

## Newsletter 27: March 2018

This is the 27th 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 announcement
- New research projects
- Publications

The STRN steering group

## Words from the Chairman

Dear transition research colleagues,

I am very happy to inform you that the STRN-associate journal *Environmental Innovation and Societal Transitions* will finally receive an 'official' impact factor from Thomson Reuters (see also the EIST section below). This recognition is likely to further raise the profile of EIST and transition research. Since many universities encourage their staff to publish in ISI-recognized journals, EIST may now also experience a further upward spiral as more submissions further improve quality and attention, which attract more citations, which increase the impact factor, which attract more papers. So, this is great news for the transitions community. I would therefore like to congratulate the editors (Jeroen van den Bergh, Bernard Truffer, Harald Rohracher, and Maurie Cohen) with this result, and thank them for their efforts and dedication over the years to make EIST into a successful journal.

Other good news is that several STRN-scholars (e.g. Sovacool, Geels) have been invited to become lead authors for the Working Group III contribution to the IPCC Sixth Assessment Report (AR6). This creates opportunities to introduce transition ideas and findings into policy-oriented debates at the global level. At the European level, a recent report by the European Environment Agency, titled *Perspectives on transitions to sustainability* (2018), also does a great job in making sustainability transitions/transformation ideas available for policymakers in the European Parliament, national environment ministries, and European Commission. The report consists of a summary chapter and five chapters written by academics who describe conceptual ideas and policy suggestions from different communities (socio-ecological, socio-technical, socio-economic, integrated assessment and action-oriented approaches).

Further good news, reported in the network news section, is that STRN membership as well as numbers of transition publications kept growing in 2017. Jochen Markard's analysis also shows that citations are 'going through the roof', which suggests that our scientific impact continues to increase

Meanwhile, organization of the 9th International Sustainability Transitions Conference in Manchester is in full swing. The conference runs from 12 - 14 June 2018, with a Newcomers & Early Career session on the 11 June 2018. We have accepted a large number of excellent proposals for full papers, speed talks, dialogue sessions and posters, and are now developing a draft program, including a spectacular party and dinner on 13 June. The program includes two academic plenary sessions with excellent keynote

speakers, who are deeply familiar with sustainability transitions debates: Fred Steward (UK), Gert Spaargaren (NL), Peter Wells (UK), and Elizabeth Wilson (USA). The third plenary session focuses on the usefulness and relevance of our ideas for stakeholders. Three keynote speakers, representing NGOs and policy-oriented agencies, that are actively engaging with system change and academic transition theories, will talk about their experiences in translating academic transitions ideas into their strategies and practices: Anna Birney (Forum for the Future), Göran Marklund (Vinnova, Sweden's Innovation Agency), Hans Bruyninckx (European Environment Agency). We've asked all speakers to be thoughtful and provocative, so the plenaries should be good fun. You can register for the conference at the conference website: <http://www.conferecare.manchester.ac.uk/events/ist2018/>.

The newsletter is again filled with many interesting event announcements, updates, new projects, and new publications. I hope you'll enjoy reading it and look forward to seeing many of you in Manchester in a few months time.

**Frank Geels**, Chairman of STRN ([frank.geels@manchester.ac.uk](mailto:frank.geels@manchester.ac.uk)).

## Environmental Innovation and Societal Transitions

The Elsevier journal *Environmental Innovation and Societal Transitions* (EIST) has been accepted by Clarivate (part of Thomson Reuters) to be included in the "Master Journal List", covering all journal titles in the Web of Science. It means EIST will obtain an 'official' impact factor (IF), likely to be published in June. EIST will appear in both the Science Citation Index (Expanded) and the Social Sciences Citation Index.

Another relevant news item is that EIST has an additional associate editor, Dr. Maurie J. Cohen. He is Director of the Program in Science, Technology, and Society at the New Jersey Institute of Technology in the USA, and also affiliated with its Department of Humanities. He further serves as editor-in-chief of the journal *Sustainability: Science, Practice, and Policy*. His research interests cover sustainable consumption, alternative mobility futures, and socio-technical transition management.

Volume 26 of *Environmental Innovation and Societal Transitions* has just been published. It contains twelve articles reporting original research:

- A social network analysis of Germany's wood-based bioeconomy: Social capital and shared beliefs, A. Giurca and T. Metz
- Creating innovative zero carbon homes in the United Kingdom — Intermediaries and champions in building projects, M. Martiskainen and P. Kivimaa
- Intermediacy and the diffusion of grassroots innovations: The case of cohousing in the United States, R.H.W. Boyer
- Navigators through the storm: A review of organization theories and the behavior of incumbent firms during transitions, A. van Mossel, F.J. van Rijnsoever and M.P. Hekkert
- Established industries as foundations for emerging technological innovation systems: The case of solar photovoltaics in Norway, J. Hanson
- Sequence and alignment of external pressures in industry destabilisation: Understanding the downfall of incumbent utilities in the German energy transition (1998–2015), G. Kungl and F.W. Geels
- Urban sustainability transitions in a context of multi-level governance: A comparison of four European states, F. Ehnert, F. Kern, S. Borgström, L. Gorissen, S. Maschmeyer and M. Egermann
- Agricultural transition: Niche and regime knowledge systems' boundary dynamics. J. Ingram
- An intermediary approach to technological innovation systems (TIS)—The case of the cleantech sector in Finland, J. Lukkarinen, A. Berg, M. Salo, P. Tainio, K. Alhola and R. Antikainen
- Systems of practice and the Circular Economy: Transforming mobile phone product service systems, K. Hobson, N. Lynch, D. Lilley and G. Smalley

- Local matters: Political opportunities, spatial scale, and support for green jobs policies, D.J. Hess, Q.D. Mai, R. Skaggs and M. Sudibjo
  - Circular Cities: Mapping Six Cities in Transition, S. Prendeville, E. Cherim and N. Bocken
- 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**

## Network News

Any news related to ongoing activities of STRN

### Sustainability Transitions: Publications, journals and topics

It has been more than a year since the last statistics review (cf. 22<sup>nd</sup> newsletter) and the new figures are impressive: Publications are still increasing rapidly and citations shoot through the roof. Last time, I thought that we would see first signs of a saturation but this is not the case. In 2016, new papers on sustainability transitions actually surpassed the 300 mark and in 2017 we were getting close to 350. The total stock is now well above 2'200. So, you need to read even more to catch up! - or write less ☺

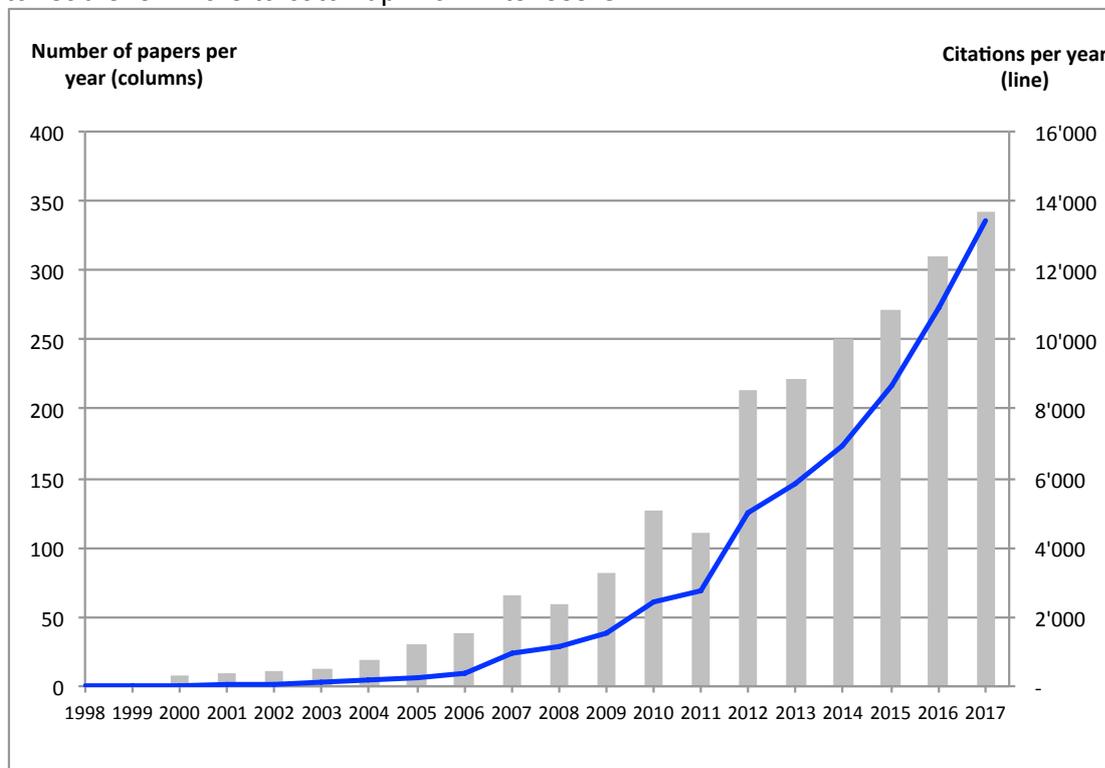


Figure 1: Number of papers on sustainability transitions and citations (Source: Scopus, March 15, 2018)

Compared to the last review, there is again a shift in the prominence of journals. JCP boosted its number of ST articles from 94 to 144, Sustainability appeared new on the list (from 26 up to 55 articles) and ERSS even climbed from 29 to 73 articles - well, isn't it all about using the right keywords?

Looking at the citations, the figures show that Research Policy is still very much in the lead. The 50+ papers in the journal attract almost 20% of all citations in the field.<sup>1</sup> We do, however, have to keep in mind that new journals such as ERSS have not had the chance to accumulate as many citations as the established ones (like Research Policy).

<sup>1</sup> We have to bear in mind though that 7 of the top-20 papers we identified back in 2012 (Markard, Raven, Truffer – 2012) were published in ResPol. As the top-20 papers still attract a lot of citations (also about 20%) our method tends to 'favor' those journals that published the early seminal papers.

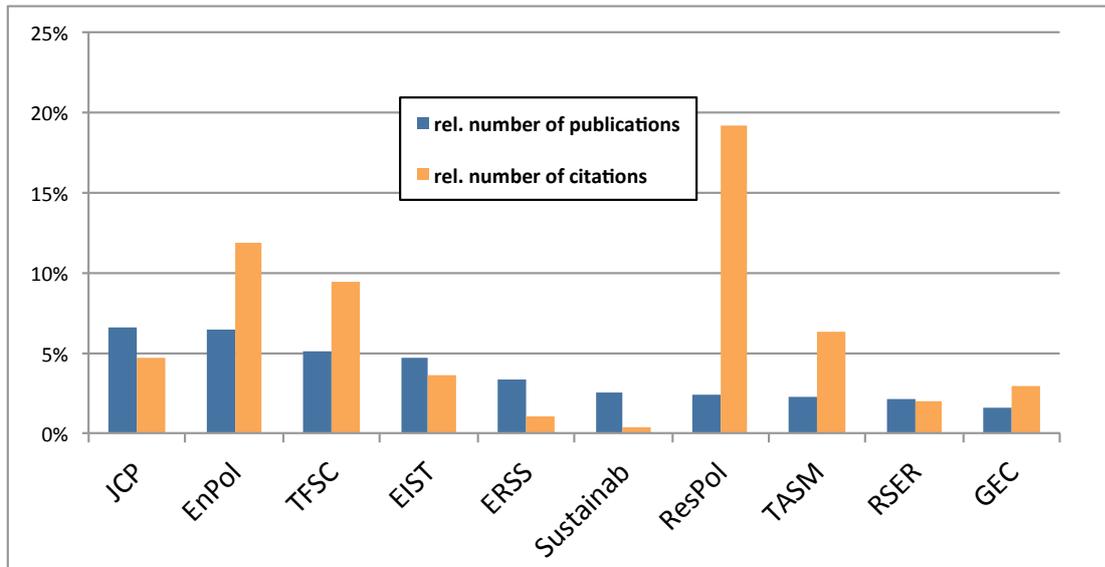


Figure 2: Key journals in the field – relative number of articles and citations<sup>2</sup>

Looking at the empirical topics, in which transition scholars are active, there are virtually no changes. Energy is still leading (45% of all papers), followed by transport (13%), food (11%), water (9%), and waste/circular economy (5%). Note that these categories are not exclusive. The final graph shows how research is distributed across different strands of research in the field (Figure 3). I also added the relative shares of accepted paper presentations in the corresponding conferences themes for IST 2018, which is certainly a better illustration of what is currently happening at the forefront of transition studies. Note that the seven categories cover only 2/3 of the conference papers, while the rest is on other topics such as whole system reconfiguration, methods or new frontiers.

**Jochen Markard (jmarkard@ethz.ch)**

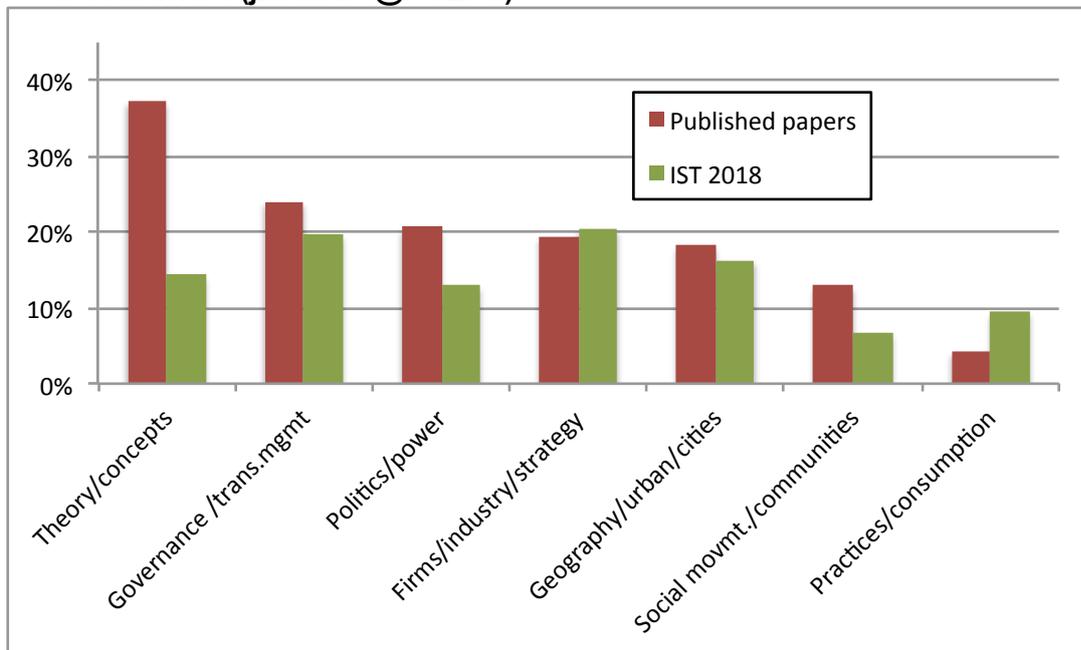
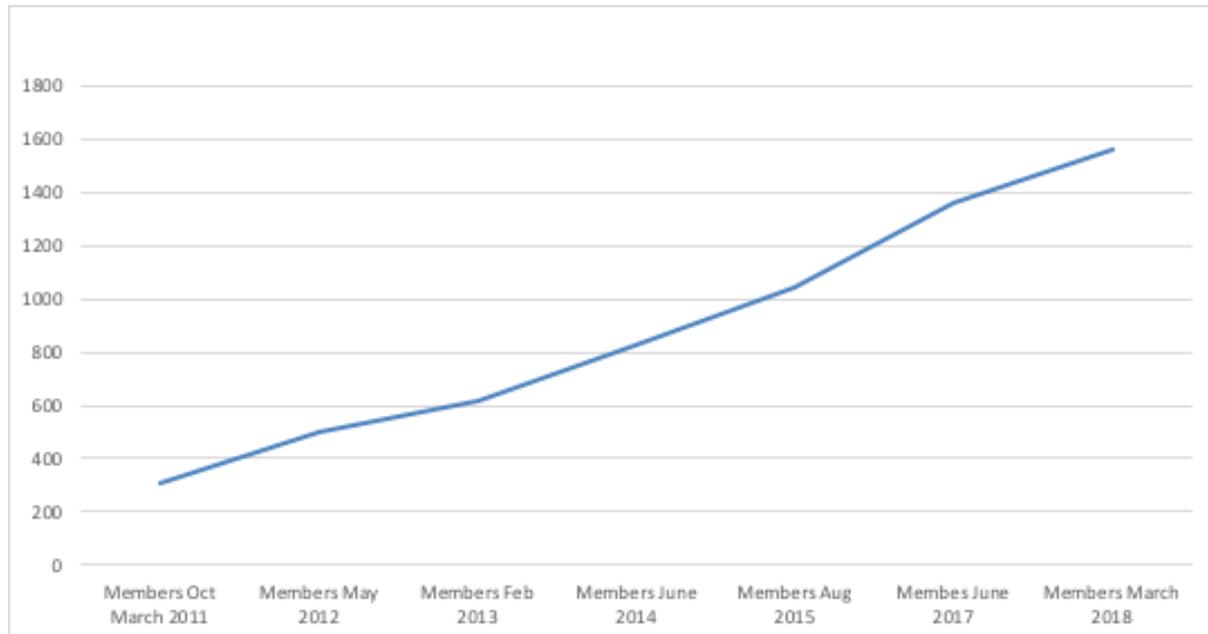


Figure 3: Share of papers in different sub-fields of sustainability transitions

<sup>2</sup> Journal of Cleaner Production (JCP), Energy Policy (EnPol), Technological Forecasting and Social Change (TFSC), Environmental Innovation and Societal Transitions (EIST), Energy Research and Social Sciences (ERSS), Sustainability, Research Policy (ResPol), Technology Analysis and Strategic Management (TASM), Renewable and Sustainable Energy Reviews (RSER), Global Environmental Change (GEC)

## STRN membership

The number of STRN members continues to steadily increase (see graph below). The total number of STRN members reached 1556 in March 2018, which is an increase of about 15% since the last measurement (June 2017).



