scale processes which would benefit the most from economies of scale. Income and earnings through savings from the waste treatment were shown to substantially improve process profitability. Challenges to implementing BFR include feedstock availability, training and maintenance requirements, access to water, and high upfront costs.

Inclusive decision making for new sustainable value chains for marine biofuels: a case study on encroacher bush in Namibia

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To achieve the Paris climate agreement goals, there is an urgent necessity to replace fossil-based energy and materials. As a result, bio-based value chains (BBVCs) are gaining immense attention for replacing fossil counterparts in industries, especially in the marine sector. However, there are some technical, social, and institutional challenges in developing such BBVCs. Due to its global nature, BBVC involves actors in different contexts, with different perspectives, capabilities, and needs connected with each other. Research on global value chains and biofuel projects has shown that the risks and benefits of BBVCs are not always distributed fairly. Especially stakeholders at the beginning of value chains, such as small-scale farmers or local communities, are in a more vulnerable position and are often underrepresented in the development of new value chains (Balkema and Pols, 2015). Therefore, inclusive development and design of new BBVCs, where all relevant stakeholders are involved in decision-making processes from early stages on are needed.

BBVCs are socio-technical systems where technical components and social arrangements are intertwined (Oosterlaken, 2015). In addition to technical aspects, choices related to institutional and social arrangements have to be made, such as ownership structures, contractual arrangements, and capacity building. To address these challenges, there is a need for methods and approaches to have an inclusive design and decision-making for new BBVCs. A value-sensitive design approach can be an effective tool to create such a value chain incorporating technical and social aspects (Parada et al., 2018).

This paper focuses on a concrete case on the design of a new value chain for shipping biofuels based on encroacher bush in Namibia. In Namibia, about 45 million hectares are bush encroached. This means that indigenous bushes, such as blackthorn (Senegalia mellifera), are spreading at the expense of grass vegetation in the Savannah areas. This causes a negative impact on the soil and leads to groundwater depletion (MEFT, 2022). With 70% of the Namibian population depending on agriculture, bush encroachment threatens the livelihoods of people due to the reduced grazing capacity of cattle. Therefore developing new BBVCs based on these bushes can contribute to local socio-economic development (DAS, 2019). Contextually, Namibian farmers are classified into 3 categories based on different ownership structures. Firstly, large commercial farmers own on average 5000 hectares. Secondly, there are communal farmers, who use land that belongs to the government and share the resources. And finally, there are resettled farmers, who are placed on land sold by commercial farmers. Their different realities and challenges should be taken into account while developing new value chains.

A novel concept of “biohub” where multiple communities can participate in the value chain has been proposed based on the context in Namibia. This case study is carried out by a multi-disciplinary team and looked into how new value chains could be set up from these residues in an inclusive manner. Data is collected during a field visit of five weeks based on field observations and 36 semi-structured interviews with multiple stakeholders along the (new) value chain. Input is gathered on the current situation, challenges, and possible benefits, conflicts, and impact of a biohub in Namibia. In addition, a multi-stakeholder workshop was organized where different stakeholders were brought together to co-design the most desirable scenario and provide input on the design choices. The design choices include different elements of BBVCs such as feedstock type, feedstock harvesting, processing, handling, transportation, and storage, biorefinery scale, location, and products and policies required for a conducive environment for a smooth transition.

Some of the key learnings are

- BBVCs should be based on one anchor product, with a strong market and not too complex.
- The value chain should be inclusive with all types of farmers as providers. That requires different ways in which the biomass will be harvested, different ways of support that are required, and different types of contracts.
- A strong resource management plan is needed, in order to sustainably harvest, both in commercial and communal areas.
- Technology development should go together with skills development and education.
-

In terms of challenges attracting investments, and sustainable sourcing of biomass including the correct choice of harvesting methods (mechanical, manual, or semi-mechanized) have to be addressed. Some preferences about elements of the BBVCs were also identified such as farmers interested in having the responsibility of bringing processed feedstock to a centralized location, and preference for multi feedstock BBVCs. Based on the same, a preliminary biohub model was created as indicated in Figure 4.

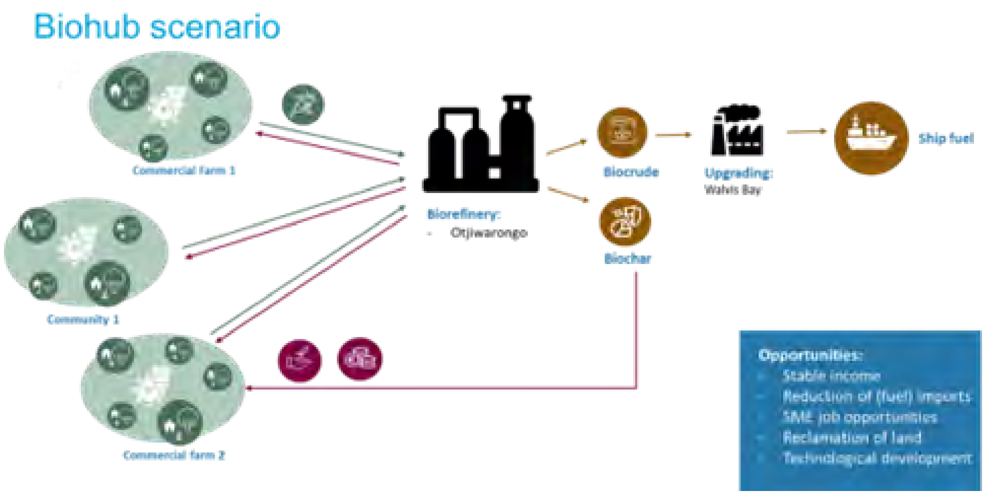

Figure 4: A preliminary model of Biohub for the marine biofuel value chain in Namibia based on encroacher bush

By combining insights from social, environmental, technical, and economic aspects, this case study presents an approach where all different types of stakeholders can be included in the early stages of decision-making. By researching the local context and connecting this to a concrete (process) design of the value chains, local values, needs, perspectives, and constraints can be incorporated. This can help make the value chain more robust and inclusive.

Scaling up the electricity access and addressing best strategies for a sustainable operation of an existing solar PV mini-grid

Emilia Ines Come Zebra

Access to electricity in a sustainable, affordable, and reliable manner is still a challenge, especially for rural communities in developing regions. In developing countries, most of the rural areas are sparsely populated, making grid extension far from being a reality due to their remoteness and geographical constraints. Off-grid renewable energy (RE) technologies seem to be the most feasible option for rural electrification, considering their technological, cost, and environmental benefits associated with resource availability. Stand-alone renewables systems are intermittent and variable, which causes instabilities in power generation. However, Therefore, the application of alternative energy configurations, in particular, hybrid renewable energy systems (HRES) with a storage device and backup power supply of diesel generators, is seen as the most appropriate option to overcome the intermittency nature of renewable resources and meet the energy demand in terms of affordability and reliability in developing countries. In this study, we applied the HOMER software to find the best system configuration that can meet the future load demand cost-effectively and reliably by increasing the number of batteries and solar photovoltaic (solar PV) in the system, thus reducing diesel fuel consumption in the system. We also investigated how the system's sustainability can be improved, based on its current operational experience, considering aspects such as the reliability of power supply to ensure the project's feasibility at the local level. Additionally, from the literature, we identified the main aspects affecting the sustainability of the energy project to inventory relevant indicators that were later refined and used to structure and compile the questionnaire used for the interviews, for data collection in the study area. The main source of information for this research was the data collection in the study area through interviews with 35 individuals, including the owners of households, revenue collectors, and local governance selected based on their level of involvement and also their knowledge about the project.

We focused on the solar PV mini-grid system installed in Mavumira village in Mozambique. Our results showed that among various configurations analyzed, hybrid solar PV/diesel/battery is the most appropriate system, as it presents the lowest cost of electricity (LCOE) of 0.47 $/kWh compared to other solutions, such as diesel-only with 0.63 $/kWh. Overall, by reducing the solar PV and battery capital cost while increasing the load demand, the LCOE of the future optimized system could be significantly reduced (0.47 $/kWh) compared to the LCOE of the current system (0.52 $/kWh). Additionally, the O&M and fuel costs of the optimized future system are lower (0.06 $/kWh and 0.14 $/kWh), than the current optimized system (0.05 $/kWh and 0.24 $/kWh). Therefore, if implemented, the optimized hybrid system will rely more on RE, reducing the total fuel consumption in the system. Hence, the local communities will save money and time spent on diesel transportation. We considered this one of the key strategies for economic development because the community will be less exposed to diesel fluctuation prices, and the money will be retained in the village. It can also be considered an opportunity to encourage RE to be added to the system, making it more sustainable. Moreover, the system overload was reported as one of the reasons for the power outages, which indicates the need for further improvement in the system's performance. Therefore, the optimized system suggested the hybridization of solar PV with a diesel generator backup to compensate the fluctuations and increase the system's capacity, thus ensuring higher reliability and continuous power supply. As a result, the system performance will improve, allowing the connection of more appliance devices to avoid failures due to system overloading, which is currently the main suspected cause of outages. Moreover, hybridization will introduce more complexities to the system, implying more components like solar panels and batteries. So, this strategy also requires more involvement and training schemes for the local communities for O&M of the system to avoid failures in the system, thus favoring the local job opportunities indicator and hence increasing their interest in the project. Additionally, from the interviews in the study area, we realized that people were not satisfied with the current tariff applied, which is far from reflecting current energy costs as the government subsidizes it. The LCOE of the optimized system considering today's load is 3.7 times higher than the current tariff applied to the mini-grid. However, by varying parameters such as the load demand, solar PV, and battery capital cost, we found that the LCOE of the optimized future system will be 1.3 times higher than the projected tariff, which makes the future system more cost-effective than the current system.

Moreover, considering parameters like local incentives, the LCOE of the optimized future system can be further reduced, making it more affordable for the community. However, with the gradual removal of government subsidies and the decrease in technology costs, for example, the fall in solar PV capital cost of up to 57% by 2025, the optimized future system will become more cost attractive and competitive to the utility scale. This will significantly impact the electricity tariff in the future, making the mini-grids more affordable for rural communities.

Energy Poverty and Fuel Stacking: The Role of Charging Ahead Electricity Systems in South Africa

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Energy poverty is a major global issue and has implications for the welfare of individuals and society. The main drivers and barometer in measuring this phenomenon have varied across specific indicators and country-specific case studies. An often underexplained cause is the payment systems constraining electricity consumption in multiple fuel use resulting in fuel switching. The research explicitly undertakes a multidimensional energy poverty index highlighting the different dimensions and understanding of energy poverty. Such broad understanding will inform academics and policymakers in looking into the energy mix and end usage component and how to tackle energy poverty among the different households. Another objective of this research is to consider households' fuel stacking patterns. The study examines how prepaid electricity meters produce substitution effects and fuel switching from electricity to alternative energy sources. Furthermore, the study examines heterogeneous impacts such as location, wealth status, race, and gender in a nationalistic frame will give a definitive guide to tackling poverty to the most affected and vulnerable groups. Lastly, this paper assessed pro-poor energy policies, notably Free basic electricity and other government subsidies such as housing grants and the Reconstruction for Development Project (RDP), if they could mitigate the problem of energy poverty. We use the General Household Survey (2020) data of South Africa to provide empirical findings for these objectives.

Applying fractional probit regression and other robustness methods, the results show that using prepaid meters potentially increases the probability of being energy poor between 0.03 and 0.06 percentage points.

The study further employed a rigorous econometric method, Propensity Score Matching (PSM), to assess the findings. This approach, while addressing endogeneity, enables impact analysis through quasi-experimental methods. To obtain the Average Treatment Effects (ATE), we utilized the Inverse Probability Weighting Regression (IPWR) technique in PSM. The results indicated that households using prepaid meters were 3.35% more likely to be energy-poor compared to those using postpaid meters. This finding was consistent across different matching techniques. The study further revealed households become energy deprived by switching to unclean energy sources, notably biomass for cooking and heating, given prepaid meters. Specifically, the study found that prepaid meters were associated with a 5.7% increase in biomass for cooking, a 10.9% increase in heating space, and a 4.3% increase in a heating room. The study further examined the impact of prepaid meters on different demographic groups. The results indicate that females using prepaid meters were 0.8% more likely to be energy poor than males using prepaid meters. Additionally, non-white South Africans were 5.1% more likely to be energy poor when using prepaid meters. Furthermore, rural dwellers and poorer South Africans recorded the highest impact of energy deprivation, with prepaid meters associated with a 6.5% and 6% increase in energy poverty, respectively. Joint use of prepaid meters and Free Basic Electricity (FBE) could reduce energy poverty. The study also examined the moderating effects of different variables on the relationship between prepaid meters and energy poverty. The findings revealed that providing Free Basic Electricity (FBE) in combination with prepaid meters reduced energy poverty by 0.5%. Additionally, FBE and prepaid meters reduced reliance on biomass for cooking by 2.5% and water heating by 0.2%. Moreover, the study highlights the effectiveness of the RDP housing scheme, a significant government program aimed at providing affordable housing for low-income households, in reducing energy poverty. The findings suggest that access to RDP housing was associated with reducing energy poverty, indicating the importance of housing policy in addressing energy poverty. The study's findings underscore the importance of policy interventions addressing energy poverty, particularly among vulnerable groups such as low-income households, women, and rural dwellers. Based on the results, it is recommended that policymakers consider providing lifeline consumers with free or subsidized electricity, such as the Free Basic Electricity (FBE) program, in combination with technologies such as prepaid meters to reduce energy poverty. Additionally, it is recommended that policymakers consider providing alternative and affordable energy sources for households that rely on biomass for cooking, heating space, and room.

This could include providing clean and renewable energy sources such as solar or wind power or promoting energy-efficient technologies. Additionally, policies aimed at increasing access to modern energy services in rural areas and among low-income households should be prioritized to mitigate the impact of prepaid meters on energy poverty. Such interventions have the potential to significantly improve energy access and reduce energy poverty in developing countries. More importantly, housing policies like the RDP housing scheme should be considered effective instruments in addressing energy poverty. Overall, these policy interventions have the potential to significantly reduce energy poverty, particularly in developing countries where energy access remains a challenge. The move to local energy systems, with renewable generation and distribution within a local area, can increase low carbon generation and storage. This can stimulate flexibility in supply and demand, optimising the use of these assets. However, this requires a reworking of the existing grid infrastructure and regulation support more local and flexible energy production and consumption. Diverse actors need to come together to bring about the transformation. Among the actors involved are national and local governments, network distributors, incumbent energy providers and local communities.

Our focus is on the role that community energy groups can play in the transformation of the electricity grid through participation in local energy and collective self-consumption schemes. Community energy groups are “social enterprises in the renewable energy sector conceptualised as collectively owned organisations that combine the production of energy from renewable sources with other ecological or social goals, and embody a specific quest for civic participation.” (Becker et al. 2017). Community energy is associated with increased participation leading to a more democratic energy sector and more empowered consumers (Burke and Stephens 2018). This builds on previous research on ways local ownership of energy assets produces local economic benefits, as well as social impacts beyond energy usage (Walker and Devine-Wright 2008; Walker et al. 2007; Seyfang, et al. 2013). However, mutually beneficial relationships between local energy infrastructure and social outcomes are not technologically determined. They must be created.

The social entrepreneurship literature has emphasised that socially motivated businesses usually require the involvement of a broad range of stakeholders in enabling social innovation (Vallaster et al, 2021; Stephan, Andries & Daou, 2019; York, O’Neil & Sarasvathy, 2016).

A key reason for this is distributed agency. Distributed agency is ‘where the required skills and resources are distributed over multiple actors to bring an idea from inception to commercialisation’ (Garud & Karnoe, 2003). Consider, for example, the technological know-how that is needed to determine the type of battery and the infrastructure to store energy locally before supplying it to the (national) grid. This type of technological knowledge needs to be paired with organisational and managerial capabilities if an innovation is to be organised and implemented by a local community. A third layer of knowledge consists of awareness of regulatory demands and financial support schemes that can facilitate such a technological solution. Furthermore, knowledge- and resource needs may be continuously evolving and stakeholders shift from core to periphery and vice versa as innovation projects develop.

From previous research in we know that distributed agency leads to the involvement of multiple stakeholders in the development of new technologies (Garud & Karnoe, 2003) and social enterprise opportunities (Corner & Ho, 2010; Akemu et al. 2016). Yet, while the existence of distributed agency has been acknowledged in previous research, we know very little about how it influences innovation processes. Therefore, we ask the following question: How does distributed agency influence the process of innovation in community energy projects? We explore the different stakeholders involved in the innovation and what role each stakeholder plays. Furthermore, we identify how community energy groups navigate distributed agency.

Method & data

We use data from 8 community energy groups in the UK and the Netherlands. We use a multiple case study approach as this research is exploratory and aims to build theory. Our selection of cases allows us to study the process of developing social innovations within the same opportunity space but across different applications of technologies, with different stakeholders and different regulatory systems.

We take a process approach, tracing the development of a social innovation in each of the community energy groups from emergence or the “spark” (Corner and Ho, 2010) which brings an innovation to some form of implementation. Our primary source of data is from interviews with key individuals, both entrepreneurs and other important stakeholders, involved in developing the community energy innovation projects.

Interviews were carried out between June and December 2021. We also make extensive use of secondary data such as (annual) reports, news articles and press releases, and selected internal reports.

Findings

The preliminary findings of this study indicate that distributed agency leads community energy groups to display considerable breadth in the type of stakeholders they involve in the innovation process. These include the SE's beneficiaries, governmental agencies, local authorities, tech companies, and other social enterprises which may play different roles in different contexts. Municipal government is a common stakeholder because they can provide physical assets on which to install solar PV and through this often provide access to beneficiaries. Government bodies are often important financial stakeholders, providing grants to enable the innovations. We see that where technology is untested or lacks a business model, our CEGs look for grant funding as they don't want to risk community raised finance on risky business ideas. Technology providers are also common stakeholders. They are partners in innovating but where the technology has become more standardised they are implementation partners.

From our preliminary analysis, we have observed that the complexity of the involvement of multiple stakeholders results in a need to simplify their involvement in the studied community energy projects. The community energy groups use distinct approaches to simplification as coping strategies; for example one community energy group uses representation – an approach whereby one type of stakeholder (users) are represented by another stakeholder. A second SE uses an approach we call compartmentalisation where engagement with different stakeholders is divided among different members of the community energy group. These different approaches of managing stakeholder involvement have implications for how opportunity development processes unfold.

Implications

Our research has important implications for community energy groups that are developing innovative approaches to community-led renewable energy, energy demand reductions and energy supply. Our findings can help shape their strategies towards managing a wide variety of stakeholders and ensure a productive use of distributed agency.

Parallel Session | Citizens, community and bottom up initiatives: Citizens perspectives and bottom up processes

Biomass: will we get it?

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Introduction

Biomass (wood; manure; organic waste; and energy crops) is the black sheep of the energy transition; although needed to move away from fossil fuels (Brémond et al., 2021). The negative media attention on biomass exemplifies the unease felt around this energy source (Mather-Gratton et al., 2021). With a growing public interest in the energy transition, we focus on biomass and its perceived suitability (acceptability and effectiveness) in the energy transition.

We formulate the following research questions:

1. How are different types of biomass evaluated compared to other energy sources?
2. What factors are essential in determining the differences in the assessment of biomass sources?

Methodology

The questionnaire was constructed to provide a broad exploratory picture of opinions among the general public. This study's target population was Dutch citizens aged 18 years or older and administered to a large-scale panel in September 2022. A total of 765 individuals were invited to the study, resulting in 409 completed questionnaires.

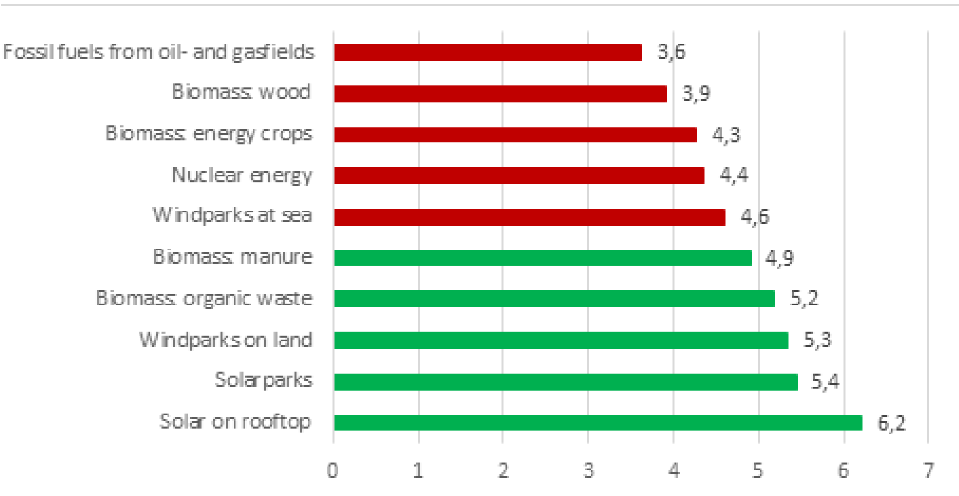
The study was designed as a survey with a split to assess the four different types of biomass. A general text of 139 words was also used to introduce biomass briefly after the first comparison of all energy sources. Quantitative analyses were performed in SPSS v.27.

Questions were asked on a 7-point scale unless otherwise indicated. The comparison of energy sources consisted of 11 categories of energy sources, where respondents could indicate acceptability on a scale of 1 (very unacceptable) to 7 (very acceptable) with the option "do not know." followingPalomo-Vélez et al. (2021).

For personal background, one question examined environmental concern (Landry et al., 2018). Split between low concern (rating 1 to 4) and high concern (rating 5 to 7). Subjective knowledge (SK) of biomass as an energy source was asked with three items following Liu et al. (2018) on a 5-point scale. For each specific type of biomass, two items on subjective wastefulness (SW) and four items on subjective sustainability (SS; Palomo-Vélez et al. 2021) were added. In this abstract, we report our preliminary, descriptive findings on the type of biomass and acceptance. The final report will include more extensive analyses that examine the explanatory role of acceptance and personal background variables such as environmental concern.

