STRN Newsletter

N°34 | December 2019

Sustainability Transitions Research Network.

Newsletter 34 – December 2019

Content

Special on Decline

About

The STRN newsletter is published four times a year. The next issue will appear in March 2020.

Cover: Decline-related images (source: pixabay.com)

Editorial

by Daniel Rosenbloom, University of Toronto
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While the lion's share of climate policy remains focused on innovation, there is mounting engagement with policies and initiatives targeting the decline of environmentally damaging technologies, practices, and substances. Over the past few years, the ranks of governments and businesses committing to phase out coal from the electricity system have swelled (see the Powering Past Coal Alliance at 91 members and counting). We have also witnessed a growing number of jurisdictions move to ban certain single use plastics. And, in transport, national and subnational governments from Norway to British Columbia have announced that they will end the sale of new internal combustion engine cars within the next two decades or so.

Efforts to promote the decline of fossil fuels extend even further, however. The financial resources of carbon-intensive systems are also being targeted through global initiatives to divest from fossil fuel assets. According to divestinvest.org, over one thousand organizations and nearly six times as many individuals have made divestment commitments worth over 8 trillion dollars in total. There are also increasing calls to end fossil fuel subsidies and the privileged position of fossil fuel interests in political decision-making.

This growing emphasis on the intentional decline of fossil fuels mirrors a similar turn in transitions research. Rather than focusing on innovation, transition scholars have increasingly moved to study the processes surrounding the destabilization of socio-technical systems such as electricity, agri-food, or mobility. They have shed light on the sites and patterns of pressures that upset carbon-intensive regimes and their path-dependent trajectories. Studies have identified the many functions policies will need to fulfill in order to support destabilization and break carbon lock-ins. These functions involve placing pressure on regimes by: disincentivizing or banning incumbent technologies (from phase-outs to carbon pricing); reforming core rules (to support broader societal goals); eroding resources (financial or otherwise); and weakening actor networks and access to decisionmakers (rebalancing advisory boards to limit incumbent involvement). Transition scholars also point to the importance of developing coherent policy mixes that target multiple pressure points and drive system change.

While the growing engagement around decline in transitions research and policy is promising, it is not without challenges. First, decline should not be interpreted as a call against all incumbency. In a number of instances, reconfiguration (a layering of old and new) rather than full substitution (only new) may be a more practicable pathway. Second, a focus on deliberate decline is likely to yield considerable political resistance that will need to be overcome. In contrast to innovation, which might take decades to manifest as a disruptive force, decline-related efforts such as coal phase-outs represent immediate and direct threats to longstanding fossil fuel interests. Third, and relatedly, there are individuals and communities that will be caught up in these disruptive episodes where livelihoods and local economies are entwined with fossil fuel production and use. Impacts on these communities must be mitigated, which opens an important conversation around just transitions and the societal benefits of transformation.

A series of contributions to this newsletter take up these issues. Bruno Turnheim traces the history of destabilization research in transition scholarship, pointing to promising future research directions but also important challenges. Adrian Rinscheid and Aya Kachi reflect upon the prospects of phase-outs in low-carbon transitions and introduce their project on the political economy of coal policy. Rounding out these contributions, Jennie Stephens responds to my questions about the justice dimensions of decline.

Taken together, decline represents an important avenue for transition research and practice. It is needed in the face of deep carbon lock-ins and strategic efforts by many incumbents to resist, coopt, or slow down transformative pathways toward sustainability. Without engaging seriously with decline, there is a risk that problematic arrangements will persist for decades and undermine our ability to mitigate the worst impacts of climate change and other sustainability challenges. Even though political and societal efforts that target decline are gaining prominence, they are still fragmented and fossil fuels remain firmly embedded. So, while current initiatives might eventually lead to a ‘death by a thousand cuts’ for fossil fuel arrangements, concerted and broader efforts toward decline will be needed to accelerate this process.

EIST Journal

Volume 33 (November 2019) has just been published. It contains 19 articles and a book review.

- Institutional entrepreneurship in the platform economy: How Uber tried (and failed) to change the Dutch taxi law, by P. Pelzer, K. Fenken and W. Boon
- A heuristic for conceptualizing and uncovering the determinants of agency in socio-technical transitions, by M. Duygan, M. Stauffacher and G. Meylan
- Agency in transition: The role of transnational actors in the development of the off-grid solar PV regime in Uganda, by P. Lakshmi Bhamidipati, U. Elmer Hansen and J. Haselip
- Transformative versus conservative automotive innovation styles: Contrasting the electric vehicle manufacturing strategies for the BMW i3 and Fiat 500e, by B.K. Sovacool, J.-C. Rogge, C. Saleta and E. Masterson-Cox
- Coping with uncertainties of sustainability transitions using exploratory modelling: The case of the MATISSE model and the UK's mobility sector, by E.A. Moallemi and J. Köhler
- Innovation challenges of utilities in informal settlements: Combining a capabilities and regime perspective, by M.J. van Welie, B. Truffer and H. Gebauer
- Conditions for the deliberate destabilisation of established industries: Lessons from U.S. tobacco control policy and the closure of Dutch coal mines, by H. Endresen Normann
- The role of regime-level processes in closing the gap between sustainable city visions and action, by R. Huxley, A. Owen and P. Chatterton
- Sharing is caring: The role of culture in the transformative capacity and continuation of agri-food networks, by M. Hubeau et al.
- Markets as leverage points for transformations of economic systems: The example of the German bioeconomy, by H. Schanz, J. Federer and M. Wilczynski
- How the regime hampered a transition to renewable electricity in Hungary, by M. Antal
- Incumbent Resistance and the Solar Transition: Changing Opportunity Structures and Framing Strategies, by D. Lee and D.J. Hess
- Towards sustainable urban basic services in low-income countries: A Technological Innovation System analysis of sanitation value chains in Nairobi, by M.J. van Welie, B. Truffer and X.-S. Yap
- Align, adapt or amplify: Upscaling strategies for car sharing business models in Sydney, Australia, by L.L.J. Meijer, F. Schipper and J.C.C.M. Huijben
- Conceptualising the built environment to inform sustainable urban transitions, by J. Nielsen and M.A. Farrelly
- Technological innovation system analysis in a follower country – The case of offshore wind in Poland, by J. Sawulski, M. Gałczyński and R. Zajdler
- Community-based initiatives and the politicization gap in socio-ecological transitions: Lessons from Portugal, by J. Morais Mourato and A. Bussler
- Governance of the circular economy: A comparative examination of the use of standards by China and the United Kingdom, by A. Flynn, N. Hacking and L. Xie
- A transition to an innovative and inclusive bioeconomy in Aragon, Spain, by A. Sanz-Hernández, M.V. Sanagustín-Fons and M.E. López-Rodríguez

Book review:

- Energy and Economic Growth: Why We Need a New Pathway to Prosperity by Timothy J. Foxon. 2018. Earthscan for Routledge. Abingdon, by R. Fouquet

In addition, several responses to the transitions research agenda paper are already online (in press section). We will soon collect these in a special issue format (foreseen to include 8 to 10 contributions).

Finally, some news items:

- First, in September we have added a fourth associate editor to the team, namely prof. Paula Kivimaa (Finish Environment Institute and SPRU-Sussex). This reduces the work load for

the other editors, given the increasing number of submissions to EIST.

- Second, the latest impact factor of EIST has been released. It stands at 7.514, which is nice.
- Third, I intend to step down as editor-in-chief around July 2021. This gives sufficient time to find a successor, for which in due time a search process will start guided by a committee consisting of editorial team members, STRN board members and possibly additional senior researchers.

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

STRN Events

Upcoming

5th NEST conference, Zurich, May 7-8, 2020

Surging right before the deadline, submissions to participate in the 5th NEST conference have surpassed the organizers' expectations. In total, about 100 submissions were sent from all corners of the World, from North America to South Africa, East Asia and the North of Europe. In the coming weeks, the organizing committee will carefully review the submissions and select 80 participants based on scientific relevance and quality of the applications.

Decisions will be communicated by mid-January.

We expect the 5th NEST conference to be an exciting event. The organizers thank all applicants for their interest.

For further inquiries, please contact the organizing team at transitions.nest@gmail.com

IST 2020 conference, Vienna, August 18-21

Planning for the 11th IST conference is in full swing. The call for papers will be published in the next days and the deadline for sending your paper abstracts or session proposals will be end of January 2020.