Top 10 in 2018	Members	Percentage	Top 10 in 2015	Members	Percentage
UK	278	17,8%	UK	203	19,5%
Netherlands	225	14,4%	Netherlands	159	15,3%
Germany	167	10,7%	Germany	107	10,3%
USA	114	7,3%	USA	81	7,8%
Sweden	101	6,5%	Sweden	62	6,0%
Australia	78	5,0%	Australia	49	4,7%
Belgium	53	3,4%	Belgium	39	3,7%
Canada	45	2,9%	Denmark	28	2,7%
Denmark	47	3,0%	Canada	25	2,4%
Norway	30	1,9%	India	24	2,3%

Country-wise there are no major changes in the composition of STRN membership. The majority of members are based at European institutes (73%), followed by North America (10%). Slightly more than half of all members are based in the UK, the Netherlands, Germany and the USA. **Rob Raven (R.P.J.M.Raven@uu.nl)**.

## Event announcements

*Calls for upcoming relevant events such as workshops and conferences*

### Transition Design Symposium, June 21-23 2018

The 4th annual Transition Design Symposium will be held at Dartington/Schumacher College, England, June 21-23, 2018. This symposium will bring together researchers and practitioners working within several transition and systems-change related areas including: Sociotechnical Transitions, the Transition Town Network, The Commons Transition, Just Transitions, Transition Design, STEPS Centre, The Next Systems Project and Forum for the

Future's Systems School. Keynote speakers include: Michel Bauwens (P2P Foundation), Rob Hopkins (found of the Transition Town movement), author John Thackara, futurist Stuart Candy and educator Cameron Tonkinwise. The symposium will be preceded by a 10-day short course on Transition Design at Schumacher College. More information can be found here: <https://www.schumachercollege.org.uk/events/ITDS>  
<https://www.schumachercollege.org.uk/courses/short-courses/transition-design-short-course-and-international-design-symposium>. Terry Irwin ([tirwin@andrew.cmu.edu](mailto:tirwin@andrew.cmu.edu))

### **2018 Organizations and the Natural Environment (ONE) Division**

Transition scholars who work in the field of management studies might be interested in the ONE Emerging Scholars Award

(<https://one.aom.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=44393ed8-23e7-4905-ab68-6cccd5dbb849>). More information can be found at the ONE (<https://one.aom.org/home>). ONE also organizes a Doctoral Consortium at the 78<sup>th</sup> Annual Meeting of the Academy of Management (AOM), Chicago, Illinois, August 10-14, 2018. Sustainability transition scholars are strongly invited (see <http://bit.ly/2u3v1eK>).

## **Event Reviews**

*Review of events interesting to the STRN community*

### **Report from the 3<sup>rd</sup> NEST Conference**

On March 15 and 16, almost 70 PhD candidates and early career researchers gathered at the Copernicus Institute of Sustainable Development, Utrecht University, to share their research with peers at the #3rdNEST conference. The conference was organized by the NEST (The Network of Early Career Researchers in Sustainability Transitions); Utrecht University's Copernicus Institute of Sustainable Development provided financial support (a special thank you to Marko Hekkert!). Participants arrived from countries and universities around the globe, and presented research covering topics such as the circular bioeconomy, bioclusters, the sharing economy, energy, water, agri-food systems, and bottom-up community initiatives, based on case studies from a wide range of countries. After the two successful "PhDs in Transition" conferences in Greenwich (UK) in 2016 and in Lausanne (Switzerland) in 2017, the #3rdNEST conference in Utrecht demonstrated an exponential growth in transitions research by juniors. With over 120 submitted abstracts, the organizers had to make some difficult choices on whom to include in the conference. Participants were a mix of 'starters' in the transitions field (about 30%) and late-stage PhD candidates and early career researchers (about 10%), with the majority being PhDs in the middle of their research. Keynotes by Anna Wieczorek, who provided an overview of the history and current developments in the field as well as on what the transition community can learn from transitions research in emerging economies, and Marko Hekkert, who gave points on how to create real-world impact with transitions research, opened the conference. Besides the two days of parallel sessions in which delegates presented their research to, and got feedback from, their peers, three workshops allowed a more hands-on approach to topics such as the resilience of sustainability transitions (led by Susan Mühlemeier, EPFL Lausanne), science communication (from Utrecht University's Communications Office) and using transition frameworks for mission-oriented innovation policy (led by Joeri Wesseling, Copernicus Institute of Sustainable Development at Utrecht University). Social evening events gave participants an opportunity to interact in a more informal setting and manner. The #3rdNEST stood out for the high quality of feedback given in the sessions, as well as the easygoing and fun atmosphere created by participants. We look forward to meeting many participants again in Manchester for the IST conference, as well as of course at #4thNEST in 2019! Katharina Schiller, on behalf of the #3rdNEST organizing committee: Julius Wesche, Denise Reike, Paul van Baal, and Kristína Hojčková.

## New research projects

*Information about ongoing research activities such as the start of new research projects*

### **Regional energy transition: The social processes of negotiating, norming and learning in the wind energy sector**

This project suggests looking at energy transition as a social process in order to gain in-depth knowledge of the specific processes of interaction that lead to these processes of change. The project draws upon transition literature and complements it with insights from institutional theory and the regional innovation systems approach. The aim is to explain why and how actors and institutions from different social fields shape transition processes in the wind energy sector. Scientific, industrial, political, administrative and financial actors as well as intermediaries and citizens are thereby taken into account. We therefore describe regional transitions by looking at processes of negotiating, norming and learning at the regional level in the context of their national, European and global embeddedness. Empirically, the project team conducts in-depth case studies of six German regions and analyses the occurring transition dynamics in the wind energy sector based on 20-30 qualitative expert interviews per region. The contribution of the project is hence threefold: First, it contributes to transition research by clarifying the underlying processes of negotiation, norming and learning of actors and by adding empirical evidence to the transition debate. Second, it identifies different paths of regional change that are characterized by their specific combination of restructuration processes and local-global orientation. This will also help to explain why and how regions develop differently within a common institutional, e.g. national, framework. These findings can later be transferred from the wind energy sector to other branches. Third, on the basis of this, the project simultaneously enhances the degree to which transition processes can be influenced: Political instruments can be fine-tuned to better target the critically involved actors and the specificities of the particular regional setup. The research is financed by the German Research Foundation for five years and started in January 2018. The research team at the University of Oldenburg involves Prof. Dr. Jannika Mattes, Dr. Camilla Chlebna, Meike Löhr and Sebastian Rohe. For more information and contact details please go to <https://www.uni-oldenburg.de/en/sociologyofeuropeansocieties/research/regional-energy-transition/>.

### **POWERSHIFTS: The potential of decentralized ownership of renewable energy to shift political power structures**

Community and co-operative decentralized renewable energy producers (DRE) are capturing a growing share of energy markets. As their market share increases, DRE producers are becoming increasingly effective political actors. The political privilege enjoyed by traditional incumbent, and centralized renewable, energy industries is challenged by these DRE actors as they shift discourse and control over jobs, economic growth and energy supplies. Political struggles are increasing. However, the nature and extent of any possible power shifts (e.g., changes in access to policy makers, media influence), and their consequences for political systems and their outcomes (e.g., carbon targets, energy subsidies) are poorly understood. The POWERSHIFTS project addresses how and why DRE transitions are shifting political power relations, and the consequences of those shifts for political systems and outcomes. It uses an interdisciplinary approach grounded in theory on power (e.g., Lukes, Bourdieu), institutions (i.e., institutional logics, historical institutionalism), and sustainability transitions (i.e., Multi-Level Perspective). Objectives are explored through 4 international comparative cases (Netherlands, U.K., U.S.A., Canada). Case study insights will be expanded through a global survey of DRE regimes across 35 OECD countries. Findings address urgent questions highlighted by academics, the EU, and global economic bodies about the political, economic and social impacts of the changing energy landscape. For more information, contact Marie Claire Brisbois ([m.c.g.brisbois@uu.nl](mailto:m.c.g.brisbois@uu.nl)), or see [www.power-shifts.com](http://www.power-shifts.com).

### **Political Steering and Industrial Policy Implementation in Chinese Renewable Energies (Deutsche Forschungsgemeinschaft Project)**

This project aims to analyse and contribute to a growing body of literature on political steering by looking at how and by whom industrial policies are formulated in the People's Republic of China under the Xi Jinping leadership. To provide a more concrete understanding of the limits and barriers of political steering with industrial policies across different administrative levels and actors in China, renewable energies and smart grid technologies serve as case studies for this research. These industries are ideally suited for our research, as they constitute a key component of China's energy transition and economic stabilization process. In addition, renewable energies and smart grid technologies are heavily reliant on government subsidies, policy formulation and central-local guidance for future development. Therefore, our central research questions focus on how different layers of government coordinate often conflicting central control mechanisms across complementary industrial policy fields, with specific attention paid to how China's energy transition is managed from a central government level down to the individual provinces, counties and townships. The three-year project, which started in January 2018, involves a triumvirate of researchers that focus on the solar, wind and smart grid industries. For further details of this project, please visit the provisional website on Research Gate (<https://www.researchgate.net/project/Political-Steering-of-Strategic-Industries-under-Xi-Jinping-Assessing-renewable-energy-transition-management>) or contact our project leader Prof. Dr. **Doris Fischer** at the Julius-Maximilians Universität in Würzburg.

### **Community-based Virtual Power Plant**

Although the local power generation by renewable sources is increasing, it has not yet had a real impact on radical decarbonisation of the energy sector. Changes need to be made by unlocking the potential of the prosumer. Community-based Virtual Power Plant (cVPP) is a novelty that can help organise and significantly boost renewable energy production and distribution at a local level. A virtual power plant (VPP) refers to a cluster of dispersed generator units, controllable loads and storage systems, aggregated to operate as a unique power plant. VPP enables integration of renewables and allows for flexibility in demand in energy markets. Several VPP designs exist on the market developed by mainly large utilities, however, implementation remained limited due to a top-down focus on technical parameters. The community-based version of a VPP is bottom-up and focusses on sustainability issues. By organising a form of Collective Power, that is increasing the level of participation and control of the local community, the cVPP takes the development of the VPP a step further. The concept offers a community the opportunity to provide its energy needs with small-scale, distributed low-carbon technologies and with participation from individual consumers, local energy companies or SMEs. It can empower prosumers and contribute to the democratisation of energy markets and thereby facilitate upscaling of low-carbon energy community-driven initiatives that, so far, missed critical mass to trigger a more radical change. In this project we have a very rare opportunity of setting up, what could be called, a disruptive innovation in practice, and studying its impact on energy transition. We will develop a model that could enable the propagation of cVPP to other territories. Funded by Interreg NWE with 30+ international partners, more information at [a.j.wieczorek@tue.nl](mailto:a.j.wieczorek@tue.nl) (project leader) or [@cVPPproject](#) or under this [link](#).

## Publications

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

**PhD thesis. Fredric Bauer, 2018. *Innovation for biorefineries – Networks, narratives, and new institutions for the transition to a bioeconomy*. Lund University.**

The transition to a bioeconomy is dependent on transformative changes to technologies, organisations, and institutions, which jointly can be described as a socio-technical change. The thesis contributes to the understanding of how the transition is shaped by expectations on and collaborations for innovation for biorefineries, which can produce chemicals, fuels, and materials needed in a bioeconomy. The thesis poses three research questions: i) what are the systemic characteristics of innovation for biorefineries? ii) how do collaborations and networks shape innovation for biorefineries? and iii) in what ways are expectations and institutions shaping pathways of innovation for biorefineries? These questions are answered with a mixed methods approach. Reorienting the socio-technical system for production and utilisation of chemicals, fuels, and materials towards a bioeconomy requires the overcoming of significant technological and institutional barriers. Though collaborations on innovation for biorefineries are needed to combine knowledge about technologies, materials, and markets they are costly and difficult. Expectations on biorefineries in the bioeconomy are divergent and conflictual. Acknowledging and resolving these conflicts is thus key to build effective and stable partnerships, which has proven to be difficult in the biorefinery field. Further, actors meet barriers to local transformative innovation in the global institutional context in which they are embedded. The thesis shows that transition initiatives are shaped by and dependent on institutional structures on multiple scales, but that opportunities exist for actors to build new networks which can enable the transition to a bioeconomy.

**PhD thesis: Silva, A. I., 2017. *The Words We Use and the Actions We Choose: The Power of Keywords, Naming and Framing in the Transition towards Sustainability. The Story of Waste*. Curtin University , Australia**

The shortcomings of conventional development, such as environmental and social injustice, have created an opportunity for a new narrative: the transition to a sustainable future. Naming sustainability transitions purposefully and effectively has been an overlooked yet crucial variable in an age of media sound bites, hashtags, search engines and rapid communication technologies. The present research contributes to the new narrative by investigating what role keywords, naming and framing play in a major sustainability transition: waste.

