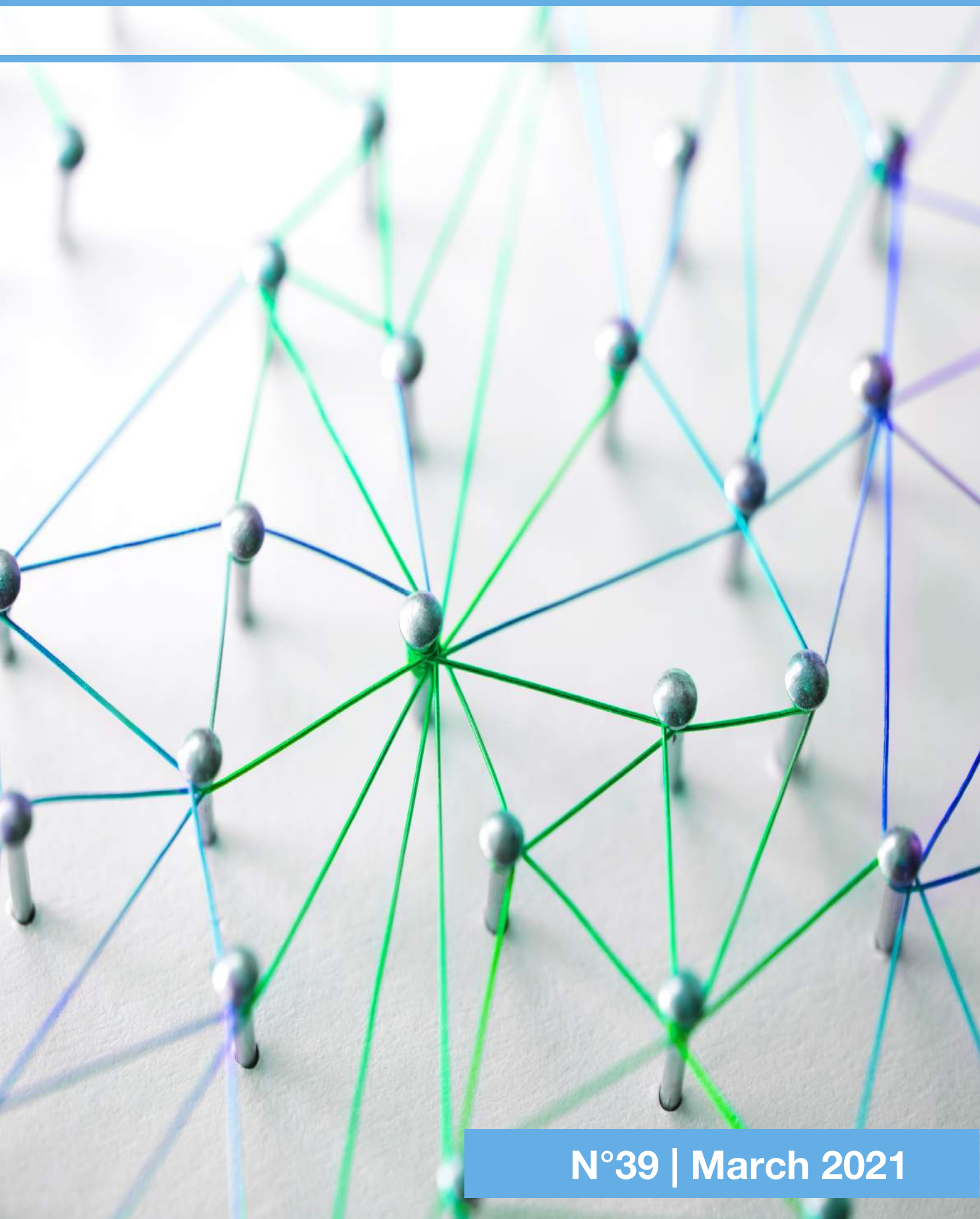
STRN Newsletter



N°39 | March 2021

Newsletter 39 – March 2021

Content

About

The STRN newsletter is published four times a year in March, June, September & December

Cover picture: Shutterstock

Editorial

by Jochen Markard (also on behalf of the governance working group)

Since its inauguration in 2009, STRN has grown substantially. We now connect over 3'000 transition scholars and practitioners from more than 80 countries through our mailing list. Our work has an increasing impact in practice, and across scientific disciplines. With mounting sustainability challenges and growing attention in different parts of society, transition perspectives are needed more than ever.

To a large extent, our network has been built on the voluntary service of many dedicated members of the transition community. Without your commitment, motivation and support we would not be where we are now. I am particularly happy to see the dedication in the NEST community presented through the blog, the active twitter feed, the webinar, the conference and many more initiatives. Together, these are the vital signs of a strong network.

The work of editors and reviewers in our target journals constitutes an equally important pillar of our field. A pillar that – as discussions in the last newsletters have shown – is challenged by a changing landscape of peer-reviewed publication. For ten years, Jeroen van den Bergh has worked relentlessly as the editor-in-chief to make EIST a leading and well-known journal – in transition studies, and beyond. Jeroen has now decided to step down. In August, Bernhard Truffer who has also been with EIST from the start will take over. Please join me in thanking Jeroen and Bernhard and the other members of the editorial team for their hard work!

And yet another transformation is beginning to take shape. As our network continues to grow, management tasks become more demanding. To continue smooth operation, to expand the resources we provide and to increase our impact, STRN has to evolve as an organization. After more than a year of preparation by a working group and various consultations, the steering group has decided to start a process of 'professionalization'.

As a first step, we want to employ a network manager and secure administrative support, similar to other academic associations. We will reach out to a number of academic institutions to support our network as 'institutional members'. For the time being, Utrecht University has agreed to host STRN and to help with administrative tasks in this early stage of development.

The vision is that, over the next 10 years, STRN will become a fully professionalized academic organization for promoting research, education and outreach in sustainability transitions. We will continue to offer the services we are known for, while building on these efforts to create new opportunities for our community. We see a central role for the network in hosting international conferences and workshops, facilitating dynamic exchanges in other formats, overseeing different journals and providing a variety of resources and teaching materials.

As part of this, we hope to encourage the ongoing development of the network's thematic groups as they grow into vibrant divisions, driving their respective research agendas and initiatives from webinars to special issues. As the network becomes increasingly global in nature, we anticipate the need to further inclusivity and diversity through a number of initiatives, including conference bursaries and even regional chapters to host smaller events and activities that are closely connected to the larger network. We also foresee a growing need to disseminate transition ideas through engagement with policy makers and businesses.

Such a process takes time and will draw on the support of the entire community. My heartfelt thanks go to all active members in the network, the steering group and everyone else who supports our mission and this ongoing transformation. We very much welcome any suggestions you might have and we will continue to communicate our progress.

EIST Journal

Volume 37 is now complete and can be found here.

It contains 24 articles and a book review. See, e.g., a comparison of coal phase-out pathways between the UK and Germany by Brauers et al.

Volume 38 is also complete and can be found here.

It includes 13 regular articles and a book review. See, e.g., the assessment of recent developments on methodological diversity in transitions research by Hansmeier et al.

Volume 39 is still in progress.

Here is a complete list of special issues.

As indicated some time ago, after serving ten years I will step down as editor-in-chief of EIST. From August on, associate editor Bernhard Truffer will take over the helm. I wish him and the journal all the best for the future. I intend to write a final editorial with my experiences and lessons learned.

As always, we look forward to receive your submissions and comments. Please don't forget to read, and if relevant cite, EIST.

Jeroen van den Bergh
Editor-in-Chief
jeroen.bergh@uab.es

Call for Viewpoints

EIST – The Next Decade

A special issue to celebrate the 10th anniversary of the journal *Environmental Innovation and Societal Transitions* (EIST).

The foreseen special issue will contain a rich collection of short viewpoints about what we can, or should, expect from research on environmental innovation and societal transitions in the coming decade. We seek creative, challenging and critical – but always inspiring – contributions. They ideally cover a variety of angles and disciplines, while addressing relevant dimensions of transitions and policies, including effectiveness, fairness, feasibility or upscaling.

Viewpoints can address foreseen or required developments of sustainability-transition theory, need for empirical data and how to obtain these, or which methods merit more attention. We further welcome connections with topical issues, such as democracy and right-wing populism, international climate cooperation, migration and geopolitics, artificial intelligence and the digital revolution, or the Covid-19 pandemic. In addition, we would be interested to hear suggestions for achieving potential synergies with exciting research in other fields.

Requirements:
Text of max. 1000 words, preferably one image and/or table, and a short list of references.
To speed up the review process, we advise that before submitting, authors have their text critically read by several colleagues, and if necessary, checked by a native speaker of English.
Please be aware that you may be asked to review another contribution.

Submission period, publication date and procedure:
April-July 2021. We aim to publish the issue at the end of 2021. When submitting select the special issue option "SI: The next decade".
Each submission is quickly judged by one editorial team member and the editor-in-chief. Based on this, some contributions may be desk-rejected. If deemed suitable, we may ask the opinion of one external reviewer. Based on feedback from the reviewer and editors, the author can then revise his paper in two weeks. The revision is judged only by the editors.

STRN Events

Upcoming Events

6th NEST Conference 2021, April 8-9

The 6th NEST conference is taking place with the theme *Sustainability Transitions Pathways*.

Instead of having a physical conference in Sofia, the conference will take place online on Gather.town. It will be a vibrant event with around one hundred attendees from all over the world aspiring to be the next generation sustainability transitions scholars. James Meadowcroft and Ralitsa Hiteva have kindly agreed to give keynote speaches.

We welcome everyone to download the program and keep an eye on the NEST website to see further developments and which parts of the conference will be open for external visitors!

Please use the hashtag #6thNEST in your public communication about the conference.

12th IST conference, October 5-8, 2021

The deadline for abstract submission is closing as this newsletter goes to press. As of 3pm on March 30, IST had received almost 300 abstracts covering - and going beyond - the themes of the STRN research agenda. In the next few days, we will begin the review process - a big thanks ahead of time to everyone who will be reviewing!

It is planned as a hybrid event with people meeting online and in person (subject to change according to the pandemic situation). The conference will be hosted by the Fraunhofer Institute for Systems and Innovation Research ISI in Karlsruhe.

For more details and the call for papers, please visit the conference website.
Please direct any questions to ist2021@isi.fraunhofer.de.

Next steps towards #IST2021:

- Decisions on abstracts will be communicated around May 15th.
- Presenters have to register for the conference by July 1st.
- By August 1st, full papers must be uploaded to the system. This is also the deadline for Global South scholarship applications and Best Paper Award nominations.
- September 10th is the regular registration deadline.

The local organizing committee is very much looking forward to welcoming you at #IST2021 !

NEST webinar series

The NEST webinar series on sustainability transitions launched last year has continued this year with great sessions including Bruno Turnheim, Derk Loorbach and. Paula Kivimaa. The recordings of these sessions, and all sessions of 2020 are available on our Youtube channel.

For the upcoming months, we are excited to announce the following sessions:

- 27 May: Boelie Elzen and Marc Barbier on Agro-food transitions
- End of June: session with the thematic group "Transitions in the Global South" - date and time to be confirmed.
- 8 July: Johan Schot on Deep Transitions

In our webinar series, we aim to give early career researchers the opportunity to learn about core concepts in the field, and facilitate the dialogue between them and established researchers. Invitations for future webinars will be sent through the STRN mailing list, and can be found on the NEST website.

