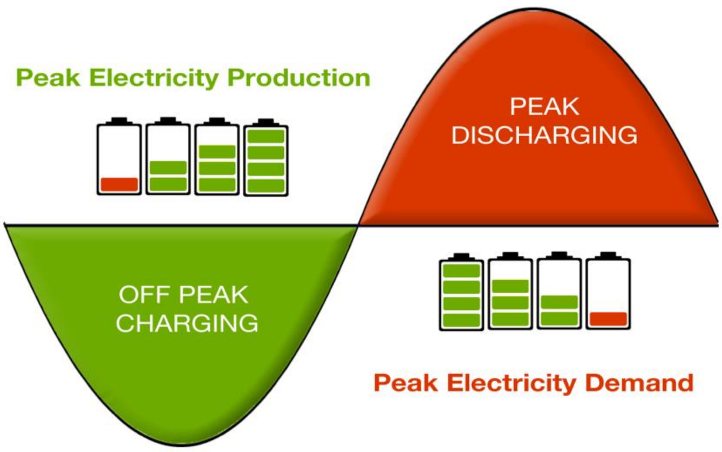
Ofgem Consultation Overview compiled by the Energy Managers Association (EMA)

Summary

This submission explains how Dynamic Response can meet the System Operator (SO) aims of 30-50% of balancing service capabilities by 2020, reduce the need for grid reinforcement and decentralise the storage and demand for power by consumers at peak periods. It works on tested and trialled models and does not require the development of no new technology or control systems. The changes needed are to make this a reality in the timescale needed, which would allow the SO to balance the grid can be achieved through changes to the BSC but may need to be assessed and included in a General Authorisation Regime (GAR). The changes fall outside the need for primary legislation or the creation of any new subsidy scheme.

Dynamic Response simply charges on site batteries when there is excess and uses the power on site to reduce demand. The system is suitable for both domestic and commercial use and would be used to reduce cost to the consumer and a flexible grid levelling mechanism for the SO. This overview should be read in conjunction with the EMA submission to the consultation.



How Dynamic Response matches the aims of the consultation

OFGEM and BEIS have launched a consultation, a smart flexible energy system, which questions how the Government can amend the legislative environment to allow the introduction of technologies that will ensure the UK has a secure, affordable and clean energy system in the future. There is a focus on the use of smart grid technology to create flexibility into the system. Ofgem's definition of flexibility refers to the ability to modify generation and/or consumption patterns in reaction to external signals, such as a change in price or a message from the System Operator.

How Dynamic Response will operate

Dynamic Response, which is defined as shifting load from off peak periods to peak periods through the medium of batteries, has a clear synergy with the stated aims of the consultation. Through market reforms the use of batteries placed “behind the meter” are incentivised to provide demand reduction services during times of peak grid use. The “behind the meter” consumer charges their batteries during times of excess supply (when the price point is reduced) and then uses this energy to power their own needs when there is excess demand – thereby reducing the load on the grid. In contrast to Demand Response, the consumer does not need to impact their operational needs i.e. refrigerators can stay on, lights and services stay operational. The system of siting batteries at the point of use and using those batteries to optimise off-peak generation for use at peak would create a decentralised energy network that would change the use of energy being dictated, as at present by supply and shift this to demand.

Dynamic Response is not primarily a frequency response mechanism although it can be used in this capacity, it is essentially a demand reduction process that can deliver the demand reduction balancing services of 30-50% needed to meet the SO target.

The economics are attractive because the price of batteries is falling and their use would replace expensive SBR measures. An example is the £76 million that is being spent to keep Eggborouh and Fiddlers Ferry power stations on standby over the winter of 2017/18. If the same money was spent on batteries the grid would have 253, 1Mwh of batteries that could be used every day for ten years. These batteries would be financed by the private sector and there would be an appetite to finance batteries to hit multiple Gigawatt capacity. The batteries would not generate power but would utilise all the wasted generation that occurs every day on the grid and move that load to times of peak use. Dynamic Response would turn renewable generation into baseload.

Dynamic Response could be a disruptive technology that could provide a means to use renewable excess off peak generation, through to a mechanism to balance the grid. Dynamic Response could be financed by the private sector through price mechanisms that would increase competition without subsidy in the marketplace. Another advantage of the system is that at scale it will reduce the level of power needed on the grid. This would reduce the amount of power generating assets that will need to be built and could reduce the cost of reinforcing the grid, which will ultimately reduce prices to consumers.

The medium of batteries that will be used is not a form of generation, but can be used to manage peak demand, in a measurable and controlled manner that will make best use of the National Grid. Power generated by all forms of generation can be stored on consumer premises to be used at their time of peak use. This will decentralize the storage and management of electricity at consumer level. This methodology is set out in document five at the end of this document. The local use of power will also encourage the efficient use of power by consumers. Consumers will not have the expertise or facilities to best utilise the stored energy for peak time use and therefore the system will be dependent on aggregators utilising smart grid technology. The aggregators will be able to charge and discharge in the most efficient manner but could create a valuable market for excess generation capacity from renewables at off peak periods.

This system will become economically feasible as electricity prices rise as predicted by many and the prices of batteries continues to drop from the present price of around £500,000 to between £200-300,000 within the next two years, Dynamic Response could be introduced at scale quickly and within five years could be a grid levelling mechanism. An adjacent advantage would be the creation of an ecosphere for new businesses in the UK around the control and automation of battery systems in a digital grid.

Dynamic Response could easily achieve the projected benefits set out in the NIC report on smart power. Using existing technology Dynamic Response could provide levels of balancing capacity that would match the SO target.

The achievement of these targets would need few changes to the present power network or charging structures, if the benefits are recognised and can be incorporated into the income stack that would finance Dynamic response, balancing costs and benefits could be achieved through the Balancing and Settlement Code (BSC) or GAR.

