Scottish Parliament Net Zero, Energy and Transport Committee: Call for Evidence

Scotland's electricity infrastructure: inhibitor or enabler of our energy ambitions

Energy Saving Trust welcomes the opportunity to feed into the Scottish Parliament Net Zero, Energy and Transport Committee's call for evidence on Scotland's energy infrastructure. We have limited our response to those questions where we have direct experience to share that may be of interest to the Committee, namely questions 7-13.

Energy Saving Trust is an independent organisation dedicated to promoting energy efficiency, low carbon transport and sustainable energy use to address the climate emergency.

Our work focuses on reaching net zero targets by taking action to reduce energy consumption, installing new infrastructure and accelerating a move to sustainable, low carbon lifestyles.

A trusted, independent voice, we have over 25 years' sector experience. We provide leadership and expertise to deliver the benefits of achieving carbon reduction targets: warmer homes, cleaner air, healthier populations, a resilient economy and a stable climate.

We empower householders to make better choices, deliver transformative programmes for governments and support businesses and community groups with strategy, research and assurance – enabling everyone to play their part in building a sustainable future.

Q7: Given the generation potential, and market ambition, is there a risk of oversupply if options for use of surplus electricity (e.g. green hydrogen production) do not become reality?

Energy Saving Trust notes that we already curtail one third of wind generation in Great Britain and that, given current infrastructure constraints and a lack of operational storage solutions, there are temporal as well as overall supply issues.

We would draw the attention of the Committee to the SPIRE 2 (Storage Platform for the Integration of Renewable Energy) project in Northern Ireland[1]. This EU-funded €6.7m Interreg VA research project operating cross-border in Northern Ireland and the Republic of Ireland is looking at the potential for energy storage technologies to be deployed in people's homes and businesses. The project looked at supplying cheaper power to storage heaters, effectively adjusting the time of day at which storage heaters were 'charged' as a mechanism to deal with oversupply whilst at the same time providing a social good by delivering cheap power to those in need. Similar solutions could be tested in Scotland if the project were to prove successful.

Q8: How much of the Scottish Government ambitions for 5 GW of hydrogen production capacity by 2030, and 25 GW by 2045 should come from green hydrogen?

It is our firmly held view that there is little value in investing in modes of production that will increase carbon emissions and will rapidly become redundant once renewable methods of generating hydrogen are commonplace[6]. For this reason, we believe that Scotland should seek to position itself as a producer of green hydrogen from renewable-powered electrolysis. Electrification should be the priority in most areas, with any gaps left as a result of economic or technical infeasibility being filled by green hydrogen. In terms of the ideal renewable sources of electricity, offshore and onshore wind and marine renewables appear to be the most promising in the Scottish context with there being scope to use hydrogen electrolysis as a form of storage onshore (as an indication of potential and as mentioned in response to question 7, one third of wind power is already curtailed at present) with this green hydrogen then deployed across Scotland and exported elsewhere.

Q9. What are the key infrastructure barriers to building a hydrogen economy in Scotland and how should they be addressed?

Energy Saving Trust considers that a key risk in the adoption of hydrogen is infrastructural lock-in and stranded assets, where we invest heavily in technologies that rapidly become obsolete or throw up barriers to full decarbonisation. For this reason, it is our view that the Scottish Government should be cautious in pursuing or supporting hydrogen production that uses fossil fuels as either the feedstock or energy

[1] https://www.ulster.ac.uk/spire2/the-project

source. Imports of hydrogen produced through these processes should also be viewed with caution. It is our view that there is little reason that Scotland's future hydrogen needs couldn't be met through green hydrogen produced in Scotland or the UK. Given the likely scarcity of green hydrogen, in the trade-off between scarce resources and plentiful electricity, the focus should be on deploying hydrogen in those industries and processes where it is most needed, (including certain industrial processes and for heavy transport).

Q10. Ofgem are "working with government, industry and consumer groups to deliver a net-zero economy". What changes have recently been made to support the delivery of net-zero? What more could be done to support a regulatory regime that delivers decarbonised energy supplies affordably?