For questions, don't hesitate to reach out to Abe Hendriks.

GeoST webinar series

The Geography of Sustainability Transitions (GeoST) is a quickly evolving research theme at the interface of transition studies and economic / human geography. Our webinar series (flyer attached) aims to expand ongoing dialogues between the transitions and geography communities. The first webinar series explored the state of the art and future research themes. The second series delves deeper into five promising topics for conceptual encounters and empirical deepening. Featuring exciting speakers, the second series explores Geographies of Sustainability Transitions to help understand: winners and losers in transitions, the emergence of green industries, local-global relations, grassroots initiatives and mission-oriented innovation policies. The webinars are organized as a series of 'mini-keynote' lectures, followed by a discussant and Q&A, intended at open and inclusive debate.

28 April 3-4pm CEST Just energy transitions: a spatial perspective. Presenter: Prof. Stefan Bouzarovski; Discussant: Prof. Jennie Stephens

5 May 3-4pm CEST Green industrial path development – Why do cleantech industries emerge in some regions and not in others? Presenters: Prof. Michaela Trippl; Discussant: Dr. Markus Steen

12 May 3-4pm CEST Unpacking transnational linkages, global-local encounters and relations in sustainable energy transition (solar PV) in East Africa. Presenters: Dr. Padmasai Lakshmi Bhamidipati, Dr. Ulrich Hansen; Discussant: Prof. Mark Swilling

19 May 3-4pm CEST Grassroots innovations: diffusion and place-making. Presenter: Dr. Giuseppe Feola;

Discussant: Prof. Tim Schwanen

26 May 3-4pm CEST Roundtable: A geographical perspective on mission-oriented innovation policies. Panelists: Philippe Larrue, Dr. Elisa Arond, Dr. Iris Wanzenböck, Prof. Lars Coenen + panellist TBA

More information available here.
This is a free event, but registration is required.

Toon Meelen, Adriaan van der Loos, Christian Binz, Gesa Pflitsch, Jonas Heiberg

Other Events

Upcoming Events

Designing for Resiliency: RE:GENERATE alpine-urban circularity

ETHZ EPFL PhD summer school June 5-13, 2021, Ostana-Italy & virtual-global

An experiential educational co-creation, hybridizing science, design, social outdoor joy, and local people action - The pandemic-resilient hybrid format of nudging social outdoor transformative action is offered onsite and online. PhD students guided by faculty will design seeds of systemic innovation for resilient and regenerative livelihoods in direct application with local communities, cultivating a new solidarity between the urban and the alpine.

The call for applications is open until April 15th (onsite) and May 1st (virtual). Further information and application: https://systemicdesignlabs.ethz.ch/

Past Events

Transition to a sustainable Netherlands

A major international Sustainability Conference was held at Vrije Universiteit Amsterdam from 24-26 February 2021. Part of this was an open colloquium in which scientists and innovative entrepreneurs discussed what is needed for a smooth transition to a sustainable Netherlands.

Together they argue for politics for bringing in the future instead of protecting the old system, which no longer works. Removing obstacles and involving the wishes of Dutch citizens will work if the discussion is conducted with society. Renewal of the economy can then go hand in hand with sustainable jobs, nature restoration, increased (digital) security and more confidence in politics.

All contributions resulted in practical recommendations for politicians to make the transition to a sustainable country now. The contributions are classified according to the 10 transition paths of the TransitieMotor and linked to the Sustainable Development Goals. All contributions and Guide to the Future (in Dutch), can be found here.

Energy communities for collective self-consumption

Renewable energies are increasingly mobilized at the building, village or city level. At the same time, "energy communities" are emerging at the initiative of citizens with the support of local authorities, associations or companies. These transformations push actors to act or react and modify the spaces, institutions and norms governing energy networks and housing.

In this recorded series of 10 webinars from June to October 2020, international speakers (Europa, Asia, Americas) from social sciences (economics, sociology, urban planning etc.) and design sciences (electrical, thermal and computer engineering, etc.) shared knowledge on the frameworks, practices and tools of energy communities

Co-organisation: Gilles Debizet, Marta Pappalardo and Frédéric Wurtz *Université Grenoble Alpes* and François Menard *Plan Urbanisme Construction Architecture, French Ministère de la Transition Ecologique*

New Projects

Pathways to post-consumer plastics in aquaculture (POCOplast)

POCOplast investigates new pathways to sustainable use of post-consumer-plastic (PCP) from aquaculture. This industry is the largest producer of hard plastic waste in Norway but only a fraction of PCP gets recycled into new products. This highlights the need to increase plastic recycling, while also reducing plastics use. Consequently, the main objective of POCOplast is to provide new knowledge on how the concept of circular economy may be applied to enable sustainable value chain development around PCP from the aquaculture industry, and also into other industries such as furniture manufacturing. In so doing, POCOplast draws on the socio-technical transition and sustainable business model literatures. The project is led by SINTEF and funded by the Research Council of Norway 2020-2024. For more information see the POCOplast website, or contact Henrik Brynthe Lund or Markus Steen.

H2020 BRIGHT

The EU-funded BRIGHT project will work to maximize the potential of demand response at the consumer level, harnessing the potential of blockchain technology to deliver data-driven cross-stakeholder and cross-domain energy fingerprinting services. Specifically, it will design a co-creation process that lifts individual consumers to center stage in order to deliver a demand response that is multi-layered, community-centered, cross-domain, adaptable and multi-timescale. It will also combine user experience design driven by social science for user behavior motivations that may include monetary and non-monetary incentives. Moreover, BRIGHT is focused on the use of digital twins for improved consumer predictability as well as artificial intelligence data-driven energy and non-energy services.

H2020 RIPEET

The H2020 funded RIPEET project will support Responsible Research and Innovation (RRI) policy experimentations for energy transition in three European territories - in Extremadura (ES), Highlands and Islands of Scotland (UK) and Ostrobothnia (FI).
RIPEET brings together quintuple helix actors of the territorial socio-technical energy regime in Transition Labs in order to envisage and implement a place-based energy transition process. Building on this evolutionary model of socio-technical transitions, RIPEET will use the existing landscape and regime-level pressures to facilitate the development of territorial socio-technical futures based on RRI actions. The governance and agency in this transformative process will be organised within the Transition Labs. These Labs will bring together stakeholders to co-create common visions, generate transition pathways and innovation needs and anchor the process on organisational as well as policy level.
For more information, please contact Gorazd Weiss, Wolfgang Haider, or Stefan Philipp.

Publications

PhD theses

Kundurpi, A. (2021)
University of Waterloo, Canada
Exploring the role of governance in supporting urban green infrastructure for sustainability transitions.
link

Green infrastructure development in urban areas may be enhanced by governing processes that are collaborative, action-oriented, and strategically organized. Past literature has provided evidence on the performance, purpose, and outcomes associated with green infrastructure development and the individual features (e.g. trees, green roofs) to provide improvements to urban sustainability. This is important because it provides a clear understanding of how green infrastructure works and why it may be scaled to contribute to supporting other urban infrastructure, the form it may take, and the functions and outcomes. Building off this it is also important to bring to light the role of actors, the approaches to embed green infrastructure actions in urban areas, and the construction of experiments to advance development through diverse organizing processes.
The dissertation addresses these opportunities by pulling together a research program guided by the conceptualization of governance arrangements supportive of urban sustainability transitions. More specifically this research demonstrates how multi-actor governance for green infrastructure is mediated by direct implementation of interventions and the construction of experiments for a range of actors to navigate installation and future development opportunities. Through empirical research, qualitative content analysis is used to construct and interpret interviews with local government representatives, businesses, business networks, and civil society organizations. Three empirical chapters are included detailing the role of private actors directing the development of green infrastructure; the role of action-oriented development to support system change for green infrastructure development; and the strategic delivery of green infrastructure experiments for improved processes and outcomes.

Lessard, G. (2020)
McMaster University, Ontario, Canada
Sustainable housing, tiny house and sustainable urban transition in Quebec - An ambiguous relationship.
link

While the sustainable transition and the fight against climate change appear to be integrated as imperatives at all levels and in all spheres of our societies, the implementation of the sustainable transition in certain sectors sometimes appears to go against the principles that guide the transition from an urban point of view. This thesis focuses on sustainable housing and on tiny houses with the objective of analyzing their ambiguous role in relation to the sustainable urban transition. By analyzing public policies relating to sustainable housing, then the discourses and finally the practices linked to the marginal tiny house ecological housing utopia, the three articles that make up this thesis constitute a case study in Quebec's context. Together, these three papers suggest that the relationship of sustainable housing to the sustainable urban transition is at the very least equivocal and even contradictory. Indeed, far from being in phase with the idea of a profound transformation of societal development pathways, in its present form, sustainable housing in Quebec is anchored in the current of ecological modernization. At present, sustainable housing in Quebec ultimately conforms to the development pathways that have produced urban sprawl and to neoliberal environmental and urban governance pathways. This thesis also notes that the capacity of urban sectoral regimes to implement a sustainable transition is restricted by neoliberalization processes already at work in urban planning and in housing, indicating that neoliberalism acts as an unavoidable exogenous factor that has to be more explicitly acknowledged by the sustainable transition perspective.

Proka A. (2021)
Erasmus University Rotterdam, The Netherlands
Organising for Power Change: Transformative Business Models for the Energy Transition.
link

The energy transition is a lot more than just part of the solution to the climate problem. It is an inevitable, yet inherently uncertain process with deep social implications. The transformation of our energy system involves a shift away from the unsustainable, centralised energy system dominated by the large-scale combustion of fossil fuels and can spur wider fundamental changes in society. Renewable energy initiatives, such as citizen-driven energy cooperatives, Energy Service Companies, peer-to-peer or crowdfunding platforms are mushrooming in Europe and beyond, and the same holds for commercial renewable energy developers. Such organisations bring to the fore a wide variety of novel business models in the energy sector. The question that emerges is whether renewable energy initiatives can transform the energy system as a whole. This thesis analyses and evaluates the impact of renewable energy initiatives on the energy transition drawing on insights from the (sustainability-oriented) business models- and sustainability transitions literature. The Transformative Business Models framework is

introduced as a tool to analyse and reflect upon a renewable energy initiative's contribution to the energy transition, but also as a device to navigate and strategize for increasing this contribution.

Stephens, R. (2020)
AgroParisTech, Paris, France
Alternative Food Networks and transition in the food provision regime. A sociotechnical study in the context of metropolitan Paris.
link

Alternative food phenomena critical of the agri-food regime have for years suggested that food system sustainability requires shortening relations between producers and consumers. The discourses, practices, and innovations of such Alternative Food Networks ("AFNs") generate frictions with regime actors who now internalize questionings on local food. This work studies AFN/regime frictions while integrating these to the Multi Level Perspective transitions studies framework. The thesis draws upon socio-historic and contemporary empirical materials, from both regime and AFN actors, that are studied through composite methodologies: lexicometrics, digital trace analysis, interviews, document analysis, on-site observations. In studying actors representative of several regime competencies strongly relevant to food provision shortening and innovation (retail, fruit and vegetable professionals, institutional food fairs), we characterize current regime questionings but also shed light on some alternatives already well in friction with the regime. In parallel, the targeted study of AFN niches reveals their typological complexity and innovativeness, and leads the thesis to focus on one very successful and particular AFN which hybridizes local food movements with digital-material platformed networks, thereby also offering data of unusual mass and scientific quality. The thesis provides an empirical basis for a regime transition dynamic oriented towards digital-material provisioning axed on prosumption processes that are carried out through transparent customizations which redefine food specifications and value(s) through proximity. It dates regime inflection to the late-2000s, when food provision economic and societal model crises meet exploding digital flows and expanding AFN claims and innovative practices. It bridges investigative fields on AFNs, transitions and prosumption.

