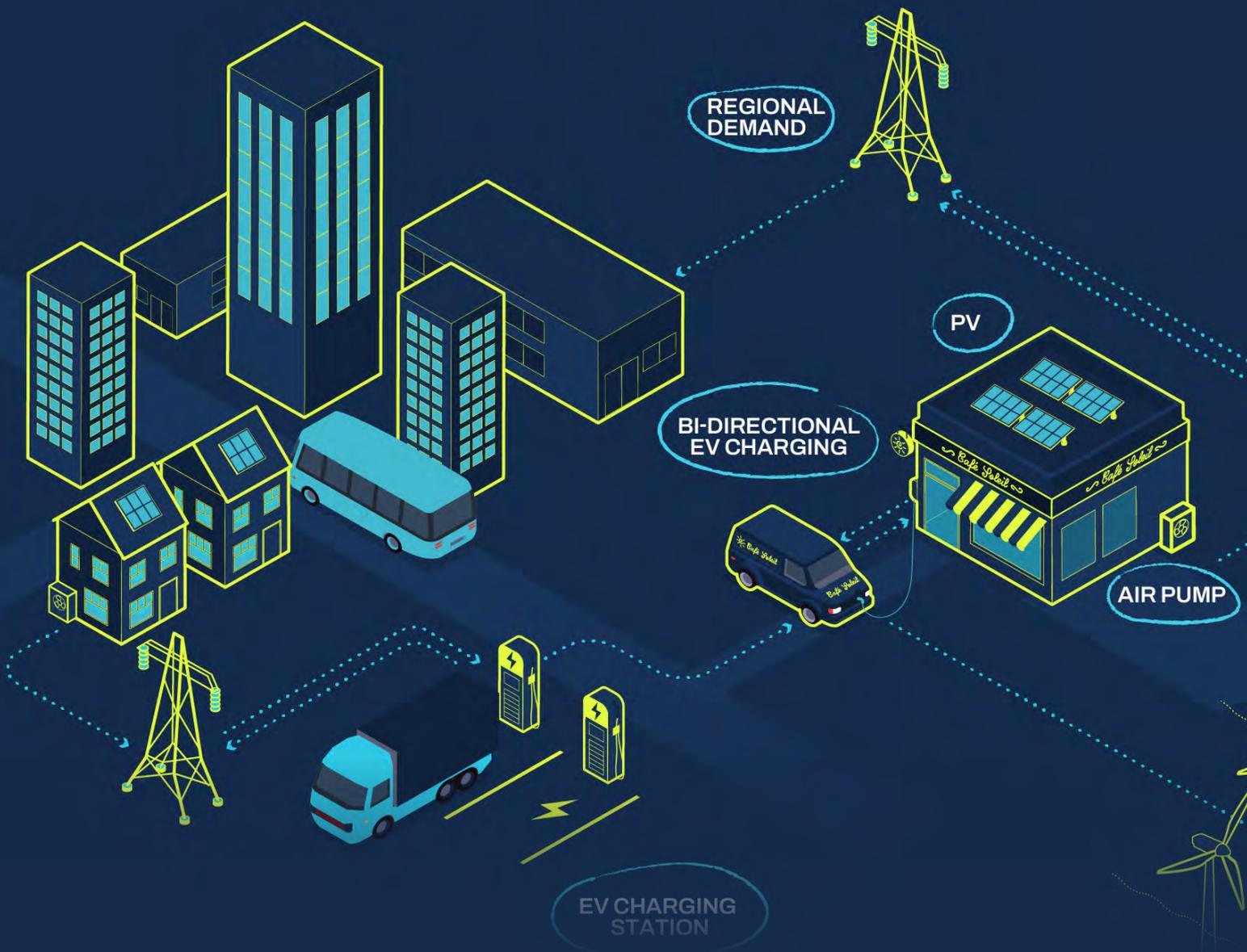


Integrate to Zero:

Carbon and cost reduction opportunities from integrated energy in GB



About Cornwall Insight

Getting to grips with the intricacies embedded in energy and water markets can be a daunting task.

There is a wealth of information to help you keep up-to-date with the latest developments, but finding what you are looking for and understanding the impact for your business can be tough. That's where Cornwall Insight comes in, providing independent and objective expertise.

You can ensure your business stays ahead of the game by taking advantage of our:

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- Market research and insight – Providing you with comprehensive appraisals of the energy landscape helping you track, understand and respond to industry developments; effectively budget for fluctuating costs and charges; and understand the best route to market for your power
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The authors



Anna Moss
Senior Consultant
Cornwall Insight
a.moss@cornwall-insight.com



Jacob Briggs
Consultant
Cornwall Insight
j.briggs@cornwall-insight.com



Euan Killengray
Senior Consulting Analyst
Cornwall Insight
e.killengray@cornwall-insight.com



Jack Downey
Consulting Analyst
Cornwall Insight
j.downey@cornwall-insight.com



Emily Lewis
Senior Consulting Analyst
Cornwall Insight
e.lewis@cornwall-insight.com

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1. About the report

1.1. Summary of research objectives

This report summarises the current market landscape, opportunities, and barriers to offering integrated energy propositions to consumers in Great Britain (GB). We define an integrated energy proposition as one which aims to provide end users with the opportunities of carbon and energy cost reduction through integrated energy activities such as those which are:

- On-site (for example electrification of heating, and deploying solar photovoltaics (PV) and battery storage assets)
- On-road for example electric vehicle charging)
- On-grid (for example electricity export from generation assets and participation in National Grid Energy System Operator's (ESO) balancing services¹)

This research is focused on consumer-centric solutions, being those installed or undertaken by the end user. It aims to understand the benefits that can be delivered across the electricity system as a result of actions taken by end users. Figure 1 outlines an illustration of integrated activity.

This independent research paper prepared by Cornwall Insight forms part of a wider initiative, [Integrate to Zero](#), commissioned by The Climate Collaboration Group.

1.2. Our approach

This report has addressed three areas of research. We aimed to set out the scale of benefits that could be achieved from delivering consumer-centric integrated energy solutions, to understand the current market propositions, and to assess the barriers and market enablers to a faster uptake of integrated energy solutions. The three areas are outlined in further detail below:

The “Size of the prize” – We have undertaken scenario-based modelling of the GB power market in 2035 to quantify the impact of integrated energy solutions on carbon and electricity costs in GB.

For more information on our approach, please see Section 4.

The current market landscape in GB – We undertook desktop research to understand the current market landscape in GB for integrated energy solutions, as at the end of 2022. We have provided a view of around 60 companies operating in this market focusing on those offering energy services and solutions intended to be integrated with others. We have therefore not focused on installers and manufacturers of solar PV or other established technologies as they are frequently sold individually.

¹ National Grid ESO's [balancing services](#), including Demand Flexibility Service, Frequency Response and Reserve Services

Barriers and market enablers to offering an integrated energy solution - To identify market barriers and enablers, we conducted 29 online surveys and nine in-depth interviews with energy market experts operating in the household and business markets for integrated energy services. We conducted interviews in November and December 2022. We thank all respondents for their time in providing their views.

1.2.1. Report structure

These areas are addressed in the report through the following sections:

- In **Section 2** we outline the headline insights and observations from the modelling, desktop research, surveys and interviews conducted in the GB market
- In **Section 3** we set out the key factors driving customer and provider interest in integrated energy solutions, as identified through interviewee discussions and desk-based research, alongside the challenges and drawbacks raised
- In **Section 4** we detail the approach taken in our GB power market modelling, focussed on quantifying the scale of benefits that could be delivered by integrating energy solutions so across the electricity system
- In **Section 5** we discuss the desktop research undertaken to understand the current market landscape for integrated energy solutions. This covers more than 60 companies, focusing on those offering energy services and solutions across the on-site, on-road, and on-grid spaces
- In **Section 6** we assess the barriers for companies looking to offer integrated energy services propositions, and the enablers that can accelerate the pace of adoption in the market
- In **Section 7** our Appendix includes further details on our modelling approach, definitions of the market propositions, and our desktop research data

1.3. Terminology

There are a range of terms used across the market to describe integrated energy services, including distributed energy, smart systems, energy optimisation and adjacent technologies. The terminology that service providers use is often determined by the audience they are addressing. These terms tend to be more defined in the business energy market, but there is limited understanding for household and Small and Medium Enterprises (SMEs) where brand names are better recognised. This report refers to integrated energy services to emphasise the optimisation of energy usage for users still connected to the transmission and distribution electricity networks.