The choices we make around infrastructure are important in tackling climate change as the types of transport, housing or energy invested in today will last for many years and can thereby lock-in a pattern of future greenhouse gas emissions. In the near term, we have to invest in the systems and infrastructure needed to achieve net zero in a timely, affordable and efficient way. In practice, this means investing ahead of need in the electricity grid so that it can handle additional loads from EVs, distributed generation and heat pumps. The grid must also be able to operate in the smart and flexible way we need to realise the full benefits of decarbonisation. New development and upgrading of network infrastructure is critical to increasing demand, therefore expanding the network to allow for increased renewable connections onto the system is critical. It is imperative that network investment is delivered at the correct locations and at the pinch points of our electricity system to enable and drive the investment that will put downward pressure on the overall cost to consumers.

The Electricity and Gas regulator, Ofgem, controls the decisions around the build-out of the transmission and distribution systems for gas and electricity. At present, Ofgem has no explicit duty to deliver net zero (currently it has duties around sustainability and the needs of future consumers). This could be addressed through the provision of a Strategic Policy Statement from the UK Government or through the amendment of Ofgem's duties via legislation. Doing so would empower Ofgem to better consider the anticipatory needs of a low carbon grid and trade off the risk of future demand against the risk of stranded assets. At present, grid expansion typically requires evidence of demand to prove that it is economically efficient before approval can be given. Because of the long lead-in time to build new grid infrastructure and the pace already needed by the low carbon transition, there is a good case to allow more anticipatory

grid investment ahead of firm demand, as otherwise there is a risk that capacity will not be in place when it is needed. This risk is arguably much greater now than the risk of building too much grid capacity.

Q11. What are the most important issues for the UK Government's Review of Electricity Market Arrangements to address? What are the benefits of the current system, and the potential pitfalls of moving away from it? What are the implications for the Draft Energy Strategy of the Review?

The REMA review needs to enable flexibility and set the underpinning rules that allow markets to respond. The correct reforms can help to drive flexibility and the associated reforms that are needed within the retail market.

Combined with that, the correct incentives must be used to ensure the right infrastructure is in place, including by making make better use of and emphasising infrastructure that already exists. Reform should help optimise better use of the current system.

We agree broadly with the vision set out for the electricity system in the UK Government's Review of Electricity Market Arrangements (REMA). In particular, it is welcome to see flexibility and consumer value so prominently set out as the necessary concomitant to massive deployment of intermittent renewable energy.

There are, however, some additional factors that Energy Saving Trust considers should be taken into account:

(i) Consumers benefitting from lower low carbon generation prices

An explicit aim of the reforms should be that consumers benefit from low carbon generation in a way that does not currently happen through existing arrangements and that the distortions created by the current system whereby gas sets the prices are removed: consumers must be able to access low-cost wind power that is deployed at scale. With the right reforms, all users in Scotland could have cheaper electricity if the costs truly reflected the generation mix.

The marginal pricing model means that gas sets the price for non-Contract for Difference (CfD) renewables, and at times of lower gas prices may keep CfDs higher than necessary. Renewables are now largely subsidy free and wind and solar are the cheapest forms of new generation. Consumers have supported the deployment of renewables over time, and it is important that they are now able to benefit from these

lower prices. We note that price cannibalisation is an important effect that will need to be managed to ensure support for renewables.

Further still, as deployment of low-cost renewables continues through to 2035 there is the opportunity to align lower renewable wholesale costs with future reforms to retail tariffs – for example by underpinning social or "essential service" tariffs.

As at March 2020, there were an estimated 364,310 private sector businesses operating in Scotland. Almost all these businesses (98.2%) were small (0 to 49 employees). Businesses with no employees – that is sole proprietors/ partnerships comprising only the owner-managers or companies comprising only the employee director – accounted for 69.9% (254,740 businesses) of all private sector businesses in Scotland[2]. Many of these microbusinesses and small and medium-sized businesses provide crucial services to remote and island communities that are not and cannot be, provided by other means. Such businesses also have a key role to play in helping to ensure a just transition to net zero.