Dynamic Response would not need many of the changes to the market mechanism governing price and supply issues that are related to traditional DSR. The main changes that would be needed to make Dynamic Response a viable and competitive system would be to value a half hour Mwh of Demand reduction at the same rate as a half hour Mwh of generation, this change would allow Dynamic Response to compete in the market, and would mean that this would be a subsidy free system.

Conclusion

The response to this consultation is based around how Dynamic Response could introduce a flexible, market based and decentralised system that will level the grid and maximise the use of generation from renewable resources. Battery storage, software interfaces and grid connections all exist and have been trialled and can be installed now.

The system is based around Dynamic Demand incorporated into the commercial and domestic sector.

Future actions that the EMA will undertake to promote Dynamic Response

The Energy Managers Association is leading a group that will be promoting all aspects of Dynamic Response; the work will include a number of work streams that should help Dynamic Response to become an installed and operational technology at scale by 2020.

The EMA through working with partners prepare most of the information needed by Ofgem or BEIS to base any decision on evidence.

The EMA will work on proposals to Ofgem around changes to regulation or BSC, C16 and if required GAR.

The EMA will work with The Energy Saving Consortium and The Home Insulation & Energy Systems Quality Assured Contractors Scheme (HIESS) to formulate a consumer protection code for those using storage under Dynamic Response schemes.

The EMA will develop a code of practice for all companies undertaking work covered by Dynamic Response.

The EMA will also set up a working group to look at standards and protocols that will be needed to implement Dynamic Response at scale.

About the EMA

The EMA is a not for profit organisation that represents the UK top energy managers whose cumulative annual energy spend is over £6 billion. The organisation's purpose is to improve the position of energy management experts, their profession and act as their united voice. The EMA's priority is to establish best practice in energy management, encourage knowledge exchange and put energy management at the heart of British business.

For more information please contact Rupert Redesdale at rupert.redesdale@theema.org.uk

Supporting Documents

1. Sets out the commercial model
2. Sets out the domestic model
3. Sets out the cost of Lithium Ion batteries, with the projected fall in costs
4. Installation Standard for Domestic Energy Storage Device
5. Work carried out in Germany, which shows the implementation of Dynamic Response at a domestic level

Annex 1

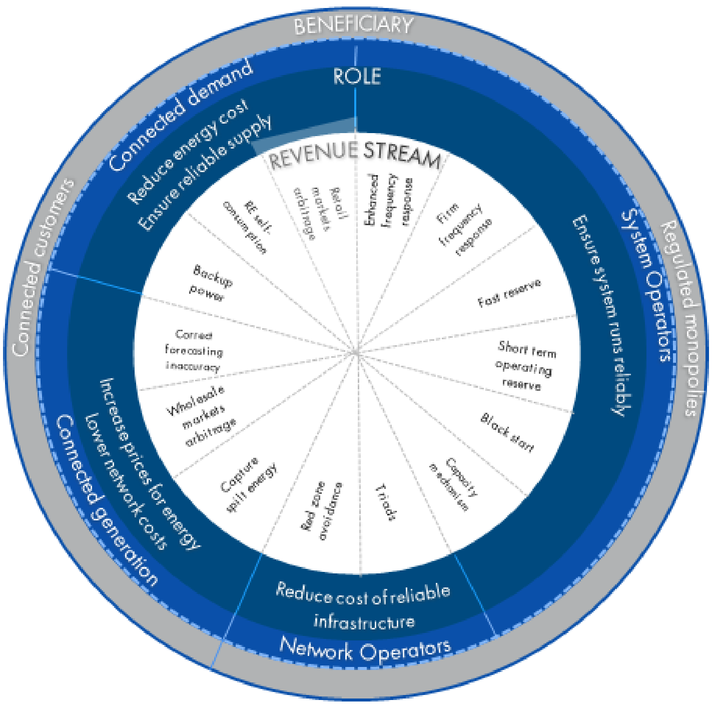
Battery Storage System - Cost Saving / Revenue Generation

An enterprise could be a factory a hospital or a supermarket or many other types of business.

The enterprise can install a battery storage system which can be inside the building or as a containerised system sitting in the car park.

The financial benefit from the system is to charge the battery with cheap electricity, usually at night, and then use electricity in the enterprise, when electricity is expensive. This concept can be used to avoid triad charges and red zone charges but is also hugely beneficial to the grid because demand from the enterprise is reduced. In addition any spare electricity could be sold into the capacity market.

The battery storage system could in future be used to provide grid services such as frequency response and reserve power to the grid and these are also illustrated in the graphic below. A further benefit is that a grid forming battery storage system could replace a diesel generator to provide backup power to the enterprise in the case of grid failure.



Technology needed for MW scale storage

Basically a battery charger and inverter – Sunny Central Storage

- Available in different sizes from 0.5MW to 2.2MW – 20 foot container
- Can be grid forming
- Connects directly into the substation/distribution transformer at the enterprise
- Includes transformer and switch gear
- Compatible with different types of battery technologies
- Containerised System

