

The 11th Biennial Conference of the European Society for Ecological Economics

Title: Investing in low carbon transitions: Energy finance as an Adaptive Market

**5. New business models and understandings of human behaviour**

Sub theme:

5.2. Investment, finance and social welfare

**Extended abstract:**

The volume of capital needed to transition energy systems to low carbon futures is almost too large to usefully comprehend. The International Energy Agency estimates up to \$49 trillion is required simply to meet projected world energy demand to 2035. In order to meet these demands within a credible emissions framework, a different mix of investment and efficiency pathways may require up to \$53 trillion over the same period (IEA, 2014). In recognising the scope of this investment challenge, much scholarship to date has focussed on different pricing and market creation tools to encourage investment, such as the design of renewable energy subsidies (Gross et al, 2010; Wood and Dow, 2011), emissions trading mechanisms (Grubb & Neuhoff, 2006; Hepburn *et al*, 2006; Hintermann, 2010) and the relative merits of pricing carbon (Ellerman *et al*, 2010; Aldy and Stavins 2012, Cetin, U., & Verschuere, M. 2009). However, many of these studies treat the availability of capital for system transitions as a given; if only the right risk and return ratios can be created by energy policy, low-carbon transitions will present a cogent profit opportunity, which mobile capital will exploit. This view is reflected in policy debates, where the emphasis is on supporting low carbon technologies through the innovation chain to commercialisation, at which point market mechanisms are expected to drive widespread deployment. This study interrogates whether the availability of capital for energy system transition can in fact be assumed. It does so in light of emergent understandings of financial markets, particularly for energy technologies, as behaviourally and structurally constrained; this is a departure from neo-classical assumptions of markets as efficient resource allocators.

The authors draw on the 'three domains of planetary economics' proposed by Grubb *et al* (2014), augmented by ideas from a coevolutionary framework (Foxon, 2011) and adaptive finance (Lo, 2004/2012; Soufian *et al*, 2013), to frame the financing of large system change. Grubb *et al* (2014) argue neo-classical market logics are necessary but insufficient framings to fully apprehend the

diverse and co-evolving institutions, policies, behaviours and structures which affect investors in energy transitions.

Given the UK has perhaps gone furthest in marketization and liberalisation of energy infrastructures, it is a useful case for analysing the private investment and finance elements of transitioning large socio-technical systems towards low-carbon futures. This research aimed to understand how the logics of UK energy policy, and wider structural shifts in the energy sector and capital markets, are affecting the market for renewable energy (RE) finance. Understanding the markets for energy finance is vital to achieving the rates of deployment necessary to meet decarbonisation targets within the Climate Change Act (2008).

The authors' theoretical framing draws on new insights from Grubb *et al* (2014) on the 'three domains' of sustainable development. Established literatures exist on the effects of both first (behavioural and organisational) and second (neo-classical/welfare) domain theories on financial markets in the energy transition. However, there is a gap in the literature on third domain (evolutionary and institutional) treatments of investment and financial markets. The paper frames the contribution of this research in these terms, proposing the Adaptive Markets Hypothesis (Lo, 2004/2012; Soufian *et al*, 2013) as a useful tool for understanding structural, evolutionary and institutional effects on energy transition finance. Based on this approach, four conditions are proposed under which renewable energy finance could be described as an 'adaptive' market.

This contribution describes the authors' results on the current investment landscape for renewable energy in the UK. We describe the energy policy landscape as a response to capital constraint from traditional RE finance providers. We then show how the UK's electricity market reform has been constructed to incentivise new actors into the RE investment space. We analyse how structural and cognitive factors co-evolve to produce a landscape of RE finance in that is immature and subject to structural constraints. These results are analysed in concert with the Adaptive Markets Hypothesis (AMH). We argue that finance markets for renewable energy in the UK satisfy the four conditions proposed, and thus an adaptive (as opposed to efficient) understanding of financial markets is more suitable to understanding energy finance in this case. The conclusion of this paper proposes the Adaptive Markets Hypothesis as a useful way forward for researching the financial element of large system change, and describes how the AMH is a useful contribution to understanding financial markets in the 'third domain' of planetary economics. This allows new questions to be asked by ecological economists, as to both the availability of capital, and the ability of extant institutions to deploy that capital for the diffusion of innovations and system change.

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