Smart Cornwall

Evidence base report

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1 Executive summary

A smart infrastructure enables diverse devices and systems to share increasingly large amounts of real-time data and interact in 'smart' ways. A smart energy network is a system that *"can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both - in order to efficiently deliver sustainable, economic and secure electricity* [or wider energy] *supplies."*[1]

The global growth of smart infrastructure, technologies and services could have a profound impact on Cornish businesses and communities. While the global trends highlighted in this report will determine the overall market for smart energy networks and the pace of technology development, how Cornwall and the Isles of Scilly responds to this opportunity will influence the rate of local adoption by both communities and businesses and the level of economic, environmental and social benefit that can be captured locally.

In the field of energy generation and supply the application of smart technology will create the potential to better manage our energy generation network, increase energy efficiency, open new local energy markets (LEMs) and to develop new products and services which are reliant on real-time energy consumption data.

By setting out a strategic direction and governance system, the Smart Cornwall programme provides the opportunity for Cornwall and the Isles of Scilly to accelerate the adoption of smart technologies, attract investment and influence how deployment is organised, and thereby maximise the benefits. These could include:

- Developing a thriving smart energy cluster creating high value and innovative jobs in a market whose cumulative revenues from 2012-2020 are predicted to be $400-494 billion
- Enabling businesses and households to reduce costs through more efficient and intelligent use of energy, as well as the potential for revenue from shifting demand
- Localising energy spend through the development of LEMs. Cornwall and the Isles of Scilly spends over £1 billion per year on energy – by way of comparison, Gross Disposable Household Income totalled £7.9 billion in 2011[2]
- Supporting Cornwall and the Isles of Scilly's greenhouse gas emissions targets. In particular by overcoming severe grid capacity issues to enable greater renewable energy penetration
- Tackling social issues such as fuel poverty and technology take up.

[1] Electricity Networks Strategy Group (2009) A Smart Grid Vision.
[2] ONS regional data

1.1 Report outline

Regen SW and a team of industry experts were commissioned by Cornwall Council to assess the potential economic, social and environmental benefits of the Smart Cornwall programme in 2020 and 2030 and to quantify these where possible.

The objective of the report was to provide an evidence base to assist Cornwall and the Isles of Scilly in becoming an exemplar in the smart energy field.

The obvious challenge in this task was predicting the impact of a programme in securing benefits from a sector that is at an early stage, but developing rapidly.

The approach in this report has been to start by reviewing the global trends in smart energy and the related opportunities and lessons for Cornwall and the Isles of Scilly, which was based on a literature and policy review, an extensive case study of a representative town and discussions with stakeholders. These analyses are presented in detail in appendices.

We have then reviewed the strengths and challenges for Cornwall and the Isles of Scilly, drawing on discussions with stakeholders and evidence on the Cornish and Scillonian economy. Detailed work on the Cornish energy economy is drawn from our case study.

We used these findings to identify a number of 'building blocks' for a successful Smart Cornwall programme. The purpose was not to design the programme in detail, but to provide a scenario where the critical success factors had been put in place, on which to base our analysis of the impacts of the programme.

The final section sets out our quantitative and qualitative analysis of the impacts of the 2020 and 2030 scenarios. The detailed calculations and assumptions are provided in the appendices.

1.2 Key findings

The leadership Cornwall and the Isles of Scilly is providing in smart energy is attracting international interest. Whilst there are many pilot projects internationally, a locality with a clear vision, aligned stakeholders, access to funding and engaged local communities is unusual.

Multinational technology companies critical to this market are no longer interested in one-off test projects that do not have clear paths to commercialisation. To attract investment, Cornwall and the Isles of Scilly will need a long-term joined-up programme that aligns stakeholders and invests in key infrastructure, R&D capacity and skills.

With such a programme in place and partnerships with technology leaders being established, Cornwall and the Isles of Scilly have significant potential in its business base to build a thriving smart energy cluster. However, engagement with local businesses indicated awareness of the opportunities was still low. Business development activities will be critical to enable innovation and to support start-ups, diversification and expansion, exports and inward investment.

Our case study work suggests Cornwall and the Isles of Scilly have the opportunity to chart an innovative path in the development of smart energy through developing a new community-led energy economy. LEMs provide the opportunity to enable businesses and householders to use energy more intelligently and localise energy spend, building key social benefits into the heart of smart energy. Businesses could also see significant benefits to their bottom line from using smart energy technologies to reduce their energy bills and generate income from becoming a 'prosumer' or from selling balancing services. Kiwi Power estimate that medium sized enterprises could earn £20k a year and large enterprises £100k a year from selling demand response services.[3]

The community based approach also provides an opportunity to address perhaps the key risk to the development of smart energy – householders' concerns around data privacy. Our survey of householders provides evidence that through providing governance and enabling local communities and social enterprises to take the lead, Smart Cornwall could play a key role in increasing technology adoption.

1.3 Conclusions

The strengths

Cornwall and the Isles of Scilly have important strengths to enable them to deliver an ambitious Smart Cornwall programme:

- The strategic leadership and governance provided by the Councils and LEP and the establishment of the Smart Cornwall programme
- The availability of European funding to invest in key infrastructure and business development activities in order to leverage in private investment
- A significant business base in relevant areas, including ICT and renewables. Approximately 13 per cent of businesses (2,845 enterprises) in Cornwall and the Isles of Scilly, identified through an analysis of SIC codes, have the potential to move into the smart energy supply chain
- Strong relationships with global multinational companies
- Physical geography providing excellent renewable energy resources coupled with a constrained grid
- Developing community energy groups that provide an opportunity for a unique approach to the development of smart energy led by the needs of local communities.

The challenges

- Cornish and Scillonian businesses currently score low on measures of competitiveness and, therefore, may struggle to compete in a global smart energy market

[3] http://www.kiwipowered.com/

- Lack of multinational technology companies with a strong presence in Cornwall and the Isles of Scilly
- The 2015-2023 business plan for the grid operators (WPD) has little investment in smart networks
- Smart energy will not necessarily deliver social benefits and the use of household data may be met with a degree of suspicion by householders
- Communities will need support to develop LEMs and to maximise the local benefits.

The success factors

To deliver the potential benefits to Cornwall and the Isles of Scilly of smart energy, the Smart Cornwall programme will need to:

- Provide clear leadership, governance and a network of aligned stakeholders
- Invest in R&D capability and engagement between academics and businesses
- Attract significant deployment projects to provide focus for getting expertise and experience
- Deliver business development activities to enable innovation and to support start-ups, diversification and expansion, exports and inward investment
- Build international relationships, access to global markets and inward investment
- Support the roll out of LEMs across Cornwall and the Isles of Scilly
- Provide strong leadership and governance to address peoples' concerns over smart data use.

The impacts

If the Smart Cornwall programme can deliver these success factors, our analysis concludes it could achieve the following outcomes:

- A central estimate of over 2,000 jobs and £110 million GVA in 2020 and just under 7,000 jobs and £370 million in 2030 - a significant boost to Cornwall and the Isles of Scilly's economy
- A comparative, top-down analysis provided a range of jobs between 1,585 and 5,900 by 2020. The higher figure is based on the growth seen in the semiconductor industry, as a example of a successful business cluster in the UK
- These jobs would be weighted toward knowledge-based industries. We estimate 59 per cent of businesses working in smart energy would be in knowledge-based sectors compared to a current average figure of 11 per cent for Cornwall and the Isles of Scilly (on a like-for-like comparison)[4]
- The environmental benefits could be significant. We estimate CO_2e savings of around 70 k tonnes by 2020 and 680 k tonnes by 2030. This would be a 1.6 per cent drop against the Green Cornwall baseline for all greenhouse gas emissions

[4] Based on a SIC code analysis. See section 4.3 for further information.

- The programme could also play key role in enabling Cornwall and the Isles of Scilly to meet their renewable energy objectives
- In addition to the social benefits from increased jobs and reduced carbon emissions, other benefits could include:
  - 37 energy cooperatives with two members of staff by 2020
  - 10% of energy consumers engaged in LEMs by 2020; facilitating local ownership of generation and reduction in energy bills and fuel poverty
  - Up to £18 million (3.8 per cent) of energy spend localised through LEMs by 2020
  - Increase in health and well-being through adoption of smart health technologies
  - An increase in adoption rates of smart technologies by up to 40 per cent.

The table below summarises the additional impact the Smart Cornwall programme could have above a business as usual scenario if it can deliver the success factors set out in this report.

Impacts		**2020**	**2030**
Economic	Jobs	2,042	6,970
	GVA	£107m	£367m
	Knowledge jobs	1,204	4,067
	New enterprises	320	920
Environmental	CO_2e emission savings (tonnes)	70,220	680,462
	Renewable energy generation (% of consumption)	5%	45%
	Household electricity efficiency savings	1.1%	3.6%
	Business electricity efficiency savings	1.9%	5.7%
Social	Technology adoption (% of premises)	Up to 40%	Up to 40%
	Local energy cooperatives established	37	60
	Income from local ownership of renewable energy generation	£5m	£96m
	Spend localised from LEM	3.8%	22.9%

The key risks

In a world of uncertainty around policy and market developments there are a number of risks to achieving these impacts that will be important for Smart Cornwall to mitigate. The report identifies a number of risks ranging from technology risks to the changes in global markets and national policy. The key risks identified in the report include the risk that:

- Measures to support Cornish and Scillonian businesses may not be sufficient to equip them with the skills and expertise to capture high value jobs
- Social needs, such as fuel poverty, may not be built into smart energy deployment
- Widespread worry over data use, online security and privacy could slow down technology uptake

2 Introduction

2.1 What is Smart?

A smart infrastructure enables diverse devices and systems to share increasingly large amounts of real-time data and interact in 'smart' ways. An obvious analogy is the Internet, which was developed as a way of linking independent networks together and this linkage then enabled the web and other applications to be developed on top of it. In the same way, smart localities will come about through the deployment of a range of different systems and infrastructures that are able to share data and interact in beneficial ways to achieve useful outcomes.

Smart technologies are already here. Some technologies, such as smart phones, are well established and will continue to grow. For emerging smart technologies, we cannot be sure which ones will take off, but the direction of travel is clear. The extent that the internet has transformed so many aspects of life could not have been foreseen in the 1990's when it was just becoming established. The same is likely to be the case with smart technologies: there will be smart applications and technologies that may not yet have even reached concept stage, but which will become mainstream in the not too distant future.

Localities will become increasingly smart. The adoption of some technologies will be driven by market forces out of a locality's control, as has been the case for smart phones. For other technologies, including some smart energy technologies, there is an opportunity for proactive localities to influence both the rate of adoption and how they are adopted.

The challenges for Cornwall and the Isles of Scilly are how it can gain market leader advantage and shape how smart technologies are adopted, so as to help achieve the economic, environmental and social outcomes sought by the Smart Cornwall programme.

2.2 Smart energy

This report focuses on smart energy.

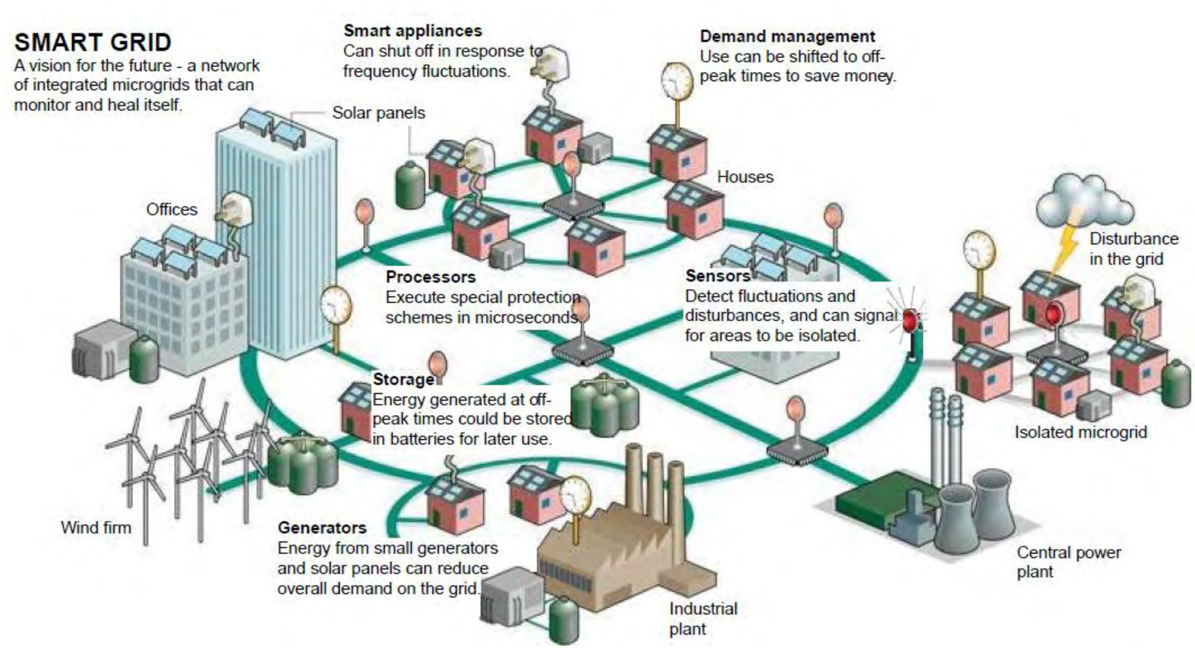
A smart energy network can be defined as a power system that *"can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both - in order to efficiently deliver sustainable, economic and secure electricity* [or wider energy] *supplies."*[5]

The World Energy Council conceptualise the smart energy network in the diagram below:[6]

[5] Electricity Networks Strategy Group (2009) A Smart Grid Vision.
[6] World Energy Council (2012) Smart grids: best practice fundamentals for a modern energy system.

Smart-grid power system

Source: Smart Grid 2030 Associates, *SG2030™ Smart Grid Portfolios*



Energy is at the heart of our economy and our daily lives and the impacts of a smarter approach are potentially enormous. For example, Korea's Smart Grid Institute argues:

"*Smart grid is a new paradigm for energy usage and distribution, with the capacity to create a totally new world*"[7]

A smart energy system will help Cornish and Scillonian **households and businesses**, on both an individual basis and working collectively as a community, to save money and generate income by providing the technical infrastructure and commercial arrangements for energy consumers to become proactive participants in a local energy market (LEM).

The technologies and services that enable and build on smarter approaches to energy are also creating a major new **supply chain** with opportunities to develop high value jobs, innovation and inward investment. Investment will take place in hardware, such as communication technologies, and software, such as data management systems. This economic opportunity maps well onto the Cornwall and Isles of Scilly LEP's priorities for an economy that supports businesses, develops value out of knowledge and preserves the natural environment.

[7] Korea Smart Grid Institute "Smart Grid: An Energy Revolution in Our Daily Lives".

2.3 Why Cornwall and the Isles of Scilly?

2.3.1 The Smart Cornwall programme

Cornwall and the Isles of Scilly Local Enterprise Partnership has set out a strategic vision and set of priorities to develop its competitiveness, most recently in the proposed EU Structural and Investment Fund Strategy.[8]

As part of this vision, Cornwall and the Isles of Scilly have developed an ambitious 'Smart Cornwall programme', whose aim is *"To develop the U.K's first fully integrated smart energy network, providing new high value jobs, creating wealth and opportunities for future generations and leading the way into a prosperous, resource efficient future."*[9]

Smart Cornwall aims to push Cornwall and the Isles of Scilly ahead in the smart energy race: by supporting local businesses to grow into this new market; by providing a test-bed and launch-pad into the European market for multinational companies; and by enabling local communities to become pioneers in smart LEMs.

The objectives for 2020 were set out in the Smart Cornwall consultation in February 2013 as:

Economic	• Have a globally recognised supply chain • Develop a new globally competitive smart engineering cluster • Have a highly competitive destination for inward investment • Develop sufficient knowledge and infrastructure capital • Continue to diversify and align their market offer into new 'Smart' growth sectors.
Technological	• Have a fully integrated, end-to-end solution within a centralised energy management architecture • Develop a single co-ordinated data centre • Have a pioneering technological support framework, including for R&D and deployment.
Social	• Have developed market and technology solutions that enable local energy supply and ownership arrangements • Reduce fuel poverty and facilitate uptake of technologies which improve health and well-being • Be a UK leader in enabling and delivering low carbon, low cost transport solutions • Have informed populations who are proactive participants in their energy economy.
Governance & policy	• Demonstrate that Cornwall and the Isles of Scilly lead in pioneering new regulatory frameworks, policy and standards.

Key to delivering the Smart Cornwall vision and desired outcomes is a set of guiding principles that all projects being delivered through the programme must meet. These are set out in full in Appendix 15 and ensure that projects contribute to:

- An integrated, open access smart energy network

[8] Cornwall Council, 2013, http://www.cornwall.gov.uk/default.aspx?page=4831
[9] Smart Cornwall programme 2020 Routemap consultation, February 2013.

- A growth engine for Cornwall and the Isles of scilly
- A new, community led energy economy.

2.3.2 Access to EU and other funding

Cornwall and the Isles of Scilly LEP plans to invest €593 million of EU Structural and Investment funding from 2014-2020, which is a unique resource. The draft strategy sets out how this will be used to: *"deliver sustainable growth through innovation, increasing our competitiveness and consolidating our existing assets, capitalising on opportunities for distinct competitive advantage presented by our natural and cultural resources."*[10]

2.3.3 Business environment

Cornwall and the Isles of Scilly have a business base with transferable skills and expertise in areas, such as information and communication technologies, engineering and technical consultancy, and renewable energy, that could diversify into smart energy technologies and services. Some businesses have already identified the opportunities in smart energy networks and are starting to develop smart technologies and services. For example, some renewable energy companies are investigating smart storage solutions to grid constraint issues. Opportunities to develop energy data analytics and software to better manage energy demand are also starting to be realised.

2.3.4 Physical and human geography

Cornwall and the Isles of Scilly have some of the best renewable energy resources in Europe, including wind, solar, marine and geothermal. Cornwall and the Isles of Scilly have already built or permitted sufficient renewable energy capacity to generate the equivalent of one quarter of its annual electricity consumption.

Cornwall and the Isles of Scilly's settlement geography is often described as a 'distributed city' with settlement spread across market towns, villages, rural settlements and islands. Each have their own identity but also share a strong Cornish identity, and multiple connections through commercial, leisure, and public sector activities and infrastructure.

2.3.5 Constrained grid

Cornwall and the Isles of Scilly's electricity network is already operating near to its limits due to high levels of renewable energy generation on the network. Therefore, there is a need for smart energy solutions if Cornwall and the Isles of Scilly are to achieve their potential for renewable energy.

[10] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013

2.3.6 Engaged communities

'Green Communities' are a core strand of the Cornwall Council Green Cornwall programme and local energy cooperatives have been established in a number of Cornish and Scillonian localities.

Positive engagement with consumers, businesses and institutions in a locality is key to deploying smart technologies and realising their benefits. The models for community engagement in energy being demonstrated in Cornwall and the Isles of Scilly are of significant interest to smart technology and service providers.

2.4 Report approach

Regen SW and team were commissioned by Cornwall Council to assess the potential economic, social and environmental benefits of the Smart Cornwall programme in 2020 and 2030 and quantify these where possible. It is intended that this Evidence Base Report will underpin the case for future investment planning for EU and national funding programmes.

The obvious challenge in this task is predicting the impact of a programme (that is still being developed) towards securing benefits from a sector that is at an early stage, but developing rapidly.

The approach we have taken is based on the steps set out below (more detail is set out in Appendix 2):

- **Section three** examines the smart energy opportunity by reviewing the literature, stakeholder views and a case study of a representative town. The aim is to understand the lessons for Cornwall and the Isles of Scilly on how it can shape the development of smart energy to help meet its economic, environmental and social objectives.
- **Section four** assesses how Cornwall and the Isles of Scilly are positioned to take advantage of the development of smart energy, looking at factors such as the business base, funding available and strategic leadership. The aim is to draw conclusions on areas of strength and how Smart Cornwall can target its efforts.
- **Section five** looks at the building blocks of a Smart Cornwall programme to maximise the opportunities and tackle the challenges of smart energy. The aim is to set out a scenario of the work of the programme on which we can base our analysis of the outcomes that Smart Cornwall could achieve. The development of a detailed Smart Cornwall programme is outside the scope of this report.
- **Section six** takes the scenario developed and provides a quantitative and qualitative analysis of key potential social, economic and environmental outcomes of the Smart Cornwall programme.
- **Section seven** draws together our conclusions.

We have aimed to keep the main report relatively short, given the complexity of the area. The detailed analysis and evidence is provided in fourteen supporting appendices which the reader can refer to.

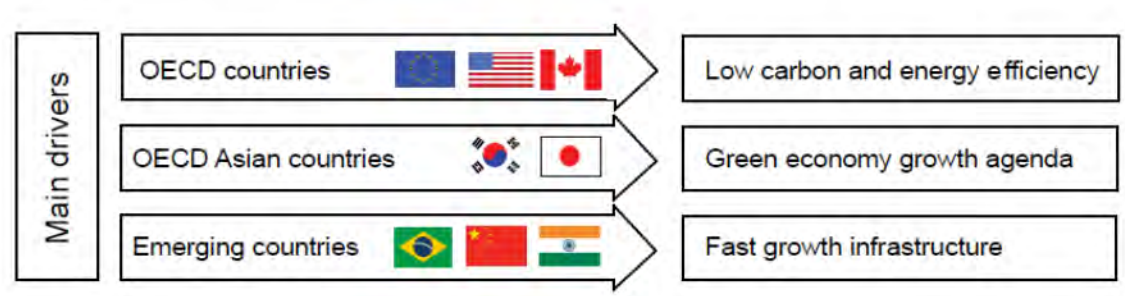
3 Opportunity review

This section draws on a literature review (Appendix 3), stakeholder views (Appendix 7) and case study of a representative market town, Wadebridge (Appendix 13) to assess the opportunities for Cornwall and the Isles of Scilly from the development of smart energy, as well as the lessons to be learned from other projects.

3.1 Economic opportunities

3.1.1 New market sector

In major economies, the development of smart energy is underpinned by investment programmes.. OECD countries tend to have ageing transmission and distribution networks needing incremental upgrading and integration of renewable generation. China, India and other rapidly emerging economies do not have such legacy 'dumb' grids and to cope with projected economic growth rates are expected to become big markets for smart applications to reduce capital investments. The drivers for growth have been summarised by the World Energy Council below:[11]



The integration of renewable energy is a particularly acute issue in Cornwall and the Isles of Scilly. Western Power Distribution (see Appendix 4) broadly characterise the grid as 'at capacity'. This is a major barrier to Cornwall and the Isles of Scilly's ambitious aspirations for the development of renewable energy.

This investment in smart energy is creating a major new market, already estimated to generate between $33 and $36 billion in global annual revenues. Recent market research reports estimate that global cumulative revenues will be $400-494 billion by 2020.

[11] World Energy Council (2012) Smart grids: best practice fundamentals for a modern energy system.

Author	Geographic scale	Cumulative revenue	Time scale	Annual compound growth rate	Technology included in market forecast
GTM Research	Global	$400 bn	2012-2020	8%	Smart grid technologies
Navigant Research	Global	$494 bn	2012-2020	10%	Smart grid technologies
Pike Research	Global	$420 bn	2012-2015	17%	Renewable energy production, storage and conversion
TSB	UK	£43 bn	2013-2023	30%	Building energy management systems

Predicted growth rates differ primarily due to what is included in the analysis. By way of comparison, the fastest growing sector worldwide in recent years is semiconductors which has a 20 year average rate of 13 per cent a year and in 2010 was worth about $304 billion in annual revenues. [12] There is a close analogy between the trend to put semiconductor chips in all sorts of devices and the deployment of smart technology.

Business opportunities for the UK supply chain 2012-2050 are forecast by Ernst & Young to be £1 billion per year by the mid 2020s.

The breakdown of the smart energy sector into sub-sectors, for example by Navigant Research, indicates that the businesses that have the potential to enter the smart energy supply chain are weighted towards the more innovative and knowledge based sectors of the economy. This is explored in more detail in section 4 on the Cornish and Scillonian business base. Jobs in the smart energy sector are, therefore, likely to be in line with a key priority set by the Cornwall and Isles of Scilly LEP "*to develop value from knowledge*" and the proposed European Structural and Investment Funding priorities, which include: "*innovation, research and technological development innovation*".

Implications for Cornwall and the Isles of Scilly

- The smart energy sector is large and is expected to grow rapidly: an opportunity for Cornwall.
- The presence of excellent renewable energy resources and the challenges of the grid in Cornwall and the Isles of Scilly provide a particularly clear value driver for smart energy and opportunities to take a leading role.
- The jobs created will be weighted towards high value and knowledge based sectors in line with the Cornwall and Isles of Scilly LEP strategy.

3.1.2 Developing a successful cluster

A number of countries have looked at this growing sector and concluded that smart energy is a key priority for economic development.

[12] http://en.wikipedia.org/wiki/Semiconductor_industry

These include, for example, Scotland[13] and Korea led by its Smart Grid Institute.[14] Scotland has set a target for 12,000 new jobs in Scotland and aims to secure a place for Scotland as an exemplar in smart grid adoption and as a leading international provider of smart grid technologies. Since launching the strategy, the University of Strathclyde has opened the Power Networks Demonstration Centre; a research and testing centre with the goal of "*accelerating the adoption of novel research and technologies into the electricity industry."*[15]

Evidence on the lessons of these projects for Cornwall and the Isles of Scilly is limited by the early stage of the market. However, test bed projects aimed to attract investment and build expertise are a common feature of all the examples we reviewed.

Evidence of what works in developing a successful cluster can also be drawn from other sectors. For example, a NESTA report on the semiconductor industry in the south west of England identifies two factors:[16]

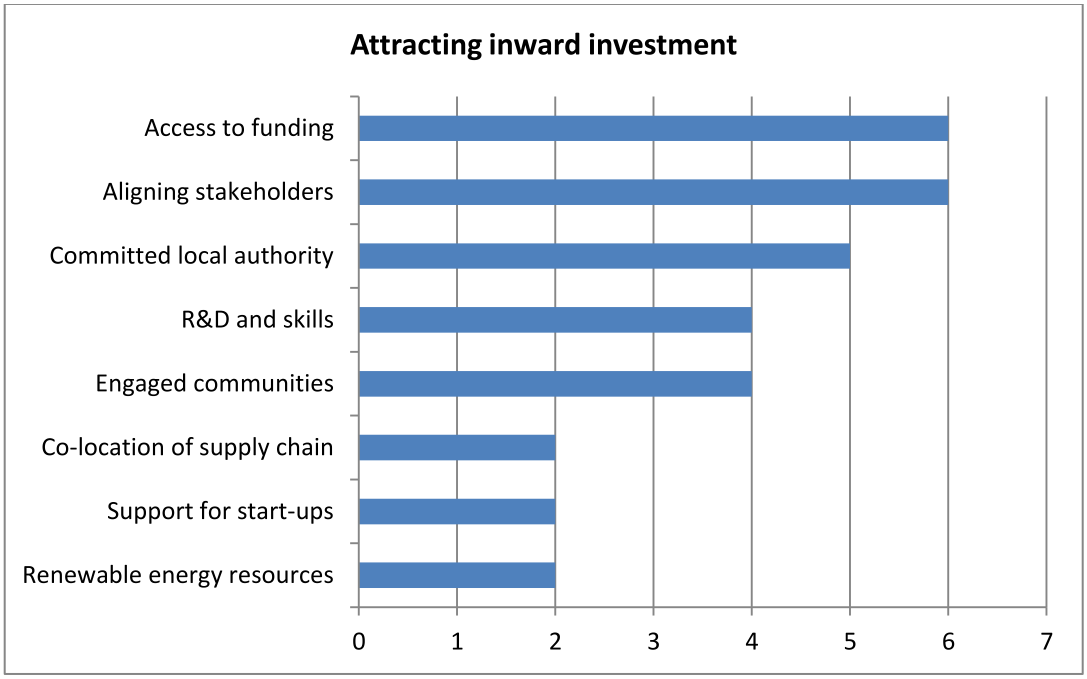
- First, investment in networks can help grow clusters by introducing customers and suppliers, providing mentoring and sharing resources
- Second, incubation models can work to promote the growth of new companies and highlight how universities can support these companies.

Ecotec's review of initiatives to develop a successful cluster for the Department of Trade and Industry concludes that the three 'critical success factors' are: [17]

1. The presence of functioning networks and partnerships
2. A strong innovation base, with supporting R&D activities where appropriate
3. The existence of a strong skills base.

To test the relevance for Cornwall and the Isles of Scilly of the conclusions of the literature, we asked multinational companies what would attract inward investment to Cornwall and the Isles of Scilly. The comments were consistent with the themes for the literature and are shown in the graph below:

[13] Scottish Enterprise. (2013). Scottish Smart Grid: Action Plan.
[14] Korea Smart Grid Institute "Smart Grid An Energy Revolution in Our Daily Lives".
[15] http://www.strath.ac.uk/pndc/
[16] NESTA. (2010). Chips with everything: Lessons for effective government support for clusters from the South West semiconductor industry.
17 Report by Ecotec for the Department of Trade and Industry. "A Practical Guide to Clustering" http://webarchive.nationalarchives.gov.uk/+/http://www.dti.gov.uk/clusters/ecotec-report/dti_clusters.pdf.



The ability to align stakeholders, such as the grid operator, regulators and engaged community groups, was cited as a key factor as businesses find this a costly process. This alignment can be facilitated by a committed local authority, which is likely to have a significant role in creating a network. The availability of funding was also cited as important.

One multinational company provided their list of considerations for investing in a new location, which is outlined in the box below:

Cornwall and the Isles of Scilly will be more attractive than other areas if there is:

- Range of stakeholders aligned e.g. council, regulators, government etc. This can be very costly and time consuming for businesses
- Willingness to progress and make things happen – e.g. in planning, regulations
- Replicability to other markets – within and beyond UK
- Resources – academia, skilled workforce etc.
- Political strength in Cornwall and the Isles of Scilly to influence national policy and draw in funding
- Reliable, highly secure telecom infrastructure – especially important for global companies
- Ability to both provide high salaries for relocating employees and provide value for money for outsourced activities (e.g. when in competition with S.America/China)
- High quality of life – "It has to be better than what you're used to" – schools, transport, connectivity, health and wellbeing, flexible ways of working
- Good ports for both air and shipping – especially important for manufacturing

- Co-location for supply chain– can minimise costs of logistics and can enable collaboration
- Strong brand to create confidence.

There is also evidence from the consultation Smart Cornwall carried out on its draft routemap. The analysis of the results (see Appendix 7) found that stakeholders valued leadership from the council and a 'locality model' that engaged communities and other key stakeholders.

Implications for Cornwall

- Evidence from multinational stakeholders and literature indicates that, to develop a thriving smart energy cluster, the critical success factors for Cornwall will be: strategic leadership and networks, access to funding, test bed demonstration projects, engaged communities, support for skills and incubation of new businesses, and an R&D programme that transfers knowledge between universities and businesses.

3.1.3 Reducing energy spend and income generation for 'prosumers'

A smart energy system has the potential to radically change the relationship of domestic and commercial consumers to their energy consumption. Smart energy systems may help homes and businesses reduce energy costs through:

- Home / business energy management systems optimising energy use
- Time of use pricing arrangements that reward consumers for matching their consumption patterns with supply.
- There is evidence that a joined up approach to demand reduction, demand management and distributed generation could maximise the impact of all three of these elements.[18]

Cornwall and the Isles of Scilly's energy spend is around 15 per cent of the total earned in salary incomes in the area (see Appendix 13). Reducing this spend would, therefore, have significant economic benefit. For example, the New York Smart Grid Consortium forecasts reductions in consumer energy bills, including business and households, of $10,730 million between 2011 and 2025 in the state of New York.[19] This saving is forecast to result from: market cost savings from peak savings; savings from reduced usage; price savings from lower usage; reduced losses; and gas conservation savings.

Businesses

There are opportunities from smart energy for businesses to reduce energy demand, earn revenue from adjusting their demand and generating energy, and reduce risks from power cuts.

[18] DECC (2013) Community Energy Call for Evidence
[19] NYS SmartGrid Consortium (2010) Smart Grid Roadmap for the State of New York

Demand reduction could come through enhanced take up of smart meters, smart applications, building-integrated smart technologies (e.g. energy management systems, smart appliances) and building-integrated renewable energy generation and storage.

There is also potential revenue to companies from adjusting their energy demand away from peak times. Already, companies can sell their ability to adjust demand to National Grid through aggregators such as Kiwi Power. Kiwi estimate that medium sized enterprises could earn £20k a year and large enterprises £100k a year from selling demand response services.[20] The Low Carbon London, LCNF project, is running demand response trials with industrial and commercial customers. It forecast contract payments to customers starting at £6,300 in 2015, rising to over £100k in 2050, based on a shift in peak demand of 8 per cent.[21]

At present, the total demand-side contribution is modest, with perhaps only 1-1.5 GW contracted in the market in some way.[22] However, new policies under the Electricity Market Reform could open up the market for demand response.

However, projects will need to be carefully designed and implemented to produce the expected benefits. The LCNF Customer-Led Network Revolution project found that initial interest from SMEs in time-of-day tariffs did not turn into actual take up and this was dropped from the project. There is an opportunity for Cornwall and the Isles of Scilly to take a strategic role in guiding smart energy projects to achieve the benefits it is targeting.

The ability to use energy more intelligently and efficiently also has benefits as a risk management strategy . A recent CBI business survey concluded that energy supplies are their top concern.[23] The ability to adjust patterns of energy demand could increase resilience.

Households

Ofgem carried out a study in the UK on the impact of different forms of energy use information on consumption patterns, and found that smart meters with a real-time display resulted in persistent savings of around 3 per cent.

Similarly, the Telegestore project in Italy estimates that, at national level, the introduction of time-based rates, made possible by the roll-out of smart meters, could reduce energy consumption by 5-10 per cent and shift 1 per cent of the energy demand to low peak load times.

It is notable that these estimates vary significantly, which points to the potential for Smart Cornwall to encourage households to adopt new technologies and services in order to maximise their benefits.

The case study of Wadebridge (see Appendix 13) looks at how engaging people in the energy economy through a local energy market (LEM) creates the potential for greater economic benefits. This is explored below.

[20] http://www.kiwipowered.com/
[21] EDF Energy Networks (2010) Low Carbon Networks Fund: Low Carbon London full submission proforma. Apendix A.
[22] Sustainability First (2012) What demand-side services can provide value to the electricity sector?
[23] www.businessgreen.com/bg/analysis/2294664/cbi-energy-blackouts-top-business-concerns

Implications for Cornwall and the Isles of Scilly

- Smart energy offers the potential for significant benefits for Cornish businesses and households from the more efficient and intelligent use of energy, as well as the potential for revenue from shifting demand.
- Businesses see power cuts as a significant risk. Local energy approaches have the potential to increase their resilience.
- There is a significant business support role that Smart Cornwall could provide in helping businesses to take advantage of this potential.

3.1.4 Local energy markets

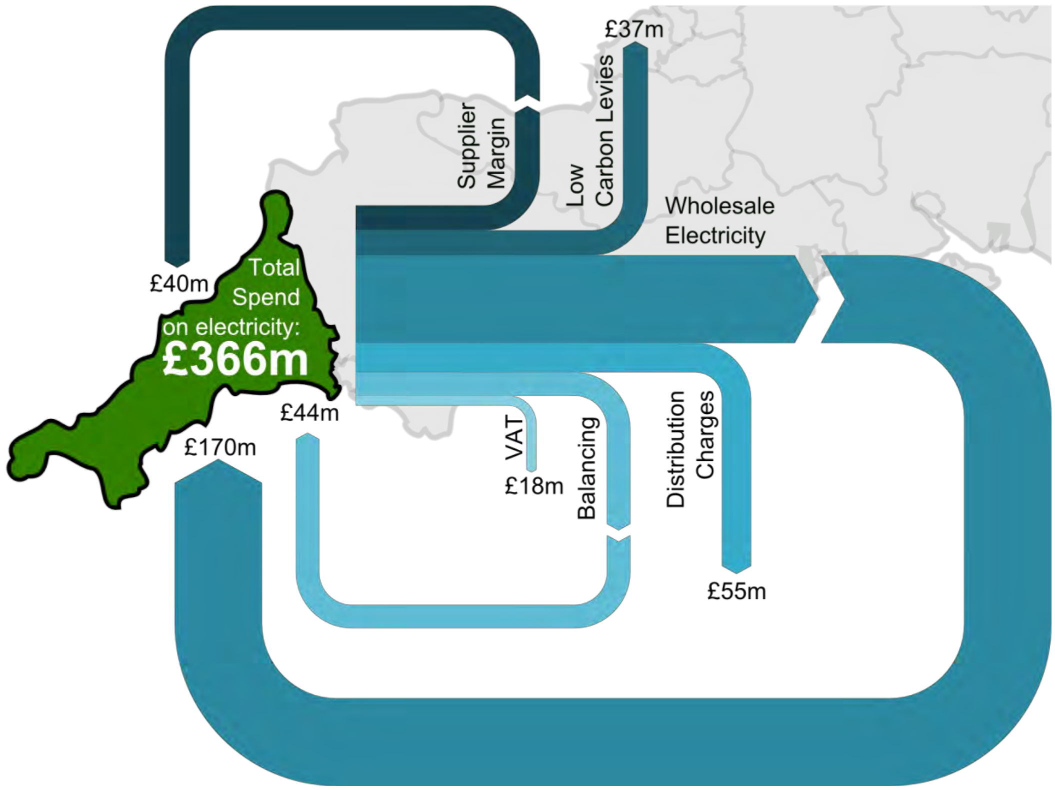
A local energy market (LEM) enables electricity consumers and producers within a local network to become active participants in trading their power demand and generation, and provides the market infrastructure for smarter management of the electricity network.

LEMs are not yet happening in the UK but the concept is gaining interest as the potential benefits are starting to be recognised. These benefits include reducing flows to and from the distribution network, enabling greater penetration of renewables and providing financial benefits to households and businesses that match local demand to local supply.

The potential economic value of a LEM is created by the components of electricity spend that could be reduced and localised. These are:

- Localisation and possible reduction in wholesale electricity cost, if purchased from locally owned generation
- Localisation of supplier costs
- Localisation of balancing costs
- Reduction of transmission costs.

These components make up around 70 per cent of electricity spend. The potential value for Cornwall and the Isles of Scilly is illustrated in the diagram below.



The LEMMA study (Local Energy Markets Modelling and Analysis), funded by the Technology Strategy Board, demonstrated the technical and economic feasibility of trading between households, in real time, at prices set bilaterally between trading partners.[24] The study concluded that while new software and hardware would need to be developed, there was no requirement for anything that was not well within the bounds of modern ICT practice and existing data networks. It also concluded that the local economic benefit could be significant, with potential savings to consumer bills to be 10 per cent with storage (5 per cent without) and producer revenue to increase by 58 per cent (17 per cent without storage).[25] With regards to the regulatory requirements, the LEMMA Project states:

> *"While current UK regulations allow for unlicensed suppliers of electricity below 5 MW (well outside the anticipated power envelope of most LEMs), there will need to be changes in the regulatory framework to ensure that LEM supply arrangements may coexist with current supply arrangements, in ways that meet the needs of traditional suppliers, LEM participants and traditional consumers."*[26]

The concept and opportunities of a LEM is explored in the Wadebridge case study (see Appendix 13).The key factors identified in the case study to enable a LEM to succeed include:

[24] LEMMA Project (2013) Local Energy Markets
[25] Information provided by Swanbarton – partner in the LEMMA study
[26] LEMMA Project (2013) Local Energy Markets

- An electricity supply company (such as a Cornwall Electricity Supply Company) could provide back office functions, such as trading power between local generators and consumers, billing services and regulatory compliance functions
- Commercial arrangements that enable the management (curtailment, scheduling and control) of both consumption and generation and provide the commercial incentives to participate
- Sufficient generation to meet a substantial share of the electricity needs of a locality that is willing to participate in the LEM. Benefits will be maximised if this generation is locally owned
- Smart metering at consumer level and at each level of the network; demand response and load switching; storage at building and community scale; and control systems and software
- A smart distribution network that enables the operation of the distributed resources (generation, storage, demand response and metering and control systems) that are required to enable the LEM to operate
- An engaged community
- Strategic direction and governance to ensure the LEM operates for local benefit.

Implications for Cornwall and the Isles of Scilly

- The development of LEMs, enabled by smart technologies, has the potential to enable the localisation of energy spend, bringing significant economic benefits to Cornwall and the Isles of Scilly.
- LEMs will require strategic support to develop in a way that benefits Cornwall and the Isles of Scilly. There may be a need to work with national government and regulators to ensure that the regulatory framework supports LEM supply arrangements.

3.1.5 Transport and retail

The opportunities for smart transport and retail are reviewed in the Wadebridge case study (Appendix 13). Applications for smart transport include:

- Real time and predictive traffic modelling and management
- Parking availability and signposting
- Tracking of buses and real-time information
- Generating traffic condition information e.g. by tracking the movement of mobile phone users
- Embedded sensing in major roads
- Cashless payments
- Development of smart, driverless cars.

Retailing and hospitality services have already been transformed by web technology and will continue to evolve rapidly. By combining location data with personal data, businesses may be able to get a picture of the numbers of people visiting and their personal preferences (e.g. the sort of food and recreational activities they like). This could enable smart signposting of businesses to visitors and enable businesses to tailor their offerings more rapidly and more closely to the visitor profile.

Implications for Cornwall and the Isles of Scilly

- Whilst this report focuses on smart energy, alongside this there is significant potential for smart approaches to other services such as transport and retail to deliver economic benefits.

3.2 Environmental opportunities

The Green Cornwall programme has set out ambitious goals to reduce greenhouse gas emissions by 34 percent by 2020 and increase renewable energy generation to 15 percent by 2020.

Energy use is, of course, a key factor in carbon emissions. Smart energy networks can reduce carbon emissions in the following ways:

- Improved opportunity to optimise energy consumption behaviour
- Greater penetration of renewables
- Increased capability to support the integration of electric vehicles (EVs) and the electrification of heat.
- Reduced use of inefficient generation to meet system peaks
- More efficient operation of the grid and reduction in system losses.

3.2.1 Demand reduction

Evidence of opportunities for reducing demand are set out in Section 3.1.3 and are not, therefore, repeated here.

3.2.2 Electric vehicles

Cornwall Council has recently gained funding to install 39 EV charging stations across the county and the council already has six EVs in a trial. Forecasts for the uptake of EVs [27] vary from 1 per cent to 10 per cent of cars in the UK by 2020. The Committee on Climate Change (CCC) recommended aiming for 1.7m EVs in the UK by 2020. Navigant Research has forecast that there will be 4.7m EVs, including hybrids, in Europe by 2020.

[27] HoP PostNote Electric Vehicles 2010

3.2.3 Renewable penetration

In the context of Cornwall and the Isles of Scilly, where the grid is described by Western Power Distribution as 'at capacity' but there are excellent renewable energy resources, the potential of smart energy to enable distributed generation could be particularly environmentally significant.

The Inovgrid project in Portugal is testing a new grid architecture in an urban area of about 32,000 customers. The project is expected to increase the capability to integrate renewables into the grid by 10-50 per cent through enhanced planning and by 50-100 per cent through active asset management, and to increase the integration of electric vehicles into the grid by 50 per cent through active network and charging management.

WPD, the grid operator in Cornwall and the Isles of Scilly, is already trialling projects to enable distributed generation. WPD's LCNF funded Dynamic Line Rating (DLR) trial project in the Skegness Regional Power Zone has trialled a system that utilises the link between increased output from wind farms on windy days and increased overhead line capacity on windy days as a result of passive cooling, to temporarily increase line ratings. This smart management of the network and a more flexible approach to setting the limits of network assets allows WPD to accept greater generation without significantly increasing network hardware.

WPD has been attracted to develop pilot projects in Cornwall and the Isles of Scilly, such as the Clean Energy Balance project proposed for LCNF funding, by the potential to engage strategically with Smart Cornwall and engaged communities. There is potential to continue to develop pilot projects and influence their design with WPD.

Implications for Cornwall and the Isles of Scilly

- Smart energy networks could play a significant role in meeting Cornwall's greenhouse gas emissions targets.
- By providing strategic leadership and direction, Cornwall has the opportunity to influence smart energy projects to deliver the benefits it is targeting.
- There is particular opportunity in Cornwall and the Isles of Scilly, given the renewable energy resources and grid capacity issues, for smart energy to enable greater renewable energy penetration.

3.3 Social opportunities and considerations

Successful adoption of smart energy technologies can bring direct benefits to households and communities. These include:

- Reduced energy costs through better control of energy demand enabled by smart energy technologies and services, such as home energy management systems, dynamic demand, time of use tariffs, trading in a LEM etc. A reduction in costs can result in a reduction in fuel poverty and therefore, improved health and wellbeing

- Opportunity to become 'prosumers' and generate income from trading energy in a LEM
- Improved service from energy suppliers, including greater reliability, reduced risk of blackouts, accurate billing and choice of tariffs
- Reduced carbon emissions and related improvement in air quality, particularly from a reduction in fossil fueled cars and greater use of electric vehicles, which can result in improvements in health and respiratory problems
- Opportunities for new jobs, training and to grow the local economy.

However, these benefits will not be realised without successful adoption of new technologies and services. The Global Smart Grid Federation Report 2012[28] argues:

> *"The most difficult challenge to a successful smart grid lies in winning consumer support. Without it, the smart grid cannot exist and it cannot deliver its promised benefits. Ultimately, the consumer is paying for the smart grid. The smart grid does yield important benefits for consumers, but they come at a significant cost and, at the individual level, the need for these benefits may feel less immediate."*
>
> *"The government is best positioned to educate consumers on the value of the smart grid. The smart grid is really part of government strategy to achieve societal goals. The electricity sector is highly regulated by government. The government has the resources and skills needed to mount large scale smart grid messaging campaigns. It is also the best advocate for citizens on consumer-oriented issues such as affordability, privacy, cyber-security, health and safety."*

The report examines these issues in detail in the case study of Wadebridge (see Appendix 13).

This issue of trust is important. Researchers have identified that governments or community groups are likely to be more trusted when promoting smart applications than energy companies. This research is also backed up by the experience in Wadebridge of WREN (a local energy cooperative), where successful community engagement has led to faster uptake and greater community acceptance of insulation programs and renewable technology than those promoted directly by energy companies.[29]

The current views of Cornish householders are explored in the Smart Technology Futures Survey of over 100 people carried out in Wadebridge (see Appendix 14). This showed a willingness to participate in smart data use where it has benefits, but a greater trust in a local not-for-profit rather than large energy company potentially exercising a degree of control over appliances in their home.

The survey also showed that the level of engagement in energy is still generally low, as is willingness (and/or ability to invest in energy generation and energy efficiency). To achieve the level of smart

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[28] Global Smart Grid Federation, *The Global Smart Grid Federation Report 2012*.
[29] To date, WREN has directly initiated over 130 renewables installations and 120 insulation measures, amounting to measures in approximately 6.6% of households in Wadebridge. This compares to an average of 1.7% of households receiving measures from a random selection of six energy supplier-led schemes (British Gas in Walsall; EDF in Bristol and London; E.On in Leicester and Isle of Wight; and Scottish Power in Hampshire)

energy technology adoption required will require sustained and imaginative public awareness and education campaigns, as well as technology deployment models that do not require the consumer to invest capital.

A LEM that is set up for the benefit of the local community and not for shareholders is likely to have greater success at engaging local households and businesses; helping them understand the potential benefits of using smart technologies and services and how to maximise those benefits, the opportunities to become prosumers and to trade their excess supply, and the benefits of buying their power from a local provider that is committed to investing in their local community.

Implications for Cornwall and the Isles of Scilly

- People need assurance that data privacy, security, and system resilience are built in from the outset, and safeguarded.
- Locations where businesses are able to engage effectively with consumers will have an advantage in attracting inward investment and stimulating innovation.
- The local councils have a key role to play in shaping the social implications of smart energy.

3.4 Policy

The policy framework is a key factor in understanding the opportunities from smart energy. A detailed review is set out in Appendix 5.

The European Commission is starting to drive smart energy policy across Europe. Proposals have been put forward to establish a regulatory framework to provide incentives for smart grid deployment, including requirements on Member States to produce action plans with targets for the implementation of smart grids.[30]

At a national level, DECC has responded by setting out a detailed implementation plan to ensure that every home in Great Britain has smart electricity and gas meters and smaller business and public sector premises have smart or advanced metering by 2020.[31] But, there is arguably a bit of a vacuum with regard to a strategy for smart grid deployment.

Stakeholder engagement with multinational companies found that the leadership of the local council was a key factor in attracting inward investment. This may reflect the fact that national policy is still evolving and long-term commitment to supporting growth in the smart energy sector at a local level goes some way in filling this gap.

This provides an opportunity for Cornwall and the Isles of Scilly to set out its own framework for smart energy through the Smart Cornwall programme. This could provide certainty and clarity for businesses, both local and outside of the area, to invest and could give Cornwall and the Isles of Scilly a competitive advantage over other areas in the UK.

[30] European Commission (2011) Smart Grids: from innovation to deployment (COM/2011/202)
[31] DECC (2012) Smart Metering Implementation Programme

Development of the smart energy sector fits well with Cornwall and the Isles of Scilly's existing aims and objectives, as well as those required through EU funding. There is already strong support in Cornwall and the Isles of Scilly for innovation, entrepreneurship and for growing sectors with environmental benefits. The Smart Cornwall programme could help drive achievement of these wider aims and objectives.

The four priorities set out in the Cornwall and Isles of Scilly LEP Strategy are:[32]

1. Inspiring businesses to achieve their national and global potential
2. Creating great careers here
3. Creating value out of knowledge
4. Using natural environment responsibly as a key economic asset.

Cornwall Council's vision is that *'Cornwall in 2030 will be an industry leader in environmental technologies (land and marine) and at the centre of a global network of businesses. It will combine internationally recognised research with skills in environmental technologies across the workforce.'*[33]

Cornwall Council's Economy and Culture Strategy expands on its goal to grow the low carbon economy by stating the following aims to:

- Promote Cornwall as a 'green' exemplar region
- Develop the commercial potential of cutting edge, renewable energy and environmental technologies
- Promote low carbon as a business growth catalyst
- Energy efficiency for business and communities
- Deliver the economic potential of a decentralised LEM.

These commitments and goals map well with Smart Cornwall's ambition to be an industry leader in smart energy networks; to have a globally recognised supply chain; and to have a pioneering technological support framework. Therefore the Smart Cornwall programme could help drive local policy in this area.

Developing the smart energy sector also fits well with European Structural and Investment Funding priorities, as it is a developing sector with significant potential for start-ups and existing SMEs to expand into the area; for innovation; skills development; employment; and to grow the low carbon economy.

[32] Cornwall and the Isles of Scilly Local Enterprise Partnership (2012) The natural place ot grow great business: Economic growth strategy for Cornwall and the Isles of Scilly 2012-2020
[33] Cornwall Council (2010) Future Cornwall. http://www.futurecornwall.org.uk/

The LEP's European Structural and Investment Funding Strategy provides a clear plan on how it will invest in growth sectors. There is a close fit between the priorities of the plan and the smart energy opportunity.

Implications for Cornwall and the Isles of Scilly
• The gaps in the policy framework provide an opportunity for the local councils and Local Enterprise Partnership to provide a clear long-term commitment to supporting the smart energy sector and the strategic context for business to operate in.

4 Cornwall and the Isles of Scilly strengths and challenges

This section assesses how Cornwall and the Isles of Scilly are positioned to take advantage of the development of smart energy based on detailed evidence set out in the appendices on policy (Appendix 5), literature review (Appendix 3), stakeholder engagement (Appendix 7), Cornish and Scillonian baseline (Appendix 8), and Wadebridge case study (Appendix 13). The following section draws conclusions on areas of strength and how Smart Cornwall could target its efforts.

4.1 Strategic leadership and alignment

The evidence from our Opportunity Review is that strategic leadership and alignment of stakeholders is a key factor in the ability of Cornwall and the Isles of Scilly to gain benefits from smart energy.

Cornwall and the Isles of Scilly are well placed to provide this leadership. Our policy review shows Cornwall Council's Economy and Culture Strategy sets clear goals to grow the low carbon economy, and the LEP draft European Structural and Investment Fund Strategy sets out key priorities for the economy and growth with a strong focus on 'green' growth.

Underneath this strategic framework, the establishment of the Smart Cornwall programme is considered by stakeholders to be an important strength. This leadership is particularly significant given the national framework for smart energy is, arguably, still lacking.

The Smart Cornwall programme has already built relationships and aligned key stakeholders, including local and international businesses, local communities, WPD and academics. For example, the Chair of Smart Grid UK identified Cornwall and the Isles of Scilly as one of two or three areas in the UK seen by stakeholders as having the commitment from the local authority and the LEP to be leaders in this area.

The level of engagement and alignment is illustrated by the impressive array of companies signed up to work with Smart Cornwall to design the delivery programme.

An agreed smart energy strategy with top level commitment and funding was seen by stakeholders as the next step to develop Cornwall and the Isles of Scilly's position.

Industry has shown its commitment to helping Smart Cornwall develop its programme of activity by offering its time free of charge to sit on the Technical Design Authority. The following companies are members of the TDA:

Implications for Cornwall and the Isles of Scilly

- Strategic leadership and stakeholder alignment is a key strength for Cornwall.
- Local priorities in the proposed EU SIF Plan strategy map well on to the opportunity provided by smart energy.
- The next step to build on this strength is a smart energy strategy with high level commitment and funding.

4.2 EU funding

Alongside strategic leadership, the ability to deploy significant funding is seen by stakeholders as a key factor to develop smart energy.

Multinationals identified this as joint top factor in their inward investment decisions, and local companies saw the support that funding could enable as key for them to diversify into the sector.

There was some concern expressed that funding might be short term leading to a small number of projects before multinationals followed the next funding opportunity elsewhere. The focus needs to be sustained and focused on deployment at scale.

The Cornwall and the Isles of Scilly LEP is likely to receive €593 million of European Structural and Investment funding between 2014-2020 to invest in development projects and programmes.[34]

[34] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013

This provides an ability to invest in key infrastructure and projects. Previous EU investments to improve productivity include:

- infrastructure advances including Wave Hub, road and rail and Superfast Broadband.
- investments in world class research facilities, such as the Environment and Sustainability Institute and European Centre for Environment and Human Health

The draft European Structural and Investment Strategy notes "*there is evidence of success in the shape of high quality HE and research facilities, award-winning innovation centres and bespoke workspace*".[35]

Detailed evidence of the impact of EU funded programmes and projects is drawn upon in section 6 of this report to assess the impacts Smart Cornwall could have.

Implications for Cornwall and the Isles of Scilly

- Access to significant structural and investment funding is a key strength for Cornwall and the Isles of Scilly, and could provide support in areas such as R&D and commercialisation of products and services
- Investment needs to be sustained over a number of years and focused on moving from pilots to deployment at scale.
- When designing detailed programmes, there is good evidence of the success of individual EU funded projects and initiatives to draw upon.

4.3 Business base

4.3.1 Supply chain potential analysis

Our assessment is that there are 2,845 enterprises in Cornwall and the Isles of Scilly undertaking activities relevant to smart energy development or deployment. This is 13 per cent from a total of 21,105 enterprises listed as active (as of 2012) in Cornwall and the Isles of Scilly (a detailed analysis of the supply chain potential is set out in Appendix 8).

This analysis, based on the Standard Industrial Classification of Economic Activities (SIC) codes, indicates the most important sectors in terms of size and scale of opportunity are software development/programming and renewable energy and storage. There is also potential for the less knowledge-intensive businesses, for example through installation of meters and other technologies.

SIC codes have limitations as a tool. We also, therefore, reviewed a recent report on the Cornwall ICT Digital sector, which found it comprises of 1,035 businesses and employs 5,100 people, 42 per cent of these businesses are involved in software activities. The sector accounts for 4.6 per cent of all Cornwall

[35] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013

and the Isles of Scilly businesses, and evidence indicates that the sector is growing.[36] This is an obvious area where support could be targeted.

Renewable energy is under represented in the SIC codes. Regen and MCS data suggest the number of businesses is around 100 rather than 20, and several companies we spoke to noted they are already diversifying into smart energy. For example, some renewable energy companies are investigating smart storage solutions to grid constraint issues.

Manufacturing of smart energy technologies is a large area in terms of scale of opportunity. For example, our literature review found manufacturing jobs have represented at least 50 per cent of total smart grid employment in the Bay Area of California. Looking at other sectors, the example of the tidal energy sector in Bristol shows that a couple of successes in developing manufacturing in a new sector can have a major impact. SIC codes suggest the relevant manufacturing base in Cornwall and the Isles of Scilly is about 90 companies, a significant but limited base. Our interview with a manufacturing organisation suggests a low level of awareness in this sector of smart energy. Whilst on the basis of this evidence, manufacturing would not be a top priority sector, the potential benefits indicate that looking for manufacturing opportunities should be part of a strategy of developing Cornish and Scillonian businesses in smart energy.

There is currently no large technology manufacturing company with a significant base in Cornwall or the Isles of Scilly. This indicates the importance of the global partnerships Smart Cornwall has been developing.

The table below maps the 2,845 enterprises against an element of smart energy development or deployment. It is important to note that this analysis has its limitations and does not necessarily present an accurate picture of the existing business base and their potential to move into the smart energy supply chain.

[36] Adroit Economics (2012) Research into the Cornwall ICT Digital Sector to support future business growth.

Smart energy sector segment	No. of enterprises
Manufacturing – Electrical	55
Manufacturing – Mechanical	35
Engineering and design	330
Software development / programming (system integration)	450
Consultancy	460
Professional support, including environmental consultancy	205
Data processing	15
Data entry	0
Repair of equipment	50
Testing	25
Installation services	435
Finance and legal	355
Research and Development	0
Energy Efficiency and renewable energy applications	20
Electric vehicles	265
Development of storage technologies	0
Retail	145
Development of secondary consumer devices	30
Total number of enterprises	**2845**

We used the SIC code analysis and stakeholder engagement findings to estimate the number of businesses and full-time equivalent (FTE) employees there were currently working directly on smart energy networks to be approximately 48 businesses and 24 FTE employees (see Appendix 8 for further information).

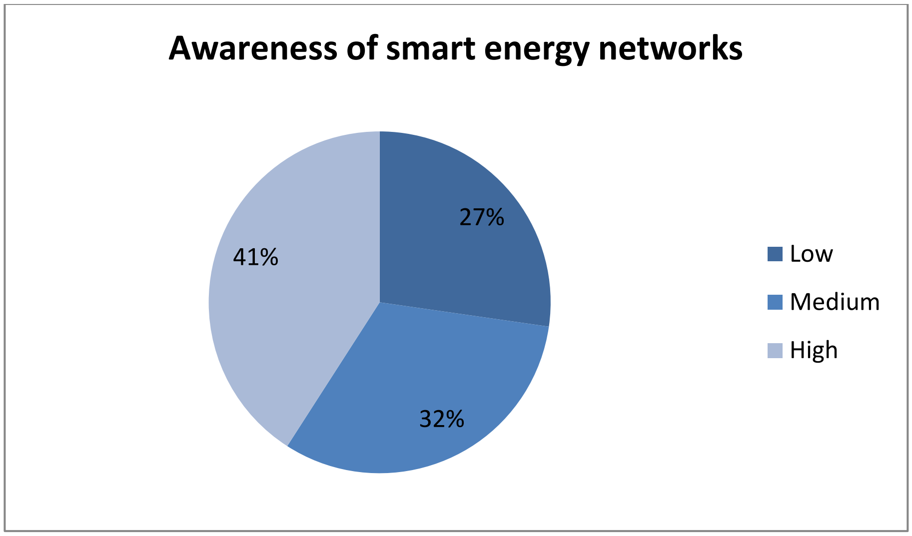
Implications for Cornwall and the Isles of Scilly

- Cornwall has a significant business base that could diversify into smart energy
- Information and communication technologies, engineering and technical consultancy and renewable energy should be the key priority business sectors to focus on.
- The installation of meters and other technologies could also be significant.
- Smart Cornwall should undertake further investigation of manufacturing opportunities and keep the opportunities under review as it targets its resources.

4.3.2 Cornish business views

To review how Cornish and Scillonian businesses are placed to diversity into smart energy, interviews were undertaken with a focus on IT and software (including creative businesses) and renewable energy companies.

General awareness of smart energy networks and the opportunities to become part of the supply chain were low. 59 per cent of businesses interviewed had low to medium level of awareness.

