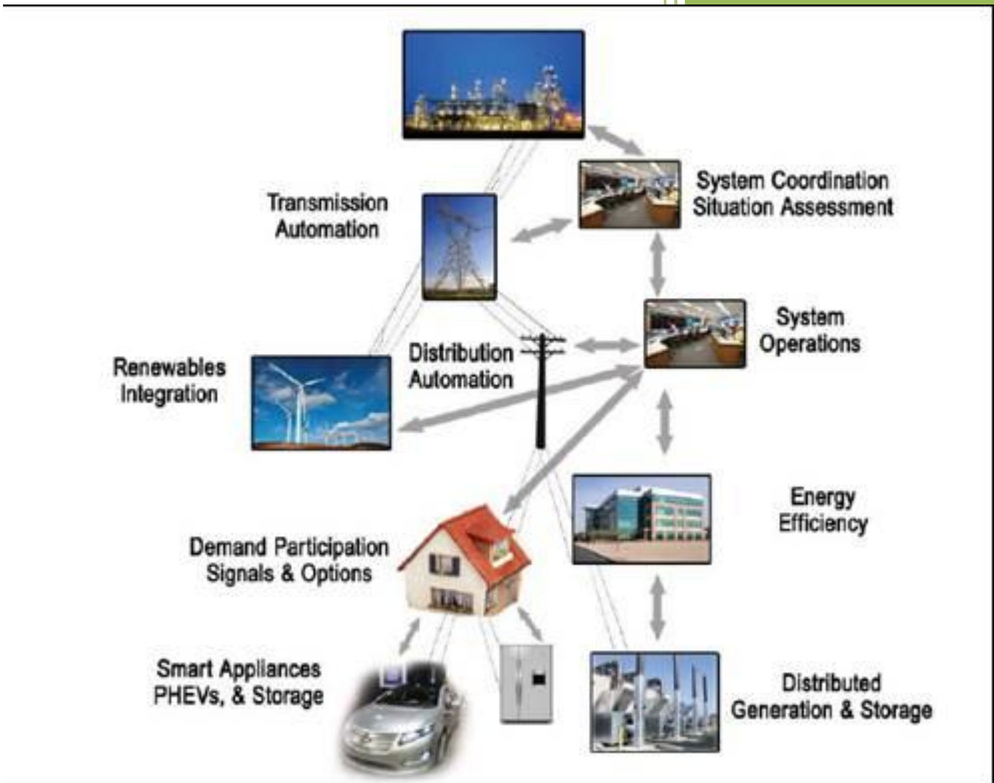
sustainable housing action partnership

2013

Practical opportunities in smart grids and energy demand management



SOURCE US DoE

SHAP TASK AND FINISH GROUP

CHAIR AND EDITOR - Matthew Rhodes

Encraft

10/21/2013

CONTROLLED COPY – 21 October 2013 – version SHAP/SG/1.1

We reserve the right to amend this document in the future without notic
this version. October 2013

Practical opportunities in smart grids and energy demand management
Facilitating investment to implement the Birmingham mini-Stern review

Executive Summary

This short report sets out what smart grids and energy demand management might mean for social landlords in the West Midlands. It summarises what smart grids are; the activities in this sector already underway led by members of SHAP and associated organisations; identifies future issues and opportunities for attracting investment and delivering member objectives, and suggests how these might be more effectively supported.

An effective approach to smart grids and energy demand management could address fuel poverty, generate almost £1 billion of revenue in the region over the next ten years, and support more than 1600 jobs. The nature of the opportunity, challenges and technologies mean that delivery activity and projects need to be focused and led locally (at LEP and local authority level and below). However, a small regional co-ordination and support group could add significant value in optimising use of scarce regional skills in this sector (e.g., by promoting appropriate collaborations); helping to attract investment funding; and sharing knowledge and best practice.

The report recommends SHAP establishes and supports such a group (e.g., with a secretariat).

1. Introduction

The purpose of this report is to inform social housing providers of the opportunities in the smart grid and energy demand management sectors and to outline the business case to LEPs for investment in smart grid infrastructure and technology. It has been prepared on a voluntary basis by a task and finish group convened by SHAP (see appendix I).

