Batteries, Exports, and Energy Security:
The deployment of 12GW of battery storage by the end of 2021 is achievable and can support post-Brexit growth

DECEMBER 2017

A position paper by the All Party Parliamentary Group (APPG) on Energy Storage

This report was produced and researched by the REA and funded by its members.

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FOREWORD

Peter Aldous MP - Chair of the APPG on Energy Storage

How Britain generates, trades, and consumes electricity is rapidly changing.

Efficient, ultra-responsive, and affordable storage is at the heart of this change and its growing deployment holds the potential to make our electricity more affordable, and to make our energy system more consumer-oriented. Driven by the coming shift towards a more electrified vehicle fleet, the cost of stationary battery storage, the technology which this report focuses on, is falling rapidly. It is my belief that there is significant commercial interest and a wide array of applications for these technologies, ranging from balancing the output and voltage of a solar farm to reducing grid stress caused by rapid electric vehicle charging.

There are also advanced manufacturing opportunities emerging if we are sagacious enough to act swiftly to become a research hub, upskill our workforce, and to develop markets for battery products. It is policy however, not technology, that is overwhelmingly the most major obstacle to rapid and widespread deployment of battery storage systems. The industry is facing a plethora of regulations, most of them vestiges from a past age in energy, that need to be amended and upgraded, each of which is moving at a different speed towards implementation. Additionally, key market players such as National Grid, the local distribution operators, and the independent regulator Ofgem are all looking at their role in this changing energy system, driven by the rapid uptake of decentralised and renewable power, and are proposing reforms to how they operate to facilitate this historic shift.

It is my pleasure to present this report which strives to quantify the impact of these policy changes on the market, and thank the Renewable Energy Association for their work in drafting it. The Government's *Smart Systems and Flexibility Plan*, launched in July 2017, provides a strong blueprint and timeline for what needs to happen. To champion this technology and to capture the opportunities before us, I urge the Government to prioritise this plan and have it implemented as swiftly as possible.

Dr Nina Skorupska CBE, CEO - Renewable Energy Association

The renewable electricity success story is well known. A combination of technological innovation, Government support, and global supply chains have driven down costs of technologies such as wind and solar to the extent that they are now the cheapest source of new power production available today.

A similar story is now emerging with battery storage. Improvements in the technology and massive levels of battery lithium-ion battery manufacturing, in part due to the connection with the electric vehicle industry, are resulting in rapidly falling costs. What's needed now is policy reform in the UK to allow these technologies to be deployed, which will in turn support the Government's aims of decarbonisation, reducing energy bills, and increasing energy security.

The Smart Systems and Flexibility Plan, released in July, is an excellent blueprint for action. This report seeks to model how important policy is to the evolution of this sector.

We thank Peter Aldous MP, and the other members of the APPG, for their ongoing commitment to developing this exciting new industry.

CONTENTS

Report highlights:

- **No one country is the out-and-out leader in energy storage**
- **There is potentially an enormous market for storage technologies globally**
- **Developing a domestic market will support the export of skills and technologies**
- **Regulation is the largest barrier to domestic storage deployment**
- **Energy storage doesn't need to be directly subsidised**

EXECUTIVE SUMMARY

There are two stories to tell about the growth of the UK's emerging energy storage industry. The first is a tale of manufacturing, of innovation, and of international trade in a high-growth sector. The second is of security and stability as the country navigates the historic transition to a low-carbon economy.

In industry circles numerous reports have been written on the significant potential for storing energy. None to date, however, have directly connected the roll-out of storage systems to specific UK Government policies, or attempted to qualify how policy might impact actual deployment levels. This paper attempts to emphasise the crucial role policy has in determining the success of this clean tech sector.

A quick glance at some of 2017's international energy headlines clearly shows a new direction in policy and investment emerging in many markets. Nearly 90 per cent of new electricity generation capacity installed in the EU in 2016 was renewable[1]. Saudi Arabia has announced an up to $50bn plan to 2023[2] to diversify away from oil using renewables, a level of investment outdone only by China which has announced a $361bn renewable funding programme to 2020[3].

Renewables are a major international industry, and employ nearly 126,000 people directly here in the UK[4]. Unfortunately, the United Kingdom missed the opportunity to become technical and manufacturing powerhouses in technologies such as solar PV and onshore wind. An opportunity now exists for the UK to become a leader in energy storage technology that every nation navigating the transition to a low-carbon decentralised energy system is going to need. Today no-one country holds a distinct lead internationally in energy storage research, development and deployment but many are positioning for leadership. Whoever wins the race will not have done so without creating a thriving domestic market first.

The global energy storage industry is growing rapidly. The battery storage sector's improvements have occurred in conjunction with the growth of the electric vehicle supply chain. The affordability of storage units such as lithium-ion batteries is dramatically improving and energy density is increasing. Bloomberg New Energy Finance estimates that battery pack prices have fallen by 73% between 2010 and 2016 and will more than halve again by 2030[5]. Commitments by the UK and French Governments to ban the sale of new petrol and diesel vehicles by 2040[6,7] and the likely introduction of similar (if not more ambitious) measures in other major European countries, such as the Netherlands and Germany, will give rapid rise to new battery and component supply chains. Additionally, China's electric vehicle sector is already more mature than that of Europe's, and India has pledged that every new car sold from 2030 will be electric[8], which speaks to how the shift towards battery-powered transport will be global, not just regional.

Whether it is to increase household or businesses' energy self-reliance, to maximise the efficiency of a solar farm, to support electric vehicle charge points, or balance the grid nationally thus reducing the need for further fossil fuel investment or grid reinforcement, there is a clear requirement for energy storage technologies at home and abroad.

In the UK, over 25% of electricity now comes from renewable sources, and variable production represents the second greatest proportion of that. Storage technologies also play an important role in managing voltage and frequency on the grid, and can make upgrades redundant, or at the very least, less costly. This is of particular importance, as new stressors will be added to the grid as the UK electrifies its passenger vehicle fleet.

Despite improving supply chains and rapidly falling battery costs, in the UK the entrenched barrier to the widespread deployment of lithium-ion battery storage (the type of battery used in modern electric vehicles) remains Government policy and regulation. A rapid upgrading of the regulatory system, such as that proposed in the Government's and Ofgem's *Smart Systems and Flexibility Plan*, would allow a wide range of storage technologies to take off nationwide. This would result in a reduction in energy and electric transport infrastructure costs, a reduction in energy bills, and an improvement in energy security. A National Infrastructure Commission report in 2016 indicated consumer savings of £8bn a year by 2030 from 4GW of new interconnection, demand flexibility, and storage capacity, in a high renewable generation system. Energy regulator Ofgem reports further potential savings, ranging from £17bn to £40bn in total by 2050.

The battery storage sector could grow from 60 MW (.06 GW), where it was in 2016, to up to 12GW by the end of 2021, if the UK regulatory framework is speedily upgraded.

Allowing this industry to take off domestically is critical to the development of a stable base from which UK companies and institutions can export products and services abroad.

Growth predictions

If the regulatory regime in the UK is upgraded to allow for the growth in deployment of storage technologies, the Renewable Energy Association, the UK's largest trade association for renewable energy and clean technologies, and the APPG on Energy Storage, anticipate up to 12GW of battery storage deployment by the end of 2021, up from 0.06GW of battery storage deployed in 2016.

Three scenarios have been forecast, dependent on policy and other factors, with the mid-range scenario projecting a further 8GW of capacity and low-range an additional 1.7GW if policy is not supportive and costs do not fall as rapidly as projected (see sections 4 and 5 for further details).

This represents billions of pounds in private sector investment, none of which is directly subsidised by Government via policies such as the Feed-in Tariff. The uptake of storage will have cross-cutting impacts across Government, ranging from affecting fuel poverty rates to rural affairs, from building policy to the electrification of the road transport system.

While acknowledging the historic role pumped hydro storage is playing (currently over 2.8GW of deployment in UK) and the significant potential for the deployment of more pumped hydro, Compressed Air Energy Storage, thermodynamic storage, and heat storage, this report solely models electric battery storage growth and deployment based on a range of policy scenarios.

1 - WHY WE NEED MORE ENERGY STORAGE

The APPG on Energy Storage believes that there are huge benefits from moving to a more decentralised, flexible energy system. The National Infrastructure Commission's 'Smart Power' report indicated consumer savings of £8bn a year by 2030 from 4GW of new interconnection, demand flexibility, and storage capacity, in a high renewable generation system. Energy regulator Ofgem reports further potential savings, ranging from £17bn to £40bn by 2050[9].

The UK needs to decarbonise its energy supplies to meet legally binding targets and increase the rate of new energy infrastructure construction if it is to replace its fleet of ageing nuclear and coal power stations. These factors alone account for a significant amount of new infrastructure that needs to be built in the 2020's, and further new generation infrastructure will be needed to power the passenger transport fleet as the UK transitions away from the internal combustion engine by 2040. Energy storage systems can play a vital role in grid reinforcement at EV charge stations across the country, be it a rural forecourt with only two charge points or an urban shopping centre with dozens of fast-charge facilities.

Globally and nationally, the economic reality is the energy market becoming more decentralised and lower-carbon, and technologies such as onshore wind and solar are cheaper, lower-risk, and faster to build than new nuclear or gas facilities. Less infrastructure will be required with a robust storage industry, ranging from fewer grid upgrades to a lower peak generation capacity as we move to a more flexible, locally-distributed, clean, yet equally secure system. The recent (November 2017) "Tipping Points" report by Bloomberg New Energy Finance (BNEF) forecasts that the cost of generating power from onshore wind and solar is set to halve between 2017 and 2040 across Europe, which will drive up to 45GW of new deployment. Accordingly, the BNEF report also emphasises the need for both short and long-duration energy storage.

Storage can be a simple, fast, and cost-effective means of balancing fluctuations between electricity supply and demand. Storage can also provide valuable grid services, such as those relating to managing frequency and voltage. If installed strategically, it can increase the efficiency of existing power generation assets. For example, storage can help reduce the need for wind power curtailment and can improve the efficiency and effectiveness of thermal generation facilities.

Addressing each of these issues improves our energy security. Electricity which is generated when it is less needed can be stored until demand is higher, and addressing frequency fluctuations can reduce the need for costly grid upgrades. Reducing wind power curtailment (asking generators not to produce when supply is high) means that existing domestic resources can be more fully utilised.

The storage industry has taken steps in recent years to ensure that its products are safe, standards put in place and that business models can be developed around the various technologies and applications. There is growing interest in these technologies from a wide range of organisations; from utilities and grid operators to community organisations and households.

From co-location on wind and solar farms to installation in homes, the growth of storage is significant because it will save money and enable a better energy system and change the relationship between homeowners, commercial power generators, utility companies and the grid operator. It is also important because it will, over time, obviate the need for some of the new power generation that would otherwise need to be installed, largely gas. The deployment of energy storage will reduce the wholesale price of electricity as "peak" demand, the most expensive time to purchase electricity, can be reduced. A reduction in peak demand also reduces the amount of new power generation capacity that needs to be built as overall electricity consumption is set to increase, which otherwise would likely be covered by gas generation, which further reduces costs.

Fuel poverty, where a household has "higher than typical energy costs and would be left with a disposable income below the poverty line if it spent the required money to meet those costs"[10] is a major issue in the UK, with an estimated 2.5 million households affected. Housing associations can use energy storage to reduce overall energy costs and to support on-site generation, which can lead to a distinct improvement in energy bills.