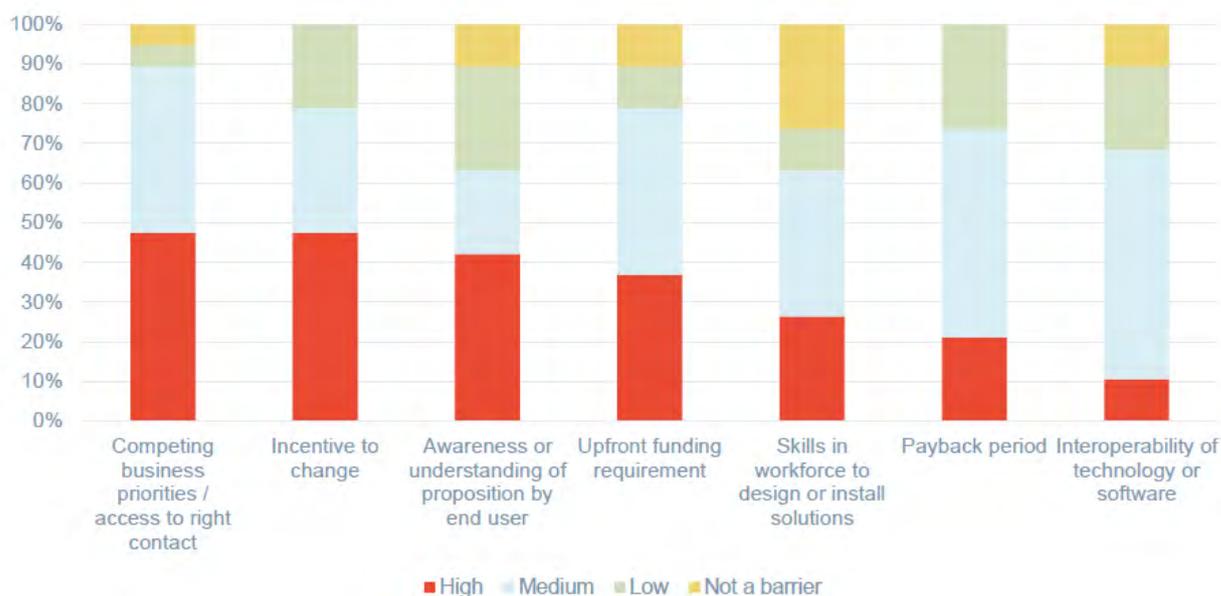
2. Headline insights

This section sets out the headline insights from modelling, desktop research, surveys and interviews we conducted focused on the GB market:

- In 2035, widespread use of integrated energy solutions could result in an annual wholesale market cost saving of £13.9bn, representing a 25% cost reduction compared to taking a non-integrated approach. Our scenario modelling shows that an integrated system which responds to market pricing signals enables a shift of electricity consumption from peak times to non-peak times, resulting in a lower requirement for gas generated power to meet peak demand. As a result, an integrated scenario results in an additional 4% decrease in carbon emissions compared to a non-integrated approach. See Section 4 for further information
- Large energy users have the greatest choice of integrated energy services. Propositions targeting the public sector or industrial and commercial (I&C) businesses provide support in reducing costs, reducing carbon and improving efficiency. The range of technologies and services targeting the household market is increasing, although uptake is expected to be more piecemeal. The SME sector has seen limited activity, with a greater focus on energy procurement and efficiency to date (e.g. LED lighting)
- A material number of companies offer integrated energy services, ranging from large international companies to small start-ups. These companies offer energy technology and/or services as their sole proposition or as a service adjacent to their core market offering. Several of the largest energy suppliers in GB offer services to businesses and (to a lesser extent) households
- There is a wide range of technologies and solutions available that support integrated energy. We found 10 examples of companies offering a fully integrated solution, where physical assets can be provided alongside energy management and revenue stream capabilities (e.g. access to National Grid flexibility services), typically offered by larger providers. There were limited examples in the current market of “energy-as-a-service” where a fully integrated offer is packaged with an energy supply tariff, to reduce complexity in contracting arrangements to the end consumer and to inform the optimisation approach taken by the software solution
- While financing options are more limited for smaller businesses and households, large businesses with a good credit rating have access to a range of options. Some businesses access services via a subscription or lease, avoiding high capex costs while ensuring assets/services are maintained for the lifetime of the contract
- The barriers to delivering faster and cheaper integrated propositions are varied and differ across market participants (Figure 1), including:
 - » *Upfront funding requirement:* Funding was commonly referenced in interviews as one of the highest barriers to delivering integrated propositions, from both a consumer and supplier perspective. While some large businesses with strong credit ratings may not find this a challenge, many businesses continue to face obstacles in accessing low interest rate loans, grants or other funding arrangements

- » *The incentive to change:* Engagement with integrated energy solutions has been led by larger businesses and the public sector, seeking to reduce costs and to decarbonise in line with Environmental, Social and Governance (ESG) commitments and/or rising bills. Interest from other user groups (SMEs, households) has been limited to date but is expected to increase, and will rely on the ability to engage customers with a proposition that adds value (financial or convenience)
- » *Access to the relevant company's contact point:* This is considered a challenge particularly when engaging with businesses. Finding the right contact within an organisation to discuss an integrated energy proposition can require access to a person with decision making responsibility across multiple service areas (buildings, vehicles), technical understanding and interest to change. In many instances these functions may be separated across different roles
- There are a number of policies in development that are expected to have an enabling effect on integrated energy solutions, including standardising the control of smart appliances and introducing new standards for household, commercial and public sector buildings. Interview participants highlighted that progress was being made in several areas, but many felt the policies were developing slowly and that there was a general wariness of making changes with unintended consequences

Figure 1: Barriers to offering an integrated solution in the business market - online survey response



Source: Cornwall Insight online survey

3. Why integrated solutions?

To meet the significant challenges and changes required to deliver the net zero transition, continued innovation, investment, and integration is required across zero carbon technologies and the wider energy sector. This section sets out an overview of the key factors identified by both the interviewee discussions and desk-based research that are driving customer and provider interest in integrated energy solutions, as well as the perceived challenges and drawbacks raised for this approach. Figure 2 below sets out the potential benefits and drawbacks raised by interview respondents and identified during the desktop research. Benefits are shown in green, with drawbacks shown in red.

Figure 2: Overview of benefits identified for integrated energy solutions

Benefit / Drawback	Consideration
Simplicity	The managed service structure common to integrated offerings lowers the need for customers to directly interact with energy assets and markets. This reduces the on-going customer engagement and commitment required to access the proposition's benefits and helps ensure they are reliably realised
Lifetime cost	Service providers can access multiple revenue streams as part of integrated propositions. This improves customer accessibility by enabling lower CAPEX solutions and more funded proposition structures
Functionality	Interoperability is a key requirement; however, gaps remain from a customer and system perspective. Taking these elements from a single service provider or point of customer contact can reduce the risk of interoperability challenges arising, with further upside available for customers from the greater choice and control that interoperability can provide
Optionality	Integrated services can support smoother customer journeys, facilitating deeper customer relationships, informing ongoing learning, and improving decision making for customers. This can facilitate ongoing refinement of the services and assets taken by the customer
Value resilience	Greater interaction across energy assets and system services can increase the value streams available to service providers. This can support revenue diversification and increased returns for service providers and end customers
Upfront cost	Fully integrated services can require customers to take multiple energy assets, which can carry high associated CAPEX costs. Accessing this CAPEX, even with some of the emerging funded solutions, is repeatedly raised as a barrier for customers
Lock-in	The range of assets, products, and services that can comprise integrated solutions can increase the risks of customer lock-in, via product design, limited interoperability, or contract structure. This can bring challenges for customers, especially in the face of market exit or obsolescence
Complexity	Integrated solutions for businesses often address customer needs across multiple business units and departments and can require significant buy in and engagement to access and maintain benefits throughout the product's lifetime

Overall, the opportunities for customers and service providers are resulting in numerous market participants developing integrated energy solutions, with some of the drawbacks currently faced from these services, such as cost and complexity, potentially reducing as the sector matures.

4. Size of the prize

To get a better understanding of the impact of integrated energy solutions on carbon and wholesale electricity costs in GB, we have undertaken modelling of the GB power market. We have assessed 2035 to understand the impact of integration at a time when there is expected to be an increased uptake of solar PV, electric heating and electric vehicles (EVs). Our objective is to quantify the “size of the prize”, to understand the scale of benefits that could be delivered by integrating energy solutions so that they are optimised across the national electricity system to deliver collective benefits, such as smart electric vehicle charging and battery storage.

4.1. Our approach

Our modelling utilises our Q422 Benchmark Power Curve (BPC). The BPC provides scenario-based projections of commodity prices and demand which allow for an assessment of changes in wholesale prices and the generation mix. These curves are based on modelling of detailed fundamental drivers that affect the market now and in the future.

We have assessed two scenarios: “Integrated” and “Fit and Forget” in the year 2035. We have taken an approach to keep the level of technology deployed in each of the two scenarios constant, including the expected deployment of solar PV, electric heating and home EV uptake. Each scenario takes a different approach to integration, utilising assets such as EV charging and battery storage in different ways.

- **Scenario 1 “Integrated”:** This scenario sees technologies respond to half hourly price signals. It includes widespread adoption of smart EV charging and vehicle to grid (V2G) participation, with fully optimised battery storage assets that respond to market pricing signals. This typically means that batteries are better aligned to the dispatch of solar PV generation (charging through the day and discharging in the evening)
- **Scenario 2 “Fit and Forget”:** Assumes the same level of technology installed as the Integrated scenario, but with limited adoption of smart EV charging and less optimised battery assets. We assume in this scenario that technologies are used in a more self-contained manner, leading to lower flexibility available on the electricity system

These assumptions allowed us to estimate the difference in carbon and wholesale market electricity prices between the scenarios for a one-year view in 2035. The fixed and variable parameters can be seen in Figure 3. More information on the changing generation mix and underlying assumptions on technology uptake are available in the appendix to this report (Section 7.1).