2. Why do smart grids and energy demand management matter?

Investment in smart grid infrastructure, associated technologies and business models is a proven and effective means to lift tenants out of fuel poverty, create local jobs, and improve the quality of public and community assets.

Over the past decade, social and public sector landlords have been at the forefront of the national drive towards energy efficiency because of their ability to access large numbers of buildings and customers cheaply and efficiently. This has resulted in £10bn+ of investment funding flowing into the sector (largely through ECO, CERT, CESP and EEC programmes). A similar logic is likely to attract substantial investment already beginning to flow into the smart grid sector. Smart grids and energy demand management are a growing focus of national energy policy and investment (as it relates to housing and buildings) and will create new opportunities for local economic benefits. Already there are commitments to invest more than £11bn nationally in smart meters by 2020, and the government are additionally sponsoring £100m a year in investment projects around smart grids from 2010-15. Once again, policymakers are likely to discover very quickly that social landlords and local authorities are by far the most effective and efficient routes to delivery, and once again there will be significant opportunities for attracting local investment in infrastructure and buildings. Unlike previous investments in energy efficiency programmes, smart grid investments also promise opportunities for financial returns (i.e., beyond those secured by occupant savings on fuel bills).

In contrast to renewable energy and energy efficiency measures such as solid walled insulation, much of the investment associated with smart grids and energy demand management will be invisible (e.g., small control units within domestic devices, changes to substations, new meters). However, this does not mean the area won’t be controversial and impact tenants significantly: there will be serious issues to address around data privacy as well as substantial opportunities to engage customers more actively in the energy system, generate revenue, direct asset investments efficiently and address skills gaps.

This means community groups, trusts, credit unions and locally-run energy services companies may all have roles to play in delivering smart grids effectively.

It’s also important to recognise that ‘smart grids’ are a means to an end, not an end in themselves. Well-implemented smart grids will enable more efficient deployment of energy efficiency measures and distributed energy, cheaper heat and power for everyone, more local control of energy systems, and a more resilient and reliable system all round. Ultimately, they are part of a fundamental shift in control of the energy system from centralised generators to individual customers.

3. What are smart grids and energy demand management?

The terms smart grid and energy demand management are not always used consistently. This is largely because they are defined by the benefits they deliver rather than the technologies and business models which make them possible (many of which are still developing).

The US Department of Energy defines smart grids by listing seven characteristics.

Power quality for the 21st century	**Asset optimisation and operational efficiency**
Self-healing networks	**Ability to integrate local generation and storage**
Resilience	**New markets and operations**
Customer participation	

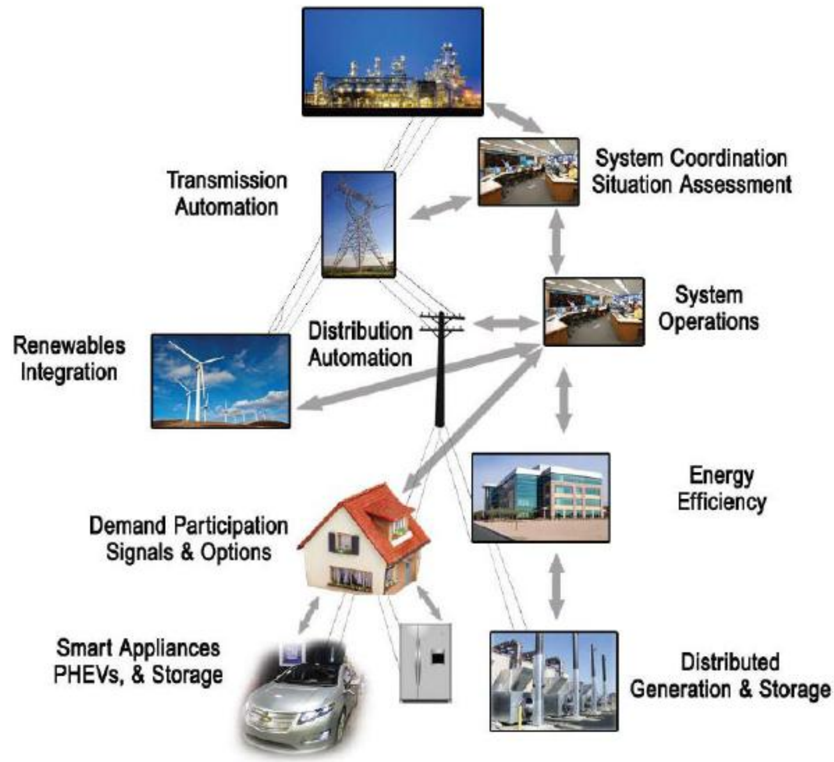
The characteristics coloured in blue in this table offer direct benefits to social landlords and local authorities in the UK. The green items are about reducing the costs of energy for everyone.

