

## Newsletter 19, March 2016

This is the 19th 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

We welcome all members to submit news items for the next newsletter. You can use the website [www.transitionsnetwork.org](http://www.transitionsnetwork.org) (submit projects, output or news), or send a message to [sustainabilitytransitions@gmail.com](mailto:sustainabilitytransitions@gmail.com). The advantage of using the website for submission is that the information also becomes available online.

The STRN steering group

## Words from the Chairman

Dear transition research colleagues,

Top academic journals are increasingly paying attention to sustainability transitions. The journal *Global Environmental Change*, for instance, is publishing increasing numbers of papers on the topic. The *Nature Public Group* has also launched a new journal *Nature Energy*, which opened with an editorial titled 'A world in transition' (January, 2016). The editorial emphasizes the importance of transitions:

"It's clear that dealing with climate change calls for deep (and, likely, total) decarbonization of our energy system, which entails a fundamental transformation of our infrastructure. (...) It is not enough to just build and implement new technologies: the way we use, interact with, and think about them is critical as well. Given several options of equal scientific merit, the choice of which to pursue hinges on social, cultural, economic and political factors. Thus, we shouldn't forget that science and technology form part of a bigger and more complicated system. (...) By thinking more carefully at a systems level, combining natural and social science considerations, we can move towards a more integrated, flexible energy system that better fulfils our goals."

This interest of a top journal is not only encouraging, but also offers new opportunities to publish and disseminate our findings and ideas. The publication section in this newsletter includes several papers from *Nature Energy*, demonstrating that this new journal may be an interesting new outlet.

*Energy Research & Social Science* is another relatively new journal that is interested in research on transitions (besides EIST, of course). The journal was created in 2014 to create an alternative outlet to *Energy Policy* with a greater focus on social science contributions. The publications section in this newsletter shows that the journal is publishing interesting transition papers, including a special issue (which is included at the end of the newsletter).

Besides the publication section (which forms the bulk of this newsletter), you will find information about the most recent EIST issue, including a special section on the politics of transitions, updates from two transition-oriented networks (POLOET and TransLACASAF). The newsletter also reports on interesting upcoming events and new research projects.

Last but not least, the newsletter contains information about a change in the governance structure of STRN, including a separation between a *Board* (with responsibility for core operational tasks) and the *Steering Group* (which offers general strategic advice). We will also create new *Working Groups* and *Thematic Groups* that offer platforms for STRN members to become more actively engaged in transition-related debates and activities. These changes are the outcome of debates in STRN Steering Group in the last few months. I would particularly like to thank Flor Avelino, Jochen Markard, Fjalar de Haan and Jonathan Köhler for their work in developing proposals for these discussions.

I hope you'll enjoy these updates from the sustainability transitions research field.  
**Frank Geels**, Chairman of STRN ([frank.geels@manchester.ac.uk](mailto:frank.geels@manchester.ac.uk)).

## Environmental Innovation and Societal Transitions

Volume 18 of *Environmental Innovation and Societal Transitions* was just published. It contains four regular papers, a viewpoint, and a special section.

The original research articles are:

- Local authorities as niche actors: the case of energy governance in the UK, by S. Fudge, M. Peters and B. Woodman
- Use of fuzzy cognitive maps to study urban resilience and transformation, by M. Olazabal and U. Pascual
- Towards a sufficiency-driven business model: Experiences and opportunities, by N.M.P. Bocken and S.W. Short
- How the policy mix impacts innovation: Findings from company case studies on offshore wind in Germany, by K. Reichardt and K. Rogge

The viewpoint is:

- Towards a political ecology of the digital economy: Socio-environmental implications of two competing value models, by V. Kostakis, A. Roos and M. Bauwens

The special section is on “The politics of innovation spaces for low-carbon energy”. It contains the following eight articles:

- The politics of innovation spaces for low-carbon energy: Introduction to the special issue, by the guest editors R. Raven, F. Kern, A. Smith, S. Jacobsson and B. Verhees
- Creating protective space for innovation in electricity distribution networks in Great Britain: The politics of institutional change, by M. Lockwood
- Remaking the material fabric of the city: ‘Alternative’ low carbon spaces of transformation or continuity?, by M. Hodson, E. Burrai and C. Barlow
- The politics and economics of constructing, contesting and restricting socio-political space for renewables – The German Renewable Energy Act, by V. Lauber and S. Jacobsson
- Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases, by R. Raven, F. Kern, B. Verhees and A. Smith
- Learning to shield – Policy learning in socio-technical transitions, by W.P.C. Boon and S. Bakker
- Creating Copenhagen’s Metro – On the role of protected spaces in arenas of development, by A.F. Valderrama Pineda and U. Jørgensen
- Socio-technical transitions and policy change – Advocacy coalitions in Swiss energy policy, by J. Markard, M. Suter and K. Ingold

We look forward to receive your submission. Please don't forget to read (and if relevant cite) EIST.

**Jeroen van den Bergh**, Editor-in-Chief [[jeroen.bergh@uab.es](mailto:jeroen.bergh@uab.es)]

## Network News

*Any news related to ongoing activities of STRN*

### **New governance structure for STRN**

The STRN network has grown considerably in recent years and has become the major platform and meeting place for researchers interested in large-scale transformation associated with sustainability. At the same time, key tasks such as the exchange of information, maintenance of the website, updating the research agenda, or organization of IST conferences and other events require efficient and professional handling. This is why the STRN Steering Group has developed guidelines for the governance of the network and suggests the following organizational structures and changes.

- A *Board* of 3 persons (including the chair), who coordinate the network and have responsibility for core operational tasks.
- A *Steering Group* of approximately 15 people, which elect the board members and give strategic advice on the development of the network.
- *Working Groups* that coordinate strategic tasks in a temporary, project based way.
- *Thematic Groups*, which are longer-term fora for interaction of STRN members on specific research topics.

Steering Group (SG) members are experienced transition scholars and/or those who play (or want to play) an active role in further developing the STRN network. Members of the Board and Steering Group will take on specific tasks and function as contact persons for Working Groups, Thematic Groups and STRN members more generally.

The SG strives for representational diversity, e.g. in terms of gender, age, topics, research groups and region. As a new feature, we intend to create two SG membership positions that specifically represent PhDs (1) and Early Career Researchers (1). There is also one position for the EIST editor and two positions for IST conference organizers (current and upcoming year). New SG members will be elected by the steering group for a term of 2 years. Each year about one third of the SG shall be renewed.

The Board will be responsible for core operational tasks including the newsletter, website and mailing list, interaction with EIST and interaction with external actors on behalf of STRN. Working Groups are created (temporarily) to perform certain strategic or operational STRN tasks that require close and intense collaboration by a small number of people (e.g. renewal of research agenda, major re-design of website etc.). They are coordinated by a member of the Steering Group and may also include STRN members more broadly.

Thematic Groups are groups of STRN members that want to gather around particular thematic sub-themes on a regular basis (e.g. geography of transitions, politics of transitions, transition modeling etc.) and present themselves as such to the network and beyond.

We are working towards implementing this new governance structure and will keep STRN members informed (and issue calls for collaboration in the one of the Working or Thematic Groups or in the Steering Group).

### **The STRN Steering Group**

### **Political economy of Energy Transitions network**

POLET (POLitical economy of Energy Transitions) is a new academic network focusing on understanding change and continuity in energy systems through a dialogue between energy modellers, scholars of socio-technical transitions, political scientists and historians.

In 2014, POLET received a seed grant from the Transformations to Sustainability program of the International Social Sciences Council (ISSC) to organise its first workshop at Central European University (CEU), Budapest in February 2015 attended by scholars from Austria, Germany, India, Switzerland, UK and the US. In September 2015, a research and a dialogue session on political economy of energy transitions were organised at the 5th Sustainable Transitions conference in Brighton. Later in the year, the ISSC nominated POLET as one of

its eight 'transnational knowledge networks'. From January 2016, POLET network is supported by CEU as part of its 'Energy and Society' intellectual theme. The current activities include interdisciplinary research projects on energy transitions and maintaining a website ([www.polet.network](http://www.polet.network)). More networking and communication activities are planned in the future. If you'd like to be involved please contact us through [polet.network](https://twitter.com/polet.network) at Twitter or either: Jessica Jewell, the International Institute for Applied Systems Analysis ([jewell@iiasa.ac.at](mailto:jewell@iiasa.ac.at)) or Aleh Cherp, Central European University ([cherpa@ceu.edu](mailto:cherpa@ceu.edu))

### **Update from the TransLACASAF network**

Since the beginning of 2016 the network has expanded its membership, wrote a blog held two webinars, with the country focus on China and Columbia and prepared two joined submissions to the IST conference. Currently the Trans LACASAF network counts 87 members from a wide variety of countries and research institutes. Further, network members published a [Blog article](#) for the group PHDs inTransitions. Also, two webinars were held, one with the focus on '*co-construction of knowledge while undertaking transition studies- a case study in Yunnan, China*' and the other one focused on transitions from a grassroots perspective by exploring product co-creation centres in Columbia. Louisa Kistemaker presented her interrogation of the methods 'Theatre forum', narratives and mental maps fed by (semi-structured) interviews and feedback loop diagrams in the rural context in China. Interesting aspects of non-technology innovations such as adaptation behaviour and the possible cross-fertilisation of development studies were raised during the discussion. Monica Ramos presented on her research on SME businesses in Columbia and how transition research was useful or challenged by the research focus. Some adaptations for the Multi-level-Perspective were suggested, such as layers instead of levels or using the term stretching rather than nurturing. Further it was suggested that cross-fertilisation with social-practice theory might have much to offer. Besides the webinars, the network also facilitated the development of two dialogue sessions for the next IST conference in Wuppertal in September 2016: (1) Studying sustainability transitions in developing contexts, which wants to provoke theoretical discussions of transition studies in an emerging and developing economy context (leader: Anna Wiezoreck) and (2) Methodological challenges and socio-cultural dynamics in transition studies with a special focus on the regions of Latin America and the Caribbean, Asia and Africa (TRANSLACASAF), which in specific intends to discuss methodological challenges in the geographical context (leader: Louisa Kistemaker). We are still looking for critical voices or experts to receive the critiques, especially for the first dialogue session. So please contact Anna Wiezoreck ([a.j.wieczorek@tue.nl](mailto:a.j.wieczorek@tue.nl)) if you are interested. Further, if you would like to join the network please email to: [transitions.lac.as.af@gmail.com](mailto:transitions.lac.as.af@gmail.com) or if you are interested in further information about the presentations please contact Louisa Kistemaker ( [louisa.kistemaker@gmx.de](mailto:louisa.kistemaker@gmx.de)) and Monica Ramos ([eme\\_ramos@yahoo.com](mailto:eme_ramos@yahoo.com)) directly.

## **Event announcements**

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

### **PhD course on: Niches in transition arenas: Critical perspectives 29-31 August 2016**

LUCSUS (Lund University Centre for Sustainability Studies) organizes a course in Lund, Sweden on the following topic. In the context of the multi-level perspective, socio-technological niche experiments are seen as bottom-up governance initiatives intended to challenge regime practices and achieve sustainability goals. The transition management (TM) literature distinguishes so-called transition arenas, where actors can reflect on the outcomes of each experiment in order to acquire knowledge that can lead to a new perspective on a transition issue. TM understands these arenas as involving visionary frontrunners and their actor-networks to create new narratives to the evolving scientific agendas and on-the-ground experiments. This process is assumed to lead to new

institutional structures and enabling administrative tools. Nevertheless, the critics interpret this as a technocratic vision. They point to challenges in terms of leadership, the clash of interests and values in prioritizing sustainability visions and naïve optimism about confronting the deep structure of regimes through adaptive and reflexive governance activities at micro level. Therefore, they call for a broader political project wherein reflexive governance can be practiced by social groups and movement lobbying to get their voices heard and prioritized by political and economic elites. This course provides PhD candidates with a critical perspective on niche characteristics in transition arenas and an in-depth investigation of the “socio” part of “socio-technological” systems, in order to capture and analyze persistent problems, especially in the contemporary context of cities of the global South. The PhD course corresponding to 3 ECTS credits will be organized in Lund but requires mandatory reading prior to the course and a written assignment after the course. The number of places is limited. **Further information:** [www.lucsus.lu.se](http://www.lucsus.lu.se) or **contact:** [Maryam.Nastar@lucsus.lu.se](mailto:Maryam.Nastar@lucsus.lu.se).