For further inquiries, please contact the organizing team at ist2020@ait.ac.at

Other Events

Upcoming

PhD course: Cities in climate and energy transformations, Bergen, June 8-18, 2020

This course is part of the Bergen Summer Research School and examines what roles cities and urban regions play in climate and energy transformations. The world is urbanising rapidly. At the same time, the world must accelerate climate action – and cities are key actors to deliver much of the requisite action.

Cities have critical policy tools at their disposal. A C40 report identifies major opportunities such as decarbonising the electricity grid, optimising building energy use, enabling sustainable mobility and improving waste management. Cities are also important political change arenas. While many national leaders have sidestepped climate commitments, city leaders have stepped up theirs. City networks equip ambitious leaders and planners locally and globally, enabling shared resources, ideas and experiences. Cities host civil society climate politics, ranging from youth-led 'climate strikes' to 'yellow vest' protests. These contentious forces behind urban change merit critical examination.

Course participants and faculty will unpack a well-rounded understanding of how cities and urban regions are shaping the global trajectory of climate and energy transformations.

The course uses lectures, group discussions, video content and workshops with concrete examples that reflect and advance our collective thematic understanding. Through innovative techniques, we channel insights from participants' projects and seek to engender actionable knowledge.

Application deadline: **1 February 2020**

More information

Håvard Haarstad and Siddharth Sareen

EGOS, July 2-4, 2020 Hamburg.
Sub-theme on Sustainability Transitions: Bridging Systems and Organizational Perspectives to Tackle Grand Challenges

Our sub-theme at the upcoming EGOS colloquium in Hamburg will bring together scholars who study grand sustainability challenges and transformation from different perspectives, including systems and organizations. We are particularly interested in contributions that explore new approaches, perspectives, and methods.

Deadline for submission of short papers (3000 words) is **January 14, 2020**.

More information

Jochen Markard, Birthe Soppe, Taran M. Thune

Other News

Policy Impact

The European Environment - State and Outlook 2020: Knowledge for transition to a sustainable Europe

New report by the European Environment Agency

The European Environment Agency launched its SOER-2020 report on 4 December 2019, in time to feed into the European Commission's deliberations on the European Green Deal. The EEA's flagship report not only describes many worsening environmental trends (e.g. in biodiversity, climate change, marine environment, chemical pollution), but also emphasizes the urgent need for sustainability transitions. Chapter 17 of the report ('Responding to sustainability challenges') focuses entirely on sustainability transitions, drawing extensively on concepts and empirical research from our community. In his foreword, the Executive Director therefore notes that SOER-2020 is "the EEA's most comprehensive integrated assessment to date, and the first to address rigorously our systemic challenges in the context of the sustainability transitions that we, as a society, must make."

The executive summary also highlights core ideas from the STRN community, noting that: "A growing body of research and practice provides insights into how fundamental systemic change can be achieved. Such transitions are long-term processes that depend critically on the emergence and spread of diverse forms of innovation that trigger alternative ways of thinking and living — new social practices, technologies, business models, nature-based solutions, and so on. (…) Environmental policy tools remain essential. But enabling systemic change will require a much broader policy mix to promote innovation and experimentation, to enable new ideas and approaches to spread, and to ensure that structural economic change produces beneficial and fair outcomes" (p. 9).

The report can be downloaded from the EEA website.

Accelerating the low carbon transition: The case for stronger, more targeted and coordinated international action.

New report by David Victor, Frank Geels, and Simon Sharpe

This new policy report, aimed at the international climate policy community, moves the debate from a focus on pledges/targets and economy-wide instruments towards a focus on situated systems, ongoing innovation dynamics, and more targeted cooperation between government, business, and civil society. The report combines insights from transitions theory and international relations theory, and applies the insights to ten carbon-intensive sectors (electricity, building, agro-food, trucking, cars, aviation, shipping, steel, cement, plastics). Each international sector analysis discusses: the

stage of the low-carbon transition, mitigation options, nature of the problem now, and how coordinated action can accelerate the transition in emergence, diffusion and reconfiguration phases. It concludes that most sectors are still in the early phase of low-carbon transition, but also identifies leverage points for acceleration.

The report can be downloaded at the website of the Energy Transition Commission.

New projects

Household innovation and the transition to the low waste city

The School of Social Science and Monash Sustainable Development Institute at Monash University (Melbourne), together with the University of Gothenburg (Sweden), have been granted funding from the Australian Research Council for a new three-year discovery project. Drawing on scholarship in sustainability transitions, household consumption studies and political science, the main objective is to develop and test an interdisciplinary comparative framework to understand household innovation in low waste transitions.

A key methodological innovation will follow a participatory action logic, through which this study will recruit and work with 50 households to co-design and evaluate their own low waste household experiments. In combination with household surveys in Adelaide, Brisbane and Melbourne, and through comparative analysis of policy rationales in Sweden and Australia, the study ultimately seeks to develop progressive theory and policy perspectives on household behaviour and innovation in low waste transitions. Amongst others, the project will host an international research workshop on households, innovation and pathways in sustainability transitions with leading scholars from the fields of sustainability transitions, consumption studies, urban geography and environmental governance in Prato, Italy.

For more information, please contact Ruth Lane or Rob Raven.

IDEALE Interplay between national defence and low-carbon energy policies: A sustainability transitions perspective

IDEALE is an Academy of Finland fellowship project lead by Research Professor Paula Kivimaa. It will connect the research streams of sustainability transitions, energy and national security, and policy interplay (policy coherence and policy integration) to analyse the interconnections between energy and security policies. Empirical research will be carried out on Finland, Estonia, Norway and Scotland. The objectives are: to develop the study of policy interplay (policy coherence & policy integration) conceptually and methodologically by incorporating elements of sustainability transitions and security studies; to conduct deep and extensive empirical analysis of synergies and conflicts between national defence and security policy and energy policy from the perspective of sustainability transitions in Finland, Estonia, Norway and Scotland; and to create novel theoretical insights regarding sustainability transitions in connection to national defence and security as extensions to energy security. The project will run from September 2019 until August 2024.

For more information contact Paula Kivimaa.

New project on "Social innovation in energy transitions" (SONNET)

A new EU-funded project called SONNET draws on sustainability transitions research, energy studies and social innovation research to investigate which conditions enable social innovation in the energy sector. SONNET will combine a variety of qualitative and quantitative methodological approaches that inform and complement each other. These include, among others, the mapping of 500 social innovation initiatives in the energy sector, in-depth case studies of 30 of these initiatives, 6 experimental City Labs in the SONNET cities, and 3 national citizen surveys.

The project aims to build and strengthen the innovative capacities and strong networks of social innovation and energy actors, identify new market opportunities for social innovation in the energy sector, and enable multiple actors to increase their engagement with social innovations.

SONNET's inter- and transdisciplinary research will be carried-out by Fraunhofer ISI (project coordinator), DRIFT, SPRU, Grenoble Ecole de Management, Kozminsky University and ZHAW, in collaboration with the Cities of Mannheim (DE), Antwerp (BE), Bristol (UK), Grenoble (FR), Warsaw (PL) and Basel (CH), as well as with support from ICLEI.

Further information on the project website.

New research centre - FME NTRANS

The Norwegian Centre for Energy Transition Strategies is a new 8-year (2019-2027) research centre hosted by the Norwegian University of Science and Technology (Trondheim, Norway) and partnered by University of Oslo, SINTEF, SINTEF Energy, Institute for Energy Technology, Norwegian School of Economics, Centre for Applied Research at NHH, Western Norway Research Institute, and Western Norway University of Applied Sciences.
NTRANS asks: (1) How can the scope of the transition be *deepened* to include citizens and their interaction with technologies and systems? (2) How can the scope of the transition be *widened*? and (3) How can the transition be *accelerated* to achieve emission reductions at the intersection of energy, climate, and sustainability?

Key aims of NTRANS are to have close interaction between researchers and user partners (as problem owners), and to provide advice on how Norway's emission reduction targets for 2030 and 2050 can be met. The centre is funded by the Research Council of Norway.

Further information on the project website.

Postdoc academy for transformational leadership

This is a unique program that trains the next generation of leaders in sustainability research affiliated with a European research institution.

With this year's focus topic "Land use practices in a globalised world", the program provides an intensive training with four seminars in two years that broaden the research competencies of early-career researchers and promote their qualification towards transdisciplinary leadership.