Figure 3: Modelling scenario assumptions

	Metric	Integrated scenario assumption	Fit and forget scenario assumption	Source	Parameter changed between scenarios
Solar PV	GW capacity trajectory	CI Central view	CI Central view	National Grid demand data	✗
Electric heating	% adoption trajectory	CI Central view	CI Central view	CI projections based on government policy	✗
Home EV uptake	% adoption trajectory	CI Central view	CI Central view	National Grid ESO FES 2022	✗
EV smart charging	% archetype take up	Widespread adoption	Limited adoption	National Grid ESO FES 2022	✓
EV V2G participation	% archetype take up	Significant adoption	Negligible adoption	National Grid ESO FES 2022	✓
Battery storage	Battery utilisation	Fully optimised to market	Less optimised to market	CI projections from long term planning model	✓

While we believe this approach provides a view of the benefits delivered by integrated energy solutions, we acknowledge there are several factors outside the scope of the scenarios assessed, including:

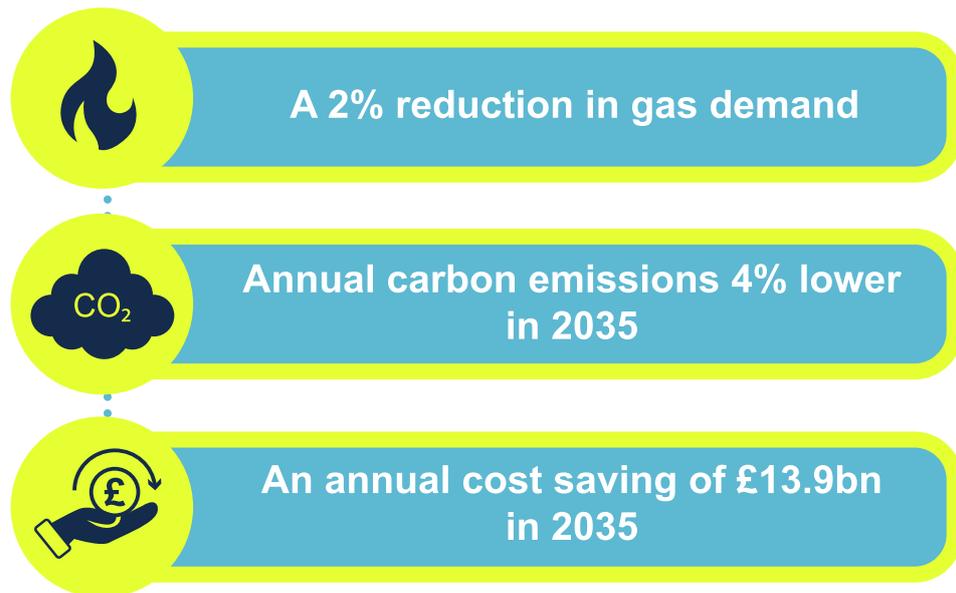
- Our modelling does not account for any cost savings resulting from fewer additional generation assets built, reflecting the lower level of consumption at peak times
 - » If additional flexibility from demand side resources was available then lower levels of capacity would likely be procured in the Capacity Auctions, which would result in lower capital spend (the cost for building peaking power stations) and lower costs for consumers (to recover the costs)
 - » As a result, if these impacts were considered savings would likely be greater than presented in the analysis. However, we do not believe this would have material impact of the findings of this study
- Our modelling does not account for any cost savings in the distribution and transmission networks that additional flexibility could create, through reduced need to build additional capacity
 - » The ability to operate a more constrained network, as enabled by greater use of flexible capacity, would likely support lower overall capital spend on network reinforcement
 - » As a result, if these impacts were considered savings would likely be greater than presented in the analysis. However, we do not believe this would have material impact of the findings of this study
- It is more likely that renewable assets, EVs, chargepoints, low carbon heating solutions and storage solutions will see greater levels of uptake and therefore higher capacities in a scenario with more integration, as the cost and carbon reductions are likely to create a stronger business case

- The comparative carbon savings presented do not account for the reduced petrol consumption from internal combustion engine vehicles to EVs, as the number of deployed EVs is consistent across the “Fit and Forget” and “Integrated” scenarios
- Operational performance from technologies may continue to improve, changing the associated benefits
- Our model assumes assets and consumption operating on half-hourly settlement periods are able to respond to price signals
- Our model optimises on a system-wide basis and does not consider the individual customer decisions about technology utilisation

Our approach assumes all consumers remain connected to the national energy network. The benefits of integration are realised in the wholesale price of electricity, and the distribution of these benefits is a commercial consideration not assessed in this research.

4.2 Integration could save 25% on wholesale electricity price

Figure 4: Carbon and wholesale electricity cost savings from an “Integrated” scenario vs “Fit and Forget”



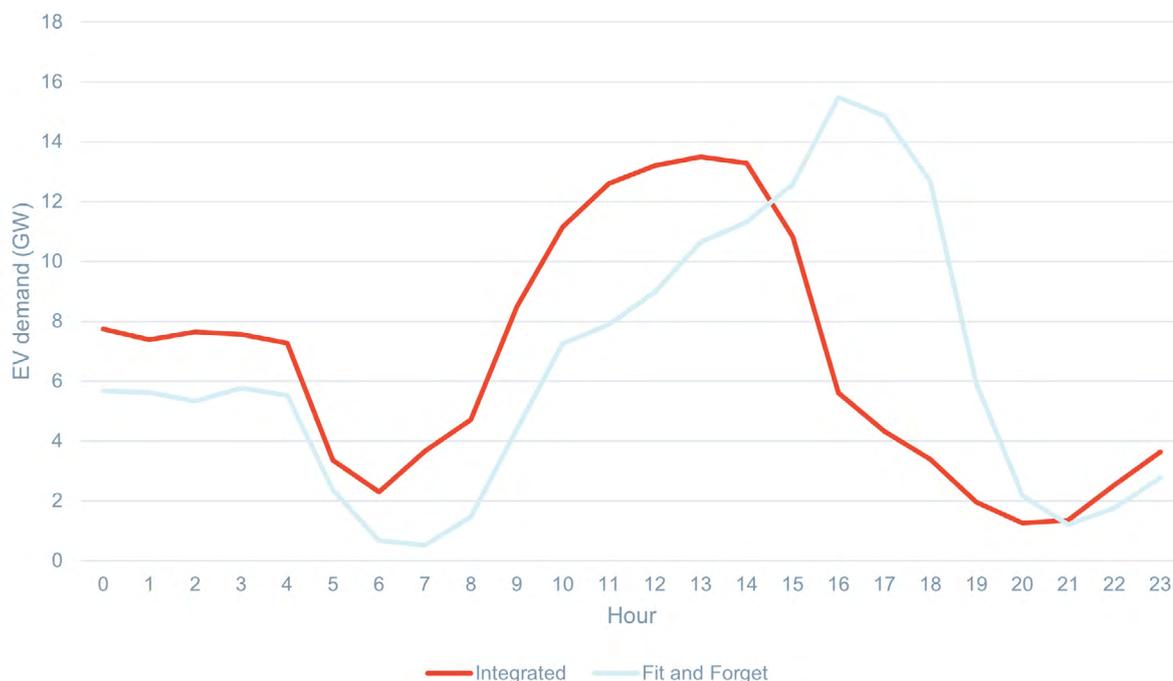
Cost savings in the electricity wholesale price. Savings assume technologies can respond to market pricing signals. Our “Integrated scenario” includes a 69% reduction in EV electricity consumption during peak periods.

We see considerable wholesale electricity cost reductions in the Integrated scenario compared to Fit and Forget. In 2035, the Integrated scenario sees a wholesale electricity market cost saving of £13.9bn, reflecting a reduction of £32/MWh on average in wholesale power prices compared to the Fit and Forget scenario. This cost saving represents a 25% decrease on the total wholesale electricity costs of the Fit and Forget scenario and is driven by the reduction in use of carbon intense dispatchable generation, reducing gas consumption by 2%. This reduced demand for gas in the Integrated scenario also drives an additional 4% decrease in annual carbon emissions for 2035 as a result of operating technologies in a more integrated way.

The main driver for lower electricity costs arises from the flexibility provided by technologies to respond to changes in price signals. This enables shifts in demand to cheaper price periods and aligns more closely to the generation of intermittent renewables such as solar PV. In the Integrated scenario, EV drivers have visibility on cheaper charging periods, and therefore alter their charging behaviour based on these price signals. In the Fit and Forget scenario a higher percentage of actions are taken in a “self-contained” manner (responding only to the requirements of the individual business or household), resulting in less flexibility being available on a grid scale to provide greater shifts in demand and access to lower non-peak prices.

This shift in demand is demonstrated in Figure 5, where the utilisation of smart EV charging allows the demand for EV charging to be scheduled to earlier in the day and overnight in the Integrated scenario. The Integrated scenario sees a 69% reduction in EV electricity consumption during the peak periods (16:00 to 19:00) compared to the Fit and Forget scenario. As a result, the Integrated scenario consistently records 27% higher hourly EV demand on average outside of peak hours compared to the Fit and Forget scenario. By comparison, the Fit and Forget scenario sees a rise in peak demand between 16:00 and 19:00, increasing the need to run more expensive carbon intense dispatchable generation. This EV demand curve coincides with the usual household demand, causing larger peaks and leading to higher costs and carbon intensity on the wholesale market

Figure 5: EV charging demand profile in April 2035



Source: Cornwall Insight

Whilst this analysis provides only a one-year view of cost and carbon savings, we could expect to see similar findings for the 2020s and 2040s if integrated solutions were more widely adopted. These savings are primarily driven by gas demand and wholesale prices which fluctuate with the changing GB fuel mix as ageing baseload gas or nuclear sites retire, and more intermittent renewables replace them.

5. The current market for integration in GB

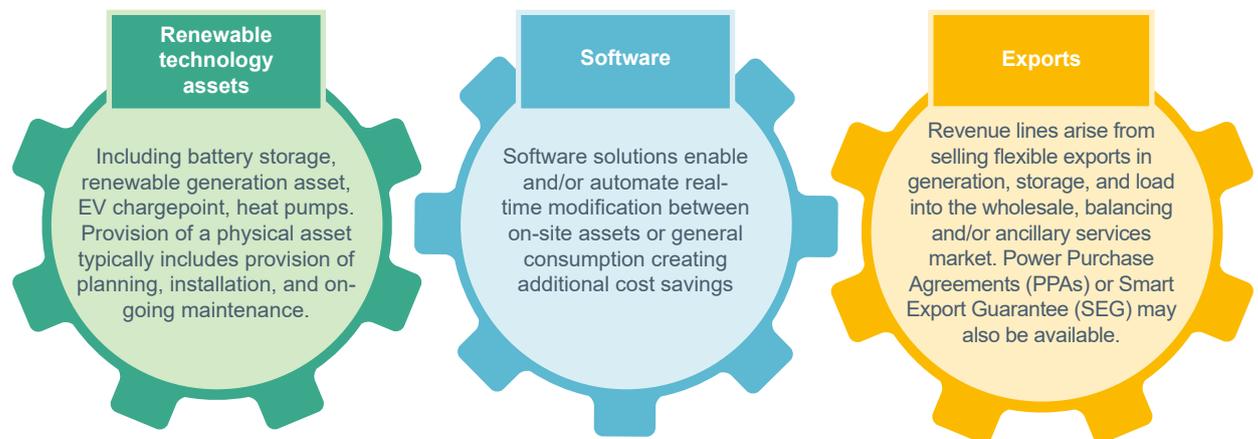
We undertook desktop research to understand the current market landscape in GB for integrated energy solutions, as at the end of 2022. We have provided views based on research assessing more than 60 companies operating in this market, focusing on those offering energy services and solutions intended to be integrated with others. This section summarises the findings of the research.

