Policy recommendations to up-scale “green” finance into the UK energy supply sector – A System Dynamics modelling approach

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What policies scale-up “green” finance into renewable energy infrastructure and what are their related socio-economic (e.g. inequality, employment) and macro-economic (e.g. GDP) consequences? These are the main research questions of this study.
Within the national “Climate Change Act 2008”, the UK committed to a reduction of at least 80% of emissions by 2050 against 1990 baseline”. In June 2016, the UK confirmed this target and set additionally a 57% interim-target for 2030 (UK Government, 2008; HM government, 2011; CCC, 2016). However, current projections of future UK greenhouse gas emissions predict that the UK will not reach this climate target without the introduction of additional policies to restructure and “green” its economy (CCC, 2016). Besides its climate target, the UK pursues other macroeconomic (e.g. high GDP, high productivity, remain internationally competitive) and socioeconomic objectives (e.g. low inequality) (HM government, 2011; HM Treasury, 2016). This is why this study aims to elaborate a System Dynamics (SD) model to analyse policies that support the UK to reduce its emissions (and therefore to scale-up green finance into infrastructure) while maximizing its other objectives.

The investigation is exemplified by the UK energy supply sector – as a case study of the “green” transition of one industry of the UK macro economy. The energy supply sector has been chosen for two main reasons: this sector was the single largest source of UK emissions, accounting for 31% of the total UK emissions in 2014 and is among the priority sectors for emissions reductions of the UK (Department of Energy & Climate Chance, 2016) and „greening“ the energy supply sector can contribute at the same time to more sustainability in other industries as well.

Current research shows that the “green” transition of the UK energy supply sector, as described in the Carbon Plan (HM government, 2011), requires a substantial amount of additional investments in energy infrastructure (DECC, 2014; Department of Trade and Industry, 2007; CCC, 2017; Ernst and Young, 2010). Scaling up investment and financing in low-carbon energy infrastructure, and especially in renewable electricity capacity, is therefore central to the implementation of the UK low-emission strategy until 2050 (CCC, 2017). Specifically, DECC (2014) estimates the required investments into low-emission energy infrastructure to be £100 bn (if transmission & generation are included) by 2020 and £130 bn by 2030. Thereby, according to Ernst and Young (2010) traditional sources of capital (e.g. project finance, infrastructure funds) will not be enough to cover the required energy infrastructure investments. Therefore, additional funding sources, such as finance from institutional investors (e.g. pension funds, insurance companies) or private investors (e.g. mainstream investors) are required to cover the „green" finance gap (see also OECD, 2016; Irena, 2016). Given the long-term time horizon of energy infrastructure, institutional investors, especially pensions funds, could be suitable for the financing of energy infrastructure (Irena, 2016). However, currently, private and institutional investors are not investing enough into „green" energy infrastructure due to different "green" investment barriers, including the following: lack of confidence given the technology risks, unstable climate policy-environment, high up-front capital requirements of renewable energy, , lack of information, lack of experience, lack of green financial products and high transaction costs etc. (e.g. Ernst and Young, 2010; Irena, 2016; OECD, 2016; Jones, 2015). However, it is neither yet fully researched nor integrated in current models used for climate policy analysis how investors do "weight" and rank different "green" investment barriers exactly (e.g. European Commission, 2016; OECD, 2016; Irena, 2016; Strachan et al., 2007, Strachan et al., 2009). Hence, the mobilization of additional investments into green energy infrastructure, requires further exploration of investment barriers so that new policies can tackle the most important barriers identified. Therefore, the focus of the thesis project lies on policies that contribute to scale-up green investment into the UK energy sector.

This PhD uses System Dynamics as main research method. The energy supply system and the economic sectors (e.g. finance, production, consumption sector) are all complex systems that involve delays, non-linearities and feedback loops and that are linked with each other. Moreover, the focus of this study lies on underlying structure (cause-and-effect relationships) and on the endogenous simulation of the behaviour of key decision-makers (e.g. investors) impacting the "green" transition of the energy supply industry. In particular, this PhD study aims to use semi-structured interviews to investigate the main barriers of investments in "green" energy infrastructure in the UK more specifically (e.g. how investors rank the different investment barriers), and to integrate this knowledge afterwards into the SD-thesis-model. This makes SD an appropriate research method for this study (see Barlas, 2002; Forrester, 1961 or Sterman, 2000).