The program is an initiative of the Robert Bosch Stiftung and a joint project with the four academic centers Humboldt-Universität zu Berlin, Leuphana University of Lüneburg, Stockholm Resilience Centre and The Dutch Research Institute for Transitions (DRIFT), Rotterdam.

For further information on this year's focus topic and the application process, please refer to the academy website.

Applications can be submitted until 16th February 2020.

Perspectives on Decline

Deliberate destabilisation for sustainability transitions: Research and practice

Bruno Turnheim, University of Manchester (MIoIR), Université Paris-Est (LISIS)

The destabilisation of established socio-technical systems has, since the early beginnings of the field, been conceived of as an integral part of transitions dynamics. Although scantily conceptualised, destabilisation was seen broadly as a dual movement: a) destabilisation and crisis dynamics (often in broader socio-political orders) as creating opportunity structures for system change, and b) socio-technical destabilisation as outcome of the breakthrough of alternatives, i.e. as socio-technical discontinuities in the context of substitution patterns. These became more explicit with formulations of transitions pathways: Smith and colleagues (2005) suggested that the articulation of selection pressures bearing on regimes (their direction and coherence) is key to understanding socio-technical change, while Geels and Schot (2007) outlined a more dynamic articulation of this dual movement, namely under a 'de-alignment and re-alignment' path. Still, given that most transitions research focussed on the emergence and development of novel socio-technical configurations, destabilisation was not yet a focal object of enquiry in its own right. As a result, specific dynamics remained poorly understood.

Destabilisation research 1.0. Over 10 years ago, this changed. A range of research projects started to investigate a number of key processes related to decline, destabilisation, and phase out. Jointly, these contributed to an emergent research programme focussed on the various 'flipsides' of novelty creation within transitions dynamics, considerably expanding the scope of possible research on decline and destabilisation. Relevant research topics included:

- industry destabilisation pathways (phases, mechanisms, outcomes, governance);
- regime de-institutionalisation processes;
- the changing role and strategies of incumbent actors;
- varieties of lock-in, barriers to change, and forms of regime un-locking;
- the role of civil society in deliberate discursive framing strategies.

Destabilisation research 2.0. Since then, these research topics and questions have attracted significant interest within the field, a second generation of research projects, a growing number of PhD students, and dedicated sessions at recent IST conferences. The expansion of related research has led to the multiplication of empirical sites and scope for comparison (different domains, kinds of industries, geographical contexts, patterns of change) to advance understandings of socio-technical destabilisation and decline. It has also led to new and refined research questions, amongst which:

- deliberate phase-out policy;
- the repurposing of transitions frameworks to deal with mature systems;
- the explicit formulation of a variety of destabilisation and phase out pathways;
- methodological interactions with various research perspectives on destabilisation and decline, including formal modelling strategies, regional industrial diversification or political sciences.

Destabilisation policy. The issue of managed phase out is also increasingly being taken up in policy discussions. On this front, ongoing puzzles concern the scope and limits of deliberate phase out policy (e.g. to what extend can it really be managed?), underlying rationales, more explicit consideration of substantial trade-offs involved, and the range of deliberate intervention strategies and instruments available. In this changing context for

policy and practice, it is also important to remain vigilant against generic claims according to which incumbent actors should be unseated at all costs and by any means. Indeed, the destabilisation of existing systems and practices, although justifiable on grounds of addressing deep-seated unsustainabilities, comes with its own set of potential injustices and undesirable effects. As is becoming so blatant in the politics of high-carbon regions, deliberate phase out is a political minefield and potential seedbed for the spread of populism, particularly if it isn't combined with forms of social empowerment. Such issues are bringing transitions research into novel territory, which in my view call for a strong engagement with political sciences and theories of justice.

To sum up, destabilisation, decline and phase out provide a vibrant and exciting avenue for research, with significant scope for conceptual elaboration, empirical applications, analytical challenges, but also very concrete sites for decidedly political struggles to be handled with care. Contributing to this agenda, the new WAYS-OUT project seeks to deepen the understanding of socio-technical destabilisation dynamics and their governance. It will mobilise a number of historical destabilisation case studies in different domains (energy, mobility, agri-food), compare existing cases in search for generic destabilisation contexts and patterns, and engage with modelling and policy communities to support the exploration of deliberate phase-out strategies and their feasibility. Furthermore, it will leverage emerging interest in destabilisation processes as an entrance point to explore the changing role of expertise at the science-policy interface dealing with transformative change.

Phase-outs: Why they are central for low-carbon transitions and what the new COALSTAKE project aims to contribute

Adrian Rinscheid
Postdoctoral Researcher, University of St. Gallen

Aya Kachi
Assistant Professor, University of Basel

Nurturing green niches and political coalitions for change is essential for low-carbon transitions. However, adding sustainable innovations on top of incumbent technologies and infrastructures alone does not lead to decarbonization. For example, notwithstanding that investments in renewable electricity generating technologies have been sustained at impressive levels, proponents of carbon-intensive regimes do not sit idly by. Incumbents also strive to bolster their resources and even expand carbon-intensive activities and infrastructures. Using the concept of 'committed emissions', a recent study shows that currently operating fossil fuel generators commit us to emissions that overshoot the levels compatible with 1.5°C or 2°C scenarios. Three quarters of these emissions come from coal-fired power plants. Adding all currently planned fossil fuel generators would lead to almost the same amount of additional commitments. The study concludes that even if the entire pipeline of planned fossil fuel projects was dismantled, 20% of the operating global capacity would need to be phased out to stay in line with the goals of the Paris Agreement. And keep in mind that time is running out.

This highlights the need to devote more attention to phase-outs. In the past, states enacted phase-outs quite effectively if problem pressure was high and technological alternatives were in reach (think of ozone depleting substances or lead in gasoline). Yet, in the context of fossil fuels, phase-out looks particularly challenging. Is carbon lock-in perhaps more difficult to overcome than Freon or lead lock-in? Where exactly do the challenges come from, and how can they be overcome?

These are some of the questions the new COALSTAKE project aims to tackle. Focusing on coal politics, COALSTAKE examines the political economy of low-carbon transitions from interdisciplinary perspectives. For example, the project harnesses the concept of institutional work rooted

in Institutional Sociology to unveil the activities performed by proponents and opponents of a phase-out of coal, aspiring to further advance our understanding of the politics of transitions. The project proceeds from a set of hypotheses that capture how successful agency depends on both agents' endowment with relevant resources (e.g., networks) and the fit of their political activities with their institutional objectives. Moreover, combining narrative approaches and network analytic tools, COALSTAKE aims at identifying discursive branching points and coalitional dynamics that open up windows for potential breakdowns of coal regimes.

COALSTAKE is a 2-year project funded by the Swiss Network for International Studies (SNIS). The empirical focus is on the politics around coal in 4 countries: Australia, Canada, Germany and Japan, and the Swiss-based core team collaborates with researchers in all of these countries. In addition, COALSTAKE partners with the International Labour Organisation and the UK-based think tank InfluenceMap.

Ultimately, the insights gained from COALSTAKE and other research efforts to investigate the political economy of phase-outs are urgently needed to inform politically feasible (yet still effective) socio-technical pathways for the phase-out of carbon-intensive technologies.

Reflecting on the justice dimensions of decline: A conversation with Jennie Stephens

Professor Jennie Stephens is the Director of the School of Public Policy and Urban Affairs at Northeastern University in Boston.

Daniel Rosenbloom: Transitions research increasingly highlights the importance of both innovation and decline in pursuing sustainability transitions. It is argued that deliberately encouraging the decline of carbon-intensive systems can weaken deep lock-ins and open space for emerging alternatives. In policy and practice, decline has, for instance, taken the form of phase-outs (for coal-fired power, gas-fueled cars, incandescent lightbulbs, and single use plastics) but also efforts to roll back subsidies and investments in fossil fuels. What role do you see for decline-related efforts in advancing sustainability transitions?

Jennie Stephens: Transformation requires us to resist, reclaim and then restructure our unsustainable systems to promote a just transition. The intentional, strategic resistance of the power structures, investments, technologies, institutions and individuals that perpetuate the status quo are "decline-related efforts", and these efforts are critical to accelerating change. Sustainability research and practice has historically paid more attention to the promotion of innovative new initiatives rather than decline-related efforts, but this is changing as there is growing focus on resisting the status quo and mobilizing for disruption.