The following table starts from these characteristics to summarise how smart grids and energy demand management differ from the current energy system, and the opportunities this creates.

Characteristic	Today's system	Smart grids	Potential benefits for social landlords
Customer participation	Customers have very limited and poor quality information, making informed market participation difficult	Customers have real time demand information and can participate actively and equitably in the market	New revenue streams at both collective and individual tenant level. For example, the ability to sell power generated by solar panels to neighbours, or to sell willingness to reduce demand to the National Grid.
Ability to integrate local generation and storage	More expensive to add local generation than large and remote central plant.	Plug-and-play convenience creates a level playing field for distributed generation.	The value of buildings as energy generation assets increases. It costs less to install solar pv and microgeneration.
New markets and operations	Virtually closed markets, accessible only by a few large players (oligopoly)	Open competitive markets, with much wider participation.	Local authorities (especially) and social landlords have an intrinsic advantage in

Characteristic	Today's system	Smart grids	Potential benefits for social landlords
			these markets (because of their control over local infrastructure) and could generate significant revenues for their stakeholders.
Power quality for the 21st century	Emphasis on keeping the lights on and minimising blackouts. 'One size fits all' approach.	More variety in price/quality options – focus on quality where needed	Lower fuel bills and more choice (e.g., tariffs structured specifically for social tenants or for a specific area). New revenue streams at both collective and individual tenant level.
Asset optimisation and operational efficiency	Asset investment and operations management are distinct: limited data sharing	Access to meaningful operational data enables much more efficient investment decisions	Lower fuel bills.
Self-healing networks	Focus on protecting network after any fault – local blackouts	Automatic fault detection and prevention	Better service to customers, cheaper fuel
Resilience	Vulnerable to natural disasters and other malicious acts	Resilient and decentralised, like the internet	Better service to customers, cheaper fuel

These changes and benefits are enabled by a range of technologies working together, illustrated in this schematic.



Source: US DoE.

Most of the barriers to realising the benefits of these technologies are less technical and more about effectively integrating systems and overcoming non-technical barriers such as customer acceptance, market regulations, and perceptions of risk. There are likely to be substantial development and pilot project funding opportunities in the next 3-5 years for those willing to develop and trial ways of addressing these barriers.

The key technologies to make smart grids viable (and relevant at local level) are listed in the table below, along with associated roles and outstanding issues.

Technology	Examples and comments	Potential issues
Demand participation signals and options	This is a whole range of sensors, displays, IT, switches and metering equipment which allows homes and occupants to communicate and control their energy demand in real time, enabling more targeted pricing by suppliers and enabling customers to secure revenue from reducing demand.	The two key issues with these technologies are 1. Protocols and standards 2. Data privacy Without common (open) communications protocols it will be very hard to get costs down. Without customer confidence in data security and privacy, take up will be low – or