Businesses will be able to protect themselves from future energy cost increases by installing storage with renewables; something UK companies will need to do when competing with savvy international companies already embarking on this journey.

Exports

The UK is also in need of new industries to support exports post-Brexit. Lithium-ion batteries can be manufactured in the UK for the forthcoming electric vehicle industry and can also be used for grid purposes. There is clearly a robust renewable energy market and domestically designed, manufactured, or assembled storage systems can be exported to a range of markets, including India, South East Asia, East Africa, and the Middle East (which are established priority regions for some trade departments).

If storage technology and expertise is to be exported abroad a strong domestic industry should be built first. Our research indicates the potential for a large domestic market if policy barriers can be removed. Supporting domestic deployment can give companies a base of expertise, and technology research and manufacturing from which they can expand. The success of the Danish model of exporting wind power technology and expertise was in part the product of the creation of a robust domestic industry. It is a similar story for Germany, who now export anaerobic digestion (biogas) technologies following significant domestic deployment (there are an estimated 9,000 biogas production sites in Germany, compared to a few hundred in the UK)[11].

2 - WHAT ARE THE ENERGY STORAGE TECHNOLOGIES?

A range of technologies are operational or are under development that store and manage power supplies for a broad variety of purposes. Already widely deployed and with further potential is pumped hydro storage, where water is pumped up a hill at times of electricity surplus and released downhill through a turbine when demand is high. Lithium-ion batteries are being co-developed alongside the electric vehicle supply chain and have an important role in shorter-term and rapid-response storage. Other batteries being deployed include flow-batteries for medium-scale storage, copper-zinc batteries and Lithium Titanate chemistry batteries. Compressed air technologies can be used at different scales, for example pressurising salt caverns for grid or regional-scale storage. Liquid-air energy storage can provide long duration, highly efficient storage while power-to-gas (such as hydrogen) is also a growing field of storage across energy vectors.

Further details on these technologies can be found in the REA's *Energy Storage in the UK: An Overview* (autumn 2016 edition).

This report specifically focuses on battery storage growth, primarily expected in Lithium Ion but also encompassing flow batteries, Lithium Titanate, copper-zinc, and other battery chemistries.

Technical note

It should be noted that energy storage by definition does not produce energy, but instead releases it during times of need (and absorbs it when required). While its deployment has an important role in the evolving energy system, it should not be seen as a reason to defer investment in new low-carbon electricity generation capacity, such as wind and solar farms, biomass, or energy from waste. New generation capacity is essential as the country retires its ageing coal and nuclear fleet, and storage will enable the replacement capacity to be low-carbon in profile.

There are several terms common to the energy storage technologies, two of the most crucial are rated capacity power, which refers to the total possible output from a energy storage system, expressed in kW or MW, or GW (eg a battery storage unit of 10MW), which is the quantity of charge that would be removed from a storage unit if it were brought from fully charged to fully discharged. The second is energy output, which differs and is expressed in kWh, MWh or GWh, and reflects the fact that storage devices discharge their electricity stores at different rates. For example a 10MW battery with a 10MWh output rate discharges all 10MWh in the space of one hour, or a 10MW battery with a 50MWh output discharges the 10MW in the space of 5 hours. These rates vary by technology, with batteries typically having a lower output range (high power, low energy), and others such as CAES having a high energy output rate.

This report is based on rated power capacity (MW) figures, rather than energy output (MWh).

In the immediate term, 'exports' of power from renewables such as solar PV and wind turbines installed on homes and offices from where it is generated into the grid network (ie not used in the building) are 'presumed' to be 50% of the power generated and it is not measured exactly. Those generating the presumed exports receive a small payment for supplying them to the grid. In the future this is expected to change, but before this happens it creates an incentive to install storage for those receiving these 'deemed' payments, as they can use the power themselves as well as gain a payment for it.

3 - WHAT MAKES THE UK UNIQUELY SITUATED TO DEVELOP AN ENERGY STORAGE SECTOR?

The UK benefits from world-class energy storage companies and technologies, as well as research and development institutions, both private and academic, that are focusing on energy storage. Cutting edge insight gained in the lab is also being deployed on the ground in the UK.

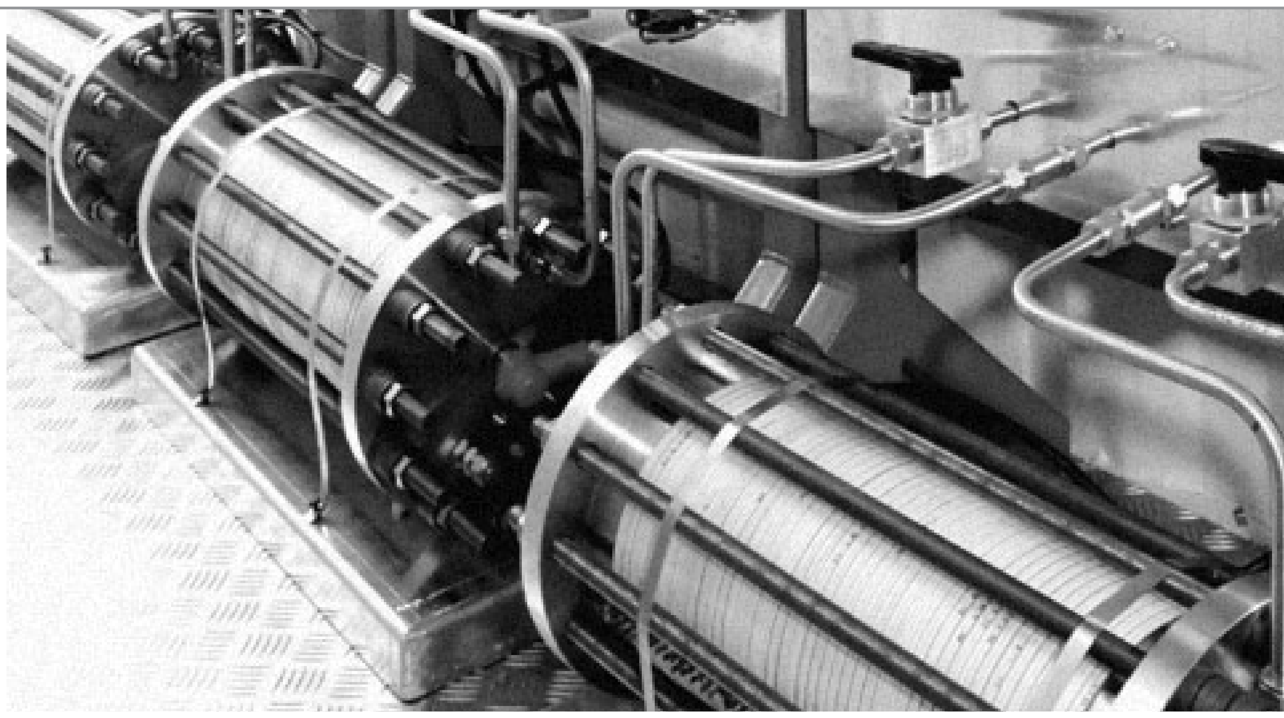
The Future Cities Catapult is driving world-class research and projects on smart grids. The Department for Business, Energy, and Industrial Strategy (BEIS) has also identified storage as a potential part of the forthcoming *Industrial Strategy* in a recent green paper. Recent grants and funding for the sector, including a January 2017 funding announcement of nearly £10m for research and deployment, are increasing confidence among investors, innovators, and developers, but policy improvements are required. In February 2017 the Business Secretary announced £126m of funding to establish a world-class advanced research centre at the University of Manchester in partnership with other organisations, which will amongst other topics develop the new material graphene and develop new energy technologies, including storage. *The Faraday Challenge*, details of which were announced in July 2017, outlined nearly £250m for research and development into new battery technology, and ring-fenced money for the creation of a British "Battery Institute."[12]

Battery storage technology is improving rapidly. As lithium-ion batteries can be used in both electric vehicles and for stationary storage alike, the success of the two sectors is closely tied together. Bloomberg New Energy Finance estimates that battery pack prices have fallen by 73% between 2010 and 2016 and will more than halve again by 2030[13], all the while with energy density improving. Commitments by the UK and French Governments to ban the sale of new petrol and diesel vehicles by 2040[14,15] and the likely introduction of similar (if not more ambitious) measures in other major European countries such as the Netherlands and Germany will give rapid rise to new battery and component supply chains.

Technology and electric vehicle manufacturing trends mean that the supply chain for batteries is rapidly growing and costs are falling. Bloomberg New Energy Finance anticipates that 54% of new car sales in the world will be EV by 2040[16], which is acknowledged in analyst briefings to be a potentially conservative estimate. By the time the Tesla Gigafactory in Nevada is fully operational (2020), the planned production from the one facility is expected to exceed global production in 2013[17]. Other companies are building similar Li-ion manufacturing facilities, and Volkswagen estimates that 40 Tesla-sized "gigafactories" for manufacturing batteries will be needed globally to meet EV demand by 2025[18]. Volkswagen (VW) itself is reported to be considering the construction of a EUR 10bn battery facility[19]. There is scope for one or more of these facilities, developed by VW, Tesla, or others, to be built in the UK.

While electric vehicles create an excellent opportunity to decarbonise the transport sector, to improve urban air quality, and to reduce costs, they also hold the potential to create new manufacturing jobs in the UK. Much of *The Faraday Challenge* is targeted at establishing the UK as a world-leading designer of batteries for the forthcoming EV industry. New electric vehicle manufacturing in the UK post-Brexit could be significantly beneficial for growth and trade. Domestic battery manufacturing should be prioritised if vehicles are to be constructed, as they make up a significant portion of the total cost and overall vehicle value. The expertise gained from battery construction, in addition to the units themselves (used and new) can be employed across the renewable power, transmission grid, and building sectors.

The UK has a considerable automotive manufacturing sector, which is well poised to take advantage of these historic shifts in technology and supply chains. The SMMT reports that UK auto manufacturing reached a 17-year high in 2016, with over 1.7m units being produced[20]. The European Automotive Manufacturers Association reports that in 2016 the UK was the EU's fourth largest automotive manufacturing country[21].



Recent investments in the UK's electric vehicle supply chain and battery manufacturing capabilities are strong steps in the right direction, and demonstrate that the market is quickly evolving. There is already one purpose-built battery manufacturing plant in operation in the UK, which produces for Nissan's Sunderland manufacturing facility[22]. Additionally, the new LTI taxi factory in Coventry will be producing electric London black cabs. BMW has agreed to assemble its new electric Minis in the UK at its site in Oxfordshire[23]. Reuters reports that Government funding is supporting the development of an additional facility which will support EVs manufactured by Jaguar Land Rover[24]. Numerous British start-ups have emerged in this space, such as Moxia and Powervault, and major partnerships are already in place between companies such as Eaton Energy Storage and Nissan (who will utilise used EV batteries from the Sunderland plant for domestic energy storage).

Domestically, the installation of solar PV has taken off and is now deployed on around 900,000 homes and businesses across the UK. This creates a significant market for storage systems "behind the meter", one which many other countries do not have. Solar is continuing to fall in cost, and solar and storage has the potential to become the cheapest form of new integrated power generation in the UK[25].