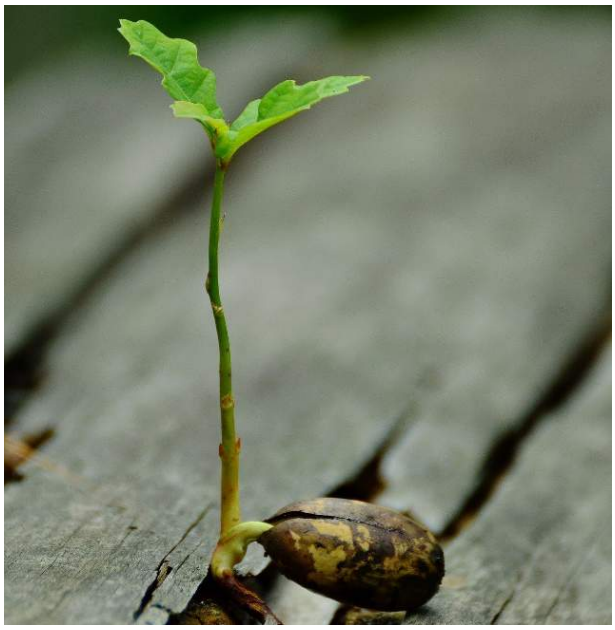
Given where the world is right now, the word "decline" can also be considered in another way relating to macro-level societal impacts of NOT transitioning. What I mean here is that the inadequacy and insufficiency of our collective efforts to transition to a more sustainable society are also inadvertently causing different kinds of decline, i.e. decline in effective governance, decline in quality of life, decline in optimism for the future, decline in climate stability, etc. These kinds of decline are creating powerful motivation for disruptive change and may also contribute to accelerating transformation.

DR: How might decline-related efforts come into conflict with or potentially promote just transitions?

JS: Efforts to resist the status quo and promote the decline of unjust and unsustainable legacy systems are essential to promoting a just transition. Investing in people, jobs and livelihoods are essential to transformation. For too long the influence of powerful corporate interests has minimized investment in people and communities and eroded the creation of good sustaining jobs and healthy communities. This has led to precarity and vulnerability of many people and communities. A sustainable transition requires connecting jobs, health, housing, education and livelihoods with sustainability and climate mitigation. Transformation requires limiting corporate power and reprioritizing the public good to prioritize support for healthy people and sustainable communities.

DR: In the context of a declining fossil fuel industry, the livelihoods and communities built up around fossil fuel extraction and combustion are at risk. What can be done to navigate potential tradeoffs and create more equitable and inclusive transitions for those affected by deliberate decline?

JS: As the fossil fuel industry declines, investments in those communities impacted by fossil fuel job losses are critically important. The individuals, families and communities that have become dependent on fossil fuel related jobs for their livelihoods need to have alternative means of support. Providing job training, healthcare, retirement benefits, and alternative forms of compensation need to be integrated into investments in these communities.



DR: The development of positive visions for change is often considered to be an important motivator for climate action. Should a transparent and open discussion about the inevitable decline of carbon-intensive systems be part of this?

JS: Yes – the decline of carbon-intensive systems is an essential part of the development of positive visions for change. Change is disruptive and everyone needs to understand that some level of disruption is essential, and change can also bring multiple benefits. Transparent and open discussions about both the practical disruptions associated with ending fossil fuel reliance as well as the multiple societal benefits of ending fossil fuel reliance are very important. For decades, the fossil fuel industry has invested in a strategic misinformation campaign to confuse people about the negative impacts of fossil fuels. To counter this, transparent and open discussion about how, in addition to climate impacts, fossil fuel reliance also contributes to public health disasters including sickness and death, species extinction, water and soil pollution, human rights violations, and growing inequities. Integrating consideration of the disruptive pieces as well as the positives of fossil fuel decline will help expand the conversation beyond climate benefits and expand how people see themselves in a more renewable-based world.

DR: The Green New Deal is now animating a considerable portion of the climate-energy policy debate in the US and in Europe. Do you see decline as complementary with this political discourse?

JS: Absolutely. The Green New Deal explicitly links climate, energy and sustainability with social justice by advocating for a renewable-based society that includes good jobs for all. This provides a framework for connecting the decline of the fossil fuel industry with investments in jobs, health, housing, transportation, and education. By advocating for major investments in people and communities, beyond investments in technology, the Green New Deal is calling for redistributing the political and economic power of the polluting elite. Given that the concentration of wealth and power has been

contributing to both growing inequities and injustices as well as resistance to sustainability transitions, the mobilization around the Green New Deal represents a political movement toward transformation.

This more transformative politics has emerged with new leadership including more young, diverse, women leaders representing different communities that have not previously been included in climate and energy policy. I describe how new innovative leadership is effectively linking climate with social justice in my forthcoming book "Diversifying Power: Why we Need Antiracist, Feminist Leadership on Climate and Energy". The Green New Deal and the youth climate strike also acknowledge the inevitable societal "decline" that is associated with the climate chaos and growing inequities being perpetuated by the status quo. If we do not invest in accelerating transformation, society will continue to decline in terms of future economic prosperity for most human beings. This is the other kind of decline that is creating powerful motivation for disruptive change which could accelerate transformation.

DR: Thank you for sharing your insights.

Publications

PhD theses

Cherunya, P.C. (2019)
Utrecht University
Rethinking user agency in sustainability transitions: Analysing the roles of informal settlement dwellers in a splintered sanitation regime
link

This thesis analysed the current and future potential roles of 'the users' in innovation and transition processes – based on the case of sanitation in Nairobi, Kenya. The study: (i) characterized the socio-technical regimes in Global South cities and established how users are constituted in them; (ii) analysed how low-income informal settlement dwellers shape embedding of innovations through their daily activities; and (iii) analysed the transformation potential by the settlement dwellers in sustainable transitions. The core concepts and theories utilized include socio-technical regime, practice theory, grassroots innovations, and technological innovation system.
A mapping of user and provider sanitation practices led to a categorization of Nairobi as a *splintered regime* whose core characteristics include a proactive engagement of the users. In the study on innovations embedding, the author elaborates how informal settlement dwellers have to mend the splintered services daily using complex routines and practices in time and space, which the author conceptualizes as *oscillating domestic spaces*. The concept provides insights to the existence of a form of 'lock-in' that is hard to change even in contexts with multiple and fragmented socio-technical regimes, which often results in low uptake of seemingly superior new service solutions.
This thesis further provides insights on the proactive engagement of settlement dwellers as service providers in their organization in grassroots groups. The analysis shows how these grassroots can contribute to the sector's innovation system with specific resources and capabilities, but they also have potential to hinder further transitions. The author discusses new actor arrangements that build on their strengths but can evade potential lock-in that hampers longer-term sustainability transitions.

Bhamidipati, P.L. (2019)
Technical University of Denmark
Actors, Agency and Politics in Sustainability Transitions: Evolution of the solar PV market in East Africa.

Access to clean, reliable and affordable energy services is fundamental to economic and social well-being. Yet nearly 600 million people in Sub-Saharan Africa lack access to electricity. Towards this end, transnational actors, such as aid agencies, financial institutions, non-profit organizations and private firms play a crucial role through their involvement in framing agendas, engaging in policy advice and mobilizing resources, both technical and financial.
Against this background, the objective of this thesis is to investigate how these transnational actors operate and influence the transition to solar PV in East Africa, focusing specifically on off-grid and utility-scale solar PV systems in Uganda, Kenya and Rwanda. By investigating the dynamics of transnational linkages, external dependencies and global-local entanglements shaping specific transition pathways, the thesis contributes to an improved understanding of agency and politics in the sustainability transitions literature. The thesis develops a typology of transnational actors and identifies their specific roles and characteristics. It makes use of transition frameworks to explore agency by nuancing simplified actor categories, assessing the underlying motives, and by explicitly unravelling the micro-politics. The thesis also highlights the interplay of transnational and local agency, which is pertinent in the highly globalized energy regimes, but has received limited attention in the literature. In doing so, the thesis explores strategic and intentional actions, locates the relative position and influence exerted by specific transnational actors, and explores the socio-political processes underpinning sustainability transitions.

Knobloch, F. (2019)
Radboud University Nijmegen
Modelling Technology Choice Behaviour in Energy Transitions
link

Technology choices made by people determine the success of decarbonisation policies, and in the end the success or failure of energy transition. Therefore, their realistic representation in computer models for policy simulation is of the utmost importance. Florian Knobloch explores how technology choice behaviour can be modelled realistically and feasibly. It shows that rational decision-making is an oversimplified representation of technology choice behaviour, which may result in expectations of policy effectiveness that are far too optimistic. In reality, people make choices in a variety of different contexts and don't always act rationally. It is shown that technology choices can still be modelled in a stylised but tractable way. This at least provides partial explanations for observed technology choices and can help estimate the effectiveness of different policy instruments. It is shown that a carbon tax on its own may not always be sufficient for effective decarbonisation and a mix of policies can be more effective than relying on a single policy instrument.

