***DYNAMIC MECHANISMS OF LOW-CARBON INVESTMENT DECISION IN THE CONTEXT OF UK ELECTRICITY GRID NETWORK***

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## Overview

The stable global CO2 emissions from electricity generation have been recorded since 1990. However, electricity-generated CO2 emissions rose significantly in the early 2010s in order to satisfy the increasing global electricity demand. The level of electricity-related CO2 emissions remains flat due to the increasing global concern for climate change (IEA, 2019). In 2019, the electricity is the leading driver of CO2 emission accounting for about 40% of global energy-related CO2 emissions and 25% of the world greenhouse gases(GHGs) emission. In addition, emissions from electricity generation rose by nearly 100 percent to 12.5GtCO2 in 2017 against 6.3GtCO2 in 1990 (IEA, 2019).

Thus, the fundamental step is to curb the use of fossil fuels in generation electricity. This implies the decarbonization of electricity sector through the deployment of renewable energy sources. In addition, more efforts from the world including the developed economies are still required to achieve the climate goals(IEA, 2019). Therefore, this paper examines how different renewable energy technologies can be optimally to achieve renewable electricity target in the context of UK electricity grid network.

Several scholarly works (e.g. Tan et al., 2013) have focused on the optimal allocated mix of renewable generation through three broad approaches, namely: conventional techniques (simulation and econometrics); artificial intelligence and hybrid intelligent system techniques. These techniques have been mainly applied to study the integration of RES-E on distribution grid. However, it is also important to consider the additional issue on the transmission infrastructure when examining allocation problems. Few studies have applied the approaches on the transmission grid level with a restriction to single renewable energy sources such as solar (Mainzer et al., 2014), wind (Grassi, Chokani and Abhari, 2012) or limited spatial scales in the case of multiple RES-E type (Zografidou et al., 2016).

While these scholarly works have increased our understanding on the cost optimal mix of the fully renewable energy system, few studies have examined the influence of the electricity grid structure on the appropriate renewable electricity mix (Deetjen, Reimers and Webber, 2018; Yan et al., 2017). These few literatures have applied the static grid topology model to determine the optimal combination of solar and wind with only one conventional technology (gas). Although, a dynamic evolutionary model of the electricity network infrastructure to prevent cascade failures is promoted in the most literature (Espejo, Lumbreras and Ramos, 2018; Azzolin et al, 2018; Kim et al., 2017). It would be more important to apply the approach to a variable grid connection of renewable energy electricity generator to investigate how the future transmission grid could be used to meet renewable electricity (RES-E) targets. Thus, this paper addresses the literature gap in the context of UK electricity grid network.

## Methods

Using the simple preferential attachment network as a starting point, the paper conducts an experimental evaluation in the behavioural space of NetLogo on the possibility of UK attaining renewable electricity target by 2030. The model is built on forest fire by generating social network and then observes how it influence the spread of innovation in line with the Bass model and a contagion model. As agent adopts innovation, its colour turns to green. With the assumption of the Bass model, the adoption remains unchanged.

## Results

The outcomes of the experimental evaluation indicate low probability of achieving the UK renewable electricity targets. However, improvement in its transmission infrastructure has a huge impact on renewable energy investment. More positive influence on renewable electricity investment is observed if the UK carbon price intervention is enhanced.

## Conclusions

This paper establishes novelty in the diffusion model by examining dynamic mechanisms of investment decision in renewable electricity deployment in the context of UK electricity grid network. Its findings show that more efforts are required in boosting the UK transmission network in order to achieve the renewable electricity targets in an optimal way.

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