Technology	Examples and comments	Potential issues
		implementation costs high.
Smart appliances, petrol hybrids and electric vehicles (PHEVs) and local storage	Fridges which turn themselves off briefly and automatically to secure payments for reduced demand from electricity generators; (recycled) electric vehicle (EV) batteries which store and release power to avoid having to pay peak tariffs for electricity; new devices which take advantage of better information and more open markets for energy.	These are mass effect technologies, which can only generate value for individual households when deployed at mass scale with appropriate business models. Battery technologies in particular need to come down significantly in cost, and there are lifecycle issues with EV batteries which may prevent them being used for grid storage. This could easily become a 'chicken-and-egg' situation. (Only works at scale, but scale only happens if demonstrated singly). Social landlord-led pilots may provide the answer.
Distributed generation and storage	Solar pv systems; a community wind turbine; combined heat and power and district energy systems; local heat stores built into community buildings; onsite energy generation of any kind.	Generating and storing energy close to the point of use is often more economic and efficient than remote generation in principle, but requires more technical skills locally, an understanding that there are no one-size-fits-all answers; and adaptation of the electricity and heat distribution infrastructures to support penetration at scale.
Distribution automation	More flexible local heat and power networks are necessary to enable demand signals to be acted on and to allow greater levels of smart appliances and distributed generation. This area covers protection and control technologies typically found in local substations.	Substantial investment is required in these 'hidden' assets to enable many other smart grid technologies and business models to work. Early and meaningful engagement with network operators will be essential to project success.
Energy efficiency	Insulation, building controls, efficient lighting and appliances, efficient heating	The ability to understand, control and optimise energy use in buildings is fundamental to smart grids working

Technology	Examples and comments	Potential issues
	systems	effectively. One of the things a smart grid needs to know is how much energy demand there is at any time, and energy efficient buildings and devices make this possible and predictable.
Systems operations	These are national level issues. Adjustments need to be made at all levels to enable smart grids to deliver optimum economic and social benefits. For example, real-time tariffs in the domestic sector make smart grids much more attractive but will need regulatory intervention. Issues such as the right to switch suppliers can make investment in smart grids harder; national systems need to value the ability to turn off demand as much as (or even more than) the ability to provide additional supply.	
Renewables integration		
Transmission automation		
System co-ordination and assessment		

Customer participation is critical to meaningful smart grids and energy demand management, which is again why social landlords and local authorities can expect to find themselves on the front line.

4. Challenges

There are many unanswered questions around smart grids, creating opportunities for collaborative pilot projects and innovation. Because there is a global trend towards smart grids, underpinned by significant potential economic and social benefits worldwide and on-going technology cost reductions, a focused effort in the Midlands could create long-term competitive advantages for the region.

Examples of unanswered questions include:

- How to engage customers efficiently and effectively, in particular overcoming any fears about data privacy? (ENGAGEMENT)
- What changes in tariffs and regulations are needed to allow benefits to be realised? (REGULATION)
- How many houses/buildings need to be engaged to make aggregation economically viable, and can this scale be achieved by pepper-potting as well as by area-based schemes? (SCALE)
- What is the total economic potential for the Midlands?) (ECONOMIC CASE)
- What are realistic deployment paths and timescales for different technologies – are some critical enablers, without which all others cannot add value; will the concept work with all types of buildings, or only some? (TECHNOLOGY TRAJECTORIES AND SCOPE)

- What kind of organisation will make the best aggregator – is it a social landlord or local authority, an utility, a community enterprise, or a completely new kind of business? (ORGANISATION)
- What skills are needed locally to implement and benefit from smart grids? (CAPABILITY)
- How do these skills relate to existing capabilities? (SKILLS GAPS)
- How best to catalyse action across the West Midlands region? (DELIVERY)

5. How is the West Midlands positioned?

There are a number of current smart grid pilot projects and feasibility studies underway in the West Midlands, as well as considerable capability in the academic sector. The table below summarises known current initiatives.

Project	Lead and partners	Objectives and deliverables
Sustainable Retrofit and Smart Grids	**Accord (ERDF Funded)**	250 homes retrofitted and 50 home smart grid pilot with PV and demand management
Modern Infrastructure for New Housing	**Encraft (TSB Funded)** Warwick District Council	Feasibility study and business case for smart grid solutions on new developments of 1-2000 homes
Smart, Green Eastside	**E.ON** Amey, Siemens, IBM, Birmingham Science City	New business model demonstration (Energy Services/Energy Performance Contract). Currently on hold due to data issues.
Buildings Better Connected Feasibility Study	**Oswald (TSB Funded)**	Exploring business opportunities of buildings as energy stores
FlexDGrid	**Western Power Distribution** Parsons Brinkerhoff, University of Warwick	£17m project funded from Ofgem's Low Carbon Networks Fund which aims to make the electricity distribution networks in dense urban environments more resilient to the addition of distributed generation by increasing fault level tolerance.
TSB Future Cities (Bid)	Heat Genius Warwick University	Data collection platform for patterns and trends in heat use

In addition, there are smart grid research activities at Birmingham and Warwick Universities, co-ordinated through the Science City initiative. These include smart grid simulation and modelling and grid-scale energy storage (electricity and heat).