**PhD thesis: Reinier Verhoog, 2018, *Three methodological contributions towards modelling endogenous policy-emergence in societal transitions*, École Polytechnique Fédérale de Lausanne (EPFL)**

Today we are facing many politically driven sustainability transitions in complex sociotechnical systems. Sustainability transition scholars look at these transitions with their own theoretical lenses, often paying too little attention to the interactions of power, politics and agency. While simulation is a useful method to address the complexity of long-term sustainability transitions, the number of transition studies using simulation is limited, as the field is still dominated by the use of qualitative case studies. This has recently been recognized by transition scholars, advocating various levels of integration of case studies, theoretical frameworks and simulation methods. However, a process to support the development of coherent and conceptually compatible mixed-methods research design is still missing. Furthermore, modeling and simulation studies are often lacking the theoretical foundations to model the intricacies of transitions at the micro-level, due to a lack of formalized transition frameworks at a low level of abstraction. In this thesis three methodological contributions are made towards modelling endogenous policy-emergence in societal transitions. First, system dynamics simulation is proposed as a method to perform a meta-analysis of Swiss energy transition scenarios, providing new insights in system level

uncertainty and sensitivity, as well as policy levers. Second, a mixed-methods process model is developed based on a comprehensive literature review of sustainability transitions studies. The process model addresses the theoretical and conceptual compatibility of prominent transition frameworks and relevant simulation paradigms, facilitating the design and reporting of coherent mixed-methods research designs. Third, a formalization of the multi-level perspective is developed at the level of agents to better address the role of individuals in sustainability transitions, as well as to internalize policy-making. The presented formalization refines and extends the closely related concepts of power, agency and politics.

**PhD thesis: Solera Ureña, Miriam, 2017, *Political crisis and structural unbalances of the world energy system versus an eventual systemic transformation of the current socio-technological energy paradigm. Systemic assessment of the German model (1973-2015)*, Universidad Nacional de Educación a Distancia (UNED), Spain, (thesis in Spanish)**

This thesis vindicates the appropriateness of the systemic approach for the analysis of multi-level socio-technological transitions towards low-carbon energy systems. The epistemic-methodological framework is based on Ludwig von Bertalanffy's concept of open-system and the work of Ilya Prigogine and Isabelle Stengers on non-linear dynamics of far-from-equilibrium systems of the thermodynamic theory. In these conditions, systems are especially sensitive to internal and external interactions and stimuli, so that new orders of higher complexity can arise out of disorder through processes of self-organization. The theoretical and empirical value of this framework is especially remarkable for the study of sustainable transitions insofar as it analyses aspects at micro and macro levels which characterize real processes of socio-technological change, e.g. disorder, instability, temporality, non-linearity and randomness, among others. Based on this theoretical approach, this thesis accomplishes an empirical analysis of the main processes of change and continuity in the German socio-technological energy system for the period between 1973 and 2015. Main influencing energy, policy, economic, technological, environmental and societal actors, institutions, events, believes and instruments are identified at both national and international levels, providing useful empirical understanding into multilevel interaction and emergence processes within socio-technical energy systems, hence contributing to the research on sustainable transition processes in complex systems.

**Book: Turnheim, B., Kivimaa, P., and Berkhout, F. (Eds.), 2018, *Innovating Climate Governance: Moving Beyond Experiments*, Cambridge University Press.**

After the perceived failure of global approaches to tackling climate change, enthusiasm for local climate initiatives has blossomed world-wide, suggesting a more experimental approach to climate governance. *Innovating Climate Governance: Moving Beyond Experiments* looks critically at climate governance experimentation, focusing on how experimental outcomes become embedded in practices, rules and norms. Policy which encourages local action on climate change, rather than global burden-sharing, suggests a radically different approach to tackling climate issues. This book reflects on what climate governance experiments achieve, as well as what happens after and beyond these experiments. A bottom-up, polycentric approach is analyzed, exploring the outcomes of climate experiments and how they can have broader, transformative effects in society. Contributions offer a wide range of approaches and cover more than fifty empirical cases internationally, making this an ideal resource for academics and practitioners involved in studying, developing and evaluating climate governance.

**Book: Westley, F., McGowan, K. and Tjörnbo, O. (eds.), 2017, *The Evolution of Social Innovation: Building Resilience Through Transition*, Edward Elgar**

At a time when governments and civil society organizations are putting ever-greater stock in social innovation as a route to transformation, understanding what characterizes social innovation with transformative potential is important. Exciting and promising ideas seem to die out as often as they take flight, and market mechanisms, which go a long way towards

contributing to successful technical innovations, play an insignificant role in social innovations. The cases in this book explore the evolution of successful social innovation through time, from the ideas which catalyzed social and system entrepreneurs to create new processes, platforms, projects, and programs to fundamental social shifts in culture, economics, laws, and policies which occurred as a result. In doing so, the authors shed light on how to recognize transformative potential in the early stage innovations we see today. This comparison of multiple historical cases across problem domains creates a map of social innovation over time - shifting our thinking on both current issues and established programs. From the American national parks and the joint stock company to the intelligence test and the financial derivatives that led to the 2008 crash, this book acts as a useful reflection and a cautionary tale, looking back to gain insight and inform the vibrant discussion of social innovation's future. This book pushes the theoretical and methodological boundaries of the field through approachable narratives, making it an ideal resource for social innovation students, scholars, instructors, and practitioners.

**Book: Van Geenhuizen, M., Holbrook, J.A., Taheri, M. (eds.), 2018, *Cities and Sustainable Technology Transitions: Leadership, Innovation and Adoption*, Edward Elgar**

Cities are undoubtedly key players in technology creation and adoption for sustainable transitions. This book addresses both the active and passive roles of cities, in technology innovation, commercialisation, mass-production and adoption. In particular, it examines elements of three socio-technical systems, energy, transport and healthcare. The authors investigate cities in Europe, Asia and North America, providing an in depth understanding of the differences in leadership roles that cities adopt across the globe. The book breaks new ground in the analysis of topical issues such as local 'cradle' conditions, incentive schemes, niche-development, living labs, impact bonds, grass-roots intermediation and adaptive policy making. Researchers and students involved in the urban studies, socio-technical transitions and sustainability would greatly benefit from reading this book. The variety of practical examples also makes this book an important tool for city policy-makers, as well as public policy and public sector scholars.

**Book: Aklin, M. and Urpelainen, J., 2018. *Renewables: The Politics of a Global Energy Transition*. Cambridge, MA: MIT Press.**

Wind and solar are the most dynamic components of the global power sector. How did this happen? After the 1973 oil crisis, the limitations of an energy system based on fossil fuels created an urgent need to experiment with alternatives, and some pioneering governments reaped political gains by investing heavily in alternative energy such as wind or solar power. Public policy enabled growth over time, and economies of scale brought down costs dramatically. In this book, Michaël Aklin and Johannes Urpelainen offer a comprehensive political analysis of the rapid growth in renewable wind and solar power, mapping an energy transition through theory, case studies, and policy analysis.

**Book: Scholten, D. (Eds.) (2018), *The Geopolitics of Renewables*. Springer,** Renewable energy represents a game changer for interstate energy relations. The abundant and intermittent nature of sources, possibilities for decentral generation and use of rare earth materials, and generally electric nature of distribution make renewable energy systems very different from those of fossil fuels. What do these geographic and technical characteristics imply for infrastructure topology and operations, business models, and energy markets? What are the consequences for strategic realities and policy considerations of producer, consumer, and transit countries and energy-related patterns of cooperation and conflict between them? Who are the likely winners and losers? *The Geopolitics of Renewables* is the first in-depth exploration of the implications for interstate energy relations of a transition towards renewable energy. Fifteen international scholars combine insights from several disciplines - international relations, geopolitics, energy security, renewable energy

technology, economics, sustainability transitions, and energy policy - to establish a comprehensive overview and understanding of the emerging energy game. Focus is on contemporary developments and how they may shape the coming decades on three levels of analysis: a) The emerging global energy game; winners and losers, b) Regional and bilateral energy relations of established and rising powers, c) Infrastructure developments and governance responses. The book is recommended for academics and policy makers. It offers a novel analytical framework that moves from geography and technology to economics and politics to investigate the geopolitical implications of renewable energy and provides practical illustrations and policy recommendations related to specific countries and regions such as the US, EU, China, India, OPEC, and Russia.

**Book: Frantzeskaki, N., Hölscher, K., Bach, M., and Avelino, F. (2018). *Co-creating sustainable urban futures - A primer on Transition Management in Cities*, Springer.**

This is a unique book that provides rich knowledge on how to understand and actively contribute to sustainability transitions in cities and urban areas. The book offers the opportunity to become actively engaged in working towards sustainable futures of cities. Readers of this book will be equipped to understand the complexity of urban sustainability transitions and diagnose persistent unsustainability problems in cities. Urban planners and professionals will build competences for designing transition management processes in cities and engaging with multidisciplinary knowledge in solution-seeking processes. The heart of the book marks the variety of very different local case studies across the world – including, amongst others, Rotterdam in the Netherlands, La Botija in Honduras, Sydney in Australia and Cleveland in the US. These rich studies give inspiration and practical insights to planners on how to create sustainable urban futures in collaboration with other stakeholders. The case studies and critical reflections on applications of transition management in cities offer food for thought and welcome criticism. They also introduce new lenses to understand the bigger picture that co-creation dynamics play in terms of power, (dis-)empowerment, legitimacy and changing actor roles. This will equip the readers with a deep understanding of the dynamics, opportunities and challenges present in urban contexts and urban sustainability transitions.

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**Madsen, S.H.J. and Hansen, T., 2018, Cities and climate change – examining advantages and challenges of urban climate change experiments. *European Planning Studies*, in press**

This paper contributes to the literature on urban climate change experiments by analysing ascribed advantages and challenges of organizing climate change experiments at the urban scale, and by examining how local actions translate into effect. We here distinguish between effects of experiments in achieving actual sustainability gains ('goal-oriented objectives') and instigating broader institutional change ('process-oriented objectives'). Empirically, we analyse efforts related to energy supply in two Danish urban climate change experiments: The 'CPH 2025 Climate Plan' in Copenhagen, and 'ProjectZero' in Sønderborg. Our analysis poses considerable question marks over the importance of the advantages ascribed to urban climate change experiments including 'authority advantages' and possibilities of 'engaging and mobilizing stakeholders'.

**Schot, J., Kanger, L. 2018. Deep Transitions: Emergence, acceleration, stabilization and directionality, *Research Policy*, in press**

Industrial society has not only led to high levels of wealth and welfare in the Western world, but also to increasing global ecological degradation and social inequality. The socio-technical systems that underlay contemporary societies have substantially contributed to these outcomes. This paper proposes that these socio-technical systems are an expression of a limited number of meta-rules that, for the past 250 years, have driven innovation and hence system evolution in a particular direction, thereby constituting the First Deep Transition. Meeting the cumulative social and ecological consequences of the overall direction of the First Deep Transition would require a radical change, not only in socio-technical systems but also in the meta-rules driving their evolution – the Second Deep Transition. This paper develops a new theoretical framework that aims to explain the emergence, acceleration, stabilization and directionality of Deep Transitions. It does so through the synthesis of two literatures that have attempted to explain large-scale and long-term socio-technical change: the Multi-level Perspective (MLP) on socio-technical transitions, and Techno-economic Paradigm (TEP) framework.

**Leipprand, A. and Flachslund, C., 2018, Regime destabilization in energy transitions: The German debate on the future of coal, *Energy Research & Social Science*, 40, 190-204**

Greenhouse gas emissions are stagnating in Germany despite increasing deployment of renewable energy. This makes the government's Energiewende appear inconsistent and has triggered a discussion on phasing-out coal. The focus has thus turned from niche technology development to the destabilization of the existing high-carbon regime. In this paper we investigate stakeholders' framings and their perceptions of different policy options to advance the understanding of regime destabilization processes and theory-building in the context of the multi-level perspective (MLP) on socio-technical transitions. We find that actors still form coalitions with traditional allies and cling to established lines of reasoning, although there are indications for a beginning disintegration of the status quo-defending coalition. In their framings, core actors emphasize risks and threats. This confirms that regime destabilization is particularly conflictual and shows that for actors pushing regime change it is more difficult to offer a positive story. Linking policies for phasing-out incumbent technologies to accompanying measures for managing structural change in affected regions may facilitate compromise. The results moreover point to a tension between national and supra-national action as a core issue in destabilization debates. Our insights are relevant for countries in similar transition phases and may inform future comparative research.

**Winfield, M., Shokrzadeh, S. and Jones, A., 2018, Energy policy regime change and advanced energy storage: A comparative analysis, *Energy Policy*, 115, 572-583**

This paper employs a multi-level perspective approach to examine the development of policy frameworks around energy storage technologies. The paper focuses on the emerging encounter between existing social, technological, regulatory, and institutional regimes in electricity systems in Canada, the United States, and the European Union, and the niche level development of advanced energy storage technologies. The structure of electricity systems as vertically integrated monopolies, or liberalized or semi-liberalized markets, is found to provide different mechanisms for niche formation and niche to regime transition pathways for energy storage. Significant trade-offs among these pathways are identified. The overwhelming bulk of energy storage policy development activities are found to be taking place in liberalized or semi-liberalized markets. The key policy debates in these markets relate to technical barriers to market participation by storage resources, the ability of storage technologies to offer multiple services in markets simultaneously, the lack of clear rules related to the aggregation of distributed energy resources, and issues related to the meaning of "technological neutrality" in liberalized market systems. Landscape conditions, particularly jurisdictional commitments to pursue deliberate reconfigurations of their energy

systems towards low-carbon energy sources, emerge as the most significant factor in the implementation of policy reforms in these areas.

**Papachristos, G., 2018, A mechanism based transition research methodology: Bridging analytical approaches, *Futures*, in press**

This paper is motivated by the discussion in the literature about the strengths and weaknesses of the Multi-Level Perspective framework and aims to provide a response to a number of criticisms. The paper proposes retroduction as a transition research methodology that is used to identify and test social mechanisms for their explanatory power. The methodology consists in the joint use of case study and system dynamics as modeling and simulation method. The paper discusses how the two methods are used iteratively, and each one complements the strengths and counters the weaknesses of the other. The methodology has particular strengths and implications for the agenda of issues that research on future transitions to sustainability faces currently.

**Pettit, S., Wells, P., Haider, J. and Abouarghoub, W., 2017, Repeating history? Can shipping achieve a second socio-technical transition for sustainability? *Transportation Research Part D*, in press**

This paper draws on socio-technical transitions theory to contextualise recent developments in the technological and operational eco-efficiency of ships, which may ameliorate but not resolve sustainability challenges in shipping. Taking an historical perspective, the paper argues that shipping is fundamentally a derived demand arising out of, but also enabling, the spatial separation of production and consumption that are integrated through global value chains. It is argued that the twin processes of innovation-enabled specialisation (into e.g. container ships; bulk carriers etc.) and increased scale both of ships and of shipping operations have embedded shipping into logistics systems of increasing complexity and reach. The objective of the paper is to demonstrate, using secondary data, the long-run trends in the growth of shipping carbon emissions for bulkers and tankers, as well as the impact of increased scale and vessel speed on such emissions. A fuel-based, top-down, methodology, based on fuel consumption estimates derived from secondary source industry data that are suitable for a macro-level analysis, is used to estimate global shipping carbon emissions. It is argued that technologies or operational innovations that reduce the environmental burdens of shipping, while useful, do not represent the socio-technical system 'regime' shift that international maritime logistics requires in order to contribute to improved sustainability. Rather, in the relative absence of strong governance mechanisms in the maritime field, it is underlying 'landscape' shifts in production and consumption that are likely to act to reduce the demand for shipping and hence to be more significant in the longer run.

**Geels, F.W. and Johnson, V., 2018, Towards a modular and temporal understanding of system diffusion: Adoption models and socio-technical theories applied to Austrian biomass district-heating (1979-2013), *Energy Research and Social Science*, 38, 138-153**

The diffusion of socio-technical *systems* is more complex than that of discrete products and cannot be understood solely with adoption models that have come to dominate the diffusion literature. The paper makes two contributions. First, it aims to broaden the conceptual repertoire by distinguishing two analytical families: adoption models and socio-technical theories of diffusion. We distinguish four adoption models (epidemic, rational choice, socio-psychological, increasing-returns-to-adoption) and three socio-technical models (system building, circulation/replication, societal embedding), and discuss their phenomenological characteristics and causal mechanisms. Second, the paper shows that system diffusion is a multi-dimensional process that is best understood with a modular approach that combines insights from different conceptual models. To demonstrate this second contribution and explore the temporal salience of different models, we apply them to the diffusion of Austrian biomass district heating (BMDH) systems (1979-2013). The paper ends with integrative suggestions by temporally positioning different diffusion models in a broader framework.