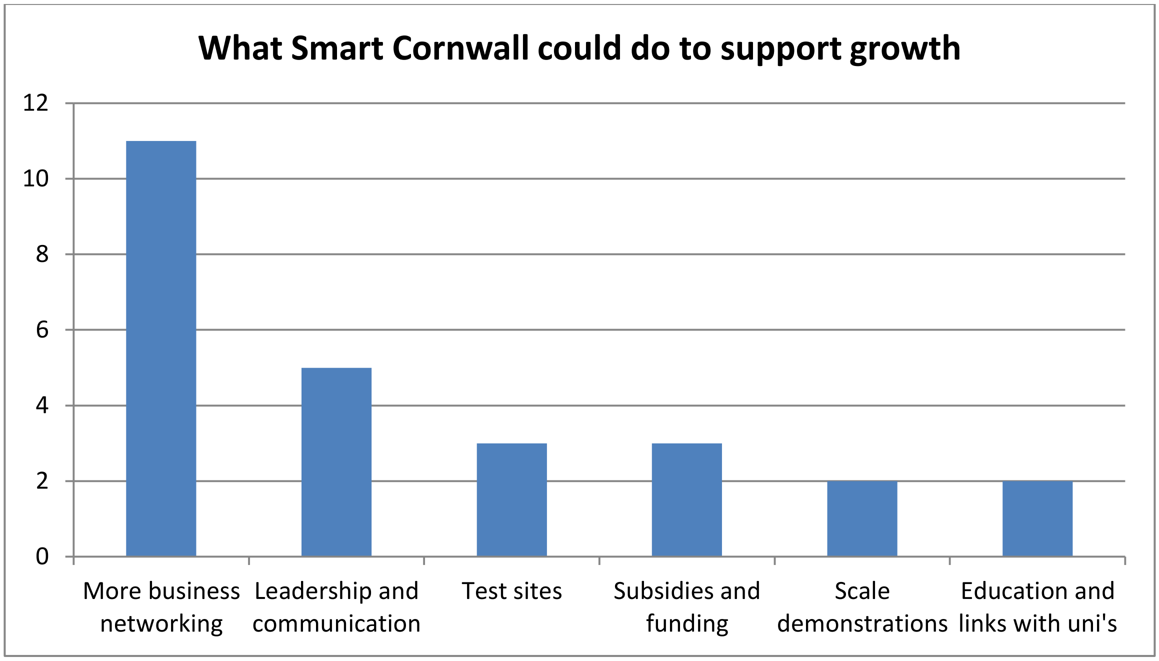


Those that were aware of the opportunities for developing smart energy networks in Cornwall and the Isles of Scilly were very positive about its potential. 33 per cent of the renewable energy and storage companies and 17 per cent of IT and creative companies were already working to some degree in the sector.

However, many local businesses were not aware of the opportunities and just over half of companies interviewed had no plans to move into the sector in the near future. Key barriers identified were inexperience and lack of skills, lack of finance and scepticism.

These results suggest there is a need to support local businesses to engage with smart energy and to help them identify the market opportunities. The businesses suggested that the most effective support the Smart Cornwall programme could provide was business networking opportunities, which could help businesses find out about existing projects, collaborate with others and establish links with larger companies already working in the field. They also emphasised the need for leadership and communication of the opportunities , funding and opportunities to test technologies and services.

The Smart Cornwall programme has set up a business support work stream with objectives to support new markets for local businesses to exploit, as well as opportunities for new start ups.



Implications for Cornwall and the Isles of Scilly

- There is a need for awareness raising and business networking for Cornish businesses to make the most of the smart energy opportunity.

4.3.3 Innovation

The draft EU Structural and Investment Strategy aims to use the funding to "*to deliver sustainable growth through innovation, increasing our competitiveness…* ".[37]

The Strategy identifies this is a key challenge for Cornwall and the Isles of Scilly, noting that, according to the Competitiveness Index, Cornwall ranks as the 314th most competitive local authority area (district/unitary) among 379 in the UK.

One indicator of innovation is the number of companies active in knowledge industries. The evidence base for the LEP Business plan analysis indicates currently 20 per cent of businesses are in 'knowledge economy' sectors.

There is a strong correlation between business with the potential to enter the smart energy sector and those in the knowledge economy. Developing the smart energy sector, therefore, would be in line with the targets Cornwall and the Isles of Scilly have set themselves. The impact of Smart Cornwall in developing a knowledge based economy is analysed in section 6 of this report.

[37] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013

Implications for Cornwall and the Isles of Scilly

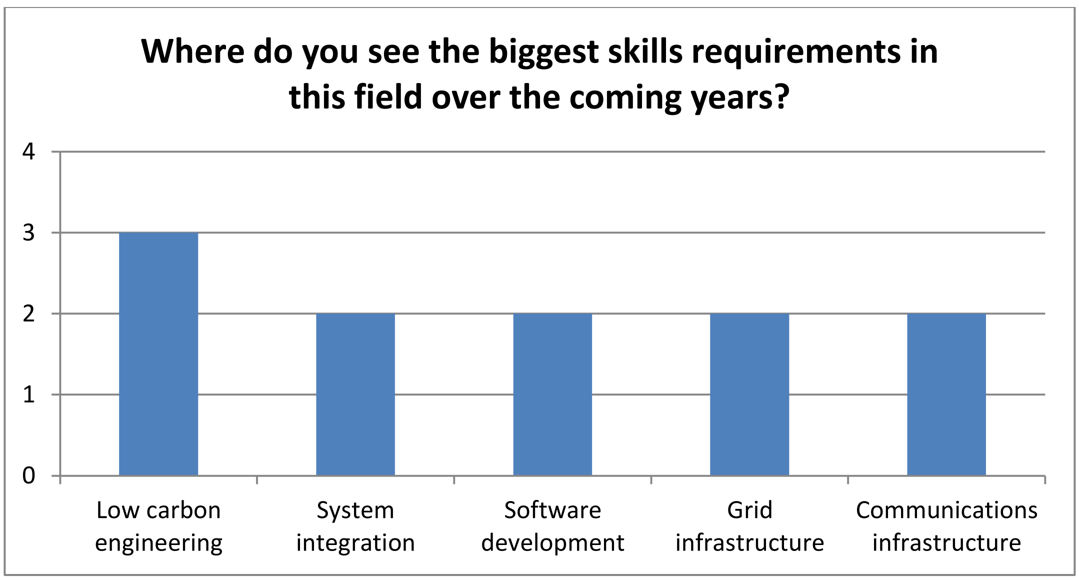
- Smart energy is an opportunity to develop a knowledge intensive sector, improving competitiveness, a key target for Cornwall and the Isles of Scilly.

4.4 Skills

In our stakeholder engagement, skills were mentioned by multinational companies as important to attract inward investment and by local companies as an area that support is needed if they were to develop in the sector.

The Ecotec review referred to in our Opportunity Review[38] concludes that a strong skills base is a critical factor in developing a successful cluster.

The Smart Cornwall programme issued a soft market testing questionnaire to a number of businesses, which asked for their views on the biggest skills requirements in the coming years. The key skill identified by respondents was in engineering, particularly power and low carbon product engineering. Other areas of skills requirements are shown in the graph below:



Cornwall is developing a set of courses in renewable energy, which include elements of smart energy networks, system integration and low carbon engineering. Exeter University already runs a highly regarded BSc/MEng in Renewable Energy in Falmouth. Cornwall College has set up (subject to approval) a BSc in Renewable Energy and Carbon Management in partnership with Plymouth University and is keen to run smart demonstration projects on campus. Cornwall College is also exploring the potential to deliver City & Guilds courses in areas such as smart meter installation.

38 Report by Ecotec for the Department of Trade and Industry. "A Practical Guide to Clustering" http://webarchive.nationalarchives.gov.uk/+/http://www.dti.gov.uk/clusters/ecotec-report/dti_clusters.pdf.

Cornwall College also runs courses in computing, networking and software development, as well as a number of engineering courses, in partnership with Plymouth University.

Looking more broadly, 25 per cent of the population has a degree (NVQ level 4+), but 40 per cent of the population has 'low' (NVQ 2, or equivalent, and below) or 'no' qualifications.[39] The table below shows employment by sector in 2011 to give an impression of the number of people with skills that are transferable into smart energy. Information and communication, and professional, scientific, and technical are perhaps the most relevant.

Sector	Number of employees	% of total employees
Accommodation & food services	33,800	14
Retail	32,400	13
Health	30,900	12
Education	20,300	8
Manufacturing	19,700	8
Construction	16,700	7
Arts, entertainment, recreation & other services	13,700	6
Agriculture, forestry and fishing	12,400	5
Business admin & support services	12,300	5
Professional, scientific, & technical	**12,100**	**5**
Transport & storage	9,600	4
Wholesale	8,200	3
Public administration & defence	7,800	3
Motor trades	5,300	2
Property	3,700	1
Information & communication	**3,500**	**1**
Financial & insurance	3,200	1
Mining, quarrying & utilities	2,700	1

Implications for Cornwall and the Isles of Scilly

- The availability of skilled people could be a significant constraint for Cornwall and the Isles of Scilly in smart energy and should, therefore, be a target area for action for Smart Cornwall.

4.5 Research and development

A number of national and multinational businesses suggested that Cornwall and the Isles of Scilly becomes a test-bed for new technologies and services. This could help attract inward investments, as

[39] Cornwall and Isles of Scilly LEP: Strategy and Business Plan Evidence Base Papers: 1 – Headline Economic Indicators. SQW 2012

well as support local businesses to move into the sector. Links with academia were identified as an important resource.

Looking at previous initiatives, the support for the Peninsula Marine Research Institute was key to establishing Cornwall's position in marine renewables.[40]

Exeter University Tremough Campus has just developed a strong research group within this field. In total, they have a group of 8 academics and associated post graduate researchers and PhD students within the Renewable Energy group at the Tremough Campus. Exeter University believe this is what makes them a leading university in this field. The areas they are covering, along with existing research capacity, are:

Area	Resource
Clean energy generation (marine and solar)	1 professor, 1 senior lecturer, 3 lecturers
Micro grid	1 senior lecturer
Smart energy systems	1 professor, 2 senior lecturers, 2 lecturer
Sustainable energy system and life cycle assessment	1 lecturer
Energy storage	2 lecturers
Smart energy policy	1 professor, 1 senior lecturer, 1 lecturer

Exeter University reports that they have had further conversations around expanding this group, as it is seen as a potential growth area.

Exeter University's Cornwall campus has a focus on arts subjects and a number of interests in smart energy technology:

- Technical overlap between communication systems required for smart grids and growth in digital media.
- The use of the arts to communicate with communities on the impact and opportunity presented by smart grid technology (they are engaged with Wadebridge Renewable Energy Network on this subject).
- The possible use of the Falmouth student village on campus as a relatively isolated test bed system for smart grid technology (i.e. a micro-grid).

Although the existing research capacity in Cornwall provides a strong base, it will need to respond to the needs of businesses and the rapidly developing sector.

In addition to links with academia, stakeholders emphasised the importance of access to 'living labs', i.e. communities that were willing to participate in studies, as well as good relationships with the network operators, regulators and local decision-makers to establish test sites. Some stakeholders highlighted the rural setting of Cornwall and the Isles of Scilly, the 'distributed city', as an opportunity to test technologies that are not appropriate for urban settings, such as those related to large scale renewables.

[40] South West Marine Energy Park (2013) Unlocking the potential of the global marine energy industry

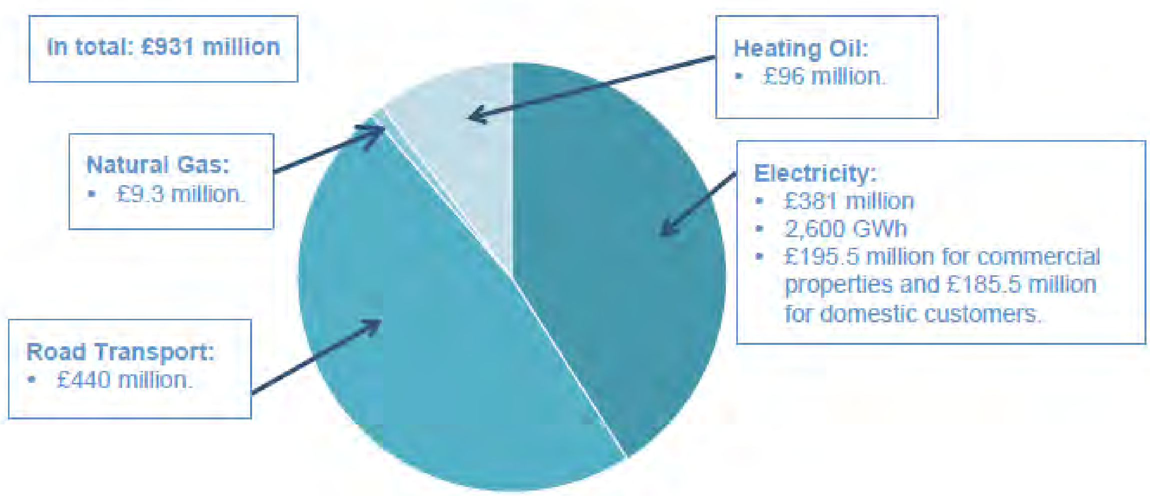
Implications for Cornwall and the Isles of Scilly
• R&D excellence in smart energy and related fields is a key strength of Cornwall • Initiatives that enable testing of smart energy and bring academics and businesses together are key to taking a leadership role in smart energy.

4.6 Energy economy

4.6.1 Energy spend

In 2011, Cornwall and the Isles of Scilly spent a total of £930 million on energy, most of which left the Cornish and Scillonian economy. By now, it is likely to be over £1 billion per year. To put this in context, Gross Disposable Household Income totalled £7.9 billion in 2011.[41]

A breakdown of Cornwall and the Isles of Scilly's total energy spend is shown below.[42]



The total spend on electricity in 2011 was £381 million, with the average household spending around £717 per annum.

[41] ONS regional data

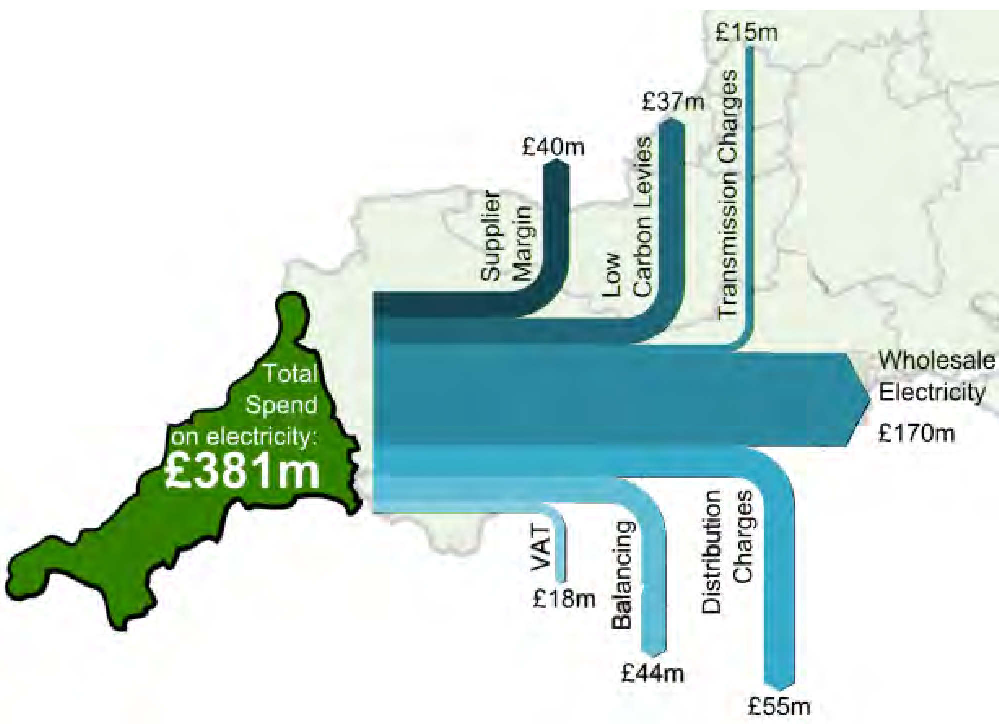
[42] The data for consumption is drawn from DECC's Sub-National Consumption series of statistical releases and the cost found using prices for 2010 from the latest edition of the Quarterly Energy Prices and historical figures in DECC's Energy and Emissions Projections. This does not include the cost of coal and other solid fuels or biomass.
DECC, Sub-national Road Transport Fuel Consumption 2005-2011 DECC, Sub-national Electricity Sales and Numbers of Customers 2010-2011; DECC, Sub-national Gas Sales and Numbers of Customers 2005-2011; DECC, Sub-national Residual Fuel Consumption 2005-2011; DECC, 'Annex F; Price Growth Assumptions'; Department of Energy and Climate Change, Quarterly Energy Prices.

4.6.2 Where the spend goes

Electricity bills can be broken down into a number of component parts:

- the wholesale price paid to the generators
- the cost of maintaining the national transmission and local distribution electricity networks
- the levies to support low-carbon policies[43]
- VAT
- the supplier margin, which accounts for the overheads
- profits of the electricity supply company
- and the balancing fees, which pay for the costs incurred in matching the real-time demand and generation levels.

The figure below illustrates how these components make up Cornwall and the Isles of Scilly's electricity bill.[44]



[43] Low carbon levies include; Carbon Emissions Reduction Target (CERT), EU Emissions trading Scheme (ETS), Renewable Obligation (RO), Feed in Tariff (FiT), Warm House Discount (WHD) and Community Energy Savings Programme (CESP).

[44] This includes approximate figures for business spend, based on consumption data from the DECC projections however using the domestic tariff as information on the breakdown of commercial bills is not available.
DECC, Sub-national Electricity Sales and Numbers of Customers 2010-2011.

As set out above in section 3.1.4, there is significant potential to localise up to 70 per cent of electricity spend through local energy markets (LEMs) by:

- purchasing power from locally owned generation and therefore localising the wholesale electricity cost
- localising and reducing the supplier margin through a not-for-profit local supplier
- localising balancing costs through time-of-use tariffs, trading and selling balancing services
- reducing transmission costs by supplying and consuming electricity within the local distribution network.

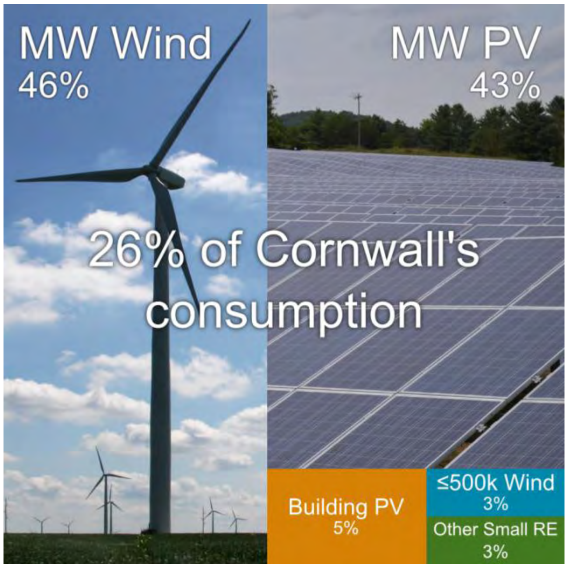
4.6.3 Renewable energy

Cornwall and the Isles of Scilly have excellent renewable energy resources, including solar, wind, biomass, wave, tidal and geothermal. Cornwall Council carried out an assessment of the renewable energy resource potential in Cornwall in January 2012, and found that there was potential for over 1.6 GW.[45] This study did not include offshore renewables or geothermal, which could add significant extra capacity.

The diagram below shows Cornwall's existing annual renewable energy production – including consented but not yet built schemes. The area of the rectangles is proportional to the annual MWh generation from each technology.[46]

[45] Cornwall Council (2012) An Assessment of the Renewable Energy Resource Potential in Cornwall

[46] This is drawn from capacity figures in DECC's renewable energy planning database and the Feed in Tariff (FiT) installations register. The expected generation per megawatt of installed capacity is from CfR figures and RegenSW publications.
Department of Energy and Climate Change, 'RESTATS - Renewable Energy Statistics Database for the United Kingdom'; Ofgem, 'FIT Installations Statistical Report'; RegenSW, *Small Scale Wood Fuel Heat and CHP Options for South West England*; RegenSW, *Micro Hydro Info*.



Implications for Cornwall and the Isles of Scilly

- Cornwall and the Isles of Scilly have a strong position in renewable energy.
- There is a huge economic opportunity if energy spend can be retained locally.

4.7 Electricity grid

The distribution network in Cornwall and the Isles of Scilly is broadly considered to be at capacity, meaning that during peak times, parts of the network equipment are operating close to their voltage or thermal limit (see Appendix 4 on Cornish and Scillonian grid). The minimal spare capacity in the network means that high voltage network reinforcement work is included in almost all generation connection quotes issued to applicants by WPD.[47]

Generation customers are encouraged to connect to areas of the network with capacity, but these areas are now very limited. Available opportunities are even more limited when network capacity is considered in combination with resource and planning constraints, meaning that generation projects are becoming increasingly uneconomical in Cornwall and the Isles of Scilly. Instead, developers are moving their focus to east Devon, Dorset and Wiltshire[48]. This is a major constraint on Cornwall and the Isles of Scilly delivering its renewable energy aspirations.[49]

Trials of smart energy approaches are already being undertaken by WPD and further trials are being proposed to Ofgem.

[47] Regen SW, May 2013, Western Power Distribution Grid Reinforcement Seminar Meeting Summary
[48] Regen SW, June 2013, Scottish and Southern Energy Renewable Energy Forecast v2.1
[49] Regen SW, December 2013, Western Power Distribution Renewable Electricity Scenarios 2015-2023

Implications for Cornwall and the Isles of Scilly

- Grid limitations in Cornwall and the Isles of Scilly provide a clear value driver towards investing in smart energy to enable distributed generation to connect.

4.8 Social and community considerations

4.8.1 Fuel poverty

Currently, around 25 per cent of households in Cornwall and the Isles of Scilly are fuel poor (meaning that they spend 10 per cent or more of their income on fuel in order to heat their home to an adequate degree), compared to a national average figure of 16 per cent of households. There are connections between fuel poverty and health and wellbeing. Among other impacts, living in cold homes can lead to multiple health problems, including contributing to excess winter deaths.[50]

Factors which exacerbate fuel poverty in Cornwall and the Isles of Scilly include low incomes relative to the cost of living and house prices, and hard to treat housing stock with poor energy performance. Community Energy Plus delivers a number of projects and initiatives to help tackle fuel poverty.

A CSE report for Which? highlights that smart meters alone will not necessarily benefit consumers and the fuel poor *"instead enabling energy suppliers and others in the energy market to gain at the expense of consumers"*.[51]

The Wadebridge case study identifies how, by engaging consumers in energy issues and working with local organisations, there is potential to use the development of smart energy to support initiatives to tackle fuel poverty.

Implications for Cornwall and the Isles of Scilly

- Fuel poverty is a key social issue. Smart Cornwall will need to shape the implementation of smart energy if it is to provide social benefits such as by reducing fuel poverty.

4.8.2 Awareness and concerns over smart data use

A critical aspect of any smart platform is the perception and reality within the community of its security and privacy. This is explored in the Wadebridge case study.

Some studies have shown consumer resistance to the sharing of data – including household energy data. However, experience on the ground with smart energy efficiency projects has shown that matters are strongly influenced by factors, such as who is holding the data, who else can get hold of it and how clear are the benefits to the user.

[50] The Health Impacts of Cold Homes and Fuel Poverty, written by the Marmot Review Team for Friends of the Earth, published in May 2011

[51] Centre for Sustainable Energy (2011) The smart metering programme: a consumer review

One finding of the Smart Technology Futures Survey (Appendix 14) carried out in Wadebridge was that as peoples' awareness of how their data is being used grows, so do their concerns. Whilst people do have concerns over smart data use, they do seem willing to participate in smart technologies where it delivers benefits. The survey identified broad support for the concept of external control over energy devices, if it delivered bill savings. However, there was strong support for this external control going to a local not-for-profit organisation (e.g. a local energy coop and/or Cornwall Electricity Supply Company) rather than a major energy company.

People need assurance that data privacy, security, and system resilience are built in from the outset, and safeguarded. A high profile failure in this regard could have a negative effect on smart adoption and undermine confidence in smart energy in Cornwall and the Isles of Scilly.

> Implications for Cornwall and the Isles of Scilly
>
> - Confidence in the security and privacy of data is a key factor in the development of smart energy technologies.
> - Confidence that smart data is being used for purposes that are socially beneficial is also important. Smart Cornwall should explore how not-for-profit business models can both help to maximise local benefits from smart energy technology deployment and provide reassurance to consumers.
> - Strong leadership and governance from Smart Cornwall is required to address peoples' concerns over smart data use. There is a key role for Smart Cornwall to play in ensuring data security and consumer confidence.

4.8.3 Participation in energy economy and engaged communities

Stakeholder interviews with multinationals identified the ability to engage positively with local communities as a significant factor to attracting inward investment. The Global Smart Grid Federation Report 2012[52] focuses on consumer issues being key to the growth of the smart grid market:

"The most difficult challenge to a successful smart grid lies in winning consumer support."

The Wadebridge case study concludes that a positively engaged community in each locality is key to achieving the uptake of smart energy technologies and notes that WREN, which has 1,000 members, has been successful in accelerating the adoption of building-scale low carbon technologies through its buying clubs and free insulation offer.

Communities are beginning to lead the way in sustainable energy, initiating exciting local projects and partnerships and realising the potential of the power that localism gives them. The government is beginning to recognise that community energy organisations are a significant component in the

[52] Global Smart Grid Federation, *The Global Smart Grid Federation Report 2012*.

delivery of low carbon policies, and have introduced a number of policies to support community energy schemes.

Cornwall and the Isles of Scilly have a growing number of community energy groups. We are currently aware of 37 active groups, which are of varying sizes and are at different stages in developing projects. The locations of the groups are mapped below:

The development of community energy has been dependent on a high level of voluntary input. WREN conclude that, whilst this level of voluntary commitment is not going to be replicated in many communities, replicable business models are being established by leading communities.

Implications for Cornwall and the Isles of Scilly

- The development of communities engaged in energy is a strength.
- A funding and professional support framework is required to enable the roll out of local energy cooperatives across Cornwall and the Isles of Scilly. The cooperatives require funding to cover seed costs, but should ultimately be financially self sustaining.

4.9 Conclusions and SWOT analysis

Thestrategic leadership from Cornwall Council and the LEP provides a favourable policy environment for supporting innovation and growth. This is coupled with access to funding that enables Cornwall and the Isles of Scilly to invest in key infrastructure and support businesses with growth potential.

The Smart Cornwall programme provides leadership and alignment of stakeholders around smart energy. The programme has already established a governance structure and an array of global relationships and is viewed as a strength by stakeholders.

The abundant renewable energy resources in Cornwall and the Isles of Scilly coupled with grid capacity challenges, provide a clear value driver that is attractive to businesses for developing smart energy solutions. Smart energy could play a significant role in supporting Cornwall's targets on greenhouse gas emissions and renewables.

Over ten percent of Cornish and Scillonian businesses have potential opportunities to diversify into smart energy. Information and communication and engineering are areas of particular potential strength. Further work will be needed with these businesses to understand their opportunities in more detail.

A key challenge for Cornwall and the Isles of Scilly identified by the LEP is the low levels of skills, productivity, innovation and entrepreneurship. Smart energy is a knowledge-based activity and a focus on this sector has potential to fit well with the LEP strategy to improve Cornwall and the Isles of Scilly's competitiveness. There is also potential to build on and support the strong R&D base being established in Cornwall's universities and to ensure that it is engaged with technology deployment by businesses.

The peripheral location of Cornwall and the Isles of Scilly is mentioned by stakeholders as a challenge, but should not be a barrier. The geography should facilitate a move towards greater energy independence.

Positive engagement from individual consumers and communities will be a significant factor in the development of smart energy. Cornwall Council has the opportunity to provide governance around data and to broker productive relationships between businesses and engaged local communities in order to lead the way in developing smart business models that maximise local benefits and involvement.

Opportunities for Cornwall and the Isles of Scilly include creating a large-scale test bed for new technologies, linking together academics and business; enabling and guiding a number of technology deployment projects to build expertise and skills and attract inward investment; supporting communities to develop LEMs; and providing support to Cornish and Scillonian businesses to diversify into smart energy and use energy more efficiently. These opportunities are explored further in the next section.

The analysis below summarises the strengths and weaknesses, opportunities and threats to the Smart Cornwall programme in getting from the baseline to the desired outcomes. It will not be possible to mitigate all the threats listed in the table above. However, if the Smart Cornwall programme is able to realise some of the key opportunities and is able to secure several large inward investments, it will be in a strong position to establish itself in the global marketplace.

Helpful	Harmful
STRENGTHS • Smart Cornwall programme has strong leadership; it is already facilitating the development of projects and partnerships and will provide business support • Growing ICT digital sector and relevant business base • Over 30 existing active community energy groups • Academic expertise at Exeter University campus at Tremough • EU and LEP funding likely to be available with focus on social, economic and environmental development; also funding may be available from ETI, LCNF, TSB • Potential capacity for 1.6 GW of renewable energy from range of sources. Already have over 300 MW installed. There are at least 100 renewable energy companies operating in Cornwall. • The geography of Cornwall and the Isles of Scilly leads to great potential for energy independence • Superfast broadband available in 70% of premises - to be 95% by 2015 • Net in-migration and a growing population	**WEAKNESSES** • Peripheral location and poor transport links. • Few existing firms involved in the smart energy market and there is low awareness of the potential future market • Skills profile is low compared to regional and national averages - 40% of the working age population has low or no qualifications • Productivity is low • Cornwall and the Isles of Scilly fares badly on measures of innovation and rates of entrepreneurship, compared to national and regional averages • Cornwall and the Isles of Scilly have many micro-businesses that may struggle to achieve critical mass and so find it difficult to access finance and markets
OPPORTUNITIES • The constrained distribution network is putting pressure on distributed generators to innovate • Cornwall and the Isles of Scilly have multiple engaged communities for companies to collaborate with • Build on research and development expertise • LEMs could localise a significant proportion of the £1bn annual spend on energy • Smart meter rollout will provide data on real time energy use by 2020, enabling development of apps and services • Isles of Scilly has a LNCF Tier 1 project which makes it an ideal test site for further smart grid project • Rural, dispersed population provides another test bed of interest to businesses • Local policy focus on increasing productivity, entrepreneurship and innovation	**THREATS** • DECC and Ofgem policy changes • Ofgem 2015-23 plans envisage little smart grid investment apart from pilots • The perception that Cornwall and the Isles of Scilly are not a strong centre for industry • Widespread worry over data use, online security and privacy • Large pilot smart grid projects have already taken place in other parts of UK or are proposed • Funding is not made available • Political priorities for Cornwall and Isles of Scilly change

5 Building blocks for a smart Cornwall

Our review of the current opportunities in smart energy networks, along with an assessment of Cornwall and the Isles of Scilly's current strengths and weaknesses, provides the basis for identifying the building blocks for a successful Smart Cornwall. By successful, we mean that it achieves the objectives listed in section 2.3.1 above.

This section sets out the building blocks to maximise the opportunities and tackle the challenges of smart energy networks. These include a set of projects and initiatives that could be led or facilitated by the Smart Cornwall programme. These make up the scenario for 2020 and enable us to quantify the potential impacts of the Programme; it is not intended to be a detailed plan.

We have identified five key areas that the Smart Cornwall programme could provide leadership and support:

- Technology deployment
- Local energy markets
- Research and development
- Business support programme
- Engaged communities

The following sub-sections summarise the main elements of each building block, which are explained in more detail in Appendix 9.

5.1 Research and development

Our research suggests that the core of Cornwall and the Isles of Scilly's offer should be a research and development facility, a data platform and a centre for innovation and collaboration. These will provide a basis from which to develop and test smart technologies and services, thereby supporting local companies to innovate and grow, start-ups to emerge and multinationals to develop their products in Europe.

5.1.1 R&D Centre

Stakeholders were clear that Cornwall and the Isles of Scilly needed to develop its knowledge and expertise in smart energy in order to attract investment and to develop confidence in the sector. Stakeholders also emphasised the importance of being able to test products and services through having access to 'living labs' (i.e. engaged communities). This is something that businesses both inside and outside Cornwall and the Isles of Scilly suggested that Smart Cornwall could help set up. The centre could be business led, but with close ties to the universities, which are already starting to develop their expertise in this area and to the local energy cooperatives in each locality.

5.1.2 Data platform

Closely linked to the ability to test technologies is access to data on consumer energy use, as well as grid level data. The key feature of a data platform is the ability to draw together multiple data streams that are currently unrelated and use the combined information to address wider systemic challenges. This is seen as essential for developing new products and services, as well as being a significant factor in the development of the wider smart sector. It is important that the platform provides open source data so that smaller companies are also able to take advantage of the opportunity to developnew apps and services.

5.1.3 Business acceleration hub

The opportunity to collaborate with others would support the smaller businesses to move into the market and would encourage knowledge spill-overs between businesses. The most commonly stated response when asked what the Smart Cornwall programme could do to support Cornish and Scillonian businesses to move into this sector was to enable business networking and collaboration. An innovation hub could provide access to a 'living lab', accommodation space and incubator support.

5.2 Technology deployment

In order for Cornwall and the Isles of Scilly to develop its expertise in smart energy networks and to gain a reputation both nationally and globally, it needs to set up a breadth of projects and to explore integrated solutions. It was suggested by stakeholders that one-off projects or pilots tend to flare and die back without leaving a sustainable business base. Therefore, a number of technology deployment projects are suggested, with more detail set out in Appendix 9.

5.2.1 Large scale integrated demonstration project

From our review of the literature and feedback from stakeholders, one of the greatest needs identified was for a large scale integrated smart technology project involving smart meters, smart grid, distributed generation and local energy trading. This would enable all the various parameters to be studied, the commercial feasibility investigated under different conditions, and detailed cost-benefit calculations made.

5.2.2 Smart meter roll out in Cornwall and the Isles of Scilly

The government has decided to roll out smart meters in a national programme[53] over the period 2015 to 2020. There would appear to be potential opportunity for Cornwall and the Isles of Scilly to

[53] https://www.gov.uk/smart-grid-a-more-energy-efficient-electricity-supply-for-the-uk

maximise the amount of work done by local businesses, in order to gain experience and expertise in smart metering that leads naturally to the sale and installation of home energy management systems and to a better understanding of consumers' needs and behaviour.

5.2.3 Technology acceleration projects

As stated above, stakeholders emphasised the importance of having a breadth of projects. Deciding what these should be will depend on the proposals that come forward from businesses and other organisations, as well as the technology development pipeline. Projects could include: smart grid projects with the DNO; installing smart technologies in social housing; smart heat; and roll out of electric vehicles. See Appendix 9 for further information.

5.3 Business support programme

The projects on the ground should create market pull. A business support programme is needed to underpin this pull. Our research showed that many Cornish businesses with the potential to move into the smart supply chain were not aware of the opportunities. Those that were would like help accessing funding, collaborating with others (particularly larger companies), finding a skilled workforce and testing their products and services. Larger companies already operating in the sector reiterated these points when asked about what would encourage them to invest in Cornwall and the Isles of Scilly. Several also stressed the importance of a strong brand to create confidence.

A number of potential aspects of direct business support are set out below and in more detail in Appendix 9.

5.3.1 Attracting inward investment

The participation of large corporations in smart energy projects will give the sector credibility in Cornwall and the Isles of Scilly. Many of the respondents to our survey of existing SMEs in Cornwall stated that sub-contracts from large businesses already operating in this field would greatly help Cornish and Scillonian SMEs to enter the sector.

There is also an opportunity for Cornwall and the Isles of Scilly to provide a launch-pad for businesses outside Europe, such as Taiwanese and Korean businesses, to commercialise their products and services in a European setting in order to gain access to these markets.

Evidence also suggests that the entry of dynamic entrepreneurs into the market stimulates productivity, competition and innovation within the region.[54] It enables 'knowledge spill-overs', where local businesses acquire technical knowledge from new entrants through demonstration effects, the interchange of employees via the labour market or as a result of being part of the supply chain.

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[54] SQI Consulting (2009) UKTI Inward Investment Evaluation Case Studies. http://www.ukti.gov.uk/uktihome/aboutukti/successStory/108749.html

Partnerships have been already been established by the Smart Cornwall Programme with a range of organisations and businesses around the world, and memorandums of understanding have either been signed or are in the process of being agreed with the Jeollanam-do provincial government in South Korea, the Korea Smart Grid Institute and Pengu Islands government in Taiwan amongst others.

5.3.2 Providing funding

National and multinational companies stated that Cornwall and the Isles of Scilly's access to EU funding made it more attractive for inward investment.

Access to finance for SMEs is also a critical success factor and was raised by a number of businesses in our stakeholder survey. It enables them to fund investment and reach their full growth potential, as well as facilitate new business start-ups.

5.3.3 Delivering marketing and export support for SMEs

It is clear from our analysis that exports will be of major importance for Cornish and Scillonian businesses, if the smart energy sector is to grow quickly.

Linked to the arguments made above about the need to win consumer support and the ability to access markets, businesses need to be able to successfully promote their own products and services to both domestic and global markets. This is an area that many SMEs struggle with, as they tend not to have a dedicated marketing resource.

5.3.4 Ensuring there is a strong skills base

An issue raised by businesses both inside and outside of Cornwall and the Isles of Scilly was the lack of relevant skills. The biggest skill requirements over the coming years, identified through Smart Cornwall's soft market testing questionnaire, were: low carbon engineering; system integration; software development; grid and communications infrastructure.

A more immediate opportunity would be to ensure that a training programme is put in place for technicians on smart meter installation, for example at a City & Guilds Level 2 Diploma level. This would put the Cornish and Scillonian workforce in a good position to benefit from some of the estimated £15.5 million to be spent on smart meter installation in Cornwall and the Isles of Scilly,[55] with the potential to export these skills to other counties in the south west.

5.3.5 Business adoption of smart technologies and services

There are significant opportunities for all businesses in Cornwall and the Isles of Scilly to adopt smart technologies and services and to benefit from both savings in their energy bills as well as from generating an income by becoming a 'prosumer' or by providing balancing services. Kiwi Power

[55] 230,400 households in Cornwall (2011 Census at a Glance - Cornwall Council) and an estimated installation cost of £68 per dual fuel meter (2011 Smart Meter Impact Assessment – DECC)

estimate that medium sized enterprises could earn £20k a year and large enterprises £100k a year from selling demand response services.[56] Businesses will need support in identifying and maximising these opportunities. This will be particularly significant for large energy users, such as manufacturers, and could help build their resilience to increases in energy prices as well as increase their overall profits.

5.4 Local energy markets

Feedback from stakeholders on Smart Cornwall's proposed 'locality model', as set out in the Routemap Consultation, was very positive and our stakeholder interviews reiterated the importance of having engaged communities. One way of achieving this is through local energy markets (LEMs). The Wadebridge Smart Technology Futures survey (see Appendix 14) showed broad support for the concept of external control over energy devices if it delivered bill savings. However, there was strong support for this external control going to a local not-for-profit organisation (e.g. a local energy coop and/or Cornwall Electricity Supply Company) rather than a major energy company. A survey done at the recent Wadebridge Energy Futures event showed over 90 per cent support for a local energy supply company.

We consider there is the opportunity to set up a new, locally- owned organisation to develop and manage LEMs, which if it was successful and grew, would be a very significant first for Cornwall and the Isles of Scilly. One multinational company stated that this would help raise the profile of Smart Cornwall and attract inward investment.

5.5 Engaging communities

As stated above, national and multinational companies saw Cornwall and the Isles of Scilly's engaged communities as a key selling point, and one that should be developed to attract inward investment. Businesses both inside and outside of Cornwall and the Isles of Scilly highlighted the importance of consumer awareness of the benefits of smart energy networks, as well as trust in the businesses supplying services and collecting data on their consumption patterns. Research has suggested that independent, trusted bodies, such as the community groups, could play an important role in encouraging consumers to maximise the benefits of smart energy networks.[57]

There are a number of active community energy groups operating in Cornwall and the Isles of Scilly that are already developing local energy economy business models for their communities. Smart Cornwall could put in place a funding and professional support framework that would enable the roll out of local energy cooperatives across Cornwall and the Isles of Scilly.

[56] http://www.kiwipowered.com/
[57] Energy Saving Trust for DECC (2013) Role of Community Groups in Smart Metering-Related Energy Efficiency Activities

6 Baseline and outcomes assessment

The aim of the Smart Cornwall programme is: *"To develop the U.K.'s first fully integrated smart energy network, providing new high value jobs, creating wealth and opportunities for future generations and leading the way into a prosperous, resource efficient future."*[58] It has identified 13 objectives or outcomes, grouped under: economic, technological, social, and governance (see section 2.3.1 above). The building blocks identified in the previous section are expected to create the nucleus for a cluster of smart energy businesses and activity by 2020, from which Cornwall and the Isles of Scilly can grow into a key player in the global smart energy market.

There are obvious methodological challenges in assessing the impact of a programme that has not yet been designed and that will aim to maximise the benefits of a new and rapidly developing sector. We investigated a range of indicators that could help monitor progress against the key outcomes and focused on those where reliable data was available at a local level.

Where possible, the likely impacts of the 2020 and 2030 scenarios has been quantified against a number of indicators: jobs, GVA, knowledge-based economy, CO_2e, technology take-up, and the creation of energy cooperatives. Where this has not been possible, we have provided a qualitative description of the likely impacts. We have based our forecasts on findings from existing projects and other forecasting studies.

Appendices 9, 10 and 11 describe the scenarios and forecast the impacts in detail. It is important to note the following points when reading the summarised findings in the sub-sections below:

- The business-as usual (BAU) scenario is not 2013-frozen but includes growth in the broader economy and increasing use of smart technology along with the rest of the UK
- The difference between BAU and the 2020 scenario is estimated in the year of 2020, so projects completed before 2020, for example construction of an R&D centre or installation of a smart energy system, must have effects after completion that can be detected in 2020. So construction work has virtually none (apart from a small decaying multiplier) but the installation of a smart system might permanently reduce energy consumption
- Most of the building block projects have relatively little long term effects in themselves. The major effect is that they create a nucleus for the development of a cluster of smart businesses which, with some business development assistance, will grow the sector in Cornwall and the Isles of Scilly and create jobs, mainly through export to the rest of the UK and the world. So the actual building block projects and number/size of them do not matter greatly provided a good nucleus is established.

[58] Smart Cornwall programme 2020 Routemap consultation, February 2013.

6.1 Jobs and GVA

Whilst many reports forecast the potential economic benefits of successfully developing the smart energy sector as a whole, few attempt to robustly attribute the impact to a specific programme of activity.

To tackle this challenge, two different approaches have been taken to forecast the impact of a Smart Cornwall programme by 2020 and compared the results to draw conclusions.

- Our central approach is a detailed 'bottom-up' assessment of the key buildings blocks, as set out in section 5 above and described in detail in Appendix 9
- For sake of comparison, a 'top-down' analysis was carried out by reviewing the scale of the global opportunity as forecast by others, and apportioned a share to Cornwall and the Isles of Scilly based on a number of assumptions, as set out in Appendix 10.

An annual growth rate was then applied from 2020 to 2030, based on the assumption that the 2020 building blocks would have created a strong cluster of smart energy businesses and activities from which to grow. See Appendix 11 for further information.

Baseline

We estimate that approximately 48 businesses are currently working in the smart energy sector with an average of 0.5 FTE per business doing smart energy related work. This is based on our assessment of business SIC codes and our stakeholder engagement. This equates to 24 FTE jobs and £1.3 million in GVA per annum.

Business as usual scenarios

Overall, we assume that Cornwall and the Isles of Scilly will benefit from some aspects of smart technology but, apart from the national smart meter roll out, business as usual will not constitute the basis for significant further growth in the use or sale of smart technology and Cornwall and the Isles of Scilly will not establish a competitive advantage that attracts investment and creates new jobs.

Therefore, we assume that we would see growth in line with global projections for the smart energy market of 10 per cent per year.[59]

When these growth rates are applied to the baseline jobs and GVA, 46.8 jobs and £2.5 million GVA could be created by 2020, and 121.3 jobs and £6.4 million GVA by 2030.

2020 bottom-up scenario

The bottom-up scenario forecast the impacts from each of the building blocks set out in section 5 above. The table below summarises the expected change by 2020, based on the bottom-up assessment.

[59] Navigant Research (2013) Smart Grid Technologies

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA
Research and development	297	15.6	119	6.3
Technology deployment	8	0.4	3	0.2
Business support programme	651.5	34.3	261	13.7
Local energy markets	159	8.4	63.6	3.3
Encouraging technology adoption	456	24	182.4	9.6
*Less double counting[60]	(80)	(4.2)	(32)	(1.7)
TOTAL	**1491.5**	**78.5**	**597**	**31.4**

So at the end of 2020, we could expect to see 2,089 new jobs resulting from the Smart Cornwall programme and an increase in GVA of £110 million. As an example, this might be seen in terms of say 10 firms of about 80 employees, 50 firms of 10 employees and around 260 firms of three employees.

The majority of the additional jobs arise from businesses created or expanded by business support activities and from engaging communities to encourage the take-up of smart technologies. The technology deployment projects do not create additional jobs because the projects would either happen anyway under business as usual (such as installing smart meters in all premises) or are construction projects in which jobs are short term and effects on employment in the longer term are negligible. It should be noted, however, that the projects and initiatives should be seen as interdependent, and that any element on its own would not deliver the same level of impact.

2020 top-down scenario

The top-down analysis gives a range of estimates of additional jobs by 2020 of between 1,585 and 5,900 additional jobs:

- Using the global market share of Cornwall's ICT sector as a proxy for Cornwall's potential share of the global smart energy market forecast by Navigant produces 3,625 jobs
- Using the semiconductor industry's market share as a proxy for Cornwall's potential share of the global smart energy market forecasts by Navigant produces 5,900 jobs. It is important to note here that this would depend on Cornwall and the Isles of Scilly developing one of the world's biggest smart energy clusters in the world.
- Calculating Cornwall's share of Ernst & Young's forecasts for growth in the UK smart grid sector produces 1,585 jobs.

2030 scenario

Using the central, bottom-up scenario for 2020 of 2,089 jobs and £110m GVA, and assuming Cornwall and the Isles of Scilly can achieve growth of 13 per cent a year, which is in line with the semiconductor

[60] It is likely that some of the jobs forecast for the Business Acceleration Hub will be created through business development activities and we assume 2/3 of them are in this category. Accordingly we deduct 80 direct FTE jobs from the total.

industry (the fastest growing industry in recent times), it could result in a total of approximately 7,090 jobs and £373 million in GVA by 2030.

Summary table of jobs and GVA

	Business as usual (BAU) scenario		Smart Cornwall (SC) scenario		Difference between SC and BAU	
	Jobs	GVA	Jobs	GVA	Jobs	GVA
Baseline	24	£1.3m	24	£1.3m	0	£0m
2020	47	£2.5m	2,089	£109.9m	2,042	£107.4m
2030	121	£6.4m	7,091	£373.4m	6,970	£367.0m

6.2 Innovation

We have identified the jobs that Smart Cornwall could create in the smart energy sector by 2020 and 2030.

Cornwall and the Isles of Scilly's objectives, however, are not only about the number of jobs, but the type of jobs. The draft European Structural and Investment Fund Strategy[61] states that a part of its 'Growth for Business' strategic priority will focus on "*Investments which will accelerate increases in productivity and competitiveness in the region's businesses".*

And continues,

> *"Our Strategy prioritises the identification and intensive support of companies that are identified as having the potential to make the greatest contribution to Cornwall and Scilly's economic growth, increases in productivity and competitiveness in the region's businesses."*

The Smart Cornwall programme will include a set of interventions to support appropriate Cornish and Scillonian enterprises to diversify into the smart energy sector by 2020. Two ways in which we can measure and forecast how this sector might impact on creativity, innovation and competitiveness are set out below.

Creation of knowledge-based jobs

We reviewed business sectors that have the potential to move into the smart energy supply chain and concluded that 2,845 enterprises were undertaking activities relevant to smart energy development or deployment. This is 13 per cent from a total of 21,105 enterprises listed as active (as of 2012) in Cornwall and the Isles of Scilly.

Of these, 1,680 enterprises are also considered to be part of the 'knowledge economy', according to the Office for National Statistics.[62] This indicates that 59 per cent of the total appropriate smart energy supply chain base in Cornwall and Isles of Scilly could be classed as knowledge economy enterprises.

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[61] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013
[62] ONS (August 2013) Count of Enterprises in Districts of the United Kingdom by 3 Digit Codes and for Class 28.23 in Knowledge Intensive Industries (Excel sheet 269Kb)

It is reasonable to conclude, therefore, that 59 per cent of enterprises working in the smart energy sector in 2020, as a result of the interventions of Smart Cornwall, will be in the knowledge economy.

- Percentage of Cornish and Scillonian enterprises currently in the knowledge economy: 11 per cent [63]
- Percentage of Cornish and Scillonian enterprises with potential to work in the smart energy supply chain in 2020 and 2030 who are in the knowledge economy: 59 per cent

If these figures are applied to the jobs that could be created by a Smart Cornwall programme, we could assume that an additional 1,233 knowledge-based jobs would be created by 2020 and a further 4,184 jobs by 2030. This is against a baseline of approximately 24 jobs in the smart energy sector, of which we can assume 14 can be classified as knowledge-based.

Creation of new businesses

We considered the birth and death of new enterprises[64] as an indicator of creativity. For Cornwall, the birth and death each year of enterprises was roughly constant between 2009 and 2011 although Cornwall did worse than the average for England on this measure. (Data for 2012 is not available.)

Cornwall UA	2009	2010	2011
Births of new enterprises	1,655	1,520	1,705
Deaths of existing enterprises	2,175	1,810	1,825
Overall change in number of enterprises	-2.6%	-1.5%	-0.6%
For comparison England overall change	*-1.9%*	*-0.6%*	*+1.5%*

We looked also at types of enterprises (actually local PAYE units[65]) that would most likely be affected by a Smart Cornwall programme. Encouragingly, the first two categories in the table below probably include the highest paying jobs and have increased faster than average. However, business admin jobs have decreased.

Cornwall UA	2010[66]	2012	Annualised difference
Professional, scientific and technical enterprises	1,825	1,950	+3.3%
Information and communication enterprises	650	690	+3.1%
Business admin and support services enterprises	1,505	1,435	-2.3%
Total of three categories	3,980	4,075	+1.2%
Overall total for all categories	25,395	25,540	+2.8%
For comparison England all categories	*2,183,845*	*2,218,215*	*+0.8%*

[63] Based on a SIC code analysis. See section 4.3 for further information.
[64] ONS: Births and Deaths of Enterprises in Local Enterprise Partnerships, 2004–11
[65] ONS: UK BUSINESS: ACTIVITY, SIZE AND LOCATION - 2010 and 2012
[66] Data for 2011 is not available

At the end of 2020, we have forecast an additional 2,089 new jobs resulting from the Smart Cornwall programme, which we could assume is made up of say 10 firms of about 80 employees, 50 firms of 10 employees and around 260 firms of three employees. Therefore, an estimate of 320 new enterprises could be created, increasing the base population of 4,075 in the three categories by 7.9 per cent.

The additional 7,090 jobs that we forecast for 2030 could create approximately another 1,000 enterprises. However, it is difficult to forecast the breakdown of small, medium and large companies at this early stage and therefore is only used here for the sake of comparison. It is also worth noting that the survival rate of enterprises after 5 years is 48 per cent in Cornwall and the Isles of Scilly, which is similar to the UK average. Therefore, we could estimate that approximately 920 new enterprises would be created by 2030, which would equate to an increase of over 20 per cent over a 10 year period.

In summary, there is potential for an annualised increase in new smart energy businesses of approximately 1.7 per cent from the baseline in 2012 to 2030.

Summary of innovation indicators

The following table summarises the additional knowledge-based jobs and new enterprises that could result from the Smart Cornwall programme's activities.

	Business as usual (BAU) scenario		Smart Cornwall (SC) scenario		Difference between SC and BAU	
	Knowledge jobs	New businesses	Knowledge jobs	New businesses	Knowledge jobs	New businesses
Baseline	14	60	14	60	0	0
2020	28	66	1,232	386	1,204	320
2030	72	74	4,139	994	4,067	920

6.3 Greenhouse gas emissions

Smart energy networks can reduce emissions by:

- Improved opportunity to optimise energy consumption through automated systems and behaviour change
- Alleviating grid constraints allowing greater penetration of renewables
- Reduced use of inefficient generation to meet system peaks
- More efficient operation and reduction in system losses
- Increased capability to support the integration of electric vehicles and the electrification of heat.

Our bottom-up scenario, as set out in Appendix 9, has enabled us to forecast emission savings from optimised energy consumption behaviour and from greater penetration of renewables. Without a detailed plan of the likely distribution network upgrades (this has not been decided) or roll out of smart technologies to support integration of electric vehicles and heat, we have not attempted to quantify other potential emission savings. Therefore, it is likely to be a conservative estimate.

Baseline

A Green Cornwall programme has put in place coordinated leadership of Cornwall Council's aim to reduce its carbon footprint, and has targets to:

- Contribute towards cutting Cornwall's greenhouse gas (GHG) emissions above national targets (34 per cent) by 2020
- Support the increase in renewable energy production to meet the national 15 per cent target of non-transport related energy by 2020.[67]

Cornwall and the Isles of Scilly's greenhouse gas emissions from gas and electricity consumption were 1,733 k tonnes CO_2e in 2011.[68] The amount of renewable electricity generation in Cornwall and the Isles of Scilly currently installed and with consent, is equivalent to 26 per cent of Cornish and Scillonian electricity consumption.

2020 and 2030 scenarios

Smart Cornwall enabled CO_2e savings will arise from a combination of the increased deployment of renewable energy installations and from increased energy efficiency gains due to consumers' greater awareness of their consumption.

The following table summarises the tonnes of CO_2e emissions avoided against business as usual (BAU) and Smart Cornwall (SC) scenarios for 2020 and 2030 (see Appendix 12 for detailed assumptions and calculations).

	BAU scenario		**SC scenario**		**SC less BAU**	
	2020	**2030**	**2020**	**2030**	**2020**	**2030**
Grid distributed renewable electricity	381,672	759,132	441,331	1,380,240	59,659	621,108
Building integrated renewable electricity: on-site consumption	39,528	72,468	50,069	131,760	10,541	59,292
Household and business efficiency gains	40	117	61	180	20	62
Total	421,240	831,717	491,461	1,512,180	70,220	680,462

The additional CO_2e savings that could be achieved through the Smart Cornwall programme above a BAU scenario is around 70 k tonnes by 2020 and 680 k tonnes by 2030, which is a 4.1 per cent and 39.3 per cent reduction respectively against the 2011 baseline for electricity and gas consumption (3.9 per cent and 37.6 per cent respectively against a 2009 baseline). It is also important to note that the BAU figures include the rollout of smart technologies (especially meters) that are expected to happen without the Smart Cornwall intervention.

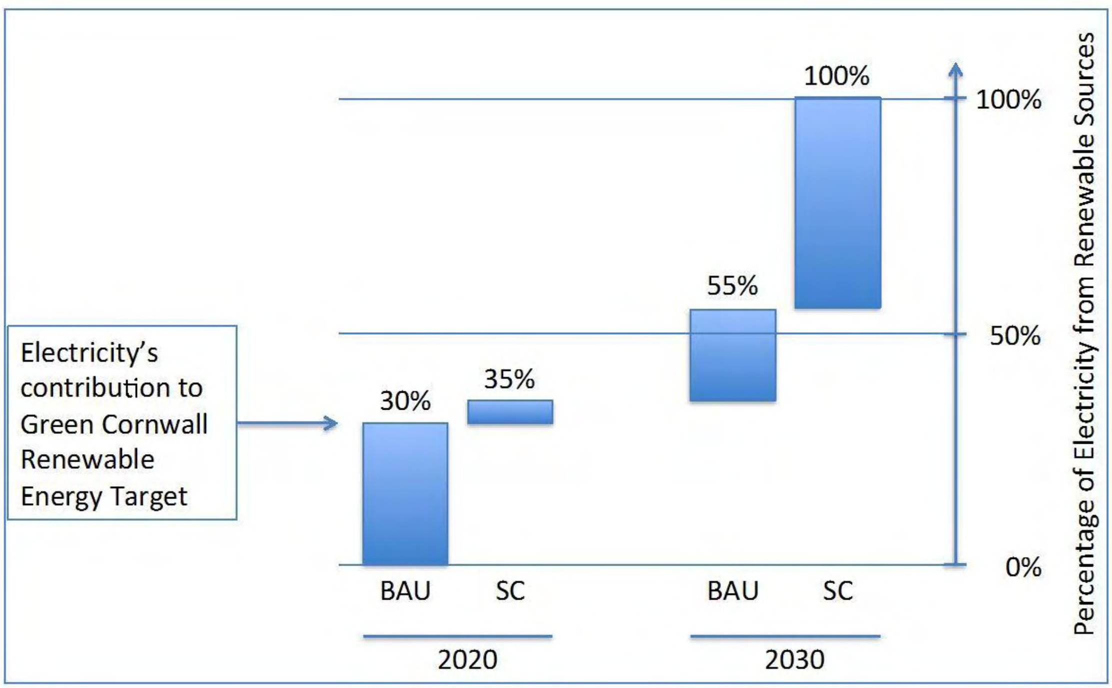
[67] Cornwall Council (2011) Green Cornwall Strategy

[68] DECC (2011) Local and Regional CO_2 Emissions Estimates. The Green Cornwall programme uses a 2009 baseline for its target and includes a wider range of emission sources including non- CO_2 greenhouse gases. In this analysis, we have chosen to use the more recent DECC data (see Appendix 12 for more information).

Green Cornwall targets

With regard to the Smart Cornwall programme's potential contribution to the Green Cornwall GHG reduction target of 34 per cent by 2020, the savings from grid-distributed renewables cannot be included as both the DECC analysis and Cornwall GHG Inventory ignore actual levels of local renewable electricity generation and are based on the same national (grid) average carbon intensity factor for electricity. Therefore, under this methodology the contribution drops from 70 to 10.5 k tonnes CO_2e saving by 2020, which amounts to an overall 0.23 per cent reduction against the Green Cornwall 2009 baseline covering all sources of greenhouse gases.

With regard to the Smart Cornwall programme's potential contribution to the target to increase renewable energy production to 15 per cent of non-transport related energy by 2020, we have only looked at renewable electricity. Government has assumed that around 30 per cent of all UK electricity will need to come from renewable sources by 2020 in order for us to meet the UK's 15 per cent contribution to the European 20 per cent renewable energy target. We have assumed that if the Smart Cornwall programme is proactive in unlocking renewables through microgrids, virtual power plants, storage and large-scale smart projects with the DNO, it could help secure 35 per cent of consumption from renewables by 2020 and 100 per cent by 2050, as illustrated below.



6.4 Social indicators

The Smart Cornwall programme has objectives to:

- Have developed market and technology solutions that enable local energy supply and ownership arrangements

- Reduce fuel poverty and facilitate uptake of technologies which improve health and well-being
- Have informed populations who are proactive participants in their energy economy.

It is clear from the literature review (see Appendix 3) that there are a range of complex, interconnected potential impacts from smart energy networks, many of which cross over with the economic and environmental impacts. The likely increases in jobs, GVA and innovation, and the reduction in greenhouse gases detailed above will all have significant social benefits.

We have also looked at a number of other social benefits, quantitatively where possible, below.

Participation in the energy economy

A positively engaged community in each locality is key to achieving the uptake of smart energy technologies, distributed resources (generation, storage and controllable demand) and a LEM. There are several means of measuring the level of participation in the local energy economy:

- **The number of local energy cooperatives:** We have proposed that Smart Cornwall put in place a funding and professional support framework that would enable the roll out of local energy cooperatives across Cornwall and the Isles of Scilly. We forecast that this would help the 37 existing community energy groups to become active energy cooperatives with two full-time employees and at least 10 per cent of the local population as members. Therefore, we would see an increase from one to 37 in 7 years. If this model is scaled to the whole of Cornwall and the Isles of Scilly, there is the potential for over 60 energy cooperatives, which could be achieved by 2030.
- **Participation in LEMs:** We have forecast that 10 per cent of the Cornish and Scillonian population will be participating in LEMs being run by the 'Cornwall Electricity Supply Company' by 2020. It is unlikely that the market will be limited to this one supply company, and therefore we can assume that this number will be higher.
- **Spend localised through LEMs:** A LEM has the potential to reduce transmission charges (as power is generated and consumed within the local distribution network), localise balancing costs (as local generators, consumers and storage operators are paid to balance local supply and demand) and localise supplier costs (as supply is managed by a local supply company). If we are to assume that 10 per cent of the population will be participating in LEMs by 2020, we forecast that up to £18 million (3.8 per cent) of energy spend could be kept in the local economy by 2020 (see Appendix 9 for further information). This is based on the assumption that significant investments are made and regulatory, technical and commercial developments are achieved.

The three indicators of participation in the energy economy are set out in the table below.

