MK*Smart*2020

Appendices

e·on | Central Networks

Contents

1. The MK*Smart*2020 Project 1
2. Milton Keynes Low Carbon Living Programme Prospectus 15
3. Research Themes, Knowledge Capture and Dissemination 16
4. DPCR6 Linkages and Capability Development 29
5. Smart Metering and Customer Empowerment 33
6. Commercial Propositions and Supporting Technology 38
7. Technical Design and Delivery 44
   - 7.1. Aligning Technical Design with Customer Value 44
   - 7.2. Information Technology 48
   - 7.3. Communications 52
   - 7.4. Network Engineering and Operational Delivery 56
8. Project Readiness and Delivery 63
9. Benefits Case 69
10. External Collaborators 77
11. Letters of Support 86
12. MK*Smart*2020 - Derogations 91

The MK*Smart*2020 Project

Executive Summary

Meeting climate change targets will require the delivery of significant levels of distributed generation, electric vehicles and heat pumps which in turn will drive demand on our network and as a result put pressure on the current network capacity. With smart grids, we have the ability to manage the network in a cost effective way for the end customer.

At Central Networks, we aim to provide our customers with low carbon electricity reliably and cost-effectively.

We are committed to trialling new solutions through the Low Carbon Networks Fund (LCNF). MK*Smart*2020 follows through on this commitment by bringing value-focused innovation in electricity networks to Milton's Keynes leading low carbon vision.

Milton Keynes City Council is passionate and committed to a low carbon future for the city. The vision for Milton Keynes is translated into its Low Carbon Living Programme, established by Milton Keynes Council and Partnership. The Low Carbon Living Programme will deliver:

- A reduction in city carbon intensity by reducing emissions from transportation, homes and businesses through energy efficiency products, electric vehicles, renewable generation and heat pumps
- The foundations for the sustainable expansion of Milton Keynes, starting with a new development of 1,200 low carbon homes
- A centre for low carbon innovation, engagement, education and business.

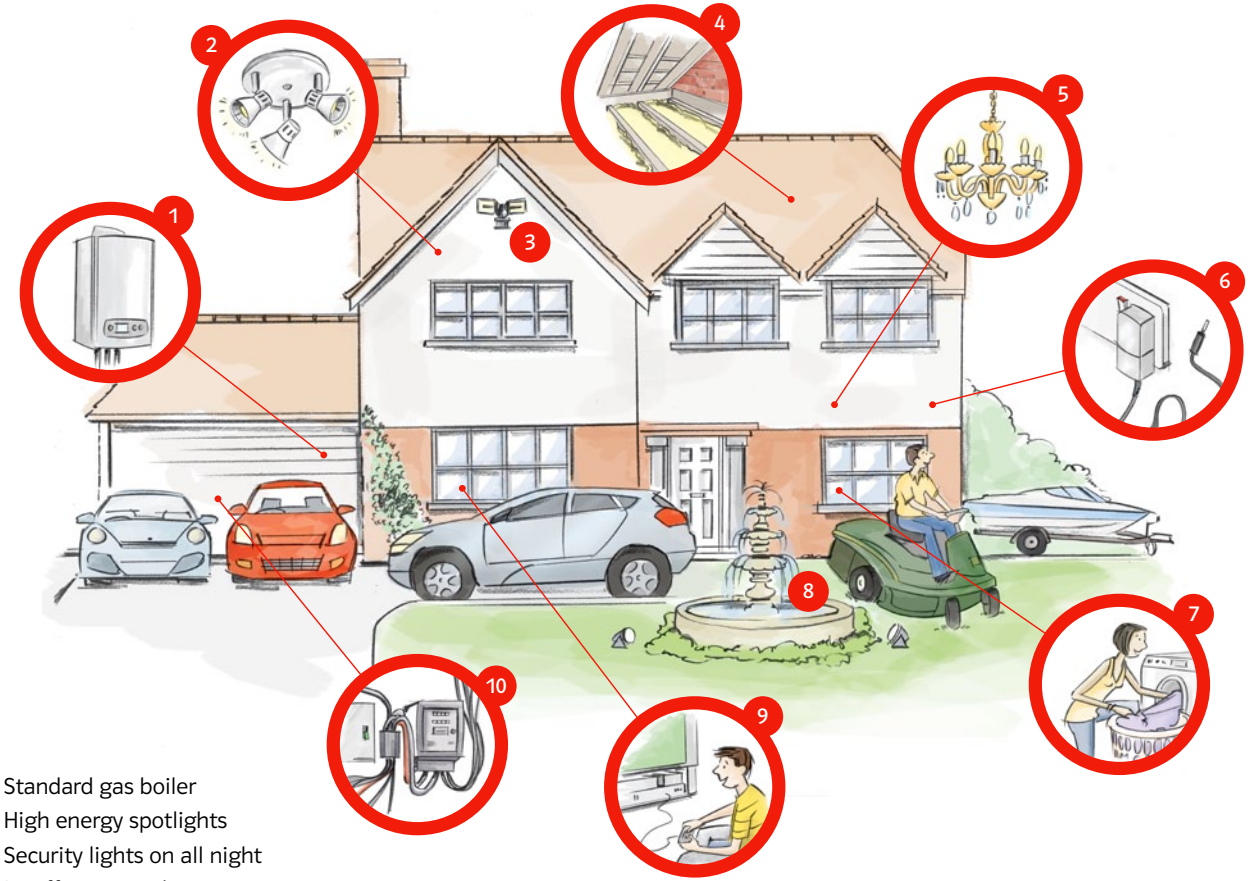
MK*Smart*2020 will help to showcase Milton Keynes as a leading low carbon city which will drive innovative and green aspirant companies to the city. MK*Smart*2020 therefore provides us with a unique opportunity in 2012 to study the network of 2020 and understand the direct customer impact of tomorrow's low carbon world.

MK*Smart*2020 will deliver a smarter and more active electricity network in three main ways:

- *Increased visibility*: we will have a better and more detailed view of our electricity network, allowing us to operate and plan improvements better
- *Greater control*: building on the benefits of increased visibility, remote control and automation will enable us to make changes in response to customer needs, thus offering better service. We will therefore apply new technologies and commercial arrangements to ensure the electricity network is used more efficiently and customers get better value for money. Examples include contracts that enable customers' electricity demand to be managed and networks that can heal themselves in the event of problems

- *Market integration*: our electricity distribution networks are part of a bigger national system. To make the most of opportunities to save customers money and reduce carbon emissions, electricity network companies need to manage their networks in a way that takes into account the wider needs of the national system. By using commercial arrangements and industry processes to integrate with the national network, we can meet both local and national needs more effectively.

Today's world



1. Standard gas boiler
2. High energy spotlights
3. Security lights on all night
4. Insufficient insulation
5. Convential light bulbs
6. Chargers left switched on
7. Using the tumble dryer on sunny days
8. Pond pumps/garden lighting left on all day
9. Skybox left on when not in use
10. Old meter technology

The project will deliver reliable and secure networks for the customer and at a lower cost to society than if conventional reinforcement of the network were to take place. Smart grids will also ensure faster uptake of Distributed Generation, electric vehicles and heat pumps.

In order to disseminate this knowledge, we have also secured significant support from other partners such as Accenture, GE, Cisco, Cranfield University and the Open University. We will be disseminating our learning in a way that will allow other parties to effectively adopt those methodologies which are viable. Our learning and dissemination platform is significant with local, national and international routes attached to it.

Our project will showcase the way in which smart grids could operate in 2020 taking on all the societal, engineering and commercial challenges associated with a modern way of life. Our MK*Smart*2020 solution will be transferrable and replicable throughout the UK as it will be using the centre and suburban areas of Milton Keynes as a platform, an environment common to many of our UK conurbations.

Milton Keynes Council, Central Networks and our other partners are totally committed to this project. We believe MK*Smart*2020 can represent an important step on the UK's journey towards its low carbon aspirations.

1. Introducing Central Networks and MK*Smart*2020

Central Networks is one of seven electricity distribution network companies in the UK. We run the network that carries power from the high voltage transmission system to homes and businesses across the Midlands.

At Central Networks, we are passionate about providing our customers with low carbon electricity, reliably and cost-effectively. This is why we have applied for customer funding to support a low carbon network project called MK*Smart*2020.

At Central Networks, we are passionate about providing our customers with low carbon electricity, reliably and cost-effectively

MK*Smart*2020 will be a fully functioning low carbon electricity network, referred henceforth as a "Smart Grid". During the project, we will try out several possible approaches to the challenges of the low carbon future, and test how these are able to minimise the costs of delivering low carbon electricity to customers. As a result, we'll learn which processes and technologies are the most effective. We will then take the learnings and use them elsewhere, while also sharing what we have learnt with other distribution network operators and other interested parties. This is an opportunity to learn about 2020 networks and consumption patterns in 2012 and understand the direct impact which this will have on customers.

For the purpose of simplicity, the project can be thought of in three phases:

1. *The Foundation – The smart grid*. We will install new technologies and devices on our network and upgrade the existing infrastructure to give us greater visibility and control over the network. These improvements will be combined with new IT systems enabling us to manage the network in a more active way.
2. *The 2020 representation – Facilitating Low Carbon Living*. We will work with public sector organisations within Milton Keynes to encourage and increase adoption of low carbon technologies such as electric vehicles, so that we can see their real, everyday impact on the network
3. *Integration – Solutions for Networks of the Future*. Pulling all the other elements together, we will manage customers' ongoing demand for electricity to help us run the network better and balance local and national needs

Through all the phases, we will be collecting all the insights that emerge, and share these with the other participants in the electricity market. We are already working with the Open University and Cranfield University to help us disseminate this knowledge.

2. The need for low carbon networks

The UK has set itself a challenging target of a 34% reduction in greenhouse gas emissions from 1990 levels by 2020, and an 80% reduction by 2050. We expect that efforts to achieve this target are going to lead customers – and are already leading energy companies – to take steps such as:

- Developing renewable generation through more wind farms across the country and off our coast
- Switching from gas or oil-fired boilers to heat pumps
- Using electric vehicles
- Installing micro technologies at or on our homes, such as mini wind, solar thermal and PV

Our 'green scenario' for customer adoption over the next decade suggests that the UK will have nearly 1.4 million electric vehicles and nearly 5 million heat pumps by 2020.

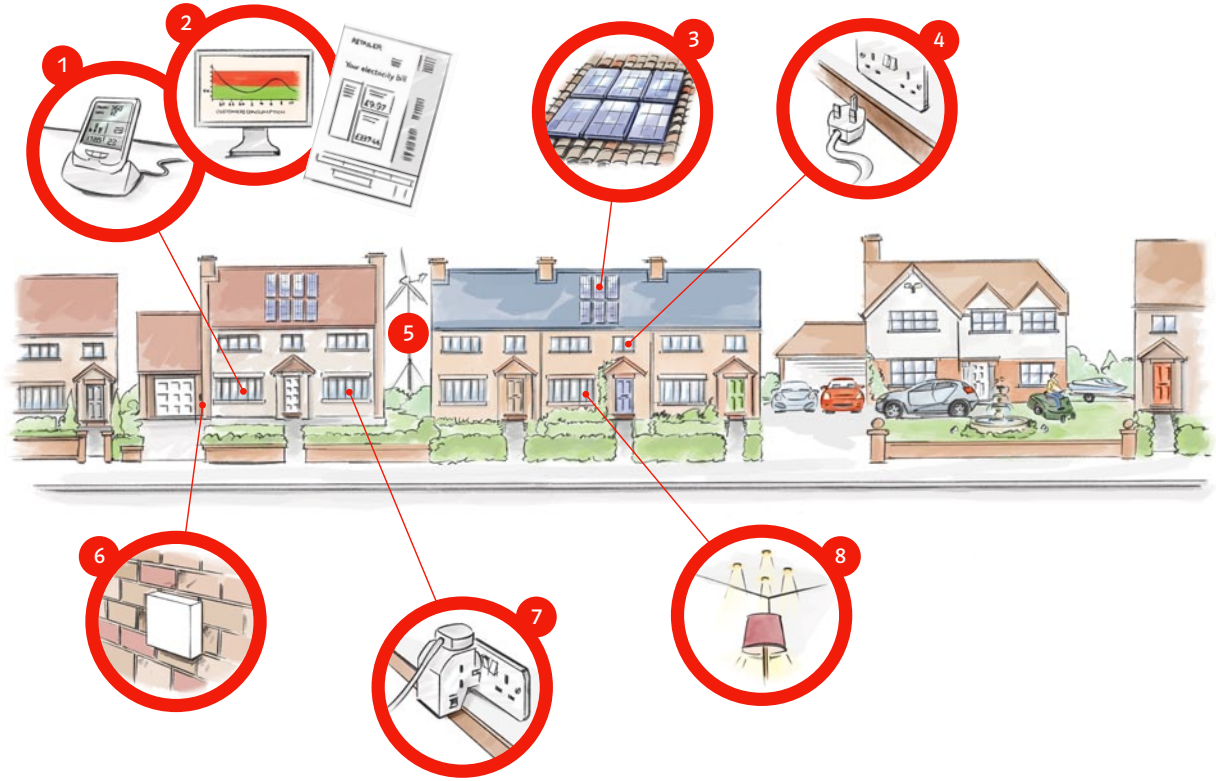
We are committed to playing an active role in helping the UK Government, Ofgem and UK electricity customers take these steps, and deliver on the UK's carbon targets. As we do this, we believe there are three changes that will bring the biggest implications for electricity distribution networks.

1. More renewable generation – such as wind and solar photovoltaic – will be connected to the distribution network
2. Uptake of electric vehicles and heat pumps will increase customer demand for electricity
3. Generation will become less flexible as coal and gas plants are replaced with wind and nuclear, increasing the dependency on flexible generation capacity (gas plants such as combined cycle gas turbines) or demand side management (managing customer demand to support the needs of the system)

Our network currently caters for customers with today's consumption patterns. Due to the uptake of technologies such as electric vehicles and heat pumps in the future, we would be hard pressed to cater for this increased demand. Indeed, figures have shown that we would have to nearly double the size of the network with the above green world scenario.

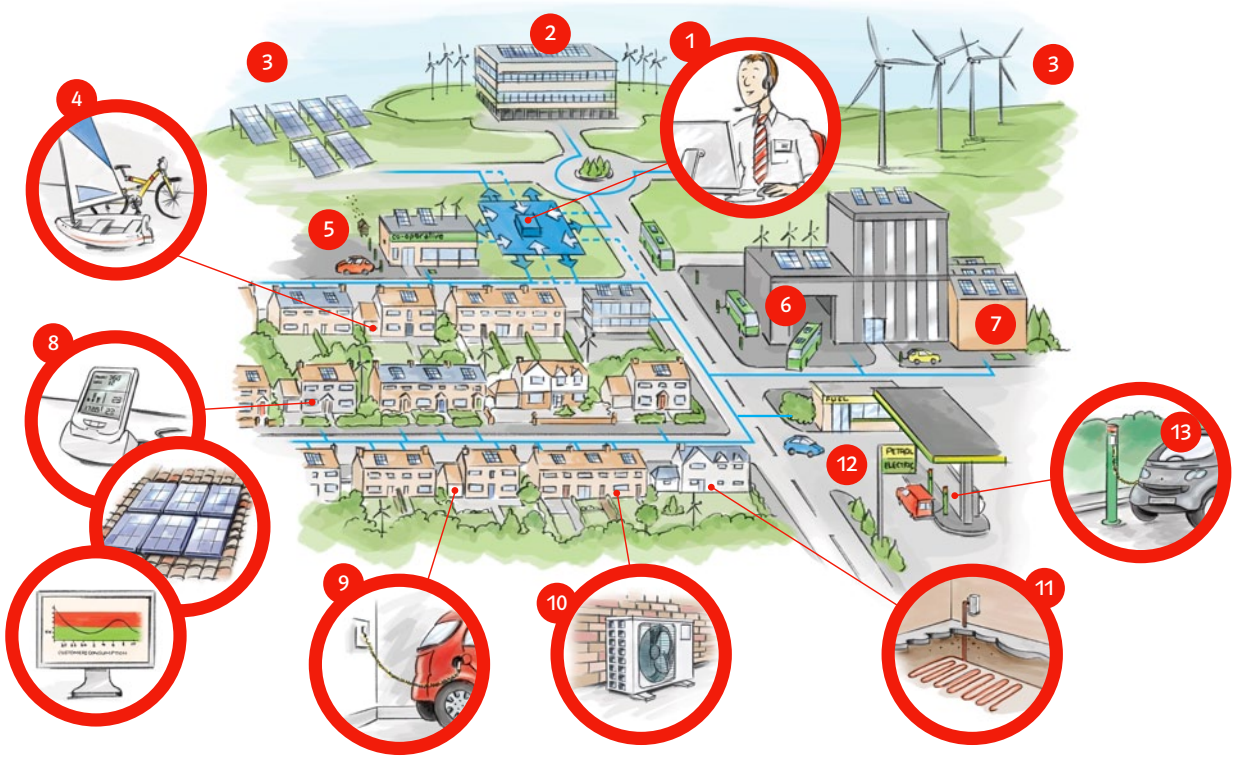
Fortunately, technological advances resulting from many years of research and development mean that more cost effective solutions are now becoming commercially available. These present us with opportunities to minimise the cost of low carbon power to the customer. So now is the time to act. With the Low Carbon Networks Fund, OFGEM has provided us with a mechanism which allows us to trial out those technological advances to determine whether we should implement them in the future.

Towards change



1. Energy monitor showing energy consumption
2. Online retailer website showing progress
3. PVs generating electricity
4. Unplugged sockets
5. Wind turbine generating electricity
6. Smart meter controlling usage
7. Powerdown adaptor
8. Low energy lamps and LED spotlights

World in 2020



1. Smart grid control centre linked to Smart grid substation
2. Milton Keynes Town hall has all new technology PV, PT ,GSHP, Smart Meters and charging posts for the vehicles and a bee hive and push bike hire scheme
3. Town with 30% of houses and strategic other buildings being fed by Wind farm and PV farm and homes have PT on roofs
4. All houses have a push bike, and one or two have sailing boats
5. The Co-op shop in town has all new technology PV, PT ,GSHP, Smart Meters and charging posts for the vehicles and a bee hive!
6. Bus station has PV and runs a fleet of electric powered solar buses
7. The commercial property/factory has all new technology PV, PT ,GSHP, Smart Meters and charging posts for the vehicles
8. Energy Monitor in most homes and the Energy tracker on the computer shows a negative figure as more energy is being exported
9. 25% of houses have two electric cars and recharging in garages
10. Air source heat pump in the home
11. Ground source heat pump one between 3 houses
12. 25% of houses have an electric and a petrol car
13. The petrol station has 50% of space for recharging vehicles

3. Our vision for low carbon electricity networks

How will electricity networks support the low carbon energy system – and what will a low carbon network look like?

In our view, three main changes to the traditional network model will enable low carbon electricity to be provided to customers reliably and cost-effectively. These are:

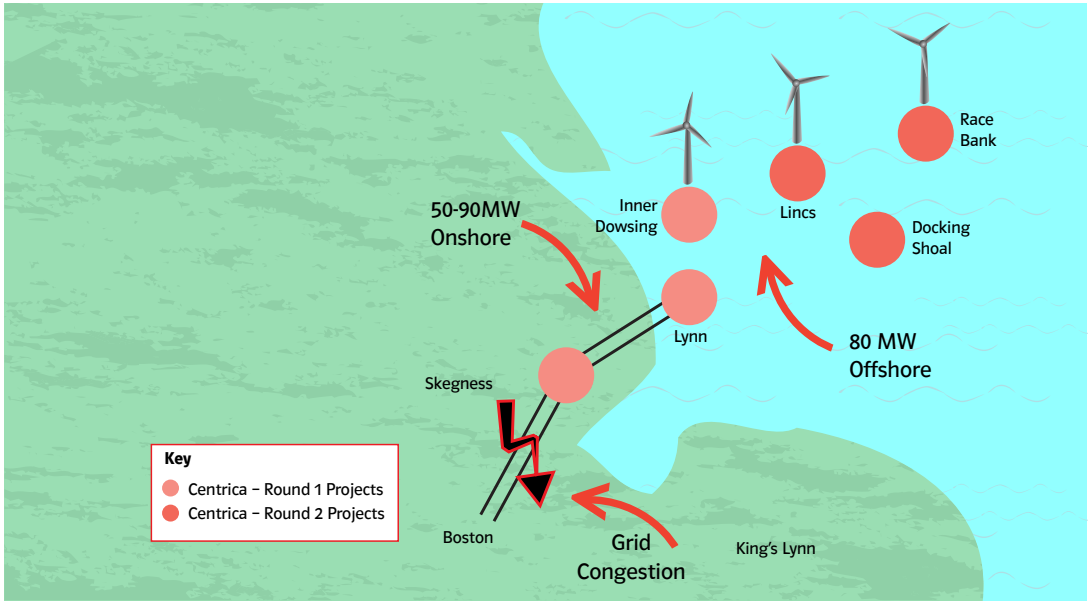
1. Make it easy and cost effective to connect low carbon sources of generation to the distribution network
2. Integrate transport and heating electricity loads, while deferring and avoiding reinforcement of the network
3. Actively support demand response measures to help maintain the balance of the national system while staying within local network constraints.

The low carbon network of the future will need to do all three of these things at the same time by using the smart grid as the enabler.

Do you have any firm evidence of what smart grid might be able to do for the UK?

We believe that smart grid will provide reliable and cost effective low carbon electricity for UK customers. We will not fully understand the impact of smart grids and the full benefits associated with them until MK*Smart*2020 and similar projects have been completed and the results have been collected and analysed. But we believe that there are major opportunities to deliver value for customers by reducing the need for future investments in network reinforcement. We already have a proven track record of delivering value and cost effectiveness through smart grid. For example, during the last regulatory price control period, which ran from April 2005 to March 2010, we successfully completed a Registered Power Zone wind farm project. This project demonstrated how wind farms located offshore could be connected to our network at a significantly lower cost using smart grid solutions. The Skegness solution cost £500,000. To connect the same amount of generation using a traditional approach would have cost between £3 million and 5 million.

We have a track record in delivering successful smart grid projects



4. Milton Keynes – A unique opportunity for a city wide UK smart grid

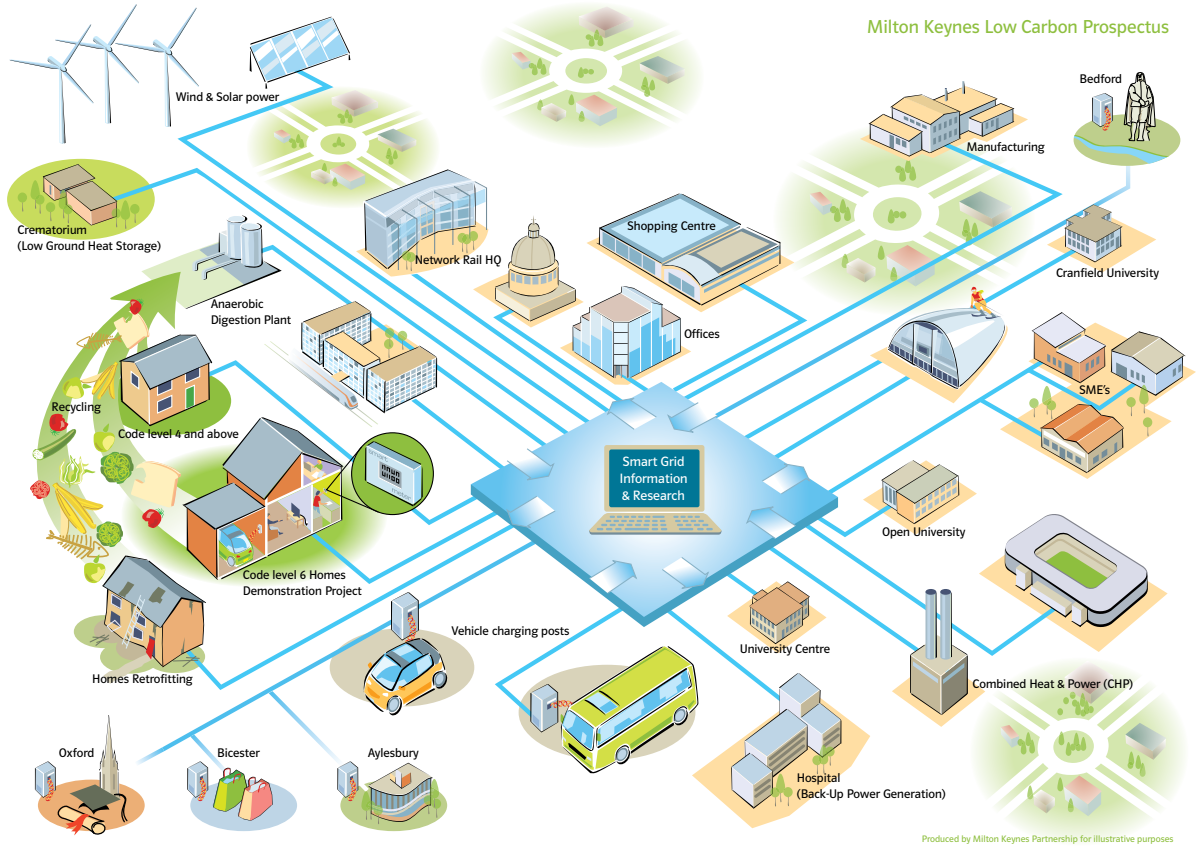
Milton Keynes Council has a history of innovation in the low carbon arena, and is about to embark on its Low Carbon Living Programme. Milton Keynes council believes in the low carbon agenda and their vision is to showcase a 2020 world in Milton Keynes by 2012. The aspiration is to transform Milton Keynes into the low carbon town of the future through new infrastructure and changes in citizens' behaviour. To help achieve these aims, the Low Carbon Living Programme includes the electrification of heating and transport, renewable distributed generation (DG), new-build low-carbon homes, improvements to older energy-inefficient housing stock, and demand response measures. By bringing all these actions together in one place, Milton Keynes is seeking to deliver:

- A step change in carbon intensity for an urban area by reducing emissions from transportation, homes and business

- The foundations for sustainable city expansion, starting with a new development of 1,200 low carbon homes
- A centre for low carbon innovation, engagement, education and business.

In combination, the Low Carbon Living Programme and Milton Keynes provide a unique and ideal location for a low carbon network pilot

Low carbon living



Milton Keynes is a city that has an electricity network that is representative of most of the UK, and the vision which we want to create through our low carbon project is one which could be easily transferable and replicable throughout the country. We want to show how an entire city can become low carbon. We are proud that MK*Smart*2020 has the opportunity to support the Low Carbon Living Programme by applying our low carbon network vision to Milton Keynes. In combination, the programme and Milton Keynes provide a unique and ideal location for a low carbon network pilot such as MK*Smart*2020. There are three main reasons why this is the case:

1. The changes that Milton Keynes will go through over the next four years will provide an early foretaste of the changes that will occur across the UK as a whole in the run-up to 2020. So what we learn and share from MK*Smart*2020 will be highly relevant and readily applicable to other parts of the country
2. Milton Keynes faces a concentrated yet varied combination of low carbon challenges due to its low carbon living programme – a blend that is hard to replicate anywhere else at present especially using a whole city. This means it provides a good model for the type and level of challenges that we expect to see in the future
3. Given the level of funding we have requested, MK*Smart*2020 will be able to cover a large proportion of an urban community

and electricity distribution network that are representative of the UK in general – encompassing new build and retrofit housing, domestic and commercial premises, and affluent and poorer areas. This will enable us to create a working microcosm of urban Britain.

By combining the Milton Keynes Low Carbon Living Programme with MK*Smart*2020, we will be able to ensure that both the citizens of Milton Keynes and all electricity customers across the UK get the greatest benefits from both projects. In our view, this represents a great opportunity.

We also believe that with the vision of Milton Keynes to aspire to be an innovative and green city, the projects should boast the local economy and attract to Milton Keynes companies with green aspirations.

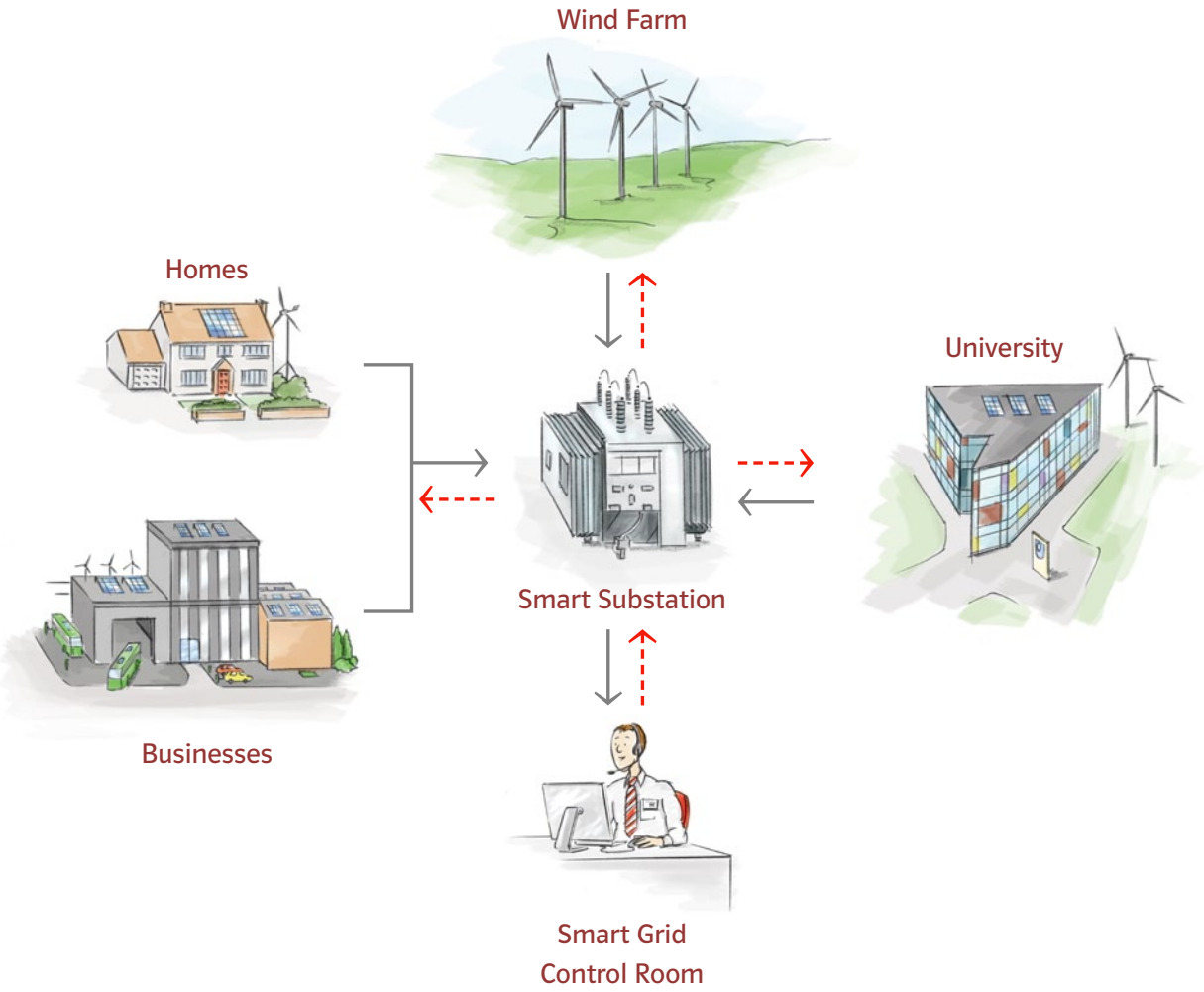
5. MK*Smart*2020

For simplicity purposes, we are defining the concepts of the project using a phased approach with each successive phase building on the previous achievements.

(a) *The Foundation – The Smart Grid*

Transforming the network into a smart grid will be the key development during the foundation phase of the programme. To do this, we will apply increased monitoring and control to the distribution network, through a combination of installing new

The future low carbon electricity distribution network



components and enhancing those that are already in place. We will collaborate closely with the Low Carbon Living Programme to coordinate the location of these changes, and generate the best possible insights from the project by using our experience of different network situations.

The technology that we install will be designed to work together to improve our visibility and control over the network. A communications backbone will enable all the required data to flow back and forth.

This foundation phase will include a number of individual sub-projects.

Retrofitting and replacement of secondary substations, and retrofitting and new build of primary substations

Substations are an important part of the distribution network, and exist in two types – primary and secondary. Primary substations are large installations that serve thousands of homes and businesses. Secondary substations are much smaller, and connected to a primary substation. Substations are key to the operation of the smart grid because they can act as a physical capacity constraint – there is a limit to the amount of power that they can handle – and they are a natural place to put sensing, computing and control devices. Network companies already have a degree of sensing and control installed within their primary substations.

MK*Smart*2020 will examine how the constraints imposed by substations can be dealt with cost effectively – such as using substations in a smarter way rather than replacing them. We will also look to find the most effective way to use the substation as a platform for sensing, distributed intelligence and control.

The telecommunications network

The most important capabilities for making a smart grid work include being able to transfer data from smart meters and other sensors, and to issue control orders to devices within the network. MK*Smart*2020 will make use of a variety of communications technologies, with the aim of providing the most cost effective solution for any given set of circumstances.

Smart metering

Smart meters allow customers to see a more accurate picture of their consumption, remove the need for estimated meter reads and can help network operators plan and manage the network more effectively. MK*Smart*2020 includes a large-scale roll-out across Milton Keynes of smart meters that will be delivered and owned by retailers. Smart meters will enable data from the meter to be used to help us run the network more efficiently to ensure reliable supplies to the customer and we will investigate the potential to use the same communications system both for metering and network management. We believe that those activities will deliver value to the customer, if we find that the meters can create benefits and synergies for the network.

Active network management

Active network management defines a number of options which open up once we have increased visibility and control of the network through the smart grid. Active network management involves managing the network in a more active way by understanding the usage on the network and determining when intervention is required to maintain the network operating in a sustainable way. This is largely enabled by IT infrastructure which handles and analyses the data, identifies the best solutions, and either takes action automatically or provides operators with the information needed to make a good decision. This process can cover several different areas of network optimisation that we think could be joined together to make the sum of the benefits exceed the constituent parts. This could involve reducing the demand on parts of the network. We hope that this will allow us to get more out of our electricity networks, and so make the transition to a low carbon energy system more affordable

The UK progresses along its low carbon path

(b) *The 2020 representation – Facilitating Low Carbon Living*

The value of the new insights from MK*Smart*2020 will be increased by the project's alignment with Milton Keynes' Low Carbon Living Programme, and the resulting high adoption of low carbon elements on the municipality's electricity network. The projects in this phase are designed to work and integrate closely to drive adoption of low carbon technologies in concentrated pockets where the impact on the network will be at its highest and most informative which will allow us to actively manage the network as well as observe the behaviours which could be associated with real time prices in the future.