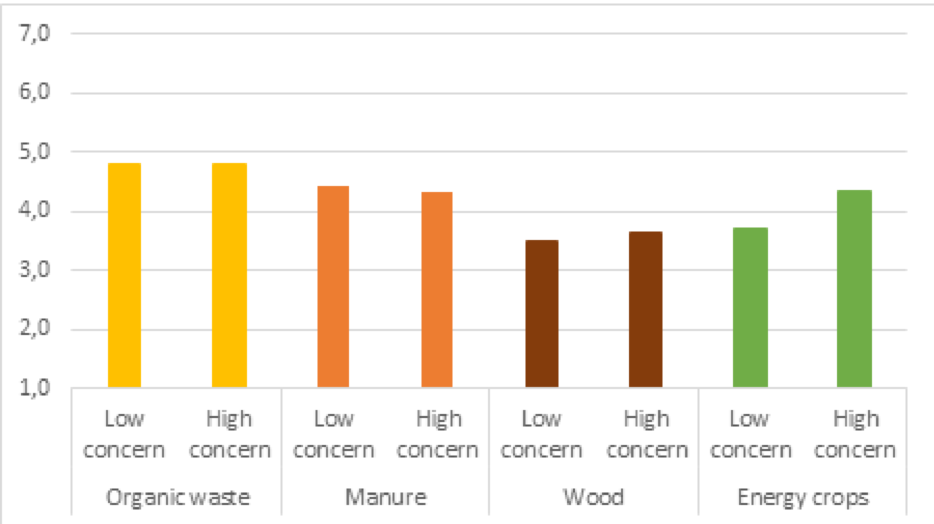
Results Comparison of energy sources We asked respondents how acceptable they found different energy sources (Figure 1). Solar panels on rooftops are rated best on average (M: 6.2; SD: 1.1). Fossil fuels are rated most negatively (M: 3.6; SD: 1.7). Our results show that the type of biomass matters for acceptance. Organic waste gets the best rating with good consensus (M=5.2; SD: 1.2). The use of manure is also rated positively on average (M=4.9: SD:1.3). The two other forms of biomass were rated relatively lower. These were energy crops (M=4.3; SD=1.4) and wood (M=3.9; SD=1.4).

Figure 1: Comparison of different energy sources



We further explored the difference in the perceived environmental impact of types of biomass by examining the differences between groups based on their environmental concern (Figure 2). We find that there is no difference between acceptance by people with low and high environmental concern for manure (Mlowconcern=4.4; SDlowconcern=1.1; Mhighconcern=4.3; SDhighconcern=1.1, p=0.6), organic waste (Mlowconcern=4.8; SDlowconcern=1.2; Mhighconcern=4.8; SDhighconcern=1.1, p=0.9), and wood (Mlowconcern=3.5; SDlowconcern=1.0; Mhighconcern=3.7; SDhighconcern=1.4, p=0.6),. We only find a significant difference for energy crops (Mlowconcern=3.7; SDlowconcern=1.3; Mhighconcern=4.3; SDhighconcern=1.4, p=0.02), suggesting that people with high environmental concern find this source of biomass more acceptable compared to people with low environmental concern. Together, these results suggest that when people are more concerned about the climate, they see the potential of alternative fuels more easily.

Figure 2: Mean differences between low- and high environmental concern



Main insights

This study examines the acceptability of different types of biomass compared to other types of biomass. The primary outcomes are: 1) The results show how differently biomass is evaluated as an energy source. It is important to distinguish different types of biomass from each other to evaluate acceptance among the wider public. 2) Organic waste is viewed most positively.

People see this as a good use of this residual stream. This is also the case for manure. This is surprising because manure can also be associated with intensive farming and the environmental impact on livestock. 3) The two types of biomass rated as unfavorable are energy crops and wood. Energy crops are also seen as unfavorable. However, people more concerned about the climate seem more accepting of this energy source. The limitations of this study are mainly due to the simplification of reality and the limitation of the number of types of biomass that could be presented. For example, roadside grass or other residual streams were not considered. Also, the fermentation process could not be explained in detail to respondents. As a result, some nuances about mixing different types of biomass were lost.

Conference discussion

We see this paper as a starting point for discussion at the conference.

- What do practitioners in the energy transition need from scholars to be an agent of change?
- How is public acceptance considered when working on energy transition projects?
- What elements in the political context shape the discussion on biomass use for energy?
- How can the public be involved in the ethical dilemmas around biomass use?

Ready, Set, Rollout? The Role of Actor Collaboration in the Delay of the Smart Meter Rollout in Germany

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Complex technological developments do not happen on a purely 'technical' side. Recent scholars often neglect the actors involved and focus on the regulation and technical aspects. However, this lens does not reach far enough as technological developments are part of a socio-technical system in which different actors as well as regulations and policy processes are connected. Therefore, the increased heterogeneous collaboration between actors is crucial to understand these processes as the actors have an influence on how technology is designed, developed or implemented. In this paper, we use the example of the delayed German smart meter rollout and analyze to what extent the heterogeneity of the actors involved contribute to a delay in the smart meter rollout.

Smart meters are one of the central technologies in both the energy transition and digitalization of the energy sector. They shift the focus on not only on the generation of renewable energy but also on distributed generation resource (DER) and consumers – a special feature compared to other technologies in the energy sector. The benefits are manifold and cover not only the consumers, who can simply read their electricity generation and consumption. Also, the distribution system operator (DSO) can use the energy data for dynamic load management and balancing. For this, they need the most accurate information of the network, which is why the analogue ‘Ferraris meters’ are no longer sufficient and area-wide smart meter systems should enable profound analysis of the energy network.

The installation of smart meters is currently taking place almost all over the world – even in the largest electricity markets. Nevertheless, Germany stands out in this process as the rollout has not started yet. Although a law for the rollout (Messtellenbetriebsgesetz (MsbG) or Metering Point Operation Act) has been enacted in 2016 in Germany, little has happened so far and even today, the German DSO E.ON describes the rollout as “sluggish”. Crucial for the delay was the complex and lengthy certification process of the devices. The BSI (Federal Office for Information Security), in particular, had set very high standards for smart meters, which producers can hardly meet. Shortly after the expected start of the rollout in 2020, it was suspended by the courts, because smart meters do not meet the technical requirements. Legislative changes followed, but legal uncertainties still remain. This lack of progress is often justified by technical and regulatory limitations.

The question arises as to whether the delay of the German smart meter rollout can really be attributed solely to regulatory and technical challenges. The delay of the German rollout seems to be more profound and multi-layered, which is why we investigate social and organizational reasons on a non-technical level for the delay (until Q4/2022). Although some researchers investigate challenges of non-technical or social nature of the smart meter rollout, their findings remain mainly at the consumer level or consumer acceptance.

For this reason, we take a broader view by looking at the entire smart meter roll-out process and the actors involved, namely the BSI, the smart meter producer, the smart meter gateway administrator (SMGA), the DSO and the consumer. It is apparent that authorities, market players as well as consumers are involved, who are driven by often diverging interests.

Following earlier work on the involvement of heterogeneous actors in the smart grid domain, we analyze to what extent the heterogeneous collaboration influenced the delay of the German smart meter rollout. In order to show the role of the involved actors, we apply the proximity model by Boschma (2005). Based on five different proximity dimensions (social, cognitive, institutional, organizational and geographical proximities), this framework allows making visible the challenges of organizational collaboration for a joint arrangement.
Based on a case study comprising qualitative expert interviews with the above-mentioned actors, we show that the reasons for delay are manifold: knowledge boundaries, new business models, working practices, collaborations or competition. More precisely, hurdles in communication as well as in collaboration between the actors are increasingly highlighted and identified as further reasons for the delay. In addition, laws and practical technical possibilities seem to be opposites and not all relevant actors were involved in the design and planning process of the rollout.

Analyzing proximities provides a holistic insight into the collaboration, as our findings highlight that different proximity dimensions are more crucial to one actor than another. This model complements the otherwise very technical view and analysis of smart grid topics by integrating a social science perspective with a focus on the actors involved. Therefore, our findings contribute to the profound analysis of heterogeneity in complex technological developments.

Developing an empirical legal methodology for exploring the concept of 'community benefits' in the context of 'energy communities' under EU law

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In the EU legal framework for energy communities (ECs), one of the key elements qualifying ECs is their purpose, establishing that they have to create 'community benefits' which can be of "environmental, social, or economic value for their members or also the wider area where they operate" (art. 2(11 b) Directive 2019/944/EU and art. 2(16c) Directive 2018/2001/EU). Despite this central requirement, no provision further specifies what 'community benefits' are, how they are established and assessed. As far as the transpositions of EU legal provisions on ECs show national laws also do not much further elaborate on this concept. While there is research on value generation by ECs, the aspect of 'community benefits' has not yet been explored from a legal perspective.

This lack of knowledge is problematic because creating 'community benefits' is necessary for legally qualifying ECs. More fundamentally, increasing transparency about 'community benefits' is a precondition for understanding who benefits on which type of aspects (economic, environmental, social) from ECs. Answering this question is relevant for further evaluating the role of ECs in contributing to a just energy transition, essentially relating to "who benefits who gets what, and the processes and procedures that govern how we decide the principles of that distribution" (Sovacool & Dworkin, 2015, 437). It is thus relevant to know whether ECs are defining their contribution to community benefits, how they decide on those aspects, and who finally benefits and who less or not at all. Information on those aspects could then further contribute to enhancing the legal framework on ECs and in particular on their purpose (creating 'community benefits') in the energy sector.

Establishing a legal definition purely based on doctrinal and comparative legal research on 'community benefits', however, will not suffice as, expectedly, 'community benefits' are very broad corresponding with a large variety of scopes and activities deployed by ECs in different contexts and with different parties. While this variety proves the richness of ECs, it also makes it notoriously complex to capture and understand their contribution to the (local) society such as in the form of 'community benefits'.

Accounting for this complexity, this contribution suggests a mixed-method approach for exploring the topic of 'community benefits' in the context of energy communities. The methodology is comprised of (i) a multidisciplinary literature review on the topic of value generation and, if available, in particular on 'community benefits' of ECs forms the basis for a theoretical understanding of the concept of 'community benefits'.

(ii) Doctrinal legal research on EU national legal frameworks implementing EU provisions on ECs with a specific focus on the purpose of ECs maps the existing legal frameworks on the established purpose of ECs. (iii) Qualitative empirical research in form of semi-structured interviews among EC members and shareholders, non-EC stakeholders located in the area where an EC is active, and local public authorities on the (self) perceived and envisaged role of ECs in providing benefits to their members and shareholders and/or the wider area where it operates (as established by EU law). The aim of the empirical data collection is to explore the expectations on the purpose and value generation (i.e. 'community benefits') and the distribution thereof among groups which are (un)related in different ways to ECs.

It is expected that the results of the different researches (i-iii) show fragmentation of the concept 'community benefits' in the context of ECs. Similarly, it is expected that the understanding of 'community benefits' and their distribution will diverge among groups which are differently related to ECs. If this holds true, this indicates that the envisaged purpose of ECs as established by EU law is very complex and requires far more than a 'copy-paste' approach in the transposition to national law. Considering the aim that ECs could contribute to a more just energy transition, laws on ECs might need to establish transparent procedures on how ECs define and distribute potential benefits among their community or the wider area where it operates.

Community action in the energy and socio-ecological transition: theory, research, and perspectives

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Socio-ecological transition can be understood as a process of change, transformation, conversion, metamorphosis, perhaps even evolution, of the social world, which is extremely complex both in terms of defining its components, dynamics and trajectories and in terms of identifying the tools and agents for its realisation, implementation or accompaniment. Presenting itself as a challenge to the established paradigms of science, politics and economics, the socio-ecological transition offers the opportunity to critically rethink the ways in which conventional change's paradigms have been implemented and made operational.

In various social domains, an alternative to the individualist and rationalist ontological perspective of competitive action has been emerging in recent years, and with increasing force, represented by models of decision and action inspired by the community dimension for the management and production of common goods. Whether we refer to the cooperative dimension of economic action, to the involvement of citizens in decision-making processes, or to spontaneous coordination initiatives for the satisfaction of common needs, community thinking and acting is taking shape as a useful tool for both the definition of social problems and the identification of possible solutions. In gaining space to the detriment of a merely individualist and utilitarian paradigm, this collective perspective shows great potential for addressing the challenges of ecological transition. If environmental goods (natural resources, geo- and ecosystem services...) can (must) be understood as common goods in the technical sense (i.e. goods subject to potential depletion due to uncontrolled competition in their consumption), community action not only offers a consensual (and not merely contractual) tool for their management but is decisive in their very production because it is based on a potential for social cooperation that we could rightly call socio-systemic services. Services - consisting of practices, performances, definitions, expectations, knowledge - that contribute to the production of both material common goods (from green city areas to self-produced energy, from food to mobility) and immaterial ones (solidarity, trust, integration, values, knowledge, cultures).

The COMETS project, albeit within the narrow framework of the energy domain, has attempted to define a profile of community action in the processes of transition to renewables. Starting from secondary data regarding the diffusion of the cooperative model in Italy and Europe and through questionnaires and the reconstruction of case studies, the project has produced new knowledge regarding the current relevance of these initiatives to varying degrees inspired by the paradigm of community action and, above all, proposes a critical reading of the challenges and opportunities they have had to face and on the basis of which possible scenarios and evolutionary trajectories have been outlined.

Parallel Session: Just energy transition, governance, policy: Energy Poverty and inclusion

Addressing the energy poverty-health nexus in France: narratives on causal relations and obstacles at the local level

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While there is a growing awareness of the links between energy poverty and poor health among both academics and policy makers, practical approaches to formally address these links within a unified policy framework have not yet been developed in France. However, several stakeholders mainly at the local level are already working on issues related to both energy poverty and health, often with a focus on one specific aspect, such as social vulnerability, housing, or health. The aim of this research is to explore the views of different local stakeholders on the energy poverty-health nexus. We contend that local authorities and other local stakeholders such as charities, housing associations, care services, health professionals, or energy suppliers, who are in direct contact with households, are well placed to identify the difficulties of vulnerable people related to both their energy use – especially the heating of their homes – and to their health. But what is their understanding of the complex relations between energy poverty and health, and to what extent are they able to integrate considerations related to the energy poverty-health nexus in their professional practice?

This research is based on a case study of a medium-sized city in central France. Based on semi-structured interviews with stakeholders working in different policy fields (social, energy, housing, and health), we identify narratives on the energy poverty-health nexus as it is seen by different types of local stakeholders. While energy poverty is identified as an issue by local stakeholders, most of them do not immediately identify health issues related to energy poverty as problems they are confronted with in their work. However, when asked more precisely about the links between housing and health, interviewees see a relation between energy poverty and housing difficulties such as cold and damp homes, which can result in asthma and respiratory problems. Several stakeholders also mention the mental health impacts of living in poor housing conditions and particularly in cold homes. Based on an analysis of the interviews, we identify three narratives regarding the relation between poverty in general, housing conditions, energy poverty and health.

Each of them has different implications for the actions what can be considered as necessary to address the problem.

The first narrative mainly focuses on the relations between poor housing and health, where cold homes are viewed as a cause of health degradation. With this approach, the main responsibility lies with public policies in the field of housing: the eradication of the worst dwellings is viewed as the main method to reduce the health impacts of energy poverty. The second narrative includes considerations on mental health as well. The relations between housing and energy poverty on the one side, and health on the other side, are in both directions, poor housing causing physical and mental health problems, while poor physical and mental health can itself result in a degradation of housing conditions. This implies that the solutions to the energy poverty-health nexus lies not only in the treatment of dwellings. It also requires approaches to deal with the more social question of whether and how people with health vulnerabilities can live in dwellings that expose them to energy poverty and a degradation of their health conditions. The third narrative includes more aspects in the analysis of causal relations between energy poverty and poor health. It links peoples' economic vulnerability and health with various stages related to the occupation of a dwelling. At the stage of the choice of a dwelling, the options of vulnerable households can be limited, resulting in (actual or perceived) difficulties to properly live in the dwelling and in the feeling to be prisoner of one's home. Over time, people may experience difficulties both in the management of their energy consumption, such as difficulties to pay energy bills, and in the maintenance of the building, result in housing degradation. Thus, vulnerable households who live in poor housing conditions are faced with various (mutually reinforcing) difficulties related to energy poverty and to poor physical and mental health.

Another contribution of this research is to highlight the main reasons that, according to the interviewees, explain why the energy poverty-health nexus is insufficiently addressed by them. Four main types of arguments have been mobilised by the local stakeholders we interviewed. (a) Firstly, stakeholders frequently mention a lack of tangible proofs that the problem exists: does energy poverty cause health problems or do health problems cause energy poverty, and what are the (quantitative) impacts of energy poverty on health degradation? (b) Another aspect stakeholders often mention is the lack of concern in the energy poverty-health nexus in national policies. (c)

Moreover, stakeholders consider that current policy approaches in the field of housing – health relations focus on other topics rather than on energy poverty. (d) Finally, they mention several practical issues that arise when it comes to addressing the energy poverty-health nexus, such as the identification of households, the identification of institutions and mechanisms that could help them best, and the coordination of various stakeholders who intervene on housing and health issues.

The findings from this research have both theoretical and practical implications. From a theoretical perspective, our analysis confirms the importance of considering the different logics that drive stakeholders' approaches and decision making, especially on issues that cut across policy fields, as it is the case with energy poverty. From a more practical point of view, this work helps to reflect on the potential and limitations of integrating the energy poverty-health nexus into local public policy making. It can help to identify possible options for stakeholder dialogue, including arrangements or compromises, that could serve as a basis for future approaches for addressing the energy poverty-health nexus. In a context where energy poverty problems as well as policies to address them could evolve rapidly, due to energy crises, price shocks and the need to accelerate the energy transition, facilitating such dialogues could be crucial.

Community Clean Energy: A Transformative Approach to Equitable and Sustainable Electricity Supply in California and Massachusetts

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The presentation provides an in-depth analysis of Community Clean Energy (CCE), also known as Community Choice Aggregation (CCA), in the context of the Massachusetts and California electricity markets. With the growing consumer demand for choice, we investigate the transformative potential of the CCE model, focusing on financial savings, equity implications for low-income customers, and alignment with broader sustainability goals. We argue that CCE not only provides a pathway to more competitive electricity rates but also embodies a shift towards a more community-centric, sustainable, and equitable energy future. Through the Massachusetts and California case studies, we aim to highlight the transformative potential of CCE in modern energy provision and its pivotal role in shaping a community-authored sustainable energy future.

We highlight how, in both states, the CCE option has experienced dramatic growth in recent years to now encapsulate over 41% and 58% of California and Massachusetts' population, respectively. The California experience is propelled forward by, among others, disastrous wildfires that exposed mistakes made by the dominant investor-owned utilities (IOU) in the state and opened the door for California's CCEs to position themselves as new governors of the electricity system. The shift is fundamental as decision-making authority is transferred from private, investor-owned, and bureaucratic utility models to municipal, community-centric and elected decision-making. Cities, counties, and towns have eagerly adopted the new ability: the combined 23 CCEs in California now include over 200 cities, towns, counties and municipalities, up from only a handful in 2010. In Massachusetts, despite initial optimism about electricity market deregulation, recent research by the Attorney General has identified higher costs for consumers, particularly those with lower incomes, under supply arrangements from private, individual retail competitive supply. The community-wide CCE option in the state represents an innovative alternative, which can be demonstrated to provide greater choice, promote renewable energy, and offer cost savings. As in California, the market in Massachusetts is characterized by rapid growth of the CCE option to the point where 176 municipalities in the state now receive electricity service through CCE arrangements, covering over 58% of the state's population and eclipsing the state's IOUs.

Mapping perspectives on the policy agendas of climate change, the energy transition and energy poverty in Portugal-The route to a just transition?

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Introduction

The pathway to a just and inclusive energy transition (ET) implies the involvement and co-ordination of stakeholders across multiple sectors and levels of governance. The co-ordination of these actors is essential in order order to deliver on the numerous environmental and social goals inherent to energy transitions.

Importantly as the scope of energy transition policy broadens beyond the integration of renewable energy technologies and energy efficiency, increasingly becoming a tool for addressing inequalities in the energy system, stakeholders are challenged with new cross-sectoral responsibilities.

Current European policies such as the European Green Deal and the Renovation Wave aim to mitigate global climate change (CC), with ambitious targets such as having no net emissions of CO2 by 2050 and decarbonisation of heating and cooling. These policies also tackle inequalities such as energy poverty (EP), generally understood as a lack of sufficient access to energy services. Additionally, the EU has tasked its Member States with assessing energy poverty in their National Energy and Climate Plans (NECPs). Thus, actors from the European scale down are challenged to implement numerous policies with multiple goals.

The result of these complex policy interactions is a current dearth of political strategies which do not have adverse effects, or in other words which do not "leave anyone behind". For example, in Germany domestic retrofit programmes have led to so called "low-carbon gentrification". In the UK energy savings following retrofit interventions have benefited middle-class and upper-class homes more than low-income homes. In Portugal, a rapid and successful adoption of renewable energy technologies coincides with high rates of energy poverty in both the winter and the summer seasons.

Focusing specifically on the Portuguese case, we argue that a significant contributor to groups being "left behind" is the range of different perspectives on how best to simultaneously meet various policy goals across multiple scales and actors. Portugal presents an interesting case due to the impressive rate of renewables integration. It also finds itself at an interesting juncture in terms of energy policy, with an upcoming revision of the National Energy and Climate Action Plan due and a draft energy poverty strategy in a stage of public consultation.

Furthermore, Portugal shares several characteristics with its Southern European neighbours, including a high vulnerability to climate change, low incomes and a high rate of excess winter deaths. We therefore argue that as a case study Portugal potentially offers insights into energy transition pathways in other Southern European contexts.

The main aim of this work is to gain a deeper understanding of how the relationships between the various policy goals in the Portuguese energy transition are perceived by actors at multiple scales and based on this to contribute to improved system management.

Method and predicted results

At this important moment in the Portuguese ET policy it is key to pursue pathways with the maximum potential to reduce energy system inequalities whilst mitigating the impacts of climate change. Given this we have chosen to apply a systems thinking approach to analyse the perceptions of actors at varying scales and levels of influence on Portuguese energy governance. Specifically, we apply Causal Loop Diagrams (CLDs) to map the perceived relationships between the drivers of energy poverty and policy debates which influence the various agendas of climate change, energy transitions and energy poverty. The diagrams, developed during a participatory workshop, build on current policy debates explored during a preceding qualitative interview process. By mapping these interrelated systems our aim is to contribute new insights on the potential outcomes of current policy trajectories, which in turn can help to anticipate unintended consequences. Identification of these consequences contributes to a more efficient management of energy transition policy which is potentially beneficial for energy system stakeholders. By including participants from a diverse range of sectors and operational scales, the outputs of the workshops will reflect a multi-level perspective on the pathway to the delivery of a just energy transition in Portugal.