### **Climate KIC, PhD Summer School, 18-20 September, 2016**

PhD Summer School on “Green Finance: Overcoming barriers to low-carbon investments” from 18 to 30 September in Frankfurt, Germany. Work on a real-life challenge of cities regarding climate finance with experts from the field and like-minded PhD students. In this two-week intensive programme, you can explore how barriers to climate finance and lock-in effects can be overcome. Turn your research into practice in one of Europe’s leading places on Finance innovation! More information soon on: <http://www.ckic-phd-ffm.net/>

## **New research projects**

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

### **TransNIK project: Actor networks, niche-regime interactions and synergies between the municipal domains of energy, water and the built environment**

Modern economic systems are increasingly focused on the topic of sustainability which has become a core issue in public, political and economic debates. A far-reaching transformation of society is needed to manage the shift to a more sustainable economy. Sustainable innovations play an essential role here and can fundamentally change existing economic systems. The TransNIK project focuses on the drivers for and obstacles to new sustainable niche approaches in the classical fields of municipal activity such as energy supply, water supply and wastewater disposal, and construction and housing. It conducts an in-depth analysis of relevant niche actors, their interconnectedness and strategies pursuing institutional change. Based on case studies and in close cooperation with practitioners, the ultimate aim of the project is to derive recommendations for the stakeholders involved and for the policy framework required to push the formation and spread of sustainable niche innovations. In addition, the project aims to identify synergy effects between the three municipal fields of activity and enable learning to take place across different domains. The selected niche in the energy domain will be local district heating. Novel sanitary systems (NASS) will be analysed in the water domain and the focus will be on multi-generational housing projects in the built environment domain. The project started in May 2015 and will run until April 2018. The research consortium consists of the Fraunhofer Institute for Systems and Innovation Research (ISI), the Institute for Housing and Environment (IWU) and Leuphana University of Lüneburg. For more information, please contact Nele Friedrichsen: ([nele.friedrichsen@isi.fraunhofer.de](mailto:nele.friedrichsen@isi.fraunhofer.de)).

### **The Knowledge Politics of Experimenting with Smart Urbanism (KNOWING)**

The aim of this research project is to develop theoretical and empirical understanding of how smart urbanism experiments are re-shaping urban knowledge politics in European cities. The project proposes a symmetrical analysis of formal, corporate-led initiatives and informal, grassroots-led initiatives, as well as hybrid combinations. Together we refer to these as smart urbanism experiments. First, an interdisciplinary and comparative theoretical

framework is developed on the knowledge politics of smart urbanism experimentation. This framework advances perspectives from critical urban geography, science and technology studies and socio-technical transitions literature. Second, the project will apply and test the framework in 8 European cities in the UK, the Netherlands, Germany, France and Spain to gain deep empirical understanding of contemporary (formal and informal) smart urbanism. Finally, this provides the opportunity to actively contribute to shaping contemporary debates on smart urbanism. The project will support cross-national, comparative analysis for refining and debating the initial theoretical framework in various settings. Project Coordination: Utrecht University (Rob Raven). Project Partners: SPRU (Sussex University), Sheffield University, Freiburg University, Leibniz Institute for Regional Development and Structural Planning, Toulouse University, University of Albi.

### **Smart Cycling Futures (SCF)**

Cycling booms in many Dutch cities. While smart cycling innovations promise to increase cycling's modal share in the (peri-)urban transport system even further, little is understood of their impact or cost and benefit. The "Smart Cycling Futures (SCF)" program investigates how smart cycling innovations — including ICT-enabled cycling innovations, infrastructures, and social innovations like new business models — contribute to more resilient and liveable Dutch urban regions. Cycling innovations benefit urban regions in terms of accessibility, equality, health, liveability, and decreasing CO<sub>2</sub>-emissions when socially well embedded. To facilitate a transition to a sustainable future that respond to pressing issues, the SCF research project runs urban living labs in close collaboration with key stakeholders to develop transdisciplinary insights in the conditions needed for upscaling smart-cycling initiatives. Each living lab involving real-world experiments responds to the urgent challenges that urban regions and their stakeholders face today. The proposed research sub-programs focus on institutional dynamics, entrepreneurial strategies, governance and the socio-spatial conditions for smart cycling. Going beyond analysis, we also assess the economic, social, and spatial impacts of cycling on urban regions. The research program brings together four Dutch regions through academic institutions (three general and one applied-science universities); governmental authorities (urban and regional); and market players (innovative entrepreneurs). Together, they answer practice-based questions in a transdisciplinary and problem-oriented fashion. Research in the four regions generates both region-specific and universally applicable findings. Finally, SCF uses its strong research-practice network around cycling to co-create the research and run an outreach program. Project coordination: Utrecht University (Rob Raven). Academic Project Partners: University of Amsterdam, Eindhoven University of Technology, Windesheim University of Applied Sciences.

## **Publications**

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

### **PhD thesis: Suyash Jolly, 2016, Collective institutional entrepreneurship for fostering sustainable energy transitions in India, Eindhoven University of Technology**

The objective of the dissertation is to explore the role of heterogeneous actors and their collective strategies in transforming institutional structures associated with incumbent fossil fuel energy system and shaping sustainable energy transitions in India. Empirically the dissertation focuses on development of wind and solar PV energy in India. The dissertation's conceptual foundation is built on a systematic literature review of sustainability transitions and sociological approaches in management studies specially literature on collective institutional entrepreneurship. Methodologically the dissertation takes a qualitative case study approach and uses archival data sources, semi-structured interviews and participant observations in forums and conferences collected during field work in India. By considering insights from the different empirical chapters, a simple typology of three overarching collective strategies which actors use in attempting to transform institutional structures

associated with incumbent energy system is developed. These collective institutional strategies include: (1) Institutional adaptation focusing on experimenting within institutional constraints and outside institutional constraints in protective spaces; (2) Institutional capacity building focusing on building new indigenous capabilities by drawing on transnational linkages; and (3) Institutional transformation focusing on deliberate attempt at transforming institutional arrangements through discursive battles between heterogeneous actors in forums. By developing this typology, the dissertation contributes towards recent debates on micro-foundations of sustainability transitions which relates to closer focus on the role of actors and their strategies on shaping socio-technical systems. Finally the dissertation points to ways of steering and manoeuvring sustainability transitions by using insights from the typology, presents implications for policy and practice and provides avenues for future research.

**PhD thesis: Kirsten Ulsrud (2015): *Village-level solar power in practice: Transfer of socio-technical innovations between India and Kenya*. Department of Sociology and Human Geography, University of Oslo, Norway.**

This dissertation investigates the two interrelated research questions of how decentralized infrastructures like village-level power provision can be socially organized and how such socio-technical innovations can be transferred between places, countries and world regions. The study builds on trans-disciplinary research and action research in collaboration with a team of researchers and practitioners from India, Kenya, Austria and Norway. On the first research question, which concerns potential solutions to the global challenges of providing basic electricity services to all, key points include the importance of developing context sensitive and equitable electricity models that give different kinds of electricity services suitable and affordable for different user groups. Project implementers should be flexible in terms of changing and improving electricity systems after implementation, through joint experiencing and learning with communities and relevant governance institutions. The dissertation shows that efforts for sustainable energy for all can benefit from academic insights in socio-technical change and system innovation, by seeing development of more inclusive and sustainable power supply systems as a diverse, unlinear, social learning process characterized by unexpected outcomes and gradual efforts for institutionalization. Also on the second research question, on how novel socio-technical configurations can travel spatially, a socio-technical system approach is found to be important for the practical design of transfer strategies. When social actors attempt to learn from promising, innovative infrastructures in other places, there is need for capturing the interactions between people, technology and socio-cultural contexts at the same time as seeing the local, socio-technical innovations as part of larger processes of system innovation influenced by factors on national and international levels. The dissertation finds that transfer of innovations from other places and countries can provide important inspiration and knowledge for locally based development of socio-technical designs suitable for local needs and contexts if strong emphasis is put on learning, socio-technical experimentation, adaptation and social embedding.

**Book: Hawkey, D., Webb, J., Lovell, H., McCrone, D., Tingey, M. and Winskel, M., 2016, *Sustainable Urban Energy Policy: Heat and the City*, Routledge**

Minimising the most severe risks of climate change means ending societal dependence on fossil fuels, and radically improving the efficiency with which we use all energy sources. Such deliberate transformative change is, however, without precedent. *Sustainable Urban Energy Policy* debates the major public issue of developing a sustainable, clean and affordable energy system by adopting a distinctive focus on heating in cities. In this way, the book constructs an original account of clean energy policy, politics and provision, grounded in new empirical data derived from case studies of urban and multi-level governance of sustainable heat and energy saving in the UK and Europe. Offering an original conceptual framework, this study builds on socio-technical studies, economic and urban sociology,

human geography, applied economics and policy studies in order to understand energy governance and systemic change in energy provisions.

**Book: Gismondi, M., Connolly, S., Beckie, M., Markey, S., Roseland, M. (eds.), 2016, *Scaling Up: The Convergence of Social Economy and Sustainability*. Athabasca University Press. Free PDF Version: <http://www.aupress.ca/index.php/books/120246>**

Contributors to *Scaling Up* investigated innovative social economies in British Columbia and Alberta, Canada and discovered that achieving a social good through collective, grassroots enterprise resulted in a sustainable way of satisfying human needs that was also, by extension, environmentally responsible. The book identifies important strategic directions in land tenure, resource management, social care, local finance, and more that will advance the transition to, not only sustainability, but also to new forms of local ownership and organizational governance, new models for federation and coalition building at the regional and national levels, and to innovative political directions that offer a means to scale up social justice and ecological sustainability.

**Book: Waddell, S., 2016, *Change for the Audacious: a doers' guide*.** This book by Steve Waddell presents knowledge and tools about transformation using a Large System Change perspective. After introducing concepts of transformation and complexity, the book presents five case studies of large systems change. These cases and others are referenced throughout the remainder of the book to present large systems change strategy, organizing structures, steps in developing the necessary collective action, tools, and personal guidance for change practitioners. To learn more about the book including download of an overview and the first chapter, go here (<http://networkingaction.net/change-for-the-audacious/>).

**Jano-Ito, M.A. and Crawford-Brown, D., 2016, Socio-technical analysis of the electricity sector of Mexico: Its historical evolution and implications for a transition towards low-carbon development, *Renewable and Sustainable Energy Reviews*, 55, 567-590**

The electricity sector of Mexico has been found itself in continuous transitions since its beginning in the 19th century. However, the historical reform to the sector that recently took place together with new energy market configurations around the globe may pose an important challenge to transitioning towards a low-carbon sector. The work presented here was aimed at understanding in a qualitative manner the complex interactions between the main social, technical and environmental aspects that have guided the sector in the past, their influence on the current structure and its future development, through the application of the multi-level perspective (MLP) with a governance and agency perspective. Additionally the work tried to elucidate the implications of the incumbent position of the natural gas industry and the possibilities for low-carbon technologies. The conclusions remark the importance of previous sector configurations in the present structure; the important role of government in promoting low-carbon technologies together with investment by market actors; and the possible window of opportunity that the natural gas industry in Mexico may provide to low-carbon energy technologies.

**Geels, F.W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M., Wassermann, S., 2016, The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990-2014), *Research Policy*, 45(4), 896-913**

This paper aims to make two contributions to the sustainability transitions literature, in particular the Geels and Schot (2007) transition pathways typology. First, it reformulates and differentiates the typology through the lens of endogenous enactment, identifying the main patterns for actors, formal institutions, and technologies. Second, it suggests that transitions may shift between pathways, depending on struggles over technology deployment and institutions. Both contributions are demonstrated with a comparative analysis of unfolding



low-carbon electricity transitions in Germany and the UK between 1990-2014. The analysis shows that Germany is on a substitution pathway, enacted by new entrants deploying small-scale renewable electricity technologies (RETs), while the UK is on a transformation pathway, enacted by incumbent actors deploying large-scale RETs. Further analysis shows that the German transition has recently shifted from a 'stretch-and-transform' substitution pathway to a 'fit-and-conform' pathway, because of a fightback from utilities and altered institutions. It also shows that the UK transition moved from moderate to substantial incumbent reorientation, as government policies became stronger. Recent policy changes, however, substantially downscaled UK renewables support, which is likely to shift the transition back to weaker reorientation.