5.1. A wide range of propositions available

There are multiple propositions available to end users that support integrated energy solutions. These range from individual renewable technology assets or software solutions to a combined proposition that includes a package of assets, services, and financing arrangements.

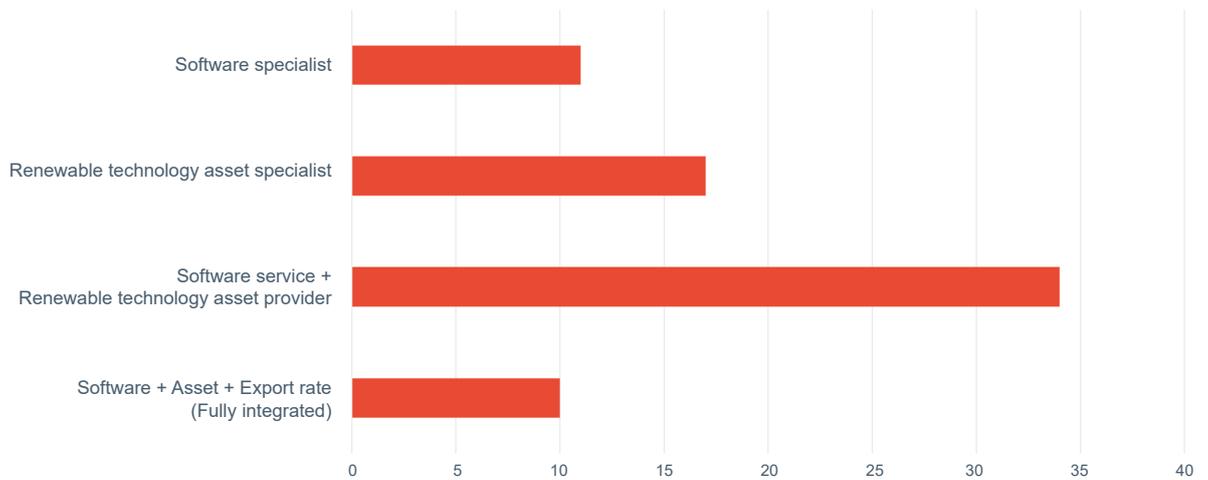
We have outlined our view of a fully integrated solution in Figure 6. While these solutions are often packaged in different ways by different market players, an integrated proposition can largely be seen as renewable technology assets (solar PV, battery storage) coupled with software (optimisation platform) and export capabilities.

Figure 6: Fully integrated proposition



For most technologies and services, there is a range of providers to choose from. We found that “gateway” products such as solar PV are more readily available in the current market, compared to fully integrated solutions. As more component parts are added to a single package of integrated solutions, the more specialised the service becomes. We found 10 examples of fully integrated solutions in our desktop research, typically offered by larger, established energy suppliers (Figure 7). 45% of companies we researched offered a combination of at least one technology alongside a software service, while around 40% of companies researched specialised in offering software services or renewable technology assets.

Figure 7: Number of companies offering at least one element of a technology/service in GB, desktop research October and November 2022



Source: Cornwall Insight

There were limited examples in the current market of “energy-as-a-service”, where a fully integrated offer is packaged with an energy supply tariff, to reduce complexity in contracting arrangements to the end consumer and to inform the optimisation approach taken by the software solution, although the overall volume of activity across the market is uncertain. During our research, Octopus Energy launched a proposition called “Octopus Zero”, described further in Figure 8.

Figure 8: Case study, Octopus Energy, integrated household proposition



Case study: Octopus Energy

Octopus Energy is a household and business energy supplier, and has recently launched an integrated energy proposition for households. Called “Octopus Zero”, the proposition offers “zero energy bills for five years” in partnership with ilke Homes. To qualify, homes will need to have battery storage, solar panels, a heat pump and a smart meter (EV charging not included in the offer). This scheme will be available nationwide to select eligible new build homes, with plans to extend to retrofitting pre-existing housing stock. Octopus Zero homes will have their total electricity usage across the year set at double the expected usage, with any customers going over this predicted usage being billed for the unit rate annually.

Octopus Energy also provides a variety of energy services within the home, including integrating renewable generation and storage, low carbon heating, and smart EV charging.

The range of elements included in integrated solutions means that some providers use partnerships with other market players to ensure the breadth of necessary capabilities are represented within the service. These partnerships are often used to add specialist service elements that are outside the traditional scope of services provided, e.g. trading and optimisation of energy assets or electric vehicle leasing. Figure 9 provides an example.

Figure 9: Case study, Marubeni, partnerships to deliver solutions



Case study: Marubeni

*Marubeni, a Japanese trading and investment business (and owner of Smartest Energy), developed a proof-of-concept V2G and vehicle to business trial, run at the Nissan Norton Way dealership. The **project** demonstrates how a business with EV charging on site may need to dynamically orchestrate and optimise the forecasted on-site solar generation, the utilisation plan for the EVs, and the underlying site power demand, while considering associated energy costs and physical constraints.*

The project uses data to inform future vehicle to grid products and services. The trial operated in partnership with Grid Edge (AI software for building energy management), Virta (electric vehicle charging platform), Origami (energy data platform) and Smartest Energy (business energy supply).

5.2 Large energy users show highest demand for solutions

The market for integrated energy solutions is growing as decarbonisation and cost saving pressures on end users persist. The largest demand for services has historically come from the public sector and I&C businesses and this continues to be an area of growing interest. There is also rising interest in the household market, although this tends to be more piecemeal, focused on single or dual technology installations to achieve rapid cost reduction. The SME sector has historically lagged these two markets, with the limited appetite reflected in the low number of targeted propositions.

Figure 10 provides an overview of these different target markets and the varying development of integrated propositions:

Figure 10: Target market for integrated propositions



Our research shows that most providers currently target the business market (60%), where higher volumes of energy are consumed, energy arrangements can be more complex over a range of sites, and companies may have a focus on energy and/or carbon reduction through a cost management plan, ESG or CSR strategy. Many of the propositions for the public sector and large businesses are well established, providing a package of services that can be segmented or joined together as appropriate. We describe these further in Figure 11.

Figure 11: Case study, E.ON Energy, large supplier propositions

Case study: E.ON Energy

E.ON UK is an energy supplier holding a top five market share in the household, SME and I&C supply markets. Its [Energy Solutions](#) and [npower Business Solutions](#) businesses offer a range of services in integrated energy. These range from physical assets (solar PV, wind power, heat pumps, combined heat and power, biomass etc) alongside EV charging solutions, monitoring services, optimisation and energy reduction, energy export, and energy management services. Business customers of different sizes can choose from “off the shelf” and bespoke propositions. E.ON Energy also offers a demand side response service, where on-site flexible generation assets or controllable energy load (e.g. lighting, refrigeration) are connected to a “virtual power plant” allowing the service provider to sell back excess energy to the grid, creating a revenue stream for the business.

These services are provided through a combination of in-house delivery and partnerships with service providers, such as their Daiken heat pumps or partnership with car manufacturer Nissan for business V2G optimisation of EVs.

For businesses with a good credit rating, there are a range of financing options. Some bundled service options are offered at a reduced cost and can ensure continuity and better integration capability between assets. Some businesses access services via a subscription or lease, avoiding high capex costs while ensuring assets/services are maintained for the lifetime of the contract. We explore financing options in more detail in Figure 12.

Just over half (51%) of companies tracked in our desktop research offer services to households. The propositions in this market are more likely to be piecemeal, with single technologies linked to single service management and control apps. These are typically focused on cost savings, for example solar PV with/without battery storage, and can be difficult to link together as an “integrated” solution with a central control system.

Figure 12: Case study, Centrica Business Solutions, financing options for I&C businesses



Case study: Centrica Business Solutions

Centrica Business Solutions (CBS) delivers integrated energy assets for the public sector and I&C customers. For large I&C businesses, CBS provides a range of financing options, including:

- *Discount Energy Purchase* – CBS provides financing for on-site generation assets, with the user paying a fixed p/kWh unit rate for the electricity generated for a 7–15-year period
- *Operation Ownership Agreement* – a hybrid option including a level of capital spending on generation assets from the customer and a lower p/kWh rate
- *Energy Services Agreement* – provides installation, operation, and maintenance of multi- technology solutions, using Centrica or dedicated 3rd party financing
- *Power Purchasing Agreement* – CBS’s service finances on-site renewable generation assets, with customers purchasing the generated electricity at a discounted rate, over periods up to 25 years

5.3 Companies offering services range from large suppliers to start ups

We have analysed a selection of companies offering propositions to business and household consumers in GB. These companies can be broadly categorised within the market ecosystem outlined in Figure 13, and many companies’ service offerings utilise partnership arrangements in delivery.

We make reference to some specialists, which, whilst not providing a fully integrated proposition themselves, are driving innovation in integrated solutions in different segments of the energy market. Figure 14 outlines a case study demonstrating innovation in the integrated energy market. A full list of companies assessed in our desktop research is available in Section 8.3.

In Figure 13, we have provided an overview of major market players that offer an integrated energy proposition and have a substantial customer base (often in an adjacent market). We have provided a view of their market share based on our market share surveys and provided an outline of their integrated energy services proposition based on desktop research.