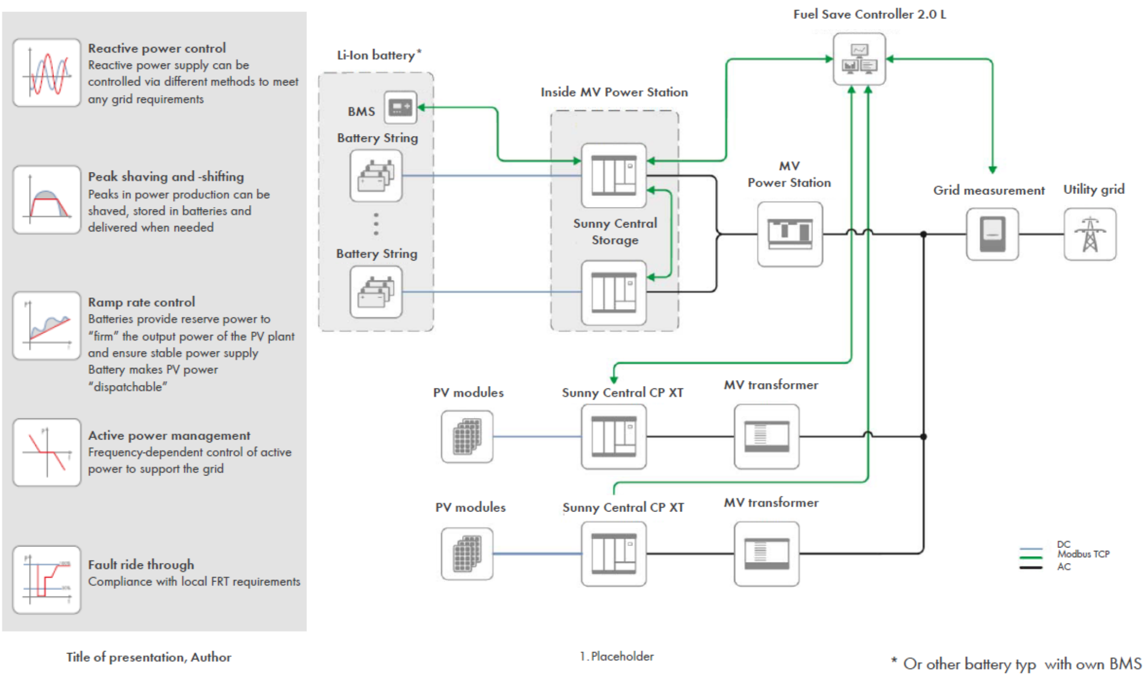
And a battery … - Tesvolt 3 MWh in a 40 foot container

- Scalable from 0.5 MWh to 100 MWh
- Ready to connect for Battery Inverter Station
- SAMSUNG SDI Lithium Cells prismatic
- 10 Years power Warranty
- Transportable
- Containerised System

Technical Architecture

The system is containerised and includes the battery charger and medium voltage transformer and also the switchgear, so can be connected into the medium voltage substation at the enterprise.

A solar PV system could be added as an option, say on the roof of the factory, and this would be able to generate low cost electricity for use in the enterprise and any spare energy could be stored in the battery.



Annex 2

Domestic Battery Storage & Dynamic Response

Introduction

To deploy batteries to domestic properties on a mass scale as part of a 'Dynamic Response' solution is both sensible and achievable. It is scalable, can be targeted at high stress areas and utilises technologies that are current and commercially available.

The use of batteries for domestic energy storage is not a new concept. There has been significant growth in this sector in recent years, with battery storage now routinely offered as an 'add-on' to solar photovoltaic systems as customers look to add value and maximise return against a backdrop of feed-in tariff diminution.

The idea that battery storage solutions can be installed in the absence of microgeneration technologies is emerging, with many manufacturers now bringing to market AC coupled inverter/chargers for this application. While this market is emerging and uptake is growing, mass deployment is not likely until there is a shift in the peak/off-peak price differential.

We will explore two potential models for Dynamic Response on a domestic level. Both models allow for the remote control and deployment of stored energy by aggregators who will trade the reduction in demand, using changes to the regulatory framework and the financial models/income streams that emerge.

Model 1

In this model, the batteries and all ancillary equipment would be owned by third-party aggregators, who would finance the installation and would retain control of the stored energy. The aggregator would then trade the reduction in demand by deploying the stored energy at designated times, or in response to periods of high stress.

Equipment & Cost of Install

Each system would comprise of an inverter/charger, battery (lithium-ion – although new technologies are emerging such as domestic level flow batteries, see 'Near Commercial Technologies' below) and ancillary parts including local metering and communications facilities and voltage optimiser where applicable.

Indicative Pricing:

Inverter/charger: £400.00-£600.00
Battery: £250-£350 per kWh of storable energy (estimated to reduce by 25-35% over the next five years)
Voltage optimiser (where applicable): £145
Cost of Installation: £500.00
Total Cost (typical): £3500.00-£4000.00

The costs will therefore vary depending on the choice of equipment, most notably the size of the battery installed. In this model, it is likely that an aggregator would choose to install a large battery in order to maximise the amount of energy/demand reduction it is able to trade. Using a 10kWh battery as an example, this could deliver up to 36.5MWh of demand reduction over a 10 year period; however a more realistic assumption would be that the battery would work to 70% of its capacity over its lifetime as it would be unreasonable to assume that a battery will complete a full charge/discharge cycle during each day of operation. The use of flow batteries would provide for greater efficiencies and yield (see 'Near Commercial Technologies' below)

The rate of charge/discharge is also a key consideration, and this may also impact on the choice of equipment and would be depend on the aggregator's preferred financial model. An aggregator might, for example, prefer a model whereby they 'forward sell' a defined level of demand reduction at specifics times. In this scenario, rapid discharge may not be a major consideration. Alternatively, a more reactive model might be preferred whereby a reduction in demand can be 'spot traded' at times of high stress, requiring higher rates of charge/discharge.

There are, however, commercially available and mature technologies suited to these different applications. Batteries can range in size from 4kWh to 13kWh and charge capacity can be anywhere between 0.5kW and 5kW.

Scalability

Mass deployment of batteries to domestic properties can have a significant impact on issues of peak demand. An average 7kWh battery installed in one million domestic properties would provide up to 7GWh of stored energy deployable at times of high demand and provide 1-2GW of reduced demand.

Remote Control

Key to this model is the ability to control systems remotely and trigger the charge/discharge of batteries on demand. Many inverter manufacturers have already developed commercially available software platforms that allow for control of aggregated systems (via the internet and therefore requiring a broadband connection). Discussions between leading manufacturers to develop a standard communications protocol utilising either an internet connection or GSM modem are on-going.