The list below presents policy debates discussed during the qualitative interview phase and explored during the participatory workshops. The participants were provided with the list of debates as a guide but were encouraged to add to and modify this list as they saw fit. The participants also identified the type of impact the respective policy drivers had on the policy agendas, i.e., whether the driver had a positive (reinforcing) or a negative (balancing) effect. The results of this process will be used to build the CLDs.

List of policy debates explored in participatory workshops

Employment opportunities (losses vs gains decarbonisation process); Health or disability status; Education; Geographical zone of residence; Age; Minority status; Gender; Building stock characteristics; Efficiency of domestic equipment (heating, cooling, washing machine); Consumer behaviour & energy literacy; Availability & structure of funding schemes; Housing tenure; Inflation; Energy source (centralized or decentralized), (renewable, fossil fuel); Energy ownership (public vs private); Level of national energy independence

Preliminary conclusions

The delivery of a just energy transition which leaves no-one behind is contingent on the shared vision and co-operation of actors at multiple scales. By undertaking a participatory systems thinking approach we elicit the perspectives of actors at different governance scales regarding the policy debates which have the potential to influence the policy agendas of CC, ET and EP. In so doing we gain novel insights into how these various policy agendas may develop over time, this in turn improves capacity to create pre-emptive mitigatory strategies to reduce exclusions and injustices which may occur as result of energy transitions. Finally in understanding how stakeholder perspectives on these policy trajectories may vary, we gain knowledge of potential gaps in terms of roles and responsibilities in the ET. This can in turn lead to improved management of different aspects of the ET.

Should energy poverty in Europe be saved by energy citizens' initiatives?

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Literature on energy transitions recognises tackling energy poverty as a crucial component to create resilient communities (Balest & Stawinoga, 2022). It is therefore imperative that the costs of the transformation are distributed in a way that allows vulnerable households to cover energy bills for essential services contributing to their wellbeing (van Hove et al., 2022). Research on the effects of the pandemic highlighted that the containment measures and economic crisis have aggravated patterns of pre-existing energy poverty (Bahmanyar et al., 2020;). Sovacool et al. (2020) argued that the pandemic did not solely incorporate health and economy related challenges but also triggered a social crisis. Van Hove et al. (2022) also argued that, although the impact of the current war between Russia and Ukraine on energy poverty is still sparse in academic literature, it is likely that this will serve as another example of how issues of energy vulnerability in Europe intensify in times of crisis.

It is difficult to grasp what exactly ‘energy poverty’ means, and the concerned literature does not provide a unanimous definition. However, many descriptions argue that an energy-poor household e.g. lacks the ‘socially and materially necessitated level of energy services in the home needed for living’ (Bouzarovski, 2014:276). In the European context, energy poverty is commonly numerically defined through Broadman’s rather simple ‘Ten Percent Rule Index’, which categorises a household as poor when more than 10% of the household income goes towards energy expenditure (Cuerdo-Vilches et al., 2021). The energy-poor households who actually face injustices as they lack the financial means to invest in renewable energy (or switch to renewable energy), so they are left out of the opportunity to use clean energy and save costs in order to become potentially self-sufficient. Thus, they should be engaged in the energy transition in a meaningful way, without being reduced only to the role of passive consumers. They need to be empowered both at the level of capacity to act and at the level of power-shift, and become meaningful energy citizens (DellaValle & Czako, 2022).

In literature, the term of Energy Citizenship (ENCI) is linked to an active form of citizen’s participation (van Veelen & van der Horst, 2018), wherein participation is intended as a journey from passive consumption to a more meaningful and active interaction with energy in everyday life, providing the basis for a more democratic, just and decentralised energy model participation (Wahlund & Palm, 2022). As part of the EnergyPROSPECTS Horizon 2020 project: “Energy citizenship refers to forms of civic involvement that pertain to the development of a more sustainable and democratic energy system. Beyond its manifest forms, energy citizenship also comprises various latent forms: it is an ideal that can be lived up to and realised to varying degrees, according to different framework conditions and states of empowerment.” (Pel et al. 2022: 64). First, this definition illustrates how ENCI is in the political-normative aspect, not an empty buzzword term. On the contrary, it appears to be a relevant term for various people and organisations involved in the energy transition. It forms a crossroads of political ideals. Second, the definition explicitly reminds of the various ‘latent’ forms that can be discerned beyond the manifest (active, individual, pragmatic, etc.) forms.

In recent years, local initiatives by groups of citizens that want to take matters into their own hands and generate local renewable energy have been booming across Europe (Coenen, et al., 2022; Katsaprakakis et al., 2022). Stemming from a bottom-up approach, these ENCI initiatives are rooted in a civic culture that aims to increase and activate more engaged citizenry and to address challenges such as energy poverty (Hoffman and High-Pippert, 2010). Such organised groups of citizens not only aim to reduce energy consumption, produce renewable energy in their direct locality but also help vulnerable households and marginalised groups (Germes et al., 2021).

As part of the EnergyPROSPECTS, we explore the role of ENCI cases in energy poverty. Our analysis follows a 2-step approach. We first provide overall data from 596 cases across all European countries related to energy poverty and as a second step we provide a more detailed analysis of 40 ENCI cases. We specifically examined to what extent ENCI cases take into account energy poverty and are able to foster adaptive measures in order to guarantee more equity. Whether ENCI actors see themselves as responsible for such concerns was also a central research question. Our study emphasises the need for the promotion of energy justice through addressing/including energy poverty, which is still under researched and underestimated in the literature.

In order to analyse the ENCI cases the capability approach is applied. Literature on the capabilities approach proposes two alternative concepts for development to express the experience of energy deprivation, meaning functionings and capabilities (Day et al., 2016). Functionings allude to the diversity of elements fundamental for a meaningful life and include states such as being in good health and adequately nourished, but also more complex conditions such as taking part in community life (Sen, 2000; Walker, 2013). Capabilities themselves refer to a person's given ability to achieve functionings, independent of whether an individual decides to exert these capacities or not (Day et al., 2016) and include amongst others, the capabilities to secure healthy food or income and engage politically. From this perspective, poverty can be conceptualized as the deprivation of capabilities to attain vital and valued functionings (Alkire, 2007). As energy is often a material prerequisite for achieving multiple capabilities (Sovacool et al., 2014) energy poverty involves the 'inability to realise essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services' (Day et al., 2016:260). Experiences of energy deprivation are shaped by multi-faceted processes and are affected by i.e. social, political and economic processes as well as structurally constituted materials (Butler, 2022). In summary, through the capabilities approach lens, our study explores the role and impact of ENCI cases in supporting vulnerable households and providing some pathways for a just and inclusive energy transition.

Programme | Day 2

08.00-09.00 Registration (Atrium of the Energy Academy)
09.00-09.15 Announcement of launch of the Wubbo Ockels School for Energy and Climate (Room 5159.0029)
09.15-10.15 Keynote: Marie Claire Brisbois (Room 5159.0029)

10.15-10.30 Break

10.30-12.00 Parallel sessions 1
12.00-13.00 Lunch (Atrium of the Energy Academy)
13.00-14.30 Parallel sessions 2

14.30-14.45 Break

14.45-16.15 Plenary Panel discussion : Key issues and new pathways for policy and research within energy transition (Room 5159.0029)
16.15-16.30 Closure (Room 5159.0029)
16.45-18.15 Excursion to Groningen North and South as part of the Making City project

18.15-19.00 Drinks in town

10.30- 12.00 Parallel sessions 1

Integrated urban and regional energy planning Room 5159.0291: Built environment, poverty and financial system

Chair: Van Dam, Zuidema, Van Geet

Truijens/Theunissen Alleviating energy poverty as a governance issue in the built environment

Woods/Henriksen Are energy efficiency policies socially sustainable? Justice in the transition of the Norwegian housing sector.

Van Geet et al. The urban financial metabolism of energy poverty: analysis of the financial mechanisms between energy poverty and municipal spending.

Pellegrini-Masini/ Carnevale Bottom up initiatives leading towards just energy transition

Energy systems and (business) modelling Room 5159.0062
Round Table: Challenges and policy recommendations for just energy transition in EU

Organizer: Sciullo

Panel members: Ganna Gadlkyh, Witold-Roger Poganietz, Giuseppe Pellegrini, Rita Vasconcellos D'Oliveira Bouman, Ramazan Sari

Global south Room 5159.0010:
Technologies

Chair: Teladia, Van Huyssteen, Béres

Nagdeve Integrating biomass co-firing in coal based thermal power plants with selling carbon credits

Sareen Importance of renewable energy certificates in green hydrogen production, a case study in Indian Perspective

Kunwar Sustainable distributed generation model. A case study of Tara Khola Hydropower company limited in Nepal.

Aghlimoghadam Solar business in an oil rich country? A socio-technical investigation of the solar PV niche actors in Iran.

Citizens, community and bottom up initiatives Room 5159.0110
Smart use of energy infrastructure: from neighborhood to industrial park

Chair: Van der Waal, Kappert

Rebman/Folmer Community energy – social innovation through distributed agency.

Van der Waal Energy communities in control of a fair and affordable system: local generation for local use.

Van der Schoor Grid governance: what new roles for the community energy movement?

Kloppenburg Energy platforms and the future of energy citizenship

Just energy transition, governance, and policy Room 5159.0009
EU-law, and governance

Chair: Diestelmeier

Chen/Vandendriessche The evolution of the EU framework for promoting RES-E: a market compatible paradigm shift?

Mauger Finding a needle in a haystack. Identifying degrowth compatible provisions in EU energy law

Van Uffelen/Ten Caat	Introducing the concept of hidden morality in energy justice
Grignani et al.	Economic, environmental, and/or social benefits of renewable energy communities: not just a matter of conjunctions

13.00- 14.30 Parallel sessions 2

Integrated urban and regional energy planning Room 5159.0291
Positive energy districts

Chair: Van Dam, Zuidema, Van Geet

Norgaard	Understanding the urban energy transition through positive energy districts
Psarra et al.	Experiences with co-creating a PED proposal: applying the Integrated Energy Landscape Approach at Hoogkerk District in Groningen
Kappert	Modelling future neighborhoods of Groningen
Tromp et al.	A balanced integration of PED

Energy systems and (business) modelling Room 5159.0062

Global south Room 5159.0010
Socio-technical frameworks and experiments

Chair: Teladia, Van Huyssteen, Béres

Mallik	Power to the people. A techno-economic evaluation of distributed generation in Nepal
Van der Merwe et al.	Socio-technical experiments for sustainable energy development of energy technology innovations: a gender perspective (part 1)
Van der Merwe et al.	Socio-technical experiments for sustainable energy development of energy technology innovations: a gender perspective (part 2)
Earl et al.	Critical making, critical niches. A conceptual framework and co-design method for energy transitions in the Global South

Citizens, community and bottom up initiatives Room 5159.0110
Workshop: Creating a roadmap for sustainable biofuel production: accounting for different values and capacities

Chair: Van der Veen, Chandrasekaran

Just energy transition, governance, and policy Room 5159.0009
Law and governance

Chair: Mauger

Ten Caat et al.	Revealing hidden injustices: filling the gap in empirical studies of energy justice
Andreasson	New offshore energy storage and transport options. Legal obstacles and solutions
Schnell/Mattes	Legitimacy gaps in energy transition. Institutional misalignments in wind energy projects
De Looze et al.	Becoming more just? Changing justice conceptions in energy policy in the NL

Keynote Speaker | Day 2

Marie Claire Brisbois

The political role of energy communities in energy system transformation

Marie Claire Brisbois is a Senior Lecturer in Energy Policy at SPRU, and Co-Director of the Sussex Energy Group. Her work examines questions of power, politics and influence in energy, water and climate governance contexts. She also works on broader issues of social change and public participation in low carbon transitions.

Parallel Session | Integrated urban and regional planning: Built environment, poverty and financial system

Alleviating energy poverty as a governance issue in the built environment

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Considering that energy poverty is caused on the one hand by an income factor and on the other hand by a household's energy expenses, one way of alleviating such energy poverty is by lowering energy expenses through better insulation of the houses people live in. And considering that – at least in the Netherlands – a very large share of the energy poor households live in dwelling of (social housing) corporation, it makes sense to look at these corporations for large-scaled insulation of the housing stock. Even though such insulation of the housing stock is currently being pursued by housing corporations (as well as home owners and landlords), it seems that the pace is slow and the obstacles for upscaling are plenty. But what is hindering the upscaling of insulating the housing stock by housing corporations?

In this paper we explicitly see the objective of accelerated improvement to poorly insulated houses as a governance question. We ask, therefore, which of the existing decision-making structures contribute to the difficulty of upscaling the insulation of the housing stock. On the basis of a case study in the Netherlands – the Metropole Region Amsterdam (MRA) – we seek to map out the current governance system relevant for renovating the housing stock of housing corporations, and look for possible improvements in that system. In this governance mapping exercise, we are interested in the mutual dependencies and interaction between relevant actors (or stakeholders). We empirically investigate which actors play a role in decision-making on renovating the housing stock; what different decision-making powers, mandates, and interests these actors have; whether and how all relevant actors communicate to one another; and what knowledge, data, and information they use (or indeed lack) to make large-scale plans for renovations.

Of special interest here are the types of agreements made between housing corporations and municipalities, the enforceability of those agreements, the extent to which (local) government can demand particular renovation action by housing corporations, and the extent to which these (local) governments can provide the (long-term policy) conditions that enable housing corporations to invest in these insulation endeavours. A seemingly central type of agreement here are the so-called performance agreements between social housing corporations and (local) governments. These agreements are said to be vital in the decision-making process on (upscaled) insulation of the housing stock. Housing corporations describe their aims with regard to maintenance of their housing stock, which is a good indicator for governments on what to expect from these corporations. However, it is so far completely unclear 1) what exactly is the content of these agreements, and 2) what exactly is the mandate of these agreements in the broader governance system. Looking into the procedure of making and executing these performance agreements is part of the governance mapping exercise and should also address questions on the interaction of actors at different governmental levels: what are the interdependencies and interactions between locally operating housing corporations and national policy?

Apart from these questions on the plan-making side of renovation and insulation of the housing stock, another factor that may significantly determine the pace in which houses are renovated is the lead time of the maintenance itself. We therefore look at the factors that determine the pace of the process between the moment at which plans are made and the moment at which the houses are effectively renovated. We distinguish between those factors that could potentially be changed (such as permit processes or coordination among various involved parties), and factors that are hard to change and should be taken as a given (such as prices or the delivery time of materials). Important here will also be the possible hindrance of existing rules and regulations. Plans for large-scaled insulation of housing blocks may be hindered by stringent rules on environmental protection (with thorough checks on bats and birds living in between layers of the building). An important question will be to what extent it is realistic that this quite determining factor can be sped up in a smart way, for instance through coordinated action in requesting these permits. Since it is already clear that shortage on the labour market is one of the crucial factors, this investigation of the execution phase may also lead to suggestions for smart and coordinated use of the limited labour force in a municipality or region. The goal of this exercise is to see whether the now taken-for-granted lead time of the renovation of about 2,5 years can be shortened by modifications in governance procedures and stakeholder cooperation and coordination.

Though the questions of how decisions are made and how plans are executed seems obvious, we may come to a breakthrough by ‘simply’ connecting the right actors, mandates, and actions.

Key words: governance mapping; housing corporations; upscaling house insulation; decision-making power; energy poverty; energy justice; socio-economic impact; broad welfare

Are energy efficiency policies socially sustainable? Justice in the transition of the Norwegian housing sector

Ruth Woods, Norwegian University of Science and Technology (NTNU), Ida Marie Henriksen, NTNU, Sara Heidenreich, NTNU

The housing sector is responsible for a large part of energy use and greenhouse gas emissions. According to the IEA, thirty-four percent of all energy produced is consumed by buildings in Norway. This is lower than the European average (forty percent), but the goal set by the Norwegian government is a general reduction in energy use by thirty percent across all sectors of society by 2030 (IEA 2022). Hence, policies aiming at improving the energy efficiency of the housing stock is a focus area in the Norwegian energy transition. The current energy crisis with its high electricity prices only increases the need for transformation in the housing sector. However, energy efficiency upgrades are costly and current policies and subsidies favour wealthy households who own their own homes and who have the financial means to invest in new technologies. Low-income households who either do not own their home or who do not have the economic resources to finance upgrades are not benefitting. Subsidy schemes always require a significant amount of own capital. In this context, this paper addresses the question: How can we ensure that energy efficiency policies and measures do not reinforce social and economic inequities and instead enable the participation of low-income households in the energy transition in Norway?

Housing politics in Norway have since WW2 had the goal of providing the entire population with housing at a price that is reasonable in proportion to their income, with emphasis on homeownership. A collaboration between the state, municipalities, housing cooperatives and the Norwegian Housing Bank has been applied to realize this goal. In 2022, eighty-two percent of Norwegians were living in privately owned homes (Statistics Norway 2022).

However, rising housing prices and the European energy crisis are challenging this housing model. Low-income households are now more dependent on the private rental market and becoming a homeowner is increasingly an option for middle-class wealthier sections of society. Norway is also a cold country and mainly uses hydroelectricity to heat houses. In 2022 record high energy prices are placing more and more households under economic pressure.

Based on a qualitative study of low-income households and data from two interactive workshops with actors from municipalities and research, as well as public and private companies, this paper first discusses how current energy efficiency policies impact low-income households and their ability to participate in energy transitions. The paper will then provide suggestions for what can be done to avoid the reinforcement of social and economic inequities in this context and thereby enable a just energy transition in the housing sector.

Preliminary findings show that actions dealing with climate change, energy efficiency and consideration of the needs of vulnerable groups often take place within different sectors, in this case social housing and welfare, city planning, or the environmental agency. There is a need for subsidy and regulatory innovation, which brings sectors together. Within municipalities this could include a platform where municipalities can share their experiences and solutions, as well as a review of the current Planning and Building Act, to enable the planning of more affordable and energy-efficient housing. Strengthening or establishing cross-sectoral connections means new cross-sectoral roles, for example public health coordinators or energy advisers who help vulnerable groups to apply for support for energy efficiency measures. Finally, decision-making processes and must be to a greater extent be rooted in the citizens' requirements. This may be achieved through good participation processes, where citizens are invited into the decision-making processes and can actively help to shape the choices that are made. A good participation process should have a reflexive understanding of who is participating, who should be included, and work actively with recruitment to secure the inclusion of voices that are not usually heard. The follow-up of participation processes should be anchored, so that learning is secured and can be shared with others. Participants should have real influence on the results of the processes.

The Urban Financial Metabolism of Energy Poverty; analysis of the financial mechanisms between energy poverty and municipal spending

Marijn van Geet - University of Groningen| Joram Nauta – TNO | Philo Tamis - New Energy Coalition | Timo Dettmering - New Energy Coalition

In recent years, energy poverty has become an important area of study and public policy. Even though energy poverty manifests at the household level, its negative effects are becoming an increasing issue for local municipal policy. Multiple studies have highlighted how energy poverty can negatively impact a household's physical and mental well-being, social participation, and cost of living. Local government often offer a range of services and policies that help alleviate these impacts. Although a significant amount of study has been conducted to understand the broader social, economic, health, and climate implications of energy poverty, few studies have examined its financial impact on governmental expenditures. Understanding the future potential public savings that could be realized by addressing energy poverty requires a thorough comprehension of the mechanisms through which energy poverty at the households level accumulates to a broader financial impact for local governments. Developing this understanding is essential for determining how addressing energy poverty now could result in large future local public cost savings. Currently, the financial benefits of governments implementing initiatives to relieve energy poverty are unknown. This work tries to address this gap in the literature by providing unique insights into the relationship between household energy poverty and municipal expenditures. Consequently, this research investigates the urban financial metabolism (UFM) of local energy poverty.

UFM is a holistic financial model based on the concept of urban metabolism that is employed here for mapping financial streams within a territory across domains, for understanding the social drivers of these financial streams, and for identifying the pathways through which these drivers influence financial flows. This study will employ urban financial metabolism to provide a comprehensive understanding of the financial mechanisms by which energy poverty influences municipal spending. Hence, this study contributes to the development of an understanding of the financial mechanisms linking energy poverty and local government spending, as well as the processes through which reducing energy poverty might have a wider financial impact.

The mechanisms linking energy poverty to municipal spending are constructing follow the causal chains logic as introduced in Dijst et al. (2019)'s work on urban metabolism. Their framework is adopted to establish a causal chain between energy poverty as a *driver* for changes in *financial stocks and flows* of municipal spending. These causal chains consist of four main interconnected links: i) divers, ii) needs, iii) activities, iv) financial stocks and flows. The following logic connects these four links: The driver is *driver*, which creates particular needs for individuals and communities. The desire to fulfil these *needs* triggers certain *activities*, which will result in changes in *financial stocks and flows*.

This research takes the form of a single, in-depth case study of Groningen, the Netherlands, to establish these causal links between energy poverty and local public spending. In 2019, over 5,740 households in the municipality were at risk of being energy poor as they spent more than 10% of their disposable income on energy. This number is expected to have increased significantly as a recent study by CBS (Statistic Netherlands) shows that the costs of an average annual energy bill has increased by 53% between 2019 and 2022, from €1829 to €2800. The current analysis focuses on investigating the financial metabolism of energy poverty in the 14 financial policy programs of the municipality of Groningen, covering a wide variety of policy sectors for which the municipality carries responsibilities. The underlying financial flows and chains will be identified and supported by triangulating qualitative information from a variety of sources, including policy research, in-depth interviews, and focus groups.

Results of the analysis reveal a number of causal chains through which Groningen's municipal public expenditures are affected by energy poverty. This study has demonstrated causal connections between energy poverty and six of the municipality's fourteen financial programs: I Work and Income, ii) Education, iii) Wellbeing, Health and Healthcare, iv) Housing, v) Safety, and vi) Overhead and Organizational Support. Overall, the study demonstrates the direct and indirect effects of energy poverty on municipal policy and identifies the processes via which energy poverty influences municipal expenditures. As a result, the study provides substantial qualitative evidence that an increase in energy poverty would lead to an increase in local public expenditures, and that adopting strategies to alleviate energy poverty is likely to result in financial gains in various policy domains. Quantifying these links will be a crucial next step in the study of energy poverty's financial metabolism.

Bottom-up Initiatives leading towards a Just Energy Transition

Giuseppe Pellegrini-Masini, Norwegian University of Science and Technology NTNU; Antonio Carnevale, University of Bari.

