

**Response to keeping the power on: Our future energy technology mix inquiry**  
**25/08/2023**

**Response authors:**

This response is on behalf of the 'Future Electric Vehicle Energy networks supporting Renewables (FEVER)' project team ([www.fever-ev.ac.uk](http://www.fever-ev.ac.uk)), funded by the Engineering and Physical Sciences Research Council (EPSRC) Programme Grant, grant reference EP/W005883/1.

**Executive Summary:**

In response to this call for evidence on the keeping the power on: our future energy technology mix by the Energy Security and Net Zero Committee, we provide evidence and policy recommendations in relation to the following questions (from the terms of reference):

- Q1 – Is the energy sector open enough to new generation technology?
- Q2 - Does the Government sufficiently support development of innovative energy infrastructure?
- Q3 - Is the Governments plan for energy security sufficiently long term?
- Q4 - What current technologies could usefully be deployed at scale to deliver better energy security in the UK?
- Q6 - What energy generation mix will get us to net zero the quickest in the most affordable way?
- Q7 - Are the energy solutions universal across the UK or are there regional and local approaches on fuel and energy?

**We recommend that:**

- The level of Government support for Research and Development (R&D) funding is increased to support local manufacturing of technologies and increase energy security.
- Support for the development of off-grid energy infrastructure is actively considered in policy development and funding calls to support new national load demands (*e.g.* heat pumps or new housing developments) whilst simultaneously avoiding further increase to the national grid demand.
- Grid independent systems are developed to achieve local generation, distribution and use of energy whilst avoiding adding new loads to the already capacity-constrained electricity grid and affording more local support for renewables use via direct local energy supply.
- The decoupling of new electricity system loads from the national grid is considered; that hybrid forms of energy storage solutions are deployed to offer the required blend of short, medium and long-term energy storage services; and that energy storage hybrid solutions are used to support the recycling and re-use of recovered materials.
- Renewable energy generation is operated with hybrid form of electrical energy storage. Continued funding is needed to continue development and demonstration of diverse energy storage technology is crucial to deliver this. Longer term, the integration of further nuclear capacity, particularly fusion based, is recommended.
- Funding for new generation technologies similar to recent announced grants for Small Modular Reactors (nuclear) is scaled-up and made available.

### Q1 – Is the energy sector open enough to new generation technology?

The energy sector is open to using new generation technologies as demonstrated by the lead and rapid deployment of off-shore wind turbines, however it is lacking in terms of manufacturing of these technologies within the UK. Most wind turbines are supplied by non-UK companies. Similarly, battery energy storage and solar photovoltaic (PV) are sourced from outside the UK and there is a tendency to buy off-the-shelf solutions rather than support UK-based manufacturing companies. The level of Research and Development (R&D) funding is also relatively small compared to overseas competitors (*e.g.* the US invested some \$11.2bn into Energy R&D from 2016-2022).<sup>1</sup>

However, there is wide support available to help the R&D and demonstration of new technology, available from:

1. UKRI – via Innovate-UK and EPSRC:<sup>2</sup> there is R&D funding support available for a range of energy generation technologies, including nuclear fusion.
2. The UK government has initiated the ‘Review of Electricity Market Arrangements (REMA)’<sup>3</sup> as a response to the tensions between ensuring a national low cost energy supply, national energy security and a clear path to achieving net-zero ambitions.
3. The summary of responses to the above consultation has now been published<sup>4</sup> and Figure 1 of the referenced document provides an illustration of the areas being further explored (and crucially areas where further consultation will not continue and the rationale for these decisions).