According to polling carried out by the Federation for Small Businesses, 49% of small firms in Scotland are extremely concerned about rising business energy costs, compared to 38% of all small businesses in the UK. 72% of small firms in Scotland reported a price increase over the past year, higher than the UK average. In addition, almost half (49%) of small businesses in Scotland have seen their energy costs increase by double or more[19].

Energy cost rises have a significant impact on micro and small businesses in particular, who tend to operate in the energy market similarly to domestic consumers. Current tariff arrangements mean that any business premises, regardless of size, is placed on a business energy tariff, which does not offer the same price protections as are in place for domestic customers. Reform that enables both domestic and business customers to benefit from low-cost locally generated renewable energy would help to address this issue.

(ii) Accelerate the deployment of low carbon technologies in homes & businesses, and community energy schemes.

REMA reforms should explicitly support the accelerated deployment of low carbon technologies in homes and businesses. This should support and incentivise the

[2] See: https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2020/11/businesses-in-scotland-2020/documents/businesses-in-scotland-2020/businesses-in-scotland-2020/govscot%3Adocument/Businesses%2Bin%2BScotland%2B2020.pdf

deployment of heat pumps at scale. The Committee on Climate Change has been clear that the rollout of heat pumps needs to be well underway well ahead of 2035. Although flexibility will play a key role around heat pumps, a longer-term response to price signals and link to low carbon generation will also be key parts of making heat decarbonisation successful.

(iii) Energy Efficiency

Energy Saving Trust strongly believes that more explicit consideration should be given to energy efficiency within the remit of REMA. From an electricity system perspective, energy efficiency is currently undervalued. It is not possible for those investing in energy efficiency measures (whether households, businesses or energy companies and financial institutions investing and delivering on their behalf) to capture the full system value of those investments.

From a REMA perspective, energy efficiency has the potential to support REMA's aims of:

- facilitating consumers to take greater control of their electricity use by rewarding them through improved price signals, whilst ensuring fair outcomes
- optimising assets operating at local, regional, and national levels

More specifically, there are two principal ways in which energy efficiency could contribute to the long-term issues identified by REMA. Firstly, energy efficiency measures can reduce peak demand and can thereby reduce the need for investment in new networks and generation. This impact will increase as more space heating is electrified. Secondly, a key concern of decarbonising the electricity system is managing "renewable droughts" where renewable generation, especially wind, is low but demand is high. REMA is currently looking at options by which to increase revenues to new generation and storage that can export for longer to address this need for a sustained response. Energy efficiency will be important during these periods but is not being considered for comparable support.

Energy Saving Trust considers that the following should be taken forward into the next phase of policy development by REMA:

- Review of international precedents for system operators modelling energy efficiency alongside that of overall demand growth, generation and system margins and how this could work in the UK with the FSO/ISOP and/or local system operators;
- A new review of the evidence for energy efficiency's potential impact on:
    - Peak shaving in 2035, using updated scenarios for heat electrification

- The capacity of dispatchable, sustained generation and storage that is needed to meet renewable energy droughts.

Where there is evidence for energy efficiency's impact, this workstream within REMA should then prioritise:

- Opening market design to competition from energy efficiency investments. As with other technologies, this may not be simply through widening eligibility requirements to a given market (e.g., the Capacity Market) but may require a different approach (e.g., system modelling across all technologies but with a targeted delivery approach for cost-effective energy efficiency funding);
- Engagement with Local Authorities and other organisations working with existing energy efficiency funding schemes to understand how funding can be effectively structured to allow them to aggregate up large portfolios of projects and the electricity capacity that this could represent;
- The interactions between any market signals for energy efficiency arising from REMA and other schemes, and how this can best support revenue stacking, including:
  - Energy efficiency's contribution to network reinforcement avoidance (as being trialled now by the DNOs and ENA through flexibility tenders);
  - Private household and business contributions
- Recommendations for how the fundamental, practical conditions that are necessary for electricity market design to support energy efficiency can be introduced alongside market reforms
  - The introduction of standardised approaches to metering energy efficiency savings
  - New contracting approaches
  - The development of a stronger pipeline of energy efficiency projects, including early support for the supply chain

We would also bring the Committee's attention to the Association for Decentralised Energy (ADE)'s briefing paper on the role of Energy Efficiency in the REMA reforms.