Books

Bazzani, G. (2020)
When Money Changes Society. The Case of Sardex Money as Community.
Wiesbaden: Springer VS
link

Sardex is an interest-free digital money created in Sardinia (IT) in 2010 that grew rapidly and created a new community. Sardex money is imbued with a utopian view of society as cooperation and local exchanges. It has technical characteristics and rules of functioning that trigger specific social mechanisms (selection, monitoring and sanctioning, signaling, and belief formation), and influences social interaction with a high level of trust, a sense of familiarity, and social support. Digital monies risk becoming a techno-leviathan, but they can also have a positive influence on social dynamics and forging the boundaries and the goals of new sustainable communities. Money can be an instrument for cooperation, instead of competition, could support institutional change that would enable transition goals. The Sardex experience has clearly demonstrated how money functioning has the capacity to support sustainability transition: Creating money is a terraforming operation that requires a new agenda for investigating money as social ties.

Evans, J., Karvonen, A., Luque-Ayala, A., Martin, C., McCormick, K., Raven, R.P.J.M., Voytenko and Palgan, Y. (2021)
Smart and Sustainable Cities? Pipedreams, Practicalities and Possibilities.
Routledge
link

Smart cities promise to generate economic, social and environmental value through the seamless connection of urban services and infrastructure by digital technologies. However, there is scant evidence of how these activities can enhance social well-being and contribute to just and equitable communities. Smart and Sustainable Cities? Pipedreams, Practicalities and Possibilities provides one of the first examinations of how smart cities relate to environmental and social issues. It addresses the gap between the ambitious visions of smart cities and the actual practices on the ground by focusing on the social and environmental dimensions of real smart city initiatives as well as the possibilities they hold for creating more equitable and progressive cities. Through detailed analyses of case studies in the United States, Australia, the United Kingdom, Japan, Germany, India and China, the contributors describe the various ways that social and environmental issues are interpreted and integrated into smart city initiatives and actions. The findings point towards the need for more intentional engagement and collaboration with all urban stakeholders in the design, development and maintenance of smart cities to ensure that everyone benefits from the increasingly digitalised urban environments of the twenty-first century.

Soliman, Ahmed M. (2021)
Urban Informality - Experiences and Urban Sustainability Transitions in Middle East Cities

This professional book introduces an analytical

framework of urban informality perspectives in the Middle East that is aligned with the Global South. The context of Egypt, Lebanon, and Jordan—in the Middle East— is the transregional focus of this book. In these contexts, the book opens a new arena of academic discussion on the theory and practice of urban informality. Urban Informality: Experiences and Urban Sustainability Transitions in Middle East Cities questions urban informality, "as a site of transitions", interrelated and interlinked with urban sustainability transitions in speedy changes in a given environment. The book presents 'urban informality sustainability transitions' regarding resilience and adaptability that require shifts in urban systems. Shifts from a static process to a dynamic process that eradicates the fragmentation between the tensions, anxieties, and pressures of four modes of production, reproduction, consumptions, and distribution of goods and services in the city and its practices. Finally, through eleven chapters, the concluding remarks explore to what extent and how can urban informality transitions be sustainable.

Papers

Andersson, J., Hellsmark, H. and Sandén, B. (2021)
Photovoltaics in Sweden – Success or failure?
Renewable and Sustainable Energy Reviews 143, 110894, p. 1-14
link

Promoting global energy transitions while stimulating domestic industrialization requires national policymaking that shapes technological innovation towards specific outcomes. Although this is inherently difficult, historical case studies may bring a better understanding of innovation dynamics and thereby guide the design of future policy interventions. The purpose of this paper is to review and analyze the emergence of Swedish photovoltaics technology from a policy perspective. Our main aim is to provide a retrospective account of historical developments, but we also derive more general insights about technological innovation and related policy challenges. The paper departs from an adapted analytical framework based on the technological innovation systems approach. Our review identifies four decades of Swedish research that has largely failed to drive domestic commercialization, the rise and fall of an industry that mainly served international markets, and a rapidly growing domestic market based on imported products. This situation is the result of mismatches and fragmentation among key innovation processes, which have not been addressed by strategic policy interventions. We suggest that policymakers should promote a full range of innovation processes and consider making innovation support subject to a payback mechanism that delivers a return on public investments even if industries and markets emerge abroad. Our study also demonstrates how the technological innovation systems approach can be extended to include the function commercialization and emphasizes the importance of paying attention to the directionality of technological innovation processes.

Bach, H., Mäkitie, T., Hansen, T. and Stehen, M. (2021)
Blending new and old in sustainability transitions: Technological alignment between fossil fuels and biofuels in Norwegian coastal shipping,
Energy Research & Social Science, Volume 74, 101957
link

Facing increasing pressure to decarbonize, innovation within the shipping sector has turned to low-and zero carbon solutions. In this paper we investigate how the development and implementation of biodiesel and liquefied biogas (LBG) in Norwegian coastal shipping has been influenced by the technological alignment with fossil fuels. We understand this influence to emanate from the (mis)match of biofuels with the structure of coastal shipping (e.g. infrastructure, knowledge, institutions, actors) which has been shaped by fossil fuels. This way we contribute to the development of Technological Innovation Systems (TIS) framework by discussing the effect of sectoral cross-technology externalities on the functionality of a TIS. Our core data consists of semi-structured interviews, supported by a firm survey with Norwegian shipowners.
Our results show that the technological alignment provides the biodiesel and LBG TISs with several benefits, such as access to established markets and infrastructure, which suggests that Norway to some extent has good conditions for maritime biofuel markets to form. However, two major barriers for implementation of biofuels are fuel availability and cost. Considering the competition with battery-electric and hydrogen solutions, the positive externalities of the interchangeability between fossil and biofuels are insufficient to make biodiesel and LBG competitive contenders for coastal shipping. In order to upscale implementation of biofuels in the Norwegian coastal shipping sector, which is needed to reach national and international emission targets, there is a need for strengthened policy interventions. To establish market formation, subsidies for biofuels and feed-in targets would be crucial policy instruments.

van den Bergh, J.C.J.M., Angelsen, A., Baranzini, A., Botzen, W.J.W., Carattini, S., Drews, S., Dunlop, T., Galbraith, E., Gsottbauer, E., Howarth, R.B., Padilla, E., Roca, J. and Schmidt, R.C. (2020)
A dual-track transition to global carbon pricing.
Climate Policy 20(9): 1057-1069
link

Unilateral climate policies have been unable to achieve intended emissions reductions. We argue that international harmonization of climate policy beyond the

Paris Agreement is the only way forward and that global carbon pricing, either through a tax or market, is the best available instrument to manage this. A foundation has already been laid, as current carbon pricing initiatives cover about 20% of global CO2 emissions. Since it limits free-riding by countries/jurisdictions, negotiating global carbon pricing is, in principle, behaviourally easier to negotiate than other instruments, such as emission targets or technical standards. To overcome political resistance, we propose a dynamic strategy consisting of two parallel tracks and five transition phases. The first track entails assembly of a carbon-pricing coalition that expands over time and exerts moral and economic pressure on non-members to join. The second track involves refocusing UN intergovernmental climate change negotiations on carbon pricing, potentially involving initially heterogeneous prices reflecting distinct income levels of countries, which then gradually converge. The dual tracks are designed to reinforce one another, increasing the likelihood of a successful outcome. The proposal results in a transition trajectory consisting of two interactive tracks and five phases, with specific attention to inequity within and among countries. We illustrate how such an approach could function with either a carbon tax or market.

van den Bergh, J.C.J.M. et al. (2020)
Response to Haites – A dual-track transition to global carbon pricing: The glass is half full.
Climate Policy 20(10): 1349-1354
link

We respond to several critical notes to our proposal for a dual-track transition to global carbon pricing by Erik Haites. We remain open to alternative proposals, but think that the dual-track proposal provides a uniquely workable solution to the tremendous challenge of keeping global warming below 2°C.

Bergmann, M., Schäpke, N., Marg, O., Stelzer, F., Lang, D.J., Bossert, M. and Sußmann, N. (2021)
Transdisciplinary sustainability research in real-world labs: success factors and methods for change.
Sustainability Science, 16(2), 541-564
link

The transdisciplinary research mode has gained prominence in the research on and for sustainability transformations. Yet, solution-oriented research addressing complex sustainability problems has become complex itself, with new transdisciplinary research formats being developed and tested for this purpose. Application of new formats offers learning potentials from experience. To this end, we accompanied fourteen research projects conceptualized as real-world labs (RwLs) from 2015 to 2018. RwLs were part of a funding program on 'Science for Sustainability' in the German federal state of Baden-Württemberg. Here, we combine conceptual and empirical work to a structured collection of experiences and provide a comprehensive account of RwLs. First, we outline characteristics of RwLs as transformation oriented, transdisciplinary research approach, using experiments, enabling learning and having a long-term orientation. Second, we outline eleven success factors and concrete design notes we gained through a survey of the 14 RwLs: find the right balance between scientific and societal aims, address the practitioners needs and restrictions, make use of the experimentation concept, actively communicate, develop a 'collaboration culture', be attached to concrete sites, create lasting impact and transferability, plan for sufficient time and financial means, adaptability, research-based learning, and recognize dependency on external actors. Characteristics and success factors are combined to illustrate practical challenges in RwLs. Third, we show which methods could be used to cope with challenges in RwLs. We conclude discussing the state of debate on RwLs and outline future avenues of research.

Contesse, M., Duncan, J., Legun, K., and Klerkx, L. (2021)
Unravelling non-human agency in sustainability transitions.
Technological Forecasting and Social Change, 166, 120634
link

While agency has received considerable attention in recent sustainability transitions studies, as well as in the literature on socio-ecological systems and sustainability transformations, the focus has been on the agency of humans. Given the emphasis on infrastructures and material culture in sustainability transitions studies, it is surprising that non-human agency has not received more attention. This paper aims to add to the body of work on agency and actor-oriented approaches in sustainability transitions, and addresses this gap by investigating the role of non-human agency in shaping sustainability transitions. Through an application of Actor-Network Theory, we followed the Bagrada hilaris pest, and analyzed the roles performed by the Bagrada as a so-called actant within a network of humans, as part of a transition-in-the-making towards more sustainable food systems. The Bagrada has been a key actant in provoking changes towards sustainable pest management in Chile, destabilizing regime practices associated with pesticides, and creating and mediating relationships between different human actors. In terms of transition theories, particularly the multi-level perspective, this case illustrates the relational nature of agency. The main theoretical implications are that: a) actants from all levels (niche, regime, landscape) are linked in networks of relations that make change happen; b) the landscape level is not void of agency; c) boundaries between levels are fluid. We conclude that relating to non-human actants and understanding how to

mobilize them for normative goals can help catalyze sustainability transitions.