The role of vulnerable groups in the Energy Transition is often insufficiently addressed in research, which results in gaps in knowledge regarding their inclusion. Vulnerable groups include low-income households, the elderly, the young, citizens living in remote areas, ethnic minorities, and intersectionally vulnerable individuals. The H2020 ACCT-ING project, AdvanCing behavioural Change Through an INclusive Green deal, aims to fill this gap by proposing inclusive actions to increase the engagement of vulnerable groups in the Green Transition.

One of the project activities involved mapping bottom-up initiatives (BUIs) in 34 countries (EU27 plus Brazil, Japan, Norway, Serbia, Turkey, UK, and the US), focusing on areas relevant to the EU Green Deal and involving vulnerable groups. Research Line 3 (RL3), “Clean energy: Energy poverty,” investigated BUIs in the form of energy community schemes targeting energy-vulnerable or energy-poor households. A total of 114 BUIs were mapped through a four-month desk research process in 2022, involving a network of national researchers.

Content analysis was conducted using a coding template to identify implementation drivers, barriers, and energy and social justice principles. The analysis found that drivers and barriers such as access to knowledge, information, funding, institutional policy framework, and social stigma significantly influenced the BUIs. Various vulnerable groups were targeted, predominantly low-income households, followed by vulnerable rural communities, and to a lesser extent, individuals deemed vulnerable because of age (elderly/young) and ethnicity.

Some implementation dynamics emerged, highlighting the importance of specific schemes and the pursuit of intertwined goals. Many BUIs aimed at delivering co-benefits, such as improving knowledge through environmental education. For instance, a portion of the BUIs focused on energy efficiency and retrofitting, seeking to reduce energy consumption and costs while raising awareness of energy-saving practices. Other BUIs emphasized renewable energy generation and distribution, aiming to foster local energy independence and reduce greenhouse gas emissions.

Several categories of justice were considered in the analysis framework. Many initiatives were relevant not only for distributional justice goals but also for implementing actions inspired by recognition justice principles. Distributional justice entails the fair distribution of benefits and burdens across society, while recognition justice acknowledges the diverse identities, values, and needs of different groups, fostering their inclusion in decision-making processes.

Several interesting cases, such as the Stromspar-Check (SSC) in Germany and Enercoop in France, demonstrated innovative approaches to addressing energy poverty and promoting renewable energy. The SSC initiative provided practical tips and immediate aids to vulnerable households, helping them reduce energy consumption and save on utility bills. In contrast, Enercoop fostered a cooperative model, allowing citizens to invest in and benefit from renewable energy production. These initiatives showcased the potential of BUIs to empower vulnerable groups and support sustainable energy transitions.

The analysis also underlined the importance of connecting the discourse on energy poverty with educational programs. For example, ScOLARGeno in Germany focused on educating the young about renewable energy and energy efficiency, encouraging them to become active participants in the energy transition. By integrating energy education into school curricula, the initiative aimed to raise awareness and foster a generation of environmentally conscious citizens.

While community energy schemes targeting vulnerable groups were established means of intervention in some countries, they were still novel, vaguely conceived, and little implemented in others. Barriers such as stigmatization of poverty, data collection challenges, vague notions about energy communities, market oligopolies, and paternalistic attitudes within the energy sector hindered the progress of BUIs.

To overcome these barriers and foster just energy transitions, it is crucial to leverage drivers such as the presence of “energy coaches,” educational programs, and supportive policy frameworks. Energy coaches can assist vulnerable households in understanding and managing their energy consumption, thereby reducing energy poverty. Educational programs, on the other hand, can enhance awareness of energy-saving practices, energy efficiency, and renewable energy sources. These programs can target not only vulnerable groups but also the general public, ensuring widespread engagement in the energy transition.

Supportive policy frameworks are essential for promoting BUIs and ensuring their success. Governments should consider providing financial incentives, technical assistance, and regulatory support to facilitate the development and implementation of initiatives targeting vulnerable groups. Collaboration between governments, NGOs, and the private sector is crucial for creating synergies and maximizing the impact of BUIs.

In conclusion, the H2020 ACCTING project has revealed significant insights into the role of bottom-up initiatives in promoting a just energy transition. By addressing the barriers and leveraging the drivers identified in the research, policymakers and stakeholders can foster a more inclusive and equitable transition to a sustainable energy future. The integration of vulnerable groups into the energy transition is not only a matter of social justice but also an essential step toward realizing a truly sustainable and resilient society. By engaging these groups in the Green Transition, we can harness their unique perspectives and capabilities, driving innovation and fostering a more comprehensive approach to the challenges we face in the pursuit of a sustainable future.

Round Table | Challenges and policy recommendations for just energy transition

Challenges and policy recommendations for Just energy transition in EU

Organizer: Alessandro Sciullo (UNITO, Italy), Joint Programme e3s (clean Energy tranSition for Sustainable Society) of the European Energy Research Alliance - EERA

Panel members:

- Ganna Gadlkyh (European Energy Research Alliance, EERA, Belgium)
- Witold Poganietz, (Karlsrhue Institute of Technology, KIT, Germany)
- Giuseppe Pellegrini (Norwegian University of Science and Technology, NTNU, Norway)
- Rita Vasconcellos D’Oliveira Bouman (SINTEF, Norway)
- Ramazan Sari (Technical University of Denmark, DTU, Denmark)
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For JET to be fostered in the EU context, it needs to be supported by adequate policies that should be able to address the many diverse dimensions of justice and the many diverse social and institutional contexts resulting from the heterogeneity of the EU landscape and the historical evolution of the context themselves.

Energy system transformations in fact are complex socio-technical processes involving not only changes to energy technologies but also to the broader social and economic aspects of energy production and consumption. These energy transformations could negatively affect the people that they pursue to serve, exacerbating current vulnerabilities and creating new ones. Therefore, striving for a more equitable distribution of benefits and burdens and ensuring that vulnerable groups are not disproportionately harmed is increasingly seen as a crucial success factor for a just transition. On these premises, the Joint Programme EERA - e3s (clean Energy tranSition for a Sustainable Society) released a white paper on Just Energy Transition (JET) addressing both theoretical and policy challenges for the justice dimension to be properly considered and implemented in the EU energy transition pathways. Within the white paper, JET is intended in the exclusive sense of the European socioeconomic and environmental consequences and their ethical implications of transitioning from fossil fuels to sustainable energy sources.

The white paper (and the proposed round table) is structured in four sections aimed at answering to as many questions.

Question 1: what is JET and why is needed?
Question 2: What are the main challenges towards achieving a JET in Europe?
Question 3: What are the current EU policies addressing JET?
Question 4: Which policies to steer the JET in EU?

Parallel Session | Global South: Technologies

Integrating Biomass Co-firing in Coal based Thermal Power Plants with selling carbon credits

Rita Nagdeve, Assistant Director-I, Central Electricity Authority, Ministry of Power, Government of India

The term “biomass” describes substances made from plant matter, such as trees, grasses, and agricultural crops. Much of the energy demands of the present day may be met by these materials, which were grown with the help of sunlight. Biomass has long been a significant energy source. Huge amounts of biomass are burned in the fields every year as a result of an insufficient biomass supply chain and value addition process. Burning straw stubble is the deliberate lighting of straw stubble on fire after paddy and other crops have been harvested.

Co-firing with biomass for generating electricity is a tested technology. Around 230 thermal power plants have exhibited and experimented with biomass co-firing in thermal power plants worldwide, the majority of which are situated in American and European nations, according to open source data. Up to 20% of the coal used in the boiler can be replaced by biomass. Coal and biomass are burned concurrently in the boiler. The United Nations Framework Convention on Climate Change (UNFCCC) has recognised biomass co-firing, based on wastes and residues as a carbon neutral technology, a method to reduce GHG emissions so that nations may sell carbon credits linked to their co-firing projects. A very inexpensive method of lowering greenhouse gas (GHG) emissions is through biomass co-firing. Co-firing by 10% results in a 10% reduction in greenhouse gas emissions by a thermal power station, and as a result, governments/utilities may sell the carbon credits linked to their biomass co-firing projects. Co-firing biomass in thermal power plants has the many advantages such as CO2 emissions are reduced when the amount of coal used to generate electricity is reduced; this would lessen the industry's reliance on coal; electricity generation from biomass, a resource that was previously wasted; farmers receive income, and biomass pellet producers create jobs; preservation of the soil culture that farm fires damage; decrease in sulphur oxide, nitrogen oxide, and GHG emissions; decrease in air pollution as million tonnes of crop waste from the paddy fields after harvesting were burned by the farmers in various countries. Stubble burning is among one of the major cited cause of smog also. The primary reasons for stubble burning are to reduce the cost of clearing the field for next crop, to reduce the turnaround time between harvesting and sowing for next crop due to lack of other alternatives etc. In this respect, utilization of biomass for co-firing in coal based thermal power plants will be of significant importance in reducing the GHG emission.

Therefore, in order to avoid such problem, integration of REC framework with biomass co-firing in coal based thermal power plants is proposed in this study. This can be explained by a typical example. Take a case of India, where to make it easier for state utilities and other required organisations, particularly those in places with limited access to RE sources, to meet their renewable purchase obligation, India's Central Electricity Regulatory Commission (CERC) created the Renewable Energy Certificate (REC) method. For renewable energy generators to recoup their costs, the REC framework aims to establish a national level market. One MWh of energy produced through renewable resources is represented by one REC. A generator can produce power using renewable resources under the REC system anywhere in the nation.

To comply with its Renewable Purchase Obligations (RPO), the obliged firm may buy RECs from any location in the nation.

Outcome:
Energy independence of a country may increase as a result of increased energy efficiency and significant use of renewable energy sources. This study of integrating biomass co-firing in coal based thermal power plants with selling carbon credits/REC mechanism will encourage the countries to use more domestic fuels and renewable energy sources which will also help in improving country's energy security. The highest chances for economically advantageous biomass co-firing in coal-fired plants are when all or most of the following requirements hold true: (1) there is an abundance of locally produced or facility-generated biomass; (2) yearly coal consumption is large; (3) local land-fill tipping fees are high, making it expensive to dispose of biomass; and (4) there are high coal prices. Because it is the most cost-effective short-term alternative for incorporating additional biomass resources into the current energy mix, biomass co-firing is generating huge interest. The aim of this study is also to propose such a framework for energy transition which is in line with United Nations Sustainable Development Goals. In this regard, Goals No. 7 (Affordable and Clean Energy), 8 (Decent work and Economic Growth), 9 (Industry, Innovation and Infrastructure), 11 (Sustainable cities and communities) and 13 (Climate Action) are found to be most correlated with the proposed framework.

Importance of Renewable Energy Certificates in Green Hydrogen Production & Nationally Determined Contributions as per Paris Agreement

Karan Sareen, Assistant Director, Central Electricity Authority, Ministry of Power, Govt. of India, New Delhi-110066

Green hydrogen produced using renewable energy, has the major potential to play a key role in building low-carbon and self-reliant economic pathways. Green hydrogen can enable utilization of domestically abundant renewable energy resources across regions, seasons, and sectors, feeding multiple usage streams, either as a fuel or as an industrial feedstock. It can directly replace fossil fuel derived feedstocks in petroleum refining, fertilizer production, steel manufacturing etc. Hydrogen fuelled long-haul automobiles and marine vessels can enable decarbonisation of the mobility sector. Green hydrogen can be particularly useful as a versatile energy carrier for meeting energy requirements of remote geographies, including islands.

Many major economies have declared hydrogen strategies as part of the broader climate and clean energy related actions. These national strategies largely seek to tackle the common underlying challenges of scaling up green hydrogen production, enhancing hydrogen use across sectors, developing technologies, and designing enabling policies and regulations. As per International Renewable Energy Agency (IRENA, 2019) report, Innovation landscape brief: Renewable Power-to-Hydrogen, only 4% of global hydrogen requirement is met from electrolysis process and the rest is from fossil fuel. As the electricity produced from RE sources is used in this process, green hydrogen can also be seen as a carrier of renewable energy, complementary to electricity. Thus, it not only address the issues associated with electricity and energy sector but also lead to effective utilization of natural resources, minimizing the use of fossil fuel and take care of certain environmental concerns.

In order to analyse the role of Renewable Energy Certificate (REC) in boosting the 'Hydrogen Economy' & also, fulfilling nationally determined contributions (NDCs) of countries as per Paris Agreement, a case study in Indian perspective is done which is as:

The Indian Electricity Act, 2003 mandates State Electricity Regulatory Commissions (SERCs) to specify percentage of consumption from Renewable Energy Sources (RES) in order to promote renewable energy. Accordingly, SERCs have notified the minimum percentage of energy consumption to be sourced from RES for their respective utilities. In this regard, considering the disproportionate resource distribution and variation thereof and to promote RES across the nation, Central Electricity Regulatory Commission (CERC) introduced mechanism to ease the purchase of Renewable Energy (RE) by the state utilities and obligated entities, including the states which are not well endowed with RE sources. REC framework seeks to create a national level market for renewable energy generators to facilitate them in recovering their cost. One REC represents one MWh of energy generated from renewable sources. Under the REC mechanism, a generator can generate electricity through the renewable resources in any part of the country and the electricity generated can be sold at cost equivalent to that from any conventional source and the environment attribute can be sold through the exchanges at the market determined price. The obligated entity from any part of the country can purchase these RECs to meet its Renewable Purchase Obligations (RPO) compliance.

Assuming 1% renewable energy (RE) generation curtailment in the year 2021 – 22 may lead to loss of 2630 Million Units (MU), instead, if it is utilized for hydrogen production, then in such a scenario:

Energy associated with 1% RE curtailment in 2021-22 = 2630*103 MWh

Assuming the price of REC = Rs 1000 / MWh

Revenue generation by selling RECs if used for the production of hydrogen in a year instead of 1% RE curtailment = Rs 1000 / MWh * 2630 * 103 MWh = Rs 263 Crores

The curtailment of RE would lead to not only lower utilization but also wastage of natural resources. Therefore, the excess RE generation, which is otherwise curtailed, may be utilized for hydrogen production and used as per requirement would address a part of the balancing requirements. It is to be noted that around Rs 263 Crores revenue will be generated by selling RECs against the unutilized / curtailed 1% RE generation, which is proposed to be used for the production of green hydrogen in a year.

Problem Statement & Research contribution: At present, the cost of green hydrogen production is quite high. Further, the availability of natural resources (solar, wind, tidal and hydro) vary from season to season, time to time and region to region. In order to tap this potential to its best, it's ideal to interconnect all countries to have one grid and exchange the power. However, water bodies, distance, historical, commercial, market factors, technical limitations, cost benefit analysis are limiting the same, and resulting in underutilization of natural resources and unnecessary burden on environment / ecological system. Accordingly, the renewable energy surplus can produce the hydrogen from the excess RE and can export the same to the countries in need of green hydrogen. Further, this will also help all countries in fulfilling the NDCs as per Paris Agreement. As countries outline the steps that they will take in their NDCs to reduce their greenhouse gas emissions in order to meet the Paris Agreement's objectives. Moreover, nations outline in their NDCs the steps they will take to increase their capacity for adaptation to climate change's effects. Therefore, from this study, one can analyse, How RECs can play a vital role in boosting the 'Hydrogen Economy' & also, help countries in fulfilling NDCs as per Paris Agreement?

This study may also support the countries in achieving the United Nations Development Programme (UNDP) Sustainable Development Goal no. 7 (Ensure access to affordable, reliable, sustainable and modern energy for all), Goal no. 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) and Goal no. 13 (Take urgent action to combat climate change and its impacts).

Sustainable Distributed Generation Model: A case study of Tara Khola Hydropower Company Limited in Nepal

Subas Chandra Kunwar, Alternative Energy Promotion Center/Renewable Energy for Rural Livelihood Project

Hydropower is the mainstay of the Nepali energy sector contributing to over 96.2% of the total generating capacity (2,190 MW) of the country. Over 95% of the population in Nepal has access to electricity and the Government has set a target to provide electricity access to the entire population within the next 2 years. There has been a rapid expansion of the national grid in the recent past with only 2% of the population are being currently served through off-grid systems. Even with the fast expansion of the grid, a national study reveals that techno-economically, the permanent off-grid solution to electrification is the only option for around 100,000 households mostly in isolated pockets in geographically challenging remote areas of the country.

The Alternative Energy Promotion Center (AEPC), the nodal government agency for the development and promotion of renewable energy particularly in rural areas of Nepal, has been playing a crucial role in developing mini/micro hydropower and solar energy technologies to fulfil the energy needs of off-grid areas. More than 1600 micro hydropower projects (MHPs) have been installed in Nepal with support from AEPC. Various studies indicate that about a third of these have been shut down due to the encroachment of the national grid to the MHP catchment areas resulting in the wastage of nearly 100 million rupees worth of investment from stakeholders including the governments, development partners, private sector and the users. Similarly, with the national grid having been extended to within 5 km of another third of the installed MHPs, there is a high likelihood that these smaller systems will eventually be redundant. Flexibility and lower tariff rates of grid electricity (including free electricity up to 20 kWh per month for household use) mean that consumers, in most cases, are likely to be diverted to the national grid abandoning the power supplied by MHPs.

Against this backdrop, there is an urgent need to interconnect technically viable plants to the national grid for the sustained operation of these numerous isolated systems. Although there have been few examples of grid interconnection of smaller off-grid systems in the country, there are some major technical constraints to interconnecting MHPs to the grid including voltage dropouts, reliability of the national grid, lengthy (often cumbersome) bureaucratic process and high upfront costs of required safety equipment.

Most of the off-grid systems promoted by AEPC are community-owned and managed systems that have issues of collective actions resulting in operational and management challenges directly affecting the operational sustainability of plants. Although grid interconnection does assist in addressing redundancy, timely repair maintenance and smooth operation that are key to reap the benefits of the interconnection is still a huge challenge for these isolated systems. Since Nepal has adopted a federal system in 2015 and the Local Government Operations Act 2017 has given exclusive rights to own, manage, operate and regulate hydropower projects up to 1 MW to the local governments, it has been felt imperative that these local governments play a prominent role in operation and sustainability of these distributed generating systems. Hence, there is a notion that post-installation support services are provided by the local governments for the efficient operation and management of these plants. However, the capacity of these newly established local governments to provide necessary services is still a major challenge. The role of the private sector in these operations and management aspects in close coordination with the local governments seems to be the most feasible solution to these challenges for sustained operation. The beauty of enhanced engagement of the private sector is bringing in professionalism to the sector and ensuring quality services in return for financial gains on investment through maximum utilization of generated power. However, the economy of scale of these systems somehow restricts the greater participation of external private companies. Hence, the modality of hydropower development through a company model by engaging local entrepreneurs and investors seems more pragmatic. A few examples of this modality of project development in Nepal have shown encouraging results that could be replicated elsewhere in the country and beyond.

A very successful example of this is the 380 kW Tara Khola Mini Hydropower Project which has been developed under the local company model. The Tara Khola Hydropower Company Limited owns, operates, and manages the plant and has been providing quality electrical services to 1800 households and over 60 micro, medium, and small enterprises that have generated employment opportunities for more than 300 local men and women. The project was constructed at a total cost of around USD 1.4 million. Although the project was developed by mobilizing available government subsidies through AEPC and local community equity, it had a significant bank loan. In a country where banks and financial institutions are reluctant to invest in these kinds of off-grid energy systems, the project has been successful in paying off the loans in time. In addition, the project signed the Net Metering Agreement with Nepal Electricity Authority (NEA), the sole utility and grid owner in the country, in 2021 and has been continuously exporting electricity to the national grid from then on. The project is currently in a sound financial and operational position. The total annual income of the project in 2021 was USD 115,384 from both local electricity sales and sales to the national grid while the project's net profit for the same year stood at USD 64,661. This modality has been a win-win for all involved with the local communities getting quality electricity and also a good return on investment while the company is also prospering in its business and also looking to expand its services in nearby areas for electrical services.

Solar business in an oil-rich country? A socio-technical investigation of the PV niche in Iran

Leila Aghlimoghadam, Doctoral Candidate at TU-Berlin

This study focuses on solar PV businesses in Iran from a sociotechnical perspective. Solar businesspeople as niche market actors are one of the effective groups of stakeholders that have been minorly investigated in sustainability transition literature. Being part of the private sector (in a majorly state-owned economy) and promising economic efficiency, diversification, innovation, and growth, they have higher levels of trust in the public society. As one of the key stakeholder groups, they have the most contact with the public society and can affect social acceptance considerably, due to giving consultation, solar system design, selling equipment, installation, and offering maintenance.

This study tries to find answers to three main research questions: first, which factors drive solar businesspeople toward accepting this business, in an oil-based and none diversified economy in Iran? Second, which barriers are there ahead of these solar businesses in Iran? And third, which roles do solar businesspeople play in bringing solar PV deployment (development) forward?

With these questions (objectives), I conducted qualitative research based on 20 semi-structured interviews with local and regional solar businesses in 5 cities in Iran: Gorgan (Golestan Province), Tehran, Rasht (Guilan Province), Mashhad (Khorasan Razavi), and Tabriz (Eastern Azerbaijan). However, the solar PV market is still at a niche level in Iran, all interview partners had a regional work scope, i.e., they were not limited to their own city or province. In my interviews, I tried to cover diversity, as much as possible, I included both genders, years of experience in the solar business field, and levels and majors of education. The qualitative interview method enabled me to retrieve information about the interviewee's perceptions of opportunities, motivations and barriers when doing solar business in Iran. I could gain a reflexive assessment of how these factors contribute to the energy transition in an oil-based and state-owned economy. The interviews were guided by three main questions (formulated). I started my interviews with more general questions and narrowed them down to specific questions: Why did you establish this solar business, and what are your motivations to continue your activity in this field? Which obstacles have you faced or are still challenging with doing your business? Which groups of society are you in contact with and why? Regarding the nature of my research questions and to prevent bias in my analysis, I applied double check, and paraphrasing (sometimes in opposite) strategies to make sure, that the interviewees mention their own perceptions (of drivers and barriers and roles) and not their personal vision. I conducted the interviews in two main rounds. The first round was conducted face-to-face, in Iran during June-July 2021, though in the second round, I had to conduct online interviews (Sep. 2021-Feb. 2022). That was regarding the far distance (Germany, and Iran), the financial limitations of the study, and the COVID-19 Pandemic restrictions.

The interviews were conducted and transcribed in Persian (Farsi) but coded in English via ATLAS.ti (version 22.2.5.0) and analysed according to the requirements of the Grounded Theory Approach. Taking an inductive approach to the gathered data, I considered sustainability transition, social acceptance, and attitude theories as sensitising concepts in my mind to find common and specific issues in terms of solar business acceptance in Iran as an oil-rich country. The grounded theory approach was selected intentionally to emphasise developing analytical categories from the data inductively in Iran, considering its specific contextual factors, not only less developed in RE but also studied very scarcely in this field.