**Wisaksono, A., Murphy, J., Sharp, J.H. and Younger, P.L., 2017, The multi-level perspective analysis: Indonesia geothermal energy transition study, *IOP Conf. Ser.: Earth Environ. Sci.* 106 012114**

The study adopts a multi-level perspective in technology transition to analyse how the transition process in the development of geothermal energy in Indonesia is able to compete against the incumbent fossil-fuelled energy sources. Three levels of multi-level perspective are socio-technical landscape (ST-landscape), socio-technical regime (ST-regime) and niche innovations in Indonesia geothermal development. The identification, mapping and analysis of the dynamic relationship between each level are the important pillars of the multi-level perspective framework. The analysis considers the set of rules, actors and controversies that may arise in the technological transition process. The identified geothermal resource risks are the basis of the emerging geothermal technological innovations in Indonesian geothermal. The analysis of this study reveals the transition pathway, which yields a forecast for the Indonesian geothermal technology transition in the form of scenarios and probable impacts.

**Hölsgens, R., Lübke, S. and Hasselkuß, M., 2018, Social innovations in the German energy transition: an attempt to use the heuristics of the multi-level perspective of transitions to analyze the diffusion process of social innovations, *Energy, Sustainability and Society*, 8: 8.**

For a successful transition to a sustainable energy system, not only technical but also social innovations are required. A major challenge to social innovation research is how to translate the social innovation from a novelty with big potential into a mainstream practice. The multilevel perspective (MLP) of socio-technical transitions provides a heuristic to understand how niches can potentially break through to the regime level. In this paper, we examine in how far a multilevel perspective approach is suited to analyze and better understand diffusion trajectories of social rather than technological innovations, taking a social practice theory perspective. Five example projects, selected among the top social innovations for the Energiewende in North Rhine-Westphalia, are analyzed. We discuss to what extent the MLP provides a helpful tool to understand the transition processes. Social innovations can be very diverse. We find that the MLP does not offer a one-size-fits-all framework for the analysis of the diffusion of social innovations. The MLP proves applicable only in those cases where the social innovation (1) can lead to a system change and (2) has a clear competing or symbiotic relationship with an existing regime. Social innovations that aim to be transformative in the sense that they have the goal to be system changing (rather than incremental) can be analyzed along the heuristics of the MLP. For this type of social innovation, the MLP can be fruitful to learn to better understand the diffusion dynamics of social innovation and the barriers and drivers they might face. However, for social innovations that aim at incremental improvements without challenging the existing system, the MLP cannot be applied to study the diffusion process.

**Geels, F.W., Schwanen, T., Sorrell, S., Jenkins, K., and Sovacool, B.K., 2018, Reducing energy demand through low carbon innovation: A sociotechnical transitions perspective and thirteen research debates, *Energy Research & Social Science*, 40, 23-35.**

Improvements in energy efficiency and reductions in energy demand are expected to contribute more than half of the reduction in global carbon emissions over the next few decades. These unprecedented reductions require transformations in the systems that provide energy services. However, the dominant analytical perspectives, grounded in neoclassical economics and social psychology, focus upon marginal changes and provide only limited guidance on how such transformations may occur and how they can be shaped. We argue that a socio-technical transitions perspective is more suited to address the complexity of the challenges involved. This perspective understands energy services as being provided through large-scale, capital intensive and long-lived infrastructures that co-

evolve with technologies, institutions, skills, knowledge and behaviours to create broader 'sociotechnical systems'. To provide guidance for research in this area, this paper identifies and describes thirteen debates in socio-technical transitions research, organized under the headings of emergence, diffusion and impact, as well as more synthetic cross-cutting issues.

**Silva, A., and Stocker, L., 2018, What is a transition? Exploring visual and textual definitions among sustainability transition networks, *Global Environmental Change*, 50, 60-74**

'What is a transition?' This question is pertinent in understanding the motivation amongst scientists, policy makers, practitioners, business actors and community groups in transitioning society towards sustainability. The Sustainability Transition Research Network and Transition Towns have emerged as two highly visible global networks, shaping and legitimising how transitions are interpreted and implemented. This ability to narrate and frame the 'transition concept' is significant in determining sustainability transitions in future. Yet, previous studies have not comparatively explored how transition knowledge is understood and defined both visually and textually by members belonging to these two global networks. Employing an innovative visual data collection methodology (the draw and write technique), we compare and contrast both the textual and visual representations of a transition across the two networks. The results suggest that there are some differences in worldviews between the two networks; however potential synergies between the two networks could promote a more comprehensive understanding of transitions, which better accounts for all aspects of social and technological change towards sustainability

**Jenkins, K., Sovacool, B.K. and McCauley, D. 2018, Humanizing sociotechnical transitions through energy justice: An ethical framework for global transformative change, *Energy Policy*, 117, 66-74**

Poverty, climate change and energy security demand awareness about the interlinkages between energy systems and social justice. Amidst these challenges, energy justice has emerged to conceptualize a world where all individuals, across all areas, have safe, affordable and sustainable energy that is, essentially, socially just. Simultaneously, new social and technological solutions to energy problems continually evolve, and interest in the concept of sociotechnical transitions has grown. However, an element often missing from such transitions frameworks is explicit engagement with energy justice frameworks. Despite the development of an embryonic set of literature around these themes, an obvious research gap has emerged: can energy justice and transitions frameworks be combined? This paper argues *that they can. It does so* through an exploration of the multi-level perspective on sociotechnical systems and an integration of energy justice at the model's niche, regime and landscape level. It presents the argument that it is within the overarching process of sociotechnical change that issues of energy justice emerge. Here, inattention to social justice issues can cause injustices, whereas attention to them can provide a means to examine and potential resolve them.

**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 and Social Science*, 42, 1-10**

Technical innovations feature prominently in the current 'energy transition' debate in Africa but societal adaptation issues seldom receive a thorough airing. The mediating role of 'societal conditionings' in the adaptation to new energy technologies and the outcomes of such energy-society interrelations can offer some important insights. A study in Ghana shows a recent enthusiasm for Solar Home Systems (SHS) as power back-ups in residential facilities due to high/convoluted tariffs, perceived corruption and inefficiencies in the state-driven/centralised provision of electricity. A new class of "energy-elites" whose livelihoods and lifestyles require uninterrupted access to electricity sought to gain some autonomy in electricity provision and consumption by investing in power storage devices (e.g. power inverters and batteries) or fuel-powered Generator-Sets for use during unexpected frequent

power outages. These infrastructures supported self-organised electrification initiatives only on ad hoc basis but SHS provided avenues to sustain that societal quest for autonomy. Achieving this autonomy, nonetheless, required SHS users to restrict their practices to energy services easily enabled by SHS alone, or adjust social practices according to the extent to which they intended to depend on the state-driven provision of electricity. The vision of energy autonomy and resultant societal practices are indeed realised through the use of SHS technology; the overarching driving force is the dynamics of energy-society interrelations. We therefore hypothesize that the adaptation to decentralised solar PV systems in Africa cannot be reduced solely to technical innovations nor even financial considerations but is instead dependent on how these factors intersect with social practices, the quality of the state's electricity services, etc. to shape societal energy visions.

**Bidmon, C.M. and Knab, S.F., 2018, The three roles of business models in societal transitions: New linkages between business model and transition research, *Journal of Cleaner Production*, in press**

Following recent calls from sustainable business model and transition research, we establish the link between both fields. We systematically integrate existing knowledge on business models into the well-established multi-level perspective on socio-technical transitions and identify three roles of business models and their respective impact on transition dynamics: (1) *As part of the socio-technical regime*, existing business models hamper transitions by reinforcing the current system's stability; (2) *as intermediates between the technological niche and the socio-technical regime*, business models drive transitions by facilitating the stabilization process of technological innovation and its breakthrough from niche to regime level; and (3) *as non-technological niche innovation*, novel business models drive transitions by building up a substantial part of a new regime without relying on technological innovation. We illustrate our findings with examples from the German energy sector and discuss our contributions to (sustainable) business model and transition research.

**Selvakkumaran, S. and Ahlgren, E.O., 2017, Understanding the local energy transitions process: a systematic review, *International Journal of Sustainable Energy Planning and Management*, 14, 57–78**

The objective of this paper is to better understand the local energy transitions process, given the importance of local energy transitions. A systematic literature search was conducted and 18 core and 18 peripheral papers on local energy transitions were selected. The 18 core papers were assessed using the framework given by Turnheim et al. [1]. Findings show that local energy transitions have characteristics or features which are not adequately explained by the framework used. Sources of innovation and the innovation in niches in local energy transitions are explained by socio-technical theories such as Strategic Niche Management (SNM) and Multi-Level Perspective (MLP). The pathway dynamics and the normative goals are covered by quantitative modeling studies of local energy transitions. The specific features of local energy transitions which are not adequately analysed by the existing framework are ownerships of transitions, situative governance issues, spatial scale issues, differing priorities and differing institutional structures, along with the analysis of pathway dynamics. A suggestion for extending a framework to analyse local energy transitions is proposed.

**Lin, X., Wells, P. and Sovacool, B.K., 2018, The death of a transport regime? The future of electric bicycles and transportation pathways for sustainable mobility in China, *Technological Forecasting and Social Change*, in press**

This paper has an empirical and theoretical focus: to empirically assess electric bicycle development in China, and to theoretically test and apply the "Multi-Level Perspective" on transitions and innovation. We examine the electric bicycle (e-bike) sector in China to understand the future prospects for urban mobility and the interaction of e-bikes as a form of vernacular technology within the existing transport regime. For this purpose, we address the following questions: 1) What factors will influence the future adoption of e-bikes? 2) How are

alternative travel modes evaluated against e-bikes? 3) Will e-bikes become a popular sustainable mobility mode in the future or only an intermediary mode to cars? To provide answers, we conducted a survey in Nanjing city in order to assess the attitude of e-bike users, and other mode users (e.g. pedestrians; bicycle users). We then analyse responses from this survey through the lens of sociotechnical transitions theory, notably the “Multi-Level Perspective” notions of niches, regimes, and landscape. The paper explores the influential factors underpinning future e-bike adoption and the decision-making calculus behind alternative mode choices. Generalised Linear Models are used to investigate the factors influencing future e-bike adoption and alternative mode choices based on the survey data. We conclude that e-bikes are an intermediary mode on Nanjing's motorisation pathway, and that they therefore may eventually reflect a dying regime.

**EI Bilali, H. and Probst, L., 2017, Towards an integrated analytical framework to map sustainability transitions in food systems. *AGROFOR International Journal*, 2(2), 24-32.**

Transitions to sustainable food systems are considered necessary to address sustainability challenges in industrial food systems – but also to achieve food and nutrition security especially in countries of the South. To facilitate such transitions, we need a thorough analytical understanding of change processes in food systems. Different transition frameworks have been suggested in the literature, with the Multi-Level Perspective (MLP) on socio-technical transitions being the most prominent. While MLP has proven to be a useful heuristic, earlier studies have identified weak points (e.g. regarding agency, power, landscape factors and institutional innovations) calling for the integration of complementary concepts. This paper proposes a framework for the analysis of sustainability transitions in food systems that integrates elements of the Social Practices Approach, Transition Management, Strategic Niche Management and Innovation Systems. The starting point of the suggested analytical process is to map emerging sustainable food systems along the MLP levels of niche, regime and landscape. To better understand processes of creating and developing initiatives in food systems, our mapping relies on Innovation System approaches (e.g. identifying actors and their networks), Transition Management (e.g. niche stabilization and expansion processes) and Strategic Niche Management (e.g. breakthroughs). As wider transitions require a reconfiguration of relevant regimes, interactions across levels are of particular interest. The Social Practices Approach helps to make niche-regime interactions explicit. Finally, by looking at the impacts and outcomes of change initiatives, we can make statements about the type of transition pathway taken – and whether an initiative has transformative potential or is an incremental adaptation. Further work is needed to refine and test the framework in different contexts.

**Köhler, J., de Haan, F., Holtz, G., Kubeczko, K., Moallemi, E., Papachristos, G., and Chappin, E., 2018, Modelling sustainability transitions: An assessment of approaches and challenges, *Journal of Artificial Societies and Social Simulation*, 21(1), 8**

Transition modelling is an emerging but growing niche within the broader field of sustainability transitions research. The objective of this paper is to explore the characteristics of this niche in relation to a range of existing modelling approaches and literatures with which it shares commonalities or from which it could draw. We distil a number of key aspects we think a transitions model should be able to address, from a broadly acknowledged, empirical list of transition characteristics. We review some of the main strands in modelling of socio-technological change with regards to their ability to address these characteristics. These are: Eco-innovation literatures (energy-economy models and Integrated Assessment Models), evolutionary economics, complex systems models computational social science simulations using agent based models, system dynamics models and socio-ecological systems models. The modelling approaches reviewed can address many of the features that differentiate sustainability transitions from other socio-economic dynamics or innovations. The most problematic features are the representation of qualitatively different system states and of the normative aspects of change. The comparison provides transition researchers

with a starting point for their choice of a modelling approach, whose characteristics should correspond to the characteristics of the research question they face. A promising line of research is to develop innovative models of co-evolution of behaviours and technologies towards sustainability, involving change in the structure of the societal and technical systems.

**Hassink, J., Grin, J. and Hulsink, W., 2018, Enriching the multi-level perspective by better understanding agency and challenges associated with interactions across system boundaries. The case of care farming in the Netherlands: Multifunctional agriculture meets health care, *Journal of Rural Studies*, 57, 186-196**

The multi-level perspective (MLP) is broadly and successfully used as a framework for understanding transitions. However several aspects need more attention like agency, interactions across system boundaries and multi-regime interactions. We used our detailed and contextualized knowledge and analysis of the developing care farming sector in the Netherlands to increase our understanding of the role of agency and challenges and successful strategies of actors associated with interactions across system boundaries. We used entrepreneurship, institutional entrepreneurship and social movement theory to better understand agency in MLP. Connecting separated sectors, overcoming lack of legitimacy, lack of embeddedness and dealing with different logics were challenges associated with the care farm innovation that transcends system boundaries. Actors with a dual identity and combining entrepreneurial and institutional behavior and actors connecting with embedded actors with corresponding logics were important in overcoming these challenges.

**Yu, Z. and Gibbs, D., 2018, Encircling cities from rural areas? Barriers to the diffusion of solar water heaters in China's urban market, *Energy Policy*, 115, 366-373**

Researchers have contributed a fruitful understanding of the facilitating factors for solar water heaters (SWH) diffusion in China at different governance levels. However, the barriers to its further diffusion in the urban environment have so far not been addressed. One feature of SWH diffusion in China is that it emerged from the rural market, mainly driven by market demand. This article explicitly focuses on China's diffusion of SWH from rural areas to urban cities and explores the problems and barriers obstructing its full potential in cities. Applying the Multi-level Perspective (MLP) framework, the results find that the technological niche is still not mature enough, and the urban regime is still powerful in terms of building infrastructure, consumer demand, policy coordination and vested interests. SWH development in China is promoted more as a business opportunity, while environmental discourses have not been powerful enough to promote further diffusion in the urban context. We suggest there is a need to focus on technology innovation with higher industry standards and to implement more benefit-based incentive policies to motivate incumbent actors.