	2020	2030
The number of local energy cooperatives	37	60
Participation in LEMs	10%	20%
Spend localised through LEMs (£ million)	£18m	£122m
Percentage of spend localised through LEMs	3.8%	22.9%

Technology adoption

We forecast the adoption rates for smart energy technologies for both homes and commercial premises for 2020 and 2030 that could result from focussed support from Smart Cornwall to accelerate technology takeup.The forecast adoption rates are shown in the table below:

Smart technology	Spend	BAU scenario		SC scenario		SC less BAU	
		2020	2030	2020	2030	2020	2030
Homes							
Smart meters	£145	90%	95%	90%	95%	0%	0%
Smart energy management apps and service	£15	25%	40%	50%	80%	25%	40%
Building integrated smart technologies (e.g. HEMS, smart appliances)	£400	10%	25%	35%	60%	25%	35%
Building integrated renewable energy generation and storage	£5,000	20%	35%	35%	55%	15%	20%
Non half-hourly metered businesses							
Smart energy management apps and service	£100	25%	40%	50%	80%	25%	40%
Building integrated renewable energy generation, storage and management systems	£5,000	20%	35%	35%	55%	15%	20%
Half-hourly metered businesses							
Smart energy management apps and service	£2,000	50%	75%	90%	90%	40%	15%
Building integrated renewable energy generation, storage and management systems	£100,000	75%	90%	90%	90%	15%	0%

The Smart Cornwall programme, the increase in energy cooperatives and local energy markets (LEMs) will enable a much higher uptake of smart energy technologies than we would expect to see under a business as usual scenario. This would enable more households and businesses reduce their energy bills with positive impacts on both the local economy and fuel poverty.

Awareness and concerns over smart data use

The Smart Technologies Futures Survey (see Appendix 14) showed that whilst people do have concerns over smart data use, they do seem willing to participate in smart technologies where it delivers benefits.

With strong governance, direction and support for engaged communities from Smart Cornwall, the level of awareness over how smart data is used should go up, and concerns should go down as people are reassured that Smart Cornwall is looking after them and ensuring that data is used for socially beneficial purposes and their privacy is protected.

Fuel poverty

Currently around 25 per cent of households in Cornwall and the Isles of Scilly are fuel poor (meaning that they spend 10 per cent or more of their income on fuel in order to heat their home to an adequate degree), compared to a national average figure of 16 per cent of households.

Without intervention from Smart Cornwall and other programmes, fuel poverty is likely to increase with energy price rises.

The Smart Cornwall program should contribute to a reduction in fuel poverty by:

- Reduction in electricity cost, and creation of energy income generation opportunities, through LEM arrangements
- Increased consumer engagement in energy issues, including through local energy organisations that can identify those in need and provide targeted support (for example as provided by WREN in Wadebridge, Low Carbon Ladock in the Ladock parish, and a number of focussed and Cornwall wide projects delivered by Community Energy Plus)
- Increased ability to control energy use through smart controls
- Specific funded programmes targeting fuel poverty.

It is not credible to try to quantify the additional impact that Smart Cornwall could have on fuel poverty reduction without identifying specific projects.

6.5 Wider smart technologies and services

We have not attempted to quantify the potential for wider smart technologies and services, such as smart-health, retail and transport, as it was not in the scope of this project. However, it is likely that the growth in the smart energy market will run in parallel with wider smart technologies and there will be much cross-over in their supply chains.

The smart city market, including smart buildings, smart homes, smart transportation, smart grids, smart healthcare, smart education, smart security and smart industry automation, is estimated to be worth £442 billion in 2011 and is expected to reach a value of US$1,026.3 billion by 2017, following growth at a compound annual growth rate of 15 per cent.[69]

We can assume that in practice the size of the global market, as far as Cornwall and the Isles of Scilly are concerned, is infinite and the percentage share they can take is limited by their competitive position (product, price, reputation, delivery and so on) and ability to increase market share (marketing, exporting, training new workers, finance, premises, etc). This is an area that the Smart Cornwall programme can provide support in ways similar to those set out in the building blocks, i.e. technology development and deployment support, a business support programme and encouraging communities to adopt new technologies.

[69] GBI Research (2013) Smart Cities Market to 2013

7 Conclusions

The global growth of 'smart' infrastructure, technologies and services will have a profound impact on Cornish and Scillonian businesses and communities. While the global trends highlighted in this report will determine the overall market for smart energy networks and the pace of technology development, how Cornwall and the Isles of Scilly responds to this opportunity will influence the rate of local adoption by both communities and businesses, as well as the level of economic, environmental and social benefit that can be captured locally.

By setting out a strategic direction and governance system, the Smart Cornwall programme provides the opportunity for Cornwall and the Isles of Scilly to accelerate the adoption of smart technologies, attract investment and influence how deployment is organised, and thereby maximise the benefits.

Cornwall and the Isles of Scilly have a number of key strengths and attributes that will make it an attractive proposition for smart energy investors, but this is a highly competitive area. It will be critical therefore for the Smart Cornwall programme to continue to work hard to support local enterprises, attract significant inward investment and to build on its impressive array of partnerships with international companies.

7.1 The strengths

Cornwall and the Isles of Scilly have important strengths to enable them to deliver an ambitious Smart Cornwall programme:

- The strategic leadership and governance provided by the Councils and LEP and the establishment of the Smart Cornwall programme
- The availability of European funding to invest in key infrastructure and business development activities in order to leverage in private investment
- A significant business base in relevant areas, including ICT and renewables
- Strong relationships with global multinational companies
- Physical geography providing excellent renewable energy resources coupled with a constrained grid
- Developing community energy groups that provide an opportunity for a unique approach to the development of smart energy led by the needs of local communities.

7.2 The challenges

- Cornish and Scillonian businesses currently score low on measures of competitiveness and, therefore, may struggle to compete in a competitive market
- Lack of multinational technology companies with a strong presence in Cornwall and the Isles of Scilly

- The 2015-2023 business plan for the grid operators (WPD) has little investment in smart networks
- Smart energy will not necessarily deliver social benefits and the use of household data may be met with a degree of suspicion by householders
- Communities will need support to develop local energy markets (LEMs) and to maximise the local benefits.

7.3 The success factors

To deliver the potential benefits to Cornwall and the Isles of Scilly of smart energy, the Smart Cornwall programme will need to:

- Provide clear leadership, governance and a network of aligned stakeholders
- Invest in R&D capability and engagement between academics and businesses
- Attract significant deployment projects to provide focus for getting expertise and experience
- Deliver business development activities to enable innovation and to support start-ups, diversification and expansion, exports and inward investment
- Build international relationships, access to global markets and inward investment
- Support the roll out of LEMs across Cornwall and the Isles of Scilly
- Provide strong leadership and governance to address peoples' concerns over smart data use.

7.4 The impacts

If the Smart Cornwall programme can deliver these success factors, our analysis concludes it could achieve the following outcomes:

- A central estimate of over 2,000 jobs and £110 million GVA in 2020 and just under 7,000 jobs and £370 million in 2030 - a significant boost to Cornwall and the Isles of Scilly's economy
- A comparative, top-down analysis provided a range of jobs between 1,585 and 5,900 by 2020. The higher figure is based on the growth seen in the semiconductor industry, as a example of a successful business cluster in the UK
- These jobs would be weighted toward knowledge-based industries. We estimate 59 per cent of businesses working in smart energy would be in knowledge-based sectors compared to a current average figure of 11 per cent for Cornwall and the Isles of Scilly (on a like-for-like comparison)[70]
- The environmental benefits could be significant. We estimate CO_2e savings of around 70 k tonnes by 2020 and 680 k tonnes by 2030. This would be a 1.6 per cent drop against the Green Cornwall baseline for all greenhouse gas emissions

[70] Based on a SIC code analysis. See section 4.3 for further information.

- The programme could also play key role in enabling Cornwall and the Isles of Scilly to meet their renewable energy aspirations
- In addition to the social benefits from increased jobs and reduced carbon emissions, other benefits could include:
  - 37 energy cooperatives with two full time employees by 2020
  - 10% of energy consumers engaged in LEMs by 2020; facilitating local ownership of generation and reduction in energy bills and fuel poverty
  - Up to £18 million (3.8 per cent) of energy spend localised through LEMs by 2020
  - Increase in health and well-being through adoption of smart health technologies
  - An increase in adoption rates of smart technologies by up to 40 per cent.

The table below summarises the additional impact the Smart Cornwall programme could have above a business as usual scenario if it can deliver the success factors set out in this report.

Impacts		2020	2030
Economic	Jobs	2,042	6,970
	GVA	£107m	£367m
	Knowledge jobs	1,204	4,067
	New enterprises	320	920
Environmental	CO_2e emission savings (tonnes)	70,220	680,462
	Renewable energy generation (% of consumption)	5%	45%
	Household electricity efficiency savings	1.1%	3.6%
	Business electricity efficiency savings	1.9%	5.7%
Social	Technology adoption (% of premises)	Up to 40%	Up to 40%
	Local energy cooperatives established	37	60
	Income from local ownership of renewable energy generation	£5m	£96m
	Spend localised from LEM	3.8%	22.9%

7.5 The key risks

In a world of uncertainty there are a number of risks to achieving these impacts. The table below sets out key risks for the development of smart energy in Cornwall and the Isles of Scilly and their likelihood and impact (H = high; M = medium; L = Low).

Risks	Likelihood	Impact	Mitigation
Smart energy development globally is slower that predicted	L	M	A leadership role will attract investment to Cornwall and the Isles of Scilly if other markets are less attractive
Slow policy and market development makes the UK an unattractive market	M	M	Cornwall and the Isles of Scilly puts in place their own local governance and funding arrangements
Cornish and Scillonian businesses lack the skills and expertise to capture high value jobs	M	H	A programme of support to raise awareness, develop skills and de-risk investment through a local market
Multinationals switch focus to a locality offering greater funding	M	M	A broad programme with R&D, local supply chain, engaged communities to develop local benefit
Widespread worry over data use, online security and privacy slows down uptake	H	M	Enabling local communities and social enterprises to take a leading role in deployment
Social needs, such as fuel poverty, are not built into smart energy deployment	H	M	Smart Cornwall governance
Political priorities in Cornwall and the Isles of Scilly change	L	H	A clear agreed LEP strategy and EU SIF funding plan

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Appendix 1: Glossary of smart products and services

Areas of 'smart'

Area	Description
Smart Grid	Part of an electricity power system that can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both - in order to efficiently deliver sustainable, economic and secure electricity supplies[71]
Smart Health/Care	Refers to the implementation of intelligent, networked technologies in order to constantly improve health provision for all within this changing health economy.[72]
Smart Education	Learning in the digital space reduces administrative burden, allows teachers to interact with pupils in multiple geographical spaces, and innovate new ways of engaging and learning.[73]
Smart Transport	By integrating technology and intelligence into the physical transportation infrastructure, improvements can be made in capacity and traveller experience. Systems become more efficient, safe, and secure.[74]
Smart Water	A Smart Water Grid delivers water from suppliers to consumers using two-way digital technology to control consumption at consumers' homes to save water, reduce cost and increase reliability and transparency. It overlays the water distribution system with an information and net metering system.[75]
Smart Retail & Hospitality	Retail and hospitality have been transformed by the internet and this will continue to evolve rapidly. Smart technology can add to this further by gathering user's changing locational data to build a large picture of the retail population, enabling business to tailor their offerings more rapidly and more closely to the visitor profile.

Hardware

Technology	Description
Smart meter or Advance metering infrastructure (AMI)	A meter that records a customer's electricity usage for time intervals of one hour or less, and can transmit that information to the utility without the need for a human meter reader.[76] Depending on the feature set the meter may also: notify the utility of voltage levels and other parameters, for example to indicate a power outage; provide pricing, consumption or other information to the customer; and allow the utility or consumer to remotely switch specific appliances on or off.
Virtual Power Plant	A cluster of distributed energy generators i.e. wind, PV, CHP that are all controlled by a central control hub.

[71] (ENSG, 2010)
[72] http://www.gtai.de/GTAI/Navigation/EN/Invest/Industries/Smarter-business/smart-health.html?view=renderPrint
[73] http://www.marketsandmarkets.com/Market-Reports/smart-digital-education-market-571.html
[74] http://www.ibm.com/smarterplanet/us/en/transportation_systems/overview/?ca=v_transportation
[75] http://bluetechblog.com/2010/06/02/it%E2%80%99s-time-for-the-smart-water-grid/
[76] http://www.smartgrid.gov/glossary/6/lettera

Micro grid or Virtual Power Network (VPN)	A microgrid is an electrical system that includes multiple loads and distributed generation that can be operated in parallel with the national utility grid or as an electrical island. [77]
Energy storage	Various methods can be used to store excess energy to be used at a later time so allowing better balance between demand and supply, e.g. the Dinorwic pumped storage hydro plant for electricity at a large scale. At smaller scale a number of different approaches have been proposed and developed to store energy depending on the source of energy and intended use. Examples are flywheels, capacitors, flow batteries, high thermal density heat tanks, the liquefaction of air, and the electrolysis of water to make hydrogen. There are some pilot projects, yet currently no commercially available storage or distributed generation currently exist.
"Smart" Electric Vehicle Charging Station	An electric vehicle charging station that uses communications technology to enable it to intelligently integrate two-way power flow enabling electric vehicle batteries to become a useful utility asset

Software

Technology	Description
Data hubs / aggregators / spines / consolidators / platforms	Central system that co-ordinates communications between smart infrastructure including distributed energy sources, consumers and producers. A centrally assigned Data Communications Company will take co-ordinate data security and privacy.
Home Area Network or Smart Home	A communication network within the home that allows transfer of information between electronic devices, including, but not limited to, in-home displays, computers, energy management devices, direct load control devices, distributed energy resources, and smart meters. Home area networks can be wired or wireless. [78]
Building Management System	HVAC (Heating Ventilation and Air Conditioning) sensor and control system. It can act as the gateway between a smart building and a smart grid.
Dynamic Demand	Ability for consumer or utility to automatically switch non- time critical devices on and off to help balance loads.
Self-healing grids	A self-healing grid is capable of automatically detecting, isolating, and responding to power system disturbances, which improves supply reliability, resilience and power quality.

[77] http://www.smartgrid.gov/glossary/term/111
[78] http://www.smartgrid.gov/glossary/term/102

Advanced forecasting	The use of data on consumer behaviour patterns and weather forecasts (long and short range), to regulate the energy mix from distributed sources.

Enablers – Technology

Technology	Descriptions
Distributed Energy Resources (DER)	A device that produces electricity, and is connected to the electrical system, either "behind the meter" in the customer's premises, or on the utility's primary distribution system. A Distributed Energy Resource can utilise a variety of energy inputs including, but not limited to, liquid petroleum fuels, biofuels, natural gas, solar, wind, and geothermal. Electricity storage devices can also be classified as DERs. [79]
Electric Vehicles	Vehicles with an electric motor and battery requiring recharging from the electricity grid rather than an internal combustion engine and fuel tank. Hybrid EVs are also available.
Electrification of heating	Smart meters control heat pumps and so facilitate the incorporation of heat into the energy supply network.
Real time pricing	Real-time pricing (RTP) is generally an energy tariff that varies on a frequent basis.

Enablers – Behavioural

Services	Descriptions
Demand side management	The term for all activities or programs used by customers to control the amount or timing of electricity they use
Community owned energy companies	Energy company owned by the community.
Local energy market (LEM)	These enable electricity consumers and producers within a local network to become active participants in trading their power demand and generation

[79] http://www.smartgrid.gov/glossary/term/85

Appendix 2: Methodology

The approach taken consisted of four main steps, which are outlined below:

1. Review of opportunities

A review of literature (see Appendix 3) was carried out to identify:

- How others have tried to quantify the impacts of smart energy networks
- What innovative projects are happening around the world and what lessons Cornwall and the Isles of Scilly can learn from them
- The most effective ways of developing new sectors
- What success has been seen in developing similar sectors.

An assessment of grid constraints and plans to make the distribution network smarter (see Appendix 4) was carried out by reviewing WPD business plans and strategies, as well as interviewing key stakeholders at WPD.

A review of local, national and European policy (see Appendix 5) was carried out to better understand the potential drivers and barriers to development of the sector.

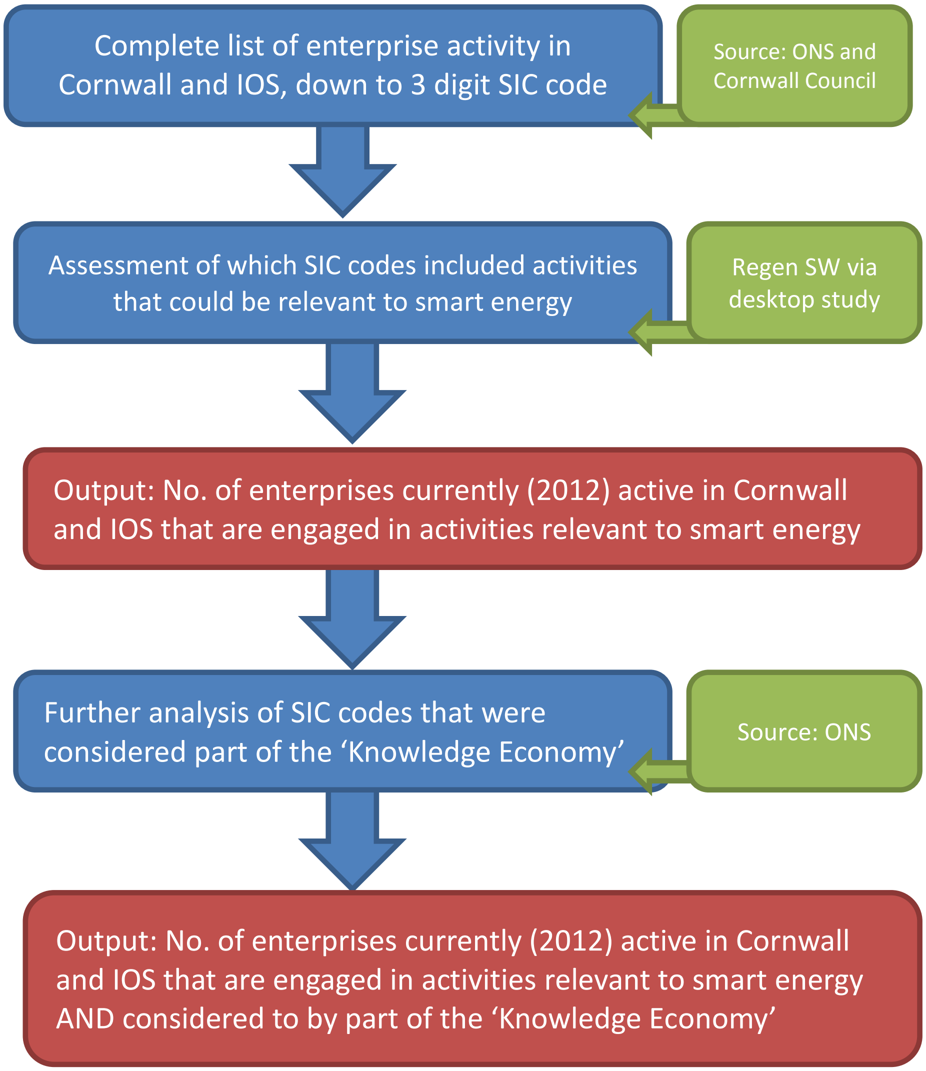
The views of key stakeholders on the opportunities for Cornwall and the Isles of Scilly were obtained through a combination of interviews with organisations with potential to enter the smart energy network supply chain in Cornwall and the Isles of Scilly, and with organisations with a specific area of interest or expertise. See Appendix 6 for a list of stakeholders consulted and Appendix 7 for a summary of findings.

2. An assessment of the capacity and baseline in Cornwall and the Isles of Scilly

An assessment was made of the current situation in Cornwall and the Isles of Scilly and its capacity to take a leading role. Key areas looked at include strategic leadership; funding; existing business base; skills; R&D; energy consumption and generation.

Information was taken from a range of sources including the Cornwall and Isles of Scilly Local Enterprise Partnership (LEP), the Office of National Statistics (ONS), Regen SW and DECC.

In order to get a picture of the existing business capacity to deliver or diversify into smart energy in Cornwall and the Isles of Scilly we followed the methodology set out in the diagram below.



Analysis was also carried out on stakeholder responses to Smart Cornwall's Routemap Consultation, Smart Cornwall's soft market testing questionnaire and over 40 interviews with a mix of Cornish and Scillonian businesses, multinational companies and other stakeholders. See Appendix 6 for a list of stakeholders consulted and Appendix 7 for a summary of findings.

We targeted businesses in Cornwall and the Isles of Scilly that had the potential to become part of the supply chain, including IT, creative, manufacturing, renewable energy, energy storage and electric vehicles.vehicle companies. Unfortunately it proved difficult to speak to manufacturing companies, so instead we interviewed two umbrella organisations that were able to give us an overview of the sector.

A summary of the interview questions is in the box below.

Summary of interview questions

Steering group members, academics and multinational companies

- What do you see as the drivers of growth in smart energy technology in Cornwall and the Isles of Scilly?
- What do you foresee as being barriers to the growth in the Cornish and Scillonian smart grid market?
- What three things would Cornwall and the Isles of Scilly have to do to attract inward investment and build a "world leading" sector?
- What is the most effective approach for the Council to engage with stakeholders to design the Smart Cornwall programme of work over the coming months?

Cornish IT, manufacturing, storage and EV businesses

- Indication of the size of the company number of FTE employees or turnover
- Are you aware of the technologies/activities/opportunities related to the smart energy technologies?
- Does movement into smart energy feature in your business plan? If yes, how and how much are you planning to invest in R&D?
- What do you see as barriers to you entering the smart market?
- Would you move into smart grids if there was a market for you?
- What are the 2 most effective approaches for the Council to engage with stakeholders to design the Smart Cornwall programme of work over the coming months?

Cornish renewable energy businesses

Same as above, but with an additional question:

- Have grid constraints affected your business plans going forward into the future?

A SWOT analysis was then carried out on the Smart Cornwall 'project' getting from the baseline to the desired outcomes, as set out in section 2.3.1.

This assessment also provided a baseline against which to set the 'Business As Usual' (BAU) or counterfactual scenario (the non-intervention trend). This was then used to measure the expected impact of the Smart Cornwall programme. It is important to note that the BAU was not 2013-frozen, but included growth in the broader economy and increasing use of smart technology along with the rest of the UK.

3. Assumptions, scenarios and outcomes

In order to forecast the change that the Smart Cornwall programme could make, it was first essential that a set of assumptions were agreed for the business as usual, 2020 and 2030 scenarios. These were as follows:

Scenario	Assumptions
BAU	• A small number of businesses will be operating in the market, probably primarily developing and selling software products and creating storage solutions to grid constraints, and they will grow in line with the rest of the UK • There will be some research work at the Penryn campus, mainly at the ESI, but it is unlikely to develop into a major work-stream compared say to renewable energy where Cornwall already has considerable expertise • Three or four smart grid pilots will be implemented by WPD looking at specific problems, such as the HV cable to the Isles of Scilly • Cornwall will not meet its carbon and renewables 'targets' (as set out in the Cornwall Council Local Plan) because of grid constraints but smart grid technology will not be used by WPD to connect the wind and PV renewable electricity projects that are currently not feasible due to high connection and reinforcement costs • Smart meters: about 400,000 smart meters will be installed in Cornwall and the Isles of Scilly by 2020 under DECC's rollout programme but under BAU we think virtually none of the installation and associated work will be done by businesses based in Cornwall and the Isles of Scilly (this is discussed more fully in the description and analysis of Flagship Project - smart meter rollout) • Cornwall and the Isles of Scilly residential and small commercial consumers will see a fall in gas and electricity energy costs due to smart meters of about 3% in line with reduction forecast for the UK (although when this occurs depends on when smart meters are installed across Cornwall and the Isles of Scilly). This will boost real incomes. • Existing organisations, such as Community Energy Plus and WREN, will continue to work to reduce energy costs and increase renewable electricity and heat generation through projects such as energy efficiency installations, bulk purchase of power and community renewable energy schemes.
2020	• Global markets for smart energy goods and services will continue to grow strongly from a mix of R&D and pilot projects and some deployment of smart grids creating a global market for Cornish and Scillonian based businesses • UK will meet its 2020 renewable energy and carbon targets • Increasing volume of energy data will become available and with it the need to process data effectively - this will require data acquisition, monitoring and analysis of demand, generation and network data. • Consumer engagement in energy supply and demand will increase (both gas and electricity), e.g. distributed generation and energy efficiency • There will be increasing automation of buildings energy management, so increasing sales of hardware and software, e.g. smart thermostats, mobile phone apps • Demand for new ways of supplying electricity and additional services, such as customised energy packages, and home energy management services will increase • Roof-top solar PV systems will become commonplace as prices continue to fall, but will eventually

	not be allowed to connect to the network in some areas due to overload • There will be some smart grid deployment by DNOs but it will not be widespread unless additional driver is put in place through changes to the regulatory regime • There will be no significant deployment of smart applications for the gas supply network • Greater involvement of councils and LEMs in helping firms and households reduce energy costs • Some technical standards to enable interoperability of smart applications will be in place (in utility equipment, building management systems etc.) but much work to be done • Electricity and gas demand level and pattern in 2020 is similar to that in 2013 according to DECC's central scenario • Funding for innovation in smart grids will be provided by TSB, research councils, NIC/NIA, ETI and other private funds.
2030	• The building blocks set out in the 2020 scenario establish a nucleus for the development of a cluster of smart businesses which grows and exports its good and services • Cornwall and the Isles of Scilly have established a significant expertise and reputation in the market by 2020 and can grow its market share at least in line with the rest of the world.

We assumed Smart Cornwall was a project with activities that would change the level of economic activity in Cornwall and the Isles of Scilly, as well as having environmental and social impacts. Importantly we envisaged positive qualitative effects that would raise the long-term growth potential of the area by a step-change and then higher than previous growth rates.

The impact of the Smart Cornwall programme was compared to the situation that would exist without the project, so-called 'Policy-Off' or 'Business As Usual' (BAU) without the Programme. The first step was to describe BAU as accurately as possible. We then developed a scenario for 2020 that we considered was achievable with focussed business support and estimated the impacts compared to BAU.

4. Assessment of impacts

Where possible, we have quantified the likely impacts of the 2020 and 2030 scenarios. Where this has not been possible, we have provided a qualitative description of the likely impacts. We have based our forecasts on findings from existing projects and other forecasting studies.

We chose a number of indicators for measuring and forecasting the economic, environmental and social impacts. A list of indicators was considered, but the majority were found to be either very difficult to get reliable data for or were too broad for our purposes. For example, it would be possible to get data on fuel poverty in Cornwall and the Isles of Scilly; however, it would not be possible to attribute the improvement solely to smart energy networks.

4.1 Economic impacts

The most regularly used measures of economic impact from sector development programmes are jobs and GVA. Another measure of growth is innovation, i.e. developing new products and services that will increase profit and drive business and sector growth. An explanation of the methodology for assessing these indicators is set out below.

Jobs and GVA

We began with attempting to carry out a top-down analysis for the 2020 scenario, but found that it was problematic to determine potential impacts from a general growth in the sector without looking at some specific activities or projects that could stimulate long-term jobs and GVA. However, we have also presented results from a top-down analysis for sake of comparison (see Appendix 10).

Based on the evidence collated from the literature review and stakeholder interviews, we set out a number of 'building blocks' – projects and initiatives – that we felt would establish a cluster of activity in smart energy, enable local businesses to move into the supply chain and establish Cornwall and the Isles of Scilly's place in the global market by 2020.

Most of the building blocks have relatively little long term effects in themselves (e.g. the construction of an innovation hub), but instead provide the nucleus for the development of smart business which would be expected to grow the sector in Cornwall and the Isles of Scilly and create jobs, mainly through export to the rest of the UK and the world. So the actual projects and initiatives do not matter greatly, provided a good nucleus is established.

We estimated the potential jobs and associated GVA for each of the building blocks based on evidence from similar existing projects/initiatives. It is important to note that we estimated the difference between the BAU and the 2020 scenario in the year of 2020, and not the cumulative impact of projects completed before 2020. For example, the installation of a smart energy system in 2018 will have minimal economic effects in 2020 (apart from a small decaying multiplier) but it will contribute to creating the nucleus, the benefit of which is captured in the economic forecast for 2030.

After forecasting the direct jobs created by the building blocks, we calculated the associated impact on the economy through the use of multipliers. The multipliers were taken from the SW Regional Accounts[80] and the online modelling tool Econ|i.[81]

The multiplier accounts for subsequent rounds of spending caused by an investment. There are five components: the *initial* impact (for example additional GVA of £5 m) shows the direct effect of the change; the *first round* effects show the impact on the immediate suppliers of the directly affected industries; the *indirect* value represents the impact on the suppliers of these immediate suppliers; and, finally, the *induced* value is the impact arising from increased spending by households as a result of the additional income/employment generated

We used the following multipliers for Cornwall and the Isles of Scilly in this report:

- 5.25 £m GVA for each 100 FTE (2010 £)
- 0.4 indirect and induced FTE for each direct FTE.

[80] South West Regional Accounts, SW RDA, March 2011 and
[81] http://economicsystems.co.uk/south-west/

Some of the cases we consider involve localising spend that is currently made outside Cornwall and the Isles of Scilly. There is evidence that local spend or spend on SME's increases the local multiplier but not necessarily the overall impact beyond the local. A recent report showed that for every £1 spent with a small or medium-sized business 63p was re-spent in the local area compared to 40p in every £1 spent with a larger business.[82] We have noted where this might occur in our scenario but not changed the multiplier. In fact the local benefit is usually more than offset by the fact that local multipliers are always smaller than regional or national ones.

The online model allows us to examine the effect of investments. For example a £1m/year increase in spending in education increase GVA by £7.1m directly plus £3.5m indirectly and creates 18 FTE direct jobs plus another 8 FTE jobs indirectly.

Market development from 2020 to 2030 was difficult to forecast in detail. We assumed that the building block projects and initiatives delivered prior to 2020 would establish Cornwall as a key global player in the smart energy sector and forecasted growth based on existing macroeconomic forecasts.

Innovation

Smart energy is a new and high tech sector. It seems likely, therefore, that the businesses engaged will be 'innovative' and deriving value from their knowledge. However measuring these outcomes is not simple task. The evidence base for the LEP Strategy compiled by SQW highlights the challenge with measuring innovation noting, "*In general terms, measures of innovation are limited, particularly at local levels."*[83]

The measures used include:

- Surveys: either at a country level, for example the EU Community Innovation Survey, or at a project level by evaluation studies after a few years' operation of the project
- Input measures: R&D spend as percentage of total revenue is the usual measure
- Output measures: Patents and other IP can be counted (see below).

All of these have limitations. For example, figures for Cornwall show just 12 successful patent applications per million population in 2008,[84] so any assumptions on growth in patents would be difficult against such small numbers. Patents also measure only certain facets of innovation.

In our stakeholder engagement we asked local businesses about whether they might invest in R&D to move into the smart energy sector. We found, however, that businesses did not feel able to answer this question at this stage, largely due to a lack of understanding of the smart energy market opportunity.

The SQW report for the LEP states,

[82] Centre for Local Economic Studies for Federation of Small Businesses 2013 http://www.fsb.org.uk/News.aspx?loc=pressroom&rec=8116

[83] SQW (2012) Cornwall and Isles of Scilly LEP: Strategy and Business Plan

[84] Cornwall Council (2013) EU Structural and Investment Fund Strategy evidence base

> *"One proxy that is often used relates to the incidence of knowledge-based activity …. The proportion of business units in the knowledge economy in the LEP area is 20%. This is again notably below the South West (31%) figure."*[85]

We have, therefore, used this as our key measure of innovation.

To assess the level of knowledge economy activity that Smart Cornwall could lead to, we reviewed business sectors that the potential to move into the smart energy supply chain and how many of those were also considered to be part of the 'Knowledge Economy'. We have used this as an indicator of the percentage of enterprises working in the smart energy sector in 2020 as a result of the interventions of Smart Cornwall that will be in the knowledge economy.

We have then compared this with the current rate of enterprises in Cornwall and the Isles of Scilly working in the knowledge economy.

It should be noted that our analysis of the SIC code data finds 11 per cent of Cornish and Scillonian enterprises are in the knowledge economy compared to the Office of National Statistics figure of 20 per cent of business units. The differences are likely to relate to the LEP report using 2009 figures (we use 2012) and that they looked at units, rather than enterprises (a unit is a location of work, of which there may be several per enterprise). We have used the 11 per cent figure so that the businesses as usual and 2020/2030 scenarios are comparable.

4.2 Environmental impacts

See Appendix 12 for an explanation of the methodology, data sources and assumptions made to calculate the greenhouse gas emission savings from the scenarios.

4.3 Social impacts

A survey was carried out to assess people's views on

- Current participation in smart data applications, awareness of how smart data is currently used, and whether people consider the benefits outweigh any concerns;
- Awareness of energy spend and willingness to invest in energy saving and income generating measures;
- Willingness to participate in external control of energy devices in return for a cost saving benefit, and whether the nature of the organisation taking on that control affects peoples willingness to participate;
- The relationship between peoples' current level of participation in smart data and smart energy, and their view of the future.

[85] SQW (2012) Cornwall and Isles of Scilly LEP: Strategy and Business Plan

This was used to help establish a baseline for measuring future changes in people's perception of smart energy technologies and services.

The survey was carried out through street interviews on Saturday 5th October in Wadebridge town centre between 9am and 5pm. Interviewers made efforts to speak to a range of age groups, but the sampling was otherwise random. In total 107 responses were collected. A questionnaire was used and all participants were asked the same questions in the same order. A copy of the questionnaire and a full set of results are included in Appendix 14.

When forecasting the impacts of smart energy networks on Cornish and Scillonian people, the main measure we used were the adoption of smart technologies, the number of new energy cooperatives and percentage of people participating in LEMs.

Appendix 3: Literature review

A core part of the research for this evidence base was a literature review. The subject area of smart energy networks and wider 'smart' is expansive, so we narrowed our review down to four key questions:

1. How have others tried to quantify the impacts of smart energy networks?
2. What innovative projects are happening around the world and what lessons can Cornwall and the Isles of Scilly learn from them?
3. How have others supported the development of similar sectors?
4. What are the most effective ways of developing new sectors?

The following sections summarise our findings.

1. Quantifying the impacts of smart energy networks

There is a strong body of evidence for the benefits from the smart energy sector and deployment of smart energy technologies and services - and that the long term benefits far outweigh its costs.[86] Much of the evidence around these benefits, or impacts, is qualitative. However, some studies have quantified the impacts of an initiative or project. Most studies are forward-looking forecasts as opposed to backward-looking analyses, but both are useful benchmarks for this evidence base.

1.1. Economic impacts

Economic impact studies

Due to the early stage of the smart energy sector, the majority of economic assessments of the impact of investment are forecasts. However, there are some retrospective studies that analyse the impact of investment in the sector. For example, the US Department of Energy looked at the economy-wide impact of the American Recovery and Reinvestment Act of 2009 funding for smart grid project deployment between 2009 and 2012. The study found that the total invested value of $2.96 billion to support smart grid projects generated at least $6.8 billion in total economic output and supported about 47,000 FTE jobs. A summary of two economic studies is shown in the table below.

[86] For instance, The National Energy Technology Laboratory (2010) Understanding the benefits of a smart grid. And the NYS Smart Grid Consortium (2010) Smart Grid Roadmap for the State of New York.

Scale	Author	Year	Impact	Methodology
US smart grid investment programme	US Department of Energy	2013	As of March 2012, the total invested value of $2.96 billion to support Smart Grid projects generated at least $6.8 billion in total economic output About 47,000 FTE jobs were supported by investments For every $1 million of direct spending the GDP increased by $2.5 to $2.6 million.	This study analyses the economy-wide impacts of the American Recovery and Reinvestment Act of 2009 (Recovery Act or ARRA) funding for Smart Grid project deployment in the United States, administered by the U.S. Department of Energy Office of Electricity Delivery and Energy Reliability (DOE OE). The time period of the investments analysed cover expenditures from August 2009 to March 2012, which encompasses nearly three billion dollars in publicly documented expenditures.
San Francisco Bay Area	Silicon Valley Smart Grid Task Force	2011	Since 1995, employment in smart grid-related sectors increased 129% in the Bay Area while total employment rose only 8%. Manufacturing jobs have represented at least 50% of total smart grid employment in the Bay Area. Number of businesses grew 138 % between 1995 and 2009, expanding from 280 to 670 establishments California accounts for 69% of total US VC investment in smart grid in 2010. Increasing 66% from 2009, total investment reached 2.8 billion dollars in 2010	Analysis of Silicon Valley's position to benefit from smart grid deployment

Forecasts for growth

There are various forecasting studies that have been carried out for the smart energy network sector, a number of which are summarised in the 'Economic Forecast' table at the end of this section. They are generally not comparable, due to being at different scales, using different methodologies and forecasting different outputs. For example, some forecast cumulative value or revenue, some forecast annual spend and others predict annual growth rates. They also differ in the technologies included in the assessment. It is possible, however, to compare growth rates when a study has forecasted cumulative revenue over a specified time period or has estimated the size of a current market and predicted a growth rate. The growth rates from four studies are summarised in the table below:

Author	Geographic scale	Cumulative revenue	Time scale	Annual compound growth rate	Technology included in market forecast
GTM Research	Global	$400 bn	2012-2020	8%	Smart grid technologies
Navigant Research	Global	$494 bn	2012-2020	10%	Smart grid technologies
Pike Research	Global	$420 bn	2012-2015	17%	Renewable energy production, storage and conversion
TSB	UK	£43 bn	2013-2023	30%	Building energy management systems

The significant difference between the GTM/Navigant and Pike global forecasts is likely to be due to the inclusion of renewable energy production in the Pike methodology, which would have significant income that is not included in the other global forecasts. TSB's forecast for a high annual growth rate for building energy management systems in the UK is based on the EU having a strong footing in this area already, and differs significantly from the other studies as it focuses on only one area of smart technologies.

Several of the country specific forecasts estimated wider economic benefits, i.e. in addition to direct financial benefits, which included environmental and reliability benefits. The table below scales these findings to Cornwall and the Isles of Scilly using population size and extrapolates them to 2020 and 2030 for sake of comparison. It is important to note, however, that the methodologies and assumptions behind them are different, as is the policy context of each country. Therefore, it is a useful benchmark, but should not be applied directly to Cornwall and the Isles of Scilly.

Study country	Author	Economic forecast – financial benefit and timescale	Equivalent revenue per annum for Cornwall	Equivalent cumulative revenue for Cornwall 2020	Equivalent cumulative revenue for Cornwall 2030
USA	Electric Power Research Institute	USD 1,294 -2,028 billion between 2011-31	£90m	£538m	£1,434m
Australia	Australian Government	AUD 5 billion per annum	£70m	£420m	£1,120m
Korea	Korea Smart Grid Institute	KRW 9.67 trillion between 2012-16	£15m	£93m	£247m

Some studies break down the economic benefits by sub sector, for example business opportunities for the UK supply chain 2012-2050 are forecast by Ernst & Young[87] to be £1 bn/y in the mid 2020s and are split broadly as:

- 56 per cent manufacturing

[87] Ernst and Young and SmartGrid GB. (2012) Smart grids: a race worth winning? A report on the economic benefits of smart grid.

- 27 per cent ICT
- 17 per cent project management and finance.

Ernst & Young conclude exports in the period 2012-2050 will be around £220m/year with 75 per cent coming from manufacturing. In addition there are benefits from Intellectual Property and Foreign Direct Investment stimulating secondary industries.

Reducing energy spend and income generation for 'prosumers'

A number of studies have stated that smart energy networks will reduce energy prices as a result of peak savings, better information and therefore lower consumption, time of use tariffs and more efficient transmission and distribution. But few studies quantify the potential energy bill reduction for the end user. An exception is the New York Smart Grid Consortium, which forecasts reductions in consumer energy bills of $10,730 million between 2011 and 2025 in the state of New York.[88] About a third of this saving is attributed to 'price savings from lower usage' and another 20 per cent to 'savings from reduced usage'.

Another area with potential significant economic impacts is from balancing services provided by large energy users or consortiums of smaller users. At present, the total demand-side contribution is modest, with perhaps only 1-1.5 GW contracted in the UK market in some way.[89] This sits against an installed generating capacity of about 80 GW and a maximum winter peak of approximately 58 GW. However, the market is growing as a result of interest from commercial players and policy-makers (see Appendix 5 for a summary of the proposed Capacity Market).

Sustainability First estimate that the total value of balancing services, in which the demand-side can in principle participate, amounts to £383 million in the UK.[90] The Low Carbon London, LCNF project, is running demand response trials with industrial and commercial customers and forecast contract payments to customers starting at £6,300 in 2015, rising to over £100k in 2050 based on a shift in peak demand of 8 per cent.[91]

We estimate that the potential income for Cornwall and the Isles of Scilly from localising balancing costs could be in the region of £44m at present, £62m by 2020 and £64m by 2030 (see Appendix 13, Smart Wadebridge Case Study for details).

Innovation

We reviewed the literature to understand the impact Smart Cornwall could have on Cornwall and the Isles of Scilly's objectives. The draft Cornwall and Isles of Scilly LEP European Structural and Investment Fund Strategy puts a high priority on supporting companies that will make the greatest economic return. It states it will focus on:

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[88] NYS SmartGrid Consortium (2010) Smart Grid Roadmap for the State of New York
[89] Sustainability First (2012) What demand-side services can provide value to the electricity sector?
[90] Ibid
[91] EDF Energy Networks (2010) Low Carbon Networks Fund: Low Carbon London full submission proforma. Apendix A.

"Investments which will accelerate increases in productivity and competitiveness in the region's businesses". [92]

We found little evidence on the impact of projects that support the development of smart energy on the level of innovation within an economy. One example is the Ernst & Young 'Race Worth Winning' report, which suggests there will be benefits from Intellectual Property but does not quantify these.

There is, however, significant literature on innovation and the role of the knowledge economy generally, which highlights the value of programmes that develop clusters of knowledge. For example, the Department for Business, Innovation and Skill's Innovation Strategyconcludes:

"Innovation is the engine of long-term economic development because it is the channel through which improved knowledge is applied to economic processes."

And notes:

"Clusters of knowledge and innovation hotspots have emerged in a wide variety of studies as a prevalent feature of competitive advantage." [93]

A report by the Work Foundation highlights the link between knowledge and economic benefits,

"Our results confirm high economic returns to knowledge – the vast majority of those in the most knowledge intensive jobs enjoyed pay well above the median." [94]

To understand better the opportunity to support the smart energy sector to improve innovation and knowledge based activity, we have undertaken our own analysis of the likely supply chains for smart energy and how these map against the knowledge economy, which is presented in Appendix 8.

In summary, support for knowledge based clusters of enterprises has a clear link to economic benefits to a locality and the objectives of the LEP SIF strategy.

The smart energy sector seems likely to be heavily knowledge based, but we have reviewed this in more detail in analysising the Cornish and Scillonian business base.

[92] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013
[93] BIS ECONOMICS PAPER NO. 15: Innovation and Research , Strategy for Growth, DECEMBER 2011
[94] Work Foundation (2009) Knowledge Workers and Knowledge Work

Economic forecasts

Scale	Author	Year	Predicted impact	Methodology
Global	Navigant Research	2013	Smart grid technology market will total $494 billion in cumulative revenue from 2012 to 2020 $73 billion in annual revenue by 2020 Compound annual growth rate of over 10%.	It examines the market dynamics and technology issues for smart grid technologies for the period from 2012 through 2020. Analysis and forecasts are presented year-by-year and cumulatively through 2020, dissecting the market by smart grid application and by region, with further technology segmentation within each application.
Global	GTM Research	2013	Cumulative value of the smart grid market to surpass $400 billion by 2020, growing with an average compound annual growth rate of over 8% Annual spend of $63 bn by 2020	The report first examines the global smart grid market from a comparative perspective, looking at the expected growth rate of the individual regions as well as the cumulative global growth rates of discrete smart grid technologies. Forecasts are based on the key metrics of market segment value, percent share of the overall smart grid market, and compound average growth rate (CAGR).
Global	Zpryme	2012	Smart Grid core and enabled technology market expected to grow to $220 billion by 2020	Not clear what this figure refers to – likely to be cumulative value. Forecasted market value by region and market segment. Included both distribution automation and energy management systems.
Global	Pike Research	2012	Renewable energy integration technologies forecast to grow to £8bn by 2020	Only looked at renewable energy integration technologies
Global	Pike Research	2012	Total revenue from smart energy and smart energy storage reached $222 billion in 2011. By 2015, total market value will be $420 billion — an increase of 90% in four years.	This study does not look at smart energy networks specifically. It looks at three main application sectors – renewable energy production, energy storage, and energy conversion devices – along with 15 key subsectors.
UK	Ernst & Young	2012	£19 bn cost saving from deployment of smarter grid rather than employing conventional technologies Expenditure required to deploy smart grid (£23bn) likely to result in economic benefits across supply chain: • Approx £13bn of GVA between now and 2050 • Average 8,000 jobs sustained during 2020s rising to	Compares the cost of meeting projected grid requirements using only conventional investments with the cost of using smart technologies. The difference in cost is the 'net benefit'. Direct, indirect and induced impacts of smart grid spend (£23bn) calculated using economic model of UK input-output tables, adjusted for the domestic share of the supply chain.

			9,000 during 2030s. • Exports could be worth £5bn between now and 2050. • Benefits from export of intellectual property and FDI may also result.	
UK	Technology Strategy Board	2013	The UK is the sixth largest supplier of energy management systems, with £2.8bn of UK sales, and £0.34bn of exports. It is predicted to grow globally at 10% a year over the next decade, while the smart-energy solutions market is expected to grow at 30% annually in the EU.	No methodology or source is provided.
USA	Electric Power Research Institute	2011	\$338 - \$476 billion net investment required between 2011-2031 \$1,294 and \$2,028 billion net benefit	Identified a number of attributes of the energy system (cost of energy, capacity, security, quality, reliability, environment, safety, quality of life, and productivity) and developed frameworks to estimate the value of improving them.
Australia	Australian Government	2009	Gross benefits could reach, at a minimum, \$5 billion annually.	Direct financial benefits considered along with reliability and environmental benefits. Four applications were flagged as especially important: customer applications, integrated Volt-VAR control including conservation voltage reduction, fault detection isolation and restoration, and distributed storage.
Korea	Seoul National University	2009	The total potential benefit of implementing SG technologies over the next 22 years is conservatively estimated to have a present value(PV) of about ₩14,711 billion	The only benefits calculated relate to the financial aspects resulting from the deferral of generation, transmission and distribution costs.
Korea	Korea Smart Grid Institute	2012	KRW 3.6 trillion will be invested in four areas and sixteen policy projects by 2016, whose economic impact and new growth engine creation are expected to amount to KRW 9.67 trillion 33,162 jobs likely to be created	Benefits included in study: Value added creation Reduction of Electricity consumption by business/households Reduction of power plant construction costs Reduction of cost of CO2 damage Reduction of electricity T&D loss and damage caused by power interruption New Growth Engine Creation, including: Smart meter; EV; storage; demand response

1.2. Environmental impacts

Environmental improvements are expected to result from a reduction in carbon emissions and consequent improvement in air quality. The reduction in emissions could result from:

- Greater penetration of renewables
- Reduced use of inefficient generation to meet system peaks
- More efficient operation and reduction in system losses
- Increased capability to support the integration of electric vehicles and the electrification of heat
- Improved opportunity to optimise energy consumption behaviour.

Various studies have quantified the potential reduction in carbon emissions from the deployment of smart energy technologies and services. For example:

- EPRI forecasts that a smart grid could reduce total U.S. electricity consumption by 1.2–4.3 per cent to 203 billion KWh's by 2030. It also estimates that a deep penetration of electric vehicles could reduce emissions by 60–211 million metric tons in 2030[95]
- Ofgem carried out a study in the UK on the impact of different forms of energy use information on consumption patterns, and found that smart meters with a real-time display resulted in persistent savings of around 3 per cent.[96] Similarly the Telegestore project in Italy estimates that at national level, the introduction of time-based rates, made possible by the roll-out of smart meters, could reduce energy consumption by 5-10 per cent and shift 1 per cent of the energy demand to low peak load times[97]
- Project FENIX (Flexible Electricity Networks to Integrate the eXpected energy evolution) predicts that large-scale use of flexible operational aggregation of distributed energy resources by a virtual power plant can result in reduction of system gas consumption and therefore in CO_2 emissions by 7.5 kg CO_2 /kWflexibleDG/year in a northern European scenario and by 13 kg CO_2 /kWflexibleDG/year in a southern European scenario[98]
- The Inovgrid project in Portugal is testing a new grid architecture in an urban area of about 32,000 customers, which is expected to increase the capability to integrate renewables into the grid by 10-50 per cent through enhanced planning and by 50-100 per cent through active asset management, and to increase the integration of EVs into the grid by 50 per cent through active network and charging management.[99]

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[95] DOE/NETL (2010) Understanding the Benefits of the Smart Grid
[96] Ofgem (2011) Energy Demand Research Project Final Analysis
[97] European Commission, Joint Research Centre, Institute of Energy (2011) Smart Grid projects in Europe: lessons learned and current developments
[98] Ibid
[99] Ibid

One aspect that hasn't been explored in much detail is the impact of balancing services provided by large energy users (either industrial and commercial or a group of smaller users) on reducing system peaks and inefficient generation. Research suggests that it is *technically* possible to shift approximately one third of the electricity load, i.e. up to 18 GW on a winter weekday evening, which could significantly reduce carbon emissions from inefficient generation.[100] There are a number of LCNF funded projects that are considering demand-side response, but have not yet quantified the impact. These include:[101]

Customer-Led Network Revolution	An integrated trial looking at how a combination of smart network technologies and flexible customer demand response can reduce the network costs associated with the mass take up of low carbon technologies. It has investigated the potential of industrial and commercial demand-side response to reduce network costs. Trials were completed in the winter of 2011/12 with commercial aggregators at three sites, which successfully responded to 9 out of 13 DSR events.[102] CE Electric state that "There may also be a carbon saving resulting from this category of load shifting, although this depends on the relative carbon intensity of the replacement, and displaced, generation… we have assumed that the net impact of DSR on carbon emissions is zero, given our conservative approach to benefit estimation."[103]
Low Carbon London	This project seeks to extract network learning from a variety of separate trials across the inner and outer London area. These include new commercial arrangements including time of use DUoS tariffs with domestic customers and demand response trials with industrial and commercial customers. The project proforma forecasts that the project will reduce CO2 emissions by 17.5% by 2050, of which demand-side management would make up 20%, i.e. 3.5% overall.[104]
FALCON	FALCON will trial a range of technical and commercial methods, including commercial agreements with industrial and commercial customers who have the ability to control appreciable amounts of load in relatively short periods of time.
New Thames Valley Vision	This is a large project which is primarily focused on developing a tool to help forecast where low carbon technologies might connect to the network. Amongst other things the project will investigate how automated demand response in commercial premises can provide network benefits.

Each of the quantification studies has estimated or calculated potential carbon emission reductions from a certain element of smart energy systems, such as renewable energy integration, the uptake of electric vehicles or time-of-use tariffs. None take a holistic approach to a geographical area that takes all known smart energy technologies and services into consideration. None, that we are aware of, have quantified the impact of reducing peak demand and consequent reduction in inefficient generation.

[100] Sustainability First (2012) What demand-side services can provide value to the electricity sector?
[101] Ofgem (2013) Creating the right environment for demand-side response
[102] Norther Power Grid (2012) Customer-Led Network Revolution: Project progress report 3
[103] CE Electric UK (2010) Low Carbon Networks Fund: Customer-led Network Revolution full submission proforma
[104] EDF Energy Networks (2010) Low Carbon Networks Fund: Low Carbon London full submission proforma

They have also used different metrics, which makes them difficult to compare. However, they do all demonstrate that significant emission savings can be made from smart energy networks.

1.3 Social impacts

There has been a greater focus on the potential economic and environmental impacts of a smart energy network, with a lack of quantification of the social implications. However, it is clear there are a range of complex, interconnected potential impacts from smart energy network, many of which cross over with the economic and environmental impacts. Below is a selection of social benefits that reoccur throughout the literature.

Reduced energy costs

- Increased capability and motivation to reduce energy consumption
- Potential to reduce fuel poverty
- Improved operating efficiencies of delivery companies and electricity suppliers will reduce their O&M and capital costs, keeping downward pressure on electricity prices

Improved energy service

- Improved quality of power supply and enhanced reliability of service
- More accurate billing and better consumption management
- Greater choice of suppliers and tariffs
- Opportunity to produce own energy from microgen or local energy markets

Benefits for wider society

- Improved air quality and reduction in carbon emissions
- Training and jobs for a new 'smart' workforce
- Better public health from improved air quality and warm homes
- Improved energy security

A useful analysis by the European Commission highlights a number of social aspects that should be taken into consideration for the success of smart grid development. These cover:[105]

- **Jobs:** both the potential for job creation (e.g. 280,000 new direct jobs and more than 140,000 new indirect jobs in the USA between 2009-2012) and potential for employment decline resulting from greater efficiency as well as mergers and acquisitions (e.g. in EU15 almost 250,000 jobs have been lost in the electricity sector since 1995)
- **Ageing workforce:** nearly 25 to 35 per cent of utility technical workforce will retire within 5 years, resulting in both an opportunity for a new workforce as well as shortages of qualified technical personnel

[105] European Commission, Joint Research Centre, Institute of Energy (2011) Smart Grid projects in Europe: lessons learned and current developments

- **New skill requirements:** high level of flexibility, adaptability, customer-focused approach, sales skills and regulatory expertise required. Adequate up-skilling of the workforce is essential. Europe is lagging behind China, India and USA in producing engineering graduates
- **Organisational and management issues:** shift from SMEs to big corporation due to mergers and acquisitions
- **Safety:** reduction of hazard exposure for field workers due to remote reading through smart meters, with an estimated annual benefit of $1 million
- **Privacy:** concern about the use of data by insurers, market analysts, or even criminals to track the daily routine of consumers
- **Gender equality in the workforce:** women represent only 15 per cent of the workforce in the energy sector. A shift to a smart grid offers an opportunity to adjust this imbalance.

The Global Smart Grid Federation Report 2012 focuses on consumer issues being key to the growth of the smart grid market:

> • *The most difficult challenge to a successful smart grid lies in winning consumer support. Without it, the smart grid cannot exist and it cannot deliver its promised benefits. Ultimately, the consumer is paying for the smart grid. The smart grid does yield important benefits for consumers, but they come at a significant cost and, at the individual level, the need for these benefits may feel less immediate.*
>
> • *Winning consumer support hinges on a radical change in thinking by utilities about their customers and by consumers about electricity. Utilities risk taking their customers for granted, being overly technocratic in their relationship with them, and possibly alienating them. They would be well-advised to engage with consumers on a new level, perhaps borrowing from the best practices of more competitive, consumer-centric industries. Likewise, in many developed countries, consumers risk taking electricity for granted as a low-cost commodity, which is always available, rather than a commodity subject to market swings in a manner similar to gasoline. Active consumer engagement in the power system will depend on a change in this perspective.*
>
> • *The government is best positioned to educate consumers on the value of the smart grid. The smart grid is really part of government strategy to achieve societal goals. The electricity sector is highly regulated by government. The government has the resources and skills needed to mount large scale smart grid messaging campaigns. It is also the best advocate for citizens on consumer-oriented issues such as affordability, privacy, cyber-security, health and safety.*
>
> • *Government can be an effective mediator between the consumer and the power system. Governments can (a) better persuade consumers of the benefits of smart grid, (b) better represent and protect their interests in smart grid developments, and (c) provide an effective*

framework of incentives (and disincentives), which induce the desired behaviours while still empowering consumers with choice. [106]

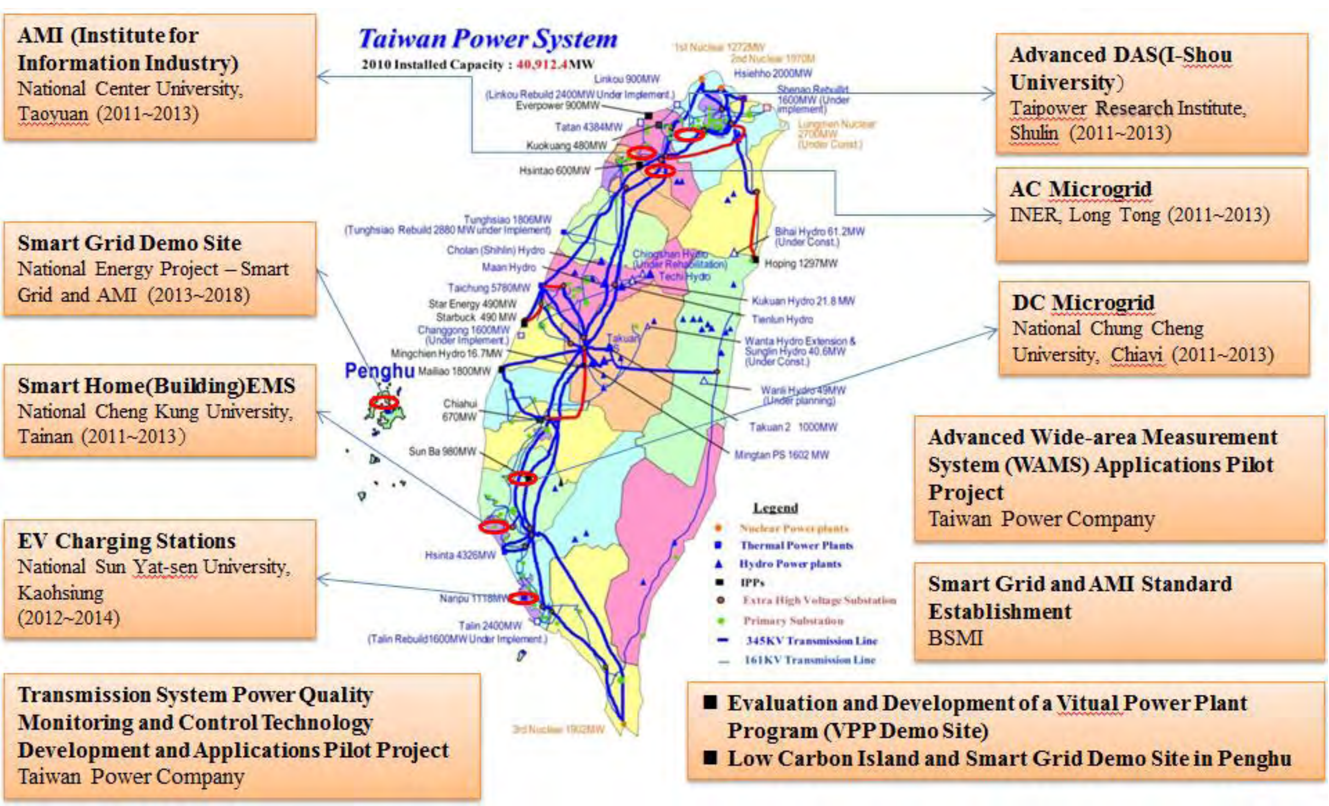
In summary, there has been very little quantification of social impacts from smart energy networks to date, other than around job creation and reducing household energy consumption. The take-up of smart technologies will become an important indicator for monitoring the need for government intervention to educate consumers and help build trust in the industry.

2. Smart development initiatives

2.1. Nationwide approaches

Several countries are leading the way for smart energy network investment and deployment, including Taiwan and South Korea. We reviewed the approach that had been taken in these countries and the types of projects and initiatives that had been established to better understand their successful positioning in the global marketplace.

Taiwan has a nationwide approach to implementing a smart grid, which is enabled by having one major electricity supplier – the state owned Taipower. The implementation plan covers everything from smart generation to transmission, distribution and customer participation. A number of projects have been set up to test different technology and systems, which are set out in the picture below:



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[106] Global Smart Grid Federation, The Global Smart Grid Federation Report 2012.

One of the most significant of these projects is the **low carbon island project in Penghu** archipelago, which is 50 km from Taiwan, has 89,000 inhabitants and has a peak load of 83 MW. The project uses smart meters, substation intelligence, power management systems, a range of renewable energy technologies and electric vehicles. It aims to produce 50 per cent of total energy demand from renewables, to reduce consumption by 7 per cent and reduce carbon emissions by 50 per cent by 2015.

South Korea also has a national strategy, with the stated ambition of having the world's first 'national level' smart grid by 2030.[107] South Korea also has a large scale smart grid demonstration project is Jeju Island in South Korea. According to South Korea's national roadmap, the Jeju test bed covers about 6,000 households and is divided into five strategic areas: smart power grid; smart place; smart transportation; smart renewable energy; and smart electricity service. Its purpose is to serve as the foundation for the commercialisation and industrial export of smart grid technologies through establishing the world's largest and high-tech test bed. The South Korean government has attracted about 170 private companies to participate and has secured KRW 76.6 billion from government and KRW 172.7 billion from the private sector.