My results show that the solar businesspeople in Iran are mainly driven by a mixture of intrinsic and extrinsic factors. I find their ecological awareness and concerns, their belief in intergenerational justice, as well as their willingness to innovate as intrinsic drivers, while the socioeconomic opportunity grounded in the untapped solar energy market in Iran, and tackling the energy imbalances (electricity and gas outages from summer 2021) as extrinsic motives. On the other hand, the low knowledge of public society about solar PV (as a technology containing its co-benefits), the fluctuating prices (as a result of the domestic currency rate's frequent depreciation), challenging access to good quality solar equipment (limitations on import, and non-self-sufficiency of Iran in R&D) and lacking favourable policies and regulatory frameworks are the major obstacles. However, solar businesspeople do educate people, drive the innovative/adaptive deployment of solar PV systems, and facilitate the diffusion of solar PV via their extensive networking. Overall, my findings show that establishing a solar business is partially a pro-environmental behaviour of some people, with significant potentials and drivers, that can be a source of radical changes in case of either more power provision or real political will and vision. I discuss the pro-environmental behaviours in a fossil fuel-rich developing country, though the concept is grounded and mainly applied in Western (better developed) Countries. I address the low knowledge of society about solar energy, as a characteristic of developing countries and mainly rich with highly subsidised and easily accessible fossil-based energy resources. In addition, I emphasise the neglected role of government to apply strategies to educate people, which is being played by solar businesspeople. Discussing the barriers, I focus on non-supportive policy frameworks and absent observations on the implementation of RE policies. Moreover, I raise arguments on two frequent but significant issues, one on the solar energy niche market in Iran, and the second on the transition pathway in Iran. One is regarding the highly subsidised electricity, which CAN NOT be a barrier to developing solar PV deployment in Iran, regarding its power system standards (different from many countries including Germany for example). This false evaluation can result in applying not sufficient strategies by solar businesspeople. Second, the imminent possibility of a not sustainable transition to RE in Iran as a fossil-rich country, with more addition of RE on top of energy consumption, than a real transition from fossil to RE. This is implicitly hidden in tackling energy imbalances which is partially driving solar businesspeople in Iran and neglecting the increasing energy intensity and low energy efficiency.

Parellel Session | Citizens, community and bottom up initiatives: Smart use of energy infrastructure: from neighborhood to industrial park

Community energy – social innovation through distributed agency

Anna Rebmann, King's College London, Emma Folmer, University of Groningen.

The move to local energy systems, with renewable generation and distribution within a local area, can increase low carbon generation and storage. This can stimulate flexibility in supply and demand, optimising the use of these assets. However, this requires a reworking of the existing grid infrastructure and regulation support more local and flexible energy production and consumption. Diverse actors need to come together to bring about the transformation. Among the actors involved are national and local governments, network distributors, incumbent energy providers and local communities.

Our focus is on the role that community energy groups can play in the transformation of the electricity grid through participation in local energy and collective self-consumption schemes. Community energy groups are "social enterprises in the renewable energy sector conceptualised as collectively owned organisations that combine the production of energy from renewable sources with other ecological or social goals, and embody a specific quest for civic participation." (Becker et al. 2017). Community energy is associated with increased participation leading to a more democratic energy sector and more empowered consumers (Burke and Stephens 2018). This builds on previous research on ways local ownership of energy assets produces local economic benefits, as well as social impacts beyond energy usage (Walker and Devine-Wright 2008; Walker et al. 2007; Seyfang, et al. 2013). However, mutually beneficial relationships between local energy infrastructure and social outcomes are not technologically determined. They must be created.

The social entrepreneurship literature has emphasised that socially motivated businesses usually require the involvement of a broad range of stakeholders in enabling social innovation (Vallaster et al, 2021; Stephan, Andries & Daou, 2019; York, O'Neil & Sarasvathy, 2016). A key reason for this is distributed agency. Distributed agency is 'where the required skills and resources are distributed over multiple actors to bring an idea from inception to commercialisation' (Garud & Karnoe, 2003).

Consider, for example, the technological know-how that is needed to determine the type of battery and the infrastructure to store energy locally before supplying it to the (national) grid. This type of technological knowledge needs to be paired with organisational and managerial capabilities if an innovation is to be organised and implemented by a local community. A third layer of knowledge consists of awareness of regulatory demands and financial support schemes that can facilitate such a technological solution. Furthermore, knowledge- and resource needs may be continuously evolving and stakeholders shift from core to periphery and vice versa as innovation projects develop.

From previous research in we know that distributed agency leads to the involvement of multiple stakeholders in the development of new technologies (Garud & Karnoe, 2003) and social enterprise opportunities (Corner & Ho, 2010; Akemu et al. 2016). Yet, while the existence of distributed agency has been acknowledged in previous research, we know very little about how it influences innovation processes. Therefore, we ask the following question: How does distributed agency influence the process of innovation in community energy projects? We explore the different stakeholders involved in the innovation and what role each stakeholder plays. Furthermore, we identify how community energy groups navigate distributed agency.

Method & data

We use data from 8 community energy groups in the UK and the Netherlands. We use a multiple case study approach as this research is exploratory and aims to build theory. Our selection of cases allows us to study the process of developing social innovations within the same opportunity space but across different applications of technologies, with different stakeholders and different regulatory systems.

We take a process approach, tracing the development of a social innovation in each of the community energy groups from emergence or the “spark” (Corner and Ho, 2010) which brings an innovation to some form of implementation. Our primary source of data is from interviews with key individuals, both entrepreneurs and other important stakeholders, involved in developing the community energy innovation projects. Interviews were carried out between June and December 2021. We also make extensive use of secondary data such as (annual) reports, news articles and press releases, and selected internal reports.

Findings

The preliminary findings of this study indicate that distributed agency leads community energy groups to display considerable breadth in the type of stakeholders they involve in the innovation process. These include the SE's beneficiaries, governmental agencies, local authorities, tech companies, and other social enterprises which may play different roles in different contexts. Municipal government is a common stakeholder because they can provide physical assets on which to install solar PV and through this often provide access to beneficiaries. Government bodies are often important financial stakeholders, providing grants to enable the innovations. We see that where technology is untested or lacks a business model, our CEGs look for grant funding as they don't want to risk community raised finance on risky business ideas. Technology providers are also common stakeholders. They are partners in innovating but where the technology has become more standardised they are implementation partners.

From our preliminary analysis, we have observed that the complexity of the involvement of multiple stakeholders results in a need to simplify their involvement in the studied community energy projects. The community energy groups use distinct approaches to simplification as coping strategies; for example one community energy group uses representation – an approach whereby one type of stakeholder (users) are represented by another stakeholder. A second SE uses an approach we call compartmentalisation where engagement with different stakeholders is divided among different members of the community energy group. These different approaches of managing stakeholder involvement have implications for how opportunity development processes unfold.

Implications Our research has important implications for community energy groups that are developing innovative approaches to community-led renewable energy, energy demand reductions and energy supply. Our findings can help shape their strategies towards managing a wide variety of stakeholders and ensure a productive use of distributed agency.

Energy communities in control of a fair and affordable system: local generation for local use

Esther C. van der Waal Grunneger Power

Energy sharing and flexibility services are increasingly important for energy communities. Through flexibility solutions communities can increase self-consumption and decrease their dependence on energy market players and prices. Furthermore, more local use of energy alleviates the pressure on the electricity grid. Grunneger power is part of two research projects looking into the benefits of increasing local use of renewable energy from cooperatively owned sources. We would like to present both projects and initial research findings.

The first project is called Local4local. As the name implies, the central question is how local energy generation can be consumed as much as possible by the local energy community itself. Affordability is a driving factor here. With the high energy prices, cooperatives ask themselves the question how they can make energy more affordable to their members. Especially, because the cost price of renewable energy is currently below the market price for electricity. This is the case because the market price of electricity is still partly reliant on the price of fossil fuels that power regular energy plants. Therefore, it would be beneficial to cooperatives if they can sell the electricity produced by their assets directly to their members. To enable this, frontrunning cooperatives and cooperative energy suppliers collectively research the opportunities for a cost price plus model. A cost price plus (CP+) model means supplying energy for the cost price plus a small fee for risk management and service provision.

The first aim of the project is to create a model for calculating the CP+.The cost price of renewable electricity is dependent on the type of generation technology, and is determined by capital costs, cost of operations and maintenance, and market matching costs. Here capital costs are one-time expenditures on the construction, enhancement, or acquisition of assets such as equipment and land that will benefit the project for more than one financial year. This is the investment necessary to move the project from a concept to commercialization, and is typically expressed in a cost per kW. The cost of operations and maintenance also includes decommissioning at the end of the lifetime of the generation technology. Lastly, market matching costs are the costs associated with matching the demand profile of the market.

For renewable energy, this could include the cost of storage options to better match the market's demand profile or the loss of profit due to curtailment.

Besides supplying close to the cost price, the second aim of the research is to develop tools that support energy communities in making investment choices to bring the cost price down. The cost price of electricity can be brought down by reducing transportation and grid connection costs per kWh. For instance, by cable pooling technologies with different temporal production patterns.

The third goal of the project is to help energy community members to make optimal use of local energy available at CP+. To facilitate matching their demand to available production, members of an energy community have a dynamic pricing contract with their supplier. They are encouraged to use electricity when it is available from their local sources. To minimize the impact on the grid, the local4local model aims at minimal electricity transport. To facilitate this, the members of the energy community ensure that the electricity produced is directly purchased, stored or converted locally.

The technologies for supplying at cost price + are already existing. In Local4local, we research how we can make these solutions available to energy communities, and how energy communities need to organize themselves and amongst themselves to couple local supply and local use.

The second project we want to introduce you to is called COMMUNITAS. COMMUNITAS is a Horizon EU consortium project inspired by the new opportunities for community energy in the Clean Energy for All Europeans package (CEP). The CEP formally recognizes energy communities as key players in the energy transition, and includes enabling legislation for "Renewable Energy Communities" (REC) and "Citizen Energy Communities" (CEC).After being transposed in national law, these concepts can help to set out a course for a more active role of EU citizens in energy markets.

Yet, to fully concretize the benefits envisioned by the CEP, a myriad of barriers needs to be overcome and progress needs to be made to clarify and streamline the concepts of REC and CEC, enabling their uptake by all interested citizens. Motivated by that challenge, COMMUNITAS will promote energy citizenship, enabling citizens to take control of their own path towards sustainability by becoming an active element of energy markets.

The project will deliver a Knowledge Base that will provide users with technical, administrative, and legal information on ECs, streamlining the creation and expansion of this concept. COMMUNITAS will also deliver an innovative set of tools - capitalizing on technologies such as IoT, Blockchain and Cloud Computing - to unlock citizens' active participation in energy markets and communities. All tools will be integrated into an open, digital "one-stop-shop" COMMUNITAS Core Platform, allowing EC members to have an aggregated position on the energy markets or explore ancillary services using different energy assets or load profiles of the community.

As a project that aims to position citizens in the centre of energy markets, COMMUNITAS has citizens at the centre of its own approach: citizens will be involved in Social and Policy Labs throughout the whole project, in order to frequently factor in their feedback, wishes, and needs into the core developments of the project.

Grunneger Power provides a leader pilot for COMMUNITAS. Our pilot will be focused on district heating, and covers two district heating networks (DHNs). One of the DHNs is the Buurtwarmte area in the city of Groningen, and the second is the DHN in Loppersum. The main socio-organizational challenge we research is creating a layered structure for control of members/clients of a publicly or cooperatively owned district heating system. The two main techno-economical challenges are designing an energy system to economically power a neighborhood heat pump (pilot area Loppersum) and providing peak supply (pilot area Buurtwarmte).

Grid governance; what new roles for the community energy movement?

Tineke van der Schoor, Hanze University of Applied Sciences

In the Netherlands, local energy cooperatives are increasingly active in the production of renewable energy. The Local Energy Monitor 2020 (Schwencke 2021) counted 623 local energy cooperatives in the Netherlands, which are spread over all provinces, all regions and 85% of municipalities.

In the past years, energy communities and prosumers also have received growing recognition on the EU-level, as is demonstrated in the Clean Energy Package (Lavrijssen 2017; Verde and Rossetto 2021). Some authors take this as the future governance model for a renewable energy system (Lowitzsch, Hoicka, and van Tulder 2020).

Many cooperatives have concrete plans to invest in energy projects, such as solar fields and wind turbines. Unfortunately, because of growing problems of net congestion in the Netherlands, room for such projects is increasingly limited. In their quest to help solve this predicament, energy cooperatives are developing new and innovative energy services, for example delivering grid services to distribution system operators (DSOs). However, there are numerous legal, technical as well as economic obstacles for such innovative energy services (Royal Haskoning DHV 2021).

In the present energy system, the grid operators (DSOs) play a significant role. As Galeano Galvan et al. (2020) remark, they have a position from which they can influence the energy transition. However, as DSOs are traditional, centralized organizations, which are not used to communication with new entrants in the energy system, it is often difficult for RECs to engage with DSOs (Van der Waal, Das, and Van Der Schoor 2020).

What is missing in the literature so far is attention to the more developed energy communities that we see nowadays, which go much further than organizing individual prosumers. These RECs often own energy production units, such as solar parks or windmills. Furthermore, they often engage in experiments such as smart grids (Summeren et al. 2020; Kloppenburg, Smale, and Verkade 2019).

In fact, a whole landscape of different organisational constellations has emerged, where local cooperatives join forces with municipalities, housing associations, project developers, owners' associations, water boards, and others.

The variety of activities employed by these community energy organisations has also broadened considerably. Drawing on Social Movement Theory, we argue that these activities indicate that energy communities engage in 'prefigurative' activities; they create in their own environment the decentralized and democratic energy system that they strive for (Van Der Schoor et al. 2016). Such prefigurative practices are different from 'activist practices' in the climate movement because they take place as part of an envisaged new energy system. New organizational forms emerge, in which RECs cooperate with other societal partners to be able to develop large projects for wind and sun power. Inspired by the models of Parag & Sovacool (2016), we aim to identify sociotechnical modules for a system design that accounts for these expanded roles and new situations.

Empirically, our contribution draws on a current research project on innovative community energy services in the Netherlands. The aim of this project is to investigate new roles for cooperatives in delivering innovative energy services to their clients, such as demand response, cooperative aggregator, or peer-to-peer energy delivery. Furthermore, we ask if and in what way the provision of balance services might be feasible and profitable for RECs. For these roles, we enquire what technical knowledge is needed, what the best scale and level is for such activities, and which business models are available.

In our view, community energy collectives are not restricted to representing prosumers which have an individual relation to the energy system. The community energy movement has evolved in such a way that RECs can provide services to all types of consumers, regardless of individual ownership of energy production units. Community energy cooperatives increasingly own and manage energy assets, such as solar roofs, solar parks, windmills. Furthermore, we see that RECs operate as a social enterprise. To guarantee continuity as an enterprise it is important to develop profitable business models and to engage paid employees in addition to volunteers.

We identified new types of actor constellations managed by RECs. These constellations can be interpreted as elements of a decentralised energy system with variable energy clusters, managed by RECs. In particular, we investigate combination of a solar park with energy storage, supply management of cooperative assets, developing the role of aggregator, demand management and balance services.

The emerging new energy services show that the community energy movement has come a long way from the early days of organising individual prosumer actions. The setup of collective production facilities has already become rather common. Energy communities now aim to take up roles in the full energy chain: as energy producer, distributor, energy trader and prosumer.

However, developing and managing these new functions takes a heavy toll in the form of knowledge acquisition, negotiation skills, organisation strength, and finally the capacity to take financial risks. The community energy movement is therefore considering new organisation and business models to be able to take up these challenges.

Expanding to more segments of the energy system could lead to more profitable economic activities, that ensures continuity for the social enterprise of RECs. To that end, RECs need to scale up; for knowledge and time intensive jobs such as energy trade and management of energy facilities it is deemed essential to include a larger volume of energy assets. These activities bring substantial financial risks with them, so the economic buffer should be relative to that.

Energy platforms and the future of energy citizenship

Sanneke Kloppenburg, Wageningen University; Marten Boekelo, Duneworks

A recent development in the decentralisation and digitalization of the energy system is the emergence of energy platforms. Energy platforms can be defined as digital infrastructure that connect small-scale energy producers and consumers and facilitate transactions between them (Kloppenburg & Boekelo, 2019). By linking domestic devices such as solar panels and home batteries of different households, these digital infrastructures create a common pool of energy that can be managed for purposes such as energy sharing, trading or providing grid balancing services. For householders, joining an energy platform opens up possibilities to participate in the energy system and its governance in new ways. Together, as a virtual energy collective, they can optimise self-consumption of green energy, or participate in energy and demand response markets.

In this article, we understand the energy platform as an energy technology that brings the energy system closer to people's everyday lives, and could provide them with new possibilities to exercise energy citizenship. To conceptualise this, we draw on approaches in the energy social sciences that highlight how energy technologies that are located in or close to people's homes enable participation and engagement in the energy transition (Marres, 2016; Ryghaug et al., 2018). This understanding of citizenship, which emphasizes its everyday and physical dimensions, is different from more conventional conceptualizations of citizenship as political activism, citizen consultation, or involvement in grassroots initiatives (Chilvers & Longhurst, 2016). We adopt this perspective, the so-called theory of material participation (Marres, 2016), because it is particularly suitable for understanding people's participation in what has been called 'the next phase of the energy transition', in which we witness complex interactions of multiple technologies and sectors (Markard, 2018; Turnheim et al., 2018).

In distinction to older forms of smart energy, platforms add a collective logic to the engagements with energy. Platforms bundle domestic energy practices, in the sense that people's practices of producing, storing, and consuming energy in their household are orchestrated in tandem with those of occupants of other households, thus creating (a kind of) collective agency. But the connection of distributed individual households through a digital infrastructure can be accomplished to various ends: as part of an energy community that wants to maximize its PV self-consumption, or as a customer in an energy trading collective. Given these new twin dimensions, we ask the following overarching research question: how does participation in energy platforms affect practices and experiences of mundane energy citizenship? In order to address this question, we build on our research in a demonstration project of a "Virtual Power Plant" (VPP) in Amsterdam. We surveyed and interviewed participants, coordinated and collaborated with project leaders and organized workshops with its stakeholders.

We find that the relationship between interaction with distributed energy infrastructure and engagement with and support for the transition is not necessarily always positive. Participation in an energy platform can trigger householders to reflect on what energy is and how their self-generated energy can be used to support the energy transition. At the same time, there is something peculiar with the latest generation collective demand response energy systems – a peculiarity which derives from the fact that at the same time as (management of) the energy grid is drawn into the household, the household is decentered in a collective arrangement. This is not necessarily a problem per se, but in our case people with experience with rooftop PV wanted to expand their sense of citizenship through engagement with the energy platform. This new system, however, disrupted pre-existing interactions and feedback mechanisms which cemented people's sense of their role in and contribution to the energy transition, without replacing it with an adequate mechanism in return.

To understand energy citizenship in a digitalising grid, we argue for further empirical studies that examine how people interact with these technologies, and how they handle the complexities of technologically mediated and automated collective actions. Such an everyday life perspective seeks to understand how people deal with distributed agency and responsibilities, when they feel frustrated or empowered, and how seek to regain a sense of control. It also recognises the new complexities digitalisation raises for people's efforts to be green or socially responsible, as well as the enthusiasm and confusion that arises from engaging in technologically-mediated collective action.

Our empirical findings suggest that it is important to understand people's participation in energy issues as part of a trajectory they are on. The "energy citizen" is by no means fixed, but develops in a particular context and through everyday interactions with technologies. 'Acceptance' of energy technology and 'public engagement' in transitions is therefore also not a one-time thing. Not only does the technology keep evolving (and thus remains in periodic need of re-evaluation), but people accrue more experience and information over time through their interactions with technologies, according to which they also evolve their position. For policymakers and project managers, this means that they have to think about how to create meaningful engagement over longer periods of time, to create the conditions of possibility for people to develop their viewpoint on new energy measures and the introduction of new technologies. Another important lesson we draw from their experience: when the scale at which people are enlisted to act goes beyond the household, there need to be feedback mechanisms that show the effects of their energy practices.

As long as these mechanisms are absent, there is a risk that new energy technologies frustrate rather than promote people's engagement with and support for the energy transition. From that frustration, disengagement rather than engagement, may well follow. Platform developers will need to design explicitly for people to know that they are doing 'their bit'.

Parallel Session | Just energy transition, governance and policy: EU law and governance

The evolution of the EU legal framework for promoting RES-E: a market compatible paradigm shift?

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EU energy law has long been challenged with reconciling respective instruments for achieving decarbonization and liberalization. In terms of promoting renewable electricity (RES-E), this trade-off appears particularly pronounced given that promotional mechanisms may contradict EU law on the internal electricity market. Alongside support schemes applied by Member States, EU law also puts in place promotion measures to remove economic and non-economic barriers to the deployment of RES-E.

The debate on EU top-down steering to align national support schemes for RES-E with the internal electricity market has been intense (Boasson, 2019; Iliopoulos, 2021; Strunz et al., 2021; Tews, 2015; Veum and Bauknecht, 2019). However, the role of Union-level promotional mechanisms in prompting a regime shift towards market compatibility has not received the attention it deserves. Addressing this research gap, this paper focuses the analytical lens on the evolution of the supranational legal framework for promoting RES-E to examine how it keeps evolving to add coherence to EU energy law. It also sheds light on the general trends in the evolution of EU law on promotion of RES-E, the lessons learned and the remaining challenges.

The time scope of the legislation analyzed goes as far as 1996 and ends in the Clean Energy Package (CEP), during which Union legislation on RES-E has gone in parallel with the ongoing liberalization of the EU's electricity market. To allow for a greater level of detail, the legal documents reviewed in this research are limited to two groups of EU law. One is the EU legislation setting out specific promotional mechanisms for RES-E. The promotional mechanisms referred to in this context are defined as 'those primarily aimed at addressing economic and non-economic barriers specific to RES-E'. Three Directives promoting renewables in the past decades as well as the Renewables Financing Mechanism Regulation are therefore the major focus (Renewables Financing Mechanism Regulation, 2020). Indeed, EU regulations dedicated to fulfilling other goals, ranging from cohesion to financing of SMEs, also offer various forms of support to RES-E (e.g. JTF Regulation, 2021; Union Funds Regulation, 2021; 2013 ESIF Regulation, 2013). However, they are not the focus of the analysis at hand because they do not aim at creating specific promotional mechanisms for RES-E but touch upon support for renewables merely for realizing those broad aims. The other group is the Union legislation laying down objectives and principles of the internal electricity market, contained in the EU's four energy packages.