Now is the time to coordinate across Government and make developing this sector a priority. The Government has identified storage as a potential growth area in its *Industrial Strategy* green paper,[26] and again the the white paper released in November. In July the Department for Business, Energy, and Industrial Strategy (BEIS) released the *Smart Systems and Flexibility Plan*[27] which was widely hailed across the industry as a robust roadmap that will allow for storage to grow. The Government's *Clean Growth Strategy* released in October 2017, contains a number of ambitious new initiatives to spur low-carbon growth. Additionally, Government departments are preparing to develop new international trade relationships once the UK leaves the EU. Storage and other clean technologies could be included in these future deals as an exportable product and as a part of any energy-related sector deal to come out of the *Industrial Strategy*.

The National Grid *System Needs and Product Strategy*[28] is an additional opportunity to incentivise storage. The Review (consultation closed in August 2017) seeks to harmonise the plethora ofincentives and schemes currently in place that are used to balance the grid.

Simplification of these schemes can support the growing storage sector and incentivise deployment.

Existing and newly-emerging industries situated in the UK are helping the storage industry grow. The development of the EV supply chain is an important factor, but so is the existence of established software and energy management industries and an entrepreneurial start-up culture.

The deployment of solar PV in the UK acts as a useful case study (see Section 7) for what can take place when a technology reaches a "tipping point" where costs rapidly fall, consumer demand is high and policy supports deployment. There is a key lesson as well in the story of solar's growth, and in the sudden recent shrinkage in this market (due to policy change the number of companies operating in solar PV has nearly halved between 2014/15 and 2015/16[29]); if technology development and policy are out of step there is a significant risk that the jobs, industrial, and export opportunities can be squandered.

Assumptions underpinning High, Medium, and Low energy storage deployment scenarios:

High Scenarios:

- Smart Systems and Flexibility Plan followed through according to the proposed timetable. Crucially, this includes the issuance of guidance for installing storage at RO/FiT accredited sites, the introduction and passage into law of a separate definition for energy storage, the creation of a license for storage, and the creation of half hourly settlement (domestic and commercial)
- Capacity Market reforms implemented, for example changes to the existing penalty regime so storage is more able to compete against diesel generation
- Movement by up to two leading DNOs to DSOs, complete by 2019
- Rapid costs reductions for batteries realised, in line with BNEF predictions
- Industrial Strategy incorporates storage in specific sector deal, including tax reforms (which are potentially introduced through the Clean Growth Plan)
- Ofgem's Significant Code Review results in favourable reforms by 2019
- "Embedded Benefits" changes, announced by Ofgem in June, are reversed[30]
- Ancillary services market is simplified and favourably reformed by National Grid by Spring 2018
- Coherent industry standards, for installation and storage use, are in place by end-2018
- Government policy compels all electric vehicle charge points over a certain size to have on-site storage capacity in order to alleviate pressures on the grid network

Medium Scenarios:

- Guidance for installing storage at RO/FiT accredited sites is introduced but not until 2019
- Slow implementation of half hourly settlement for domestic energy users
- Separate definition and license introduced but behind schedule
- Capacity Market not reformed
- The transition to DSOs by two leading DNOs is slower, none successfully completed by 2022
- Rapid cost reductions for batteries realised, slightly slower than BNEF projections
- No tax support in Industrial Strategy
- Ofgem's Significant Code Review results in favourable reforms by 2020
- "Embedded Benefits" cuts are slowed or cut by less than planned
- Certain Ancillary Services are reformed, some not
- Delays to further renewable power deployment following the Energy Cost Review
- Coherent industry standards, for installation and storage use, are in place by end-2019
- Government policy compels only some electric vehicle charge points, largely rapid charge points, to have on-site storage capacity

Low Scenarios:

- Continued ambiguity regarding installing storage at FiT/RO accredited sites
- Half hourly settlement not introduced by 2021
- Separate definition and license introduced but not until 2020
- Capacity Market not reformed
- A slower transition from DNO to DSO, with none completed by 2022
- Slower cost declines than BNEF prediction
- Limited domestic battery manufacturing
- No tax support in Industrial Strategy or storage-specific sector deal
- Significant Code Review outcomes delayed or are unfavourable
- Embedded Benefits changes go ahead as proposed in June 2017
- Ancillary services market not sufficiently reformed
- No coherent, coordinated industry standards in place
- Government policy does not compel EV charge points of any size to install on-site energy storage

4 - METHODOLOGY

This forecast for the deployment of energy storage in the UK has been informed by:

- analysis of existing Government energy policy and infrastructure pipeline reports, including the REA's database,
- discussions with the companies (manufacturers, developers, operators, utility companies, others) operating in the UK's energy storage sector that are members of the Renewable Energy Association (as a whole this sector of the REA numbers over 100 companies),
- consideration of the number and size of applications to previous energy storage auctions, including the National Grid's Enhanced Frequency Response auction in summer 2016,
- the potential for storage to be developed through the Capacity Market,
- discussion with a range of organisations at the UK's Energy Storage and Connected Systems conference,
- critical analysis of the rate of take-up in the solar PV market from 2008 to 2016,
- consideration of global electric vehicle supply chain developments and forecasts for growth in the sector.

The growth forecast in this report is anticipated to come primarily from increased battery deployment. There is also potential for the expansion of pumped hydro capacity in the coming years, as there is already a significant project pipeline. Other storage technologies, such as compressed gas, are expected to play a role but large scale deployment will be slower than batteries.

Key policies need to be upgraded to "unlock" the energy storage market. The majority of these were correctly identified in the Government's *Smart Systems and Flexibility Plan* and include the adoption of a definition for energy storage, a licensing regime for storage, the ability for storage to integrate into existing renewable energy support schemes, and a move towards a Distribution System Operator (DSO) model (further details can be found in Section 6).

The "High Deployment" scenarios assume that all policies contained in the Smart Systems and Flexibility Plan are rolled out on-schedule and in parallel with other key reforms, including the transition from Distribution Network Operator (DNO) to Distribution System Operator (DSO), and that storage is offered a strong "sector deal," including tax reforms, in the Government's Industrial Strategy. The full set of assumptions for each scenario can be found opposite.

Over the next few years, the companies which own the regional power lines in the UK (known as DNOs or Distribution Network Operators), will transition to taking a more active role in the localised energy management and balancing supplies, when they will become known as Distribution System Operators (or DSOs).

Technical note

For a full description regarding power capacity, energy output and the design of this report, see the Technical note in Section 2.

Report note; MW and MWh

This report is based on rated power capacity (MW) figures, rather than energy output (MWh).

5 - WHAT COULD WE ACHIEVE IN THE UK?

Last autumn the REA published its updated report, *Energy Storage in the UK, A Market Overview*, which provides a comprehensive introduction to the sector and the only database of energy storage projects in the UK market extending beyond batteries.

This identified around 3.23GW of existing energy storage capacity in the UK in 2016. Of that, around 60MW (0.06GW) is battery storage.

Based on this as a starting point, and further market analysis, we believe the UK could see up to 12GW of additional battery energy storage capability installed by the end of 2021 (the 'high-deployment' scenario). The low-range scenario envisages just 1.7GW extra capacity, if policy is not effective, and the mid-range just under 7GW (6.95GW) by the end of 2021.

In the scenarios modelled below, policy is identified as the largest barrier to deployment as the global EV supply chain is built out, battery technology improves, and battery storage costs fall.

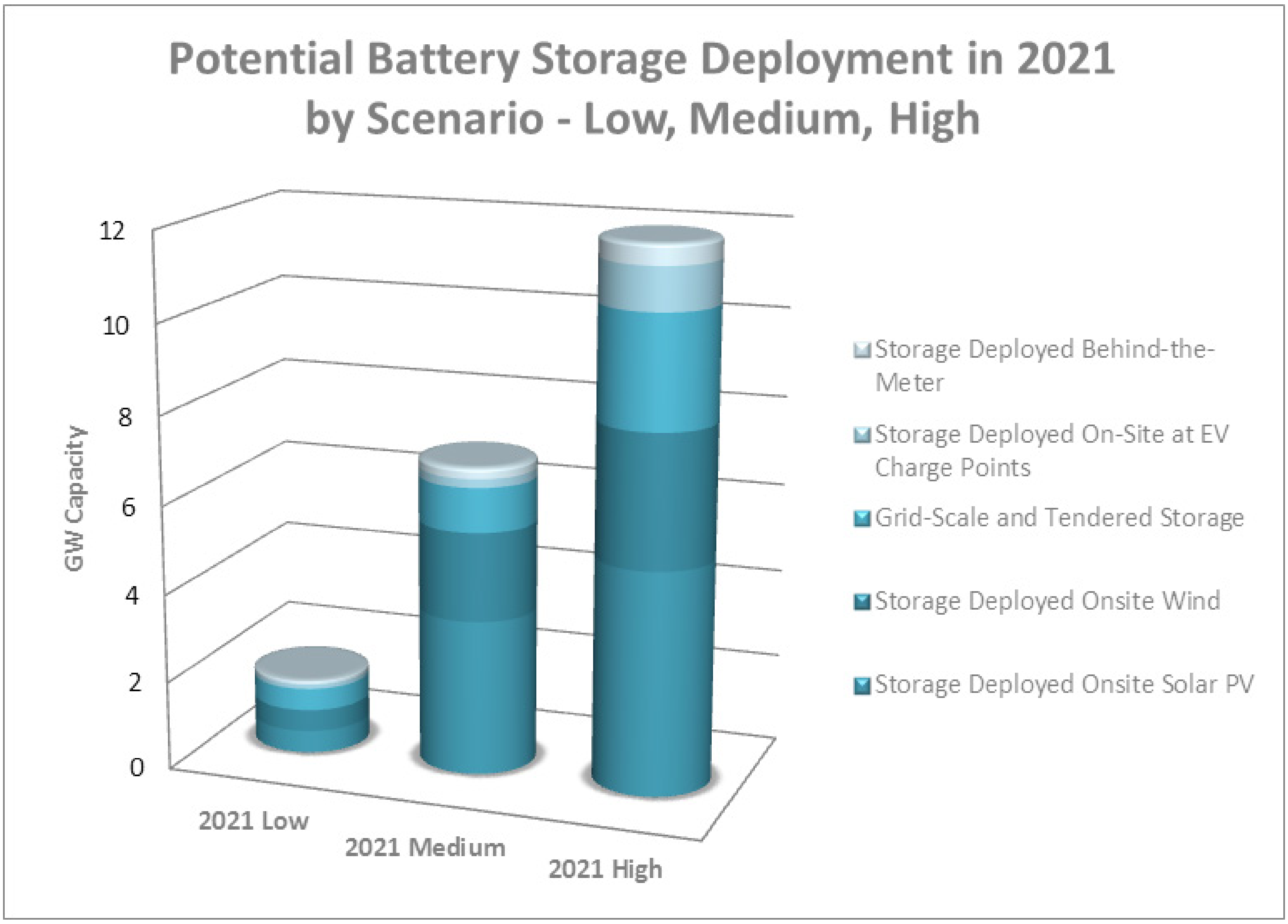
The billions of investment this could create would be in sharp contrast to the under-investment in the UK's power sector as Government policy has failed to deliver the new generation capacity required. Recent reports predict a 95% reduction in investment in low-carbon electricity from 2017 to 2020, compared to the previous five years[31].