**Panetti, E., Parmentola, A., Wallis, S.E., and Ferretti, M., 2018, What drives technology transitions? An integration of different approaches within transition studies, *Technology Analysis and Strategic Management*, in press**

This paper aims to provide a deeper understanding of transition drivers by reviewing four major strands of inquiry in transition studies: Multi Level Perspective (MLP); Strategic Niche Management (SNM); Transition Management (TM); Technological Innovation Systems (TIS). To the best of our knowledge, none of these contributions have so far provided a clear-cut classification of main drivers of transitions, as evidenced by the difficulty of practitioners in reaching goals as entrepreneurs, or policy makers in supporting economic growth. We believe that these theoretical streams share views relating the origin and drivers of transitions and that the analysis of the multi-level developments and systemic sub-processes by using the Integrative Propositional Analysis (IPA) allows for a more comprehensive identification of transition drivers. By mapping causal relationships within each perspective and by developing an integrative framework that takes in due account of overlaps between theories, we derived a new conceptual structure for the identification of transitions' drivers.

**Morgan, N., 2018 Cycling infrastructure and the development of a bicycle commuting socio-technical system: the case of Johannesburg, *Applied Mobilities*, in press**

There is robust debate in the cycling literature on the relationship between infrastructure and utility cycling. This paper explores whether the provision of bicycle ways can initiate a bicycle commute culture. Drawing on insights from the transitions' literature, it analyses developments in Johannesburg where, as of 2007, bicycle ways have been installed as a road safety solution. It examines in particular user responses to a series of protected bicycle ways, which were aimed at encouraging populations proximate to two universities to travel by bicycle. I argue that a bicycling commuting culture did not materialise as initially expected because other key elements of a bicycle commuting socio-technical system were absent, weak and misaligned. Some of these included negative symbolic meanings, low levels of bicycle ownership, limited knowledge and information and poor clarity on municipal laws that govern the misuse of bicycle ways. Formation of these elements was constrained by historical factors; embryonic bicycling actor-networks; a robust system of automobility; and context barriers, such as inequality and crime. These findings support other studies, which argue for a systematic and coordinated approach to utility cycling development. Finally, this paper draws attention to social, economic and political place barriers that often receive little prominence in cycling literature.

**Hermans, F., 2018, The potential contribution of transition theory to the analysis of bioclusters and their role in the transition to a bioeconomy, *Biofuels Bioproducts and Biorefining*, in press**

Biocluster initiatives have become an important tool for governments to establish, promote, and strengthen economic collaboration, learning, innovation, and employment within particular regions. However, in addition to issues like competitiveness and employment, bioclusters operate with the additional goal of fostering the transition to a sustainable bioeconomy. The profound changes that are required for a successful shift from a fossil-based economy to a bioeconomy are called transitions and the relatively new scientific field of transition theory has emerged to study them. The aim of this paper is to show the contribution that transition theory can make to the study of bioclusters. In this paper I will review frameworks from the study of sustainability transitions (multi-level perspective and technical innovation systems) and frameworks from theories of evolutionary economic geography and cluster studies (regional and sectoral innovation systems). The review shows how the choice of a particular framework will shape the analysis of the biocluster through the particular focus and delineation associated with each framework. The review shows the advantages and disadvantages these frameworks have for incorporating the various issues related to the shift towards a bioeconomy that are currently neglected in the literature on bioclusters.

**Järnberg, L., Kautsky, E.E., Dagerskog, L. and Olsson, P., 2018, Green niche actors navigating an opaque opportunity context: Prospects for a sustainable transformation of Ethiopian agriculture, *Land Use Policy*, 71, 409-421**

Identifying trajectories of agricultural development that enable substantial increases in food production is of prime importance for food security and human development in Sub-Saharan Africa in general, and Ethiopia in particular. To ensure long-term welfare for people and landscapes, it is imperative that such agricultural transformations sustain and enhance the natural resource base upon which agriculture depends. To understand the prospects for a sustainable transformation of Ethiopian agriculture we develop a new conceptual framework for sustainability transformations that combines insights from the social-ecological transformations literature with research on socio-technical transitions and institutional entrepreneurship. Using this framework, we analyse the agricultural development trajectory currently envisaged by the government, as expressed in policy narratives and public institutions. We also explore the opportunity context facing non-state actors who promote

sustainable intensification (referred to as green niche actors), as well as the strategies they employ to navigate this context and lever change in the direction they perceive as desirable. We find that current policies for agricultural development are primarily dominated by a narrative of *Agriculture as an engine for growth*, which focuses on the role of external inputs and commercialisation in boosting agricultural production so as to drive economic growth. While another narrative of *Natural resource rehabilitation* exists in policy, it sees natural resource management as a means of reducing degradation rather than a crucial component of enhanced and sustainable agricultural production, and the policies largely decouple issues of natural resources from issues of agricultural production. Institutional structures in the agricultural sector are found to reflect these discursive patterns. Further, the general institutional context in the country is characterised by strong government domination and rigid structures, which indicates an opaque opportunity context with limited opportunities for niche actors to have an impact. Given these challenging conditions, green niche actors adapt their strategies to fit the existing opportunity context and choose to collaborate closely with the government and the extension system. While this strategy offers the possibility of a direct impact at potentially large scale, it also leads to a range of trade-offs for the green niche actors and ultimately reduces the prospects for a sustainable agricultural transformation. In conclusion, an adaptation of the regime's proposed development trajectory for Ethiopian agriculture is, under current conditions, a more likely scenario than a more fundamental sustainability transformation, although options remain for more transformative action. Through the case of Ethiopian agriculture, this study adds insights into how transformation processes could play out in non-Western contexts where a strong state plays a dominant role, thus broadening the scope of empirical applications of the emerging research field on social-ecological transformations. We also demonstrate how the multilevel perspective from the transition literature and the concepts of opportunity context and situated agency from the literature on institutional entrepreneurship can be fruitfully merged with the social-ecological transformations literature, thereby moving towards a more comprehensive conceptual framework for analysing sustainability transformations.

**Soler, N.G., Moss, T. and Papasozomenou, O., 2018, Rain and the city: Pathways to mainstreaming rainwater harvesting in Berlin, *Geoforum*, 89, 96-106**

Rainwater harvesting has long been part of the standard repertoire of the aspiring sustainable city. The multiple benefits of on-site retention, infiltration and use of rainwater have been illustrated with a plethora of successful pilot projects in industrialized cities across the globe. The leap from niche to mainstream has, however, proved largely elusive. Recent research has provided important explanations for such impeded transitions in terms of unfavourable institutional contexts and obdurate sociotechnical regimes. Little attention has been paid, however, to the urban dimensions of rainwater harvesting. Despite many case studies of rainwater harvesting in cities, we know very little about how the 'urban' shapes, and is shaped by, rainwater management policies and practices. This paper draws on recent contributions to transitions research from human geography and urban studies in order to explicate the dynamic interactions between rainwater harvesting and the city. Taking the city of Berlin – an early pioneer of such technologies – as a case study, it conducts a long-term analysis of the policies and projects implemented to promote rainwater harvesting in the city. The paper's findings demonstrate huge variety regarding not only the instruments applied and schemes developed, but also the political motives and priorities over the past 30 years. This is interpreted spatially and temporally in terms of shifting contexts and contingent events in (and beyond) Berlin. The paper argues for a more nuanced understanding of how the 'urban' permeates sociotechnical transitions in general, and pathways to reconfigure rainwater management in particular.

**Elmustapha, H., Hoppe, T. and Bressers, H., 2018, Comparing two pathways of strategic niche management in a developing economy; the cases of solar photovoltaic and solar thermal energy market development in Lebanon, *Journal of Cleaner Production*, 186, 155-167**

There is abundant solar potential in the Middle East North Africa region. Yet access to sustainable energy is still a fundamental challenge in many countries of this region. In this paper we seek to understand the success and failure of the development and the diffusion of solar energy technologies by analysing using a Strategic Niche Management framework to compare the niche development of solar thermal energy and solar photovoltaics in Lebanon. This paper has two main questions: (1) *How have the solar thermal niche and the solar photovoltaic niche developed in Lebanon, and how do they compare?* (2) *In which ways does the Strategic Niche Management framework help us to understand the development of solar energy niches in a developing country context?* To answer these questions, a cross case analysis of solar thermal and solar photovoltaic systems was conducted. Due to the absence of research using Strategic Niche Management in Middle Eastern developing countries, this study uses an illustrative case from a country in this region to contribute new insights. Moreover, unlike the Strategic Niche Management research that only focuses on single case studies, this paper presents the results of a comparative study of two niches. The main Strategic Niche Management propositions were grouped and compared per item (i.e. on voicing and shaping expectations, social networks, and learning). The results show that the solar thermal niche affected the solar photovoltaic niche to a large extent. This was especially in relation to the learning and coordination processes. This has gradually contributed to establishing a clear vision. However, both niches lacked a niche manager who was able to coordinate, manage and maintain the dynamics of the niche processes. It also lacked horizontal collaboration between key actors involved (i.e. ministries). International donors were found to play a crucial role in initiating and shaping the market with certain constraints of prioritization in the region. The paper ends with conclusions and ideas for future research on solar energy niche development in the context of developing countries.

**Torrens, J., Johnstone, P., and Schot, J., 2018, Unpacking the formation of favourable environments for urban experimentation: The Case of the Bristol energy scene, *Sustainability*, 10(3), 879**

Urban experimentation with sustainability has been gaining prominence in policy and academic discourses about urban transformations, spurring the creation of urban living laboratories and transition arenas. However, the academic literature has only begun examining why experimentation flourishes in particular cities, and why it conforms to place-specific styles. Meanwhile, the strategic niche management (SNM) tradition has extensively explored how protective spaces for experimentation emerge but has dealt only tangentially with why this happens in particular places. In this paper, we develop an approach for unpacking the formation of favourable environments for experimentation in specific places. We adopt an abductive research design to create a dialogue between distinct theoretical positions and one in-depth case study. Our case examines the formation of the Bristol energy scene, which hosts a variety of experimental initiatives concerning civic energy alternatives. Based on our findings, we refine the understanding of the processes shaping this experimental setting. There is value in characterising the 'genealogy' of experimental spaces and acknowledging their antecedents, path-dependencies and place-specificities. Efforts to foster urban transformation demand nuanced accounts of how places become experimental because they are not static backgrounds for experimentation.

**David, M. and Schönborn, S., 2018, Bottom-up energy transition narratives: Linking the global with the local? A comparison of three German renewable co-ops. *Sustainability* 2018, 10, 924.**

Bottom-up transition narratives help to enable the implementation of energy transitions. Yet, scholarship shows that little light has been shed on how bottom-up transition narratives change during the course of transition. By proposing a framework that envisions bottom-up transition narratives, we analyze narratives on three German bottom-up renewable energy initiatives to address this gap. Relying on semi-structured interviews with innovators and adopters, we show that, during the establishment phase, the analyzed narratives take non-place-bound factors like climate change as a point of contention. At the same time,

narratives underscore place-bound factors as, for instance, civil society's knowledge and participation as means for an alternative, non-rent-seeking energy system. During the adoption phase, the analyzed narratives travel easily. This represents a paradox because bottom-up energy transition narratives move beyond their local, place-bound origin in order to be reproduced in different spatial settings. By so doing, bottom-up energy transition narratives diverge from their original message. By falling short on the promotion of citizen's participation, they begin to promote sociotechnical systems that differ little from the sociotechnical systems from competing, rent-seeking energy industries during the innovation adoption pathway. Our comparative approach outlines how bottom-up energy transition narratives adapt to this trade-off during innovation adoption events. We discuss what this means for bottom-up energy transitions and conclude that bottom-up energy transition narratives are faced with a fixity-travel dilemma during the adoption phase.

**Acosta, C., Ortega, M., Bunsen, T., Koirala, B.P. and Ghorbani, A., 2018, Facilitating energy transition through energy commons: An application of socio-ecological systems framework for integrated community energy systems, *Sustainability*, 10(2), 366.**

Integrated Community Energy Systems (ICES) are an emerging local energy system focusing on the collective use of distributed energy resources (DER). These socio-technical systems (STSs) have a high potential to advance the transition towards socially inclusive, environmentally-friendly energy systems and to stimulate the local economy. While there is an analogy between energy in ICES and other common goods such as natural resources, it is not clear to what extent the existing theoretical framework for Socio-ecological Systems (SES) on the commons accounts for the specificities of common resources in ICESs and other STSs. This research explores the applicability of the SES framework to energy commons that are firmly embedded in STS with reference to the DE Ramplaan ICES in the Netherlands. The formation process and governance characteristics of this ICES are revised, further aided by stakeholder interviews. A framework and a strategic plan that can be used to design and implement an ICES are proposed.

**Koirala, B.P., Araghi, Y., Kroesen, M., Ghorbani, A., Hakvoort, R.A., Herder, P.M., 2018, Trust, awareness, and independence: Insights from a socio-psychological factor analysis of citizen knowledge and participation in community energy systems. *Energy Research and Social Science*, 38:33–40.**

In order to decarbonize the energy sector, there is a widespread consensus that the role of end-users in the energy system should change from passive consumption to active prosumption and engagement. This is of particular importance as an increasing number of technologies and business models are focusing on the end-users. These developments provide new opportunities for further technical and social innovation to smarter, flexible and integrated systems such as community energy systems (CESs). Through system integration and community engagement CESs assist in transition to a low-carbon energy system. Despite the high importance, there is limited knowledge on willingness of local citizens to participate in the local energy systems such as CESs as well as associated factors determining such willingness. Through a survey among 599 citizens in the Netherlands, this research analyses the impact of demographic, socio-economic, socio-institutional as well as environmental factors on willingness to participate in CESs. Factor and multi-variate regression analysis reveals that the environmental concern, renewables acceptance, energy independence, community trust, community resistance, education, energy related education and awareness about local energy initiatives are the most important factors in determining the citizens' willingness to participate in CESs. Citizens should be empowered to take active role in steering the local energy initiatives.

**Wesseling, J.H. and Edquist, C., 2018, Public procurement for innovation to help meet societal challenges: a review and case study, *Science & Public Policy*, in press**

Public procurement for innovation (PPI) is a powerful, underutilized demand-side innovation policy instrument. How this instrument can contribute to meeting societal challenges, which require goal-oriented transformation of socio-technical systems, remains unclear and is explored in this article. This article draws on the transitions and PPI literature to propose transformative processes to which PPI can contribute and identifies factors that determine the effectiveness of PPI in meeting societal challenges. The propositions are explored with a case study on the procurement of radically new flood barrier technology, using event history mapping analysis. The article concludes that, under certain conditions, PPI can contribute to the transformative processes of (1) the articulation of societal demands to direct challenge-driven transformation; (2) the development and production; (3) selection; and (4) the diffusion and use of new technologies to meet these societal demands. The article ends with policy recommendations on how PPI can help meet societal challenges.

**Ehnert, F., Frantzeskaki, N., Barnes, J., Borgström, S., Gorissen, L., Kern, F., Strenchock, L., and Egermann, M., 2018, The acceleration of urban sustainability transitions: A comparison of Brighton, Budapest, Dresden, Genk, and Stockholm, *Sustainability* 2018, 10(3), 612**

City-regions as sites of sustainability transitions have remained under-explored so far. With our comparative analysis of five diverse European city-regions, we offer new insights on contemporary sustainability transitions at the urban level. In a similar vein, the pre-development and the take-off phase of sustainability transitions have been studied in depth while the acceleration phase remains a research gap. We address this research gap by exploring how transitions can move beyond the seeding of alternative experiments and the activation of civil society initiatives. This raises the question of what commonalities and differences can be found between urban sustainability transitions. In our explorative study, we employ a newly developed framework of the acceleration mechanisms of sustainability transitions. We offer new insights on the multi-phase model of sustainability transitions. Our findings illustrate that there are no clear demarcations between the phases of transitions. From the perspective of city-regions, we rather found dynamics of acceleration, deceleration, and stagnation to unfold in parallel. We observed several transitions—transitions towards both sustainability and un-sustainability—to co-evolve. This suggests that the politics of persistence—the inertia and path dependencies of un-sustainability—should be considered in the study of urban sustainability transitions.