Key learning points from Taiwan and South Korea are the importance of:

- An overall strategy, which provides leadership and certainty for investors
- Large scale demonstration projects, which help establish a reputation in the sector and enable a joined up approach to developing different technologies and services
- Strong links with businesses and the opportunity for the commercialisation of products and services.

Each of these points is echoed in interviews with stakeholders (see Appendix 7), particularly the need for strong leadership, governance and commitment to the sector.

Closer to home, we have the **Scottish** national Smart Grid Sector Strategy.[108] The strategy was led by an industry working group comprising SSE, Scottish Power, GE Energy, Cisco, the University of Strathclyde and Scottish Enterprise. It sets a target for 12,000 new jobs in Scotland and aims to secure a place for Scotland as an exemplar in smart grid adoption and as a leading international provider of smart grid technologies. The strategy was launched by First Minister Alex Salmond and has strong buy-in across government. Since launching the strategy, the University of Strathclyde has opened the Power Networks Demonstration Centre; a research and testing centre with the goal of "*accelerating the adoption of novel research and technologies into the electricity industry.*"[109]The Scottish government has not yet reported on progress made, however, it can be assumed that the strategy has provided some certainty for investors and support for the Power Networks Demonstration Centre.

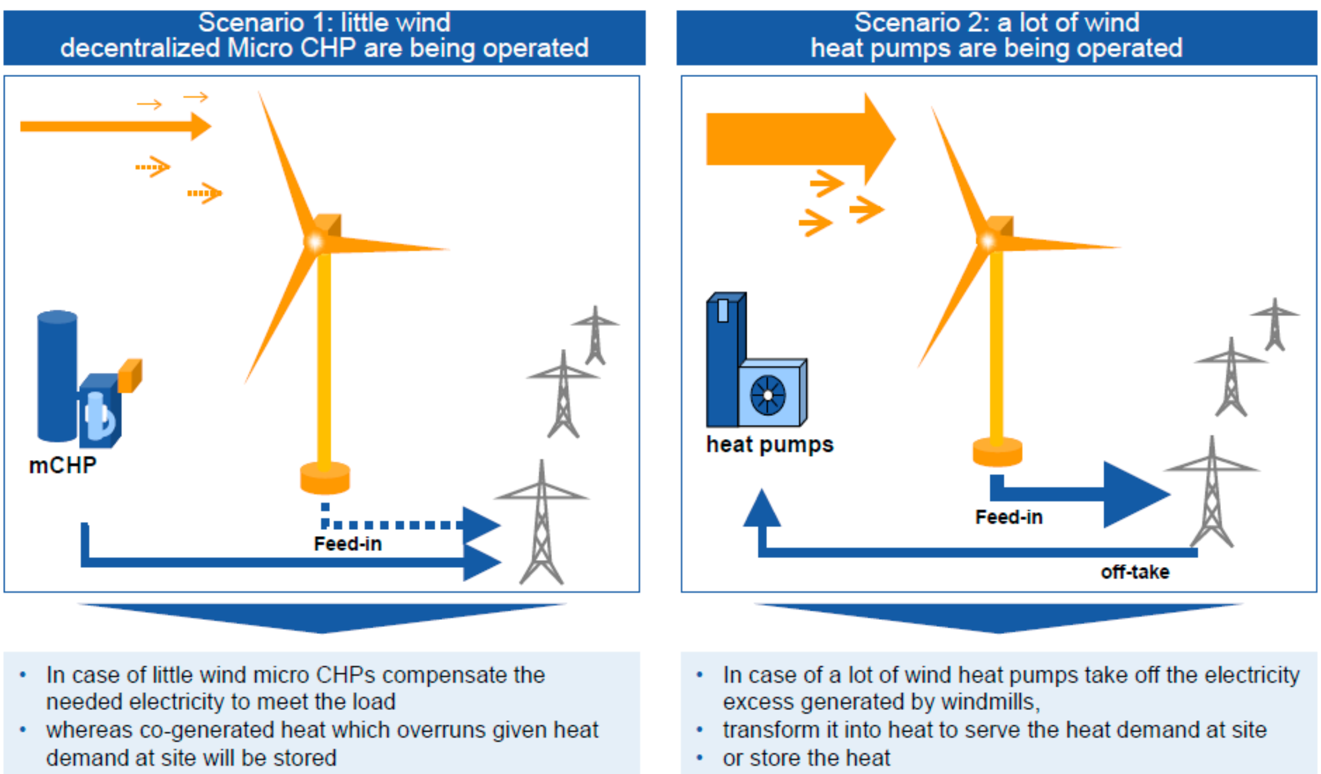
[107] Korea Smart Grid Institute, 2012, Smart Grid, An Energy Revolution in Our Daily Lives.
[108] Scottish Enterprise, 2012, Scottish Smart Grid Sector Strategy: Enabling the Low-Carbon Economy, Creating Wealth
[109] http://www.strath.ac.uk/pndc/

2.2. Projects and initiatives

In addition to looking at nationwide approaches, we reviewed a number of smaller scale projects that are relevant to Cornwall and the Isles of Scilly and feedback that we have had from stakeholders on the opportunities.

Virtual power plants (VPP) have the potential to unlock renewable energy resources, which are plentiful in Cornwall and the Isles of Scilly, and the opportunity to develop storage technologies, as well as increase the electrification of heat and transport. These were all potential growth points raised by stakeholders in interviews. For example the Swedish power company, Vattenfall, has successfully tried and tested a VPP concept in Germany. It has found that small scale decentralised assets (wind turbines, heat pumps and CHP) can be used for heat production, which accounts for 89 per cent of household energy consumption in Germany. The approach consists of the smart control of decentralised plants through a centralised control centre, which is able to forecast the wind and heat load and therefore create generation schedules. Vattenfall currently has 150,000 housing units under VPP control.

The diagram below illustrates the virtual heat and power concept developed by Vattenfall:



Vattenfall account some of the success of the project to their long-time experience in controlling large power plants. So for Cornish and Scillonian businesses to benefit from VPPs, they may need to partner with larger companies or to initially develop smaller scale projects. There is also potential for VPPs to be locally owned, therefore ensuring that more of their value is retained locally.

Research and development was another important element raised by stakeholders. An example of a research and demonstration project is Pecan Street in Texas, USA, which was set up to enable academic research as well as the commercialisation of new technologies and services. It has two divisions:

The Pecan Street Research Institute, which focuses on utility system reliability, climate change, renewable energy integration and customer needs and preferences. It has its own data centre that processes over 89 million unique electricity use records per day from over 540 homes on how customers use electricity, natural gas and water in their homes and businesses. The Institute makes this data available to the research community.

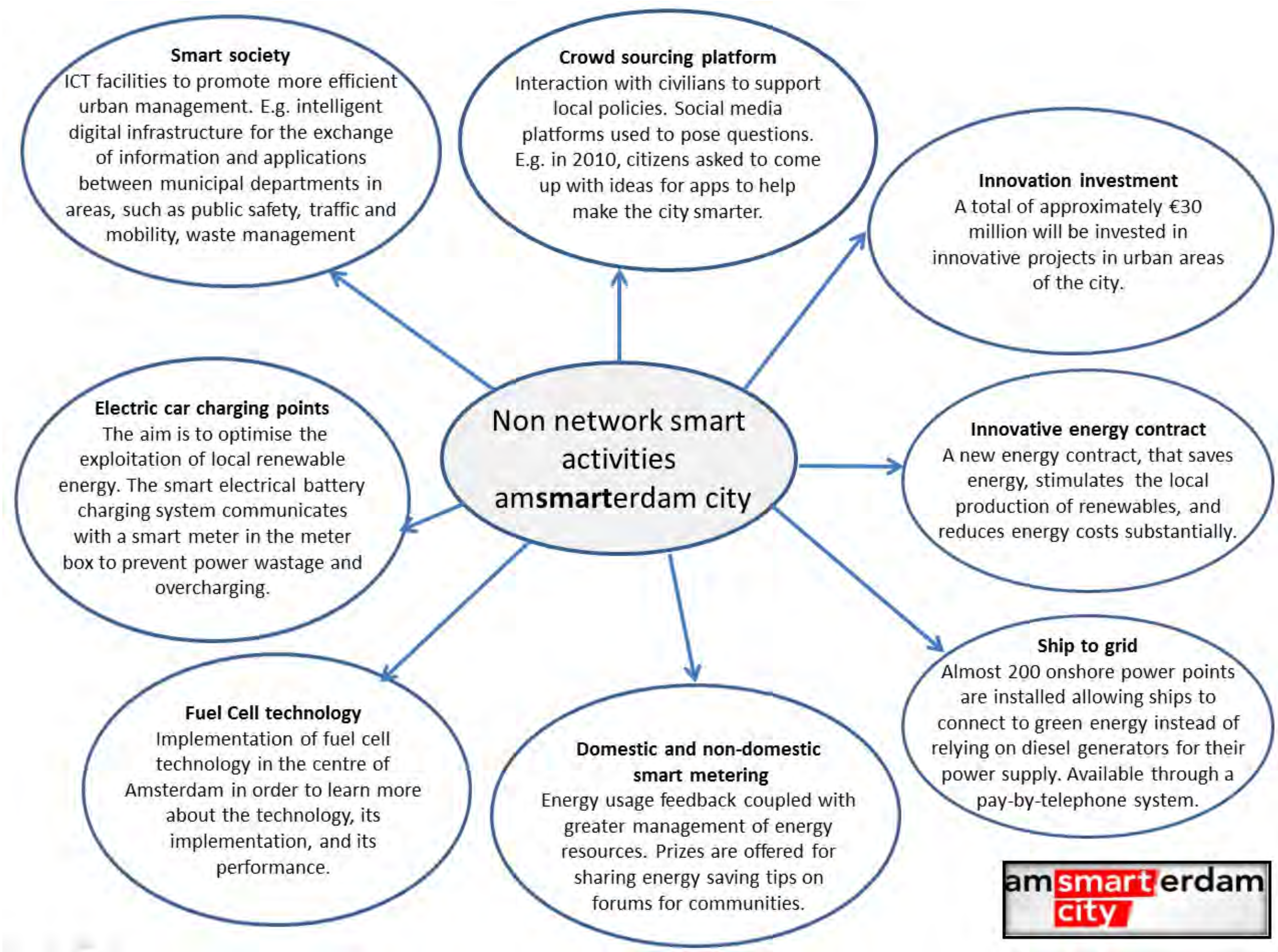
The Pike Powers Laboratory and Centre for Commercialisation, which offers specialised capabilities for developing, testing and validating a wide range of smart grid, distributed energy and consumer electronics hardware and software.

The initiative started three years ago and now employs 20 people. It has been mainly funded by the public sector and industry, but is investigating various business models to become financially independent, the most promising of which is offering data analytics to owners of commercial buildings. It has not attempted to measure the economic impact of the programme as yet, but there is some evidence that several local companies have benefited from an association with Pecan St. The view of the CTO is that local SMEs will focus on local opportunities, and that big US and global markets are a long-term opportunity.

Key points for consideration for Cornwall and the Isles of Scilly are:

- The research institute relies on data from over 540 homes and is seen as a key output. Making the most of the data produced is seen as a key element of maximising the benefits of smart energy projects.
- Research and commercialisation centres are not enough on their own to stimulate rapid growth in local SMEs and innovation.

Non-grid smart activities were another area of interest, particularly in light of the strong ICT and creative industries in Cornwall and the Isles of Scilly. An example of a set of non-grid smart activities is provided by the Amsterdam Smart City project in the Netherlands, which was initiated by the Amsterdam Economic Board, the City of Amsterdam, Liander and KPN. It has grown into a broad platform, with more than 70 partners that are involved in a variety of projects focussing on energy transition and open connectivity. Examples of the different elements of the project are set out below:



Key points for consideration for Cornwall and the Isles of Scilly are:

- Smart energy is seen by many as part of wider smart activities
- Adoption of wider smart activities requires buy-in and participation from a significant number of skakeholders, and therefore requires strong leadership, coordination and facilitation.

3. Examples of business development programmes

We also looked in the literature for examples of how similar sectors had been supported and how successful these initiatives had been.

One of the largest silicon design clusters in the world is the semiconductor industry in south west England. NESTA reports that the south west cluster contains around 50 companies and directly employs in the region of 5,000 people.[110] The growth in the sector is attributed to several large

[110] NESTA (2010) Chips with everything: Lessons for effective government support for clusters from the South West semiconductor industry

companies, such as Inmos and Plessey, bringing in a highly skilled workforce and attracting entrepreneurs, companies and investors to the region. This has been supplemented by targeted support by the universities. The industry and universities have worked together to solve challenges such as difficulties in recruiting good quality graduates and adequate access to finance for start-ups. NESTA concludes that public sector funding is only required to support networks and incubation models, and to enable private sector funds to be leveraged.

Innovation has been supported in Cornwall and the Isles of Scilly through the use of EU funding to create innovation centres. An example of which is the Tremough Innovation Centre, which opened in February 2012. It has floor space to accommodate up to 70 enterprises each of which, on average, could be expected to employ between 3 and 4 people. It is ahead of its original projections and currently reports:[111]

It is expected to continue to grow and to create in the region of 160 new jobs.

Another example of where public sector funds have proven successful is in developing the renewable energy sector in the south west. In February, 2010 DTZ[112] was commissioned by the South West RDA to undertake the evaluation of Regen SW, whose role was to maximise the deployment and uptake of renewable energy in the region and to unlock sustainable energy business opportunities. The quantitative impact assessment identified the following net impacts (between 2002-10):

- 67 net additional jobs created
- Total GVA impact of £22.1 million – comprising £11.7 million of impact to date, plus £10.3 million projected future impact including persistence, equivalent to a return of £5.10 for every £ invested by the South West RDA
- Deployment of 15.3 MW of renewable energy attributable to Regen SW to date, this is around 16 per cent of the total renewable energy capacity deployed over the period between 2005-2009,
- Total Carbon Saving on projects deployed to date of 120,000 tonnes CO_2e
- Projected future carbon saving of 443,000 tonnes CO_2e from projects not yet deployed

[111] http://www.cornwallinnovation.co.uk/tremough-innovation-centre/our-centre
[112] DTZ (2010) Evaluation of the "Regen SW", "SW Bioheat Programme" and "SW Bio-energy Capital Grants Scheme" Projects

- Direct leverage of £9.1 million – just over twice the original investment.

In summary, the Tremough Innovation Centre and Regen SW provide examples of where public money has been spent to support innovation and sector development, which has successfully resulted in creating jobs. Universites have played an essential role in R&D and facilitating networking in the semiconductor industry, and public sector funds have been required to support incubation models and to leverage in funds.

4. Developing new sectors

The smart energy sector is relatively new, and evidence on the success of efforts by countries and regions to support growth is limited. However, there is a significant amount of literature on how to support emerging sectors and how to create business clusters, including academic studies, national and local strategies. We have reviewed a number of reports in order to summarise the key principles. The UK Government Industrial Strategy sets out its commitment to backing and developing key economic sectors of the economy with high growth potential. The Strategy concludes:

> *"It is clear that there is no single prescription, and there are many variants of targeted policies. They include policies to: foster clusters, support innovation activity, build links between education providers and industry to strengthen market signals on industry skill demand, attract foreign direct investment, and ensure access to finance."* [113]

There is more detail on local action to develop the economy in the BIS paper on local growth, which concludes "*Localities themselves are best placed to understand the drivers and barriers to local growth and prosperity, and as such should lead their own development to release their economic potential*".[114]

In deciding where localities should focus their efforts to support local specialisation and clusters there is a useful summary in the South West Regional Development Agency's 'Economic Development Guide', which sets out the following criteria: [115]

- Comparative advantage: where sector support can help to develop and / or maintain a national or international advantage
- Economic scale: sector employs a large number of people and / or contributes a significant share of the region's output
- Economic potential: sector with potential for significant growth in the medium term based on knowledge, technology and locational factors
- Sustainability and aspiration: support for the sector helps the region achieve wider goals such as sustainability.

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[113] BIS Economics Paper No. 18 Industrial Strategy: UK Sector Analysis, September 2012
[114] BIS Economics Paper No. 7 Understanding Local Growth October 2010
[115] South West Regional Development Agency's (2011) Economic Development Guide

The critical factors for policy makers to focus on in sector development are set out in report by Ecotec for the Department of Trade and Industry, which concludes that the three 'critical success factors' are:

1. The presence of functioning networks and partnerships
2. A strong innovation base, with supporting R&D activities where appropriate
3. The existence of a strong skills base.[116]

Four other factors also are seen to contribute to successful 'cluster' development, but do not figure as prominently in the evidence:

4. Access to sources of finance
5. An adequate physical infrastructure
6. The presence of large corporations
7. A strong entrepreneurial culture.

NESTA looked at the success of the semiconductor cluster in the south west and drew out two important lessons for supporting growth:

> *"First, investment in networks, whether university or private sector-led, can help grow clusters by introducing customers and suppliers, providing mentoring and sharing resources.*
>
> *Second, incubation models, embodied by the SETsquared partnership in the South West, can work to promote growth of new companies in these regions and highlights how universities can effectively pool their resources to support these companies."*[117]

These two lessons echo the first two critical success factors above and emphasise the importance of universities in the development of high tech businesses.

The extensive experience of sector development provides Cornwall and the Isles of Scilly with an important checklist in focusing and targeting its efforts.

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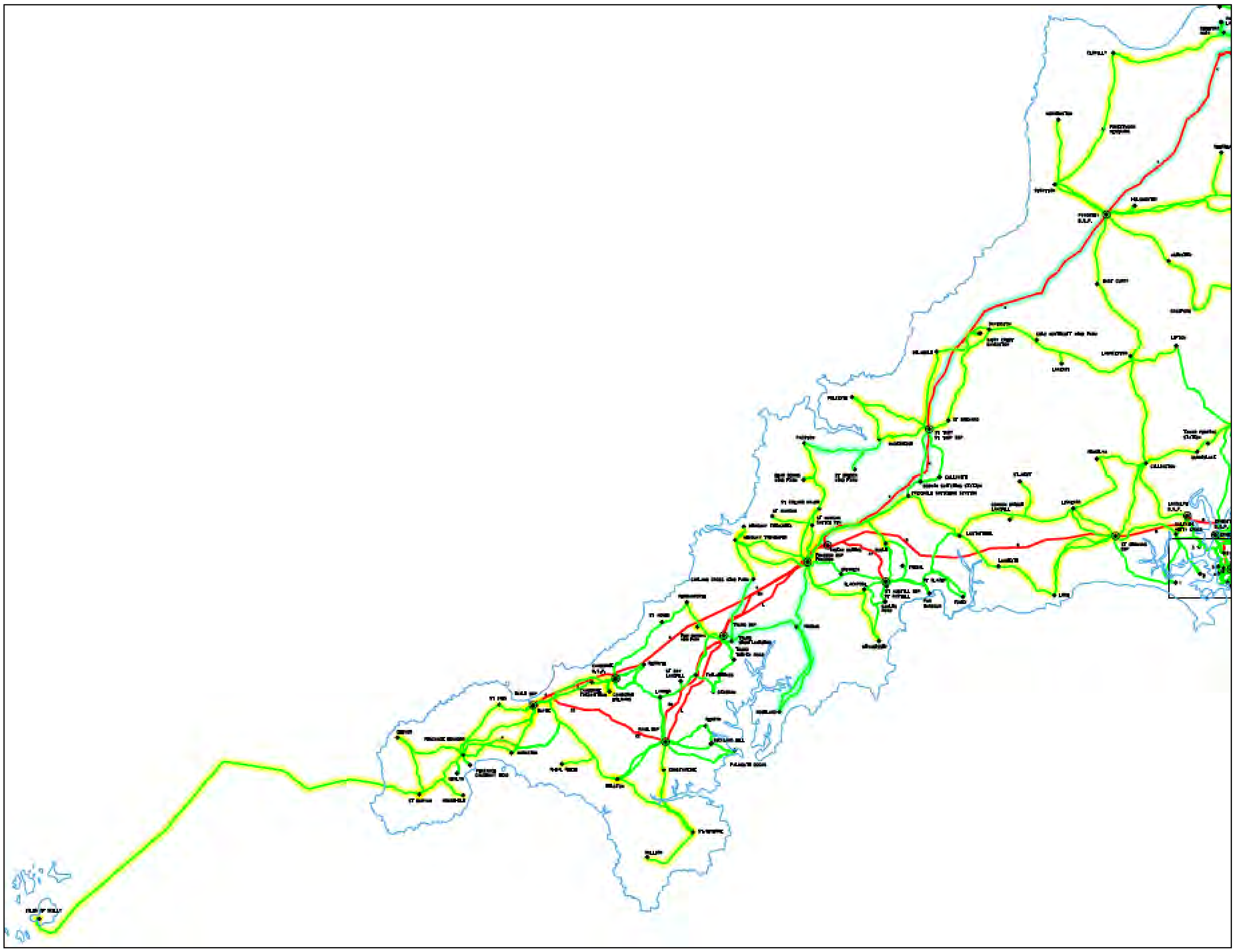
[116] Report by Ecotec for the Department of Trade and Industry. "A Practical Guide to Clustering" http://webarchive.nationalarchives.gov.uk/+/http://www.dti.gov.uk/clusters/ecotec-report/dti_clusters.pdf.

[117] NESTA (2010) Chips with everything: Lessons for effective government support for clusters from the South West semiconductor industry

Appendix 4: The Cornish and Scillonian electricity grid

The distribution network in Cornwall and the Isles of Scilly is broadly at capacity, meaning that during times of peak demand and supply, network equipment is operating at its voltage or thermal limit. This is a major barrier to Cornwall's ambitious aspirations for the development of renewable energy set out in its draft Local Plan.

The map below[118] illustrates the extent of the grid constraints. The red lines are the 132/275 kV lines and the green are the 33 kV. The yellow shows where there is voltage constraint and the blue where there is thermal overload.



[118] Western Power Distribution 2013, http://www.westernpower.co.uk/docs/connections/Generation/Generation-capacity-map/Distributed-Generation-EHV-Constraint-Maps/South-West-Thermal-Map.aspx

Under Ofgem regulations, WPD (and all Distribution Network Operators) are unable to speculatively invest in their network for the benefit of generators. This regulation protects demand customers from the associated network reinforcement costs and means that connecting generators must pay for the entirety of sole use assets plus a proportion of shared use assets[119] (e.g. 132kV reinforcement) required to connect their project. High voltage network reinforcement is now included in almost all generation connection quotes issued to applicants by Western Power Distribution (WPD),[120] greatly increasing the risk and cost and viability to developers of new generation projects.

One potential solution Ofgem encourages is the use of collaborative applications for new grid connections from groups of developers (allowed under Section 22 of The Electricity Act 1989) as the mechanism by which the cost of connections could be shared, reducing cost to individual developers. Regen SW have been exploring this approach with WPD and project developers. However, feedback is it is only likely to work in some cases.

Smart grid solutions present a set of alternative opportunities to free up capacity in the network by using existing network assets more effectively. Although, WPD are clear that the current state of the grid means reinforcement will be required in addition to smarter approaches. At present, WPD's development work in smart grid technology is funded under the Low Carbon Network Fund (LNCF),[121] Innovative Funding Initiative (IFI) and similar grant funding programmes. Only a small portion of funding and effort is assigned to the development of Smart Grid work under their latest RIIO-ED1 Business Plan (2015-2023).

Investment in the network driven by demand and/or ageing infrastructure replacement was discounted for the following reasons:

Demand – current demand is fairly flat, rising at a rate of approximately 1 per cent per year; a result of the slowdown in the construction sector and implementation of energy efficiency measures. This means that current demand customer needs do not present a driver for significant grid reinforcement or the development of Smart Grid technology.

Ageing infrastructure – network assets are replaced on a piecemeal basis, only replacing equipment that is at the end of its life. This means that there is no case to replace large sections assets at once which might have presented an opportunity to develop a dedicated section of the network for a Smart Grid demonstration project.

Planning for smart grid work is informed by EA Technology's Transform model, used to develop an understanding of the investment needs of growth in low carbon technology on the network.[122] WPDs *Foundation for Smart Grids* section of the RIIO-ED1 business plan summarises the output of the Transform model with respect to the need for enabler technologies (data communication and analysis

[119] Western Power Distribution, May 2013, Regen SW Connections Meeting (document included in Appendices)
[120] Regen SW, May 2013, Western Power Distribution Grid Reinforcement Seminar Meeting Summary (document included in Appendices)
[121] Phone conversation with Ben Godfrey, Western Power Distribution 13/08/13
[122] Western Power Distribution, July 2013, RIIO-ED1 Business Plan, pg. 101

systems) required to support future smart grid development. The majority of the communication technologies identified are local monitoring and control systems. At present these costs are rolled up with Operational Information Technology and Telecoms (IT&T) expenditure which totals £2.9m per year for the RIIO-ED1 period (totalling £23.4m). Communication infrastructure between local monitoring and control systems and central control centres is also identified as a requirement for Smart Grid foundation work. The budget forecast for this particular requirement over the RIIO-ED1 period is estimated at £5m, corresponding to a very small budget for Cornwall and the Isles of Scilly when divided over the 8 year time period and across WPD's total network coverage.

In the Business Plan Annex – SA-03 Innovation, WPD state that they anticipate all customers to be equipped with a smart meter[123] providing future options for demand side response and integration with network level smart grid technology. WPD have estimated as a result of increased uptake of smart meters they expect to see a total gross benefit of £9-12m.[124]

As discussed, this limited budget allocation under RIIO-ED1 means that most smart grid work will be undertaken as trial projects and funded under grant schemes such as LCNF and IFI. Some examples of current projects are given below.

WPD's LCNF funded Dynamic Line Rating (DLR) trial project in the Skegness Regional Power Zone has trialled a system that utilises the link between increased output from wind farms on windy days and increased overhead line capacity on windy days as a result of passive cooling to temporarily increase line ratings. This smart management of the network and a more flexible approach to setting the limits of network assets allows WPD to accept greater generation without significantly increasing network hardware.

A further smart grid solution under development by WPD that could increase network capacity for generation customers is the development of novel generation curtailment contracts). Generator curtailment contracts would enable WPD to use capacity on the network traditionally reserved to manage faults, with more flexibility. Freeing up this capacity with the understanding and technology to enable WPD to recover the capacity to manage faults when required would be a smart grid approach that could be used to provide additional capacity for generation customers. In order to implement such a scheme, WPD would need to upgrade 30-40 supply points across the network at a cost of approximately £250k per supply point, giving a total cost of £7.5-10.0m.[121]

Future projects under development by WPD include: a) energy storage through conversion to hydrogen and integration with the gas grid; b) installed technology for network fault mitigation and 'mesh networking' of the system; c) 'templates' for better network management (different templates for different network scenarios); and d) facilities for dealing with additional demand from electric vehicles (including fast charging) and heat pumps and additional generation load from low voltage embedded generation (e.g. small rooftop PV). Funding network wide implementation of successful projects will be

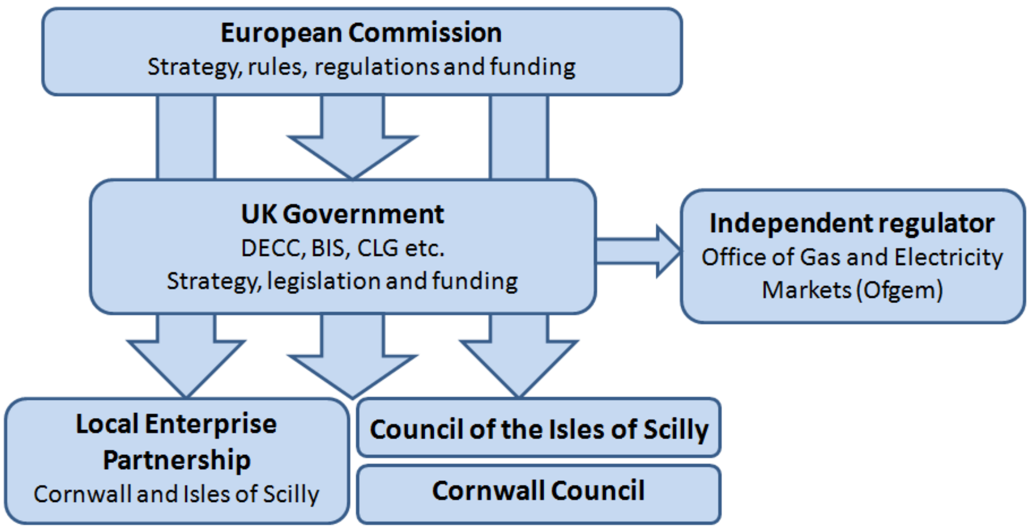
[123] Western Power Distribution, July 2013, RIIO-ED1 Business Plan, SA-03 Innovation, pg. 22
[124] See note 10, pg.31

carried out as and when it can be demonstrated that the approach is the most cost effective solution for the demand customer rather than as a speculative investment.

Appendix 5: Policy review

European, national and local policies play a key role in the smart energy market. The diagram below illustrates how European Commission policy drives UK national policy, which in turn provides a framework for how the gas and electricity markets are regulated, as well as for how Local Enterprise Partnership and local authority policy and spending is determined.

This analysis and following table of policies, strategies and commitments has focused on smart energy, with the exception of local policy, which has looked at wider strategy and vision.



The European Commission is starting to drive smart energy policy across Europe. It has recognised that smart grids are a key enabler for a future low carbon electricity system,[125] and has committed funds, for example to enable research, development and demonstration through the European Electricity Grid Initiative.[126] To date, the Commission has required Member States to assess the roll-out of intelligent metering systems and has begun work to develop common European smart grid standards. Proposals have been put forward to establish a regulatory framework to provide incentives for smart grid deployment, including requirements on Member States to produce action plans with targets for the implementation of smart grids.[127]

At a national level, DECC has responded by setting out a detailed implementation plan to ensure that every home in Great Britain has smart electricity and gas meters and smaller business and public sector premises have smart or advanced metering by 2020.[128] But there is arguably a bit of a vacuum with regard to a strategy for smart grid deployment. However, the Smart Grids Forum has plans to refresh

125 European Commission (2011) Roadmap for moving to a competitive low-carbon economy in 2050 (COM(2011) 112/4)
126 http://www.smartgrids.eu/European-Electricity-Grid-Initiative
127 European Commission (2011) Smart Grids: from innovation to deployment (COM/2011/202)
128 DECC (2012) Smart Metering Implementation Programme

the GB Smart Grid 2009 Vision and Routemap and to demonstrate the technical viability of a smart distribution network in 2030.

Another area that we have seen some momentum at the national level is in demand side response (DSR), a key aspect of smart grid development. In 2012, DECC looked at value of balancing technologies under different future generation mixes and demand profiles to understand when the electricity system might start to experience significant cost savings,[129] and consequently included DSR and storage in the Capacity Market to incentivise its development.[130] Smart Grid UK has welcomed the proposals to incentivise investment in DSR technologies, but has warned that that the pace of the Capacity Market reforms risks damaging the future demand side response industry.[131]

The regulator of gas and electricity markets (Ofgem) has also acknowledged the need for smarter energy markets and the importance of its role in smart grid policy development.[132] However, it is yet to place a requirement on DNOs to invest in smart grid technologies. The new regulatory framework – the RIIO model (Revenue set to deliver strong Incentives, Innovation and Outputs) – encourages technical and commercial innovation through incentives in the price control package and a stimulus package for innovation through the Low Carbon Network Fund (LCNF), the Network Innovation Allowance (NIA) and Network Innovation Competition (NIC).[133]

Overall, at a national level there are a range of policies, initiatives and incentives being rolled out. However, at present there is no overall strategy that links them all up and provides long-term assurance for the sector. There are signals that this will follow shortly.

This lack of a long-term strategy provides an opportunity for Cornwall and the Isles of Scilly to set out its own framework for smart energy. This could provide certainty and clarity for businesses, both local and outside of the area, to invest and could give Cornwall and the Isles of Scilly a competitive advantage over other areas in the UK.

There is strong support in Cornwall and the Isles of Scilly for innovation, entrepreneurship and for growing sectors with environmental benefits. Development of the smart energy sector fits well with Cornwall and the Isles of Scilly's wider aims and objectives, as well as those required through EU funding. The four priorities set out in the LEP's 2013 business plan are:

5. Inspiring businesses to achieve their national and global potential
6. Creating great careers here
7. Creating value out of knowledge
8. Using natural environment responsibly as a key economic asset.

[129] DECC (2012) Electricity System: Assessment of Future Challenges
[130] DECC (2013) Electricity Market Reform: Capacity Market – Detailed Design Proposals
[131] Smart Grid GB (2013) Energy Bill 2013 - Demand Side Response and the Capacity Market in focus.
[132] Ofgem (2012) Promoting smarter energy markets: a work programme
[133] Ofgem (2010) RIIO: A new way to regulate energy networks; Ofgem (2010) Handbook for implementing the RIIO model.

Similarly, Cornwall Council's vision is that *'Cornwall in 2030 will be an industry leader in environmental technologies (land and marine) and at the centre of a global network of businesses. It will combine internationally recognised research with skills in environmental technologies across the workforce.'*[134]

Cornwall Council's Economy and Culture Strategy expands on its goal to grow the low carbon economy by stating the following aims:

- Promote Cornwall as a 'green' exemplar region
- Develop the commercial potential of cutting edge, renewable energy and environmental technologies
- Promote low carbon as a business growth catalyst
- Energy efficiency for business and communities
- Deliver the economic potential of a decentralised local energy market (LEM).

These commitments and goals map well with Smart Cornwall's ambition to be an industry leader in smart energy networks; to have a globally recognised supply chain; and to have a pioneering technological support framework.

Developing the smart energy sector also fits well with European Structural and Investment Funding priorities, which are:

- innovation, research and technological development
- support for small businesses
- the low carbon economy
- skills
- employment
- social inclusion.

The Cornwall and the Isles of Scilly LEP is likely to receive €593 million of European Structural and Investment Funding between 2014-2020 to invest in economic development projects and programmes.[135] The smart energy sector is in a good position to receive support from the Structural and Investment Fund due to being a new, developing sector with significant potential for start-ups or existing SMEs to expand into the area; for innovation; skills development; employment; and to grow the low carbon economy.

A summary of the key policies and commitments at EU, national and local levels is shown in the table below.

[134] Cornwall Council (2010) Future Cornwall. http://www.futurecornwall.org.uk/
[135] Cornwall and Isles of Scilly LEP (2013) Draft European Structural and Investment Fund Strategy. Update 9 October 2013

Author	Date	Title	Key policies/commitments/targets
EU			
European Commission	2011	Smart Grids: from innovation to deployment [COM/2011/202]	Energy End-Use Efficiency and Energy Services Directive (2006/32/EC) calls for metering that accurately reflects the final customer's actual energy consumption and provides information on actual time of use Electricity Directive (2009/72/EC) explicitly oblige Member States to assess the roll-out of intelligent metering systems Communication on a Roadmap for moving to a competitive low-carbon economy in 2050 (COM(2011) 112/4) identifies Smart Grids as a key enabler for a future low-carbon electricity system The Commission proposes to focus on: (1) Developing common European Smart Grids standards (2) Addressing data privacy and security issues (3) Establishing a regulatory framework to provide incentives for Smart Grid deployment (EC expects requirement to set out implementation plan for smart meters to address this) (4) guaranteeing an open and competitive retail market in the interest of consumers (5) providing continued support to innovation for technology and systems.
European Commission	2012	Commission Recommendation on roll-out of smart metering systems	Guidelines for Member States on how to conduct cost-benefit analysis by 3 September 2012. It also sets common minimum functionalities of smart metering systems and addresses data protection and security issues.
European Commission	2010	The European Strategic Energy Technology Plan	Aim to make low-carbon technologies affordable and competitive. **The European Electricity Grid Initiative** Activities: • An integrated R&D and demonstration programme. • A network of up to 20 large-scale demonstration projects covering diverse geographical, social and climatic conditions. • A technical support structure to monitor project progress according to common indicators and to enable successes to be replicated across Europe. Investment: The cost of this initiative is estimated at €2 billion over ten years excluding the costs of generic assets used in the demonstration.
UK			
Electricity Networks Strategy	2009	Vision and Route Map for Smart Grids	'A Smart Grid Routemap' provides a high level view of the steps that need to be taken to progress the ENSG's smart grid vision

Group (ENSG)			The routemap includes a framework to move from the UK's high level objectives to a set of potential pilot projects. NB. Commitment from Smart Grid Forum to refresh the vision and routemap (link)
Gov.uk		Info on funding	Ofgem provided £500m over five years through the Low Carbon Networks Fund to support smart grid trials sponsored by the Distribution Network Operator (DNO) Companies. DECC provided £2.8 million to 8 smaller smart grid demonstration projects through the Low Carbon Investment Fund
DECC	2012	Smart Metering Implementation Programme	Sets out programme and plans for roll-out of smart meters, along with government's and energy suppliers' roles
DECC	2012	Electricity System: Assessment of Future Challenges – Summary	Imperial College and NERA Economic Consulting looked at value of balancing technologies under different future generation mixes and demand profiles to understand when the electricity system might start to experience significant cost savings -> The analysis suggests that balancing technologies start to deliver significant savings in the 2020s and increasing into the 2030s and beyond. Actions include: DECC will work to ensure that DSR and electricity storage can play a fair and equivalent role in the Capacity Market DECC will undertake an assessment as to whether there is a need for Government to do more to support the development of key balancing technologies, esp. DSR; consumer engagement; storage; heat networks DECC will work with DNOs and stakeholders: to develop a model that can be used during the RIIO-ED1 process to inform the nature and timing of distribution network investments; to understand the impact of increasing levels of DG on the electricity system including the roles and responsibilities of the SO and DNO; to analyse potential transmission network impacts of longer term developments in the electricity system and the potential network solutions
DECC	2013	Business Plan	2.2 Ensure energy is better used through rolling out smart electricity and gas meters across Britain 3.6 Support delivery of smarter electricity networks to ensure they can adapt to changes in electricity supply and demand. (Only action is on offshore transmission commissioning)
DECC	2013	Electricity Market Reform: Capacity Market – Detailed Design Proposals	Demand side response (DSR) and storage capacity will be eligible for the Capacity Market, and will be supported by transitional arrangements to develop the capability of the sector To ensure DSR (including embedded generation and smaller storage) and smaller storage (i.e. storage connected to the distribution rather than the transmission network) can participate, we propose to: Run one year ahead auctions, as well as four year ahead auctions, because DSR finds it difficult to commit to providing capacity four years ahead of delivery Put in place transitional arrangements for DSR in advance of the first full delivery year.

			Larger storage will be able to participate in the Capacity Market in the same way as generation.
Ofgem	2010	RIIO: A new way to regulate energy networks	This document sets out a new regulatory framework: Sustainable Network Regulation using the RIIO model – Revenue set to deliver strong Incentives, Innovation and Outputs. RIIO will first be used for sixth electricity distribution price control review (DPCR6, from 2015-23). Technical and commercial innovation encouraged through: Core incentives in price control package Option of giving responsibility for delivery to third parties Innovation stimulus gives support and 'prizes' for innovation, building on Low Carbon Networks Fund (LCNF)
Ofgem	2010	Handbook for implementing the RIIO model	Under the RIIO model we will have the option of providing licensed third parties with a greater role in delivery by giving them responsibility for delivering key projects following a competitive process. The third party would be responsible for operating and owning the associated assets. The regulatory framework needs to provide the encouragement or stimulus to enable innovation on energy networks that stakeholders agree is needed for a sustainable energy sector but that the network companies might otherwise have little incentive to pursue, through: the longer-term, outputs-led, incentive-based, ex ante price controls will provide their own incentives to innovate, by giving companies commitment around the potential rewards that they could earn from successful innovations and committing not to recognise them for unsuccessful innovations; and providing partial financing for innovation related to delivery of a sustainable energy sector through an electricity networks innovation stimulus and a gas networks innovation stimulus. (The Network Innovation Allowance (NIA) and Network Innovation Competition (NIC)) NB. Under the innovation stimulus package it will be possible for non-network parties to lead on projects financed under the stimulus. This will represent a departure from the LCN Fund where third parties are only involved in projects led by network companies. They will require an 'innovation license'.
Ofgem	2012	Promoting smarter energy markets: a work programme	Our vision is for smarter markets that are more efficient, dynamic and competitive, delivering better outcomes for consumers. We have recognised four areas of the market that require further analysis and where Ofgem needs to play a key role in policy development. Our longer-term objective in each area is as follows: Change of supplier – a fast, reliable and cost-effective change of supplier process, which will facilitate competition and build consumer confidence Electricity settlement – settlement arrangements that use smart metering data to allocate energy in an accurate, timely and cost-effective way, which will facilitate product innovation and efficient use of energy Demand-side response – a market environment that supports the efficient, system-wide use of demand-side response, which has the potential to reduce bills for consumers, enhance security of supply and

			contribute to sustainable development Consumer empowerment and protection – regulatory arrangements that empower and protect consumers to participate effectively in smarter retail energy markets, recognised the opportunities and risks involved.
Ofgem	2013	Creating the right environment for demand-side response	This document considers and seeks stakeholder views on whether current regulatory and commercial arrangements are fit for purpose or may in some way constrain the development of demand-side response. It identifies 3 key challenges: • Industry parties need to be confident that there is value for them in demand-side response which justifies the investment • The value of offering different demand-side response services needs to be recognise effectively to customers. • Customers need to be aware of the opportunities to provide demand-side response, able readily to access information on options and able to act.
Cornwall and the Isles of Scilly			
LEP	2013	Business Plan	**Priorities**: • Inspiring businesses to achieve their national and global potential • Creating great careers here • Creating value out of knowledge • Using natural environment responsibly as a key economic asset **Guiding principle**: culture, communities and the environment will remain special and unique **Target for 2020**: GDP per head will be above the average 75% for the EU; exceed expected growth by an additional £338m.
Cornwall Council	2012/ 13	The Business Plan 2010-2014	**Vision and purpose** To be a high performing council, using resources well to secure good public services for all and targeted support for those who need it most. To be a strong and effective community leader, ensuring sound investment in a sustainable future for Cornwall **Long term priorities** • Sustainable economic growth • Better environment • Improved health and wellbeing • Resilient, safe communities with affordable housing to meet local needs • To become a high performing council through continual improvement – fix, prepare, transform and excel. **Medium-term priorities** • Bring Cornwall out of recession • Improve the resilience of communities

			• Improve health and wellbeing through radical redesign of social care and health services • Minimise waste and generate sustainable energy • Achieve a balanced housing market that meets local needs • Integrate and transform Cornwall's public services to achieve efficiencies and improvements • Manage public resources well and always look to improve.
Cornwall Council	2010	Future Cornwall 2010-2030	**Vision** Cornwall in 2030 will be an industry leader in environmental technologies (land and marine) and at the centre of a global network of businesses. It will combine internationally recognised research with skills in environmental technologies across the workforce. **Long term objectives** • To become a market leader in innovative business and low carbon technologies; increase productivity and raise quality across the economy • To enhance and build a robust network of small and medium businesses to secure Cornwall's economic stability • To improve our communities through quality building… • To promote equality of opportunity and well-being… • To make it easier for people to lead healthy, active lifestyles and to get involved in their local community • To make the most of our environment, reduce greenhouse gas emissions and invest in and promote sustainable use of natural resources.
Cornwall Council	2011	The Cornwall Local Investment Plan	Summary of strengths and weaknesses of Cornish economy. **Priorities**: • Leadership – Council and CDC involvement in projects etc. • Business transformation – skills, innovation, culture of enterprise etc. • Connectivity – transport (including EV), broadband etc. • Place shaping – regeneration and investment • Low carbon – sustainable construction, retrofit, work hubs.
Cornwall Council	2013	Economy and Culture Strategy	**Vision**: A confident, resilient Cornwall that is a leader in innovative business and low carbon technologies, increasing self-sufficiency for communities and individuals with a focus on six strategic issues and the action programmes required to tackle them. **Key impacts and outcomes sought from delivery of the strategy**: • An economy that is resilient and draws upon our strengths • Economic progress that has positive outcomes for people and supports and improved quality of life • Responsible use of the natural environment as a key economic asset • More local people employed in prosperous businesses

			• An increase in skill levels, offering opportunities for higher incomes • Business inter-connectivity supporting business and employment growth • A vibrant busines base where business can innovate and flourish • An exemplar Council, leading in the areas of business friendly procurement, planning, regulartion and using our economic footprint to support local business
Cornwall Council	2013	Draft Local Plan	**Relevant policies include:** Policy to stimulate new jobs and economic growth development proposals will be supported where they contribute to any of the following: tourism; marine sector; Enterprise Zone Aerohub; educational facilities. All new development will be expected to take advantage of any opportunities to minimise energy consumption... This should achieve at least Zero Carbon new builds from 2016 for domestic buildings and from 2019 for non-domestic buildings. Additionally, the development of decentralised low carbon heat networks is particularly encouraged to connect or be designed to facilitate future connection to an existing or planned heat network. **Renewable and low carbon energy:** 1. To increase use and production of renewable and low carbon energy generation development proposals will be supported that: a. Maximise the use of the available resource by deploying installations with the greatest energy output practicable taking into account the provisions of this Plan; b. Make use, or offer genuine potential for use, of any waste heat produced; and c. In the case of wind turbines they avoid, or adequately mitigate, unacceptable shadow flicker and adverse impact on air traffic operations, radar and air navigational installations. 2. Particular support will be given to renewable and low carbon energy generation developments that: a. Are lead by, or meet the needs of local communities; and b. Create opportunities for co-location of energy producers with energy users, in particular heat, and facilitate renewable and low carbon energy innovation. 3. When considering such proposals, regard will be given to the wider benefits of providing energy from renewable sources, as well as the potential effects on the local environment; including any cumulative impact of these proposals.

Appendix 6: List of stakeholders consulted

Sector	Organisation
National/Multinational companies	22nd Century Energy Argand Solutions British Gas BT Centrica Elexon Hitachi Hyosung IBM Pecan Street, USA Toshiba International Vodafone
Academics	Cornwall College University of Exeter University of Falmouth University of Nottingham University of Plymouth
IT companies	Altcom Ampersand Industries Ltd Bocaina Business Services Coderscollective.pz Focus Technology Europe Ltd Packet Ship Serpentine Software Limited Sullivan Cuff Software Trio Computing Limited Uknetweb Limited
Creative industries (website design)	Altcom Limited Bearcomm Differnet Design Limited Microangelo Limited
Manufacturing companies	SBD consultants South West Manufacturing Advisory Service
Renewable energy companies	35 degrees Celtic Solar Eco Energies Ecotec Renewable Energy ltd Kensa Engineering Natural Gen REG Wind power
Energy storage and EV companies	Dales of Cornwall ITM

	PV3Technologies Swanburton
Energy management systems	Passiv Systems Carnego Systems
Other stakeholders	Combined Heat and Power Association Cornwall Council Cornwall Development Company Council of the Isles of Scilly Eden Project Energy Share Invest in Cornwall Kiwi Power Oxford Innovation Serco Regional Services Smart Grid GB Superfast Cornwall Western Power Distribution

Appendix 7: Stakeholder views on the Smart Cornwall programme

The Smart Cornwall programme has been clear from the outset that its success is dependent on strong relationships and communication with stakeholders. To date, the programme has engaged industry and key stakeholders through a soft market testing questionnaire and the Smart Cornwall Routemap Consultation, along with meetings and facilitated discussions.

As part of this evidence base, we also spoke with over 60 different organisations (see Appendix 6 for a list). The majority of the interviews addressed a set of general questions around their level of awareness, the perceived drivers and barriers to growth in smart energy, as well as the ways in which the Smart Cornwall programme can support growth. See Appendix 2 for the list of questions asked. However, some interviews addressed specific issues, such as ideas or plans for a particular project or answering questions around a specific area of expertise.

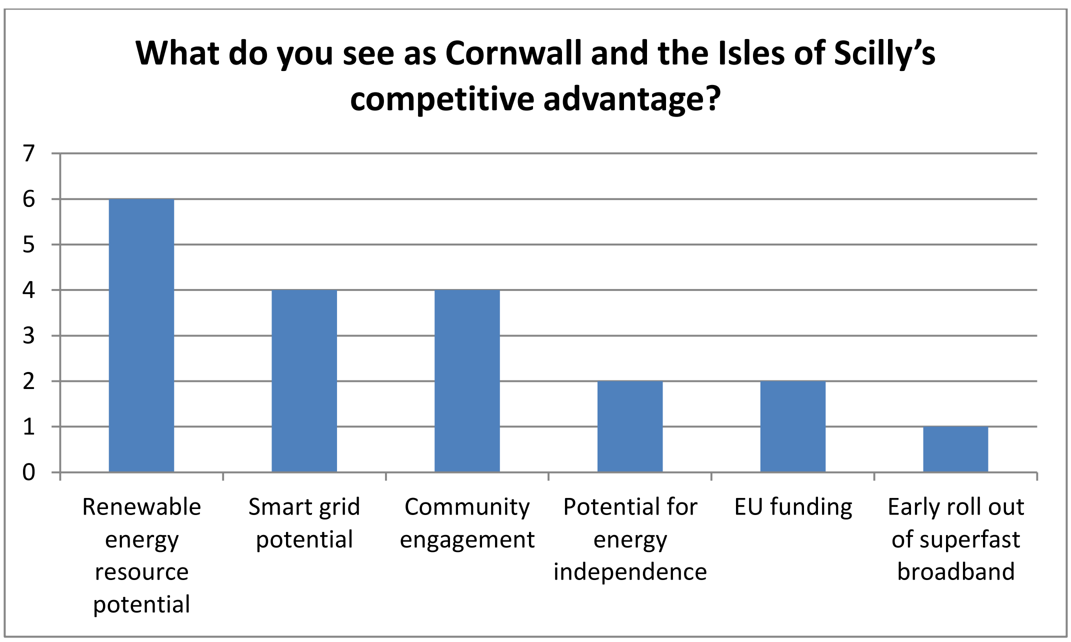
This appendix summarises the high level findings from the Smart Cornwall soft market testing questionnaire; the Smart Cornwall Routemap Consultation; and our stakeholder survey.

1. Smart Cornwall soft market testing questionnaire

The Smart Cornwall programme received responses from eight large companies to its soft market testing questionnaire.

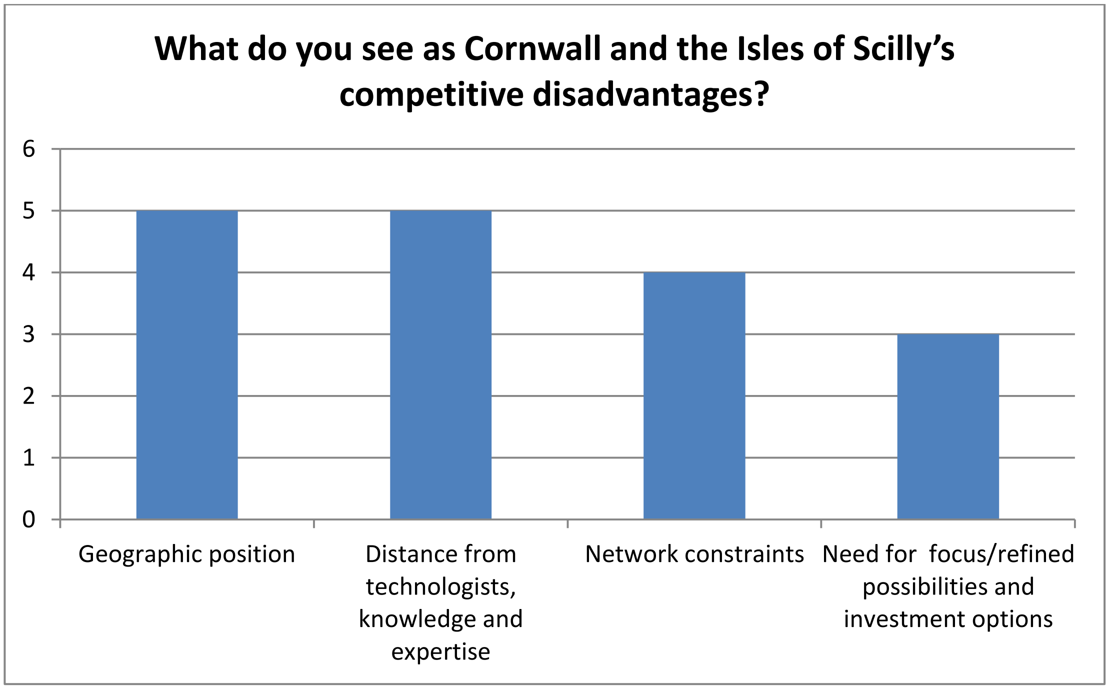
Cornwall and the Isles of Scilly's competitive advantage

When asked about Cornwall and the Isles of Scilly's competitive advantage, the most frequent response was the renewable energy resource potential. The ability to engage the local community and get their buy-in to pilot projects, along with greater participation in energy markets, was also seen as a key competitive advantage. Other responses are shown in the graph below.



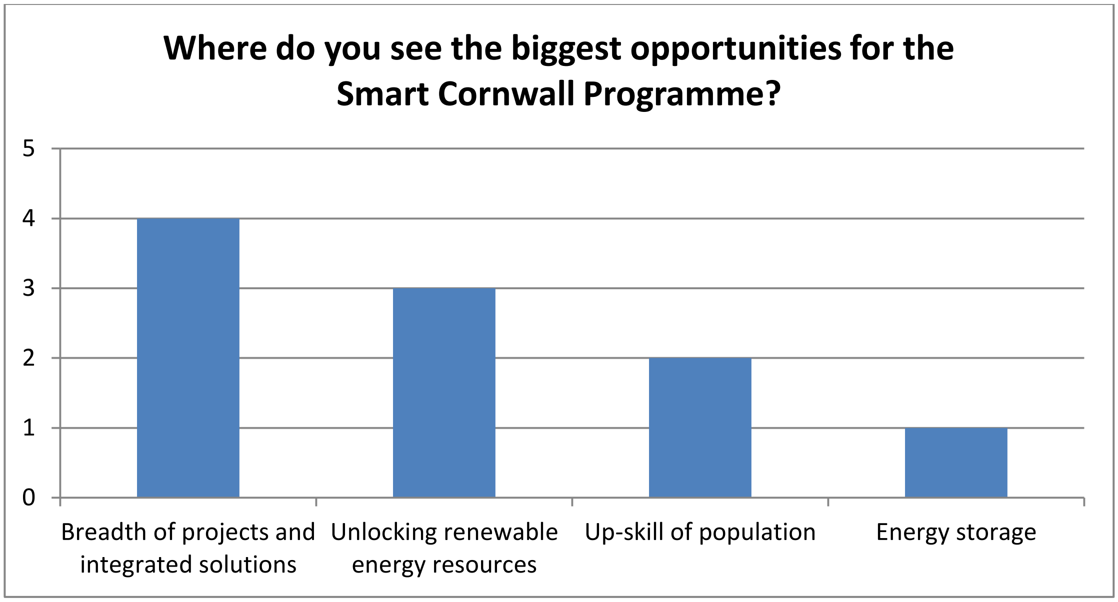
Cornwall and the Isles of Scilly's competitive disadvantage

With regard to the perceived competitive disadvantages, the peripheral location and distance from the experts were the most frequent responses. Four respondents raised network constraints as a disadvantage, however, it can also be seen as a driver for investment in smart energy technology to help overcome this problem.

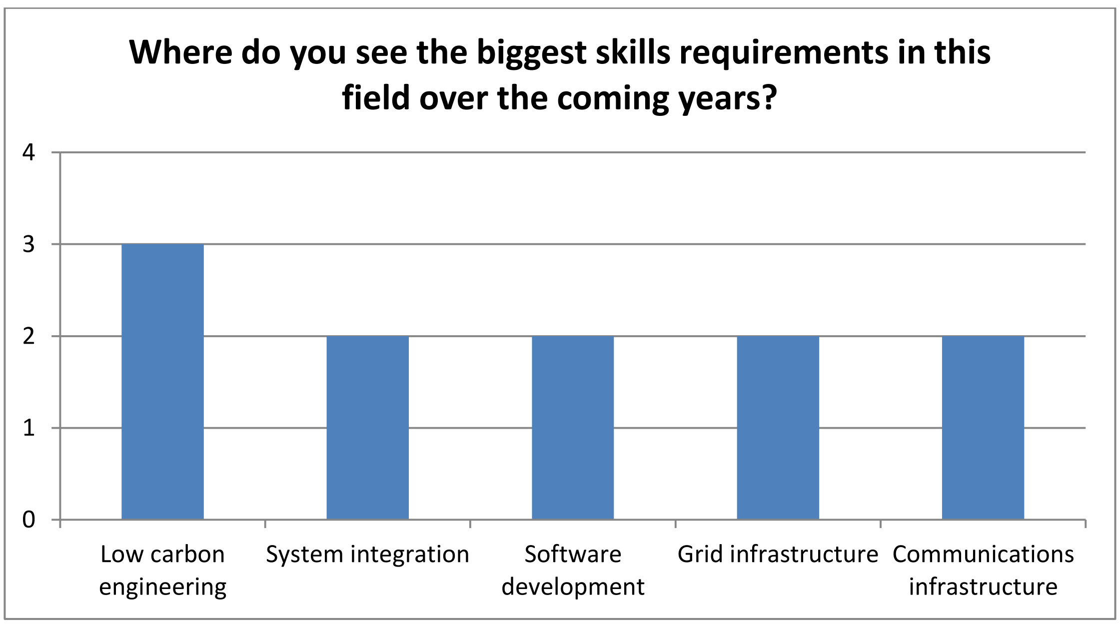


Opportunities for the Smart Cornwall programme

The most frequently cited opportunity for the Smart Cornwall programme was to set up a breadth of projects including different elements of the smart energy network into an integrated solution. It was suggested that one-off projects or pilots tend to flare and die back, without leaving lasting solutions. Other key opportunities are shown in the graph below.



Another opportunity was the potential to up-skill the population. The biggest skills requirement identified by respondents was in engineering, particularly power and low carbon product engineering. Other areas of skills requirements are shown in the graph below:

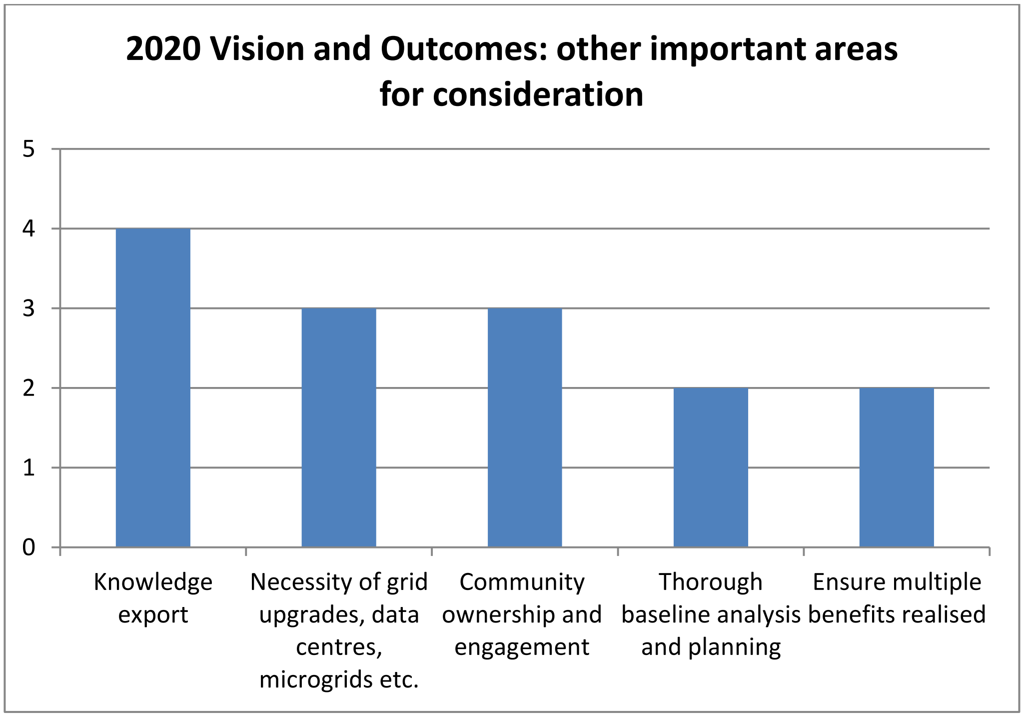


2. Smart Cornwall Routemap Consultation

The Smart Cornwall programme published a Routemap Consultation in February 2013 and received responses from seven companies, the majority of which were the same as the soft market testing questionnaire respondents.