Figure 13: Market ecosystem for integrated propositions

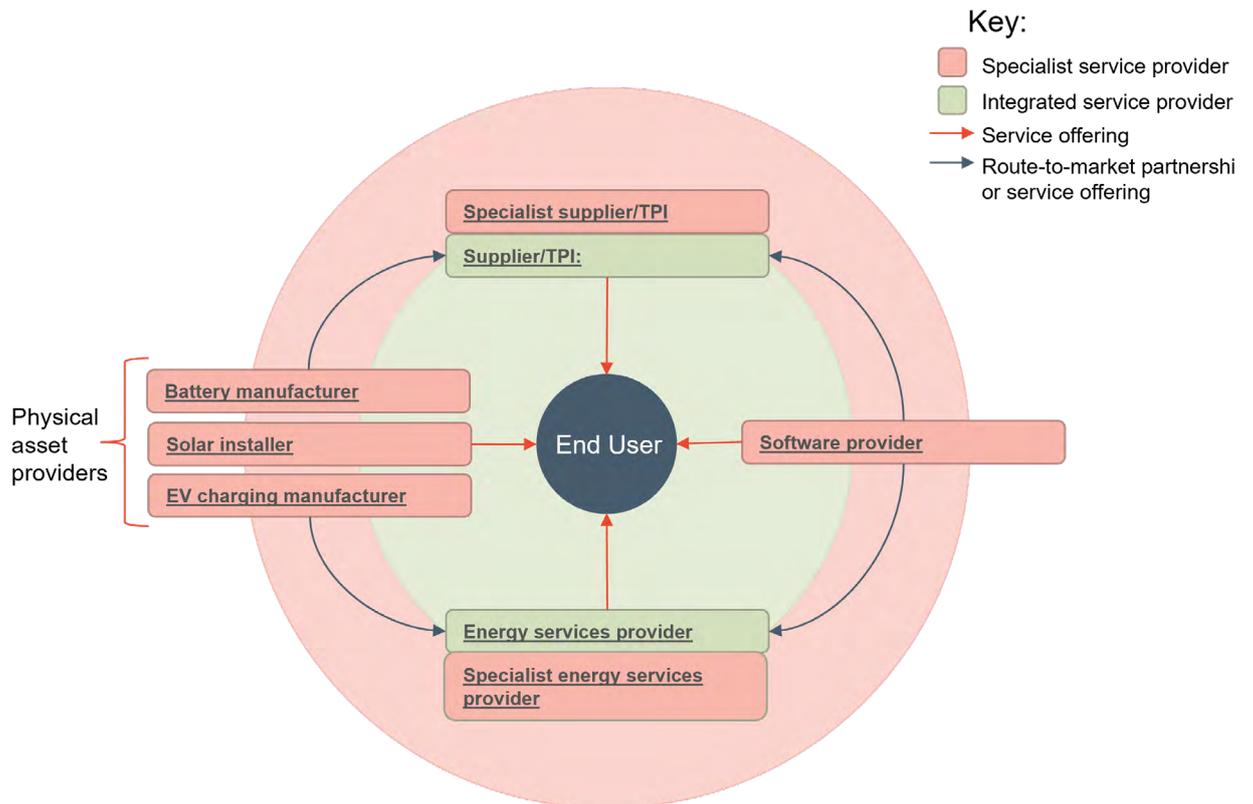


Figure 14: Case study, ev.energy, innovation in integration



Case study: ev.energy

ev.energy offers a suite of EV services for domestic and commercial charging. The services allow for differing degrees of integration with on-site generation and storage, with the ability to engage in grid flexibility. Products include apps to help optimise smart charging as well as managing fleets for business customers. ev.energy also offers charging management software that can integrate with on-site generation and utilises flexibility services. The services help businesses and households to save money by integrating assets and using smart technology and offers cash and voucher rewards for using smart charging services.

Figure 15: Examples of major players operating in adjacent markets with fully integrated service offerings

Key				
Top 5 market share in core market(s)		Top 10 market share in core market(s)		Top 20 market share in core market(s)
Company	Core market(s)	Core market(s) banding	Overview of integrated service	Comentary on energy services
Centrica	Household and business supply	Top 5 in household, SME and I&C supply markets	Deliver in-house, end-to-end heat and energy solutions to the public sector and I&C organisations. Partial solution for domestic end users	<u>"7000+ solar sites installed in the UK, totalling over 90MW"</u>
E.ON UK	Household and business supply	Top 5 in household, SME and I&C supply markets	Integrated energy solutions delivered in-house and through partnerships to help create a more sustainable home and business. Equally focused on domestic and businesses	<u>"1,200 business EV charge points installed in the UK by 2022"</u>
EDF Energy	Household and business supply	Top 5 in household, SME and I&C supply markets	Integrated solutions aimed at large businesses to help achieve net zero, and domestic consumers to achieve "energy independence"	<u>"Over 175,000 Pod Point EV charge points installed in the UK as of June 2022"</u>
Octopus Energy	Household and business supply	Top 10 in household supply, Top 20 in SME and I&C supply	Beginning to offer integrated services, with a specific focus on households. Looks to install low-carbon technology to provide "free, clean energy" through its new "Zero Bills" smart tariff	<u>"Kraken as of January 2022 controlled hundreds of batteries across the UK - enough to store 1.2GWh of power"</u>
Mitie Energy	I&C procurement	Top 20 in I&C procurement	Engineering focused TPI providing the installation of end-to-end energy services for I&C customers	<u>Installed over 250MW of solar PV in the last decade"</u>
Schneider Electric	I&C procurement	Top 5 in I&C procurement	Manufacturing and engineering focused TPI providing the installation of end-to-end energy services for I&C customers	<u>"480,000+ installations of its EcoStruxure optimisation platform"</u>
Scottish Power	Household and business supply	Top 5 in household supply, Top 10 in SME and I&C supply	Deliver in-house integrated propositions, with mostly a domestic focus. Business market services currently limited to EV chargepoints	<u>"Holds 327,000 smart solutions contracts as of September 2022"</u>

6. Barriers and enablers of integrated solutions

Whilst there are many benefits of integrated systems, barriers to scaling exist and the market is still nascent compared to centralised and siloed energy supplies. In this section we describe these barriers for companies looking to offer an integrated energy services proposition and explore the enablers that could increase the pace of adoption of integrated energy solutions.

To gain a better understanding of the direct implications for businesses, we undertook online survey and interview research between October and December 2022. Our online survey “Investigating the integration of energy service propositions” saw 29 energy experts respond across the GB market. Follow up in-depth interviews were undertaken with nine of the respondents to gain a deeper understanding of the survey responses. 46% of respondents were physical or digital solutions providers/installers, 25% were energy suppliers or TPIs, 17% were large end users, and the remaining 13% were categorised as research/trade body. Questions focused on:

- What are the biggest barriers to launching an integrated energy solution?
- Are there any changes that could enable a faster or cheaper uptake of integrated energy solutions?

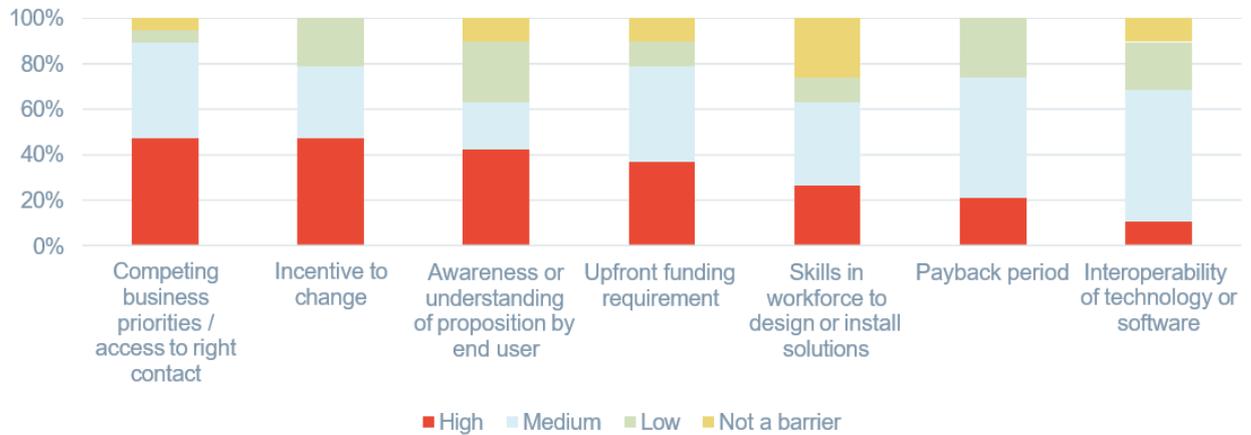
Respondents self-selected to respond to questions with a focus on the business or household market, relevant to their professional experience. We have presented the results of the survey and interviews below, outlining the main barriers experienced in the business and household markets, the ease of solutions presented and some enabling changes being made in policy/regulation.

6.1 There are a range of barriers to offering an integrated solution

Survey respondents scored barriers to offering an integrated solution based on our preidentified barriers. The mixed results seen across all categories suggests that the barriers to integration are varied and differ across market participants dependent on their role and prior experience.

Figure 16 shows that “competing business priorities/ access to the right contact” and “Incentive to change” were commonly found to be limiting factors, alongside “Upfront funding requirements”. In the in-depth interviews, respondents stated that it can be hard to find the right person within a business that has decision making responsibility to authorise a change, the time to dedicate to understanding the change, and/or the knowledge or understanding of the internal business system. There is often a reliance on local knowledge within the organisation and without a central organised scheme or campaign to advertise the benefits of integrated solutions, the proposed benefits can be easily misunderstood or not trusted.