There are also district energy initiatives across the region, including in Coventry and Birmingham, and at Warwick University itself.[1]

6. What are the potential business models?

It isn't yet clear what the future landscape of organisations operating in the smart grid space will look like, although the utilities themselves recognise that this is likely to be very different from today's utility and energy management landscape. This is largely because realising value from smart grids will require much more localised control and management, either through very sophisticated ICT, or through motivated organisations and individuals locally.

Emerging roles in a smart grid future and potential business models include:

Role	Possible opportunities and business models
Information and data provider	Aggregators need to know the state of energy demand across their customer base, and be able to control this, in order to offer value to the national grid.
Demand aggregator	Organisations who can aggregate many customers' demand can create value by securing lower cost supply deals and (potentially more valuably) offering demand reduction capability to the national grid.
Energy storage provider	Energy storage could be provided by batteries, large thermal stores, buildings (thermal mass) or more imaginative options such as parked electric vehicles, fridges and freezers. Storage providers make life easier for demand aggregators and information providers because they make energy systems less sensitive to sudden changes and smooth out expensive peaks and troughs in supply and demand.
Building asset owner	Houses and non-domestic buildings are a form of energy storage as well as being major sources of energy demand and some asset owners are aggregators by default.

[1] District heating networks are a large topic worthy of a report in their own right. They overlap with smart grids and many of the same arguments apply, but for the purposes of this report we have simply treated them as one of many potentially relevant technologies.

Role	Possible opportunities and business models
Energy efficiency equipment supplier or installer	The benefits of on-site generation and energy efficiency measures could change significantly (controllable and predictable technologies will be worth a lot more) in a smart grid context. On-going maintenance and asset optimisation will be more important – this may be best achieved through energy services models and energy performance contracts.
Data standards and market regulator	This role can easily make or break this market. Common and open standards for metering and data communications will facilitate innovation and competition. Time-based tariffs accurately reflecting supply and demand conditions will make the value of smart grid and energy demand management technologies visible.

The minimum and optimal scale for viable business models remains a matter for debate. Economies of scale do not always apply in this sector (for example, above a certain size it becomes difficult to manage risk efficiently, and solutions need to be tailored to local areas and needs). This suggest that optimal projects and organisations may well be roughly commensurate with the scale of a local planning authority or social landlord. However, early indications and studies suggest that a minimum of 1000 houses is normally necessary for any kind of self-sustaining scheme to make sense, although modern IT means that for some technologies these properties need not be in the same area.

It should also be noted that business models for new build and existing housing are likely to be different. New housing offers greater and more economic opportunities to implement enabling infrastructure, while existing housing usually offers greater scope to generate revenue by saving on fuel bills and optimising existing assets.

7. How might the business case develop?

There are multiple potential benefit streams from smart grids which will potentially support business cases for social landlords and local authorities.

Potential benefit stream	Beneficiaries	Comment
Lower energy bills	Building occupants	Can be shared through ESCO/EPC[2] models
Payments for onsite or community generation	Owners of generation	Usually benefits building occupants, but can be third parties through 'free-pv' or similar models

[2] See glossary.

Potential benefit stream	Beneficiaries	Comment
Availability of demand reduction	Aggregator	Once aggregators can offer the ability to reduce demand by 10MW (i.e., ~2000 houses) for 30 mins, payments from the national market are available because national investment in new generation can be avoided.
Supply of demand reduction	Aggregator	If the national market actually uses the demand reduction capability offered by the aggregator, this should generate income equivalent to supplying the same level of generation.
Optimised investment and maintenance programmes	Asset owners	Better information available through smart meters and systems allows maintenance and capital investment to be managed more efficiently
Local social benefits	Communities	Reduced fuel poverty; better quality infrastructure and buildings; more engaged building occupants.
Environmental benefits	Society	A more efficient energy system will generate less greenhouse gas.
Local economic benefits	Communities and local businesses	Smart grids require skilled local installation, maintenance and operations organisations: rather than jobs and wealth being centralised in a small number of power stations they are distributed where the buildings and energy demand is concentrated. The Greater Birmingham Mini-Stern Review[3] estimated 1651 jobs could be created in the region.