**Wainstein, M.E. and Bumpus, A.G., 2016, Business models as drivers of the low carbon power system transition: A Multi-Level Perspective, *Journal of Cleaner Production*, in press**

Decarbonising the electrical power system holds a critical role in climate change mitigation. Recent developments in technology are helping change the current centralized paradigm into one of integrated distributed clean energy resources. In spite of these developments, radical transformation is not occurring at a speed to effectively meet environmental targets, mostly due to the incumbent carbon lock-in trajectory. We argue that business model (BM) innovation dynamics are key drivers in accelerating the low carbon power system transition, often operating irrespective of the underlying technology. We combine BM theory with the multi-level perspective on sociotechnical transitions to present a useful framework to analyze this potential transition. This paper presents the application of this framework characterizing relevant BM dynamics of niche and regime business actors, and supporting these with illustrative examples. Particularly, we find that new actors in the distributed energy business are achieving market scale by offering financially innovative BMs that do not require upfront costs from customers. Higher penetrations of renewable energy sources in liberalized electricity markets are destabilizing the historical BM of large centralized utilities through erosion of wholesale prices. Furthermore, a shift towards distributed and dynamic energy resources further challenges incumbents and might bring opportunities for BMs focused on active customer participation and social value creation. As these tendencies are expected to accelerate, we find analyses of BMs will have important relevance for future power system transition research.

**Manning, S. and Reinecke, J., 2016, A modular governance architecture in the making: How transnational standard setters govern sustainability transitions, *Research Policy*, in press**

Sustainability transitions have been studied as complex multi-level processes, but we still know relatively little about how they can be effectively governed, especially in transnational domains. Governance of transitions is often constrained by the equivocality of sustainability goals, the idiosyncrasy of niche experiments and the multiplicity of governance actors and interests. We study the role of transnational standard-setters in mitigating these challenges and governing sustainability transitions within a transnational sector. Our case is the global coffee sector where 'sustainability standards' are increasingly being adopted. We find that the emergence of a 'modular governance architecture' has helped diverse and heterogeneous actors turn sustainability from an ambiguous concept into a concrete set of semi-independent practices, while mitigating governance complexity. We show how standard-setters create governance modules through local niche experimentation, negotiate and legitimate their content with peers across local contexts, and re-integrate them into an emerging architecture. Our findings shed light on the role of modular processes in managing sustainability transitions and transnational governance, and the dynamics of meaning-making in this process.

**Brooks, A. and Rich, H., 2016, Sustainable construction and socio-technical transitions in London's mega-projects, *The Geographical Journal*, in press**

Sustainable construction attempts to mitigate the destructive impacts of building on the global environment. Mega-projects in London, such as Blackfriars Station and the Shard, symbolise urban renewal and are promoted as engines for sustainable development, principally through their use of sustainably procured materials. Unique buildings which are monumental and often state backed act as niches or incubators for sustainable construction, because they operate as protected spaces where the general rules of construction do not apply. Decision making in sustainable construction is complicated by the multiple state and public stakeholders involved in projects such as large stations and skyscrapers, and the different perspectives of architects, developers, procurement specialists, end users and others. While there are diverse actors involved, there has been some international convergence in the construction sector around how to deliver sustainability, and sustainable procurement has become the primary social and technological change through which more sustainable approaches to construction are delivered. Using interviews and questionnaires undertaken with six leading contractors involved in some of London's mega property and transport infrastructure projects, we analyse how sustainability procurement is deployed in the construction industry. Socio-technical transition theory provides a way to understand the context-specific developments led through mega-projects, which are at the forefront of promoting the use of sustainably procured materials and technologies. Our research demonstrates that moves to deploy a more sustainable approach are based around modifications to current practices rather than fundamental transformation. Cost and risks are frequently cited as barriers to the sustainable procurement of materials, while some contractors are sceptical of the improvements that can be delivered through sustainable procurement.

**Regeer, B., De Wildt-Liesveld, R., Van Mierlo, B. and Bunders, J.F.G., 2016, Exploring ways to reconcile accountability and learning in the evaluation of niche experiments, *Evaluation*, 22(1), 6-28**

While evaluation is seen as a mechanism for both accountability and learning, it is not self-evident that the evaluation of niche experiments focuses on both accountability and learning at the same time. Tensions exist between the accountability-oriented needs of funders and the learning needs of managers of niche experiments. This article explores the differences in needs and expectations of funders and managers in terms of upwards, downwards and internal accountability. The article shows that as the multi-stakeholder contexts in which niche experiments take place give rise to various requirements, tensions in evaluation are essentially a specific manifestation of tensions between niche experiments and their multiple contexts. Based on our findings, an adjusted accountability framework is proposed, including several strategies that can reconcile a learning approach with accountability needs in niche experiments aiming to change current practices in a more sustainable direction.

**Mignon, I., Bergek, A. 2016, Investments in renewable electricity production: The importance of policy revisited, *Renewable Energy*, 88, 307-316.**

Finding ways to encourage investments in renewable electricity production is crucial to reach a transition to a sustainable energy system. While in the energy policy literature, investments are usually explained by economic or regulatory policies, recent studies have suggested that some investors are boundedly rational and may respond differently to policies. In this paper, a framework is proposed to make a more complete analysis of the institutional demands influencing emerging investors in renewable electricity production. Based on 35 cases, both formal and informal demands were identified and their impact on emerging investors' behavior was analyzed. Results show that besides formal institutional demands, emerging investors were influenced by their task environment and by various informal demands which originated in investors' collective and internal contexts. However, different investors were affected by different institutional demands. They also responded in different ways to the same demands; while some perceived a specific demand as imposing, others regarded it as

inducing. These findings provide a better understanding of the institutional forces affecting emerging investors in renewable electricity. The paper suggests new policies to handle the heterogeneity of investors and opens up for a new panorama of informal policy channels, where network effects can be utilized to trigger emerging investors' decisions.

**Hermwille, H., 2016, The role of narratives in socio-technical transitions—Fukushima and the energy regimes of Japan, Germany, and the United Kingdom, *Energy Research & Social Science*, 11, 237-246**

In order to reconfigure global socio-economic systems to be compatible with social imperatives and planetary boundaries, a transition towards sustainable development is necessary. The multi-level perspective (MLP) has been developed to study long-term transformative change. This paper complements the MLP by providing an ontological framework for studying and understanding the role of narratives as the vehicle of meaning and intermediation between individual and social collective in the context of ongoing transitions. Narratives are established as an analytical entity to unpack how disturbances at the level of the socio-technical landscape are translated into and contribute to the transformation of socio-technical regimes. To illustrate and test the approach, it is applied to the case of the Fukushima catastrophe: The narratives in relation to nuclear power in Japan, Germany and the United Kingdom are scrutinized and it is explored how these narratives have co-determined the policy responses and thus influenced ongoing transformation processes in the power sectors of the respective countries.

**Kuzemko, C., Lockwood, M., Mitchell, C. and Hoggett, R., 2016, Governing for sustainable energy system change: Politics, contexts and contingency, *Energy Research & Social Science*, 12, 96–105**

This paper offers a new, interdisciplinary framework for the analysis of governing for sustainable energy system change by drawing together insights from, and offering critiques of, socio-technical transitions and new institutionalist concepts of change. Institutions of all kinds, including rules and norms within political and energy systems, tend to have path-dependent qualities that make them difficult to change, whereas we also know that profound change has occurred in the past. Current decisions to pursue climate change mitigation by dramatically changing how energy is produced and used depend to some extent on finding the right enabling conditions for such change. The approach adopted here reveals the highly political and contingent nature of attempts to govern for innovations, how political institutions mediate differently between forces for sustainable change and forces for continuity, as well as specific interactions between governance and practice change within energy systems. It concludes that it is only by being specific about the contingent nature of governing for innovations, and about how this affects practices in energy systems differently, that those of us interested in sustainability can credibly advise policy makers and drive for greater change.

**Schmid, E., Knopf, B. and Pechan, A., 2016, Putting an energy system transformation into practice: The case of the German Energiewende, *Energy Research & Social Science*, 11, 263-275**

Low-carbon energy system transformations are usually seen from a technical perspective; the decisive societal dimensions of actors and institutions are widely neglected. We contribute to filling this gap by reviewing the German energy transition (Energiewende), which targets a competitive low-carbon economy until 2050, jointly from the three perspectives of technology, actors and institutions. We analyze seven sub-fields of the electricity system that are central for decarbonization from a technology view. For each, we identify and characterize key actors and institutional conditions for future electricity infrastructure developments they favor. The analysis reveals a large variety of engaged actors that differ with respect to their motives and underlying worldviews. Electricity infrastructure visions range from the archetypes of decentralized regional solutions (favored

by challengers) to centralized European solutions (favored by incumbents). We illustrate that the determining factors for both developments are primarily of institutional nature and will be fought out between actors in the political arena. From a technology perspective centralized and decentralized solutions may well coexist to a certain degree. However, in either case the long latency period in technical infrastructure development requires anticipatory planning.

**Eikeland, P.O. and Inderberg, T.H.J., 2016, Energy system transformation and long-term interest constellations in Denmark: can agency beat structure?, *Energy Research & Social Science*, 11, 164-173**

Since the oil crises in the 1970s, Denmark's energy system has evolved from import- and fossil fuel-dependency to self-sufficiency with a high share of renewable energy. This transformation has been supported by co-evolving energy policies. A policy shift in 2001 brought a temporary halt to the transformation, which resumed after a return in policy in 2008. Applying public choice- and path-dependency perspectives, this article analyses the development of the Danish energy system and co-evolving policies. Initial structural characteristics have strong explanatory power for the long-term policy trend: de-central ownership, and entrepreneurship have given local-level actors leverage as a political constituency. Over time de-central small-scale solutions (like windpower and district heating) secured generous state aid. Local-level actors provided technology solutions offering broad opportunities. One consequence was strong support for de-central technology solutions. The first policy shift is explained by a new government that advocated dismantling state regulation, subsidies and taxes, supported by a new political majority. The second policy shift is explained by mobilization of interests that had grown to include actors that generally supported de-regulation but saw their commercial interests threatened. The Danish model has inspired similar transformations elsewhere and offers lessons on how to overcome resistance to change.

**Pant, L.P., 2016, Paradox of mainstreaming agroecology for regional and rural food security in developing countries, *Technological Forecasting and Social Change*, in press**

Paradox of mainstreaming agroecology refers to an apparent contradiction between upscaling niche innovations to produce more food in sustainable ways, and the concerns for a loss of core values and principles of agroecology in the mainstreaming process. This paper examines this paradox of mainstreaming and sidestreaming (continuity of niche practises) using longitudinal case studies of agroecological innovations in soil and water conservation, crop improvement, crop intensification, and market differentiation in the regional and rural contexts of developing countries. Findings suggest that there are latent and salient paradoxes of mainstreaming niche innovations, respectively explaining cooperative and competitive interactions with the incumbent regime of industrial food and agriculture. While the former paradox involves continuity of niche practises as well as regime conditions through incremental adaptations, the latter comprises regime shifts through transformational adaptations. However, as these two paradoxes are in flux a latent paradox can become salient when competitive elements of seemingly cooperative niche-regime interactions unravel.

**Späth, P., Rohrer, H. and Von Radecki, A., 2016, Incumbent actors as niche agents: The German car industry and the taming of the "Stuttgart E-Mobility Region, *Sustainability*, 8(3), 252**

The system of mobility currently faces severe challenges. Particularly in cities, strategic interventions are made to support a transition towards sustainable mobility. Incumbent actors from the car industry are often invited to play a key role in such initiatives. The Stuttgart region is supported with public money to become a model region of sustainable mobility because it is base to key actors of the German car industry. This paper examines the locus of agency in such a "transition arena". How do key actors frame the challenge of sustainable mobility? What role is attributed to public policy at various governance levels and

to the “local” industry, respectively? In the case of the Stuttgart region, we find a high ability of key industry actors to reframe transition initiatives for sustainable mobility and align public policy with their interests—particularly in local, *i.e.*, place-bound contexts. This underlines the need for transition studies to pay more attention to the agency of incumbent actors and their capacity to absorb sustainable alternatives without changing dominant industry structures.

**Sica, E., 2016, Financial constraints and Multi-Level Perspective: The case of the Italian manufacturing enterprises, *Journal of Modern Accounting and Auditing*, 12(2), 102-110**

Following a multi-level perspective (MLP), a sustainability transition is the consequence of destabilization pressures from the landscape level that are exerted towards the current unsustainable regime contributing thus to the emergence of niche-level eco-innovations (EI). However, the existence of financial barriers to eco-innovative companies may hinder the development and diffusion of EIs at regime level, jeopardising the creation of windows of opportunity that are necessary for niche-level innovations to succeed. In this framework, the present paper investigates to what extent financial constraints are hampering the eco-innovative investments at regime level, by employing an *ad hoc* designed survey addressed to a sample of Italian manufacturing enterprises. Results reveal the existence of significant financial barriers to eco-innovative companies which are hindering the development and adoption of incremental technological EIs and organizational EIs at regime level, delaying the transition towards a more sustainable regime. Moreover, findings suggest that environmental reputation of companies can positively contribute to reducing asymmetric information in eco-innovative investments, relieving thus the financial constraints faced by eco-innovative enterprises.

