

Newsletter 30: December 2018

This is the 30th newsletter from the steering group of the Sustainability Transitions Research Network. The newsletter is divided into the following sections:

- Words from the Chairman
- Environmental Innovation and Societal Transitions
- Network news
- Event announcements
- Publications

The STRN steering group

Words from the Chairman

Dear transition research colleagues,

After 8 years as your STRN chairman, I have decided to step down for several reasons. I have personally transitioned to fatherhood to which I want to dedicate plenty of time. To mitigate against the risk of incumbency, I also think it's good for any organization to change leadership at some point and create space for new people and ideas. And it's gratifying to hand over when things are going (very) well!

Based on discussions in the STRN Steering Group, I am pleased to inform you that from January 2019 Jochen Markard will be the new STRN chairman and Lea Fuenfschilling will join the STRN Board. Next summer, Rob Raven will step down, which creates space for another new Board member. This renewal and replacement strategy aims to ensure both continuity and change in the STRN leadership.

It's been an honor and pleasure to be STRN chair over the past 8 years and see STRN develop, expand and deepen in so many ways:

- Membership has grown (from 300 in March 2011 to more than 1740 now) and diversified in terms of countries, from an initial (Western) European focus to a global representation.
- The number of publications has sky-rocketed in this period, and the kinds of journals in which we publish have diversified tremendously.
- The STRN newsletter has become a highly appreciated vehicle for collecting and sharing relevant information with the transitions community. I have compiled 30 newsletters, which have expanded from 9 pages (1st newsletter in March 2011) to 34 pages (the 29th newsletter). This not only represents our increasing output, but also the willingness of STRN members to send their contributions, without which the newsletter could not have become a success.
- The analytical topics and empirical fields we address have expanded as the updated STRN research agenda documented (https://transitionsnetwork.org/about-strn/research_agenda/) and our scholarship is deepening its conceptual repertoire by increasingly mobilizing insights and approaches from the wider social sciences.
- Our publications are also noticed (and widely cited) by other scientific communities, who increasingly recognize sustainability transitions as a vibrant, important and interesting research field (as evidenced by various recent overviews of sustainability research).
- The STRN-linked journal *Environmental Innovation and Societal Transitions* has received an official impact factor and continues to publish important and interesting transition articles.

- IST-conferences are organized on an annual basis, providing an important meeting place for transition scholars. The 10th anniversary conference will take place outside of Europe (in Canada), in line with the globalization trend, mentioned above.
- The NEST network of PhD students and early career researchers has emerged as a vibrant community, with dedicated meetings and another yearly conference.
- As a network, STRN is diversifying into several active thematic groups, e.g. on methodology, emerging and developing countries, urban transitions, and various national chapters (in Brazil, Australia, Canada/North America).
- Our impact on policy debates has increased tremendously through dedicated activities by STRN members with policymakers (locally, nationally and internationally) and because our ideas are increasingly being taken up. The recent IPCC report on *Global warming of 1.5 °C*, for instance, references many publications by transition scholars. Especially chapter 2 (on mitigation pathways) and chapter 4 (Strengthening and implementing the global response), draw strongly on our work, stating, for instance, that “The socio-technical transition literature points to multiple complexities in real-world settings that prevent reaching ‘idealised’ policy conditions but at the same time can still accelerate transformative change through other co-evolutionary processes of technology and society”.

These activities and achievements show that STRN and sustainability transitions research is performing very well on a wide range of dimensions. I want to thank you all for your contributions to the research field, which looks set to continue strongly into the future.

On a personal note, I want to thank my fellow Board members (Jochen and Rob) for our smooth and productive collaboration over the years, and also the STRN Steering Group for providing stimulating inputs and thoughtful suggestions. I will, of course, continue to be active in sustainability transitions research and attend IST-conferences and other events. But you will probably receive less emails from me, calling for newsletter contributions or asking for considerate mailing list use. I wish STRN and its new leadership all the best and look forward to following the interesting outputs and activities in the coming years.

Frank Geels, Chairman of STRN (frank.geels@manchester.ac.uk).

Dear Frank,

On behalf of the STRN community, we thank you for your time, untiring efforts and great dedication as STRN chairman! Over the past eight years as chairman, your service to our community has been instrumental in molding the STRN into a leading scholarly network, expanding the network internationally, and successfully navigating the challenges that inevitably confront such a task. Among the countless leadership and administrative efforts you have undertaken, we are particularly grateful for your work on the highly visible newsletter, policy outreach, the development of the new research agenda along with conference organization and appearances.

While your service has been integral to the outwardly visible accomplishments of the network, we also want to acknowledge the equally important behind-the-scenes work on network governance and coordination that you have done. It was a pleasure working with you as Chairman and we are looking forward to your continued support of the network.

We wish you all the best in your future endeavors,

The STRN steering group,

Floortje Alkemade, Anna Bergek, Jeroen van den Bergh, Lea Fünfschilling, Florian Kern, Jonathan Köhler, Jochen Markard, Susan Mühlemeier, Rob Raven, Daniel Rosenbloom, Jonas Torrens, Bruno Turnheim, Julius Wesche, Anna Wieczorek

Environmental Innovation and Societal Transitions

Volume 29 of *Environmental Innovation and Societal Transitions* has just been published. It contains a Special Section on “Community organizing, sustainability transitions and public policies” edited by Filippo Celata and Raffaella Coletti, and in addition 7 regular articles, a viewpoint and a commentary:

- Special issue:
 - A Community organizing, sustainability transitions and public policies: Introduction to the special section, by Filippo Celata, Raffaella Coletti
 - Regime pressures and organizational forms of community-based sustainability initiatives, by S.L. Becker, F. Franke, A. Gläsel
 - The policing of community gardening in Rome, by Filippo Celata, Raffaella Coletti
 - The influence of public funding on community-based sustainability projects in Scotland, by Elizabeth Dinnie, Kirsty L. Holstead
 - The socio-spatial politics of urban sustainability transitions: Grassroots initiatives in gentrifying Peckham, by Irene Håkansson
- Viewpoint: Co-producing urban sustainability transitions knowledge with community, policy and science, by Niki Frantzeskaki, Ania Rok
- Commentary: Policy and community-led action on sustainability and climate change: Paradox and possibility in the interstices, by Thomas Henfrey, Gil Penha-Lopes
- The creation of legitimacy in grassroots organisations: A study of Dutch community-supported agriculture, by Laura M. Van Oers, W.P.C. Boon, Ellen H.M. Moors
- The institutionalisation of sustainable practices in cities: how initiatives shape local selection environments, by Jake Barnes, Rachael Durrant, Florian Kern, Gordon MacKerron
- Planning roles in infrastructure system transitions: A review of research bridging socio-technical transitions and planning, Linda Carroli
- Power transmission: Where the offshore wind energy comes home, by Jeremy Firestone, Alison W. Bates, Adam Prefer
- A typology of intermediary organizations and their impact on sustainability transition policies, by Ingrid Mignon, Wisdom Kanda
- Designing industrial strategy for a low carbon transformation, by Jonathan Busch, Timothy J. Foxon, Peter G. Taylor
- An institutional analysis of the Japanese energy transition, by Jeffrey B. Kucharski, Hironobu Unesaki

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)

Network News

Any news related to ongoing activities of STRN

Sustainability Transitions Brazil at the International Conference on Business Management and Environment (XX ENGEMA) (photo below)

On December 5th, in Sao Paulo, founding members of the Sustainability Transitions Brazil conducted an exciting workshop on *Sociotechnical Transitions towards Sustainable Urban Mobility* at the 20th edition of the International Conference on Business Management and Environment (XX ENGEMA), organised by the School of Business, Economics and Accounting at Sao Paulo University (FEA-USP). We would like to thank our colleagues Minelle Silva (Unifor), Mauricio Maldonado (UFSC), Sieglinde Cunha (Positivo), Adriana Marotti (USP) and Jose Carlos Lazaro (UFC) for making this workshop possible and sharing sustainability transitions approaches with Brazilian researchers from other communities. Sustainability Transitions Brazil (sustaintransitionsbrazil@gmail.com)



Event announcements

Calls for upcoming relevant events such as workshops and conferences

International Workshop on the Sharing Economy

The 6th International Workshop on the Sharing Economy (IWSE) will be held on 28-29 June, 2019, at Utrecht University. Martijn Arets, Rense Corten, Joyce Delnoij and Koen Frenken will act as the local organizing committee. For updates, see: <https://6thiwse.sites.uu.nl/>

STEPS summer school, 13-14 May, 2019, UK

The ESRC STEPS Centre invites applications for its 2019 Summer School, which will take place from 13-24 May in the UK. Applications are invited from highly-motivated doctoral and postdoctoral researchers working in fields around development studies, science and technology studies, innovation and policy studies, and interested in transdisciplinary methods and the politics of the environment. The Summer School is a two-week immersive course on theories and practical approaches to sustainability, through creative, interactive and participatory learning. Participants will explore the theme of *pathways to sustainability* through a mixture of workshops, lectures, outdoor events and focused interaction with STEPS Centre members. The Summer School takes place on the University of Sussex campus, near Brighton, UK. The deadline for applications is 27 January 2019 at 23.59 GMT. There is a fee to attend, but a small number of bursaries are available to non-OECD applicants. For details of how to apply, financial support, programme information, and materials from previous years, visit the STEPS website <https://steps-centre.org/>

Publications

Announcement of new publications such as article, PhD theses and books

PhD thesis/book: Nagorny-Koring, N. 2018, *Kommunen im Klimawandel: Best Practices als Chance zur grünen Transformation? (Cities in (Climate) Change: Best Practices as an opportunity for urban sustainability transitions?)*, transcript.

Climate policy has for decades been primarily an international and a national concern. Only recently have municipalities explicitly become involved in climate change governance and are establishing themselves as independent actors. In European and nationally funded programs as well as in international, national or regional city networks a particular focus on the promotion of knowledge transfer and exchange of experiences can be observed. But in spite of the enormous popularity of policy instruments such as *best practices* and *case studies*, little is known about the reasons for and mechanism of the ample dissemination of these technologies of government. Even more important, the broader implications of the focus on the transfer of “best practices” for the political problematization of climate change and for appropriate ways of governing it remain opaque. The book *Cities in (Climate) Change: Best Practices as an opportunity for urban sustainability transitions?* is addressing this research gap by questioning the widespread belief in the “replication principle” and explaining why best practices are so popular despite the apparent gap of claim and reality. It presents in detail how climate change is made governable in municipalities by the creation, use and dissemination of purportedly “best climate practices”. The program “Masterplan 100% climate protection” of the German Federal Ministry for the Environment and the Climate-KIC Innovation Project “Transition Cities” serve as case studies.