**Mallett, A., 2018, Beyond frontier technologies, expert knowledge and money: New parameters for innovation and energy systems change, *Energy Research & Social Science*, 39, 122-129**

Many people agree on the need for energy system change, and that innovation is a pivotal component in attaining these changes. For this reason, a flurry of activity exists – by scholars, policy makers and practitioners – about how to realize these changes most effectively. Emerging concepts and activities underway on the ground point to systemic changes afoot. By contrast, policy makers and their advisors often rely on outdated assumptions when espousing advice about policy, investment and markets. Through an examination of a number of sustainable energy experiences, this paper argues that conventional ways of approaching innovation are inadequate at effectively understanding innovation systems; by doing so, we miss important sources of innovation. This is important because to realize these transitions further alignment between these scholars, policy makers and practitioners is required. We must look beyond frontier technologies, experts and money by taking a broad view of innovation that also attempts to capture less orthodox innovation sources. To do so we must apply a comprehensive approach to energy system change; one that acknowledges that aspects such as culture, social, environmental, and political issues can play as important roles in understanding change as economic and technical aspects.

**Wolfram, M., 2018, Cities shaping grassroots niches for sustainability transitions: Conceptual reflections and an exploratory case study, *Journal of Cleaner Production*, 173, 11-23**

This paper discusses the crucial role cities play in the emergence and formation of grassroots socio-technical niches for sustainability transitions. Drawing on research engaged with strategic niche management, grassroots innovations and urban social innovations, it conceptualizes the interdependencies between urban contexts and grassroots niche dynamics, and explores a critical case in point: Current policy efforts in the city of Seoul to create, diversify and network social innovations in urban neighborhoods. The analysis illustrates the specific characteristics of innovative place-making activities in everyday-life urban environs and how empowerment, proximity and institutional thickness enable them to meet basic conditions for niche formation in terms of networking, shared expectations and social learning, while also raising new questions of inclusion, legitimacy and strategy. In conclusion, four issues are highlighted that appear to decisively impact on the formation of urban grassroots niche and related sustainability transition pathways: 1) Urban empowerment capacities, 2) Embedded holistic innovation, 3) Novel community-oriented governance modes, and 4) Urban niche/regime interactions. These issues thus require particular attention in future research and policy in order to guide the coevolution of cities and urban grassroots initiatives towards sustainability.

**Aalbers, C.B.E.M. and Sehested, K., 2018, Critical upscaling. How citizens' initiatives can contribute to a transition in governance and quality of urban greenspace, *Urban Forestry & Urban Greening*, 29, 261-275**

Studies show that municipalities often develop a type of urban greenspace that is rather uniform in its shape and use. Citizens' initiatives develop different types of greenspace. This article uses concepts from transition studies and identifies what happens during a citizens' initiative in urban greenspace in the Netherlands in terms of transition of municipal management and development and how these initiatives can lead to a change of practices of the municipality. A single, qualitative study of Diepenheim Inside-Out-Forest in the Netherlands as a critical case is presented, based on 8 semi-open interviews. The study gives insight in how the municipality has changed in relation to this one case, and how such transition of 'regime' takes place. The study explains how the different benefits that arise in a greenspace development and management initiative relate to the 'critical knowledge' and 'situated knowledge' of the actors involved and that the quality of urban greenspace is very much the result of that knowledge. 'Fit and conform' and 'stretch and transform' are usable strategies for the empowerment of such initiatives through sharing of resources, and policy advocacy by 'critical niche' innovators. 'Regime' is not uniquely a feature of the local state but also of market parties and citizens themselves with their own values and routines. A change among all parties seems needed if greenspace is to be developed, managed and used differently.

**Hojcková, K., Sandén, B., and Ahlborg, H., 2018, Three electricity futures: Monitoring the emergence of alternative system architectures, *Futures*, in press**

The socio-technical systems literature provides the theoretical base for exploration of electricity systems in transition. We identify three idealized future renewable electricity systems: the 'Super-grid', the 'Smart-grid' and the 'Off-grid' system. We found *the level and type of interconnectedness* to be a decisive characteristic in descriptions of different future renewable electricity systems. We analyse socio-technical overlaps of the idealized future systems with the regime and other sectors.

**Fuenfschilling, L. and Binz, C., 2018, Global socio-technical regimes, *Research Policy*, in press**

This paper addresses the question why socio-technical transitions follow similar trajectories in various parts of the world, even though the relevant material preconditions and institutional contexts vary greatly between different regions and countries. It takes a critical

stance on the implicit methodological nationalism in transition studies' socio-technical regime concept and proposes an alternative 'global' regime perspective that embraces the increasingly multi-scalar actor networks and institutional rationalities, which influence transition dynamics beyond national or regional borders. By drawing on globalization theories from sociology and human geography, we show that socio-technical systems often develop institutional rationalities that are diffused via international networks and thus become influential in various places around the world. In so doing, we shed light on the multi-scalar interrelatedness of institutional structures and actors in socio-technical systems and elaborate on the implications for the conceptualization of transition dynamics. The paper illustrates this with the case study of an unsuccessful transition in the Chinese wastewater sector. Recent studies indicate that key decisions on wastewater infrastructure expansion were not only influenced by path-dependencies stemming from China's national context, but equally (or even more critically) by the dominant rationality of the water sector's global socio-technical regime. We conclude by discussing the contours of a new research agenda around the notion of global socio-technical regimes.

**Bohnsack, R., 2018. Local niches and firm responses in sustainability transitions: The case of low-emission vehicles in China, *Technovation*, in press**

The Chinese government has implemented a comprehensive strategy to push low-emission vehicles (LEVs). Local municipalities have played an important role in this transition. Programs such as the "Ten Cities Thousand Vehicles" (TCTV) program created protection mechanisms in local niches for the development of LEVs in which public and private actors have been able to experiment without market pressures. However, often the setup of local niches has favoured local companies which led to incompatibility across provinces and barriers to diffusion. This article aims to explore the dynamics in the local niche and how the niche has been shaped by local protection and firm responses. Heeding the call for a better conceptualization of the spatial dimension in sustainability transitions, we draw on the recent second generation, multi-scalar multi-level perspective (MLP) and conceptualize the local niche. Based on our empirical results we find four ideal type local niches – the open niche, the technology shielding niche, the market shielding niche and the closed niche – and distill respective firm responses. This has important implications for policy-makers and managers in China and for industries in sustainability transition in general.

**Ulsrud, K., Rohrer, H. and Muchunku, C. (2017). Spatial transfer of innovations: South-South learning on village-scale solar power supply between India and Kenya, *Energy Policy*, 114, 89-79.**

This article presents research on the transfer of sustainable energy innovations between countries of the global South from a socio-technical perspective. The analysis identifies factors important for how a deliberate transfer process may unfold. It is based on monitoring a case of South-South transfer of experiences with village-level solar power supply models from India to Kenya. This research shows that it is not so much stable technical solutions which travel between different spatial and cultural contexts, but that experiences with sustainable technologies in one country can provide important inspiration and knowledge for the development of new sociotechnical designs based on local needs in a new socio-spatial context in a different country. Such learning processes can be especially effective between countries with similar problem situations, such as poverty and lacking access to electricity in rural areas. To achieve a successful transfer, strong emphasis must be put on mutual learning and exchange of knowledge, socio-technical experimentation, adaptation and social embedding. Learning from promising, innovative infrastructures in other geographical areas needs to capture the micro-level interactions between people, technology and socio-cultural contexts, while also taking into account larger processes of system innovation and emerging transitions.

**Hess, D.J., 2018, Energy democracy and social movements: A multi-coalition perspective on the politics of sustainability transitions, *Energy Research & Social Science*, 40, 177-189**

This study develops research on social movements, political coalitions, and sustainability transitions with a multi-coalition perspective. The perspective begins with a typology of coalitions based on two pairs of goals—general societal change versus the sociotechnical transition of an industry or technological system, and sunrising versus sunseting of systems and structures. Mapping the diversity of energy-transition coalitions makes it possible not only to identify the various wings of a broader industrial transition movement in a specified time and place but also to show the dynamics of how coalitions interact and change over time. Drawing on case studies of four energy-transition coalitions in New York State that approximate the four ideal types, the study shows differences in the goals, strategies, organizational composition, and frames of the coalitions. The study then shows the mechanisms that enable integration across coalitions, including the role of bridge brokers and new frames. As the networks of the energy-transition coalitions become more connected, the organizations make use of a wider set of frames, including the newer frame of energy democracy. Thus, the study develops an approach to the study of energy democracy that shows how it can serve as a frame that bridge brokers use to integrate coalitions.

**Chang, R. and Lu, Y., 2017, Facilitating systemic changes towards green buildings: Developing conceptual frameworks of socio-technical transitions, *Energy Procedia*, 143, 301–306**

The building industry is a major contributor to various grand challenges e.g. climate change. Green buildings have been regarded by many as the solutions and opportunities to improve the environmental sustainability of the built environment. However, the development of green buildings in many countries is very slow, facing tremendous barriers technologically, culturally, economically and institutionally. How to understand and eliminate these barriers thereby effectively accelerating the development of green buildings presents a significant challenge for both researchers and practitioners. This paper aims to enrich the current efforts in promoting green buildings by proposing conceptual frameworks from a socio-technical transition perspective. The conceptual frameworks provide guidelines for analysing (1) factors affecting the socio-technical transition towards green buildings; (2) the transition phases towards green buildings; and (3) the actions of systemic changes to promote green buildings. The frameworks holistically demonstrate the complexity, struggles and potential strategies to effectively promote green buildings, which could offer references for policymakers, researchers and practitioners involved in green building development.

**King, L.C., and J.C.J.M. van den Bergh (2018). Implications of net energy-return-on-investment for a low-carbon energy transition. *Nature Energy*, in press**

Low-carbon energy transitions aim to stay within a carbon budget that limits potential climate change to 2 °C—or well below—through a substantial growth in renewable energy sources alongside improved energy efficiency and carbon capture and storage. Current scenarios tend to overlook their low net energy returns compared to the existing fossil fuel infrastructure. Correcting from gross to net energy, we show that a low-carbon transition would probably lead to a 24–31% decline in net energy per capita by 2050, which implies a strong reversal of the recent rising trends of 0.5% per annum. Unless vast end-use efficiency savings can be achieved in the coming decades, current lifestyles might be impaired. To maintain the present net energy returns, solar and wind renewable power sources should grow two to three times faster than in other proposals. We suggest a new indicator, ‘energy return on carbon’, to assist in maximizing the net energy from the remaining carbon budget.

**Gazheli, A., and Van den Bergh, J. (2018). Real options analysis of investment in solar vs. wind energy: Diversification strategies under uncertain prices and costs. *Renewable and Sustainable Energy Reviews*, 82(3): 2693-2704.**

In this paper we study a community or firm considering to diversify its investment in two distinct renewable energy technologies, namely wind and solar PV electricity. We assume technological learning curves as a function of cumulative capital investment. A real options approach is applied as it takes into account uncertainty about prices and learning, as well as irreversibility associated with investment decisions. We investigate three different cases, dealing with uncertainty about future electricity prices, and uncertainty about the speed with which learning drives the costs of wind and solar electricity down. We assess the minimum threshold for the stochastic price and the maximum electricity production cost that makes it optimal for the firm to invest in the two technologies. The results show that the learning rate affects the option to invest in but reducing critical threshold for exercising it. The greater the amount of capital invested, the more learning stimulates earlier exercising of the option to invest. The firm will then anticipate the option to invest and exercise it for lower critical threshold values if all capital is invested in one technology. If capital investment is diversified, the option should be exercised at a higher critical threshold. More uncertainty in energy prices or technology costs postpones the option to invest. Although investing in both solar and wind may be profitable under particular conditions of price and cost uncertainty, the theoretically optimal strategy is generally investing in only one technology, that is, solar or wind, depending on their relative initial costs and learning rates. This suggests that the practice in most countries of diversifying renewable energy may reflect a mistaken strategy.

**Van den Bergh, J. and Botzen, W. (2018). Global impact of a climate treaty if the Human Development Index replaces GDP as welfare proxy. *Climate Policy* 18(1): 76-85.**

This study explores the implications of shifting the narrative of climate policy evaluation from one of costs/benefits or economic growth to a message of improving social welfare. Focusing on the costs of mitigation and the associated impacts on gross domestic product (GDP) may translate into a widespread concern that a climate agreement will be very costly. We consider the well-known Human Development Index (HDI) as an alternative criterion for judging the welfare effects of climate policy, and estimate what the maximum possible annual average increase in HDI welfare per tons of CO<sub>2</sub> would be within the carbon budget associated with limiting warming to 2°C over the period 2015–2050. Emission pathways are determined by a policy that allows the HDI of poor countries and their emissions to increase under a business-as-usual development path, while countries with a high HDI value (>0.8) have to restrain their emissions to ensure that the global temperature rise does not exceed 2°C. For comparison, the well-known multi-regional RICE model is used to assess GDP growth under the same climate change policy goals.

**Svensson, O. and Nikoleris, A., 2018, Structure reconsidered: Towards new foundations of explanatory transitions theory, *Research Policy*, 47(2), 462-473**

The most prominent framework for studying socio-technical transitions to date is the multi-level perspective (MLP). While appreciated for its flexibility and usefulness for studying socio-technical transitions it has not been without its critics. In this paper we focus on the ontological foundations of the MLP and its (in)ability to explain transitions and how they come about. The purpose is to initiate development of an explanatory theory for socio-technical transitions, by carrying out an immanent critique of the ontological foundations of the MLP together with a methodological critique. We show that the ontological foundations of the MLP to a large extent inhibits explanatory capacity. The argument is fourfold: since structure and agency are understood as inseparable, (i) the causal influence of material properties are undervalued, and (ii) different degrees of structural constraint and freedom of actors are ignored. As a consequence (iii) transitions are reduced to shifts in the maturity and spread of socio-cognitive rules, without analysis of systemic change. Moreover, (iv) mechanisms are reduced to recurring patterns of events which cannot explain why some transitions fail while others succeed. To remedy these limitations we outline alternative critical realist foundations for transitions theory.

**Mazur, C., Offer, G.J., Contestabile, M. and Brandon, N.B., 2018, Comparing the effects of vehicle automation, policy-making and changed user preferences on the uptake of electric cars and emissions from transport, *Sustainability*, 10(3):676**

Switching energy demand for transport from liquid fuels to electricity is the most promising way to significantly improve air quality and reduce transport emissions. Previous studies have shown this is possible, that by 2035 the economics of alternative powertrain and energy vectors will have converged. However, they do not address whether the transition is likely or plausible. Using the UK as a case study, we present a systems dynamics model based study informed by transition theory and explore the effects of technology progress, policy-making, user preferences and; for the first time, automated vehicles on this transition. We are not trying to predict the future but to highlight what is necessary in order for different scenarios to become more or less likely. Worryingly we show that current policies with the expected technology progress and expectations of vehicle buyers are insufficient to reach global targets. Faster technology progress, strong financial incentives or a change in vehicle buyer expectations are crucial but still insufficient. In contrast, the biggest switch to alternatively fuelled vehicles could be achieved by the introduction of automated vehicles. The implications will affect policy makers, automotive manufactures, technology developers and broader society

**Tàbara, J.D., Frantzeskaki, N., Hölscher, K., Pedde, S., Kok, K., Lamperti, F., Christensen J.H., Jäger J., Berry, P., 2018, Positive tipping points in a rapidly warming world, *Current Opinion in Environmental Sustainability*, 31, 120-129.**

The challenge of meeting the UNFCCC CoP21 goal of keeping global warming 'well below 2 °C and to pursue efforts towards 1.5 °C' ('the 2–1.5 °C target') calls for research efforts to better understand the opportunities and constraints for fundamental transformations in global systems dynamics which currently drive the unsustainable and inequitable use of the Earth's resources. To this end, this research reviews and introduces the notion of positive tipping points as emergent properties of systems – including both human capacities and structural conditions — which would allow the fast deployment of evolutionary-like transformative solutions to successfully tackle the present socio-climate quandary. Our research provides a simple procedural synthesis to help identify and coordinate the required agents' capacities to implement transformative solutions aligned with such climate goal in different contexts. Our research shows how to identify the required capacities, conditions and potential policy interventions which could eventually lead to the emergence of positive tipping points in various social–ecological systems to address the 2–1.5 °C policy target. Our insights are based on the participatory downscaling of global Shared Socio-economic Pathways (SSPs) to Europe, the formulation of pathways of solutions within these scenarios and the results from an agent-based economic modelling.