Creutzig, F., Callaghan, M., Ramakrishnan, A., Javaid, A., Aneeque, N., Niamir, L., Müller-Hansen, F., Minx, J., Sovacool, B. K., Afroz, Z., Andor, M., Antal, M., Court, V., Das, N., Diaz Jose, J., Doebbe, J. et al. (2021)
Reviewing the scope and thematic focus of 100,000 publications on energy consumption, services and social aspects of climate change: A big data approach to demand-side mitigation.
Environmental Research Letters 16(3), 033001
link

As current action remains insufficient to meet the goals of the Paris agreement let alone to stabilize the climate, there is increasing hope that solutions related to demand, services and social aspects of climate change mitigation can close the gap. However, given these topics are not investigated by a single epistemic community, the literature base underpinning the associated research continues to be undefined. Here, we aim to delineate a plausible body of literature capturing a comprehensive spectrum of demand, services and social aspects of climate change mitigation. As method we use a novel double-stacked expert—machine learning research architecture and expert evaluation to develop a typology and map key messages relevant for climate change mitigation within this body of literature. First, relying on the official key words provided to the Intergovernmental Panel on Climate Change by governments (across 17 queries), and on specific investigations of domain experts (27 queries), we identify 121 165 non-unique and 99 065 unique academic publications covering issues relevant for demand-side mitigation. Second, we identify a literature typology with four key clusters: policy, housing, mobility, and food/consumption. Third, we systematically extract key content-based insights finding that the housing literature emphasizes social and collective action, whereas the food/consumption literatures highlight behavioral change, but insights also demonstrate the dynamic relationship between behavioral change and social norms. All clusters point to the possibility of improved public health as a result of demand-side solutions. The centrality of the policy cluster suggests that political actions are what bring the different specific approaches together. Fourth, by mapping the underlying epistemic communities we find that researchers are already highly interconnected, glued together by common interests in sustainability and energy demand. We conclude by outlining avenues for interdisciplinary collaboration, synthetic analysis, community building, and by suggesting next steps for evaluating this body of literature.

Grubb, M., Drummond, P., Poncia, A., McDowal, W., Popp, D., Samadi, S., Penasco, C., Gillingham, K.T., Smulders, S. Glachant, M., Hassall, G., Mizuno, E., Rubin, E.S., Dechezlepretre, A. and Pavan, G. (2021)
Induced innovation in energy technologies and systems: a review of evidence and potential implications for CO2 mitigation
Environmental Research Letters 16(4), 043007
link

We conduct a systematic and interdisciplinary review of empirical literature assessing evidence on induced innovation in energy and related technologies. We explore links between demand-drivers (both market-wide and targeted); indicators of innovation (principally, patents); and outcomes (cost reduction, efficiency, and multi-sector/macro consequences). We build on existing reviews in different fields and assess over 200 papers containing original data analysis. Papers linking drivers to patents, and indicators of cumulative capacity to cost reductions (experience curves), dominate the literature. The former does not directly link patents to outcomes; the latter does not directly test for the causal impact of on cost reductions. Diverse other literatures provide additional evidence concerning the links between deployment, innovation activities, and outcomes. We derive three main conclusions. (a) Demand-pull forces enhance patenting; econometric studies find positive impacts in industry, electricity and transport sectors in all but a few specific cases. This applies to all drivers—general energy prices, carbon prices, and targeted interventions that build markets. (b) Technology costs decline with cumulative investment for almost every technology studied across all time periods, when controlled for other factors. Numerous lines of evidence point to dominant causality from at-scale deployment (prior to self-sustaining diffusion) to cost reduction in this relationship. (c) Overall innovation is cumulative, multi-faceted, and self-reinforcing in its direction (path-dependent). We conclude with brief observations on implications for modelling and policy. In interpreting these results, we suggest distinguishing the economics of active deployment, from more passive diffusion processes, and draw the following implications. There is a role for policy diversity and experimentation, with evaluation of potential gains from innovation in the broadest sense. Consequently, endogenising innovation in large-scale models is important for deriving policy-relevant conclusions. Finally, seeking to relate quantitative economic evaluation to the qualitative socio-technical transitions literatures could be a fruitful area for future research.

Heiberg, J., Binz, C. and Truffer, B. (2020)
The Geography of Technology Legitimation: How Multiscalar Institutional Dynamics Matter for Path Creation in Emerging Industries.
Economic Geography, 96:5, 470-498
link

Research in economic geography has recently been

challenged to adopt more institutional and multiscalar perspectives on industrial path development. This article contributes to this debate by integrating insights from (evolutionary) economic geography as well as transition and innovation studies into a conceptual framework of how path creation in emerging industries depends on the availability of both knowledge and legitimacy. Unlike the extant literature, we argue here that not only the former but also the latter may substantially depend on nonlocal sources. Conceptually, we distinguish between multiscalar export, attraction, and absorption of legitimacy. Coupled with conventional knowledge indicators, this approach enables us to reconstruct how not only external knowledge sourcing but also multiscalar institutional dynamics contribute to a region or country's ability to leverage its potential for path creation in an emerging industry. Methodologically, we develop legitimation indicators from a global media database, which was built around the case of modular water technologies. Cross-comparing the evidence from six key countries (India, Israel, Singapore, South Africa, the UK, the US) with differing path creation constellations for this emerging industry, allows us to hypothesize how multiscalar legitimation influences a country's prospects for creating a radically new industrial path.

Hessevik, A. (2021)
Network-led advocacy for a green shipping transformation: A case study of governance networks in the Norwegian maritime sector.
Regulation & Governance
link

Climate action has until recently been slow in the shipping industry. The sector is notoriously difficult to regulate by individual states, and international governance is moving slowly. In such a context, networks of actors can potentially contribute to a sustainability transition. In Norway, which is widely considered a leader in maritime environmental innovations, two networks have become prominent. This article studies how the cluster organization Norwegian Centre of Expertise Maritime CleanTech and the public–private partnership named the Green Shipping Programme have developed, gained influence in policymaking, and are now taking part in governing a transition toward low- and zero-emission shipping. I argue that these governance networks gained governance capacity because of how network organization allow for utilization of the resources of individual members. The resources of individual network members are "mixed and matched" through network activities. In particular, the combination of technical expertise, lobbying expertise, and relational capital is important when a network seeks to influence policy in sustainability transitions.

Hirt, L.F., Sahakian, M. and Trutnevyte, E. (2021)
What socio-technical regimes foster solar energy champions? Analysing uneven photovoltaic diffusion at a subnational level in Switzerland.
Energy Research & Social Science 74, 101976
link

Transitioning to cleaner modes of electricity production requires a major uptake of renewable technologies, including solar photovoltaic (PV). However, the uptake has been spatially uneven within countries and requires more exploration. We analyse the spatial pattern of solar PV growth in Switzerland (76′587 PV projects) by quantifying the features of socio-technical regimes at a subnational level. We combine the multi-level perspective (MLP) framework with the literature on solar PV adoption to select 36 quantitative indicators at the level of 2′212 municipalities. Using principal component analysis and cluster analysis, each municipality's socio-technical regime is quantitatively assessed and municipalities with similar regime features are clustered together. We find nine clusters of municipalities with different socio-technical regimes and different rates of solar PV uptake. Specifically, solar PV uptake is greater in clusters with more prevalent techno-scientific knowledge and market dimensions of the MLP, in particular agricultural activities, higher education institutions, and innovation activities. Within each cluster, we identify extreme outliers (i.e. municipalities where solar PV is growing much faster) and further analyse them through a comprehensive Internet search. Our results suggest that, given the same national policy, different local actors, such as local authorities, energy companies, and devoted citizens, can accelerate PV uptake using various strategies based on local specificities. Building on these findings, we suggest that knowledge of regime configurations may provide additional tools to create context-specific strategies and more decentralized transformative policies to foster solar PV uptake.

Hoicka, C.E., Das, R.R. and Zhao, Y. et al. (2021)
Methodology to identify demand-side low-carbon innovations and their potential impact on socio-technical energy systems.
MethodsX
link

The rapid diffusion of low-carbon innovations has been identified as a key strategy for maintaining average global temperature rise at or below 1.5°C. Diffusion research tends to focus on a single sector, or single technology case study, and on a small scope of factors that influence innovation diffusion. This paper describes a novel methodology for identifying multiple demand-side innovations within a specific energy system context and for characterizing their impact on socio-technical energy systems. This research employs several theoretical frameworks that include the Energy

Technology Innovation System framework to develop a sample of innovations; the Sustainability Transitions framework to code innovations for their potential to impact the socio-technical system; the energy justice framework to identify the potential of innovations to address aspects of justice; and how characteristics of innovations are relevant to Innovation Adoption. This coding and conceptualization creates the foundation for the future development of quantitative models to empirically assess and quantify the rate of low-carbon innovation diffusion as well as understanding the broader relationship between the diffusion of innovations and socio-technical system change. The three stages of research are: Contextualization: surveys and desk research to identify low-carbon innovations across the ETIS; Decontextualization: the development of a codebook of variables; Recontextualization: coding the innovations and analysis.

Hölscher, K., Frantzeskaki, N. (2021)
Perspectives on urban transformation research: transformations in, of, and by cities.
Urban Transformations 3, 2
link

The narrative of 'urban transformations' epitomises the hope that cities provide rich opportunities for contributing to local and global sustainability and resilience. Urban transformation research is developing a rich yet consistent research agenda, offering opportunities for integrating multiple perspectives and disciplines concerned with radical change towards desirable urban systems. We outline three perspectives on urban transformations in, of and by cities as a structuring approach for integrating knowledge about urban transformations. We illustrate how each perspective helps detangle different questions about urban transformations while also raising awareness about their limitations. Each perspective brings distinct insights about urban transformations to ultimately support research and practice on transformations for sustainability and resilience. Future research should endeavour to bridge across the three perspectives to address their respective limitations.

Hölscher, K., Wittmayer, J.M., Hirschnitz-Garbers, M., Olfert, A., Walther, J., Schiller, G. and Brunnow, B. (2021)
Transforming science and society? Methodological lessons from and for transformation research.
Research Evaluation: 1-17
link

Transformation research has in the past years emerged as a shared lens to study and support radical societal change towards sustainability. Given the nascent and exploratory—yet highly normative and ambitious—character of transformation research, we aim to enhance the under- standing of transformation research: when do research designs qualify as transformation research, what is needed for putting transformation research into practice, and what are results? To this end, we develop a framework that identifies criteria for designing and reflecting on research results, design and processes as transformation research. We employ this framework to reflect on our work in a research project that was designed in the spirit of transformation research: The TRAFIS (Transformations towards resource-conserving and climate-resilient coupled infrastructures) project sought to understand and support the development of innovative coupled infrastructures to mobilize their critical role in achieving sustainability transformations. Our results yield lessons and recommendations about what transformation research looks like in practice and how it can be strengthened, focussing on 1, redefining and re-valuing research for societal impact; 2, redesigning research to integrate perspectives on radical societal change; and 3, re-equipping researchers and research partners for social learning. We conclude that while transformation research already contributes to framing and generating knowledge about real- world sustainability challenges, its transformative impact is still limited. Practicing transformation research requires far-reaching changes in the science system, but also continuous reflection about legitimacy, power relations, and impacts.