Metering

The Smart Meter Network has not been implemented country wide and therefore does not offer a complete metering platform. The GSM modem option for remote control can also facilitate the metering requirements. MID approved metering systems are available which can differentiate between the battery charge and discharge energy flow and automatically record battery contribution to energy usage.

End User Benefits

The end customer would not own the system, or have any control over it. They would however benefit from the use of off-peak energy during high-tariff periods. Additionally a voltage optimiser could be included in the system (adding approximately £145 to the cost) the end user could see up to 10% power reduction across their total power usage.

Model 2

In this model the consumer would purchase the equipment and finance the cost of installation. From a technical perspective, there is little difference between this and the previous model.

The customer would therefore seek to benefit from the peak/off-peak price differential which would be reflected in reduced energy bills. Control of the system would still be passed to an aggregator who would trade the reduction in demand.

A mechanism that allows some revenues from the trading in reduced demand to be shared with the customer should be developed in order to incentivise uptake.

In addition, there are further possible revenue streams that would allow upstream savings to be passed on to the end user. In one such scenario, the power companies themselves would become aggregators and would have an arrangement with the end user whereby they are paid a premium for discharging batteries at set times. Metering solutions are intelligent enough to easily deal with this. Although this would remove the 3rd party aggregator from the loop, it would be cheaper for the energy companies, reduce the complexity of the control system and most importantly, encourage end users to invest in battery storage technology.

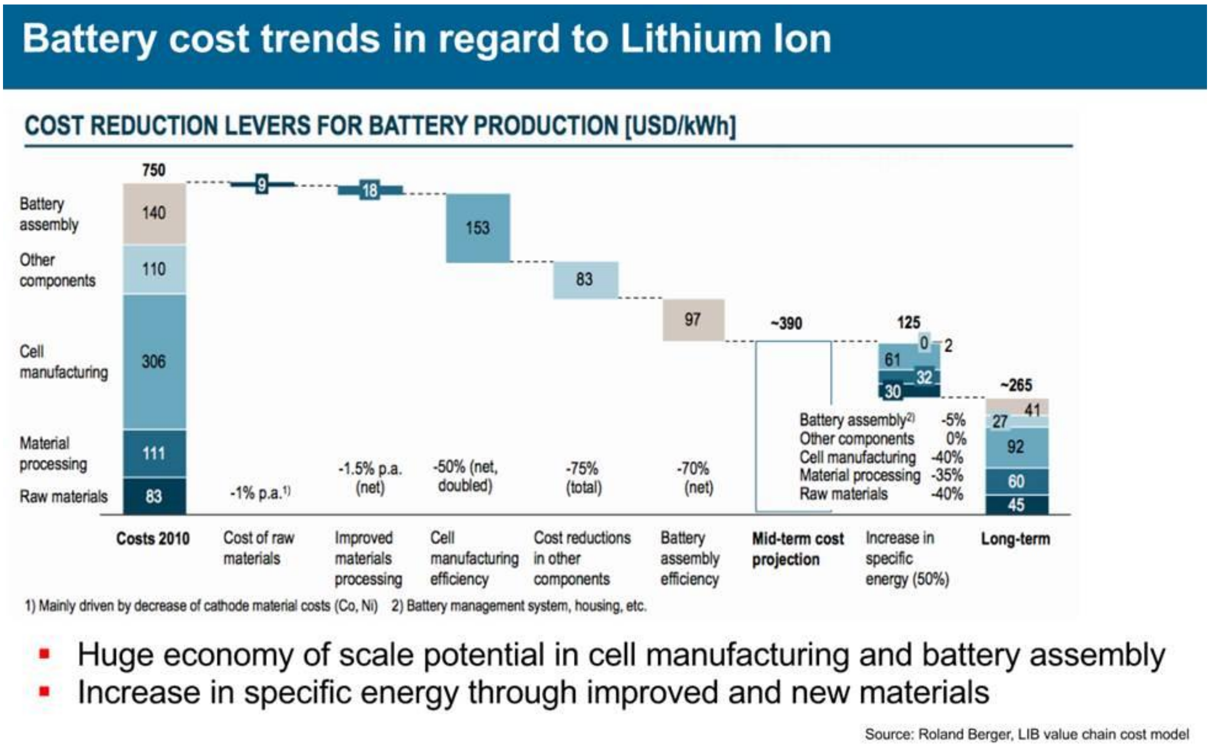
Near Commercial Technologies

Small scale (domestic) flow batteries will be available by 3rd quarter 2017. These are ideal for long term investment projects

Benefits of Flow batteries

- Guaranteed 10 year lifespan at 100% of rated performance
- 100% depth of discharge, discharge cycle tolerant
- Can be repurposed or recycled at the end of guarantee period
- Present no fire risk
- Scalable technology
- Unlimited shelf life

Annex 3



Battery cost trends in regard to Lithium Ion
COST REDUCTION LEVERS FOR BATTERY PRODUCTION [USD/kWh]
750
Battery assembly
140
Other components
110
Cell manufacturing
306
Material processing
111
Raw materials
83
9
18
153
83
97
~390
125
0
2
61
32
30
~265
41
27
92
60
45
-1% p.a.1)
-1.5% p.a. (net)
-50% (net, doubled)
-75% (total)
-70% (net)
Battery assembly2) -5%
Other components 0%
Cell manufacturing -40%
Material processing -35%
Raw materials -40%
Costs 2010
Cost of raw materials
Improved materials processing
Cell manufacturing efficiency
Cost reductions in other components
Battery assembly efficiency
Mid-term cost projection
Increase in specific energy (50%)
Long-term
1) Mainly driven by decrease of cathode material costs (Co, Ni) 2) Battery management system, housing, etc.
Huge economy of scale potential in cell manufacturing and battery assembly
Increase in specific energy through improved and new materials
Source: Roland Berger, LIB value chain cost model

Annex 4

ENERGY SAVING
CERTIFICATION SCHEME

The Certification Scheme for Energy Saving
Technologies and Installations

Installation Standard for Domestic Energy Storage Devices

ESCS 01 – [DATE] – [VERSION]

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1.0 Introduction

1.1 The purpose of this Installation Standard is to enable the effective operation of distributed dynamic response to energy shortages through the use of domestic energy storage devices.