(iv) Flexibility

Energy Saving Trust appreciates the attention paid to flexibility in REMA and strongly agrees that flexibility will be both a cross-cutting concern of overall market design (e.g., signals in the wholesale market) and needs specific mechanisms (e.g., targeted balancing services). However, more attention needs to be given to the impacts of some of the options on flexibility. While certain wholesale market reforms are theoretically

interesting, such as split markets, they fail to explore in any real detail the impacts for flexibility. Further, we strongly believe that any reforms to the wholesale market, capacity market and balancing markets must have as a baseline priority the need to facilitate large amounts of smaller capacity assets in an optimised way. The IT infrastructure and market mechanisms currently in place profoundly disincentivise the participation of Demand Side Response assets and portfolios.

(v) Heat Networks

Heat networks will be impacted by REMA in two ways. Firstly, heat networks (especially those using heat pumps and thermal stores, as seen in Europe) will be an important source of long-duration flexibility in their own right and as part of overall flexibility and should be incentivised through reforms to the wholesale market and supporting markets. Secondly, industry expects electrification to be one of the main, if not the principal, means of delivering net zero heat networks. As a result, achieving reform that delivers overall lower electricity (commercial) retail prices will strongly impact the growth of the sector.

Q12. Are community and locally owned projects inhibited by the current electricity network?

Specific regions in the UK face a significant challenge in developing community energy due to constraints in parts of the electricity grid and high connection charges for accessing it. Constraints on the network and delays in connection hold back further progress in renewable deployment, particularly in rural areas and for smaller projects which can struggle to address this barrier. The UK Government should as a priority work with the relevant distribution and transmission companies, Ofgem, and devolved governments where relevant, to identify and tackle these constraints. We think that particularly constrained areas and areas of strategic importance should be prioritised.

Taking a flexibility first approach should reduce the need to reinforce the grid, which will lower any costs for consumers. There are many community energy groups interested in pursuing innovative flexibility and demand-side response approaches. These groups should be supported to do so. DNOs could offer more innovative connection arrangements – for example SSEN offer a range of managed connection options[3] which can offer faster connection and avoid some reinforcement costs.

[3] https://www.ssen.co.uk/our-services/flexible-solutions/flexible-connections/

Under current arrangements, local energy generators pay for use of the electricity system, including at transmission level. If local distribution continues to grow and is maximised - reducing import from and export to the transmission network - there is a case to be made for only generators requiring transmission to bear the costs of that transmission in the future. The system should be looked at to avoid the potential for underdevelopment of the distribution network and to prevent any disincentive for local supply-focused energy groups to be formed.

Ofgem must aim to act strategically and long term with a clear vision and targets to accompany this vision. Achieving an effective decentralised energy system will require efforts from the 'bottom-up' and so community groups should be engaged with and necessary upgrades (identified through modelling of anticipated demand increase) to the distribution system prioritised. Ofgem can use the RIIO-ED2 price control process to encourage DNOs to support community energy. Ofgem can make best use of this process by recognising those companies who have extensively engaged with community energy groups in designing their plan and responded to their concerns. Ofgem could also recognise where DNOs commit to work with community energy groups during ED2 to find solutions to the issues they face, and where DNOs provide active support and guidance to community energy groups.

The availability of Contracts for Difference (CfD) for only large-scale projects contributes to the challenges small scale, distributed generation faces. While CfD has been successful in reducing the cost per kWh of renewable generation at large sites, we think that Government should develop a clearer understanding and evidence base for the additional value per kWh associated with distributed and locally owned generation. This should take account of the impacts on local economies, the supply chain, effective maximisation of the use of distribution infrastructure (and reduced investment in new infrastructure) via smart systems and local supply/demand balancing.

13. What are the key infrastructure barriers to Scottish Government community energy ambitions and how should they be addressed? Is it enough to "encourage" shared ownership models, or should a more formal mechanism be implemented?