**Lönnqvist, T., Sandberg, T., Birbuet, J.C., Espinosa, C., Thorin, E., Grönkvist, S. and Gómez, M.F., 2018, Large-scale biogas generation in Bolivia – A stepwise reconfiguration, *Journal of Cleaner Production*, 180, 494-504**

Renewable energy is well recognized not only as resource that helps to protect the environment for future generations but also as a driver for development. Waste-to-energy systems can provide renewable energy and also improve sustainability in waste management. This article contributes a case study of stepwise reconfiguration of the waste management system in a developing country to the literature of transitions. The conditions for a systemic transition that integrates large-scale biogas generation into the waste management system have been analyzed. The method included a multi-criteria evaluation of three development steps for biogas, an economic analysis, and an institutional and organizational analysis. The results revealed economic as well as institutional and organizational barriers. Clearly, public and private sectors need to engage in sustainability. There is also a lack of pressure – mainly because of fossil fuel subsidies – that prevents a transition and creates a lock-in effect. To break the lock-in effect the municipality's institutional capacity should be strengthened. It is possible to strengthen biogas

economically by integrated waste management services and sales of biofertilizer. A stepwise reconfiguration would be initiated by adopting technologies that are already established in many developed countries but are novelties in a Bolivian context – as a response to sustainability challenges related to waste management. The article focuses on the main challenges and the potential for biogas technology in Bolivia and a pathway towards a new, more sustainable system is suggested.

**Gernert, M., El Bilali, H. and Strassner, C., 2018, Grassroots initiatives as sustainability transition pioneers: Implications and lessons for urban food systems, *Urban Science*, 2(1), 23.**

This review explores the current evidence on the role and success factors of grassroots initiatives in sustainability transitions, with special attention given to social innovations and the transformation of urban food systems, a field that is still rather scantily dealt with in literature compared to technological innovations in other sectors such as energy. In addition to their contributions to get the necessary transformation towards sustainable futures off the ground, the preconditions for grassroots initiatives to thrive are presented—as well as limitations regarding their possibilities and the challenges they face. Increasingly, the importance of civil society and social movements in facilitating societal transformation is recognized by both researchers and policy makers. Within their radical niches, grassroots initiatives do not have to adhere to the logics of the wider systems in which they are embedded. This allows them to experiment with diverse solutions to sustainability challenges such as local food security and sovereignty. By means of democratic, inclusive and participatory processes, they create new pathways and pilot a change of course. Nevertheless, upscaling often comes at the loss of the transformative potential of grassroots initiatives.

**Scordato, L., Klitkou, A., Tartiu, V.E. and Coenen, L., 2018, Policy mixes for the sustainability transition of the pulp and paper industry in Sweden, *Journal of Cleaner Production*, in press**

The need to view innovation policy through the lens of policy mixes has gained momentum given the growing complexity, the dynamics of real-world policy and the wide array of difficulties to address the current great societal challenges, notably the increasing pressure on the ecosystems that support our society. One of the main challenges concerning the transition towards bioeconomy, is to gain a more in-depth understanding on the policy mix to stimulate innovation in sustainability transitions. Our paper aims at enriching the portfolio of empirical case studies on policy mixes for innovation and sustainable transitions, by investigating the development of the policy mix underpinning the sustainability transition of the pulp and paper industry in Sweden. We apply a case study approach which draws on event history analysis, semi-structured interviews with industry and policy makers, literature reviews, a participative workshop with stakeholders from the pulp and paper industry, as well as on the IEA databases on climate change and energy efficiency policies and measures. Our analysis emphasises coordination, timing and scale in policy mixes as important elements to understand how instruments interact to accelerate sustainability transitions. The mapping of the policy mix shows that destabilising policies were crucial for accelerating the transition process of the industry. Prior to novelty creation policies, destabilising policies (e.g. environmental policies) were needed for 'innovation policy instruments' to be effective. More specific instruments (e.g. carbon tax), targeting particular functions of the innovation systems, require 'on-the-ground' policy intelligence and benefit from close interaction with industry.

**Carley, S., Evans, T.P., Konisky, D.M., 2018, Adaptation, culture, and the energy transition in American coal country, *Energy Research & Social Science*, 37, 133-139**

The U.S. coal industry has experienced economic decline over the past several decades, which has resulted in a loss of mining jobs and severe economic hardship in many coal communities. Recent efforts to relax environmental regulations are ostensibly intended to

help relieve this hardship and to revitalize this industry. Based on evidence gathered from focus groups and interviews conducted in U.S. coal communities, we argue that coal communities that have experienced mine closures have already begun an economic and social transition, one that is based on reshaping their culture and sense of identity, and false promises to return coal jobs can be destructive to the progress that has been made.

**Krantz, D. 2018. Solar sacrifice: How an Arizona church lost money by going solar — and solutions for when energy incentives fail to serve the needs of nonprofits. *Case Studies in the Environment*. DOI:10.1525/cse.2017.000646.**

By policy design, consumers are supposed to save money when they invest in solar energy. This paper presents a case study of what happens when a church goes solar and the finances go wrong. Following the installation of solar-photovoltaic panels, the Arizona church—in the Valley of the Sun, among the sunniest places in the country—decreased its energy consumption, but its electric bills went up. Through oral-history interviews of key stakeholders, the author investigates what happened, and what could be done to prevent other religious institutions and nonprofits from experiencing the church's fate.

**Barton, J., Davies, L., Dooley, B., Foxon, T.J., Galloway, S., Hammond, G.P., O'Grady, A., Robertson, E. and Thomson, M., 2018, Transition pathways for a UK low-carbon electricity system: Comparing scenarios and technology implications, *Renewable and Sustainable Energy Reviews*, 82, part 3, 2779-2790**

The United Kingdom (UK) has placed itself on a transition towards a low-carbon economy and society, through the imposition of a goal of reducing its 'greenhouse' gas emissions by 80% by 2050. A set of three low-carbon '*Transition Pathways*' were developed to examine the influence of different governance arrangements on achieving a low-carbon future. They focus on the power sector, including the potential for increasing use of low-carbon electricity for heating and transport. These transition pathways were developed by starting from narrative storylines regarding different governance framings, drawing on interviews and workshops with stakeholders and analysis of historical analogies. Here the quantified pathways are compared and contrasted with the main scenarios developed in the UK Government's 2011 *Carbon Plan*. This can aid an informed debate on the technical feasibility and social acceptability of realising transition pathways for decarbonising the UK energy sector by 2050. The contribution of these pathways to meeting Britain's energy and carbon reduction goals are therefore evaluated on a 'whole systems' basis, including the implications of 'upstream emissions' arising from the 'fuel supply chain' ahead of power generators themselves.

**Andersson, C. and Törnberg, P., 2018, Wickedness and the anatomy of complexity, *Futures*, in press**

Traditional scientific policy approaches and tools are increasingly seen as inadequate, or even counter-productive, for many purposes. In response to these shortcomings, a new wave of approaches has emerged based on the idea that societal systems are irreducibly complex. The new categories that are thereby introduced – like "complex" or "wicked" – suffer, however, by a lack of shared understanding. We here aim to reduce this confusion by developing a *meta*-ontological map of types of systems that have the potential to "overwhelm us": characteristic types of problems, attributions of function, manners of design and governance, and generating and maintaining processes and phenomena. This permits us, in a new way, to outline an inner anatomy of the motley collection of system types that we tend to call "complex". Wicked problems here emerge as the product of an ontologically distinct and describable type of system that blends dynamical and organizational complexity. The framework is intended to provide systematic *meta*-theoretical support for approaching complexity and wickedness in policy and design. We also points to a potential causal connection between innovation and wickedness as a basis for further theoretical improvement.

**Musiolik, J., Markard, J., Hekkert, M., and Furrer, B. 2018, Creating innovation systems: How resource constellations affect the strategies of system builders, *Technological Forecasting and Social Change*, in press**

Novel technologies require the support of larger technological innovation systems (TIS). A key feature of innovation systems are system resources - collective structures such as common standards, support programs, shared expectations or testing facilities all actors can use. System resources emerge either uncoordinated or as a result of strategic action by 'system builders'. In this paper we explore the conditions of system building. Taking a strategy perspective, we analyze how system building depends on resource constellations at a certain point in time. Drawing from research in the field of stationary fuel cells in Germany, we identify three generic modes, of system building: a) the "single mode", in which a system builder uses its own organizational resources to create a system resource, b) the "partner mode", in which a system builder joins forces with partners in order to co-create system resources, and c) the "intermediary mode", in which a system builder collaborates with other actors to set up an intermediary organization, which then works towards the creation of system resources. We show that the modes were chosen depending on i) what resources were initially available and ii) how they were distributed in the innovation system. Our paper contributes to a more differentiated understanding of system building in the TIS literature and beyond.

**Nciri, A. and Miller, B., 2017, Energy systems, socio-spatial relations, and power: the contested adoption of district heating with combined heat and power in Sweden, 1945-2011, *Die Erde*, 148(4), 212-228**

District heating (DH) and combined heat and power (CHP) are often considered complementary green technologies (DH-CHP) that can reduce greenhouse gas emissions. They are, however, complex given their operation at the intersection of shifting socio-spatial relations and political power struggles. We investigate the political processes behind the diffusion (and blocked diffusion) of DH and CHP in Sweden from 1945 until 2011, considered through the lens of Jessop, Brenner and Jones' (2008) Territory, Place, Scale and Networks (TPSN) framework. Foregrounding the socio-spatial constitution of policy decisions, we examine Sweden's changing patterns of DH and CHP adoption. First, we present the TPSN framework that considers space as simultaneously a structuring principle, enabling and constraining action, as well as a field of operation in which agency is exercised. Second, we examine the socio-spatial structuration of energy systems. Third, we analyse how the changing socio-spatial constitution of each socio-technical system affects key actors' interests and actions, including the spatial strategies they develop to advance their interests. District heating rapidly diffused across Swedish municipalities in large part because it was considered to be urban infrastructure aligned with the mission of municipalities and was not in direct competition with other actors supplying heat. CHP electricity generation, on the other hand, was initially seen as a benefit to municipal utilities, but was later considered a threat to the interests of large-scale utilities and blocked, only to gain favour again when changing sociospatial conditions made CHP an asset to large-scale utilities. Our analysis suggests that technological diffusion and blockage is far from a straightforward matter. It requires examination of the dynamics of multi-level governance and overlapping socio-technical systems. Socio-technical regimes are in constant evolution and actors struggle to adapt to new circumstances. Socio-technical systems are not merely material systems, but an expression of dynamic power relations and adaptation strategies.

**Sharp, D., 2018, Sharing cities for urban transformation: Narrative, policy and practice. *Urban Policy and Research*, in press.**

Commercial sharing platforms have reshaped the transportation and housing sectors in cities and raised challenges for urban policy makers seeking to balance market disruption with community protections. Transformational sharing seeks to strengthen the urban commons to address social justice, equity and sustainability. This paper uses Transformative Social Innovation theory to develop a comparative analysis of Shareable's Sharing Cities

Network and Airbnb's Home Sharing Clubs. It argues that narrative framing of the sharing economy for community empowerment and grassroots mobilisation have been used by Shareable to drive a "sharing transformation" and by Airbnb through "regulatory hacking" to influence urban policy.

**Sharp, D. and Salter, R., 2017, Direct impacts of an urban living lab from the participants' perspective: Livewell Yarra, *Sustainability*, 9, 1699.**

Urban living labs have emerged as transition arenas for undertaking process-oriented and reflexive experiments in the multi-stakeholder governance of sustainability. This paper evaluates Livewell Yarra, an urban living lab in Melbourne, Australia, that brought together academic researchers and community actors to engage in experiments for low-carbon living. This paper evaluates transition team experiments in governance of the lab itself and community experiments in carbon reduction that took place in people's homes and small group settings known as decarb groups. This paper's primary research question is: what are the direct impacts of urban living lab experiments from the participants' perspective? The research methods utilised include action research, asset-based community development, participatory co-design and most significant change research. This paper evaluates experiments in low-carbon living through data collected via stories of change from participant interviews. The results indicate that experiments in urban living labs create opportunities for social learning and empowerment, but also raise issues of leadership and ownership of transition governance. The findings suggest that Livewell Yarra could have benefited from clearer agenda setting and continuous monitoring to feedback results. The paper concludes by suggesting future research directions that utilise the operational processes of transition management to support experiments in urban living labs.

**Fazey, I., Schöpke, N., Caniglia, G., Patterson, J., Hultman, J., Van Mierlo, B., ... & Al Waer, H. (2018). Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. *Energy Research & Social Science*, 40, 54-70.**

The most critical question for climate research is no longer about the problem, but about how to facilitate the transformative changes necessary to avoid catastrophic climate-induced change. Addressing this question, however, will require massive upscaling of research that can rapidly enhance learning about transformations. Ten essentials for guiding action-oriented transformation and energy research are therefore presented, framed in relation to second-order science. They include: (1) Focus on transformations to low-carbon, resilient living; (2) Focus on solution processes; (3) Focus on 'how to' practical knowledge; (4) Approach research as occurring from within the system being intervened; (5) Work with normative aspects; (6) Seek to transcend current thinking; (7) Take a multi-faceted approach to understand and shape change; (8) Acknowledge the value of alternative roles of researchers; (9) Encourage second-order experimentation; and (10) Be reflexive. Joint application of the essentials would create highly adaptive, reflexive, collaborative and impact-oriented research able to enhance capacity to respond to the climate challenge. At present, however, the practice of such approaches is limited and constrained by dominance of other approaches. For wider transformations to low carbon living and energy systems to occur, transformations will therefore also be needed in the way in which knowledge is produced and used.

**Nagorny-Koring, N. and Nochta, T., 2017, Managing urban transitions in theory and practice: The case of the pioneer cities and transition cities projects. *Journal of Cleaner Production*, 175, 60-69.**

The central role of cities in advancing sustainability transitions is nowadays universally recognised by the scientific community. Simultaneously, local leaders increasingly advocate for the sustainable, low-carbon development of social and technological systems in their cities. This situation provides a window of opportunity for academic research to guide the development and implementation of innovative governance mechanisms capable of

delivering urban low-carbon transitions in practice, and for practitioners to influence research. The current interest in tailoring the Transition Management (TM) approach to the urban scale is a result of such an interaction. However, as we argue in this article, there is still much to learn about the ways in which decisions related to local transitions are made *in practice*, in order to build a more complete understanding of the usefulness of TM techniques in the urban context. Our claim is based on a case study analysis of a pair of EU-funded projects involving eight cities from a diverse set of European countries. The main findings highlight the role of five contextual barriers specific to the urban level within the European multilevel governance scene, which sustain inertia and resistance to change among municipal administrators and other local stakeholders and counteract the successful implementation of TM-inspired governance mechanisms at the local level. As a consequence, a rather shallow version of TM is applied in practice, which is not powerful enough to overcome the messy and contingent character of decision-making surrounding ongoing urban low-carbon transition processes.