Zero carbon development

Milton Keynes Council plans to build a low carbon development of about 1,200 homes in Tattenhoe. Around 50 to 60 of these dwellings will be 'Homes Demonstrators'. These will have many low carbon features such as EV charging, demand response, electric heating and distributed renewable generation. Tenants will be required to participate in a low carbon trial over their two year lease periods. The development presents a valuable opportunity to link low carbon housing with a low carbon network. This type of concentrated combination has historically been difficult to create, and should provide an ideal platform for trialling low carbon network solutions.

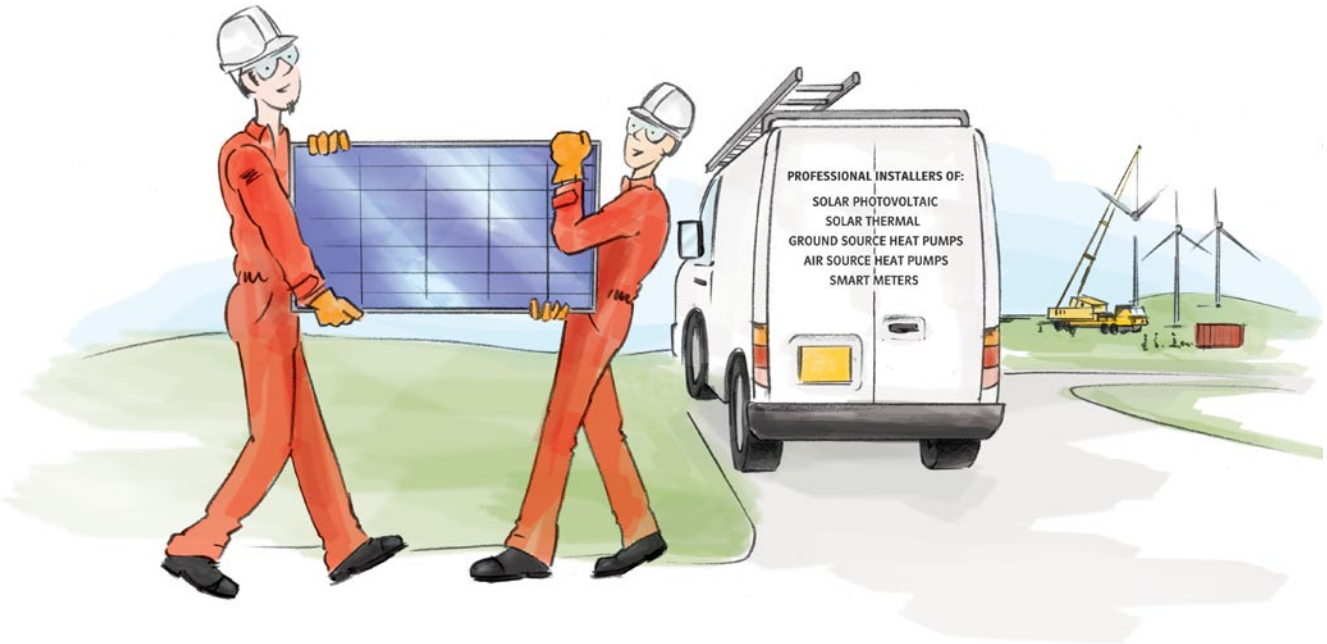
Electric Vehicle Infrastructure Scheme (ELVIS) integration

ELVIS is Milton Keynes' transport electrification project, which already has funding to install car charging points and run a fleet of electric buses. The city is also providing free parking for electric vehicles, therefore driving the adoption towards Milton Keynes' target of 1,000 cars by 2014. Milton Keynes already has over three and a half times the national average when it comes to the proportion of vehicles that are electric (data from the Department for Transport). By working with the Council and local businesses, Central Networks plans to create concentrated car-charging – potentially for employees or company vehicle fleets – that includes charge scheduling for network management.

Distributed generation

Milton Keynes has EU funding for a solar array on top of the central bus station, and the Council and Milton Keynes Partnership will be working with residents and businesses to encourage growth in distributed generation (DG), supported by the Government's feed-in-tariff. We believe that this will increase the levels of DG, so we can gain a better understanding of DG's impacts on the network, and the best ways of managing those impacts.

Distributed generation is installed across the UK



(c) *Integration – Solutions for Networks of the Future*

At this stage, active network management capabilities are in place and data is coming in from the grid. The impact of low carbon challenges can be seen. We can then trial fully integrated solutions, including striking the best balance between local and national needs, and involving the customer as a key participant in the energy system of the future.

Industrial and commercial demand response

We want to encourage as many companies as possible in Milton Keynes to take part in this phase of the project, and we will be working closely with Milton Keynes Council to achieve this. MK*Smart*2020 will include installing technology within offices and business premises to control electricity loads such as air conditioning. This will be complemented by commercial arrangements through the customer's electricity supplier enabling Central Networks to manage these loads.

Time and location network tariffs

Working via the customers' electricity retailers, we will trial tariff structures based on time and location with the customers participating in the Tattenhoe Home Demonstrator trial. Our aim is to see whether customers will change their consumption behaviour and electricity demand in response to simulated tariffs reflecting expected future constraints on the network.

Load aggregation

From recent discussions, we know that a number of industrial and commercial customers are prepared to allow some of their electricity consumption to be interrupted under certain conditions. We will use our new active network management capabilities to see how this opportunity to interrupt the supply might be used to optimise the local distribution network.

The local distribution network is part of a wider national power system – and MK*Smart*2020 will investigate how the needs of the local and national system might both best be served. We will do this by adding up the load that has been made available to be interrupted, and working out whether this load is needed to manage local constraints. If it is not needed locally, we will work with retailers and aggregators to allow the load to be used on a commercial basis for balancing the national system.

6. Giving customers value for money and meeting Ofgem's LCNF requirements

Customers are paying for this project – so how can they be confident they are receiving value for money?

We know that many consumers and businesses in the UK are currently facing financial challenges – and we fully recognise the investment that customers will be making in MK*Smart*2020. We believe that the value we can create for customers through this project will exceed this investment.

Our project will showcase the way in which smart grids could operate taking on all the challenges associated with a modern way of life. As the UK transitions to a low carbon energy system, we believe that making more efficient use of network capacity will cost less than the current approach of reinforcing the network. This will help to reduce the cost of the low carbon economy to the end customer as well as facilitating the uptake of distributed generation, heat pumps and electric vehicles through ensuring more cost effective connections to the network .

This is the basis on which we are applying for customer funding under OFGEM's £500m Low Carbon Networks Fund.

MK*Smart*2020 will enable us to trial a variety of approaches on a part of our network that will be undergoing early low carbon adoption, and which will resemble what the network will look like in 2020. We will evaluate these approaches and will share what we learn the rest of the industry. Whenever we find an approach that works, we will also make sure that we start using it as soon as we can on other parts of our network.

By investing in learning today, the customer will be able to save money in the future.

Ofgem, the UK's regulator of electricity distribution networks, has set clear requirements for companies applying for Low Carbon Networks Fund capital. These requirements ensure that projects receiving funding are designed to give customers value for money. MK*Smart*2020 meets all Ofgem's requirements.

This all sounds sensible, but what in particular makes MKSmart2020 a good investment for the customer?

We think there are three key features that mark out MK*Smart*2020 from other projects:

1. MK*Smart*2020 benefits from opportunities from the LCLP that are unique to Milton Keynes. This is because of Milton Keynes Council and Partnership's clear commitment to a low carbon economy – including funding for 'Plugged-in-Places' charging points for electric vehicles; an EU Concerto-funded solar array on the bus station; a low carbon development built on land owned by the local Council; and coordination with BT's roll-out of fibre for super fast broadband. All of these local factors will help the project to deliver more for less
2. We have assembled a number of leading companies – Accenture, Cisco and GE – who are all fully committed to the project, and whose collective experience and assets will help to support the success of the pilot
3. Central Networks and our external partners are contributing more than a third of the total cost of the project

Customers in Milton Keynes participating in the project receive certain benefits in return. These will include:

- 20,000 smart meters, which will eliminate estimated bills and help customers to reduce their energy consumption, electricity bill and carbon footprint
- A remotely monitored network, allowing faults to be automatically notified to us, supporting faster resolution
- Support to help Milton Keynes achieve its aspiration to have 1,000 electric vehicles by 2014
- Providing financial rewards to industrial and commercial customers that participate in the project's demand response trial, in return for allowing their usage to be managed.

7. Ensuring we deliver our project

There are a number of things that we aim to achieve over the course of the project:

1. *Milton Keynes smart grid is delivered and working*: equipment is installed where we planned, the communications links are carrying valuable smart grid data, and Central Networks is managing the network in a new and different way
2. *Third-parties have access to the data coming from the network*: we are collecting and storing data, and handing it over to bodies that can make valuable use of it, such as the Open University, Cranfield University, First Sustainability other Distribution Network Operators (DNOs)
3. *We are publishing papers and points of view based on our findings from the project*: we are sharing what we have learnt, and providing insights into the approaches that we are testing out

We have made every effort to reach an accurate assessment of the costs of MK*Smart*2020. The project's complexity makes it difficult to predict the final costs with complete certainty, so we have included a small element of contingency. Throughout the project we will monitor the costs closely, and follow the processes OFGEM has laid down for managing the risk of cost overruns.

8. The wrap-up

Climate change targets will deliver significant levels of distributed generation, electric vehicles and heat pumps which will drive demand on our network and put pressure on the current network capacity.

With smart grids, we have the ability to manage the demand on our network in a cost effective way for the end customer.

Milton Keynes is driving its own low carbon agenda ahead of the rest of the UK, leading to accelerated low carbon adoption. MK*Smart*2020 therefore provide a unique opportunity to study the typical UK network of 2020.

We have also secured significant support from other partners such as Accenture, GE, Cisco, Cranfield University and the Open University. We will be disseminating our learning in a most effective way to allow other parties to adopt those methodologies which are viable.

Our project will showcase the way in which smart grids could operate in 2020, taking on all the societal, engineering and commercial challenges associated with a modern way of life. This is a solution which will be transferrable and replicable across the UK.

New opportunities in the low carbon economy

Appendix 2: Milton Keynes Low Carbon Living Programme Prospectus

milton keynes

MILTON KEYNES
A SUSTAINABLE FUTURE
A Low Carbon Prospectus

Milton Keynes: A Sustainable Future
A Low Carbon Prospectus

Commissioning Partners

Milton Keynes Council
Working to deliver the best possible future for MK by creating sustainable communities & opportunities for all.
www.milton-keynes.gov.uk

Civic Offices
1 Saxon Gate East
Central Milton Keynes
MK9 3EJ

Tel: 01908 691691
Email: info@milton-keynes.gov.uk

Milton Keynes Partnership
Working through collaborative partnerships to deliver the vision for the city & act as a bridge to government resources that can help turn vision into reality.
www.miltonkeynespartnership.info

Central Business Exchange II
414-428 Midsummer Boulevard
Milton Keynes
MK9 2EA

Tel: 01908 353636
Email: enquiries@miltonkeynespartnership.info

NHBC Foundation
Targeting zero carbon and sustainability agendas within the house building & wider construction industry.
www.nhbcfoundation.org

NHBC House
Davy Avenue
Milton Keynes
MK5 8FP

Tel: 0844 633 1000
Email: info@nhbcfoundation.org

Zero Carbon Hub
Facilitating the mainstream delivery of low and zero carbon homes in the UK.
www.zerocarbonhub.org

NHBC House
Davy Avenue
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MK5 8FP

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Project Partner

PRP Architects
Our commitment to sustainability lies at the heart of our policy, which encompasses the promotion of sustainable design practices and extends to reducing our own carbon footprint.
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MILTON KEYNES
A SUSTAINABLE FUTURE

A Low Carbon Prospectus

FOREWORD

As well as being one of the fastest growing and most successful commercial centres in the UK, Milton Keynes is known as 'the city within the country'. It's little wonder with 40 per cent green space, more than 22 million trees, 4,500 acres of lakes and parkland, and Europe's cleanest urban air quality. We have an outstanding rural and urban environment which is proving to be a model for other cities around the world.

But being green is much more than having a pleasant landscape. From its very beginning, Milton Keynes was designed to be a sustainable community making the most effective use of its resources. Alongside our many other 'firsts', our Borough has proudly led the way on a number of green initiatives during the past forty years. The introduction of the UK's first solar powered house in 1972, the first to adopt energy standards in buildings, and the UK's first kerbside recycling collection in 1992 are just three of many.

In producing this Low Carbon Prospectus we take a look back at green initiatives of the past, we mark the importance of some of MK's current projects as diverse as combined heat and power supply, low carbon homes, and electric vehicles, and we look to the future and our goal to be a showcase low carbon city.

We are in a strong position to deliver this goal, with our flexible outlook, a growing population, dynamic economic growth, and a series of well co-ordinated low carbon programmes featuring cutting edge technologies and pioneering partners.

Milton Keynes as a showcase low carbon city is a collective piece of work. It involves the public and private sectors, voluntary groups, academics, and of course the people who live and work in Milton Keynes. This prospectus helps to set a vision in which all groups will be working together, so we can best respond to the challenge of climate change and reduce Milton Keynes' carbon footprint as we grow.

Councillor Debbie Brock
Mayor of Milton Keynes

CONTENTS

Foreword

Introduction 2

Milton Keynes – what kind of city? 4

Document Overview 8

Your Part in the Future
Engaging the Community and Local Initiatives 10

A Low Carbon City
Reducing the Environmental Impact of Buildings and Transport 14

Technology
Improving the Present and Protecting the Future 18

Direction
Clear and Informed Strategies, Policies and Masterplanning 22

Future Forum 26

Acknowledgements and Credits 28

INTRODUCTION

Thinking Differently, Embracing Evolution and Championing Change

Milton Keynes was planned and built with future growth in mind, to be a sustainable community long before we knew what sustainable communities were. It is grounded in the spirit of a balanced lifestyle, providing nature on your doorstep, and communities that have soul, energy and dynamism. Over the years Milton Keynes has developed a reputation as a national leader for innovation in low energy buildings. Collaborations with the Open University since the mid 1970's led to pioneering low energy housing developments. Supported by research and monitoring, these projects helped to provide a better understanding of how to minimise heat losses from buildings. At that time, quality of life and lower energy bills were the dirvers for change rather than concern over climate change. This early work informed national policy, leading to higher building standards, and created a method for calculating energy demand of housing which would later become the national approved standard we use today. Since then, our awareness of the need to reduce carbon dioxide emissions from the built environment has grown, and Milton Keynes Council responded by introducing policies requiring developments to take responsibility for their contribution to Climate Change, through their D4 policy, and carbon offset fund.

Since then, the city and borough of Milton Keynes continue to grow, applying many of the same principles attributed to its past success, such as 40% of land retained as open green space, managed and maintained by the successful Parks Trust model. Milton Keynes Council (MKC) and Milton Keynes Partnership (MCP) have made a commitment to continue to build on the reputation as a national leader for innovation in low energy buildings, research and environmental policy, and to demonstrate that it is an international leader in low carbon living.

A key objective is careful, environmentally sensitive master planning to provide a green, clean and safe environment. A joined up approach to the provision of new efficient homes, community facilities, sustainable infrastructure and 'smart' energy supply will benefit existing and new residents and companies attracted to the quality of life offered by Milton Keynes.

In Partnership with the Zero Carbon Hub and NHBC Foundation, this Low Carbon Prospectus for Milton Keynes has been developed to document the visionary approach, projects and initiatives which have taken place in the city since its inception in 1967. It brings together four themes; people, buildings, technology and direction, which contribute to ensuring the continuing growth of Milton Keynes will be sustainable and will provide an environment where low carbon living is part of everyday life.

This vision for a low carbon society includes:

- A sustainable approach to housing, education, energy, water and transport;
- Electrification of transport, low carbon housing development, retrofitting insulation in older properties, 'smart' power grids, local green power generation and new waste reduction and treatment facilities;
- Engaging local communities and partners, drawing on local expertise and capacity, including the local centres of academic excellence;
- Achieving economic advantage for the borough and supporting the development of the 'green' economy and jobs;
- An integrated approach to the borough's rural and urban areas.

MILTON KEYNES – WHAT KIND OF CITY?

Defining the City

Carbon Footprint

Tonnes of CO_2 per person per year*

* Sources of Data:
Based on data from the Stockholm Environment Institute (SEI) REAP Programme, 2006

This graphic shows the components of the carbon footprint of a typical Milton Keynes resident. The biggest carbon footprint from the six main categories comes from our homes, followed by transport. The use of energy for lighting, heating and appliances accounts for 18% of our total footprint, and driving around in a car accounts for 15%. The size of each icon is proportional to the amount of CO_2 emitted, and looking at it this way does reveal some interesting patterns - through carbon goggles, cars are much bigger than buses, and shoes are much bigger than sofas...

The Parks Trust estimate that they are managing over 22 million trees in Milton Keynes - this is a staggering amount of trees (that's almost a hundred trees per person!) Milton Keynes has a well-founded reputation for its open spaces, which are jointly maintained by the Milton Keynes Council and the Parks Trust, comprising around 3,000 ha. of open space, 565 play areas, 550 km trails and pathways, 250 ha of woodland, 60 km rivers and streams, 9 sq km of grass, 210 km of hedges, and 21 km canals and towpaths.

A Low Carbon Lifestyle

How do we compare?$

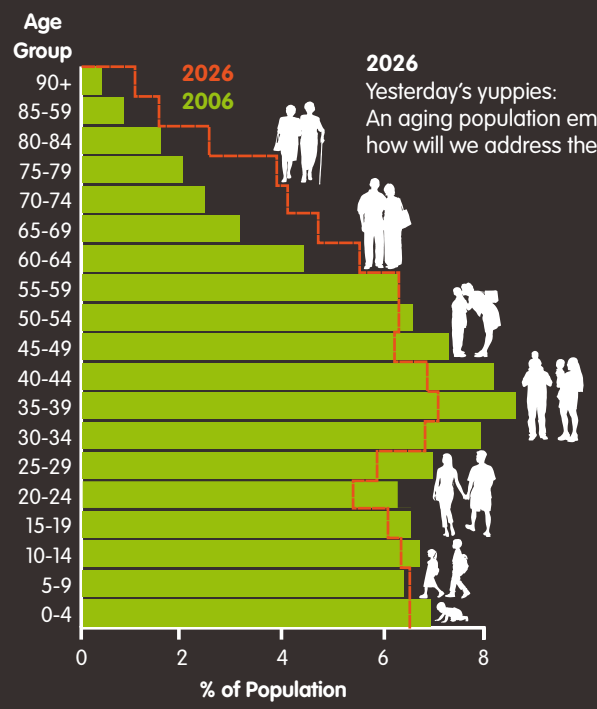
South East

Compared to the rest of the Southeast, a Milton Keynes resident has a smaller carbon footprint, although at 16.9 tCO_2/person/year, still slightly higher than the UK average, roughly five and-a-half times that of a typical Chinese resident, and fifteen times that of someone living in Uganda!

$ Sources of Data:
UK data from the Stockholm Environment Institute (SEI) REAP Programme, 2006
International data from the Norwegian University of Science and Technology (NTNU) Carbon Footprint for National Programme

Population

2006 vs 2026: an evolving demographic



2026
Yesterday's yuppies:
An aging population emerges - how will we address their needs?

2006
Milton Keynes is generally composed of a youthful population: young professionals, families with young children

Milton Keynes today is made up of a young and dynamic demographic that has given the city its energy and vibrancy. But what will the population be like in 2026? The general trend predicted for Milton Keynes as well as the rest of the country, is one towards a more mature population - by 2026, the current generation will turn into an aging population with very different needs and we have to be prepared to address their issues. With fuel prices predicted to increase, will we have designed today's homes so that heating will be affordable for the elderly? Will we have provided enough infrastructure and community amenities that will support the needs of an older population? We need to future-proof our city so that it can meet the needs of present and future communities.

New York
5.2 million trees (0.27 trees per person)

Milton Keynes
22 million trees (that's 94.75 trees per person!)

MILTON KEYNES – WHAT KIND OF CITY?

Defining the City

Housing

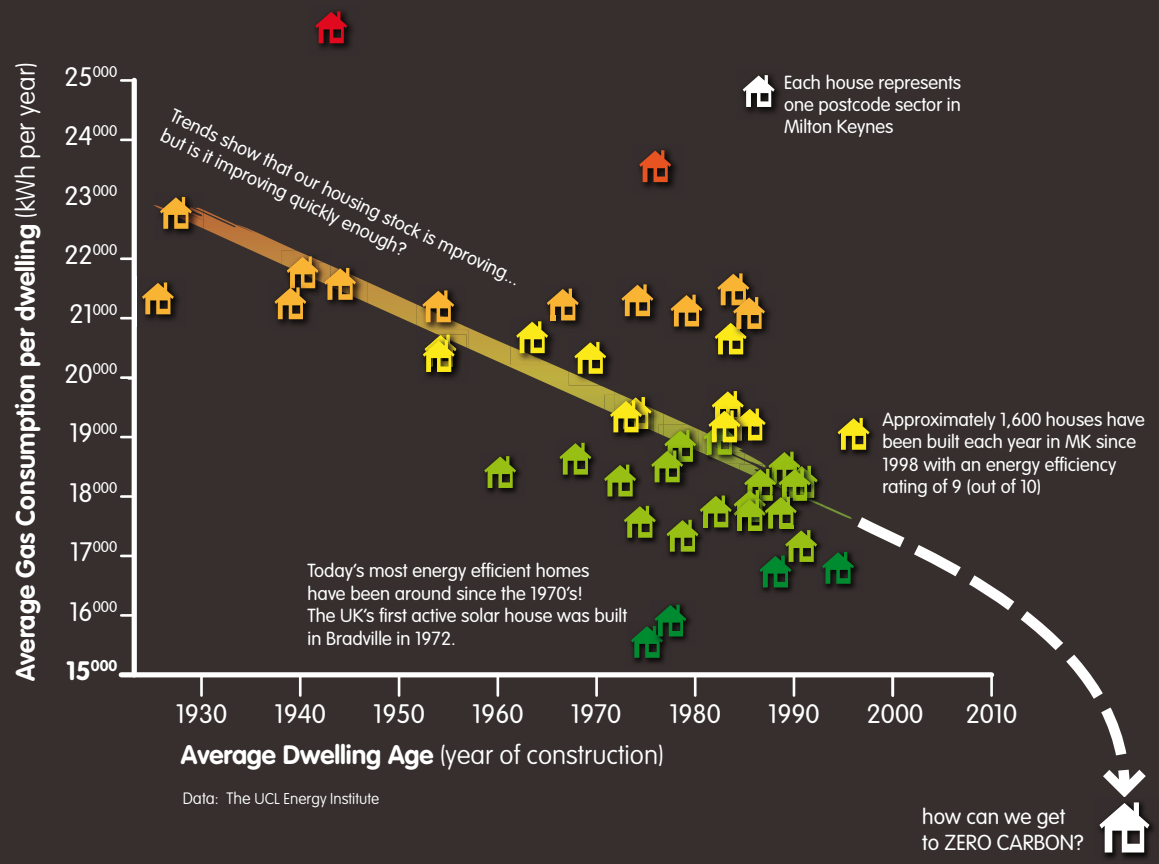
Dwelling age and gas consumption

Not only does Milton Keynes have innovative energy-efficient estates and developments, all Milton Keynes housing built after 1970 was designed to better levels of efficiency than the required building regulations of the time. In addition, there is some evidence that the actual energy consumption for heating in Milton Keynes houses is lower than the UK average.

In 1999, English Partnerships announced that all new houses built in MK must have an energy efficiency rating of 10/10 compared to the national average of 4.3/10

Milton Keynes houses used 6 to 10% less gas energy per dwelling than the average UK house in 2006 - this despite the fact that Milton Keynes residents being more affluent than the UK average, which normally results in higher rather than lower energy use!

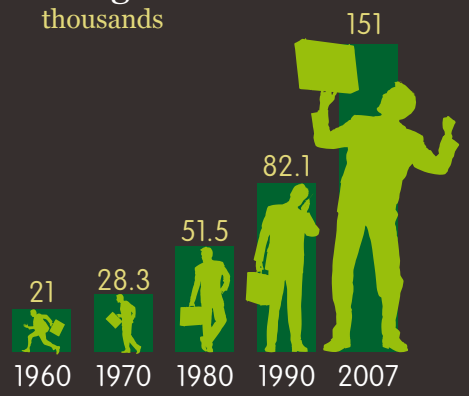
All new homes in MK are built to energy specifications which are well in excess of national building regulations requirements.



Data: The UCL Energy Institute

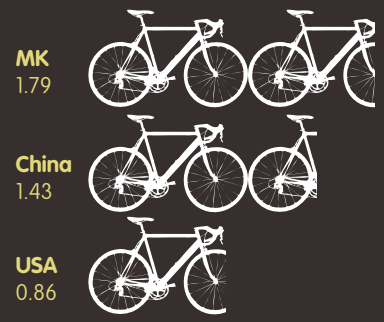
Job growth

thousands



A Healthy Lifestyle?

Cycles per household



60 km rivers and streams

225 km Redways

MK to London: 100 trains a day

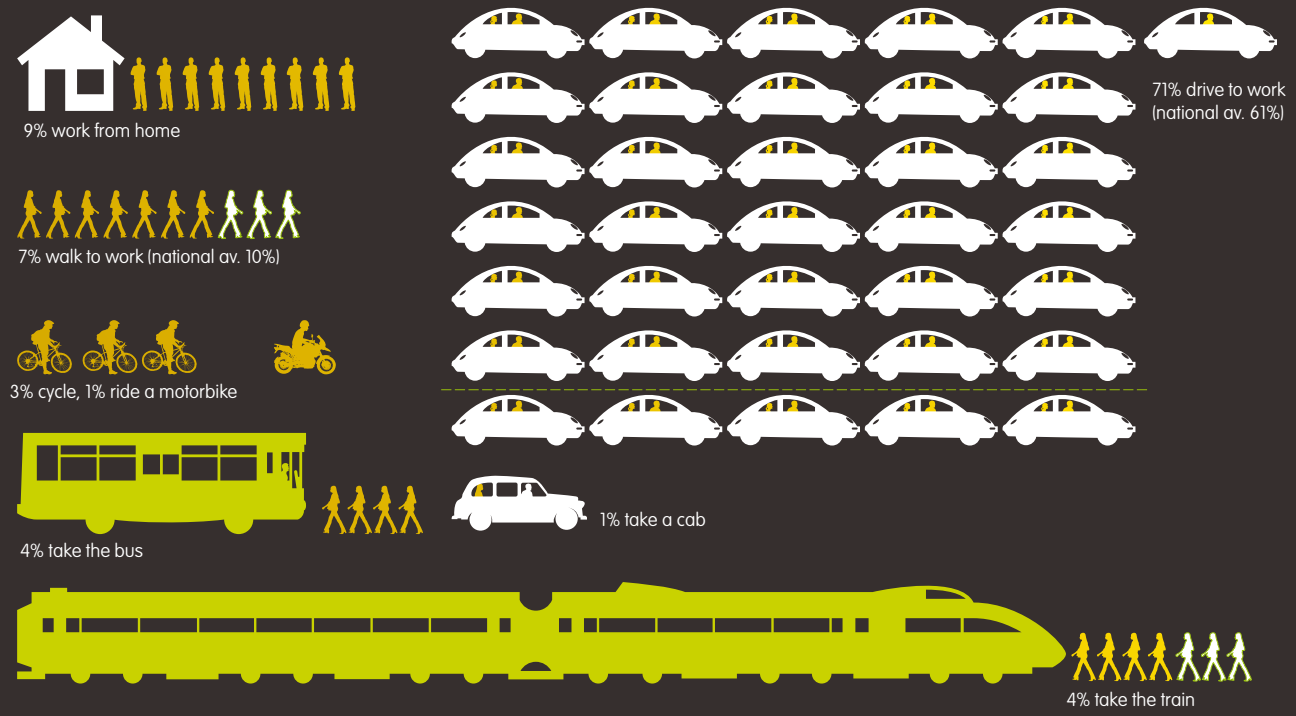
There are currently more than 5,200 employment establishments in Milton Keynes, 151,000 jobs. Unemployment stands at less than 2% of the workforce, and 29% of this workforce is in skilled, managerial and professional categories. Milton Keynes is considered to be an 'enterprise city' with 80% of the workforce employed in companies of of 10 employees or less.

Curious Milton Keynes factoid: a typical Milton Keynes resident owns more bikes on average than a typical Chinese person, and twice as many bikes as a typical American person!

Milton Keynes has over 550 km of footpaths and cycle ways, including 225 km of well-maintained Redways. An excellent infrastructure to encourage greater cycle use as part of a sustainable, healthy lifestyle."

Mode of Transport

How do people in Milton Keynes get to work?



this graphic shows how people in Milton Keynes get to work, compared to the rest of the country. The patterns are roughly the same for people working from home, cycling, taking a bus, and riding a motorbike. But people in Milton Keynes use cars 10% more, use trains 3% less, and walk to work 3% less!

DOCUMENT OVERVIEW

The Milton Keynes Low Carbon Prospectus sets out the city's sustainable development under four main themes. The four boxes on this page explain each of these themes and why they are significant. In the following pages, each theme is developed in more detail, with an illustrated timeline, reviewing milestones, followed by highlighted selected projects and initiatives. This provides unique insights into what shaped the city, what is going on today and a view of what is planned for the future.

A final section of the Prospectus captures views from a cross section of people who work or live in Milton Keynes, showing how the city has supported them in taking forward their own ideas on sustainability or stimulated their interest in a greener future.

YOUR PART IN THE FUTURE

Community Engagement and Local Initiatives

This theme is about people and their important contribution to MK in relation to low carbon living. It documents how the community has been engaged throughout the development of Milton Keynes. It identifies the' key organisations which have been established to provide information and support for residents and businesses, and also some of the great initiatives which have come out of the local communities themselves.

A LOW CARBON CITY

Reducing the Environmental Impact of Buildings and Transport

In the UK almost half of our carbon emissions come from the use of buildings (27 per cent from homes and 17 per cent from non-domestic buildings). Milton Keynes has explored low energy design since the 70's and this theme documents some of the innovative building projects which set out to exceed national targets and inform legislation in the rest of the UK.

The 1960's saw a dramatic increase in car use so Milton Keynes was designed with a grid system to minimise future congestion. Today, road transport accounts for 10% of our carbon footprint, therefore initiatives which have taken place and are planned to reduce the impact of transport and encourage non-polluting forms of transport in Milton Keynes are also included.

TECHNOLOGY

Improving the Present and Protecting the Future

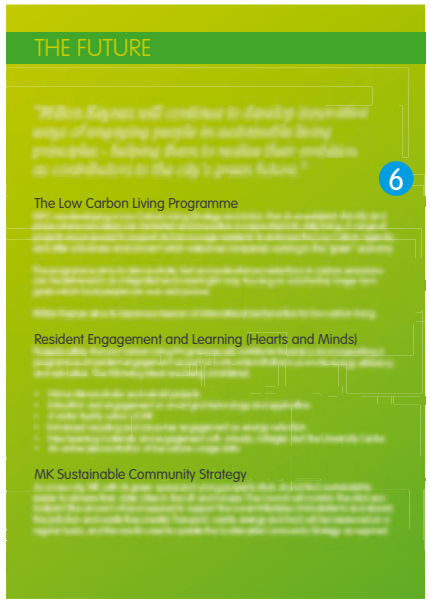
The generation of energy accounts for 25% of all emissions, and is the largest single contributor to global warming. The third theme therefore looks at what has been done in Milton Keynes to understand and apply technologies which reduce this impact, and the plans to deliver a long term energy strategy which is smarter and sustainable for the long term.

The application of technology to reduce the impact of waste in Milton Keynes is also documented, from the introduction of mixed recycling schemes, garden and kitchen waste collection, waste treatment and new innovations to generate renewable energy from our waste.

DIRECTION

Clear & Informed Strategies, Policies and Masterplanning

This theme illustrates the careful, environmentally-sensitive master planning which has contributed to Milton Keynes' success over the past 30 years. A green, clean and safe environment has been the key incentive for inward investment, company relocation and a thriving community. This is demonstrated through clear and informed strategic leadership, policy development and a co-ordinated approach to the delivery of growth which ensures that low carbon homes, infrastructure, jobs and community facilities are provided as part of a joined up approach.



1 Theme
The theme to which the events correspond is highlighted in the title bar and by an icon for easy reference.

2 Timeline
Events start from the inception of Milton Keynes when it was designated a new town in 1967 and run through to present day. Where the programme is known for future projects these have also been included.

3 Event
The projects and initiatives included are a small selection of the large numbers of initiatives which have taken place in Milton Keynes over the duration of the timeline.

4 Key Data
Icons along the timeline include information such as population, showing how this has changed over time as MK has developed.

5 Images
Some of the events and projects are illustrated by images at the top of the pages.

6 Future Vision

7 Word Cloud

8 Project Case Studies

YOUR PART IN THE FUTURE

Engaging the community and local initiatives

The Milton Keynes Master Plan envisaged "a community of active citizens, participating in the provision of its own services and able to take up the opportunities presented by the new city". It recognised the need for a close knit web of community services at all levels and aimed for "a network of opportunities, which must be available to, and understood by the residents of Milton Keynes".

1969 The Open University

1981 Home World

1992 Future World Exhibition

1967
Population of the designated new town area is 40,000 (60,000 MK Borough).

1969
Open University moves into Walton Hall. Today, it is the largest academic institution in the UK, and one of the largest universities in the World. The OU will later work closely with Milton Keynes Development Corporation on many groundbreaking energy-related projects in Milton Keynes.

1970
Public exhibition of the new Milton Keynes Master Plan. MK will be a 'city of trees' with no building higher than the tallest tree and 40% set aside for green spaces.

1972
Master Plan adopted as the way forward. Public awareness and participation is one of six goals. Milton Keynes Development Corporation (MKDC) believe that by stimulating active interest and encouraging people to get involved, the community as a whole will benefit.

1976
Buy Insulation Cheap Campaign by MKDC helps existing householders buy loft insulation, draught stripping and insulation jackets for hot water cylinders, at half the normal price. Estimates showed the cost of the materials could be recouped through lower fuel bills within, on average, a year.

1977
Energy Research Group produce an 'Energy in the Home' course for OU, aimed at teaching householders more about the practical problems of domestic energy conservation.

1981
Home World exhibition showcasing innovation in energy efficient homes is seen by more than 140,000 people. The homes will be occupied and form part of the city. Over 95% of the houses have better insulation than required by building regulations at the time, and fuel conservation measures are seen by developers as advantageous in selling the homes.

1984
The Living Archive Project established to collect and document the cause and effect of change on local residents.

1985
Residents get involved in energy management of their homes at Shenley Lodge, a demonstration project for Energy World, an international showcase of energy efficient housing.

1987
The City Discovery Centre is an amalgamation of two earlier bodies: the Milton Keynes Urban Studies Centre (focused upon urban environmental education, including history and geography) and the Bradwell Abbey Field Centre Trust (focused upon history, archaeology and the natural environment). The charitable company informs and educates visitors about urban geography and new city planning, historical and natural heritage of Milton Keynes.