Lessons could be drawn from the COBEN programme[4] which, through a Scottish pilot, sought to develop an approach to Community-led Local Energy Plans which viewed communities' energy generation, energy efficiency, heat, transport, storage and future

[4] https://www.civic-energy.eu/

usage as a whole system. The Scottish pilot, led by Local Energy Scotland, developed a common local energy plan methodology and supporting toolkit[5] .

Local authorities can also support community energy by identifying suitable sites on public estates while making fast-tracked planning available in these locations. Energy Saving Trust was a partner in the recent EU HEROES[6] Horizon2020 project which brought together seven European nations with the overall aim of enabling the continued development of community-owned solar systems without the direct use of subsidies. A key lesson learned through this project was that an area planning approach which identifies suitable sites and supports their development by community energy groups was particularly valuable. Such an approach is already being employed in Lithuania. Another key recommendation of this project that has already proven effective in the UK (and which we believe could be scaled up to increase the deployment of renewables and produce greater public benefit) is the use of Power Purchase Agreements (PPA) for small scale renewables. This approach has been pioneered successfully by Egni Coop in south Wales which has amassed a strong portfolio of small-scale community solar projects[7]. Energy Saving Trust and the Welsh Government Energy Service played a significant role in enabling this programme of work.

An enhanced role for community energy in the CfD process, either through a dedicated funding pot for these projects or through pre-qualification criteria in the existing pots which would require a degree of community involvement and local ownership. This is an approach already being undertaken in the Republic of Ireland through their Renewable Electricity Support Scheme (RESS)[8].

Energy Saving Trust was asked in 2011 by the Scottish Government to produce a database of all community and locally owned renewable energy installations in Scotland and to produce a short report on the information it contained.

This database has been updated annually since 2011 and includes, as far as possible, all installations known to be operating, under construction, or in earlier stages of development as of 31 December 2021. This report is produced annually[9] and Energy Saving Trust should be happy to provide further information if this would assist the Committee in its work.

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[5] https://www.localenergy.scot/resources/community-led-local-energy-plan-toolkit/
[6] https://www.euheroes.eu/
[7] https://egni.coop/our-sites/
[8] https://www.gov.ie/en/publication/36d8d2-renewable-electricity-support-scheme/
[9] https://energysavingtrust.org.uk/wp-content/uploads/2022/03/Community-and-locally-owned-energy-report-2021.pdf

The Association for Decentralised Energy

Combined Heat & Power
Demand Side Services
Energy Efficiency
Heat Networks

FINAL ADE Appendix B | The role of energy efficiency in electricity market reform | 10 October 2022

Context

Why could energy efficiency contribute to REMA?

From an electricity system perspective, energy efficiency is currently undervalued. It is not possible for those investing in energy efficiency measures (whether households, businesses or energy companies and financial institutions investing and delivering on their behalf) to capture the full system value of their investments.

From a REMA perspective, energy efficiency has the potential to support REMA's aims of –

- Facilitating consumers to take greater control of their electricity use by rewarding them through improved price signals, whilst ensuring fair outcomes
- Optimising assets operating at local, regional, and national levels

More specifically, there are two principal ways in which energy efficiency could contribute to the long-term issues identified by REMA.

Firstly, energy efficiency measures can reduce peak demand and thereby, can reduce the need for investment in new networks and generation. This impact will increase as more space heating is electrified.

Secondly, a key concern of decarbonising the electricity system is managing "renewable droughts" where renewable generation, especially wind, is low but demand is high. REMA is currently looking at options by which to increase revenues to new generation and storage that can export for longer to address this need for sustained response. Energy efficiency will be important during these periods but is not being considered for comparable support.

How far could REMA support growth in energy efficiency

From an energy efficiency sector perspective, energy efficiency funding is currently too precarious and too limited for what is needed by households and by the energy system as a whole. It has also been highly politicised – creating a pattern of very short-term grant funds and unexpected cancellation of such schemes that has undermined investment in the sector.

Investment is only one factor – many other areas also need to be improved (e.g., minimum energy efficiency standards). However, placing investment for energy efficiency on a more sustainable basis that more closely reflects its system value, as has been done for the generation needed for net zero, could support the UK's overall progress towards net zero, reduce unnecessary supply-side investment and support growth in the energy efficiency supply chain.

