Early insights into system impacts of Smart Local Energy Systems

Marko Aunedi and Tim Green | May, 2020

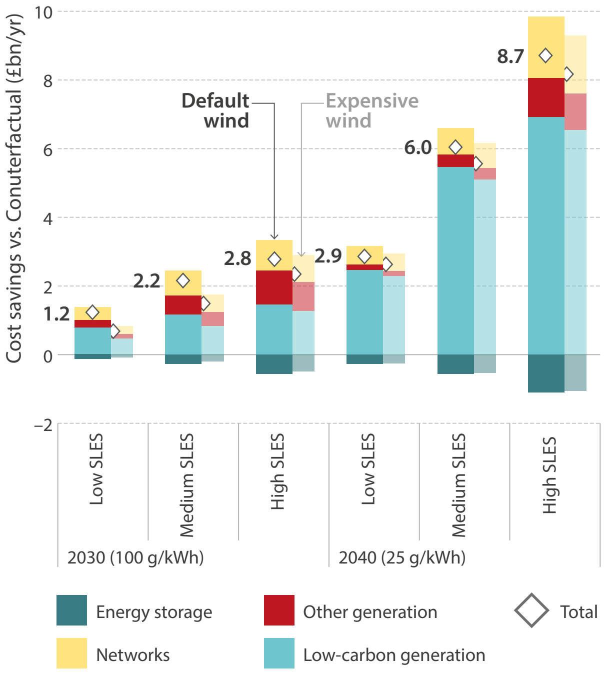
To assess the benefits of smart local energy systems (SLES) for the UK's future low- or zero-carbon electricity system we modelled the flexibility released through SLES using our Whole-electricity System Investment Model (WeSIM). This has enabled us to directly quantify cost savings from SLES deployment. Assuming that SLES delivers an enhanced uptake of demand-side response (DSR), our modelling compares scenarios in 2030 and 2040 when the transition to a low- or zero-carbon energy system is to take place.

Main messages

- The model shows that SLES lead to cost savings in the wider system.

  All SLES deployments, on both time horizons, show a saving in total system cost compared to the no-SLES Counterfactual (see figure, right). Much higher savings are achieved in the 2040 context where SLES flexibility enables large savings in the cost of low-carbon generation.

  With a 100 gCO_2/kWh emissions target in 2030, the average cost of electricity could reduce from 9.5 p/kWh in the no-SLES case to 9.2 p/kWh at 10% SLES uptake, and to 8.7 p/kWh at 50% SLES uptake. Here the cost per kWh covers owning and operating generation and networks; retail prices would include additional costs and be higher.



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- With a more stringent emissions limit of 25 gCO_2/kWh in 2040, the average cost reduces from 10.3 p/kWh in no-SLES case to 9.7 p/kWh at 10% SLES uptake, and to 8.4 p/kWh at 50% SLES uptake.
- The first investments in flexible resources deliver the highest benefits: further additions lead to substantial but diminishing contributions to cost savings. For example, increasing the SLES uptake in 2040 by 2.5 times (from Low to Medium) increases benefits by a factor of 2.1, while 5 times the uptake (Low to High) improves the benefits by a factor of 3.0.
- SLES are beneficial even when the costs of enabling demand side response (DSR) vary. Such costs would need to reach several thousand GBP per kilowatt to negate SLES savings, which well exceeds the available DSR cost estimates.
- Substituting wind for carbon capture and storage leads to substantial savings even if the cost of wind does not fall by as much as expected by 2040. In this case, the projected system benefits of SLES in 2040 would only reduce by 7–8%.
- SLES reduce the need for investing in electricity generation, and the local and national network infrastructure. DSR and local storage reduce the net peak loading of the power system infrastructure, allowing demand to be met with less installed generation capacity and less network capacity while maintaining the same level of security of supply. This leads to reduced need for Open Cycle Gas Turbine (OCGT) capacity for "peaking".
- The flexibility made possible by SLES has a very significant effect on net peak demand. In 2040 the net peak loading of the distribution grid reduces from 80 GW in a no-SLES context to 63 GW for a High SLES context.
- Cost savings from SLES flexibility are affected by implementation of other domestic DSR means. A 20% uptake of non-SLES DSR in 2040 still allows SLES to create cost savings of £6.8bn/year at 50% uptake (a 20% fall from £8.7bn/year).

The full paper, Early Insights into System Impacts of Smart Local Energy Systems, is available online.

About EnergyREV

EnergyREV was established in 2018 (December) under the UK's Industrial Strategy Challenge Fund Prospering from the Energy Revolution programme. It brings together a team of over 50 people across 22 UK universities to help drive forward research and innovation in Smart Local Energy Systems.

EnergyREV is funded by UK Research and Innovation, grant number EP/S031898/1.

www.energyrev.org.uk

@EnergyREV_UK

info@energyrev.org.uk