**Mercure, J-F., Pollitt, H., Bassi, A.M., Vinuales, J.E. and Edwards, N.R., 2016, Modelling complex systems of heterogeneous agents to better design sustainability transitions policy, *Global Environmental Change*, 37, 102-115**

This article proposes a fundamental methodological shift in the modelling of policy interventions for sustainability transitions in order to account for complexity (e.g. self-reinforcing mechanisms, such as technology lock-ins, arising from multi-agent interactions) and agent heterogeneity (e.g. differences in consumer and investment behaviour arising from income stratification). We first characterise the uncertainty faced by climate policy-makers and its implications for investment decision-makers. We then identify five shortcomings in the equilibrium and optimisation-based approaches most frequently used to inform sustainability policy: (i) their normative, optimisation-based nature, (ii) their unrealistic reliance on the full-rationality of agents, (iii) their inability to account for mutual influences among agents (multi-agent interactions) and capture related self-reinforcing (positive feedback) processes, (iv) their inability to represent multiple solutions and path-dependency, and (v) their inability to properly account for agent heterogeneity. The aim of this article is to introduce an alternative modelling approach based on complexity dynamics and agent heterogeneity, and explore its use in four key areas of sustainability policy, namely (1) technology adoption and diffusion, (2) macroeconomic impacts of low-carbon policies, (3) interactions between the socio-economic system and the natural environment, and (4) the anticipation of policy outcomes. The practical relevance of the proposed methodology is subsequently discussed by reference to four specific applications relating to each of the above areas: the diffusion of transport technology, the impact of low-carbon investment on income and employment, the management of cascading uncertainties, and the cross-sectoral impact of biofuels policies. In conclusion, the article calls for a fundamental methodological shift aligning the modelling of the socio-economic system with that of the climatic system, for a combined and realistic understanding of the impact of sustainability policies.

**Kirkels, A., 2016, Biomass boom or bubble? A longitudinal study on expectation dynamics, *Technological Forecasting and Social Change*, 103, 83-96**

Early research, development and demonstration of technologies tend to be strongly driven by expectations of the technology, as in this stage the technological and economic performance of technologies is poor. Our main interest is in the longitudinal development of these expectations. This perspective pays more attention to periods before and after hype, highlighting where expectations are coming from and how they are disappearing. As an empirical case we studied advanced biomass gasification. The technology has been at the forefront of developments in energy-from-biomass since the late 1970s. It received recent interest of several innovation scholars, however the role of expectations remained underexposed. We reconstructed two hype-disappointment cycles and a period of more gradual and contested development. The approach offers insight in how development over the different periods relate. Expectations mainly adapted to contextual changes and were less influenced by progress in technology or earlier expectations.

**Beers, P., B. van Mierlo, and A.-C. Hoes. 2016. Toward an integrative perspective on social learning in system innovation initiatives. *Ecology and Society* 21(1):33**

Sustainability transitions go hand in hand with learning. Theories in the realm of sustainability sciences mostly concentrate on diversity and learning outcomes, whereas theories from the educational sciences mostly focus on learning as an interactive process. In this contribution, we aim to benefit from an integration of these perspectives in order to better understand how different interaction patterns contribute to learning. We studied STAP, an innovation initiative of Dutch greenhouse growers. The Dutch greenhouse sector is predominantly focused on production and efficiency, which causes problems for its future viability. STAP aimed to make the sector more market-oriented while at the same time increasing its societal acceptability (societally responsible innovation). To that end, STAP focused on the development of integrated value chains (primary production, sales, trade) that can contribute to a transition towards a societally sensitive greenhouse sector. As action researchers, we collected extensive transcripts of meetings, interviews, and various other documents. We used an open coding strategy to identify different patterns of interaction and the learning outcomes produced by the initiative. We then linked the interaction patterns to the outcomes. Analysis suggests that seemingly negative attack-and-defend patterns of interaction certainly can result in substantial learning results, while seemingly positive synthetic interaction patterns, where participants strive to build on each other, can result in rather bland interaction without substantial outcomes. The results offer an empirical basis to our approach of linking learning interactions to learning outcomes, and it suggests that learning for sustainability can be enhanced by focusing on interaction patterns.

**Dumas, M., Rising, J. and Urpelainen, J., 2016, Political competition and renewable energy transitions over long time horizons: A dynamic approach, *Ecological Economics*, 124, 174-184**

Climate change mitigation requires sustainable energy transitions, but their political dynamics are poorly understood. This article presents a general dynamic model of renewable energy policy with long time horizons, endogenous electoral competition, and techno-political path dependence. We calibrate the model with data on the economics of contemporary renewable energy technologies. In doing so, we discover transition dynamics not present in economy-energy models, which ignore politics, or in formal political economy models, which ignore long-term technological dynamics. We show that the largest effects of partisan ideology on policy occur when the competing parties disagree on the importance of energy policy. In these cases, the less ideological party appeases the more ideological one, while the more ideological party attempts to appease the electorate. The results demonstrate that political dynamics could have large effects on the development of renewable energy and carbon dioxide emissions over time, influencing the ability of countries to reach various climate mitigation trajectories.

**Canzler, W. and Wittowsky, D., 2016, The impact of Germany's "Energiewende" on the transport sector – Unsolved problems and conflicts, *Utilities Policy*, in press**

Politically-driven climate protection targets call for decarbonization and a massive reduction of total energy consumption by 2050. A comprehensive transformation of existing transport systems and individual mobility is needed to achieve this. There will be no energy transition ("Energiewende") without a transport transition. Electromobility provides great savings compared to fossil-fueled transport. In addition information and communication technologies (ICT) have become a key factor of innovation and inter- and multimodality. With all structural changes (e.g. industrial restructuring or social change), converting existing organizational forms and mobility evokes conflicts. For example, competing spatial requirements of the energy sector and mobility as well as the exclusion of certain categories of persons are to be expected. Indeed, the transformation process is slowed down by shortcomings in the combination of energy and transport technologies, organizational culture and regulations. A number of questions still remain unanswered.

**Vankeerberghen, A. and Stassart, P.M., 2016, The transition to conservation agriculture: an insularization process towards sustainability, *International Journal of Agricultural Sustainability*, in press**

Part of the Sustainability Transition Studies, this work addresses the question of the relationship between niches and regimes by examining the transition to conservation agriculture. It seeks to understand how farmers' transition to conservation agriculture can contribute to a better understanding of the transition of agro-food systems towards sustainability. Based on an analysis of farmers' trajectories in the Walloon region in Belgium, the paper develops the notion of insularization in order to characterize the emergence of conservation agriculture as a niche that is a dynamic process, growing from within and progressively detaching itself from the conventional agricultural regime. The analysis of farmers' transition shows how, after an initial phase of destabilization of the conventional ploughing regime, learning and experiencing processes can lead to a transformation in soil and soil quality management perceptions. Our hypothesis is that this cognitive transformation constitutes a tipping point in the insularization process because of its effects on agricultural practices, which increase the detachment of conservation agriculture from the regime and thus embed the irreversibility and sustainability of the transition. Insularization describes an ecologizational pathway of agricultural practices endogenous to the regime that can not only lead to adaptive changes on the periphery of the system, but might also induce a deep and systemic transformation of conventional agricultural practices.

**Lösch, A. and Schneider, C., 2016, Transforming power/knowledge apparatuses: the smart grid in the German energy transition, *Innovation: The European Journal of Social Science Research*,**

Politics and the dominant actors in the German energy system fear that the politically promised integration of renewable energies in the course of the Energy Transition will lead to losses of control due to increasing volatility, decentralization and heterogeneity of processes and actors. Yet, a novel form of control through the artificial intelligence of smart grids is envisioned that would tame the chaos in the system. To analyze the conditions and effects of smart grids we introduce the Foucauldian concept of a "power/knowledge apparatus" into the study of sociotechnical transitions. It brings into focus the entwined changes of positions of actors, knowledge and power constellations and their effects. These are crucial to innovation and transformation processes, yet the question how they emerge is only marginally addressed in other science and technology studies approaches. The article analyzes the problem framing and solution by smart grids as an emerging power/knowledge apparatus which implies a comprehensive re-arrangement of the power/knowledge constellations in the energy system. The order and ordering of the emerging apparatus of transformation is getting visible by an empirical case study based on expert interviews and document analysis. The apparatus aims at and engenders a permanent experimentation of

all relations between the actors, organizations, techniques, knowledges, etc., which are included in an energy system based on the envisioned smart grid.

**Wentland, A., 2016, Imagining and enacting the future of the German energy transition: electric vehicles as grid infrastructure, *Innovation: The European Journal of Social Science Research*,**

The electrification of transportation in Germany has failed so far, but the disappointment has given way to more radical visions and new coalitions. Utilities, grid operators, and ICT companies have started to challenge the traditional image of the car. In their future scenarios, transportation, energy, and communication infrastructures must be aligned in order to achieve a sustainable society. This paper explores the co-production and enactment of this technological vision using the analytical framework of sociotechnical imaginaries. First, I describe how the idea of the electric vehicle as energy infrastructure was able to take hold within the German expert community. To understand how this approach might transform the existing mobility and energy practices, I examine two of the first R&D experiments that have enacted this vision in two radically different ways. Both reflect unarticulated assumptions about social life, including implicit cultural notions of self-determination, ownership, living arrangements, privacy, and control.

**Filho, W.L., Platje, J., Gerstlberger, W., Ciegis, R., Kääriä, J., Klavins, M. and Kliuconinkas, L., 2016, The role of governance in realising the transition towards sustainable societies, *Journal of Cleaner Production*, in press**

It is widely known that governance is central to the successful implementation of sustainable development policies and measures. Yet, there is a paucity of research which explore the links between governance and sustainability. This paper attempts to address this research need by providing an analysis of the role of governance in enabling – and to some extent – fostering a transition towards sustainable societies. A set of indicators for assessing the capacity for and willingness and commitment to transition to a more sustainable society is presented, enabling identification of direction of change. This paper presents the results of a study, in the context of which sustainability governance has been comparatively investigated in a sample of European countries with, by methodological purpose, very different economic, environmental, political and social conditions (Denmark, Finland, Germany, Latvia, Lithuania and Poland). Lessons learnt and examples of good practice – which may be replicable elsewhere-are outlined. For instance, it is discussed that limited knowledge about sustainable development amongst municipal development planners and decision-makers, deficiencies in policy integration, intersectoral cooperation, municipality and stakeholder cooperation and urban management practices are major reasons for weak governance practices in sustainable development. Furthermore, some recommendations on the role of sustainability governance are made, so as to allow the integration of the principles of governance into sustainability practice and hence provide a more general basis upon which a transition towards sustainable societies may become a reality in different types of European countries and societies. The scientific value of this paper lies in identifying opportunities for integrating principles of governance into sustainability practice, as well as outlining the basis for sustainability transitions, providing a general picture of required policy measures. The paper offers a unique comparative analysis of sustainability governance in the Baltic Sea countries, outlining some of the challenges in sustainability governance in the Baltic Sea region.

**Rolffs, P., Ockwell, D. and Byrne, R., 2015, Beyond technology and finance: pay-as-you-go sustainable energy access and theories of social change, *Environment and Planning A*, 47, 2609–2627**

Two-thirds of people in sub-Saharan Africa lack access to electricity, a precursor of poverty reduction and development. The international community has ambitious commitments in this regard, e.g. the UN's Sustainable Energy for All by 2030. But scholarship has not kept up



with policy ambitions. This paper operationalises a socio-technical transitions perspective to analyse for the first time the potential of new, mobile-enabled, pay-as-you-go approaches to financing sustainable energy access, focussing on a case study of pay-as-you-go approaches to financing solar home systems in Kenya. The analysis calls into question the adequacy of the dominant, two-dimensional treatment of sustainable energy access in the literature as a purely financial/technology, economics/engineering problem (which ignores sociocultural and political considerations) and demonstrates the value of a new research agenda that explicitly attends to theories of social change – even when, as in this paper, the focus is purely on finance. The paper demonstrates that sociocultural considerations cut across the literature’s traditional two-dimensional analytic categories (technology and finance) and are material to the likely success of any technological or financial intervention. It also demonstrates that the alignment of new pay-as-you-go finance approaches with existing sociocultural practices of paying for energy can explain their early success and likely longevity relative to traditional finance approaches.