However, there remain gaps in Government support for scaling new generation technologies to grid-scale. For example, the UK government recently announced grants of £77.1 million "to accelerate advanced nuclear business development in the UK and support advanced nuclear designs to enter UK regulation",<sup>5</sup> however this is to assist anticipated Small Modular Reactor designs being built between 2024 -2029 and similar scale funding is not readily available for other technologies. **It is therefore recommended that the level of Government support for Research and Development (R&D) funding is increased to support local manufacturing of technologies and increase energy security.**

### Q2 - Does the Government sufficiently support development of innovative energy infrastructure?

Yes, however the level of support funding is also relatively small compared to overseas competitors. There is support available via:

1. Ofgem – Strategic Innovation Fund (SIF): this Fund recently focussed on i) whole system integration, ii) data and digitalisation, iii) heat and iv) zero-emission transport, and is delivered in partnership with Innovate-UK.<sup>6</sup> The SIF is part of Ofgem’s RIIO<sup>7</sup> model (RIIO stands for

<sup>1</sup> <https://www.eia.gov/analysis/requests/subsidy/#4>

<sup>2</sup> <https://public.tableau.com/app/profile/epsrdatateam/viz/VisualisingourPortfolio/VoP>

<sup>3</sup> <https://www.gov.uk/government/news/uk-launches-biggest-electricity-market-reform-in-a-generation>

<sup>4</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1140189/review\\_of\\_electricity\\_market\\_arrangements\\_summary\\_of\\_responses.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1140189/review_of_electricity_market_arrangements_summary_of_responses.pdf)

<sup>5</sup> <https://world-nuclear-news.org/Articles/UK-launching-SMR-selection-competition>

<sup>6</sup> <https://www.ofgem.gov.uk/publications/strategic-innovation-fund-discovery-projects-approved-funding>

<sup>7</sup> <https://www.ofgem.gov.uk/publications/riio-new-way-regulate-energy-networks-factsheet>

Revenue=Incentives+Innovation+Outputs) and is the current regulation method being employed to secure a £32bn investment in the UK's energy networks (versus the net value of the UK's energy networks of £43bn)

2. UKRI – via EPSRC: there is support for novel Direct Current (DC) energy networks (as well as further development of Alternating Current [AC] smart grids), materials and power electronic systems.

There remains the area of **off-grid** energy infrastructure, such as the FEVER project, where there is clear capacity for innovation as current strategy e.g. for electric vehicles (EVs)<sup>8</sup> is solely focussed on delivery of grid connected chargers, but which currently is not a focus of funding or policy support from the UK government.

***It is recommended that support for the development of off-grid energy infrastructure is actively considered in policy development and funding calls to support new national load demands (e.g. heat pumps or new housing developments) whilst simultaneously avoiding further increase to the national grid demand.***

### **Q3 - Is the Governments plan for energy security sufficiently long term?**

No. The UK Government's recent 'British Energy Security Strategy'<sup>9</sup> does now recognise the issue of energy security, as does the creation of the Department for Energy Security and Net Zero in February 2023. However, both are reactions to recent geo-political factors and associated energy price rises. The breadth of issues stated with the recent Strategy does seek to explore the long-term; however, we believe that a crucial element in energy security, namely the local generation, distribution and use of energy **without connection to the national grid system**, should also be included. Such local or regional independent systems, which delivered most electricity prior to the creation of the UK's national grid, can be more secure and appropriate for certain types of loads. For example, the new electric vehicle charging demand or future heat pump demand can be met using local renewable energy generation **working with local electrical energy storage** to regulate and act as a buffer between stochastic generation and loads, and avoid lengthy grid connection processes and costs.

***The local generation, distribution and use of energy are crucial elements for energy security. The development of grid independent systems would help achieve these elements whilst avoiding adding new loads to the already capacity-constrained electricity grid and affording more local support for renewables use via direct local energy supply.***

### **Q4 - What current technologies could usefully be deployed at scale to deliver better energy security in the UK?**

There is scope for decoupling several potential new electricity system loads from the national grid; for example, Electric Vehicle (EV) loads and new housing estates. Such loads can be supplied on an **off-**

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1065576/taking-charge-the-electric-vehicle-infrastructure-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1065576/taking-charge-the-electric-vehicle-infrastructure-strategy.pdf)

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1069973/british-energy-security-strategy-print-ready.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1069973/british-energy-security-strategy-print-ready.pdf)

**grid** basis, thereby improving the energy security of such loads and avoiding further electricity network capacity constraints. The FEVER project is one example of the technology required to achieve off-grid EV public charging stations, using local onshore renewable energy generation and novel, low cost, hybrid energy storage.