1992
Future World Exhibition provides the public with a glimpse of the way homes might operate in the 21st century.

The Parks Trust is established to provide, maintain and equip parks, gardens, landscaped areas, woodlands, open spaces, playing fields, playgrounds and recreational amenity space for the benefit of the inhabitants and visitors to the area.

1995
South Midlands Renewable Energy Advice Centre set up to offer expert advice and information on energy saving, domestic renewables, personal transport, water and waste.

2002
Commonwealth Common Waste student conference held in Council Chamber - 150 children explore aspects of waste minimisation around the Commonwealth as well as in MK. Statements from the event are included in the next version of the Council's waste plan.

2003
Milton Keynes Sustainable Community Strategy aims to ensure active involvement of MK citizens in shaping the future of the Borough.

Olney Farmers market starts.

Sustainable Schools pilot scheme set up by GEMK, an educational resource centre working to increase awareness and understanding of sustainability and development issues.

2005
A strategy for future sustainable growth is developed by MKP through widespread public engagement in the planning process.

Working Together: A Compact for Milton Keynes, provides a framework to facilitate interaction between statutory organisations, voluntary and community groups in order to achieve common aims and aspirations for the ultimate benefit of local people.

2005
'Food Train' community enterprise works to create sustainable local alternatives to the current food system in ways that improve human health, environmental quality and animal welfare, stimulate enterprise and create community.

2006
Wolverton Farmers market started Food Train.

Food Train receive funding from Natural England to look at food economy in MK, and ways of supplying more locally produced food.

Population of Milton Keynes Borough
Population of the designated new town area

2002 Commonwealth Common Waste

2005 Food Train

2008 Wolverton Urban Farm

2008 USEA founded

2008 MK Low Carbon Living

2010 Wolverton Energy Roadshow

2007
Milton Keynes celebrates its 40th birthday.

Gulliver's Eco-Park opens at Newlands, Europe's first environmental theme park.

Newport Pagnall Farmers market opens.

2008
Wolverton Community Orchard established.

Wolverton Urban Farm grows fresh produce for local consumption using innovative, environmentally sensitive growing methods.

14 schools have signed up to GEMK Sustainable Schools project. This involves a wide-ranging annual audit linking sustainability to school improvements, the curriculum, the environment and the community.

2009
Downs Barn Community Orchard is established.

MK based charity Sustainable Energy Academy win Ashden Awards Charity and Community Category for Sustainable Energy for their 'Old Home Superhome' programme which spreads awareness of the ways in which household CO_2 emissions can be reduced by 60-80%, and inspires people to make similar changes to their own homes. There is now a network of homes across the UK that have achieved over 60% CO_2 reductions and open for the public to visit.

2010
MK Energy Day is the first annual event focused on the contribution of individuals to reducing MK's carbon footprint. Events included the launch of an online MK carbon footprint calculator, promotion of energy efficient driving techniques, an energy monitor borrowing scheme, business energy efficiency event and various energy related activities in schools across the borough.

2011
Greenfest Mark II planned (subject to funding) following the success of the 2010 seminar, up to 1,000 young people to attend and investigate sustainability at the OU.

205 370
169 370
2000s

235 320
198 570
2010

2010 and beyond

257 690
219 600
2016

2008
The site is cleared for the Urban Farm in Wolverton, new home for Growing People initiative, a horticultural social enterprise project for young people.

Transition Wolverton is a growing collective of local people who want to see a community wide response to climate change and peak oil happen.

MK Community Enterprise formally established, providing advice and support on social enterprise business planning and funding, such as the Scrapstore at MK Play Association which promotes reuse of waste materials from business for community use.

2008
Shenley Church End is chosen as one of only six areas across the country for a pioneering new project aimed at drastically cutting rubbish. Two Zero Waste promoters are appointed and visit homes, businesses and schools, and a Zero Waste Day is held which included pond clearance, home composting and a real nappy event.

2009
Four young people attend international Bright Green Youth Camp in Denmark, sponsored by OU. This previewed the Climate Change summit in December 2009.

The Council resolve to become a leader in low carbon living. A Low Carbon Living Strategy & Action Plan will be developed which builds on existing and emerging initiatives in MK, and engages local communities.

2010
Greenfest two day Sustainability Conference at the OU for seventy-five 11-14 year olds to come up with solutions for sustainability problems.

Milton Keynes Sustainable Cities event.

Milton Keynes International Festival takes place from 16 to 25 July 2010.

2012
Sustainability Celebration planned (subject to funding) - 20,000 young people to share their learning at the Stadium:MK with a spectacular presentation of ideas in an Olympic-style opening ceremony.

THE FUTURE

"Milton Keynes will continue to develop innovative ways of engaging people in sustainable living principles - helping them to realise their ambition as contributors to the city's green future."

The Low Carbon Living Programme

MKC are developing a Low Carbon Living Strategy and Action Plan to re-establish the city as a place where new ideas can be tested and innovation incorporated into daily living. A range of projects are proposed to support and encourage residents to embrace the Low Carbon agenda, and offer a business environment which welcomes companies working in the "green" economy.

The programme aims to demonstrate, test and evaluate how reductions in carbon emissions can be delivered in an integrated and meaningful way, focusing on substantial, longer term goals which local people can own and pursue.

Milton Keynes aims to become a beacon of international best practice for low carbon living.

Resident Engagement and Learning (Hearts and Minds)

Projects within the Low Carbon Living Programme will contribute towards a fund supporting a programme of resident engagement as part of a city wide initiative to promote energy efficiency and education. The following ideas are being considered:

- Home demonstrator and retrofit projects
- Education and engagement on smart grid technology and application
- A visitor facility within UCMK
- Enhanced recycling and consumer engagement on energy reduction
- New learning materials and engagement with schools, colleges and the University Centre
- An online demonstration of live carbon usage data

MK Sustainable Community Strategy

As a new city, MK with its green space and young property stock should find sustainability easier to achieve than older cities in the UK and Europe. The Council will monitor the city's eco footprint (the amount of land required to support the current lifestyles of inhabitants and absorb the pollution and waste they create). Transport, waste, energy and food will be measured on a regular basis, and the results used to update the Sustainable Community Strategy as required.

City Aims strategy
Carbon programme green city
Efficiency Waste to Energy
Sustainable Infrastructure Protecting the future
Community programme
Carbon Electric Vehicles energy
projects sustainable efficiency
Photovoltaics Meeting national targets
waste engagement Ideas
Anaerobic Digester support

YOUR PART IN THE FUTURE

Highlighting community projects from Milton Keynes

Transition Wolverton

Transition Wolverton is a small group of very enthusiastic volunteers aiming to start a town-wide community response to the challenges of climate change and peak oil. The main aim of the group is to bring together Wolverton's collective skills and creativity to create a Community Energy Transition Plan, which will set out a roadmap for Wolverton's low carbon sustainable future.

So far the group have organised a number of events designed to get people thinking and talking about this roadmap and what they can do. These activities include film screenings, talks, exhibitions and workshops focusing on the themes of climate change and the reduction of our dependence on fossil fuels for heating our homes, travelling to work and producing and distributing our food. The Transition Towns: Wolverton webpage provides a venue for exchanging information - from interesting books to energy case studies, to a calendar of events.

In 2010 Transition Wolverton organised the Wolverton and Greenleys Energy Roadshow in collaboration with the Energy Saving Trust. This successful event featured stalls from suppliers and organisations that offered advice and products ranging from draught proofing windows to wood stoves, to renewable technologies. Wolverton residents who had made energy saving changes to their homes were also on hand to share their experiences.

They also organised an 'Open House' which was an open invitation to all residents to visit a number of homes in Wolverton and see a range of energy-saving installations at work, including smart meters and energy monitors, sash window renovations, wood burning stoves, and pellet heating.

transitiontowns.org/Wolverton/Wolverton

Urb Farm

'Growing People' is all about growing food, growing people and growing community. This group runs a market garden that supplies fresh produce all year round to 'Think Food', a health eating project that promotes healthy aging, raises awarenesss of the social, economic and environmental impact of food production, and develops skills for employment, as well as individuals and local restaurants.

The focus of the Urb Farm is the development of food growth and healthy eating in an urban environment. It was developed from a partnership with Food Train, another local charity which is working to create sustainable local alternatives to the current supply chain. The focus is on "food yards" instead of "food miles" and the activities range from running the Wolverton Farmers market, community learning and health improvement initiatives and engaging young people and the community in the food growing process.

www.mkchristianfoundation.co.uk
www.foodtrain.org

Parkland Produce

Parkland Produce is a new venture set up by the Parks Trust, providing meat from sheep and cattle which have been reared on Parks Trust land. The Trust's grazing animals have been used to sensitively manage its meadows in order to encourage a greater diversity of wildflowers and wildlife.

All the profits get invested back into maintaining the city's beautiful parks and landscapes, including the creation of new parks, planting trees and shrubs, maintaining footpaths, providing community events and teaching schoolchildren about farming, nature and the environment.

www.parklandproduce.co.uk

National Energy Foundation

The National Energy Foundation (NEF) has worked with Milton Keynes Council since Autumn 2008 to develop and implement a long term community wide carbon reduction campaign aimed at engaging individuals, communities, businesses and organisations in addressing the issues of climate change, specifically to reduce CO_2 emissions.

As part of the campaign, a website of local and national carbon reduction initiatives that were available to support people in Milton Keynes was developed. The ThimkAgain! website was launched during Energy Saving Week in October 2008, and it showcases energy in MK, past, present and future; climate change impacts both global and local, and a carbon calculator for households to assess their carbon impact. Local stakeholders and community partners have subsequently supported the campaign through their websites and actions of carbon reduction.

Other activites related to the carbon reduction campaign include evolving the website into the 'MK Low Carbon Living website, providing training days for local businesses on energy management in the workplace, and developing, marketing and delivering a number of events and activities during 'MK Energy Day', a key part of the Council's commitment to the EU Covenant of Mayors initiative, and as a means of profiling the work done to date and maintaining public interest in the campaign and momentum in CO_2 reduction.

The MK Low Carbon Living website also features a domestic carbon calculator and an on-line business carbon calculator.

www.milton-keynes.gov.uk/mklowcarbonliving/

Bright Green Youth & GEMK

Bright Green Youth's vision is to pool the creative powers and diverse experiences of visionary young people to produce ambitious yet practical solutions. In August 2009, 500 of the world's most talented, engaged and creative youths gathered in Denmark for four days of workshops and fast-paced, dynamic problem solving.

Four young people from MK took part in this workshop, joining others from around the world to consider the questions facing world leaders at the Climate Change Summit in December 2009, and to devise innovative solutions to make our world more sustainable.

Global Education Milton Keynes (GEMK), an educational resource centre working to increase awareness and an understanding of sustainability and development, organised a follow-up workshop called Greenquest, building on the experiences from Bright Green Youth in Denmark and opening the forum to Key Stage 3 students from all 12 Milton Keynes secondary schools.

Other sustainability initiatives by the GEMK include:

- Sustainable Schools - a programme for assisting schools in attaining 'Sustainable School' status through baseline audits, recommendations and staff training programmes.
- Who Am I - a programme for primary school children to increase their awareness of local heritage.
- Global Dimension and Local 4 Global - two programmes for encouraging schools to give 'global citizenship' more of a central role in the life of their school and to increase the awareness of global issues in children.
- Commonwealth Common Waste - investigates the issues of waste minimisation and recycling in the local area.

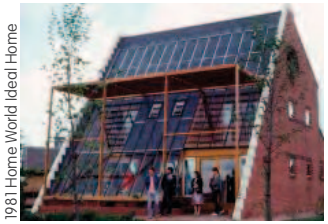
www.gemk.org.uk

A LOW CARBON CITY

Reducing the environmental impact of buildings and transport

Thanks to the visionary planning in its early days Milton Keynes stands up well against modern measures of sustainability, allowing city growth to proceed while retaining open spaces and maintaining an uncongested transport infrastructure. In the 1970s, architects were attracted to Milton Keynes as a city where it was possible to test innovative ideas for low energy and sustainable homes. Early experiments focused on gaining free energy from the sun - including homes designed to actively capture the sun's warmth to heat water and the rooms inside. Some homes also included much higher levels of insulation than were normal in Britain at the time.

1979 Solar Court, Linford



1981 Home World Ideal Home

1982 MK Central Station

1967
MK formally designated a New Town.

Late 1960's
Work begins on developing the Master Plan which sought to align closely the decisions on transport and the arrangement of land use. Key structuring principles include the grid system, linear parks and establishment of Redways.

1974-79
Key local facilities, commercial and municipal buildings crucial to the success of the city centre are built.

1976
MK Development Corporation demonstrates real financial benefits of energy efficiency measures in their own offices: £2,000 of energy efficiency measures saved approximately £3,600 in fuel bills the following year.

Studies begin on low energy housing design something relatively new in the UK at the time. The project generated house designs for two estates: Linford and Pennyland.

1980
Rainbow Cooperative explores thermal upgrading of Victorian terraced housing.

1981
Home World is the first housing exhibition in the city showcasing innovation in energy efficient homes. Three homes in particular were seen as being groundbreaking:

The Ideal Home - The entire south facing wall of this house was triple glazed, forming in effect a double height conservatory.

1982
Central Milton Keynes Railway opens. Since its opening, the number of trains calling at the station has increased, providing a wide range of places which can be directly accessed from MK by train, thus encouraging some change of mode, particularly for longer-distance journeys.

1983
CMK Bus Station opens and is used by over 500,000 passengers a year since.

1985
Insulation standards for Building Regulations are raised, following findings from Pennyland and Gifford Park projects.

The Energy Research Group publishes findings of Pennyland and Linford energy use monitoring identifying key messages for British designers.Four timber framed houses at Two Mile Ash feature extremely low space heating energy consumption, comparable to standards anticipated for zero carbon homes. The houses sold for just 6% more than a conventional house, resulting in only a two year payback and potentially huge savings for owners.

1986
Energy World Exhibition opens - an international showcase of energy efficient housing. The houses must be built to a new energy standard, and perform at least 30% higher than required by the 1985 Building Regulations. It was a significant milestone for progress in design and construction of low-energy housing, and in the development of energy efficiency evaluation tools, and is rolled out to all new development by MKDC.

1960s | 1970s | 1980s | 1990s

1972 – Masterplan is launched

1995 – 50,000 homes

2000 – Over 150 miles of Redways & Leisure Routes

1970
First section of the new city grid road system is constructed. Designed to avoid rush hour congestion, it is successfully expanded to accommodate the city's growth and maintain free flowing traffic, reducing pollution and inefficient use of fuel.

1972
Bradville Solar House is first in the UK to incorporate active solar heating as well as hot water. It demonstrates that it is difficult to get active solar heating to work, and leads to a stronger focus on passive solar design.

1979
Solar Court demonstrates extreme passive solar design, incorporating double glazing and much more insulation than was required by building regulations at the time.

National Bowl re-uses sub-soil excavated from the many new developments to fill in the former clay pit and form the amphitheatre.

The design and construction of the Futurehome 2000 was televised by the BBC's Money Programme. The house incorporated a conservatory from which warmed air was vented into the house by small fans. Glazing was all double with a heat-reflecting low emissivity coating: this had the equivalence of triple glazing.

OU Alternative Technology Group develop a car sharing meter to promote the shared ownership of cars.

1983
A total of 177 low energy homes are completed at Pennyland the entire development designed to showcase a low energy layout using passive solar design, and with the aim of producing a cost-effective mass-market low energy house. This project informed national thinking on the benefits of passive solar measures.

1984
36 flats and houses at Gifford Park demonstrate 60% reduction in space heating fuel for no more than £500 additional construction cost. Dwellings incorporate 75% south facing glazing to living spaces, gravity fed solar panels and conservatories.

1986
The Milton Keynes Energy Cost Index (MKECI) is developed. This computer programme later evolved into the UK's first national energy efficiency rating scheme for buildings in 1990, the National Home Energy Rating (NHER). Standards introduced (at least 30% higher than the Building Regulations in force at the time) became the norm for all new Milton Keynes housing developments.

1994
Future World Exhibition demonstrates how homes might operate in the 21st century, with an emphasis on energy efficiency and the environment.

1999
The Energy Centre Phase 1 building demonstrates how a 1000m^2 low energy office can be heated by a domestic-scale condensing boiler.

2000
Development at Broughton & Atterbury begins. HCA establish a number of key principles for the area which underpin the creation of an integrated sustainable community which will be applied to town extensions elsewhere.

1983 Pennyland

1984 Giffard Park

2009 Ashlands

2009 Broughton and Atterbury

2009 Wolverton Park

2011 Nissan Leaf Electric Car

2002
MK Car Share, the most successful car share scheme in the UK starts. Today, over 10% of CMK employees are members and benefit from discounted travel and free parking.

2005
Measures to improve public transport start in the city, which will include further bus lanes, introduction of bus priority signals, and real time passenger information providing passengers with up to the minute information on bus arrivals at bus stops, on the internet and through mobile phone text messaging.

2006
Parklands development (former Nampak site) in Woburn Sands incorporates solar water heating on all houses and flats with an estimated combined total output of almost 250,000kWh per year. It is one of the first developments to comply with the new D4 policy.

Places for People's flagship mixed-tenure development at Broughton Atterbury, is one of the largest in the UK to be rated EcoHomes 'Excellent'. The homes incorporate Electrisave meters which tell people how much energy they are using in financial terms and how much CO_2 they are emitting, a first for the social housing sector.

2007
Mercedes-Benz install wind turbine and three charging points for electric vehicles. Electricity generated in one year is enough to power an electric smart car for 30,000 miles.

2008
Vizion development in CMK demonstrates best practice and innovation in high density, mixed-use development with advanced energy performance.

2009
The Pinnacle building has an A rated Energy Performance Certificate and has heat and electricity supplied by the Central Milton Keynes Combined Heat and Power system. The building has an EPC A rating and energy is supplied by the CMK CHP system. In addition to the efficient layout of accommodation, environmentally friendly features of the building include thermally-efficient glazing, good natural lighting, energy-efficient lighting and air conditioning based on absorption chillers served by the CHP network.

2010
Bletchley Leisure Centre achieves BREEAM 'Excellent'. Hot water and space heating demand is met by a biomass boiler. The building utilises natural ventilation for cooling in the bowls and sports hall areas. The atrium is also cooled with natural ventilation and a thermal wheel uses heat from extract air to warm the fresh air intake. Rain water harvesting is used to supply the majority of the WCs.

2012
National Centre for Network Rail due to open. Plans for the building include recycling rainwater to flush WCs, using reclaimed materials from the demolition of the National Hockey Stadium and sourcing materials locally to reduce CO_2 emissions from their transportation. The building will have living 'green' roofs, be naturally ventilated and incorporate renewable energy technology.

2000s

2005
Local Plan D4 policy is adopted

2009
100,000 homes

2010
Building Regulations Part L updated - 25% improvement compared to 2006.

2013
Building Regulations Part L updated - 44% improvement compared to 2006.

2013
Building Regulations Part L updated - Zero Carbon.

2010 and beyond

2005
Oakgrove Phase 1 is the first secondary school to be built to the highest national environmental assessment method standard at the time, BREEAM 'Excellent'. The building uses green materials and sustainably sourced timber, and incorporates rainwater harvesting. Energy is supplied by thirteen 15kW wind turbines, photovoltaics, solar thermal panels and a ground source heat pump.

IKEA store incorporates innovative operational and environmental solutions including rainwater harvesting and 90% recycling.

2007
New 7000m² Makita warehouse extension incorporates recycled wood pellet fired heating boiler and movement sensor control of lighting to reduce CO_2 emisions and achieve the 10% renewable energy target for Policy D4.

Oxley Woods was a response to the Government's demands for affordable, sustainable housing through the Design for Manufacture Competition. The houses were built at low cost by use of factory-manufactured panels and featured passive solar air warming, cooling and ventilation.

2008
Industrial units in Bletchley are each supplied with electricity by from their own wind turbine. Feedback has been positive and the turbines are seen as being a real bonus, not only reducing running costs but improving company credentials by reducing their CO_2 emissions.

2009
Wolverton Park, an award winning sustainable regeneration project, includes the listed Royal Train Shed shell, within which has been constructed elegant townhouses with triple-height windows and the ribbon glazing in the roof providing lots of natural daylight.

2009
The Milton Keynes Academy in Woughton is a landmark building providing an inspiring state-of-the-art environment. It is constructed using off-site prefabrication and multi-service modules. It features controlled natural ventilation, biomass heat generation and daylight heating controls.

2010
More than 3,000 existing homes have been retrofitted with insulation, funded by contributions to the D4 carbon offset fund.

New coach station and Park & Ride facility opens to aid the promotion of sustainable movement in Milton Keynes, and offer people an alternative to using their car.

2011
The new chapel at Crownhill Crematorium incorporates several features to enhance sustainability, such as intelligently-controlled natural ventilation, and a ground source heat pump for water heating.

Nissan LEAF zero emission electric car goes on sale.

2017
Oakgrove is being developed as one of seven Millennium Communities across the country. The 1000 homes will be heated and powered by a district CHP system and the focus will be on minimising the ecological footprint by reducing the need to travel and by encouraging biodiversity and green infrastructure. It will promote best practice in information and communication technology as part of the Digital Infrastructure Strategy for Milton Keynes.

THE FUTURE

"The City will base its low carbon programme on the benchmark set by the other leading cities of the world."

The Low Carbon Living Programme

From the outset Milton Keynes was designed to make most effective use of resources in its development and long-term future - to be a sustainable community. Projects have included a real focus on energy efficiency in homes and commercial premises, and innovative public transport solutions.

The Low Carbon Living Programme has grown out of this Milton Keynes experience, driven forward by a desire to capitalise on what the city has achieved, a commitment to mitigating the risks of Climate Change, and to exceed targets set by Government. Below are some of the projects which will be delivered by the programme.

ELVIS is a project to bring electric vehicles to the city. It aims to have 1,000 electric vehicles on the streets by 2014. Two successful bids have been made for funding to support the purchase of electric buses, and funding from Plugged in Places and SEEDA for electric vehicle infrastructure.

MK Smart Green Development housing demonstrator project will monitor 50 new homes over a two year period to test the technologies and attitudes of people. The project will also help understand how the new homes perform with Smart Grid and Electric Vehicle technology.

MK Smart Brown Development will provide funding, advice and resources to improve the energy efficiency and carbon footprint of existing housing stock in MK. Additional projects being considered include:

- An enhanced focus on cycling and use of Redway infrastructure.
- A city wide energy measuring and usage project looking at older housing.
- Participation at the EV10 Event at Millbrook to demonstrate the city's approach to the Low Carbon Agenda.

Pre-submission Core Strategy

Core Strategy Objectives to mitigate the Borough's impact on Climate Change and reduce CO_2 emissions include:

- Implementing higher than national requirements for sustainable homes and buildings
- Sustainable transport initiatives

A LOW CARBON CITY

Highlighting low-carbon projects from Milton Keynes

Oakgrove School

Completed in 2009, the new three-storey extension at Oakgrove School incorporates high standards of energy-efficiency and low environmental impact, and achieved a BREEAM Very Good rating.

Sustainable design. Extensive use of recycled materials include rubber from used bus and lorry tyres to make the floor matting in corridors, and insulation made for from old newspapers to fill cavities in the walls, providing extra insulation to keep the heat in and the cold out. All timber used on the project is FSC-accredited, which means that it comes from managed forests where new trees are planted as existing ones are cut down and used.

Rain water is harvested to flush the toilets, reducing water consumption, and the building is naturally ventilated, with solar shading to keep the building naturally cool. An 'intelligent' Building Management System (BMS) monitors energy use which is displayed on plasma screens in the reception area, and internal lighting controls operate on movement and daylight sensors.

Oakgrove School incorporates one of the biggest ground source heat pump installations in Europe, extracting heat from the ground and pumping it into the building to provide free space heating. Water heating for sinks and showers is provided by solar collectors that absorb the sun's heat, and a geothermal heat core also provides heated water for radiators.

The estimated cost savings on the schools utility bills could be as much as 80% on gas consumption, 30% for water, and 30% for electricity. Based on estimated savings and utility usage at other schools this could amount to as much as £15,000 a year and a possible £375,000 saving over the life of the building.

The eco-friendly features are often used as teaching aids, and an eco orienteering game has been developed for the students.

Vizion

Vizion is a high quality mixed use development by Abbeygate Developments Ltd completed in April 2009.It includes a large Sainsbury's store of approximately 1100 square metres, additional commercial and retail units, and 441 apartments and townhouses.

The English Partnerships competition-winning design by q2 Architects is a vibrant high density mixed-use development, which not only creates a landmark for the Central MK but also addresses the city's sustainable development objectives. It was the first scheme to respond to the new Development Framework for Central Milton Keynes which aims to create a new urban environment.

Buildings gradually step up in height from 4 to 12 storeys, providing active frontages to the existing streets, increasing connectivity to adjacent areas and providing non-obtrusive security by maximising sightlines to the main footpath routes.

Residential units have large balconies which also provide solar shading, and a pleasant open streetscape is maintained by providing two levels of basement parking below the main buildings. High quality landscaped courtyards are a major feature of Vizion, with the large "green roof" to the Sainsbury's store creating a park for residents.

All buildings are designed to meet BREEAM Excellent and EcoHomes Very good ratings with electricity and heating supplied by the CMK district wide CHP system.

Tattenhoe Park

A new neighbourhood of approximately 1,300 new homes, with shops and community facilities, allotment gardens and public open space is planned for Tattenhoe Park, south-west of Milton Keynes. A new primary school, 'Priory Rise' has already been completed.

The objective is to develop Tattenhoe Park in a sustainable way and deliver an attractive, well-designed place to live, with strong connections to surrounding neighbourhoods and the wider city. Much of the open space has been landscaped and the primary infrastructure (roads and services) constructed. There is a Sustainable Urban Drainage System (SUDS), a series of waterways and ponds which deal with the surface water for the site.

It is intended to explore ways to deliver smart metering technology across the site which, together with other planned smart grid applications, will provide an early test bed for reducing the future carbon impact of the grid.

Low Carbon Housing Demonstrator

The development proposes to bring together a number of national low carbon initiatives in a single, replicable neighbourhood, including electric vehicles, the Code for Sustainable Homes, Smart Grids, demand management tariffing, feed in tariffs, new technology, low carbon learning/ promotion and the accessibility of lower carbon living.

It is proposed to build approximately 50 of the homes to test the technologies available and the attitudes of the occupiers to their application in a real world environment. At the end of the two year monitoring period we will have a clear understanding of how these elements work together.

In order to achieve a significant reduction in personal impacts, residents will need to adopt and maintain lifestyle changes, ranging from use of sustainable transport to near zero waste while still enjoying the benefits of living in Milton Keynes. Support will be provided by a specially trained carbon coach, and social monitoring will be led by the Open University.

The project still in its early stage would if successful demonstrate how we can make efficient use of land, energy and materials whilst achieving a significant reduction in carbon production within the home and the community at large. It will also help establish replicable methods and an advanced understanding of costs and of the skills involved in successful low carbon construction.

TECHNOLOGY

Improving the Present and Protecting the Future

Ever since its inception, Milton Keynes has been a city that thinks differently, embraces evolution and champions change. Back in the 1960s, no-one had heard about climate change, and we seemed to be entering into a world of cheap reliable energy. But even then, people were asking questions about how the new city should be powered. Could the city be all-electric, using the output from the then newly-built nuclear power stations? Or should everyone have their own gas central heating system? - an idea which was still quite novel in the 1960s. Now with the low carbon prospectus, delivered through a continuation of the 'test bed UK' philosophy championed by the city since its inception the city can achieve a truly sustainable living environment.

1986 Energy World

1986 'Cogeneration' demonstration project

1988 National Energy Foundation

1967
MK formally designated a New Town.

Late 1960's
Work begins on developing the new MK Master Plan. It is an era of low fuel prices, therefore energy is not considered in the design. The low density layout adopted, with its own advantages, does however impact on some future options, like the ease of incorporation of community heat and power and the future reliance on the car for transport.

1972
Master Plan is launched. Early proposals for heating and cooling include district heating as well as individual systems. Combined Heat and Power (CHP), a 'total energy scheme' is considered, with an option for incorporating refuse incineration. It was concluded that a full district solution would not prove economic, but may be viable for specific areas.

Central London Polytechnic and MKDC collaborate to incorporate and monitor active solar heating in the UK's first Solar House in Bradville. The Solar House was one of the few projects exploring alternative energy sources to oil.

1976
Energy Research Group commissioned by the Transport and Road Research Laboratory to study the long term availability of fuels for transport, subsequently including studies of the potential for electric vehicles.

The Alternative Technology Group is set up. Research projects include the Car Sharing Scheme, Rainbow Greenhouse, food production efficiency of smallholdings, and community-scale waste paper recycling.

1979
Network for Alternative Technology and Technology Assessment (NATTA) established at the OU, offering the latest information on low-impact renewable energy developments and policy.

Solar Court in Great Linford tests innovative heating systems using solar collectors, a heat pump and waste water heat recovery on three homes. Other houses have a conventional heating system and form a control group. The houses are monitored extensively over the next 3 years, funded by the Department of Energy.

1979
East Flank Study looks at how local planning could take energy saving more into consideration using solar orientation, concentrating higher densities along defined routes for public transport, incorporating CHP and providing allotments.

1981
Home World demonstrates the latest ideas in housing design and technology. Futurehome 2000 had three alternative heating systems; a gas boiler, a coal boiler and a FIAT 'Totem', a car engine converted to use gas instead of petrol - probably the first example of a micro-CHP installation in the UK.

1985
Pennyland and Linford is the largest monitoring exercise undertaken to date, providing a transparent understanding of energy uses in houses and demonstrating that the biggest savings come from insulation and efficient energy systems.

1986
Energy World Exhibition opens. EU funding allows early Zero Carbon study to assess if all energy needs can be provided by installation of a wind turbine (one of the first in a city) and photovoltaics on the site to serve 5-6 homes.

1960s 1970s 1980s

Early 1970's
Energy projections indicate that by the time Milton Keynes is scheduled to be finished in the 1990's, there could be a UK energy shortage. Inhabitants could expect to enter the 21st Century faced with large heating bills and expensive and scarce fuels for transport.

1976
Energy efficient design becomes a key development objective following monitoring and improvements to MKDC offices.

MKDC (Energy Consultative Unit) and OU (Energy Research Group) collaboration begins, drawing on the research expertise of the Energy Research Group, the university located in Milton Keynes, and other research organisations. The Unit's first report describes eight projects underway in Milton Keynes which amount to fuel bill savings of £150,000 per annum.

1977
Gas fired heat pump prototype is designed by OU ERG in collaboration with Lucas Aerospace. It used a single cylinder motor boat engine converted to run on gas and was capable of providing 15kW heat output, enough to heat two or three houses. Another project with the Rutherfield Laboratories looks at a chemical heat pump energy storage system.

1979
Housing Layout Study by ECU explores the implications of passive solar design on layouts, using computer modelling to examine orientation and overshadowing. 'Shadow prints' drawn up for single houses and terraces of varying heights and orientations are used to lay out Pennyland. Housing density is also analysed by the Martin Centre at Cambridge and conclude that passive solar systems could be used for housing densities of up to 44 dwellings per hectare.

COMTEK community technology festival takes place, organised by the Alternative Energy Group at the OU.

1982
Energy Consultative Unit publishes second progress report for projects undertaken 1976-81. The report includes a number of significant conclusions:
1. Energy saving measures can be cost effective within short periods;
2. Immediate energy saving can be made by simply improving the levels of insulation and heating control systems in existing buildings; and
3. Active solar heating systems are not cost effective, although technical advances and further increases in fuel costs suggest potential for the future.

1986
OU Energy and Environment Research Unit (EERU) established to undertake and co-ordinate research on sustainable energy technologies and to support the development of environmentally sound approaches to the generation and use of energy.

1988
The National Energy Foundation (NEF) established by MKDC to preserve for the future benefit of the UK public some of the energy initiatives that had been undertaken within the new city and to encourage more sustainable use and generation of energy.

1994 Futureworld

1993 MRF

2006 CMK CHP

2007 IKEA Biomass

2008 The Pinnacle

2008 Vizion

1992
First borough wide door to door recycling scheme in the UK starts in MK. It serves 75,000 properties and collects paper, cardboard, cans and plastic bottles.

1993
UK's first purpose built Materials Recycling Facility (MRF) built in MK. The MRF is a state-of-the-art facility and uses a range of technologies to sort recyclables by their physical and chemical properties; shape, size, weight, magnetism and light absorption.

1998
Cranfield University Energy Technology Centre offers specialist research, education and consultancy in renewable energy, biomass conversion and energy from waste.

Milton Keynes Energy Agency is set up with a remit to focus on improving the energy efficiency of homes within the city.

2001
First UK Automatic Plastics Sort installed at the MRF, increasing the volume and quality of the material processed.

2004
Demonstration energy crops such as short rotation willow are grown on part of the new Phase 2 of the National Energy Centre site.

2005
MKC has distributed more than 28,000 compost bins and leaflets.

2005-07
University College London monitor energy use in homes first monitored in 1988-92 by MKDC and NEF. After 20 years the low energy homes continue to perform well.

2007
Biomass heat plant installed at IKEA.

Mercedes-Benz UK takes the lead in pioneering energy saving technology at its Tongwell site, by installing a vertical axis wind turbine. Three charging points have been installed next to the turbine which can be used to charge electric vehicles.

2009
Combined food and garden waste collections are rolled out in two phases to all properties in the borough. The waste is sent to Buckinghamshire CC's High Heavens in-vessel composting facility. Most residents are positive about the trial, and it has a much greater uptake than anticipated (85%, 75% expected), thereby diverting even more waste from landfill.

Materials Recycling Facility (MRF) begins to collect and process new additional materials including aerosols, rigid plastics and waxed cartons.

2011
A new state of the art anaerobic digestion plant will be completed to treat the city's municipal waste, and use it to generate renewable energy.

The "Concerto" Project, a European funded project that aims to deliver low carbon, energy efficient infrastructure. MK is one of four European cities taking part, and has to date delivered the CMK CHP plant that currently provides heat and power to the Hub, Pinnacle and Vizion developments. Photovoltaics will also be installed to provide 165 KWp of electricity.

1994
Future World Exhibition sponsored by the NHBC in 1994. Architects, builders and producers of building products are invited to demonstrate how homes might operate in the 21st Century. As with the Home World Exhibition 13 years earlier, the common themes of the exhibition were energy efficiency and conservation of the environment.

1997
Kyoto Protocol agreement is the first international treaty to set legally binding emissions cuts for industrialised nations. It was signed by 178 countries and came into force in 2005.

2002
Energy Review and Outline Energy Strategy for Milton Keynes considers how the predicted growth of the city to 2025 may affect CO_2 emissions. Recommendations include setting a zero carbon growth target and investigating a local Carbon Offset Fund to help achieve this.

2003
MKC introduces optional alternate weekly garden waste collection scheme. The waste is composted on a local farm and used as an alternative to chemical fertiliser.

2006
Food waste trials begin in MK. Waste from about 1,200 properties (expanded to cover 2,200 properties in 2008) is sent for anaerobic digestion at the Bedfordia Bio-gas plant.