**Bache, I, Reardon, L, Bartle, I, Flinders, M and Marsden, G (2015), Symbolic meta-policy: (not) tackling climate change in the transport sector, *Political Studies*, 63(4), 830-851**

This paper seeks to understand how the UK government's headline climate change targets are translated into action at the local level in the transport sector drawing on the findings of research in two English regions. In doing so, these headline targets are identified as a symbolic meta-policy that results in little action on the ground and which challenges established conceptions of policy implementation. Both the ‘meta’ and ‘symbolic’ aspects of the policy offer part of the explanation for the lack of substantive action on the ground. As a meta-policy, the headline targets across government require the elaboration of other policies at other levels such as targets for government departments and local authorities, but these are largely absent, leaving the meta-policy without teeth. Over time, these headline targets have developed into a symbolic policy, serving political goals but having little practical effectiveness.

**Biggs, C., 2016, A resource-based view of opportunities to transform Australia’s electricity sector, *Journal of Cleaner Production*, in press**

Proponents of low-carbon transformation face an uphill battle to reconfigure incumbent energy systems and aligned interests protecting the status quo. Australia’s electricity sector is an example of such a system, wedded to fossil fuels and strongly supported by the country’s political establishment. However, uncertain times are ahead. This paper addresses the potential for low-carbon transformation in Australia’s electricity sector. It explores the complex and uncertain dynamics shaping the sector and outlines how these can be understood from the perspective of strategic agency - with an eye for opportunities and mechanisms to drive a shift to renewables. This paper offers a review of the dynamics of change and re-stability shaping the Australian electricity sector between 2006 and 2015 and applies a resource-based view of transformative agency to analyse these dynamics. Results show the sector suffers multiple stressors that point to disruptive changes ‘in the pipeline’. Critically, many of these dynamics stem from factors outside the influence of the sector and its supporters. While results do not point to a clear trajectory or outcome of transformation, they indicate the uptake of small-scale solar PV systems by households and small business will play a defining role in the sector’s future configuration. Furthermore, the exploration of transformative dynamics affecting the electricity sector through a resource-based lens shows that many opportunities exist for strategic agents to intervene in support of a disruptive shift to renewables. The paper suggests a range of mechanisms that agents could use to undermine the strength of fossil energy in the electricity sector and encourage a shift to renewables.

**Kenis, A., Bono, F. and Mathijs, E. (2016): Unravelling the (post-)political in transition management: Interrogating pathways towards sustainable change, *Journal of Environmental Policy & Planning*, in press**

Coming to terms with recent insights concerning the (post-) political is a key challenge for transition management. To start with, transition management understands the relation transition initiatives adopt towards existing regimes not in political, but in market terms. This impacts their internal processes, which are based on a deliberative notion of democracy, assuming the existence of a common good and misrecognizing the constitutive role of conflict. Moreover, transition management embraces a governance approach centring on public–private bodies which, in the name of bottom-up processes and participation, especially gives a voice to a privileged group of business, policy and civil society actors. Insofar as citizens get a place, it is merely in their role as consumers. Finally, as it is based on a market model itself, transition management fails to politicize one of the most fundamental current ‘landscape’ elements. The crucial question is how these features affect transition management's possibilities to contribute to effective and democratic sustainable change.

**Xue, Y., You, J., Liang, X., and Liu, H-C., 2016, Adopting Strategic Niche Management to evaluate EV demonstration projects in China, *Sustainability*, 8(2), 142.**

Electric Vehicles (EVs) are considered to be a potential viable technology to address the persistent unsustainable problems in transport sector. In this paper, we focus on analyzing the transition processes of EVs in China because the sustainability of developing countries is essential for the worldwide sustainability. The two-round demonstration programs of EVs in China were analyzed by adopting the strategic niche management (SNM) approach so as to find out what niche protection has been provided and which obstacles hamper the further development of EVs. The results show that the financial subsidy is the most important protective measure. However, the diffusion results of EVs in different pilot cities are greatly different. The main reason lies in the uneven geographical landscape. In addition, some obstacles were exposed during the niche internal processes including low quality of expectations and poor alignment within the network. Based on the analysis results, we develop a list of suggestions that are important to consider when developing EVs.

**Dijk, M., Wells, P. and Kemp, R., 2016, Will the momentum of the electric car last? Testing an hypothesis on disruptive innovation, *Technological Forecasting and Social Change*, 105, 77-88**

In this paper we study to what extent electric propulsion is disrupting ‘the order’ in the automotive industry with six extensions to Christensen's notion of disruptive innovation (1997). For decades the automotive sector has relied on the internal combustion engine (ICE) as the established propulsion technology, but due to environmental regulation and geo-political scarcity problems associated with fossil fuel use, electric propulsion is increasingly applied as sole or additional power source. We elaborate the Christensen typology, rooted in industrial analysis, with a regime evolution framework based on changes in technology and the institutional context of production and use, with special attention to consumer perspectives and government regulation. We offer a hypothesis for structural conditions for market disruption and test this hypothesis against the development trajectory of full-electric vehicles (FEV). Drawing on evidence from a range of recent FEV studies, our analysis suggests that the disruptive niche of full-electric mobility is currently insufficient to displace the ICE regime.

**Betsill, M. and Stevis, D., 2016, The politics and dynamics of energy transitions: Lessons from Colorado's (USA) ‘New Energy Economy’, *Environment and Planning C*,**

This article examines the political dynamics of energy transitions in a case study of the State of Colorado's (USA) efforts to create a “New Energy Economy” through a series of legislative and administrative actions between January 2007 and January 2011. Drawing on an emerging literature on the politics of social-technical transitions, we argue that transitions

involve contestation between and within coalitions of incumbents and challengers, which result in policies that benefit particular actors and a reconfiguration of the core values around which transition policies are articulated. We explore these dynamics through an analysis of the process that led to the adoption of Colorado's 30% Renewable Energy Standard in 2010, which is often held up as one of the crowning achievements of the New Energy Economy initiative, in order to illustrate how these political debates shape the nature and trajectory of the transition process.

**Foran, T., Fleming, D., Spandonide, B., Williams, R. and Race, D., 2016, Understanding energy-related regimes: A participatory approach from central Australia, *Energy Policy*, 91, 315-324**

For a particular community, what energy-related innovations constitute no-regrets strategies? We present a methodology to understand how alternative energy consuming activities and policy regimes impact on current and future liveability of socio-culturally diverse communities facing climate change. Our methodology augments the energy policy literature by harnessing three concepts (collaborative governance, innovation and political economic regime of provisioning) to support dialogue around changing energy-related activities. We convened workshops in Alice Springs, Australia to build capability to identify no-regrets energy-related housing or transport activities and strategies. In preparation, we interviewed policy actors and constructed three new housing-related future scenarios. After discussing the scenarios, policy and research actors prioritised five socio-technical activities or strategies. Evaluations indicate participants enjoyed opportunities given by the methodology to have focussed discussions about activities and innovation, while requesting more socially nuanced scenario storylines. We discuss implications for theory and technique development.

**McLellan, B., Chapman, A.J. and Aoki, K., 20106, Geography, urbanization and lock-in – considerations for sustainable transitions to decentralized energy systems, *Journal of Cleaner Production*, in press**

The importance of moving towards sustainable energy systems is critical to achieving societal sustainability. Transitions theory is a useful approach to look at the potential and limitations of systemic transitions, and has been applied in a number of alternative contexts. In the current study, we examine transitions theory and its implications for the progress of decentralized energy systems in Japan in the period after the Fukushima accident of 2011. Empirical data from a targeted nation-wide survey is used to examine the progress and change in consumer preference and behavior since the disaster, as possible evidence for the potential transition paths likely to be occurring. Importantly, this study utilizes data that examines a spectrum of urban–rural and disaster–non-disaster areas in order to explore whether any differences in response patterns were present. Results indicate that although the desire of stakeholders has been to change the energy system, there are barriers to transformation. Variation between rural and urban sites and between disaster-affected and unaffected areas was examined, indicating that (at least under the chosen classification) there was surprisingly little difference. The results have implications for understanding transitions at a much broader level, and imply that, if the empirical data is a useful indicator, Japan is within a locked-in or reorganization transition. In order to move to a more radical conversion type change a new approach is likely to be required to nurture niche innovations effectively.

**Røpke, I., 2016 Complementary system perspectives in ecological macroeconomics — The example of transition investments during the crisis, *Ecological Economics*, 121, 237-245**

Globally, societies are facing a number of interrelated environmental, economic and social crises. This paper is intended to contribute to the development of an ecological macroeconomics that addresses these multiple crises in combination. Insights from different research communities will be included in this effort. Taking an ecological economic

understanding of sustainability as the point of departure, and inspired by systems thinking, it is discussed which economic sub-systems should be in focus for sustainability transitions, and whether relevant guides for sustainability can be formulated for these systems. In particular, the focus is on systems that are decisive for resource consumption and pollution although their influence on these is indirect. A simple typology of sub-systems is suggested and applied in relation to an example that highlights the importance of the interplay between macroeconomic, provision and distribution systems. The example concerns investments in sustainability transitions of provision systems and demonstrates the complexities of implementing such transformations during the economic crisis. It also addresses the need for ecological macroeconomics to develop a third position beyond austerity policies and Keynesian approaches.

**Williams, J., 2016, Can low carbon city experiments transform the development regime?, *Futures*, in press**

The paper explores the ability of urban transition experiments to transform the development regime in which they are embedded. Using three European case studies – BedZed, Vauban and Hammarby – it investigates the processes of broadening and scaling-up within cities, nations and across cities globally; and finds that transition experiments do influence the development regime in which they are embedded. The impact of experiments on the development regime does vary significantly with scale. The innovative components, which are assembled in experiments (cultural, structural and practices) also seem to have differing propensity to influence the development regime at different scales. Thus, cultural innovations have a greater propensity to influence the development regime across all scales, whilst the structural and practice innovations tend to influence the development regime locally and nationally. The case studies also demonstrated the significance of context (historical and geographical) in shaping experiments and influencing the transformation process. This finding suggests that the importance of broadening in the transformation process has been overstated. The experiments show that broadening across national boundaries and for prolonged periods, can result in expanding niche-regimes which become increasingly diverse. But it does not result in transformation.

**Acheampong, E.N., Swilling, M., and Urama, K., 2016, Sustainable urban water system transitions through management reforms in Ghana, *Water Resources Management*, in press**

Despite decades of water reforms, Ghana's struggle to achieve sustainable urban water system is deepened by complex interactions of multi-layered political, socio-economic and managerial characteristics, leaving a rationing system of water supply in major cities like Accra. Using a multi-level perspective framework, the paper examines the dynamics of urban water system transition through management reforms. The study showed how external pressure at the landscape level influenced policy direction within urban water regime through the implementation of neo-liberal economic policies, paving way for resistance and grassroots innovation at the niche level. The implementation of such policies in the reform process did little to help achieve the desired sustainable urban water system goals. The paper suggests a blend of public and private financing with support for grassroots to improve urban water system management. However, subsequent urban water policy reforms must be informed by knowledge of social, economic, and political realities rather than imported generic "best policies and practices" that often conflict with local realities.

**Kamp, L.M. and Forn, E.B., 2016, Ethiopia's emerging domestic biogas sector: Current status, bottlenecks and drivers, *Renewable and Sustainable Energy Reviews*, 60, 475-488**

Ethiopia experiences an energy and environmental crisis due to the sustained reliance on woody biomass to satisfy its energy needs. This situation could be improved by using biogas. This paper analyses the current status of the domestic biogas sector in Ethiopia and

identifies barriers and drivers that influence its development and further growth. The analytical framework used for the analysis combines the Multi-Level Perspective (MLP) and Strategic Niche Management (SNM). The information sources are: desk study through literature and internet research, online interviews and questionnaires with Ethiopian stakeholders, and an extensive field study including a large number of interviews with stakeholders inside and outside Ethiopia. The biogas sector in Ethiopia started with the launch of the National Domestic Biogas (NBPE) programme in 2008, which has led to the dissemination of over 8000 biodigesters so far, about 60% of what was initially intended. The use of domestic biogas has been triggered by the energy crisis in Ethiopia and the suitability of the technology with the physical geography. However, the dissemination has been affected by factors such as economic instability, poverty and illiteracy. Also, many Ethiopian farmers are trapped in a lock-in, where due to their limited purchasing power they cannot afford the niche technology; at least in the way it is being disseminated. Within the emerging biogas sector, the NBPE designated a diverse set of actors to contribute to the implementation of the niche technology. However, their alignment is poor and the private sector is not involved. Expectations have had to be lowered because targets were not met. Also, learning processes are not optimal. The paper is innovative because it provides an up-to-date review of status of and bottlenecks and drivers in the biogas sector in Ethiopia and it provides more insight in the applicability of the SNM and MLP frameworks to a sustainable innovation in a developing country.