(available in German as open access: <https://www.transcript-verlag.de/978-3-8376-4627-6/kommunen-im-klimawandel/?number=978-3-8394-4627-0>)

(Nanja.Nagorny-Koring@provadis-hochschule.de)

PhD thesis: Sebastian F. Knab, 2018, *Business model innovation in the age of sustainable development: New perspectives based on transition and strategic cognition theory and cases from the German energy industry* (thesis can be downloaded here: http://bit.ly/Thesis_SKnab)

It has been suggested that business model innovation (BMI) is crucial for incumbent firms to drive and master sustainability transitions. Yet there is not much knowledge about how business models (BMs) and sustainability transitions interrelate and how incumbents (can) innovate BMs in a transition context. BM research typically takes a firm-centric perspective, disregards the mutual influence between firms and the socio-economic system they are embedded in, and fails to address the particularities of BMI in a transition context. To address these shortcomings, I embark on this cumulative dissertation by identifying BM research directions which are particularly relevant in a transition context. The five dissertation papers follow these directions, are theoretically informed by transition and strategic cognition theory and empirically situated in the German energy industry. Methodologically, this dissertation includes conceptual papers, action research and longitudinal case studies. Overall, I find that the BM concept is well suited to link firms and the wider system because it is firm-centric yet context-oriented. To drive and master sustainability transitions, incumbents need to emphasize BMI with a focus on inter-organizational collaboration and support cognitive change within and across organizational boundaries. In this dissertation, insights from the transition and BM literatures are conceptually integrated and a method for collaborative BM design is developed, applied and evaluated. Furthermore, BM implementation is portrayed as a recursive process of cognitive change and alignment at and across organizational levels, and ensuing action. This dissertation primarily contributes to BM research; however, individual papers offer secondary contributions to the transition and strategic cognition literatures.

Book: Jensen, J.S., Späth, P. and Cashmore, M. (eds.), 2018, *The Politics of Urban Sustainability Transitions: Knowledge, Power and Governance*, Routledge

Cities, the world over, are increasingly recognised to be both a principal source of the environmental and social sustainability challenges facing contemporary society and a critical site for addressing these challenges. Socio-technical systems are at the heart of these challenges as they configure central aspects of urban life: from mobility and energy infrastructures to leisure activities and patterns of mobility. This observation has led to substantial interest in how societies might initiate and actively steer radical transitions in these systems in the pursuit of sustainable urban futures. This book contributes to emerging debates on the politics of urban transitions by examining the intimate interlinkages between knowledge, power and governance. Drawing upon real-world examples of urban governance, the authors explore the strategies, struggles and controversies involved in configuring knowledge and how knowledge constructions influence governance by rendering some concerns and issues visible and valuable, while obscuring others. The book draws attention to how novel ways of conceptualising, knowing and observing socio-technical systems may be harnessed productively in redefining the power relationships underpinning unsustainable practices. Understanding these dynamics can ultimately inform and enable new approaches to support much-needed urban transitions. This book provides a compelling examination of urban knowledge politics for the twenty-first century that will be of great value to academics, policy-makers and practitioners working in the social sciences, urban studies, geography, urban governance or sustainability transitions.

Book: Jenkins, K. and Hopkins, D. (eds.), 2018, *Transitions in Energy Efficiency and Demand: The Emergence, Diffusion and Impact of Low-Carbon Innovation*, Routledge

Meeting the goals enshrined in the Paris Agreement and limiting global temperature increases to less than two degrees above pre-industrial levels demands rapid reductions in global carbon dioxide emissions. Reducing energy demand has a central role in achieving this goal, but existing policy initiatives have been largely incremental in terms of the technological and behavioural changes they encourage. Against this background, this book develops a sociotechnical approach to the challenge of reducing energy demand and illustrates this with a number of empirical case studies from the United Kingdom. In doing so, it explores the emergence, diffusion and impact of low energy innovations, including electric vehicles and smart meters. The book has the dual aim of improving the academic understanding of sociotechnical transitions and energy demand and providing practical recommendations for public policy. Combining an impressive range of contributions from key thinkers in the field, this book will be of great interest to energy students, scholars and decision-makers.

Special issue on: Understanding transition pathways: Insights from bridging modelling and transition-science based studies, *Technological Forecasting and Social Change*, in press

Hof, A.F., Van Vuuren, D.P., Berkhout, F., Geels, F.W., 2018, Editorial introduction, *Technological Forecasting and Social Change*, in press

De Cian, E., Dasgupta, S., Hof, A.F., Van Sluisveld, M.A.E., Köhler, J., Pfluger, B., Van Vuuren, D.P., 2018, Actors, decision-making, and institutions in quantitative system modelling, *Technological Forecasting and Social Change*, in press

Hof, A.F., Carrara, S., De Cian, E., Oehler, P., Pfluger, B., Van Sluisveld, M.A.E., Van Vuuren, D.P., 2018, From global to national scenarios: bridging different models to explore power generation decarbonisation based on insights from socio-technical transition case studies, *Technological Forecasting and Social Change*, in press

Nilsson, M., Dzebo, A., Savvidou, G. and Axelsson, K., 2018, A bridging framework for studying transition pathways – From systems models to local action in the Swedish heating domain, *Technological Forecasting and Social Change*, in press

- Zwartkruis, J.V., Berg, H., Hof, A.F. and Kok, M.T.J., 2018, Agricultural nature conservation in the Netherlands: Three lenses on transition pathways, *Technological Forecasting and Social Change*, in press
- Geels, F.W., McMeekin, A., and Pfluger, B., 2018, Socio-technical scenarios as a methodological tool to explore social and political feasibility in low-carbon transitions: Bridging computer models and the Multi-Level Perspective in UK electricity generation (2010-2050), *Technological Forecasting and Social Change*, in press
- Van Sluisveld, M.A.E, Hof, A.F., Carrara, S., Geels, F.W., Nilsson, M., Rogge, K., Turnheim, B., Van Vuuren, D.P., 2018, Aligning Integrated Assessment Modelling with socio-technical transition insights: An application to low-carbon energy scenario analysis in Europe, *Technological Forecasting and Social Change*, in press
- Rogge, K.S., Pfluger, B. and Geels, F.W., 2018, Transformative policy mixes in socio-technical scenarios: The case of the low-carbon transition of the German electricity system (2010-2050), *Technological Forecasting and Social Change*, in press
- Köhler, J., Turnheim B., Hodson M., 2018, Low carbon transitions pathways in mobility: Applying the MLP in a combined case study and simulation bridging analysis of passenger transport in the Netherlands, *Technological Forecasting and Social Change*, in press

Special Issue (virtual) on: The uptake and diffusion of solar power for energy access in developing countries, *Energy Research & Social Science*, Vol. 44

- Ockwell, D., Byrne, R., Hansen, U.E., Haselip, J., Nygaard, I., 2018, The uptake and diffusion of solar power in Africa: Socio-cultural and political insights on a rapidly emerging socio-technical transition, *Energy Research & Social Science*, 44, 122-129.
- Hansen, U.E., Gregersen, C., Lema, R., Samoita, D., Wandera, F., 2018, Technological shape and size: A disaggregated perspective on sectoral innovation systems in renewable electrification pathways, *Energy Research & Social Science*, 42, 13-22.
- Pedersen, M.B. and Nygaard, I., 2018, System building in the Kenyan electrification regime: The case of private solar mini-grid development, *Energy Research & Social Science*, 42, 211-223.
- Boamah, F. and Rothfuß, E., 2018, From technical innovations towards social practices and socio-technical transition? Re-thinking the transition to decentralised solar PV electrification in Africa, *Energy Research & Social Science*, 42, 1-10.
- Ulsrud, K., Rohracher, H., Winther, T., Muchunku, C., Palit, D., 2018, Pathways to electricity for all: What makes village-scale solar power successful?, *Energy Research & Social Science*, 44, 32-40.
- Winther, T., Ulsrud, K., Saini, A., 2018, Solar powered electricity access: Implications for women's empowerment in rural Kenya, *Energy Research & Social Science*, 44, 61-74.
- Batchelor, S., Brown, E., Leary, J., Scott, N., Alsop, A., Leach, M., 2018, Solar electric cooking in Africa: Where will the transition happen first?, *Energy Research & Social Science*, 40, 257-272.
- Bisaga, I. and Parikh, P., 2018, To climb or not to climb? Investigating energy use behaviour among Solar Home System adopters through energy ladder and social practice lens, *Energy Research & Social Science*, 44, 293-303.
- Rodríguez-Manotas, J., Bhamidipati, P.L., Haselip, J., 2018, Getting on the ground: Exploring the determinants of utility-scale solar PV in Rwanda, *Energy Research & Social Science*, 42, 70-79.
- Byrne, R., Mbeva, K., Ockwell, D., 2018, A political economy of niche-building: Neoliberal-developmental encounters in photovoltaic electrification in Kenya, *Energy Research & Social Science*, 44, 6-16.
- Cross, J., and Murray, D., 2018, The afterlives of solar power: Waste and repair off the grid in Kenya, *Energy Research & Social Science*, 44, 100-109
- Davies, G., 2018, Clean energy product markets in sub-Saharan Africa: Complex market devices and power asymmetries, *Energy Research & Social Science*, 42, 80-89.

Simmet, H.R., 2018, "Lighting a dark continent": Imaginaries of energy transition in Senegal, *Energy Research & Social Science*, 40, 71-81

Yadav, P., Malakar, Y. and Davies, P.J., 2019, Multi-scalar energy transitions in rural households: Distributed photovoltaics as a circuit breaker to the energy poverty cycle in India, *Energy Research & Social Science*, 48, 1-12

A transformation in energy structures and governance models are required to meet the needs of communities living in rural and remote areas and particularly for those subject to energy and economic poverty. New models must be reflexive to global climate concerns, align with social, economic and environmental agendas of national, state, and local governments, and be compatible with embedded energy infrastructure. Decentralised solar solutions are a resilient technology which can support energy transformation to spatially, economically and socially disadvantaged communities yet the deployment of this technology is hamstrung by path dependencies including policy frameworks, business models and infrastructure. In this study, the multi-level perspective has been used to examine energy transformation within rural and remote communities in India through interviews with regime and niche level actors. We identify various barriers impeding successful deployment of decentralised solar PV including a disconnect between policy makers and implementers, poor coordination within and between actors, and limited institutional focus and competence. To support a successful transition to off-grid solar based regimes for rural and remote communities, participants suggested strong political determination, setting enabling policy frameworks, and implementing a collaborative ecosystem with businesses, system suppliers, financial intermediaries, distribution companies, civil society and end users.

Matschoss, K.J. and Heiskanen, E., 2018, Innovation intermediary challenging the energy incumbent: Enactment of local socio-technical transition pathways by destabilisation of regime rules, *Technology Analysis and Strategic Management*, 30(12), 1455-1469

The energy sector needs to transform towards sustainability. The multi-level perspective on sociotechnical transitions is embracing an enactment perspective, which focuses on the agency of various actors in shifting transitions pathways but has yet to study local urban experiments from such an enactment perspective. Our empirical research examines an innovation intermediary's work in destabilising the regime rules in relation to the local energy incumbent company in Helsinki, Finland. Our paper seeks answers to the questions: How does the collaboration of the intermediary and the local energy company unfold? What are the impacts of the intermediary work on the local energy company in terms of enactment of transition pathways and what are the mechanisms causing the impact? Our research shows that the intermediary contributes to the transition by disturbing existing rules, structures, practices and networks by convening innovation champions from different constituencies, renegotiating regime rules and disrupting existing R&D alliances.