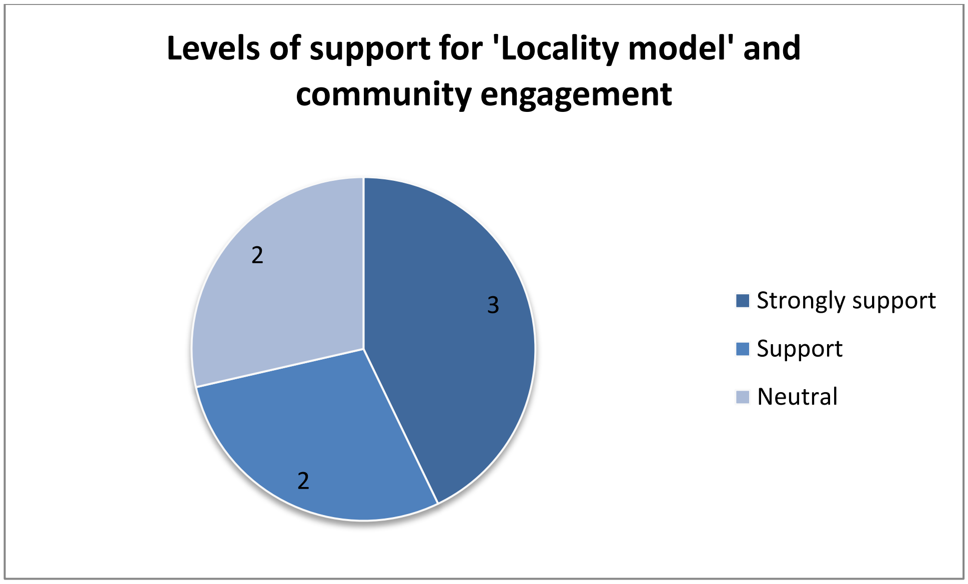
Smart Cornwall vision and outcomes

The Routemap set out a vision and 13 desired outcomes for the programme by 2020. The respondents were asked if there were other more important areas that should be taken into account. The graph below sets out the areas raised, many of which emphasised the importance of outcomes that had already been covered.



Smart Cornwall 'locality model'

The Routemap explains the importance of a 'locality model' as a key strand underpinning its future work programme and asks for respondents views on this. The pie chart below illustrates the level of support.



One respondent highlighted,

> *"The role of a council as an independent but interested aggregator is likely to become a key requirement in driving these schemes. It would be interesting to understand the potential interest in a council like Cornwall taking on (either directly or indirectly) these responsibilities."*

This raises the point that if the council is going to play a role as the trusted facilitator, it will need to be explicit in its goal to maximise the benefits of smart energy systems in Cornwall.

Developing a strategic approach

The Routemap sets out some core objectives for the period up to 2020 along with current thinking on the type of approach that might be taken to deliver these objectives. There was overall approval from the respondents on this approach. Reoccurring themes were the importance of programme management and governance, and allowing for project monitoring, evaluation and redesign.

3. Stakeholder engagement

As part of this evidence base, we carried out interviews with a range of stakeholders in academia, IT and software, renewable energy, energy storage, manufacturing and other key areas. A full list of contributers can be found in Appendix 6.

53 interviews were carried out in total, the majority of which addressed a set of general questions around their level of awareness, the perceived drivers and barriers to growth in smart energy, as well as the ways in which the Smart Cornwall programme can support growth. These have been analysed to draw out conclusions below.

A number of interviews were carried out to address specific issues. For example, we spoke with the Combined Heat and Power Association about the potential for selling balancing services; to the Eden Project about setting up a Cornwall electricity supply company; and to Smart Grid GB to get an overview of the sector. The evidence from these interviews is included in the relevant section of the report and not summarised here.

3.1 Local stakeholders

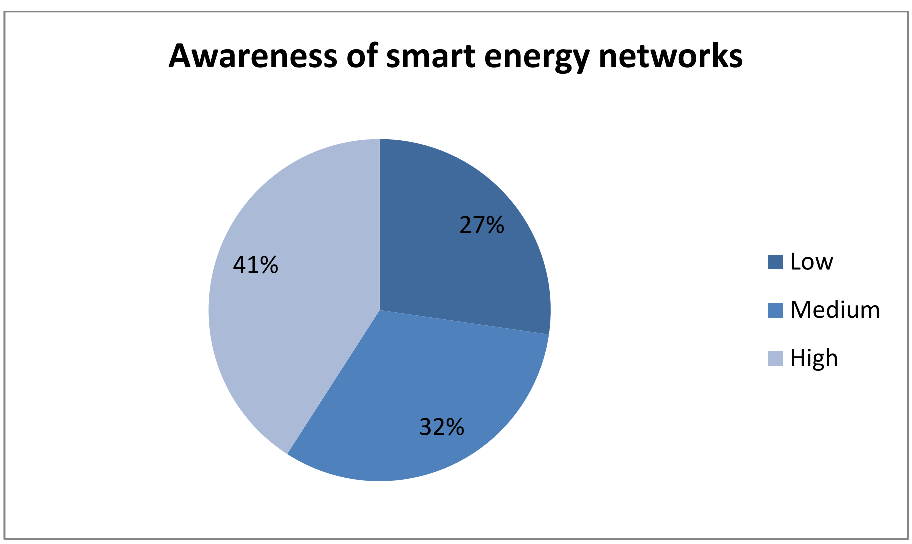
We interviewed 30 stakeholders in academia, renewable energy, IT and software, energy storage, electric vehicles, manufacturing and other key stakeholders in Cornwall and the Isles of Scilly. Our main objectives were to identify:

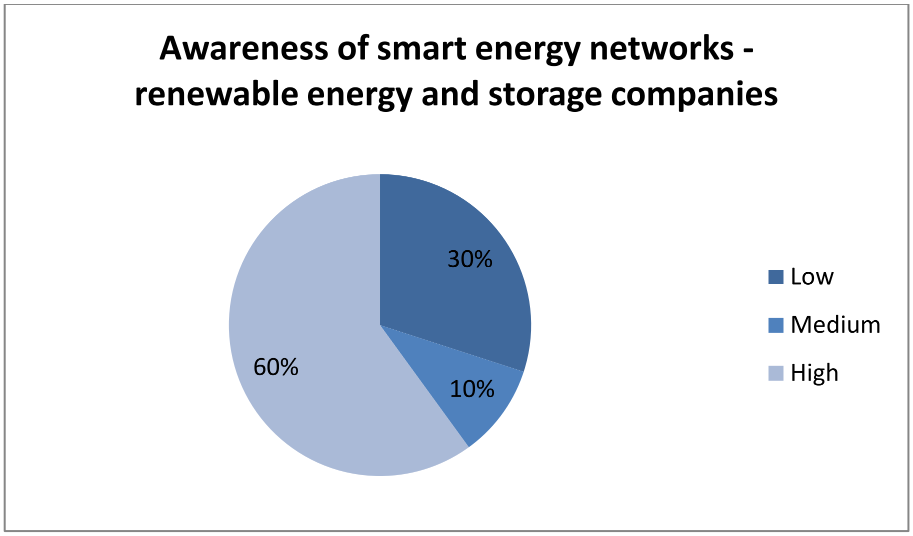
- the current level of awareness surrounding smart energy networks and business opportunities related to a "smarter" Cornwall and the Isles of Scilly
- the key barriers to growth that companies might face in Cornwall and the Isles of Scilly, coupled with the drivers that enable growth
- the most effective ways the Smart Cornwall programme could engage them to make the project a success.

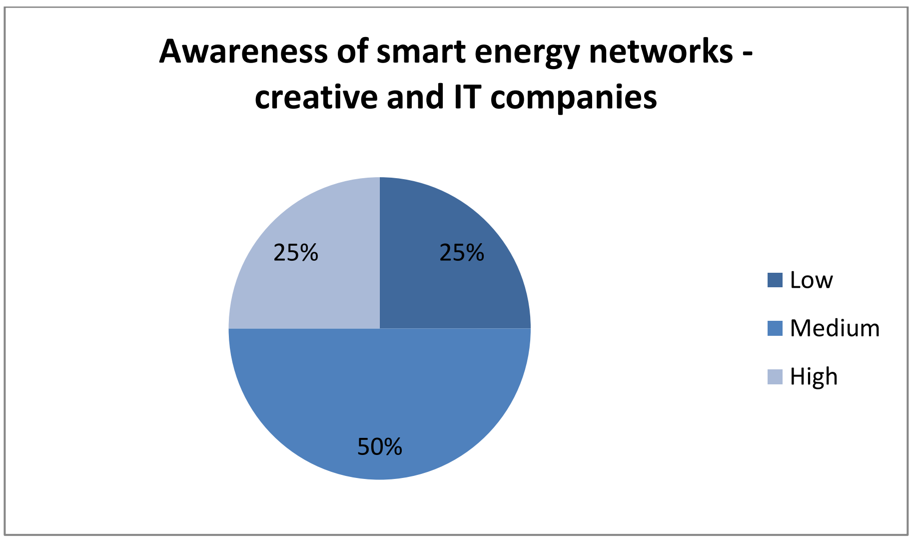
Due to the relatively small sample size, it should be noted that the findings may not be representative of the general views of stakeholders. It should also be noted that the manufacturing sector did not respond to the request for input, and therefore has not been included other than through the responses received from manufacturing umbrella organisations.

Awareness of opportunities related to smart energy networks

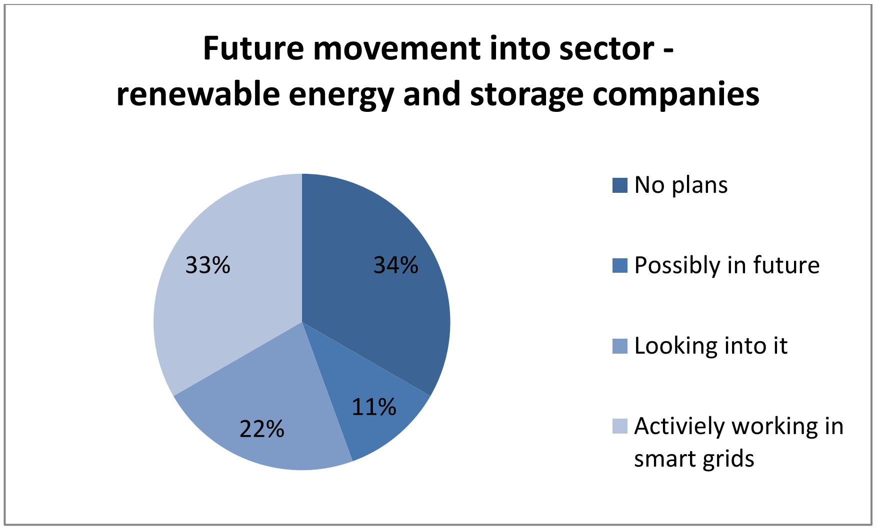
We found that 59 per cent of the companies had low to medium levels of awareness of smart energy. However, this varied between sectors, with the renewable energy and storage companies showing a higher level of awareness. The manufacturing umbrella organisations were not aware of any manufacturing firms working in the smart energy supply chain. The first chart below shows the awareness of smart energy networks for all Cornish companies interviewed, followed by a breakdown by sector.

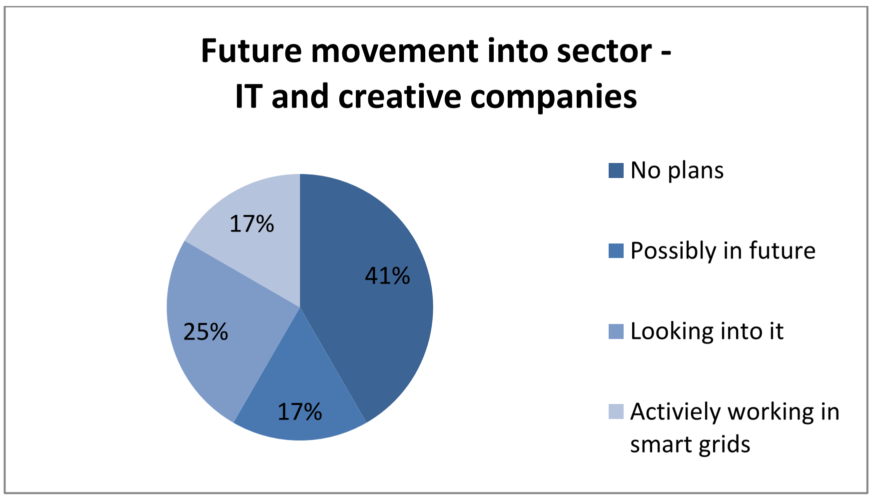






As could be expected, there was a very strong correlation between the company's awareness of smart energy networks and its prospects for future movement into the sector, which means that those that are not aware of the opportunities are missing out. There was a higher proportion of IT and creative companies that were missing out on the opportunities compared to the renewable energy and storage companies, as shown in the pie charts below.



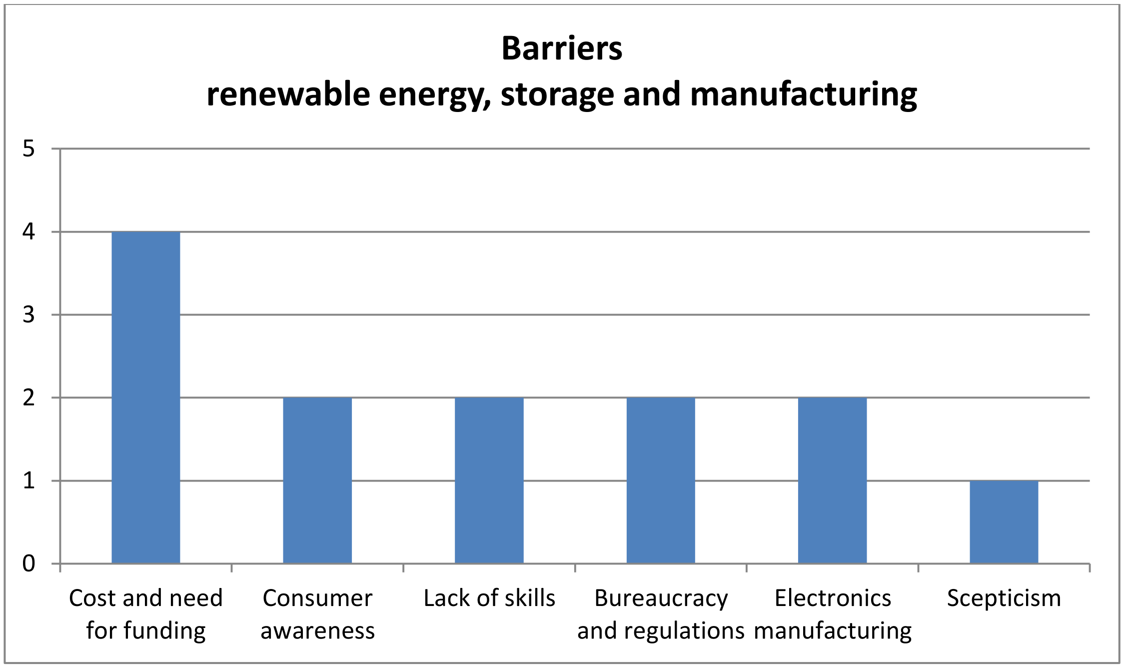


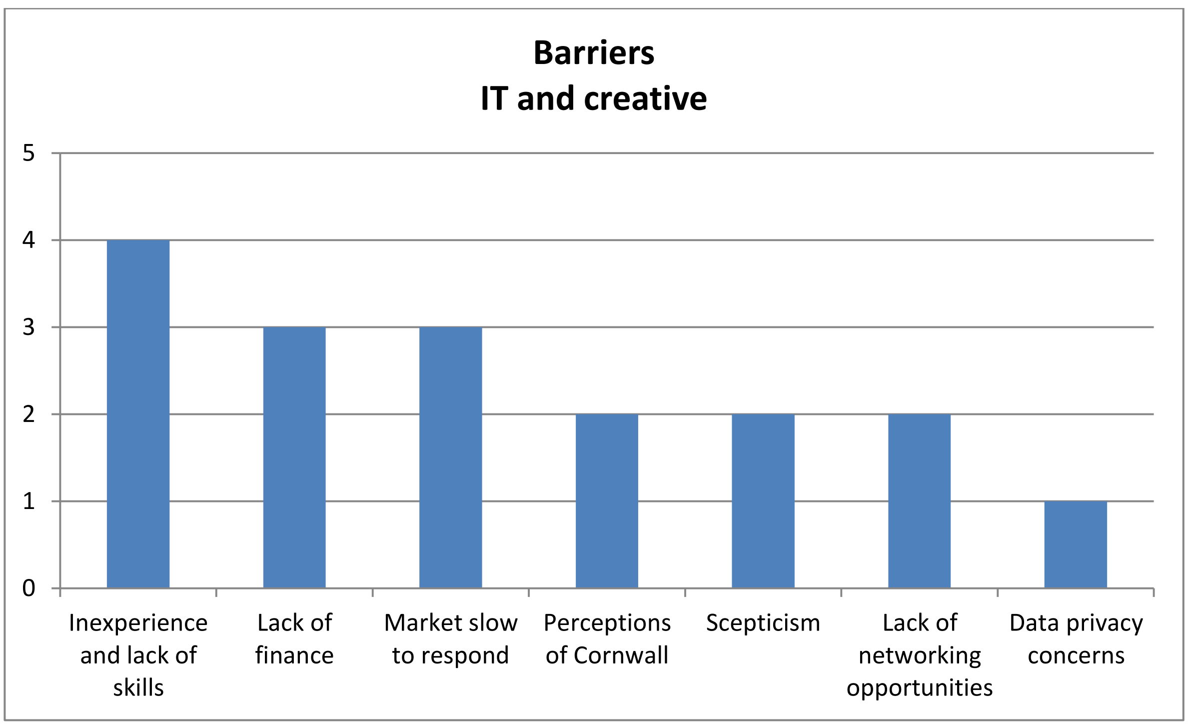
When we asked local businesses whether they might invest in R&D to move into the smart energy sector, we found that none were able to answer this question at this stage, largely due to a lack of understanding of the smart energy market opportunity.

Barriers to entering the smart energy sector

When asked about barriers to entering into the smart energy sector, there were many crossovers between the different sectors. Inexperience and lack of skills, lack of finance and scepticism were all reoccurring themes. However, there were also some differences. For example, the IT and creative companies were concerned about data privacy being an issue, whereas the renewable energy and storage companies were more concerned about a general lack of consumer awareness. One respondent stated, *"The ability to engage with people is key, and the project [Smart Cornwall program] will live or die by its ability to communicate with people."*

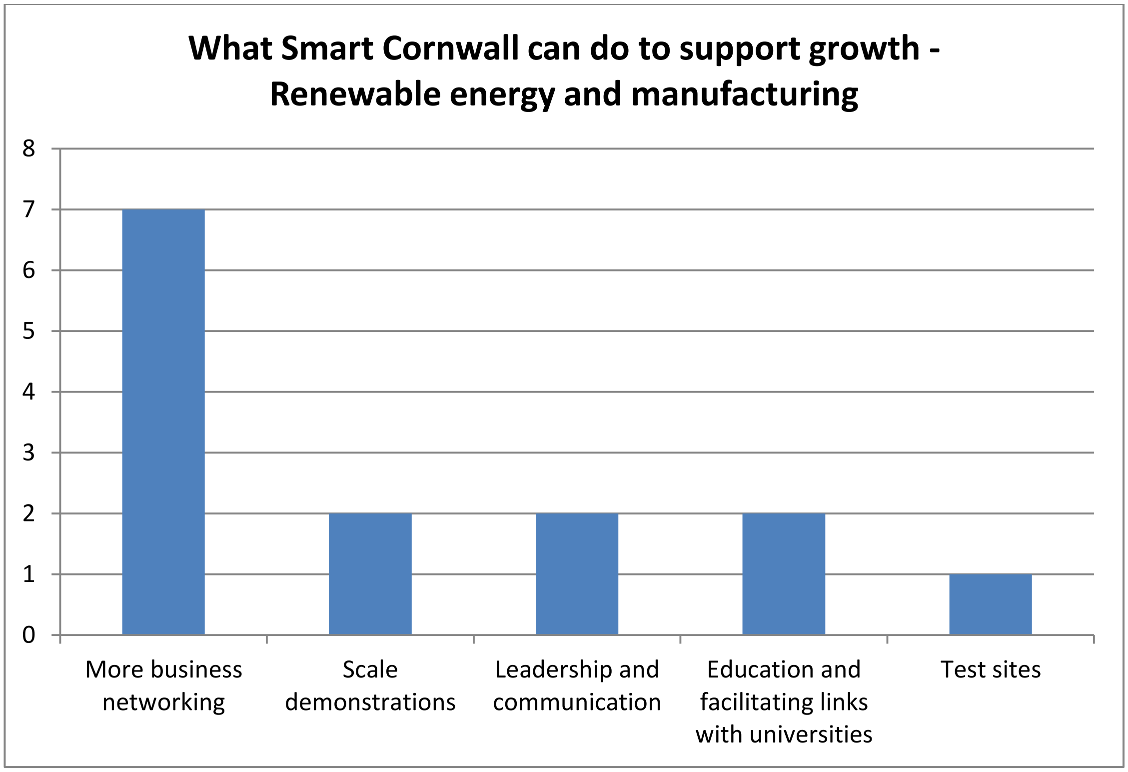
The following graphs show the key barriers to growth raised by each sector.

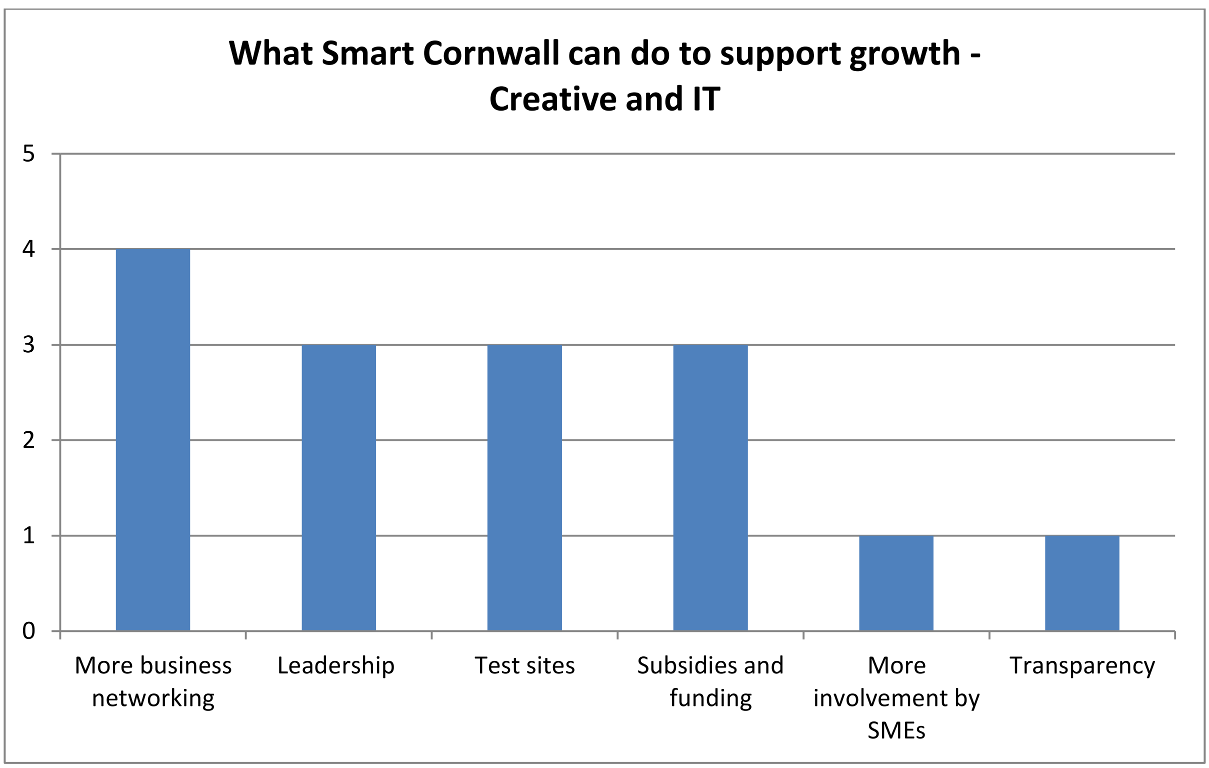




What Smart Cornwall could do to support Cornish and Scillonian businesses

When asked about what the Smart Cornwall programme can do to support growth in the smart energy sector or to help them move into the sector, the most commonly stated response was to provide more business networking opportunities. Strong leadership, communication and transparency also came up, along with the importance of test sites. The following graphs cover the key responses.


What Smart Cornwall can do to support growth - Renewable energy and manufacturing
8
7
6
5
4
3
2
1
0
More business networking
Scale demonstrations
Leadership and communication
Education and facilitating links with universities
Test sites


What Smart Cornwall can do to support growth - Creative and IT
5
4
3
2
1
0
More business networking
Leadership
Test sites
Subsidies and funding
More involvement by SMEs
Transparency

Key recommendations from companies and key stakeholders:

IT and creative companies

- Facilitate information and networking sessions in order to help SMEs enter the market and partner with larger companies to stimulate projects and sharing of expertise
- Communicate effectively with stakeholders and be completely clear about what the Smart Cornwall programme can offer to manage expectations
- Establish broad objectives in order to allow market led innovation. The development of a project that is too niche will limit its effectiveness.

Renewable energy and storage companies

- Facilitate better relationships and partnerships between small local installers and larger companies to support movement into the smart sector
- Work with the DNO on innovative projects to support independent generators to get installations connected.

Academics

- Work closely with the universities of Exeter (Cornwall campus) and Plymouth to ensure skills are developed
- Turn Cornwall into a test bed/laboratory to test the effect of smart technology take up on its population and facilitate collaboration between large and small companies
- Create the right environment for inward investment – provide suitable office space, a skills platform from the universities and advertise Cornwall as a test bed.

Stakeholders in the Isles of Scilly

- Upgrading to superfast broadband and establishing a communication platform is essential
- Opportunity to replace aging diesel generators with renewable technologies, for example, offshore renewables, which requires a close working relationship with the DNO.

3.2 National/multinational companies

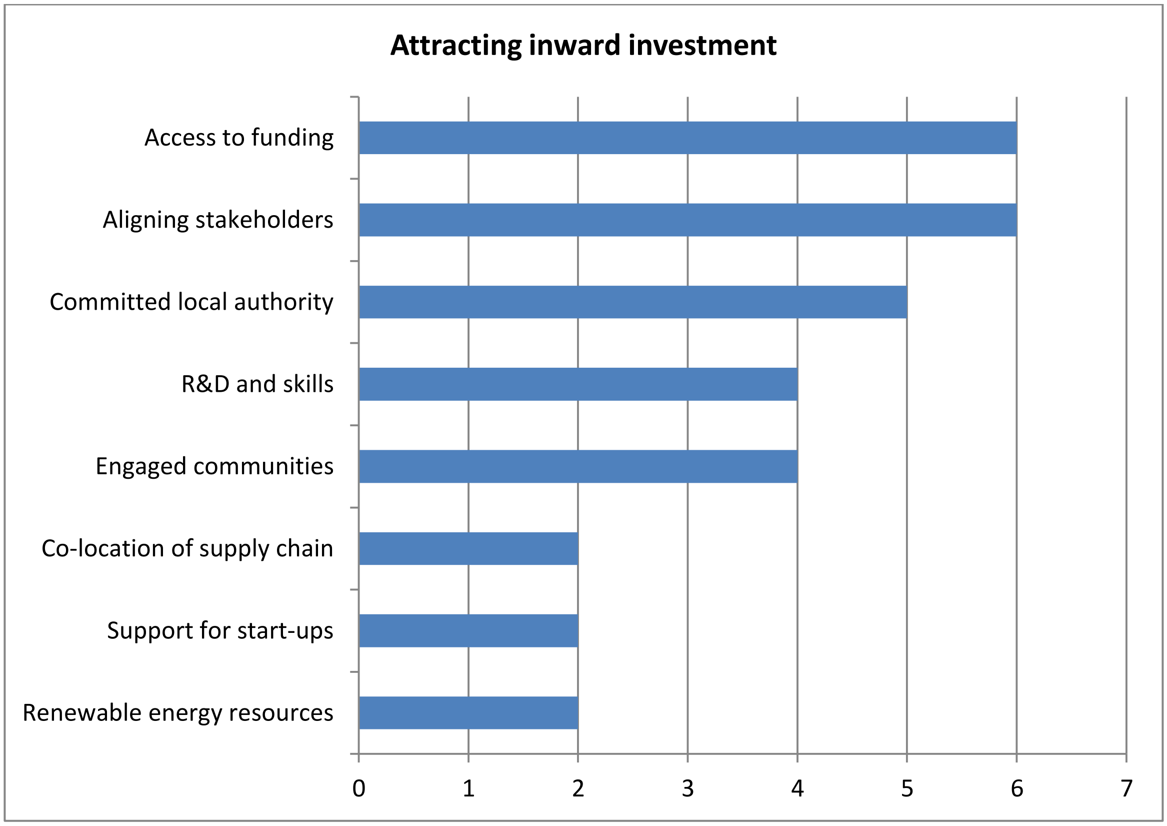
We interviewed 10 stakeholders from national and multinational organisations. All of them had a high awareness of smart energy sector technologies and services and were already working in the sector.

Barriers to growth in the Cornish and Scillonian smart energy market

The key perceived barriers to growth in the smart energy sector in Cornwall and the Isles of Scilly were: reliance on EU funds and questions about the sustainability of the programme; and Cornwall and the Isles of Scilly's lack of reputation in the global market. Furthermore, its peripheral location and poor transport infrastructure could make it less attractive than other locations in the UK.

How to attract inward investment and build a "world leading" sector

The key selling points for Smart Cornwall would be its access to EU funding; its ability to align key stakeholders, such as regulators and the supply chain; and the strategic commitment of the local authority and the willingness to make projects happen. Other issues that could help attract inward investment to Cornwall and the Isles of Scilly are shown in the graph below.



One multinational company provided their list of considerations for investing in a new location, which is outlined in the box below:

Cornwall and the Isles of Scilly will be more attractive than other areas if there is:

- Range of stakeholders aligned e.g. council, regulators, government etc. This can be very costly and time consuming for businesses
- Willingness to progress and make things happen – e.g. in planning, regulations
- Replicability to other markets – within and beyond UK
- Resources – academia, skilled workforce etc.
- Political strength in Cornwall and the Isles of Scilly to influence national policy and draw in funding
- Reliable, highly secure telecom infrastructure – especially important for global companies

- Ability to both provide high salaries for relocating employees and provide value for money for outsourced activities (e.g. when in competition with S.America/China)
- High quality of life – "It has to be better than what you're used to" – schools, transport, connectivity, health and wellbeing, flexible ways of working
- Good ports for both air and shipping – especially important for manufacturing
- Co-location for supply chain– can minimise costs of logistics and can enable collaboration
- Strong brand to create confidence.

One company emphasised the need for test sites, and suggested how Smart Cornwall could help facilitate the testing of products and services, which is outlined in the box below.

Make it easy to test new systems

- Keep a number of households on a retainer so that new technologies can be quickly installed and removed
- Implement a complete measurement regime with second by second metering via broadband linked back to the meter so that any new technologies tested can be measured
- Gain derogations from current regulatory pricing in order to test new markets, tariffs etc.

Make it easy to test new services and business models

- Create a business case for Cornwall and the Isles of Scilly by developing a Cornwall Energy Supply company (ideally owned by the Council in the same way that Kingston Communications was owned by Hull Council)
- Fund one or two community groups to get strong community buy-in to develop a community owned energy infrastructure. Link this back to the Council Energy Supplier.

3.3 Summary

From a Cornish and Scillonian perspective, those that are aware of the opportunities for developing smart energy networks in Cornwall and the Isles of Scilly were very positive about its potential. However, the majority of local businesses were not aware of the opportunities. A third of the renewable energy and storage companies and 17 per cent of IT and creative companies were already working in the sector, but just over half of companies interviewed had no plans to move into the sector in the near future. Key barriers identified were lack of skills and contacts, as well as lack of at-risk finance. It was suggested that the most effective support the Smart Cornwall programme could provide was business networking opportunities, leadership, guidance and opportunities to test technologies and services.

From a national/multinational company perspective, there was a consensus that Cornwall and the Isles of Scilly have the potential to be a national leader in smart energy networks. Key selling points for attracting inward investment were the natural renewable energy resources; engaged communities;

access to funding; and the commitment of the local authorities and LEP. Areas that could strengthen Cornwall and the Isles of Scilly's position are:

- developing local knowledge and expertise
- formalising Cornwall and the Isles of Scilly's commitment to the sector through some form of plan or strategy
- developing local skills
- establishing a sustainable funding model.

Appendix 8: Cornish and Scillonian baseline

Population

The population of Cornwall at mid-2012 was estimatedto be 536,000 (an additional 2,100 people live on the Isles of Scilly).[136] Cornwall's population has grown in recent years mainly due to net in-migration and is forecastto be about 590,000 by 2021 and 637,000 by 2031.[137] According to Cornwall Council, more than two-thirds of in-migrants are of working age and the majority find employment before moving to Cornwall.[138]

The number of households in the 2011 census was 230,389 and is forecast to grow to 277,000 in 2021 and to 307,000 by 2031.

There are 25 towns (more than 3,000 people) containing 63 per cent of the population. These towns include: Camborne/Pool/Redruth at 55,400; Falmouth/Penryn 33,000; Truro/Threemilestone 23,000; and Wadebridge 7,900.

Economy

Employment

In 2012, about 238,000 residents were either employed (182,000) or self-employed (52,700) and 16,000 were unemployed. About 60 per cent of all jobs are full time.

Employment by sector in 2011 is shown in the table below:

Sector	Number	%
Accommodation & food services	33,800	14
Retail	32,400	13
Health	30,900	12
Education	20,300	8
Manufacturing	19,700	8
Construction	16,700	7
Arts, entertainment, recreation & other services	13,700	6
Agriculture, forestry and fishing	12,400	5
Business admin & support services	12,300	5
Professional, scientific, & technical	12,100	5
Transport & storage	9,600	4
Wholesale	8,200	3
Public administration & defence	7,800	3

[136] ONS Population Estimates for England and Wales 2012
[137] Population and Household Change, Cornwall Council 2011
[138] Ibid

Motor trades	5,300	2
Property	3,700	1
Information & communication	3,500	1
Financial & insurance	3,200	1
Mining, quarrying & utilities	2,700	1

Employment by occupation in April 2012-March 2013[139] is shown below:

Sector	Number	%
Managers, directors and senior officials	22,100	9
Professional occupations	30,700	13
Associate professional & technical	27,700	12
Administrative & secretarial	25,300	11
Skilled trades occupations	36,200	15
Caring, leisure and other service occs.	30,200	13
Sales and customer service occs	14,700	6
Process plant & machine operatives	22,700	10
Elementary occupations	26,800	11

Some 30 per cent of the population has a degree (NVQ level 4+) but 22 per cent of 16-74 year olds have no academic or professional qualifications.

Economy size

Gross Value Added (GVA) is an indicator of the size of the economy in an area and is calculated as the value of the products and services minus the bought-in cost of producing them. GVA in Cornwall and the Isles of Scilly was £7.5 billion in 2011. Cornwall GVA per head was £13,848 in 2011 compared to the south west average of £19,093 and the UK average of £21,368.

GVA per hour worked is a measure of productivity. In 2011 Cornwall had[140] nominal GVA/hour equal to 72.6 of the UK average, where UK = 100. On this measure Cornwall's productivity has been declining since 2004 when it scored 75.7.

The number of VAT or PAYE registered business was 20,105 in 2012, of which some 89 per cent were micro-businesses with 0-9 employees.

Average annual earnings are low at £22,087 in 2012 compared to £26,551 for UK.

Growth drivers of employment and productivity

HM Treasury identifies a number of “drivers of productivity” (skills, innovation, competition, investment and entrepreneurship). Some of these cannot be readily measured at a local level, but on

[139] ONS annual population survey

[140] ONS Sub-regional productivity 2013

most of those that can, Cornwall and the Isles of Scilly compares badly with regional and national figures.

According to the Competitiveness Index,[141] Cornwall and the Isles of Scilly ranks as the 314th most competitive local authority area (district/unitary) among 379 in the UK. The competitiveness index is an integrated measure of competitiveness focusing on both the development and sustainability of businesses and the economic welfare of individuals.

A thumb-nail sketch of Cornwall and the Isles of Scilly's situation below has been taken from a report[142] for the LEP.

- **Productivity** per capita is low: measures of GVA per capita in Cornwall and the Isles of Scilly are significantly below those for the south west and England: just over £13k compared to £18.1k and £20.4k. Moreover, a number of factors suggest that GVA per capita and growth in GVA and employment in C&IOS will continue to lag behind the UK average.
- The **skills** profile of Cornish and Scillonian residents is below both regional and national averages. Looking at higher level skills, Cornwall and the Isles of Scilly have a lower proportion of the working age population with NVQ 4 +, or equivalent, qualification: 25 per cent compared to 30 per cent in the South West and England. In terms of the proportion of the working age population with 'low' (NVQ 2, or equivalent, and below) or 'no' qualifications, Cornwall and the Isles of Scilly again fare worse than national, regional and other local comparators (bar Norfolk). In Cornwall and the Isles of Scilly, 40 per cent of the working age population has low or no qualifications compared to 33 per cent in the South West region and 38 per cent nationally.
- Cornwall and the Isles of Scilly also fare badly on measures of **innovation**. One proxy that is often used for innovation relates to the incidence of knowledge-based activity. Two different measures of the 'knowledge economy' can be used: the proportion of employees and the proportion of business units associated with the knowledge economy. Looking first at employees, 43 per cent of C&IOS's employees are in the knowledge economy compared to 51 per cent in the south west as a whole. The proportion of business units in the knowledge economy in C&IOS is 20 per cent. This is again notably below the south west (31 per cent).
- A final indicator that is typically considered to be important in explaining the productivity performance of local economies relates to levels and rates of **entrepreneurship**, often measured by the business births per 1,000 working age population. The business birth rate of 4.6 per 1,000 working age population in C&IOS area is below both the national (6.1) and regional (5.4) averages. The table below explores this issue further.

[141] Robert Huggins and Associates

[142] Cornwall and Isles of Scilly LEP: Strategy and Business Plan Evidence Base Papers: 1 – Headline Economic Indicators. SQW 2012

Cornwall UA	2009	2010	2011
Births of new enterprises	1,655	1,520	1,705
Deaths of existing enterprises	2,175	1,810	1,825
Overall change in number of enterprises	-2.6%	-1.5%	-0.6%
For comparison England overall change	*-1.9%*	*-0.6%*	*+1.5%*

We looked also at types of enterprises (local PAYE units) that would most likely be affected by a Smart Cornwall programme. Encouragingly the first two categories in the table below probably have the highest paying jobs and have increased faster than average, although business admin has decreased. (Data for 2011 is not available.)

Cornwall UA	2010	2012	Annualised difference
Professional, scientific and technical enterprises	1,825	1,950	+3.3%
Information and communication enterprises	650	690	+3.1%
Business admin and support services enterprises	1,505	1,435	-2.3%
Total of three categories	3,980	4,075	+1.2%
Overall total for all categories	25,395	25,540	+2.8%
For comparison England all categories	*2,183,845*	*2,218,215*	*+0.8%*

If the Smart Cornwall programme created say 1,500 jobs in total and half were in new SMEs with 3 staff then an additional 250 new enterprises would be created, increasing the base population of about 4,000 in the three categories by 6 per cent.

The survival rate of enterprises in Cornwall and the Isles of Scilly is similar to the UK average; 48 per cent of new enterprises are still in existence after 5 years.

Cornwall and the Isles of Scilly Smart Energy Supply Chain Potential

The smart energy sector is at an early stage and few Cornish and Scillonian companies would currently see themselves as being part of it. We came across a handful of Cornish companies that are actively engaged, including Enigin (metering and analytics), Carnego Systems (intelligent energy management) and WATTSTOR (energy storage).

We used the SIC code analysis below and stakeholder engagement findings to estimate the number of businesses and full-time equivalent (FTE) employees there were currently working directly on smart energy networks. Out of the ICT and creative businesses we spoke to, 17 per cent were working on ‘smart’ products and services (of which we about half were related to smart energy), and 33 per cent of the renewable energy businesses were investigating storage opportunities. When these percentages were applied to the software and renewables companies in the table below, we got 43 businesses. We also identified three electric vehicle retailers and two energy storage businesses. Making a total of 48 businesses assumed to be working directly on smart energy related products and services. The majority of businesses we spoke to were only working occasionally on smart energy related areas of work, and therefore we have assumed only 0.5 FTE employees per business, that is a baseline of 24 FTE jobs in smart energy.

To assess how many companies there are with significant potential to move into smart energy we used the breakdowns of the smart energy sector in the literature to create a simple list of smart energy sectors and reviewed this against the Cornish and Scillonian business base using SIC codes. Overall analysis using this methodology shows that 2845 enterprises are undertaking activities relevant to smart energy development or deployment. This is 13 per cent from a total of 21,105 enterprises listed as active (as of 2012) in Cornwall and the Isles of Scilly.

Given the breadth of the opportunity in smart energy, this analysis will miss out on some companies. However, some categories will also overstate the scale of the opportunity.

Smart Energy Sector segment	No. of enterprises	Comments
Manufacturing – Electrical	55	In the world of smart energy, electromechanical devices form the backbone of networked solutions. Mechanical, electrical and systems integration specialists will find opportunity in smart energy, and their scope of expertise will often spread over several disciplines, making SIC identification challenging. Manufacturers who already undertake electromechanical and communications equipment development will have early opportunities in smart energy.
Manufacturing – Mechanical	35	
Engineering and Design	330	The bulk of the enterprises in this group are from 7112 : Engineering activities and related technical consultancy. This covers a huge level of activity. Many enterprises in this segment, however, are flexible and capable of quickly re-tooling and upskilling to meet new demands. Many enterprises in this segment may well be able to deliver aspects of smart energy deployment.
Software Development / programming (system integration)	450	Many IT enterprises are commercial IT support (providing networked computer support). Many of these will not be looking to develop first generation smart energy capability, but may incorporate elements of smart energy into their products and services at a later stage
Consultancy	460	Business and management consultancy, not technical consultancy
Professional support	205	All located in 'Other professional Scientific and technical activities. Includes environmental consultancy
Data processing	30	
Data Entry	0	
Repair of Equipment	50	Specialist repair of machinery
Testing	25	
Installation Services	435	365 of these enterprises are electricians. An important market segment, but potentially at a low level with limited focus on smart energy
Finance and legal	355	This is a huge sector, with a small number of specialists in energy
Research and Development	0	
Energy efficiency and	20	SIC code 3511 ‘production of energy’. Regen’s data shows this under-

renewable energy		plays the renewable energy sector.
Electric vehicles	265	The bulk of this figure is car sales enterprises We know that only a tiny proportion of car sales enterprises are actively pursuing electric vehicles. This figure over estimates the potential
Development of storage technologies	0	We are aware of two businesses working in this field
Development of secondary consumer devices	30	
Retail	145	Including electronic equipment, machinery, telecommunications, household appliances etc.
Total number of enterprises	**2845**	

Source: ONS, UK BUSINESS: ACTIVITY, SIZE AND LOCATION – 2012 via Cornwall Council

SIC codes have limits as an analytical tool, particularly when considering a new sector of the economy. So we also looked at other sources of information on the IT sector and renewable energy sector, which are both of particular relevance to smart energy.

According to a recent report, the Cornwall ICT Digital sector comprises 1,035 businesses and employs 5,100 people, 42 per cent of these businesses are involved in software activities. The sector accounts for 4.6 per cent of all Cornwall businesses, and evidence indicates that the sector is growing.[143] This is an obvious area where support could be targeted.

The renewable energy sector tends not to show up in SIC code analysis. Regen's directory shows 100 renewable energy companies active in Cornwall and this is backed up the Microgen Certification Scheme (MCS) database. We also found two companies in Cornwall that are developing storage technologies: WATTSTOR and PV3 Technologies which are not reflected in the SIC codes. There are clear transferable skills between renewable energy companies and smart energy and our stakeholder engagement showed a higher level of understanding and awareness of the smart energy amongst these companies than other sectors.

This analysis indicates the most important sectors in this in terms of size and scale of opportunity are software development/programming and engineering and design. Renewable energy is under represented in the SIC codes but is also likely to be a significant opportunity for businesses to diversify into smart energy. Lower down the knowledge scale, installation of meters and other technologies could be significant.

Manufacturing of smart energy is a large area in terms of scale of opportunity. For example our literature review found manufacturing jobs have represented at least 50 per cent of total smart grid employment in the Bay Area of California. Analysis of SIC codes shows 90 Cornish companies in

143 Adroit Economics (2012) Research into the Cornwall ICT Digital Sector to support future business growth.

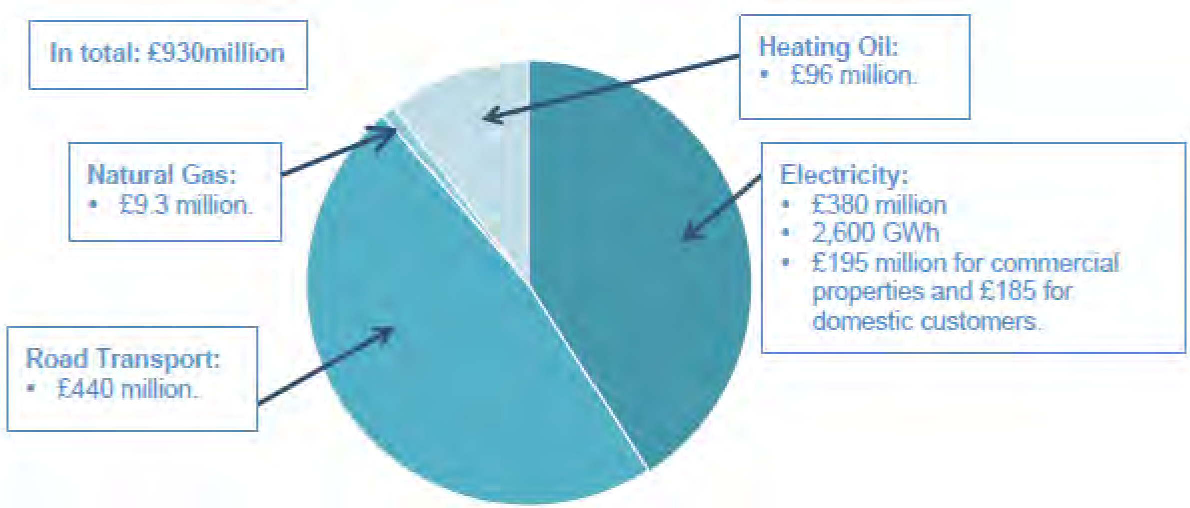
relevant manufacturing sectors, a limited base. Conversations with SW MAS indicated awareness of smart energy opportunities is low in the Cornish manufacturing sector.

It is instructive to look at tidal device manufacturing which now employs over 130 people in Bristol in Siemens Marine Current Turbines and Alstom Tidal Generation Ltd, both of which were local start-ups, including one university spin out, and are now part of Siemens and Alstom. This shows how one or two successes in establishing manufacturing companies can have a major impact. However, TGL in particular benefited from knowledge spill-overs from the huge aerospace sector in the West of England as it received substantial investment from Rolls Royce.

Energy spend

In 2011 Cornwall spent a total of £930 million on energy, most of which left the Cornish and Scillonian economy. By now it is likely to be over £1 billion per year. To put this in context, Gross Disposable Household Income totalled £7.9 billion in 2011.[144]

A breakdown of Cornwall's total energy spend is shown below.[145]



In 2011, a quarter of households in Cornwall and the Isles of Scilly were fuel poor (meaning that they spent 10 per cent or more of their income on fuel in order to heat their home to an adequate degree) compared to a national average figure of 16 per cent of households.

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[144] ONS regional data

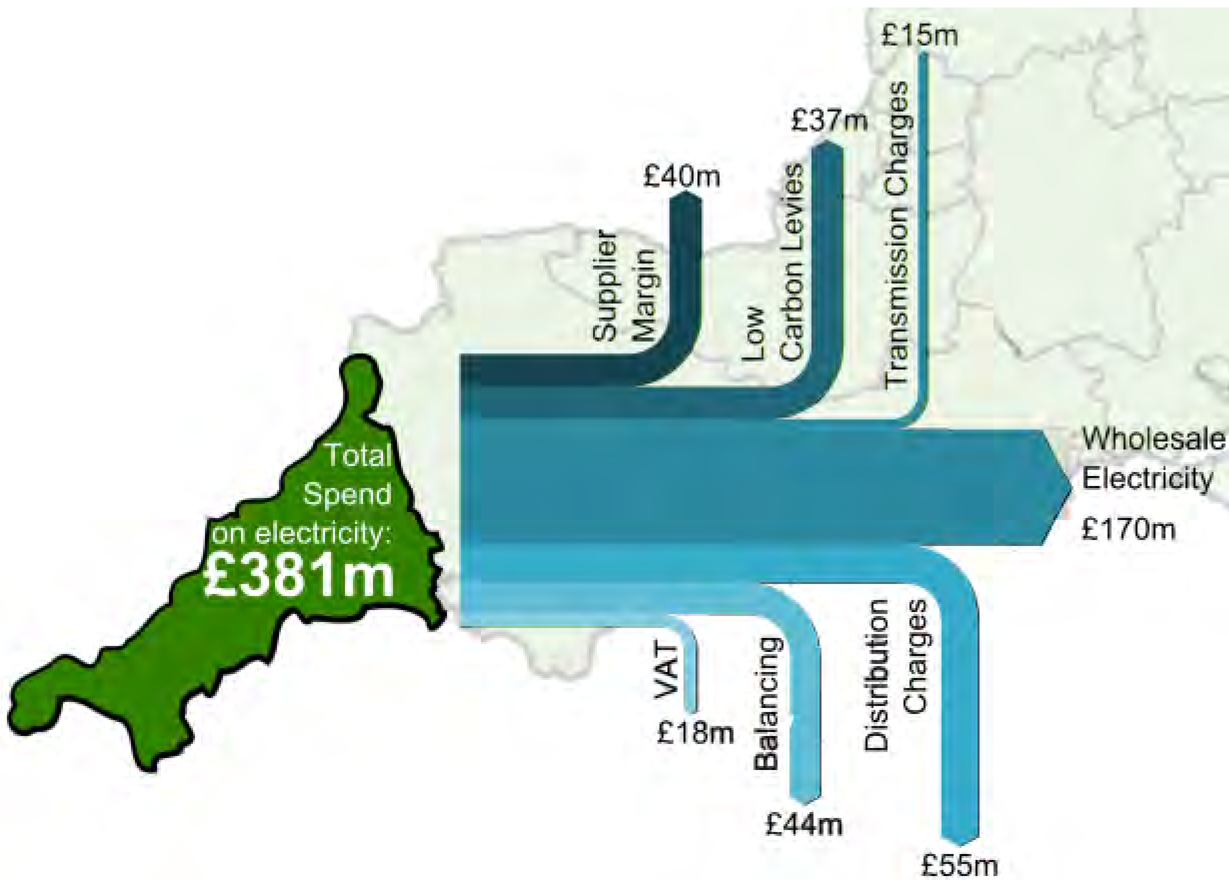
[145] The data for consumption is drawn from DECC's Sub-National Consumption series of statistical releases and the cost found using prices for 2010 from the latest edition of the Quarterly Energy Prices and historical figures in DECC's Energy and Emissions Projections. This does not include the cost of coal and other solid fuels or biomass.
DECC, Sub-national Road Transport Fuel Consumption 2005-2011 DECC, Sub-national Electricity Sales and Numbers of Customers 2010-2011; DECC, Sub-national Gas Sales and Numbers of Customers 2005-2011; DECC, Sub-national Residual Fuel Consumption 2005-2011; DECC, 'Annex F; Price Growth Assumptions'; Department of Energy and Climate Change, Quarterly Energy Prices.

Electricity spend

The total spend on electricity in 2011 was £380 million, with the average household spending around £717 per annum.

Electricity bills can be broken down into a number of component parts: the wholesale price paid to the generators, the cost of maintaining the national transmission and local distribution electricity networks, the levies to support low-carbon policies,[146] VAT, the supplier margin, which accounts for the overheads, and profits of the electricity supply company and the balancing fees which pay for the costs incurred in matching the real-time demand and generation levels.

The figure below illustrates how these components make up Cornwall's electricity bill.[147]



[146] Low carbon levies include; Carbon Emissions Reduction Target (CERT), EU Emissions trading Scheme (ETS), Renewable Obligation (RO), Feed in Tariff (FiT), Warm House Discount (WHD) and Community Energy Savings Programme (CESP).

[147] This includes approximate figures for business spend, based on consumption data from the DECC projections however using the domestic tariff as information on the breakdown of commercial bills is not available. DECC, Sub-national Electricity Sales and Numbers of Customers 2010-2011.

Renewable energy

Renewable energy resources

As part of the development of the Cornwall Core Strategy, Cornwall Council carried out an assessment of the renewable energy resource potential in Cornwall in January 2012, which found that there was potential for 820-825 MW of renewable electricity and 178-190 MW of renewable heat.[148]

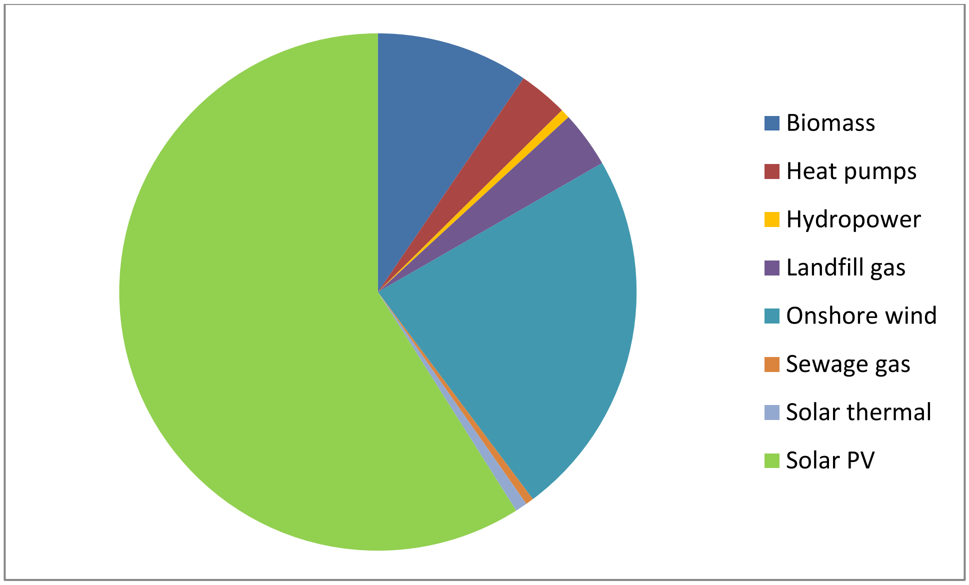
Recent correspondence with the Council indicates this figure has been revised to a total of 1.6 GW. These figures (which are not final) are an input to the draft Local Plan and are described as "targets" in the sense that they are the MW that Cornwall Council would like to attract and commission in the Local Plan period, which is through to 2030. The current figures are shown below:

	Cornwall Renewable Energy Resource Potential to 2030		
	Potential Installed Capacity (MWe)	Potential Installed Capacity (MWth)	Potential Land Take
Onshore Wind	402	-	Equivalent of approximately 120x2.5MW turbines and 100x1MW turbines (including existing turbines)
Biomass – Energy Crops	2	4	0.4% of the land in Cornwall
Biomass – Forestry Residue	5	12	Produced by ongoing management of existing woodland
Energy Recovery from Waste	24	40	Space only required for the processing facilities
Livestock Slurry	5	13	Derived from existing livestock
Hydropower	2	-	-
Solar – Photovoltaic	987	-	244MW on existing rooftops and 743MW ground-mounted, requiring 0.6% of the land in Cornwall
Solar – Thermal	-	120	On existing rooftops
TOTALS	1427	189	

Existing distributed generation

As of March 2013, Cornwall and the Isles of Scilly had 253 MW of renewable electricity and 40 MW of renewable heat in operation.[149] This totals just less than 300 MW, showing that there is a long way to go to reach the 1.6 GW target. The chart below shows a breakdown of the different technologies by capacity installed.

[148] Cornwall Council (2012) An Assessment of the Renewable Energy Resource Potential in Cornwall
[149] Regen SW (2013) South West Renewable Energy Progress Report 2013



Community energy groups

Communities are beginning to lead the way in sustainable energy, initiating exciting local projects and partnerships and realising the potential of the power localism gives them. This is an important time for community energy as it becomes increasingly popular across the UK. A positively engaged community in each locality is key to achieving the uptake of smart energy technologies, distributed resources (generation, storage and controllable demand) and a local energy market (LEM).

Cornwall and the Isles of Scilly have a growing number of community energy groups. We are currently aware of 37 active groups, which are of varying sizes and are at different stages in developing projects. The locations of the groups are mapped below:

The model of a local energy co-operative with the broad support and involvement of the local population, businesses, and key institutions (e.g. councils, schools and chamber of commerce) has been demonstrated in Wadebridge through the activities of WREN. WREN, which has 1,000 members, has been successful in positively engaging the local community in large-scale renewable energy generation (the repowering of St Breock windfarm) and in accelerating the adoption of building-scale low carbon technologies through its buying clubs and free insulation offer.

The success of WREN has been dependent on a high level of voluntary input that is not going to be replicated in many communities. However, WREN (and other local energy co-operatives across the UK) have established a range of replicable business models and an approach to community engagement that is replicable with an appropriate framework of support and funding to enable professional management by suitable people.

Smart Cornwall programme

The Smart Cornwall programme was set up to help Cornwall and the Isles of Scilly establish its place in the smart sector global marketplace. The programme recognises the need to create the right catalysts for driving innovation and growth, and has already taken steps to develop partnerships and projects to make this happen.

A Smart Cornwall Business Development Team is being set up to support local and international businesses, as well as other partners, to capitalise on smart energy opportunities. In addition, a number of pilot projects are being developed with industry partners. These include:

- **Clean Energy Balance** – potentially funded by the Network Innovation Competition, the project aims to deliver an innovative energy storage and production project in Wadebridge
- **ETI Smart Systems and Heat** - a potential pilot location for the demonstration of 'the first Smart Energy System' in the UK, with a focus on heat
- **Korea Smart Grid Institute** – proposal to make a specific fund available to Korean companies by KSGI to deliver Smart Grid projects in Cornwall. Potential projects include university R&D programmes; community home energy management systems; EV infrastructure.
- **Local energy market development** - proposed LEM trial with a group of interested parties including Elexon (who run the UK energy market), Hitachi, Co-op, WREN, WPD and DNV Kema.
- **Carbon Tracing** – potential system to provide real-time and forecasted carbon savings of the local grid.
- **PROMESA** - Community Energy Plus is part of an EU consortium for an IEE bid to develop and test an innovative smart meter behavioural change tool.

Partnerships have been established with a range of organisations and businesses around the world, including the Global Smart Grid Federation; Jeollanam-do Provence in Korea; the Penghu Islands in Taiwan; and the region of Navarra in Spain, home to the CENER centre.

The Business Development Team also has objectives to support local businesses and attract inward investment, as well as to effectively communicate the benefits of the Programme to stakeholders both inside and outside of Cornwall and the Isles of Scilly.

Industry has shown its commitment to helping Smart Cornwall develop its programme of activity by offering its time free of charge to sit on the Technical Design Authority. The following companies are members of the TDA:

Superfast broadband

Cornwall's broadband infrastructure is being upgraded on a scale unprecedented anywhere in Europe. Superfast Cornwall,[150] an initiative funded by the European Union, BT and Cornwall Council, will bring superfast fibre optic broadband to 95 per cent of homes and businesses in Cornwall and the Isles of Scilly by 2015, with the remaining 5 per cent benefiting from faster broadband speeds resulting from alternative technologies, such as satellite.

Cornwall is also benefitting from 'Fibre to the Premises' (FTTP) technology, which makes superfast broadband even faster. It is expected that 30 per cent of premises will get access to FTTP technology by the end of 2014.

It is expected that Superfast broadband will provide a boost to the economy by enabling businesses to work more efficiently and to invent the next generation of online applications and software.

[150] http://www.superfastcornwall.org/

Appendix 9: 2020 bottom-up scenario and impacts

Section 5 above sets out the building blocks for a smart Cornwall and the Isles of Scilly. These include a set of projects and initiatives that could be led or facilitated by the Smart Cornwall program. These make up the scenario for 2020 and enable us to quantify the potential impacts of the Programme; it is not intended to be a detailed plan.