What is being reformed?

There are three reforms which should support a new approach to energy efficiency –

1. **Reform of Electricity Market Arrangements (REMA):** This could be the most significant reform of electricity markets since at least the introduction of Contracts for Difference and the Capacity Market. It aims to reform the wholesale market and supporting markets.
2. **Introduction of an Independent System Operator and Planning (ISOP):** The ISOP will provide strategic analysis and advice across the energy system, including energy efficiency.
3. **Reform of Local Energy Governance:** Ofgem is reforming governance across the Distribution System Operators, Gas Distribution Operators, and touching on the role of the Local Authority. This has the potential to lead to a more strategic, whole system planning role at local level.

Evidence to date

Academic research on the impact of energy efficiency on the electricity system

Academic research has modelled energy efficiency's impact on reducing electricity system peaks. Much of this work in Europe has focused on appliance and lighting energy use, given the small amount of electric heating in many countries. In some cases, this work has shown relatively large potential savings. For example, a Swiss study[1] suggested that evening appliance peak demand could be reduced by 38% if appliances were replaced by those with the highest energy efficiency label available on the market. Work in the US tends to focus on shifting cooling demands, as the summer peak is usually the largest constraint on the electricity system in many states. One recent study[2] found that US-wide potential benefits to the grid of 'grid-interactive, efficient buildings' totalled $100-$200 million at a minimum. At the distribution system level, peak reductions caused by energy efficiency were found to defer or avoid the need for substation and other distribution equipment upgrades and also to reduce system losses (which are highest at times of high energy flows).

There is one recent study[3] that specifically focuses on the potential impact of high thermal efficiency on the potential to shift peak heating load demand. This study found that deep renovation reduces the peak demand on energy grids (district heating networks or electricity networks) by 75%, and that a highly energy efficient building can remain thermally comfortable for up to 4 days following 1 day of heating. Another Europe-focused study looking at how to mitigate heat demand peaks[4] found that building renovation would deliver energy system cost savings of up to 14%. As noted above, this is important in particular relation to managing renewable droughts in the future.

Real-world trials and broader precedent

[1] Yilmaz S, Rinaldi A and Patel MK (2020) DSM Interactions: what is the impact of appliance energy efficiency measures on the demand response (peak load management)? *Energy Policy* (139)

[2] Jackson R, Zhou E and Reyna J (2021) Building and grid system benefits of demand flexibility and energy efficiency *Joule* 5 (8) 1927-1930

[3] Pagliano L, Armani R, Erba S and Sangalli A, *Highly insulated buildings as a crucial element for smart cities, grid balancing and energy storage for renewables*, report produced under research agreement between Knauf Insulation Italia and the Politecnico di Milano

[4] Zeyen E, Hagenmeyer V and Brown T (2021) Mitigating heat demand peaks in buildings in a highly renewable European energy system *Energy* (231) 120784

USA - Integrated resource planning

Incorporation of energy efficiency within strategy energy system planning and procurement is used in the Integrated Resource Planning (IRP) approach taken by several US States. One notable case study is the Pacific Northwest 1980 Act which required energy efficiency to be considered the highest priority resource and assigned an assumed 10% cost advantage over supply side resources.

The approach taken to incorporating energy efficiency within IRP differs across jurisdictions. In particular, different states will differ regarding how sophisticated the modelling is that informs the strategic plans. At its most basic, this includes only building the effect of reduced demand from energy efficiency into forecasts for network infrastructure requirements at local or national level. A more sophisticated approach involves evaluating electricity generation options against a variety of demand reduction forecasts from different levels of energy efficiency, including using Monte Carlo approaches to create probability forecasts.

Whilst this approach offers several important insights for the UK market, there are several limitations. Firstly, most US states with IRP tend to have integrated utilities where retail supply and network distribution is bundled into regulated entities which are then subject to the requirements coming from such IRPs. This is clearly very different from the UK's context of unbundled retail supply, networks and generation. Secondly, in many US states, peak electricity demand is driven by Summer cooling, rather than Winter heating as in the UK. Finally, whilst IRPs have generated investment in energy efficiency, they have not led to sustained, large-scale markets for deep retrofit.