Roberts, C. and Geels, F.W., 2018, Public storylines in the British transition from rail to road transport (1896-2000): Discursive struggles in the Multi-Level Perspective, *Science as Culture*, 27(4), 513-542

An analysis of the transition from railways to highways as the dominant transport system in the United Kingdom during the twentieth century adds to the multi-level perspective's account of discourse by showing that public storylines about competing niche and regime technologies can have a powerful influence on socio-technical transitions. These storylines are developed by supporters and opponents of the competing technologies, with each group attempting to frame their favoured technology as positively as possible. The public salience of these storylines can be evaluated by assessing how highly they score on four elements of frame resonance: empirical fit, experiential commensurability, actor credibility, and macro-cultural resonance. The development, salience, and influence of these storylines can be seen at play across the entirety of the transition to a road-based transport system, from the very early history of the automobile through to the turn of the millennium, when public

opposition to road transport was becoming increasingly pronounced. This case study is unique in the fact that it is longitudinal, tracing discursive conflict over the entire course of a multi-decade transition. While existing literature in the multi-level perspective typically emphasises the disadvantages faced by niche-innovations, this case study shows that powerful storylines, enabled by the right cultural repertoires and possibly negative storylines about existing socio-technical systems, can create powerful political support for a new technology, giving it an advantage against more established incumbents.

Boodoo, Z. and Olsen, K.H., 2018, Assessing transformational change potential: the case of the Tunisian cement Nationally Appropriate Mitigation Action (NAMA), *Climate Policy*, 18(6), 794-812

To effectively address the root causes of carbon lock-in across developing countries, Nationally Appropriate Mitigation Actions (NAMAs) with transformational change characteristics are being supported by donors and finance mechanisms as a means to achieve ambitious nationally determined contributions (NDCs). However, there is still a scarcity of empirical studies on how transformational change policies and actions are designed and supported in practice. This article addresses such a gap in knowledge by combining theoretical insights from the multi-level perspective and transitions management literature to examine a donor-supported cement sector NAMA in Tunisia developed during 2012–2013. A narrative is constructed to analyse the adequacy of the NAMA design to promote structural shifts towards low carbon development in the cement sector. Data collection is based on semi-structured interviews and documentation gathered during field work in Tunisia 2014–2015. The study finds that the NAMA design is not likely to lead to transformational change of the cement sector, since underlying factors accounting for lock-in are not properly tackled. Although the NAMA has enabled new and promising sectoral partnerships across the cement sector, the analysis suggests that the NAMA's transformational potential is currently limited by a number of factors not being adequately addressed. Measures are proposed to reorient the NAMA towards promoting system innovation, building on further research and experimentation with the policy entrepreneurial role of donors.

Marletto, G., 2019, Who will drive the transition to self-driving? A socio-technical analysis of the future impact of automated vehicles, *Technological Forecasting and Social Change*, in press

Automated driving is an emerging transport innovation whose future impact is increasingly studied. With this paper I want to show that such a literature misses a crucial point: which impacts automated driving will generate depends on the competition between different networks of innovators, each supporting its own approach to the integration of automated driving into the system of urban mobility. As technological, business and policy innovations are simultaneously at stake, a socio-technical approach is followed. In particular, socio-technical maps representing urban mobility in year 2040 are used to represent the results of three transition pathways towards automated driving, each being led by a different network of innovators. The first socio-technical map results from the ability of today incumbent automotive companies to integrate the suppliers of technologies and components for connected automated vehicles into their network, and to successfully lobby for public investments on vehicle-to-infrastructure technologies for long-haul mobility. No relevant changes in urban mobility are generated in this transition pathway, except for the diffusion and the peer-to-peer sharing of household electric automated vehicles. The second socio-technical map emerges from the cooperation between leaders of the internet and managers of shared and collective transport systems. This new network of innovators is able to gain support from multilevel policies that consider shared automated vehicles as the core element of diffused systems of integrated urban mobility. Impacts on urban mobility are positive, also because the strict regulation of household automated vehicles avoids any rebound effect. In the third socio-technical map, urban mobility is taken over by energy agents who integrate automated vehicles and smart grids. Such innovators foster a new political discourse on

energy efficiency and sustainability, and eventually gain support from the public co-funding of national and international smart grids. In this scenario, unregulated pervasive rebound effects of automated driving may result from the limited attention paid by policies to the issue of urban quality and sustainable transportation.

Rosenbloom, D., 2019, A clash of socio-technical systems: Exploring actor interactions around electrification and electricity trade in unfolding low-carbon pathways for Ontario, *Energy Research & Social Science*, 49, 219-232

Examining interactions *within* socio-technical systems forms a staple of the literature on sustainability transitions (e.g., interactions among low-carbon challengers and carbon-intensive incumbents in the electricity system). The interactions *between* multiple socio-technical systems have, however, received more limited attention (e.g., how different systems of energy provision might come into contact as part of a low-carbon transition). In response, this study draws upon insights from transition studies and recent debates about 'disruption' to consider how different energy systems (electricity, transport, and heating) and their affiliated actors are interacting around key pillars of low-carbon pathways: expanded societal electrification and electricity trade. These dynamics are explored in the context of Ontario, Canada as this province appears to be moving along a decarbonisation pathway that is anticipated to be widely reflected across transition contexts. Steps along this pathway include the decarbonisation of the electricity system (through the procurement of low-carbon supply from domestic generators and regional interties) followed by the electrification of broader energy end-uses. Based on the analysis of actor positions surrounding climate-energy planning in Ontario, findings indicate that emerging interactions around the electrification of transport are marked by greater alignments, whereas electrification of heat and electricity trade are characterised by deeper tensions. These patterns hold implications for the acceleration of low-carbon transitions.

Kanger, L., Geels, F.W., Sovacool, B.J., Schot, J.W., Technological diffusion as a process of societal embedding: Lessons from historical automobile transitions for future electric mobility, *Transportation Research Part D: Transport and Environment*, in press

Technological diffusion can be understood as a broader process of co-construction of technology and its environment. This article conceptualizes this co-construction as a process of societal embedding, in which new technologies find their place in wider societal domains, which include immediate user contexts, cultural meanings, policies, and infrastructures. This perspective helps address three under-developed dimensions in adoption models: (1) diffusion includes more actors than users/adopters, (2) user characteristics and environments are not known in advance, but are articulated during the technological diffusion process, and (3) societal embedding is full of choices and struggles that affect the directionality and thus shape of socio-technical systems. Societal embedding therefore calls importance to the "demand side" of sustainability transitions. Because electric vehicles have, so far, only achieved limited diffusion globally, we cannot use it to test and illustrate our framework. We therefore use a historical comparative research design, which utilizes the societal embedding framework with two case studies of automobile diffusion in the United States and the Netherlands between the 1880s and 1970s. We subsequently apply the resulting lessons and insights to the future development of electric vehicles, with examples from multiple countries. An important finding is that the successful diffusion of electric vehicles demands a more robust co-construction policy focus that includes tinkering with all aspects of the societal embedding process, and one involving a constellation of agents beyond policymakers and purchasers.

Susur, E., Hildago, A. and Chiaroni, D., 2019, The emergence of regional industrial ecosystem niches: A conceptual framework and a case study, *Journal of Cleaner Production*, 208, 1642-1657

The objective of this paper is to understand how industrial symbiosis initiatives can contribute to the emergence of regional industrial ecosystems for sustainability transitions of local industrial production systems. We offer a conceptual framework that integrates industrial ecology literature and strategic niche management perspective from the sustainability transitions research field. The framework provides a conceptual foundation for analysing the individual industrial symbiosis initiatives and their aggregated contribution to the emergence of regional industrial ecosystems. Analytically, we conceptualise two different heuristic levels – the local industrial symbiosis experiments level and the regional industrial ecosystems niche level – which are interlinked through three niche processes. We represent the merits of our conceptualisation through a case study in an empirical setting where we selected a highly industrialised and rarely explored region; namely, the Autonomous Region of Catalonia in Spain. We identify and analyse eight industrial symbiosis initiatives that evolved during 18 years in the region. In the light of our conceptual framework, the results show that interlinked initiatives from the region have been gradually adding up to emerging regional industrial ecosystems. However, the region is still missing a broad regional network with articulated expectations and visions and shared cognitive, formal and normative rules. If emerging regional network provides support and protection for new initiatives, a regional culture change can be realised to achieve sustainability transition of local industrial production systems employing closed industrial production loops. The theoretical contribution of this paper is that we combine two different research streams that have not often learned from each other and we also develop a novel conceptual approach for ex-post evaluation of regional industrial ecosystem development. Moreover, our conceptual framework can be extended as a prescriptive management tool for planning and implementation of industrial symbiosis initiatives in Catalonia as well as in other regions.

Roesler, T. Hassler, M., 2019, Creating niches: The role of policy for the implementation of bioenergy village cooperatives in Germany, *Energy Policy*, 124, 95-101

Visions of alternative and more sustainable energy systems are commonly associated with the development and innovation of renewable energy technologies. Geels (2002) notes that regime transition is affected by a set of technological, socio-economic, organisational, political, institutional and region-specific dimensions that can be triggered by niche developments. Indeed, the transition toward a sustainable energy regime is strongly influenced by governance and regulatory frameworks extending from a global to a local scale, which set boundaries and incentives for the direction in which energy transition can evolve. Since 2007, several local initiatives have emerged in the county of Marburg-Biedenkopf in Germany promoting the use of biomass on a local scale. These initiatives successfully established locally owned cooperatives to run a decentralised heating supply infrastructure to supply their households. This paper highlights the role of multi-scalar policy processes that are allowing for the development of bioenergy villages and provides details on the role of regional and local policy processes. Supplementing the national policy framework with regional and local policy makers is a key factor in implementing bioenergy villages.

Schmitt, T.M., 2018, (Why) did Desertec fail? An interim analysis of a large-scale renewable energy infrastructure project from a Social Studies of Technology perspective, *Local Environment*, 23(7), 747-776

In 2009 the Desertec Industrial Initiative (DII) was founded by several, predominant German enterprises. The objective of DII was to organise the conditions for the realisation of the Desertec idea, which aimed to both (a) supply Europe, in a large-scale manner, with electricity produced in solar power plants in North Africa and the Arabic peninsula and (b) contribute to the self-supply of the Middle East North Africa region (MENA). Protagonists of

the desert energy idea saw this megatech project as a starting point for a new trans-Mediterranean EU-MENA union, critics in contrast as a neo-colonial project. Disputes over the adequate interpretation and implementation of the Desertec idea broke out from the beginning. In 2014/2015, the media talked of the failure of DII and of the Desertec concept. The majority of the members left DII at the end of 2014. On the other hand, in some MENA countries renewables are playing a crucial role in securing the future of the energy sector. This paper analyses the development of DII and the Desertec idea by using concepts from Social Studies in Technology, and especially by the multi-level perspective approach in Transition Studies. It shows how the interplay of different factors, such as technological developments, entrepreneurial performances and political processes, lead to internal conflicts and the non-realisation – up to now – of related large-scale energy projects. As an important aspect of the paper, different understandings of the future of our energy supply and of North–South relations are presented in detail.