Figure 16: Barriers to offering an integrated solution in the business market – online survey responses



Source: Cornwall Insight online survey. Question: We have identified some of the biggest barriers to increasing uptake of integrated energy solutions for businesses. Based on your experience, please rate these as barriers in offering a proposition to a consumer. Online survey November 2022. Number of respondents: 19

While significant progress has been made in offering an integrated energy service, respondents in interviews identified several barriers which, if addressed, could speed up the pace of adoption. One respondent summarised: “We see this as an integrated problem as much as an integrated solution. Change will need to happen in a range of places”. Some responses focused on barriers to uptake from energy consumers, and others focused on barriers to offering an integrated energy proposition. We believe the two are closely linked, and have captured key responses in Figure 17.

Figure 17: Main barriers to offering an integrated solution in the business market

01

Incentive to change

While there are increasing requirements on commercial businesses to report and reduce carbon emissions, some participants felt these were insufficient to drive mass market change

02

Upfront funding

Upfront funding requirement is a limitation on customer demand for those without a strong credit rating and access to a finance lease

03

Access and awareness

Decision making functions in a business may be segmented by department, or there may be no central responsibility/decision maker for overarching energy and carbon

04

Skills in the workforce

Availability of skilled labour (e.g. engineers, designer and installer, roof specialists) has reduced in recent years

05

Payback periods

Payback periods are higher than expected for some customers and may not align with commercial building lease periods

06

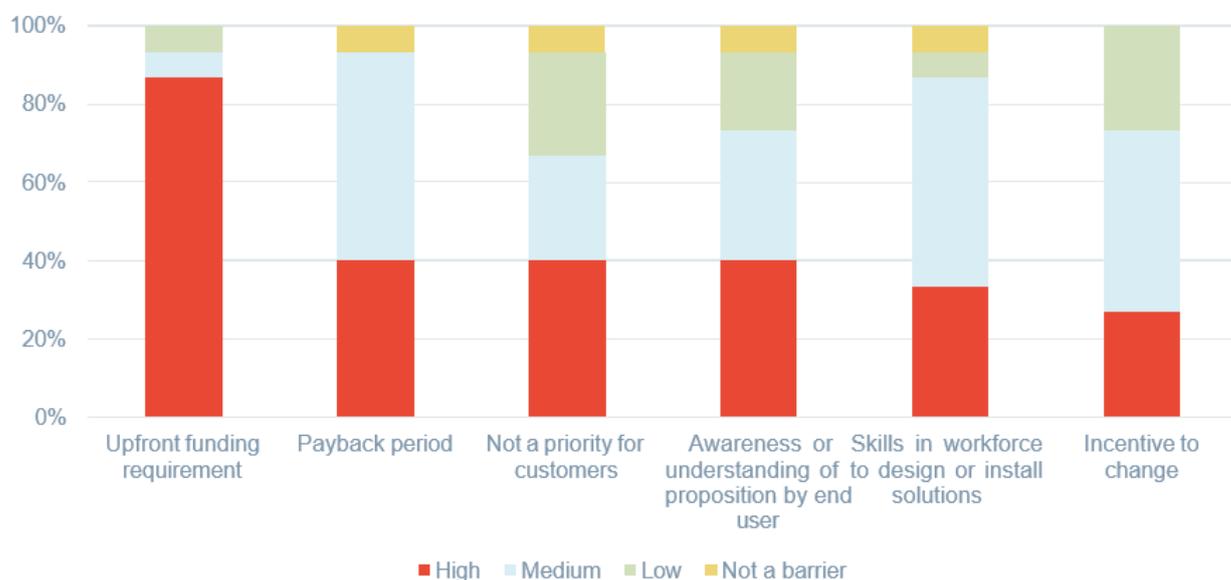
Regulation

The structure of some propositions may require the company to adhere to Financial Conduct Authority regulations, which can be a barrier to entry or to offering a proposition with funding in place

In the household market, survey respondents scored upfront funding requirements as the highest barrier (Figure 18). In the interviews, respondents identified many similar challenges to those operating in the business market. Respondents referenced the cost of living crisis as having a major impact on household consumer decision making, particularly across different customer segmentations, but noted that interest levels in individual technologies across some consumer groups were much higher as a result. Customer engagement was also referenced as a challenge to creating a mass market household solution. A proposition would need to overcome a level of customer apathy, and would need to clearly and simply convey financial value and/or convenience, with a limited level of disruption and be simple to operate from a single access point (e.g. an app). Even then, it was felt that interest in energy solutions is currently limited and would require significant innovation and funding to achieve something at scale.

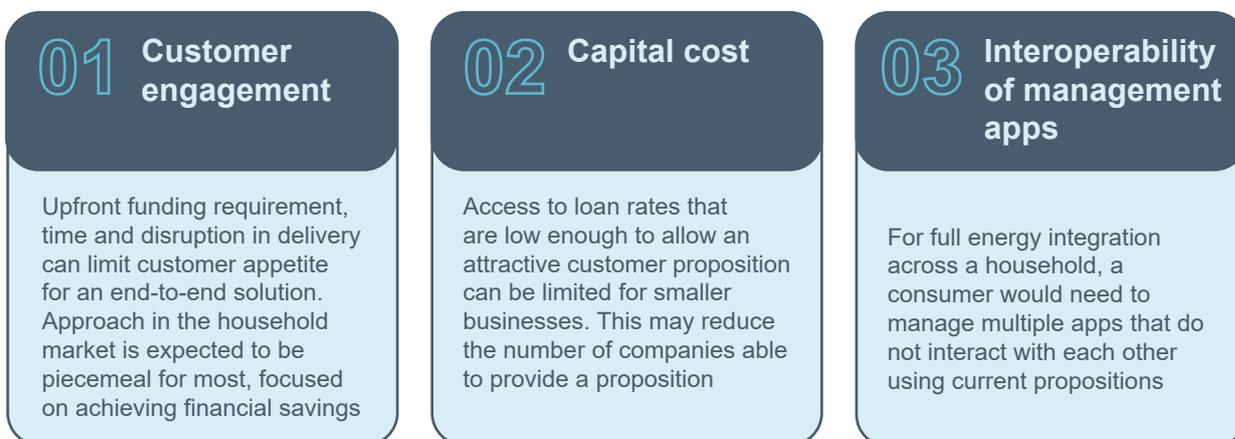
Figure 19 outlines additional barriers raised in the interviews. For smaller businesses offering services in this market, it can be challenging to access loan rates that allow for an attractive customer proposition. This in turn may reduce the number of companies able to offer an arrangement that spreads the upfront cost across a period of time suitable to a household consumer or small business.

Figure 18: Barriers to offering an integrated solution in the household market – online survey responses



Source: Cornwall Insight online survey. Question: We have identified some of the biggest barriers to increasing uptake of integrated energy solutions for households. Based on your experience, please rate these as barriers in offering a proposition to a consumer. Online survey November 2022. Number of respondents: 17

Figure 19: Main barriers to offering an integrated solution in the household market



6.2 Ease of providing solutions to the barriers

Figure 20 sets out the barriers to offering integrated solutions against the potential solutions that could arise in the market and the level of complexity associated with delivering these solutions.

We have scored the size of the problem and complexity of the solution on a three-point scale, with:

- A score of 1 (Green) representing a small problem / easy solution
- A score of 2 (Amber) representing a moderately challenging problem / easy solution
- A score of 3 (Red) representing a significant problem / complex solution

In assessing the size of the problem, we have reflected the quantitative and qualitative feedback received in the primary research for this project, alongside the supporting desk-based analysis. When grading the complexity of the solution, we have considered the range of stakeholders and associated level of specific action and intervention required to mitigate the barrier. Therefore, barriers where there are wider market factors supporting emerging solutions (e.g. falling asset costs and expansion of flexibility market participation) have received a comparatively lower score than areas which are more likely to require significant and sophisticated interventions (e.g. cross-sector legislation towards interoperability).

Figure 20: Summary of barriers and associated potential solutions for offering integrated energy solutions

Barrier	Solution	Size of the problem (1-3)	Complexity of the solution
Upfront funding requirement	Reduced capital costs	3	2
Skills in workforce to design or install solutions ²	Public and private investment in training Increasing market maturity	2	2
Competing business priorities amongst end users ³	Consumer engagement and informational campaigns Increasing market maturity	2	2
Incentive to change	Fall in technology cost Rising wholesale price Legal requirements to change	2	2
Payback periods ⁴	Reduced capital costs Size of value pool	3	1
Interoperability across the sector	Improved regulatory frameworks Commercial incentives and market growth	1	3
Awareness or understanding of proposition by end user	Central source of information Consumer engagement and informational campaigns Increasing market maturity	2	1

