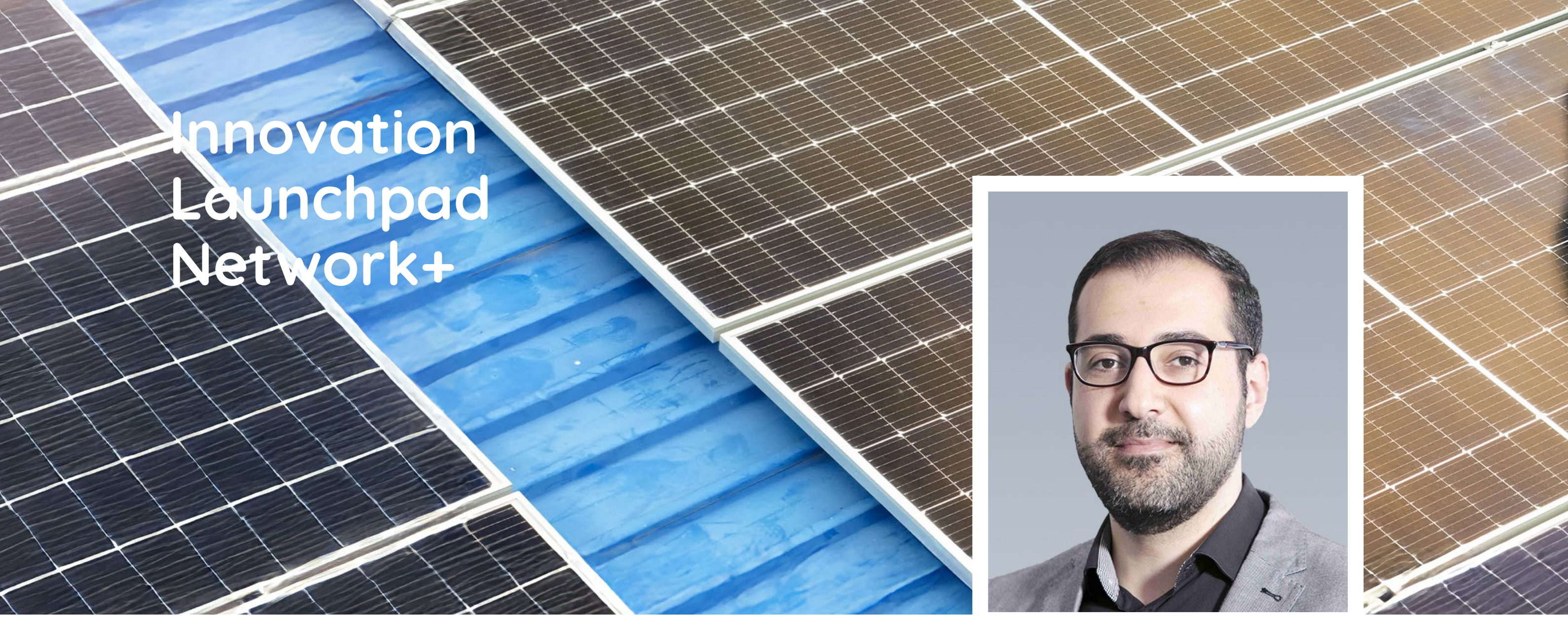

CASE STUDY

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The Challenge

The increased share of variable renewables is changing the nature of the electrical grid in the UK. However, dwindling revenues from electricity exports is disincentivising more renewable generation and making it less feasible. At the grid level, ensuring the supply always meets demand is a key remit of the National Energy System Operator (NESO). This is mostly achieved via electricity trading between generators and consumers through several electricity markets such as the wholesale, inter and intraday markets, the Balancing Mechanism and Ancillary services. Each of these markets has its own complicated participation rules and dynamics. Historically, access to electricity markets was the reserve of large players (generators, suppliers and intermediaries in the 100s of MWs of capacity portfolio). However, this is changing through several market reforms in the past decade, which is encouraging more participation and therefore unlocking new revenue opportunities for distributed generation and microgrids as well as providing the grid with essential services. Currently there is a lack in computational tools to help with investment decisions for small players. This could prevent risk-averse owners from participating or could create hype and over optimism for risk-tolerant owners exposing them to penalties and financial loss.
This project will aim to create a computational tool to help small generation and flexibility asset owners decide whether it makes sense to participate in trading independently or not (i.e. participate as a trader rather than having a contract with a large supplier that is already doing the trading).