The following sections describe the building blocks in more detail and forecast the impacts of them in 2020. It is important to note the following points when reading the summarised findings in the sub-sections below:

- The business-as usual (BAU) scenario is not 2013-frozen but includes growth in the broader economy and increasing use of smart technology along with the rest of the UK
- 2020 is the year that we estimate the difference to BAU so projects completed before 2020, for example construction of a Hub or installation of a smart energy system, must have effects after completion that can be detected in 2020. So construction work has virtually none (apart from a small decaying multiplier) but the installation of a smart system might permanently reduce energy consumption
- Most of the building block projects have relatively little long term effects in themselves. The major effect is that they create a nucleus for the development of a cluster of smart businesses which, with some business development assistance, will grow the sector in Cornwall and the Isles of Scilly and create jobs, mainly through export to the rest of the UK and the world. So the actual building block projects and number/size of them do not matter greatly provided a good nucleus is established.

1. Research and development

Stakeholders were clear that at the core of Cornwall and the Isles of Scilly's offer should be a research and development facility, a centre for innovation and collaboration and a data platform. These will provide a basis from which to develop and test smart technologies and services, therefore supporting local companies to innovate and grow, start ups to emerge and multinationals to develop their products in Europe.

1.1. Centre for R&D

Smart energy R&D centres are starting to emerge all around the world. They are taking different forms to meet different needs. For example, the EV-Smart Grid Interoperability Centres in the US and Europe have been set up to develop standards and technologies, and to harmonise test procedures. Another example is CENER, the National Renewable Energy Centre in Navarra, Spain, which is a technology centre that specialises in applied research.

The centre would be designed to meet the needs of Cornwall and the Isles of Scilly's businesses as well as having strong links with academia.

The centre could draw on Falmouth University's expertise in design and media and the University of Exeter's expertise in environmental sustainability behavioural change, energy policy and engineering through the new Environmental & Sustainability Institute (ESI) which includes in its areas of research: clean technologies, including renewable energy and energy control systems; sustainable construction; policy and regulation; and behavioural change

The Centre could focus on the following aspects of smart technology:

- government policy and regulation
- design aspects of human interfaces and consumer response
- testing interfaces between smart devices and users
- smart home devices and automation
- smart devices in the built environment
- development of standards and improving interoperability
- sharing and disseminating knowledge.

This would have an important relationship with the Business Acceleration Hub(s) and the data platform to enable knowledge sharing and cross-fertilisation.

Assessment of impacts

In assessing the potential for the Centre we have drawn on a report on the European Centre for Environment and Human Health (ECEHH),[151] as an existing research centre in Cornwall. The conclusions drawn were that universities, research and knowledge/technology transfer activities have a major impact on the international, national and local economies. Local economic benefits include:

- Research jobs generated by externally funded research
- Impacts arising from engagement with, and support to, local firms
- Impacts arising from spin-outs and other start-ups in the Centre's research fields and from inward investors attracted to Cornwall and the Isles of Scilly because of the Centre's presence and activities
- Impacts arising from companies that benefit from wider networking and general up skilling enabled by the Centre
- Impacts arising from the Centre's activities enabling the increased adoption of renewable energy technologies in local communities, resulting in additional supply chain jobs, reduce energy costs and increase energy security and hence improved productivity

[151] ECEHH Interim Evaluation, Adroit Economics, December 2011

- Impacts arising from the Centre's activities in overcoming existing grid constraints so enabling the connection of large renewable energy technologies.

Other reports support these conclusions. For example, a report on the economic impact of the University of Birmingham estimates the multiplier on direct jobs at 1.9.[152]

Establishment of the Centre will give Cornwall and the Isles of Scilly a competitive advantage over other regions that lack similar facilities. Other research centres exist but they tend to focus on different areas, such as power systems and devices at Strathclyde University and building energy systems at the UCL Energy Institute.

In estimating the jobs and GVA potential, we have used the ECEHH as the main source of evidence. The overall objective was to create a research centre of international significance in the fields of environment and human health which is relevant to the Cornish economy.

ECEHH was funded by £6m over three years. The requirements were to create 35 gross jobs and to achieve supplementary targets, including assistance with the creation of one new business, involving local firms in collaborative research and involving local firms in business and wider cluster networks. It had exceeded these objectives by late 2011. Longer term the report suggested that, under various assumptions, that ECEHH's activities could safeguard or create about 225 jobs between years 3-5 and 725 jobs between years 6-10 although such forecasts are in a different area of research to smart technology.

The ECEHH started with advantage of the backing of an existing medical school and large general hospital whereas the proposed Centre for research in smart technology would start from a smaller foundation. For this reason we have assumed the Centre will be one third the size of ECEHH initially, that is it would aim to establish with a FTE staff of 12 researchers and knowledge transfer staff and we assume that no capital investment would be required. A similar growth path to that forecast for the ECEHH has been assumed, resulting in estimated net additional jobs stimulated by the Centre in years three to five to be 75 and a further 240 by year 10.

If we assume the Centre could be up and running by 2015, we estimate that about 87 additional FTE might result by 2020; 12 from the initial investment and further 75 in the years 2017-2020.

The GVA associated with 87 FTEs is £4.57m (but it should be noted that jobs and GVA are two sides of the same coin - the 87 jobs are in the £4.57mn).

Summary impacts for 2020

Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA/y £m
87	4.6	35	1.8

[152] Our Economic Impact, Oxford Economics for University of Birmingham, 2013

1.2. Business Acceleration Hub

A space for innovation, collaboration and networking appeared in both the literature review and stakeholder interviews as an essential element for developing this sector. The aim of such an acceleration hub would be to stimulate the creation of a Cornish eco-system of home-grown smart technology SMEs that will be in a good position to exploit growing national and international 'smart' markets.

This proposal is based on the initial outline proposal for a Smart Innovation Hub (SIH) at Wadebridge as produced by WREN, Falmouth University and Wadebridge and District Chamber of Commerce. However, it would not necessarily be built in Wadebridge and there may be a need for more than one, for example, a hub could take the form of a Smart Fibre Park in Pool, which is also being considered. In the Wadebridge proposal the SIH is positioned as a business acceleration facility with high-speed, fibre based connectivity.

The business acceleration hub will deliver a number of complementary functions including:

- access into a living lab, and would therefore need to be positioned close to an urban area
- accommodation space to SMEs providing innovative, commercial smart technology solutions
- accommodation space to Smart Cornwall partner organisations, such as large multinationals
- incubator support for new start-ups
- a demonstration centre open to visiting delegations, the public and potential customers
- educational support
- meeting and networking facilities
- the Smart Cornwall Data Platform management centre.

Assessment of impacts

At this stage, it is envisaged that the business accommodation offer would be similar in scale to the Tremough Innovation Centre with a total net rentable floor space of approximately 2,200m², accommodating up to 70 enterprises each of which, on average, could be expected to employ between 3 and 4 people.

Some of the business occupants could be entirely new businesses whilst others could be existing businesses that have relocated (although we net out the economic impact of re-locators unless they expanded). Over the period 2020 to 2030, some of the start-ups would migrate out of the hub into their own premises, some may go on and become globally significant players, whilst some will inevitably fail – in the UK one in three start-ups fail in their first three years.[153]

[153] http://www.insidestartups.co.uk/blog/the-uk-startup-economy-in-numbers-nov-2012/

It was predicted that the £12 million Tremough Innovation Centre would deliver 161.6 FTE gross new jobs and over £5 million pa increase in gross GVA in Cornwall by 2015.[154]

It was opened in February 2012 and reported in August 2013 that clients were growing by an average of 27 percent in year one and that 21 new jobs had been created.

Similar figures for 2020 are projected for the impact of a business acceleration hub, but it is possible they will be higher due to the targeted activity to grow the smart grid sector as well as links with the research centre, data platform and access to a living lab.

As far as we can tell, a business acceleration hub would be a unique facility in the UK and could give Cornwall and the Isles of Scilly a competitive edge.

Summary of impact for 2020

Direct FTE jobs	Direct GVA/y £m	Capital investment £	Indirect FTE jobs	Indirect GVA/y £m
160	8.4	£12m	64	3.4

Having access to a living lab may lead to a greater take-up of smart technologies and services, which could have an impact on energy consumption and related carbon emissions. Quantification of carbon emissions is accounted for in Appendix 12 below.

1.3. Smart data platform

In 2012, all but one of the 30 cities that took part in the TSB Future Cities Demonstrator competition published a feasibility study and all 29 included a data platform. Most of these had an open data portal. The key driver for a platform is to be able to draw together multiple data streams that are currently unrelated and use the combined information to address wider systemic challenges.

A data platform also provides an opportunity for businesses to develop new products and services using the data, smart parking applications were mentioned for example.

The key challenge in a platform is not in its hardware, but in delivering its functionality. Server capacity can easily be purchased 'off the shelf', but the challenges are:

- creating the APIs for multiple data interfaces
- ensuring security, privacy and authenticity
- keeping data streams up to date
- dealing with data in real time.

A platform does not necessarily need to store the data – provided the data is stored and is immediately accessible from somewhere else; the platform can act as a sign poster and interpreter.

Assessment of impacts

[154] Cornwall Council (2010) Tremough Innovation Centre Business Plan.

In terms of hardware, Cornwall and the Isles of Scilly could build its own data centre to host the platform. This is unlikely to be any different to a standard data centre. It may create a few short-term jobs but most of the investment will inevitably be spent outside the county. It is also a very crowded market that will be difficult for new, small entrants to get a foothold. Building a dedicated data centre is therefore only recommended if it is more cost effective than buying server capacity.

There are a number of options regarding the fulfilment of a platform's functionality:

Options	Jobs
i) Buy a solution from one of the key players already in the market such as Cisco, IBM, HP, etc. This option is lowest risk and is likely to come with a £5-10m price tag. The IP will primarily remain with the vendor.	3-5
ii) Purchase a shared platform with one or more other locations - this is a lower cost version of option i).	4-6
iii) Create a platform from scratch using local developers. This is much highest risk and will take much longer to deliver. However, it will generate more local jobs if a local firm wins the contract - although public procurement rules will require an open competitive tender. It could also generate some useful IP that could then be sold elsewhere – especially if a novel approach was identified.	30-60 development jobs, 10 maintenance + jobs from future sales

Given that the platform market place is already very active with the big IT players, rather than adopting option iii) it could well be a better strategy for Smart Cornwall get a platform up and running as quickly and cheaply as possible and then focus attention on exploiting it. We assume here that option ii) is pursued, sharing a platform and creating say 5 FTE jobs.

Whatever approach is taken the platform should be designed to put as many data sets as possible into the public domain. In this respect there have been a number of estimates from across Europe covering the impact of open data on GVA. These indicate an uplift in GVA per capita between £54 and £650.[155]

A CEBR report[156] also makes an assessment of jobs created and forecasts 58,000 new UK jobs to be created between 2012 and 2017 as a result of reduced barriers to entry and increased demand for data analytics skills. On a population basis, Cornwall and the Isles of Scilly could get about 500 jobs in this sector. But they will not necessarily be linked to the creation of a data platform in Cornwall. Furthermore, IT skills are in short supply in Cornwall and the Isles of Scilly. Therefore, we take the conservative estimate that one tenth is created, i.e. 50 jobs by 2020 but with the potential to grow faster than ICT sector trend to 2030.

Summary impact for 2020

[155] Gartner, Innovative use of public data, report to the National IT and Telecom Agency, and the Danish Agency for Science, Technology and Innovation (Danish), 2009; Analysis by CS Transform Limited, based on modelling by Pollock, R. (2011), "Welfare gains from opening up Public Sector Information in the UK"; Open data measures in the Autumn Statement 2011, Cabinet Office as quoted in *Open Data - driving growth, ingenuity and innovation*, Deloitte, 2012.; Data equity - Unlocking the value of big data, Centre for Economics and Business Research Ltd, April 2012

[156] Data on the Balance Sheet, CEBR, June 2013

Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA/y £m
50	2.6	20	1.1

2. Technology deployment

The key Smart Cornwall activities in technology deployment will comprise of such activities as the identification of projects, making partnership arrangements, bidding for funding, project support and dissemination of results. Many of these projects, such as LCNF demonstration projects, will be led by others.

A number of potential projects and their impacts are set out below.

2.1. Large scale integrated demo project

From our review of the literature one of the greatest needs identified was for a large scale integrated smart technology project involving smart meters, smart grid, distributed generation and local energy trading. This would enable all the various parameters to be studied, the commercial feasibility investigated under different conditions, and detailed cost-benefit calculations made.

As deployment of smart energy technology in the distribution networks is not expected to start until after the regulatory period 2015 to 2023 there is ample time to set up and run such a demo in Cornwall or the Isles of Scilly. Although pilots funded by LCNF publish much useful information, each DNO and energy supplier will wish to get practical experience in deploying smart grid and smart energy technology before a major deployment commences.

Examples include Penghu Island in Taiwan, Jeju province in Korea and the three-year Customer Led Network Revolution[157] project in the north of England. The potential for such a scheme in Cornwall or the Isles of Scilly is great as there are several towns of a reasonable size that have a mix of residential, commercial and industrial loads, for example Falmouth, Truro and Camborne/Pool/ Redruth. It would differ from the potential 'living lab' in Wadebridge in size, and would have less of a focus on local energy trading.

Assessment of impacts

Benefits to Cornwall and the Isles of Scilly would come from:

- the benefits of the project itself in the pilot period as energy cost savings, employment increased economic activity
- the knowledge and experience gained by firms involved
- continuing benefits after the end of the study period

[157] www.networkrevolution.co.uk

- a large demonstration project that helps to build Cornwall and the Isles of Scilly's reputation and attract inward investment.

Numerous studies have suggested that the benefit-cost ratio of smart grid investments is greater than one, for example:

- a US study[158] found the multiplier on investment as between 1: 2.8 and 1:6
- an investment of $7.2 billion by New York State utilities over 10 years was forecast to lead to $18.9 billion benefits by 2025
- in California 1995-2009 smart grid sectors grew twice as fast as other sectors
- the US Recovery Act invested $2.96 billion in smart grids and is estimated[159] to have supported $6.8 billion in economic output (in 2010$) supporting 12,000 direct jobs and 35,000 indirect jobs; the study found direct jobs were mostly higher pay and the multiplier on investments between 2009 to 2012 was about 1:2.5.

We have assumed the project will be the same size as the Customer led Network Revolution project.[160] In line with that project's benefits case we forecast no additional jobs by 2020, although there will be capital investment of £12m. We assume that both the supply of equipment and the installation work will be done by firms based outside Cornwall and the Isles of Scilly and the local impact of the construction work will be insignificant.

The reduction in carbon emissions that would result from a large scale demonstration project can also be taken from the Customer Led Network Revolution project, which estimates that if the project was successful and the learning was adopted nationally, it would deliver savings of 283k tonnes of carbon by 2020 and 8,267k tonnes by 2030.[161] If this was scaled to a Cornish town of 19,000 people, Truro for example, this would equate to savings of 85 tonnes by 2020 and 2,486 tonnes by 2030.

Summary impact for 2020

Direct FTE jobs	Direct GVA/y £m	Capital investment £m	Indirect FTE jobs	Indirect GVA
0	0	12	0	0

Savings of 85 tonnes of CO_2e can be assumed by 2020 if a large scale demonstration project is established in a Cornish town the size of Truro similar to that set up by the Customer-Led Network Revolution.

158 Estimating cost benefits of smart grids, EPRI 2011
159 Economic Impact of Recovery Act Investments in Smart Grid, US Dept of Energy, April 2013
160 www.networkrevolution.co.uk
161 CE Electric UK (2010) Low Carbon Networks Fund: Customer-led Network Revolution full submission proforma. Appendix 6: Business Case

2.2. Smart meter roll out in Cornwall and the Isles of Scilly

The government has decided to roll out smart meters in a national programme[162] over the period 2015 to 2020. In Cornwall and the Isles of Scilly this will involve installing 125,000 gas and 287,000 electricity smart meters with associated communications equipment and the removal and disposal of the old meters. Each residential customer will be offered an in-home display (IHD) that will show information about their energy usage and allow communication with the suppler.

Current plans are that DECC will carry out a national awareness campaign but responsibility for installing the smart meters and engaging with the consumer lies with the electricity or gas supplier.

There would appear to be potential opportunity for Cornwall and the Isles of Scilly to maximise the amount of work done by local businesses to gain experience and expertise in smart metering that leads naturally to the sale and installation of home energy management systems and to a better understanding of consumers' needs and behaviour.

Assessment of impacts

For the purposes of this study, we assume that local businesses in Cornwall and the Isles of Scilly manage to secure an increased share of the installation work for smart meters and work is complete before 2020. There is no permanent change in jobs or GVA from BAU so net additionality is minimal.[163] However this involvement provides Cornwall and the Isles of Scilly with a cadre of skilled and experienced labour and with several businesses that understand smart metering in residential and commercial premises.

There is potentially large indirect benefit for Cornwall and the Isles of Scilly in ensuring that consumers take an IHD when it is offered (they can decline) and then understand and use it. A wide uptake of IHDs and a focus on how to reduce energy consumption will greatly benefit individuals and the economy in Cornwall and the Isles of Scilly. As an illustration, if Cornwall and the Isles of Scilly's energy consumption decreased by 0.5 per cent over the amount the government expects on average across the UK, then consumers in Cornwall and the Isles of Scilly would save 0.5 per cent of £389m, which is a £2m a year increase in disposable income. The effects of a £2m spend on 'Food, drink and tobacco' (the most relevant option in the economic model) is shown in the table below. In addition, the 0.5 per cent decrease in consumption would reduce CO_2 emissions by 177,600 tonnes.[164]

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[162] https://www.gov.uk/smart-grid-a-more-energy-efficient-electricity-supply-for-the-uk

[163] The principal evidence of economic impact of smart meters is DECC's Impact Assessment, the latest version of which is dated January 2013. Using cost data from DECC's Impact Assessment gives an estimate of total capital cost of £28.5m for Cornwall and installation work costing £12.6m. None of the capital cost is attributable to economic benefit in Cornwall but some proportion of the installation work might be. However, it is assumed that net employment is unchanged because the smart meter rollout brings forward the replacement of meters that would be done anyway. So there could be an increase in employment due to the extra installation work up to 2020, but then it will fall back below BAU because smart meters will eliminate the need for meter reading. For simplicity we assume this loss is compensated for by the increase in maintenance and repair work needed for the smart meters and communications infrastructure.

[164] Based on baseline of 3,552 kt CO_2 . DECC 2011 Carbon Dioxide Emissions at Local Authority and Regional Level

Summary of impacts for 2020

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA/y £m
Meter installation	0	0	0	0
0.5% decrease energy consumption	8*	0.37	3	0.2

* all figures in this row are from the economic model of SW Economy so multipliers are slightly different from those used elsewhere in the report.

The 0.5 per cent decrease in energy consumption would reduce CO_2 emissions by 177,600 tonnes. This is incorporated into the carbon savings set out in Appendix 12 below.

2.3. Technology acceleration projects

The following set of technology acceleration projects provide examples of the types of projects that could be carried out. Since the scope of the schemes is unclear and it is unknown which ones would go ahead, it has not be possible to estimate the direct impacts that might result.

Many of the economic benefits of the schemes must be regarded as intangible at this stage. However, they are likely to enhance Cornwall and the Isles of Scilly's expertise and reputation, and therefore, its economic potential. This potential will be reflected in the projected growth in jobs and GVA from the wider Smart Cornwall programme initiatives set out in this scenario.

The CO2e savings from the programme as a whole are captured in Appendix 12 below. It is possible that some technology accelerator projects could increase CO2e savings, however, it is not possible to quantify the potential additional savings at this stage.

Social housing

This project could focus on the use of smart technology and possible renewable energy (most likely solar PV) to reduce tenant's energy bills by fitting smart meters and home energy management systems.

There are several housing associations in Cornwall, for example Devon & Cornwall Housing has 9,000 homes in Cornwall, Cornwall Housing 10,500 and Ocean Housing 4,000. A possible project would be to obtain funding to fit smart meters and home energy management systems in say 2,000 homes together with a customer engagement initiative to ensure tenants could make the most of the technology. The energy usage and costs could – with the tenants' agreement – be monitored and the effect measured.

The benefits to the tenants would be reduced energy costs, and to the community reduced carbon emissions. The benefit to the programme is the knowledge and insight into the effectiveness of the approach and learning about issues in design and deployment.

Smart grid projects with the DNO

Several smart grid projects are underway or are proposed by the DNO, Western Power Distribution (WPD). It is important that the Smart Cornwall technology accelerator programme is involved in these projects at least to the extent that it can showcase them as example of work ongoing in Cornwall. The projects so far are:

- Roscrow wind farm: a static compensator and controller has been installed to ensure the wind farm generator does not overload the network
- Isles of Scilly: Power Plus Communications is working with WPD on ways to automatically co-ordinate and optimise electricity flows between the islands
- Clean Energy Balance: a proposed project being put forward for LCNF funding by Toshiba and WPD to convert excess renewable electricity to hydrogen and inject it into the gas grid.

Electric vehicles

If the uptake of electric vehicles (EVs) is large, it could in time have a big impact on the distribution system; for example if commuters charged their electric cars on returning home at the time of the evening peak electricity demand. There is also the possibility that EV batteries could be used as storage for electricity when it was cheaper to produce. Smart control of connection from mains electricity network to EVs is therefore seen as fundamental for successful deployment.

Forecasts for the uptake of EVs [165] vary from 1 per cent to 10 per cent of cars in the UK by 2020. The Committee on Climate Change (CCC) recommended aiming for 1.7m EVs in the UK by 2020. Currently about 1.3m new cars are sold each year in the UK so the CCC target would imply an average penetration of EVs of about 19 per cent. Navigant Research has forecast that there will be 4.7m EVs, including hybrids, in Europe by 2020.

Cornwall Council has recently been given funding to install 39 EV charging stations across the county and the government plans more will be provided. In addition, the council has six EVs in a trial. There is the opportunity to carry out a large scale pilot of EVs and their impact on the distribution network if it were combined with another smart grid areas scheme, such as the large-scale smart energy demo.

Smart heat

We understand Cornwall Council has put Cornwall forward as a location for a demonstration project on smart heat. In this ETI funded project it is proposed that 2-10,000 homes are retro-fitted with energy management systems and monitored.

3. Business support programme

Underpinning the projects on the ground, which should create the market pull, will be a business development programme. This could provide leadership, strategy and direct support for businesses

[165] HoP PostNote Electric Vehicles 2010

and projects. A number of potential aspects of direct business support are set out below, along with what impact they could have by 2020. The impacts are summarised in the table at the end of the section (3.6 below).

3.1. Attracting inward investment

The participation of large corporations in smart energy projects will give the sector credibility in Cornwall and the Isles of Scilly. Many of the respondents to our survey of existing SMEs in Cornwall stated that sub-contracts from large businesses already operating in this field would greatly help Cornish SMEs to enter the sector.

There is also an opportunity for Cornwall and the Isles of Scilly to provide a launch-pad for businesses outside Europe, such as Taiwanese and Korean businesses, to commercialise their products and services in a European setting in order to gain access to these markets.

Evidence also suggests that the entry of dynamic entrepreneurs into the market stimulates productivity, competition and innovation within the region.[166] It enables 'knowledge spill-overs', where local businesses acquire technical knowledge from new entrants through demonstration effects, the interchange of employees via the labour market or as a result of being part of the supply chain.

Partnerships have been already been established by the Smart Cornwall Programme with a range of organisations and businesses around the world, and memorandums of understanding have either been signed or are in the process of being agreed with the Jeollanam-do provincial government in South Korea, the Korea Smart Grid Institute and Pengu Islands government in Taiwan amongst others.

Assessment of impacts

We assume that a team of two FTE employees is set up in Invest in Cornwall to focus on attracting 'smart' businesses from 2015 to 2020. Based on Invest in Cornwall's performance to date in 2013 and the experience of MIDAS in Manchester,[167] we assume that each specialist will attract an average of four investments per annum and each will result in 8.3 FTE jobs. This could amount to about 66 additional jobs each year due to inward investment.

In addition, we assume that each year existing companies grow and add 10 per cent employment. Therefore, in the seven years between 2014 and 2020, a total of 500 jobs could be created.

These jobs are likely to be knowledge-based and high value, with the potential to raise the level of innovation and knowledge-based work in Cornish and Scillonian SMEs and start-ups.

[166] SQI Consulting (2009) UKTI Inward Investment Evaluation Case Studies. http://www.ukti.gov.uk/uktihome/aboutukti/successStory/108749.html

[167] Invest in Cornwall successfully attracted 9 investments in last 7 months, including 75 jobs. Calculate average 2 investments per officer per year. Average 8.3 jobs per investment. MIDAS works to attract inward investment and retain foreign investment in the Manchester city-region. Findings were that the average number of investments resulting per annum works out at 8-10 per enquiry handling officer. (MIDAS overview provided to Manchester City Council Economy, Employment and Skills Overview and Scrutiny Committee, 20 July 2010)

3.2. Providing funding

National and multinational companies stated that Cornwall and the Isles of Scilly's access to EU funding made it more attractive for inward investment.

Access to finance for SMEs is also a critical success factor and was raised by a number of businesses in our stakeholder survey. It enables them to fund investment and reach their full growth potential, as well as facilitate new business start-ups.

Debt finance has been harder to access since the credit crunch and there has also been a significant reduction in the availability of equity finance, which it is especially important for those early stage businesses with the highest potential for growth. [168]

Assessment of impacts

We assume that a FTE role is set up in the Smart Cornwall team to support businesses to access finance, along with the creation of a local revolving loan fund to operate in the equity gap and provide equity finance to high growth potential SMEs. BIS forecasted that its Enterprise Capital Fund (up to £2m) would increase employment in the funded businesses by three times in three years, and that the majority of businesses would grow sales turnover from under £1m to £5m or more within 3-5 years. If we assume that the Smart Cornwall fund supports 25 SMEs by 2020, each growing from an average of three to nine jobs then approximately 150 additional jobs will be created.[169]

The majority of these jobs are likely to be knowledge-based and potentially high value. However, funds may also be used to finance projects and kit, and therefore a proportion of jobs may be in construction, operation or maintenance as well as knowledge-based.

3.3. Delivering marketing and export support for SMEs

It is clear from our analysis that exports will be of major importance for Cornish and Scillonian businesses, if the smart energy sector is to grow quickly.

Linked to the arguments made above about the need to win consumer support and the ability to access markets, businesses need to be able to successfully promote their own products and services to both domestic and global markets. This is an area that many SMEs struggle with, as they tend not to have a dedicated marketing resource.

Assessment of impacts

[168] BIS (2012) SME Access to External Finance. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32263/12-539-sme-access-external-finance.pdf

[169] Average size of SME is 2.95 employees (BIS http://www.bis.gov.uk/assets/biscore/statistics/docs/b/12-92-bpe-2012-stats-release.pdf).

Exports will be greatly facilitated by a dedicated officer in Invest in Cornwall and close working with UK Trade and Investment, which has estimated the benefit cost ratio of trade development support to be around 17:1.

In addition, we assume that a marketing support programme is established and run from 2017 to 2020, provided by a 0.5 FTE in Smart Cornwall to provide bespoke support as well as training events and materials.

There is limited evidence on the success of marketing support services for SME's. However, a review of the Business Link local service, which delivered a range of support services, suggests that every £1 spent by the public authorities through the Business Link generated £2.26 of value. [170]

3.4. Ensuring there is a strong skills base

The existence of a strong skills base is a critical success factor for developing new industries. An immediate opportunity is to create a workforce that is capable of installing smart meters and home energy management systems. Smart Cornwall could ensure that a training programme is put in place for technicians on smart meter installation, for example at a City & Guilds Level 2 Diploma level. This would put the Cornish and Scillonian workforce in a good position to benefit from some of the estimated £15.5 million to be spent on smart meter installation in Cornwall and the Isles of Scilly,[171] with the potential to export these skills to other counties in the region.

Looking beyond the immediate opportunity, there is a need to develop skills relating to wider smart technology and services at both the further education level, for example through Cornwall College, and at higher education level. We propose that the University of Exeter introduce a degree course that is linked to the Centre for R&D, as set out in section1.1 above.

Assessment of impacts

It is likely that the local colleges and universities would find teaching resource from within their existing capacity, as well as from the Centre for R&D. Therefore we forecast that there would be no additional direct jobs. Indirect jobs are likely to be captured by the other elements of the 2020 scenario, as a strong skills base is a prerequisite for the success of the scenario as a whole.

3.5. Business adoption of smart technologies and services

There are significant opportunities for all businesses in Cornwall and the Isles of Scilly to adopt smart technologies and services and to benefit from both savings in their energy bills as well as from generating an income by becoming a 'prosumer' or by providing balancing services. Businesses will need support in identifying and maximising these opportunities. This will be particularly significant for

[170] Department for Business Enterprise and Regulatory Reform review of Business Link local service (2006): Every £1 spent by the public authorities through the Business Link generated £2.26 of value.

[171] 230,400 households in Cornwall (2011 Census at a Glance - Cornwall Council) and an estimated installation cost of £68 per dual fuel meter (2011 Smart Meter Impact Assessment – DECC)

large energy users, such as manufacturers, and could help build their resilience to increases in energy prices as well as increase their overall profits.

Assessment of impacts

The potential income from local ownership of generation and the likely reduction in bills as a result of signing up to a LEM are covered under LEMs in section 4 below. The impact of technology adoption and the resulting energy efficiency savings are accounted for in section 5 below.

3.6. Summary of impacts by 2020

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA
Inward investment	500	26.3	200	10.5
Funding	150	7.9	60	3.2
Consumer awareness	5	0.3	2	0.1
Marketing and export support	1.5	0.1	1	0.0
Skills development	-	-	-	-
Business tech adoption	-	-	-	-

4. Support for local energy markets

Feedback from stakeholders on Smart Cornwall's proposed 'locality model', as set out in the Routemap Consultation, was very positive and our stakeholder interviews reiterated the importance of having engaged communities. One way of achieving this is through local energy markets (LEM).

A LEM enables electricity consumers and producers within a local network to become active participants in trading their power demand and generation, and provides the market infrastructure for smarter management of the electricity network.

An individual home or business could be paid on a real time pricing basis for electricity exported to the network from their own solar panels and releasing power from their own storage. They may get paid a higher price for supplying power at peak demand times. They may also avoid paying high prices at peak demand times (or even get paid for reducing their demand) through shifting to consume their own stored power and/or turning down demand from controllable devices.

An independent generator could be paid on a real time pricing basis for the power they supply into the local network. Variable generation sources such as wind and solar may benefit from employing their own storage to enable them to better match supply with demand.

A LEM has the potential to avoid transmission charges (as power is generated and consumed within the local distribution network), localise balancing costs (as local generators, consumers and storage operators are paid to balance local supply and demand) and localise supplier costs (as supply is managed by a local supply company).

If run as a social enterprise, rather than a profit maximising enterprise, any economic gain from the LEM could be passed back to local consumers through reduced bills and/or generators through increased purchase price. We have assumed below that the saving to consumers bills would be around 10 per cent.[172] We have also captured the economic benefit through predicting the potential income from locally owned generation and from setting up a local electricity supply company.

4.1. Cornwall Electricity Supply Company

We consider there is the opportunity to set up a new, local authority owned organisation to develop and manage LEM, which if it was successful and grew, would be a very significant first for Cornwall and the Isles of Scilly. One multinational company stated that this would help raise the profile of Smart Cornwall and attract inward investment. The Eden Project is already investigating this option with Cornwall Council and a commercial partner, and hopes to launch a supply company in 2014.

The organisation could be structured as a limited company, perhaps named the Cornwall Electricity Supply Company, and could become a licensed supplier of electricity. This would enable the licensee to buy power from de-centralised generators and sell it into the electricity market. Some local authorities are exploring the 'Licence Lite' option, for example the Greater London Authority.[173] However, there is scepticism as to whether this will be successful.

The company could provide the back office function for LEMs, buying power from local generators, selling power to local consumers and trading power both ways outside of the local network when needed. It would provide accounting and billing services and regulatory compliance function.

Assessment of impacts

Cornwall and the Isles of Scilly have 290,000 domestic and commercial electricity consumers. Of the £381 million per year that Cornwall and the Isles of Scilly spends on electricity, £40 million goes to the suppliers; mostly the 'big six.' If Cornwall and the Isles of Scilly set up its own electricity supply company, some of that £40 million could be retained locally through the jobs and GVA that would be created by the operation of the supply company. Capturing 10 per cent of the Cornwall and the Isles of Scilly's consumers would create a business the size of Good Energy, which has around 35,000 electricity customers and employs 120 people. It is possible that a local authority backed supply company could reach this size by 2020 and then double its customer base by 2030, perhaps with an increase in staff of another 25 per cent.

[172] This is in line with the LEMMA study findings. See section 3.1.4 in the main body of the report.
[173] http://www.businessgreen.com/bg/analysis/2255250/how-londons-licence-lite-can-help-your-business-shed-co2

4.2. Incentivising investment in smart energy technologies

£44 million of Cornwall and the Isles of Scilly's annual electricity spend is the cost of balancing supply and demand on the national balancing market. If Cornwall and the Isles of Scilly had a LEM and a smart energy infrastructure, this cost might be reduced and some of it retained locally through incentives paid to homes and businesses to manage their demand, and to generators to manage their generation. This would create an incentive for investment in smart energy technologies that enable homes and businesses to participate in the local balancing market. Some of this money would go to smart energy services companies (e.g. service and maintenance, IT services, and smart device service payments) to maintain the smart energy infrastructure. Smart Cornwall could support Cornwall-based companies to help them secure a substantial share of this work.

Assessment of impacts

This potential benefit has been reflected in the jobs from additional local spend on smart energy technologies set out in section 5.2 below. The likely reduction in CO_2e is captured in Appendix 12.

4.3. Local ownership of generation

£170 million of Cornwall and the Isles of Scilly's annual electricity spend is the wholesale cost of electricity. Some of this spend can be localised where generation is locally owned, with additional local income generated by the revenue incentives paid to renewable generation (e.g. feed in tariff or Renewables Obligation). Currently only building-scale generation and some medium-scale generation are locally owned. With focused support, it would be possible that a significant percentage of the new medium to large-scale generation to be built could be locally owned through local energy co-operatives. This would retain the income that would otherwise go to outside investors locally through local people investing and earning a return on their investment, and surplus income (after operating costs and investors have been paid) going to local energy co-operatives.

Assessment of impacts

If we assume that Smart Cornwall enabled 50 per cent of the additional renewable energy generation required to meet the equivalent of 30 per cent of Cornwall and the Isles of Scilly's electricity consumption in 2020, and 100 per cent in 2030, it would create additional local income of £5m by 2020 and £96m by 2030, equating to 20 and 384 jobs respectively.[174] See the Appendix 13 for further information.

The CO_2e saving from additional integration of renewables is set out in Appendix 12.

[174] Based on the economic model of SW Economy so multipliers are slightly different from those used elsewhere in the report

4.4. Cost reduction through a LEM

If the Cornwall Electricity Supply Company and LEM is operated on a social enterprise basis, with the objective of stabilising and reducing local energy costs (whilst maintaining a financially viable business), rather than maximising profit, then a price reduction may be achieved. Consumers in Cornwall and the Isles of Scilly could receive the benefits of renewables which generate power at a long-term stable cost, which does not yet happen in the national electricity market where prices are driven largely by the cost of gas. Some of this price reduction, along with energy efficiency gains, will increase disposable income of firms and households.

Assessment of impacts

If we assume 10 per cent of Cornwall and the Isles of Scilly's domestic and commercial electricity consumers participate in the LEM and achieve a 10 per cent reduction in their electricity bill, it would amount to savings of £4.7m per year by 2020 and £5.3m per year by 2030. The jobs multiplier assumes one job per £250,000 of increased disposable income, amounting to 19 additional jobs in 2020 and another 2.4 in 2030.[175]

4.5. Summary of impacts by 2020

The methodology for calculating the potential jobs from supporting LEMs is different from above, with the exception of the Cornwall electricity supply company, as we have used the estimated increase in income to calculate the additional jobs based on the economic model of SW Economy so multipliers are slightly different from those used elsewhere in the report.

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA
Cornwall electricity supply company supplying 10% of domestic and commercial consumers by 2020 and 20% by 2030	120	6.3	48	2.5
Income from local ownership of generation (50% of additional capacity)	20	1.1	8	0.4
Bill saving from 10% of consumers saving 10% of their electricity bill	19	1	7.6	0.4

An alternative model for calculating the impact of a LEM is to assume that it would localise the wholesale cost, supplier margin, balancing and transmission costs. The total of these costs is forecast to rise to £322 million by 2020 and £372 million by 2030 (see table 13 in Appendix 13). It should be noted, however, that significant regulatory, technical and commercial developments are required to realise even some of this value. Significant investment would also be required.

[175] Based on the economic model of SW Economy so multipliers are slightly different from those used elsewhere in the report

The table below breaks down the elements of the cost and calculates the maximum value that could be localised if 10 per cent of consumers sign up with a LEM by 2020 and 20 per cent sign up by 2030. However, it should be noted that it does not take into account the investments required and that it assumes the balancing cost and supplier margin could be localised in full, which is unlikely.

Element	Cost by 2020	Value of 10% penetration of LEM by 2020	Cost by 2030	Value of 20% penetration of LEM by 2030
Wholesale cost	£182m	£5m*	£228m	£96m*
Balancing cost	£62m	£6.2m	£64m	£12.8m
Supplier margin	£57m	£5.7m	£59m	£11.8
Transmission charges	£21m	£1.1m**	£21m	£1.1m**
Total	**£322m**	**£18m**	**£372m**	**£121.7m**

*Forecast for 50% locally owned additional renewable energy capacity

** Transmission charges may be reduced by a LEM but unlikely to be eradicated, so we assume half the cost is localised.

This model for calculating the impact of a LEM forecasts that up to £18 million (3.8 per cent) of energy spend could be localised each year by 2020 and up to £120 million (22.9 per cent) per year by 2030, based on the assumption that significant investments are made and regulatory, technical and commercial developments are achieved.

5. Engaging communities

As stated above, national and multinational companies saw Cornwall and the Isles of Scilly's engaged communities as a key selling point, and one that should be developed to attract inward investment. Businesses both inside and outside of Cornwall and the Isles of Scilly highlighted the importance of consumer awareness of the benefits of smart energy networks, as well as trust in the businesses supplying services and collecting data on their consumption patterns. Research has suggested that independent, trusted bodies, such as the community groups, could play an important role in encouraging consumers to maximise the benefits of smart energy networks.[176]

We can assume that there would be a number of impacts from firstly, establishing energy cooperatives, and secondly, from both the Smart Cornwall programme and the energy cooperatives encouraging homes and businesses to take-up and use the technologies.

5.1. Supporting energy cooperatives

A positively engaged community in each locality is key to achieving the uptake of smart energy technologies, distributed resources (generation, storage and controllable demand) and a LEM. An example of a local energy co-operative with the broad support and involvement of the local population, businesses, and key institutions (e.g. councils, schools and chamber of commerce) is the

[176] Energy Saving Trust for DECC (2013) Role of Community Groups in Smart Metering-Related Energy Efficiency Activities

Wadebridge Renewable Energy Network. WREN, which has 1,000 members, has been successful in positively engaging the local community in large-scale renewable energy generation (the repowering of St Breock windfarm) and in accelerating the adoption of building-scale low carbon technologies through its buying clubs and free insulation offer.

The success of WREN has been dependent on a high level of voluntary input that is not going to be replicated in many communities. However, WREN (and other local energy co-operatives across the UK) has established a range of replicable business models and an approach to community engagement that is replicable with an appropriate framework of support and funding to enable professional management by suitable people.

Smart Cornwall could put in place a funding and professional support framework that would enable the roll out of local energy cooperatives across Cornwall and the Isles of Scilly. The cooperatives require funding to cover seed costs, but should ultimately be financially self-sustaining.

Assessment of impacts

WREN has 2 FTE for a town of 8,700 people. If we scale this to Cornwall and the Isles of Scilly, there would be over 60 energy cooperatives employing 120 FTE. We are already aware of 37 active community energy groups in Cornwall and the Isles of Scilly. We could assume that, with focused support, all 37 will grow to the size of WREN by 2020. Therefore, creating 74 jobs.

5.2. Encouraging technology take-up

The Smart Wadebridge Case Study (see Appendix 13) describes how smart technologies may be adopted in 2020 and 2030. It looks at smart energy, smart health and wellbeing, smart transport and smart retail. It also quantifies the additional local spend on smart energy technologies installed in homes and commercial properties that could result from focussed support from Smart Cornwall to accelerate adoption and increase the percentage of spend retained locally (e.g. through supply chain development).

Assessment of impacts

The following table provides the forecasted additional spend and jobs figures. These figures are the result of a calculation of estimated spend per property on each technology, the percentage of properties adopting the technology, and the percentage of spend retained in the local economy for 2020 and 2030 with and without focussed support from Smart Cornwall. The jobs multiplier assumes £47,000 of revenue per job. This is applied to service spend and the install cost of the technology (i.e. excluding spend on the technology itself which is assumed is imported).

Smart energy technology area	Additional spend and jobs above BAU resulting from Smart Cornwall			
	Additional local spend per year 2015-2020	Additional jobs maintained per year 2015-2020	Additional local spend per year 2021-2030	Additional jobs maintained per year 2021-2030
Homes				
Smart meters (weighted cost - assumes all elec half gas)	£1,089,153	23.2	£73,646	1.6
Smart apps and services (annual)	£155,658	3.3	£326,091	6.9
Building integrated smart technologies (e.g. HEMS, smart appliances)	£1,513,408	32.2	£619,616	13.2
Building integrated renewable energy generation and storage	£11,128,000	236.8	£3,038,000	64.6
Total for homes	**£13,886,219**	**295.5**	**£4,057,353**	**86.3**
Businesses - 31,200 x non-half hourly metered commercial properties (ave consumption 15,000kWh/yr, £2,250/yr)				
Smart energy management apps and services (annual)	£117,000	2.5	£222,300	4.7
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£1,248,000	26.6	£273,000	5.8
Businesses - 940 x half hourly metered commercial properties (ave consumption 880,000kWh/yr, £100k/yr)				
Smart energy management apps and services (annual)	£122,070	2.6	£86,858	1.8
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£1,267,650	27.0	£0	0.0
Total for businesses	**£2,754,720**	**58.6**	**£582,158**	**12.4**
TOTAL FOR CORNWALL	**£16,640,939**	**354.1**	**£4,639,511**	**98.7**

The take-up for smart technologies will also reduce energy consumption by giving households and businesses the opportunity to optimise energy consumption through automated systems and behaviour change. This could result in financial savings as well as CO_2 savings.

We have estimated the financial savings from electricity bills based on the technology adoption scenarios set out in the Smart Wadebridge case study, see Appendix 13.

The table below sets out the estimated electricity efficiency savings against a 2013 baseline.

	BAU		Smart Corwall		Smart Cornwall less BAU	
	2020	2030	2020	2030	2020	2030
Households	3.4%	6.3%	4.4%	9.9%	1.1%	3.6%
Businesses	2.2%	10.9%	4.0%	16.6%	1.9%	5.7%

We then applied the estimated efficiency savings to the forecast annual electricity spend for 2020: £228.9 million for households and £241.1 million for businesses (see Appendix 13, table 5).

The estimated annual saving in electricity bills as a result of the Smart Cornwall programme in 2020 is £2.5 million for households and £4.5 million for businesses, amounting to £7 million. And by 2030, this could total an annual saving of £25 million. We can translate the 2020 financial saving into jobs using the SW Economy model - £250,000 per job – to get 28 direct jobs.

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA/y £m
Electricity efficiency savings	28	1.5	11.2	0.6

The related reduction in CO_2 emissions is taken into account in Appendix 12. Related benefits include a reduction in fuel poverty, healthier people and homes.

5.3.Summary of impacts by 2020

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA
Supporting energy cooperatives	74	3.9	29.6	1.6
Technology take-up	354	18.6	141.6	7.4
Electricity efficiency savings	28	1.5	11.2	0.6

We can assume that the energy cooperative jobs will be knowledge-based, but that the majority of the technology take-up jobs will be in installation and servicing, and therefore would not be classed as knowledge-based.

6. Summary of impacts

This assessment of a bottom-up scenario for 2020, based on the building blocks set out in section 5 of the main report, has focused on the potential increase in jobs and GVA. It has also provided a commentary on the types of jobs we would be likely to see, along with activities that are expected to reduce CO_2 emissions.

The table below summarises the expected change that we would see by 2020, as a result of the Smart Cornwall programme.

	Direct FTE jobs	Direct GVA/y £m	Indirect FTE jobs	Indirect GVA
Technology development				
Centre for R&D	87	4.6	35	1.8
Business Acceleration Hub*	160	8.4	64	3.4
Smart data platform	50	2.6	20	1.1
Technology deployment				
Large scale demo	-	-	-	-
Smart meter roll out	-	-	-	-
Smart meter decrease in cost	8	0.4	3	0.2
Technology acceleration projects	-	-	-	-
Business support				
Attracting inward investment	500	26.3	200	10.5
Providing funding	150	7.9	60	3.2
Marketing and export support	1.5	0.1	1	0.0
Skills base	-	-	-	-
Support for local energy markets				
Cornwall Electricity Supply Company	120	6.3	48	2.5
Local ownership of generation	20	1.1	8	0.4
Cost reduction in bills	19	1	7.6	0.4
Engaging communities				
Supporting energy cooperatives	74	3.9	29.6	1.6
Encouraging tech take-up	354	18.6	141.6	7.4
Electricity efficiency savings	28	1.5	11.2	0.6
*Less double counting[177]	(80)	(4.2)	(32)	(1.7)
TOTAL	**1491.5**	**78.5**	**597**	**31.4**

So at the end of 2020, we could expect to see about 2,089 new jobs resulting from the Smart Cornwall programme and an increase in GVA of £110 million. As an example, this might be seen in terms of say 10 firms of about 80 employees, 50 firms of 10 employees and around 260 firms of three employees.

The majority of the new jobs come from business support activities and from engaging communities to encourage the take-up of smart technologies. The technology deployment projects do not create additional jobs because the projects would either happen anyway in BAU (such as installing smart meters in all premises) or are construction projects in which jobs are short term and effects on employment in the longer term are negligible. It should be noted, however, that the projects and initiatives should be seen as interdependent, and that any element on its own would not deliver the same level of impact.

[177] It is likely that some of the jobs forecast for the Business Acceleration Hub will be created through business development activities and we assume 2/3 of them are in this category. Accordingly we deduct 80 direct FTE jobs from the total.

Appendix 10: 2020 top-down scenario and impacts

To test the results of our bottom-up analysis of the impact of Smart Cornwall 2020 scenario we reviewed the scale of the global opportunity and what share Cornwall and the Isles of Scilly could potentially achieve under certain assumptions.

1. Issues in the top-down approach

A top-down approach takes forecasts of the size of selected market areas and then estimates what share might be taken. This approach is straightforward in established markets where data exists for previous years or for other regions where growth trends can be determined. Tourism or renewable energy generation are examples applicable to Cornwall where the county's current market share and future prospects can be estimated. However, smart technology is at an earlier stage of development than these sectors and such market data is not available.

Problems arise with the market forecasts for smart technology which commonly lack detailed evidence and frequently are obscure about the exact definition of the market area and the underlying assumptions for the forecast. Further problems arise when estimating the share of a market that Cornwall and the Isles of Scilly might take since there is scant basis for selecting a percentage. Even where there is a tenuous connection to an existing measure of Cornwall and the Isles of Scilly's performance this has to be modified as we can expect Cornwall and the Isles of Scilly to do better in future than it has in the past. Thus attempts to estimate future smart technology revenues on Cornwall and the Isles of Scilly's existing share of measures such as GVA are prone to produce low estimates of what might be achieved because Cornwall and the Isles of Scilly is relatively small (0.9 per cent of UK population for example).

Accordingly we have had to make some important assumptions to estimate Cornwall and the Isles of Scilly's share or, where this was not feasible, only to illustrate the possibilities by selecting reasonable figures.

2. Market size

As set out in section 3.1 of the main report on economic opportunities, there are various estimates of the size of the global market for smart energy technology and all show markets of several billion dollars a year. However, the scope and methodologies underlying these estimates are not clear (e.g. the technologies, equipment, services etc. that are included) and little basic evidence is presented. Broadly, data in this area is unreliable at a global/UK level and absent at a Cornwall and the Isles of Scilly level.

More detailed estimates of sub-markets come from Navigant Research, which publishes a series of market analyses. Although there may be overlap between sub-sectors, the global forecasts shown in the table below give some impression of 2020 market size and growth rates expected.

	2012 or 2013	2020	Approx growth /year
Annual global vendor revenue (US $ billion/year)			
Smart grid technology	33	73	12%
Distribution automation	6.3	11.3	9%
Microgrids (mostly in USA)	10	40	22%
Virtual power plants	-	3.6	-
Building energy management systems	1.8	5.6	15%
Home appliances and home automation	-	35	-
Networked lighting	1.7	5.3	15%
Smart grid analytics for network optimisation	0.7	4.3	25%
Smart city technology	-	20.2	-
Other forecasts			
Electric vehicles in Europe (number)	-	4,700,000	
Smart meters installed each year (number/year)	-	114,000,000	
Energy storage connected to grid	-	14,000 MW by 2022	

The table suggests that by 2020 the main sub sectors (outside the USA) will be smart grid technology, home appliances and home automation, and smart city technology. The table indicates that growth rates of 10 per cent a year or more can be expected to 2020.

3. Cornwall and the Isles of Scilly's share of global markets

If we use the estimate of global annual revenue for smart energy technologies as US $117.2 billion[178] by 2020 from the table above we can try to estimate what share Cornwall and the Isles of Scilly might take based on two proxies:

- the ICT sector, as the nearest equivalent to smart technology
- the semiconductor industry, as an example of a successful cluster in the south west.

3.1. ICT sector as a proxy

We have based our estimate on the following data but as none of the data is available for the same year, we can only use it to get orders of magnitude. The data is:

- An OECD report[179] showed that in 2007 OECD countries represented 52 per cent of world trade in ICT goods and services and total world trade was $3,700 billion. The UK is one of the OECD's largest exporters of ICT services, with exports in 2007 of $21.9 billion (but is a net importer of ICT goods).

[178] Navigant Research forecasts for smart grid technologies (including Transmission upgrades; Substation automation; Distribution automation; Smart grid information and operations technology; and Smart metering), virtual power plants, building energy management systems and home automation. See table above.

- In 2012 UK GDP was 5.14 per cent of the OECD total[180]
- Cornwall and Isles of Scilly's GVA in 2011 was 0.6 per cent of the UK's total.[181]

Then we can calculate that Cornwall and the Isles of Scilly's proportionate share of the UK's ICT exports would be $21.9bn*0.6%=$131m and Cornwall and the Isles of Scilly's proportionate share of world ICT trade would be $3,700bn*52%*5.14%*0.6% = $593m (or about 160 millionths of total world trade).

For comparison the whole ICT sector turnover in Cornwall and the Isles of Scilly in 2010 was about $200m and the sector's sales to customers outside the UK were probably less than 10 per cent of this figure.

On the optimistic assumption that Cornwall and the Isles of Scilly, through the Smart Cornwall programme, could achieve six times its proportionate share of the global market then it would have a one thousandth share of the global market. Clearly this is based on a number of large assumptions and hence is subject to a very large margin of uncertainty, but it provides a reasonable 'order of magnitude' basis for the estimates that follow.

A one thousandth share of $73 billion (the annual global vendor revenue from smart grid technology in the table above) would give Cornwall and the Isles of Scilly smart grid revenue of about $73m or £47m/year. If we include Navigant forecasts for virtual power plants, building energy management systems and home automation, this provides an additional $44.2 billion, equating to an extra £27.7m/year for Cornwall and the Isles of Scilly. This provides a total of £121.7m/year.

The report mentioned earlier found that the ICT Digital sector in Cornwall averaged revenue per employee of about £47,000.[182] On this basis exports of £121.7m/y would imply about 2,589 jobs.

When we apply a multiplier to calculate the indirect and induced jobs, we get a total of about 3,625 jobs.

3.2. Semiconductor sector as a proxy

An alternative approach would be to look at the semiconductor industry, which is one of the world's fastest growing sectors. The UK has around 2.7 per cent of the global semiconductor market and is the third biggest player in Europe (after Germany and France).[183] The region around Bristol and Bath is home to one of the biggest silicon design clusters anywhere in the world outside California's Silicon Valley and is twice the size of the next biggest UK cluster around Cambridge. The Bristol/ Bath cluster

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179 OECD (2009) "International trade in ICT goods and services", in OECD Science, Technology and Industry Scoreboard 2009

180 www.oecd-ilibrary.org/economics/gross-domestic-product-in-us-dollars_2074384x-table3

181 Cornwall County Council , 2013, Cornwall's economy at a glance

182 Average revenue per employee in UK is about £220,000, although there are big variations; for example oil companies' revenues are over £2m/employee which increases the UK average.

183 NESTA (2010) Chips with everything Lessons for effective government support for clusters from the South West semiconductor industry

has about 50 firms, which is 10 per cent of the UK total. Therefore, we could assume that the south west cluster accounts for around 0.27 per cent of the global market.

A 0.27 per cent share of the $117.2 billion would give Cornwall and the Isles of Scilly smart sector revenue of about $316.4m or £198.3m/year. Equating to 4,219 jobs.

When we apply a multiplier to calculate the indirect and induced jobs, we get a total of about 5,900 jobs.

4. Estimates based on UK forecasts

The SmartGrid GB report "Smart Grid: A race worth winning?" points out that while the UK may not start to deploy smart grids until after 2023 there is an export potential as other countries, particularly the USA, are already spending large sums of money on smart grid technologies. The report found that the potential export benefits could be sustained through the 2020s and 2030s, and would be approximately as follows:

- GVA: Estimated increases in GVA total £13 billion (direct GVA £6 billion, indirect GVA £5 billion and induced GVA £2 billion)
- Jobs: The report highlights how jobs could be boosted by an average of 8,000 during the 2020s rising to 9,000 during the 2030s if sufficient investment in smart grid development is made.
- Exports: The report also shows how the value of exports from the emerging smart grid industry could be worth £5 billion between now and 2050 to Britain, and that benefits arising from intellectual property and foreign direct investment may also occur.

When Cornwall and the Isles of Scilly's percentage share of UK GVA (0.6 per cent) is applied to the estimated increase in national GVA, it produces £78 million.

On a population basis, Cornwall and the Isles of Scilly at 0.9 per cent of UK would get just 72 new jobs (0.9 per cent *8000).

Cornwall and the Isles of Scilly's exports are less than 1 per cent of UK exports by value. If we assume Cornwall and the Isles of Scilly by 2020 took 1 per cent of the £5 billion/year exports forecast by E&Y, then its exports of smart grid technology would amount to £50m/year. If we use a figure of £47,000/employee then exports would support 1,060 jobs. This figure, plus the 72 new jobs, plus a multiplier to calculate the indirect and induced jobs equals 1,585 jobs.

5. Semi-quantitative analysis of wider smart technologies and services

Deployment of wider smart, for example tele-health, retail and transport, might lead to job reductions where implemented (as smart is generally labour saving) but open new markets for technologies and services allied to, or similar to, smart energy devices/software. There are many estimates of what different sub-sectors of the market will do by various dates in reports that cost thousands of dollars to purchase. The only overall estimate we have found is in a report, the summary is below, which includes smart grids and suggests a growth rate of 15 per cent per year and a global market of $1,560 billion by

2020. This is very different from the Navigant research which forecasts $198 billion by 2020. The problem is one report may include for example all sales of electric vehicle chargers and another might include all the vehicles themselves.

The Smart Cities Market to 2013 report states,

> *"The global Smart Cities market was worth US$442 billion in 2011, and is expected to reach a value of US$1,026.3 billion by 2017, following growth at a compound annual growth rate of 15%. This report gives an in-depth analysis of the global smart cities market, and provides market revenues for the global smart cities market and its major sectors, such as smart buildings, smart homes, smart transportation, smart grids, smart healthcare, smart education, smart security and smart industry automation between 2011 and 2017."*[184]

We can assume that in practice the size of the global market as far as Cornwall and the Isles of Scilly are concerned is infinite and what per cent share Cornwall and the Isles of Scilly can take is limited by its competitive position (product, price, reputation, delivery and so on) and its ability to increase market share (marketing, exporting, training new workers, finance, premises, etc). These are real constraints, for example we know from the Digital ICT report that availability of skilled ICT staff in Cornwall is a concern (cited by 42 per cent of firms surveyed).

So an upper limit on the number of direct jobs by 2020 and 2030 is how fast the smart sector in Cornwall and the Isles of Scilly can develop. One of the fastest growing sectors worldwide in recent years is semiconductors which has a 20 year average rate of 13 per cent a year and in 2010 was worth about $304 billion. However growth rates year to year have varied with economic conditions and the fortunes of even large semiconductor companies have varied considerably up and down over time. There is close analogy between the trend to put semiconductor chips in all sorts of devices and deployment of smart technology. Currently the UK has 2.7 per cent of the global market for semiconductors.

About 15,000 people in the Bristol area are engaged in other aspects of ICT including hardware, software, media and publishing, and telecommunications although annual growth rates are only 2 or 3 per cent a year.

Another example is space where the UK has 6 per cent of the world market, employs over 19,000 people, and the UK sector achieved sales growth of 9 per cent a year between 1999 and 2007.

We can conclude from these pieces of evidence that:

- The global market for wider smart technology products is virtually unlimited as far as Cornwall and the Isles of Scilly are concerned (although since firms will inevitably chose to specialise this may not be true for all sub-sectors)
- Growth rates of 9 to 13 per cent a year are realistic for certain areas of business over a period of years (assuming a reasonably large starting base, early growth will produce very high per cent)

[184] Smart Cities Market to 2013 GBI Research (January 2013)

- It would be realistic to forecast a wider smart technology industry in Cornwall and the Isles of Scilly employing several thousand people by 2020 but unrealistic to expect it to employ tens of thousands
- The principal constraint on growth of smart businesses in Cornwall and the Isles of Scilly is likely to be difficulty in recruiting and retaining skilled staff.

6. Conclusions

The top-down analysis of the smart energy market, not including wider smart, gives a range of estimates of additional jobs by 2020 of between 1,585 and 5,900 additional jobs, with an average of 3,703:

- If we use the ICT sector's global market share as a proxy for Cornwall and the Isles of Scilly's potential share of the global smart energy sector forecasts by Navigant, we get 3,625 jobs
- If we use the semiconductor industry's global market share as a proxy for Cornwall and the Isles of Scilly's potential share of the global smart energy sector forecasts by Navigant, we get 5,900 jobs
- If we calculate Cornwall and the Isles of Scilly's share of E&Y's forecasts for growth in the UK smart grid sector, we get 1,585 jobs.

Appendix 11: 2030 scenario and impacts

Stakeholders we interviewed were clear that to try to forecast in detail the ways in which the market for smart energy networks will develop up to 2030 is not a useful exercise given the rapidly developing nature of the market. We have assumed, therefore, that Cornwall and the Isles of Scilly have established a significant expertise and reputation in the market by 2020 and that Cornwall and the Isles of Scilly can grow their market share at least in line with the rest of the world.

As explored earlier in this report, the forecasts for the smart energy market are huge and predict compound annual growth rates of between 8-30 per cent up to 2020, as shown in the table below.

Author	Time scale	Cumulative revenue	Annual growth rate	Technology included
GTM Research	2012-20	$400 bn	8%	Smart grid technologies
Navigant Research	2012-20	$494 bn	10%	Smart grid technologies
Pike Research	2011-15	$198 bn	22%	Renewable energy production, storage and conversion
TSB	2013-23	£35.8 bn	30%	UK building energy management systems

However, very few forecasts extend beyond 2020. An exception is the E&Y forecast for Great Britain, which extends up to 2050. It concludes that investment of £23 billion (net present value) is anticipated between 2012 and 2050 to upgrade the distribution network.[185] This investment is expected to generate an average 9,000 jobs during the 2030s if sufficient investment in smart grid development is made. The estimated direct impact on GVA is £3 billion in 2030, with a further £2.5 billion in supply chain effects. If we assume that Cornwall and the Isles of Scilly retains its 0.6 per cent share (2011) of UK GVA activity and 0.9 per cent of UK population, this direct effect nationally could mean £192m GVA and 81 jobs for Cornwall and the Isles of Scilly by 2030.

However, due to the extent of the differences between the E&Y and other forecast studies, we feel it would be more appropriate to apply a growth rate to our projection for 2020 up to 2030. It is likely that some areas of smart technology could have very high rates of growth, for example, consumer orientated software applications which might grow at 20 to 50 per cent a year (rates similar to those seen in smart phone apps). Other areas will depend on the deployment of smart technology on the electricity network, a process that will depend in part on replacing equipment as it becomes time-expired and is planned to take decades up to 2050. The table in Appendix 10 above estimates annual growth rates for different aspects of smart energy networks, which range between 9 per cent for distribution automation to 25 per cent for smart grid analytics.