1.2 The Installation Standard will enable the effective deployment of energy storage devices to domestic premises in a fair, safe and cost-effective manner. It will enable the realisation of energy efficiency and load reduction at peak periods (known as dynamic or demand response).

1.3 To work, individual energy storage devices, smart inverters, smart meters and communications equipment all has to work seamlessly with energy storage aggregators and the National Grid.

1.4 The benefits for consumers include:
- (a) Access to lower cost energy through dynamic response tariffs
- (b) Provision of local resilience to cope with energy shortages or blackouts
- (c) High quality equipment that meets international standards
- (d) Guarantees and consumer protection for the whole lifetime of the product
- (e) Ability to participate in the energy market place, carbon trading and tariff trading

(f) Integration with Microgeneration Systems, Combined Heat and Power Systems and Hybrid Fuel Cell Systems
(g) Environmentally friendly and recyclable products and materials.

1.5 This Installation Standard is a standard or normative document for the purposes of BS EN ISO IEC 17065 on conformity assessment for bodies certifying products, processes and services.

1.6 The Energy Saving Certification Scheme provides an ongoing, independent, third party assessment of Certified Installers and technologies to ensure that the requirements of the appropriate standards are met and maintained.

2.0 Scope

2.1 The scope of this Installation Standard covers the requirements for companies undertaking the supply, design, installation, set to work, commissioning and handover of Energy Storage Devices installed in domestic properties.

3.0 Definitions

Consumer means either:

- The purchaser of the goods;
- The subscriber to the energy supply at the household; or
- The owner of the household

If, and only if:

- They are an individual acting in a private capacity; or
- They are a micro-business employing less than 10 people and with a turnover less than £1 million.

Domestic Property means any property that is used as a dwelling regardless of whether or not it is also used for any other purpose.

4.0 Consumer Protection

4.1 All installers shall operate in a manner that secures the highest standards of consumer protection and does not bring this Installations Standard into disrepute.

4.2 All installers must be a member of scheme that operates a consumer code of practice approved for that purpose by the Chartered Trading Standards Institute.

4.3 All installers must have in place a maintained documented quality management system in accordance with this table. The status of the documented system must be clear in terms of issue level and/or date.

4.4 All installations must be carried out under a contract between the installer and a consumer, the standard business terms of which have been approved by the consumer code of practice scheme provider.

4.5 The consumer code of practice scheme provider may extend the coverage of the code, so far as is relevant, to manufacturers, aggregators, financiers and investors, assessors or any other commercial party in the supply chain.

4.6 The consumer code must provide a means of alternative dispute resolution to resolve disputes.

5.0 Grid Code Compliance

5.1 All installations shall be carried out in accordance with the requirements of the Grid Code.

5.2 All Energy Storage Devices shall be manufactured in accordance with the requirements of the Grid Code.

6.0 International Electrotechnical Commission (IEC) Compliance

6.1 All installations shall be carried out in accordance with Part P of the Building Regulations.

6.2 All Energy Storage Devices installed shall comply with the requirements of BS EN 60335-1:2012+A11:2014, providing general safety requirements for electrical installations. No Energy Storage Devices shall be for use by or in play by children.

6.3 All Energy Storage Devices installed shall be electromagnetically compatible, insofar as that applies to:
- (a) Emissions (EN 55014-1:2006/A2:2011)
- (b) Immunity (EN 55014-2:1997/A2:2008)
- (c) Limits for harmonic current emissions (BS EN 61000-3-2:2014)
- (d) Limitation of voltage changes (BS EN 61000-3-3:2013)

6.4 All Energy Storage Devices shall adhere to the following minimum operating characteristics:
- (a) A depth of depletion (DoD) of at least 95%
- (b) A lifespan of at least 7,360 cycles (two cycles/day over 10 years)
- (c) Operability between -15^{o}C and +50^{o}C

7.0 Software Interoperability

7.1 It is critical to success that the Energy Storage Devices installed under this standard are interoperable with centrally aggregated demand response protocols. This enables the overall grid management.

7.2 This standard utilises the interoperability standards established by the Demand Response Research Center at US Department of Energy.

7.3 The Energy Storage System shall meet or exceed the requirements established in Open Automated Demand Response Communications Specification (Version 1.0).

7.4 All Smart Inverters installed to support Energy Storage Devices shall comply with the requirements of BS EN/IEC 61850-90-7, IEEE 1547

8.0 Environmental Requirements

8.1 All Energy Storage Devices must be managed in accordance with the Waste Batteries and Accumulators Regulations 2009 and, for the purpose of those Regulations are to be treated as Industrial Batteries.

8.2 Manufacturers of Energy Storage Devices are responsible for minimising harmful effects of waste batteries on the environment, by improving the design of new batteries and paying for waste battery collection, treatment, recycling and disposal.

8.3 It is illegal to send waste Energy Storage Devices for incineration or to landfill.

8.4 Installers must not install any Energy Storage Device that has not been registered, by the manufacturer or producer, on the National Packaging Waste Database.

8.5 Installers are responsible, acting on behalf of the manufacturer, for recovering any installed Energy Storage Devices at the end of their operating life or if a replacement Energy Storage Device is installed. All recovered Energy Storage Devices must be returned to the manufacturer or to another Approved Battery Treatment Operator or Exporter.

9.0 Installer Competence

9.1 All staff employed in installation, set to work and/or commissioning activities must have received adequate training in each of the areas/operations in which they are involved.

9.2 The Installer must have a training record for each employee which details training received, and any qualifications or certificates held by the individual. The record should be signed or verified by the employee.