2007
New Anglian Water biosolids and energy plant provides energy as well as sludge treatment.

6MW Combined Heat and Power (CHP) plant generates and supplies heat and electricity to commercial and residential areas in the west end and central business district of central MK.

2008
Vizion mixed-use development on Witan Gate connects to the CMK CHP system.

Four electric vehicles introduced to the MKC street cleansing fleet.

The BREEAM Excellent rated Pinnacle office development connects to the CMK CHP system. Air conditioning uses absorption chillers served by the CHP network.

2010
MK awarded 1.6 million Euros for project to clean up bio-gas from food waste to inject back into national supply.

Low Carbon Network Funding bid, if successful, will support the development of a smart grid to reduce peak power cuts.

MK Wind Farm at Petsoe End operational. 7 turbines erected in Olney will generate approximately 38,000,000 kWh of electricity per year, equivalent to the average annual consumption of 8,085 households.

2014
Joint residual waste project with Northamptonshire County Council due to come online.

2016
All new homes to be zero carbon from 2016.

2019
All new buildings to be zero carbon from 2019.

THE FUTURE

"Milton Keynes will actively strive towards the goal of being self-sustaining in energy generation as part of its transition from non-renewable to renewable energy sources."

The Low Carbon Living Programme

Over the past 40 years, a range of projects demonstrate how Milton Keynes is able to turn innovation into real development. The aim of the Council's Low Carbon Living Strategy and Action Plan is to build upon this experience, and to demonstrate, test and evaluate how the different elements of the drive to reduce carbon emissions can be delivered in an integrated and meaningful way.

Milton Keynes, with its foundations in Low Carbon Development provides a unique test bed to demonstrate how best to achieve the 2050 carbon reduction targets, and demonstrate collectively how at a city level the range of carbon reducing initiatives from UK Government and Europe work together.

MK Smart Business

Through this programme, an MKP and MKC business investment fund will provide support for local low carbon business innovation.

Research, Data Capture and Learning

A city scale project will measure power usage and local energy generation, to understand the contribution and demands new homes, retrofit projects, smart grid and electric vehicles will make on UK power distribution and generation.

Additional projects being considered include:

- City wide energy measuring and usage project to compare performance of older housing and impact of smart grid applications.
- Participation at the EV10 Event at Millbrook to demonstrate the city's approach to the Low Carbon Agenda.
- An OU project for research into Low Carbon, based on Wolverton.

TECHNOLOGY

Highlighting technological innovations from Milton Keynes

Smart Grid Project

This project is an essential component in reducing the risk of future power outages, due to increasing demand on the grid, the introduction of electric vehicles and the increasing contribution of renewable power streams.

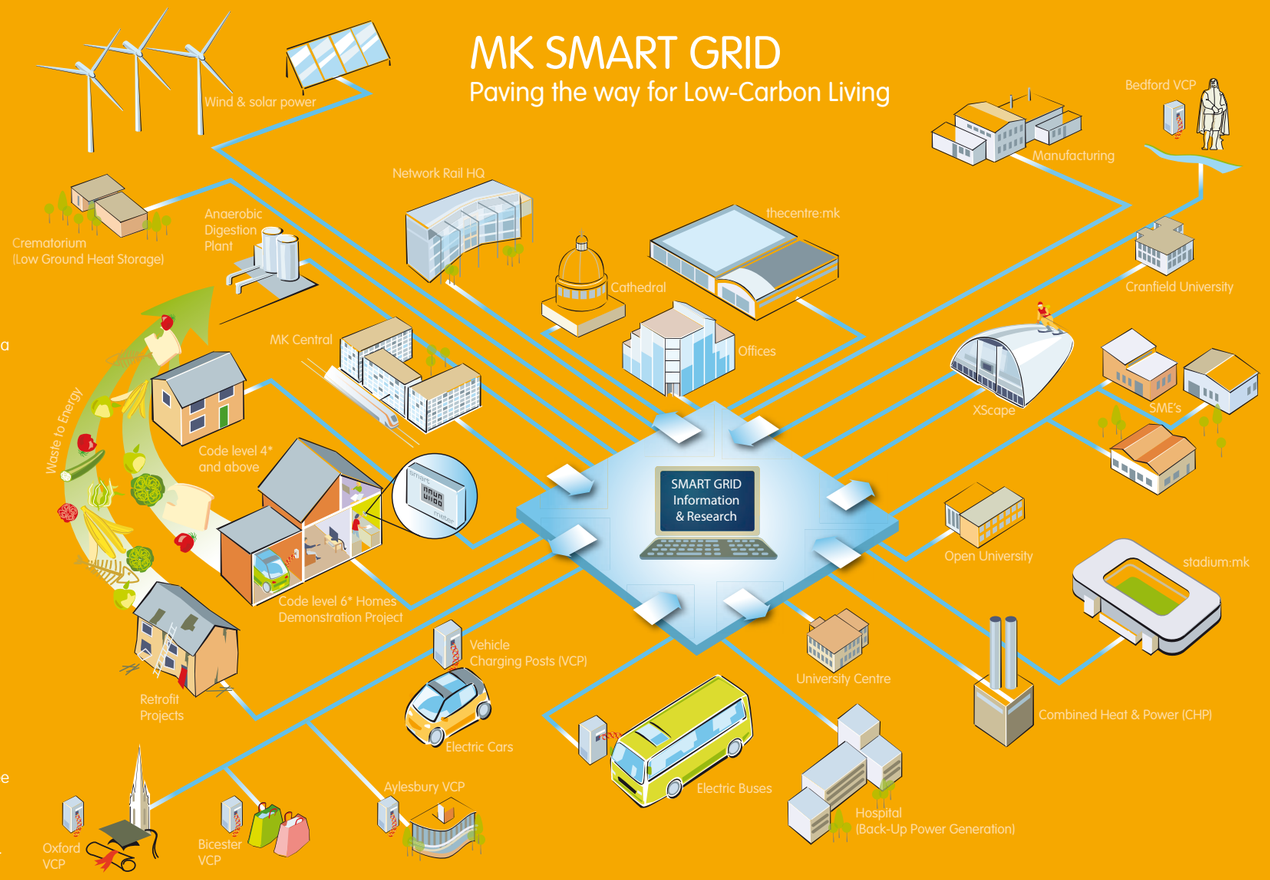
We need to produce more electricity than we do today but must do so largely without emitting greenhouse gases which contribute to Climate Change. These changes need to be supported by a modernised electricity grid with larger capacity and the ability to manage greater fluctuations in demand, while maintaining security of supply. The smart grid therefore lies at the centre of a vision for a transformed low carbon electricity system.

Smart Grid Concept
A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it in order to efficiently deliver a sustainable, efficient and secure supply of energy.

Smartening the grid includes steps such as the installation of smart meters in residences and businesses, new methods of power storage, demand management, and smart sub-station technology.

Smart Grid Trial
Central Networks are leading the development of a bid for part of the OFGEM £350 million Low Carbon Network Fund to support electrical distribution companies in trialling "smarter" or more efficient electrical distribution and supply technology. MKP/MKC & Central Networks have signed a memorandum of understanding in which they agree to work together to develop this bid and trial.

The smart grid trial will go beyond individual homes looking at both local and on-building power generation, linking generation to power usage in the home and moderating customers demand and usage. This technology will also be applied to existing homes particularly on the older estates.



Produced by Milton Keynes Partnership for illustrative purposes

Anaerobic Digestion Plant & Gas Scrubber

Food and garden waste is currently separately collected by the council for in-vessel composting however, next year a new state of the art anaerobic digestion plant will be completed to treat the city's municipal waste, and use it to generate renewable energy. The facility will process all of Milton Keynes food and garden waste - more than 25,000 tonnes each year, as the council expects the amount of organic waste to rise to 30,000 tonnes in the next five to seven years.

The Process

Anaerobic Digestion (AD) is a biological process that happens naturally when bacteria breaks down organic matter in environments with little or no oxygen. It is effectively a controlled and enclosed version of the anaerobic breakdown of organic waste in landfill which releases methane.

Renewable gas

HCA have supported the AD project in Milton Keynes by providing Low Carbon Infrastructure Funding of £1.5 million towards the addition of a gas scrubber to the plant that will allow biogas from the plant to be injected directly into the local gas network. This will be the first time that this type of gas injection has been installed in the UK and will provide a significant increase in the renewable gas available to MK residents.

Domestic food and garden waste

Garden waste bins and kitchen caddies

Waste bins and caddies are collected by the Council

Waste is taken to the AD facility, where micro-organisms break down the organic material

Biogas is produced, a gas scrubber enables injection into the mains gas grid

Digestate material produced by the facility can be used as a biofertiliser

Combined Heat & Power

A 6 megawatt combined heat and power plant (CHP) is located in Avebury Boulevard/ Midsummer Boulevard at the rear of CBX II.

CHP is a system that will generate and supply electricity and heat to new commercial and residential areas in the West End and central business district of Central Milton Keynes. It is a means by which the heat produced during the generation of electricity can be put to good use, rather than being wasted. CHP systems can lead to substantial savings in total energy usage as well as helping the environment since less heat and fewer carbon dioxide emissions are rejected into the atmosphere.

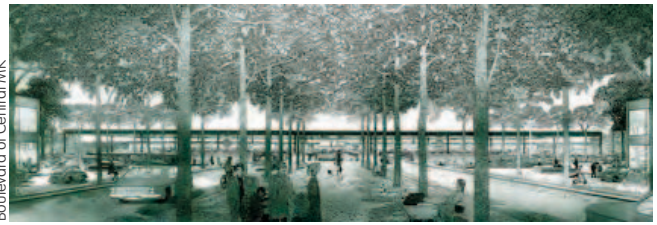
Conventional power plants generally use only 40% of the fuel they burn in producing electricity. This can result in 60% of the burnt fuel being rejected or 'wasted' up the smoke stack. By comparison, CHP can achieve an efficiency of over 70%. CHP will be connected to the mains power grid for back-up electricity and the opportunity to sell excess electricity back to the grid.

In addition, CHP uses this generated heat to produce hot water for heating buildings in the surrounding area by a district heating system. This is most efficient when there is a mix of uses creating a varied need for heat through the day and night such as residential, retail,schools/ colleges and businesses.

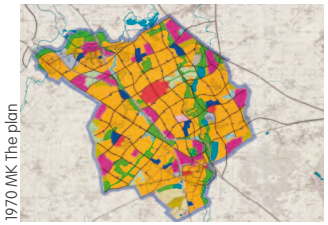
DIRECTION

Clear and informed strategies, policies and masterplanning

The Master Plan sought to anticipate the forces which create cities and facilitate their healthy development. It recognised the close connection between transport systems and the arrangement of land uses and the need to consider these two basic elements together. The Plan was not intended as a town map or a 'blueprint' for the development of the city, but a strategic framework with considerable flexibility and capable of responding to changing needs.



Helmut Jacoby's vision for the Boulevard of Central MK



1970 MK The plan

1967
Milton Keynes Development Corporation is established to provide the vision and execution of a 'new city'. The city will not reach maturity until the turn of the century therefore must provide the kind of environment which will fit wants and needs at that time. Monitoring and development of the city must be fed back into the planning system to improve and change what is being done.

1972
The Master Plan is launched and outlines the policies to be followed during the development period, and the structure of the city. Great importance is placed on parks and open space, zoning residential and commercial areas, and building a road system that distributes traffic to avoid rush hour congestion.

1974
MKDC produces plans for £100m City Centre, intended to be a business and shopping district that supplements the local centres in most of the grid squares. 22% of the city centre is green spaces.

1974
MK Borough Council is created (as a district of Buckinghamshire until 1997). MKBC is now responsible for local services such as waste collection, and highways.

1976
Campbell Park opens, and around 40,000 trees and shrubs have been planted in the new city to date. The parks and green spaces make an important contribution to minimising the impacts of climate change (although this was not known at the time), through carbon capture and localised cooling and shading.

1992
The Parks Trust is established by MKDC to care for 4,500 acres of multi-functional green spaces, comprising parkland, floodplain, ancient woodland, scheduled monuments, transport corridors and parkways. The Trust is endowed with a property and investment portfolio, and rents from shops, offices and workshops pay for the vital work of nurturing and enhancing the young landscape. Today, the management and enhancement of MK green spaces is vital to ensuring the city is resilient to the impacts of climate change in the future.

1997
Borough of Milton Keynes becomes a unitary authority. MKC is now a waste disposal authority in addition to being a waste collection authority - 'Project Reduce.' MKC also becomes responsible for transport policy and schools which use approximately 40% of our total energy budget.

2002
The Energy Review and Outline Energy Strategy for Milton Keynes considers how the predicted growth of the city to 2025 may affect CO_2 emissions under 3 scenarios, using a Dynamic Regional Energy and Emissions Assessment Model (DREAM). Its recommendations include setting a zero carbon growth target and investigating a local Carbon Offset Fund to help achieve this.

1960s 1970s 1980s 1990s

1967
MK is formally designated a New Town. It is to be the biggest yet, with a target population of 250,000, in an area of 21,850 acres. Located equidistant from London, Birmingham, Leicester, Oxford and Cambridge it is intended to be self-sustaining and eventually become a major regional centre in its own right.

1974
Willen Lake (North and South) and its linear parks are created on the former flood plain for the River Ouzel, protecting the existing flood plains, and ensuring the risks from flooding are no greater for the new city following development. This was an innovative and sustainable approach to flood management which was being dealt with in other new towns at the time by oversized pipes and other engineered solutions.

1983-89
Caldecotte and Furzton balancing lakes and linear parks, like Willen provide sustainable drainage, valuable habitats for wildlife and an attractive environment for leisure activities.

1992
Government transfers control from MKDC to the Commission for New Towns (CNT). CNT continues to require energy standards in excess of national Building Regulations.

2000-04
MKC takes the environmental standards applied to CNT sites a stage further by 2004 developing local plan policies incorporating environmental requirements to cover all buildings not just residential.

2001
The NHBC, the leading warranty supplier for new homes and a champion for housing quality, moves its National Operations Centre to Milton Keynes.

2002
Central MK is entering the second generation of its development, with the adoption of a new framework for future development over the next 30 years. A major masterplanning exercise has been undertaken, which aims to radically reshape CMK. One of the strategic goals is to a demonstrate sustainability through environmentally sensitive development, improvements to the existing building stock, energy efficiency and reduction of waste. Plans include a sustainable residential quarter and public transport improvements.

1971 Willen Lake

1980 Concrete Cows

1983 Caldecote Lake

1992 The Parks Trust

2001 NHBC

2007 Zero Carbon Hub

2003
John Prescott announces the Government's Sustainable Communities Plan and the next stage of major growth for MK - 133,000 new homes.

2004
Milton Keynes Partnership Committee is created by the Government to ensure a coordinated approach to the planning and delivery of growth and development in MK.

2005
Milton Keynes Council Local Plan is adopted, and includes an ambitious sustainable construction policy (known as 'D4'). All new projects over a certain size must be 'carbon neutral' or offset their emissions elsewhere, incorporate renewable energy technologies to deliver a 10% reduction in CO_2, feature water conservation and drainage technologies, use sustainable building materials and minimise waste.

2008
The Government passes the Climate Change Act, setting legally binding targets for reducing emissions by 80 per cent on 1990 levels by 2050.

Milton Keynes Carbon Offset Fund is launched, requiring developers to contribute financially to upgrading the energy efficiency of older properties in the city. Today, 3,000 homes have received improvements paid for from the fund.

2009
Government's Low Carbon Transition Plan states that to respond to the challenge of climate change, we need to become a low carbon country.

2010
MKC publish the pre-submission Core Strategy, setting out the vision for the Borough to the year 2026, and the objectives and strategy for future development, including targets for increasing trips by public transport and cycling, and 'greener; construction standards for new developments.

2013
Building Regulations Part L requires 44% less CO_2 emissions than the 2006 target emission rate.

2000s

2004-05
Development frameworks for the Northern, Western and Eastern Expansion Areas set out the broad planning principles that will guide the future development, and provide more detail on how various aspects of the development should be dealt with e.g. movement and connections, residential densities, landscape and open space and sustainability.

2006
The Stern report published. The HM Treasury report on the economic impact of climate change found that the costs of inaction far outweighed the costs of action.

The Strategy for Growth to 2031 (MKP) provides a long-term growth plan and strategic policy framework to enable Milton Keynes to grow in a sustainable way beyond 2011. The Strategy proposes urban intensification and the development of new sustainable extensions that integrate with the provision of new and enhanced public transport systems and interchanges.

2008
The original Plan for the new city is completed.

The Zero Carbon Hub, a new independent private-public partnership to take day-to-day operational responsibility for co-ordinating delivery of low and zero carbon new homes and overcoming barriers, set up base in MK.

2010 and beyond

2009
MKC Interim Climate Change Action Plan is prepared for 2009/2010, incorporating a climate strategy and energy management policy. The plan focuses on actions by Milton Keynes Council that help to reduce greenhouse gas emissions in the local authority area. Its purpose is to set a programme for cutting the Councils own emissions whilst setting an example to others helping to communicate the message to the wider community

2010
Building Regulations Part L (Conservation of Fuel and Power) requires 25% less CO_2 emissions than the 2006 target emission rate.

2016
All new dwellings to be Zero Carbon.

2019
All buildings to be Zero Carbon.

THE FUTURE

"We aim to achieve carbon reduction levels in advance of statutory guidelines ensuring Milton Keynes is one of the low carbon front runners."

Council Resolution

The Interim Climate Change Action Plan 2009/2010 focused on actions by Milton Keynes Council that would help to reduce greenhouse gas emissions in the local authority area. Its purpose was to set a programme for cutting the Councils own emissions whilst setting an example to others helping to communicate the message to the wider community. The Council has made a number of public commitments to demonstrate how seriously it takes the effects of climate change and the need to take local action. It is a signatory to the Nottingham Declaration on climate change and to the EU Covenant of Mayors requiring a commitment to cut CO_2 emissions by at least 20% by 2020. The Council has also joined the national 10:10 campaign, which seeks to get individuals and organisations to cut their carbon emissions by 10% by the end of 2010. For the Council this means a CO_2 cut of about 2,500 tonnes resulting in a reduction in its energy bills by £250k. The Council has a duty to report on the progress of CO_2 reduction against National Indicators.

Core Strategy

The Milton Keynes Core Strategy is a key part of the Local Development Framework that will replace the existing MK Local Plan. It sets out the vision for the Borough in the year 2026, provides the objectives and strategy for the future development of the city and identifies the major areas where growth and change will take place. Core Strategy Objectives to mitigate the Borough's impact on Climate Change and reduce CO_2 emissions include:

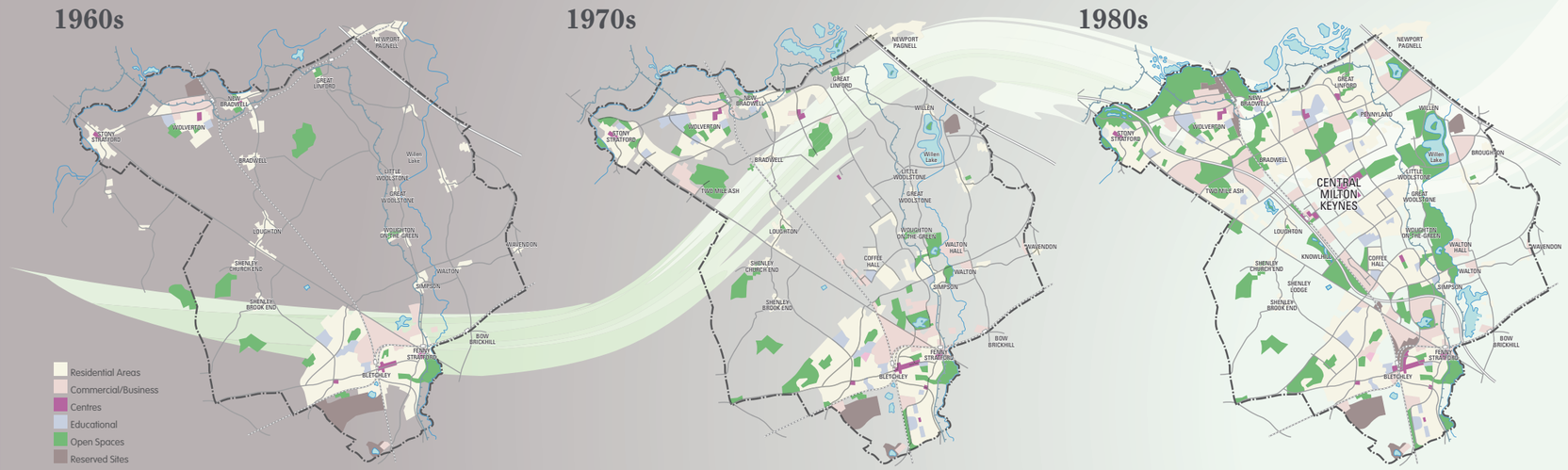
- Implementing higher than national requirements for sustainable homes and buildings
- Locating development away from areas of flood risk
- Promoting community energy networks and strategic renewable energy developments
- Reducing waste generation and increasing amounts of recycling
- Sustainable transport initiatives

According to the Strategy, "The scale of growth planned for MK will inevitably increase activity and carbon emissions and put pressure on natural resources." It is therefore imperative that new buildings are designed to the highest possible viable standards to minimise their environmental impact. Policies for tackling Climate Change and building sustainable communities include:

- Developing Successful Neighbourhoods
- Ensuring High Quality, Well Designed Places
- Sustainable Construction
- Community Energy Networks and Large Scale Renewable Energy Schemes

DIRECTION

Clear and informed strategies, policies and masterplanning



Grid Squares

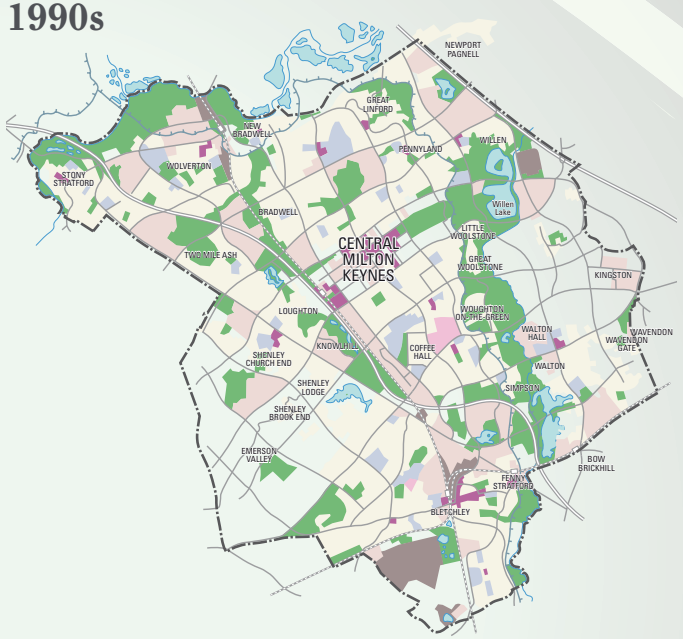
Major roads were planned using a grid pattern and the districts between them are known as grid squares. Grid intervals of 1 km were chosen so that people would always be within walking distance of a bus stop, and each grid square is a semi-autonomous community, making a unique collective of 100 clearly identifiable neighbourhoods within the overall urban environment. Most grid squares have Local Centres (retail hubs) and also community facilities as well.

Roads and Cycleways

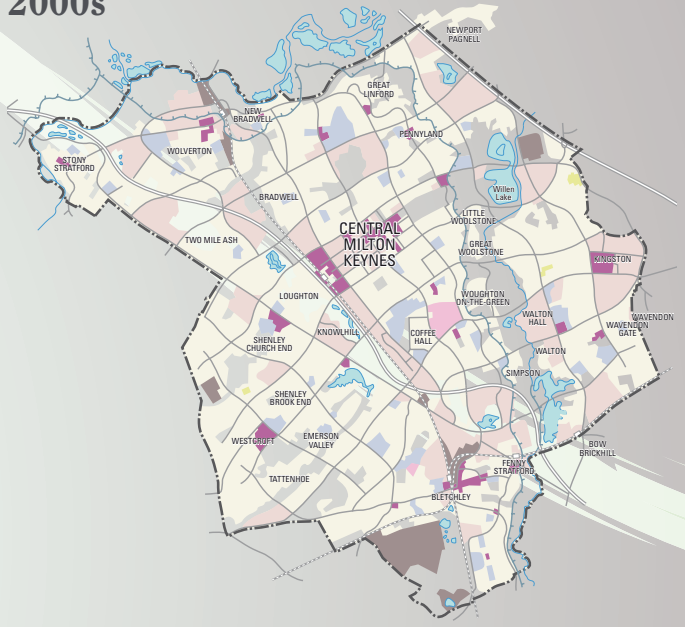
The grid roads and roundabout junctions are designed to reduce congestion and efficiently deal with volumes of traffic. Generous reservations accommodate main services, allow for future upgrading (and future alternative forms of transport), and landscaping protects adjacent development from noise, pollution and the visual intrusion of traffic.

A separate cycleway network (the 'redways') runs through the grid-squares and sometimes runs alongside the grid-road network. This was designed to segregate slow moving cycle and pedestrian traffic from fast moving motor traffic, and provide safe and easy access to activity centres and other parts of the city via underpass and bridge crossings.

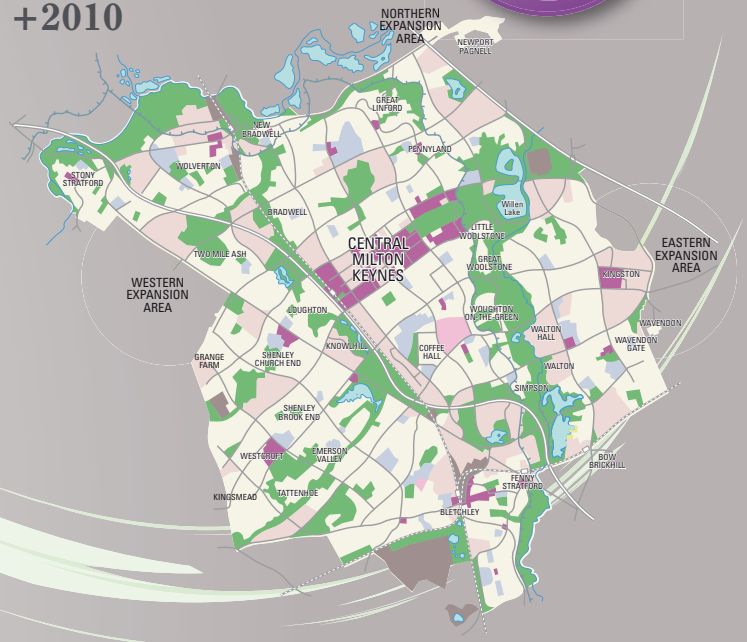
1990s



2000s



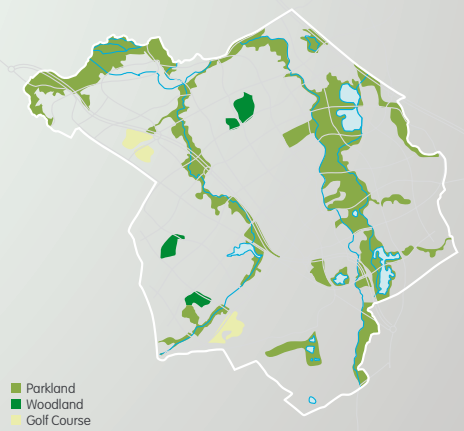
+2010



Landscape, Parks & Open Space

Park development principles combine the advantages of the town park with those of the country park and provide opportunities for agriculture, sporting, commercial and other features and activities. Managed and maintained by the Parks Trust, the parks planting and tress play an important part in biodiversity and carbon sequestration.

A system of linear parks protect the flood plains and tributaries of the Great Ouse river and incorporate a number of balancing ponds which help manage surface water run-off and mitigate flooding in and around Milton Keynes.



Sustainable Growth

A long-term vision has been developed to guide the proposed expansion of Milton Keynes and ensure that the implications of growth are firmly rooted in regional plans and strategies. The Strategy for Growth provides a platform for major economic and cultural development and also takes into account the physical infrastructure required to ensure development is sustainable.

The Council's adopted 'Core Strategy' will include standards and targets for reducing carbon emissions from new development and supplying energy from low and zero carbon sources. Strong leadership from the Council and Milton Keynes Partnership will help ensure the vision of Milton Keynes as a low carbon city will be fulfilled.

FUTURE FORUM

Ideas, Opinions and Perspectives

Milton Keynes VOICES

The story of MK is not just about the masterplan or the projects. It's also about it's people and how they are living and working towards a better future for themselves and coming generations.

MK Voices is all about how it's citizens perceive Milton Keynes today and how they think the city should move forward into a low carbon future.

It's all about what inspires them, what they care about, and what they think is really important. These voices and thoughts present the many faces of Milton Keynes: it's leadership, community spirit, youth, green lifestyle and spirit of innovation.

Imtiaz Farookhi

David Foster

Pete Winkelman

Tadj Oreszczyn

Clive Faine

John Walker

Julia Upton

Rosemary Clarke

Youth Voices

Clive Faine is the Managing Director of MK based Abbeygate Development. He is also a member of the Milton Keynes Transport Partnership and chairs both the local Sustainable Transport Group and the Milton Keynes Cycling Forum.

"MK is leading the low carbon agenda compared to many other local authorities with their D4 policy and carbon offset fund. The CHP in CMK was the first to be installed it in a modern city centre and the next step is to look for opportunities to roll out CHP with alternative fuel sources, which do not rely on gas."

Clive Faine,
Managing Director, Abbeygate Development

Rosemary Clarke of Global Education Milton Keynes (GEMK) engages young people in the low carbon agenda and increases awareness and understanding of sustainability and development issues within schools.

"Children are really receptive and care about the environment. Through Eco Councils, conferences and other activities they come up with great ideas, such as rerouting a school redway so it works better. By learning about the impact their homes and lifestyles have on the environment they also influence their parents' actions."

Rosemary Clarke,
Co-ordinator,GEMK

Imtiaz Farookhi is Chief Executive of NHBC, the standard setting body and leading warranty provider for new homes in the UK. NHBC is pivotally involved in the drive to develop low and zero carbon new homes. NHBC funds both the Zero Carbon Hub and the NHBC Foundation, a research body which promotes best practice to help industry and the government respond to the UK's housing needs in the best interests of home owners.

"We are currently in the process of moving our head office to Milton Keynes, having established our national operations centre here in 2001. We are now a major employer in Milton Keynes. Milton Keynes has a good track record of linking innovation, CO_2 reduction and energy efficiency on the one hand and quality of life on the other. These aspects are integral to the exciting and ambitious agenda represented in this Prospectus."

Imtiaz Farookhi
Chief Executive of NHBC

David Foster leads The Parks Trust, which cares for a large proportion of the city's green space and the richly planted grid road corridors. The Trust, which was established by the Milton Keynes Development Corporation, works to maintain and protect an intricate interconnected mix of woodland, grassland and wetland.

"Here the emphasis is on encouraging biodiversity and ensuring that this important part of the city delivers something special for its population - the chance to experience peaceful and interesting landscapes and habitats on their doorsteps."

David Foster
Chief Executive, The Parks Trust, Milton Keynes

John Walker worked at the Milton Keynes Development Corporation from 1975, where he was Planning Director between 1980 and 1992; then Chief Executive of the Commission for the New Towns from 1992 to 1999.

"Milton Keynes has always looked for new ways to improve life for residents and businesses. Low energy buildings have been an important part of this pioneering attitude since the 1970s, helping people to live in more comfortable homes that are cheaper to run and cause less damage to the environment. Aiming high, following through and demonstrating what can be achieved are key features of the new city's character. The low carbon city is right in line with this tradition."

John Walker
Chairman of the Green Gauge Trust, promoting better delivery of low energy buildings.

Amy, Jasmine and Anais represented MK at the first global climate change conference for young people in 2009, the Bright Green Youth Conference. The trip was a project by the OU and local schools to commit to thinking about carbon neutral planning.

"Meeting people from all over the world in Denmark was brilliant and we came back to Milton Keynes with new ideas, things like the ecogym and ecofriendly homes, and really enthusiastic about what we could do next."

Amy Bosworth, Jasmine Satchell & Anais Berriman,
Bright Green Youths

Julia Upton is Chief Executive of Milton Keynes Community Foundation, a charity that funds and supports projects which respond to the needs of the local community, including cultural activities and the promotion of healthy lifestyles.

"We help people to learn how to live more sustainably whether it is how to grow their own food or how to cook healthy recipes. We are centrally located so people can get to us by public transport but we also go out into the community."

Julia Upton
Chief Executive, Milton Keynes Community Foundation

Tadj Oreszczyn did his PhD in solar energy at the OU in the 1980's but now directs the UCL Energy Institute, advises government on energy efficient buildings and supports leading energy efficient organisations located in MK such as the NEF and the ZCH.

"Milton Keynes has over the last four decades been at the forefront of demonstrating low energy building technology. It has led the way in the integration of renewable technologies in buildings and the control and labelling of the energy performance of buildings. Lessons learnt from Milton Keynes have helped to inform National energy policy and regulations."

Tadj Oreszczyn

Pete Winkelman, Chairman of MK Dons FC, is the man responsible for the development of stadium**mk** – the centrepiece of Milton Keynes' role as a Candidate Host City in England's 2018 World Cup Bid and forming part of its cultural identity.

"The Football Club and its Sport and Education Trust are building Milton Keynes a sporting legacy that will sit proudly at the heart of our community. A low carbon vision, reached by working together in partnership, shows our city's determination to take the initiative and provide a framework for modern sustainable living."

Pete Winkelman,
Chairman, MK Dons

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Commissioning Partners

Neil Jefferson	Zero Carbon Hub/NHBC Foundation
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Pages 4-7 Pictograms courtesy of **www.allsilhouettes.com**

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Page 4 Carbon Footprints
Page 5 A Low Carbon Lifestyle
Page 5 Population
Page 5 Trees
Page 6 Housing
Page 6 Job Growth
Page 6 A Healthy Lifestyle
Page 6 Pathways
Page 10 Mode of transport

Courtesy of **The Open University**
Page 10 1969 The Open University

Courtesy of **Global Education Milton Keynes**
Page 10 Commonwealth Common Waste
Page 11 2008 USEA founded
Page 13 Bright Green Youth and GEMK

Courtesy of **Food Train**
Page 11 2005 Food Train

Courtesy of **MK Christian Foundation**
Page 11 2008 Wolverton Urban Farm
Page 12 Urb Farm background image

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Page 11 2010 Wolverton Energy Roadshow
Page 12 Transition Wolverton - Energy Roadshow

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Courtesy of **Renewable Power Systems**
Page 21 Anaerobic Digestion Plant Image

Artist: **Helmut Jacoby**
Page 22 Helmut Jacoby's vision for the Boulevard of Central MK

From **'The Milton Keynes Master Plan"** by the **Milton Keynes Development Corporation**, 1970
Page 22 1970 MK The plan

Courtesy of **The Parks Trust**
Page 23 1992 The Parks Trust

Courtesy of the **NHBC Foundation**
Page 23 2001 NHBC

Courtesy of the **Zero Carbon Hub**
Page 23 2007 Zero Carbon Hub

From **'The Milton Keynes Master Plan'** by the **Milton Keynes Development Corporation**, 1970
Pages 24-25 Grid Squares, Roads and Cycleways, Landscape, Parks and Open Space

MILTON KEYNES COUNCIL

Milton Keynes Partnership

NHBC FOUNDATION
Housing research in partnership with BRE Trust

ZERO CARBON HUB

MILTON KEYNES
A SUSTAINABLE FUTURE
A Low Carbon Prospectus

Appendix 3: Research Themes, Knowledge Capture and Dissemination

Introduction

Global smart grid learning has tended to focus on trialling individual technologies and concepts at a smaller scale than what we are attempting here. For example, our Skegness project showed how dynamic line rating can reduce the level of reinforcement required when wind generation is connected to our network lowering generator connection costs. We shared the learning from this project with the rest of the industry.