[3] The Economics of Low Carbon Cities, A Mini-Stern Review for Birmingham and the Wider Urban Area (2012)

8. Conclusions and recommended next steps

It's clear from the review carried out by this group that:

1. There are substantial opportunities in smart grids and demand management for social landlords. For example, The Mini-Stern Review identified potential annual benefits for the region of just under £1 billion per year from investment of up to £3.4 billion by 2022.
2. Accessing these opportunities effectively will require broad technical and regulatory understanding combined with control of (or influence over) substantial asset bases.
3. The optimal scale of activity and schemes in the immediate future is likely to be at 1000 - 10,000+ house scale, with considerable diversity in business models and technologies as the sector evolves.
4. The region already has a diversity of 'small-but-beautiful' centres of excellence, expertise and enterprise in organisations like those represented on this group, covering the full spectrum from social landlords, local authorities, SMEs, universities and utilities. These have ambitious and diverse aims and developing projects, all of which should be encouraged.
5. Some degree of regional co-ordination is likely to be helpful, for example in engaging with the global corporations supplying the technologies associated with Smart Grids (e.g., IBM, Hitachi, E.ON) and also potential investors and funders (e.g., ETI, Green Investment Bank). Political support at LEP and regional level as well as local level is also fundamental to success.

Taking these conclusions together, we recommend the best way for SHAP to support members in this area would be to establish a small regional co-ordination and support group focused specifically on smart grids and demand management. This would enable specialist expertise to be shared across the region, and provide a focus for securing political, financial, and commercial support for projects.

Such a group would have the objective of maximising the benefits to members from the transition to smart grids over the next decade by:

- Promoting knowledge transfer between organisations and projects
- Encouraging collaborations to maximise the benefits from existing regional skills and expertise
- Assisting in engaging with investors, potential project funders and infrastructure providers (DNOs)
- Communicating issues and opportunities in the area
- Identifying and promoting good practice, including international exemplars
- Representing the interests of and acting as an advocate for smart grids and demand management at LEP level

Effective operation of such a group would require a small amount of funding for a secretariat and network management.

Development and delivery of projects in this sector is best carried out and led at local level (i.e., within individual LEPs, social landlords or local authorities).

Appendix I

Task group membership

Matthew Rhodes, Encraft (Chair)

Phil Beardmore, LWM
Keith Budden, E.ON
Rosemary Coyne, SHAP
Mark England, Accord
Sam Hardy, Warwick University
Paul Hutchens, Eco2Solar
David Jullien, Act on Energy
Susan Lee, Birmingham University
Alex Metcalfe, Warwick District Council
David Terry, Branta Consulting/AIMHIGH
Paul White, Accord
Alasdair Woodbridge, Heat Genius
Jeremy Woolley, Oswald Consultancy

Appendix II

Glossary of terms

CERT/CESP	Schemes which ran from 2006-2012 requiring energy utilities to fund subsidised insulation and energy efficiency projects on housing.
DNO	Distribution Network Operator – responsible for maintaining the local electricity grid (including substations, lower voltage distribution).
ECO	Energy Company Obligation – the current scheme requiring energy utilities to fund subsidised insulation and energy efficiency projects (previously called CERT and CESP)
EEC	Energy Efficiency Commitment – the predecessor to CERT, CESP and ECO (running from 1999-2006) with identical objectives and a virtually identical mechanism
EPC	Energy Performance Contract – when a supplier is incentivised to optimise energy costs rather than sell as much energy as possible
ERDF	European Regional Development Fund
ESCO	Energy Services Company – whose customers pay for energy services (often including use of assets such as boilers) rather than units of fuel
ETI	Energy Technologies Institute (joint UK government and major industrial partner investments in energy development projects, including smart systems and heat)
LEP	Local Enterprise Partnership
TSB	Technology Strategy Board (UK government funding for commercialisation of R&D)
SME	Small or Medium-sized Enterprise
US DoE	The US Department of Energy