9.3 The Installer must have a record detailing the skills for which each individual is approved on the basis of their competence.

10.0 Installer Assessment

10.1 Any installer may apply to the Energy Saving Certification Scheme for assessment under this standard. The installer shall complete the appropriate application form and pay the applicable fees.

10.2 An Assessment is an objective examination of an Installer, including an assessment of their technical competence to carry out work in accordance with the applicable standards.

10.3 Assessments are conducted using elements of questioning and observation techniques. Assessments start with an opening meeting to explain the purpose of the visit, the work that is to be assessed, the reporting method, the selection of the installation site(s) to be visited, and the approximate time, place and purpose of a closing meeting. The Installer must their relevant technical representatives are present or available throughout the assessment process.

10.4 At the end of assessment or surveillance visits a closing meeting is held to discuss any non-conformity or observation reports raised and the assessor's recommendation.

10.5 If the assessment demonstrates competence that is limited to a specific product type(s) the Assessor may recommend certification that is limited in its scope.

10.6 Where non-conformity reports are raised, they must be completed and returned to the Energy Saving Certification Scheme with completed corrective and preventative actions within 8 weeks of an assessment or surveillance visit.

10.7 Where certification cannot be recommended at an initial assessment visit, a full or partial re-assessment will be considered and may be required at additional cost.

10.8 The assessment is conducted in two parts.

Off Site Assessment

10.8.1 This is an assessment of the policies and procedures that the Installer has in place to meet the requirements of this Standard. The Assessor shall also check the following:

(a) That the details on the application form or certificate(s) are correct
(b) The status of the Installer's quality management system documents
(c) That corrective and preventive actions associated with any previous non-conformities have been taken and have been satisfactorily completed and implemented
(d) The records of internal reviews, corrective and preventive actions
(e) That no changes have occurred that should have been notified to the Certification Body
(f) The correct use of certification marks

10.8.2 This includes the contract review, design, installation, set to work, commissioning and handover of the appropriate Energy Storage Device system and technology.

10.8.3 Design is defined as the formulation of a written plan including a specific list of products and fixings to form a completed system for a defined Energy Storage technology. It includes extensions and alterations to existing Energy Storage systems.

10.8.4 All systems must be designed in accordance with the requirements set out in the appropriate Standards.

10.8.5 Where Companies do not engage in the design of Energy Storage systems, but work solely as an Installer for a client who has already formally agreed a system design; then the Installer must be competent to review and verify that the design would meet the design requirements set out in the appropriate Microgeneration Standards and this should be recorded.

10.8.6 On site assessment

10.8.7 This is an assessment of an installation to review the work that has been undertaken against the system design and the procedures for the installation, set to work, commissioning and handover of the system / technology.

10.8.8 Where requested, the Installer shall provide details of recent or current installations as required by the Energy Saving Certification Scheme. The Installer shall arrange access to installations selected by the Assessor.

10.8.9 The Energy Saving Certification Scheme may use an installation that is not fully within the scope of the Scheme for the on site assessment, if that installation provides objective assessment evidence against specific requirements of the relevant Installation Standard.

10.9 Certification is maintained through at least one annual visit, referred to as “a surveillance", which is similar in format to Assessment. Surveillance ensures that the Installer is continuing to comply with the requirements of the scheme and is working within the scope of its certification. If a surveillance programme is via the minimum annual visit, this should take place during a time period that is between 2 months prior to and 4 months beyond the anniversary of the certificate issue date.

10.10 If the Installer has not carried out installation work for a particular technology during the year, the surveillance may proceed on the basis of a desktop review of capability at the Installer’s office, subject to the Installer agreeing to inform the Energy Saving Certification Scheme the next time they accept a contract to carry out an installation of the type concerned. When such an installation goes ahead an additional site assessment shall be required.

10.11 Additional surveillance visit may be required;

(a) If substantiated complaints against the Installer are received; or

(b) As a result of a significant number of non-conformities being raised during a visit (in this circumstance an additional visit may be required within 12 weeks of the original visit date).

10.12 Where non-conformities cannot be resolved within 12 weeks of the original visit date the Installer is suspended or the certificate withdrawn.

10.13 The certificate holder may be expected to bear the costs of investigating complaints and additional surveillance visits.

11.0 Installer Certification

11.1 Certificates are awarded to Companies when all assessment activities have been satisfactorily completed, the Assessor has recommended that certification is granted, any non-conformities raised during assessment are cleared and the Energy Saving Certification Scheme has formally reached a certification decision in accordance with its procedures.

11.2 Certificates contain the name and address of the Installer, the Energy Storage technology(s) that have been assessed, any limitations on the scope of the certification, a unique certificate reference number and the issue number and date.

11.3 Certificates are maintained and held in force subject to satisfactory completion of the requirements for maintenance of certification, but remain the property of the Energy Saving Certification Scheme.

11.4 All Certified Installers are listed [on the Energy Saving Consortium Website]

11.5 An Installer shall be eligible to remain certificated provided it continues to be engaged in energy storage installation work for the scope indicated on the certificate and continues to comply with this standard. Certificates are valid from the date of issue and are maintained and held in force subject to satisfactory surveillance assessments but remain the property of the Energy Saving Certification Scheme.

12.0 Certification Mark

12.1 The Installer shall use the Certification Mark only in accordance with the terms of the licence issued by the Energy Saving Certification Scheme.

12.2 An example of the Certification Mark is as follows:

ENERGY SAVING
ACCREDITED INSTALLER

13.0 Installer Responsibilities

13.1 The Installer shall specify a named individual "Nominee", whose responsibility shall be the control and overall supervision of all activities, which fall within the scope of the Scheme. This Nominee shall be the senior contact between the Installer and the certification scheme. The Installer may name an administrative contact person for the Certification Scheme to communicate with who is not the Nominee and whose responsibility would be coordination and communication. The Installer shall document who is responsible for each activity and their deputy or nominee.