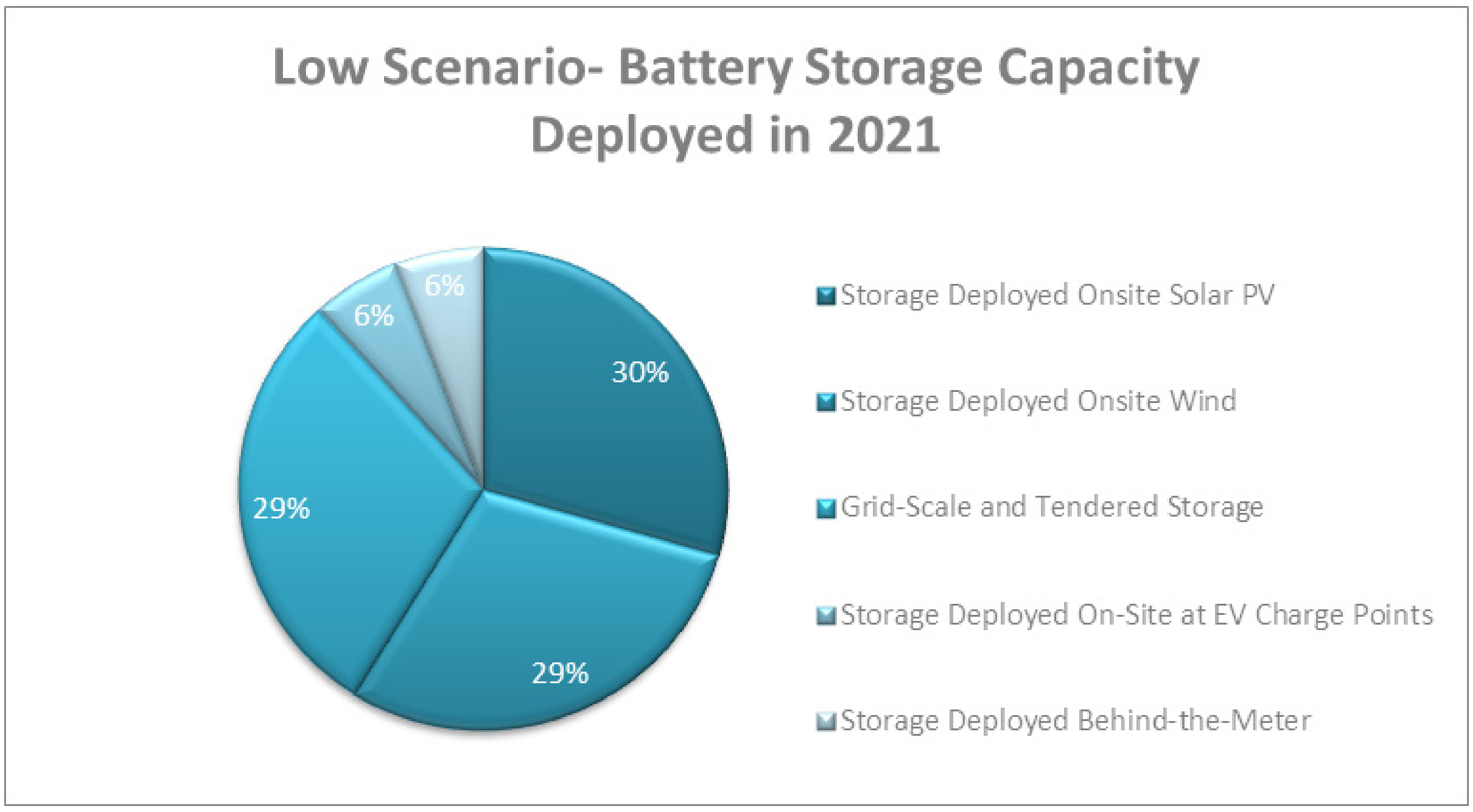
The 12GW, high deployment scenario forecast is based on the following applications:

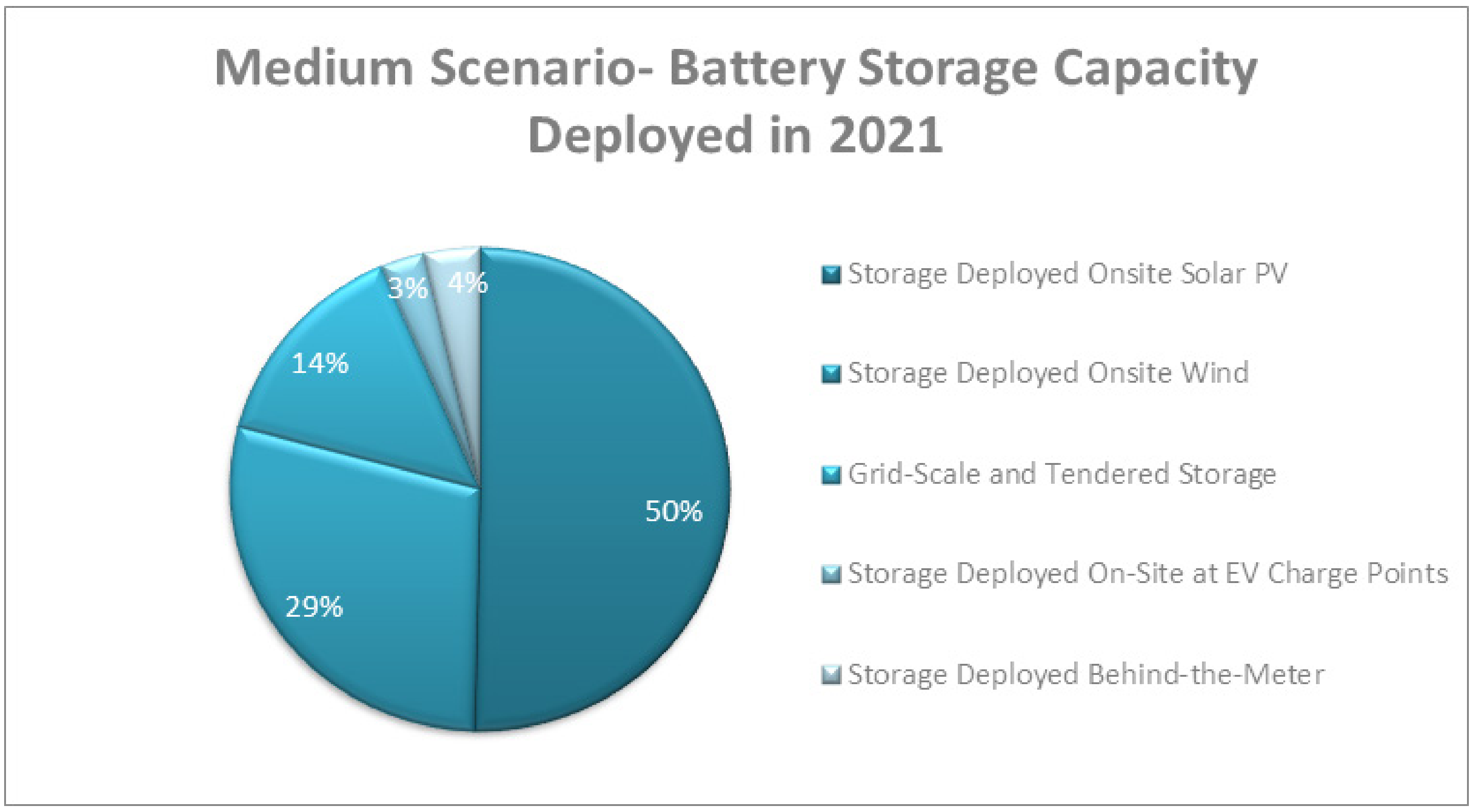
- Energy storage projects co-located at existing and new solar and onshore wind sites,
- Storage connected to EV charging points,
- Behind the meter applications at smaller scale, and,
- Larger, grid connected projects.

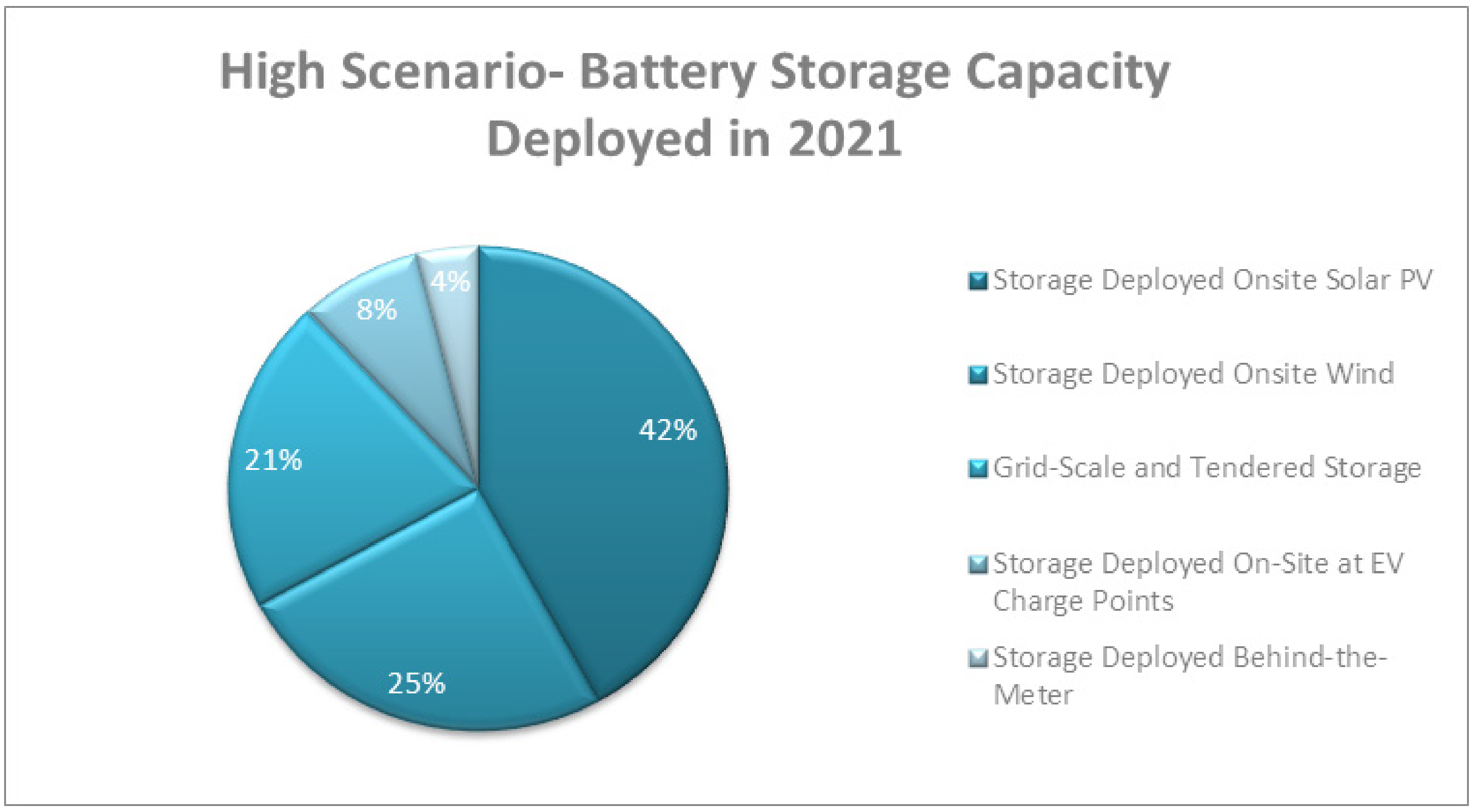
The variations between Low, Medium and High Deployment scenarios are informed by differing levels of policy change between 2017 and the end of 2021, detailed in Section 4 (Methodology).