Edomah, N., 2019, Governing sustainable industrial energy use: Energy transitions in Nigeria's manufacturing sector. *Journal of Cleaner Production*. 210, 620–629

The governance of industrial energy use in recent times has been driven by the quest for greater energy security and sustainable industrial growth. Sustainable use of energy necessitates a rethink in the production, use and governance of energy resources that stimulates and supports transition to a more effective and efficient energy system. However, how do we ensure an effective transition in industrial energy use in the midst of gross energy poverty within a developing country context? This paper explores the motives and drivers of changes in energy use within the industrial sector. Statistical data from published reports, as well as informal interviews of stakeholders in Nigeria's industrial sector were used. Following analysis of data, four important salient phases (eras) of industrial energy transition in Nigeria's manufacturing sector was established. These distinct eras are: (1) Grid-dependent era; (2) Self-generation era; (3) Industrial energy outsourcing era; (4) Industrial energy conservation era. The study reveals that: outsourcing of industrial services; cost reduction; and business realignment motives are key drivers of transitions in Nigeria's industrial sector. This paper concludes by highlighting the implications of these changes for the future of energy and sustainable industrial growth in Nigeria.

Diercks, G., Larsen, H. and Steward, F., 2018, Transformative innovation policy: Addressing variety in an emerging policy paradigm, *Research Policy*, in press

This paper presents an analytical framework for assessing the emergence of a new policy paradigm labelled “transformative innovation policy”, which can be seen as layered upon, but not fully replacing, earlier policy paradigms of science and technology policy and innovation systems policy. The paper establishes conceptual diversity in this emerging policy paradigm. Despite a common agenda for transformative change, there are notable differences concerning the understanding of the innovation process. Two global initiatives to promote such new innovation policies, Mission Innovation and the Global Covenant of Mayors for Climate and Energy, are used to illustrate how different articulations of transformative innovation policy are expressed in practice. These may be seen as a positive expression of the breadth of the emerging policy paradigm. While there are grounds for such a positive reading, this paper ends with a caution by stressing the political nature of paradigm change and the strong legacy of an economic, firm-centred and technology-oriented tradition in innovation policy. It makes a plea for more emphasis on a broader conceptualization of transformative innovation, and suggests that a socio-technical understanding of innovation provides several appropriate analytical concepts that can help to shape our thinking and understanding of transformative innovation policy.

Grillitsch, M., Hansen, T., Coenen, L., Miörner, J. and Moodysson, J., 2018, Innovation policy for system-wide transformation: The case of strategic innovation programmes (SIPs) in Sweden, *Research Policy*, in press

The orientation towards grand societal challenges can be seen as a new wave or paradigm for innovation policy. Such policy aims at system-wide transformation and is often referred to as system innovation policy. While insights from transition studies have provided novel and useful rationales for innovation policy targeting system-wide transformation, it remains unclear how to design, implement and evaluate such policies. The contribution of this paper is to translate and concretize the challenges of system innovation policy towards scope for policy action and analysis. Building on insights from transition studies we group the challenges into four domains: directionality, experimentation, demand articulation, and policy coordination and learning. We relate challenges within the four domains to three generic features of innovation systems: interests and capabilities of actors, networks, and institutions. The derived framework is applied in a case study on the strategic innovation programmes, a recent policy initiative by Vinnova, Sweden's Innovation Agency, targeting system innovation.

Yap, X-S. and Truffer, B., 2018, Shaping selection environments for industrial catch-up and sustainability transitions: A systemic perspective on endogenizing windows of opportunity, *Research Policy*, in press

Transitioning economic sectors towards more sustainable futures is a major global challenge, in particular for non-OECD countries. Policymakers in these countries are confronted with a double challenge: how to implement cleaner technologies and infrastructures while at the same time promoting rapid industrial development. In catch-up studies, this trade-off has been increasingly interpreted as providing windows of opportunity for gaining strong leadership in new generations of cleantech industries. In this paper, we maintain that in order to specify how these windows of opportunity can be endogenized, a deeper understanding is needed about whether, how and by whom the directionality of innovation systems can be influenced. For this purpose, we propose an analytical approach that draws on the technological innovation system framework extending the current understanding of directionality in two ways: first, we complement the prevalent top-down perspective with a bottom-up view exemplified by the institutional entrepreneurship literature. Second, we posit that the focus has to be shifted from the manufacturing of single technologies to the transformation of entire socio-technical systems. The presented framework is validated by a case study on recent shifts in the dominant technology in China's urban water management sector. Major changes in the country's sectoral selection environment led membrane bioreactor technology to become the dominant design in urban water management – a development that is unmatched in any other country in the world. Owing to these transformations, China's technology firms outcompete multinational players and therefore they show strong potentials for industrial leapfrogging. However, although the promise to solve environmental problems played a decisive role in the shaping of the selection environment, it remains unclear whether the observed transformation leads the way to a more sustainable sector structure in the longer run. The case, however, still enables us to specify how windows of opportunity can be endogenized through the interplay of different actors trying to shape different layers of the selection environment in a specific sector.

Bugge, M.B., Fevolden, A.M. and Klitkou, A., 2018, Governance for system optimization and system change: The case of urban waste, *Research Policy*, in press

This paper analyses urban waste systems to explore how local authorities can resolve challenges related to climate change, urbanization and resource depletion. The paper investigates how different public governance regimes affect local authorities' ability to move upwards in the waste hierarchy. It identifies three different governance regimes – traditional bureaucracy, new public management and networked governance – and uses the insights from innovation in urban waste in three Norwegian city regions – Oslo, Drammen and

Bergen – to illuminate how these regimes possess both strengths and weaknesses in how they affect system optimization and system change. The observed working practices signal that the issue of urban waste systems is perceived as a challenge of system optimization rather than system change. Viewing this as a challenge requiring system change would probably have ensured a stronger directionality and a broader anchoring of actors. Such an approach is likely to have arrived at a waste prevention mode earlier than the step-by-step-solutions implemented so far. The paper concludes that there is not one best governance regime, but a need to acknowledge their co-existence and carefully consider the characteristics of the respective regimes in order to arrange urban waste systems for long-term dynamic and sustainable city regions.

Kivimaa, P., Boon, W., Hyysalo, S., Klerkx, L., 2018, Towards a typology of intermediaries in sustainability transitions: a systematic review. *Research Policy*, in press

Intermediary actors have been proposed as key catalysts that speed up change towards more sustainable sociotechnical systems. Research on this topic has gradually gained traction since 2009, but has been complicated by the inconsistency regarding what intermediaries are in the context of such transitions and which activities they focus on, or should focus on. We briefly elaborate on the conceptual foundations of the studies of intermediaries in transitions, and how intermediaries have been connected to different transition theories. This shows the divergence – and sometimes a lack – of conceptual foundations in this research. In terms of transitions theories, many studies connect to the multi-level perspective and strategic niche management, while intermediaries in technological innovation systems and transition management have been much less explored. We aim to bring more clarity to the topic of intermediaries in transitions by providing a definition of transition intermediaries and a typology of five intermediary types that is sensitive to the emergence, neutrality and goals of intermediary actors as well as their context and level of action. Some intermediaries are specifically set up to facilitate transitions, while others grow into the role during the process of socio-technical change. Based on the study, as an important consideration for future innovation governance, we argue that systemic and niche intermediaries are the most crucial forms of intermediary actors in transitions, but they need to be complemented by a full ecology of intermediaries, including regime-based transition intermediaries, process intermediaries and user intermediaries.

Schilling, T., Wyss, R. and Binder, C.R., 2018, The resilience of sustainability transitions, *Sustainability*, 10(12), 4593

Finding ways to understand, analyze, and manage sustainability transitions is a fundamental challenge for sustainability science. In this paper, we show how we can substantially deepen our understanding of factors that determine the success of sustainability transitions by combining two key concepts from the resilience literature—stability and adaptability—with a dynamic understanding of the progress of socio-technical transitions. We propose a conceptual perspective for sustainability transitions, the resilience of sustainability transitions (RST) concept, which integrates progress, stability, and adaptability as key dimensions to comprehend the dynamics of sustainability transitions. In a case analysis of the energy transition process in the Austrian region of Weiz-Gleisdorf, we apply the concept. In doing so, we illustrate how RST thinking helps identify and understand crucial elements that influence the dynamics of a sustainability transition process.

Barnes, J., 2018, The local embedding of low carbon technologies and the agency of user-side intermediaries, *Journal of Cleaner Production*, in press

‘Local embedding’ is a term increasingly used by transition researchers but in a variety of ways. As a concept it is emotive but lacks clarity. The first contribution of this paper is to explore and substantiate the concept of local embedding by drawing on three theoretical fields: socio-technical transitions, domestication studies and research on innovation

intermediaries. Emphasis is placed on the work required to integrate low carbon technologies into local contexts of use by aligning multiple system elements into configurations that work. This points to a particular form of actor – those performing relational work between multiple actors and technologies, commonly known as intermediaries – as being central to the process. Three key intermediary processes – of facilitating, configuring and brokering - are thought to define the work that intermediary organisations do. Nonetheless, understanding how these key intermediary processes relate as well as the agency of intermediary organisations in local embedding is still largely uncharted territory. The paper's second contribution is the development of a process perspective on the agency of intermediary organisations in local embedding. The resulting perspective offers a means to situate and understand the agency of user-side intermediaries in local embedding and insights into later phases of transition processes.

Ilieva, R.T. and Hernandez, A., 2018, Scaling-up sustainable development initiatives: A comparative case study of agri-food system innovations in Brazil, New York, and Senegal, *Sustainability*, 10, 4057

To effectively address the sustainability crises our planet faces, decision-makers at different levels of government worldwide will have to get a handle on three key challenges: learning from Global North and South initiatives in tandem, taking stock of social innovations alongside technological fixes, and nurturing grassroots sustainable development initiatives next to, or in place of, top-down corporate and government interventions. Current scientific literature and grant-making institutions have often reinforced the compartmentalized fashion in which we learn and draw policy lessons from North/South, social/technical, and bottom-up/top-down sustainability initiatives, including local food system innovations. The strategic levers for global sustainable development lying in-between are thus left out. This paper uses exploratory, multiple case study analysis to address this omission. By concurrently drawing lessons from grassroots innovations in Brazil, New York, and Senegal—three profoundly different socioeconomic and geographic contexts—we identify common pressure points that have enabled local communities to drive system-wide transformations toward climate adaptation, resilience, and sustainability in the agri-food system. The findings of this paper would be of value to scholars, government officials, and community groups engaged in agri-food systems sustainability and interested in the processes of change that have allowed budding innovations to stabilize and scale up.