**Mäkitie, T., Andersen, A. D., Hanson, J., Normann, H. E., & Thune, T. M. (2018). Established sectors expediting clean technology industries? The Norwegian oil and gas sector's influence on offshore wind power. *Journal of Cleaner Production*, 177, 813-823.**

The development and deployment of clean technologies must be accelerated to avoid a more than 2-degree warmer world. Redeployment of the vast resources concentrated in established sectors is one possible way to advance cleantech industries. However, prior research on sustainability transitions tends to emphasize competition and conflict between established sectors and cleantech industries. There is thus a need for exploring in more depth how established sectors may positively contribute to cleantech industries. Based on the notion of structural overlaps, we propose an extended version of the technological innovation systems framework to study how established sectors influence cleantech industries, and present new conceptual definitions and indicators. We apply the framework to a case study of the relationship between the oil and gas sector and the offshore wind power industry in Norway. Our empirical results show that the oil and gas sector has several positive influences on offshore wind power enabled by technological overlaps and diversifying firms. However, misaligned informal institutions weaken such influences, manifested as e.g. conflicting priorities and wavering commitment of diversified oil and gas firms to the new industry. We conclude by discussing the usefulness of the proposed framework and the relevance of our findings for policy and further research.

**Leising, E, Quist, J., Bocken, N., (2018) Circular Economy in the building sector: Three cases and a collaboration tool, *Journal of Cleaner Production*, 176, 976-989**

The Circular Economy (CE) gained significant traction in business and academia. While in the building sector issues around energy efficiency are being widely explored, CE is still a relatively new topic. This article reports on three CE pilots in the Dutch building sector and develops a collaboration tool for developing and operating circular buildings and their supply chain collaborations. First, a conceptual framework is developed to study supply chain collaboration in circular buildings, which uses theoretical building blocks for visions, actor learning, network dynamics and business model innovation. Second, a case study is presented where the framework is applied to three cases using semi-structured interviews and document analysis. Third, an empirically-based tool is developed to enhance collaboration for CE in the building sector. The cases include a newly built project, a renovation project and a demolition project. It was found that developing circular buildings requires (i) a new process design where a variety of disciplines in the supply chain is integrated upfront, (ii) the co-creation of an ambitious vision, (iii) extension of responsibilities to actors along the entire building supply chain, and (iv) new business and ownership models

**Pyka, A. 2017, Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy, *Journal of Open Innovation: Technology, Market, and Complexity*, 3(27).**

In order to counter something to the most thrilling challenges of mankind at the beginning of the twenty-first century, production and consumption systems need to transform towards sustainability. We argue that the knowledge-based bioeconomy and digitalization are two promising technological approaches which require to be thought together in order to contribute to the transformation and to trigger the required technological dynamics. However, such a broad transformative process requires a participation of all societal stakeholders. Innovation systems in principle offer a framework for policy designs supporting the transformation, but they need to be extended to include the direction towards overcoming the lock-in in oil-based economic activities and mass consumption. For this purpose, we introduce the idea of a Dedicated Innovation System, which takes care of potential inertia due to the interest of established (oil-based) industries and consider the economic opportunities raised by social and responsible innovation. The transformation process will likely compensate for decreasing jobs in traditional sectors, which are increasingly replaced by robotics and artificial intelligence. The knowledge-based digital bioeconomy is likely to generate the emergence of new sectors with new employment opportunities, e.g. in periphery regions or in the emerging sharing-economy sector.

**Manders, T.N., Wieczorek, A.J. and Verbong, G.P.J., 2018, Understanding smart mobility experiments in the Dutch automobility system: who is involved and what do they promise?, *Futures*, 96, 90-103**

In this paper, we aim to understand what ICT-related automobility experiments are initiated in the Netherlands, who is involved and what promises they make, in order to get a better understanding of the magnitude and direction of change. We show an example of how to study a large variety of experiments to understand the emergence of niches before predetermining these as analytical constructs. By analyzing 118 experiments, we can identify the emergence of two niches: an automated mobility niche and a mobility services niche. The automated niche is characterized by large involvement of incumbents and a strong technological orientation. The services niche focuses more on organizational innovations and involves many new entrants. The involvement of a third actor category, 'mature entrants', applies to both niches and concern those actors that fall more or less in-between the common 'incumbent-new entrant' dichotomy. In general, experiments in the automated niche seem to strengthen the dominant role of the car in the automobility system, while services niche experiments mainly portray an altered role of the car in an alternative mobility system. We conclude that we gained a better understanding of the experiments and emerging niches, but at this stage, developments can still head in different directions. Nevertheless, the involvement of mature entrants in both niches, we argue, can be an important indication that more substantial change is likely to occur.

**Trindade, P.C., Antunes, P., and Partidário, P., 2018, SPP Toolbox: Supporting sustainable public procurement in the context of socio-technical transitions, *Sustainability*, 10(1), 67; doi:10.3390/su10010067**

Public procurement can shape production and consumption trends and represents a stimulus for both innovation and diversification in products and services, through a direct increase in demand. In recent years, the interest in demand-side policies has grown and several approaches have emerged, such as Green Public Procurement (GPP), Sustainable Public Procurement (SPP) and Public Procurement of Innovation (PPI), representing strategic goals to be achieved through public procurement. In this context, there is a need to guide and support public organizations in the uptake of GPP, SPP and PPI practices. To respond to the challenges raised by the operationalization of such strategies, this paper proposes a new tool—the SPP Toolbox—for guiding public organizations as they re-think the procurement process, raising their ambitions and broadening their vision, thus changing the

organizational approach towards culture, strategies, structures and practices. This toolbox integrates insights from GPP, SPP and PPI objectives and practices, in the context of the emergence of socio-technical transitions. The toolbox coherently links GPP, SPP and PPI, allowing flexibility in terms of goals, yet promoting an increasing complexity of institutionalized practices and skills—from GPP to SPP and then from SPP to PPI, organized in a framework fully integrated into the organizational strategy.

**Holtz, G., Xia-Bauer, C., Roelfes, M., Schüle, R., Vallentin, D. and Martens, L., 2018, Competences of local and regional urban governance actors to support low-carbon transitions: Development of a framework and its application to a case-study, *Journal of Cleaner Production*, in press**

Urban areas, being responsible for large shares of global greenhouse gas emissions, are important arenas for achieving global decarbonisation. However, the systemic challenge of decarbonisation requires deep structural changes – transitions – that take place across multiple scales and along entire value chains. We argue in this article that understanding the role of urban areas for global decarbonisation therefore requires consideration of their context and analysis of urban areas' contributions to transitions that extend past the individual urban area. We develop an analytical framework that proposes three principal ways urban areas contribute to low-carbon transitions and ten competences that regional and local governance actors have to support them. We apply this framework to the Cologne metropolitan area in Germany to demonstrate the ability of our framework to relate urban-scale activities to more encompassing low-carbon transitions. The paper concludes with future research possibilities.

**Fastenrath, S. and Braun, B., 2018, Ambivalent urban sustainability transitions: Insights from Brisbane's building sector, *Journal of Cleaner Production*, in press**

Cities are suggested as being the key level for shifts towards more sustainable modes of production and consumption. The building sector with its significant carbon footprint plays an important role in urban climate change adaptation strategies. Using the case study of Brisbane (Australia), the paper examines the place-specific contextualisation of green building transitions by analysing the co-evolution and interplay of building practices, policy making and involved actors. Drawing on theoretical approaches of Transition Studies and Evolutionary Economic Geography, we trace back and analyse policy and economic trajectories focusing on formative and hindering processes. The paper discusses ambivalent pathways and 'regime resistance' caused by local economic and political specificities. The analysis illustrates how crucial the continual support from both policy makers and industry actors can be when economic market mechanisms do not drive sustainability transitions. Regime actors can play a powerful role as 'transition detractors' and can determine the dynamics and the scope of sustainability transitions.

**Kriechbaum, M., Prol, J.L., and Posch, A., 2018, Looking back at the future: Dynamics of collective expectations about photovoltaic technology in Germany & Spain, *Technological Forecasting and Social Change*, in press**

The widespread diffusion of new technologies is often preceded by hypes, that is periods of a strong rise and subsequent fall in collective expectations, which are usually followed by disappointment. In this study, we focused on the multilevel nature of collective technological expectations and analysed the dynamics of expectations about photovoltaic technology in Germany and Spain over the period of 1992–2015 by conducting a media analysis. Our results indicate that a hype and subsequent phase of disappointment with regard to photovoltaic technology occurred in both countries. However, the results also suggest that these, and particularly the phase of disappointment, were associated with different levels of expectations: while the Spanish hype was followed by a period of pessimism with regard to the profitability of the technology, the disappointment in Germany was dominated by the fear that the technology would negatively affect the economy as a whole. Furthermore, the results allow researchers to gain a better understanding of the interactions among

technological expectations and policies, and suggest that, in both countries, national policies played a key role in supporting the formation of positive as well as negative expectations.

**Hjerpe, M., Glaas, E., Fenton, P., 2017, The role of knowledge in climate transition and transformation literatures, *Current Opinion in Environmental Sustainability*, 29, 26-31**

Rooted in different theories and focusing on different elements of the socio-ecological fabric, climate transitions and transformations are conceived to have various forms. Although these literatures recognize the significance of learning and boundary spanning, systematic reviews of the role of knowledge in climate transitions are lacking. We review how targets of transformation, functions, types, and intermediaries of knowledge are conceptualized in five types of literature. We highlight that knowledge has a role as: the *motor* of transition in Transition Management literature, a *consultant* supporting transition in Transformational Climate Adaptation literature, an *emancipator* of transition in Transform Political and Economic Systems literature, the *beacon* guiding transition in Social–Ecological Transformation literature, and an *Ad Hoc Committee* motivating transition in Grassroots Transitions literature.

**Miremadi, I., Saboohi, Y., Jacobsson, S., 2018, Assessing the performance of energy innovation systems: Towards an established set of indicators, *Energy Research and Social Science*, 40, 159-176.**

Energy innovation is essential for tackling climate change. However, an established set of indicators, that can support policy makers in their design of policy mixes, has not been developed for evaluating the performance of energy innovation systems. The purpose of this study is, therefore, to list and classify a large set of indicators of the performance of energy innovation systems at sectoral and technological levels. 120 listed indicators are evaluated using four usefulness criteria, demonstrating significant weaknesses in the available indicators. The indicators are also classified according to an innovation process categorization to see if they cover all aspects of an innovation system along the entire innovation chain. In order to illustrate their application, the Nordic countries are selected for an analysis at the sectoral level, demonstrating a variety in the dynamics of energy innovation systems among these countries. At the level of an individual technology, we show how 90 indicators match the seven functions in a technological innovation system and how they, therefore, can guide policy by helping to analyze the strength of each function. Policy making may be further supported by an understanding of the dynamic relations between different indicators. Finally, recommendations for further research are given.

**Dehdarian, A., 2018, Scenario-based System Dynamics modeling for the cost recovery of new energy technology deployment: the case of smart metering roll-out, *Journal of Cleaner Production*, 178, 791-803.**

Smart meters are crucial technologies for enabling smart grid solutions and applications. Although smart metering deployment has been started at the national and regional levels, there is still the question that how should the costs of deployment be allocated among stakeholders. Cost-Benefit Analysis (CBA) is the common method for analyzing the economic feasibility of the deployment process. Starting from the CBA approach, this paper argues an efficient cost recovery scheme depends not only on the costs and benefits for each actor, but also on the interdependencies between the behavior of different actor groups. By taking a dynamic modeling approach and using System Dynamics models, this study examines the dynamics of interaction between different actors in the technology deployment process, and proposes scenarios for an efficient cost recovery. It is claimed that a dynamic view to the common Cost-Benefit Analysis approach has three advantages. First, the possibility of including actors benefiting from positive externalities or actors that can contribute to system efficiency is provided. Second, a balance can be found between the short term and long term consequences of system interventions; and finally, the development of innovative solutions, in the forms of business and policy scenarios is facilitated. The results may explain why reluctance to participate in the technology

deployment process persists even after introducing dynamic pricing policies, and what factors are more critical in analyzing the cost and benefit structures of the technological system.

**Debizet, G., Tabourdeau, A., Gauthier, C., Menanteau, P., 2016, Spatial processes in urban energy transitions: considering an assemblage of Socio-Energetic Nodes, *Journal of Cleaner Production*, 134, 330-341**

Urban and energy transitions are increasingly seen as being deeply intertwined. The way this relation impacts our approach to energy transition is a current issue for research. Implementing renewable energy sources in built-up areas challenges incumbent supply chains and large technical systems, especially for electricity, gas and heat. Approaches to transition such as the Multi-Level Perspective (MLP) highlight the transformation of socio-technical regimes but have been criticised for overstating stability of regime and for overlooking spatial (and consequently urban) processes. Other concepts are required in order to understand local and non-local relationships between niches and regimes. This paper suggests a constructivist and pragmatic concept for urban energy transition, the Socio-Energetic Node (SEN), thanks to which actors and artefacts can be traced within energy networks. The SEN is a group of elements, which collects, converts and/or supplies energy, built by a decision-maker interacting with stakeholders and regime rules. Having identified SENs in four French eco-districts, we observed how they took shape around continuous energy flows and across decision-making boundaries, highlighting how spatial-scale and place-specificity impact on energy transition.

**Sonnenfeld, D.A. and Taylor, P.L., 2018, Liberalism, illiberalism, and the environment, *Society & Natural Resources*, 31(5), 515-524**

Environmental social science faces daunting theoretical and empirical challenges today, as the modern political ideas of liberalism that shaped its historical development encounter the growing influence of illiberal ideas and politics. This special issue seeks to advance social scientific understanding of society–environment relations in illiberal political and institutional contexts through evidence informed analysis of a series of cases around the world. Its central question is: What are the implications of today’s wide variety of sociopolitical forms and ideologies for a social science of the environment that seeks to study the full range of nature–society interactions and to support the attainment of a more sustainable future across the globe?

**Koch, N., 2018, Green laboratories: University campuses as sustainability “Exemplars” in the Arabian Peninsula, *Society & Natural Resources*, 31(5), 525-540**

Like many universities in the West, universities across the Arabian Peninsula are increasingly home to various conspicuous sustainability initiatives. This article examines this trend at three of the region’s most prominent projects: NYU-Abu Dhabi in the Emirates, Qatar Foundation’s Education City, and Saudi Arabia’s King Abdullah University of Science and Technology. Based on the textual analysis and informed by fieldwork in these countries since 2012, this article joins interdisciplinary research in political geography, sustainability experimentation, and laboratory studies to understand their iconic campuses not as enclaves, but as “exemplars” of sustainability and renewable energy futures in the region. Tracing their effects beyond their walls, I argue that they have mostly been limited to symbolically injecting sustainability into public discourse. While more substantial shifts toward sustainable development in the region are underway, these have largely stemmed from market forces rather than a new environmental consciousness promoted by these three iconic universities.

**Simpson, A. and Smits, M., 2018, Transitions to climate and energy security in Southeast Asia: Civil society encounters with illiberalism in Thailand and Myanmar. *Society & Natural Resources*, 31(5), 580-598.**

All states, whether governed by liberal or illiberal regimes, face the prospect of momentous and potentially catastrophic environmental impacts due to climate change. Historically, energy policy has been directed towards simply achieving energy security. This goal has now been significantly complicated by the need to achieve it while minimizing greenhouse gas emissions. Environmental non governmental organizations (ENGOS) could play a crucial role in promoting the transition to energy and climate security but the relative (il)liberalism of the political regime they operate under influences their effectiveness. This article assesses how ENGOS have impacted on the transition to energy and climate security in Myanmar and Thailand, two Southeast Asian countries highly susceptible to climate impacts and characterized by illiberal rule. It finds that the impact of ENGOS was highly dependent on their strategies, tactics and operation, with community-level projects providing a key route to effect change under conditions of extreme illiberalism.