The high and medium forecasts assume continued rapid cost reductions in battery storage, in line with (if not more rapid than) those projected by Bloomberg New Energy Finance.



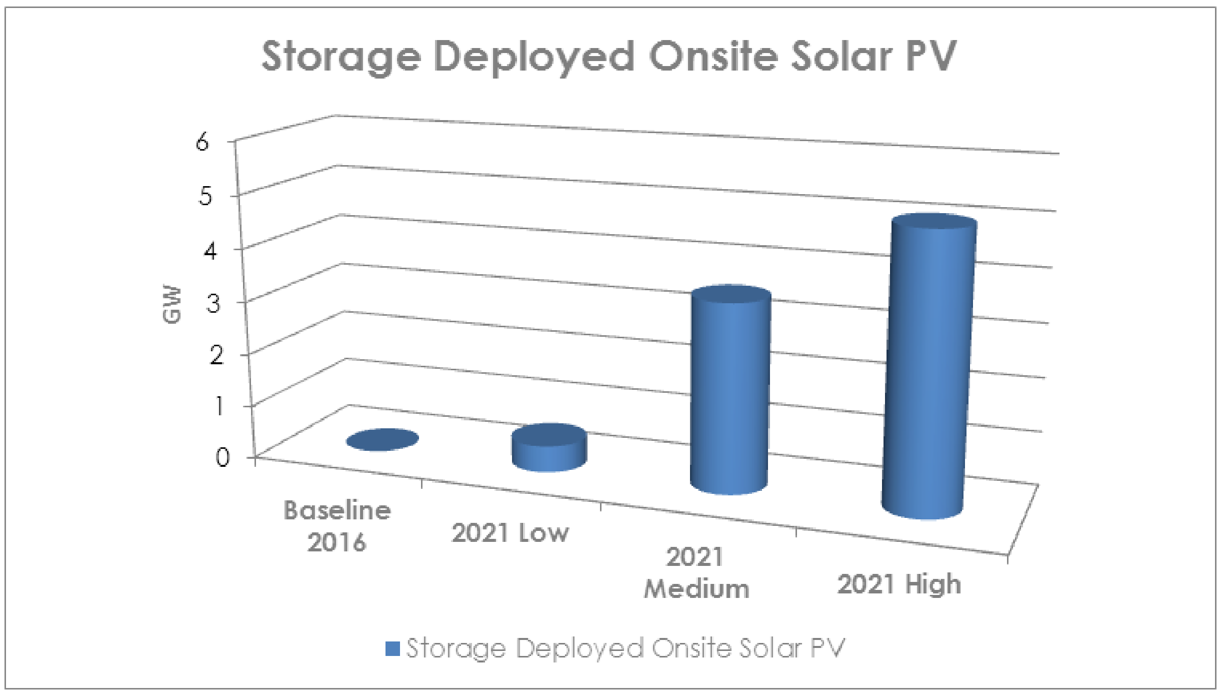

Low Scenario- Battery Storage Capacity Deployed in 2021
30%
29%
29%
6%
6%
Storage Deployed Onsite Solar PV
Storage Deployed Onsite Wind
Grid-Scale and Tendered Storage
Storage Deployed On-Site at EV Charge Points
Storage Deployed Behind-the-Meter


Medium Scenario- Battery Storage Capacity Deployed in 2021
50%
29%
14%
3%
4%
Storage Deployed Onsite Solar PV
Storage Deployed Onsite Wind
Grid-Scale and Tendered Storage
Storage Deployed On-Site at EV Charge Points
Storage Deployed Behind-the-Meter


High Scenario- Battery Storage Capacity Deployed in 2021
42%
25%
21%
8%
4%
Storage Deployed Onsite Solar PV
Storage Deployed Onsite Wind
Grid-Scale and Tendered Storage
Storage Deployed On-Site at EV Charge Points
Storage Deployed Behind-the-Meter

6 - WHERE WILL STORAGE ACTUALLY BE INSTALLED?

Co-location at solar farms



The UK has around 13GW of solar PV capacity currently installed. The large-scale sites, similar to onshore wind sites, can generally sell their power for less than other technologies due to the balancing risks inherent in their operation - therefore have an incentive to install storage which ensures stable supplies, reducing these imbalances and gaining a higher share of power income. In addition, they have unused valuable grid export capacity after dark which can be used by storage services.

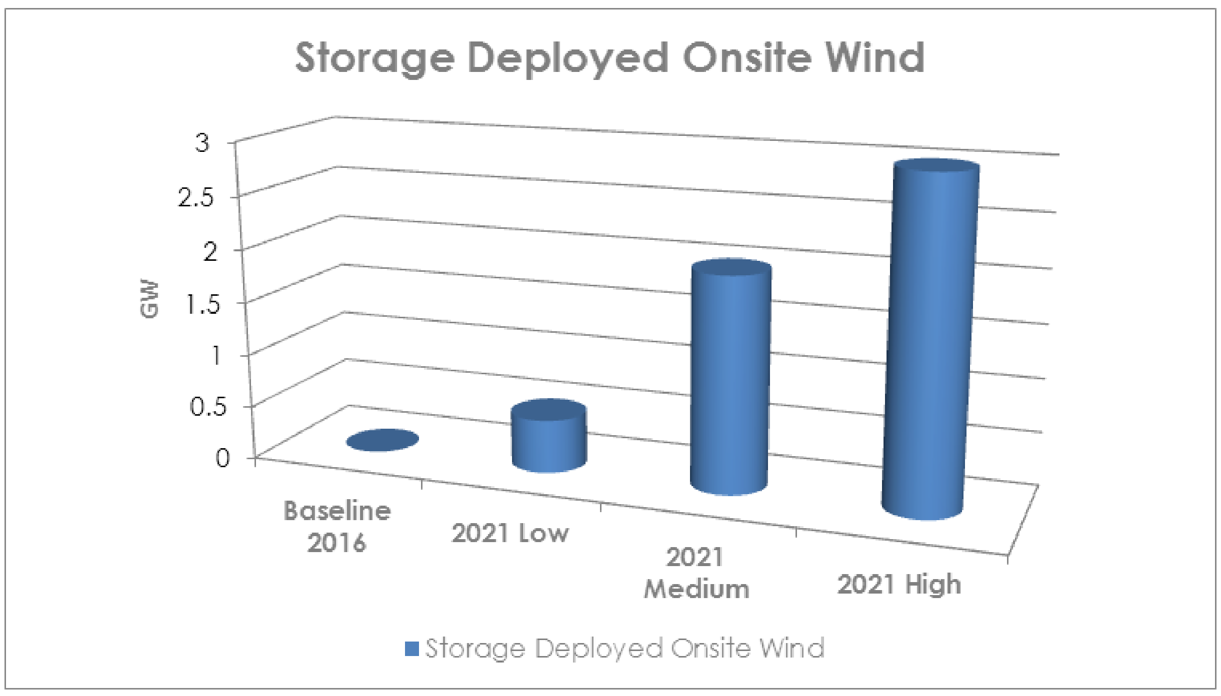
Co-location at existing renewable energy sites is also beneficial as it can help regulate frequency and voltage at the point of production, and a connection to the grid is already established.

- In the **high deployment scenario**, of existing solar farms, 40% (by installed capacity) put storage capacity on-site, leading to around 5GW of storage capacity. There are sound reasons for deploying storage in this form of application - avoided grid charges, higher PPA prices, and maximising grid connection capacity.

- In the **medium deployment scenario** the lack of clarity regarding installing storage at RO and FiT accredited sites are key barriers to deployment.

- In the **low deployment scenario** the lack of clarity regarding installing storage at RO and FiT accredited sites mean that in certain circumstances solar farms risk losing their renewable support by installing storage. Grid fee double charging and slower cost reductions hamper deployment, a total of 500MW is installed.

Co-location at onshore wind farms



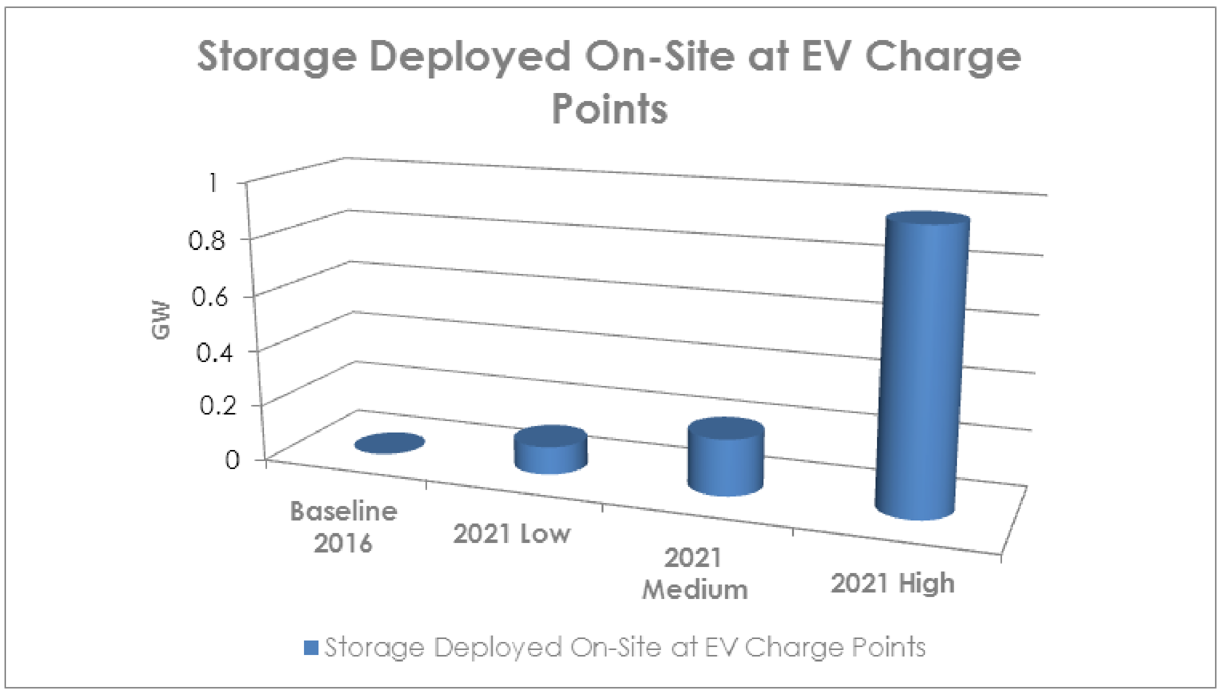
Similarly for solar farms, these sites are incentivised to install storage in order to maximise the value for their power sales and increase efficiencies, as well as to play in to ancillary services and related markets.

- In the **high deployment scenario**, of existing wind farms, 25% (by installed capacity) put storage capacity on-site, leading to 3GW of storage capacity. Solar farms will have greater excess grid connection capacity than wind farms, in most circumstances, leading to the lower deployment at wind farms.

- In the **medium deployment scenario** key policies such as the lack of clarity regarding installing storage at RO and FiT accredited sites are key barriers to deployment. A total of 2GW is installed.

- In the **low deployment scenario** regulatory barriers mean that in certain circumstances wind farms risk losing their renewable support by installing storage. Grid fee double charging and slower cost reductions hamper deployment. A total of 500MW is installed.