El Bilali, H., 2018, Transition heuristic frameworks in research on agro-food sustainability transitions, *Environment, Development and Sustainability*, in press

The agro-food system needs a genuine sustainability transition to achieve sustainable food and nutrition security in the face of climate change, population growth, ecosystem degradation and increasing resource scarcity. Agro-food sustainability transitions refer to transformation processes needed to move towards sustainable agriculture and food systems. There is a broad range of theoretical and conceptual frameworks that have been used to understand and promote transition towards sustainability. These include the multi-level perspective (MLP) on socio-technical transitions, transition management (TM), strategic niche management (SNM), technological innovation system (TIS) and social practice approach (SPA). The paper analyses the use of these heuristic frameworks in research on agro-food sustainability transitions. A search carried out in March 2018 on Scopus yielded 791 documents, and 127 research articles underwent a systematic review. Results show that more than three-fifths of research papers dealing with sustainability transitions in agriculture, food processing, distribution and consumption use at least one of the five heuristic frameworks (MLP, TM, SNM, TIS and SPA). The MLP is the most prominent framework in research on agro-food sustainability transitions, followed by TM, SPA, SNM and then TIS. Nevertheless, MLP is increasingly complemented with frameworks that focus on human-related and social factors (SPA), management and governance (TM, SNM) or agency and interactions between actors (TIS) in sustainability transitions processes. Therefore, the paper makes the case for more integration of

transition frameworks in order to better nurture and foster transitions towards sustainable agro-food systems.

Marsden, T., Hebinck, P. and Mathijs, E., 2018, Re-building food systems: embedding assemblages, infrastructures and reflexive governance for food systems transformations in Europe, *Food Security*, in press

This introductory paper to the special section argues that there are now significant signs and opportunities of real transformations of food systems in which to create new synergies between sustainable consumption and production, and which can potentially shift agri-food into more secure and sustainable sets of conditions. With reference to empirical research in Europe, the paper assesses the transformative potential of a series of mobilisations associated with: sustainable city networks, community cooperative and share schemes, and regional agro-ecological, seed, plant and livestock schemes. Not denying the significance of countervailing intensive and industrialised food regimes, the paper introduces a set of conceptual building blocks, which emerge as ways of both assessing and progressing these mobilisations. It is argued that to succeed they need elements of at least four conditions: (i) a significant and lasting reconfiguration of governance and regulatory conditions; (ii) an ability and capacity to both promote sustainable production and food access and diet through the development of new assemblages; (iii) develop new social and physical and distributional infrastructures which can scale out their impacts; and (iv) be embedded in a more reflexive governance context which is both supportive and spatially sensitive to their diverse conditions. The succeeding papers in the special issue will deal with these transformatory factors in comparative and empirical depth. Here we outline how and why such a 're-building' has become so critical at this current juncture.

Meynard, J-M., Charrier, F., Fares, M., Le Bail, M., Magrini, M-B., Charlier, A., Messéan, A., 2018, Socio-technical lock-in hinders crop diversification in France, *Agronomy for Sustainable Development*, 38: 54

Crop diversification is considered as a major lever to increase the sustainability of arable farming systems, allowing reduced inputs (irrigation water, pesticides, fertilizers), increasing the heterogeneity of habitat mosaics, or reducing yield gap associated with too frequent returns of the same species. To free up paths of collective action, this article highlights obstacles to crop diversification, existing at various levels of the value chains. We used a threefold approach: (i) a cross-cutting analysis of impediments to the development of 11 diversifying crops (5 species of grain legumes, alfalfa, flax, hemp, linseed, mustard, sorghum), based on published documents and on 30 interviews of stakeholders in French value chains; (ii) a detailed study (55 semi-structured surveys, including 39 farmers) of three value chains: pea and linseed for animal feed, hemp for insulation and biomaterials; and (iii) a bibliometric analysis of the technical journals and websites (180 articles) to characterize the nature of information diffused to farmers. We highlight that the development of minor crops is hindered by a socio-technical lock-in in favor of the dominant species (wheat, rapeseed, maize, etc.). We show for the first time that this lock-in is characterized by strongly interconnected impediments, occurring at every link of the value chains, such as lack of availability of improved varieties and methods of plant protection, scarcity of quantified references on crop successions, complexity of the knowledge to be acquired by farmers, logistical constraints to harvest collection, and difficulties of coordination within the emerging value chains. On the basis of this lock-in analysis, that could concern other European countries, the article proposes levers aimed at encouraging actors to incorporate a greater diversity of crops into their productive systems: adaptation of standards and labelling, better coordination between stakeholders to fairly share added value within value chains, and combination of genetic, agronomic, technological, and organizational innovations.

Savaget, P., Geissdoerfer, M., Kharrazi, A., Evans, S., 2018, The theoretical foundations of sociotechnical systems change for sustainability: A systematic literature review, *Journal of Cleaner Production*, in press

This paper provides a critical literature overview of the foundations of the concepts of sustainability and sociotechnical systems change. This review covers the analysis of 182 scientific articles through a combination of bibliometric analysis, snowballing, content analysis and problematization. Our results identify and discuss 14 unique ontological and normative foundations shaping how we understand sociotechnical system change for sustainability. These influence both what system change is perceived as desirable and as attainable; as well as how to navigate between all the coexisting pathways, trade-offs, and complexities of the three dimensions of sustainability. By identifying the theoretical foundations, we illustrate the most up-to-date theoretical developments and concomitantly pinpoint a few opportunities for future contributions that improve, refute or complement them, hence shedding light on various research questions to develop the literature further.

Lee, H., Jung, E-Y., and Lee, J-D., 2019, Public–private co-evolution and niche development by technology transfer: A case study of state-led electricity system transition in South Korea, *Energy Research & Social Science*, 49, 103-113

Energy infrastructure is closely tied to national development and securing a reliable, affordable, and sustainable energy infrastructure is one of the great challenges for developing as well as developed countries. In this study, we aim to broaden our understanding of energy infrastructure transitions by analyzing how the East Asian way of development affected the energy infrastructure transition process in South Korea. This study focuses on two special features that have attracted much interest in development literature: 1) the strong state as an initiator and enabler of the transition, and 2) technology transfer as a pathway to niche development. Our case study confirms the state's leading role—based on development-oriented political leadership and elite bureaucracy—in the transition process. However, the government transferred technology and related policies from developed countries, the transition did not go as planned, and it took much longer to deal with the bottlenecks in the private sector. However, in this process, policymakers have shown that they recognize their mistakes, adapted to the environment, and changed the policies. In addition, private companies and customers are evolving as government and external environments change. In other words, the success factors for a long state-led transition seem more related to policy learning and evolution allowing broad public–private sector co-evolution than the typical policy style of strong-state leadership and powerful execution.

Van der Voorn, T. and Quist, J., 2018, Analysing the role of visions and paradigms in historical transitions in watershed management in the Lower Mississippi River, *Water* 10(12), 1845

This paper analyses five major transitions in watershed management in the Lower Mississippi River from the early 19th century to the present. A conceptual framework is developed for analysing the role of visions, agency, and niches in water management transitions and applied to a historical case on water management in the Lower Mississippi River. It is shown that water management regimes change over time and that major transitions were preceded by niches, in which new visions were developed and empowered. The case shows that: (i) emerging visions play an important role in guiding transitions; (ii) agency enables the further diffusion of visions and niches; (iii) vision champions play an important role in transitions, but are not decisive; (iv) each transition has led to an extension of the number of societal functions provided, which has led to more complex water management regimes in which functions are combined and integrated; and (v) external landscape factors are important, as they can lead to awareness and urgency in important decision making processes.

Hansen, P., Liu, X. and Morrison, G.M., 2019, Agent-based modelling and socio-technical energy transitions: A systematic literature review, *Energy Research & Social Science*, 49, 41-52

Agent-based modelling has the potential to provide insight into complex energy transition dynamics. Despite a recent emphasis of research on agent-based modelling and on energy transitions, an overview of how the methodology may be of value to understanding transition processes is still missing from the literature. This systematic review evaluates the potential of agent-based modelling to understanding energy transitions from a social-scientific perspective, based on a set of 62 articles. Six topic areas were identified, addressing different components of the energy system: Electricity Market, Consumption Dynamics/ Consumer Behaviour, Policy and Planning, New Technologies/ Innovation, Energy System, Transitions. Distribution of articles across topic areas was indicative of a continuing interest in electricity market related enquiries, and an increasing number of studies in the realm of policy and planning. Based on the relevance of energy transition specific complexities to the choice of ABM as a methodology, four complexity categories (1–4) were identified. Indicating the degree of association between the complexity of energy transitions and ABM's ability to address these, the categorisation revealed that 35 of the 62 studies directly linked the choice of ABM to energy transition complexities (complexity category 1) or were set in the context of energy transitions (complexity category 2). The review further showed that the greatest potential contribution of ABM to energy transition studies lies in its practical application to decision-making in policy and planning. More interdisciplinary collaboration in model development is recommended to address the discrepancy between the relevance of social factors to modelling energy transitions and the ability of the social sciences to make effective use of ABM.

Mekhdiev, E.T., Khairullina, N.G., Vereshchagin, A.S., Takmakova, E.V., Smirnova, O.M., 2018, Review of energy transition pathways modelling, *International Journal of Energy Economics and Policy*, 8(6), 299-312

This article discusses how quantitative modeling of energy scenarios for transition towards sustainable energy can be made more realistic, by taking into account insights and concepts from the related literature on modeling of complex dynamic energy systems with higher shares of variable renewable energy. The proposition is that an enriched modeling approach would focus not just on deployment of technologies, but also on feedback loops, learning processes, policy and governance, behavioral changes, linkages between energy and other economic sectors, and infrastructure development. In this context, application of system dynamics modeling (SDM) for energy transitions analysis is introduced. The use of causal loop diagrams provides a conceptual framework for this type of modeling, illustrating endogenous approach of SDM and its ability to capture co-evolution of economic, policy, technology, and behavioral factors over long term.

Fischer-Kowalski, M., Rovenskaya, E., Krausmann, F., Pallua, I., and McNeill, J., 2019, Energy transitions and social revolutions, *Technological Forecasting and Social Change*, 138, 69-77

The transition from a traditional agrarian to a fossil fuel based energy regime began before the industrial revolution and is still ongoing. This paper explores the relation of this transition process and social revolutions. Using statistical analysis, we find that at the very beginning of countries' energy transition, a critical phase can be identified, within which social revolutions are most likely to happen. This applies to the grand revolutions across the past five centuries investigated for a core set of industrial and emerging economies, as well as to supplementary samples of Latin American and post-World War II developing countries. No statistically significant relation between the historical time and the pace of transition towards modern fuels is found, which means that the energy transition does not accelerate. Among the sample of developing countries with revolutions after World War II we find an even slower pace of transition to an industrial energy regime. Apparently, transitions in primary

energy source and energy abundance are not just a matter of technological change, but strongly interact with the social, institutional and political fabric of societies.

Egli, F., Steffen, B. and Schmidt, T.S., 2018, A dynamic analysis of financing conditions for renewable energy technologies. *Nature Energy*, 3, 1084–1092

Renewable energy technologies often face high upfront costs, making financing conditions highly relevant. Thus far, the dynamics of financing conditions are poorly understood. Here, we provide empirical data covering 133 representative utility-scale photovoltaic and onshore wind projects in Germany over the last 18 years. These data reveal that financing conditions have strongly improved. As drivers, we identify macroeconomic conditions (general interest rate) and experience effects within the renewable energy finance industry. For the latter, we estimate experience rates. These two effects contribute 5% (photovoltaic) and 24% (wind) to the observed reductions in levelized costs of electricity (LCOEs). Our results imply that extant studies may overestimate technological learning and that increases in the general interest rate may increase renewable energies' LCOEs, casting doubt on the efficacy of plans to phase out policy support.