Innovation
Launchpad
Network+

Innovation

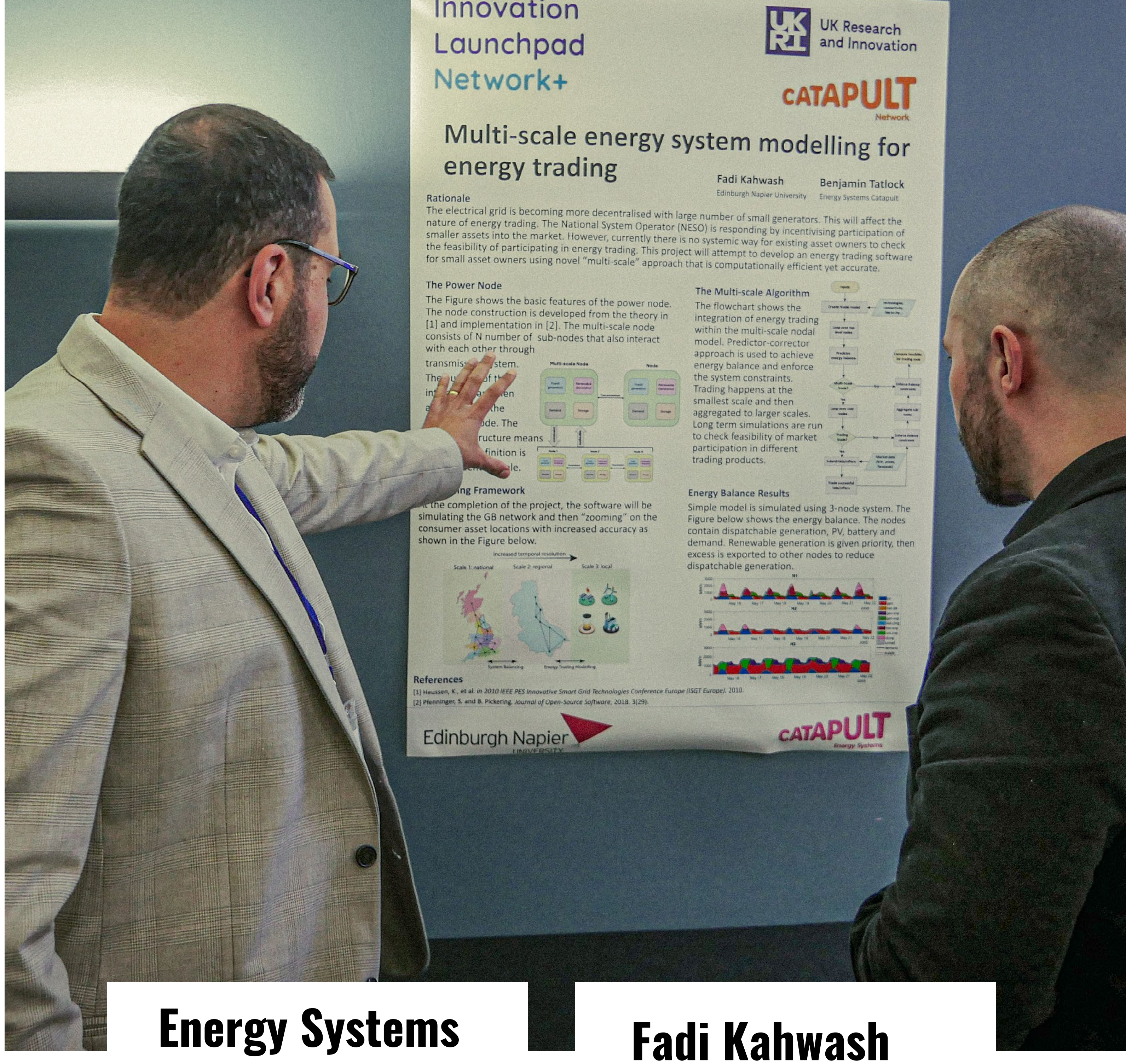
We started by conducting a literature survey of the different British electricity markets to identify the most suitable one for small players participation. The Balancing Mechanism (BM) emerged as a top candidate because it's increasing in importance in recent years and the reforms aiming to encourage participation of small players. For example, the participation threshold was reduced from 100MW to 1MW. Following deep dive into the BM's rules and procedures, we developed a trading algorithm for small demand response assets. This "local model" reflects the current market set up, thereby giving a realistic picture of potential earnings. We then worked on creating a national energy systems model to simulate the network dynamics and provide controllable conditions for the local model. This "national model" followed the structure and parameters of the Energy Systems Catapult's national flagship model ESME, but with capabilities of running with high temporal resolution and embedded the rules of market. This makes the national model a valuable tool in its own right. For example, a planned future study using this model relates to the effect of transmission system constraints on the volumes traded in the balancing mechanism. We then integrated the local model for trading into the national model to enable accurate and controllable trading simulations and thereby giving confidence in the results. This "multi-scale" energy systems model will be able to estimate economic feasibility for small players over a predefined time horizon (e.g. 1 year).