Larsen, H (2019)
Imperial College London
Capabilities, Networks, and Directionality: Innovation Policy for Sustainable Development Goals.

Over the past decades, the systems of innovation approach has gained widespread use and is arguably the most influential framework guiding innovation scholars and policymakers today. Notwithstanding its explanatory power, the systems of innovation approach is mainly directed at optimising innovation systems to fulfil national economic policy objectives, such as growth, jobs, and competitiveness.
It is increasingly understood that addressing societal challenges, such as poverty, inequality, and climate change, requires more than optimising innovation systems to fulfil economic policy objectives but also inducing directionality and processes of transformative change toward a broader range of societal and environmental objectives. This 'normative' turn towards transformative innovation policy is grounded in an understanding of system innovation of socio-technical systems towards more sustainable modes of production and consumption.
The objective of this research is to conceptually refine the systems of innovation approach, and in particular revise the national innovation systems concept. Focussing mainly on the needs and challenges of developing countries to accumulate the capabilities needed to manage innovation and technological change, three separate case studies are used to validate central features of transformative innovation policy: *capabilities, networks, and directionality*.
The first empirical chapter develops an understanding of how a Brazilian latecomer firm accumulated the capabilities needed to pursue innovation in new and different directions along more sustainable development pathways. The second empirical chapter furthers the understanding of how the formation of global innovation networks enhances interactive learning in national innovation systems, and in what way international technology cooperation complements creation and accumulation of innovation capabilities. The third empirical chapter integrates insights from the system innovation perspective and opens up the systems of innovation approach to incorporate directionality and a strategic orientation of innovation systems towards a broader range of societal and environmental objectives.

Books

Korsnes, M. (2020)
Wind and Solar Energy Transition in China.
Routledge
link

This book explores the mobilisation of China's wind and solar industries and examines the implications of this development to energy generation and distribution, innovation and governance. Unlike other publications that focus mainly on the formal policy landscape and statistics of industry development, this book delves deeper into the ways in which the wind and solar industries have evolved through negotiations made by the involved stakeholders, and how these industries play into larger Chinese development and policymaking interests. Overall, it sheds new light on the strategic development of China's renewable energy industry, the flexible governance methods employed and the internal struggles which Chinese local, regional and central policymakers, and state-owned and private enterprises have faced. The book will be of great relevance to students and scholars of renewable energy technologies, energy policy and sustainability transitions, as well as policymakers with a specific interest in China.

Sareen, S., Moss, T., Lund, C., Haarstad, H., Sovacool, B. and Wolf, S. (2020)
Enabling sustainable energy transitions: Practices of legitimation and accountable governance
Palgrave, open access
link

This open access book reframes sustainable energy transitions as being a matter of resolving accountability crises. It demonstrates how the empirical study of several practices of legitimation can analytically deconstruct energy transitions, and presents a typology of these practices to help determine whether energy transitions contribute to sustainability. The real-world challenge of climate change requires sustainable energy transitions. This presents a crisis of accountability legitimated through situated practices in a wide range of cases including: solar energy transitions in Portugal, urban energy transitions in Germany, forestland conflicts in Indonesia, urban carbon emission targets in Norway, transport electrification in the Nordic region, and biodiversity conservation and energy extraction in the USA. By synthesising these cases, chapters identify various dimensions wherein practices of legitimation construct specific accountability relations. This book deftly illustrates the value of an analytical approach focused on accountable governance to enable sustainable energy transitions. It will be of great use to both academics and practitioners working in the field of energy transitions.

Moallemi. E.A. and de Haan, F.J. (2020)
Modelling Transitions: Virtues, Vices, Visions of the Future
Routledge
link

Transitions modelling has been part of the transitions research portfolio since its inception, and it is now a growing niche within the sustainability transitions community. This new volume critically investigates what modelling of transformative change means and could mean for transitions research and for other disciplines that study societal changes and could potentially benefit from transition concepts. This leads us to examine both the virtues and the vices of modelling and to look further to approaches that are currently not part of the standard toolkit of modellers in transition research. The volume gives due attention to the state of the art of transitions modelling but with the explicit aim of evaluating the contributions to the broader transitions field and the modelling lessons learnt. This volume speaks to modellers and non-modellers alike who value the development of robust knowledge on transitions to sustainability, including colleagues in congenial fields. Be they students, researchers or practitioners, everyone interested in transitions should find this book relevant as reference, resource and guide.

Papers

Hötte, K. (2019)
How to accelerate green technology diffusion? Directed technological change in the presence of coevolving absorptive capacity
Energy Economics, 104565
link

The time window for effective climate change mitigation is closing. Technological change needs to be accelerated to limit global warming to a manageable level. Path dependence of technological change is one explanation for sluggish diffusion of green technologies. Firms acquire capital that differs by technology type and build up type-specific technological know-how needed to use capital efficiently. Path dependence emerges from cumulative knowledge stocks manifested in the productivity of supplied capital and firms' capabilities. Increasing returns arise from induced innovation feedbacks and learning by doing. Relatively lower endowments with technological knowledge are a barrier to diffusion for new technologies. This paper shows how the evolution of relative stocks of technological knowledge explains different shapes of diffusion curves. Using an eco-technology extension of the macro-

economic agent-based model Eurace@unibi, it is shown how the effectiveness of different climate policies depends on the type and strength of diffusion barriers. Environmental taxes can outweigh lower productivity and subsidies perform better if lacking capabilities hinder firms to adopt a sufficiently mature technology.

Cherunya, P. C., Ahlborg, H. and Truffer, B. (2020)
Anchoring innovations in oscillating domestic spaces: why sanitation service offerings fail in informal settlements.
Research Policy, 49, 1, 103841
link

A persistent conundrum for practitioners and researchers in the development context is that, often, newly provided and improved basic services are not maintained by users despite seemingly superior functionality and user convenience. We argue that one major reason for this is an insufficient understanding of the context in which users have to manage their daily lives. We therefore propose an approach to analysing the embedding of basic services that focuses on the users' daily practices. We do so by borrowing insights from 'socio-technical transitions' and 'practice theory' in developing our concept of oscillating domestic spaces. The concept reflects the need for people to constantly respond to quickly changing and precarious circumstances by rearranging their daily practices in time and space and developing a multiplicity of alternative options and partial solutions. We illustrate the analytical approach in a case study of sanitation access in informal settlements of Nairobi, Kenya. The analysis shows how the introduction of a container-based toilet resulted in partial embedding. The innovation anchored to only a part of the oscillating domestic spaces and was in disarray with the needs of users most of the time. The conceptual approach contributes to the understanding about how users take part in sustainability transitions as well as the added value of the time-space dimension in analysing practices in highly complex contexts. We conclude by reflecting on the potential applicability of the analytical approach to transition cases in the Global North.

Janipour, Z., de Nooij, R., Scholten, P., Huijbregts, M. and de Coninck, H. (2020)
What are sources of carbon lock-in in energy-intensive industry? A case study into Dutch chemicals production.
Energy Research & Social Science 60, 101320
link

Keeping global mean temperature rise well below 2 °C requires deep emission reductions in all industrial sectors, but several barriers inhibit such transitions. A special type of barrier is carbon lock-in, defined as a process whereby various forms of increasing returns to adoption inhibit innovation and the competitiveness of low-carbon alternatives, resulting in further path dependency. Here, we explore potential carbon lock-in in the Dutch chemical industry via semi-structured interviews with eleven key actors. We find that carbon lock-in may be the result of (i) technological incompatibility between deep emission reduction options over time, (ii) system integration in chemical clusters, (iii) increasing sunk costs as firms continue to invest in incremental improvements in incumbent installations, (iv) governmental policy inconsistency between targets for energy efficiency and deep emission reductions, and (v) existing safety routines and standards. We also identify barriers that do not have the self-reinforcing character of lock-in, but do inhibit deep emission reductions. Examples include high operating costs of low-carbon options and low risk acceptance by capital providers and shareholders. Rooted in the Dutch policy setting, we discuss policy responses for avoiding carbon lock-in and overcoming barriers based on the interviews, such as transition plans for individual industries and infrastructure subsidies.