Steffen, B., Hirschler, D., and Schmidt, T. S., 2018, Historical and projected improvements in net energy performance of power generation technologies. *Energy & Environmental Science*, 11, 3524 - 3530.

Renewable energy technologies are a key lever to mitigate climate change. However, net energy analyses showing low energy returns on energy invested (EROIs) for these technologies raise the question of whether current prosperity can be maintained with an increasingly renewables-dependent energy sector. Here we argue that static net energy analyses disregard the inherent potential to improve technologies through innovation. We present energetic experience curves for power generation technologies utilizing hard coal, solar irradiation, and wind, and show that EROI of new technologies improves as more capacity is installed. By 2015, solar PV and onshore wind were already outperforming coal, with further improvements to be expected. Therefore, concerns that a large-scale transition to renewable energy sources jeopardizes societal net energy efficiency and prosperity seem unfounded.

Steffen, B. and Schmidt T.S., 2018, A quantitative analysis of 10 multilateral development banks' investment in conventional and renewable power-generation technologies from 2006 to 2015. *Nature Energy*, available online

Multilateral development banks (MDBs) play a pivotal role in the financing of electricity-generation projects in developing countries, thus having a major impact on the emission pathways of these countries. While information about the MDBs' investments is publicly available, it is dispersed and hard to compare. A comprehensive compilation of all MDBs' power-generation investments over the years has been missing. To address this gap, here we assess power-generation financing by all ten relevant MDBs during 2006–2015, in different regions, and through different branches of the banks. The study assesses technology choices by compiling a bottom-up dataset drawing information from 841 projects and programmes. We find that MDBs financed a major portion of all power-generation growth in the developing world, with an increasing share of renewables. However, MDBs have 'greened' their portfolios to different extents, and the activities of their public- and private-sector branches differ substantially.

Proka, A., Loorbach, D. and Hirschmüller, M., 2018, Leading from the niche: Insights from a strategic dialogue of renewable energy cooperatives in The Netherlands, *Sustainability*, 10(11), 4106

Renewable energy cooperatives envision and manifest an alternative way of organising within the energy system (and beyond). Yet, despite their growth, it is uncertain whether such initiatives are able to increase and deepen their impact, leading the transition to an environmentally sustainable and socially just energy system. This paper presents insights

from a strategic dialogue co-organised with the Dutch national interest group of renewable energy cooperatives “ODE Decentraal”. We used transition management as action research methodology to organise the dialogue to understand and support the transformative potential of the cooperative energy movement. The dialogue helped to clarify the challenges and possibilities for scaling energy cooperatives beyond the niche, supporting at the same time the participants to reflect, strategize and develop a shared transition agenda. This contribution presents and analyses our intervention and its impact, also specifically evaluating the potential of transition management to facilitate social learning processes, reflexivity and the development of strategic actions. Our intervention confirmed the hypothesis that actors in the niche often focus too much on the competition with the regime for individual goals, thereby failing to collectively strategize and engage with incumbent regimes in a systematic way.

Antal, M. and Karhunmaa, K., 2018, The German energy transition in the British, Finnish and Hungarian news media, *Nature Energy*, 3(11), 994–1001

Germany was the first major country to commit itself to an electricity system transition based on decentralized renewable sources and energy efficiency. This experiment has attracted interest worldwide, but its influence on national energy debates is largely unknown. We study how the German transition appeared in the news media of three countries following alternative nuclear pathways—the United Kingdom, Finland and Hungary—between 2011 and 2015. We show that most discussions are techno-economic, supply-oriented and focused on nuclear, wind and solar energy. Key issues such as energy democracy, regional development, participation, demand-side measures, and bioenergy are neglected. We find that topics are detached from their original contexts and selectively contextualized elsewhere, resulting in very different pictures of the same transition in specific countries and news sources. The ‘Energiewende’ has become part of the international energy policy landscape, but its representation depends on local visions of a good society.

Mah, D.N.-y., 2019, Community solar energy initiatives in urban energy transitions: A comparative study of Foshan, China and Seoul, South Korea. *Energy Research & Social Science*, 50, 129-142.

Urban community solar energy initiatives have flourished around the world, suggesting that community energy can be an important pathway for energy transitions. The deployment of solar energy has however remained limited. The complexity of these community-level transition processes has not been well understood and conceptualised. By advancing studies on community energy and socio-technical energy transitions, this paper proposes an integrated framework to conceptualise community-level energy initiatives from a systemic perspective. The framework builds the linkages among five critical processes and their associated contexts and outcomes, and is applied in a comparative study of two cities in Asia: Foshan and Seoul. Based on 19 semi-structured interviews in the case cities, this study has three major findings. First, the two cities’ solarisation pathways exhibited similarities as well as differences that could be understood within our conceptual framework. Second, distinctive modes of community solarisation can be identified in the two cities. Foshan was a mixed mode which was characterised by a combination of top-down, state-led and entrepreneur-driven approaches, whereas Seoul developed a bottom-up grassroots-driven transition. Third, the actual impacts of community solarisation on regime shifts appeared to be very modest, but we identify important reinforcing effects between some processes and local contextual factors. This paper concludes that community energy can play an important role in urban energy transitions, but that sufficient policy attention must be given to complex interactions in the critical processes.

Smeds, E. and Acuto, M., 2018, Networking cities after Paris: Weighing the ambition of urban climate change experimentation. *Global Policy*, 9: 549-559.

Over the past few decades, cities have repeatedly demonstrated high levels of ambition with regard to climate action. Global environmental governance has been marked by a

proliferation of policy actions taken by local governments around the world to demonstrate their potential to advance climate change mitigation and adaptation. Leading 'by example' and demonstrating the extent of action that it is possible to deliver, cities have aspired to raise the ambition of national and international climate governance and put action into practice via a growing number of 'climate change experiments' delivered on the ground. Yet accounts of the potential of cities in global environmental governance have often stopped short of a systematic valuation of the nature and impact of the networked dimension of this action. This article addresses this by assessing the nature, and challenges faced by, urban climate governance in the post-Paris era, focusing on the 'experimentation' undertaken in cities and the city networks shaping this type of governance. First, we unpack the concept of 'urban climate change experimentation', the ways in which it is networked, and the forces driving it. In the second and third parts of the article, we discuss two main pitfalls of networked urban experimentation in its current form, focusing on issues of scaling experiments and the nature of experimentation. We call for increased attention to 'scaling up' experiments beyond urban levels of governance, and to transformative experimentation with governance and politics by and in cities. Finally, we consider how these pitfalls allow us to weigh the potential of urban climate ambition, and consider the pathways available for supporting urban climate change experimentation.

Boodoo, Z., Mersmann, F., and Olsen, K.H., 2018, The implications of how climate funds conceptualize transformational change in developing countries, *Climate and Development*, 10(8), 673-686

The search for globally coordinated mitigation strategies that could contribute effectively towards bridging the gap between current emissions reduction efforts and a rapidly closing 2°C climate target remains contentious. The participation of developing countries through Nationally Appropriate Mitigation Actions (NAMAs) is emerging as a crucial feature to attain this goal. Against this background, two of the major NAMA funding agencies have embraced 'transformational change (TC)' and 'paradigm shifts' as policy concepts. Yet, their operationalization within aid management approaches has not been fully justified. Concurrently, academic interest in theories of sustainability transitions has been growing, out of which the Transition Management (TM) approach provides the theoretical inspiration to study, and eventually promote, systemic TCs. However, there is still limited knowledge with which to contextualize the steering of such transitions to different settings. This article engages in these debates by reviewing the theoretical grounding behind the Green Climate Fund and the NAMA Facility's conceptualizations of TC through NAMA interventions against the corresponding theoretical assumptions of TM. Based on a critical review of relevant literature, it is argued that the logical framework-based approach adopted by the funds contains implicit assumptions of causality, which do not adequately cater for the uncertainties, non-linearity and feedback loops inherent in transition processes. The incorporation of more adaptive and reflexive elements is proposed as an alternative. This paper contributes to existing knowledge by critically reflecting on the applicability of TM towards governing sociotechnical transitions in the developing world and by exposing the limitations behind the current thinking underpinning NAMA funding. In conclusion, the systems perspective adopted in sustainability transition theories is thus recommended as a more rewarding approach towards understanding how attempts at transforming paradigms through support to climate policies and actions in developing countries are played out.

Okereke, C., Coke, A., Geebreyesus, M., Ginbo, T., Wakeford, J.J. and Mulugetta, Y., 2019, Governing green industrialisation in Africa: Assessing key parameters for a sustainable socio-technical transition in the context of Ethiopia, *World Development*, 115, 279-290

The concept of 'sustainable industrialisation' is now integral to the UN's Sustainable Development Goals. However, there are no historical examples or current models to emulate. Scholarly analyses of putative initiatives to green industrialisation, especially in developing countries, are few and limited. This article explores the conception and

implementation of green industrialisation in Ethiopia, one of the world's poorest nations, where an ambitious Climate Resilient Green Economy (CRGE) strategy has been created, alongside a multi-sectoral Growth and Transformation Plan (GTP), to leapfrog environmentally unsustainable development and bring the country to middle-income status by 2025. Using the socio-technical transition (STT) perspective and in particular Smith, Stirling, and Berkhout (2005) framework for assessing sustainable transition programmes, it analyzes the 'selection pressures' on the industrial 'regime' and its 'adaptive capacity'. It finds: (i) clear articulation of the imperative for climate change mitigation and economic growth; (ii) strong high-level government commitment to a greening agenda within the context of accelerated industrialisation; and (iii) a nascent innovation system that is beginning to evolve according to these priorities. However, the analysis also identifies important challenges, including: coordination mechanisms between different stakeholders; framing issues; availability of resources; and ongoing tension between addressing climate change and promoting economic growth. It also highlights the importance of the availability of cross-border resources for purposive sustainability transition within low-income countries.

Haas, T., 2019, Struggles in European Union energy politics: A gramscian perspective on power in energy transitions, *Energy Research & Social Science*, 48, 66-74

Over the past decades, a profound energy transition has begun. In 2014, the EU agreed to increase the share of renewable energy sources in its final energy consumption to at least 27 percent by 2030. This goal indicates that the transition will continue even as the speed of the transition is contested. To an even greater extent debates over the social character of the future energy regime also persist. This article argues that the energy transition is increasingly taking the shape of a passive revolution in a Gramscian sense, i.e. that transnational energy corporations (TNECs) are strengthening their efforts to dominate the new energy regime. Aside from its empirical focus, this paper also contributes to the attempts to better understand the role of politics, power and conflicts in energy transitions. Gramsci's integral understanding of structure and agency and the mediation of material interests and discursive constructions in struggles over hegemony offer a novel framework for the analysis of energy transitions.