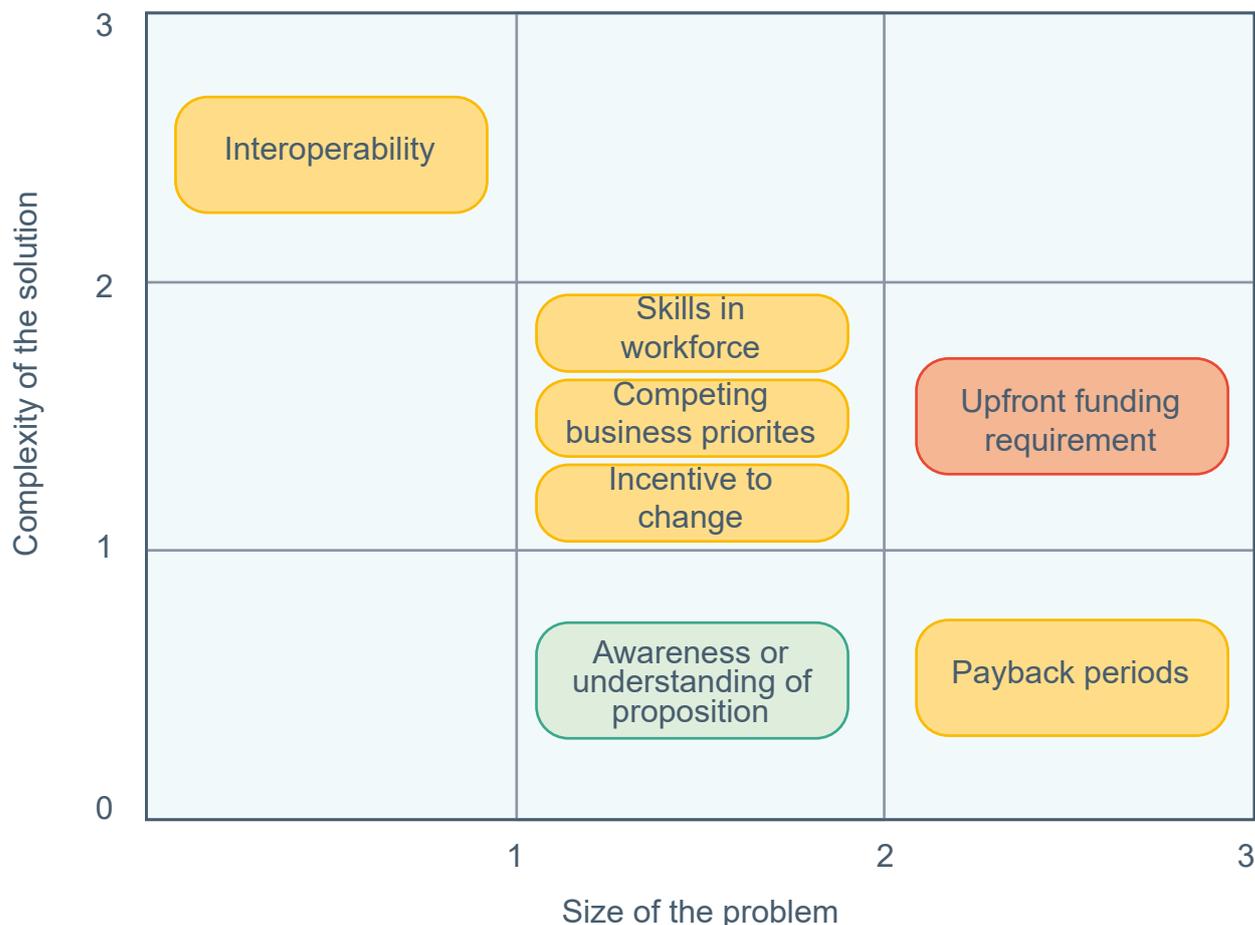
2 We have specifically considered the energy market challenges when considering the scale of challenge and complexity of solution and recognise that retraining entailed here is part of wider structural skills and employment challenges that may be more complex to address but that sit outside the scope of this study

3 Although the informational campaigns highlighted here can have lower hurdles to implement than other solutions, we note challenges in bridging the value action gap and translating these into customer actions

4 Although payback periods were considered to present a lower barrier in the business market, the challenges identified across both business and household sectors together see this barrier score a 3 overall

These rankings are compared in Figure 21 below, showing the combined scores across the barriers and solutions scoring categories. An overall Red-Amber-Green ranking is used in this graph, based on the product of the component scores in Figure 20 above, with Red boxes representing the most complex barriers and vice versa.

Figure 21: Overview of extent of barrier and complexity of solution



6.3 Market enablers are being progressed

There are several policies currently in development that are expected to have an enabling impact on integrated energy propositions. Interview respondents identified several of these as market enablers, acknowledging that progress is being made, albeit slower than expected.

Figure 22: Summary of policy enablers



Smart interoperability

The government has been considering how to ensure that energy smart appliances are able to be used by all demand side response service providers. In [July 2022](#) BEIS issued a consultation setting out plans to require energy smart appliances to conform with a standard based on Publicly Available Specification 1878, which sets out criteria that appliances need to meet in order to be classified as an energy smart appliance. Standardising the control of smart appliances is intended to support several use cases including the reduction of peak demand and helping to balance demand with the output of intermittent generation sources.



Future Homes and Buildings Standards

The Future Homes Standard will introduce new requirements for heating and efficiency measures in new build homes from 2025. The Standard will include requirements based on the use of primary energy, emissions, and affordability. Meeting the standards are likely to require the deployment of low carbon heating and onsite generation technologies, such as solar PV and batteries. For non-domestic buildings and existing homes, the [Future Buildings Standard](#) is intended to set out energy and ventilation standards from 2025, again with a role for low-carbon heating and other technologies such as solar PV.



Regulatory sandbox

The [regulatory sandbox](#) is an initiative set up by Ofgem to support new products, services, and business models that may face barriers under the existing energy market regulatory arrangements. In some cases, Ofgem can facilitate temporary relief from certain rules, allowing trials to take place and potentially leading to enduring regulatory changes. Trials to date have included peer-to-peer local trading, the use of innovative tariffs in combination with smart home technology, and the switching of supply between local solar, battery storage, and the grid. The sandbox could be used in the future to support trials of further integrated smart propositions.



EPC ratings

Energy Performance Certification (EPC) ratings have been used to drive energy efficiency improvements in household, commercial and public sector buildings. The ratings give a view of the energy performance of a building and can be improved by taking actions such as installing solar panels. For households, the government has set an ambition of all homes meeting EPC band C by 2035. Government has also [consulted](#) (awaiting outcome) on the implementation of a B rating by 2030 for all non-domestic buildings with an interim rating of C by April 2028, under the Minimum Energy Efficiency Standards (MEES). It is also considering (consultation awaiting outcome) introducing Performance Based Ratings for large commercial and industrial buildings in England and Wales, including a focus on flexible energy use as a part of the rating system.

7. Conclusions

Overall, this research has explored the value available from establishing integrated energy solutions in the market, with an annual wholesale market cost saving of £13.9bn possible in 2035, representing a 25% cost reduction compared to taking a non-integrated approach. Our scenario modelling shows that an integrated system enables this through a shift of electricity consumption from peak times to non-peak times, resulting in a lower requirement for gas generated power to meet peak demand. As a result, an integrated scenario also results in an additional 4% decrease in carbon emissions compared to a non-integrated approach. As well as offering benefits to the system and market as a whole, value can also be realised by service providers and individual users through dedicated propositions and services.

There is a wide range of technologies and solutions available that support integrated energy, where physical assets can be provided alongside energy management and revenue stream capabilities (e.g. access to National Grid flexibility services). A material number of companies offer integrated energy services, ranging from large international companies to small start-ups. These companies offer energy technology and/or services as their sole proposition or as a service adjacent to their core market offering. Several of the largest energy suppliers in GB offer services to businesses and (to a lesser extent) households. Amongst these services, there were limited examples in the current market of “energy-as-a-service” where a fully integrated offer is packaged with an energy supply tariff, to reduce complexity in contracting arrangements to the end consumer and to inform the optimisation approach taken by the software solution.

Large energy users have the greatest choice of integrated energy services. Propositions targeting the public sector or I&C businesses provide support in reducing costs, reducing carbon and improving efficiency. In particular, large businesses with a good credit rating have access to a range of options, with some businesses accessing services via a subscription or lease, avoiding high capex costs while ensuring assets/ services are maintained for the lifetime of the contract. While financing options are more limited for smaller businesses and households, the range of technologies and services targeting the household market is increasing, although uptake is expected to be more piecemeal. The SME sector has seen limited activity, with a greater focus on energy procurement and efficiency to date (e.g. LED lighting)

The barriers to delivering faster and cheaper integrated propositions are varied and differ across market participants, including:

- *Upfront funding requirement:* Funding was commonly referenced in interviews as one of the highest barriers to delivering integrated propositions, from both a consumer and supplier perspective. While some large businesses with strong credit ratings may not find this a challenge, many businesses continue to face obstacles in accessing low interest rate loans, grants or other funding arrangements
- *The incentive to change:* Engagement with integrated energy solutions has been led by larger businesses and the public sector, seeking to reduce costs and to decarbonise in line with Environmental, Social and Governance (ESG) commitments and/or rising bills. Interest from other user groups (SMEs, households) has been limited to date but is expected to increase, and will rely on

the ability to engage customers with a proposition that adds value (financial or convenience)

- *Access to the relevant company's contact point:* This is considered a challenge particularly when engaging with businesses. Finding the right contact within an organisation to discuss an integrated energy proposition can require access to a person with decision making responsibility across multiple service areas (buildings, vehicles), technical understanding and interest to change. In many instances these functions may be separated across different roles

There are a number of policies in development that are expected to have an enabling effect on integrated energy solutions, including standardising the control of smart appliances and introducing new standards for household, commercial and public sector buildings. Interview participants highlighted that progress was being made in several areas, but many felt the policies were developing slowly and that there was a general wariness of making changes with unintended consequences

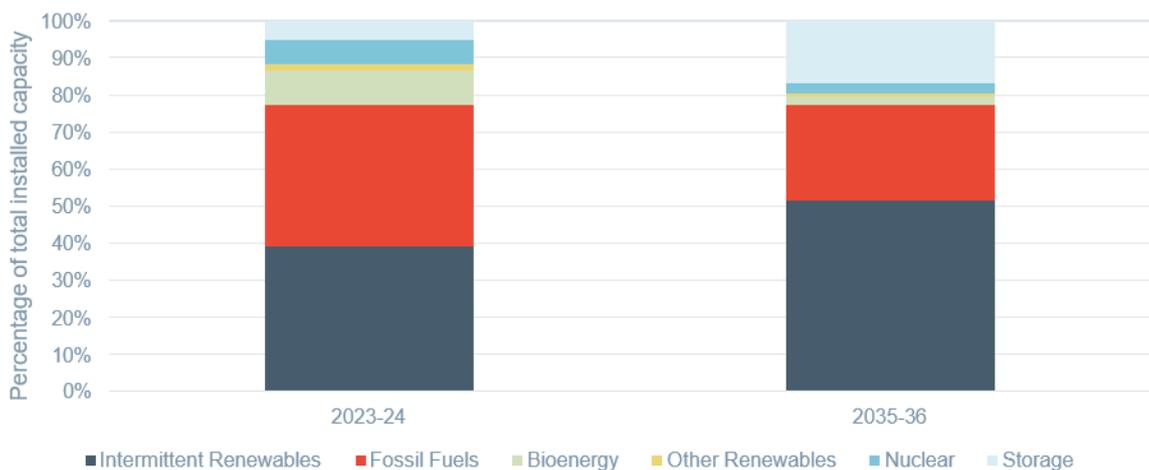
8. Appendix

8.1 Underlying assumptions for “Size of the Prize” modelling

The underlying assumptions built into this modelling exercise have been taken from the outputs of the Q422 Central case in our Benchmark Power Curve. The following assumptions are uniform across both the Integrated and the Fit and Forget scenario.