The evolutionary phases of EU law promoting RES-E could be divided into three stages. The 1996-2008 period coincides with the enactment of the first and second Energy Packages, witnessing the early steps of reducing barriers to the deployment of RES-E. From 2009 to 2017, apart from preserving measures for mitigating regulatory barriers, EU law stepped up support to RES-E investment, network access and dispatch. The third and most recent stage is heralded with the adoption of the CEP, which represents a fundamental shift towards promoting RES-E in a market conform way.

Our retrospective analysis demonstrates that the three evolutionary stages vary in the degree of reconciling with electricity market legislation and the legal approaches to pursuing consistency. This is reflected in the changing way of combining market-conform measures and out-of-market measures in the EU's regulatory toolbox. The former embrace (i) measures aimed at removing unjustified non-economic barriers for RES-E, (ii) market-conform investment support, and (iii) market-based mechanisms prompting RES-E producers to seek market revenues. The latter refer to special advantages for RES-E, such as mandating priority dispatch and priority access. Our findings indicate that the relative weighting of such two streams of promotional mechanisms keeps changing over time along with the growing penetration level of RES-E. In parallel with the increasing role of market-conform promotion measures, the role of out-of-market support has been progressively marginalized. These findings lead to a conclusion that, overall, RES-E promotional mechanisms at Union level have been heading in a market-compatible direction.

Drawing on the EU case study, there are several lessons worth highlighting in the following. First, while significant, pursuing market compatibility of renewables promotion schemes does not mean that respecting electricity market principles is absolute. Instead, it means striking a feasible balance and compromise in the linkages between effectively promoting RES-E and preventing competitive electricity markets from undue detriment. In other words, market conformity should be delivered in a way that neither the legal objective of liberalization nor that of decarbonization will be unduly compromised. This highlights particular attention to the timing at which market-based instruments are introduced and the proper combination of market-compatible mechanisms and out-of-market support as well as adjusting their respective weighting over time. The two respects serve as key solutions to the dilemma between the continued evolution of competitive electricity markets and increasingly ambitious low-carbon energy transition goals. Our analysis demonstrates that the timing of making such adjustments could be determined based on the improved market functioning, the widening impact on competitive markets made by increasing shares of RES-E, and the emergence of grid parity of certain renewable electricity based on mature technologies. The comparison of the Third Energy Package and the CEP particularly indicates that when foreseeing these conditions, the measures for prompting RES-E producers to seek market revenues should be introduced.

To ensure investment certainty for small producers, novel technologies and new entities such as prosumers, market-compatible public funds and clearly defined out-of-market support could serve as supplementary tools.

Moreover, we also point to regulatory gaps relating to reforming market structures, which limit the potential to promote market integration of renewables prosumers. While the CEP introduced several ways of selling self-generated electricity, the centrally organized electricity market remains the dominant market architecture. This could not adequately mirror and suit the tendency of decentralized renewables generation, which is playing a key role to power the RES-E rise of the EU (Hvelplund, 2006; Parag and Sovacool, 2016; Rosen and Madlener, 2016). A solution for creating a tailor-made market model for sufficiently incentivizing renewables distributed generation may lie in the (partial) shift towards decentralized or local markets (Agostini et al., 2021; Askeland et al., 2021; EC, 2016; Hoggett, 2017; Rosen and Madlener, 2016).

Finding a needle in a haystack? Identifying degrowth-compatible provisions in EU energy law

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EU policy related to energy is explicitly guided by a green growth rationale. Such rationale consists in securing a growing economy in GDP terms while protecting natural assets and resources. To do so, the idea of green growth contends that it is possible to decouple resource use and GHG emissions from economic growth. However, evidence is mounting in academic literature against the argument that green growth would allow to limit the global temperature increase to 1.5°C or even 2°C. In a nutshell, it is much more difficult to decarbonise the economy by shifting its energy matrix to renewable (or at least decarbonised) energy sources if energy consumption is constantly rising or even stagnating. Yet, another pathway is possible: degrowth. This theory proposes to consume less materials and less energy through a voluntary, equitable and democratically-led process in order to remain within planetary boundaries. Indeed, technological fixes will not solve the situation and energy efficiency improvements are not sufficient, especially due to the rebound effect.

RQ: As it translates policies into provisions, EU energy law also openly favours the green growth paradigm. Yet, it is relevant to look for the existing and forthcoming provisions that are already compatible with a degrowth pathway.

In other words, this research aims to identify legal islands of degrowth within an ocean of green growth. The corresponding research question is the following: Are there degrowth-compatible provisions within a selection of EU energy law texts covering the electricity chain?

Method: This research uses a classic doctrinal research method. In detail, it consisted in identifying the relevant existing and forthcoming legal texts at EU level and to assess their components (the language used but also the underlying logic of the provisions, e.g. those reinforcing the liberalised market vs those creating alternatives). When needed, the analysis was also extended to preparatory or explanatory documents tied to the legal texts (e.g. the impact assessment of a former piece of legislation or Commission Staff Working Documents). The criteria for this assessment were determined following a literature review centred mainly on the theoretical framework of degrowth. This research proposes an interdisciplinary approach to legal studies, given that degrowth is mostly emerging in ecological economics academic literature and is barely integrated into legal debates. In addition, energy justice and the just transition are also part of this article's theoretical framework, as they are considered by the author as the necessary finality of EU energy law but they need a degrowth pathway in order to come to fruition.

Results and conclusion: This research unpacked some key pieces of EU energy law, covering the energy chain with a focus on electricity, RESs and energy efficiency. It analysed both existing EU energy law but also the forthcoming regime, as discussed by EU institutions within the Fit for 55 and REPowerEU packages. The results of this analysis show that despite the focus of EU energy law on green growth, there is already a number of provisions that are open to be interpreted with a degrowth lens.

Among the degrowth-compatible provisions are mechanisms such as targets (as a percentage of RESs in total energy consumption or of energy efficiency improvement) or hard caps on energy consumption (as in the existing and forthcoming EE-Directive). These targets and caps need to be toughened to reach the 2050 net zero target in spite of the rebound effect, for instance, but there is no need to replace these mechanisms with others. The existing 2018 RES-Directive and 2019 E-Directive both count new actors that are very much degrowth-compatible: energy communities (CECs and RECs).

However, these remain niche actors. In addition, forthcoming EU energy law reinforces district heating, cooling and domestic hot water consumers' protection, especially vulnerable ones, and places obligations to undertake energy efficiency improvements for vulnerable consumers and in social housing as a priority. Such measures are deeply in line with a degrowth paradigm and contribute to a general improvement in terms of energy justice. Finally, the proposed provisions to make the energy efficiency first principle a reality are a great step forward, yet complementing this principle with or even placing it under an energy sufficiency first principle would be more consistent with a degrowth rationale.

Introducing the concept of hidden morality in energy justice

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Energy transitions have a significant impact on societies and nature, as they often disrupt the landscape, affect the environment, influence behaviour, bring about safety concerns, and exacerbate inequalities. As a consequence, people often experience "negative emotional reactions, such as ashamed or enraged, feeling hurt or indignant" (Honneth, 1995b, p. 136). Subsequently, people express moral concerns, which can be understood as concerns about justice. As such, sociotechnical energy systems are prone to spark social resistance and energy conflicts (Pesch et al., 2017).

In 2013, the challenge was formulated to "address justice-based concerns within energy systems" (McCauley et al., 2013). Addressing people's justice concerns is important, because perceptions of injustice are important indicators for detecting unjust consequences of sociotechnical energy systems (Roeser, 2017). In other words, stakeholders might perceive injustices, and detecting and mitigating those paves the way toward more just energy systems.

Concerns of injustice surface through both institutional and non-institutional participation procedures. A first way to uncover what the publics perceive as unjust is via institutionalised forms of participation, such as voting, being a member of a party, and official meetings or participation events (Hooghe & Marien, 2013). In such participatory settings, the publics have the opportunity voice their values and concerns, in other words, their perceptions of injustice. Another method for uncovering what people perceive as unjust is by studying energy conflicts. Resistance, protests and controversies can be seen as pro-active, self-initiated, or non-institutionalised participation (Jenkins et al., 2020).

Here, it is assumed that injustices inspire citizens to resist energy policies or projects by means of activism (e.g., Cuppen et al., 2015, 2020; Pesch et al., 2017). Studying the roots of energy conflicts leads to detecting perceived energy injustices that can inform decision-making towards a more just energy system.

So, current methods for detecting what the publics perceive as (un)just rely on explicit articulations of beliefs by citizens in official participatory settings or during energy conflicts. However, it is implausible that all injustices manifest within these contexts. For example, many municipalities in the Netherlands struggle to organise inclusive participation trajectories that involve a truly diverse publics. Moreover, not all citizens easily engage in public resistance. As a result, it is plausible to state that not all energy injustices are detected, understood and mitigated. To make energy systems more just, it is important to explore which mechanisms prevent injustices from surfacing.

This study introduces a concept that is helpful to understand why injustices might remain unseen and unaddressed, namely the problem of hidden morality (Honneth, 1995a). The term was coined by the philosopher Axel Honneth who theorises that there are several steps between the occurrence of injustices and social change, namely: (1) injustices are experienced as “negative emotional reactions” (Honneth, 1995b, p. 136); (2) injustices are expressed as claims of injustice; (3) people collectively organise themselves and engage in collective action; (4) claims are taken up in the public discourse; (5) claims are reformulated positively; and (6) actual social change. Between each of these steps, different obstacles can arise that prevent an injustice from going “up the ladder”. This paper explores possible obstacles between each step, in other words, the mechanisms that prevent energy injustices from surfacing. To do so, inspiration is drawn from his analysis and from other philosophical and empirical studies on justice and social change. Moreover, two qualitative case studies illustrate how such obstacles manifest in energy contexts, namely the heat transition in Moerwijk, The Hague, and the conflict about compensation for gas storage in Grijpskerk and Norg in the North of the Netherlands.

This article introduces the problem of hidden morality as a promising avenue for future research on detecting and understanding energy injustices. Its contribution is twofold: (1) It rises awareness of the fact that injustices can remain undetected, and (2) It proposes a conceptual framework that allows for distinguishing mechanisms that prevent injustices from surfacing.

This framework acts as a starting point in understanding why injustices sometimes remain hidden. The problem of hidden morality prescribes methodological innovation and interdisciplinary research, as uncovering the different barriers between different steps requires multiple research methods from diverse academic disciplines. In sum, understanding which and why injustices remain hidden is the first step towards making energy transitions more just.

Economic, Environmental, and/or Social Benefits of Renewable Energy Communities: not just a matter of conjunctions

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The EU Directives 2018/2001 has introduced Renewable Energy Communities to facilitate the decentralised generation and supply of renewable energy. Under the Directive, the primary purpose of these communities is, rather than to generate financial profits, to create environmental, economic or social benefits for community members or for the local areas where the community operates.

The purpose of this paper is to analyse in a few Member States the implementation of the definition of REC and assess its compliance with the Directive.

The motivation behind this paper is that the Directive, in the description of the benefits that a REC has to generate, uses the copulative conjunction “or” meaning that, to be recognised as a REC, an energy community could generate social benefits but this is not compulsory since the Directive does not say “and”. A preliminary desk review uncovers a significant diversity of approaches to this part of the definition in the Member States. While some essentially copy-pasted this part of the definition (Italy: Art. 31 Legislative Decree n. 199/2021; Netherlands: 2021 Energy Law bill), others do not require any benefits beyond the generation of renewable energy (Germany: § 3 EEG 2023), and yet others only refer to the benefits of the members but not of the surrounding community (Poland).

This finding poses the question how these approaches relate to the goal of the Directive and its character as minimum harmonisation directive. On the one hand, the goal of the Directive is to facilitate the activities and market integration of energy communities, suggesting that Member States may set more lenient but not stricter requirements regarding the benefits of these communities.

On the other hand, as a review of the academic debate on the various potential benefits of energy communities shows, their benefits beyond the generation of renewable energy are essential to the justification of the special protection given by the law of energy communities.

What we examine is, first, how the Member States have transposed the RED II into domestic law. Subsequently, we explore how this choice has produced, if any, effects in the practice of renewable energy communities. Specifically, the paper investigates whether, if a Member State has not imposed the requirement of social benefits for the recognition as renewable energy community, energy communities still aim to produce such social benefits. Finally, the paper investigates whether the domestic transpositions comply the RED II and, specifically, the extent to which this minimum harmonisation directive limits possible transpositions with regard to the production of social benefits.

In order to answer these questions, we will conduct a review of the transposition laws of a number of Member States as well as an analysis of the literature concerning minimum harmonization contrasted with the consideration of social impact in the RECs that are being established in the different EU countries.

Parallel Session | Integrated urban and regional planning: Positive Energy Districts

Understanding the Urban-Energy Transition Through Positive Energy Districts

Lasse Schytt Nørgaard, Aalborg University (PhD-fellow)

The aim of this presentation is to provide an initial conceptualization of Positive Energy Districts (hereafter PEDs) as socio-technical, transdisciplinary support for a just energy transition in urban settings. Building on an understanding of PEDs as an inherently interdisciplinary concept means working with the mobilization of citizens and stakeholders, which in turn implies the consideration of technical aspects of energy balance and energy flexibility and the economic as pects related to renewable energy production in times of energy crisis. In the European context, PEDs have been defined by JPI Urban Europe policies as one of the transition pathways (PED) to more sustainable cities and communities with the aim ‘to optimize the local energy system through energy efficiency, flexibility, and local energy generation from renewables in actions towards the (urban) en ergy transition and climate-neutrality and mainstreaming these actions in urban planning processes.

From this definition, the urban-energy transition opens a new research agenda; bridging two fields that traditionally have been disciplinarily divided, energy studies and urban scholarship both have diverse roots in planning. It is therefore urgent to explore the ways for bridging urban planning and energy planning to establish a common-ground ontology. Employing this ontology should allow PEDs to become a vessel for urban-energy transition through citizen and stakeholder engagement, by changing the roles of consumers, and by creating new connections between diverse geographic scales and local governance. The broader research that surrounds this presentation seeks to address the following questions “How can Positive Energy Districts be conceptualized from a socio-technical standpoint, what is the urban dimension and societal purpose of their implementation, and how can we establish a common ontology for engaging with PEDs in an interdisciplinary practice?”

The premise of this research is that the increasing risks presented by climate change are forcing a shift in the role of cities and urban planning. The energy crisis has also constituted an important twist in the interest and attention on the energy sector and the required societal transition to integrate into urban planning. Municipalities are therefore primarily engaged to encompass a broader scope than previously that is bringing closer energy management within urban transformations. The urban-energy transition is becoming an increasingly evident need that cities must address to secure a more sustainable future. The United Nations Sustainable Development Goals (SDGs) are a major talking point on the international agenda, both in terms of sustainable cities and communities (SDG 11), but also responsible consumption and production (SDG 12). To achieve a just and sustainable transition urban planning must engage with energy systems; exploring the intersection between the two fields of knowledge and associated expertise is adamant to enhance future planning work.

The concept of Positive Energy Districts (PEDs) shows exactly this potential. In relation to the SDGs, PEDs primarily address SDG 7 (Affordable and clean energy) but also provide ample opportunity to address more specifically SDG 11 (Sustainable cities and communities), SDG 12 (Responsible consumption and production), and SDG 17 (Partnerships for the goals). This is exemplified in the EU-backed program “Positive Energy Districts and Neighbourhoods for Sustain able Urban Development” from 2018 within the framework of the Strategic Energy Technology (SET) Plan Action 3.2 “Smart Cities and Communities” in which they define PEDs as an integral part of sustainable urban development.

According to Krangsås et. al (2021) future research on PEDs must aim to establish cross-cutting frameworks that enable interdisciplinary work in urban, energy, and environmental planning. The theoretical foundation of PEDs is, therefore, transdisciplinary – meaning it must engage with more than a purely technical issue to produce a positive energy balance in a demarcated area – but also includes the socio-technical transformation of cities (and the concept of ‘positive’ itself becomes a goal for urban development rather than solely as an accumulation of energy capacity). PEDs provide a unique opportunity to unfold comprehensive and deeply integrated planning practices with the potential to support both a sustainable energy transition and sustainable urban development.

This conceptualization has its root in the proposed approaches and different perspectives on how to address the potential of PEDs in existing energy planning methodologies. The gap identified in the literature is the lack of a theoretical synthesis that brings urban and energy studies together in the framing of the PEDs. The aim of this presentation is to create a frame of reference to develop future research among these two fields. The focus point will be a consideration of social justice as a meeting point between energy and urban planning and to understand the urban-energy transition from a multitude of perspectives, much in the same vein as Sovacool et al. (2021) do in their meta-theoretical framework. PEDs, therefore, offer the opportunity to move beyond technocratic approaches to energy-efficient assessments that often do not engage with existing urban problems. On the opposite end, urban problems are wicked problems that are intrinsically complex and difficult to address in a holistic manner.

PEDs can therefore offer a specific perspective of utilizing energy processes to address urban problems in specific areas and neighborhoods to pave the way for a more sustainable future. The potential of PEDs is to uncover at the same time the material aspect of energy consumption and urban aspects of social inclusion and social justice. Casamassima et al. (2022) for example point to PEDs as ‘a set of buildings where the community controls the energy flows and aims at a net positive energy balance over a year by utilizing renewable energy sources.’ Integrating a socio-technical perspective can seem a daunting task, but with the application of a framework that stresses the necessity of its inclusion and overall importance, it seems not only feasible but as the only possible way to proceed, to ensure that cities remain places for people and not just testbeds for technical scientific problems.

Experiences with co-creating a Positive Energy District proposal: applying the Integrated Energy Landscape Approach at Hoogkerk District in Groningen

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The lack of a thorough understanding of local community's viewpoints and considerations with regard to energy transition, frequently results in the unsuccessful implementation of top-down energy plans and interventions, to which local residents develop strong opposition. Citizen engagement, as well as paying attention not only to the technical and financial, but also to the social and spatial aspects of (local) energy transition, is emphasized in literature. Specifically, the Integrated Energy Landscape approach constitutes the major theoretical framework of this study, according to which Integrated Energy Landscapes are multifunctional physical and socio-economic landscapes, characterized by synergies between the built environment and the energy systems. Therefore, the area-based conditions are of key importance for integrating energy in the local context, and local citizen initiatives and co-operatives can play a catalyst role into this process. The main goal of this study is to experiment with ways of implementing the main principles of the Integrated Energy Landscape approach, and thus to get valuable insights in the ways that this could be applied in practice. The case study area is the Hoogkerk district in Groningen, the Netherlands, due to the energy transition challenges it faces, but also due to the active role of the recently formulated local citizen initiative. The study consists of three research phases.

The purpose of the first research phase is to gain insights into the way in which the Hoogkerk residents perceive, prioritize and relate to the various aspects of the local energy transition process and its spatial outcome. In general, perspectives and viewpoints of all the relevant energy transition stakeholders can constitute an integral element of a participatory approach, in the context of which local, provincial and national governments could incorporate these insights into their policy making processes, as well as into their co-creation procedures and communication strategies. Moreover, citizen initiatives could also take this input into account when formulating their vision and approach.

A Q methodological study has been conducted and three main viewpoints emerged, while insights into a number of overarching consensuses and disagreements were surfaced, as well. Indicatively, the protection of social renters in the energy transition policy is prioritized by all the formulated viewpoints. Furthermore, it is interesting to observe the gradual transition from the first viewpoint group of residents mainly emphasizing the local values and characteristics, to the second viewpoint group that mainly emphasises the importance of energy saving approaches, and finally to the third viewpoint calling for a comprehensive energy transition district plan, in which the municipality will play the leading role while the citizens will contribute. That is a finding that local stakeholders, such as the municipality and the local initiative, could take into account to avoid the risk of overestimating the potential of bottom-up processes. Moreover, it is interesting to observe that the first two viewpoints mainly focus on the spatial aspect of energy transition, prioritizing the concern of safeguarding key characteristics and attributes of the place. The third viewpoint mainly emphasized the process aspect of energy transition and the role local residents can play in it. We argue that these insights can be integrated into the development of a local energy vision.

By taking into account the findings of the first phase, an effort to come up with a pre-proposal for a Positive Energy District in Hoogkerk, by applying the Integrated Energy Landscape Approach and the Ecosystem Services Framework, has been conducted in the second phase of this research study. Ecosystem Services are critical services of ecological systems, which contribute to the well-functioning of the Earth's life-support system. They consist of the regulating, provisioning, supporting and cultural services. Identifying, listing, and mapping them when implementing Renewable Energy Technologies can inform decision makers of the impact that certain interventions will cause in a specific region. Moreover, a Positive Energy District is defined as a delimited urban area where the total annual energy balance must be positive. As a result, the district will produce additional energy that can be shared with other urban zones. The PED concept is important because it not only mitigates energy poverty, but it is also tailored to the specific needs of a certain district in a city, by taking into account the environmental, social and cultural context. However, in literature there are very limited studies focusing on how these aspects can be taken into account in an explicit way when developing a Positive Energy District. Thus, in the second phase of the current study, there has been an attempt to combine the Integrated Energy Landscape approach and the Ecosystems Framework with the Positive Energy District methodology, aiming at arriving at place-based energy transition solutions, taking into account the social and spatial context. The proposed interventions are sufficient to cover the energy usage of the district, while an energy surplus is generated. The pre-proposal has been developed within a participatory process, in close collaboration with key local stakeholders and mainly the local citizen initiative. The identification of the local Ecosystem Services served as a crucial starting point for this study, while it also served as the base for analyzing the subsequent trade-offs and synergies derived by the proposed energy transition interventions.

In the third phase of the research study, a sustainable business case model has been developed based on this Positive Energy District pre-proposal. The main outcome of the model lies within the value creation through cost savings from foregoing traditional energy sources and sale of electricity to the grid, but also through including the economic value of Ecosystem Services and synergies when integrating the Renewable Energy Technologies. Beyond the local case, the findings lay the groundwork for more systematic studies on merging the methodologies of Positive Energy District development, the Ecosystem Framework and the Integrated Energy Landscape approach. Finally, by adding the benefits of Ecosystem Services and synergies as a significant contributor in the financial analysis and decision-making process, this study opens the door for a new approach of valuing sustainable projects.