In theory, there is no upper limit on the number of direct jobs by 2020 and 2030. Instead, growth is limited by how fast the smart sector in Cornwall and the Isles of Scilly can develop. The fastest growing sector worldwide in recent years is semiconductors which has a 20 year average rate of 13 per cent a

[185] Ernst and Young and SmartGrid GB. (2012) Smart grids: a race worth winning? A report on the economic benefits of smart grid.

year and in 2010 was worth about $304 billion. However, growth rates year to year have varied with economic conditions and the fortunes of even large semiconductor companies have varied considerably up and down over time. There is close analogy between the trend to put semiconductor chips in all sorts of devices and deployment of smart technology. Currently the UK has 2.7 per cent of the global market for semiconductors.

If we take the central, bottom-up scenario for 2020 of 2,089 jobs and £110m GVA, and assume Cornwall and the Isles of Scilly can achieve growth of 13 per cent a year in line with the semiconductor industry, it could result in a total of approximately 7,090 jobs and £373 million in GVA by 2030.

Appendix 12: Greenhouse gas emission forecast

The CO_2e savings are presented in a way that lines up with the Green Cornwall outcomes. A number of external factors and underlying assumptions have been made, as described below.

The Green Cornwall Strategy has two targets particularly relevant to the Smart Cornwall CO_2e analysis:

- Supporting the increase in renewable energy production to meet the national 15 per cent target of non-transport related energy by 2020; and
- Contributing towards cutting Cornwall's green house gas (GHG) emissions above national targets (34 per cent) by 2020.

These are now considered in turn, followed by a list of assumptions and data used for the analysis.

1. Renewable Energy

Target: Supporting the increase in renewable energy production to meet and exceed the national 15% target of generation by 2020

This national target is the UK's agreed contribution to the overall European target of 20 per cent of energy to be derived from renewable sources by 2020. As electricity is the easiest energy type to decarbonise most commentators, including the Committee on Climate Change (CCC), expect the 2020 renewable energy target to be met mostly from renewable electricity generation. The lead scenario of the National Renewable Energy Action Plan for the United Kingdom as required under Article 4 of the Renewable Energy Directive 2009/28/EC, expects the following split:

	Electricity	Transport	Heat
% of energy from renewables	30%	10%	12%
% contribution to 2020 target	49%	21%	30%

That is to say that in order for electricity to contribute to 49 per cent of the targeted amount of renewable energy, around 30 per cent of all UK electricity will need to come from renewable sources by 2020. The 2012 Renewable Energy Plan Update states *"We are accordingly confident that the UK can deliver around 30* per cent *of electricity generation from renewable sources by 2020".*

Business as usual scenario

The amount of renewable electricity generation in Cornwall currently installed and with consent, is already equivalent to 26 per cent of Cornish and Scillonian electricity consumption. We therefore predict that under BAU conditions a Cornish interpretation of the UK goal of 30 per cent will be readily achieved.

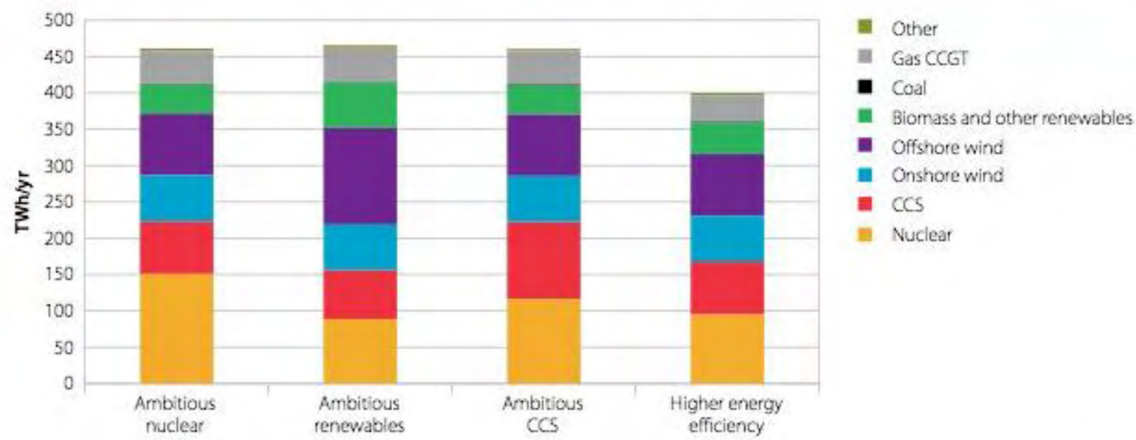
This BAU scenario on renewable electricity in Cornwall assumes:

- Consented projects already have grid connections and will go ahead
- Large scale projects (e.g. over 20 MW) will be able to afford necessary grid reinforcement costs

- WPD will allocate some funds to reinforcing the grid, but this will be limited and will not enable more renewables to be connected.

Looking further ahead and under their ambitious renewables scenario for 2030, the CCC project around 55 per cent of electricity will be produced from renewables.[186]

Figure 1.6a: Power sector scenarios reaching 50gCO_2/kWh by 2030 – generation (TWh)/yr



Source: Redpoint, CCC calculations.
Notes: Other includes Pumped Storage and Gas CHP. Other renewables includes solar PV, marine and hydro. Excludes autogeneration consumed onsite.
CCGT: Combined Cycle Gas Turbine. All the scenario data are presented at UK level, including a small adjustment to add Northern Ireland to the GB-level outputs of the Redpoint modelling.

Again we believe this should be achievable in the county without the intervention of Smart Cornwall.

Smart Cornwall scenario

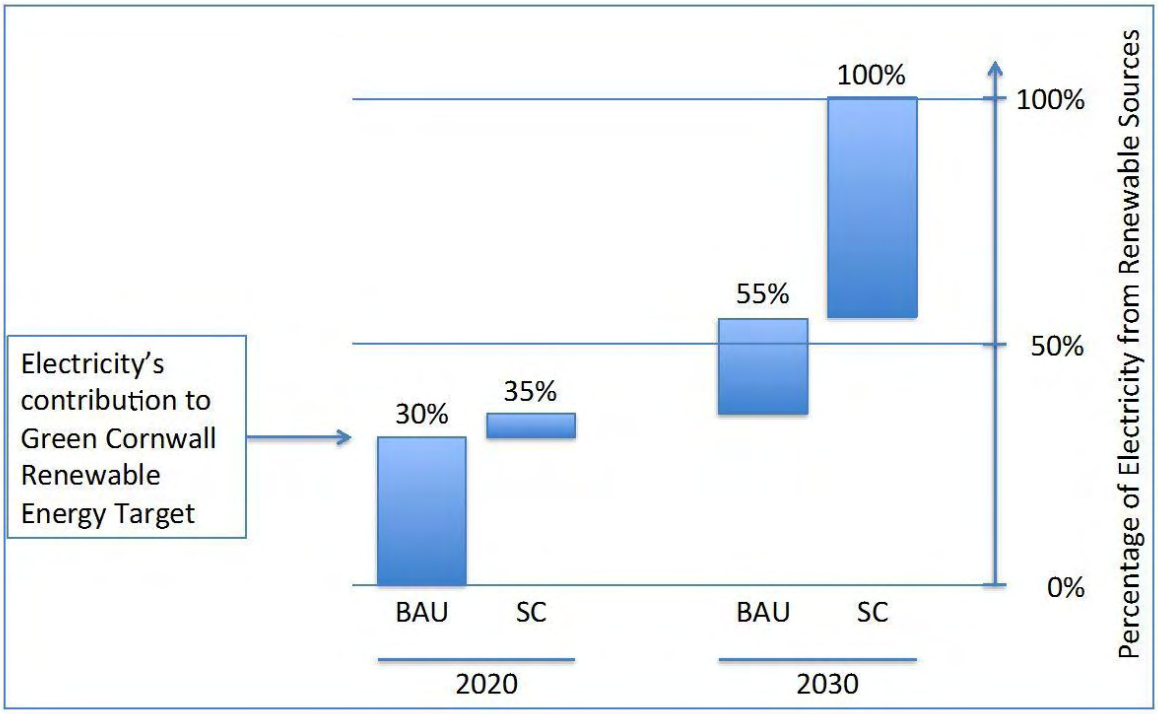
Moving to a Smart Cornwall scenario we do not expect there to be a significant number of additional projects up and running before 2020, but that there will be a few that have been supported by Smart Cornwall. We therefore predict the percentage of electricity to be generated from renewables under Smart Cornwall in 2020 to be 35 per cent.

Beyond 2020, and with the Smart Cornwall programme in full swing, we expect a number of significant grid constraints to be alleviated with grid storage helping to balance times of peak demand / supply. We therefore propose that, under SC, it should be possible for Cornwall and the Isles of Scilly to achieve renewable electricity generation equivalent to 100 per cent of its electricity consumption by 2030.

Whilst ambitious, we believe Cornwall and the Isles of Scilly are capable of generating 100 per cent electricity from renewables due to its natural resources, including new sources such as geothermal and

[186] Next steps on Electricity Market Reform – securing the benefits of low-carbon investment, The Committee on Climate Change, May2013

potentially floating wind, wave etc. The figure below shows the percentage of Cornwall and the Isles of Scilly's electricity from renewable sources.



2. CO_2e Savings

Target: Contributing towards cutting Cornwall's green house gas (GHG) emissions above national targets (34%) by 2020

Smart Cornwall enabled CO_2e savings will arise from a combination of the increased deployment of renewable energy installations as described above and from Smart Cornwall enabled energy efficiency gains. These are now covered in turn.

Savings from Renewable Electricity

The Cornwall Greenhouse Gas Inventory includes an assessment of the overall CO_2e savings associated with local renewable electricity generation. Taking a similar approach and using the renewable electricity projections presented above gives the following gross CO_2e avoided from renewable electricity generation:

	BAU		Smart Corwall		Smart Cornwall less BAU	
	2020	2030	2020	2030	2020	2030
Renewable as % of electricity consumed	30%	55%	35%	100%	5%	45%
Renewable Electricty Generated (MWhrs)	780000	1540000	910000	2800000	130000	1260000
Renewable Electricity Capacity (MW)	571	1194	666	2171	95	977
CO2e Avoided (k tonnes)	**421**	**832**	**491**	**1512**	**70**	**680**

Unfortunately it is not possible to apply all these savings to meeting the Green Cornwall CO_2e target as both the DECC analysis and the Cornwall Greenhouse Gas Inventory both ignore actual levels of local renewable electricity generation and are based on the same national (grid) average carbon intensity factor irrespective of location.

However, whilst the large, utility scale renewable electricity installations will feed power directly into the grid, the electricity generated by integrated building renewables will part feed into the grid and part be consumed on the premises. The general assumption made by the government and used by the Feed-in Tariff scheme is that this corresponds to a 50/50 split.

If we assume the same, and say that 50 per cent of the power generated by building integrated renewables will be used in situ, then this will reduce metered consumption accordingly and appear as an energy efficiency gain in the DECC report. In other words it will be included as a CO_2e saving in the DECC accounts as estimated below.

Net Accountable CO_2e Savings from building integrated renewables:

	BAU		Smart Corwall		Smart Cornwall less BAU	
	2020	2030	2020	2030	2020	2030
Building Scale PV (MW)	146	268	185	488		
Building Scale PV (MWhrs)	146400	268400	185440	488000		
Percentage used on site	50%	50%	50%	50%		
CO2e Avoided (k tonnes)	40	72	50	132	11	59

Savings from Energy Efficiency

Most of the input data on energy efficiency has been taken from the Wadebridge Case Study and scaled up to Cornwall. The Wadebridge model and assumptions underlying the roll out of smart electricity meters, smart apps and services, building integrated smart technologies, and smart energy management apps and services, was extended to estimate associated energy demand reduction.

In addition, an estimate using identical deployment assumptions to the Wadebridge smart electricity meter calculations has been made for the impact on energy consumption from domestic smart gas meters.

From this assessment the CO_2e savings associated with the Smart Cornwall energy efficiency gains can be calculated.

Energy Efficiency CO_2e savings against 2011 baseline (tonnes):

	BAU		Smart Corwall		Smart Cornwall less BAU	
	2020	2030	2020	2030	2020	2030
Homes: electricty	21.3	39.7	28.2	62.7	6.8	22.9
Homes: gas	4.6	5.3	5.7	6.7	1.1	1.3
Businesses: electricty	14.3	72.2	26.8	110.3	12.5	38.1
Total	**40.2**	**117.3**	**60.7**	**179.7**	**20.4**	**62.4**

3. Summary

The CO_2e savings are summarised as follows:

Summary of gross and net CO_2e savings (tonnes):

	BAU		Smart Corwall		Smart Cornwall less BAU	
	2020	**2030**	**2020**	**2030**	**2020**	**2030**
Renewables (Gross savings)	421,200	831,600	491,400	1,512,000	70,200	680,400
Building Renewables (Net)	39,528	72,468	50,069	131,760	10,541	59,292
Energy Efficiency	40	117	61	180	20	62
Total Net Savings	**39,568**	**72,585**	**50,129**	**131,940**	**10,561**	**59,354**

4. External factors and assumptions

Baseline Data

DECC publish an annual report entitled "Local and Regional CO_2 Emissions Estimates". The latest data set covers 2011 (in thousand tonnes per year).

Year	A. Industry and Commercial Electricity	B. Industry and Commercial Gas	G. Domestic Electricity	H. Domestic Gas
2006	877.5	248.8	757.4	321.4
2007	844.0	235.6	747.4	305.2
2008	795.6	213.5	718.5	310.3
2009	686.8	186.3	654.2	281.6
2010	729.2	212.4	666.6	310.4
2011	663.0	181.5	633.9	254.0

For 2008 this gives 1,514 k tonnes for electricity and 523.8 k tonnes for gas per year.

Cornwall and the Isles of Scilly have also published its own, and more comprehensive, assessment of CO_2e emissions, in a report entitled "Greenhouse Gas Inventory for Cornwall and the Isles of Scilly". The latest data set covers 2008:

Source of emissions	Total equiv. CO_2e (t/yr)
Domestic electricity	381,810
Economy domestic electricity	324,643
Commercial /industrial electricity	781,545
Domestic natural gas	300,803
Commercial /industrial natural gas	207,002

For 2008 this gives 1,490 k tonnes for electricity and 507.8 k tonnes for gas – both lie within 4 per cent of the 2008 DECC data.

The CO_2e savings for Cornwall and the Isles of Scilly calculated here are based on the 2011 DECC data for the county, i.e. 1,297 k tonnes for electricity and 436 k tonnes for gas, and a total of 1,733 k tonnes.

Conversion Factors

All calculations assume DEFRA's 2012 conversion factors for electricity carbon intensity. This is assumed to remain fixed, whereas in reality it will decrease over time. However one can argue that it is still reasonable to calculate future CO_2 savings against today's conversion factors.

Smart Meters

The BAU energy and CO_2 savings from smart meters are as per the DECC / Ofgem Impact Assessment for the national roll-out programme (2.8 per cent). Smart Cornwall is assumed to stimulate an additional 0.5 per cent, over and above the BAU savings.

BEMs and Apps

The energy and CO_2 savings from BEMs and Apps are based on an ROI of 2.5 years for commercial users and 5 years for domestic users.

Renewables

Data on the current and projected deployment of renewables in Cornwall was provided by Communities for Renewables CIC.

Smart Wadebridge Case Study

October 2013

Contents

1 Background

1.1 Purpose and methodology

The Wadebridge case study explores the benefits and challenges of developing a smart economy in the context of a specific but representative locality. Wadebridge is a typical Cornish market town and quite typical of market towns across the UK. Around 37% of the UK population and 67% of Cornwall and the Isles of Scilly's population lives in settlements the size of Wadebridge or smaller (i.e. towns of 10,000 people down to single rural dwellings).

The case study sets out a vision for how Wadebridge could develop as a smart locality. A broad description of smart technology adoption is given, covering energy, health, transport and retail. However, the focus of quantitative analysis is energy and electricity in particular. The economic benefits are assessed from 3 perspectives:

1. Spend on smart energy technologies for domestic and commercial buildings, and the percentage of that spend that could be retained in the local economy;
2. The economic potential of a local energy market (LEMthat enables local consumers to buy locally generated energy through a local electricity supply company, as well as providing the commercial arrangements for incentivising smarter energy use and the uptake of storage and demand response technologies;
3. The development Wadebridge as an industry hub for businesses providing smart technologies and services.

The focus is smart electricity. There are wider benefits, e.g. local spend on other smart technologies and services and increased sales and profits from smart retail that are not quantified.

The case study is visionary. The smart technology market is new and evolving and there is not yet a precedent on which to base assumptions for the development a smart town. However, with support where required from Smart Cornwall and an engaged population, the opportunity for the rapid adoption of smart technologies in Wadebridge and other towns in Cornwall and the Isles of Scilly is real, and the assumptions made on technology uptake are reasonable.

1.2 What is a 'smart locality'?

A smart infrastructure enables diverse devices and systems to share increasingly large amounts of real-time data and interact in 'smart' ways. An obvious analogy is the Internet that was developed as a way of linking independent networks together and this linkage then enabled the web and other applications to be developed on top of it. In the same way smart localities (e.g. a town) will come about not through the implementation of a single, centralised system but by the deployment of a range of different systems and infrastructures that are able to share data and interact in beneficial ways to achieve useful outcomes.

Smart technologies are already here, and this report illustrates how localities will become increasingly smart. The adoption of some technologies will be driven by market forces out of a locality's control, as has been the case for smart phones. For other technologies, including some smart energy technologies, there is an opportunity for proactive localities to influence both the rate of adoption and how they are adopted, and so to help achieve economic and social outcomes sought by the local community.

1.3 How smart technologies will be adopted

The adoption of smart technologies will not be uniform. It will vary by type of technology and demographic. It is possible to consider smart technology adoption in terms of the following categories

- Infrastructure based;
- Home-based technology;
- Service-provider / Commercial company led;
- Personal devices and systems.

Infrastructure based

These types of smart systems are physical devices built into infrastructures such as electricity networks, water pipelines or roads. They therefore require physical rollout and this becomes a major determining factor on the rate of deployment and uptake. Examples would include smart distribution network capabilities that require new equipment to be physically deployed by the DNO, and the use of sensor technologies in smart transport.

The deployment of infrastructure based smart technologies is likely to be driven by regulation and investment by government. Unless accelerated by focussed investment, a market town such as Wadebridge is likely to be much slower in being equipped with smart infrastructure technologies than metropolitan areas.

Home-based technology

Devices and appliances within the home are likely to become increasingly smart. 'Smart' devices and appliances could be connected to a home's wireless infrastructure and monitor and report on their own performance. This connectivity will be used to report upon energy use, usage of the device and its maintenance state, with data being sent back to the manufacturer or some other service provider. This will be used to supply preventive maintenance services and provide marketing opportunities to suggest device replacement due to obsolescence, underperformance etc.

Some element of remote control will also be possible. This control could be used to manage energy consumption (either independently by the individual or collectively by an external operator) according to price signals and/or to balance supply and demand in the local network.

Home-based smart technology will see widely varying adoption rates, as is the case with existing home energy technologies. Even after decades of effort there still remains a significant proportion of homes in the UK that are not properly insulated, whilst others are models of environmental performance.

Even in ‘new build’ projects there is considerable variation in the adoption of new technologies by developers, housing associations and homeowners. Embedding new technologies into houses may be seen as risky due to concerns about cost, technological obsolescence and the ongoing cost of maintenance. This changes when there is a clear customer requirement that significantly impacts the saleability of properties and/or the sale price that can be achieved - but despite a lot of activity in this area it is likely to be some years before such smart systems become mainstream.

The retrofit of smart systems into houses is likely to take even longer, unless significant financial incentives are introduced as happened with the feed in tariff for solar PV.

Service-provider / commercial technologies

Some of the fastest adoption of smart technology will be where it is embedded within a competitive service offer. Competitive industries such as telecoms, transport and logistics, and some sectors of the healthcare market are already driving the adoption of smart technology. For example, real-time tracking and traffic information are already widely used in the logistics industry, and the use of tele-medicine is moving forward rapidly in some sectors of the healthcare market.

The embedding of smart technologies in day-to-day life, where the technology itself is not necessarily obvious to the consumer but is rather being used to deliver an enhanced level of service, will attract rapid investment in deployment. Once smart platforms/infrastructures have been put in place there will also be the commercial desire to sweat the assets to deliver as much value as possible. This will again act as a spur to continued innovation and investment in new services that can be delivered using the smart infrastructure and the data it produces.

In addition, large energy users in both the private and public sector will have an economy of scale that makes direct investment in retrofit smart systems far more attractive than may be the case at a domestic level.

Personal devices and systems

Some personal devices and systems are already increasingly smart. The rapid adoption of smart phones, tablets and their associated apps has happened by the individual choice of millions of people. This adoption has enabled the rapid uptake of the first generation of smart solutions, including the use of GPS location data, search histories, and movement rates. This is likely to continue in the future but with a much wider range of devices in use that happen to be smart rather than the current focus on a single smart device such as a smart phone.

1.4 Why Wadebridge?

Cornwall and the Isles of Scilly's geography - a peninsula containing a number of population centres, each with its rural hinterland - provides a useful framework for developing, deploying and iterating smart energy solutions on an ‘island’ basis.

Wadebridge, supported by the Smart Cornwall programme, has the opportunity to be a leading centre for real-world, smart systems development and deployment. ‘Real-world’ as it is the interaction between technological solutions and people (individuals and communities) that will be the main test of smart systems in the years ahead.

There are a number of factors that could enable Wadebridge to accelerate the growth of a smart economy in Wadebridge, and shape it to maximise local benefits:

1. Wadebridge has a community that is positively engaged in developing a local low carbon economy through the activities of the WREN Co-operative;
2. An industry hub of businesses supplying smart technologies and services (the Smart Innovation Hub) is already being considered in the Wadebridge Neighbourhood Plan (see text box below);
3. Plans are underway for a highly innovative hydrogen-based smart network management project in the area (Clean Energy Balance), with funding being sought from the Low Carbon Networks Fund;
4. Proactive engagement with the Smart Cornwall programme that will provide a wider supportive environment for the deployment of real-world projects in Wadebridge with a clear emphasis on repeatability across Cornwall, the UK and overseas;
5. WREN is interested in developing a local energy market (see text box below);
6. The Cornish research community (Exeter, Falmouth and Plymouth Universities and commercial companies) is already studying Wadebridge, with projects looking at the interaction of technology, design, human behaviour and health/wellbeing.

1.5 Vision for Wadebridge

With proactive promotion by the town (led by WREN) and focussed support and investment from Smart Cornwall in key areas, the vision is that Wadebridge could achieve the following by 2020:

- Wadebridge, as part of Smart Cornwall, will have an international reputation for the development and deployment of smart systems;
- Wadebridge will specialise in systems that bring benefits to local communities and businesses - and will do this in a leading-edge context that will engage with new economic models (e.g. Local Energy Markets) and not only focus on technological demonstrations;
- A Local Energy Market will be in place, possibly enabled by a Cornwall Electricity Supply Company, using smart systems and techniques to bring direct economic, social and environmental benefit to the people of Wadebridge and act as a clear pathfinder for what can be done elsewhere in the UK and beyond;
- A Smart Innovation Hub (SIH) will be in place, assisted by a ‘Technology Acceleration Programme’ that will support businesses engaging with Wadebridge-based projects. This will help businesses and communities to develop, productise and deploy smart systems. It will also act as a physical focus for UK / international visits and provide a tangible demonstration / presentation environment for the Smart Cornwall programme. Not all businesses will be based in Wadebridge physically (this would not be ‘smart’) but the SIH act as clear focus to drive company commercial development. ;

- Wadebridge will help to accelerate the development of smart companies in Cornwall and the Isles of Scilly by providing a test bed for an on-going series of deployment projects that demonstrate and evaluate technology adoption in an engaged community environment. This will include providing opportunities to interact with multi-nationals engaged in Wadebridge / Smart Cornwall projects;

This will lay the foundation for the mainstream development of smart localities across Cornwall and the Isles of Scilly in the 2020 – 2030 timeframe (and earlier for some elements).

Without proactive promotion by the town and focussed support and investment from Smart Cornwall neither the local energy market nor the Smart Innovation Hub will happen and Wadebridge will not establish itself as a test bed for smart technology deployment. Smart technology adoption will happen, but to a lesser extent and slower. Adoption will be driven by market forces that are unlikely to achieve the level of local benefits that may be achieved if it had been driven by local interests.

What is a Local Energy Market?

A local energy market (LEM) enables electricity consumers and producers within a local network to become active participants in trading their power demand and generation, and provides the market infrastructure for smarter management of the electricity network.

An individual home or business could be paid on a real time pricing basis for electricity exported to the network from their own solar panels and releasing power from their own storage. They may get paid a higher price for supplying power at peak demand times. They may also avoid paying high prices at peak demand times (or even get paid for reducing their demand) through shifting to consume their own stored power and/or turning down demand from controllable devices.

An independent generator could be paid on a real time pricing basis for the power they supply into the local network. Variable generation sources such as wind and solar may benefit from employing their own storage to enable them to better match supply with demand.

A LEM would be enabled by a local electricity supply company that buys power from local generators and sells it to local consumers, and trades power both ways outside of the local network when needed. The 'License Lite' model being explored in the UK is that the back office and regulatory compliance functions of the supplier, which require an economy of scale, could be performed by a central company (e.g. a Cornwall Electricity Supply Company) that provides the infrastructure for local level trading (e.g. a Wadebridge Electricity Supply Company).

A LEM has the potential to avoid transmission charges (as power is generated and consumed within the local distribution network), localise balancing costs (as local generators, consumers and storage operators are paid to balance local supply and demand) and localise supplier costs (as supply is managed by a local supply company).

If run as a social enterprise, rather than a profit maximising enterprise, any economic gain from the LEM could be passed back to local consumers through reduced bills and/or generators through increased purchase price.

The local energy market will rely upon smart technology to make it happen. There are a number of different economic models for LEMs, but all of them require smart systems to collect and manage the data required to operate a LEM effectively.

A LEM will enable and encourage smart interaction by home users and businesses. Whilst the adoption of the LEM will not be universal, its creation and promotion will help to normalise and accelerate the adoption of smart approaches within Wadebridge.

The Wadebridge Smart Innovation Hub

The existing Innovation Centres in Cornwall have demonstrated how developing sector specific industry hubs can create jobs. Smart Cornwall will create local market opportunities for local businesses diversifying into the sector, new businesses setting up, and national and international businesses moving into Cornwall. As Cornwall's smart industry capacity and reputation become established, so will the 'export' opportunity.

Wadebridge is at the forefront of developing a local low carbon economy, and will shortly have one of the best superfast broadband infrastructures in Europe. The development of a Smart Innovation Hub (SIH) is already being discussed through the Neighbourhood Plan process. The development process has been commissioned by Cornwall Council, and a site has been identified.

The SIH is positioned as a business acceleration facility with high-speed, fibre based connectivity. The principal driver is to stimulate the creation of a Cornish eco-system of home-grown smart technology SMEs that will be in a good position to exploit growing national and international 'smart' markets. The vision is for SIH to be a key facility within a Cornwall hosted "European Centre for Smart Energy Research, Testing and Standards".

The SIH will deliver a number of complementary functions, as part of a Cornwall Smart Business Accelerator programme, including:

1. Accommodation space to SMEs developing and selling innovative, commercial smart technology solutions;
2. Accommodation space for Smart Cornwall partner organisations such as large multinationals;
3. Incubator support for new start-ups;
4. A demonstration centre open to visiting delegations, the public and potential customers;
5. Educational support;
6. Meeting and networking facilities;
7. Access into the Wadebridge living lab; and
8. The Smart Cornwall Data Platform management centre.

The Cornwall Smart Business Accelerator programme will take a hub and spoke configuration with the SIH at its heart. Members of the Accelerator need not be sited at the SIH but can be based in their current premises. That may include the existing Innovation Centres, as well as initial start-ups working from home. Wherever they are physically sited, members of the accelerator will be able to:

- Incorporate their products into the demonstration suite;
- Gain supported access into the Data Platform; and
- Make use of the SIH meeting room and demonstration facilities.

Clean Energy Balance smart network management project

A community-scale storage and generation network management project is already being proposed in Wadebridge through the Clean Energy Balance (CEB) project which is seeking investment from the Low Carbon Networks Fund (LCNF). CEB will enable the connection of renewable electricity generation capacity that would otherwise be grid constrained through a combination of:

- A generation zone management system that enables variable generation to share grid capacity;
- A hydrogen electrolyser converting electricity into hydrogen gas;
- A hydrogen store with around 24MWh of capacity;
- A hydrogen gas powered electricity generator;
- A gas inject that will feed hydrogen gas into the gas network at low percentages.

Once demonstrated the system may be used to smooth the output of variable generation in the area and for supplying power at peak demand times.

2 Smart Wadebridge 2020 and 2030 scenarios

2.1 Introduction

The following sections describe how smart technologies may be adopted in a smart town in 2020 and 2030, using Wadebridge as the example. The scenarios assume, for the reasons set out in Section 1 above, that Wadebridge will be an early adopter of smart technologies. A range of areas are described where smart technologies will become important. However, the focus is on energy (and electricity in particular). The emphasis is on the outcomes achieved, with reference then made to the technologies, services and arrangements that enable those outcomes.

For each technology area an example is given of an existing business that has taken advantage of 'smart' opportunities, to illustrate the sorts of business that Smart Cornwall could be a catalyst for. Whilst there is plenty of opportunity for Cornish companies to work on the technological side of smart systems, it is the engagement of smart systems and people that will be a substantial opportunity in the future. Being able to understand both the technology and the social / economic contexts in which the technology is being used can be a source of differentiation and sustainable competitive advantage for Cornish companies.

2.2 Smart technology adoption scenarios

The smart technologies considered have been sub-divided into categories (energy, health etc). This is useful for analysis purposes but it should be noted that users may not see these distinctions, rather smart applications will be increasingly taken for granted and seen as normal as people go about their day-to-day lives.

In the tables below the following scoring system has been adopted to indicate the predicted level of adoption for each application.

1. In some use, but not at all widespread / mainstream - still in the realm of 'enthusiasts' or very early adopters / innovators;
2. In wider use - starting to become mainstream but still unusual;
3. In common use at a significant proportion of properties - consider mainstream;
4. Used ubiquitously across virtually all properties.

The business as usual (BAU) scenario assumes no intervention. The Smart Wadebridge (Smart W) scenario assumes the local promotion and support and investment from Smart Cornwall described in section 1.

Smart energy applications

The deployment of smart Energy systems and technologies will lead to:

- Increased levels of energy data collection from homes / businesses;
- Smart(er) control systems within homes and businesses;

- Interactions between energy consumers, generators and distribution networks to optimise performance at multiple levels (e.g. consumer cost, generator income supply/demand balancing, grid utilisation and carbon emissions);
- Greater degree of effective consumer and community engagement with behavioural impact.

The overall aim is smarter management of energy demand and supply within a locality. This should lead to increased self-sufficiency from locally generated renewable energy, reduced energy bills, and greater energy efficiency. Social benefits arise through the reduction in fuel poverty and an increased engagement in the energy economy, which will become a collective activity.

A set of typical applications (seen from the user's perspective) are set out in the table below.

Table 1: Smart Energy Applications adoption

Application	Comments	BAU		Smart W	
		2020	2030	2020	2030
Smart Metering - Basic	Current government plan - smart meter plus basic display enables consumers to view consumption data.	3	4	4	4
Smart Metering - Advanced	As above but with smart data analysis / display (e.g. house-specific benchmarking, community comparison, appliance specific data, etc.).	1	2	2	3
Local energy market	Supply of locally generated energy to local consumers through a local energy market. Results in better local energy balance, reduced pricing for consumers, greater utilisation of local renewable energy, and energy spend retained in the community.	na	na	3	4
Human Demand Optimisation	Mechanisms that encourage people to shift demand to optimum times. May include price signals as a mechanism.	2	3	3	4
Auto Demand Optimisation	Automatic mechanisms that adjust energy supply and/or demand automatically.	1	2	2	3
Renewable energy ownership	Greater local ownership of renewable energy generation by households, businesses and community energy co-operatives. This retains income within the community.	2	3	4	4
Smart energy controls - standard	Smart controls covering heating systems and main appliances in the home. Systems are home control based. Will include some remote control capabilities (e.g. via smart phone app) but integration with external data sources is limited.	2	3	3	3

Application	Comments	BAU		Smart W	
		2020	2030	2020	2030
Smart energy controls - advanced	Wider smart control adoption, including higher degree of sensing within the home, integration with external data and presentation elements covering all aspects of daily life.	1	2	2	3
Fuel poverty reduction	Energy bills reduced through installation of renewable energy and energy efficiency technologies on fuel poor homes, smart energy controls, behavioural change and local tariffs.	2	3	3	4
Storage – home	Battery and heat stores within the home	2	3	3	4
Storage – community	Grid connected storage devises and co-ordinated management of home-scale storage.	1	1	3	4
Smart Network	DNO investment in the local network to enable integration of smart energy technologies, distributed generation and local energy market.	1	2	3	4

Smart energy business case study – Carnego Systems

Carnego Systems is a Cornwall-based smart services SME focussed on getting the most out of buildings and the people who use them. This covers both technical performance and the behaviour of building users / occupiers across commercial / industrial and residential sectors. Carnego's systems collect large volumes of data in near-real-time and use this in combination with behavioural techniques and modern technology.

A key smart software product is the Hab Shimmy: Developed in partnership with Hab, the Hab Shimmy is a software system deployed in people's homes that provides real time energy display, up-to-date public transport information, community information, messaging systems between all residents in the community and means of interacting with housing associations and other groups. Delivered on a fixed touch-screen Shimmy also addresses the requirement for integrated and simple controls in modern housing. All of the above is designed with human behaviour in mind - not just a technical widget. The Hab Shimmy is already being trailed in Wadebridge in collaboration with WREN.

Carnego has already sold Shimmy into projects in Wiltshire, Bristol and Shropshire. Shimmy has been selected to be deployed in all homes in the NW Bicter Ecotown project commencing construction autumn 2013.

Smart health and well-being

There is a developing market in smart health and wellbeing solutions that will continue to grow. Smart health and wellbeing applications will be naturally integrated into day-to-day life. This will involve data sharing and interaction with formal healthcare and social care providers (e.g. local GP surgeries). It will also involve an increasing level of independent commercially driven smart interaction, such as people being able to monitor and receive advice / alerts on a wide range of health & wellbeing matters.

Some aspects of this revolution are visible now, such as: fitness aids that integrate physical activity monitoring with online services that track calorie expenditure; bathroom scales that track weight, body fat and provide intelligent feedback; the adoption of online appointment booking and patient records; and the ability to track food purchases and nutritional content online through a smart phone.

By bringing together both the 'formal' (e.g. NHS patient treatment records) and 'informal' health / wellbeing data together with a wider range of in-home sensing/testing solutions, the development of smart health & wellbeing applications is likely to have a significant impact on people's day-to-day lives. Results should include improved health, enabling elderly and ill people to stay in their homes for longer, and reduced costs for healthcare provision.

The growing market provides an opportunity for businesses in Cornwall and the Isles of Scilly, involved in the development of smart health products and provision of services in and beyond the county.
If Wadebridge is proactively engaged in the deployment of other smart technologies, it makes it a useful test bed for deploying smart health technologies and services, as the community is likely to be more receptive and engaged. Smart health services are already being developed by the BT Cornwall program, but Smart Wadebridge could help achieve accelerated uptake in the town.

Table 2: Smart health and well-being adoption

Application	Comments	BAU		Smart W	
		2020	2030	2020	2030
Appointment booking	Online appointment booking.	3	4	3	4
Remote consultations	Consultation with health professionals via video / remote sensing etc.	2	3	3	3
Health data collection in home	Extension of data collection (blood pressure etc.) plus activity monitoring / diet via sensing and remote data collection.	2	3	3	4
Smart fitness applications	Smart fitness aids, as described above.	2	3	3	4
Technologies that assist with home care	Devises that assist with care of elderly and infirm in the home – e.g. communications devises, remote health and environment monitoring by family and care providers.	2	3	3	4

1.1.1.1 *Smart health and wellbeing business case study – BT Cornwall*

BT, Cornwall Council and some of the Cornwall NHS health trusts have created a long-term partnership for a range of services, including tele-health, tele-medicine and assistive technologies. This includes establishing a Telehealth/Telecare 'Centre of Excellence and Innovation' in Cornwall with a focus on applied assistive technology. The centre's activities will include:

- Research;
- Re-designing health and well-being services;
- Demonstrating the benefits of Assistive Technology in terms of quality of life, clinical outcomes and finance;
- Controlled testing of products and technology, in situ, by BT adopting open standards and a product 'neutral' approach;
- Teaching, learning, curriculum development and consultancy.

The partnership is expected to generate hundreds of jobs for Cornwall.

Smart Transport

The field of smart transport is already developing. Applications in this area include:

- Real time and predictive traffic modelling and management;
- Parking availability and signposting;
- Tracking of buses and real-time information;
- Generating traffic condition information e.g. by tracking the movement of mobile phone users;
- Embedded sensing in major roads;
- Cashless payments;
- Development of smart, driverless cars.

Given its importance, smart transport will be a key product development and service development area. Areas that could see innovative development could include demand-based public transport solutions (e.g. mini-buses provided on a real-time allocation system) and possibly linkages between traffic flows and tourism / retail / hospitality venues within the town, enabling businesses to respond to day-to-day fluctuations in visitor numbers based on time of year, weather conditions etc.

It is likely that a city-based focus will continue, with solutions for towns and rural areas following on behind as solutions are proved and unit costs fall. In the 2020 timescale, without major intervention, it is likely that transport facilities within a town like Wadebridge may start to approach the level seen in major cities today.

Table 3: Smart Transport adoption

Application	Comments	BAU		Smart W	
		2020	2030	2020	2030
Real-time traffic monitoring (incl. parking and public transport)	Already in place in some areas.	1	2	3	4
Traffic pattern analysis (historic / predictive)	Already in place in some areas – many trials are currently taking place.	1	2	3	4
Private / public transport co-ordination	Co-ordination of through transport services and more rapid adaption to traffic flows.	1	2	3	4
Context based travel information	Real time advice to users, some applications already in place.	2	3	3	4
Smart delivery services	Smart logistics management, including greater roll-out of same-day delivery services, and services based on predicted demand.	1	2	2	3
On-demand transport solutions	Predictive and voting mechanisms to provide dynamic public transport solutions (bus on demand etc.).	1	1	2	3
Smart ticketing / charging	Integrated tickets services and road charging.	2	3	3	4
Vehicle share	Use of real time information to enable efficient vehicle sharing e.g. electric cars for local deliveries by small businesses	1	2	2	3

Smart transport case study – Google Traffic

Google Traffic collects location data from smartphones and uses the change in location data as a feed to detect traffic congestion. For main roads / motorways Google Traffic can use live traffic data supplied by the Highways Agency etc. but for smaller roads there are no embedded sensors in the road. Google Traffic is therefore able to use movement data streams from smartphones and turn this into meaningful information regarding the speed of traffic in that area.

Smart retail and hospitality

Retailing and hospitality services have already been transformed by web technology and will continue to evolve rapidly. Some applications will happen with or without intervention. What Smart Wadebridge can do is to enable accelerated exploitation by retailers and hospitality providers in the town, and the development of applications that benefit them.

By combining location data with personal data, the town may be able to get a picture of the numbers of people visiting and their personal preferences (e.g. the sort of food and recreational activities they like) and how this varies over the course of a year. This could enable smart signposting of businesses to visitors (e.g. through their smart phone) and enable businesses to tailor their offerings more rapidly and more closely to the visitor profile.

Use of technology in this way could enable small retailers and hospitality companies to effectively compete with large physical and online competitors by using smart systems to be ‘fleet of foot’ and provide a more tailored and engaging experience to customers than would be possible otherwise. Having a detailed picture of consumer preference in the town will not only help existing businesses to be successful, but will also enable the town to attract new businesses to address unfulfilled needs in the town.

Collaborative consumption is an area which is likely to develop further, and there are opportunities for effective promotion at a local level. Collaborative consumption includes hiring or sharing items when needed rather than buying them (e.g. Zipcar), redistribution markets (e.g. ebay) and peer to peer service sharing such as accommodation swaps (e.g. Airbnb), parking (e.g. ParkatmyHouse) and domestic tasks (e.g. TaskRabbit). Smart retail technologies could also open up new opportunities such as virtual markets that enable people to purchase directly from local famers and food producers.

Table 4: Smart Retail adoption

Application	Comments	BAU		Smart W	
		2020	2030	2020	2030
Smart payment solutions	Payment by smart phone exists today and is likely to grow, plus new services including small shop based ‘accounts’ and local currency.	2	3	3	4
Increased online ordering / smart delivery solutions	Large online retails such as Amazon / ebay etc. will continue to grow. Smaller retailers will use these platforms, and also develop their own solutions that enable them to compete, such as virtual high streets / markets that enable people to buy from a range of small retailers in a geographic area, and even directly from local food producers.	2	3	3	4
Personalised recommendations in town	Smart recommendations that direct consumers to shops, restaurants and services available in a town (e.g. through their smart phone) based on their personal preferences and behaviours.	2	3	3	4
Smart services for small retailers / hospitality companies	Services providing greater degree of data / knowledge to small retailers so that market towns can complete with out-of-town and online large retailers.	1	2	3	4

Smart retail business case study –Google Now

Retail services can be transformed by delivering personalised recommendations to people based on their existing habits and preferences. For example, when arriving in a town, a person is automatically recommended via their smart phone to the shops, pub/restaurants and attractions that are likely to be of most interest to them. It would be possible to create such services for Wadebridge / Cornwall. This type of capability already exists via solutions such as Google Now.

Along with answering user-initiated queries, Google Now passively delivers information to the user that it predicts they will want, based on their search habits.

Google Now is implemented as an aspect of the Google Search application. It recognizes repeated actions that a user performs on the device (common locations, repeated calendar appointments, search queries, etc.) to display more relevant information to the user in the form of "cards". The system leverages Google's Knowledge Graph project, a system used to assemble more detailed search results by analyzing their meaning and connections.

3 Economic analysis

3.1 Baseline - Wadebridge today

Wadebridge economy

In this case study 'Wadebridge' is used to refer to the town and adjoining parishes of St Breock and Egloshayle. Wadebridge has a population of around 8,300 people. The number of homes is around 3,750.

A 2006 study[187] (the most recent available) identifies Wadebridge as 'a local centre of shops, services and tourism, with a buoyant local economy and vital town centre', and estimates that the GVA of the Wadebridge local economy[188] was £103 million.

Data from Cornwall Council[189] estimates that 4,150 people work in Wadebridge. The average adult wage in Cornwall is £21,000 per annum[190], implying earned income in Wadebridge is of the order of £87 million per year. The same report describes the employment split for the Wadebridge and Padstow areas together as: 26% working in accommodation and food services, 21% in retail, 7% work in each of construction, health, and education. 5% work in arts and entertainment with some of the remaining 27% spread across business administration and support (4%), professional scientific and technical (4%).

Wadebridge's current energy economy

Energy spend

Wadebridge spends just under £13m per year on energy (gas, transport fuels and electricity)[191] which amounts to around £1,600 per person. This is 1.4% of Cornwall's total energy spend of around £930m, which corresponds to Wadebridge's share of Cornwall's population.

The breakdown by fuel is illustrated in the charts (Figure 1 and Figure 2) below[192]

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[187] The strategic contribution of the main towns to the economy of Cornwall, Roger Tyms and Partners
[188] Gross Value Added, the value of goods and services minus the costs of their production
[189] Annual Business Inquiry, 2010
[190] Source; Cornwall Council, 2010
[191] There is no data available on heating oil consumption, but this is low in the town as most areas are gas-connected.
[192] These figures are compiled from different sources. Road transport and gas prices and consumption figures are from 2010. Electricity consumption figures are 2011 but prices 2012. Department of Energy and Climate Change, *Sub-national Energy Consumption Statistics (series)*; Department of Energy and Climate Change, *Quarterly Energy Prices*; Department of Energy and Climate Change, 'Annex F; Price Growth Assumptions'. These figures do not include coal, other solid fuels or biomass.

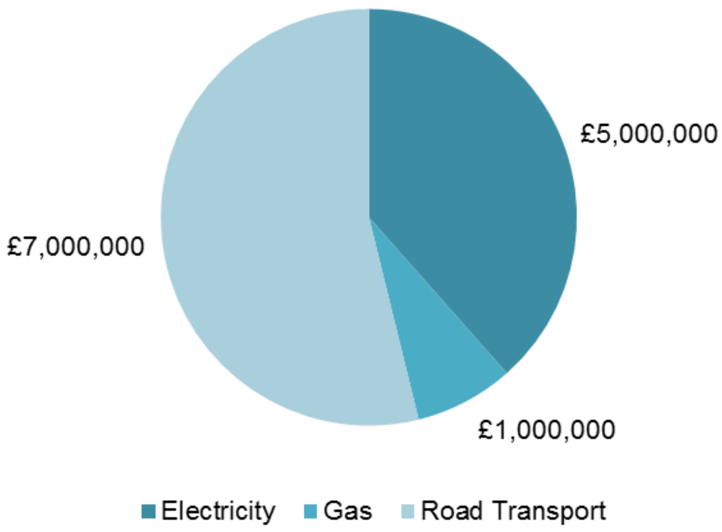

Figure 1: Wadebridge's spend on energy - £13m total.

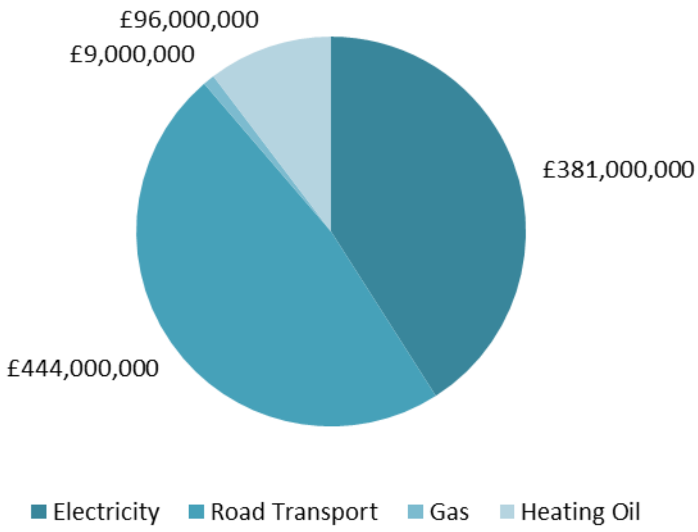

Figure 2: Cornwall's spend on energy - £930m total.

Average spend on home electricity and heating is £1,100 per household per year. Around 15% of households in Wadebridge are in fuel poverty (spending more than 10% of household income on household energy bills). In the surrounding areas fuel poverty rates are as high as 1 in 3 homes.

Wadebridge's energy spend is around 15% of the total earned in salary incomes by people in the town. Whilst there will be some local economic benefit from sales of heating and transport fuel the majority of Wadebridge's energy spend leaves the Cornish economy. Energy prices are currently driven by factors out of Wadebridge's control and so are an economic risk currently unmanaged.

The focus of this case study, and Smart Cornwall, is electricity, as this is the area where smart energy technologies will have the greatest impact within the 2020 timeframe. Electricity spend is 6% of salary income.

Table 5: Electricity spend compared to earned salary income of Wadebridge and Cornwall (2012 prices). The 2020 and 2030 figures take into account new build houses[193] and are based on DECC central electricity retail price scenario.

	Earned salary income	Current electricity spend	2020 projection	2030 projection
Wadebridge	£87m	£4.9 million	£6.2 million	£7.1 million
Cornwall		£381 million	£470 million	£530 million

Local renewable electricity generation

Relative to the rest of Cornwall and the Isles of Scilly, Wadebridge has a high uptake of building-scale solar PV generation. There are also a number of large-scale wind and solar PV projects in the area, or just outside the area. Together these generate the equivalent of 105% of Wadebridge's annual electricity consumption. The bulk of the generation comes from St Breock windfarm and a number of green field solar parks. These supply power into the grid and are owned by commercial developers. 5% of the renewable electricity generated comes from building scale generation (mostly solar PV). Most of this building scale generation is locally owned.

The treemap below (Figure 3) shows the source of Wadebridge's renewable electricity generation by technology whilst Figure 4 shows that breakdown for Cornwall's generation. The 11 kV and 33 kV electricity network in the Wadebridge area suffers from thermal and voltage constraints that mean proposed new medium to large-scale renewable electricity generation projects face very large connection and reinforcement charges from the DNO, which make most such projects financially unfeasible. These constraints have even begun to restrict larger building-scale installations over 4kW.

[193] Department of Energy and Climate Change, 'Annex F; Price Growth Assumptions'; Department of Energy and Climate Change, *Sub-national Electricity Sales and Numbers of Customers 2010-2011*; Cornwall Council, *Cornwall Local Plan, Strategic Policies 2010-2030: Pre-submission Document*.

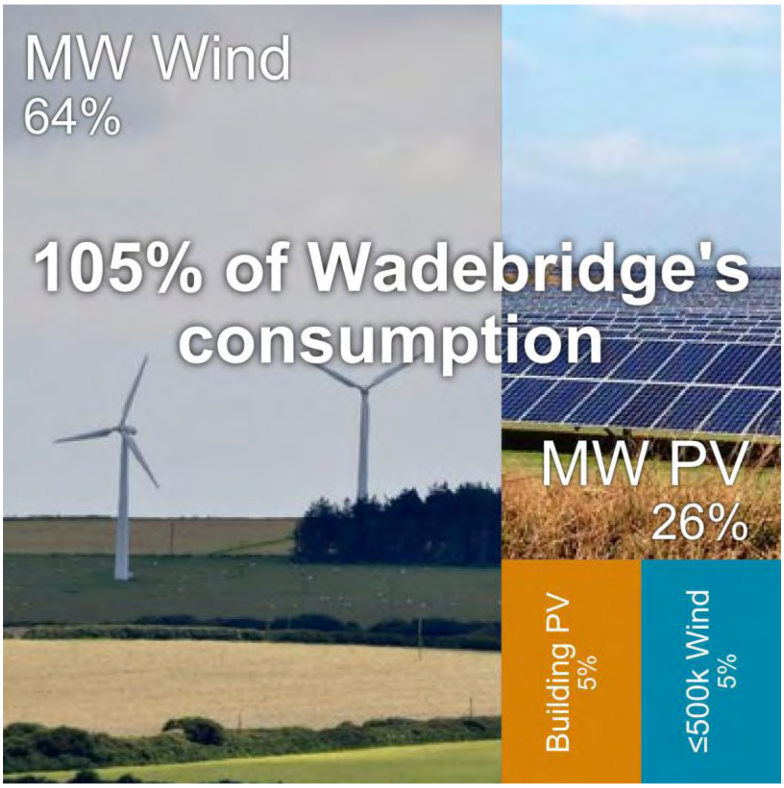

Figure 3: Wadebridge's annual renewable energy production. The area of the rectangles is proportional to the annual MWh generation from each technology [194].

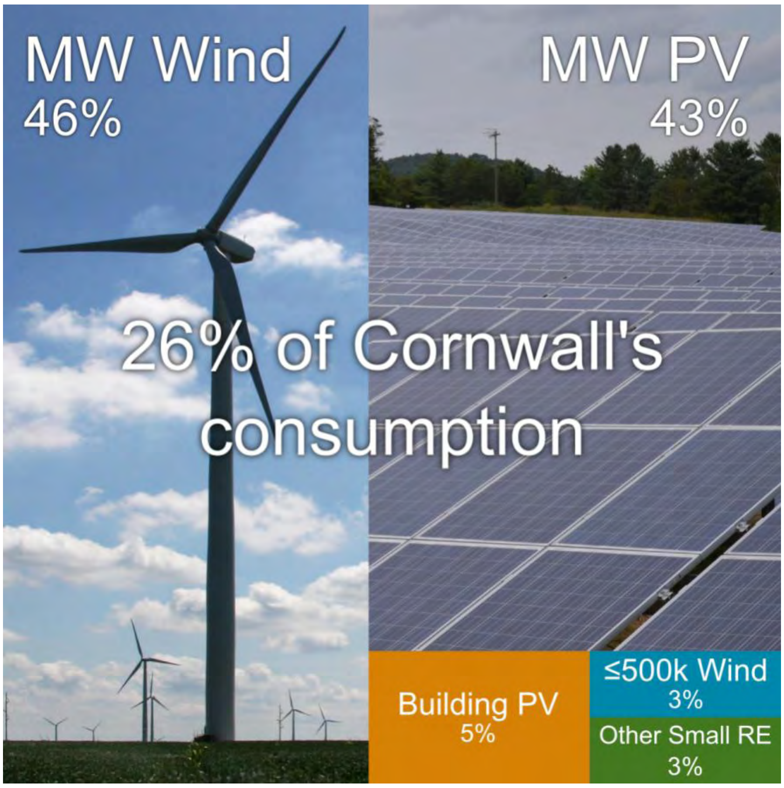

Figure 4: Cornwall's annual renewable energy production. The area of the rectangles is proportional to the annual MWh generation from each technology [195].

[194] Ibid.

Economic impact of local renewable electricity generation

Renewable electricity generation can benefit the local economy in a number of ways:

- The economic benefit from the share of capital investment that may go to local installers and contractors (see Table 6);
- The share of operational costs going to local companies and lease payments to landowners (see Figure 5);
- Bill savings for electricity consumed directly on-site for building-scale generation (see Table 7), and potentially from a local energy market arrangements in the future;
- Income generation from the sale of electricity and renewable energy subsidy payments where these are retained locally through local community or private ownership (see Figure 5). With the exception of a single 500kW wind turbine and 250kW solar park, the medium to large-scale wind and solar generation in Wadebridge is not locally owned. Most of the building-scale solar PV generation is locally owned.

The tables and charts below illustrate the local economic benefits from Wadebridge's existing renewable energy generation under current ownership models.

Table 6: Investment in renewable energy capacity in Cornwall and Wadebridge and the estimated local (Cornwall) economic benefit, based on DECC figures for local spend from wind farm construction.

	Capital investment in renewable energy to date[196]	Estimated Cornwall GVA[197]
Wadebridge	£26 million	£2.8 million
Cornwall	£500 million	£50 million

Table 7: Annual income and savings from building-scale solar PV, which is mostly locally owned.

	Bill saving (assumed 50% of generation used on-site)	Income from FiT and export sales	Total
Wadebridge	£290k	£297k	£587k
Cornwall	£4.7m	£4.8m	£9.5m

[195] This is drawn from capacity figures in DECC's renewable energy planning database and the Feed in Tariff (FiT) installations register. The expected generation per megawatt of installed capacity is from CfR figures and RegenSW publications.
Department of Energy and Climate Change, 'RESTATS - Renewable Energy Statistics Database for the United Kingdom'; Ofgem, 'FIT Installations Statistical Report'; RegenSW, *Small Scale Wood Fuel Heat and CHP Options for South West England*; RegenSW, *Micro Hydro Info*.

[196] 'Communities for Renewables Market Benchmarks'.

[197] Department of Energy and Climate Change and renewableUK, *Onshore Wind - Direct and Wider Economic Impacts*.

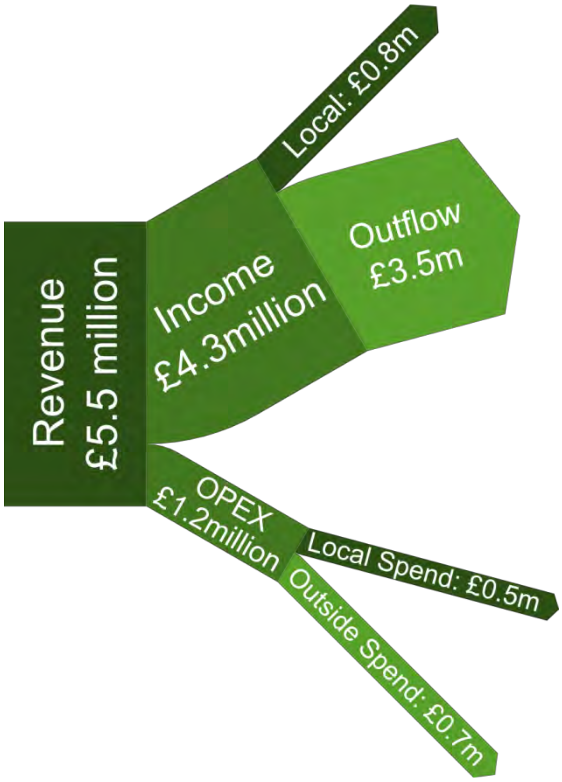

Figure 5: Estimated annual flow of revenue from Wadebridge's renewable energy generation. This includes the solar and wind farms in the area (and assumes the St Breock windfarm repowered up to 10MW) and building-scale PV.

- Revenue of £5.5m includes FiT/RO income and electricity sales, but not bill savings from electricity used on-site.
- The operational costs (OPEX) retained locally (i.e. within Cornwall) of £0.5m includes landowner payments, business rates, community fund payments and local service and maintenance contractor payments.
- The income retained locally of £0.8m is that generated by the farmer-owned wind turbines and solar parks, and building-scale PV.
- The income leaving Cornwall of £3.5m is that generated by commercial developer-owned solar parks and St Breock wind farm[198] and non-opex costs of locally owned generation such as insurance and interest on loans.

3.2 Economic impact of Smart Wadebridge 2020 and 2030

Introduction

The potential economic impact of Wadebridge becoming an exemplar smart market town are explored from the following perspectives:

1. Spend on smart energy technologies and 'distributed resources' (e.g. distributed generation, demand response, and storage), and the percentage of that spend that could be retained in the local economy;

[198] 'WREN / Communities for Renewables Estimates'.

2. The local economic potential of a local energy market;
3. The jobs and GVA that could be attracted to Wadebridge through the development of a Smart Innovation Hub in the town.

The focus is smart electricity. There are wider benefits, e.g. increased sales and profits from smart retail that are not explored.

Local spend from capital investment in distributed resources

Smart distribution network

Substantial investment in distribution network monitoring and control systems (as well as some conventional upgrades) will be required to enable the connection of distributed generation, storage and active network management (including smarter voltage control, reactive power control and dynamic line rating). This investment is not considered in the Wadebridge case study.

If it goes ahead, the Clean Energy Balance project (described in Section 1) will be a key part of Wadebridge's smart distribution network infrastructure.

Smart homes and commercial properties

Table 11 below set out scenarios for the additional spend on smart energy technologies installed in homes and commercial properties that could result from focussed support from Smart Cornwall to accelerate adoption and increase the percentage of spend retained locally (e.g. through supply chain development).

The tables only provide the additional spend and jobs figures. These figures are the result of a calculation of estimated spend per property on each technology, the percentage of properties adopting the technology, and the percentage of spend retained in the local economy for 2020 and 2030 with and without focussed support from Smart Cornwall. The jobs multiplier assumes £47,000 of revenue per job. This is applied to service spend and the install cost of the technology (i.e. excluding spend on the technology itself which is assumed is imported). The spreadsheet showing this calculation is included in Appendix A and has been provided separately. The numbers are copied directly from the spreadsheet and have not been rounded. The scenarios include building integrated renewable generation and storage which, although not inherently 'smart' in themselves, are key components in any smart energy system. The scenarios do not include the substantial local benefits from increased spend on energy efficiency and building renovation that may arise from Smart Cornwall helping to increase engagement in energy.

Wadebridge currently has 3,750 homes. The scenarios assume 400 new homes will have been built by 2020 and 800 by 2030. The assumption is that the planning system will ensure all new homes will be built 'smart'.

Table 8: Wadebridge; additional local spend (2013 prices) on home-scale smart technologies from 2013 to 2020 (4,150 homes) and to 2030 (4,550 homes) and additional jobs supported.

Smart energy technology area	Additional spend and jobs above BAU resulting from Smart Cornwall			
	Additional local spend per year 2015 to 2020	Additional jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
Smart meters (assumes all gas and elec)	£24,987	0.5	£1,965	0.0
Smart apps and services (annual)	£2,334	0.0	£4,975	0.1
Building integrated smart technologies (e.g. HEMS, smart appliances)	£22,576	0.5	£9,642	0.2
Building integrated renewable energy generation and storage	£166,000	3.5	£47,813	1.0
	£215,898	**4.6**	**£64,395**	**1.4**

Table 9: Cornwall: additional local spend (2013 prices) on home-scale smart technologies from 2013 to 2020 (278,200 homes) and to 2030 (299,200 homes) and additional jobs supported.

Smart energy technology area	Additional spend and jobs above BAU resulting from Smart Cornwall			
	Additional local spend per year 2015 to 2020	Additional jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
Smart meters (weighted cost - assumes all elec half gas)	£1,089,153	23.2	£73,646	1.6
Smart apps and services (annual)	£155,658	3.3	£326,091	6.9
Building integrated smart technologies (e.g. HEMS, smart appliances)	£1,513,408	32.2	£619,616	13.2
Building integrated renewable energy generation and storage	£11,128,000	236.8	£3,038,000	64.6
	£13,886,219	**295.5**	**£4,057,353**	**86.3**

Wadebridge currently has around 400 commercial electricity consumers, of which 15 are large consumers on half hourly meters.[199] Growth in the number of commercial properties

[199] DECC sub-national area statistics state 387 non-half hourly metered non-domestic electricity consumers in Wadebridge. There are no figures for the number of half hourly (HH) metered consumers in Wadebridge,

has not been considered, nor has the specific nature and size of commercial properties in Wadebridge. Clearly there is a much greater range in size and energy consumption (and therefore investment) for commercial properties than domestic properties.