CGE (General Classical Equilibrium) models are the dominating modelling approach used for climate policy analysis (e.g. Brockway, 2017). The UK government as well as the independent Climate Change Committee use, predominantly, the well-established Macro-hybrid energy-economic MARKAL Model for climate policy analysis and the investigation of related long-term macroeconomic consequences (Strachan et al., 2007, Strachan et al., 2009). This model is a combination of a neoclassical CGE economic model and the technological-rich bottom-up energy system MARKAL model (Strachan et al., 2007; 2008). However, this modelling approach involves certain restrictive assumptions. For example, it relies on the assumptions of cleared markets (equilibrium in the economy) in the long-run, rational agents and perfect information. Further, it focuses mostly on linear correlations, rather than on complexity, non-linear cause-and-effect relationships and feedback loops (which is the case for SD models) (see Strachan et al., 2007; 2008). The described characteristics of this modelling approach are not only important from a technical perspective, but also from a practical perspective as the application of these models can lead to biased policy recommendations and therefore to sub-optimal social welfare outcome for societies. Furthermore, another limitation of this type of models is that they generally don't include the simulation of investment decisions from a behavioural perspective (e.g. they do not show how investors form their risk-perceptions) (European Commission, 2016; Strachan et al., 2007;2008;2009. Therefore, this type of models does generally not show by construction what and how policies can scale-up green finance.

The expected contribution of this study is threefold: First, it contributes to a better understanding of the system structure of the economy (incl. finance sector) and energy supply sector. This is crucial for the identification of leverage points for policy implementation. The model (which integrates the results from semi-structured interviews, including investment experts) contributes in particular to a better understanding on how investors make decisions (e.g. how they decide to invest or not to investment in green energy infrastructure, how they price risks of green infrastructure investments or how they form risk perceptions in general). Second, it delivers policy recommendations to scale-up "green" finance in the energy supply sector of the UK while maximizing the outcome of other important economic objectives (e.g. low inequality, high employment). Finally, this study demonstrates macroeconomic and socioeconomic costs and benefits of the recommended policies.

The expected results that will be presented at this conference is the conceptional framework (see figure 1&2) of the thesis SD-model and a more detailed model structure of certain sectors of the thesis SD model. Thereby, the SD model includes the relevant economic sectors (production, labour market, consumption and financial sector) and a bottom-up representation of the energy supply sector. The production structure is on industry-level and differentiates industries with regard to their carbon intensity. Further, with regard to the simulation of the investment choices of investors for new energy infrastructure. A summary of the first round of the semi-structured interviews will be given as well as the presentation of the follow-up plan with regard to the online survey.