Result

Initial assessment of the project outputs indicates that there are many conditions where it is feasible for small players to participate in the balancing mechanism. Higher retail electricity prices emerged as an important factor in determining how profitable the participation could be. Furthermore, a market asymmetry was found. Instances of high demand on the grid seem to be more favourable than periods of low demand from the point of view of demand response assets. This trading algorithm was packaged in a stand-alone application and is available freely online for potential users to test. Initial results from the national model indicate the increasing importance of transmission system constraints in creating regional imbalances in the system that will cause curtailment of renewable generation and the operation of fossil fuel generators. This is especially acute in the north-south axis, where significant portion of the wind generated in Scotland can't be transmitted effectively to the high demand centres in the south of England.

Impact

The balancing mechanism is increasing in importance due to increased regional variations in generation and demand, adding to more constrained transmission system. This provides a valuable opportunity for the right energy asset in the right geographical area to help balance the grid and earn a good revenue. The developed national multi-scale model will help answer questions such as: where is the best place to have a flexible load, solar/wind farm or battery storage facility by looking at the entire grid as it stands now or in a specific future grid? The Energy Systems Catapult national model (ESME) runs different scenarios of the evolution of the grid through to 2050. This information is then integrated into our proposed national model, allowing us to study different potentialities of grid development and its effect on revenues of small players. The updates to the balancing system code from NESO and their improved capacity for processing large numbers of trades will help to facilitate participation further. Most important of these changes is increasing the granularity of metering to include assets behind the grid connection point. Furthermore, the increased importance of the balancing mechanism in the British markets makes the developed tool relevant as the number of participants increases.



Energy Systems Catapult

"This Researcher in Residence project provided a useful new perspective on potential interactions between electricity trading markets and the wider system. The tools developed provide a valuable mechanism for evaluating the economic viability of energy assets and the potential impact on energy system design. Analysis of this can inform inputs to other models within the Catapult". - Benjamin Tatlock

Fadi Kahwash

"This project unlocks new possibilities in techno-economic assessment for energy assets in the range of 1-10MW, grounded in the realities of the British markets. The developed national and local models will allow detailed studies of assets in different localities and across different market conditions".

CATAPULT Energy Systems

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