Johnstone, P., Rogge, K., Kivimaa, P., Fratini, C.F., Primmer, E. (2021)
Exploring the re-emergence of industrial policy: Perceptions regarding low-carbon energy transitions in Germany, the United Kingdom and Denmark.
Energy Research & Social Science 74,101889
link

Industrial policy has re-emerged as an area of policy discussion in recent years, but the characteristics and role of industrial policy vary across national contexts. Particularly, the role of industrial policy in the ongoing energy transitions of different countries has received little attention. We introduce an analytical framework to explore the relationship between industrial policy and different energy policy trajectories and apply this framework in an empirical analysis of the perceptions of key stakeholders in the energy sector in Germany, the United Kingdom and Denmark. We identify four key elements of industrial policy – industrial visions, industrial policy instruments, industrial policy governance, and employment concerns – and based on these analyse perceptions of how industrial policy has facilitated changes in the energy system of the three countries. We find significant differences in industrial policy styles for low-carbon transitions, reflecting broader differences in political institutions and cultures. Our analysis shows how sustainability transitions relate to industrial policy, and which elements can act as

enablers and barriers to low-carbon transitions

Kiefer, C.P., del Río, P., Carrillo-Hermosilla, J.
On the contribution of eco-innovation features to a circular economy: A microlevel quantitative approach
Business Strategy and the Environment. 2021; 1–17.
link
The circular economy (CE) and eco-innovation (EI) are two concepts deemed instrumental in achieving a sustainable transition. They have been proposed in the academic literature and by practitioners and have acquired very high public policy relevance, being endorsed by policymakers and ultimately leading to regulations supporting them. It has been argued that both concepts are compatible and interrelated and that EI is instrumental in achieving the CE. However, little is known about how different EI features contribute to the CE at the microlevel. This article tries to cover this gap. Its aim is to assess and quantify the causal relationship between different EI features and the CE with the help of a unique dataset of small- and medium-sized firms in Spain and an econometric analysis. Our results show that only systemic EIs contribute to a global CE, whereas other EI types such as component additions or small changes in existing production processes could even be barriers to high levels of circularity. It is found out that technological novelty is not relevant for reaching the CE. The results support the understanding of how EIs enable a transition to the CE. Care should be taken not to promote incremental EIs that do not only achieve low (or no) circularity but that effectively lock-in the economic system in solutions that entail a barrier to the achievement of high-level circularity.

Kivimaa, P., Sivonen, M.H. (2021)
Interplay between low-carbon energy transitions and national security: An analysis of policy integration and coherence in Estonia, Finland and Scotland.
Energy Research & Social Science, in press
link

Sustainable Development Goals aim for a better future, but gains are threatened by conflict and governance failures, exacerbated by climate change. While research on energy security is well-established, conceptual-analytical research on sustainability transitions has paid little attention to security threats as factors influencing transitions or security policy as part of policy mixes. This paper combines policy coherence and integration analysis of energy and security strategy documents with sustainability transitions' research, considering how landscape pressures and energy niches are presented in documents pertaining to Estonia, Finland and Scotland during 2006-2020. The findings show that security and energy policies present a functional overlap. Yet, policy integration and coherence are insufficiently addressed, conflicts created by coexisting low-carbon and hydrocarbon-based security considerations. An increasingly multifaceted landscape creates a complicated policy environment where pursuing policy coherence becomes harder. Despite the accelerating energy transition, the security implications of energy niches have received too little attention.

Koirala, B., Hers, S., Morales-España, G., Özdemir, Ö., Sijm, J. and Weeda, M. (2021)
Integrated electricity, hydrogen and methane system modelling framework: Application to the Dutch Infrastructure Outlook 2050.
Applied Energy 289, 116713
link

The future energy system is widely expected to show increasing levels of integration across differing energy carriers. Electricity, hydrogen, methane and heat systems may become increasingly interdependent due to coupling through conversion and hybrid energy technologies. Market parties, network operators, policy makers and regulators require tools to capture implications of possible techno-economic and institutional developments in one system for the operation of others. In this article, we provide an integrated electricity, hydrogen and methane systems modelling framework focusing on interdependencies between them. The proposed integrated electricity and (renewable) gas system model is a market equilibrium model with hourly price and volume interactions, considering ramp rates of conventional units, variability of intermittent renewables, conversion, transport as well as storage of electricity, hydrogen and methane. The integrated model is formulated as a linear program under the assumption of perfect competition. As proof-of-concept, the model has been applied to a test case consisting of 34 electricity nodes, 19 hydrogen nodes and 22 methane nodes, reflecting the regional governance scenario in the Dutch Infrastructure Outlook 2050 study. The case study also includes different sensitivity analyses with regard to variable renewable capacity, energy demand and biomass prices to illustrate model response to perturbations of its main drivers. This article demonstrates that the interweaving of electricity, hydrogen and methane systems can provide the needed flexibility in the future energy system.

Kok, K.P.W., Loeber, A. M. C. and Grin, J. (2021)
Politics of complexity: Conceptualizing agency, power and powering in the transitional dynamics of complex adaptive systems.
Research Policy, 50(3), 104183
link

This paper seeks to bridge the gap between socio-material and complex adaptive systems approaches in conceptualizing the politics of transformation. Our contribution in particular is a further clarification of the

relational nature of power, and the role of non-humans in transitional dynamics of complex adaptive systems. We explore and operationalize the role of non-humans and relationality in (1) agency and (2) power, and the implications thereof for processes of (3) powering, through which power relations shape resource distributions and associated macro-scale dynamics. We consider agency as an embedded and temporal capacity for reorientation. This also entails attributing agency to entangled networks of humans and non-humans. Such a capacitive conception of agency follows from our understanding that agents and structures consist of comparable ontological building blocks, both being (networks of) components in complex adaptive systems. Power we understand as a productive and relational phenomenon that emerges from interactions between components and that structures their agency. We argue that such a 'force-field' understanding of power enables the observation of different types of power relations. Finally, we consider six different mechanisms through which power relations can result in a (re)distribution of resources and with that, contribute to self-reproducing or transformative systemic dynamics. With this conceptualization, we hope to advance the debate on the different facets of the politics of transformation, and to help further urgently needed transitions towards a more sustainable future.

Konc, T., Savin, I. and van den Bergh, J. (2021)
The social multiplier of environmental policy: Application to carbon taxation.
Journal of Environmental Economics and Management 105, 102396
link

We analyze the effectiveness of environmental policy when consumers are subject to social influence. To this end, we build a model of consumption decisions driven by socially-embedded preferences formed under the influence of peers in a social network. This setting gives rise to a social multiplier of environmental policy. In an application to climate change, we derive Pigouvian and target-achieving carbon taxes under socially-embedded preferences. Under realistic assumptions the social multiplier is equal to 1.30, allowing to reduce the effective tax by 38%. We show that the multiplier depends on four factors: strength of social influence, initial taste distribution, network topology and income distribution. The approach provides a basis for rigorously analyzing a transition to low-carbon lifestyles and identifying complementary information and network policies to maximize the effectiveness of carbon taxation.

Krantz, D. (2021)
Solving Problems like Maria: A Case Study and Review of Collaborative Hurricane-Resilient Solar Energy and Autogestión in Puerto Rico.
J Sustain Res., 3(1), 210004
link

After Hurricane Maria, Puerto Rico experienced the second-largest blackout in modern history, with parts of the island left without power for up to 18 months. Because the problems of Maria are multifold, this case study and review presents the historical, political, social, economic and cultural context of Puerto Rico, including a review of post-Maria solar interventions, along with two novel unconventional hybrid approaches to solving the problems of Maria: (i) Solar de Autogestión, a solar-energy racking that permits panel removal and storage in advance of a storm's arrival and reinstallation after the storm passes — a system that was developed through (ii) collaboratory-action parachuting, a novel community-interaction method developed as an oral history-based applied-scholarship hybrid of conventional parachuting research and community-based participatory research. This paper finds that addressing the problems of Maria involves understanding the holistic context of a place and its people; working in partnership with communities to form collaborations; and providing disaster response, addressing climate change, and expressing allyship and solidarity with communities through hurricane-resilient solar energy to help create energy citizenship and an energy community. Befitting its unconventional methodologies, this transdisciplinary paper - which by its nature may not fit neatly into any single discipline - also takes an unabridged, critical and hybrid descriptive-normative approach to subject matter and style, coupling academic sourcing and discourse with quotes, narrative details and fluid writing in order to be accessible to academics, policymakers and practitioners alike.

Kundurpi, A., Westman, L., Luederitz, C., Burch, S., and Mercado, A. (2021)
Navigating between adaptation and transformation: How intermediaries support businesses in sustainability transitions.
Journal of Cleaner Production, 283 (February)
link

Small and medium sized enterprises (SMEs) often require external support to make progress on sustainability and contribute to both environmental integrity and social well-being. Previous research has highlighted the important role of local governments and business networks as intermediaries in facilitating sustainability-action in SMEs and the pursuit of sustainability transitions in society. Missing, however, is a clear understanding of how other forms of organizations help SMEs perform sustainability-oriented actions and how various intermediaries can collectively support businesses as they contribute to social and environmental well-being. The objective of this study is to investigate the role of organizations acting as intermediaries in supporting SMEs to contribute to transitions towards sustainability. We build on the results

of a large-n survey and semi-structured interviews with SMEs, non-governmental organizations, and relevant units in local government in the Greater Toronto Area (GTA) Canada. Using qualitative content analysis, our results show that local government, and more specifically economic development units and sustainability units within local government, often are disengaged from encouraging SMEs to take on sustainability-oriented initiatives. Other types of intermediaries fill knowledge and resource gaps, and act as boundary spanners in an increasingly complex web of actors, actions, and sustainability driven goals. This analysis calls for a new understanding of the role of intermediaries in sustainability transitions with regards to the relationship between incumbents and niche innovators.

Laakso, S., Heiskanen, E., Matschoss, K., et al. (2021)
The role of practice-based interventions in energy transitions: a framework for identifying types of work to scale up alternative practices.
Energy Research & Social Science, 71, 101861
link

Practice-based interventions have recently emerged as one way to question established practices and experiment with new, less energy-intensive ones within households. Yet, how practice-based interventions contribute to energy transitions on a larger scale still awaits to answer. The challenge is that practices are embedded in local conditions and contexts; therefore, scaling up is not simply a matter of multiplying or transferring particular solutions at new sites and larger scales, but it requires dedicated work to translate and support the local reinvention of practices. Drawing on insights from Social Practice Theory, Strategic Niche Management and Institutional Entrepreneurship, we build a conceptual framework for analysing the types of work needed to scale up alternative, energy saving practices in practice-based interventions. Based on the empirical investigation of six European practice-based interventions and the work conducted by the organisers, researchers, participants and stakeholders of these interventions, we identified three types of work to scale up: (i) proximate work to make the practice transferable; (ii) work to gain allies and resonance for the practice; and (iii) work to shape the conditions for scaling up. The paper serves as a valuable resource for future interventions, providing a framework for researchers and practitioners to support scaling up of alternative practices for low-carbon energy transition.

Laakso, S., Aro, R., Heiskanen, E. and Kaljonen, M. (2021)
Reconfigurations in sustainability transitions: systematic and critical review.
Sustainability: Science, Policy and Practice, 17(1), 15-31
link

Two streams of literature have become especially prominent in understanding social change toward sustainability within the past decades: the research on socio-technical transitions and applications of social practice theory. The aim of this article is to contribute to efforts to create dialogue between these two approaches. We do this by focusing on the concept of reconfiguration, which has become a much-used, but poorly defined notion in the discussion on sustainability transitions. To understand what is defined as reconfiguration in systems and practices, and how the understanding of reconfiguration in regimes could benefit from insights about reconfiguration in practices, we conducted a systematic and critical literature review of 43 journal articles. The findings showed a trend toward a focus on whole-system reconfiguration and interlinked dynamics between practices of production and consumption. However, our study suggests that a less hierarchical understanding of transitions utilizing insights from practice theory might be fruitful. Future research on sustainability transitions could benefit from addressing the tensions between and within niche and regime practices; the dynamics maintaining and challenging social and cultural norms; the efforts in creating new normalities and in recruiting actors in practices; and investigating the different roles the various actors play in these practices.