Figure 1: Overview of the System Dynamics thesis model

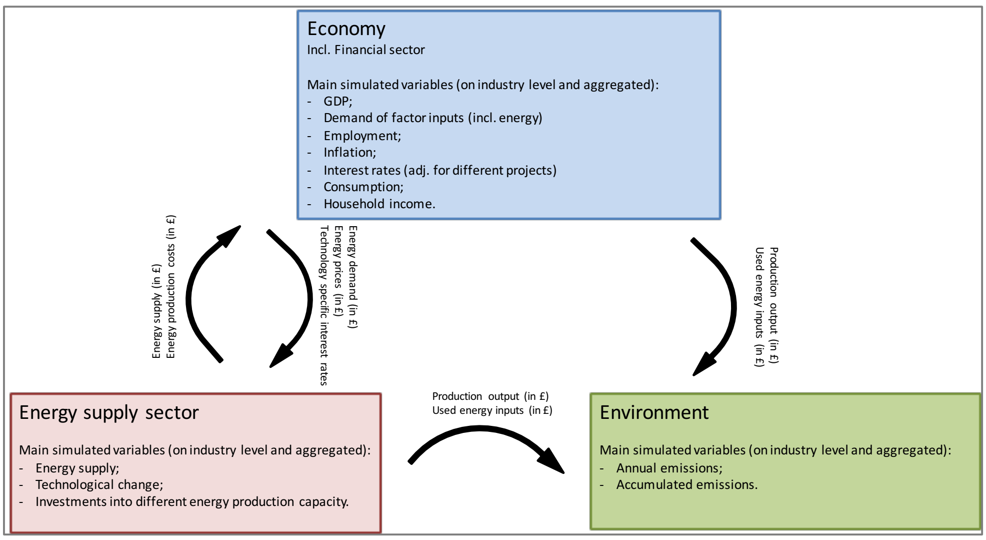
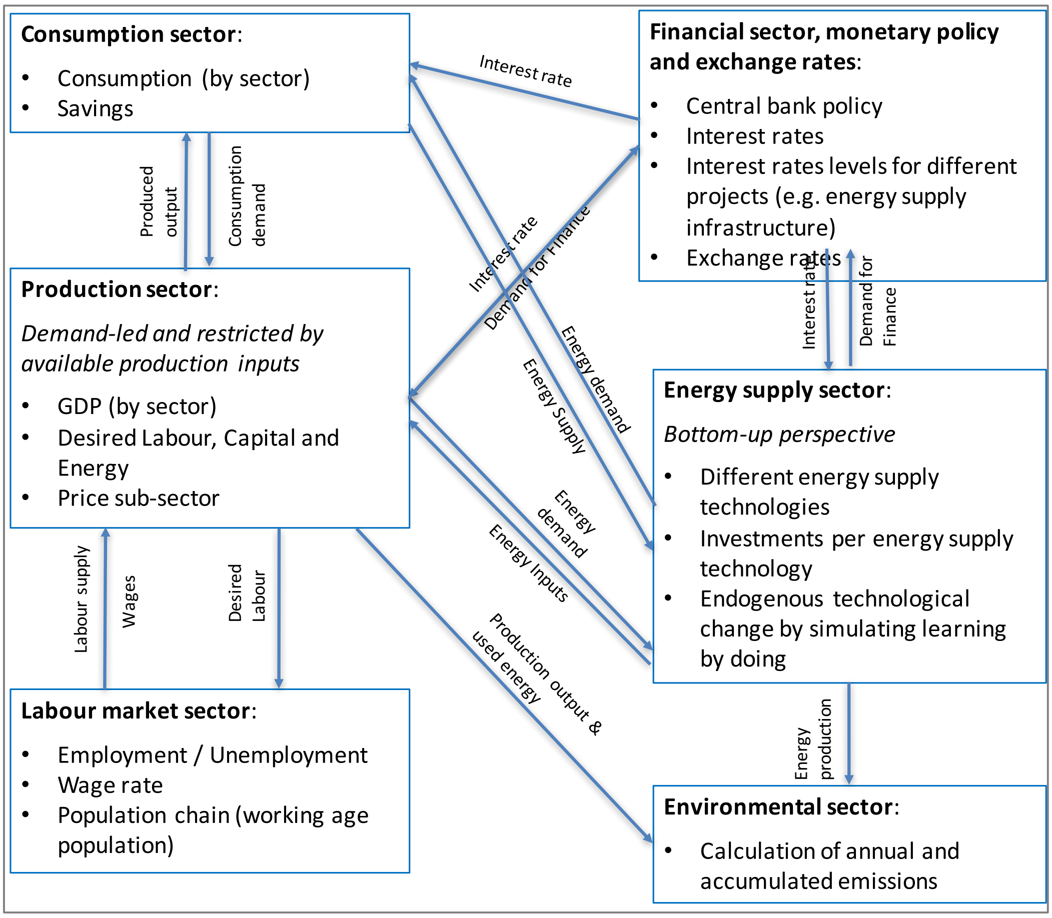


Figure 2: Overview of the System Dynamics thesis model – more detailed



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