Selby, J., 2018, The Trump presidency, climate change, and the prospect of a disorderly energy transition, *Review of International Studies*, in press

This article reflects on the implications of the Trump presidency for global anthropogenic climate change and efforts to address it. Existing commentary, predicated on liberal institutionalist reasoning, has argued that neither Trump's promised rollback of domestic climate-related funding and regulations, nor withdrawal from the Paris framework, will be as impactful as often feared. While broadly concurring, I nonetheless also in this article take a wider view, to argue that the Trump administration is likely to exacerbate several existing patterns and trends. I discuss four in particular: the general inadequacy of global greenhouse gas emissions reduction targets and implementation efforts; the inadequacy of contemporary climate financing; the embrace between populist conservatism and opposition to action on climate change; and not least, the current global oil and gas boom which, crucially, is being led by the US. I submit that these patterns and trends, and the Trump administration's likely contributions to them, do not augur well for climate change mitigation, let alone for an orderly transition to a low-carbon global economy. Given current directions of travel, I suggest, this coming transition is likely to be deeply conflict-laden – probably violently so – and to have consequences that will reverberate right across midtwentieth-century international order.

Håkansson, I., 2019, Urban sustainability experiments in their socio-economic milieu: A quantitative approach, *Journal of Cleaner Production*, 209, 515-527.

This paper deals with the geographically uneven distribution of urban sustainability experiments. It focuses on largely neglected demographic, socio-economic, and socio-cultural characteristics to explain where and why experiments are likely to emerge or not. In

doing so, it presents the first quantitative study to examine a systematic relationship between the incidence of experiments and neighbourhood-level indicators. Theoretically informed by transitions studies and urban geography, the study draws on unique data from an urban agriculture initiative consisting of nearly two thousand individual projects across metropolitan London. Applying spatial statistical analyses, its results suggest that, on the one hand, gentrifying and, on the other hand, income-deprived neighbourhoods provide distinct urban milieux in which initiatives emerge disproportionately often. In contrast, already gentrified or otherwise advantaged urban neighbourhoods are found to have a disproportionately low number of projects. The paper discusses the socio-spatially variegating roles of experiments and identifies implications of these findings for our theoretical understanding of the emergence of sustainability experiments, their interrelationship with differing socio-economic and cultural contexts, and their expected significance for wider societal sustainability transitions.

McCauley, D, Ramasar, V., Heffron, R.J., Sovacool, B.K., Mebratu, D., and Mundaca, L., 2019, Energy justice in the transition to low carbon energy systems: Exploring key themes in interdisciplinary research, *Applied Energy*, 233, 916-921

With the dual challenges of reducing emissions from fossil fuels and providing access to clean and affordable energy, there is an imperative for a transition to a low carbon energy system. The transition must take into consideration questions of energy justice to ensure that policies, plans and programmes guarantee fair and equitable access to resources and technologies. An energy justice framework is outlined to account for distributional, procedural and recognition inequalities, as well as emerging themes such as cosmopolitan and non-Western understandings of justice, in decision-making relating to energy systems. The spectrum of research offers critical perspectives on the energy transition as well as tools for decision-making and policy processes. Quantitative, qualitative and mixed methods all contribute to our understanding of the problems and the success of responses. The studies presented in this special issue illustrate that the field of energy justice is a rapidly growing arena. There is constant innovation taking place in enabling the transition with new structures, processes and metrics being introduced to guide decision-making and a more holistic view of the community emerging where acceptance, mobilisation and empowerment are opening possibilities for a just transition to a low carbon energy system. The importance of introducing the interdisciplinary approach between social sciences and natural sciences as well as engineering implementation supported by scientific data and experiments shall be emphasized in future studies.

Sovacool, B.K. and Axsen, J., 2018, Functional, symbolic and societal frames for automobility: Implications for sustainability transitions, *Transportation Research Part A*, 118, 730-746.

Automobility refers to the continued, self-perpetuating dominance of privately-owned, gasoline-powered vehicles used primarily by single occupants—a system which clearly has broad environmental and societal impacts. Despite increasing societal interest in transitions to more sustainable transportation technologies, there has been little consideration of how such innovations might challenge, maintain or support different aspects of automobility, and what that means for technology deployment, transport policy, and user practices. To bring attention to the complexity and apparent durability of the automobility system, in this paper we develop a conceptual framework that explores automobility through a categorization of frames, or shared cultural meanings. This framework moves beyond the typical focus on private, functional considerations of user choice, financial costs and time use to also consider symbolic and societal frames of automobility that exist among users, non-users, industry, policymakers and other relevant social groups. We illustrate this framework with eight particular frames of automobility that fall into four broad categories: private-functional frames such as (1) cocooning and fortressing and (2) mobile digital offices; private-symbolic frames such as (3) gender identity and (4) social status; societal-functional frames such as (5) environmental stewardship and (6) suburbanization; and societal-symbolic frames such

as (7) self-sufficiency and (8) innovativeness. Finally, we start the process of discussing several transportation innovations in light of these automobility frames, namely electrified, autonomous and shared mobility—examining early evidence for which frames would be challenged or supported by such transitions. We believe that appreciation of the complex and varied frames of automobility can enrich discussion of transitions and policy relating to sustainable transportation.

Valentine, S.V. and Sovacool, B.K., 2019, Energy transitions and mass publics: Manipulating public perception and ideological entrenchment in Japanese nuclear power policy, *Renewable & Sustainable Energy Reviews*, 101, 295-304

How can leaders successfully craft energy or climate policy to support an initiative that citizens oppose? This paper considers this challenge from a change management perspective applied to public governance. It first draws on change management theory to develop a framework for altering mass public perspectives. The framework consists of four phases: i) problematizing the issue, ii) laying a foundation for change, iii) reshaping perspectives, and iv) entrenching support. Drawing from the insights gleaned from the establishment of Japan's nuclear power program, the paper further argues that in order to succeed in mass perceptual change, policymakers must first clearly understand the contextual environment in which the policy is being formulated. In doing so, policymakers will be better able to customize policy design to appeal to stakeholder perceptions and sentiments. Although the context of this paper is the perceptual modification of public opinion to support nuclear power, the authors suggest that the same framework can be applied to perceptual modification of any policy that the general public might be opposed to. In the energy sector, this could apply to fostering a transition to renewable energy as easily as it applies to nurturing nuclear power development. However, the Japanese case puts forth a caveat in this regard, there is evidence that the mindsets of the Japanese policymakers were predisposed to advocacy of nuclear power and once policymakers commit to a technological trajectory, it is hard to engender a change of course. Therefore, the article concludes by speculating on how the perceptions of policymakers might be similarly altered through efforts from the alternative energy sector to foster policy change.

Kester, J., Noel, L., Lin, X., De Rubens, G.Z., and Sovacool, B.K., 2019, The coproduction of electric mobility: Selectivity, conformity and fragmentation in the sociotechnical acceptance of vehicle-to-grid (V2G), *Journal of Cleaner Production*, 207, 400-410.

In this article we explore how a single standard dealing with vehicle-to-grid (V2G) mobility, ISO 15118, is coproduced in divergent ways across Asia, Europe, and North America. Specifically, ISO 15118 enables V2G as it oversees the communication between electric vehicles (EVs) and electric vehicle service equipment. It allows for bidirectional electricity flows and thereby offers electricity grids the use of EV batteries for grid services like frequency control and demand side management. We observe that highly technical and invisible standards like these are understudied in the energy literature and commonly misinterpreted as purely technical in scope. Hence in our contribution we offer such a study and use ISO 15118 to show how even in the most technical and invisible of cases, politics is still at work. We argue that standards, through a process of coproduction, are of vital importance for the governance of energy systems and play a major role in energy transitions through the various nontechnical assumptions scripted into them. Drawing from a synthesis of the literature on standardization, innovation studies, and science and technology studies, we thus analyse the implementation of ISO 15118 in the United States, China, Denmark and the Netherlands. We find a detailed technical standard that is implemented with differing degrees and in different sociotechnical and institutional contexts. We conclude by suggesting what this selectivity, compliance and fragmentation means for electric mobility and energy policymaking more generally.

Sovacool, B.K., Noel, L.D., De Rubens, G.Z., and Kester, J., 2019, Energy injustice and Nordic electric mobility: Inequality, elitism, and externalities in the electrification of vehicle-to-grid (V2G) transport, *Ecological Economics*, 157, 205-217.

Much research on electric mobility transitions has been descriptive or positive, rather than normative or critical, assessing the deeper ethical, justice, or moral issues that arise. To address this gap, this study qualitatively examines the ongoing transition to Nordic electric vehicles (EVs) and vehicle-to-grid (V2G) systems. It does so through the various lenses of distributive justice, procedural justice, cosmopolitan justice, and recognition justice. It asks: what are the types of injustices associated with electric mobility and V2G? In what ways do emerging patterns of electric mobility worsen socio-environmental risks or vulnerabilities? Based on original primary data collected from 257 experts across Denmark, Finland, Iceland, Norway, and Sweden, the study finds that electric mobility can erode elements of distributive justice for being accessible only to the rich, and for raising risks related to privacy, hacking, and cyberterrorism. Electric mobility may contravene aspects of procedural justice by reinforcing exclusion and elitism in national planning. It can erode cosmopolitan justice by producing negative environmental externalities, and exacerbating rural (and global) vulnerability. It may threaten recognition justice through unemployment, disruption to traditional businesses, and the entrenchment of patriarchy. Thankfully, the study also proposes a suite of policy mechanisms to address many of these concerns.

Mahzouni, A., 2019, The institutional challenges of scaling-up housing retrofit: The Swiss cities of Basel and Sion, *Journal of Facilities*, in press.

This paper discusses the nexus between two societal (sub) systems of housing and energy supply in order to analyse key institutional barriers to achieving energy transition in the built environment. A comparative case study of the Swiss cities of Basel and Sion is conducted to map retrofitting policies and practices in a wide range of residential buildings e.g., multi-family and single family. The key research question is to explore if and how key patterns of institutional elements associated with energy retrofit and renewable energy supply are combined, co-evolved and played out in the housing system, leading to an alternative energy transition pathway in the built environment. Insights from different strands of literature (institutions and sustainability transition) are combined to understand if and how retrofitting practices go along with other elements of urban sustainability including architectural, technical and socio-cultural factors leading to a city wide energy transition. The key finding is that the regulative institutions support energy transition in each urban form/housing type. However, the co-evolution of regulative institutions with normative and cultural-cognitive institutions does not play out very clearly in the housing system. One reason is that the norms and cultures are deeply rooted in the practices exercised by business community and households and therefore normative and cultural-cognitive institutions need a longer time frame to adapt to a new regulation. Thus, the planning policy framework should systematically support new business models and energy-consuming practices to enable the co-evaluation of all three institutional elements for a sustainable energy transition in the built environment.

Kiefer, C.P., del Río, P. and Carrillo-Hermosilla, J. , 2019, Drivers and barriers of eco-innovation types for sustainability transitions: A quantitative perspective” *Business Strategy and the Environment*, in press

Firms are influenced by internal factors and external factors when taking the decision to eco-innovate. However, the analysis of the internal factors has received much less attention than the external ones. This paper aims to fill this gap in the literature by analyzing the role of resources, competences and dynamic capabilities (RCCs) as determinants (drivers and barriers) of different eco-innovation (EI) types. Those EI types contribute differently to the sustainable transition of the economy and society, i.e., towards the Circular Economy. The results may guide firms to pursue competitive and sustainable advantage by innovating through certain EI types corresponding to available and dedicated RCCs. They may also be useful to policy makers who are willing to promote specific EI types.

Holmberg, J. and Larsson, J., 2018, A sustainability lighthouse—Supporting transition leadership and conversations on desirable futures. *Sustainability*, 10(11), 3842.