Co-location at electric vehicle charging points



There are already a significant number of EV charging points in the UK and this is growing at a steady pace due to policy support and private sector investment. By 2020 there could be as many EV charging points as currently there are petrol stations in the country (almost 8,000). This creates pressure on the grid network as they are often in more isolated locations. Therefore in our high-deployment scenario, all EV charging points are required to install appropriately sized storage at the same site, in order to alleviate pressures on the grid network, and there are as many EV charge points as current petrol stations. This creates an additional 960MW of storage capacity. The other scenarios are more conservative in terms of EV charge point deployment and on-site storage - leading to 200MW and 100MW of additional capacity respectively, only deployed at the most constrained grid locations.

It should be noted that battery technology will advance rapidly, with EVs soon having expanded range (300+ miles per charge) and rapid charging (30 minutes or less) stations installed at charge stations.

The installation of large numbers of fast chargers in the UK, at motorway service stations and rural locations will require grid network upgrades as these are often locations where the network capacity is lower. Such locations will face restraint in connecting to the grid and this will therefore create a demand for energy storage units on-site, and may even become a requirement from some of the DNOs. It is unlikely that storage will be able to completely alleviate this problem, but it can contribute to easing the issue therefore will drive the installation of more storage.

- In the **high deployment scenario** 960MW of storage is installed across all EV charge point locations, particularly as EV charge points are required by Government policy to have on-site storage capacity in order to alleviate pressures on the grid network.

- In the **medium deployment scenario** an extra 200MW is installed as charge points increase in number but grid constraints and slower EV sales results in a reduced installation rate. Storage is predominantly deployed at rapid charge points.

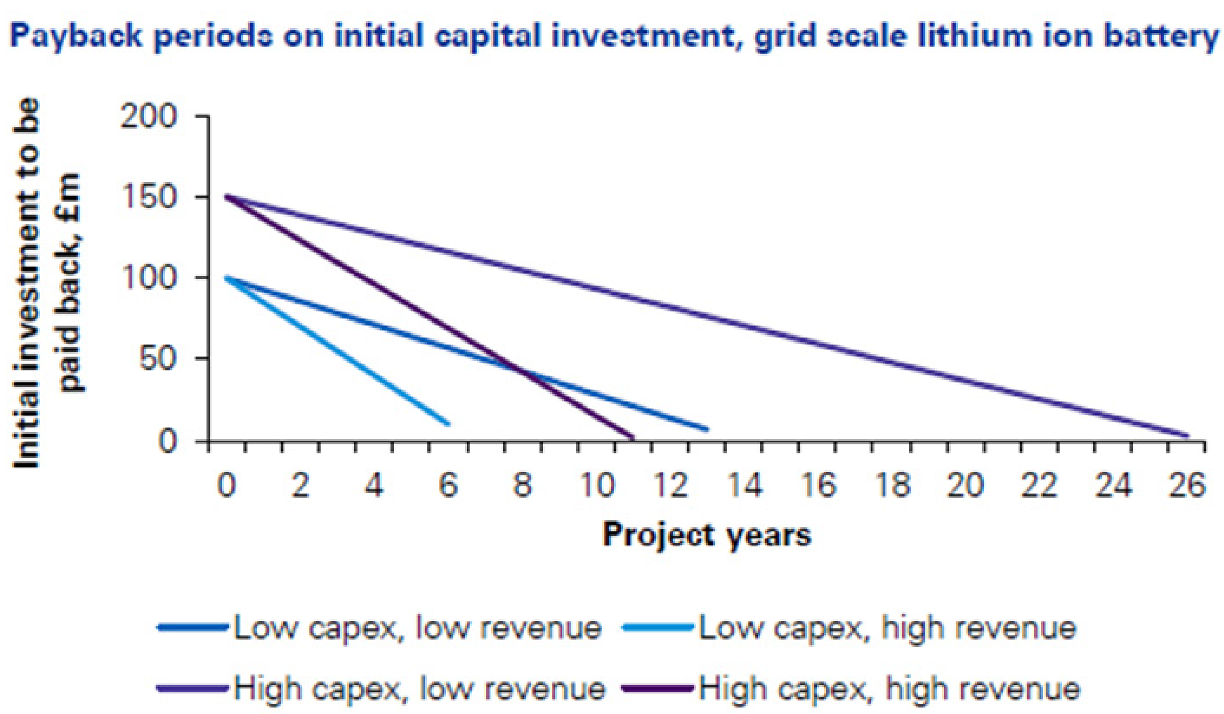
- In the **low deployment scenario** regulatory barriers mean that EV charge points are not rapidly deployed, and regulation does not stipulate that storage needs to be installed alongside charge points. A total of 100MW is installed.

Grid-connected energy storage

Note

Power produced via offshore wind is directly connected to the transmission network and the storage capacity developed with this technology is included in the "grid connected" section. This includes "stand-alone" distribution network connected projects not associated with on-site solar or onshore wind generation.

Source: KPMG, Decentralised Energy & Energy Storage, 2016 (http://www.r-e-a.net/resources/rea-publications)

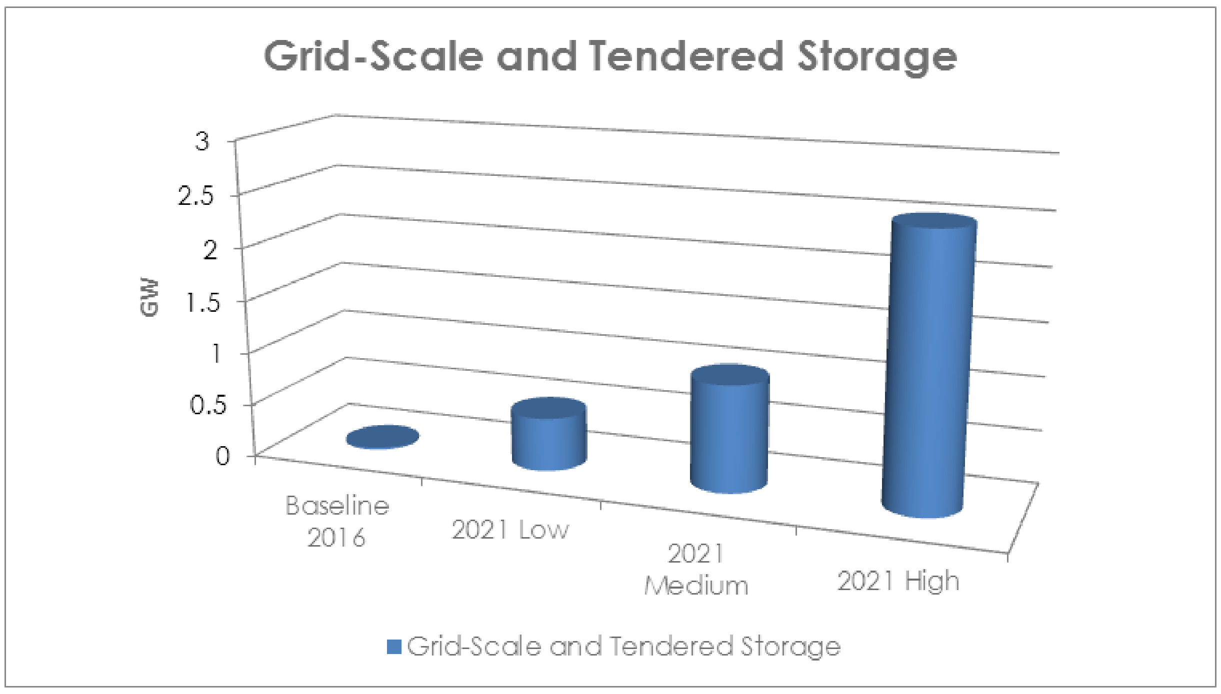


Summer 2016 saw the first ever auction for 'Enhanced Frequency Response (EFR)' services aimed at battery energy storage. Some DNO companies (e.g. UKPN) are already considering or planning similar such auctions. Nearly 1.4GW of capacity applied for the 200MW of contracts and this illustrates the potential and appetite for this type of service and project both from grid operators and developers.

Energy storage projects are also eligible for Capacity Market (CM) contracts, and new-build storage projects received CM contracts in the last main auction. Deploying a standalone, grid connected storage project relies on 'stacking' the various possible revenue streams, which is currently challenging but could be better enabled. Many such storage projects will be co-located on site with renewable power projects but some will be standalone. Given the interest in this section of the market, we have modelled an arguably conservative 2.5GW of such capacity by the end of 2021 under the high deployment scenario.

This is based on at least 200MW of capacity deployed through National Grid Ancillary Services auctions over each of the next three years, DNO auctions amounting to a similar amount and a similar amount of CM / speculative projects being developed.

The potential is illustrated by the KPMG report Decentralised Energy & Energy Storage, commissioned by the REA in 2016, which showed standalone lithium-ion projects of this type at the best sites have favourable payback periods of as little as four to six years if the policy environment is right.



- In the **high deployment scenario** an arguably conservative 2.5GW of grid connected capacity is installed by 2020. This is based on at least 200MW of capacity deployed through National Grid auctions over the next three years, DNO auctions amounting to a similar level of capacity, and a similar amount of Capacity Market / speculative projects being developed. There are already significant projects, like the 49MW Barrow battery project in advanced development to contribute to this.

- In the **medium deployment scenario** the stacking of revenues is not enabled (this is proposed in the Smart Systems and Flexibility Plan and is a key element of policy). DNOs do not significantly procure storage as the transition to DSOs (Distribution System Operators) is slowed and the market is more dependent on the government or National Grid auctions alone, leading to 1GW under the medium scenario.

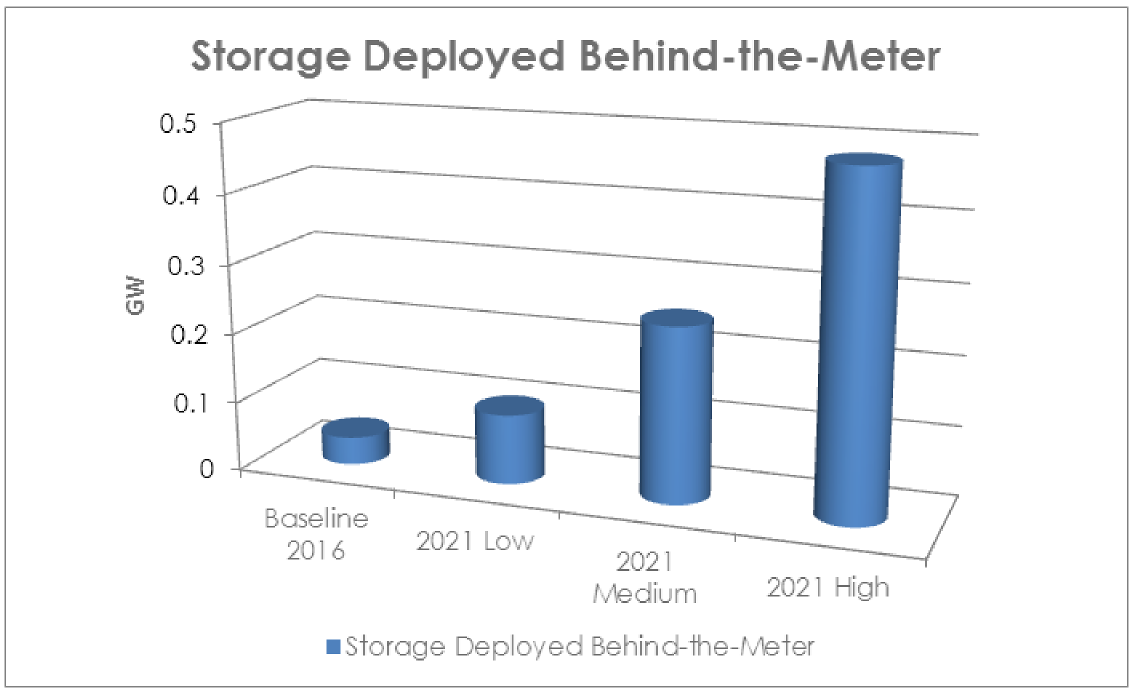
- In the **low deployment scenario** a similar set of factors as above apply but only 0.5GW is installed, primarily due to grid charges changes negatively impacting business cases, a lack of reform to the Capacity Market, and slowed implementation of ancillary services reforms. This is based on at least 200MW of capacity deployed through National Grid Ancillary Services auctions over each of the next three years, DNO auctions amounting to a similar amount and a similar amount of CM / speculative projects being developed.