MK*Smart*2020 has been designed to allow the integration of significant uptake of low carbon technologies in 2012 to reflect a 2020 world. This project should allow us to generate and capture valuable knowledge for DNOs and other industry participants. This knowledge will enable us to understand the most cost effective and reliable way for the customer to connect new low carbon technologies to our network. It will also provide us with a view of the amount of savings smart grids could deliver for the 2050 low carbon plan.

The project knowledge dissemination approach will focus on three key areas:

1. Understanding the main challenges which the customer and our network will face around delivering the low carbon economy
2. Developing a research agenda with key and clear data and knowledge capture strategies to ensure cost effective dissemination of the solution for the customer
3. Producing a comprehensive knowledge capture and dissemination strategy drawing on our partners' assets and expertise

Distribution Challenges

The impact of a low carbon economy on distribution networks is currently unclear for the customer and for the DNO; however wide-scale uptake of distributed generation, electric vehicles and heat pumps will challenge many of the operating practices of DNOs. This presents a number of key questions for future network operators and for the customer including the following:

- How can we avoid the cost of conventional reinforcement for customers who want to connect additional load to our network?
- How will we reduce the cost of the low carbon economy for the customer?
- Will demand response help?
- How will we plan our networks accordingly?
- How will we manage our networks on a daily basis?
- What operational constraints will we face?

- What impact will smart metering have?
- What role will demand response play?
- Will this create new roles for us as a business?
- How can we use the newly available data to improve our customer service?
- How will this inform our future regulatory processes and price control reviews?

Many academic studies have forecasted the impact of low carbon technologies, whilst relying on assumptions which remain untested. There is still a gap between desk-based research and reality which MK*Smart*2020 will help to close. This project will allow us to understand the impact which the low carbon economy will have on the end customer. The project will analyse both the operation of the network and customer behaviour and preferences. The customer is central to the future of low carbon networks so it is essential to understand how they can be engaged, encouraged and incentivised to play their critical role.

We believe that the Milton Keynes Low Carbon Living Programme supported by MK*Smart*2020 will achieve a level of low carbon adoption representative of the world in 2020. This will in turn lead to an accelerated opportunity to learn how networks will need to adapt to a low carbon environment. It will also create conditions to test technical and commercial solutions in a range of low carbon scenarios. The project is focused on how concentrated adoption of low carbon technologies might impact the network and how customers' willingness to deploy certain technologies and sign up to certain commercial arrangements might be used to optimise network operation and planning. The project is about understanding how DNOs can best help the customer to create a low carbon society. We believe that the timing of Milton Keynes' Low Carbon Living Programme is ideal to assess many of these key areas and hence inform an industry for the future.

Research Agenda

MK*Smart*2020 has been designed to test a wide range of smart grid hypotheses that are central to the future of UK low carbon distribution networks. These are outlined in the table in at the end of this appendix. We believe this project will inform Central Networks' DPCR6 process, underpinning the development of new transferable capabilities including: planning and design standards, modelling and simulation tools, daily operational practices and business processes.

To maximise the incremental learning generated from MK*Smart*2020, Central Networks will use Accenture's global Smart Grid Leadership Network to refine the research agenda and project scope. This network, fully funded by Accenture as an LCNF External Collaborator, includes electricity distribution businesses and cities from around the world. Accenture will establish a special UK session, inviting all UK DNOs, as well as the global members, to discuss and enhance the MK*Smart*2020 research plan. This will feed into the detailed design process. It will hopefully also support the development of other LCNF projects.

Ensuring outputs are statistically and technically sound, reliable and verifiable

We want to ensure that what we learn from MK*Smart*2020 can be applied across the UK, maximising customer value for money. We therefore believe that, where possible, the scale of project activities should be significant enough to be able to draw statistically sound conclusions.

We aim to create a comprehensive data collection process linked to open access research databases. This will facilitate the independent review of fundamental conclusions. Papers will be open to peer review and all the underlying data will be freely available for other parties to perform their own analysis.

Asset selection to provide robust results is covered in more detail in the network engineering section of the technical design and delivery appendix.

Given this targeted coverage, we believe that we can create robust and sound network learning, both statistically and technically. MK*Smart*2020 will not cover every network configuration in the UK, but we believe that many of the insights will be relevant in many circumstances. This is, in itself, a hypothesis for testing.

We recognise the customer aspects of the project may present challenges statistically. Whilst the Low Carbon Living Programme is expected to drive higher than average levels of adoption, it may be hard to achieve a statistically representative population across all aspects of low carbon living. However from a national perspective the project will demonstrate key principles that will support wider adoption of low carbon technology. We hope that uptake of industrial and commercial demand response will provide a statistically representative sample across the test area.

We hope that the wider Low Carbon Living Programme and focused efforts to drive EV and DG adoption across Milton Keynes mean that outputs that analyse the impact of low carbon technologies and the use of network based solutions will also be representative.

Ensuring knowledge and learning is captured and used

Capturing raw data, analysing it and generating knowledge is a critical part of MK*Smart*2020. To support this fundamental objective we have developed a structured research agenda. Data architecture will be designed to support data capture, organisation and with access through bespoke research databases. The research agenda is intrinsically linked to the overarching project plan. There will also be focused activities to identify, capture and share intellectual property.

Target hypotheses and a range of data sharing options will be used to help shape the range of data captured throughout the project duration. We envisage a range of expected outputs such as academic papers, seminars and intellectual property rights, with varying levels of detail across the life of the project. Below is a range of outputs that MK*Smart*2020 is expected to contribute through the life of the project:

- Understanding customer behaviour and preferences in relation to their future low carbon lifestyle
- Defining the types of propositions and interactions which would be acceptable to the customer
- Working in collaboration with Suppliers, Aggregators and Industrial and Commercial entities to understand how best the industry can interact with customers around demand response
- Low Carbon Network Deployment Lessons Learnt and Best Practice
- 'As Is' Network Performance Evaluation from LV Sensing
- Metering and Grid Synergies and Communications and Data Design
- Metering Network Benefits and Business Implications
- DMS LV Potential and Business Implications
- Network Impact of Low Carbon Adoption
- Potential Benefits of Persistent Voltage Reduction
- Active Network Management for Low Carbon Networks (Individual and Integrated / Technology and Commercials – combined benefits vs. sum of individual parts)
- Potential Contribution of Time and Location Tariffs for Maintaining Network Stability
- Advanced Condition-Based Monitoring and Dynamic Rating – Predictive and Proactive Asset Management
- Advanced Planning and Asset Management to Defer and Avoid Reinforcement
- The Potential of Distribution System Operators – Integrating Local and National Demand-Side Needs

- Low Carbon Network IT and IT Roadmap
- Low Carbon Network Operating Model
- The Future of Network Planning and Design Standards
- The Future Network Operating Centre: electricity network, communications network, distributed intelligence and integrated security
- Centralised vs. Distributed Intelligence
- DPCR6 Implications of MK*Smart*2020
- Review of MK*Smart*2020 hypothesis testing.

We hope that other parties will use the MK*Smart*2020 database to carry out other lines of research leading to further knowledge creation and will support any parties seeking to do this.

Knowledge Dissemination Strategy

As we seek to maximise the benefits from participating in LCNF projects, we recognise that the key output is wide scale learning for the industry as a whole. Therefore MK*Smart*2020 has a comprehensive and robust knowledge dissemination approach. The approach is geared toward delivering a number of outcomes:

- Support development of low carbon network capabilities across the industry, including scaling and industrialisation
- Inform customers and other stakeholders across the UK of the importance of low carbon networks, the role they have to play and the potential benefits and implications
- Inform customers of opportunities for participating in low carbon networks – demand response – with messages targeted at different customer groups
- Receive feedback from Milton Keynes' customers to understand their concerns, preferences, needs and opinions and share this insight across the industry.

These outcomes will be delivered by the end-to-end approach below:

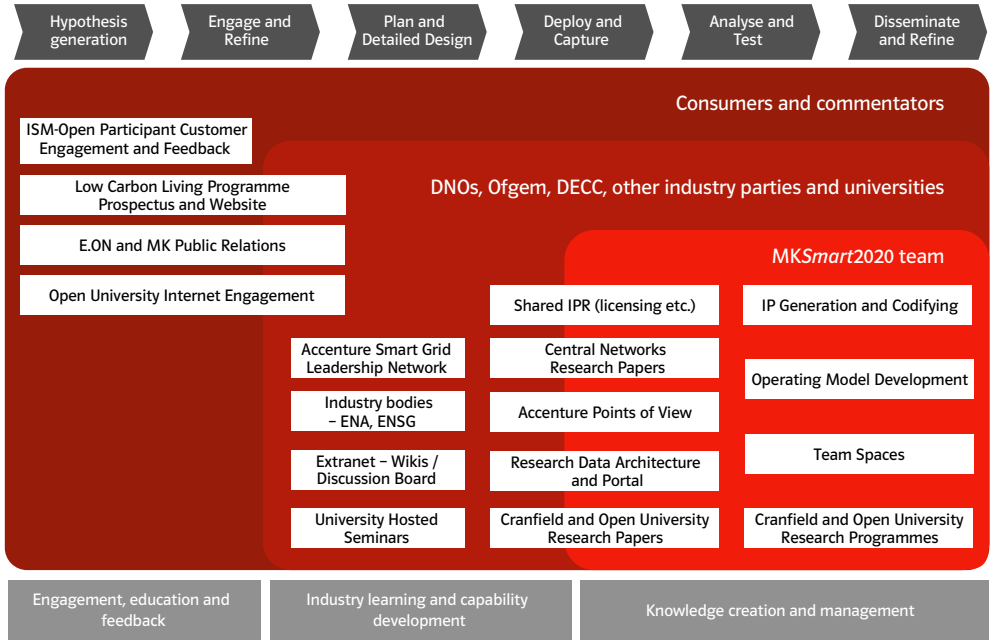


Figure 1: Knowledge Management and Engagement

There are a number of innovative aspects deploying a variety of different tools:

- *Research data architecture and portal*: research and knowledge dissemination is an integral part of the overarching IT architecture. The low carbon network data architecture will include a focused database for research data. Fields will be defined by the research agenda with data transferred from operational databases and buses. This database will be available to other DNOs and academic institutions through a security-protected portal, with a process for requesting additional data as needed

- *Cranfield University and Open University Papers*: publishing academic papers drawing on Cranfield's capabilities in asset monitoring and management and Open University's expertise in customer behaviour
- *Accenture Points of View*: publishing joint Central Networks and Accenture points of view providing key business insight and learning drawing on Accenture's global smart grid experience and high performance utility assets
- *Open University Virtual Engagement*: a variety of innovative engagement techniques building upon Open University's proven virtual platforms (see below)
- *Accenture Smart Grid Leadership Network*: this global network of utilities and cities will provide review / assessment of the data and knowledge generated and a proven platform for UK DNO and city engagement to complement the ENA and ENSG

The approach benefits from the proven and specialist knowledge dissemination and engagement capabilities of Cranfield University, Open University and Accenture.

Cranfield University

Cranfield University will be bringing its experience, expertise and assets in condition-based monitoring and predictive maintenance developed through its work in aerospace (critical assets with a high cost of failure) and other vehicles.

The Boeing Company has launched an Integrated Vehicle Health Management (IVHM) Centre located at Cranfield University. Boeing has been joined by BAE Systems, Rolls-Royce, Meggitt, Thales, the Ministry of Defence and Alstom Transport. The increasingly important area of IVHM technology informs existing concepts of vehicle maintenance, repair and overhaul by offering a total health-check for high-tech, high-value vehicles such as aircraft, ships, high-speed trains and high-performance cars.

We aim to apply these IVHM technologies to the MK*Smart*2020 in order to evaluate the potential to combine condition-based monitoring, predictive models, dynamic rating, enhanced network control and advanced simulation and planning to defer and avoid network reinforcement and optimise asset replacement. We will develop algorithms, visualisation techniques, simulation models and planning and design standards that allow what works to be rapidly scaled across the UK.

This will draw upon IVHM's test rig and laboratory environment and control centre test rig (Figure 2).

Figure 2: IVHM Control Centre

The knowledge gained in this project will also be disseminated through seminars and short courses to the industry, maximising the benefits that can be reaped from Cranfield's involvement. The technology gained from this project will also be published via peer-reviewed journals and conferences.

Cranfield University has multi-domain expertise in power engineering. Cranfield School of Engineering has a Department of Power and Propulsion

and Department of Offshore Energy Engineering. Recently, the Vice Chancellor, Professor Sir John O'Reilly, made an active decision to create an additional chair in Power Engineering to support low carbon initiatives.

Cranfield University also has an active carbon management plan[1] and the IVHM Centre is currently helping to monitor the carbon emissions for Cranfield University by monitoring various buildings and a substation, similar to the ones that we will be monitoring in this bid.

Open University

MK*Smart*2020 will draw upon both the Open University's expertise for public engagement through mass and web-based media and its specific experience of engaging users of low carbon technologies. The University has large and well-established resources on energy and environmental issues that support its teaching, research and outreach work in Environment and Energy issues. It also has a large teaching programme in Environment, Development and International Studies that includes, for example, the popular course T206 *Energy for a Sustainable Future*.

The University's environment and energy programmes are supported by its award-winning public engagement internet operations, which include:

- **OUverte:** the new Open University Online Community for environmental, social and economic sustainability
- **OpenLearn** website (openlearn.open.ac.uk) which links to many of the OU/BBC co-produced programmes and includes an online discussion forum on subject areas. This site won the ICT Initiative of the Year Award at the Times Higher Leadership & Management Awards ceremony in June 2010.
- **Podcasts** (podcast.open.ac.uk and also available through YouTube)
- OU's **iTunesU** pages (the first university worldwide to hit 20 million downloads)

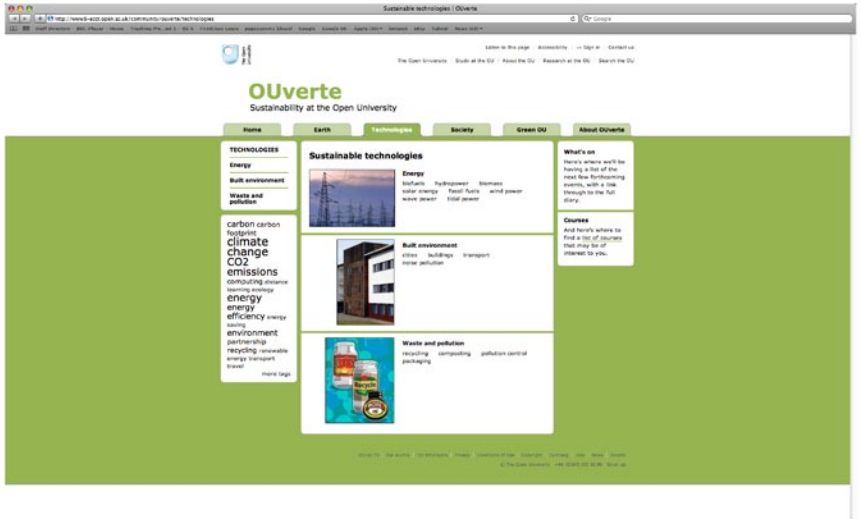


Figure 3: OUverte website

The energy and environment content of these will be drawn upon, versioned, and new specific Smart Grids-related interactive materials added to create a *Low Carbon Living* website. This will not only be a resource for the MK*Smart*2020 project, but can be designed to support the LCNF programme nationwide. Opportunities will also be pursued to link the MK*Smart*2020 project to the University's co-produced programmes with the BBC (e.g. *Electric Dreams*, *Money Programme*, *Coast and Life*).

The OU will also contribute to a programme of local engagement activities. The University is already working on the Milton Keynes Electric Vehicles project, helping to identify pioneer business fleet users and how EVs can present business development opportunities. Work with local schools includes, for example, the recent Milton Keynes *Big Green Youth* event at which local school teams developed sustainability proposals to present to a 'Dragon's Den' of local business people and MK council members. Several of their ideas are being taken forward by the 'Dragons' organisations.

Overall, the customer engagement approach will be developed and implemented by a team including key people engaged with the University's energy and environment programmes, IT experts and the Institute for Social Marketing, a world-renowned academic research centre in social marketing run by the Open University and the University of Stirling.

The OU team will also include people with specific expertise in programmes that promote low carbon domestic technologies. An OU team under Professor Robin Roy has worked with the Energy Savings Trust to conduct interviews and focus groups with households concerning their adoption and use of a range of low carbon domestic technologies (CHP, solar PV, solar thermal, heat pumps, biomass etc). This social monitoring of users has helped identify how behaviours shift – from passive to engaged users seeking active involvement in the new technology. This work has provided an understanding of user factors that drive the adoption of carbon saving technologies, result in user satisfaction and realise the full carbon saving potential. This experience and established method will be taken forward and used for the MK*Smart*2020 programme to analyse the relationship between the customer and low carbon networks.

Accenture

Accenture can support the MK*Smart*2020 research and knowledge dissemination agenda by drawing on:

- Experience and assets from Accenture's role as the solution architect, project management office and systems integrator for Xcel Energy's SmartGridCity project in Boulder Colorado, including Accenture's Intelligent Network Date Enterprise (INDE) smart grid IT solution
- Accenture's Smart Grid Leadership Network, which provides a global discussion forum to develop ideas, critique outputs and share knowledge. The network currently has 35 members and is targeting the following objectives:
  - » Increase the exchange of knowledge and accelerate learning through sharing smart grid knowledge with members
  - » Provide a forum for smart grid executives to discuss their experiences, challenges, present projects and ideas on how to thrive in today's marketplace
  - » Drive action that successfully tackles smart grid challenges and, when appropriate, increases the speed of planning and implementation of initiatives
- Accenture's global utility practice regularly publishes research and points of view on a variety of salient topics, including smart grid. Examples include: Achieving High Performance in Smart Grid Data Management, Accenture and World Economic Forum Smart Grid Point of View, Understanding Consumer Preferences in Energy Efficiency: Accenture end-consumer observatory on electricity management and Networks for High Performance in Utilities: The Journey to a Smarter Grid

Figure 4: Examples of Accenture Smart Grid Points of View

Hypothesis	MK*Smart*2020 Scope Alignment	Testing Methodology	Research Owners
Actively facilitating the cost-effective electrification of heating and transportation and connection of DG whilst maintaining standards of service			
• Localised concentrations of electrification of heating and transportation and DG can present issues for maintaining standards of service that require a DNO response	• Home Demonstrator • EV concentrations – corporate employees and fleet • DG growth • Heat pumps	• Analysing grid state data across distribution network – low carbon challenges vs. no low carbon challenges	• Central Networks
• Dynamically managing network voltage using data from the LV network and on-load tap changers at the primary or manual intervention at the secondary can allow voltages to remain within the statuary bounds as new low carbon technologies are connected to the distribution network	• Dynamic voltage management across primary substations • Emerging EV and heat pump loads and growth in DG (including Concerto-funded bus station solar array)	• Dynamically manage on-load tap changers in response to changes in end-user voltages and analyse impact and capacity for remaining within statutory limits under different loading conditions • Develop and test algorithms to enable optimised dynamic voltage management	• Central Networks • GE
• Targeted load control can avoid network overloading whilst deferring and avoiding reinforcement	• Demand response contracts for I&C interruptible loads and EV charging • Network sensing and control	• Monitor the asset loading impact of dispatching interruptible load and the constraints and limitations of demand response arrangements	• Central Networks

Hypothesis	MK*Smart*2020 Scope Alignment	Testing Methodology	Research Owners
• Customer responses to time- and location-specific tariffs are sufficiently predictable for them to be a viable means of avoiding and deferring network reinforcement	• Homes Demonstrator time- and location-specific tariffs for EV charging • EV point automation and control • Customer engagement and education	• Evaluate how customers' load profiles alter when time- and location-specific tariffs are applied by using control groups, varying the tariff arrangements and comparing load curves • Carry out focused analysis on probability of customer response to tariffs (and demand elasticity) under different circumstances e.g. time of day (includes assessment of individual and aggregated probabilities) • Review response data against network requirements	• Central Networks • Open University
• With low carbon adoption, outage risks could rise due to the unpredictable nature of new power flows (EV and DG) creating a compelling case for advanced outage and fault intelligence	• Outage and fault sensing and analytics / decision support	• Evaluate outage risk impact of low carbon adoption • Trial new outage and fault functionality in the event of occurrence / simulate outages to trial capabilities	• Central Networks
• Combining (combined benefits are greater than sum of individual parts) active management of asset loading (utilising demand response), dynamic asset ratings and condition-based monitoring and predictive maintenance can allow deferral and avoidance of network reinforcement whilst maintaining standard of service	• Primary substation sensing and central systems architecture • I&C demand response	• Integrate multiple technical solutions and evaluate impact upon assets • Build models of network health / security of supply risk impact of different operational regimes • Develop algorithms to support optimised asset load management • Assess impact of operational regimes on network reinforcement and replacement	• Central Networks • Cranfield University

Hypothesis	MK*Smart*2020 Scope Alignment	Testing Methodology	Research Owners
• Integrating multiple dimensions of active network management with scenario-based low carbon network simulation and enhanced network planning methodologies can enable DNOs to systematically defer and avoid reinforcement (as new low carbon network challenges emerge)	• Integrated IT architecture • Cranfield University research and development programme	• Link operational experience to network scenario and planning models • Evaluate potential to avoid and defer reinforcement • Test modelling assumptions against empirical data from MK*Smart*2020	• Cranfield University
Support optimisation between local network and national system			
• The DNO is an appropriate owner of demand-side load control and should sit at the top of the control hierarchy	• Demand response arrangements through retailer (offering and payment)	• Evaluation of criticality of demand response for local network management and the level of constraint the network would place upon other system parties (regularity and duration of dispatch and 'payback') • Evaluation of the practical commercial and technical implications of DNO's management of demand response	• Central Networks
• Remaining demand response capacity can be aggregated and offered for national system balancing after local network needs have been met	• System aggregation • Cross-industry commercial contracts and manual data and commercial flows – DNO performs action aligned to needs of other parties	• Evaluation of commercial returns and operational performance • Evaluation of commercial and operational flows • Survey of customer experience	• Central Networks

Hypothesis	MK*Smart*2020 Scope Alignment	Testing Methodology	Research Owners
Maximising smart meter network benefits and synergies			
• A smart grid-ready smart metering communications solution can be delivered at a cost equivalent to other options	• Deployment of 20K smart meters with a subset utilising a communication solution that meets the complete needs of smart grid	• Build the communications solution, calculate the per year / per meter lifetime cost and evaluate its capacity to provide the necessary smart grid functionality	• Central Networks • E.ON
• Using smart meter data, long-run network planning can be enhanced	• Deployment of 20K smart meters with a representative subset providing half-hourly load profiles	• Evaluate whether granular consumption data leads to different planning outcomes vs current assumptions / standards	• Central Networks
• The use of smart meter data can deliver significant benefits through real-time network management: managed persistent voltage reduction, dynamic voltage control and technical loss identification	• Localised trials of persistent voltage reduction and dynamic voltage control using only meter data • Subset smart meters with exception reporting, meter polling and half-hourly consumption data	• Evaluate net energy and carbon saving associated with persistent voltage reduction within statutory limits • Evaluate capacity to dynamically manage voltages using smart metering data • Identify technical losses and evaluate their materiality, root cause and the business case for resolution	• Central Networks
DNO technology, commercial frameworks, customer and industry interactions and operating models for cost-effective delivery of low carbon networks			
• Deployment of smart grid technologies (especially retrofit) can be complex and requires new skills and capabilities	• Smart grid installation – primary and secondary	• Evaluate deployment performance and capability gaps	• Central Networks

Hypothesis	MK*Smart*2020 Scope Alignment	Testing Methodology	Research Owners
• For cost effective delivery of low carbon networks, DNO operating models need evolutionary change across multiple dimensions	• Multiple aspects	• Review current DNO operating model against required capabilities identified by MK*Smart*2020	• Central Networks • Accenture
• DNOs need to adopt new IT architectures to effectively handle smart grid data volumes, applications and levels of integrated optimisation	• MK*Smart*2020 low carbon network IT deployment	• Evaluate capacity to deploy enhanced functionality within current SCADA • Review performance of deployment low carbon network IT	• Central Networks • Accenture
• Network planning methodologies and standards will have to change to maximise smart grid benefits and to respond to a changing power system	• Multiple aspects	• Evaluate current network planning approach against MK*Smart*2020 requirements	• Central Networks • Cranfield University
• Asset management principles and processes will need to alter to maximise the deferred and avoided reinforcement benefits from smart grid	• Condition based monitoring, predictive analysis and dynamic rating at the primary substation	• Evaluate current asset management approach against MK*Smart*2020 requirements	• Central Networks • Cranfield University • Accenture
• DNOs need to develop a series of commercial capabilities to deliver demand-side benefits and play an effective role as part of a wider low carbon power system	• Variety of commercial arrangements	• Evaluate current commercial capabilities against MK*Smart*2020 requirements	• Central Networks
• More complex and comprehensive real-time network management will require new skills and capabilities	• Variety of active network management functionality	• Evaluate project performance	• Central Networks
• Smart grid will require rigorous security standards and operation	• Across ICT	• Evaluate security risks and solutions	• Central Networks • Accenture

Hypothesis	MK*Smart*2020 Scope Alignment	Testing Methodology	Research Owners
• Smart grid solutions can be used to overcome localised network constraints in a variety of circumstances, making them a viable alternative to traditional methods in DPCR6	• Variety of smart grid solutions deployed	• Evaluate proven smart grid solutions against DPCR6 planning to identify opportunities to deploy smart grid solutions	• Central Networks
• Domestic customers require a high degree of engagement and automation if they are to participate effectively in demand response programmes	• Homes Demonstrator and EV fleet / employee vehicle charging • Tariffs and commercial arrangements associated with roll out of smart meters	• Customer surveys / interviews and review of customer behaviour • Evaluate implications of customer behaviour for low carbon networks	• Central Networks • Open University
• Industrial and commercial customers need a material commercial incentive to enter demand response contracts and the current system value of interruptible load is likely to be insufficient (in many but not all cases)	• I&C demand response	• Customer surveys / interviews and review of customer behaviour • Evaluate implications of customer behaviour for low carbon networks	• Central Networks • Open University

Footnote:

1. http://www.cranfield.ac.uk/about/CSR/carbonplan.pdf

Appendix 4: DPCR6 Linkages and Capability Development

Introduction

Central Networks will maximise DPCR6 customer benefits from MK*Smart*2020 by linking the project outputs to the DPCR6 planning process. Additionally we will use the project to develop the capabilities that will enable these plans to become a cost-effective reality. Other DNOs will also be able to deliver these benefits by taking advantage of the knowledge dissemination covered in the previous appendix.

This appendix describes Central Networks view on the expected MK*Smart*2020 DPCR6 impact, the process by which project learning will feed into DPCR6 planning and the approach for maximising the development of key capabilities and then embedding them in Central Networks' operating model.

DPCR6 Impact

Understanding the challenges

Distribution Network Operators will need dynamic and flexible networks to tackle the challenges which they will face in DPCR6 and beyond. These challenges arise from;

- Wind generation intermittency – in order to meet the renewables target, a significant amount of wind generation will be connected. Much of this will be connected directly to the distribution networks which will need to cater for their intermittency.
- Electrification of the heat and transport sectors which will significantly increase network loading and add to the reinforcement requirements.
- Changes in generator usage – increased dependency on flexible generation such as Combined Cycle Gas Turbines and increased distributed generation on the network , requiring flexibility to cater for electricity flows that can change quickly in size and direction.
- Increase in demand response activity – reducing and rescheduling demand alongside managing generation.

MK*Smart*2020 will give us real experience of these challenges which will in turn inform many elements of DPCR6 including creating business plans that rely less on reinforcement, determining outputs, shaping the regulatory framework and developing the required skills.

Reducing Reinforcement

Meeting these challenges could require very high levels of reinforcement. Such a degree of reinforcement would be costly to customers and would bring significant logistical challenges. However, we believe the levels of reinforcement can be reduced with increased demand response on the system to optimise the use of the current capacity on the networks.

MK*Smart*2020 involves implementing network sensing and control technologies which will provide us with the data required to use our networks more optimally, reducing reinforcement requirements.

There will be investment costs associated with installing the additional network sensing and controlling technologies. There will also be operational costs incurred for items such as maintenance and data processing. However, this will result in the long term in reduced overall cost requirements on the network within Milton Keynes. These savings in capital expenditure could be repeated across the networks nationally. We believe that these approaches to managing networks with reduced reinforcement could be adopted nationally by 2020. The expected total national savings for all distribution networks is significant. Our analysis shows that there is some £8-10bn of savings to be gained in a "green world" scenario which assumes a 25% penetration of heat pumps and electric vehicles by 2030.

Informing Cost and Incentive Frameworks

The cost incentive framework for DPCR5 has removed some of the barriers to exploiting trade-offs between operational costs and network investment (opex and capex) by setting the same incentive rate for both types of network expenditure. DPCR6 is expected to continue the focus on minimising total lifetime costs and is expected to lengthen the timeframes associated with evaluating network investment. As DNOs will need to make up-front investments and bear higher operating costs to avoid longer term reinforcement, it is important that the time-frames for cost incentives allow DNOs to be rewarded for avoiding reinforcement costs. Similarly there may be a need to include further sophistication in the approach to outputs such that DNOs are rewarded for increasing the utilisation of the network. This may re quire the development of some form of network utilisation measure within the suite of output measures.

MK*Smart*2020 will help us to understand the likely costs and timescales associated with transforming how we operate our networks. This information will be used to help refine the DPCR6 framework such that it creates the correct environment and incentives for DNOs and therefore enable the customer gain from the long term benefits.

Informing Business Plans

The integrated nature of the MK*Smart*2020 project will advance the industry's understanding of the alternative technology based network management solutions that deal with multiple drivers and offset the need for network reinforcement. The learning from the MK*Smart*2020 project will be used in the business plans drawn up for DPCR6. Having a greater understanding of the costs and benefits of smart grid operation will allow us to identify and plan for the longer term transition, identifying areas to benefit most from similar investment and the likely associated outputs.

The impact on DPCR6 will be to reduce the need for significant increases in high cost reinforcement, through investment in technology, communications and data analysis capability. Traditional planning processes will be changed to consider the application of smarter operating protocols instead of upgrading assets. Progressively, and where appropriate, more parts of the network would migrate to the new way of operating.

New skills will be developed and the MK*Smart*2020 project will identify the necessary training and development requirements that would be factored into DPCR6 business plans.

Incorporating the knowledge gained into DPCR6 proposals

One of the benefits of embarking on the MK*Smart*2020 project in the early part of the DPCR5 period is that it will provide the industry with knowledge and capability to reduce bids for reinforcement requirements prior to the start of the next price control negotiations (assuming regulatory process remains the same and draft business plans are submitted in Aug 2013).

Since the project covers many facets of future network requirements it will identify both the investment and operating cost requirements.

Moreover, the project will help to identify the type of mechanisms which will need to be in place in DPCR6 to incentivise companies to move away from reinforcement into more sophisticated solutions.

Maximising the development of key capabilities

Whilst many of the traditional engineering skills will remain very important, there will be a need for an alternative way of managing the network based upon a greater understanding of the real time demands and operating parameters of the network.

There will be additional challenges and new skills required to ensure that the needs of customers are satisfied, whilst maintaining power quality within statutory limits and minimising the losses of the network.

New data flows over enhanced data communication infrastructure will provide more sophisticated real time network control capability and new commercial frameworks for demand side response will provide incentives to customers to reduce demand at peak times.

The MK*Smart*2020 project will identify the skills that will be required to operate and maintain the new systems, to develop and negotiate commercial arrangements and to influence and support customer behaviour. It will also enhance project management skills and the processes for collaborative work and behaviour.

Acquiring this understanding will enable the early identification of training requirements and staff development needs to ensure that there are sufficiently qualified and experienced people in place to manage a more widespread deployment of the smarter way of operating.

Embedding changes into the Central Networks operating model

We expect to be able to apply the learning from MK*Smart*2020 to other areas of the network where there is either significant load growth or extensive installation of distributed generation. We expect to repeat this progressively, duplicating the success and benefits.

This will ensure that maximum benefit is being gained in DPCR6 through offsetting the need for reinforcement.

During the transitory period, there will be two operating models in place, allowing the new technology to 'bed in', operator confidence to be gained and widespread skills to be developed for the consideration of a wholesale changeover into DPCR6.

The installation, operation and maintenance of the new network sensing and control equipment will require new skills for those involved in the day to day activities on the network. MK*Smart*2020 will provide a training ground for our staff to develop these skills.

Similarly the increased complexity involved in managing real time rapidly changing loads, quality of supply issues and minimising losses will show us how our approach to network management will evolve. This will indicate the degree to which traditional approaches to network control can accommodate new responsibilities, whether new supporting roles or systems are required or whether more radical changes will be required.

Greater stakeholder engagement

DPCR6 will require network operators to engage with stakeholders and to make this engagement effective. We see stakeholder engagement as one of the ingredients to creating workable smart grids, with new commercial agreements and more interaction with stakeholders than would be the case with traditional network operation.

This project will also allow us to develop our approach to stakeholder engagement and review its effectiveness both corporately and as individuals.

Appendix 5: Smart Metering and Customer Empowerment

Introduction

This appendix outlines how smart metering will be utilised in MK*Smart*2020 and some of the key hypotheses we aim to test through integration with the local grid.

Smart metering has been identified as an essential and foundational element in the development of a low carbon economy. From the point of view of the consumer, smart metering provides them with an opportunity to understand in more detail their own energy usage through in-home display units (IHDU). These will enable consumers to make more informed energy choices, in turn reducing their power consumption and carbon footprints. A 2.8% energy consumption saving was assumed in the DECC Smart Metering Impact Assessment published in 2009.

In the context of Milton Keynes, we will work with the Council and Partnership and participating retailers to support energy efficiency measures enabled by smart meters. As the local network value of demand-side resources grows we will be able to support commercial propositions through the retailer that reflect the network value of load management. This will provide a material customer opportunity, built on smart metering – both the technology and associated engagement activities. Customers will be able to realise direct benefits from entering into demand side commercial arrangements and will benefit from a more cost effective electricity distribution network, allowing them to reduce their bills as well as reducing the utilisation of high carbon generation.