**Schiller, F., 2016, Urban transitions: Scaling complex cities down to human size, *Journal of Cleaner Production*, 112, part 5, 4273-4282**

Complexity science has become prominent in studying cities as concepts like “smart city” and “big data” indicate. In particular network analysis has allowed to studying various aspects of cities in new ways. As such these analyses are often disconnected and subsequent business models often remain disembedded. However, complexity science can also compare various patterns extending over different scales (scaling) if they belong to the same entity (allometry). Such relationships pertain to cities too suggesting that buildings, infrastructure and traffic amongst other things develop interdependently and, that across specific city systems scaling phenomena can be compared according to cities' population size. The article argues that while many scaling phenomena of physical and social networks can indeed inform urban transition research the proposed central role of cities' population size is highly ambivalent. This is particularly true for economic indicators like GDP, which do not reflect the need for sustainability. Still, network and scaling analysis of the built environment can contribute to transition theory if explanatory social mechanisms relating human behaviours *and* social institutions to existing scaling phenomena are provided.

**Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L. and Schösler, H., 2016, Transition towards circular economy in the food system, *Sustainability*, 8(1), 69**

Growing population and increased demand for food, inefficient resource use and food distribution, environmental impacts, and high rates of food wasted at all stages of the food system are all calling for transition towards more sustainable practices. In this article we apply the concept of circular economy to the case of a sustainable food system. Furthermore, we explore the transition towards a circular food system through the lens of socio-technical transition theory towards sustainability. We discuss challenges and potential solutions for the production stage (focusing on nutrient flow), the consumption stage (focusing on meat consumption), and food waste and surplus management and prevention.

**De Boer, J., De Witt, A. and Aiking, H., 2016, Help the climate, change your diet: A cross-sectional study on how to involve consumers in a transition to a low-carbon society, *Appetite*, 98(1), 19-27**

This paper explores how the transition to a low-carbon society to mitigate climate change can be better supported by a diet change. As climate mitigation is not the focal goal of

consumers who are buying or consuming food, the study highlighted the role of motivational and cognitive background factors, including possible spillover effects. Consumer samples in the Netherlands (n = 527) and the United States (n = 556) were asked to evaluate food-related and energy-related mitigation options in a design that included three food-related options with very different mitigation potentials (i.e. eating less meat, buying local and seasonal food, and buying organic food). They rated each option's effectiveness and their willingness to adopt it. The outstanding effectiveness of the less meat option (as established by climate experts) was recognized by merely 12% of the Dutch and 6% of the American sample. Many more participants gave fairly positive effectiveness ratings and this was correlated with belief in human causation of climate change, personal importance of climate change, and being a moderate meat eater. Willingness to adopt the less meat option increased with its perceived effectiveness and, controlling for that, it was significantly related to various motivationally relevant factors. The local food option appealed to consumer segments with overlapping but partly different motivational orientations. It was concluded that a transition to a low carbon society can significantly benefit from a special focus on the food-related options to involve more consumers and to improve mitigation.

**Rocher, L., 2016, Governing metropolitan climate-energy transition: A study of Lyon's strategic planning, *Urban Studies*, in press**

Given that in-depth place-specific studies are needed for a better understanding of the role of cities in coping with climate change and implementing the energy transition, this paper, based on the case of Lyon (France), brings empirical evidence of how climate and energy are being governed at a city level. A comprehensive understanding of this is achieved with emphasis put on the modes of governing enacted by the local authority, as well as the positioning of the city at broader scales. The framing and localising processes involved in the policy-making process are at the core of this analysis, with a particular focus on two interrelated questions: how are climate and energy making their way as new urban issues that call for specific responses, and how do they reinforce – and are they also reinforced by – metropolitan-wide governance in a context of institutional change?

**Poustie, M., Frantzeskaki, N., and Brown, R., 2016, A transition scenario for leapfrogging to a sustainable urban water future in Port Vila, Vanuatu, *Technological Forecasting and Social Change*, 105, 129–139**

The ability of urban centres in developing countries to rapidly transition to sustainable practices will be critical for human health and environmental sustainability as the world progresses into the twenty-first century. Sustainability transitions in the urban water sector in developing countries has received limited scholarly attention, with very few studies demonstrating methodologies offering potential for promoting and enabling “leapfrog” transitions. This paper presents an adapted Transition Management process which demonstrates the importance of establishing a future vision and strategic agenda for promoting a leapfrogging trajectory. Utilising the case study of the urban water sector in Port Vila, Vanuatu, empirical evidence draws from transitions management workshops, supported by in-depth interviews and mediated participation. Results suggest that the desire in Vanuatu is for the development of a sustainable urban water future, and that there is untapped latent energy which can be better utilised to assist in guiding the direction of change and promoting sustainable alternatives. The paper concludes by providing critical insights into enabling leapfrogging change in other developing contexts highlighting the importance of targeted institutional capacity development, the role of purchaser-provider relationships between governments and international development banks, and the potential for visions to stimulate leapfrog trajectories.

**Frantzeskaki, N., Thissen, W. and Grin, J., 2016, Drifting between transitions: Lessons from the environmental transition around the river Acheloos Diversion project in Greece, *Technological Forecasting and Social Change*, 102, 275-286**

Systems can experience different types of transitions. The existing literature on transitions distinguishes socio-technological, social-ecological and institutional transitions that each focus on different aspects of real-life systems. For every one of these types of transitions we have identified a common set of forces that co-shape and drive the transition. Building on previous work and based on an in-depth empirical analysis, we investigate the complex dynamics of transitions in terms of how changes in different societal subsystems may unravel and trigger each other. We start with a conceptual scheme that captures the main characteristics of socio-technological, social-ecological and institutional transitions as discussed in the respective literatures. We then employ a case study on the emergence of a *transition* in the *environmental protection regime in Greece* (for the period of 1986 until early 2000s) in the face of a river diversion project. Following a socio-ecological transition, the river Acheloos case went through a transition involving five co-evolving and competing regimes: the environmental protection policy regime, the energy policy regime, the water management policy regime, the Acheloos river restoration interest regime, and the Acheloos diversion interest regime. The environmental protection transition in Greece was (and remains) a battlefield for both supporters and opponents of the Acheloos Diversion Project. We analyze how the dynamics of socio-ecological and institutional transitions have affected each other, and we identified three transition drifts that signal how transformation unfolds: change transcends across subsystems and regimes, problem framings shift over time and some driving forces tip multiple subsystems creating spillover effects.

**Frantzeskaki, N., Jhagroe, S., and Howlett, M., 2016, Greening the state? The framing of sustainability in Dutch infrastructure governance, *Environmental Science and Policy*, 58, 123-130.**

This paper investigates how the notion of 'sustainability' is strategically framed in the context of Dutch infrastructure governance in the Netherlands. By conducting a frame analysis (based on policy documents, websites and semi-structured interviews), the paper discerns six sustainability frames. These frames concern substantive (e.g. more focus on ecology), process (activating new networks) and organizational (e.g. new practices of work) aspects. The paper also illustrates how these sustainability frames relate to the changing institutional context of infrastructure policy and governance more broadly. The paper discusses some of the productive and challenging implications of the dynamics of sustainability in today's complex and multi-dimensional world of governance.

**Wolfram, M., and Frantzeskaki, N., 2016, Cities and systemic change for sustainability: Prevailing epistemologies and a future research agenda, *Sustainability* (8) 144.**

Cities are key for sustainability and the radical systemic changes required to enable equitable human development within planetary boundaries. Their particular role in this regard has become the subject of an emerging and highly interdisciplinary scientific debate. Drawing on a qualitative literature review, this paper identifies and scrutinizes the principal fields involved, asking for their respective normative orientation, interdisciplinary constitution, theories and methods used, and empirical basis to provide orientations for future research. It recognizes four salient research epistemologies, each focusing on a distinct combination of drivers of change: (A) transforming urban metabolisms and political ecologies; (B) configuring urban innovation systems for green economies; (C) building adaptive urban communities and ecosystems; and (D) empowering urban grassroots niches and social innovation. The findings suggest that future research directed at cities and systemic change towards sustainability should (1) explore interrelations between the above epistemologies, using relational geography and governance theory as boundary areas; (2) conceive of cities as places shaped by and shaping interactions between multiple socio-technical and social-ecological systems; (3) focus on agency across systems and drivers of change, and develop corresponding approaches for intervention and experimentation; and (4) rebalance the empirical basis and methods employed, strengthening transdisciplinarity in particular.

**Wolfram, M. 2016. Conceptualizing urban transformative capacity: A framework for research and policy, *Cities* (51), 121-130.**

Cities play a crucial role in shaping coupled human-environment systems at local and global scales. With a view to amounting sustainability deficits, urban stakeholders thus require transformative capacity to perform radical change within and across the multiple socio-ecological and socio-technical systems embedded in cities. However, existing (transformative) 'capacity' concepts refer to distinct subjects and purposes and do not adequately address the particularities of urban contexts and/or practical operationalization. Therefore, this paper suggests an integrated conceptual framework for developing 'urban transformative capacity', drawing on contributions from a range of research areas. It identifies 10 key components and a range of factors that describe the forms of agency and interaction, development processes and relational dimensions involved in building up urban transformative capacity, emphasizing the vital role of place and scale in this. It thus establishes a baseline and direction for capacity growth. This allows recognizing the particular requirements and assets of diverse types of cities and urban contexts in the global North and South, and offers strategic orientation for urban policy making, planning practice and research.

**Ely, A., Geall, S., and Song, Y., 2016, Sustainable maize production and consumption in China: practices and politics in transition, *Journal of Cleaner Production*, in press**

China provides a stark and globally significant illustration of how changing patterns of food production and consumption (especially related to increased intake of animal protein) are creating negative impacts on biodiversity, climate, nitrogen and phosphorous cycles and the use of freshwater. However, China's rapidly growing innovation capabilities and dynamic pattern of development also offer a unique opportunity for transitions towards more sustainable and resilient agri-food systems. Applying a 'food practices in transition' framework (Spaargaren et al 2012), this paper discusses the technological, political and socio-cultural factors central to such systemic changes, with a focus on maize as a core case study. In particular it presents and discusses two contending (but not mutually-exclusive) pathways towards more sustainable maize production and consumption. One, which we call the 'indigenous innovation' pathway is framed by 'systemic rationalities' and characterised by a focus on R&D-intensive technologies for agricultural intensification, including the controversial use of transgenic phytase maize. The second, which we term the 'alternative' pathway, is framed by 'lifeworld rationalities' and focusses on improved management practices, shorter supply chains, agro-ecological and participatory research. The two pathways claim different environmental benefits and present different risks and political implications. This paper analyses the food practices in transition in each pathway, identifying links with shifting political conditions and pointing to the increasingly significant role of consumer agency in steering patterns of maize production and consumption in China.

**Hodson, M., and Marvin, S. (2016) The mutual construction of urban retrofit and scale: Governing ON, IN and WITH in Greater Manchester. *Environment and Planning C*, in press**

In this article, we focus on the mutually interrelated processes of constructing urban retrofit and the city-region as a scale for action. Urban retrofitting – the systematic reconfiguration of socio-technologies of energy in the existing built environment and infrastructure – is critical to the achievement of ambitious carbon reduction targets. To realise the ecological and economic benefits of retrofit cities are continually searching for a 'fix' that allows them to upscale retrofit from a largely ad hoc and piecemeal activity of repair and maintenance into strategic and systemic retrofit programmes that transform existing cities. This article is primarily concerned with understanding the politics and purpose of such experimentation and analyses efforts to integrate retrofit and governing in Greater Manchester. To do this, the article draws on a programme of interviews with national, city-regional, local authority and neighbourhood scale actors, documentary analysis and observations. We address on who is constructing retrofit responses in Greater Manchester and also why they are being



constructed: Is it to transform the city-region and, if so, in what ways? And ask, in what ways are governance frameworks mediating and interpreting wider sets of global pressures at city-regional scale and which of these – economic, ecological, governing, social justice, etc. – pressures are more and less prioritised? We set out dominant city-regional responses (ON), alternative responses (IN) and assess the possibilities for integrated responses (WITH).