Keywords: Local energy transition; Integrated Energy Landscape; Positive Energy District; Co-creation; Public Engagement; Q-methodology; Sustainable Business Case Model; Ecosystem Services Valuation; Co-ownership; Making City H2020 EU project

Making City: Modeling (future) neighborhoods of Groningen

Rosa Kappert (Hanze University of Applied Sciences)

Due to the pursued energy transition of the Netherlands, changes within the Dutch built environment are expected. Goals defined in the Dutch climate agreement include insulation of housing, energy savings, and replacement of grey electricity and natural gas with renewable energy sources.

The aim of the Dutch Regional Energy Strategy (RES) program is to govern the energy transition in a more decentralized way. Inside a RES, multiple governance levels jointly lay out the regional choices for renewable-energy implementation. Hence, municipalities contribute to their local Regional Energy Strategy (RES). Additionally, municipalities play a central role in the development of the so-called neighborhood-oriented approach to reach goals set for the built environment. Within the responsibilities of the local municipalities, there are multiple aspects and stakeholders to consider to make these neighborhood-oriented approaches workable. Therefore, it is essential to understand the energy system as a whole, and create valid scenarios that can aid municipalities with the immense tasks layered out in front of them.

This research focusses on the municipality of Groningen and is part of the work package “New long-term urban planning towards 2050” (WP1.5.3) of The Making City Project. The Making City Project is a Horizon 2020 project that aims to address and demonstrate the transformation of the urban energy system towards smart and low-carbon cities, based on supporting long-term energy planning, with a key focus on the Positive Energy District (PED) concept. The purpose of PEDs is to achieve urban areas that net energy production over a year.

Within this research several specified neighborhoods within the municipality of Groningen are studied. The different selected neighborhoods have different proposed solutions for the heat and electricity demand, depending on the location, current state of the neighborhood, and its buildings (e.g. age of houses, insulation levels, proximity of buildings to heat grid). As a result of the mentioned aspects, the current and future energy demand will differ per neighborhood.

The goal of the research is to gain insight in the (techno-economic) possibility and achievability of the renewable-energy scenarios proposed by the municipality of Groningen. To achieve this goal, a coherent picture is required of the current parameters of the individual neighborhoods, and the possible renewable-energy solutions proposed within the scenarios. The scenarios themselves need to be formulated unambiguously, mainly based on the technical parameters per neighborhood.

The complexity of the energy transition and its interrelations requires an integrated and transparent overview of the energy system, including the interconnections of the neighborhoods. Specifically, it is important to provide insight in the multiple indicators defining a sustainable scenario (e.g. production, impact on the planet, costs, impact on the energy grid, and spatial impacts). Therefore, a modeling-based approach is used to review and expand on the current and future scenarios for the energy transition in the selected neighborhoods in Groningen. The modeling-based approach will use several proven models combined with methods for indicating clear scenarios to verify the scenarios on achievability in a wide range of indicators. The different modeled scenarios are the result of a continuous interaction between the modeling team and representatives of the municipality and/or citizens.

The effect of the different scenarios will be evaluated for an extended timeframe, and a sensitivity analysis will be performed to indicate the most sensitive variables. Major criterions for evaluation are, for instance, the hourly energy balance, costs associated with the corresponding technologies, and environmental aspects, such as CO2 emissions and spatial impact. Furthermore, the results and intermediate steps need to be communicated in a clear and transparent fashion to make them understandable for a wider public. This is achieved by presenting key scenario components on a high-level, geographic map of the neighborhood. Additionally, one of the utilized models is Excel-based, allowing accessible insight in the model assumptions and impacts. The Excel-based descriptions of the different scenarios will be shared with the relevant stakeholders, such that the stakeholders themselves could examine the effect of changing certain parameters.

A balanced integration of Positive Energy Districs

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An important aspect of the energy transition is the integration of urban-industrial area development. Positive energy districts (PED) (areas with a net positive energy balance annually) offer the possibility for integrating the fields of energy transition and urban development. This is done by combining the planning procedure of urban-industrial projects with energy projects and involving a committed network of stakeholders from the public and private sector during the whole process. The FLEXPOSTS project aims to improve the process of creating PEDs by developing replicable strategies, methodologies, and tools that focus on stakeholder engagement and to foster development of flexible energy systems by creating replicable innovative business models for these systems. Integration of energy and urban planning will be applied in an interdisciplinary approach on an organizational, regulatory and planning basis. FLEXPOSTS will develop these ideas using two demosites: the industrial area De Zwette (Leeuwarden, the Netherlands) and the mixed industrial/residential area Aalborg East (Denmark). De Zwette demo will focus specifically on how using more flexible energy systems can alleviate energy system planning issues which are hindering further urban development, i.e. electricity grid congestion. The lessons learned and insights gained from the research will be translated to practice and vice versa. Targeted implementations include facilitating the emergence of PEDs as green energy solutions for urban areas and enabling PEDs as a solution for energy planning issues such as electricity grid congestion.

In De Zwette demo, the specific issue of electricity grid congestion alleviation via flexibility, storage and/or grid reinforcement is analysed. The (local) electricity grid congestion is partly caused by the large increase of demand, the non-dispatchable nature coupled with the decentralized production capabilities of solar and wind, which at times give a large surplus in production and congestion on a local level. This can bring issues, such as a limit on the amount of new distributed intermittent energy resource (DIER) projects that can be integrated, the amount of new consumers/businesses which can be connected to the grid, and/or the ability of existing consumers/businesses to switch from fossil fuel energy to (renewable) electricity sources. In other words, these local constraints can stifle the energy transition.

Traditionally, the intervention by the electricity grid system operator is to reinforce/expand the grid, while other options such as flexibility and storage are not studied in depth. This brings up questions such as: Is the grid being expanded just to transport locally produced renewable energy to other locations? Are there ways to use this energy locally and forego grid expansion? What is the optimal intervention to eliminate grid congestion taking into account different technological options? What is the optimal intervention needed on a local level such that there is minimum delay in the development of a PED? These are the challenges being analysed in De Zwette demo, where we want to quantify the techno-economic impact of different possible solutions that can ameliorate grid congestion, while taking into account regulatory, structural and technical barriers.

With the system boundaries set, we define the current condition of this system (base case) as accurately as possible, taking into account factors such as (temporal) energy demand, energy production, net load signal and various component specific technical constraints (cable capacity etc.). The best-case scenario would be to base this all on measured data, by working together with the distribution system operator Liander, businesses with high energy use in the area, and the municipality to procure the data taking all stakeholders along on the journey. As necessary, energy flows must be approximated using simulations. This will give insight into the organisational side of things. In case no data is available, system components will be modeled. The summation of modeled components and data will be compared to measured data on a higher level in the topology to validate the base case.

With the base case established, the net load signal of the electricity grid model (PowerNodes) will be analysed on a per node basis to identify nodes that can be contributing to the congestion and/or act as bottlenecks. With all the suspected nodes identified, the PowerNodes model will be used to quantify the impact which different interventions, such as flexibility, storage and grid reinforcement, could have on the congestion and the (economic) results of the intervention. Based on all the different scenarios modeled, an intervention to eliminate grid congestion will be proposed, whereby the regulatory barriers and social acceptance are taken into account. Eliminating the grid constraints on DIER makes developing PEDs and expanding (sustainable) industrial areas feasible. The interventions also provide insight into new innovative flexible energy system business models. These, along with knowledge gathered on the organisational level, help promote the growth of PEDs in a mixed urban-industrial setting.

Parallel Session | Global South: Socio-technical frameworks and experiments

Power to the people: a techno-economic evaluation of distributed generation in Nepal

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Nepal has made tremendous achievement in the last two decades in providing electricity access to its people; recent reports shows that 86% of the population has access to grid electricity and another 10% from isolated renewable energy (RE) systems.

Despite such a high household connection rate, the Trilemma Indices of the World Energy Council; (i) Energy Security, (ii) Energy Equity (Accessibility and Affordability) and (iii) Environmental Sustainability, published in October 2021, ranked Nepal 84 out of 127 countries. The main reasons given in this report for such low rank for Nepal are due to poor energy security primarily because of high share of imported electricity and lack of generation diversity. The imported electricity from India has been helping to meet the current demand. However, as witnessed during the economic blockade, import cannot always be relied upon. Thus, even if we rely on imported electricity for the short term, it is imperative that we think about indigenous energy generation. Further, natural disasters such as earthquakes and seasonal floods and landslides clearly demonstrate the short-comings due to lack of generation diversity. The philosophy of portfolio diversification follows the famous saying of "don't put all eggs in one basket". In the case of the electricity sector, diversification applies both in terms of generation sources and geography (Distributed Generation) so that even if some generation sources are down others continue to supply electricity smoothly. The distribution generation refers to the small-scale renewable energy based grid interconnected system in the vicinity of load centers.

Nepal is world-renowned for having successful community-led stand-alone micro hydro plants (MHP) that have transformed rural economies of Nepal. Unfortunately, as soon as the national grid reaches the micro hydro catchment areas, things start falling apart. For various reasons, the community people eventually start using grid electricity and stop the operation of MHP making these precious rural infrastructure redundant. In this context, the Government of Nepal has come up with the new policy for grid interconnection of MHPs having capacity less than 100kW. This opportunity of transforming a stand-alone system to a grid connected system (distributed generation) owes several advantages for both the national grid and the micro hydro plants. After the policy breakthrough, six MHPs has been interconnected with the national grid. With the grid interconnection of MHPs, the utility has realized the advantages of power loss reduction, improvement in reliability, enhancement of power quality, etc. For instance, the power injection from 23kW MHP to the grid has boosted the voltage by 3% at point of common coupling. The power injection in the distribution line also enhances the fault ride through (FRT) capability and low voltage rid through (LVRT) of the distribution system. Moreover, the plant load factor of this MHP has been improved from merely 25% to 77% which leads to financial sustainability of the community owned MHPs.

Consequently, the Government of Nepal has come up with the policy to promote distribution generation up to 1MW capacity in each of the 753 municipalities in Nepal to enhance energy security at the local government level. This paper presents the case study of one of the MHPs that has been interconnected to the grid and its impact on rural feeder power line of the national grid. Comparative analysis of the technological difference between grid interconnection of micro hydropower and large hydropower projects as well as the financial analysis and economic analysis of the grid interconnected micro hydropower systems is also discussed in this paper.

This paper shall also describe how Nepal's strategic direction to promote community owned and operated small size distributed generation enhances the energy security of the nation. Therefore, realizing the advantages of distributed generation seen in the developing countries, it should also be replicated for the advanced power system countries in the Europe which follows the mantra of Small is Still Beautiful".

Socio-technical experiments for sustainable energy development of energy technology innovations: a gender perspective (Part 1)

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This paper is part 1 of a two-part series. In Sub-Saharan Africa (SSA), energy poverty is not eradicated at a sufficient pace, thus exacerbating energy insecurity (Kende-Robb, 2016). The impact of this prevalence of energy poverty is most severely felt in urban poor environments. Resultantly, efforts are made by various organisations to counter the effects of a lack of access to energy (i.e., energy insecurity), often working under the umbrella terms 'social development', 'community upliftment' or 'empowerment' (Batliwala, 2013; Winther, Ulsrud & Saini, 2018; Sovacool et al., 2020). However, the approaches used in these efforts are not always systematic or structured, and many of the efforts designed in the energy sector, specifically with the aim of eradicating energy poverty, have thus been unsustainable (Corbett & Fikkert, 2012; Sovacool, 2014; Khandelwal et al., 2017). An alternative approach to addressing energy insecurity through energy innovations is therefore required.

Moreover, with the global urban population set to grow exponentially over the next few years, with the associated energy needs that accompany urban migration, new perspectives and approaches to energy security-related innovation within the context of urban poor environments is needed. Given the complex and interconnected nature of sustainability issues, this paper argues that sustainability should be considered holistically. This emerges from the multifaceted and complex intricacies of sustainable development (Smith & Raven, 2012; Sengers, Wieczorek & Raven, 2019). It follows, then, that addressing energy insecurity requires addressing energy as a system that is complex by nature, and socio-technical by design. Energy technology innovations thus need to combine (i) the (nuanced) social implications of the societal needs that energy seeks to address, and (ii) technical research and science. Stated differently: energy technology innovations aimed at alleviating energy poverty need to be contextualised in light of energy as a complex socio-technical system (Rohracher, 2018).

Energy justice is a concept that has been gaining prominence in the literature on energy (technology) innovations (Sovacool et al., 2017). Energy justice is defined as a global energy system that distributes the benefits and burdens of energy services fairly, and contributes to energy decision-making that is more representative and inclusive. One of the concepts that energy justice principles thus seek to address, is that of gender and the disparate effect that energy insecurity has on women. In recent years, scholars have found a statistically significant correlation between energy and gender, pointing to the potential impact of including gender as an important dimension when designing energy technology innovations to combat energy insecurity women (Winther, Ulsrud & Saini, 2018; Lieu et al., 2020). Three main research themes are thus highlighted in this paper: energy, gender, and sustainability. The nexus where these three themes meet, forms the foundation of the problem space of this two-part paper series.

Part 1 of this series is explorative in that it investigates the problem-space to examine the inputs required to establishing a research product of a framework for gendered energy technology innovations (GETI). For a framework to be constructed effectively (i.e., to ensure the right solution is built), prior knowledge of the relevant aspects pertaining to energy sustainability and the socio-economic context of urban poor communities in SSA is important. For the framework to be built efficiently (i.e., to ensure the solution is *built in the right way*), the applicable tools, practices, and theoretical constructs need to be used to contribute to it as its constituting parts.

The first statement regarding effectiveness, is addressed by means of a systematic approach to requirements specification, whereas the second statement, regarding efficiency, is addressed by consulting the literature on several research areas of interest.

The requirements for designing and developing the framework are synthesised according to the work of Van Aken, Berends and Van der Bij (2007). Functional requirements, user requirements, design restrictions, attention points and boundary conditions are established for the intended research output of the GETI framework. Based on the requirements specifications, several guiding questions arise to inform the structure of the subsequent parts of the paper series to efficiently identify the relevant tools and contributing theoretical constructs in the literature.

A structured conceptual literature study is then employed to explore the theoretical underpinnings and constructs that inform the process towards a more structured approach to designing, developing and implementing gendered energy technology innovations in the specific context of urban poor environments. Based on the extent to which gender is mainstreamed for energy security: (i) gender mainstreaming on a cultural level; and (ii) gender mainstreaming on a technical level are two specific areas that are highlighted as gaps in the current literature.

Additionally, structed understandings of several theories are formed through the conceptual literature study in order to define the problem space: First, energy is investigated as a socio-technical system. This entails investigating the foundational constructs and guiding principles of systems thinking, social innovations and system innovations (considering energy being argued for as a socio-technical system). This builds the foundation on which socio-technical experiments (and the associated characteristics, forms and dynamics thereof) can be conceptualised. Next, the energy value chain in described to identify potential points of intervention in order to design, develop and implement gendered energy technology innovations. This includes identifying the barriers and drivers to the successful implementation of energy initiatives.

Furthermore, stakeholders are identified by means of the quadruple helix model, in support of the interconnected nature of sustainability issues as this paper argues that the innovation process should be from the bottom up. This notion aligns with the principles of energy justice, which are explored in light of the energy justice framework. Energy justice principles are contextualised for urban poor contexts and ensures that energy decision-making supports and facilitates due process and representation, and that the most vulnerable communities are not harmed by efforts and initiatives aimed at countering energy insecurity. Thus, by definition, energy justice requires that all stakeholders be involved in and have access to energy decision-making processes.

Finally, the literature is consulted on scaling efforts in light of gendered energy technology innovations by considering the diffusion of innovations theory, scaling of social enterprises and scaling archetypes.

A structured basis is thus formulated on which the GETI framework can be built, as will be established in Part 2 of this two-part series.

Socio-technical experiments for sustainable energy development of energy technology innovations: a gender perspective (Part 2)

Ms. S van der Merwe (Department of Industrial Engineering, Stellenbosch University) | Prof. I.H. de Kock (Department of Industrial Engineering, Stellenbosch University) | Dr. N. Mohlakoana (Center for Sustainability Transitions, Stellenbosch University)

This paper is part 2 of a two-part series, and is best understood in context of part 1. Where part 1 explores the problem space and has established a structure and basis of the required inputs to building a solution effectively and efficiently, part 2 explores the solution space for establishing the gendered energy technology innovations (GETI) framework.

The aim of the GETI framework is to provide a structured process of facilitating and supporting the design, development and implementation of gendered energy technology innovations and add practical utility to the field of socio-technical experimentation. The GETI framework seeks to address all the functional requirements, user requirements, design restrictions, attention points and boundary conditions required, as defined in part 1 of this series.

The framework thus guides its user through the end-to-end process of facilitating and supporting the design, development and implementation of gendered energy technology innovations. In other words, there are two features: (i) a facilitation feature; and (ii) a support feature.

The facilitation feature refers to the value stream of the gendered energy technology innovations (involving three phases: design, development and implementation), and the support feature refers to the enabling environment (involving both the uncontrollable and controllable variables) of socio-technical experiments. Finally, there are three perspectives: gender, energy and technology.

The GETI framework therefore has three parts, delineated as follows:

- The facilitation feature with:
  - Phase 1: Design (and its associated elements);
  - Phase 2: Development (and its associated elements);
  - Phase 3: Implementation (and its associated elements);
- The feature that supports the facilitation feature, with:
  - Controllable variables;
  - Uncontrollable variables;
- The three perspectives on each of the constituting elements and variables of both the facilitation and support features are:
  - The gender perspective;
  - The energy perspective; and
  - The technology perspective.

A high-level overview of the generic design of the GETI framework is displayed in Figure 1. Figure 2 conceptually shows how the perspectives of gender, energy and technology are applied to each of the elements of the GETI framework and can supplement one another, or be used individually as layers of information.

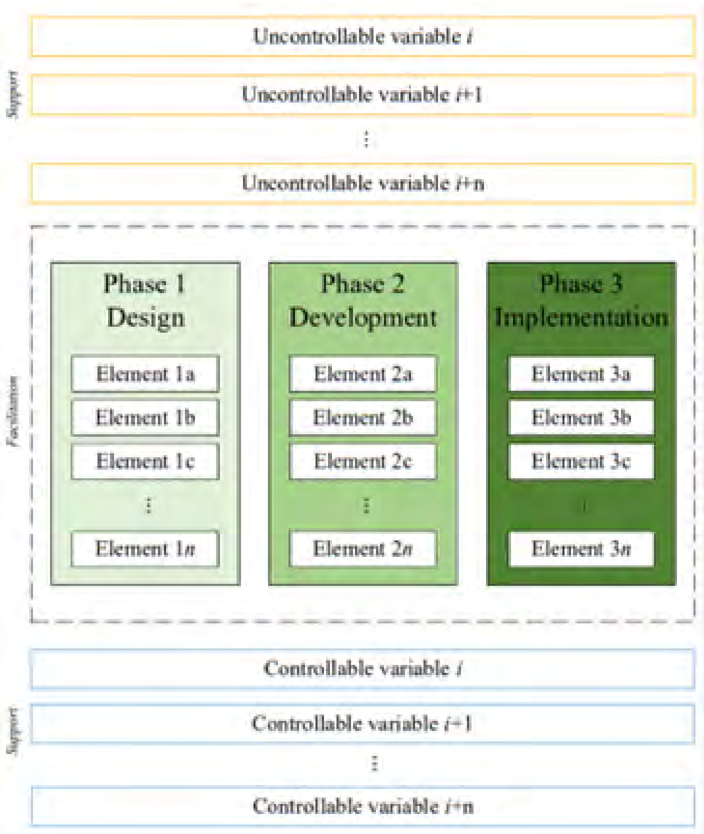

Figure 1: An outline of the generic GETI framework

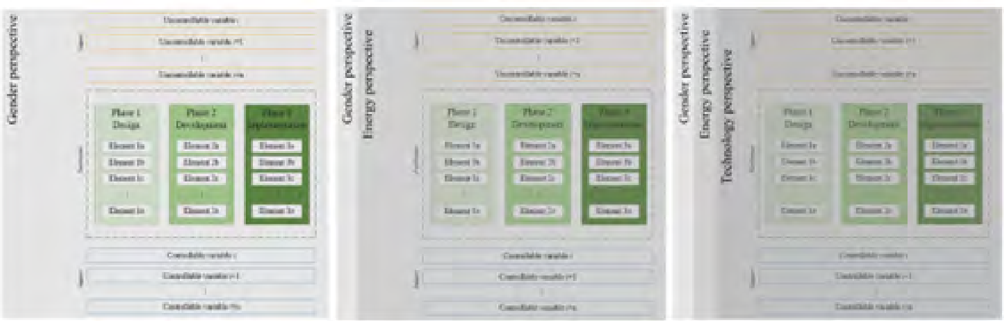

Figure 2: Applying the perspectives to the generic GETI framework

Subsequently, the generic framework is populated with the relevant insights and the GETI framework is presented in Figure 3. Additionally, there are accompanying tables with more information on each of the phases, variables and elements, as well as an interactive web-based tool to assist the user of the framework to work through the GETI framework in a step-wise manner.

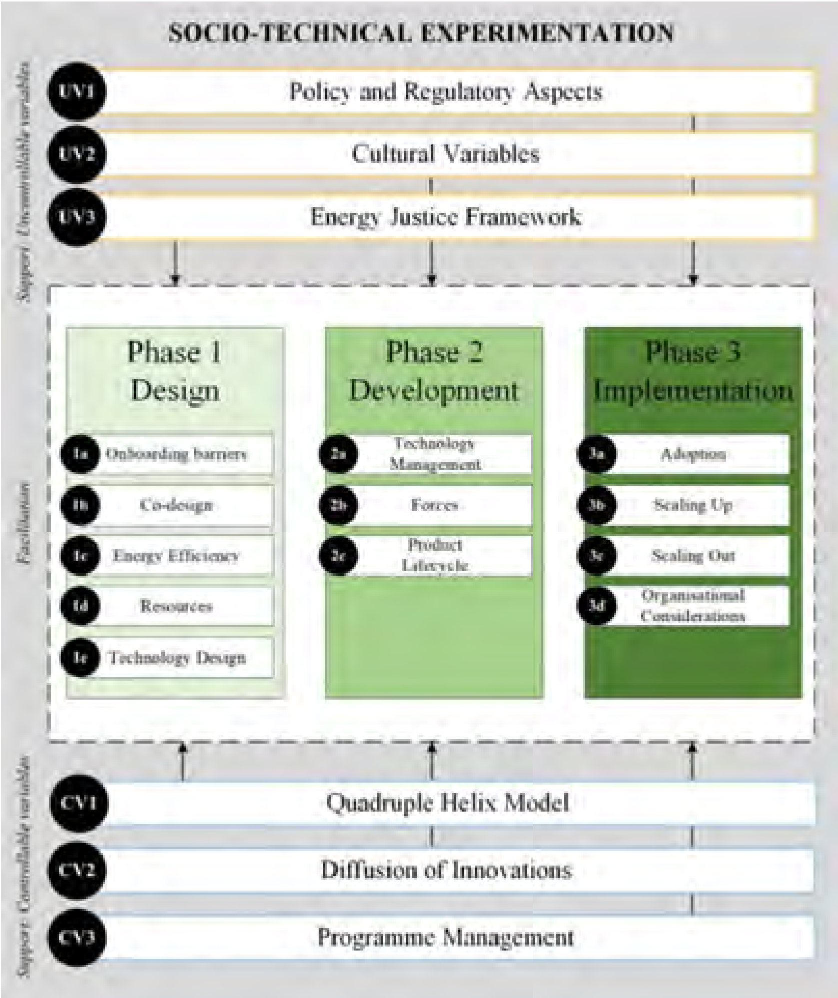

Figure 3: The GETI Framework

The users of the GETI framework are identified as ‘knowledge intermediaries’, concurring with the role of a project leader and facilitator, who can trigger collaboration among different stakeholder groups in the quadruple helix model (as established in part 1). The specific context in which the GETI framework is grounded in, is that of socio-technical experimentation.