There are customer benefits from smart meters that do not require customer participation. We believe that more granular consumption data from smart meters has the potential to help us plan more effectively. Smart meters could act as valuable sensors on the network, providing data for outage management, dynamic voltage control and reduction of technical losses. MK*Smart*2020 will evaluate the potential network benefits from smart meters and the potential to use smart grid communications for smart meter data flows.

The development of metering specification and functionality at a national level has been undertaken on the desk-top and, as yet, many of the potential DNO applications associated with smart metering have not been field tested in the UK. With the unique energy industry structure and smart metering deployment model in the UK, realising some of the DNO benefits from smart metering could present operational and commercial challenges. MK*Smart*2020 seeks to provide a platform to test many of the hypotheses associated with smart metering data supporting smart grid development.

There are a number of issues we would like to investigate through MK*Smart*2020 across two phases of deployment – the first in 2011 and the second in 2012.

Area	Phase 1	Phase 2
Installation	• Investigate installation support techniques to ensure service position defects can be readily rectified by supporting retailers own deployment programmes	
Data Collection and Proliferation	• Meter data can be gathered and passed successfully to DNO via retailer comms medium • Meter data can be gathered from multiple retailers and passed to DNO via retailer comms medium. Most likely facilitated through implementation of Electralink's Smart Metering Interoperability Portal (ESIPS)	• Interim smart metering market processes to be supported to allow commercial and technical interoperability between multiple retailers • All of the above processes to be undertaken with Power Line Carrier (PLC) technology for last mile communications in selected areas
Smart Meter Data Source Development	• Voltage and load data used to support planning activity • Ad-hoc poling of load and voltage data	• Meter to send alarms on tamper and voltage out of bounds • Meter to send loss of supply alarm • Develop DNO demand response signal to be proliferated through the smart metering infrastructure – Homes Demonstrator

Area	Phase 1	Phase 2
Integration with DNO Core Systems and Smart Grid	• Creation of LV network model, populated with recent smart metering data	• Live outage data from smart meters to feed into outage management systems • Population of LV network model with more real time smart metering data • Usage of smart metering data for persistent and dynamic voltage management • Localised testing of PLC communications to demonstrate synergy between smart metering and smart grid communications infrastructures • Inform the debate on customer data protection • Use the modular communications to trial swapping comms modules in a live customer environment

We have already agreed the installation of 20,000 smart meters with E.ON. This will take place ahead of the mandated smart metering rollout, during 2011 and 2012. We are also in the process of securing the involvement of other retailers as we recognise this allows the testing of a greater number of hypotheses around smart metering integration.

Design and Delivery

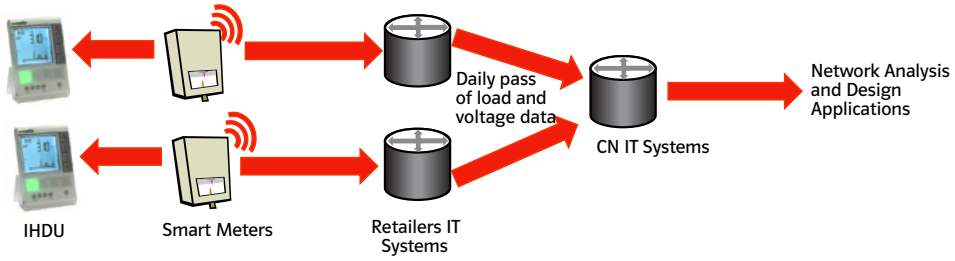
We recognise that a high degree of functionality in the meter will facilitate both detailed levels of data retrieval and innovation around that data. Therefore, the smart meters that will be used in MK*Smart*2020 will meet the specification as detailed by the ERA in the SRSM (Suppliers Requirements for Smart Metering) specification, along with the ENA smart metering requirements. All communications are to be modular, allowing the initial metering deployment with cellular technology. This will allow for further trialling of communications technologies at a later date.

Over and above the base specification, we are seeking to install a number of smart meters with additional functionality. These meters may include technology such as last gasp automatic outage notification or more enhanced power quality monitoring. This will allow us to test further hypotheses as to the use and appropriateness of certain data streams. The meter deployment will include home area networks and in-home display units to support customer engagement and behaviour change. Smart meters used for the Home Demonstrator properties will be linked into the wider set of low carbon technology.

E.ON will be installing 15,000 smart meters in 2011, with a further 5000 in 2012. We are aiming to use this process to gain vital lessons that will feed into the mandated smart metering rollout. This will include how to manage the increased volume of service defects that will naturally follow an increased metering installation programme. We recognise that the data available from smart metering represents a step change in the way we can potentially manage the network, and so we propose adopting a two-phase approach.

Smart Metering Integration - Phase 1

In phase 1 we aim to get the basics right; support the metering installation programme and return basic metering data to our IT systems on a daily basis. This is akin to an automated meter reading system (AMR) rather than full smart metering.

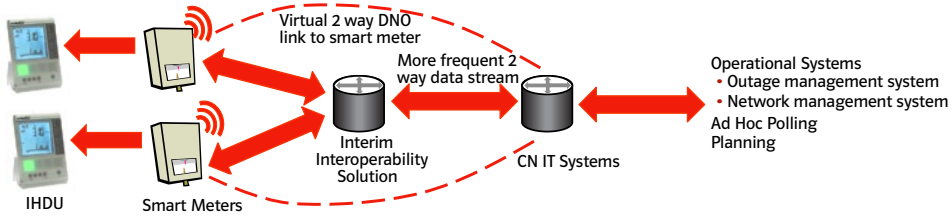


Phase 1 Data Flows

Smart Metering Integration - Phase 2

Once we are assured we have the basics right, we will move into more dynamic use of smart metering data. This will include passing data to core operational systems such as network management and outage management (NMS and OMS). It will also include two-way communications with the meter, allowing ad-hoc polling and a near real time understanding of the network state. This will support activities such as dynamic voltage management.

Further developments in phase 2 could include the use of some form of interim interoperability solution. This is dependent on support from multiple energy retailers in Milton Keynes.



Phase 2 Data Flows

Customer and community engagement and empowerment

Empowered customers actively engaged in the power system present an opportunity to save energy and carbon, defer and avoid network reinforcement and support national system balancing. We believe that supporting changes in customer behaviour may be best facilitated through a combination of community based initiatives and direct individual engagement. Both can occur through multiple channels – face-to-face, the web (including social networking), smart phones, over the phone, print material and informal networks, such as community groups.

MK*Smart*2020 will explore the potential for customer engagement and empowerment as a means to provide demand side capacity for local network management and national system balancing. We want to understand what kinds of engagement work and support high levels of interest, trust and education which can then be converted into higher levels of demand side adoption. Demand side adoption will deliver power system savings that can be passed through to the customer.

We will be working closely with our External Collaborator, E.ON Retail, to trial and evaluate the opportunities and implications surrounding customer and community engagement and empowerment. These activities will be focused around E.ON's deployment of 20K smart meters as a catalyst for change and will link in with wider local engagement activities being performed by Milton Keynes' Council and the Open University.

E.ON Retail will work with the Milton Keynes' Council and Open University to engage with customers who have received a smart meter to understand how it changes their behaviour and attitude.

Appendix 6: Commercial Propositions and Supporting Technology

Introduction

We believe that commercial propositions will be an important part of low carbon networks. MK*Smart*2020 will trial a number of commercial arrangements. These will allow the project to deliver the target capabilities and will provide valuable lessons in relation to:

- Propositions required to deliver credible solutions for local network management
- Customer behaviour and preferences in relation to price signals and load management contracts
- Optimised industry allocation of demand side resources – for national system balancing and local network requirements
- Practical interactions between industry participants – DNOs, GB System Operator, aggregators and retailers – and customers
- The level of savings that customers can realise
- The degree of intervention required to deliver the available savings

We want to understand how the industry and customers can use commercial propositions to deliver a reliable and cost effective low carbon energy system. We then want to share what we learn.

Customers as individuals and communities

Active customer participation is expected to support a cost effective transition to a low carbon economy. We believe that active demand response will reduce the level of investment required in the network in the future as well as reduce the potential requirements for high carbon generation. Compelling commercial propositions enable active participation and will empower individuals and communities to play an important role in meeting the UK's carbon targets. Customers will benefit from the value their active participation creates through appropriate commercial arrangements.

Tariffs and other commercial propositions

The Homes Demonstrator and industrial and commercial demand response elements of MK*Smart*2020 will allow evaluation of a variety of commercial propositions and the resulting customer response and impact. Complimenting these functionally deep trials, which involve a relatively small number of customers, will be a series of trials covering a larger number of customers. These trials will be built upon the foundations of E.ON Retail's deployment of 20K smart meters and the functionality and customer engagement they provide.

Selection of appropriate tariffs and commercial propositions will be decided closer to deployment. The selection will be based upon an understanding of prevailing customer preferences and market developments, which we expect to evolve over the next couple of years. Also, what we can do will ultimately depend upon the propositions that customers are willing to sign-up to, although an absence of customer interest is an interesting and informative result in itself.

There are a whole variety of commercial propositions that could support understanding of the network implications and opportunities: pay-as-you-go tariffs, time of use tariffs, direct load control or critical peak pricing to name but a few. E.ON Retail will be looking to trial a variety of customer propositions to support MK*Smart*2020 and we hope that other suppliers will join them to increase the scale a variety of commercial propositions being trialled. Such trials can be phased in across the life of the project as the commercial complexity and operational capabilities around smart metering evolve.

E.ON will invest in the capabilities that will make some of these ideas an operational reality – meter data management functionality, changes to their billing system to support new tariffs and training of customer service representatives to help customers understand and take advantage of the opportunities available to them.

Industry participants and the market

Electricity distribution networks are part of a wider electricity system. The commercial aspects of MK*Smart*2020 will cover the wider interactions between different industry participants within the UK's electricity market.

We believe that cost effectively building and running the UK's low carbon power system will require working across the industry. In areas such as the demand side network operators, suppliers, the GB system operator and other parties such as aggregators will need to work together through industry processes and commercial arrangements.

Throughout MK*Smart*2020 we will be working with E.ON and hopefully other retailers, commercial aggregators and the GB system operator to better understand customer engagement and commercial propositions and activities. As part of these activities we will seek practical feedback from all the involved parties to better understand the potential to enhance cross industry commercial frameworks and industry process.

Design

MK*Smart*2020's commercial propositions are designed to cover three areas:

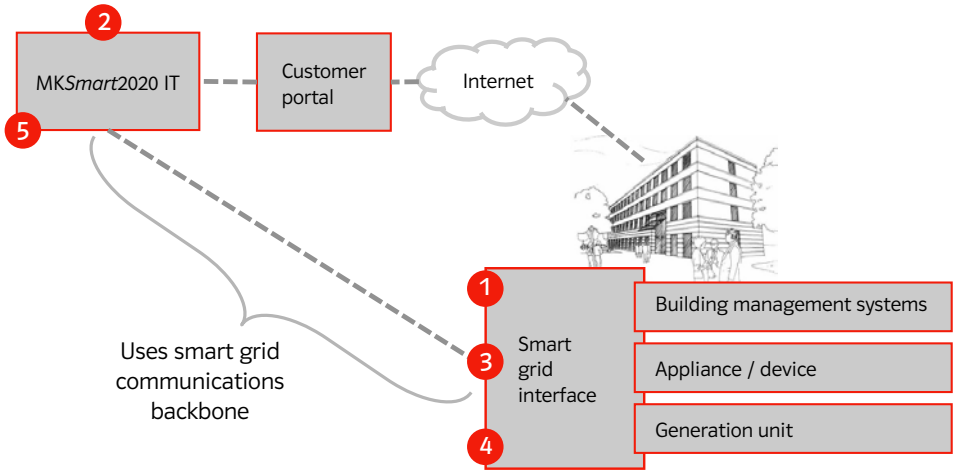
1. Responding to information from the network and optimising network operation with available demand side loads
2. Testing commercial virtual power plant arrangements- over and above network optimisation, aggregating demand reduction loads and offering them up as a virtual power plant to the Transmission System Operator (TSO) as and when required
3. Testing time and location network tariffs – evaluating whether customers will change their electricity demand due to simulated tariffs that reflect expected future network constraints and whether this response meets network requirements

The small scale of the commercial propositions means we will be managing them through manual processes and calculations that involve extracting data from MK*Smart*2020 systems and manual flows to other industry participants. We have chosen this approach to maximise learning while keeping cost to the customer to a minimum.

Can we use Demand Response to help manage and optimise our network?

We will be testing this hypothesis using Industrial and Commercial (I&C) customers within Milton Keynes. We want to encourage as many companies as possible to take part in this project and so we will be working with the Council, Milton Keynes Partnership and the Low Carbon Living Programme to to encourage participation.

MK*Smart*2020 will include installing technology within offices and other business premises to control electricity loads such as commercial refrigeration, air conditioning, lighting and possibly different forms of on-site generation. This will be complemented by commercial arrangements through the customer's electricity supplier to allow Central Networks to manage this load as shown below. These commercial arrangements will apply to Industrial and Commercial customers. The technology required at the customer premises to provide the required functionality will vary depending upon the load being managed and the associated prevailing control systems and interfaces. The smart box that interfaces with network communications and systems will need to be integrated into customer building management systems, appliances or devices or generation units. The diagram below shows how the technical solution will operate.



1. Smart grid interface evaluates technical load availability
2. Network analytics evaluates network need for load curtailment or generation dispatch

   Review technical load availability and assesses customer commercial arrangements and preferences (can be managed by the customer through an Internet portal)
3. Enact control order through smart grid interface
4. Measure load impact at device level
5. Perform back-end manual processes for commercials using IT data extracts

Key points with regards to interactions:

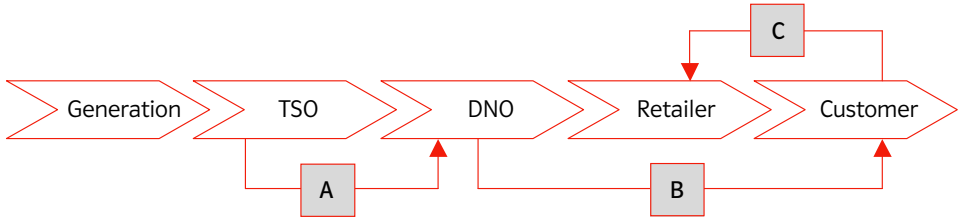
- Customer signs up to proposition through supplier
- Network operator physically manages the load in line with customer preferences defined by the contract
- Load reduction is enacted on the principle of minimising customer inconvenience
- Customer receives a discount on total annual electricity bill for providing this service in the first two years of the trial. The price signal on which our hypothesis is built cannot reflect the cost of the low carbon economy in 2020 and therefore there is no economic advantage for the customer in 2012. It has to be simulated
- After the first two years, we will be using the National Grid contracts as a means of self financing this activity subject to National Grid being amiable to this
- Network operator provides customer and retailer with:
  - » The reduction in consumption achieved over the month
  - » A view of the year's savings based on the year's prices
  - » A view of 2020 savings based on a "green world scenario" wholesale market and DuOS charges taking into account the penetration of heat pumps, distributed generation and electric vehicles within the region. We hope this will help engage businesses to think about low carbon network opportunities and empower them to take actions that support the development of low carbon networks

Can we use local demand response to offer additional load to the TSO?

To examine this hypothesis, we will be using the same technologies installed within offices and business premises to control load. In addition to the rescheduling of load to take account of network constraints, we will also be interrupting load as per the contract with the customer to offer it into the balancing market or as pre-gate closure contracts as and when required by the TSO.

Key points to note:

- The customer will sign up to the proposition via their supplier or an aggregator
- A signal would be sent from the TSO to the DNO requiring a certain level of demand reduction
- The DNO would look into the proposition (sold to the customer by the supplier or the aggregator) and determine where those loads might be available
- DNO would act on those propositions and offer those loads to the TSO
- The economics of the transaction would operate as shown in the chart below.



A – TSO pays the DNO from the balancing mechanism or through pre-gate closure contracts

B – DNO pays the customer for providing the demand response

C – Our customers will then pay the retailers for their services or imbalances which might have occurred.

Can advanced tariffs support low carbon network operation?

The tariff structures will be trialled via the customer's retailer. The customers will be those who live in the Milton Keynes' Low Carbon Living Programme's Homes Demonstrator properties. We hope that these customers and the wider Tattenhoe new build estate, of which the Homes Demonstrator is a part, will form the core of an empowered and engaged low carbon community within Milton Keynes. This will be supported by the Council and Partnership and the activities of Open University as one of our MK*Smart*2020 partners.

We have identified three potential tariff arrangements.

1. **Option A** – Sending hourly pricing signals which take into account wholesale prices and the DuOS charges through the smart meter
2. **Option B** – Sending a weekly tariff in advance with specific peak hours in a similar way to how economy 7 operates
3. **Option C** – Enforcing a capacity payment at peak times during the winter – for example 4-7pm, Monday to Friday from November to February

We believe that the most appropriate tariff signal for the purposes of this arrangement would be Option A. It provides us with an appropriate market-based view of how customers would change their behaviour to accommodate increased wholesale prices and DuOS charging.

This will also allow us to understand the network potential of customer responses to new tariff structures. Of particular importance is the predictability of the customer's response. Network operators need to have certainty to maintain reliable supply particularly in a smart grid world where network utilisation is increased to defer and avoid network reinforcement.

As MK*Smart*2020 is an early mock-up of a green world scenario in 2020, we would use a pricing signal to the house that would be proportionate to the avoided capex in relation to the uptake of EV and heat pumps which we anticipate in the region in 2020. This avoided capex is then translated into a pricing signal. This price signal would be sent directly to the customer via the smart meter.

Complimenting these functionally deep trials, which involve a relatively small number of customers, will be a series of trials covering a larger number of customers. These trials will be built upon the foundations of E.ON Retail's deployment of 20K smart meters and the functionality and customer engagement they provide.

The commercial arrangements outlined above will require the support of a range of enabling technology. This technology will be include as part of the Homes Demonstrator property and we anticipate that it will be funded through the land value of the site, Plugged in Places (for EV charging posts) and potential contributions from organisations involved in the wider Low Carbon Living Programme. The homes will include:

- EV charging posts
- Smart meters, in home displays and a home area network
- Heat pumps with smart thermostats
- Smart appliances
- Home automation

These will be supported by a customer portal that forms part of the MK*Smart*2020 IT architecture which will provide customers with the ability to define their preferences for load management as well as being able to monitor their consumption patterns if they wished to do so. The customers would be charged differently to other customers and we would require a derogation from the current SLC13 license condition to do so. We would, however, ensure that the overall impact on the customer is neutral through payment at outturn.

Appendix 7: Technical Design and Delivery

7.1: Aligning Technical Design with Customer Value

Introduction

MK*Smart*2020 will be realised through a combination of technology, commercial arrangements and operating model developments. Collectively, these will:

- Enable knowledge development by testing targeted hypotheses
- Inform Central Networks' DPCR6 submission
- Begin building the operating model-embedded business capabilities that will turn DPCR6 and subsequent submissions into a fully functioning low carbon network

This appendix focuses on the technical aspects of MK*Smart*2020. The technical design is built around the capabilities needed to deliver the research and knowledge dissemination plan.

MK*Smart*2020 Capabilities

The capabilities that MK*Smart*2020 will deliver are detailed below in *italics*.

The Government has mandated the deployment of smart meters for domestic and commercial properties. MK*Smart*2020 will include capabilities to enable evaluation of potential benefits and synergies. The capabilities include:

- *Enhanced network planning* (targeted subset of meters): more granular customer consumption data would support improved network reinforcement planning and new connection design, optimising the value delivered to customers. MK*Smart*2020 smart meter deployment will include a subset of meters that record half-hourly consumption data
- *Meter data and retailer integration* (targeted subset of meters): by integrating metering and grid data flows and communications (which use the same infrastructure), it may be possible to deliver cost synergies, while providing DNOs with data, when and where they need it. MK*Smart*2020 will include a subset of meters that use the same communications as the smart grid and which have the capacity to produce and transmit data that supports network management. These meters would alert network systems should the voltage or load exceed pre-defined limits, as well as supplying voltage and load data on demand (supporting active network management)

Data from smart meters, evaluated via the capabilities outlined above, could deliver major improvements in real-time network management. The next two capabilities, which focus on the integration of enhanced network observability with smart grid functionality, explore these benefits in more detail:

- *Maintain statutory voltage*: as more customers opt to drive electric vehicles and install distributed generation and electric heating, statutory voltage will likely be more difficult to maintain. By combining a real-time view of voltages received by customers, the technology for regulating network voltage (primary on-load tap changers and voltage regulators at the secondary) and voltage optimisation analytics, it may be possible to defer or avoid network reinforcement whilst safeguarding power quality
- *Persistent voltage reduction*: as EV and DG adoption increases, dynamic voltage management is expected to be an important feature of future low carbon networks. Before mass adoption takes place, however, there may be opportunities to deliver direct network carbon benefits. These could be achieved by managing primary on-load tap changers or manually changing the settings on secondary substations to consistently reduce network voltage whilst using smart meter data to ensure statutory requirements are met

In future, smart meters are expected to be complemented by other sensing devices within primary and secondary substations. These will deliver a central platform that supports other important capabilities, including:

- *Comprehensive grid state observability*: this is a prerequisite for optimising the low carbon network and improving overall network management. MK*Smart*2020 will provide comprehensive observability through sensing on primary and secondary substations, as well as grid state sensing from a subset of the project smart meters

With comprehensive grid state observability and the associated communications backbone in place, it will be possible to layer on various low carbon network capabilities that work independently and together to support transition to the low carbon energy system:

- *Condition-based operation and maintenance*: this combines analysis of asset condition, degradation and risk of failure with new maintenance and operating regimes to defer and avoid reinforcement. In the future, using analysis of long-run reinforcement options, DNOs may choose to increase asset loading to reduce capital costs for the customer . This capability would make that possible, whilst simultaneously maintaining security of supply
- *Dynamic asset rating*: Central Networks has already shown how customer value can be realised from dynamically rating overhead lines in the Skegness Registered Power Zone (RPZ) project. In MK*Smart*2020 the same concepts will be applied in an urban environment with a variety of emerging low carbon challenges. Substations, rather than overhead lines, will be dynamically rated. By considering the temperature and loading profile (historical and predicted) of an asset, it may be possible to increase asset loading without putting customer supply at greater risk. Working in conjunction with condition-based monitoring and maintenance, this could enable reinforcement to be deferred or avoided
- *Outage and fault intelligence*: customers expect a secure and constant supply of electricity. MK*Smart*2020 will look at how low carbon adoption might impact distribution outage risks, as well as evaluating the potential for reducing the risk and impact of outages. This capability will include detection and categorisation of faults and methods for reducing the time that customer are off supply (e.g. identification of nested outages). By linking to condition-based monitoring and dynamic rating, this will illuminate the relationship between asset loading, health and outage risk in a low carbon environment
- *Load management and optimisation*: in a low carbon future, to defer and avoid network reinforcement whilst maintaining standards of service, customers' interruptible load is likely to be actively managed. MK*Smart*2020 will include the integration of demand-side management into network optimisation through demand response contracts with industrial and commercial customers. This can be linked with condition-based monitoring and dynamic rating to provide new ways of asset loading management

- *Enable and optimise EV charging and heat pump management*: electric vehicles and heat pumps are expected to be an important part of the UK's low carbon future. MK*Smart*2020 will include functionality for the cost effective integration of EVs and heat pumps into the distribution network. This will be based on understanding the network impact of EV and heat pump loading and being able to provide optimised load management solutions
- *DG integration*: generation connected to the distribution network is expected to grow due to feed-in-tariffs and other drivers. This could present issues for the distribution network. MK*Smart*2020 will include the capability for integrating DG by monitoring its impact and dynamically managing network voltage. In the future, this capability could be expanded to include constrained dispatch commercial arrangements that help to increase overall control

Each of these low carbon network capabilities has the potential to deliver customer value. By using technology to integrate them, it may be possible to make this exceed the sum of its parts.

- *Integrated optimisation*: MK*Smart*2020 is explicitly evaluating the potential value of integrated solutions for real-time optimisation and, in the longer run, network planning. For example, while a demand response contract can defer reinforcement, it is possible that a longer deferral of capital spend can be achieved by combining demand response with dynamic rating and condition-based monitoring

Electricity distribution networks are part of a national power system and it is essential that low carbon distribution networks take account of and maximise value for this wider system. In particular, MK*Smart*2020 will consider a future with greater levels of inflexible and intermittent generation and the implications of that for market and system balancing and the use of demand-side resources. Some of the above capabilities include elements of market integration: specifically, the provision of smart metering communications and EV and industrial and commercial load management through the retailer. As well as incorporating these, this capability takes them further to explore the role of DNOs in the wider power system as a controller, integrator and intermediary for load management.

- *Market integration and optimisation*: MK*Smart*2020 will include the evaluation of DNO aggregation and dispatch of interruptible load for national system balancing once local network needs have been met. Aggregation and dispatch will be performed by DNO systems in alignment with requests from other market participants. While it will not include automated industry commercial and data flows, it will include key manual commercial processes bringing together customers, retailers, aggregators, GBSO and Central Networks. It will also include evaluation of passing-through time and location distribution system charges to the customer via the retailer to influence customer load profiles (50-60 Homes Demonstrator).

MK*Smart*2020 technology will also directly support research, knowledge dissemination and customer engagement.

- *Research database and portal*: MK*Smart*2020 will capture large amounts of data. The research database will structure and store this data and provide access to relevant parties as part of the knowledge dissemination strategy. It will be an important part of the integrated IT architecture
- *Engagement website*: data on energy flows or network performance will be displayed on the MK*Smart*2020 website in order to engage customers

The high-level capabilities outlined above need to be turned into high-level functional requirements that are then reflected in the technical appendices that follow. The table below outlines the high-level functional requirements for each capability.

Functional Requirements

Capability	Functional Requirements
Enhanced network planning	• Half-hourly meter data • Retailer systems to manage data • Historical extraction of consumption data to DNO – high latency
Meter data and retailer integration	• Meter data access between meter and head end – at the substation • Decode variety meter types • Meter reading routing on separate path • Grid state exceptions data from meter on separate path – voltage out of range, load out of range and ad hoc polling of single or individual meters • Meter flexibility for modification – enhanced functionality (modular)
Maintain statutory voltage	• Primary on-load tap changer and secondary voltage regulator • End-point voltages measured and exception reporting and polling (midpoint and end feeder) • Voltage optimisation analytics
Persistent voltage reduction	• End-point voltages measured and exception reporting and polling (midpoint and end feeder) • Primary on-load tap changer management and secondary voltage regulator • Energy use impact analysis at secondary
Comprehensive grid state observability	• State measurement, state estimation, and visualisation • Real and reactive power flows, voltage and current • Measure variations of voltage and current waveforms from ideal sinusoids • Harmonic distortions in voltage • Harmonic distortions in current • Transient distortions (sags, spikes, etc) • Frequency variations • Logging and notification

Capability	Functional Requirements
Condition based operation and maintenance	• Primary on-load tap changer monitoring and transformer dissolved gas analysis, loading and temperature • Device health condition determination • Device and system failure diagnostics • Device failure or imminent failure notification • Asset accumulated stress measurement • Loss of Life (LoL) calculation • Estimated Time to Failure (ETTF) prediction • Asset Failure System Risk (AFSR) calculation
Dynamic asset rating	• Transformer loading vs. rating and temperature • Peak load measurement (amplitude, frequency) • Actual demand curve measurement • Load/power flow balance measurement • Dynamic (real-time) de-rating/re-rating • Asset visualisation – loading, temperature asset running strategy (condition-based monitoring and asset strategy [life extension / defer] – linked to visualisation and decision support)
Outage and fault intelligence	• Detection of short or open circuits and device failures • Fault and failure classification • Characterisation (fault parameters) • Fault location determination • Filtering and logging of momentary faults • Extent mapping and outage verification • Root cause determination • Restoration tracking and verification • Nested root cause discovery • Outage state and process visualisation • Crew dispatch support
Load management and optimisation	• Commercial propositions to the customer via the retailer • Load available, capable and forecast at the device level aggregated • Dispatch control • Optimisation analytics

Capability	Functional Requirements
Enable and optimise EV charging and heat pump management	• Commercial propositions to the customer via the retailer • Customer scheduling • Rapid vs. trickle selection and impact analysis • Control and analytics • Tariff messaging and charging automation
DG integration	• Grid state impact measurement • Dynamic voltage management
Integrated network optimisation	• Integrating and optimising analytics for combined condition-based monitoring and asset strategy, dynamic rating, dynamic voltage management and load management • Integrated visualisation and decision support – long-run asset strategy (reinforcement defer and avoid) and real-time local network stability and power quality
Market integration and optimisation	• Commercial propositions to the customer via the retailer • Time and location tariffs simulated and customer pass-through via retailer • Virtual power plant aggregation factoring in network needs • Commercial offering to GBSO
Research database and portal	• Focused research database with data structures and data extract from operational systems matching to research agenda • Secure portal access to research database
Engagement website	• Real-time network representation demand intensity

7.2: Information Technology

Introduction

Information Technology is expected to be an essential component of future low carbon networks. IT will provide the data handling, analytics, visualisation and decision support necessary to run a low carbon network. The IT section of the Technical Design and Delivery appendix outlines the IT strategy and architecture required to deliver MK*Smart*2020. The IT approach is aligned with the MK*Smart*2020 vision and target capabilities.

The project's IT solution will deliver:

- An integral part of the MK*Smart*2020 smart grid
- IT learning and capability development – a robust, scalable and secure reference architecture for future low carbon network deployment that builds upon existing systems to keep down costs for customers. The licence for this architecture will be made available to all UK DNOs at no cost. Insights gained from the implementation and operation of this new architecture will be disseminated
- A platform for collecting and disseminating knowledge – the research database and portal

The smart grid reference architecture that will be made available to all UK DNOs – called the Low Carbon Intelligent Network Architecture (LCINA) – will cover:

- Data architecture
- Applications architecture
- Integration architecture (end-to-end enterprise integration)

The overall IT solution will provide capacity for managing a diverse set of network end-points connected over a wide area telecommunications backbone in a controlled and sustainable manner. Although new, this IT solution is built upon proven foundations:

- Central Networks' existing network control and customer management systems
- GE's smart grid enhancements to this control system
- Accenture's smart grid integration architecture developed for Xcel Energy's SmartGridCity project in Boulder Colorado and subsequently enhanced by Accenture. Accenture's architecture is called Intelligent Network Data Enterprise (INDE)

Design and Delivery

The project's IT solution has been designed to deliver MK*Smart*2020's target capabilities. Where possible we have selected available and proven solutions. This will reduce delivery risk and ensure that the customer is not paying for unnecessary software development. We went through a systematic process with our External Collaborators, Accenture and GE, to review the target capabilities and identify where existing solutions could meet the project's needs. The table below outlines the capabilities, coverage and further requirements.

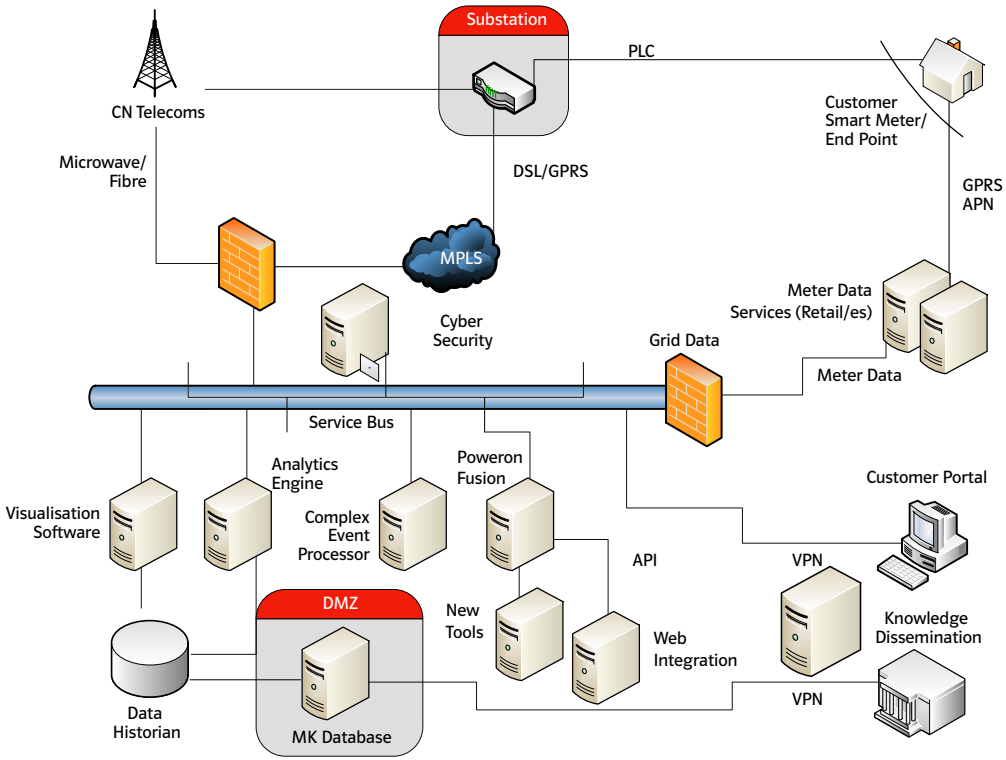
MK*Smart*2020 Capabilities	GE Product Set Coverage	Accenture INDE Coverage	Further requirements
Enhanced Network Planning	No	Supports	Yes (Integration with 3rd party planning & engineering tools & applications)
Meter Data and Retailer Integration (AMI, MDMS, Head-end)	No	Yes	Yes
Maintain Statutory Voltage	Yes	Supports	No
Persistent Voltage Reduction			
Comprehensive Grid State Observability	Yes	Supports	No
Condition-based Operation and Maintenance	Yes	Supports	Potential custom applications
Dynamic Asset Rating	Supports	Yes	No
Outage and Fault Intelligence	Yes	Supports	No
Load Management and Optimisation	Yes	No	Potential custom applications
Enable and Optimise EV Charging and Heat Pump Management			
DG Integration	Supports	Yes	No
Integrated Network Optimisation	Integration of other elements across LCINA		
Market Integration and Optimisation	Largely performed through manual processes with extracts from LCINA		

From the target capabilities, knowledge of our current systems, GE's product set and Accenture's integration architecture we were able to develop an overarching IT design. The principles of this design are as follows:

- Sufficiently close to a possible 'to-be' scale smart grid IT solution that provides insight into future smart grid IT approaches
- Supports collection and structuring of data that will enable target hypotheses to be tested
- Provides interested parties with access to structured project data
- Provides a platform for trialling and evaluating new software (e.g. algorithms for condition-based monitoring developed by Cranfield University)
- Ensures continued safe and secure operation of the Milton Keynes' electricity distribution network whilst new approaches are trialled and evaluated

The high-level design that meets these principles is shown in the diagram opposite.