14.0 Installation & Equipment Guarantees

14.1 Every installation shall be covered by a workmanship guarantee for a period of 10 years.

14.2 Every Energy Storage Device and Smart Inverter shall be covered by a product guarantee for a period of 10 years.

14.3 Every workmanship and product guarantee shall be underwritten by appropriate financial protection which shall be supported by a fund of a size commensurate with the risks and shall be available to the consumer regardless of whether or not the installer and/or manufacturer continue to trade.

15.0 Complaints

15.1 The Installer shall have a written procedure for managing complaints and shall keep a record of any complaints received (justified or otherwise) and the corrective and preventative actions taken to satisfy the complaint. All complaints must be dealt with in a timely and effective manner and, where required, be handled in accordance with the requirements of the consumer code.

16.0 Internal Review

16.1 The Nominee shall conduct regular (at least quarterly) reviews involving relevant staff members to review the effect of each of the procedures and deal with any problems in the system.

16.2 Records of these reviews and corrective/preventive actions shall be kept by the Installer. The reviews should consider, as appropriate:

(a) Feedback from members of staff, customers and suppliers
(b) Complaints
(c) Products
(d) External audits
(e) A review of controlled documents held (currency and availability)

(f) Performance of suppliers and subcontractors
(g) Changes to Installer documents
(h) Changes to Installer's structure or activity
(i) Issues arising from inspections
(j) Any other issues with an impact on the quality management system

17.0 Corrective/Preventative Action
18.0 Suppliers and Sub-Contractors
19.0 Documents, Document Control and Record Keeping
20.0 Changes to Installer Certification
21.0 Information Sharing

Annex 5

Caterva, a startup cofounded and partially supported by Siemens, has developed a revolutionary energy management system. The system makes it possible for homes outfitted with photovoltaic systems to rent out part of their battery power to network operators. The operators, in turn, pay the homeowners to temporarily store excess regeneratively-produced energy, which can be used to stabilize the network, thus supporting homeowners, network operators, and, of course, Caterva.
In his rural home in Bavaria, Andreas Seubert has a 1.8-meter high steel cabinet in the basement that houses stacks of lithium-ion batteries on one side, while the other side contains inverters, a smart meter, electronic switchgear, and a card-size circuit board with a processor and a mobile communications unit. Together with a number of solar panels on the roof, the systems provide an impressive example of what experts mean by decentralized power distribution.

Pilot Test

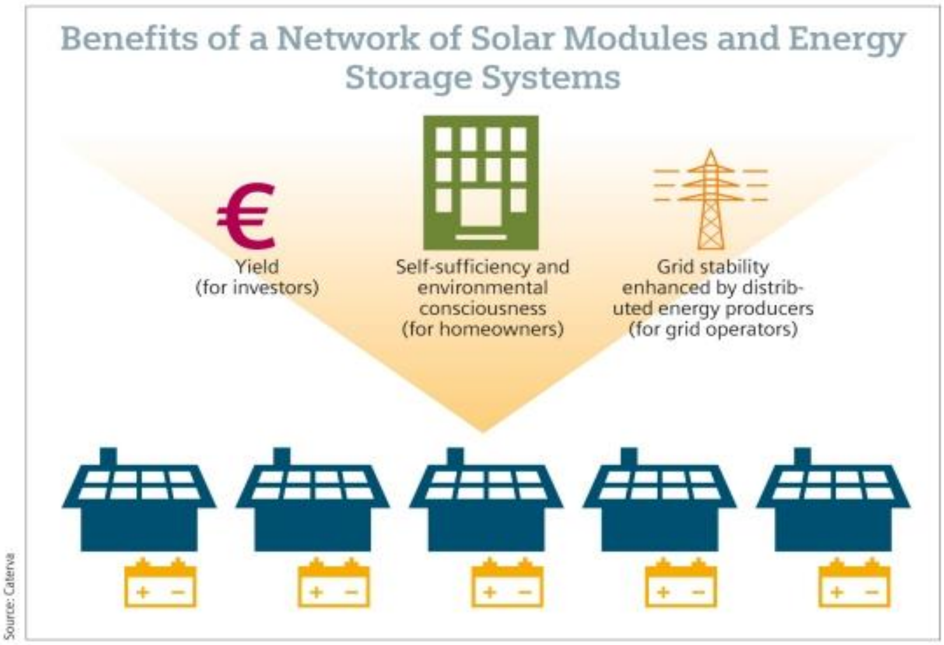
If Germany succeeds in its energy transition, energy storage systems (ESS) such as the one in Seubert's basement will become an important part of a sustainable energy network in the future. That's because such systems will help keep grid frequency stable and offset power deficits when the sun isn't shining and the wind isn't blowing. This task is currently still performed by conventional power plants, such as quick-start gas-fired power plants.

Cabinet with lithium-ion batteries and electronic switchgears

The Caterva solution consists of lithium-ion batteries and a mobile communication network. When linked with units in other buildings, they form a virtual storage system.

However, Caterva, a young Munich-based company, is demonstrating that there is also another way. "Caterva is the Latin word for swarm," says the company's managing director, Markus Brehler. The swarm principle is simple, and involves storing the electricity produced by photovoltaic modules such as those on the roof of Seubert's home in lithium-ion batteries. Each cabinet of batteries has a total output of 20 kilowatts and a capacity of 21 kilowatt-hours (kWh). Cabinets in buildings throughout a region are connected through the grid, creating a swarm or virtual storage system with an output of over one megawatt. The cabinets are controlled via mobile radio, and electronic systems in the cabinets allow a control center to tap or recharge Caterva participants' batteries. If there is demand for additional electricity in the grid, "the control center draws power from the swarm of batteries" in order to offset fluctuations, Seubert explains.