The GETI framework is verified and validated in a structured manner in order to evaluate its credibility. In this paper, it is argued that verification concerns the correctness of a solution (i.e., testing whether the right solution is built) and validation concerns the suitability of a solution (i.e., testing whether the solution has been built the right way). Verification is done through a series of semi-structured subject-matter expert interviews. In this study, 13 subject-matter experts are identified (seven from industry, and six from academia or with research backgrounds). Six of the subject-matter experts are men and seven of them are women, additionally providing a balanced view.

Validation is done through case study application. Based on several selection criteria, the urban poor community of Groenheuwel in the Western Cape province of South Africa is used as a case study. One of the examples of a socio-technical experiment, is a living lab. The GENS (gendered mainstreaming for energy security) living lab (LL) is established in Groenheuwel. The vision of the GENS LL is to increase energy access for the community by mainstreaming gender as a strategy to contravene energy poverty. Community members act as co-researchers in co-design processes, some youths are identified as ‘youth champions’, and the co-researchers and youth champions are consulted throughout the GENS project. In essence, the end-users of the (intended) energy technologies are seen as subject-matter experts of the problem.

What makes the contribution of the real-life case study application especially valuable, is the addition of contextual aspects as it provides some examples of insights to the nuances of culture, gender, and other social aspects of energy as a socio-technical system. Language, cultural artefacts, religion, gender roles, as well as economic models and worldviews of the end-users are addressed and practical ways of incorporating an Afro-centric approach in the solution are suggested. Concepts such as ubuntu, ujamaa, stokvels, microloans, etc. are also explored in light of gendered energy technology innovations.

Through subject-matter expert engagements and case study application, it is found that the GETI framework is an applicable and appropriate tool to address energy as a socio-technical system in the context of urban poor environments to combat energy insecurity and contribute to a more sustainable and just energy system in sub-Saharan Africa. The GETI framework thus adequately achieves its aim.

Critical Making, Critical Niches: a conceptual framework and co-design method for energy transitions in the Global South

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The proposed paper presents a conceptual framework and co-design method for co-design in living labs for energy transitions in the Global South. A series of three structured reviews are presented, covering the fields of co-design, living labs, energy transitions and the Global South. These reviews were used to systematically evince a gap in the intersections between these field, isolate the overlapping problems and find the most useful theoretical frameworks used for addressing these problems. The overlapping problems found were power dynamics and knowledge differences between stakeholders in energy transition projects. These issues were more prevalent in studies taking place in the Global South, but authors did not use frameworks for addressing these problems that papers located in the Global North used. These frameworks for understanding power dynamics and knowledge differences in co-design and living labs for energy transitions (used primarily in the Global North) are then synthesized into an overarching conceptual framework and co-design approach for the Global South context. The conceptual framework developed, namely: Critical Making, Critical Niches, provides researchers and designers with a tool for addressing these problems while bringing them to light in design projects and living labs for energy transitions in the Global South.

Workshop | Creating a roadmap for sustainable biofuel production: accounting for different values and capacities

Parallel Session | Just energy transition, governance and policy: Law and governance

Revealing hidden injustices: filling the gap in empirical studies of energy justice

Sander ten Caat (Leiden University) | *Nynke van Uffelen (Delft University of Technology)* | *Eefje Cuppen (Leiden University)*

To create more fair energy systems and transitions, energy justice scholars examine energy policy, production, consumption and transportation systems to evaluate the injustices therein and the underlying reasons for such injustices [1,2]. These scholars commonly distinguish between distributive, procedural, recognition and restorative justice. These four tenets respectively relate to the fairness of the division of burdens and benefits, the procedures and decision-making processes, the recognition and inclusion of all actors and their values and needs, and the reparation of harms previously done to these actors [2,3].

In order to take citizens' concerns into account in the design and evaluation of the energy transition, both scholars and policy-makers currently rely on the ability of citizens to voice their concerns. However, citizens are not equally able to construct opinions on the energy transition, let alone to voice these [4]. This is especially a concern for vulnerable groups in society whose voices are marginalised and who run the greatest risk of being negatively affected by the energy transition [5,6]. It is thus important to examine who is impeded from expressing injustices, to what extent, in which cases and why.

This study therefore introduces and applies the concept of "hidden morality", first introduced by philosopher Axel Honneth [4]. Honneth states that there are several steps between the existence of an injustice and the social change that addresses this injustice. Different groups of people might encounter different obstacles between these steps. They need to be able to 1) experience an injustice; 2) express their claim of injustice; 3) develop this claim into an idea of which change is necessary (positive normative claim); 4) translate their claim into collective expressions and action; 5) bring their claim into public discourse; and 6) bring about social change.

The authors show the merits of the study of hidden morality through the analysis of a case study of the heat transition in the Dutch city of The Hague.

The Dutch heat transition is managed by municipalities and mainly comprises the phase out of natural gas. The case concerns the experiences of individuals with a low socio-economic status (SES) and a migratory background, which is a group vulnerable to injustices [5]. It answers the research question: In what forms is hidden morality present in the ways low-SES individuals with a migratory background experience the heat transition in The Hague?

To study hidden morality, the first author devised a conceptual framework which he applied to key municipal heat transition documents and to interviews with low-SES migrants. The framework was based on the concept of hidden morality and a literature review on energy justice. This framework was used to deductively construct a codebook, which was then applied to municipal heat transition documents. These documents concerned the municipal heat transition and public participation policies. The documents indicated the municipal view on the role of citizens in the heat transition, citizens' rights and options for participation, and the allowable impact of the transition on citizens. This view was compared to interviews with citizens to conclude whether they were unknowingly subject to injustices. This related to the first step of hidden morality: the experience of injustices. The other steps, from people's ability to express claims to their capacity for social change, were analysed using only the interview data. This data comprised of 26 semi-structured interviews with citizens of varying migratory backgrounds, conducted by the first author. Questions were based on the concept of hidden morality, municipal heat transition plans and a case study by Marques et al. on perceived injustices [7]. Documents and transcribed interviews were coded in ATLAS.ti.

The results indicated that 19 out of 26 interviewees were unknowingly subject to procedural and recognition injustices. In spreading information on the heat transition and in designing participatory processes, the municipality had not taken the needs of these low-SES migrants into account. This made both information and participation inaccessible to the interviewees. As these injustices were not consciously experienced, these were not expressed by the interviewees. Instead, interviewees expressed different distributive, procedural and recognition injustices. These expressions were, however, hardly paired with an idea of what change would be necessary to address their perceived injustices. Several factors, such as language barriers, a lack of social cohesion in neighbourhoods and a fear of reprisals from housing corporations furthermore hindered interviewees from translating their individual claims into collective claims and action.

Only two interviewees managed to find a collective voice for several specific claims of misrecognition. They brought this voice into public discourse and caused social change for their specific claims, whereas the other individual claims remained hidden from policy-makers.

The interviewed low-SES migrants were thus subject to injustices they could hardly voice through conventional channels of public participation. Existing approaches for analysing energy injustices do not allow scholars to study these hidden injustices. Having shown the applicability of the concept of hidden morality to the energy transition, the authors therefore propose the use of this concept for further research. It allows scholars to uncover injustices that might otherwise stay hidden. Importantly, it also allows scholars to identify obstacles between the different steps of hidden morality and the necessary policy changes to remove such obstacles. The use of the concept of hidden morality thereby helps towards the creation of more just and inclusive energy transitions.

New Offshore Energy Storage and Transport Options: Legal Obstacles and Solutions

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Due to the dependence on energy supply from plants running on coal, oil and natural gas, decarbonisation of the energy sector has become a strategic priority necessary to meet the climate targets set by the Dutch government (Climate Agreement, 2019). Although renewable sources provide emission-free energy supply, its intermittency makes it less reliable than fossil fuels. Surplus renewable energy can be stored for later use, but so far little storage capacity has been developed in the electricity system (IEA, 2020). To ensure a reliable, affordable and renewable energy supply, it is therefore necessary to introduce new energy technologies and system solutions.

The North Sea is an energy powerhouse and a pivotal region for achieving the ambitious goal of reducing greenhouse gas emissions, in particular through the extensive development of offshore wind energy (European Commission, 2020). Currently, 2.5 gigawatts (GW) of offshore wind capacity have been installed in the Dutch North Sea (RVO, 2023). In the medium to long term, the objective is to install 21 GW by 2030 and approximately 70 GW by 2050 (Parliamentary Letter Offshore Wind Energy, 2022).

With this rapid growth of offshore wind energy in the Dutch North Sea, several challenges arise, such as the management of intermittent offshore energy generation and the costs associated with transporting large volumes of electricity to the shore.

These challenges can be addressed by developing the following innovative energy technologies and system solutions: (i) alternative offshore cable connections linking Dutch offshore wind farms directly, or indirectly via other wind farms, to electricity transmission systems in other North Sea states or to offshore electricity consumers (e.g. gas production platforms), which can contribute to a more efficient and reliable electricity supply; (ii) offshore electricity storage installations, which can reduce congestion on the existing cables and postpone the supply of electricity to the market, thus offering the possibility to shift the time of sale to hours with higher electricity prices; and (iii) offshore hydrogen infrastructure, which can reduce the need for major investments in the existing offshore and onshore electricity grid.

The offshore development of these innovative energy technologies and system solutions require a stable and enabling legal framework. Without legal certainty, investments will not be made and novel developments will not take place. This research, therefore, focuses on international, EU and Dutch legal issues associated with managing large-scale offshore wind energy developments. The aim is to identify legal obstacles and develop legal solutions to facilitate the deployment of alternative cable connections, electricity storage installations and hydrogen infrastructure in the Dutch North Sea. Hence, the central research question is: Which legal solutions are required to enable large-scale offshore wind energy developments by providing alternatives for bringing large quantities of offshore renewable energy to the market?

This research is part of the DOSTA project ('Developing Offshore Storage and Transport Alternatives') financed by the Dutch Research Council (WIND.2019.002). The project takes an interdisciplinary approach to investigate the feasibility of implementing innovative energy technologies and system solutions to facilitate large-scale development of offshore wind energy in the Dutch North Sea. This contribution presents some of the main findings of the research project from a legal perspective. The focus will be on the legal obstacles that may hinder the development of new offshore energy storage and transport options, as well as the potential legal solutions identified to enable the successful offshore implementation and integration of these options.

Legitimacy gaps in energy transition: Institutional misalignments in wind energy projects

Tamara Schnell, Jannika Mattes, Carl von Ossietzky University Oldenburg

Legitimacy is in the meantime an established concept for understanding dynamics within energy transition. It is mainly applied from a superior perspective to explain the effect of institutions on (organizational) decisions. At the same time, Bitektine and Haack (2015) show that legitimacy can also be understood as a continuum that allows for a multi-level perspective. Accordingly, legitimacy can be defined as “a fundamentally cross-level construct consisting of two components present at different levels – individual-level propriety and collective-level validity” (Bitektine and Haack 2015, 51). Therefore, legitimacy assessment processes are related to the stability of institutions and isomorphisms in the selection of sets of norms. In times of institutional change, as is common in an (energy) transition, a greater diversity of arguments for propriety can be assumed – rather than one valid way of acting. As a result, institutional misalignments and ‘unconformities’ of actions and institutions naturally appear. To describe these unconformities, we apply the concept of legitimacy gaps (Genus and Iskandarova 2020; Markard, Wirth, and Truffer 2016). We build on this understanding of legitimacy and examine the extent to which the emergence of legitimacy gaps differs across wind energy projects and how they are dealt with. Therefore, this paper asks: To what extent can differences in wind energy projects be explained by the effect and handling of legitimacy gaps?

In order to answer this question, we build on the understanding of (Scott 1995) and the three pillars of institutions, i.e. regulative, normative, and cognitive aspects. These are combined.

into an analytical framework to analyze legitimacy gaps in wind energy projects. Following the isomorphism thesis, it is assumed that institutions (e.g. laws, expectations, or norms) cause a certain action of the organization (or project) via different mechanisms. At the same time, the organization-specific handling of institutions is related to the assessment about the legitimacy of the organization. With respect to all three pillars of institutions, this paper examines legitimacy gaps of wind energy projects. In order to grasp the isomorphism dynamics empirically, we differentiate between three groups of factors influencing a project: first, manifest, (context) site-related characteristics, e.g. the geographical, socio-economic situation of the site (1); second, more manipulable project charac teristics, e.g. the concrete project and its design, but also factors remaining the involved actors and their specific resources like knowledge,\ money, or social capital (2); and third, (social) project dynamics, e.g. path dependencies that arise from the project- and site-specific interaction of the actors involved (3). The empirical analysis shows that for the analysis of legitimacy gaps and how to deal with them, especially the last aspect – the (social) project dynamics – are relevant to explain differences between projects.

Empirically, we analyze two qualitative case studies on onshore wind energy projects in Germany. Both investigated projects are located in the same municipality. Although one project was realized without any significant problems, the other project has still not been realized after 16 years and its history involves many complaint proceedings. Due to the more or less similar spatial and social conditions, the spatial differences are less central than the project characteristics. Above all, however, the specific project dynamics have a significant explanatory power for the differences between wind projects. Based on the introduced framework, we are able to show the extent to which both actors involved in the project and opponents of the projects use their resources through strategic action to close the legitimacy gaps, or to exploit them and thereby sabotage the project.

The paper facilitates an institutional perspective for assessing the legitimacy of wind energy projects. It highlights that the perspective of legitimacy gaps is useful for enhancing our understanding of those factors influencing wind energy projects. Hereby, the paper contributes to transition studies and organizational sociology.

Becoming more just? Changing justice conceptions in energy policy in the Netherlands

Annemiek de Looze (Leiden University), Sander ten Caat (Leiden University), Prof. Dr. Ir. Eefje Cuppen (Leiden University), Dr. Antonella Maiello (Leiden University), Dr. Shivant Jhagroe (Leiden University)

Energy conflicts in the Netherlands are increasing in frequency and severity (Mensink, 2021) as varied stakeholders such as policymakers, energy producers, and citizens disagree over how much, where, how, and when renewable energy should be produced in a country in which space is scarce and values are diverse (Cuppen, 2018).

Inherently linked to these diverse values and perspectives is the concept of energy justice, an increasingly emerging field in which principles of social justice are applied to energy policy, production, consumption, and transportation (Jenkins et al., 2016; Sovacool & Dworkin, 2015). Energy justice is commonly divided into distributive, procedural, recognition and restorative justice, relating to a fair division of burdens and benefits, a fair procedure and decision-making process, the recognition and inclusion of diverse actors' values and needs, and the reparation of harms previously done to actors, respectively (Heffron & McCauley, 2017; McCauley et al., 2013).

Justice conceptions are not static. They are informal institutions that structure, enable or restrict human behaviour, but they are likewise shaped by humans and by human interaction and are therefore subject to continuous change (North, 1990; Tang, 2012). Change can be both sudden and gradual, and can be exogenously and endogenously driven (Gerschewski, 2021). Especially exogenous ruptures, sudden disturbances to the status quo, may trigger new justice perspectives to come up. Think about, for example, the recent increase in attention towards energy poverty issues as a result of the high energy prices in Europe following the war in Ukraine. Such societal debates and arising justice conceptions may over time become more formalised and get reflected in formal institutions such as policies, rules, and regulations (Pesch et al., 2017).

Despite this possibility for institutional change, policy choices are rooted in the past and are self-reinforcing: they build upon a pre-existing institutional and material world (Hodgson, 2006). Policy constructed in the past, and its underlying justice conceptions, form the frame within which new policies are written and renewable energy technologies are adopted. Hence, past decisions lay out a certain pathway for future policy and technology. This path dependency impacts leeway for policy change reflecting novel justice conceptions (Mishra et al., 2020). Therefore, it is important to shed light on the justice conceptions that underly these past policies. To this aim, we conducted a study of the past to reveal the justice conceptions at the core of Dutch energy policy. This study contributes to a discussion on how policy and technology need to change to align with current and future conceptions of justice.

dynamics empirically, we differentiate between three groups of factors influencing a project: first, Therefore, in this paper we answered the research question:

Which justice conceptions can be identified in the Dutch national energy policy from 1974 to 2016?

To study these justice conceptions, we built a conceptual framework and applied this framework in a document analysis of key Dutch energy reports. First, we constructed a conceptual framework on energy justice based on an extensive literature review on energy justice. This framework formed the basis of our empirical analysis, allowing us to construct a codebook with key search words encompassing a wide range of energy justice concepts currently identified in academic literature. This codebook was used for the deductive coding of Dutch national energy reports. Our document analysis consisted of ten key energy reports published between 1974 and 2016. We chose 1974 as our starting point, as this marked the year of the first national energy report in which a new Dutch energy policy pathway was adopted which focused on integrated policymaking (de Jong et al., 2005). The reports that follow reflect on this pathway throughout the years, displaying policy choices and their justification. In these reports, the Dutch government critically assessed the state of the Dutch energy system and the policies in place to govern this system in order to address energy crises and crucial socio-technical challenges. We first manually skimmed the documents to elaborate on our key search words, as some outdated terms or synonyms were not included in our initial codebook. Using ATLAS.ti, we then adopted an automatic coding approach following our codebook. Based on the results of the coding, we categorised which justice elements were most predominant in which reports, to control for patterns over time of which justice conceptions were adopted in the Dutch national energy policy.

This research has both a conceptual and an empirical contribution. The development of a framework to conceptually connect energy justice literature with institutional theory aided in understanding the path dependency of justice conceptions and its implications for policymaking. Empirically, we depicted the development of justice conceptions in the Dutch renewable energy transition to better understand the pathways chosen towards the energy system we are currently in. Thereby we contributed to a discussion on the necessary changes to policy and technology for a just and effective energy transition.

Plenary Panel Discussion: Key Issues and New Pathways for Policy and Research Within Energy Transition

Introduction

We will explore fruitful interactions with practitioners and pay attention to the impact of political developments such as the 27th UN Climate Change Conference of the Parties in Egypt and the energy crisis on the energy transition. We will hold a plenary panel discussion with discussants who represent different fields.

Panelists

Bipashee Ghosh is a research fellow at the Science Policy Research Unit (SPRU), University of Sussex. She is a postdoctoral researcher working in interdisciplinary and transdisciplinary teams, skilled in system change, sustainable transport and policy action. She is researching sustainability transitions, deep transitions, and transformative Innovation Policy.

Leo Meyer is freelance consultant on climate and energy science and policy and Guest Lecturer at Earth Sciences Faculty Utrecht University. He is an expert in communicating climate change and the interface between policy and energy science.

Nienke Homan is Boardmember of the Green Hydrogen Organisation. She is a leader in the energy transition and green hydrogen and former regional Minister Province of Groningen.

Jerzy Jendrośka is the President of the Environmental Law Center. Mr. Jendrośka has represented the Government of Poland in various EU and international processes, including serving as a Vice-chair of the UNECE Aarhus Convention negotiations (1996-1998) and of the UNECE SEA Protocol negotiations (2000-2002) as well as a member (2000-2006) and the Chair (2002-2003) of the Aarhus Convention Bureau.

Marie Claire Brisbois is a Senior Lecturer in Energy Policy at SPRU, and Co-Director of the Sussex Energy Group. Her work examines questions of power, politics and influence in energy, water and climate governance contexts. She also works on broader issues of social change and public participation in low carbon transitions.

Monica Maduekwe is a sustainable energy specialist with rich experience in renewable energy, energy efficiency, gender mainstreaming, resource mobilisation and project development. She is at the forefront of those influencing the design and development of the sustainable energy industry in West Africa.

Excursions

Groningen Making City Project

MAKING-CITY is a project that aims to address and demonstrate the urban energy system transformation towards smart and low-carbon cities. Groningen is one of the two "Lighthouse cities" involved in the MAKING-CITY project and has the goal to become energy neutral by 2035. During this excursion we will visit several projects in the city to show how Groningen will reach this goal.

Eemshaven excursion

During our excursion to the Groningen Eemshaven we will show the importance of energy production and the energy transition for the landscape, people and industrial development in the province of Groningen The extraction of natural gas in this area resulted in countless earth quakes, while the huge profit was not invested in this area, which was very frustrating. However, in many villages people took initiatives to develop all kinds of community energy, In addition, the Eemshaven is transformed into a huge energy hub, including LNG landing facilities, biogas production, offshore wind and a modern coal plant.

New Energy Forum: Breaking Barriers

The New Energy Forum is an event organised by EnTranCe - Centre of Expertise Energy, the New Energy Coalition and Hive.Mobility.

The event takes place on the 22nd of June, the day after the ICNP2023 and it is the event for the (future) energy- and mobility-professional. Various groundbreaking initiatives in the energy- and mobility transition will be presented. The chairman of the day is Ben van der Burg, ex-professional skater and commercial director of Triple IT. Keynotes will be given by, among others, Kristel Groenenboom, businesswoman of the year 2022 and director of Container Service Groenenboom, and by sr. Reint Jan Renes, Behavioral Scientist and Lecturer Psychologie for a Sustainable City at the Applied University of Amsterdam. The various presentations, activities and demonstrations will be held at EnTranCe.

For more information check www.newenergyforum.nl

NEW ENERGY FORUM

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