**Reiner, D.M., 2016, Learning through a portfolio of carbon capture and storage demonstration projects, *Nature Energy*, 1, 16013**

Carbon dioxide capture and storage (CCS) technology is considered by many to be an essential route to meet climate mitigation targets in the power and industrial sectors. Deploying CCS technologies globally will first require a portfolio of large-scale demonstration projects. These first projects should assist learning by diversity, learning by replication, de-risking the technologies and developing viable business models. From 2005 to 2009, optimism about the pace of CCS rollout led to mutually independent efforts in the European Union, North America and Australia to assemble portfolios of projects. Since 2009, only a few of these many project proposals remain viable, but the initial rationales for demonstration have not been revisited in the face of changing circumstances. Here I argue that learning is now both more difficult and more important given the slow pace of deployment. Developing a more coordinated global portfolio will facilitate learning across projects and may determine whether CCS ever emerges from the demonstration phase.

**Konrad, K., 2016, Expectation dynamics: Ups and downs of alternative fuels, *Nature Energy*, 1, 16022**

The transport sector must undergo radical changes if it is to reduce its carbon emissions, calling for alternative vehicles and fuel types. Researchers now analyse the expectation cycles for different fuel technologies and draw lessons for the role of US policy in supporting them.

**Melton, N., Axsen, J., and Sperling, D., 2016, Moving beyond alternative fuel hype to decarbonize transportation, *Nature Energy*, 1, 16013**

In the past three decades, government, industry and other stakeholders have repeatedly been swept up with the ‘fuel du jour’, claiming that a particular alternative fuel vehicle (AFV) technology can succeed in replacing conventional gasoline-powered vehicles. However, AFV technologies have experienced relatively little success, with fossil fuels still accounting for about 95% of global transport energy use. Here, using the US as a case study, we conduct a media analysis to show how society’s attention has skipped among AFV types between 1980 and 2013, including methanol, natural gas, plug-in electric, hybrid electric, hydrogen and biofuels. Although our results provide no indication as to whether hype ultimately has a net positive or negative impact on AFV innovation, we offer several recommendations that governments can follow to move past hype to support significant AFV adoption and displace fossil fuel use in the transportation sector.

**Parag, Y. and Sovacool, B., 2016, Electricity market design for the prosumer era, *Nature Energy*, 1(3), 16032**

Prosumers are agents that both consume and produce energy. With the growth in small and medium-sized agents using solar photovoltaic panels, smart meters, vehicle-to-grid electric automobiles, home batteries and other ‘smart’ devices, prosuming offers the potential for consumers and vehicle owners to re-evaluate their energy practices. As the number of prosumers increases, the electric utility sector of today is likely to undergo significant changes over the coming decades, offering possibilities for greening of the system, but also bringing many unknowns and risks that need to be identified and managed. To develop strategies for the future, policymakers and planners need knowledge of how prosumers could be integrated effectively and efficiently into competitive electricity markets. Here we identify and discuss three promising potential prosumer markets related to prosumer grid

integration, peer-to-peer models and prosumer community groups. We also caution against optimism by laying out a series of caveats and complexities.

**Van den Bergh, J., C. Folke, S. Polasky, M. Scheffer and W. Steffen (2015). What if solar energy becomes really cheap? A thought experiment on environmental problem shifting. *Current Opinion in Environmental Sustainability* 14: 170-179.**

Solving one environmental problem may often invoke or intensify another one. Such environmental problem shifting (EPS) is a neglected topic in global sustainability research. Indeed, it is difficult to study as it requires the merging of insights from various research areas. Here we identify relevant studies, and provide an illustration and guidelines for the systematic study of EPS. As a modest thought experiment to illustrate the relevance of EPS, we consider solutions to scarcity of energy resources and climate change that, due to their extreme nature, may lead to considerable environmental problem shifting. We qualitatively assess the likely environmental and socioeconomic impacts of three hypothetical energy futures to highlight the possibility that as we resolve one environmental problem, another may be aggravated. We further present a set of guidelines to study EPS in a systematic and focused way. Here we stress that shifting can be mediated by biophysical as well as socioeconomic mechanisms, which means that its analysis requires a genuine interdisciplinary effort.

**Subtil Lacerda, J., and J.C.J.M. van den Bergh (2015). Diversity in solar photovoltaic energy: Implications for innovation and policy. *Renewable and Sustainable Energy Reviews* 54: 331-340.**

We undertake a qualitative empirical study of the solar photovoltaic (PV) industry in order to investigate the role of diversity in stimulating innovation and diffusion. Based on evolutionary-economic concepts, we identify the main dimensions and components of diversity in the solar PV industry. Using nine indicators and additional information about recent developments regarding technologies, markets and actors (countries and firms), the dynamic potential is assessed for the various solar PV technologies. It is concluded that the dominant trend is an increase or maintenance of diversity among solar PV technologies, which likely contributes positively to innovation and diffusion. We discuss the implications of taking into account the role of diversity of solar PV in the design of energy policies.

**Antal, M. and J.C.J.M. van den Bergh (2016). Green growth and climate change: Conceptual and empirical considerations. *Climate Policy* 16(2): 165-177.**

The feasibility of green growth is studied in the context of climate change. As carbon emissions are easier to quantify than many other types of environmental pressure, it will be possible to reach a more definite conclusion about the likelihood of green growth than has been possible in the long-standing historical debate on growth versus the environment. We calculate the rate of decoupling between gross domestic product (GDP) and GHG emissions needed to achieve internationally agreed climate targets. Next, eight arguments are considered that together suggest that fast decoupling will be very difficult. Subsequently, we examine the main lines of research used by proponents of green growth to support their viewpoint, including theoretical arguments, exercises with integrated assessment models, and studies of the environmental Kuznets curve hypothesis. It will be concluded that decoupling as a main or single strategy to combine economic and environmental aims should be judged as taking a very large risk with our common future. To minimize this risk we need to seriously consider reducing our dependence on growth. This requires a fundamental change of focus in both economic research and policy.

**Lopes, M.A.R., Antunes, C.H., Janda, K.B., Peizoto, P. and Martins, N., 2016, The potential of energy behaviours in a smart(er) grid: Policy implications from a Portuguese exploratory study, *Energy Policy*, 90, 233-245**

The transition to smart grids is an on-going process that may both shape and be shaped by end-users' energy behavioural adaptations. This study explores current and potential energy

behavioural adaptations in Portugal during the smart grid transition process. A web-based survey was made to a representative sample of a specific segment of Portuguese residential end-users. The survey evaluated current energy behaviours and hypothetical future behaviours in a dynamic pricing scenario. Results show this population segment has a positive predisposition towards smart technologies and demand shifting, but it is less likely to accept load control and switch to the liberalised energy market. Factors influencing the behavioural potential are mostly related with market regulation, households' practices and usage behaviours, interference with the private domain, information and technical aspects, and social values. To facilitate behavioural adaptations several strategies are recommended, such as improving the energy market regulation, assessing households' behaviours, prioritising actions already embedded in households daily routines, not interfering with their activities and ensure an override option, and improving energy services, trust and information provided to end-users. The conclusions of the present study are of utmost importance for the design of more effective demand response programmes and energy policies.

**Hecher, M., Vilsmaier, U., Akhavan, R. and Binder, C.,R., 2016, An integrative analysis of energy transitions in energy regions: A case study of *ökoEnergiewelt* in Austria, *Ecological Economics*, 121, 40-53**

'Energy regions' are regional initiatives, which are engaged in becoming energy self-sufficient by using regionally available energy sources. They support the overall transition towards renewable-based energy and are of key interest to understand how the energy systems and institutional settings in these energy regions changed over time. In this article, a historical and integrative perspective is employed in analyzing the transition process of an Austrian energy region towards energy self-sufficiency. Specifically, (i) an Energy Flow Analysis (EFA) was performed for three points in time (1990, 2000, and 2010); (ii) the institutionalization process was analyzed in terms of the key actors, key milestones, and key factors influencing the transition process; and (iii) an integrative analysis was performed to indicate how the technical and social systems are interrelated. It was found that the most significant changes in the energy region were the efforts made in setting up a decentralized energy system. The co-action of actors from all spheres of society is crucial for aiding energy transition while this process needs to be supported by activities fostering awareness, generate acceptance, and engage the public at large. While there is a clear correspondence between improvements in energy self-sufficiency and the requisite effort at institutionalization, there is also a noticeable time delay between the development of an 'energy vision' and the subsequent impact on energy infrastructure.

**Gsodam, P., Rauter, R., Baumgartner, R.J., 2015, The renewable energy debate: how Austrian electric utilities are changing their business models, *Energy, Sustainability and Society*, 5:28**

The growing need for energy and the associated increase in environmental problems are leading to ever greater demands for a radical transformation in today's power systems with a move towards higher levels of sustainability. Energy utilities need to adapt both their structure and their business model. The aim of this paper is to investigate utility business models related to the provision of renewable electrical energy in Austria. An explorative qualitative research strategy is applied; this means that case studies were carried out during November 2013 and January 2014. Six interviewees—all leaders in their field—are questioned on their business model for renewable energy. The results show that utilities focus on large-scale renewable energy projects as these do not pose a threat to their current business. Small-scale decentralized renewable energy projects are less important for utilities and require new competencies and business models. Furthermore, some utilities have already started to address other important issues related to their business model such as smart metering or e-mobility. In applying the business model concept to change processes in one specific branch in Austria, the results presented contribute to business model literature. As

business model innovation is perceived to be an important step in mastering the challenges of energy transition, the findings are interesting for the utilities concerned.

**Augenstein, K. and Palzkill, A., 2016, The dilemma of incumbents in sustainability transitions: A narrative approach, *Administrative Science*, 6(1), 1;**

In the context of the larger sustainability discourse, “sufficiency” is beginning to emerge as a new value throughout Western societies, and the question asked in this article is: Can we observe and conceptually identify opportunities to link successful business strategies of incumbents to principles of sufficiency? Thus, how feasible is sustainable entrepreneurship for incumbents? In this paper, a conceptual approach is developed combining insights from sociology, transition research, management and sustainable entrepreneurship research with a focus on narratives as a translation mechanism in situations where tensions emerge between corporate narratives and unexpected societal trends, e.g., the emergence of sufficient lifestyles. It will be shown that even though these are still a niche phenomenon, a focus on corporate narratives is an important element in understanding the role of incumbents in transitions to sustainability.

**Haarstad, H., 2016, Where are urban energy transitions governed? Conceptualizing the complex governance arrangements for low-carbon mobility in Europe, *Cities*, in press**

This article addresses the question of where urban low-carbon energy transitions are governed. A challenge is that urban governance is not simply urban, but a complex assemblage of institutions, networks and socio-technical arrangements. There are several on-going literature debates discussing the different types of processes in which cities are involved. I disaggregate these into vertical processes (multilevel governance perspectives), horizontal processes (network and policy mobility perspectives), and what I term infrastructural processes (steering by conditions in the built environment). The purpose of the article is to show how all these types of governance processes combine to drive urban low-carbon energy transitions. Using the notion of policy assemblage, I outline a framework through which the different types of governance processes can be reconciled. This is illustrated through a discussion of how the different types of processes interact in the context of urban low-carbon mobility in Europe. A discussion of the case of Stavanger, Norway, shows how different types of governance processes combine to drive and constrain low-carbon energy transitions and underlines the importance of taking seriously the constraints of the built environment.

**Gaede, J. and Meadowcroft, J., 2016, A question of authenticity: Status quo bias and the International Energy Agency's World Energy Outlook, *Journal of Environmental Policy & Planning*, in press**

Over the past decade, transition scholars have argued that images of the future (of what sort of change is possible or probable, desirable or undesirable) play a critical role in societal transitions, and there is a long-standing tradition of analysis that points out the political significance of visions of the future. This article explores the politics of the future in sustainability transitions by looking at controversy surrounding a prominent global energy future report—the International Energy Agency's *World Energy Outlook*—between 1998 and 2008/2009. A key theme of this controversy was that the Outlook's record on global oil supply projections demonstrated a bias towards the preservation of the status quo. Based on research interviews conducted with key participants in this controversy, and a review of Outlooks produced between 1998 and 2008, we explore the main ‘sites of contention’ in the allegation of bias from both an ‘internal’ (sympathetic) and an ‘external’ (critical) perspective. We argue that the politics of bias have less to do with one's relationship vis-à-vis the preservation of the regime, and more to do with a question concerning the speaker's authenticity.

