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Understanding the heterogeneity of regional energy transitions: opportunities and limitations for regional development

Organizers: Lars Coenen (University of Melbourne), Teis Hansen (Lund University), Robert Hassink (Kiel University)

Energy transitions (Grubler 2012) can be regarded in the broader framework of the well-researched sustainability transitions (Köhler et al. 2019). They are often theoretically framed in the socio-technical transitions literature around the multi-level perspective and technical innovation systems (Geels 2002). The geography of energy transitions is increasingly taken seriously (Bridge et al. 2013; Calvert 2016; Coenen et al. 2010; Hansen and Coenen 2015; Truffer and Coenen 2012; Truffer et al. 2015)which lead to more research on energy transitions at the local and regional level (Mattes et al. 2015; Yu and Gibbs 2018; Rutherford and Coutard 2014).

However, despite advances, we still have important gaps in our knowledge about regional energy transitions, not least as the spatial organisation of energy systems is rapidly changing in many ways. Firstly, the range, role and responsibility of actors involved in energy production, distribution, innovation and use is expanding significantly due to renewable energy deployment. This rise of renewables has created a more decentralised energy geography, where prosumers and community energy organisations play an increasingly critical role (Seyfang and Haxeltine 2012; Radtke 2016) while incumbent actors have been coerced to re-think and reconfigure their original business models. Secondly, R&D for energy technologies is gradually decentralised, as various new small and medium-sized enterprises enter the market around the world giving rise to Schumpeterian waves of creative destruction, reconfigurations of value chains and emergence of regional energy clusters. Thirdly, energy policy and politics is becoming increasingly complex with a growing role for inter- and supranational actors as well as increased attention for issues such as energy poverty, justice and 'just transitions' (Newell and Mulvaney, 2013). However, at the same time, important countertendencies such as the re-municipalisation of the local energy

grid in Hamburg (Becker et al. 2015) and general calls for city and regional governments to actively steer and ensure social benefits from infrastructures delivering foundational services (Engelen et al. 2017) are also observed. This requires a fundamental re-think of the ways in which we conceptualize energy innovation, and its geographies, beyond technological innovation but inclusive of grassroot, social and responsible innovation.

These developments pose fundamental questions about the opportunities and limitations for regions to simultaneously achieve energy transitions and economic development. No matter in which variety of capitalism it is embedded, energy transition is widely seen as a growth path for local and regional economies, which may nevertheless take very different forms depending on regional industrial specialisations, natural resource endowments and institutional set-up (Grillitsch and Hansen 2018; MacKinnon et al. 2018).

For this special issue, we therefore invite contributions on regional energy transitions from different academic backgrounds, such as geography, economics, sociology and political science including but not limited to the following topics:

- the actual drivers of regional energy transition;
- the impact of regional energy transition in both economic, social and environmental terms;
- the relative importance of energy technology development and deployment activities in instigating economic development in different regional contexts;
- the multiple types of actors and innovation that may transform the opportunities offered by the energy transition into regional development in various forms;
- the potential deficiencies of ongoing transformations in the energy sector;
- the impact of different varieties of capitalism on regional energy transition;
- the governance of regional energy transitions across different scales;
- the potential of energy transition in different regional contexts, such as in old industrial areas (Dawley et al. 2015; Fornahl et al. 2012)

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