Behind the meter

Although sales of this type of application are currently relatively low, there is potential for significant growth in domestic and commercial storage as costs continue to fall. Buildings with solar and other on-site renewables already installed are given an added incentive to install storage in order to use as much of their own power as possible, therefore saving money by buying less from their electricity supplier. There are over 900,000 small-scale solar installations in across the UK, approximately 800,000 on homes and 100,000 on businesses. UK solar installers have begun to sell energy storage devices and use their expertise to build this revenue stream, which has been given added impetus due to cuts to solar support in the past 18 months. Cost declines for domestic storage, taken from the Decentralised Energy & Energy Storage report, are modelled in the graph on page 18.

In addition, Government has proposed enabling domestic Time of Use Tariffs which would be a major incentive for installing storage at this scale as households would save money by not buying power at certain times of the day. It should be noted that Time of Use Tariffs are essential, particularly if there is to be deployment in the social housing sector. Significant social housing deployment will, in our view, lead to a meaningful reduction in fuel poverty.

It is challenging to predict the uptake of storage at this scale due to the speed at which solar PV was deployed, and a range of other factors, however if 20% of existing solar installations on UK homes (totalling c.800,000) each put in 2kWp battery systems, this would deliver an additional 320MW from domestic installations.



If 20% of commercial solar installations installed larger 4kWp storage systems this would lead to an additional c.160MW of storage capability.

This conservative modelling, based only on properties which already have renewables on-site, would therefore mean almost 0.5GW of storage capability 'behind the meter' by the end of 2021 under the high-deployment scenario. This sector will be driven primarily by cost reductions in lithium-ion battery technologies although other technologies may also be widely deployed.

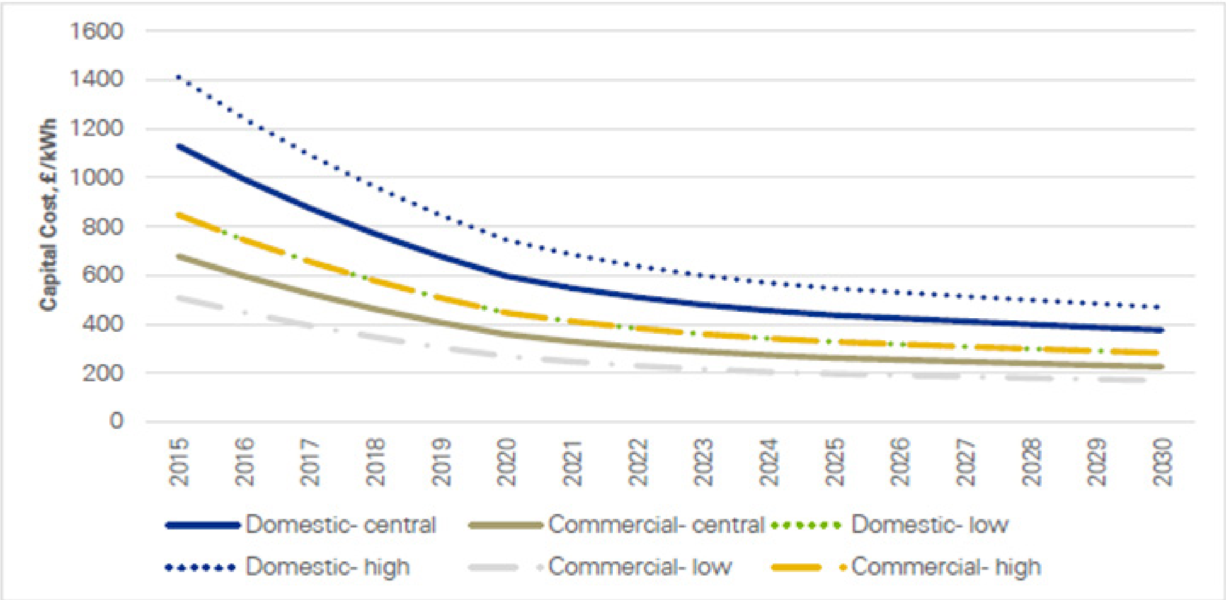
It should be noted that although it is not modelled, anecdotal evidence indicates that there is a strong market for standalone domestic storage.

- In the **high deployment scenario** 480MW of behind-the-meter storage capacity is installed. While this market is particularly challenging to model, if 20% of existing solar installations on UK homes (totalling c.800,000) each put in 2kWp battery systems, this would deliver an additional 320MW on domestic roofs. If 20% of commercial solar installations installed larger 4kWp storage systems this would lead to an additional c.160MW of storage capability. Critical factors here include rapid battery price declines, clarifications around installing storage alongside Feed-in Tariff accredited solar sites, the introduction of half-hourly metering and the uptake of coherent industry installation standards.

- In the **medium deployment scenario,** key policies such as half hourly metering are not introduced and unit costs fall at a moderate pace, leading to 250MW deployed.

- In the **low deployment scenario** the above factors apply and there are additional policy barriers introduced by utilities, the grid, or the regulator as concerns regarding consumers going 'off the grid' (and therefore not paying for the uptake of the system) translate to specific barriers for this type of storage, leading to only 100MW of deployment. Smart tariffs (such as half-hourly metering) not being introduced is another major barrier.

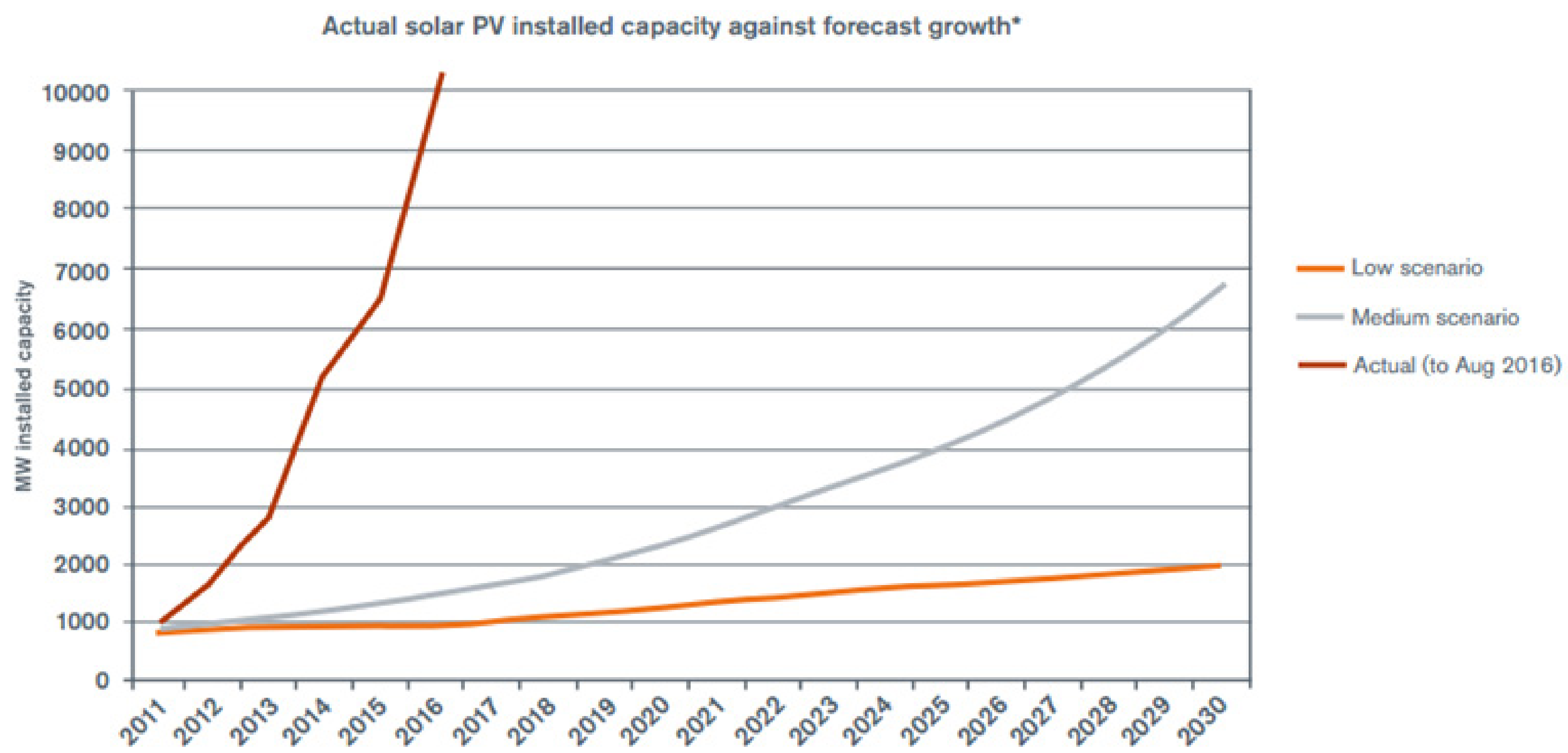
Projected lithium-ion battery storage prices as of early 2016 (note: battery costs have fallen rapidly and REA discussions with industry indicate that costs may have already fallen more rapidly than this graph suggests).



Source: KPMG, Decentralised Energy & Energy Storage, 2016 (http://www.r-e-a.net/resources/rea-publications)

The figure shows a steady cost decline of 12% per annum through to 2020, followed by slower reductions through the 2020's.

7 - COMPARISONS



Source: Ofgem's Future Insights Series Overview Paper 2016 - https://www.ofgem.gov.uk/system/files/docs/2016/10/future_insights_overview_paper.pdf

To give an indication of the scale and impact of this investment:

- California, seen as one of the most advanced markets, has a target to install 1.8GW of additional storage by 2018.
- New York City has a target of installed energy storage capability of 100MWh.

One of the clearest comparisons that can be made about the anticipated take-up of energy storage is the growth of solar PV in the UK from 2011 to 2016. The below chart, taken from Ofgem's *Future Insights Series Overview Paper* in 2016, tracks its remarkable growth in deployment.

Actual and predicted solar deployment 2011- 2016.

The graph above, taken from Ofgem's *Future Insights* series in 2016, identifies the similarities between solar and energy storage costs and the potential for deployment. The report notes that costs could fall below $200/kwh by 2019. Many estimates are already more ambitious. Bloomberg New Energy Finance analysis (July 2017) estimates that "producing a battery [pack] in a Korean manufacturing plant in 2017 costs $162/kWh, dropping to $74/kWh in 2030"[32]. Advancements in this sector should not be underestimated like they were in the solar sector, and reports such as this indicate an underestimation in Government about the speed in which the storage sector is moving.