Libertson, F. (2021)
Competing socio-technical narratives in times of grid capacity challenges: the representative case of Sweden.
Energy, Sustainability and Society, 11(1), 1-13
link

Around the globe the electricity sector is strikingly similar, as regardless of nation it is structured around centralized large-scale power production. However, these centralized systems are currently experiencing operational problems related to climate change, energy security and aging grid infrastructures. In Sweden, the lack of investment and maintenance of the grid have created bottlenecks in certain regions, which are now facing an electricity shortage. This capacity crisis has received the attention of the media and generated a debate around the future trajectory of the electricity system. The purpose of this study is to analyze the ongoing media discourse in Sweden to determine whether there is a dominant narrative in the debate and its potential implications. The findings indicate that the government is unanimously held accountable for the electricity shortage and that there is a strong inclination toward a centralized electricity system as a solution. The results indicate that the dominating centralized narrative, should it receive too much traction, might create a technological lock-in and result in overlooking the many advantages of a decentralized electricity system. Ultimately, this might give rise to an outdated electricity system that stalls its transformation toward a more

sustainable path.

Martin, R. (2021)
AV futures or futures with AVs? Bridging sociotechnical imaginaries and a multi-level perspective of autonomous vehicle visualisations in praxis.
Humanities and Social Sciences Communications
link

Current depictions of autonomous vehicle (AV) futures are produced primarily by automobile manufacturers that largely reflect and reinforce existing sociotechnical systems in a 'business as usual' model that frames this technology within a narrative of crisis and technological salvation. This article argues for a more complex analysis of AV futures in which images are understood as vessels for sociotechnical imaginaries that direct and delimit what we think is possible in the future. Through an analytical framework incorporating automobility, transitions, and imaginaries, I explore how depictions of AVs frame the technology as responding to various system pressures over time through a comparative analysis of two actors. The analysis suggests that regime actors deploy visual discursive material as a tool of regime stability or change to benefit their own agendas. The intention of the article is not to anticipate current trajectories but is a methodological exploration of how policymakers and planners can interpret AV visualisations. Therefore, the paper concludes with a discussion of the implications of these imaginaries for future transportation systems. It further suggests that policymakers and planners need to take a more active role in the development of AV futures by paying much more attention to the latent meanings behind AV visualisations and working collaboratively with those who produce them.

Moberg, K.R., Sovacool, B.K., Goritz, A., Hinojosa, G.M., Aall, C., and Nilsson, M. (2021)
Barriers, emotions and motivational levers for lifestyle transformation in Norwegian household decarbonization pathways.
Climatic Change 165 (3), pp. 1-25
link

Meeting the Paris Agreement targets requires strong near-term climate change mitigation in all sectors of the economy. Increasing demand-side emission abatement efforts is one important area to pursue, yet there are significant barriers that must be overcome in order to realize its potential. We ask: What barriers may be hindering deep emissions reduction at the household level? What kinds of levers are available to achieve emission reductions? Based on an original and extensive qualitative dataset, our in-depth study of households in Bergen, Norway, shows that individuals perceive they are confronted with considerable individual, economic, and infrastructural barriers that prevent them from taking deep mitigation actions. Our results however also suggest that some barriers can be overcome with motivational levers such as the availability of more sustainable alternatives, support networks and by the positive emotions felt when having a positive impact on the environment. Other barriers are more difficult to overcome, pointing to the overarching lesson from our study that households will need to be forced or incentivized beyond voluntary efforts to achieve rapid and comprehensive decarbonization. The current policy approach, aimed mostly at nudging for voluntary mitigation actions, is wholly inadequate to achieve significant emission reductions. Our study indicates that households are open for increasingly including more "sticks" into climate policymaking. While there are significant challenges to individuals taking stronger mitigation action, these can be overcome by strengthening government policies targeting the patterns and, importantly, volumes of household consumption.

Mutter, A. and Rohracher, H. (2021)
Competing Transport Futures: Tensions between Imaginaries of Electrification and Biogas Fuel in Sweden.
Science, Technology, & Human Values
link

The choice of fuels has frequently been at the center of debates about how a future low-carbon mobility system can be achieved. This paper introduces two visions of biogas fuels and electricity using material from interviews and documents in Swedish transport. These visions are analyzed as interrelated sociotechnical imaginaries. To better understand the way visions of biogas and electric vehicles (EVs) dynamically shape and condition each other, four dimensions of sociotechnical imaginaries are further developed: spatial boundedness, temporality, coherence and contestation, and the socio-material relations they are associated with. Imaginaries of biogas and EVs differ with respect to these characteristics. The biogas imaginary is made up of locally bounded visions of the desirable future, showing how imaginaries can be fragmented and contested, often because of their embeddedness in local socio-material systems of resource use. This local boundedness is exemplified by contrasting cases of contested biogas imaginaries in the Swedish municipalities of Linköping and Malmö. The imaginary of EVs, in contrast, is more uniform nationally and even influenced by international expectations that in the future vehicles will be shared, electric, and autonomous. The qualities of these imaginaries shape the way they interrelate and coevolve as sociotechnical changes of the transport system unfold.

Noel, L. D., Rubens, G. Z. D., Kester, J. and Sovacool, B. K. (2021)
Leveraging User-based Innovation in Vehicle-to-X and Vehicle-to-Grid Adoption: A Nordic Case Study.

Journal of Cleaner Production 287, 125591
link

While vehicle-to-grid technology could provide substantial benefits to consumers and society, its adoption has been confined to a niche and relatively stagnant. In this article, we study the role of user-based innovations in increasing the acceptance and adoption of niche technologies such as vehicle-to-grid. To do so, we connect three interrelated concepts—tinkering, testing and tacit knowledge—and then theorize how they interact in three theories—diffusion of innovation, social construction of technology, and the multi-level perspective. Drawing from a rich set of original data, we then apply the theorization of user-based innovation to the adoption of vehicle-to-grid in the Nordic region, by focusing on how users can influence an emerging state-of-the-art innovation, vehicle-to-X. We find that the three concepts of tinkering, testing, and tacit knowledge should be encouraged in order to accelerate and stabilize the adoption of vehicle-to-grid. We conclude the study by examining how the theorization of tinkering may benefit the understanding of other technologies' diffusion pathways and recommend directions for future research.

Pappalardo, M. and Debizet, G. (2020)
Understanding the Governance of Innovative Energy Sharing in Multi-Dwelling Buildings through a Spatial Analysis of Consumption Practices.
Global Transitions 2, 221–29
link

In collective self-consumption (CSC) communities, citizens come together to produce renewable energy and need to find ways to organise the sharing of consumption at the (micro-)local level. The articulation between the exposure of individual practices and the collective objective of lowering consumption outside solar periods leads to dynamics of social control and privacy preservation that vary according to the nature of spaces. Observing two operations of solar energy sharing in multi-dwelling buildings, our ethnographic analysis investigates the practices of occupying different types of space – from the common to the private - as well as the scenes of discussion among individuals. In this sense, our research reveals a strong intertwining between, on the one hand, the governance of energy communities and, on the other, the spaces in which consumption practices, energy accounting and deliberation processes take place.

Pappalardo, N., and Reverdy, T. (2020)
Explaining the Performance Gap in a French Energy Efficient Building: Persistent Misalignment between Building Design, Space Occupancy and Operation Practices.
Energy Research & Social Science 70, 101809
link

Relying upon sociotechnical analysis of technology in organizations, space occupation studies, and the sociology of organizations, this paper investigates the dynamics of appropriation of space and equipment by the occupants of a high-performance tertiary building, the adaptation of equipment by the building operator, and the effects on energy performance. Through an ethnographic qualitative survey, we analyze the dependencies between occupants, operators and managers associated with the use and the adaptation of the building and its equipment. Our analysis shows that the dynamics of appropriation of technologies and occupied space have decisive effects on the functioning of the system, comfort experience and energy performance. The learning dynamics of users and operators can overcome some misfits between building design, space occupancy and operation practices, but the persistence of misalignments hinders energy optimization and comfort experience. Organizational structure and the subcontracting of building operations contribute to this misalignment, while organizational reconfigurations through informal cooperation remain limited.

Petzer, B. J. M., Wieczorek, A. J. and Verbong, G. P. J. (2021)
The legal street: a scarcity approach to urban open space in mobility transitions.
Urban Transformations 3, 3
link

An urban mobility transition requires a transition in space allocation, since most mobility modes are dependent on urban open space for circulation and the storage of vehicles. Despite increasing attention to space and spatiality in transitions research, the finite, physical aspects of urban space, and the means by which it is allocated, have not been adequately acknowledged as an influence on mobility transitions. A conceptual framework is introduced to support comparison between cities in terms of the processes by which open space is (re-)distributed between car and bicycle circulatory and regulatory space. This framework distinguishes between regulatory allocation mechanisms and the appropriation practices of actors. Application to cases in Amsterdam, Brussels and Birmingham reveal unique relationships created by the zero-sum nature of urban open space between the dominant automobility mode and subordinate cycling mode. These relationships open up a new approach to forms of lock-in that work in favour of particular mobility modes within the relatively obdurate urban built environment. Empirically, allocation mechanisms that routinise the production of car space at national level within the EU are shown to be far more prevalent than those for bicycle space, highlighting the constraints faced by radical city-level policies aimed at space reallocation.

Rohe, S. and Chlebna, C. (2021)
A spatial perspective on the legitimacy of a technological innovation system: Regional differences in onshore wind energy.
Energy Policy, 151
link

Legitimacy is a key function within Technological Innovation Systems (TIS), influencing the development and diffusion of novel technologies such as onshore wind energy. By combining insights from TIS and from organization studies, we provide theoretical and empirical underpinnings to 'legitimacy', a concept often defined superficially and mapped at an aggregate, national level. We add a spatial perspective by comparing dimensions of legitimacy between two heterogenous regions in Germany. They have similar diffusion trajectories of wind energy but differ in structural features (socio-economic factors and TIS elements). To capture place-specific institutions and dynamics influencing regional legitimacy, we focus on decision makers and their perception of the TIS. Even though politicians and civil servants are crucial for wind development in their constituent regions and are thus important contextual actors to the TIS, their perspective has been mostly neglected. Applying a comprehensive, mixed methods approach, we conducted an online survey among these decision makers and complemented the insights with qualitative expert interviews. Our analysis shows that pragmatic and moral dimensions of legitimacy are particularly susceptible to place-specific influences. These spatially sensitive insights have been missing from the debate on legitimacy so far and might inform policy directed at advancing technological legitimacy in certain regions.