Shown in Figure 23 below, in the year of 2035, our Central case forecasts that intermittent renewables such as wind and solar PV providing around 50% of the GB generation mix, followed by fossil fuels (25%) and storage (25%). The other 25% is made up from bioenergy, nuclear, and other renewables such as hydro or tidal.

Figure 23: Proportions of installed capacity from different technologies on GB electricity system in 2023-24 and 2035-36



Source: Cornwall Insight

This forecasted view of the GB electricity system in 2035 would see the installed capacity of intermittent renewables increase by over three times compared to the current installed capacity in 2023. To support the intermittency of solar PV and wind, we forecast a substantial increase in storage provided by Li-ion batteries, with the proportion on the system rising from 5% to nearly 20%. This forecasted increase of renewables and storage assets aligns with current government targets, including the ambition to achieve net zero by 2050, and the [aim](#) to produce 50GW of offshore wind by 2030.

The scenarios also include the forecasted growth of EV charging and electric heating demand. By 2035, it is expected that EV charging demand increases by over tenfold, whilst we forecast current demand from electric heating to rise by nearly four times due to the rollout of heat pumps.

Assumptions for energy efficiency and building retrofitting align with current government policies and targets, with the expectation that energy efficiency is improved in 2035 compared to current day levels.

8.2 Proposition definitions

Figure 24 below outlines all the potential components of an integrated proposition that we reviewed different market players offering in the desktop research. We have then provided the definition of the proposition that we reviewed.

Figure 24: Definitions of the components of an integrated proposition

Proposition	Definition
Battery storage	The company will typically provide the planning, installation, and ongoing maintenance of a battery asset.
Demand Side Response (DSR)	The company will provide software to control a site's usage, import and exports to take advantage of different the different flexibility markets available. This service can be included alongside or separate from an optimisation platform.
EV solutions	The company will provide the planning, installation, and ongoing maintenance of EV charge points. This will usually be on-site (business or household) charging points, but some companies also offer on-road charging infrastructure such as rapid chargers at services. This can also include vehicle-to-grid (V2G) solutions where EVs can export back to the grid in times of high demand.
Export tariff	The company offers an export tariff. This is usually through PPAs (Power Purchase Agreements) or a Smart Export Guarantee (SEG) tariff (note: suppliers with over 150,000 domestic customers are required by their licence to provide a SEG tariff by Ofgem).
Heating solutions	The company will provide the installation and ongoing maintenance of heating assets which can be integrated with the energy optimisation of the building. This can include air/ground source heat pumps, smart thermostats/heating controls and district heating.
Optimisation platform	The company will provide software to optimise the turn up and turn down of electricity usage between the assets on-site. This can include optimising the usage of solar PV, battery storage or EV charge points/fleets.
Renewable generation	The company will provide the planning, installation, and ongoing maintenance of a renewable generation asset. Usually solar PV, but occasionally small onshore wind, CHP or biomass assets.
Time off Use (ToU) tariff	The company offers a ToU tariff that provides access to real time or pre-determined prices linked to changes in the wholesale price of electricity.

8.3 Full list of companies reviewed in desktop research

Figure 25: Full list of companies and proposition offerings, reviewed as part of desktop research analysis

Company Details			Proposition Type						
Company Name	Company Type	Target market	Physical Asset			Software		Energy Proposition	
			Renewable generation/ battery storage	Heating	EV / Charge Points	DSR	Optimisation Platform	ToU tariff	Export tariff
Agile Energy Recovery Ltd	Generation developer	I&C end users	x						
Altenex Energy	Energy services company	SMEs/I&Cs end users					x		
Ameresco	TPI	SME and I&C end users	x	x		x			
Asset Plus	Renewable infrastructure developer	SME, NGO, public sector	x	x			x		
BMW	Car manufacturer	End user	x		x				
Boxergy	Energy services company	Domestic end users	x	x					
Breath Energy	Renewable infrastructure developer	I&C		x		x	x		
British Gas/ Centrica	Supplier	Domestic & Business end users	x	x	x	x	x	x	x
Business Wise NI	Energy services company	SME, NGO, public sector	x						
Catalyst Commercial	TPI	SME and I&C end users	x	x	x	x	x		

Company Details			Proposition Type						
Company Name	Company Type	Target market	Physical Asset			Software		Energy Proposition	
			Renewable generation/ battery storage	Heating	EV / Charge Points	DSR	Optimisation Platform	ToU tariff	Export tariff
Climate Connect Digital	Energy services company	I&C end users					x		
Consultus	TPI	I&C end users			x	x	x		
E.ON UK	Supplier	Domestic & Business end users	x	x	x	x	x	x	x
Ecotricity	Supplier	Domestic & Business end users	x			x			x
EDF Energy	Supplier	Domestic & Business end users	x	x	x	x	x		x
eEnergy Group	TPI	SME and I&C end users	x		x		x		x
Eliq	Software provider	End user					x		
Enel X	Energy services company	SME and I&C end users	x			x	x		
ENGIE	Supplier	SME and I&C end users	x			x	x		
Equans	Energy services company	SME and I&C end users	x		x		x		
ev.energy	EV charge software	End user				x	x		
Flexitricity	Supplier	SME and I&C end users				x	x		x
Ford	Car manufacturer	End user	x		x	x			

Company Details			Proposition Type						
Company Name	Company Type	Target market	Physical Asset			Software		Energy Proposition	
			Renewable generation/ battery storage	Heating	EV / Charge Points	DSR	Optimisation Platform	ToU tariff	Export tariff
Good Energy	Supplier	SME and I&C end users	x	x	x			x	x
Grid Beyond	Software provider	SME and I&C end users, retailers	x			x	x		
GridEdge	Software provider	SME and I&C end users, retailers					x		
Honda	Car manufacturer	End user						x	
Horizonei	Energy infrastructure	I&C		x	x				
Hyundai	Car manufacturer	End user	x		x				
IBECCS Ltd	Energy consultancy	SME and I&C end users					x		
Inenco	TPI	SME and I&C end users	x			x	x		x
Inspired	TPI	SME and I&C end users	x			x	x		
JBF Energy Solutions	Engineering contractor	I&C end users	x						
JLR	Car manufacturer	End user			x				
Logical Utilities	TPI	I&C end users			x		x		
Lunar Energy (owns Moixa)	Energy services company	Domestic & Business end users	x				x		
Marubeni	Energy services company	I&C end users			x	x			

Company Details			Proposition Type						
Company Name	Company Type	Target market	Physical Asset			Software		Energy Proposition	
			Renewable generation/ battery storage	Heating	EV / Charge Points	DSR	Optimisation Platform	ToU tariff	Export tariff
Mistubishi	Car manufacturer	End user (both)	x	x					
Mitie Energy	TPI	SME and I&C businesses, other TPIs	x	x	x	x	x		
Myenergi	Smart device designer/ manufacturer	Domestic	x		x		x		
Nissan	Car manufacturer	End user	x		x	x			
Octopus Group	Supplier	End users, suppliers (KrakenFlex platform)	x	x	x	x	x	x	x
Open Energi	Software provider	SME/I&C/TPIs/Suppliers	x			x	x		
Ovo	Supplier	Domestic & Business end users	x	x	x	x	x	x	x
Pearlstone Energy	Software provider	SME and I&C end users				x			
Powervault	Manufacturer	SME and I&C end users, retailers						x	
Reactive Technologies	Software provider	Grid operators and traders					x		
Resilience Energy	Software provider	End users, solar installers, suppliers					x		
Schneider Electric	TPI	Businesses/Suppliers/ Installers	x	x	x	x	x		
Scottish Power	Supplier	Domestic & Business end users	x	x	x				x

Company Details			Proposition Type						
Company Name	Company Type	Target market	Physical Asset			Software		Energy Proposition	
			Renewable generation/ battery storage	Heating	EV / Charge Points	DSR	Optimisation Platform	ToU tariff	Export tariff
Shell Energy UK	Supplier	Domestic & Business end users	x	x	x				x
Smartest Energy	Supplier	I&C end users				x	x		x
So Energy	Supplier	End user	x					x	
Social Energy	Supplier	SME and domestic end users	x				x		x
SSE Energy Solutions	Supplier	SME and I&C end users			x	x	x	x	x
Stark Energy	TPI	SME and I&C end users			x		x		
Stellantis	Car manufacturer	End user			x				
Tesla	Manufacturer	End users, retailers	x	x	x	x			
TotalEnergies	Supplier	SME and I&C end users	x	x	x				x
Vauxhall	Car manufacturer	End user			x			x	
Vital Energi	Renewable infrastructure developer	I&C	x	x			x		
Volvo	Car manufacturer	End user				x			
VW	Car manufacturer	End user	x		x			x	
Your Home Better	Home retrofitter	End users (domestic)	x	x			x		

Integrate to Zero:

Carbon and cost reduction opportunities from integrated energy in GB