The ongoing research within the FEVER project has identified that hybrid forms of energy storage, as opposed to a single energy storage technology solution, is likely to offer the required blend of short, medium and long-term energy storage to support 24/7 operation of a renewable-energy-supplied EV public charging station, and at the required cost to enable economically competitive EV charging.

Further, energy storage hybrid solutions also offer a route to a more sustainable solution. Using a hybrid fraction of lead-acid batteries working in combination with lithium-ion batteries (as opposed to a lithium-ion only battery solution) offers up to 99% recycling<sup>10</sup> and re-use of the materials within lead-acid batteries, whereas lithium-ion battery recycling achieves far lower material recovery and re-use and is significantly hampered by the wide range of material chemistries used and necessity to pre-sort these types before processing.<sup>11</sup>

***In order to deliver better energy security in the UK, it is recommended that the decoupling of new electricity system loads from the national grid is considered; that hybrid forms of energy storage solutions are deployed to offer the required blend of short, medium and long-term energy storage services; and that energy storage hybrid solutions are used to support the recycling and re-use of recovered materials.***

#### **Q6 - What energy generation mix will get us to net zero the quickest in the most affordable way?**

It is clear that most forms of renewable energy generation now offer both the lowest cost generation and zero-emission output.<sup>12</sup> However, to deliver this effectively this stochastic energy supply needs to be operated with effective energy storage. Similarly, to deliver the FEVER vision of off-grid EV public charging stations (and other load demands) a low-cost, hybrid form of electrical energy storage is required. Such forms of storage, capable of offering a range of temporal storage capabilities, and in particular long-term or seasonal storage, have not been widely supported (there was a recent (2021) BEIS Call for Longer Duration Energy Storage (LODES) Demonstration Competition, however this competition has now closed) and the availability of continued funding to continue development and demonstration of such diverse energy storage technology is critical, in addition to also supporting the incremental scale-up to the appropriate scale (*i.e.* from current ~4GW of storage to some 22 – 40GW by 2050).<sup>13</sup>

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<sup>10</sup> <https://ecobat.com/sustainability/recycling/>

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<https://onlinelibrary.wiley.com/doi/epdf/10.1002/aenm.202102917><https://onlinelibrary.wiley.com/doi/epdf/10.1002/aenm.202102917>

<sup>12</sup> <https://commonslibrary.parliament.uk/why-is-cheap-renewable-electricity-so-expensive/>

<sup>13</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1002842/All\\_Longer\\_Duration\\_Energy\\_Storage\\_Slides\\_1\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002842/All_Longer_Duration_Energy_Storage_Slides_1_.pdf) and [NGESO Future Energy Scenarios 2020](#).

There is some evidence of continued support for such diversity of type, cost and duration of energy storage via the recently announced UK Aid supported Ayrton Fund,<sup>14</sup> however this has a clear focus on supporting the clean energy transition in the developing countries. It is recommended that the study of the applicability of any such technologies to UK operation should be investigated.

Over the longer term the integration of further nuclear capacity, particularly fusion based, would offer net-zero, secure, controllable generation, and continued focus on improving energy efficiency and reduction of demand growth, will all positively contribute to long-term national goals.<sup>15</sup>

***It is recommended that renewable energy generation is operated with hybrid form of electrical energy storage. Continued funding is needed to continue development and demonstration of diverse energy storage technology is crucial to deliver this. Longer term, the integration of further nuclear capacity, particularly fusion based, is recommended.***

**Q7 - Are the energy solutions universal across the UK or are there regional and local approaches on fuel and energy?**

Within the context of the FEVER project (*i.e.* the use of local renewable energy resources with appropriate hybrid energy storage to deliver secure, low cost public EV charging stations), this naturally embraces a local/regional approach, relying on site specific availability of (principally but not exclusively) wind and solar energy resources. Clearly this will also alter on a rural/urban basis as well, and a robust, detailed modelling methodology is being developed within the FEVER project to permit site specific analysis and determination of available energy generation and define the associated energy storage type(s) and capacity to deliver 24/7 operation of EV charging stations.

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<sup>14</sup> <https://www.gov.uk/guidance/ayrton-fund>

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1022540/towards-fusion-energy-uk-government-fusion-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1022540/towards-fusion-energy-uk-government-fusion-strategy.pdf)