Sharma, A., & Banerjee, R. (2021)
Framework to analyze the spatial distribution of the labor impacts of clean energy transitions.
Energy Policy, 150, 112158
link

This paper presents an analytical framework to study the spatial distribution of the labor impacts of clean energy transitions. While there exists optimism about the job creation potential of clean energy industries, just transitions literature has emphasized that the costs and benefits of energy transitions will not be distributed equally. Aggregate labor estimates hide the regional inequalities that might surface sub-nationally. We use the analytical framework to study India's power sector. Our results suggest that Indian government's 2022 target of 100 GW solar capacity will generate jobs primarily in western and southern parts of India as 60% of the total jobs will be located in the states of Maharashtra, Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh, and Karnataka. If solar capacity addition targets are accompanied by retirement of thermal capacity, net employment impact will be negative with job losses being concentrated in the coal-mining states located in eastern India. Policy-makers can use this framework to identify the sub-national regions – states, districts, and counties – that will experience job losses due to energy transitions and estimate the number of jobs or economic compensation required for the negatively impacted communities. This framework can be applied to other industries and regions as well.

Silva, V. (2020)
The Emerging research field of sustainability transitions: an evolutionist perspective on scientific advance.
Transversal: International journal for the historiography of science
link

The main goal of this article is to understand the process of formation of the sustainability transitions (ST) research field. The working hypothesis of this article states that the field arises through a process of speciation: gradual differentiation, from an older and already established research field (innovation studies). This exercise is useful both as a first approximation into the history of ST thought and as a means to assess the explanatory potential of different approaches towards scientific advance (epistemological discussion). Our proxy to investigate the evolution of the field is the ST language or scientific lexicus (concepts, terms and vocabulary) and how it came to be. The methodology to assess the evolution of this object is threefold: documental analysis (epistemic communities' newsletters); critical review of the literature (retrofitted concepts and proto-ideas) and bibliometric analysis (Scopus/Vantage Point). The documental analysis provides evidence that ST is, indeed, an emergent scientific field. A critical review of the literature points to connections and redetermination of pre-existent concepts and terms from the innovation studies area; bibliometric evidence points to a movement of distancing: after building its own lexicon coherent to its problem framing, ST research area is gradually leaving innovation studies terms and concepts behind. General results point to a process of speciation, reinforcing the explanatory potential of epistemological evolutionism.

Sovacool, B.K. (2021)
When subterranean slavery supports sustainability? Power, patriarchy, and child labor in artisanal Congolese cobalt mining.
Extractive Industries & Society 8(1), pp. 271-293
link

Through the critical lenses of "modern slavery," "dispossession," and "gendering," this study examines the contours of power, patriarchy, and child labor in the artisanal and small-scale mining (ASM) of cobalt in the

Democratic Republic of the Congo (DRC). There, a veritable mining boom for cobalt is underway, driven by rising global demand for batteries and other modern digital devices needed for future sustainability transitions. Based on extensive and original field research in the DRC—including 23 semi-structured expert interviews with a purposive sample, 48 semi-structured community interviews with ASM miners, traders, and community members, and site visits to 17 artisanal mines, processing centers, and trading depots—this study asks: What power relations does ASM cobalt mining embed? What are its effects on patriarchy and gender relations? Critically, what is the extent and severity of child labor? It documents the exploitation of ASM miners by the government, the police, and even at times other mining actors such as traders or local communities. It reveals the often invisible gendered nature of mining, showing how many vulnerabilities—in terms of work, status, social norms, and sexual abuse and prostitution—fall disproportionately on women and girls. It lastly reveals sobering patterns of child labor and abuse, again at times by the government or police, but other times by families or mining communities themselves. These factors can at times make cobalt mining a modern form of slavery and a catalyst for social, economic, and even regional dispossession. However, rather than despair, the study also draws from its empirical data to showcase how mining can in selected situations empower. It also proposes a concerted mix of policy reforms aimed the Congolese government (at all scales, including local and national); suppliers and end-user companies for cobalt; and international governments and trading bodies. In doing so, the study humanizes the plight of Congolese cobalt artisanal miners, reveals the power relations associated with the recent mining boom, and also proposes pathways for positive change.

Sovacool, B.K. (2021)
Who are the victims of low-carbon transitions? Towards a political ecology of climate change mitigation.
Energy Research & Social Science 73, 101916, pp. 1-16
link

This study critically examines 20 years of geography and political ecology literature on the energy justice implications of climate change mitigation. Grounded in an expert guided literature review of 198 studies and their corresponding 332 case studies, it assesses the linkages between low carbon transitions—including renewable electricity, biofuel, nuclear power, smart grids, electric vehicles, and land use management—with degradation, dispossession and destruction. It draws on a framework that envisions the political ecology of low-carbon transitions as consisting of four distinct processes: enclosure (capture of land or resources), exclusion (unfair planning), encroachment (destruction of the environment), or entrenchment (worsening of inequality or vulnerability). The study vigorously interrogates how these elements play out by country and across countries, by type of mitigation option, by type of victim or affected group, by process, and by severity, e.g. from modern slavery to organized crime, from violence, murder and torture to the exacerbation of child prostitution or the destruction of pristine ecosystems. It also closely examines the locations, disciplinary affiliations, methods and spatial units of analysis employed by this corpus of research, with clear and compelling insights for future work in the space of geography, climate change, and energy transitions. It suggest five critical avenues for future research: greater inclusivity and diversity, rigor and comparative analysis, focus on mundane technologies and non-Western case studies, multi-scalar analysis, and focus on policy and recommendations. At times, low-carbon transitions and climate action can promote squalor over sustainability and leave angry communities, disgruntled workers, scorned business partners, and degraded landscapes in their wake. Nevertheless, ample opportunities exist to make a future low-carbon world more pluralistic, democratic, and just.

Sovacool, B.K., Bazilian, M., Griffiths, S., Kim, J., Foley, A. and Rooney, D. (2021)
Decarbonizing the food and beverages industry: A critical and systematic review of developments, sociotechnical systems and policy options.
Renewable & Sustainable Energy Reviews 143, 110856, pp. 1-35
link

From farm to fork, food and beverage consumption can have significant negative impacts on energy consumption, water consumption, climate change, and other environmental subsystems. This paper presents a comprehensive, critical and systematic review of more than 350,000 sources of evidence, and a short list of 701 studies, on the topic of greenhouse gas emissions from the food and beverage industry. Utilizing a sociotechnical lens that examines food supply and agriculture, manufacturing, retail and distribution, and consumption and use, the review identifies the most carbon-intensive processes in the industry, as well as the corresponding energy and carbon “footprints”. It discusses multiple current and emerging options and practices for decarbonization, including 78 potentially transformative technologies. It examines the benefits to sector decarbonization—including energy and carbon savings, cost savings, and other co-benefits related to sustainability or health—as well as barriers across financial and economic, institutional and managerial, and behavioral and consumer dimensions. It lastly discusses how financing, business models, and policy can be harnessed to help overcome these barriers, and identifies a set of research gaps.

Sovacool, B.K., Cabeza, L.F., Pisello, A.L., Colladon,

A.F., Larijani, H.M., Dawoud, B. and Martiskainen, M. (2021)
Decarbonizing household heating: Reviewing demographics, geography and low-carbon practices and preferences in five European countries.
Renewable & Sustainable Energy Reviews 139, 110703
link

What commonalities are there in sustainable or unsustainable heating practices in five high-income, high-emitting western European countries? What preferences do a nationally representative sample of the public in these countries hold towards low-carbon options? It is imperative that climate policy researchers and practitioners grapple with the difficulty of decarbonizing heat, which remains the largest single end-use service worldwide and which accounts about half of total final energy consumption. Based on a comparative assessment of five representative national surveys in Germany (N = 2009), Italy (N = 2039), Spain (N = 2038), Sweden (N = 2023), and the United Kingdom (N = 2000), this study explores the demographics and geography of household heat decarbonisation in Europe. By analyzing our country level data as well as our combined sample of 10,109 respondents, it investigates how people conceive of the purposes of low-carbon heat, their preferences for particular forms of heat supply, and their (at times odd) practices of heat consumption and temperature settings. Grounded in its original data, the study organizes its findings inductively across the five themes of literacy (heating knowledge, awareness and control), sustainability (heating practices, dynamics and conflicts), temperature (heating satisfaction and preferences), desirability of change (low-carbon heating priorities, business models and trust), and culture (country and national variation). The study also explores intersections between these dimensions, using multivariate analysis, as well as how preferences differ according to varying types of actors as well as geography and space.

Sovacool, B.K., Griffiths, S., Kim, J. and Bazilian, M. (2021)
Climate change and industrial F-gases: A critical and systematic review of developments, sociotechnical systems and policy options for reducing synthetic greenhouse gas emissions.
Renewable & Sustainable Energy Reviews 141, 110759
link

Humanity has come to depend on synthetic, factory made gases that have extremely significant global warming potential. Fluorinated greenhouse gases, or F-gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3) have been termed “super pollutants” and “super greenhouse gases” given their severe and powerful impact on the climate. They are the most potent greenhouse gases known to modern science, with global warming potentials far greater than carbon dioxide, some up to almost 24,000 times more so. Troublingly, they are also the fastest growing class of greenhouse gas emissions around the world, especially in developing countries. Research suggest that almost 40% of their emissions by 2050 will fall outside the scope of international agreements such as the Paris Accord, Montreal Protocol and Kigali Amendment. Without comprehensive and sustained interventions, uncontrolled growth in F-gas emissions could offset all of the gains made by the Clean Development Mechanism of the Kyoto Protocol, or the cornerstone of existing international climate governance, the Nationally Determined Contributions of the 2015 Paris Accord. This review asks: What options are available to mitigate the environmental impacts of F-gases and thus make their manufacturing or disposal far more sustainable? What technical solutions and innovations exist to make their industrial usage low to zero carbon? What benefits will accrue from F-gas mitigation, and what barriers will need addressed? It undertakes a comprehensive and critical review of more than 140,000 sources of evidence, and a short list of 855 studies on the topic. It utilizes a sociotechnical lens that examines the manufacturing and use of F-gases across multiple sectors (including refrigeration, electronics manufacturing, non-ferrous metals processing, and applications in consumer goods) and components of its lifecycle (including not only manufacturing, but also use, disposal and destruction). We find that there are several policies and regulations that can be employed to address this already serious and growing climate change challenge.

Sovacool, B.K., Kim, J. and Yang, M. (2021)
The hidden costs of energy and mobility: A global meta-analysis and research synthesis of electricity and transport externalities.
Energy Research & Social Science 72, 101885
link

What is the range and scope of externalities associated with electricity supply, energy efficiency, and transport? What research methods and techniques of valuation does the community use to monetize these externalities? What policy implications arise in terms of better governing energy and mobility systems? To answer these questions, this study offers a comprehensive and global research synthesis of externalities for energy and mobility. It synthesizes data from 139 studies with 704 distinct estimates to examine the hidden social and environmental costs. The mean external cost for electricity supply is 7.15¢/kWh. When correlating this with the actual amount of electricity generated per year, the amount is $11.644 trillion. This likely exceeds both the reported revenues for electricity sales, oil and gas production as well as the levelized costs of energy. The mean external cost for mobility is 17.8¢/km. Using differentiated estimations of the externalities associated with aviation, road travel for

passengers and freight, rail, and coastal water/marine modes of travel, transport's global externalities amount to another $13.018 trillion. When combined, this $24.662 trillion in externalities for energy and transport is equivalent to 28.7% of global Gross Domestic Product. Energy efficiency or demand response by contrast has net positive externalities of approximately 7.8¢/kWh. When put into the context of global efficiency and demand management efforts, this approaches an annual positive value of $312 billion. The fundamental policy question is whether we want global markets that manipulate the presence of externalities to their advantage, or a policy regime that attempts to internalize them.