Jewell, J. and Cherp, A. (2020)
On the political feasibility of climate change mitigation pathways: Is it too late to keep warming below 1.5°C?
WIREs Climate Change, 11, 1
link

Keeping global warming below 1.5°C is technically possible but is it politically feasible? Understanding political feasibility requires answering three questions: (a) "Feasibility of what?," (b) "Feasibility when and where?," and (c) "Feasibility for whom?." In relation to the 1.5°C target, these questions translate into (a) identifying specific actions comprising the 1.5°C pathways; (b) assessing the economic and political costs of these actions in different socioeconomic and political contexts; and (c) assessing the economic and institutional capacity of relevant social actors to bear these costs. This view of political feasibility stresses costs and capacities in contrast to the prevailing focus on benefits and motivations which mistakes desirability for feasibility. The evidence on the political feasibility of required climate actions is not systematic, but clearly indicates that the costs of required actions are too high in relation to capacities to bear these costs in relevant contexts. In the future, costs may decline and capacities may increase which would reduce political constraints for at least some solutions. However, this is unlikely to happen in time to avoid a temperature overshoot. Further research should focus on exploring the "dynamic political feasibility space" constrained by costs and capacities in order to find more feasible pathways to climate stabilization.

Urmetzer, S., Lask, J., Vargas-Carpintero, R. and Pyka, A. (2020)
Learning to change: Transformative knowledge for building a sustainable bioeconomy.
Ecological Economics 167, 106435
link

The transition towards a bioeconomy is considered a powerful approach to combating current trends of unsustainability. To date, the concept has been widely perceived as a predominantly technical endeavor. This is, however, not sufficient and will not really tackle the global sustainability challenges. Therefore, the imparting of technological knowledge must be accompanied by instruction in other types of knowledge, particularly transformative knowledge. The authors explore the various elements of transformative knowledge necessary to equip the protagonists of a bioeconomy transformation. On this basis, four academic bioeconomy programs across Europe are analyzed using a hybrid methodological approach, combining a keyword-based content analysis of the module descriptions with semi-structured interviews of key representatives of the programs. It is shown that the syllabi of all four programs include important elements of transformative knowledge, such as communication, participation, and decision-making skills. Skills related to the ability to revise and reflect personal values, in contrast, are mainly only an implicit part of the program. The study applies insights into education for sustainable development to the requirements of a fundamental transformation towards a sustainable bioeconomy. It offers a first appraisal of the consideration transformative knowledge is given in the design of European academic bioeconomy curricula.

Mukhtar-Landgren, D., Kronsell, A., Voytenko Palgan, Y., and von Wirth, T. (2019)
Municipalities as enablers in urban experimentation.
Journal of Environmental Policy & Planning, 21, 6, 718-733
link

In the light of increasing urban challenges, municipalities are developing and advancing new forms of governing. One such example is 'urban experimentation', a process where city-based innovation processes are initiated to test solutions that – if deemed successful – are intended to be scaled up with the ambition to leverage a broader urban sustainability transition. Research on experimental governance has shown that municipalities can play various roles in these processes, including the role as enabler. The article contributes to the literature on the roles of public actors in urban experimentation on sustainability challenges by advancing understanding of the less studied 'enabler' role. We probe the politics of enabling by focusing on the policy instruments employed by municipalities. Our aim is to provide deeper insights into the everyday work of urban administrations when they act in the 'enabler' role. One particular approach of urban experimentation is Urban Living Labs (ULL), and this paper analyses ULL that address sustainability challenges. Along the four dimensions of nodality, authority, treasury, and organisation, we identify the politics of enabling in four ULL examples from Sweden and the Netherlands.

Ampe, K., Paredis, E., Asveld, L., Osseweijer, P. and Block, T. (2019)
A transition in the Dutch wastewater system? The struggle between discourses and with lock-ins.
Journal of Environmental Policy & Planning
link

Recently, calls have increased for a paradigm shift or transition towards resource recovery and a circular economy in the Dutch wastewater system. However, we have observed diverging interpretations on the nature of the transition. This reflects the political environment of sustainability transitions: political struggle emerges over the definition of problems, futures and strategies to be used. In order to help clarify the emerging debate and identify political choices, we conducted a discourse analysis. We identified three discourses that reveal some of the political choices to be made. One discourse is becoming dominant and focusses on optimising the large-scale infrastructure, market development and legislative changes. The discourse draws on the existing infrastructure and current political-economic institutions, which gives it an advantage in becoming dominant. Our findings also suggest that this discourse shapes a transition pathway that is characterised by lock-in effects and, at most, incremental changes instead of a fundamental shift in the established Dutch wastewater system.

Hoppmann J., Anadon, L.D. and Narayanamurti, V. (2020)
Why Matter Matters: How Technology Characteristics Shape the Strategic Framing of Technologies.
Research Policy, 49, 1, 103882
link

Previous work stresses that actors use strategic technology framing—i.e. purposeful language and rhetoric—to shape technology expectations, persuade stakeholders, and influence the evolution of technologies along their life-cycle. Currently, however, the literature predominantly describes strategic technology framing as a sociopolitical process, and provides only limited insights into how the framing itself is shaped by the material characteristics of the technologies being

framed. To address this shortcoming, we conducted a comparative, longitudinal case study of two leading research organizations in the United States and Germany pursuing competing solar photovoltaic (PV) technologies to examine how technology characteristics shape the strategic framing of technologies. We show that to frame PV technologies in their own favor, executives made use of four framing dimensions (potential, prospect, performance, and progress) and three framing tactics (conclusion, conditioning, and concession). Moreover, we show that which framing dimensions and tactics actors selected depended on the maturity and evolution of the technology they pursued, respectively. By highlighting how technology characteristics shape strategic technology framing, we contribute to the literatures on social movements, institutional entrepreneurship, and impression management. Additionally, by providing a coherent framework of strategic technology framing, our study complements existing findings in the literature on the sociology of expectations and contributes to a better understanding of how technology hypes emerge.

Elsner, I., Monstadt, J. and Raven, R.P.J.M. (2019)
Decarbonising Rotterdam? Energy transition and the alignment of urban and infrastructural temporalities.
City
link

Low carbon transitions of urban energy systems have been on urban research and policy agendas for several years now. While the spatialities of infrastructure transitions have been widely discussed, their temporalities have attracted much less attention. This is surprising, since the transition of urban infrastructures in the course of system integration and decarbonisation reveal strong temporal dynamics: new temporalities or temporal requirements not only emerge as a result of technological change (e.g. by integrating fluctuating renewables or storage technologies) but also of changing social practices (e.g. in urban load management or energy use). We argue that aligning urban and infrastructure temporalities involves negotiations between the various energy providers, regulators and users involved and is a highly political process. As we know little about such temporal dynamics so far, this study uses an explorative methodology to elaborate on a conceptual framework of urban and infrastructural temporalities. This framework has been developed in an iterative way by going back and forth between conceptual contributions and empirical findings drawn from expert interviews regarding low carbon transitions in Rotterdam. Our case study of Rotterdam indicates that unsolved challenges in aligning urban and infrastructural temporalities can be seen as a major restriction to realise low carbon energy solutions.

Hacking, N., Pearson, P. and Eames, M. (2019)
Mapping innovation and diffusion of hydrogen fuel cell technologies: Evidence from the UK's hydrogen fuel cell technological innovation system, 1954–2012.
International Journal of Hydrogen Energy, 44, 57, 29805-29848
link
With the global sustainability transition in energy, hydrogen fuel cell (HFC) applications currently have important niche roles to play across several industrial sectors. Theorists examining this innovative activity have identified key socio-technical factors affecting the nature and pace of change. One functional approach to innovation, Technology-Specific Innovation Systems (TSISs), places national HFC Technological Innovation Systems (TISs) within a framework of a global HFC TSIS. This analytical approach suggests that HFC innovation can start anywhere in space. However, in a case study of HFC innovation and diffusion in the UK covering sixty years' activity, this theoretical assumption is challenged. Event history analysis and interviews using a neofunctionalist TSIS approach suggest that positive feedback was on the brink of occurring in the UK HFC TIS by 2012. When additional organisational and spatial indicators are added, the evidence on the ground does not support the aspatial assumptions that underlie TIS heuristic thinking. Rather, it suggested that type of investment funding and spatial location can influence HFC innovation. In this context, the implications for HFC policy in the UK are discussed.