This IT design will be able to process the high volumes of data coming from devices within the electricity distribution network. The data returned will be processed through a bus architecture, providing access for both real-time and analytical software solutions. This will enable decision support for the network operator, facilitating changes in the real-time operation of the distribution network. It will also provide an analytical platform for testing target hypotheses. A data historian that structures and stores network data will support analysis of network data to test hypotheses and more broadly understand low carbon network conditions and smart grid operation. This will enable knowledge generation and DPCR6 readiness.



The IT solution is built around our existing network control system, PowerOn^{Fusion}, and a new architecture, LCINA. Development will be phased, starting with extension of current capabilities, followed by deployment of an integrated smart grid architecture on which new functionality can be layered. This approach will accelerate learning whilst reducing delivery risk.

Initially, PowerOn^{Fusion} will be utilised and extended to enable connectivity and control at secondary substations. Whilst some new functionality will be added, the process of connecting additional end-points will be similar to existing processes for data management and commissioning. Once connected, PowerOn^{Fusion} can be used to manage new devices installed on the electricity network. Enhanced visualisation will be delivered with new software and tools. This will help control engineers better understand the data coming from the network.

PowerOn^{Fusion} will be further developed by GE to provide an extensive range of new functionality for operating in a low carbon environment. This software development represents a considerable investment by GE to produce the next generation of network control and analytics that will be needed to manage the large amounts of additional data produced and provide decision support tools for efficient network operation.

The development of LCINA will be aligned to this enhancement of PowerOn^{Fusion}. LCINA is the glue that binds together all the different aspects of the IT solution. It manages data, provides a platform on which new applications can be built and integrates all components. This means that applications can get hold of the data they need when they need it, data can be put in the right place and applications can easily talk to each other. LCINA will include meter data processing, interfaces with third parties for meter data transfer and a series of applications supporting analytics, visualisation and decision support across the MK*Smart*2020 capabilities.

As the number of IT access points across the electricity network grows, the exposure of critical infrastructure will increase. This means that a cohesive and robust security strategy is essential. From the start, the overall IT solution will have security built in as a fundamental part of the underlying Low Carbon Intelligent Network Architecture. We will ensure that foreseeable vulnerabilities and emerging trends in smart grid security are accounted for. Because we recognise that security must be an end-to-end priority, at each given point across the smart grid design different security tools will be employed to protect the integrity of the network while ensuring that valid critical information gets through. Every aspect of the solution will be evaluated to identify potential security risks. The appropriate approaches and tools will be deployed to minimise these risks. These include monitoring the infrastructure, communication backbone and end-points, along with security event management including identification, analysis and response, access control and other risk management tools.

7.3: Communications

Introduction

Communications are an important part of a smart grid. The communications backbone enables data and control orders to go where they are needed, providing visibility and enabling network operation to be managed. Communications must be secure, reliable and have high availability. They should also provide value for money. We do not want to invest in solutions that are over-specified, but we do want a communications solution that is flexible in light of future uncertainty. This appendix covers MK*Smart*2020's telecommunications solution. The solution will deliver:

- An integral part of the MK*Smart*2020 smart grid
- Communications learning and capability development

The learning and capability development builds upon work that Central Networks has already completed. The current electricity distribution network includes communications. Central Networks believes that as low carbon networks evolve, the communications solutions that network companies deploy will have to keep pace. This belief, and the work we have already carried out, has informed the development of our operational telecommunications strategy and architecture, which outlines our view of what a communications solution for a low carbon network might look like.

MK*Smart*2020 will provide an opportunity to trial and develop this solution, putting in place important foundations for the future. We will share what we learn to help others take advantage of the same foundations. There are a number of areas of learning that we will be particularly emphasising:

- The role of third-party network assets in the fulfilment of smart grid telecommunications requirements
- Communications as a part of the network asset base
- Fit-for-purpose but cost-effective solutions – precise requirement alignment for areas such as latency, bandwidth and burst handling
- Potential synergies with smart metering communications

Design and Delivery

The telecommunications solution for MK*Smart*2020 will build on Central Networks existing strategy and architecture, linking all measurement devices and end-points (via a distributed communications network) to the control and network management centres.

To design an appropriate solution, we have started with a series of requirements that reflect the capabilities we want to put in place. The project will enable us to refine these requirements. The requirements table below is based upon delivery for the entirety of our network – we want to start with the end in mind so that everything we learn from MK*Smart*2020 is as relevant to the future as possible.

Site Types	Core/Access	Approx Qty	Service Types														
			Protection Class A (Cat 1 - Unit Protection)	Protection Class B (Cat 1 - Distance, HSOC Protection)	Protection Class C (Cat 2 - Intertripping Protection)	Protection Class D (Remote access for protection relays)	SCADA Class A (Grid + Primary Substation)	SCADA Class B (Distribution Substations and Automation Points)	SCADA Class D (Smart Grid)	SCADA Class E (Local Smart Grid)	SCADA Class F (Event recorders)	Emergency Voice Class A (Substation phones)	Emergency Voice Class B (Mobile Radio)	CCTV Class A (Image download)	CCTV Class B (Site Entry)	Management Class A (Remote Access)	Management Class B (Internal OpTel NM)
Control Centres	Core	4				Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y
Grid Interconnect Points (400/132kV)	Core	32	Y		Y	Y	Y				Y	Y		Y	Y	Y	Y
Primary Substations (132/66kV, 132/33kV, 132/11kV)	Core	251	Y		Y	Y	Y				Y	Y		Y	Y	Y	Y
Primary Substations (66/11kV, 33/11kV)	Core	583			Y	Y	Y				Y	Y		Y	Y	Y	Y
Radio sites (if not co-located with any other site)	Core	50										Y					Y
Distribution Automation Points (11kV)	Access	10,000						Y									Y
Distribution Substation (11kV/400V) (inc poles)	Access	89,899						Y									
Smart Grid Hub (May be at Distribution Substation)	Access	2,000						(Y)	Y								Y
Smart Grid End Point (Non 11kV Substations)	Access	100,000								Y							Y
Total Core sites		920															
Total Access		201,899															
Total Substations		90,765															

Central Networks' telecommunications strategy will be developed on a core layer and an access layer, with the following major elements:

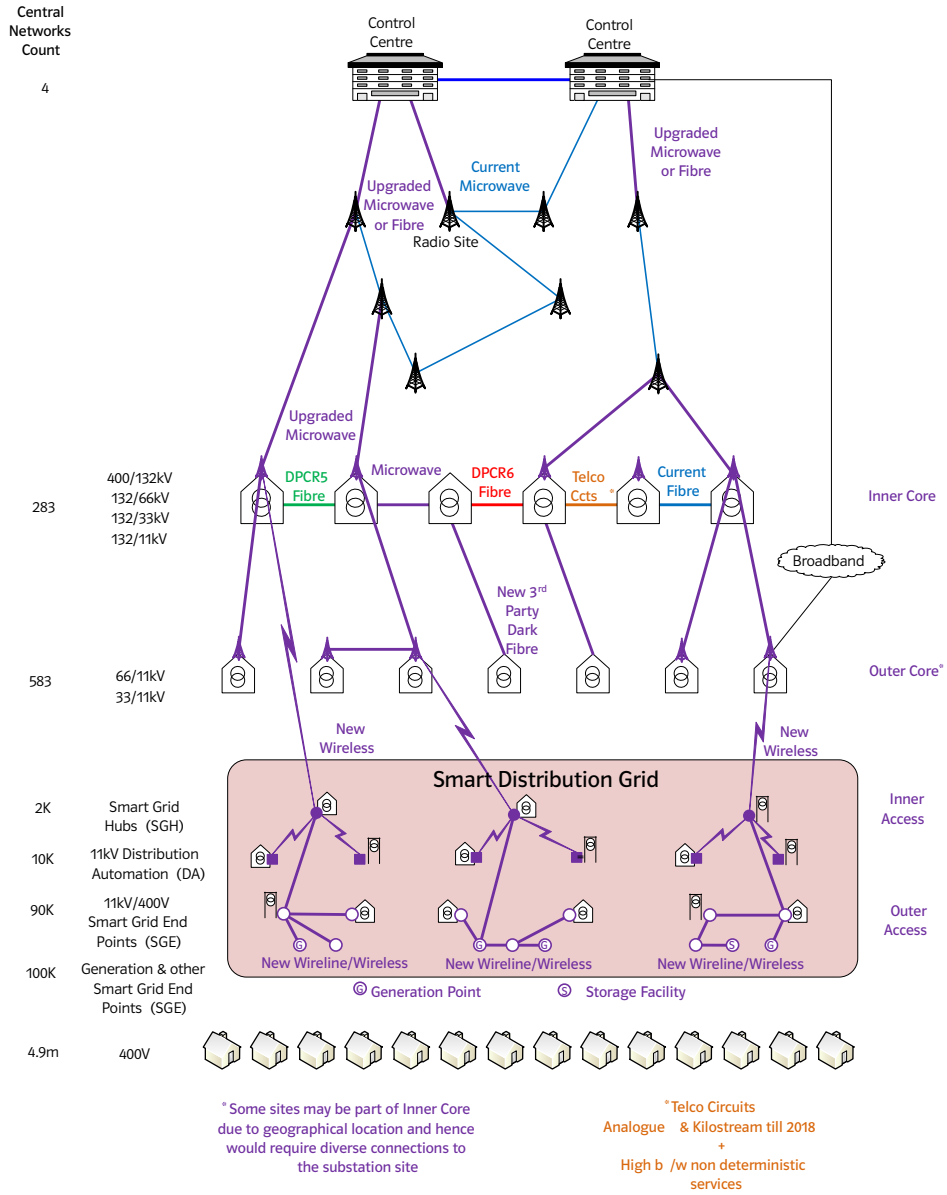
- A fibre infrastructure and microwave-based core
- The use of IP protocol to integrate the elements and allow for ease of data access and build
- A Wireless Access infrastructure for the access layer

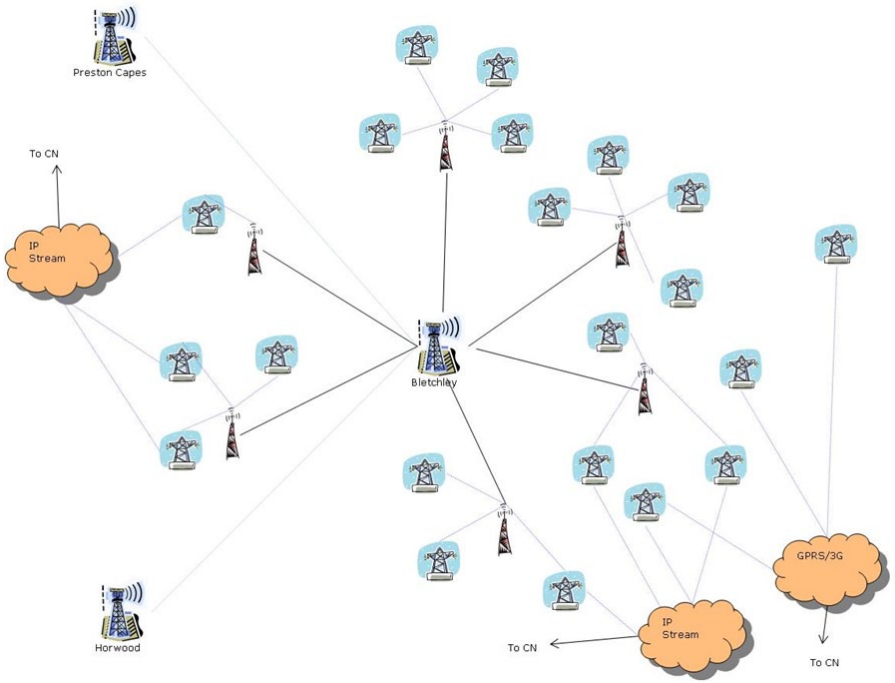
The overall architecture is shown in the figure below. This also shows the relationship between core and access telecommunications networks and the electricity distribution assets.

Applying this approach to MKSmart2020

The approach is to extend the existing Central Networks core network and install 12 satellite UHF radio sites to allow access to the network from MiMOMax UHF radios at remote sites. To complement the radio deployment, ADSL (provided as IP Stream) and GPRS links will be used. The architecture is shown below.

Future Network Architecture



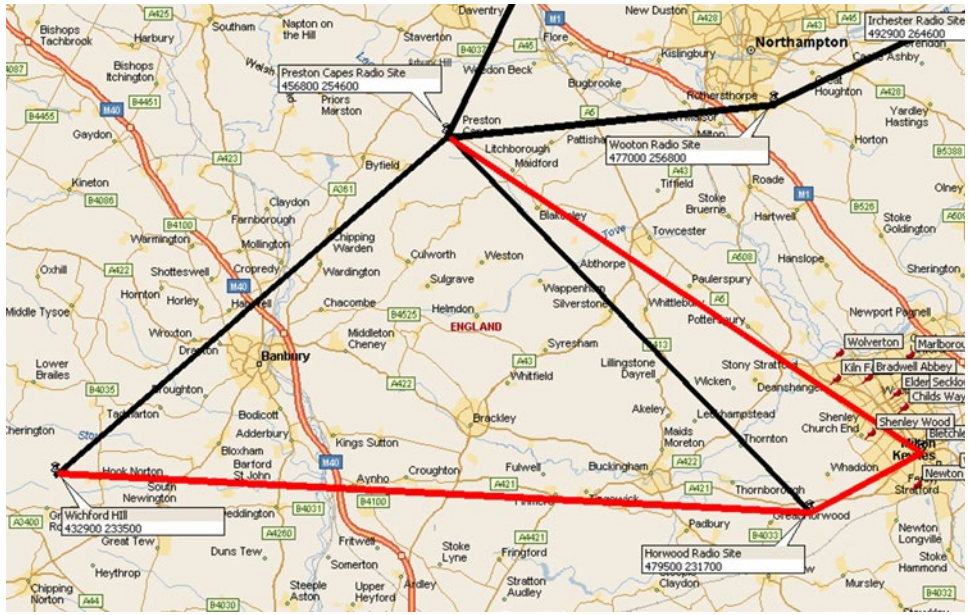


The core

The Central Networks Core will be expanded to link the Primary Sub-stations within the Milton Keynes' area to the existing Central Networks' network. This will require the following activities:

- Inner Core
  - » A new radio tower, at Bletchley
  - » Microwave links to be built from Bletchley into core nodes at Horwood and Preston Capes. This will provide a resilient core
  - » Deploy routers to sub-stations

The inner core diagram is shown below with the existing core network as black links and the new links in red.



- Outer Core:
  - » Deploy 12 smaller towers for MiMOMax Satellite sites, linked to the microwave sites via Ethernet Bridges

The sites for the towers are shown as red points on the map below. Note that 14 sites are shown to allow for options during the radio-planning phase.

- Access Layer:
  - » The interconnect access technology will be realised through Central Networks' deployed assets and third-party assets
  - » This will allow Central Networks to measure the performance and cost/benefit of each approach
  - » Central Networks' deployed assets will consist of UHF radio links using a MiMOMax product. The risk of deployment of this produce has been mitigated through trials undertaken by Central Networks
  - » The third-party assets will consist of ASDL fixed-line links and GPRS mobile radio links

7.4: Network Engineering and Operational Delivery

Introduction

This section describes the technical proposal for the primary and secondary distribution network upgrades within Milton Keynes needed to realise MK*Smart*2020. The network engineering work programme will deliver new measurement and control capabilities through substation sensing and hardware. This will enable us to:

- Gather detailed network data from 33/11kV and 11kV/LV systems and determine how this information can be used to manage and operate low carbon networks
- As demands on the electrical infrastructure become more onerous, ensure new and existing customers continue to receive electricity supplies within statutory voltage limits and of the required power quality
- Identify ways to manage the anticipated increase in network losses arising from higher levels of asset utilisation (made possible by smarter networks)
- Establish how electric vehicles can be connected to the grid in a timely and efficient manner, exploring 'active' control mechanisms
- Trial demand-side management techniques with a variety of customers
- Develop new technical standards and asset management techniques for DPCR6

By supporting these actions, as well as the target capabilities, these investments will allow us to test the hypotheses that we have outlined within the MK*Smart*2020 research agenda. There are also a number of key questions that we want to answer in relation to network engineering and operational delivery. We hope that by answering them we will be able to facilitate the cost-effective deployment of low carbon networks. Specifically:

- How does historic network design or geographic area impact on the need for a smart distribution network and our ability to deploy one?
- What are the existing physical constraints that could delay the move to widespread low-carbon networks?
- What are the practical challenges associated with retrofitting smart functionality to existing substations?

Design and Delivery

Candidate locations for MKSmart2020 investment

We are committed to giving customers value for money from their investment in MK*Smart*2020. For example, we do not believe that the benefits obtained from upgrading every substation in Milton Keynes would justify the level of investment required. The identification of optimum investment targets is therefore a vital consideration, particularly so because we are committed to maximising incremental learning from every pound spent. This thinking has fed through into our approach for selecting which parts of the Milton Keynes network will be made smart.

The obvious place to start is the alignment of smart grid investments with the Low Carbon Living Programme. Known low carbon development zones such as Tattenhoe (1,200 low carbon homes) and the ELVIS (electric vehicle) programme will feature strongly in MK*Smart*2020. We will be aligning smart grid deployment with both these initiatives. These activities represent a unique opportunity to both monitor and respond to 'accelerated' low carbon living, providing us with valuable early insights into the types of investments that may be required during DPCR6 and beyond.

In addition, a range of other locations will be identified for smart grid investment during the detailed planning phase (following site visits) based on the following criteria:

- Network utilisation to provide 2020 reflective network conditions when electrification of transport and heating increases network loads
- Proximity to the deployment of smart meters
- Suitability of assets for retrofitting monitoring technologies and active control systems
- Number of customers benefitting from the investment
- Asset condition
- Alignment with the DRCR5 asset investment work programme (enhancing what we already have in plan)

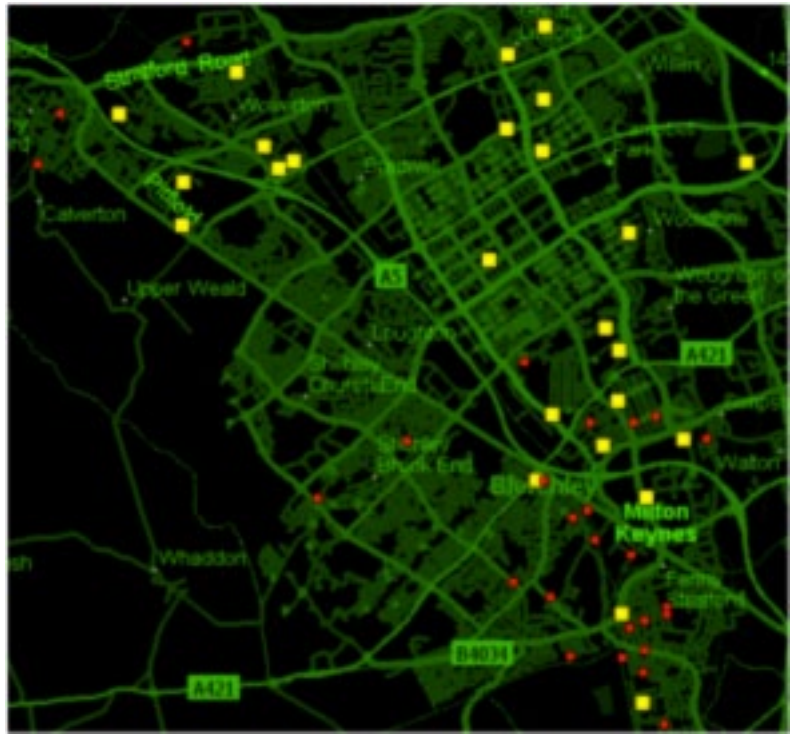
The trial will also cover a variety of network hardware, network configurations and customer demographics – areas of social and private housing, multiple occupancy and individual dwellings of both ultra-modern and existing housing stock dating back to the 70's. This will provide robust data and will support statistical comparison.

The following pictures demonstrate the types of information we have at our disposal to ensure that investments are targeted so as to maximise value for money.

(Red) - Primary Substations

Strategic development areas

(Yellow) - Distribution Substations



(Yellow) - Switchgear changes (i.e. visit planned during DPCRS)

(Red) - Primary Substations

(Blue) - Existing Automation (and hence Comms)

ELVIS - confirmed EV charging point locations (1000 EVs by 2014)

Possible microwave deployment sites

Typical distribution (package) substation

Proposed investment areas

Significant effort has already been made to identify target investment locations, and exact locations and volumes will be finalised after an even more detailed design exercise following the confirmation of funding.

We believe that the types of investments listed below will allow us to meet our key objectives, whilst minimising the level of LCNF investment required through carefully targeted deployments.

Investment	Number	Description
Primary Substations, 33/11kV	7 (of 19)	
Existing	5	New Remote Terminal Units (RTUs), Intelligent Electronic Devices (IEDs) and improved accuracy Current Transformers (CTs) will be installed. Transformer condition monitoring to be installed in one site. These investments will deliver significantly enhanced monitoring capabilities and processing.
New	2	As above, but LCNF will pay for upgrade to design specification. Transformer monitoring to be installed in one site. These investments will deliver significantly enhanced monitoring capabilities and processing.
Secondary Substations 11kV/415	c.200 (of 1319)	
Smart Substation	c.150	Basic IED, temperature sensors and CTs to be installed. This will enable LV monitoring and network data acquisition. It will also allow us to explore dynamic plant ratings.
Smart Substation +	c.50	As above, only these will include advanced IEDs and distributed processing (active network capabilities) with the functionality to gather information from our control smart grid end-points (the extremes of the LV network).
Smart LV Link Boxes	c.10 (of 000's)	New monitoring capabilities in a device that is historically 'dumb.'
LV Voltage Regulators	4	Generally only used on HV networks, but given anticipated increase in microgeneration, voltage management is expected to be an issue. We will be able to evaluate how LV voltage regulators might help deal with such issues.

Appendix 8: Project Readiness and Delivery

Introduction

MK*Smart*2020 will be a complex programme of work spanning a four-year lifecycle. Central Networks' experience and capabilities, when combined with the specialised skills and assets of our External Collaborators, will enable us rapidly to mobilise and reduce delivery risk.

We will put in place a robust and comprehensive delivery approach to drive benefit realisation and manage costs. Controls and governance will be put in place to ensure that customers' money is well spent. We will continually evaluate actual and estimated project cost and customer benefit. As part of our Project Governance structure, progress against achievement of customer benefit will be reviewed by the Central Network's Customer panel, which consists of domestic and business customers.

Through a robust quality management framework we will ensure that remedial action is put in place where we believe the project is not meeting our high quality standards. As part of this process we will consult with Ofgem in the event that major changes and key decisions require escalation to, and approval by Ofgem.

MK*Smart*2020 and many aspects of Milton Keynes' Low Carbon Living Programme are interdependent. These interdependencies make MK*Smart*2020 a unique opportunity for developing the electricity network of the future. But they also create risks. We consider team working to be fundamental to the success of the project, and with this in mind, both programmes will work together to meet each other's needs. This will be further facilitated by a joint development plan and transparent governance structure

We have already demonstrated how we can work together. A series of 'Low Carbon Networks Fund Workstream Lead' meetings have already taken place. These sessions bring together representatives from the Council and Partnership, Central Networks, Cranfield University, Open University and a specialist project manager from the Homes and Community Agency.

During these meetings all the workstream leads (LCNF submission, ELVIS electric transport, Tattenhoe low carbon new development, Homes Demonstrator, building retrofit, business engagement and public engagement and communications) have provided updates and worked together to ensure

alignment across activities and plans. All the workstream leads have also performed a detailed review of the proposal.

Central Networks have also been working outside of these meetings with the business engagement lead to meet with local businesses and discuss opportunities to participate in the MK*Smart*2020 demand side project.

These activities ensure:

- The project is viable and all opportunities to maximise the value of every pound spent have been explored
- The project is well planned and designed with coordination between the Low Carbon Living Programme and MK*Smart*2020 fully covered (timelines, interdependencies and requirements)
- Formal governance structures, informal relationships and other foundations are in place to support rapid mobilisation and delivery

Design and Delivery

The Project Plan

We want to reap the benefits from MK*Smart*2020 as soon as possible. There are a number of ways that we will support this objective:

- Ready to mobilise as soon as funding is announced
- Already have the design foundations in place – reflected in the content of this submission document
- Use the experience and scale of our External Collaborators who have previously delivered similar projects and can call on established global networks of experienced specialists
- Have a robust and integrated plan

We have drawn together people from across Central Networks, our External Collaborators, and the Milton Keynes' Low Carbon Living Programme workstream leads to develop a fully integrated plan. The plan is shown in appendix D.

There are a number of key interdependencies associated with the project plan:

1. MK*Smart*2020 and Milton Keynes Low Carbon Living Programme
2. Deployment is dependent upon detailed design and procurement
3. Telecommunications, network engineering, IT and smart metering are all interrelated and require a high degree of coordination

And a series of contingency actions that can be taken:

1. If aspects of the Low Carbon Living Programme are delayed, cancelled or have their scope cut, MK*Smart*2020 will be able to employ simulation of low carbon network conditions and can cut back on the proportion of the network where smart grid functionality is installed
2. Functionality can be layered to enable aspects of the build to begin prior to full completion of design and procurement
3. Other communications solutions such as GPRS could act as a contingency option, the IT deployment can be phased and network coverage can be adapted if issues are encountered

The Project Management Office

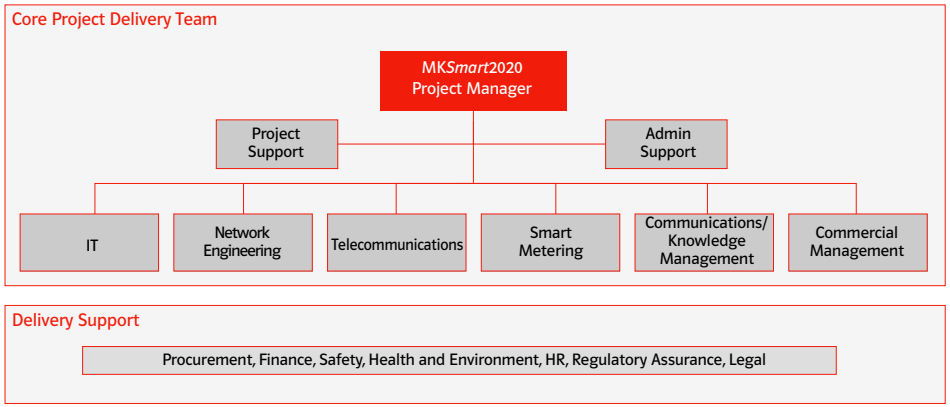
An integrated project management office across all of MK*Smart*2020 will be essential. To ensure effective and efficient project delivery, we will adopt Prince2™ project management methodology and tailor it to our needs. The PMO will be responsible for:

- Cross-project coordination and integration
- Governance management including linkage between MK*Smart*2020 and the Low Carbon Living Programme
- Performance and reporting (including Delivery Success Criteria and benefits realisation)
- Scope and requirements management
- Planning and tracking
- Issue management
- Risk management
- Quality management
- Stakeholder engagement and communications
- External Collaborator management
- Supplier management
- Financial management, audit and control

As soon as funding is announced the PMO will be mobilised and will put in place the key project foundations. These include

- Project Plans – construct robust and detailed plans, outlining critical path activities, key dependencies and contingency arrangements
- Project Delivery Success Criteria – relationship of Delivery Success Criteria to deliverables, dependencies, risks, responsibilities and accountabilities and the project reporting and quality management framework
- Project Reporting and Risk and Issue Management – develop key project metrics, accountabilities, risk and issue management and escalation and process for managing suspension and cost overrun
- Project Governance – establish governance framework including lines of reporting, ways of working, membership, roles and responsibilities and schedules

The PMO will link together with the project managers for each of the workstreams and use Central Networks functional teams for delivery support.



Risks and mitigating actions

The known project risks associated with MK*Smart*2020 project delivery are outlined below, each with a mitigating action:

Risk	Mitigating action
• Milton Keynes' Low Carbon Living Programme is not implemented as a result of local authority spending cuts	• Central Networks has already worked extensively with the Low Carbon Living Programme workstream leads • A comprehensive joint governance structure to be established with Milton Keynes to support coordinated delivery • The entire project is not dependant on the Milton Keynes Low Carbon Living programme. For example, Milton Keynes is only an enabler to Central Networks industrial and commercial customer engagement
• Smart Metering roll out is not implemented in the timescales required by MK*Smart*2020	• The smart metering Project Manager will form part of the core project delivery team to ensure roll out is closely coordinated and issues/risks/dependencies are managed effectively
• EU requirements for competitive tendering could impact on delivery timescales if specific products/ services being procured are beyond the thresholds	• Determine requirements with E.ON procurement and plan for any potential EU tendering requirements
• Following the election, the ongoing role of Milton Keynes Partnership is unknown. Central Networks has built many strong relationships within the partnership and the decision could delay the delivery of the Low Carbon Living Programme	• Pre-bid submission, work is being done to strengthen Central Networks relationships with Milton Keynes Council. This strengthening will continue post submission
• Assumed that there will be line of slight between the radio sites	• An initial radio plan activity has been undertaken
• Planning permission may not be granted for the radio tower	• Start the application early • Contingency plan to use a fixed line link until the planning permission is granted
• Smart grid IT involves large data volumes, a high degree of system integration and a number of new applications	• Use Accenture and GE's proven solutions as foundations • Layer on functionality
• Integration and interoperability of equipment	• Work closely with partners and vendors to ensure interoperability • Effective contracts to ensure that all vendors work together to resolve integration issues
• Network installation challenges	• Perform review of target assets prior to installation • Carry out series of pilot installations to learn key lessons and develop capabilities for scaling

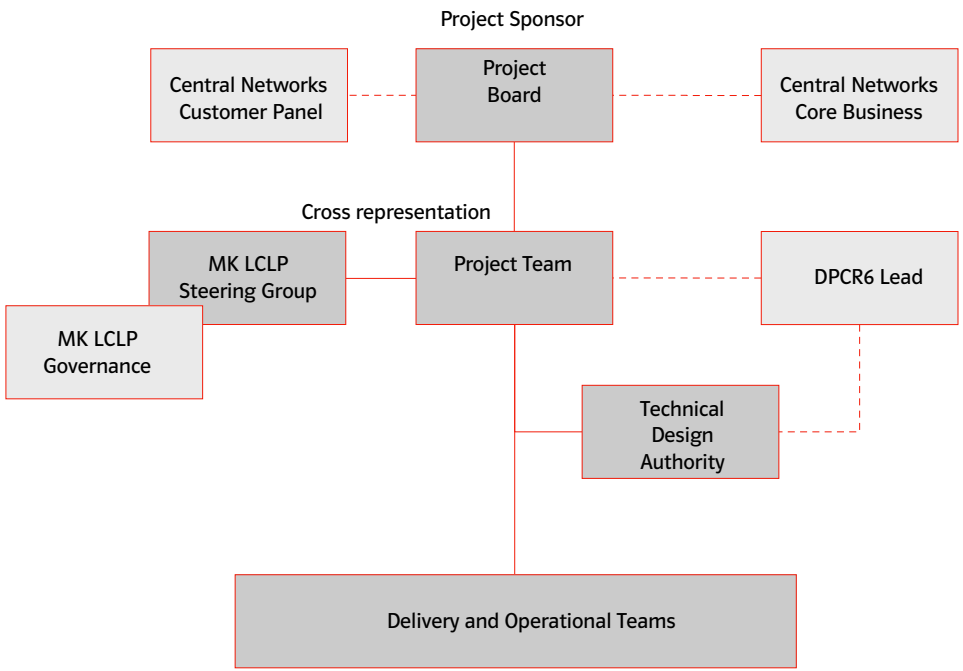
Project Governance

The governance structure will enable a number of outcomes:

- Alignment between MK*Smart*2020 and the Milton Keynes Low Carbon Living Programme
- Coordination between MK*Smart*2020 and DPCR5 delivery
- Alignment of MK*Smart*2020 with Central Networks network and regulatory strategy and DPCR6 submission to maximise the customer benefits generated from project learning
- Management of interdependencies and risks across the project workstreams
- Alignment of project deliverables with the Delivery Success Criteria
- Stringent cost management and value delivery

The governance structure will include processes for day-to-day management as well as those required to determine when it may be appropriate to suspend the project or flag to Ofgem that it may have to apply for a cost over-run. The project governance structure has a number of elements:

- Project Board (meets monthly)
  - » Members: Project Manager, Central Networks senior management, senior External Collaborator Representatives and representatives from Milton Keynes Council and Partnership
  - » Roles and Responsibilities: addressing critical cross programme delivery risks and issues, coordinating cross partner responses, owning the suspension and cost over-run process, tracking against high level milestones, coordinating across Central Networks, financial tracking and control and reviewing against Successful Delivery Reward Criteria
- Central Network's Customer panel (Meets 6-montly) progress against achievement of customer benefit will be reviewed by a panel of independent domestic and business customers
- MK LCLP Steering Group (meets quarterly): coordinates activities between MKLP and MK*Smart*2020. Feeds into LCLP governance structure
- Project Team (meets weekly)
  - » Members: Project Manager, workstream leads (External Collaborator representatives and Low Carbon Living Programme representatives as required)
  - » Roles and Responsibilities: workstream management, DPCR6 feed in as required, developing Project Board inputs, financial tracking and management and delivery tracking and escalation
- Technical Design Authority: ownership of solution, alignment with objectives and research plan and ongoing review and management against the target solution. Contains technical experts from Central Networks, E.ON and External Partners
- Delivery and Operational teams: manage workstream risks, issues, plan, costs and milestones (standard weekly reporting template to feed into Project Team)



There will be a specific process for suspension and cost over-run management.

- Risk and issue log categorisation to identify potential for suspension or cost over-run. Standard risk / issue review will include evaluation of whether issues could lead to cost over-run or justify suspension
- Review paper produced
- Project Board assessment, response plan and escalation
- Project Board review followed by suspension and flag or mitigating action with focused ongoing management to resolution

Appendix 9: Benefits Case

Introduction

Low carbon network pilots such as MK*Smart*2020 are instrumental in ensuring that the low carbon future is delivered cost effectively and reliably.

MK*Smart*2020 will provide the learning and expertise to cost effectively deliver a low carbon electricity distribution network, which will directly feed into our DPCR6 plan. Our comprehensive knowledge dissemination approach will ensure that learning will be shared across the industry to ensure the GB-wide adoption of those capabilities which we believe are the most effective.

Our GB-wide business case is based upon the principle of deploying the MK*Smart*2020 capabilities across the UK. The MK*Smart*2020 capabilities are described in appendix 7.1. These capabilities will enable the delivery of a variety of benefits.

The business case includes a series of assumptions and sensitivities that MK*Smart*2020 can help evaluate. It will provide data and insight that will help with the evaluation of particular smart grid investments.

Our business case gives an NPV of £8.6bn out to 2050 with smart grid investments gradually layered from 2015 to 2025 with a discount rate of 3.5%. The submission spreadsheet assumes that the project starts in 2011.