USA – Standardised pay for performance contracting for energy efficiency

Several programmes now exist to standardise how to measure delivery of energy efficiency in reducing demand and to create more standardised contracts.

A key barrier to large-scale finance investing in energy efficiency is the lack of standardisation regarding measuring performance. This involves two main aspects: monitoring actual energy consumption following installed measures; and secondly, establishing standardised and robust baselines or counterfactuals by which to compare that actual energy consumption.

CalTRACK[5] is a methodology developed to address this. It has developed an approach to calculating avoided energy use and so the counterfactual by which to assess the performance of energy efficiency measures. The Open EE Meter project[6] is then an open source package of software which implements this method.

Organisations are now investigating how CalTRACK can be introduced into the UK and adapted to work for half-hourly settlement, rather than working on a daily basis.

USA – "MEETS", PPAs for energy efficiency

Using this standardised method for energy efficiency avoided consumption, a very interesting contracting structure for energy efficiency is now being trialled in Seattle. MEETS stands for Metered Energy Efficiency Structure and works as follows.

An outside investor signs and long-term agreement with a building owner that gives them the right to install and maintain energy efficiency measures in the latter's commercial building. The performance of these measures is metered using the standardised, dynamic baselines generated

[5] **CalTRACK**

[6] **OpenEEMeter** supported by LF Energy

through methods like CalTRACK. The investor then also signs a long-term PPA with the supplier for that supplier to buy the energy efficiency. The investor then shares a proportion of that PPA revenue with the building owner. The supplier then continues to charge the building owner for both the energy used *and* the energy avoided (i.e., the energy consumption prior to energy efficiency measures being installed).

As a result, the impacts on each party are –

- **Building owner:** Does not need to pay anything upfront, pays the same as they did before and receives revenue from the investor
- **Building tenant:** Does not need to pay anything upfront and pays the same as before but is more comfortable
- **Supplier:** The supplier maintains their overall revenue because payments to the investor are offset by maintaining their revenue from the building owner for less energy consumption
- **Investor:** The investor can invest in significant energy efficiency retrofit measures over the long-term, with a revenue stream backed up by long-term PPAs with the building owner and supplier

UK – Inclusion of energy efficiency within DNO flexibility tenders

In the UK, the DNOs run flexibility tenders where using turn-down and turn-up from assets such as demand-side response, storage and distributed generation are a more cost-effective means of managing constraints at Distribution than reinforcement.

The network companies, with the ENA, are now expanding eligibility for these flexibility tenders to projects that include energy efficiency. Whilst this work is at an early stage, it will offer interesting insights into the competitiveness of such projects compared to DER-based bids and the approach to baselining for projects that include energy efficiency.

UK – Electricity Demand Reduction Pilot

In 2015-16, the Government piloted a scheme to test the competitiveness of energy efficiency projects reducing system peak in the Capacity Market. The findings of this pilot were –

- Overall societal CBA was positive in both phases at £11.7m (£15.8m benefits, £4.1m costs) and £4.3m (£6.8m benefits, £2.4m costs); but
- The reductions in electricity demand peak were small, averaging 2MW per phase
- Bids were high and averaged at ~£200-220/kW (out of a maximum of £300/kW set at the maximum possible revenue in a Capacity Market auction of £75/kW for 4 years), and participants reported that this did not cover the costs of installing the energy efficiency measures
- 21 of 22 projects involved installing LEDs and none involved deep retrofit measures
- It had been hoped that the scheme would encourage energy efficiency aggregation, as the UK sees already for demand-side response and as the US sees for energy efficiency. However, this did not happen.

As a result, the pilot concluded that energy efficiency would not be competitive in the Capacity Market.

Whilst this was a disappointing result, there are limitations to how far its findings can be taken with respect to the overall potential of energy efficiency to reduce demand peak cost-effectively.