This innovative concept was originally developed by Siemens Novel Businesses, and then enhanced by various departments at Siemens Corporate Technology until the basic version of the swarm software was completed. Experts at SNB also helped establish Caterva, because it is their job to create new companies whenever a promising business idea cannot be further developed by Siemens AG as well, as quickly, or as flexibly as by an external firm. Before becoming the managing director of Caterva, Brehler gained extensive experience at another Siemens spinoff: EnOcean GmbH. Siemens will continue to support Caterva in many ways in the future. For example, it connects the cabinets to all of the hardware and is also a minority shareholder in the company.



Graphic: Benefits of a Network of Solar Modules and Energy Storage Systems

Several months ago, in cooperation with energy supplier N-Ergie, Caterva launched a pilot test involving some 65 private owners of photovoltaic systems and storage batteries. Since July 2015, these participants have been generating and storing over one megawatt of electrical energy, thereby contributing to the stability of Germany's grid. Thanks to the batteries in their homes, project participants can now consume more of their own electricity than they would without such an energy storage system — between 60 and 80 percent on average compared with just 30 percent, which would otherwise be the case.

Seubert, a 52-year-old sector manager for packaging machines at Siemens, is the first person to take part in the project. When he and his family moved into their new home in the little town of Dettelbach in the fall of 2013, he installed solar panels on the roof as a matter of course. The panels produce vast amounts of electricity on sunny days, and Seubert was annoyed that he could use relatively little of it himself. Although the electricity that is not immediately used is fed into the grid and Seubert is paid for it, his longterm goal was to become independent of energy suppliers.

Positive Response

He thought it would be unprofitable for him to buy the batteries for storing the solarpower. "Experts advised me against it, because they still consider high-performance batteries to be too expensive for private households," he says. By chance, he found out about the Caterva project. "My colleagues at Siemens who are working on technologies for smart grids told me how batteries and smart technology could make me part of the energy supply system," says Seubert. After he registered to take part in the pilot project, Caterva installed its new ESS unit in his basement in the early summer of 2014. People like Andreas Seubert are the pioneers that Caterva needs in order to demonstrate the swarm concept's capabilities. The same applies to N-Ergie, which is involved in the pilot project. "We are working hard on ways to implement the energy transition," explains project manager Ingo Sigert from NErgie's Strategic Corporate Development unit. Sigert is convinced that energy supply companies will have to offer innovative solutions in order to survive on the market over the long term. That's why N-Ergie recently put a 70-meter hot water heat storage system into operation. The storage system, which is one of the tallest in Europe, is connected to a combined-cycle plant that has an integrated biomass heating station. One of the main issues that N-Ergie is addressing is how to solve the problem of energy storage and grid regulation in a network characterized by widely fluctuating amounts of electricity from renewable sources of energy. "We were immediately captivated when Caterva came to us and presented its swarm concept," explains Sigert. The two companies quickly agreed to form a partnership and also brought Friedrich Alexander University (FAU) in Erlangen on board. Scientists from the university will support the pilot project until 2017. "We can now gain experience for a time in the future when more and more electricity will be obtained from renewable energy sources," says Sigert.

Each project partner is responsible for specific tasks. N-Ergie contacts customers in its grid area who have relatively new solar panels installed on their roofs. "The response has been very positive. We quickly found more than 25 potential participants and expect to find the rest soon," says Sigert. Caterva is the contract partner for the participants. It supplies them with the system for the steel cabinet and connects it to the network. "Participants pay a single rental fee for this service. This fee amounts to around €4,000 during the pilot phase," Brehler explains. Households recoup this through the difference between the amount that they would have to pay for electricity from the grid in

Germany — currently about 27 Eurocents per kWh — and the amount that the use of their own electricity would cost them. This currently results in savings of 10 to 15 ct/kWh. Caterva can offer such favorable rental terms because of the income it gets from supplying primary controlling power to the transmission grid operator.

Swarm Coordination

N-Ergie, in turn, provides the overarching infrastructure. In the future, its control center will manage not only the company's power plants but also the Caterva project swarm. "One of its key tasks is coordination of the swarm," says Brehler. Mobile radio is used to transmit data from ESS units in participants' basements to the control center. As a result, N-Ergie knows the batteries' charge levels at all times.

At the same time, the ESS units "know" when the grid frequency fluctuates due to an imbalance between the supply and demand for electricity. This is the case, for example, when the distributed power producers generate too much electricity or when conventional producers such as power plants break down. In such situations, electricity has to be immediately fed into or taken out of the grid so that the difference between electricity production and consumption can be offset and grid frequency kept at 50 hertz. This is traditionally done by conventional power stations such as gas-fired power plants.

Since 2011 Germany has also allowed distributed energy producers to perform this task, provided they feed at least 1 megawatt of controlling power into the grid. In its system services roadmap for the year 2030, the German Energy Agency (dena) plans to have more and more distributed producers take over this task. But before that can happen, Germany will have to test and use new technologies such as those from Caterva. "We have to act now so that we will have solutions to keep the grid stable five years from now," says Brehler.

This pilot project, which was only recently launched, is just the beginning of a far-reaching development. N-Ergie is thinking of integrating owners of photovoltaic modules from all over Germany, because "the bigger the swarm, the bigger its contribution to grid stability," says Sigert. Germany is especially well suited for the implementation of the Caterva concept, whose slogan is "Mit der Sonne im Netz" (Into the grid with the sun). At approximately 1.1 million, Germany has far more owners of private photovoltaic modules than any other country in the world — a figure that highlights the potential opportunities for new business concepts associated with the energy transition. Markus Brehler is convinced of this as well. "We are now looking for infrastructure investors who are interested in business models for future energy concepts," he says. But that's still a long way off. For now, Seubert is satisfied that the system in his basement works reliably. "I hope that I will one day have enough energy for my household even if there is a widespread power outage," he says. "I would even be satisfied if I had enough energy to watch an important soccer game on TV." That should already be possible today.