Dijk, M., Backhaus, J., Wieser, H. and Kemp, R. (2019)
Policies tackling the "web of constraints" on resource efficient practices: the case of mobility.
Sustainability: Science, Practice and Policy, 15, 1, 62-81
link

In practice, environmental policy is only moving slowly from a focus on promoting environmental technologies to a focus on greening socio-technical systems. Policy measures to stimulate resource efficiency (RE) typically address the national, sectoral, or company level. This article shows how an analysis addressing practices that citizens engage in, such as eating or mobility, can contribute to more effective RE policy. It is instrumental to highlight policy contradictions in the current mix of policies and offer suggestions for stronger policy synergies. We offer a conceptual and empirical analysis based on the results of a large-scale survey (1200þ respondents) in three countries (Austria, Hungary, and The Netherlands), focusing on one of the most resource intensive consumption domains: mobility. We apply a framework that includes the social context of resource

consumption, addressing how practices that citizens engage in are shaped by both "collective" physical infrastructures, the business models of products, social meanings, and regulatory incentives, and also by "individual" knowledge and skills, values, and financial capabilities. Our "web of constraints" perspective on RE highlights the interrelatedness of individual actor and collective factors. It is instrumental for an integrative policy discussion, addressing a range of factors hindering RE, anticipating policy contradictions, to capitalize on synergies.

Andersen, A.D. and Markard, J. (2020)
Multi-technology interaction in socio-technical transitions: How recent dynamics in HVDC technology can inform transition theories
Technological Forecasting & Social Change, in press
link

Studies of socio-technical transitions have often focused on niche emergence or on the interaction of niche and regime technologies in a 'single-sector' setting. Such analyses are particularly important in the early stages of transitions, when there is a primary interest in developing novel technologies. In later phases, transitions do not only involve multiple technologies but also multiple sectors, which means that the complexity of technology dynamics increases. We want to improve established frameworks—technological innovation systems and the multi-level perspective—to account for such phenomena. We study HVDC technology, which is a mature technology for electricity transmission that has remained in a niche for decades but recently gained new momentum as the ongoing transition in the electricity sector accelerated. Our case highlights: i) the importance of multi-technology interaction within and across sectors, ii) an important role for innovating incumbents responding to these dynamics, and iii) an increasing relevance of multi-technology interactions and organizational responses in advanced stages of transitions. To guide our analysis, we introduce a novel multi-technology map. Such a tool can be useful to complement existing frameworks.

Sovacool, B.K. and Griffiths, S. (2020)
The cultural barriers to a low-carbon future: A review of six mobility and energy transitions across 28 countries.
Renewable & Sustainable Energy Reviews, in press

This review focuses on how culture can complicate and impede attempts at promoting more efficient, more sustainable, and often more affordable forms of mobility as well as energy use in homes and buildings. In simpler terms: it illustrates the cultural barriers to a low-carbon, low-energy future across 28 countries. Rather than focus on energy supply, it deals intently with energy end-use, demand, and consumption. In terms of low-carbon transport and mobility, it examines the cultural barriers to aggressive driving, speeding, and eco-driving; automated vehicles; and ridesharing and carpooling. In terms of cooking and building energy use, it examines the cultural barriers to solar home systems, improved cookstoves, and energy efficient heating, cooling, and hot water practices. For each case, the review synthesizes a wide range of studies showing that culture can operate as a salient but often unacknowledged barrier to low-carbon transitions as well as sustainability transitions more generally. The paper concludes with recommendations aimed at catalyzing the effectiveness and efficiency with which policymakers, researchers and practitioners are able to research, develop, demonstrate and deploy culturally appropriate technologies and policies for a low-carbon transition.

Sovacool, B.K., Martiskainen, M., Hook, A. and Baker, L.H. (2020)
Beyond cost and carbon: The multidimensional co-benefits of low carbon transitions in Europe.
Ecological Economics, 169,106529, 1-19
link

The paper explores the myriad potential benefits of four low-carbon transitions beyond those in the environmental or economic domain. Drawn from a rich set of original mixed methods data—across expert interviews, focus groups, and public internet forums—we examine the presumed multidimensional, qualitative co-benefits to nuclear power in France, solar photovoltaics in Germany, electric vehicles in Norway, and smart meters in Great Britain. We catalogue 128 identified prospective co-benefits to these four European low-carbon transitions, 30 for nuclear power, 30 for solar photovoltaic panels, 26 for electric vehicles and 42 for smart meters. Tellingly, 37 of these collective benefits are identified as economic and 14 environmental, but the remaining ones illustrate a broader spectrum of technical benefits (31 in total), social benefits (30 in total) and political benefits (16 in total). After presenting this body of evidence, the paper then discusses these benefits more deeply in terms of complementarity, temporality, scale, actors, and incumbency. We conclude with insights for energy and climate research and policy more broadly.

Kotilainen, K., Aalto, P., Valta, J., Rautiainen, A., Koko, M. and Sovacool, B.K. (2019)
From path dependence to policy mixes for Nordic electric mobility: Lessons for accelerating future transport transitions.
Policy Sciences, 52, 573-600
link

We examine the problem of how to accelerate policies related to electric vehicles (EVs) in the Nordic countries Denmark, Finland, Norway and Sweden. These four Nordic countries represent an interesting collection of cases by virtue of having common decarbonization targets extending to the transport sector, interlinked electric energy systems and a joint electricity market largely based on low-carbon energy while they are open societies bent on innovation, making them well adaptable to a transition toward electric mobility. Our analytical framework drawing from transition research, lock-in and path dependency and institutionalism enables us to discern technological, institutional and behavioral mechanisms which can have both constraining and enabling effects vis-à-vis this transition by means of shaping national socio-technical systems and regimes. On this basis, we also discuss how to develop policies accelerating the transition. We find that the incumbent industries can shape policy choice through the lock-in into institutional inter-dependencies. The accumulation of social and material features, and vested interests of actors, for its part can maintain regime level inertia, impeding the transition. Yet, technological lock-in can also enable EVs, by means of learning effects from technologically interrelated wind energy projects and available infrastructure in buildings that support the EV charging needs. Overall, the complexity of path-dependent mechanisms embedded in the dominant regimes, together with the diversity of emerging policy mixes, demands attention both on the technologies and broader socio-technical systems in order to properly assess the prospects of transition toward electric mobility.

Sovacool, B.K. (2019)
Toxic transitions in the lifecycle externalities of a digital society: The complex afterlives of electronic waste in Ghana.
Resources Policy, 64, 101459, 1-21
link

This study examines the contours of electronic waste ("e-waste") governance in Ghana, one of the top five importers of e-waste in the world, as well as the site of one of the most intensive e-waste scrapyards in the world, Agbogbloshie. At Agbogbloshie, despite the intentions of national Ghanaian regulations and hazardous waste laws, most e-waste is untreated or crudely processed via burning or acid baths. These practices release dioxins, furans, and heavy metals into the environment, invariably harming scrapyard workers, their families, and the greater urban community of Accra. However, the scrapyard also provides a critical source of livelihood for some of Ghana's most poor, vulnerable, and unskilled migrants. The aim and objective of this study is to humanize the conundrums and challenges that e-waste invokes in places such as Ghana. Based on extensive and original field research—including expert interviews, community interviews with scrapyard workers and families, and naturalistic observation at waste sites and other parts of the e-waste supply chain—this study asks: What benefits has e-waste brought communities in Ghana? What risks has it created? And, critically, what policies need implemented to make e-waste more sustainable? It documents ten ostensible benefits of e-waste alongside ten very real and growing risks. Then, it identifies a concert of fifteen different policy recommendations as well as four research gaps. It concludes by emphasizing the duality of the e-waste phenomenon and e-waste policy, and by underscoring the political economy dynamics of e-waste activities and practices.