Central in leadership for sustainability transitions is the capability to create transformative momentum in a sustainable (desirable) direction, calling for meaningful conversations on sustainable futures. The aim of this study is to develop a conceptual framework to inspire and support such conversations. A qualitative literature review of sustainability conceptualizations was conducted, followed by a thematic analysis. The resulting framework consists of an overarching question and an accompanying set of categories for four sustainability dimensions: the social, the economic, the ecological, and 'human needs and wellbeing'. Furthermore, the framework is visualized as a lighthouse for pedagogical reasons. We foresee that the lighthouse might be of value in processes guiding socio-technical transitions towards sustainability in three different ways: (1) by attempting to bridge the issue of 'transition' with that of 'sustainability'; (2) as part of a backcasting process; and (3) modes of transdisciplinary research where relevant actors take part in the conversation. The study is related to over 20 years of experience from working with a backcasting approach engaging with sustainability transitions in a variety of processes. We invite further dialogue on how one may approach the concept of sustainability to inspire and support conversations on sustainable futures.

Meckling, J. and Nahm, J., 2018, The politics of technology bans: Industrial policy competition and green goals for the auto industry, *Energy Policy*, 126, 470-479

After decades of failure to reduce greenhouse gas emissions in the transport sector, several jurisdictions have in rapid succession announced future goals to phase out sales of internal combustion engine vehicles. This article argues that these announcements are predominantly a form of political signaling in a green industrial policy competition for alternative transport technologies, notably electric vehicles. We show that such signaling games in green industrial policy are likely to emerge when market growth for alternative technologies initiates industrial policy competition, which explains the clustered timing of political signals. A country's position in the global auto industry, however, shapes the domestic political economy for announcing a phaseout goal. Countries with aspirations to develop export-oriented EV industries seek *industrial upgrading*; countries with existing export-oriented auto industries promote industrial *renewal* to maintain international competitiveness; and importing countries pursue phaseout goals primarily for *environmental reasons*. Our findings suggest that industrial upgraders can induce incumbent producer countries to participate in green industrial policy competition, leading to the "trading up" of energy technology policy goals. This contrasts with classic patterns of environmental policy competition, in which advanced industrialized nations are the pacesetters.

Meckling, J. and Hughes, L., 2018, Global interdependence in clean energy transitions, *Business and Politics*, 20(4), 467-491

The global energy industry is transforming as governments invest in clean energy technologies to address climate change, enhance energy security, and strengthen national competitiveness. Comparative research on clean energy transitions highlights the domestic drivers and constraints of clean energy transitions. This article contends that we need to understand the effects of global interdependence on clean energy transitions. Shifts in forms of interdependence between firms—influenced by the rise of global supply chains—have new implications for policy choices made by governments. Governments face more complex demands from domestic industries facing global economic competition, and act strategically in response to the actions of other governments, including sub-national actors, and firms in the global economy. We suggest that research on interdependence in clean energy transitions benefits from an analytical focus on mechanisms of transnational change such as cross-national and multi-level policy feedback and cross-national policy sequencing. Global interdependence has important implications for economic and environmental outcomes,

affecting the durability of competitive advantage, and influencing the pace of the diffusion of clean energy technologies.

Dobson, J., 2019, Reinterpreting urban institutions for sustainability: How epistemic networks shape knowledge and logics, *Environmental Science & Policy*, 92, 133-140

Long term urban resilience demands a transition to a low-carbon society but poses a dilemma: the institutions that stabilise and perpetuate sociotechnical systems must become agents of radical change. The possibility of alternative futures challenges the logics and values central to institutional identity. 'Sustainability transitions' thus raise questions of institutional reinterpretation. The extent of such reinterpretation hinges on the everyday 'institutional work' of actors who bring diverse understandings to bear on their roles and responsibilities. These understandings derive not only from actors' professional roles but also from their engagement in wider epistemic networks. Based on case studies of three urban organisations in northern England, this paper examines the impact and influence of epistemic networks in validating or challenging approaches to sustainability transitions. The research found such networking a necessary, but not sufficient, condition for institutional reinterpretation. Epistemic networks serve five functions: they inspire, legitimise and facilitate potential transitions, and challenge slow progress - but they can also limit transitions. From these findings, it is argued that epistemic networks are central to the identification and development of nascent 'transition arenas' (Loorbach, 2010) where more sustainable, and ultimately more resilient, futures may be tested and trialled.

Kumar, A., 2019, Beyond technical smartness: Rethinking the development and implementation of sociotechnical smart grids in India, *Energy Research & Social Science*, 49, 158-168

How smart grids are understood and defined will influence the kinds of smart grids users will encounter in the future and their potential impacts. Practitioners and policymakers largely perceive smart grids as technological interventions. However, a number of social, financial and governmental interventions can also make grids smart, i.e., more efficient, more responsive, more inclusive and more robust. Drawing on qualitative research done using elite interviews, site visits and document analysis of eight micro-grids in India, this paper provides concrete examples of what could be understood as social, financial and governmental smartness, and in doing so, broadens the knowledge on smart grids beyond the technical understanding. This paper argues that social, financial and governmental interventions are central to 'smartness', and that multifaceted and relational sociotechnical approaches will build cheaper, just, more democratic and sustainable smart grids. The paper observes that smart grids are not conceived as smart grids but rather develop incrementally. An incremental approach, rather than pushing a premeditated set of ideas and technologies, reduces adoption of non-contextual interventions as well as unnecessary investments in new technologies. The paper recommends that policymakers and practitioners should understand and develop smart grids as sociotechnical and incremental grids.

Marquardt, J. and Delina, L., 2019, Reimagining energy futures: Contributions from community sustainable energy transitions in Thailand and the Philippines, *Energy Research & Social Science*, 49, 91-102

This article counters conventional discourses where sustainable energy transitions in the Global South have been broadly linked to top-down policy frameworks, large-scale installations, and donor-driven interventions. It does so by highlighting the roles played by and the potentials of bottom-up, small-scale, and community-driven initiatives in shaping energy transitions in these locations. We shed light on two of these initiatives: a rural, community-based renewable energy project in Thailand, and a community-led social movement that prevented the construction of a coal-fired power plant in the Philippines. Both cases demonstrate how community mobilizations help facilitate sustainable energy transitions in the Global South, despite their many social, political and economic constraints. The analysis draws from concepts of local activism and community engagement on energy

transitions, marrying the social movement concept of prefigurative activism with the concept of sociotechnical imaginaries in science and technology studies. This article highlights that valuable insights can be generated from rural- and community-driven renewable energy initiatives and their power to reimagine the futures of energy systems in the Global South.

Söderholm, P., Hellsmark, H., Frishammar, J., Hansson, J., Mossberg, J. and Sandström, A., 2019, Technological development for sustainability: The role of network management in the innovation policy mix, *Technological Forecasting and Social Change*, in press

Despite the key role of actor networks in progressing new sustainable technologies, there is a shortage of conceptual knowledge on how policy can help strengthen collaborative practices in such networks. The objective of this paper is to analyze the roles of such policies – so-called network management – throughout the entire technological development processes. The analysis draws on the public management and sustainability transitions literatures, and discusses how various network characteristics could affect the development of sustainable technologies, including how different categories of network management strategies could be deployed to influence actor collaborations. The paper's main contribution is an analytical framework that addresses the changing roles of network management at the interface between various phases of the technological development process, illustrated with the empirical case of advanced biorefinery technology development in Sweden. Furthermore, the analysis also addresses some challenges that policy makers are likely to encounter when pursuing network management strategies, and identifies a number of negative consequences of ignoring such instruments in the innovation policy mix. The latter include inefficient actor role-taking, the emergence of small, ineffective and competing actor networks in similar technological fields, and a shortage of interpretative knowledge.

Blumer, Y.B., Braunreiter, L., Kachi, A., Lordan-Perret, R., Oeri, F., 2018, A two-level analysis of public support: Exploring the role of beliefs in opinions about the Swiss energy strategy, *Energy Research & Social Science*, 43, 109-118

Energy system transitions in democracies require that national interests and central planning are reconciled with the public's preferences. This pilot study investigates public support for the Swiss national energy strategy and two specific technologies that are part of it: expansion of hydropower and deep geothermal energy. It addresses two research questions. First, how does public support for a national energy transition differ from public support for specific technologies endorsed in an energy transition strategy? Second, are there differences in the factors influencing public support for these technologies? We investigate these questions empirically with a survey (N = 640), focusing on understanding the role lay-people's expectations about the future energy system, political ideology, and future orientation play in generating support for these two levels of public support and for two technologies with different characteristics. We find that while support for an energy transition is well explained by above factors, this is true to a much lesser extent for technology support. One conclusion is that support for an energy transition and for energy technologies is politicized to varying degrees, which is why their acceptability may be less shaped by their objective characteristics, but rather by subjective perceptions and beliefs the public holds towards them

Moore, T. and Doyon, A., 2018, The uncommon Nightingale: Sustainable housing innovation in Australia, *Sustainability*, 10, 3469

There is a need to deliver more environmentally and socially sustainable housing if we are to achieve a transition to a low carbon future. There are examples of innovative and sustainable housing emerging around the world which challenge the deeper structures of the existing housing regime. This paper uses the analysis of socio-technical dimensions of eco-housing presented by Smith to explore the development of an emerging sustainable housing model known as Nightingale Housing in Australia within a sustainability transitions framing. While there were several similarities to Smith's analysis (e.g., establishment of guiding

principles, learning by doing), there were also some key differences, including the scaling up of sustainable housing while using tried and tested design principles, materials and technologies, and creating changes to user relations, policy, and culture. Smith's dimensions remain a good framework for understanding sustainable housing development, but they must be located within a scaling up sustainable housing agenda. What is required now is to develop a better understanding of the processes and opportunities that such housing models offer policy makers, housing researchers, and building industry stakeholders to achieve a broader scale uptake of sustainable housing both in Australia and globally.

Rodríguez-Morales, J.E., 2018, Convergence, conflict and the historical transition of bioenergy for transport in Brazil: The political economy of governance and institutional change, *Energy Research & Social Science*, 44, 324-335

The history of liquid bioenergy in Brazil is a meaningful source of information vis-à-vis the political economy dynamics that underlie low-carbon energy transitions. By studying the political economy of bioenergy under a historical long-run perspective, this research seeks to shed light on the interplay between governance and bioenergy transition. Understanding governance as the dynamic interface between private and public interests, in turn conditioned by the natural, institutional and technological context, we explore the sources of institutional and economic change regarding bioenergy development. Using an analytical framework designed to study bioenergy governance in the US, this inquiry addresses the Brazilian bioenergy transition. The analysis reveals that beyond the incremental learning process of institutional and industrial transformation, the historical patterns of bioenergy evolution result from the dynamics of governance between the agro-industry and the government, a historical process of convergence and conflict of opportunity costs regarding bioenergy penetration. Thus, by altering the expected gains of the key actors, contextual factors related to energy and agricultural markets affects the decision-making process at the private and public dimension of governance, determining by convergence or by conflict, the pace of institutional change, the development of markets and the historical transition of liquid bioenergy in Brazil.