Stephan, A., Anadon, L. D. and Hoffmann, V. H. (2021)
How has external knowledge contributed to lithium-ion batteries for the energy transition?
iScience, 24 (1), 101995
link

Innovation in clean-energy technologies is central toward a net-zero energy system. One key determinant of technological innovation is the integration of external knowledge, i.e., knowledge spillovers. However, extant work does not explain how individual spillovers come about: the mechanisms and enablers of these spillovers. We ask how knowledge from other technologies, sectors, or scientific disciplines is integrated into the innovation process in an important technology for a net-zero future: lithium-ion batteries (LIBs), based on a qualitative case study using extant literature and an elite interview campaign with key inventors in the LIB field and R&D/industry experts. We identify the breakthrough innovations in LIBs, discuss the extent to which breakthrough innovations—plus a few others—have resulted from spillovers, and identify different mechanisms and enablers underlying these spillovers, which can be leveraged by policymakers and R&D managers who are interested in facilitating spillovers in LIBs and other clean-energy technologies.

Stephens, R. and Barbier, M. (2021)
Digital fooding, cashless marketplaces and reconnection in intermediated third places: Conceptualizing metropolitan food provision in the age of prosumption.
Journal of Rural Studies, 82, pp. 366 – 379
link

This article adopts the concept of prosumption in order to better understand the array of contemporary food sustainability transition initiatives that often come under the umbrella term of Alternative Food Networks (AFNs). AFNs have developed in parallel to prosumption, which is significant because AFNs are oriented towards localized and direct relationships between producers and consumers, while prosumption explains the hybridization of the consumer into a more complex and productive actor. Scholars argue that producer-consumer reconnections enable greater transparency and information exchange between the two types of actors. In addition, digitalization has recently brought new perspectives for both prosumption and AFN research. We explain the digital food prosumption phenomenon by drawing upon several years of research on an alternative food network with strong digital focus – *La Ruche qui dit Oui!.* As a decentralized network of local food operations that converge around a digital platform, it provides innovative virtual-material mediations between producers and consumers. This suggests that increasingly, consumers may be getting more deeply engaged in the (co-)production of commodities across different sectors and activities. Thus, while the prosumption and AFN literatures have mostly existed in parallel, future efforts should be made to intersect these two areas of sociological research. This is particularly pertinent today, as both prosumption and AFN phenomena are now increasingly mediated by powerful digital technologies. In the digital age, the alternative food prosumer phenomenon may well contribute to reconfiguring global food flows and industrial cultures towards sustainability.

Stephenson, J., Sovacool, B.K. and Inderberg, T. H. J. (2021)
Energy cultures and national decarbonisation pathways.
Renewable & Sustainable Energy Reviews 137, 110592
link

Global climate change negotiations are delivering expectations that all nations must commit to rapidly reducing their reliance on fossil fuels. It is unclear why there is such significant variability in nations' decarbonisation ambitions. We use the lens of 'energy cultures' to explore what insights this analysis can offer to this question. We suggest that a country's 'energy culture' can be envisaged as the interplay between normative, material, institutional and policy-related attributes of the national decision-making apparatus. This provides a meta-framework which underpins our exploration of factors which previous studies suggest may shape national energy ambitions. We apply this framework to case studies of India, Denmark, China and Russia to see whether it has explanatory power across diverse cases, initially using four empirical indicators. There was no consistent correlation between the indicators and low-carbon ambitions, which led us to draw more deeply and inductively on the cultural influences evident in each nation over a 30-year period. Our findings suggest that national low-carbon ambitions are strongly cultural, contingent upon how any particular nation sees the role of energy, and the choices, policies, investments and actions that flow from this. This energy culture may constrain the extent to which nations are

willing to respond to the challenge of climate change. The analysis indicates how nations require very different stimuli if they are to strengthen their low-carbon trajectories. We conclude that the concept of national energy cultures is a useful addition to approaches that are examining how to raise national low-carbon ambitions.

Super, S., Klerkx, L.W.A., Hermens, N. and Koelen, M.A. (2020)
A multilevel transition perspective on embedding intersectoral action in local health policies.
Health Promotion International
link

Intersectoral action is advocated as a social practice that can effectively address health inequalities and related social issues. Existing knowledge provides insight into factors that may facilitate or hinder successful intersectoral action, but not much is known about how intersectoral action evolves and becomes embedded in local health policies. This is where this study aims to make its contribution, by adopting the multilevel perspective on transitions, which is increasingly used to study social innovation in sustainability transitions but has not yet been applied to public health and health promotion. Through this perspective, it was unravelled how intersectoral action between youth-care organizations and community sports clubs became embedded in local health policies of Rotterdam, a large city in the Netherlands. A single explorative case study was conducted based on content analysis of policy documents and 15 in-depth interviews with policy officers, managers and field workers operating in the fields of youth and sports in Rotterdam. The findings showed that intersectoral action between community organizations and policymakers evolves through congruent processes at different levels that changed institutional logics. Moreover, it emerged that policymakers and other actors that advocate novel social practices and act as boundary spanners can adopt multiple strategies to embed these practices in local health policy. The multi-level perspective adds value to earlier approaches to research intersectoral collaboration for health promotion as it allows to better capture the politics involved in the social innovation processes. However, further sharpening and more comprehensive application of transition concepts to study transitions in public health and health promotion is needed.

Svensson, O. (2021)
The matter of energy emerges: Bridging the divide between conflicting conceptions of energy resources.
Energy Research & Social Science, 72, 101895
link

After decades of theoretical neglect of material properties and relations, a much welcome material turn within social science energy research has recently raised discussions of materiality to the centre of current debates. So far, the efforts to rematerialize energy has to a large extent drawn on new materialist thinking. Against the substantivalist conception of energy resources as self-standing natural things with inherent properties new materialists have developed relational conceptions that are anti-essentialist and emphasize indeterminacy, contingency, and unruliness. This article critically and constructively discusses new materialism, some of its limitations and problems, and how a critical realist perspective can resolve these. Based on the concept of emergence, a stratified conception of natural resources is developed, which seeks to dialectically sublate conceptions of natural resources as either things-in-themselves with intrinsic properties or relational effects.

Tsouri, M., Hanson, J. and Normann, H.E. (2021)
Does participation in knowledge networks facilitate market access in global innovation systems? The case of offshore wind.
Research Policy, 50
link

This article explores how knowledge networks function as structural couplings in global innovation systems (GIS). Based on a unique dataset we investigate the effects of Norwegian offshore wind firms' participation in different knowledge networks on international market access. The results show that international knowledge networks facilitate access to market resources in a GIS under certain conditions. First, participating in pilot and demonstration projects positively affects firms' access to international markets. Second, participation in R&D projects has only a positive effect on international market access when R&D collaboration involves international partners. This effect is stronger when collaborators come from countries with a domestic market. Our results show that knowledge networks can function as one type of structural coupling (between a country and the GIS), which can facilitate another type of coupling (between knowledge and markets). The extent of coupling depends on the innovation mode and geographic scale of the knowledge networks. An implication for policy is that knowledge resources can be leveraged through incentives for international collaboration, and support for pilot and demonstration activities.

Ulsrud, K. (2020)
Access to electricity for all and the role of decentralized solar power in sub-Saharan Africa.
Norwegian Journal of Geography, 74 (1), 54-63
link

As stated by the United Nations, several hundred million

people in sub-Saharan Africa are at risk of being without access to electricity by 2030. This paper offers explanations of the problem from a bottom-up perspective, based on qualitative interviews, quantitative surveys, observation, and participation in Kenya and Senegal between 2010 and 2018. The findings give new insights in the pervasive issue of affordability and extreme poverty, the mismatch between the internal, micro-level geographies of village communities and existing grid-based electricity systems, and the lower access to electricity for women than for men. In the study areas, decentralized small-scale solar power addressed these three issues better than conventional electricity grids where such grids were present. The paper further shows how village communities have started to mix and combine the use of solar-powered electricity with grid-supplied electricity at the same time as large portions of local populations are unable to use any of the options due to extreme socio-economic inequalities. The author argues that these findings add to earlier knowledge on the shortcomings of centralized grids as well as remaining weaknesses and growing opportunities of decentralized solar power models. A recommendation for the further work on just energy transitions and access to electricity for all in sub-Saharan Africa is that energy sector decision makers and international partners take such bottom-up insights much stronger into account and facilitate comprehensive system innovation to fully integrate decentralized solar power in energy sector institutions and strategies.

Weber, H., Poeggel, K., Eakin, H., Fischer, D., Lang, D. von Wehrden, H. and Wiek, A. (2020)
What are the ingredients for food systems change towards sustainability? Insights from the literature.
Environmental Research Letters 15, 113001
link

Many detrimental effects on the environment, economy, and society are associated with the structure and practices of food systems around the world. While there is increasing agreement on the need for substantive change in food systems towards sustainability, divergent perspectives exist on what the appropriate points of intervention and strategies to achieve such change are. Change in diets and nutrition, the importance of social food movements, and sustainable farming practices are all disparately featured in the literature; yet, there is little effort to compare and integrate these perspectives. This review offers a comprehensive overview of perspectives on food systems change towards sustainability. We discern where there is convergence and assess how the literature reflects emergent theory on sustainability transformation. We analyzed more than 200 peer-reviewed articles employing an approach that combines quantitative and qualitative analysis. First, we performed a semantic hierarchical cluster analysis of the full texts to identify thematic clusters representing different perspectives on sustainability transformations and transitions of food systems. Second, we conducted a qualitative text analysis for representative articles of each cluster to examine how deep changes in the food system are conceptualized. We identified five distinct approaches to food systems change that are currently discussed, i.e. *Alternative food movements, Sustainable diets, Sustainable agriculture, Healthy and diverse societies,* and *Food as commons*. Each approach provides a nuanced perspective on identified sustainability problems, envisioned sustainable food systems, and proposed actions to change food systems towards sustainability. The findings offer guidance for researchers and practitioners working on food systems change towards sustainability.

Woiwode, C., Schäpke, N., Bina, O., Veciana, S., Kunze, I., Parodi, O. and Wamsler, C. (2021)
Inner transformation to sustainability as a deep leverage point: fostering new avenues for change through dialogue and reflection.
Sustainability Science, 1-18
link

This article provides a rationale for inner transformation as a key and hitherto underresearched dimension of sustainability transformations. Inner transformation relates to various aspects of human existence and interactions such as consciousness, mindsets, values, worldviews, beliefs, spirituality and human–nature connectedness. The article draws on Meadows' leverage points approach, as places to intervene in a system, to reveal the relevance of inner transformation for system change towards sustainability. Based on insights from a series of dialogue and reflection workshops and a literature review, this article provides three important contributions to sustainability transformations research: first, it increases our conceptual understanding of inner transformation and its relevance for sustainability; second, it outlines concrete elements of the inner transformation-sustainability nexus in relation to leverage points; and third, it presents practical examples illustrating how to work with leverage points for supporting inner transformation. In sum, the paper develops a systematized and structured approach to understanding inner transformation, including the identification of deep, i.e., highly influential, leverage points. In addition, it critically discusses the often contentious and divergent perspectives on inner transformation and shows related practical challenges. Finally, current developments in inner transformation research as well as further research needs are identified.