Sovacool, B.K., Baker, L., Martiskainen, M. and Hook, A. (2019)
Processes of elite power and low-carbon pathways: Experimentation, financialisation, and dispossession.
Global Environmental Change, 59, 101985, 1-14
link

What is a low-carbon pathway? To many, it is a way of mitigating climate change. To others, it is about addressing market failure or capturing the co-benefits attached to low-carbon systems, such as jobs or improved health. To still others, it represents building adaptive capacity and resilience in the face of climate change. However, these interpretations can fail to acknowledge how pathways of low-carbon transitions can also become intertwined with processes and structures of inequality, exclusion and injustice. Using a critical lens that draws from a variety of disciplines, this article explores three ways through which responses to climate change can entrench, exacerbate or reconfigure the power of *elites*. As society attempts to create a low-carbon society, including for example via coastal protection efforts, disaster recovery, or climate change mitigation and renewable energy, these efforts intersect with at least three processes of elite power: experimentation, financialisation, and dispossession. Experimentation is when elites use the world as a laboratory to test or pilot low-carbon technologies or policy models, transferring risks yet not always sharing benefits. Financialisation refers to the expansion and proliferation of finance, capital, and financial markets in the global economy and many national economies, processes of which have recently extended to renewable energy. Dispossession is when elites use decarbonisation as a process through which to appropriate land, wealth, or other assets (and in the process make society more majoritarian and/or unequal). We explore these three themes using a variety of evidence across illustrative case studies, including hard and soft coastal protection measures (Bangladesh, Netherlands), climate risk insurance (Malawi), and renewable energy auctions and associated mechanisms of finance and investment

(South Africa and Mexico).

Sovacool, B.K. and Yazdi, A.H. (2019)
Technological frames and the politics of automated electric Light Rail Rapid Transit in Poland and the United Kingdom.
Technology in Society 59, 101190, 1-15
link

Light Rapid Transit (LRT) systems are often backed not only because they satisfy basic mobility functions, but because they can revitalize urban centers, affirm the legitimacy of state planners, support innovation and even cultivate an image of a city or region as progressive and modern. In this study, we argue that electrified, automated LRT systems can fulfill private functional frames, private symbolic frames, societal functional frames, and societal symbolic frames. In particular, we argue that light rail can fulfill private functional frames (making passengers feel safe, offering a cheap and efficient mode of transport), private symbolic frames (signifying political identity or exclusionary planning), societal functional frames (environmental stewardship), and societal symbolic frames (such as modernism or innovativeness, or the lack of it). Essentially, these frames encompass not only what light rail is and does, but what it means and represents, and even some of its failures and challenges. The article then identifies ten specific frames associated with two case studies of automated light rail systems, the established Docklands Light Rail (DLR) in the United Kingdom, and the emerging Personal Rapid Transit (PRT) in Poland. We find that the DLR is not only a vital part of meeting (functional) demand for mobility, it is innovative and exciting to ride, legitimation of a conservative approach to project development, a social injustice (to some), an environmentally friendly alternative to cars, and a perceived magnet for global investment into the greater Docklands area. Similarly, the PRT is not only a reliable and safe mode of transit, but also a technical marvel, a monopoly breaking symbol, a clean and sustainable form of mobility, and a reflection of either progressive Polish innovation and entrepreneurship, or enduring failure.

Sovacool, B.K. and Brisbois, M.C. (2019)
Elite power in low-carbon transitions: A critical and interdisciplinary review.
Energy Research & Social Science, 57, 101242, 1-10
link

Modern energy systems have tended towards centralized control by states, and national and multinational energy companies. This implicates the power of elites in realizing low-carbon transitions. In particular, low-carbon transitions can create, perpetuate, challenge, or entrench the power of elites. Using a critical lens that draws from geography, political science, innovation studies, and social justice theory (among others), this article explores the ways in which transitions can exacerbate, reconfigure or be shaped by "elite power." It does so by offering a navigational approach that surveys a broad collection of diverse literatures on power. It begins by conceptualizing power across a range of academic disciplines, envisioning power as involving both agents (corrective influence) and structures (pervasive influence). It then elaborates different types of power and the interrelationship between different sources of power, with a specific focus on elites, including conceptualizing elite power, resisting elite power, and power frameworks. The Review then examines scholarship relevant to elite power in low-carbon transitions—including the multi-level perspective, Michel Foucault, Antonio Gramsci, Anthony Giddens, Karl Marx, and other contextual approaches—before offering future research directions. The Review concludes that the power relations inherent in low-carbon transitions are asymmetrical but promisingly unstable. By better grappling with power analytically, descriptively, and even normatively, socially just and sustainable energy futures become not only more desirable but also more possible.

Sovacool, B.K., Hook, A., Martiskainen, M. and Baker, L.H. (2019)
The whole systems energy injustice of four European low-carbon transitions.
Global Environmental Change, 58, 101958, 1-15
link

The need for multi-scalar analysis of energy and low-carbon systems is becoming more apparent as a way to assess the holistic socioeconomic and environmental impacts of energy transitions across a variety of scales and lifecycle stages. This paper conducts a whole systems energy justice analysis of four European low-carbon transitions—nuclear power in France, smart meters in Great Britain, electric vehicles in Norway, and solar photovoltaic panels in Germany. It asks: in what ways may each of these transitions result in injustices that extend beyond communities and countries, i.e., across the whole system? It utilizes a mixed-methods research design based on 64 semi-structured research interviews with experts across all four transitions, five public focus groups, and the collection of 58 comments from twelve public internet forums to answer this question. Drawing inductively from these data, the paper identifies and analyzes 44 injustices spread across three spatial scales. *Micro* scale injustices concern immediate local impacts on family livelihood, community health and the environment. *Meso* scale injustices include national-scale issues such as rising prices for electricity and gas or unequal access to low-carbon technology. *Macro* scale injustices include global issues such as the extraction of minerals and metals and the circulation of

waste flows. The paper then discusses these collective injustices in terms of their spatiality and temporality, before offering conclusions for energy and climate research and policy.

Sovacool, B.K., Hook, A., Martiskainen, M. and Baker, L.H. (2019)
Decarbonisation and its discontents: A critical energy justice perspective on four low-carbon transitions.
Climatic Change, 155, 4, 581–619
link

Low-carbon transitions are often assumed as positive phenomena, because they supposedly reduce carbon emissions, yet without vigilance, there is evidence that they can in fact create new injustices and vulnerabilities, while also failing to address pre-existing structural drivers of injustice in energy markets and the wider socio-economy. With this in mind, we examine four European low-carbon transitions from an unusual normative perspective: that of energy justice. Because a multitude of studies looks at the co-benefits of renewable energy, low-carbon mobility, or climate change mitigation, we instead ask in this paper what are the types of *injustices* associated with low-carbon transitions? Relatedly, in what ways do low-carbon transitions worsen social risks or vulnerabilities? Lastly, what policies might be deployed to make these transitions more just? We answer these questions by first elaborating an "energy justice" framework consisting of four distinct dimensions—distributive justice (costs and benefits), procedural justice (due process), cosmopolitan justice (global externalities), and recognition justice (vulnerable groups). We then examine four European low-carbon transitions—nuclear power in France, smart meters in Great Britain, electric vehicles in Norway, and solar energy in Germany—through this critical justice lens. In doing so, we draw from original data collected from 64 semi-structured interviews with expert participants as well as five public focus groups and the monitoring of twelve large internet forums. We document 120 distinct energy injustices across these four transitions, including 19 commonly recurring injustices. We aim to show how when low-carbon transitions unfold, deeper injustices related to equity, distribution, and fairness invariably arise.

Axsen, J. and Sovacool, B.K. (2019)
The roles of users in electric, shared, and automated mobility transitions.
Transportation Research Part D, 71, 1-21
link

This paper synthesizes insights from 19 peer-reviewed articles published in this Special Issue on the roles of users in electric, shared and automated mobility. While many researchers and stakeholders remain inspired by the potential low costs and societal benefits of these innovations, less is known about the real-world potential for uptake and usage. To better understand the likelihood and impacts of widespread uptake, we explore the perceptions of actual and potential users, including drivers, passengers, owners, and members, as well as other stakeholders such as pedestrians, planners, and policymakers. The Special Issue examines a range of cases, including plug-in electric vehicles, car-share and bike-share programs, ride-hailing and automated vehicles. For each innovation, we organize insights on user perceptions of benefits and drawbacks into four categories. Much of the research to date focuses on the first category, private-functional perceptions, mainly total cost of ownership (e.g., $/km), time use and comfort. Our synthesis however spans to the three other categories for each innovation: private-symbolic perceptions include the potential for social signaling and communicating identity; societal-functional perceptions include GHG emissions, public safety and noise; and societal-symbolic perceptions include inspiring pro-societal behavior in others, and the potential to combat or reinforce the status quo system of "automobility". Further, our synthesis demonstrates how different theories and methods can be more or less equipped to "see" different perception categories. We also summarize findings regarding the characteristics of early users, as well as practical insights for strategies and policies seeking societally-beneficial outcomes from mass deployment of these innovations.