Table 10: Wadebridge: additional local spend (2013 prices) on commercial building-scale smart technologies from 2013 to 2020 and to 2030 and additional jobs supported.

Smart technology area	Additional spend and jobs above BAU resulting from Smart Cornwall			
	Additional local spend per year 2015 to 2020	Additional jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
385 x non-half hourly metered commercial properties (ave consumption 15,000kWh/yr and spending ave £2,250/yr)				
Smart energy management apps and services (annual spend)	£1,613	0.0	£3,838	0.1
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£17,200	0.4	£6,235	0.1
15 x half hourly metered commercial properties (ave consumption 880,000kWh/yr and spending ave £100k/yr)				
Smart energy management apps and services (annual spend)	£1,890	0.0	£1,417	0.0
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£19,630	0.4	£0	0.0
	£40,332	**0.9**	**£11,490**	**0.2**

which has been estimated at 15 on the basis of the number of HH consumers in Cornwall scaled down pro-rata population.

Table 11: Cornwall: additional local spend (2013 prices) on commercial building-scale smart technologies from 2013 to 2020 and to 2030 and additional jobs supported.

Smart technology area	Additional spend and jobs above BAU resulting from Smart Cornwall			
	Additional local spend per year 2015 to 2020	Additional jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
31,200 x non-half hourly metered commercial properties (ave consumption 15,000kWh/yr and spending ave £2,250/yr)				
Smart energy management apps and services (annual spend)	£117,000	2.5	£222,300	4.7
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£1,248,000	26.6	£273,000	5.8
940 x half hourly metered commercial properties (ave consumption 880,000kWh/yr and spending ave £100k/yr)				
Smart energy management apps and services (annual spend)	£122,070	2.6	£86,858	1.8
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£1,267,650	27.0	£0	0.0
	£2,754,720	**58.6**	**£582,158**	**12.4**

Economic potential of a local energy market

The potential economic value of a local energy market (as described in Section 1) is created by the components of electricity spend that could be reduced and localised. These are:

- Localisation and possible reduction in wholesale electricity cost, if purchased from locally owned generation. That could include domestic and commercial building-scale generation owned by the building owner or a local energy co-operative, and medium to large-scale generation owned by local farmers, energy co-operatives, businesses and public sector bodies;
- Localisation of Supplier costs, if electricity is supplied through a Cornwall Electricity Supply Company;
- Localisation of balancing costs, if balancing is enabled by local smart grid infrastructure and market arrangements. For example, the Cornwall Electricity Supply Company could pay incentives to consumers to reduce their demand in peak periods, rather than buying top up power on the national balancing market;
- Reduction of transmission costs, as the need for importing electricity from outside the distribution network is reduced.

These components make up around 70% of electricity spend. Their potential value for Wadebridge and Cornwall are illustrated in the diagrams (Figure 6 and Figure 7) below.

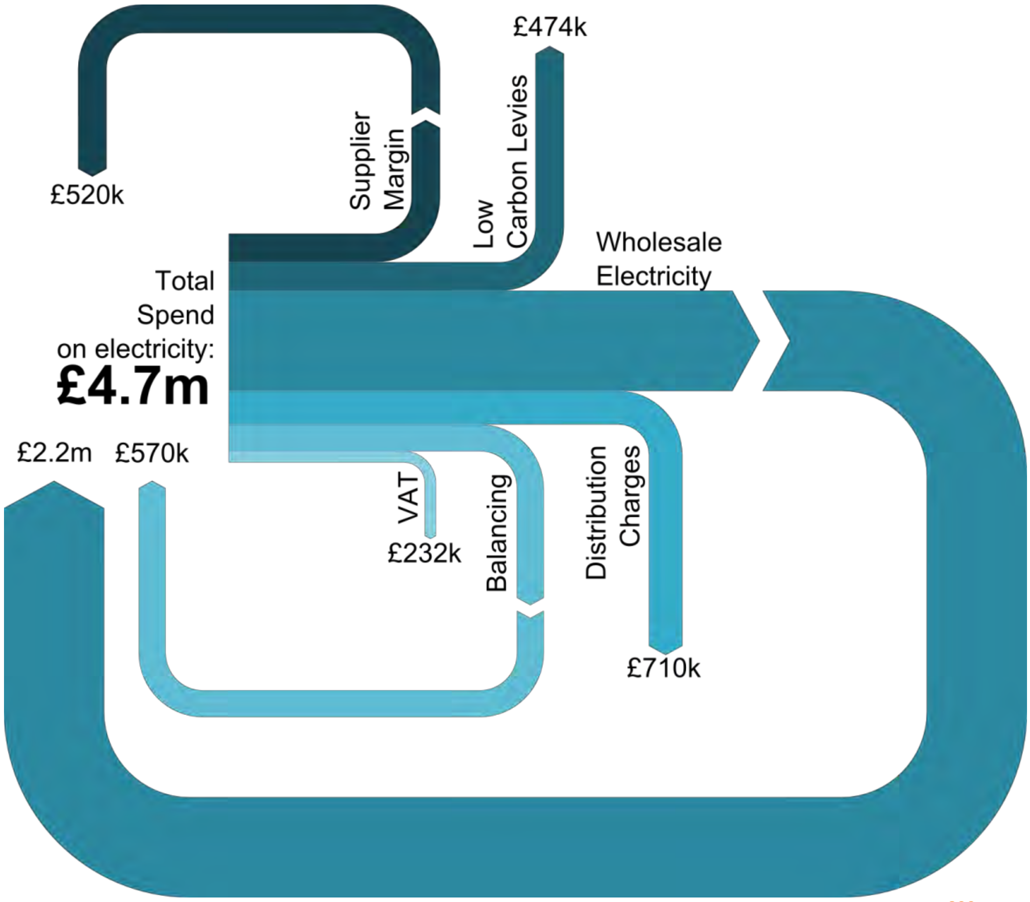

Figure 6: Breakdown of Wadebridge's electricity spend, showing localisable elements[200]. Note that the transmission charges (£200k) are excluded as it is assumed that these can be avoided.

200 Ofgem, *Updated: Household Energy Bills Explained.*; Department of Energy and Climate Change, *Estimated Impacts of Energy and Climate Policies on Energy Prices and Bills.*; Department of Energy and Climate Change, 'Annex F; Price Growth Assumptions'; Department of Energy and Climate Change, *Sub-national Electricity Sales and Numbers of Customers 2010-2011*; Department of Energy and Climate Change, *Middle Layer Super Output Area (MSOA) Consumption Figures*.

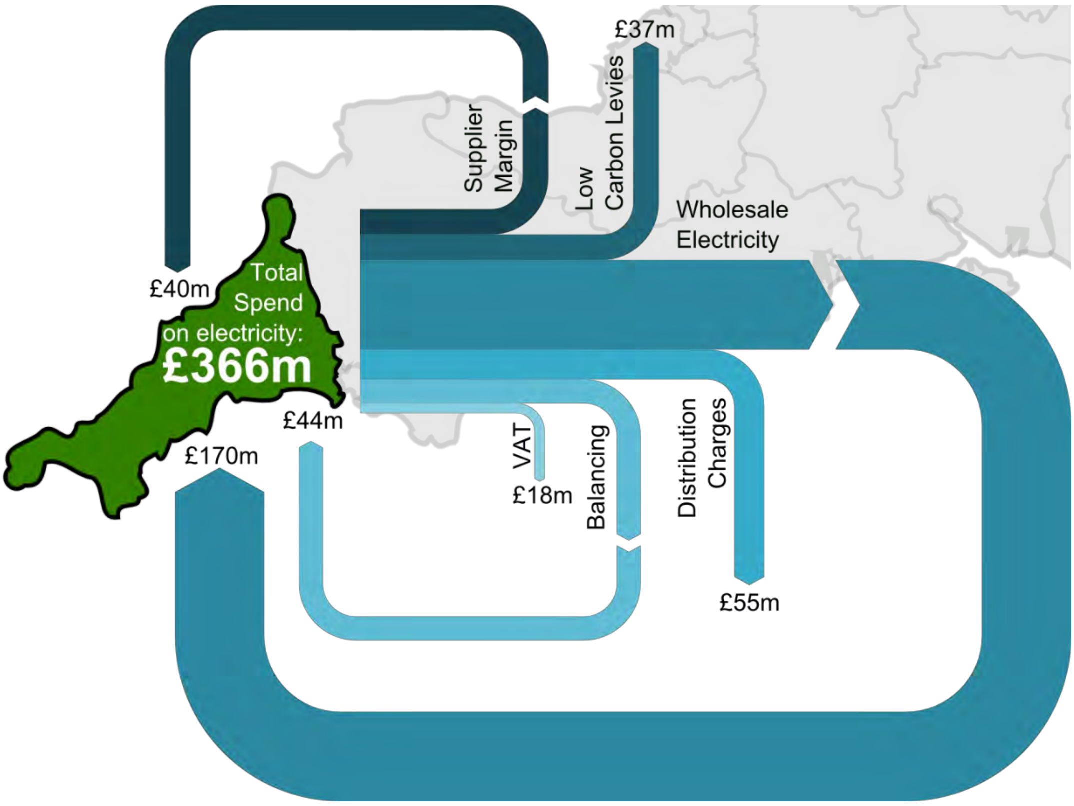

Figure 7: Breakdown of Cornwall's electricity spend, showing localisable elements. Note that the transmission charges (£15m) are excluded as it is assumed that these can be avoided.

Projections for electricity spend (and its component parts) for Wadebridge and Cornwall in 2020 and 2030 are shown below. These are based on the DECC central scenario for wholesale electricity values, and housing growth from the Cornwall Local Plan.

Table 12: Wadebridge electricity spend breakdown, projections for 2020 and 2030.

	Current		2020		2030	
Wholesale	£	2.2m	£	2.4m	£	3.0m
Balancing	£	0.6m	£	0.8m	£	0.9m
Supplier Margin	£	0.5m	£	0.7m	£	0.8m
Local (Cornwall) Value Potential in a LEM	£	3.3m	£	3.9m	£	4.7m
Transmission Charges (may be reduced in LEM)	£	0.2m	£	0.3m	£	0.3m
Distribution Charges	£	0.7m	£	1.0m	£	1.1m
Low Carbon Levies	£	0.5m	£	0.7m	£	0.7m
VAT	£	0.2m	£	0.3m	£	0.3m
Total spend	**£**	**4.9m**	**£**	**6.2m**	**£**	**7.1m**

Table 13: Cornwall electricity spend breakdown, projections for 2020 and 2030

	Current		2020		2030	
Wholesale	£	170m	£	182m	£	228m
Balancing	£	44m	£	62m	£	64m
Supplier Margin	£	41m	£	57m	£	59m
Cornwall Value Potential in a LEM	£	255m	£	301m	£	351m
Transmission Charges (may be reduced in LEM)	£	15m	£	21m	£	21m
Distribution Charges	£	55m	£	78m	£	80m
Low Carbon Levies	£	37m	£	52m	£	54m
VAT	£	18m	£	23m	£	25m
Total spend	**£**	**381m**	**£**	**474m**	**£**	**532m**

This economic value may be converted into local economic benefits in a range of ways considered below. It should be noted that significant regulatory, technical and commercial developments and investment are required to realise even some of this value. These are discussed in Section 5.

A/ Cornwall Electricity Supply Company

Cornwall has 290,000 domestic and commercial electricity consumers. Of the £366million per year that Cornwall spends on electricity, £40million goes to the suppliers; mostly the 'big six.' If Cornwall set up its own electricity supply company, some of that £40million could be retained locally through the jobs and GVA that would be created by the operation of the supply company. Capturing 10% of the Cornwall's consumers would create a business the size of Good Energy, which has around 30,000 customers and employs 120 people. Due to the economy of scale required, it is likely that the benefit of localising supplier costs in a local energy market will be realized by a Cornwall Electricity Company, so the jobs benefit will arise wherever that company is located.

B/ Local energy market incentivising investment in smart energy technologies

£44million of Cornwall's annual electricity spend is the cost of balancing supply and demand on the national balancing market. If Cornwall had a local energy market and a smart energy infrastructure, this cost might be reduced and some of it retained locally through incentives paid to homes and businesses to manage their demand, and to generators to manage their generation. This would create an incentive for investment in smart energy technologies that enable homes and businesses to participate in the local balancing market. Some of this money would go to smart energy services companies (e.g. service and maintenance, IT services, and smart device service payments) to maintain the smart energy infrastructure. Smart Cornwall could support Cornwall based companies to help them secure a substantial share of this work. This potential benefit has been reflected in the jobs from additional local spend on smart energy technologies set out in Table 8 to Table 11 above.

C/ Local ownership of generation

£170million of Cornwall's annual electricity spend is the wholesale cost of electricity. Some of this spend can be localised where generation is locally owned, with additional local income generated by the revenue incentives paid to renewable generation (e.g. feed in tariff or Renewables Obligation). Currently only building-scale generation and some medium-scale generation owned by local farms and businesses in locally owned. With focussed support (as suggested in Section 5) it would be possible that a significant percentage of the new medium to large-scale generation to be built could be locally owned through local energy co-operatives. This would retain the income that would otherwise go to outside investors locally through local people investing and earning a return on their investment, and surplus income (after operating costs and investors have been paid) going to local energy co-operatives.

Table 14 below illustrates the additional local income and resulting jobs potential if, in line with WREN projections, Smart Cornwall enabled the development of 5MW of additional locally owned generation by 2020, and a further 5MW by 2030. The income figures are scaled from the Cornwall figures to represent a mix of technologies.

Table 14: Wadebridge: additional local income and jobs potential from Smart Cornwall supporting local ownership of renewable energy generation

Additional renewable electricity generation capacity	MW locally owned (WREN projection)	Local ownership income (return to local investors and surplus to local energy coop)	Jobs resulting from additional local income (£250k per job)
Additional 2015 – 2020	5MW	£640,000	2.5
Additional 2021 – 2030	5MW	£640,000	2.5

Table 15 below illustrates the additional local income and resulting jobs potential if Smart Cornwall enabled 50% of the additional renewable energy generation required to meet the equivalent of 30% of Cornwall's electricity consumption in 2020, and 100% in 2030.

Table 15: Cornwall: additional local income and jobs potential from Smart Cornwall supporting local ownership of renewable energy generation

Additional renewable electricity generation capacity (from 2013 base of 440MW)	MW locally owned (assumes 50% of new build is locally owned)	Local ownership income (return to local investors and surplus to local energy coop)	Jobs resulting from additional local income (£250k per job)

Additional 2015 – 2020 (equivalent of 30% of consumption)	39MW	£5,000,000	20
Additional 2021 – 2030 (equivalent of 100% of consumption)	602MW	£96,000,000	384

A local energy market could still operate with local generation that is not locally owned as long as the generation owners are willing to participate.

D/ Cost reduction through a local energy market

If the Cornwall Electricity Supply Company and local energy market is operated on a social enterprise basis, with the objective of stabilising and reducing local energy costs (whilst maintaining a financially viable business), rather than maximising profit, then a price reduction may be achieved. Consumers in Cornwall could receive the benefits of renewables which generate power at a long-term stable cost, which does not yet happen in the national electricity market where prices are driven largely by the cost of gas. Some of this price reduction, along with energy efficiency gains, will increase disposable income of firms and households.

Table 16 below illustrates the potential assuming 10% of Cornwall's domestic and commercial electricity consumers participate in the local energy market and achieve a 10% reduction in their electricity bill. The jobs multiplier assumes one job per £250,000 of increased disposable income.[201]

Table 16: Potential increase in disposable income and jobs created from a local energy market reducing energy bills for participants.

	Increase in local disposable income from 10% of domestic and commercial electricity consumers saving 10% on their electricity bill		Jobs benefit (assuming 1 job per £250k of increased disposable income)	
	2015 - 20	**2021 - 30**	**2015 - 20**	**2021 - 30**
Wadebridge	£60k	+£10k	0.25	0
Cornwall	£4.7m	+£600k	19	2.4

Smart Innovation Hub

The Smart Innovation Hub and Smart Business Accelerator has been described in Section 1.

[201] South West RDA online calculator http://economicsystems.co.uk/south-west/

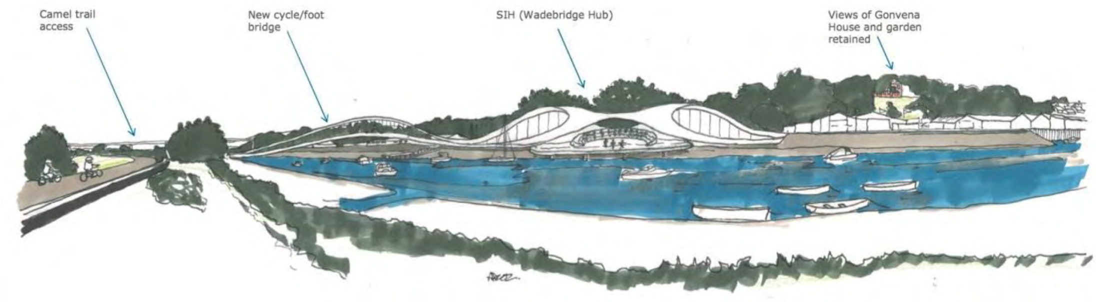

Figure 8: An initial architect's sketch of the Smart Innovation Hub, drawn up by ARCO2.

An analysis of the local economic benefit of the SIH is set out in Table 17 below. This assumes that the SIH will be of similar scale to the existing Innovation Centres in Cornwall, and the businesses attracted deliver similar jobs benefit. The SIH will accommodate a range of business sizes from single person start-ups to offices of major companies.

Table 17: Local economic benefit of the Smart Innovation Hub and associated Smart Business Accelerator

	2015 - 20	2021 - 30
Additional direct jobs	160	NA
Additional indirect jobs	64	NA
Total new jobs	224	NA

The Smart Innovation Hub is one of a number industry hubs that could be developed across Cornwall. Not every locality will have such a hub, but the businesses benefiting from the hubs and accelerator programs may be spread across Cornwall.

Combined benefits of Smart Wadebridge

The tables below set out the combined local economic benefits for Wadebridge and Cornwall of all three areas considered above.

Table 18: Wadebridge: Summary of potential jobs created by Smart Cornwall

Activity	Additional jobs created 2015 - 20	Additional jobs created 2021 – 30
Installation of smart energy technologies for homes and businesses	5.5 in period	1.4 in period
Local energy market		
Cornwall electricity supply company supplying 10% of domestic and commercial consumers	NA (as jobs benefit will accrue where company located)	NA
Income from local ownership of generation (5MW of additional capacity in each period)	2.5 long term	2.5 long term
Bill saving from 10% of consumers saving 10% of their electricity bill	0.25 long term	0
Smart Innovation Hub	224 long term	0
Total	**232**	**4**

Table 19: Cornwall: Summary of potential jobs created by Smart Cornwall

Activity	Additional jobs created 2015 - 20	Additional jobs created 2021 - 30
Installation of smart energy technologies for homes and businesses	354	99
Local energy market		
Cornwall electricity supply company supplying 10% of domestic and commercial consumers	120	120
Income from local ownership of generation (50% of additional capacity)	20	384
Bill saving from 10% of consumers saving 10% of their electricity bill	19	2.4
Smart Innovation Hub	224	0
Total	**737**	**605**

4 Social considerations – The importance of an engaged community

4.1 Social factors in technology adoption

The rate of adoption of smart technologies will vary widely. This will be governed by many factors but social factors will include:

- The perceived level of complexity;
- The perceived benefits to the user;
- The level of trust in those seen as promoting the technology, and concerns over privacy.

The Global Smart Grid Federation Report 2012[202] focuses on consumer issues being key to the growth of the smart grid market:

- *The most difficult challenge to a successful smart grid lies in winning consumer support. Without it, the smart grid cannot exist and it cannot deliver its promised benefits. Ultimately, the consumer is paying for the smart grid. The smart grid does yield important benefits for consumers, but they come at a significant cost and, at the individual level, the need for these benefits may feel less immediate.*
- *Winning consumer support hinges on a radical change in thinking by utilities about their customers and by consumers about electricity. Utilities risk taking their customers for granted, being overly technocratic in their relationship with them, and possibly alienating them. They would be well-advised to engage with consumers on a new level, perhaps borrowing from the best practices of more competitive, consumer-centric industries. Likewise, in many developed countries, consumers risk taking electricity for granted as a low-cost commodity, which is always available, rather than a commodity subject to market swings in a manner similar to gasoline. Active consumer engagement in the power system will depend on a change in this perspective.*
- *The government is best positioned to educate consumers on the value of the smart grid. The smart grid is really part of government strategy to achieve societal goals. The electricity sector is highly regulated by government. The government has the resources and skills needed to mount large scale smart grid messaging campaigns. It is also the best advocate for citizens on consumer-oriented issues such as affordability, privacy, cyber-security, health and safety.*
- *Government can be an effective mediator between the consumer and the power system. Governments can (a) better persuade consumers of the benefits of smart grid, (b) better represent and protect their interests in smart grid developments, and (c) provide an effective framework of incentives (and disincentives), which induce the desired behaviours while still empowering consumers with choice*.

If Wadebridge and Cornwall are to lead the UK on smart technology adoption, WREN and Cornwall Council will need to play a key role in ensuring the smart future is built around

[202] Global Smart Grid Federation, *The Global Smart Grid Federation Report 2012*.

consumer needs, building the trust of the community and developing a smart energy aware culture. Whilst there will always be a wide variation in views and behaviour in a population, the cultural aspects of behaviour are extremely strong and effective in promoting the adoption of new behaviours and technology.

There is not one single set of benefits that smart solutions can bring that will be uniformly recognised by the entire population, and promotion of smart technology should be done in such a way that different groups of people can recognise the particular benefits (financial, time-saving, comfort, health) that are relevant to them.

4.2 Social benefits and risks of smart technology adoption

Whilst it is possible, and sometimes necessary, to segment smart technologies into energy, transport, retail, health etc. there is a large degree of overlap and interconnection between all of these areas. For example, the successful adoption of smart energy technologies can also bring direct benefits to building environments and the well-being and health of residents/occupants.

Conversely, an over simplistic adoption of smart approaches can also lead to unplanned negative eventualities. For example, whilst variable pricing of electricity may prove to be a useful tool for good management to encourage demand shifting, it could also lead to vulnerable people failing to heat their homes properly.
Unintended consequences (positive or negative) are a common thread throughout the history of technological innovation and adoption.

4.3 Trust in technology promoters

There are wide variations between different smart technologies. A smart transport solution that monitors traffic flows and directs users quickly and efficiently to an available parking space is likely to be seen as useful, easy-to-use and trusted. Unfortunately, this is not necessarily the case for smart energy applications. A number of smart energy applications require changes in consumer behaviour and/or a change in the perceived level of control that the user has. Depending on how the application is deployed, the main benefit may be seen to be to the energy supplier rather than the consumer themselves. In the UK, the big six energy suppliers are not highly trusted by consumers.

This issue of trust is important. Researchers have identified that governments or community groups are likely to be more trusted when promoting smart applications than energy companies. This research is also backed up by WREN's experience in Wadebridge where successful community engagement has led to faster uptake and greater community acceptance of insulation programs and renewable technology than those promoted directly by energy companies.

4.4 Privacy & Security

A critical aspect of any smart platform are the perception and reality within the community of its security and privacy.
Recent trends have shown that most people are willing to consciously or unconsciously share large amounts of personal data with friends, colleagues and businesses via Facebook, Google and other applications. The level of awareness of this data sharing is low but growing.

Some studies have shown consumer resistance to the sharing of data – including household energy data. However, experience on the ground with smart energy efficiency projects have shown that matters are strongly influenced by factors such who is holding the data, who else can get hold of it and how clear are the benefits to the user.

Where benefits are clear and there is a reasonable level of trust in the data holding organisation the majority of people appear willing to share data. It is expected that this may continue with concerns triggered by high profile data losses leading people to expect better levels of data security rather than immediately withdrawing from the benefits provided by the data sharing.

People need assurance that data privacy, security, and system resilience are built in the from outset, and safeguarded. A high profile failure in this regard could have a negative effect on smart adoption in Wadebridge and undermine confidence in Smart Cornwall and its promoters.

4.5 Wadebridge Smart Technologies Futures survey

To explore Wadebridge peoples' views on some of the above issues, a street survey was carried out in the town. The full survey report has been provided separately. Some of the key findings included:

- People are concerned about how their Smart Data (e.g. gathered from smart phones, store cards and social networking) is being used. Interestingly, the greater peoples' awareness of how their data is already being used, the greater their concerns;
- People are aware of their energy spend, but most are still unwilling (or unable) to invest in energy saving and income generating technologies;

There was general willingness to allow external control of energy devices (which is key to some smart energy applications and a local energy market), if it saved money and did not affect the performance of devices. Of those happy with allowing external control, 67% would prefer to do this through a locally owned not for profit energy company than a 'big 6' energy company.

5 Key enablers

The Wadebridge case study provides a vision for a smart market town and an illustration of the potential economic value that could be realised. It does not set out the pathways for achieving the vision and economic potential, nor does it assess the likelihood of achievement. Some of the key enablers that need to be in place for the business models and economic benefits to be realised are considered below. These provide pointers for what needs to be addressed in detail in the business plan for Smart Cornwall.

Strategic direction and governance

Cornwall will become increasingly 'smart' even without the Smart Cornwall programme. However, through strategic direction and governance, the Smart Cornwall programme provides the opportunity for Cornwall to accelerate the adoption of smart technologies, and influence how deployment is organised to ensure local social and economic benefits are maximised. The Smart Cornwall Guiding Principles that have already been drafted are a key foundation this.

Engaged community

A positively engaged community in each locality is key to achieving the uptake of smart energy technologies, distributed resources (generation, storage and controllable demand) and a local energy market. It will also provide the best chances of avoiding the potential pitfalls discussed in Section 4. The model of a local energy co-operative with the broad support and involvement of the local population, businesses, and key institutions (e.g. councils, schools and chamber of commerce) has been demonstrated in Wadebridge through the activities of WREN. WREN, which has 1,000 members, has been successful in positively engaging the local community in large-scale renewable energy generation (the repowering of St Breock windfarm) and in accelerating the adoption of building-scale low carbon technologies through its buying clubs and free insulation offer.

The success of WREN has been dependent on a high level of voluntary input that is not going to be replicated in many communities. However, WREN (and other local energy co-operatives across the UK) have established a range of replicable business models and an approach to community engagement that is replicable with an appropriate framework of support and funding to enable professional management by suitable people.

Smart Cornwall should consider putting in place a funding and professional support framework that would enable the roll out of local energy cooperatives across Cornwall. The cooperatives require funding to cover seed costs, but should ultimately be financially self sustaining.

Local ownership of renewable energy generation

The greatest potential value element in a local energy market comes from local ownership of generation. This is possible now, but with some notable exceptions has not been the case in Cornwall to date. Over £100million per year of revenue is generated in electricity sales and FiT/RO payments from Cornwall's renewable energy capacity. Only 10% or so of this revenue is retained in Cornwall through local ownership (mostly farmer-owned and building-scale generation). Whilst it is conceivable that some of the existing renewable energy generation (and that currently under development) might be sold to local ownership in the future, the opportunity is really only with new medium to large-scale generation projects and the continued uptake of building scale generation.

Smart Cornwall should consider facilitating local ownership of generation through:

- Supporting the development of local energy co-operatives in each locality as described above;
- Providing or facilitating investment to help cover the risk investment required to costs develop projects (as provided by the existing Defra Rural Community Energy Loan Fund);
- Providing or facilitating investment to under-write co-operative share offers (as per the existing Cornwall Council Community Energy Revolving Loan Fund);
- Favourable planning policies for community owned generation projects.

Adoption of smart energy technologies

The rates of adoption of smart energy technologies anticipated in the Wadebridge case study, and the level of local economic benefit derived is unlikely to happen without focussed support and investment. Measures that Smart Cornwall should consider include:

- Engaged communities (as considered above);
- Business support to help Cornish businesses diversify into smart technology and services markets;
- Industry hubs (as considered below);
- Facilitating the development of smart distribution networks, that enable smart energy technologies to be connected;
- Supporting the development of a local energy market (as considered below) that will provide a market driver for the adoption of smart energy technologies.

Local energy market

Local energy markets are not yet happening in the UK. Their implementation is dependent on a range of factors including:

- An electricity supply company (such as a Cornwall Electricity Supply Company) that can provide the back office functions including: a platform for trading electricity locally and managing balancing through both local distributed resources and the national balancing market; regulatory compliance; finance and billing. The company may provide power purchase and supply offers to generators and consumers directly, and provide the back office function to enable LEMs to function at a more local scale (e.g. a town-scale LEM managed by a local energy co-operative);
- Commercial arrangements that enable the management (curtailment, scheduling and control) of both consumption and generation and provide the commercial incentives to participate;

- Sufficient generation to meet a substantial share of a locality's electricity needs that is willing to participate in the LEM. Benefits will be maximised if this generation is locally owned. Investor requirements will restrict many medium and large-scale generators' ability to participate in a LEM, unless measures can be taken to address their concerns over price and credit risk;
- Smart metering at consumer level and each level of the network; controllable demand and load switching; storage at building and community scale and controllable generation; and control systems and software;
- A smart distribution network that enables the operation of the distributed resources (generation, storage, demand response and metering and control systems) that are required to enable the LEM to operate. The distribution network will continue to be managed by Western Power Distribution, but some of the upgrades required will be outside of their planned investment programme;
- Any regulatory changes required to achieve the above;
- An engaged community;
- Strategic direction and governance to ensure the LEM operates for local benefit.

Smart Innovation Hub

The SIH will require ongoing strategic support and direction from Smart Cornwall, as well as local stakeholders, and is likely to require similar investment support as has been provided to the existing innovation centres.

Appendix A. Calculation for predicted local spend and jobs from installation of smart energy technologies

Wadebridge homes

n. homes 2020	4150	(of which 400 / 11% are new)	n. homes 2030	4550	(of which 800 / 18% are new)	Turnover/employee	47000	Based on ICT for Cornwall as uses install element, excl kit

Smart technology investment	Spend per house	% homes adopting				% spend retained				£ retained				Additinoal £ retained above BAU		Additional spend and jobs above BAU			
		BAU		Smart W		BAU		Smart W		BAU		Smart W							
		2020	2030	2020	2030	2020	2030	2020	2030	2020	2030	2020	2030	2015-20	2021-30	Additional local spend per year 2015 to 2020	Additinoal jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
Smart meters (assumes all gas and elec)	£223	90%	95%	90%	95%	10%	10%	25%	25%	£83,291	£96,392	£208,226	£240,979.38	£124,936	£19,651.88	£24,987	0.5	£1,965	0.0
Smart apps and services (annual)	£15	25%	40%	50%	80%	5%	5%	10%	10%	£3,891	£20,475	£15,563	£81,900.00	£11,672	£49,753.13	£2,334	0.0	£4,975	0.1
Building integrated smart technologies (e.g. HEMS, smart appliances)	£400	10%	25%	35%	60%	2%	2%	20%	20%	£3,320	£9,100	£116,200	£218,400.00	£112,880	£96,420.00	£22,576	0.5	£9,642	0.2
Building integrated renewable energy generation and storage	£5,000	20%	35%	35%	55%	15%	15%	20%	20%	£622,500	£1,194,375	£1,452,500	£2,502,500.00	£830,000	£478,125.00	£166,000	3.5	£47,813	1.0
															Total	£215,898	4.6	£64,395	1.4

Cornwall homes

n. homes 2020	278200	(of which 18900 / 11% are new)	n. homes 2030	299200	(of which 39900 / 18% are new)

Smart technology investment	Spend per house	% homes adopting				% spend retained				£ retained				Additinoal £ retained above		Additional spend and jobs above BAU			
		BAU		Smart C		BAU		Smart C		BAU		Smart W							
		2020	2030	2020	2030	2020	2030	2020	2030	2020	2030	2020	2030	2015-20	2021-30	Additional local spend per year 2015 to 2020	Additinoal jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
Smart meters (weighted cost - assumes all elec half gas)	£145	90%	95%	90%	95%	10%	10%	25%	25%	£3,630,510	£4,121,480	£9,076,275	£10,303,700	£5,445,765	£736,455	£1,089,153	23.2	£73,646	1.6
Smart apps and services (annual)	£15	25%	40%	50%	80%	5%	5%	10%	10%	£264,963	£1,346,400	£1,043,250	£5,385,600	£778,288	£3,260,913	£155,658	3.3	£326,091	6.9
Building integrated smart technologies (e.g. HEMS, smart appliances)	£400	10%	25%	35%	60%	2%	2%	20%	20%	£222,560	£598,400	£7,789,600	£14,361,600	£7,567,040	£6,196,160	£1,513,408	32.2	£619,616	13.2
Building integrated renewable energy generation and storage	£5,000	20%	35%	35%	55%	15%	15%	20%	20%	£41,730,000	£78,540,000	£97,370,000	£164,560,000	£55,640,000	£30,380,000	£11,128,000	236.8	£3,038,000	64.6
															Total	£13,886,219	295.5	£4,057,353	86.3

Wadebridge businesses

Non HH business consumers 2020 (ave consumption 15,000kWh/yr and spending ave £2,250/yr)	430	Current + 50	Non HH business consumers 2030	516	2020+20%
HH business consumers 2020 (ave consumption 880,000kWh/yr and spending ave £100k/yr)	15	Wadebridge share of Cornwall HH commercial consumers pro-rata population	HH business consumers 2030	15	

Smart technology investment	Ave spend per business	% businesses adopting BAU 2020	% businesses adopting BAU 2030	% businesses adopting Smart W 2020	% businesses adopting Smart W 2030	% spend retained BAU 2020	% spend retained BAU 2030	% spend retained Smart W 2020	% spend retained Smart W 2030	£ retained BAU 2020	£ retained BAU 2030	£ retained Smart W 2020	£ retained Smart W 2030	Additinoal £ retained above BAU 2015-20	Additinoal £ retained above BAU 2021-30	Additional spend and jobs above BAU: Additional local spend per year 2015 to 2020	Additinoal jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
Non-HH businesses																			
Smart energy management apps and services (annual spend)	£100	25%	40%	50%	80%	5%	5%	10%	10%	£2,688	£15,480	£10,750	£61,920	£8,063	£38,377.50	£1,613	0.0	£3,838	0.1
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£5,000	20%	35%	35%	55%	15%	15%	20%	20%	£64,500	£135,450	£150,500	£283,800	£86,000	£62,350.00	£17,200	0.4	£6,235	0.1
HH businesses																			
Smart energy management apps and services (annual spend)	£2,000	50%	75%	90%	90%	5%	5%	10%	10%	£3,635	£16,875	£13,086	£40,500	£9,451	£14,173.68	£1,890	0.0	£1,417	0.0
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£100,000	75%	90%	90%	90%	15%	15%	20%	20%	£163,580	£202,500	£261,729	£270,000	£98,148	(£30,648.27)	£19,630	0.4	£0	0.0
															Total	£40,332	0.9	£11,490	0.2

Cornwall businesses

Non HH business consumers 2020 (ave consumption 15,000kWh/yr and spending ave £2,250/yr)	31200	Current	Non HH business consumers 2030	31200	Current
HH business consumers 2020 (ave consumption 880,000kWh/yr and spending ave £100k/yr)	939	Current	HH business consumers 2030	939	Current

Smart technology investment	Ave spend per business	% businesses adopting BAU 2020	% businesses adopting BAU 2030	% businesses adopting Smart C 2020	% businesses adopting Smart C 2030	% spend retained BAU 2020	% spend retained BAU 2030	% spend retained Smart C 2020	% spend retained Smart C 2030	£ retained BAU 2020	£ retained BAU 2030	£ retained Smart C 2020	£ retained Smart C 2030	Additinoal £ retained above 2015-20	Additinoal £ retained above 2021-30	Additional spend and jobs above BAU: Additional local spend per year 2015 to 2020	Additinoal jobs maintained per year 2015-2020	Additional local spend per year 2021 to 2030	Additional jobs maintained per year 2021-2030
Non-HH businesses																			
Smart energy management apps and services (annual spend)	£100	25%	40%	50%	80%	5%	5%	10%	10%	£195,000	£936,000	£780,000	£3,744,000	£585,000	£2,223,000	£117,000	2.5	£222,300	4.7
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£5,000	20%	35%	35%	55%	15%	15%	20%	20%	£4,680,000	£8,190,000	£10,920,000	£17,160,000	£6,240,000	£2,730,000	£1,248,000	26.6	£273,000	5.8
HH businesses																			
Smart energy management apps and services (annual spend)	£2,000	50%	75%	90%	90%	5%	5%	10%	10%	£234,750	£1,056,375	£845,100	£2,535,300	£610,350	£868,575	£122,070	2.6	£86,858	1.8
Building integrated renewable energy generation, storage and management systems (cumulative capital spend)	£100,000	75%	90%	90%	90%	15%	15%	20%	20%	£10,563,750	£12,676,500	£16,902,000	£16,902,000	£6,338,250	(£2,112,750)	£1,267,650	27.0	£0	0.0
															Total	£2,754,720	58.6	£582,158	12.4

Appendix 14: Smart technology futures survey report

6

Smart technology futures survey report

October 2013

Contents

1 Introduction

1.1 Survey purpose

The purpose of the survey was to explore the following issues in relation to the general population in Cornwall:

a) Current participation in smart data applications, awareness of how smart data is currently used, and whether people consider the benefits outweigh any concerns;
b) Awareness of energy spend and willingness to invest in energy saving and income generating measures;
c) Willingness to participate in external control of energy devices in return for a cost saving benefit, and whether the nature of the organisation taking on that control affects peoples willingness to participate;
d) The relationship between peoples' current level of participation in smart data and smart energy, and their view of the future.

1.2 Methodology

The survey was carried out through street interviews carried out on Saturday 5th October in Wadebridge town centre between 9am and 5pm. Interviewers made efforts to speak to a range of age groups, but the sampling was otherwise random. In total 107 responses were collected. A questionnaire was used and all participants were asked the same questions in the same order. A copy of the questionnaire and a full set of results are included in Appendix A below. No statistical significance analysis was performed. The age distribution of the sample largely reflected Cornwall's age distribution, as can be seen in figure 1. This gives some indication that the survey population was broadly representative.

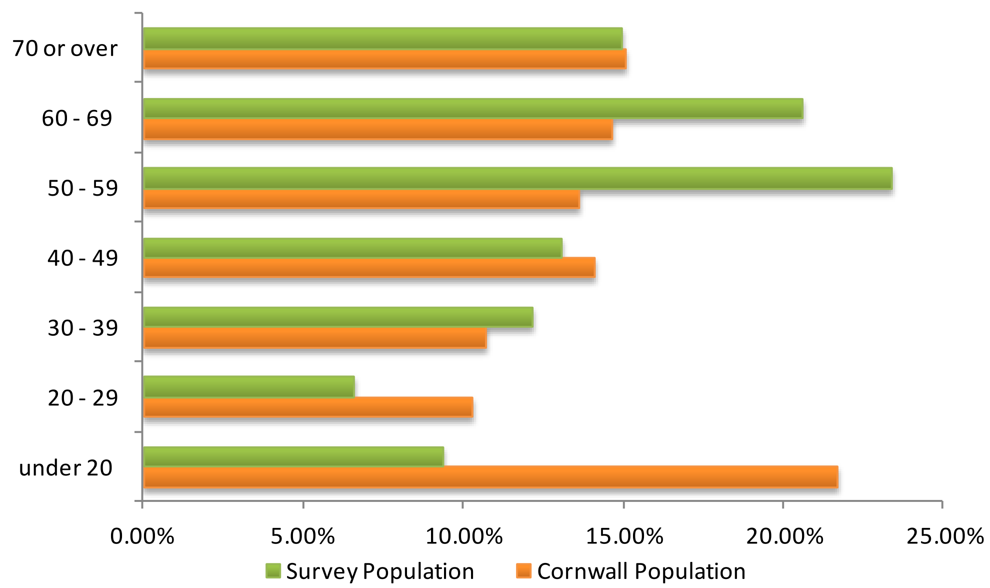

Figure 1: The demographic of Cornwall and the survey sample

2 Results and analysis

2.1 Current participation in smart data

Three indicators were used to assess current active participation in smart data: smart phone ownership (and use), use of store cards, and use of social networking. Respondents' level of participation in smart data was classified as follows:

Open participant	Active participation in all 3 smart data participation indicators (agree or strongly agree to Q2, 4 and 6)
Selective participant	Active participation 1 or 2 of the 3 (agree or strongly agree to 1 or 2 out of Q2, 4 and 6)
No active participation	No participation in any of the 3 (disagree or strongly disagree to Q2, 4 and 6)

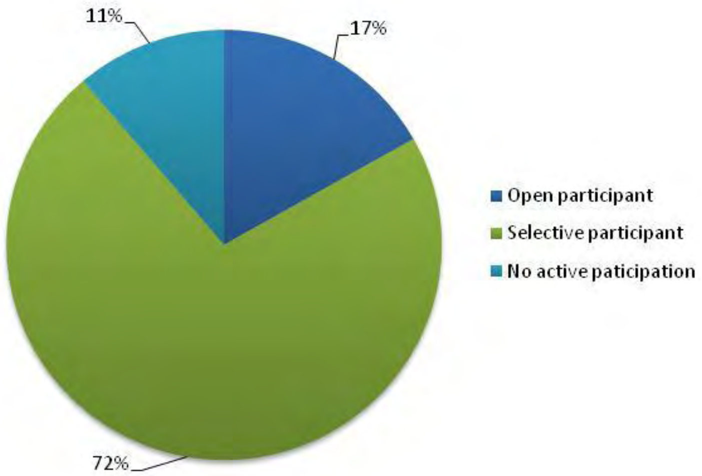

Figure 2: Smart data participation levels

Question 8 tested level of awareness of commercial use of smart data and whether people felt the benefits they gained from participation outweighed any concerns.

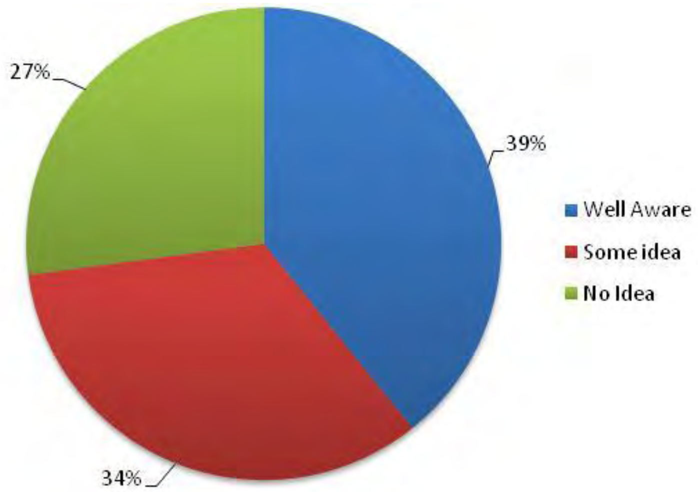

Figure 3: Shows how people perceive their awareness of how their data is used

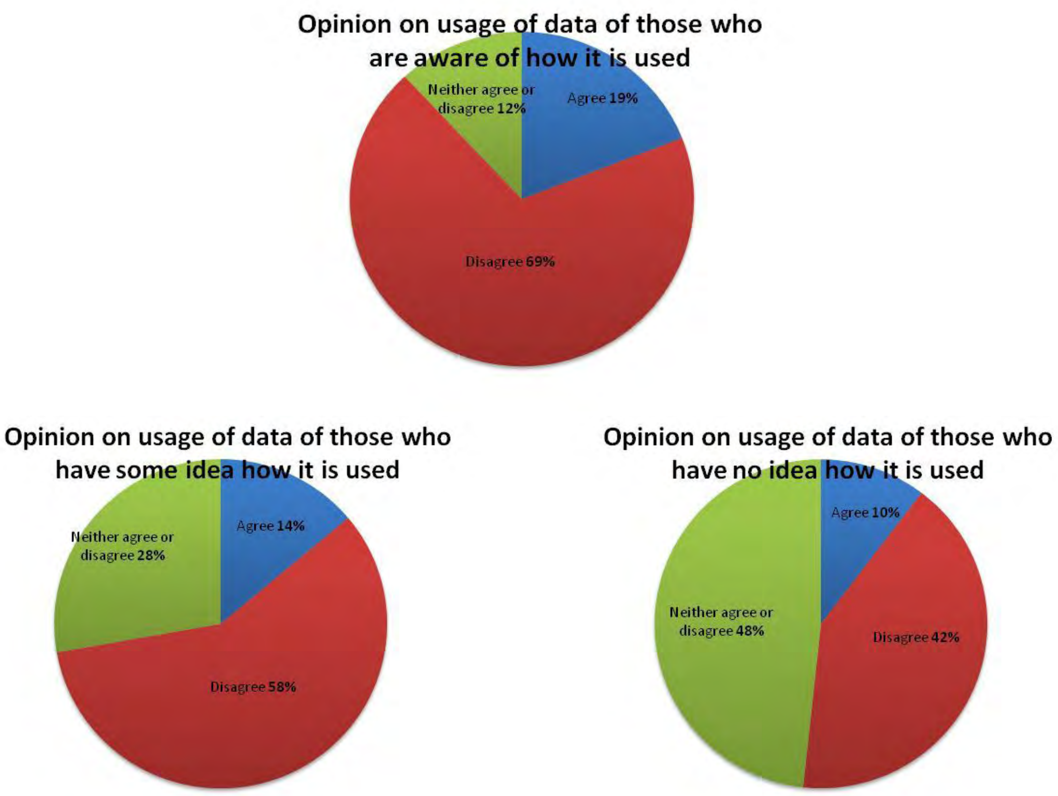

Figure 4: Charts showing how much of the sample agreed that the benefits of sharing data outweighed any concerns, and how this changes with awareness of how the data is used.

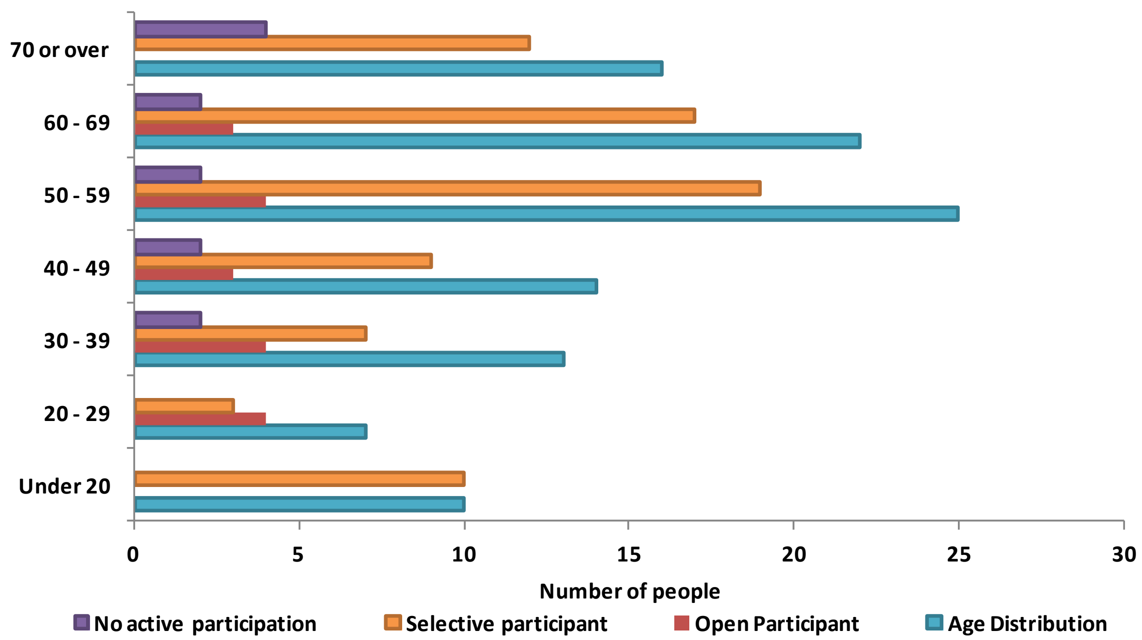

Figure 5: Shows the influence of age on the sample's participation in smart technology.

Analysis:

- 39% of the sample felt they were well aware of how their data was used, and 34% had some idea how it was used. Only 27% claimed to have no idea how it was used. This largely aware response could be due to people not wanting to appear unaware.
- 58% of people don't think the benefits of smart data participation outweight concerns they have over how their data is being used. Only 15% agreed that the advantages outweighed concerns, with only 1 participant strongly agreeing. Interestingly, as peoples' awareness of how smart data is used increases, so does the level of concern over its use, as illustrated by the charts in figure 4.
- How people of different ages integrate with smart technologies can be seen in figure five. Both the under 20's and over 70's had no open participants in smart data. This was due to the under 20's not having store cards, and the over 70's not having smart phones or social media accounts. Open participants were spread evenly over the other age groups. Selective participants tended to be over 50, and those with no participation were spread relatively evenly post 30, with none younger than 30-39.

2.2 Energy spend awareness and current and future willingness to invest in energy saving/income generating devices

Energy awareness was assessed through asking people whether they knew how much they spend on energy for their home.

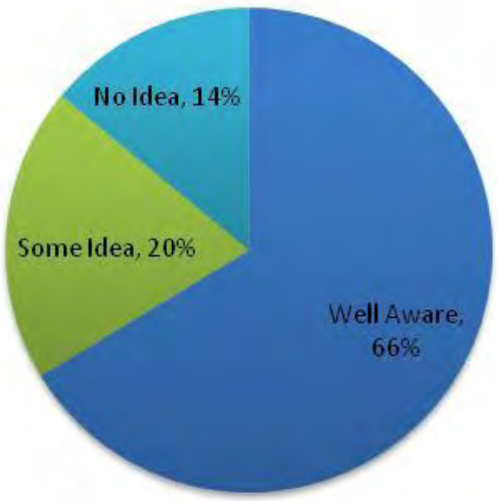

Figure 6: Pie chart showing how aware people are of their energy usage (Q13).

Question 12 assessed whether people had already invested in energy efficiency or generation, and question 11 the payback they would seek on future investments.

Table 1: Shows how much people have already invested on energy efficiency and/or renewable energy

>£10,000	£5,000 – £10,000	£1,000 - £5,000	£100 - £1,000	<£100	N/A
3%	10%	7%	11%	9%	60%

Table 2: Shows how much people were willing to spend on a device that saves £100 per year

£1,500	£1,000	£500	£300	£100	£0
1%	2%	2%	7%	41%	47%

Table 3: Shows the combined results of Q11 and Q12 (numbers of people)

		How much people have invested in their energy use					
		>£10,000	£5,000 – £10,000	£1,000 - £5,000	£100 - £1,000	<£100	N/A
Suitable payback period for an energy saving device	15 years	0	0	0	0	0	1
	10 years	0	0	1	0	0	1
	5 years	0	2	0	0	0	0
	3 years	0	0	1	1	1	5
	1 year	1	5	2	7	4	25
	no payback	2	4	3	4	5	32

Table 4: Shows the relationship between energy spend and energy awareness

		How much people have invested in their energy use					
		>£10,000	£5,000 – £10,000	£1,000 - £5,000	£100 - £1,000	<£100	NA
Energy use awareness	Well Aware	3%	8%	7%	8%	6%	35%
	Some idea	0%	2%	0%	2%	2%	14%
	No idea	0%	0%	0%	1%	2%	11%

Analysis:

- Clearly most of the sample felt they were well aware of their energy spend. With only 14% claiming they had no idea.
- The majority have not invested in renewable energy or energy efficiency (60%).
- Table 2 can be interpreted as what payback period people feel is appropriate for energy saving and generating devices. It shows that 88% expect little to no payback period at all. And only 12% of the sample would be happy with a payback time of 3 years or more. This could be interpreted as a general unwillingness, or inability, to invest at all. There was some misunderstanding the nature of the question 12, with many considering the £0 option as a 'free' option.
- Those that had invested in energy saving and generation had a greater awareness of their energy spend, as can be seen in table 4.
- Those that were well aware of their energy usage tended to be 40-49 years old and above. 94% of the over 70's were well aware of their energy use, as were 68% and 78% of 50-59 and 60-69 year olds respectively. Only 4 people under 30 were well aware of their energy usage. 60% of the under 20's had no idea of their energy usage.

- Generally people under 20 and between 30-60 were more likely to be happy with 1 year payback. Outside of this, most wanted to spend no money on an energy saving appliance.

2.3 Willingness to participate in external control of energy devices

Allowing a degree of external control of energy devices, and sharing energy consumption and generation data, is key to enabling smart balancing of supply and demand, which is a key component of a local energy market. Questions 9 and 10 assessed peoples' willingness to participate in this, and whether the sort of organisation they were giving up control to made a difference.

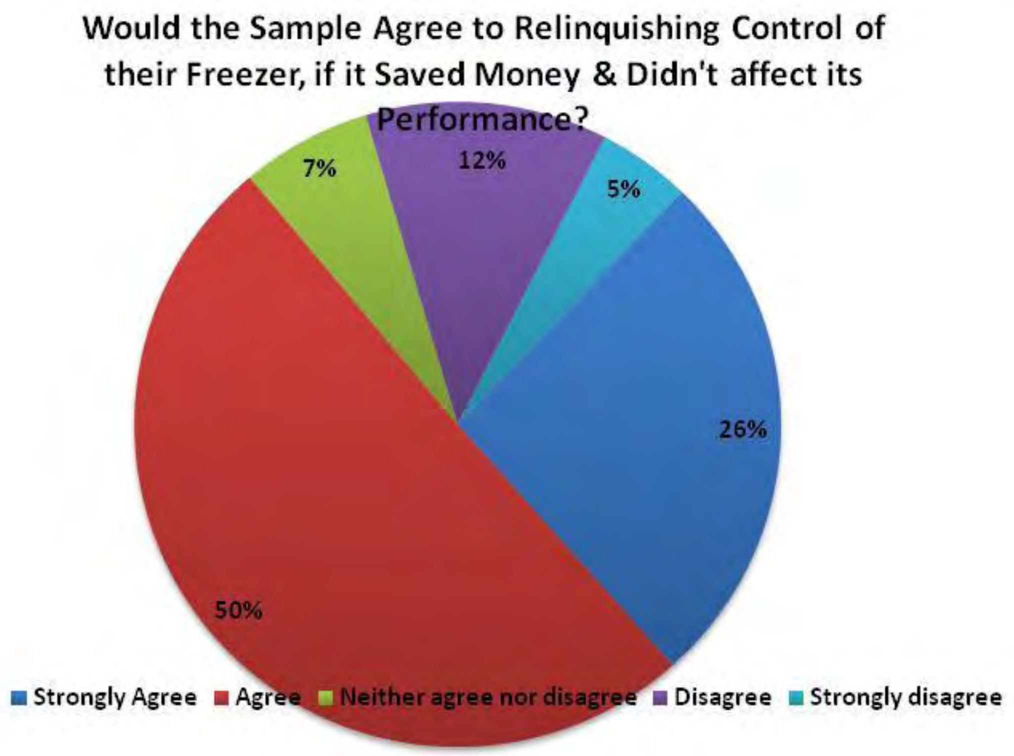

Figure 7: Opinion of smart energy saving products

Analysis:

- The results show general willingness (76% agree or strongly agree) to allow external control of energy devices if it saved money, and did not have negative consequences.

- Of those happy with allowing external control, 67% would prefer to do this through a locally owned not for profit energy company than a 'big 6' electricity company.

- Of those not happy with external control, there is no preference over a local community supplier or a 'big 6' energy company (24% each). 53% neither agreed nor disagreed.

- 33% of those who would not be happy with external control over their energy devices currently do not participate in any of the three smart technologies used as indicators. This suggests a general concern over smart technology participation.

3 Implications for Smart Cornwall

Strong leadership and governance from Smart Cornwall is required to address peoples' concerns over smart data use.

Whilst people do have concerns over smart data use, they do seem willing to participate in smart technologies where it delivers benefits. There is broad support for the concept of external control over energy devices if it delivered bill savings. However, there was strong support for this external control going to a local not for profit organisation (e.g. a local energy coop and/or Cornwall Electricity Supply Company) rather than a major energy company. Smart Cornwall should explore how not for profit business models can both help to maximise local benefits from smart energy technology deployment and provide reassurance to consumers.

The level of engagement in energy is still generally low, as is willingness (and/or ability to invest in energy generation and energy efficiency). To achieve the level of smart energy technology uptake required will require sustained and imaginative public awareness and education campaigns, as well as technology deployment models that do not require the consumer to invest capital.

Appendix A: **Survey and results**

1. I own smartphone?

Yes	No
69	38
64%	36%

2. If yes – I download new apps and use smart features on my smartphone

Yes	No	N/A
46	24	37
43%	22%	35%

3. Most of my friends have smartphones

Yes	No	Don't Know
85	15	7
79%	14%	7%

4. I use store loyalty cards regularly (e.g. Tesco Club Card)

Yes	No
73	34
68%	32%

5. I have a social networking account (Facebook / Twitter etc.)?

Yes	No
59	48
55%	45%

6. I use social networking frequently

Yes	No	N/A
48	11	48
45%	10%	45%

7. My friends use social network frequently

Yes	No	Don't Know
84	17	6
79%	16%	6%

8. Companies use data from your smart phone, store card and social networking to gather information about you for marketing and other purposes *Please answer even if you don't use these technologies*

A) I am aware of how my data is being used

Well aware	Some idea	No idea
42	36	29
39%	34%	27%

B) I feel the benefits I gain from sharing data in this way outweigh any concerns

Strongly Agree	Agree	Neither Agree / Disagree	Disagree	Strongly Disagree
1	15	29	37	25
1%	14%	27%	35%	23%

9. If it saved money on my electricity bill, I would be happy for my electricity supplier to place a device on my freezer that enabled them to turn it off for short periods to help manage peaks in energy demand. It would not affect the performance of the freezer – the food would still stay frozen.

Strongly Agree	Agree	Neither Agree / Disagree	Disagree	Strongly Disagree
28	54	7	13	5
26%	50%	7%	12%	5%

10. I would be happier if the device were to be controlled by a community owned energy company than a 'big 6' electricity supplier.

Strongly Agree	Agree	Neither Agree / Disagree	Disagree	Strongly Disagree
29	33	32	7	5
27%	31%	30%	7%	5%

11. What would you be willing to pay for a smart energy device (e.g. a controller or battery) which could save you £100 per year on your electricity bill.

£1500	£1000	£500	£300	£100	£0
1	2	2	8	44	50
1%	2%	2%	7%	41%	47%

12. I have already invested in renewable energy generation and/or energy efficiency measures for my home. If so how much?

>£10,000	£5,000 – £10,000	£1,000 - £5,000	£100 - £1,000	<£100	£0
3	11	7	12	10	64
3%	10%	7%	11%	9%	60%

13. I know how much I spend on energy at home.

Well Aware	Some Idea	No Idea
71	21	15
66%	20%	14%

14. What is your age?

Under 20	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 or over
10	7	13	14	25	22	16
9%	7%	12%	13%	23%	21%	15%

Appendix 15: Smart Cornwall Guiding Principles

The Smart Cornwall Programme has the ambition to:

Develop the UK's first fully integrated smart energy system, providing new high value jobs, creating wealth and opportunities for future generations and leading the way into a prosperous, resource efficient future.

Key to the successful delivery of this vision will be ensuring that all projects being delivered through the Smart Cornwall programme do so in the context of the guiding principles outlined below.

An integrated, open access Smart Energy Network

The Smart Cornwall programme is a long term commitment by Cornwall and the Isles of Scilly and will therefore build over time. Ensuring individual projects build on each other is an important guiding principle. To this end:

1. Projects should be delivered under the presumption of interoperability with a commitment to deliver open standards
2. Data derived from projects should be openly available and accessible unless there is good reason for it not to be
3. Projects should be replicable and scalable outside of Cornwall and the Isles of Scilly
4. Projects must be secure, safe and controlled

A growth engine for Cornwall and the Isles of Scilly

The development of a globally recognised hub of innovation in the Smart Energy marketplace is a key pillar in delivering our vision. To this end: -

5. Projects should always seek, where appropriate, to use local supply chains and knowledge
6. Public funding should be focused on levering in private capital, delivering positive economic outcomes for Cornwall and the Isles of Scilly

A new, community led energy economy

The Smart Cornwall programme provides a unique opportunity to develop a new energy economy retaining the benefits locally and ensure security of supply. Ensuring this happens is a priority. To this end: -

7. Projects should explore the viability for local benefit and ownership models for their deployment
8. Where appropriate, local communities should be actively engaged, and participate in projects
9. Social outcomes such as value for money for the consumer and improving quality of life must be considered.