Issues in the pilot	Evidence
Cost per kW savings was too high to be competitive	The pilot assumed that energy efficiency projects would compete each year for Capacity Market contracts. It then assumed that it could achieve the maximum possible from the auction and would do so for 4 years. Whilst the assumption of receiving £75/kW was an approach that was highly favourable to energy efficiency projects, the other assumptions were not. Long-term contracts of 15 years are available to other forms of new capacity where it can be demonstrated that these projects would not have gone ahead otherwise (based on capex thresholds). Over the last few years and if the same relatively simple calculation is used, the auction results have led to new capacity revenues of – • T4 2025/26 - £30.59/kW/yr – £459/kW/yr • T4 2024/25 - £18/kW/yr – £270/kW/yr • T4 2023/24 - £15.97/kW/yr – £240/kW/yr • T4 2021/22 - £8.70/lW/yr – 130.5/kW/yr There is no reason to assume that the impact of energy efficiency measures is limited to only 4 years and there is more reason to assume that it has a similar, if not longer, duration as new generation. When the comparison is made on the basis of equivalent terms, the energy efficiency projects under EDR were competitive with new generation in every year apart from the T4 in 2021/22 (noting the somewhat simplistic method used).
Individual projects were of a small size, without the same level of larger aggregation seen, for example, in the DSR market	The Government's LAD scheme offers interesting insights into how organisations, in this case Local Authorities, are trying to aggregate larger portfolios of projects. The LAD scheme has been difficult for those looking to invest in energy efficiency projects. The timelines have been very short for both applications and delivery, the rules have been different in each phase, the revenue caps are too low to support deeper retrofit and PAS2035 has added further complexity. In contrast, what has worked in aggregating larger portfolios of projects is where – • Projects are concentrated on a specific area (rather than, for example, pepper-potted across a region and in which case, quality management becomes difficult) • Local Authorities are able to establish a presence in that specific area for at least 3 years, and if possible longer • Local Authorities can use their own social housing as the starting point to demonstrate the benefits to the local community • The funding and overall long-term commitment at national and local level means that the project can achieve very high (e.g., 95%) penetration in that given area
Only lighting came forward	The pilot's timescales were very short which the evaluators believed had limited the types of projects and, especially, the types of organisations who participated. Further to this, given the pilot was done in 2015-2016, the majority of organisations that participated had relatively low electricity use compared to their overall energy use because space heating was gas-fired. This will not be

	the case going forward when the majority of homes and businesses are likely to electrify their heating. Finally, PAS2035 now requires a whole house retrofit approach that favours multiple measures, rather than single measures. This is also the approach taken in ECO4. Whilst it would not have addressed the timescales, there is more focus on deeper retrofit now than in 2015/16.

Taking energy efficiency forward within REMA

The ADE considers that the following should be taken forward into the next phase of policy development by REMA –

- Review of international precedents for system operators modelling energy efficiency alongside that of overall demand growth, generation and system margins and how this could work in the UK with the FSO/ISOP and/or local system operators
- A new review of the evidence for energy efficiency's potential impact on –
    - Peak shaving in 2035, using updated scenarios for heat electrification
    - The capacity needed of dispatchable sustained generation and storage to meet renewable energy droughts

Following this review of evidence for energy efficiency's impact, this workstream within REMA should then prioritise –

- Opening up market design to competition from energy efficiency investments. As with other technologies, this may not be simply through widening eligibility requirements to a given market (e.g., the Capacity Market) but may require a different approach (e.g., system modelling across all technologies but with a targeted delivery approach for cost-effective energy efficiency funding)
- Engagement with Local Authorities and other organisations working with existing energy efficiency funding schemes (e.g., LAD, PSDS, SHDF etc.) to understand how funding can be effectively structured to allow them to aggregate up large portfolios of projects and the electricity capacity that this could represent
- The interactions between any market signals for energy efficiency arising from REMA and other schemes, and how this can best support revenue stacking including –
    - Energy efficiency's contribution to network reinforcement avoidance (as being trialled now by the DNOs and ENA through flexibility tenders)
    - Private household and business contributions
- Recommendations for how the fundamental, practical conditions that are necessary for electricity market design to support energy efficiency can be introduced alongside market reforms –
    - The introduction of standardised approaches to metering energy efficiency savings
    - New contracting approaches
    - The development of a stronger pipeline of energy efficiency projects, including early support for the supply chain

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