**Gabaldón-Estevan, D., Mezquita, A., Ferrer, S., Monfort, E., 2016, Unwanted effects of European Union environmental policy to promote a post-carbon industry. The case of energy in the European ceramic tile sector, *Journal of Cleaner Production*, 117, 41-49**

Global warming combined with low carbon transition plans is threatening the future of high energy consumption industry sectors in the European Union (EU). The need to respond to environmental challenges is demonstrated by support for international level energy policies and legal requirements, such as the Kyoto Protocol which the EU supports, and increased EU-level environmental legislation and energy policies. The effect of these initiatives is gradually transforming industrial activities in the EU. However, since not all countries have adopted these policies, evaluation of their net effect needs to take account also of side-effects such as delocalization of industry activity and the legal environmental frameworks in the countries where companies have chosen to relocate. This paper analyses EU energy policy and its impact on a particular energy intensive industry, the European ceramic tile sector. The discussion in this paper is not about the purpose of EU legislation, but about its effects on a specific industry. The effect of policy on industry is not a new topic, but the question of the unwanted effects of environmental and energy policy on European industry is becoming more relevant as the struggle to achieve a post-carbon Europe increases. In focussing on a specific set of EU legislation on a particular industry this article adds to the debate by showing the negative effects of policy mechanisms. The need for a scientific evaluation of the systemic changes required for a transition to a resource-efficient, green and competitive low-carbon economy outlined in the 7th Environment Action Programme is highlighted. It is suggested that the EU should periodically re-evaluate its Emissions Trading Scheme legislation to include specific actions and a follow up system which would prevent the best performing environmental companies from delocalizing or shutting down.

**Gorissen, L., Vrancken, V. and Manshoven, S., 2016, Transition thinking and business model innovation: Towards a transformative business model and new role for the reuse centers of Limburg, Belgium, *Sustainability* 2016, 8(2), 112**

The current dynamics of change, including climate change, resource depletion, energy transition, internet of things, *etc.* will have substantial impacts on the functioning of contemporary business models. Most firms and companies, however, still largely focus on efficiency strategies leading to sub-optimal solutions (reducing bad impact), rather than radically changing their business model to develop new transaction models more appropriate for today's world (doing better things). However, persistent sustainability issues arising from our changing societal systems, require more radical and structural changes both within and between organizations to change the way we do business. There is limited empirically established research literature on how businesses can be more proactive in this regard and how they can move beyond "management of unsustainability". In this paper, we present a transformative business model innovation approach inspired by transition theory combining elements of systems thinking, value-inspired envisioning, reflexive design and co-creation that was pioneered for a consortia of reuse centers in the province of Limburg, Belgium. We demonstrate that this approach contributed to the development of new business model concepts, was conducive for mobilizing support and resources to ensure follow up activity and holds potential to promote a more proactive role for businesses as agents of transformative change.

**Special issue on 'Energy transitions in Europe: Emerging challenges, innovative approaches, and possible solutions', *Energy Research & Social Science***

**Sarrica, M., Brondi, S., Cottone, P., Mazzara, B.M., 2016, One, no one, one hundred thousand energy transitions in Europe: The quest for a cultural approach, *Energy Research & Social Science*, 1-14**

Far from being a univocal process, energy transitions involve several pathways and require research that connects multiple theoretical, disciplinary and methodological perspectives. The European scenario is a clear example of how the boundaries and the direction of such process are difficultly identifiable and merged with culturally situated meanings and practices. In this opening paper, drawing on a psychosocial background, we propose a cultural approach as an attempt to overcome the dichotomies between technical and human, social and individual accounts of energy transitions. In this framework, we illustrate the two main axes that guided this collection of research: a situated perspective, and a focus on different planes of transition (individual, community, societal). Then, we present the European scenario and introduce the contributions, which propose a large variety of epistemological perspectives, and theoretical, methodological and disciplinary integrations. We conclude with a commentary of the main challenges to be addressed in order to develop a shared scientific paradigm: the need for further integration towards shared interpretative frameworks, the quest for a constructive and future-oriented research attitude, the importance of connecting different planes of analysis to foresee alternative scenarios, and the need for proposals and solutions to be addressed to decision makers.

**Van der Schoor, T., Van Lente, H., Scholtens, B. and Peine, A., 2016, Challenging obduracy: How local communities transform the energy system, *Energy Research & Social Science*, 94-105**

The transformation from the current energy system to a decentralized renewable energy system requires the transformation of communities into energy neutral or even energy producing communities. Increasingly, citizens become 'prosumers' and pool their resources to start a local energy initiative. In this paper we present an in-depth study of networks that recently developed, which challenge the established way of centralized decision-making on energy resources. Many local communities are eager to promote sustainable energy production, to use local financial resources for the local community and to employ democratic governance of energy production and supply. Furthermore, we study how these co-operations are linked to local, regional and national networks for community energy. We use both Actor-Network Theory (ANT) and Social Movement Theory (SMT) to investigate the initiatives, as this allows a dynamic analysis of collective strategies. We discuss the obduracy of the energy system and how this system is challenged by new connections between communities and global networks and by new types of energy providers that are rooted in social networks. Furthermore, we draw attention to the way community energy networks provide a social innovation while realizing a decentralized and decarbonized energy system.

**Rasch, E.D. and Kohne, M., 2016, Hydraulic fracturing, energy transition and political engagement in the Netherlands: The energetics of citizenship, *Energy Research & Social Science*, 106-115**

This paper analyses how citizens (re)define their relation to the state in the contestation of hydraulic fracturing in the Noordoostpolder (the Netherlands) in the context of energy transition. It approaches citizenship as the negotiations between governments and citizens about in-and exclusion in decision-making processes and argues that these are also produced at the site of energy transition. It focuses on how residents of the Noordoostpolder construct their citizenship, resisting the advent of fracking in their environment while at the same time negotiating their own inclusion in decision-making processes. Our ethnographic material encompasses almost a year of these negotiations starting shortly after the announcement of the Noordoostpolder as a site for exploratory drilling, when people feel highly disempowered and excluded. We closely follow a process of gradual empowerment in the face of energy transition as inhabitants start to produce their own knowledge base and coalesce into unusual partnerships to negotiate their inclusion. Our main argument is that negotiations about hydraulic fracturing in relation to energy transition goes beyond energy issues. It is also -if not mostly -about who gets to decide on energy and land use.

**Magnani, N. and Osti, G., 2016, Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition, *Energy Research & Social Science*, 148-157**

The paper analyzes the role of civil society in Italy's energy transition with particular attention paid to those forms of social innovation developing new energy pathways alternative to the dominant ones. The international literature emphasizes the weakness of such initiatives in southern Europe as compared to Northern European countries. However, there is a lack of analysis of empirical cases in this area, as well as convincing explanations for the lagging behind of Southern European countries. Against this background, on the basis of qualitative research centered on semi-structured interviews with civil society actors, we analyze the main grassroots initiatives emerging in Italy in regard to the production, consumption, and recently the provision, of renewable energy. In the discussion part of the paper, we explore these innovative practices with a comparative approach taking Germany as the main reference point. Hence we explain the fragility of Italian experience in relation to structural socio-economic characteristics of the country – namely municipal socialism and dualism of the capitalist system – and to the evolution of the Italian cooperative movement. Eventually we also assess the potential of emerging initiatives for challenging the existing centralized energy system.

**Wagner, A., Grobelski, T., and Harembski, M., 2016, Is energy policy a public issue? Nuclear power in Poland and implications for energy transitions, *Energy Research & Social Science*, 158-169**

In this article we assess public communication on nuclear energy in Poland against four theoretical ideal types of the public sphere in modern democracies. We investigate law, media discourse, and civil society as dimensions of the public sphere, and use the analysis to draw out broader implications for energy transitions. We conclude that although in the legal and civil society realms there are some elements of the participatory liberal type, the current functioning of the public sphere is rather aligned with the representative liberal democracy type and does not further energy transition. The representative liberal type is supported by mainstream media, focused mainly on economic and political elites. This is why initiatives of grassroots movements are not reflected in public discourse, neither in traditional media nor on the Internet. Even if they appear, their impact is limited because of weak exposition. Our research offers reflections on how energy transition may be furthered via the public sphere. The article brings a sociological and socio-legal analysis of the public sphere to energy policy research. By presenting the unique case of potential new nuclear power plant build in Poland, we contribute an integrative view of energy policy as a public governance issue in contemporary Central and East European democracies

**Edberg, K. and Tarasova, E., 2016, Phasing out or phasing in: Framing the role of nuclear power in the Swedish energy transition, *Energy Research & Social Science*, 170-179**

This article examines how members of the Swedish Parliament framed nuclear energy in the 2010 debate on the future of nuclear power in Sweden in order to understand how politicians construct and contextualize their views on the role of nuclear energy in energy transitions. Our findings suggest that four themes could be identified in the debate and that these were formative for politicians in framing nuclear energy. Even though all political actors anticipate an energy transition towards a more sustainable system, different paths to advancing in this process were brought up in the debate, both with and without prolongation of the nuclear energy program. Our analysis suggests that framings of nuclear energy are closely related to the political ideologies of the parties in the Parliament because the two framings of nuclear energy correspond with the division of the Swedish Parliament into two political blocs. However, views on nuclear energy are not inherent to political ideologies but are constructed. This article thus integrates the politics of nuclear energy within the research on energy transitions.

**Silveira, A. and Johnson, F.X., 2016, Navigating the transition to sustainable bioenergy in Sweden and Brazil: Lessons learned in a European and international context, *Energy Research & Social Science*, 180-193**

This paper uses a socio-technical approach to explore why the transition towards modern bioenergy has achieved success in some segments and/or countries but not in others. We reflect on the availability of initial socio-technical resources in the form of established platforms, policy motivations, and the roles of different stakeholders. We analyse how socio-technical networks evolved over time in response to enabling policies and interest groups as well as opposition groups in four different bioenergy segments: solid biomass for district heating in Sweden, charcoal for iron and steel industry in Brazil, and ethanol for transport in both countries. The Swedish and Brazilian experiences illustrate the importance of coordinating policies between local and national levels and across sectors in order to advance modern bioenergy platforms. The focus on Sweden—an EU and global bioenergy pioneer—along with Brazil—a recognised global biofuels leader—helps to illustrate the linkages to regional and global markets that are important for European energy transitions. The analysis also emphasizes the need to look beyond the energy sector, considering actors and stakeholders' interests at large, as well as broad boundaries for socio-technical regimes. Our analysis draws on the established literature concerning socio-technical transitions, innovation systems and systems approaches.

**Chabrol, M., 2016, Re-examining historical energy transitions and urban systems in Europe, *Energy Research & Social Science*, 194-201**

This contribution questions the implication of energy use in the evolution process of urban systems and examines the role of energy systems, their evolution, socio-economic and technological factors related to them, in differentiations or regularities observed. Then, this evolutionary approach asks about future urban dynamics in an energetic crises context. This analysis is based on historical energy consumption data (Centre for History and Economics, Harvard) and on e-Geopolis database for population of urban areas 10.000 inhabitants and more. The targets are exploration and recognition of the role of energy in urban dynamics, growth and structuration in hierarchies during 200 years.

**Sovacool, B., 2016, How long will it take? Conceptualizing the temporal dynamics of energy transitions, *Energy Research & Social Science*, 202-215**

Transitioning away from our current global energy system is of paramount importance. The speed at which a transition can take place—its timing, or temporal dynamics—is a critical element of consideration. This study therefore investigates the issue of time in global and national energy transitions by asking: What does the mainstream academic literature suggest about the time scale of energy transitions? Additionally, what does some of the more recent empirical data related to transitions say, or challenge, about conventional views? In answering these questions, the article presents a “mainstream” view of energy transitions as long, protracted affairs, often taking decades to centuries to occur. However, the article then offers some empirical evidence that the predominant view of timing may not always be supported by the evidence. With this in mind, the final part of the article argues for more transparent conceptions and definitions of energy transitions, and it asks for analysis that recognizes the causal complexity underlying them.

**Andrews-Speed, P., 2016, Applying institutional theory to the low-carbon energy transition, *Energy Research & Social Science*, 216-225**

The low-carbon energy transition is a form of socio-technical transition and, as such, it involves profound changes in the institutions that govern society. Despite the acknowledged importance of institutions in shaping the pace and nature of transition, a relatively small proportion of the academic literature on the topic applies institutional theory to the analysis of this transition in a systematic and detailed manner, and these accounts draw mainly on organizational and sociological institutionalism. This paper aims to demonstrate the benefits of applying a wider set of institutional theories to the study of the low-carbon energy



transition. It draws principally, but not solely, on rational choice and historical institutionalism with selective reference being made to key concepts within social and organizational institutionalism as well as discursive institutionalism. The paper demonstrates the high degree of parallelism that exists between the literatures on socio-technical regimes and institutions, and also shows how the systematic application of institutionalism can provide a deeper understanding of socio-technical transitions. It concludes by outlining the main elements of a research agenda relating to the low-carbon energy transition.