With solar, a globally integrated supply chain, falling costs, Government support through domestic Feed-in Tariffs and large-scale Renewable Obligation Certificates, and robust popular demand for low-carbon electricity resulted in deployment far exceeding expectations. Ofgem's medium scenario anticipated nearly 7GW of capacity by 2030, instead over 12GW was deployed by 2016.

The integration of this variable power production, and establishment of this model of international deployment driving down costs, has in turn laid the groundwork for the take-off of storage technologies.

8 - EXPORT AND MANUFACTURING OPPORTUNITIES

The Government's (January 2017) *Industrial Strategy Green Paper* identified a potential role for the Government to support certain elements in the economy through "sector deals." Energy storage was identified in this paper[33] as a potential sector where the UK could develop a world-class industry with potential manufacturing and export opportunities.

This Green Paper was supported by the January 2017 announcement of "£28 million for energy innovation projects," including £9.6m for energy storage R&D and deployment[34]. The Faraday Challenge, a £246m Government investment in battery technology will also drive new innovation in the sector[35]. It is important to note, however that there are already existing technologies and companies in a position to **deploy now**.

In the REA's view, the ability to develop robust international exports of storage technology and expertise is contingent on the development of a strong, vibrant UK market.

UK export and manufacturing opportunities in the storage sector include:

- The manufacturing of large scale batteries, including copper-zinc and flow batteries,
- Lithium-ion battery manufacturing principally developed for the automotive sector,
- Intellectual Property (IP) value derived from research and development in UK laboratories and academic instructions. IP value can also be derived through early-stage commercial deployment of these technologies, including the integration of the distributed power and storage network with the electricity grid and electric vehicle infrastructure,
- The manufacturing, deployment, and export of thermal batteries,
- Consultancy and advisory services derived from experience in early-stage commercial storage deployment,
- Provision of finance and financial products to the global energy storage industry, including investment, insurance, and contract negotiation,
- In the longer term, newer technologies and applications such as CAES, and hydrogen,
- Energy modelling and management,
- Expertise and technology for battery recycling and second life EV battery use in fixed deployment,
- Integrated management offerings for smart charging systems for plugin vehicles including associated hardware, including integration with local distributed energy resources such as fixed storage and local generation,
- Software algorithm, big data analysis, and machine learning expertise for management of storage in complex scenarios such as where there are different commercial interests or technical needs competing to control or influence the behaviour of storage assets[36].

9 - HOW TO DELIVER THIS OPPORTUNITY

There is a considerable opportunity available but it is only with effective policy in place that it can be delivered.

The Government issued an extensive call for evidence on energy storage and energy system flexibility in November 2016[37] and in response, in July 2017 launched the *Smart Systems and Flexibility Plan*, a plan for increasing the deployment of energy storage and demand response technologies. The REA fed into the consultation and has issued a document on the policy changes needed to deliver growth and strongly believe certain policy areas should be progressed as quickly as possible. The APPG and the REA will work with the Department for Business, Energy, and Industrial Strategy (BEIS) and Ofgem to assist in their roll out of their Plan. DIT should also work to ensure storage remains an Intellectual Property (IP) export priority.

The Ofgem *Targeted Charging Review - Significant Code Review* is ongoing[38]. Simplifying ancillary services will also result in a more successful industry.

Key policy changes that are needed (most of which are included in the *Smart Systems and Flexibility Plan*) include:

- **Introducing a definition for energy storage as quickly as possible,**
  - o *either implemented through legislation or as a new electricity licence type, to overcome the problem of there being definitions for 'generation' and 'demand' in the electricity system, but not for storage. Implementation should take place as soon as possible.*
- **Network charging methodology reform,**
  - o *to retain the 'Embedded Benefits' and ensure suitable Significant Code Review outcomes to incentivise storage devices on the network which alleviate pressures on the gird and reduce the need for extra infrastructure.*
- **A move from Distribution Network Operator (DNOs) to Distribution System Operators (DSO) models,**
  - o *this would result in regional grid operators taking steps to manage the system in their areas and the procurement of more flexible services such as storage. Discussions have started already on this.*
- **Ancillary services reform,**
  - o *this would open up a series of existing grid services markets to new entrants such as storage.*
- **Reform of the Capacity Market support mechanism, including removal of restrictions on "stacking" of revenues,**
  - o *this would allow grid connected storage projects to more easily combine different revenue streams and make their projects financially viable.*
- **Reform enabling the introduction of "smart tariffs,"**
  - o *which would incentivise behind the meter storage to a greater extent by introducing different prices for power at different times of the day.*
- **The amendment of existing renewable energy support schemes to accommodate co-location of renewables and storage,**
  - o *as some schemes are currently designed in such a way that installing energy storage could lead to significant problems.*
- **Targeted R&D innovation support for larger-scale energy storage.**

Local authorities should be involved in the process of deploying storage. Many local authority energy companies are specifically seeking to reduce fuel poverty levels and input from these organisations will be critical to ensure that these technologies assist in their goals.

Industrial Strategy Proposals

The Government is also currently drafting its 'sector deals' as part of the *Industrial Strategy*. Any energy-related sector deal should include a section on energy storage.

Key points that could be included in an energy storage sector deal in the Industrial Strategy (not already included in the *Flexibility Plan*):

- Infrastructure / export guarantees for energy storage companies.
- Offer Enterprise Investment Scheme and Enhanced Capital Allowances tax support for storage devices, both of which are well understood and liked by investors.
- Increase support through, and promote access to, the existing R&D tax credit scheme. The ability to claim back funding on investment, or receive tax rebates while growing, has provided valuable support to early stage innovation projects, especially while operating pre-revenue.
- Establish a funding mechanism beyond the innovation stage, by offering early stage equity backing or debt support. The UK Guarantees Scheme, as promoted within the Industrial Strategy Green Paper, should be extended to decentralised energy storage systems.
- Demonstration Funding and support for risk-taking SME's. This is effective in realizing efficiencies during early projects as well as beginning to establish supply chains.
- Support innovative projects in seeking export opportunities. This can be done in particular by supporting trade associations to facilitate linking of UK industries with foreign markets. Grant schemes that trade bodies can apply for to host international delegations could be a means of achieving this.
- Fund standards work to ensure joined up and overarching standards in place.
- Tax breaks or other assistance for UK manufacturing / supply chain activity.
- Any sector deal should reflect the wide-ranging implications of advancements in battery and energy storage technologies, including for electric vehicle charge point roll-out, agriculture, energy in buildings, national and company-level energy security, and beyond.
- Research into further storage technologies alongside lithium-ion batteries, including flow batteries, heat batteries and uses for second-life EV batteries.
- Further research into IT systems that allow for sophisticated local energy system balancing and enable 'stacking' revenues on ancillary services based on the benefits brought to grid by storage systems.
- A review of building codes that results in higher energy efficiency standards and onsite generation in new homes, factories, and offices. This should also include requirements for onsite energy storage at rural and large-scale EV charge stations (non-domestic).
- Similarly, the new £2.3 billion Housing Infrastructure Fund should be focused on ensuring decentralised energy generation and storage is embedded in local housing developments. This aim could be supported by encouraging the use of the Merton Rule[39] within Local Authorities or introducing a Zero Carbon Homes policy.
- Embedded Benefits changes as proposed in June 2017 should be reversed.
- Maintain stability with long-term commitments to sector deals.
- The Government's recently-launched (September 2017) Green Finance Taskforce is could look into the provision of funding for energy storage demonstration sites and into expanding the use of green bond financial products being sold through crowd funding platforms.

Key tasks for industry to develop this market:

- Industry to create better shared data on deployment and locations.
- Industry to coordinate standards development.
- Investment in UK assembly /manufacturing.
- Industry to work with Systems Operator to open Ancillary Services market to greater competition and transparency.

The REA is available to discuss the growth of storage in the UK, the Government's Call for Evidence and its policy proposals in further detail.

10 - CONCLUSION

Developing a domestic energy storage industry will give the UK a competitive edge and can create a new series of post-Brexit export products. Globally, costs are falling, the technologies are improving and there are a range of new commercial applications becoming viable. Storage technologies and expertise is exportable and the UK's support for a domestic electric vehicle industry places it in an advantageous position to become a leader in this area. The storage industry is not seeking a direct subsidy such as a feed-in tariff but instead calls for the urgent upgrading of the tax and regulatory system.

Little has been written on the potential size of the UK storage market to date, and this report shows that even with conservative assumptions in many respects, there could be as much as 12GW of energy storage in the UK by the end of 2021.

The UK is well-suited to become a pioneer in these technologies, in part because of its established technical and academic expertise, in part because of the development of an EV supply chain domestically and in part due to strong variable renewable electricity deployment to date.

Greater storage integration will be crucial to new infrastructure investment. From new house-building to the roll-out of an electric vehicle charging network, storage can help reduce bills and reduce the need for power grid reinforcement. It will also be crucial in supporting the UK's need to decarbonise its energy sector as it can support low-cost and rapidly built renewable power generation sources. Storage deployment will have significant impacts beyond the energy sector and should be incorporated into planning policy, new construction requirements, and energy policy. Significant growth in storage capacity would also be beneficial for energy security.

In the next five years it is anticipated that battery packs, particularly lithium-ion batteries, will comprise most of the forecast energy storage deployment. This is not to downgrade the role of other storage technologies, all of which have a place in the mix, but instead to emphasise the rate of cost-reduction and supply chain growth relating to this particular technology type.

The Government has proposed a plan that will allow for storage deployment in its *Smart Systems and Flexibility Plan*. It is additionally considering storage as part of its Industrial Strategy. Policy and regulatory barriers are the single greatest issue holding back deployment, and other countries are keen to also be leaders in this new industry.

The UK Government must build on progress made to date. By keeping to its own deadlines and by incorporating storage in the Industrial Strategy and Clean Growth Strategy it can help British businesses take a leadership role in this burgeoning global industry.

APPG on Energy Storage
December 2017

Peter Aldous MP (Con) is the Chair of the APPG, and the Group's Vice-Chairs are Lord Teverson (Lib Dem), Dr Alan Whitehead MP (Lab), Hywel Williams MP (Plaid Cymru), Alan Brown MP (SNP) and John McNally MP (SNP).

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38 Ofgem: Targeted Charging Review - Significant Code Review launch – August 2017: https://www.ofgem.gov.uk/publications-and-updates/targeted-charging-review-significant-code-review-launch
39 The Merton Rule involves councils introducing perspective planning policy requirements that dictate that new buildings must generate a minimum level of their total energy needs on-site.
Section 1 - 'Tipping Points' report reference: https://uk.eaton.com/content/content-beacon/RE-study/GB/home.html

About the APPG on Energy Storage

The APPG on Energy Storage has been set up to promote awareness of energy storage technologies and create a dedicated forum to share knowledge and debate future policy options. Bringing together Parliamentarians, businesses, NGOs and experts in the field at a range of events, the APPG will offer a unique platform from which to propel innovative energy storage technologies into the mainstream.

About the REA

The Renewable Energy Association (REA) is the Secretariat to the APPG on Energy Storage and represents organisations operating in the decarbonisation of heat, power, and transport, including generators, project developers, fuel and power suppliers, investors, equipment producers and service providers. Members range in size from major multinationals to sole traders. There are around 600 corporate members of the REA, making it the largest renewable energy trade association in the UK. This includes nearly 100 energy storage members, also making it the largest trade body for the energy storage industry.

Energy Storage in the UK: Market Overview

Latest update autumn 2016, download the latest version here: http://www.r-e-a.net/resources/rea-publications

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