Our approach

The benefits that we have quantified

Low carbon networks will actively facilitate low carbon choices. They will enable network companies to manage the electricity network impact of these choices in a more cost effective way by deferring and avoiding network reinforcement. The benefits which we have quantified include:

- Deferral and avoidance of reinforcement associated with growth in distribution connected generation
- Reduction in reserve market requirements due to increased competition with demand side products being offered alongside flexible generation capacity
- Energy saving attributable to dynamically managed persistent voltage reduction (independent of dynamic voltage management to optimise network utilisation and then integrated)
- Avoidance of peaking generation plant build and operation due to the growth and allocation of demand side load facilitated by demand side activities for local network management.

The benefits that we have not quantified

- Deferral and avoidance of reinforcement associated with transport and heating electrification - involves avoiding reinforcement and shaving peak demand instead of conventional reinforcement which would only be used periodically over the year
- Demand side competition: Network companies can be expected to support growth in the demand side from retailers and aggregators and its integration into market and balancing activities. This will help ensure that benefits are passed through to the customer
- Cost saving from metering and network communications and data synergies: There may be opportunities to reduce the cost of the mandated smart metering deployment by exploiting synergies between the smart grid and metering communications and data infrastructure.

Benefit assumptions and data sources

Carbon Benefits

Smart grid will not deliver material direct carbon savings. Electrification of heating and transport as well as decarbonisation of the power sector will reduce the carbon content of the industry. Low carbon networks will facilitate and accelerate this transition to a low carbon economy. Hence, it is the cost savings of the low carbon network not the carbon benefits that are the focus of our benefits case. This view aligns with that presented in the ENSG Smart Grid Vision CBA, endorsed by ENSG which is chaired by DECC and Ofgem.

Whilst smart grid capabilities around persistent voltage reduction will deliver direct energy savings and hence carbon savings these will diminish as the generation fleet is decarbonised. In the case of the benefits attributable to persistent voltage reduction we have used the annual benefit identified in the ENSG Smart Grid Vision CBA. The electricity price this benefit is based upon is assumed to include tradable carbon costs.

Low carbon networks may support the growth and allocation of the demand side. This has the potential to accelerate and increase the displacement of carbon intensive back-up generation in the form of open cycle gas turbines and combined cycle gas turbines beyond the levels expected if the demand side were not pursued for local network management. This will deliver benefits in terms of avoided generation investment and operation. We have used the same electricity price as that used in the ENSG Smart Grid Vision CBA to account for the benefit associated with avoiding generation investment and operation costs.

For the purposes of this business case we have only factored in the carbon benefit where we deem it credibly attributable to the smart grid investments costed within the business case. For example the most material carbon savings come from the electrification of heating and transportation in conjunction with the decarbonisation of generation. Whilst smart grid will allow ensure these changes occur with reduced network investment as well as at an accelerated pace, (a central aspect of MK*Smart*2020), the carbon benefits are attributable to the investment in new cars, heat pumps and power plants not smart grid. We are not therefore including the associated carbon benefits. In the case of persistent voltage reduction and the displacement of back-up generation by demand side growth we are attributing benefits to smart grid investment through a price of electricity assumed to include tradable carbon costs.

Other Benefits

Benefit	Approach and Assumptions	Data Sources
Reinforcement saving associated with transport and heating electrification	• The ENA analysis has shown the potential savings on distribution network reinforcement that can be realised by shifting customer load given local network constraints (enabled by smart grid capabilities for network observation and demand response management) • MK*Smart*2020 includes additional functionality such as dynamic rating, condition based monitoring and dynamic voltage management that could increase these benefits further • We have taken the 50% penetration scenario to 2030 and allocated the benefits evenly across the years from 2015 to 2030 • We have taken the additional benefits identified by the 75% scenario and allocated the benefits evenly across the years from 2031 to 2050	• ENA, Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks

Benefit	Approach and Assumptions	Data Sources
Reinforcement saving associated with DG	• Central Networks Skegness RPZ project realised £3-5m of reinforcement saving from a £500K investment • We anticipate that there will be small scale DG penetration including the EU funded bus station solar array in Milton Keynes • MK*Smart*2020 does not include dynamic ratings of overhead lines • MK*Smart*2020 does include dynamic rating of substations, load and voltage sensing and the data processing and analytics able to evaluate real time network capacity and then take action • Hence, we believe that MK*Smart*2020 will contribute further to reinforcement savings associated with the integration of DG • Approach takes the saving achieved in Skegness per MW of new generation connected • Annual distribution connected generation forecasts from Central Networks' 'Green World' scenario • Multiply new generation MW by 50% Skegness saving (accounting for fact that smart solutions will not be appropriate for all network circumstances)	• Central Networks Skegness RPZ • Central Networks 'Green World' scenario
Energy saving from persistent voltage reduction	• Assumed an £81m per year energy saving • Scaled from 2015 to 2025 according to percentage of smart grid investment made (100% from 2025 onwards) • Electricity price used in the ENSG CBA includes the cost of tradable carbon (ETS the driving mechanism) – takes a high level assumption about the price of electricity out to 2050 of £0.1 per kWh (selected to be a conservative price given the extensive end to end power system investments that need to be made out to 2050 to replace, expand and decarbonise the UK's electricity infrastructure)	• ENSG Smart Grid Vision CBA

Benefit	Approach and Assumptions	Data Sources
Displaced back-up generation	• Low carbon network contribution to accelerating, increasing and efficiently allocating demand side resources • Assumed levels of generation displacement by the demand side from Central Networks 'Green World' scenario (evenly distributed from start year to end year): » 2015-2030 - 8GW OCGT by 2030 - 2GW CCGT by 2030 » 2031-2050 - 3GW OCGT by 2050 - 2GW CCGT by 2050 • We believe this level of displacement is feasible given increasing generation intermittency and inflexibility and the large increase in interruptible load attributable to the electrification of heating and transportation • Assumed electricity price to 2050 of £0.1per kWh (same as ENSG Smart Grid Vision CBA) • OCGT and CCGT load factor of 10% on basis of installed capacity at the mid-year point • Smart grid adjustment of 10% to account for contribution of the saving attributable to low carbon network investment	• ENSG Smart Grid Vision CBA • Central Networks 'Green World' scenario

The costs

We have developed a robust set of cost data for the equipment required to deliver the MK*Smart*2020 capabilities across the country:

- All the unit cost data for network hardware has been taken from the MK*Smart*2020 cost estimation
- The communications cost has been derived from the MK*Smart*2020 design and cost estimation methodology
- The IT costs have been taken from the Accenture data used in the ENSG Smart Grid Vision CBA. We have not used the MK*Smart*2020 cost estimates as they relate to a pilot scale IT architecture.

Cost assumptions

- All the costs decrease at 2% from 2015 onwards per year to account for economies of scale and increasing levels of competition and innovation in the market for smart grid products and services
- We have assumed that all the network hardware will need to be replaced according to the original deployment schedule after 20 years beginning in 2035 and ending in 2045. We have assumed that the cost of the replacement deployment will be 20% lower than the original deployment due to technical development
- The costs are distributed across an assumed delivery timeline (same distribution from 2035 to 2045):

Deployment cost phasing	2015	2016	2017	2018	2019	2020
Annual percentage	2%	3%	4%	5%	6%	7%
		2021	2022	2023	2024	2025
		15%	15%	15%	15%	15%

- It is significantly cheaper to replace primary substations with smart grid functionality in-built than to retrofit. To account for this we have assumed that 1% of primary substations are replaced per year and that these have smart grid functionality built in. This means that 11% of primary substations are replaced rather than retrofitted
- We do not believe that all network assets will have expensive smart grid functionality installed. To ensure customers get value for money functionality will be targeted toward local need. For this reason we have assumed that a percentage of assets have certain level of increased functionality:

Percentage primary substations with transformer monitoring	5%
Percentage secondary substations with voltage regulators	2%
Percentage secondary substations with advanced IEDs	10%
Percentage secondary substations with distributed intelligence	5%

- We have assumed that the cost of load control technology (smart appliances, smart thermostats, EV load control, building management systems, smart meters and in home displays) will either be included within the cost of the smart metering deployment or will be covered by the falling price of appliances, heat pumps, EVs and building management systems that will include load control functionality as standard
- There are costs for PMO and business change that we have assumed to be 2% of the total cost of IT, communications and network hardware
- The costs account for both the original cost deployment and the cost of operation, ongoing maintenance and ICT upgrades and ongoing development. We have calculated this annually as 2% of the original network hardware and ICT investment. In the case of system operation in terms of increased network control engineer headcount (10 people per DNO).

The Central Networks' 'Green World' Scenario

In order to construct the GB-wide business case we have in places used Central Networks' 'Green World' scenario (we have aligned the data taken from the ENA analysis with this scenario through the selection of the appropriate penetration rates). We believe that this scenario represents a viable transition path to cost effectively meet the UK's carbon targets in 2020 and 2050. The key aspects of this scenario are as follows:

- Installed DG capacity of 22GW by 2030 which includes PV, onshore wind, other renewables generation as well as CHP
- Nuclear capacity of 16GW by 2030
- Total Wind and other renewables capacity of 44GW by 2030
- Back up capacity requirements greater than 35GW in the form of CCGTs and OCGTs
- Significant levels of heat pumps, approximately 16m air source and ground source by 2030
- Approximately 30m electric vehicles by 2030 which would account for 50% penetration.

Discussion of the business case approach and key sensitivities

Business case approach:

The business case approach has not attached specific benefits to specific capabilities. Nor has it looked at the tailoring of capabilities to specific local network conditions and localised adoption rates. This approach reflects the realities of smart grid and the gaps in empirical data and understanding that pilots such as MK*Smart*2020 will help address:

- There is probably a high degree of overlap in the benefits available to each capability and a complex interplay between capability layering and incremental benefits. Of particular importance are the potential network benefits that could be realised by smart meter enabled demand response dispatched for system balancing or wholesale market risk management. This will depend upon the extent to which national system driven dispatch meets local network requirements for deferred and avoided reinforcement
- The relationship between adding capabilities that increase network capacity and realising benefits is not expected to be linear. It will also vary depending upon local circumstance. Achieving a hypothetical additional 1% of capacity by adding in another capability might seem inconsequential. But if this 1% enables ten years of reinforcement deferral the business case could be extremely strong
- In some circumstances smart grid solutions won't have time to realise deferral benefits as the pace of adoption forces reinforcement
- In some cases it may be more cost effective to replace with bigger assets in the expectation of high levels of low carbon adoption. If the increased cost of putting in more cable is small combining replacement with reinforcement could in some situations displace the use of smart grid solutions.

Sensitivities:

- GB benefits are sensitive to the willingness of customers to enter into commercial arrangements that can deliver reinforcement savings whilst maintaining expected security of supply standards. If network redundancy is reduced then network operators require a very high degree of confidence that demand response load will be there when they need it. This will need to be true every minute of every hour of every day. This highlights the importance of customer engagement and compelling customer propositions
- The costs are sensitive to the proportion of the network that requires coverage of base smart gird functionality and the more expensive equipment such as transformer condition monitors and voltage regulators. MK*Smart*2020 will provide a better understanding of the incremental benefits associated with this more expensive equipment and the enhanced functionality it provides.

Appendix 10: External Collaborators

Introduction

Careful thought and consideration has gone into picking the right External Collaborators for MK*Smart*2020. We've worked with many organisations and companies, both big and small, to maximise project learning and to reduce delivery risks.

We've pulled together organisations from the public and private sectors, including from sectors not traditionally involved in energy projects. Our major bid partners, Accenture, GE and Cisco systems, are as excited as we are about being part of building a world class, city wide Smart Grid. To demonstrate this they are planning to make substantial contributions to the project during the delivery phase and they have already helped to fund the project definition stage. In preparing this bid document, where it was needed, we've also taken advice from many other companies and organisations. Those who have been most involved are outlined in this appendix.

Our External Collaborators have now been working with us since the beginning of the year, and we know we've the right partners to ensure MK*Smart*2020 is a success.

External Collaboration Strategy

Before we selected our designated External Collaborators, we carried out thorough research and met with many organisations. We were also active at exhibitions and conferences, to ensure that our aspirations to be a low carbon leader were widely known. We've also engaged with stakeholders and customers through our external forums, originally established during DPCR5 planning, but now embedded into our business as usual.

Our collaboration strategy for MK*Smart*2020 has the following characteristics:

- Full integration of project into the broader, city wide low carbon strategy for Milton Keynes. This means close cooperation with the key public sector, community groups and citizens across the city
- Positioning the customer at the heart of our project. This means working with companies across the energy delivery chain, and looking at what we deliver from a customer perspective.
- Learning from and building upon previous Smart Grid projects from across the globe. This means choosing bid partners who have world class experience of developing new solutions and delivering network innovation.
- Ensuring we have a broad mix of experience and perspectives on our project. This means building a network of organisations to advise on and steer our project – not just our usual suppliers.
- Maximising value for money for our customers. This means making sure that collaborators recognise any value to their own organisations of being involved in the project.

MK*Smart*2020 – External Collaborator Organisations

The companies and organisations we are working with fall into the following groups:

- Milton Keynes Municipality
- Bid Partners
- Energy Collaborators
- Research Partners and Learning Dissemination
- Project Advisory Collaborators

Milton Keynes Municipality

Milton Keynes Council (MKC)

Who are they and what do they do? Milton Keynes Council is a unitary authority in South-East Midlands. MKC serves a population of 230,000 and is planned to grow to circa 350,000 (making it the tenth largest city in the UK).

Their involvement in MK*Smart*2020: Through their commitment to becoming a Low Carbon exemplar city, they have set out to deliver the Low Carbon Living Programme. MK*Smart*2020 is a critical to facilitate the delivery of the desired outcomes.

We will be working alongside MKC throughout the delivery stage of the project, and in particular supporting each other's communications and interaction with residents / customers and businesses.

Milton Keynes Partnership (MKP)

Who are they and what do they do? In January 2004, the UK government announced expansion plans for Milton Keynes. It was proposed that the population of Milton Keynes should double in the subsequent 20 years. Milton Keynes Partnership, part of the Homes and Communities Agency (HCA) was established to do so. MKP has full planning controls for the expansion areas rather than MKC.

The Partnership brings together Milton Keynes Council, HCA, Local Strategic Partnership representatives from the health, community and business sectors

and independent representation. The role of MKP is to co-ordinate and implement the delivery of growth, ensuring that homes, infrastructure, jobs and community facilities are provided as part of a joined up approach.

Their involvement in MK*Smart*2020: MKP has been the architect of the Low Carbon Living Programme. We have worked closely with them throughout the project definition phase and our project team have co-location facilities within their offices in Milton Keynes.

MKP have introduced us to many local groups and interested parties. Regional and local organisations have helped us to engage with local businesses, for their services or to gain their participation in the project (for example as demand response customers).

MKP are principally responsible for the "Homes Demonstrator" aspect of MK*Smart*2020 but are also co-ordinating our interaction with the following MKC projects:

- anaerobic digestion and biogas injection
- electric car and infrastructure

Bid Partners

Accenture

Who are they and what do they do? Accenture is a global management consulting, technology services and outsourcing company, with more than 190,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. Their involvement in the widely acclaimed 'SmartGridCity' project with Xcel Energy and Boulder, Colorado demonstrates Accenture's experience around Smart Grids and associated strategies, technologies and thought leadership.

- Xcel Energy initiated a broad program to bring to fruition the concept of Smart Grid to its network in Boulder, Colorado
- Its vision includes a fully network-connected system that identifies all aspects of the power grid and communicates its status and analyzes the impact of forces (e.g., economic, environmental and reliability related) in order to automate decision-making and actions on that network.
- Xcel Energy partnered with Accenture as well as specific product specialists within the industry to build the first version of the Smart Grid in North America.

Accenture was the strategic and technical advisor and chief consulting engineer, as well as the systems integrator, for the SmartGridCity programme. During the programme Accenture developed, built, tested and deployed an integrated smart grid IT architecture. This has been developed further to become the Intelligent Network Data Enterprise (INDE). The INDE asset can be

used to accelerate and reduce the risk associated with smart grid delivery.

The Lead Technical Architect of 'SmartGridCity' has been part of our team developing MK*Smart*2020.

Their involvement in MK*Smart*2020: Acting as Bid Partner Accenture have jointly developed the MK*Smart*2020 proposal with Central Networks. This includes substantial contributions to the systems and data architecture, as well as helping to define hypothesises to be tested in the accompanying research programme.

We fully expect to continue working with Accenture as Delivery Partners following project award. This expectation is reflected in a Memorandum of Understanding between our organisations and demonstrated by their substantial contribution to the cost of the project.

As a likely Delivery Partner, Accenture will take on the role of Systems Integrator, including the development of a standard IT architecture for UK smart grids. that builds upon the proven INDE asset. They will also support research and knowledge dissemination efforts by drawing on their global network, including utilities and smart grid specialists and their global smart grid experience.

General Electric (GE)

Who are they and what do they do? The General Electric Company, or GE is a multinational conglomerate corporation. In 2010, Forbes ranked GE as the world's second largest company. The company has 304,000 employees around the world.

GE has been defining and delivering multi billion dollar electricity grid solutions globally for over 100 years. GE views the development and deployment of a smart grid as a transformation of the whole utility sector, its context and its stakeholders. As a leading solution provider to every element of the power value chain, from generation to consumption, GE holds an unrivalled perspective of the Smart Grid opportunity and is well positioned to support MK*Smart*2020.

Their involvement in MK*Smart*2020: As Bid partner, GE has brought its experience and knowledge of our legacy IT system interfaces to evaluate the most effective migration path for optimum integration of Smart Grid technologies and future solution scalability.

They have also helped to develop our target IT system architectures, defined the necessary extensions of communications protocols and planned the substation elements for the smart grid telemetry at substations.

We fully expect to continue working with GE as Delivery Partners following project award. This expectation is reflected in a Memorandum of Understanding between our organisations and demonstrated by their substantial contribution to the cost of the project.

As a likely Delivery Partner, GE will take on the necessary enhancements to our Network Management and Control Systems. They will also continue to contribute to our engineering design authority.

Cisco Systems

Who are they and what do they do? Headquartered in California, Cisco Systems has more than 65,000 employees and is the worldwide leader in networking that transforms how people connect, communicate, and collaborate. Founded in 1984, Cisco pioneered the development of Internet Protocol (IP)-based networking technologies.

This tradition continues with the development of routing, switching, and other network-based technologies such as application networking services, collaboration, home networking, security, storage area networking, TelePresence systems, unified communications, unified computing, video systems, and wireless.

As an innovator in the communications and information technology industry, Cisco and their partners work alongside businesses of all sizes, governments, service providers, and consumers.

For the smart grid Cisco is developing an end-to-end, IP-based, highly secure communications infrastructure, from generation to consumption. It will enable DNOs and other organizations in the energy industry to build secure, standards-based IP communication networks. Efficiently meeting the demands of energy generation, distribution, storage, and consumption.

The Cisco portfolio includes industry-leading communication networking equipment and computing platforms that cover the spectrum of requirements for a scalable, reliable, and secure smart grid.

Their involvement in MK*Smart*2020: As Bid Partner, Cisco has supported the development of the IT architecture, and has also provided specialist assistance to our other Bid Partners.

We fully expect to continue working with Cisco as Delivery Partners following project award. This expectation is reflected in a Memorandum of Understanding between our organisations and demonstrated by their substantial contribution to the cost of the project.

Cisco has offered to provide the necessary smart grid routing and switching equipment for MK*Smart*2020 at a discounted price level. Furthermore they will provide the project with specialist support and services during the network design, build and subsequent phases which will be partially granted free of charge. In addition, it is likely that MK*Smart*2020 will become a base for field testing of new products, aimed specifically at the smart grid market, positioning the UK at the forefront of smart grids in Europe.

Energy Collaborators

E.ON Energy

E.ON has the largest proportion of electricity customers within Milton Keynes. They have worked with us to develop the smart metering aspects of the project, and requested the opportunity to be involved in the delivery phase.

E.ON have already committed to rolling out 20,000 "DNO suitable" smart meters as part of MK*Smart*2020 at their cost. A substantial contribution to the project.

EDF Energy

EDF Energy has responded to our invitation to all retailers to participate in the MK*Smart*2020 programme. We are currently discussing with them the nature of their involvement, but anticipate smart meters being fitted at some of their customer's properties.

British Gas

British Gas has also responded positively to our invitation to participate in the MK*Smart*2020 programme. British Gas are the second largest electricity retailer by customer numbers for Milton Keynes. Our discussions are centred around the early installation of smart meters and the integration of smart grid and smart meter communications.

Scottish Power

Scottish Power has recently responded to our invitation to participate in the project. They have requested further information and a meeting.

National Grid

We have consulted with National Grid on the impacts of MK*Smart*2020 on the DSO / TSO interface. We are also discussing with them the aggregation and system balancing aspects of MK*Smart*2020 and how best to integrate these into the national systems for the purpose of the demonstration project.

Research Partners and Learning Dissemination

Cranfield University / IVHM Centre

Cranfield University is a British postgraduate university based at Cranfield, Bedfordshire. Cranfield University has multi-domain expertise in power engineering. Cranfield School of Engineering has a Department of Power and Propulsion and Department of Offshore Energy Engineering. Recently, the Vice Chancellor, Professor Sir John O'Reilly, made an active decision to create an additional chair in Power Engineering to support low-carbon initiatives. Cranfield University has worked on several projects related to Smart grids. Cranfield University is also part of the "Electronics Enabling the Low Carbon Economy" Innovation Network which aims to facilitate the development of key technologies that have the potential to significantly impact carbon emissions in the UK and beyond.

The Boeing Company founded the Integrated Vehicle Health Management (IVHM) Centre located at Cranfield University. Boeing has now been joined by BAE Systems, Rolls-Royce, Meggitt, Thales, the Ministry of Defence and Alstom Transport. The increasingly important area of IVHM technology informs existing concepts of vehicle maintenance, repair and overhaul by offering a total health-check for high-tech, high-value vehicles such as aircraft, ships, high-speed trains and high-performance cars.

The IVHM Centre aims to apply these Integrated Health Management technologies to the MK*Smart*2020 in order to evaluate the potential to combine condition-based monitoring, predictive models, dynamic rating, enhanced network control and advanced simulation and planning to defer and avoid network reinforcement and optimise asset replacement. The Centre also hope to develop algorithms, visualisation techniques, simulation models and planning and design standards that allow what works to be rapidly scaled across the UK.

The Open University

The Open University is a distance learning university founded and funded by the UK Government. It is notable for having an open entry policy, i.e. students' previous academic achievements are not taken into account for entry to most undergraduate courses. The majority of undergraduate students are based in the United Kingdom, but its courses (both undergraduate and postgraduate) can be studied anywhere in the world. There are a number of full-time postgraduate students based on campus where they take courses and attend the OU facilities for research.

The administration is based at Walton Hall, Milton Keynes in Buckinghamshire, but has regional centres in each of its thirteen regions around the UK. It also has offices in other European countries.

With more than 180,000 students enrolled it is the largest academic institution in the UK and Europe by student number, and qualifies as one of the world's largest universities. Since it was founded, more than 3 million students have studied its courses.

MK*Smart*2020 will draw upon both the Open University's expertise for public engagement through mass and web-based media and its specific experience of engaging users of low carbon technologies. The University has large and well-established resources on energy and environmental issues that support its teaching, research and outreach work in Environment and Energy issues. It also has a large teaching programme in Environment, Development and International Studies that includes, for example, the popular course T206 Energy for a Sustainable Future.

Organisations acting in an advisory capacity during project development

British Telecom (BT)

BT Group plc is the largest provider of fixed telephony in the United Kingdom and is the oldest and one of the largest communication companies in the world, with operations in more than 170 countries. BT have advised on communications options, and provided their costing tools to assist in cost estimating.

In addition, we have agreed to work together during the delivery phase of MK*Smart*2020 to align our construction activities with BT's deployment of super high speed broadband in the city over the same period. Further we have agreed to explore the mutual benefits of combining parts of high speed broadband, smart grid and smart meter communications infrastructure.

Flexitricity

Flexitricity is a major supplier to National Grid of balancing services. National Grid pays Flexitricity to hold reserve available, and makes further payments when this reserve electricity is required. In turn, Flexitricity shares these payments with its clients, who own the assets Flexitricity uses.

We have discussed the commercial and VPP elements of our project with Flexitricity on number of occasions. In turn they have shared their own views on how a local distribution system can be best integrated into the national system from a market perspective.

We have developed a close relationship with Flexitricity and anticipate their further involvement as delivery partners.

ElectraLink

Fulfilling DNO Licence Condition 38, ElectraLink was set up back in 1997. The core network the Data Transfer Network is intelligent and understands both the gas and electricity industry's respective file formats.

We have worked with ElectraLink to identify the most effective means to enable smart meter and smart data to be recovered from customers in Milton Keynes. In conjunction with Ofgem's work to define the Smart Meter programme, and particularly the interim arrangements, we are continuing to discuss the potential of using their proposed smart metering data platform for MK*Smart*2020.

Arqiva

Arqiva is a telecommunications company which provides infrastructure and broadcast transmission facilities in the United Kingdom and Republic of Ireland. Its main customers are broadcasters and mobile phone network operators, and its main asset is a network of over 1,000 radio and television transmission sites. It has been active in the Smart Metering debate, and offers a wireless based solution for data retrieval.

We have worked with Arqiva to understand the telecommunications infrastructure requirements for MK*Smart*2020. They have carried out radio planning and design work on our behalf. Arqiva have already produced a

detailed proposal for the delivery phase of the project, including a substantial financial contribution.

Silver Spring Networks

Silver Spring is a smart grid solutions company. It connects utilities with their customers They provide the hardware, software and services that connect every device on the smart grid. Silver Spring have provided advice and assistance in the development of the smart metering aspects of the bid. They are keen to be involved during the delivery phase.

Conclusion

The collaborators we have selected have proven to be knowledgeable and supportive in the development of MK*Smart*2020. They have also demonstrated a willingness to work together, and to commit their own resources when appropriate.

We are therefore confident that the project is of a high quality, and that substantial new learning will come from it.

We will continue to identify new organisations to work with as we enter the delivery phase, and in particular those organisations that may be unsuccessful with other LCNF project bids.

We also intend to engage fully in the SME market, to stimulate UK based enterprises specialising in Smart Grids. Through SEEDA and subsequently a proposed Local Economic Partnership centred on Milton Keynes, we plan to run further business awareness seminars to attract further interest.

Assembling the right team of External Collaborators will maximise learning, and minimise the cost to customers. With our MK*Smart*2020 plans – we think we're on the right track.

Appendix 11: Letters of Support

Professor Clifford M Friend
Deputy Vice-Chancellor

Cranfield UNIVERSITY

Cranfield University
Cranfield, Bedfordshire
MK43 0AL England
Tel +44 (0) 1234 754000
Fax +44 (0) 1234 751637
Email: clifford.friend@cranfield.ac.uk
www.cranfield.ac.uk

19th August 2010

Dr R Bidwell
Chairman
Ofgem
9 Millbank,
London,
SW1P 3GE

Dear Dr Bidwell

Cranfield University wishes to express its strongest support for the Central Networks bid to Ofgem for the Milton Keynes Low Carbon Network Project, MKSmart2020.

In 2006 Cranfield established a new initiative, our global centre of excellence in Integrated Vehicle Health Management (IVHM), in partnership with Boeing, Rolls-Royce, BAE Systems, Meggitt, Thales, the UK Ministry of Defence and Alstom Transport, with support from EEDA and EPSRC. This Centre is researching and delivering generic IVHM solutions to an increasingly wide range of sectors including the Energy sector. Our work is able to bring real value to smart grids since IVHM solutions applied to complex vehicle platforms read across well to the operation of complex assets such as the primary sub stations in an electricity network.

MK*Smart2020* provides an excellent opportunity for us to work with our partners and local community, to test, learn and explore how future electricity networks need to change and, in turn, how such changes can be managed.

The project will look at the current state of electricity networks, evaluate the problems expected in the future, identify and deliver solutions that are best value for money, and share the lessons learnt from industry and consumers.

The project will include looking at smart grid solutions involving wide scale deployment of smart meters, real-time condition monitoring on substations, predictive maintenance and more "active management" of the network, allowing increased flexibility and efficiency.

We aim to play a full and active role in the project should this bid be successful, making use of the considerable experience and expertise we already possess in the technical analysis of IVHM systems. We have contributed both to the shaping of the bid with Central Networks and in supporting the wider aspiration of Milton Keynes to become Europe's leading low carbon city.

Yours sincerely

Professor Clifford Friend
Deputy Vice-Chancellor

ElectraLink

ElectraLink Ltd.
Ground Floor, Grafton House
2-3 Golden Square
London W1F 9HR
Tel: 020 7432 3000
Fax: 020 7432 3015
www.electralink.co.uk

LCNF Expert Panel
Ofgem
9 Millbank
London
SW1P 3GE

25th August 2010

Dear Sir / Madam,

MKSmart2020 and Interoperability

The Smart Metering Prospectus (27th July 2010) rightly identified interoperability as fundamental to the smooth functioning of the future energy retail market. The prospectus also notes that smart metering is an essential enabler for a move to a low carbon energy system involving greater use of electric vehicles, renewable energy and more active management of energy networks i.e. a smart grid.

ElectraLink is pleased to support Central Networks' MKSmart2020 bid for the Low Carbon Networks Fund by providing expertise and services which will enable interoperability. Central Networks' ambition to engage consumers served by a number of suppliers highlights in microcosm the importance of interoperability. Working together, Central Networks and ElectraLink can validate solutions that enable the network operator to coordinate smart metering data from a number of suppliers, and also maintain integrity of the smart metered cohort throughout change of supply events.

ElectraLink looks forward to working with all industry participants to provide interoperability for the market. MKSmart2020 is a valuable opportunity to test strategies and learn lessons on how network operators and suppliers can cooperate for the benefit of consumers.

Yours sincerely,

Dave Mutton
Chief Executive Officer

ElectraLink Ltd
Registered Number: 3271981. VAT Registration Number: 698 2336 89. Registered Office: Ground Floor, Grafton House, 2-3 Golden Square, London W1F 9HR

MILTON KEYNES COUNCIL

David Hill
Chief Executive

Dr Robin Bidwell
Chairman
Ofgem – London
9 Millbank
London
SW1P 3GE

Our Ref: DH/BL
Our Ref:
Reply To: David Hill
Direct Line: 01908 252200
david.hill@milton-keynes.gov.uk

26 August 2010

Dear Dr Bidwell

In support of the Central Networks bid to receive customer funding from Ofgem for the Milton Keynes Low Carbon Network Project, MKSmart2020, we would like to invite you to formally demonstrate your backing of the Central Networks proposal by means of a letter of support. We would like to submit your letter as part of our final bid submission on 3 September 2010.

As you are aware:

- MKSmart2020 is an element of Milton Keynes' Low Carbon Living Programme, which offers a great opportunity for us to work together with Milton Keynes Council and our other partners to deliver the proposed "smart city" project.
- Milton Keynes has already built significant momentum behind their programme and aspires to be Europe's leading low carbon city. The Low Carbon Living Programme will enable us to test what is need to deliver a smarter network future and will allow industry to learn from firsthand experience how low carbon energy technologies can be integrated into a reliable distribution network, and how consumers will interact with these new technologies.

Chief Executive's Office, Civic Offices, 1 Saxon Gate East,
Central Milton Keynes MK9 3EJ
Tel: (01908) 691691 Fax: (01908) 252768 Hays DX 31406 Milton Keynes

THE NATIONAL ENERGY FOUNDATION

The National Energy Centre • Davy Avenue • Knowlhill • Milton Keynes • MK5 8NG
Tel: 01908-665555 • e-mail: nef@nef.org.uk • www.nef.org.uk

Chairman
Ofgem - London
9 Millbank,
London,
SW1P 3GE

13th August 2010

Letter of Support for MKSmart 2020

The National Energy Foundation (NEF) would like to offer its full support to the transformational project being put forward under MKSmart 2020, to truly connect Milton Keynes' consumers of power in the home and in business to the carbon intensity of their electricity at different times of the day and hence to manage the overall energy demand in the most effective manner.

NEF has since been working with local partners since 1990 to ensure that Milton Keynes is seen as an exemplar in efficient use of energy by the rest of the country. Examples, such as the latest rounds of building regulations adopted for the UK mirroring standards set in the early 1990's in Milton Keynes, shows the success of the approaches we have been taking. Through the Low Carbon Living Programme, Milton Keynes aims to raise the bar yet again across the full range of sources of carbon emissions, from low carbon housing to a leading electric vehicle demonstrator. MKSmart2020 is a key element of Milton Keynes' Low Carbon Living Programme, which offers a great opportunity for us to work together with Central Networks, Milton Keynes Council and the other partners to deliver the proposed "smart city" project.

Milton Keynes has already built significant momentum behind their programme and aspires to be Europe's leading low carbon city. The Low Carbon Living Programme will enable us to test what is need to deliver a smarter network future and will allow industry to learn from first-hand experience how low carbon energy technologies can be integrated into a reliable distribution network, and how consumers will interact with these new technologies.

The project provides an excellent opportunity for Central Networks, working with their partners and the local community, to test, learn and explore how the electricity network needs to change and, in turn, how to manage that change. The project will include looking at smart grid solutions involving wide scale deployment of smart meters and more "active management" of the network, allowing for increased flexibility and efficiency. NEF's Trustees are fully committed to support that wider engagement with the local community and to bring to bear the significant experience we have in understanding the motivators and barriers for individual and institutional change to patterns of energy consumption.

The project will clearly also look at the current state of the electricity network, evaluate the problems expected in the future, identify and deliver the solutions that are the best value for money, and share the lessons learnt across industry and with consumers. The network challenges and opportunities identified in Milton Keynes are representative of what we can expect to see across the UK during the transition to a low carbon energy future.

Registered in England No 2218531 as a Company Limited by Guarantee
Registered Charity No. 298951 • Registered Office as above • VAT No. 536 3163 54

HOUSE OF COMMONS
LONDON SW1A 0AA

August 2010

To whom it may concern,

Having met with the team developing MKSmart2020 we are writing in support of the bid from Central Networks to receive Ofgem funding from the Low Carbon Network Fund for this project in Milton Keynes.

We are well aware that smarter electricity networks will be vital for consumers to be able to benefit from the new, low carbon technologies that are starting to be available, such as electric vehicles or distributed energy in the home.

MKSmart2020 is an element of the Milton Keynes' Low Carbon Living Programme, which offers a great opportunity for Milton Keynes to lead the way in delivering a 'smart city' project.

This project is an exciting opportunity to understand how electricity distribution networks can make the transition to a low carbon energy world a reality.

As a young, dynamic, forward-thinking city with a reputation for innovation, Milton Keynes is the perfect place to be Europe's leading low carbon city and we know that there is already significant momentum behind this vision.

We fully support the bid and agree that it provides an excellent opportunity for the partners to work with the local community, to test, learn and explore how the electricity network needs to change and, in turn, how to manage that change.

Yours faithfully,

Mark Lancaster TD MP
Milton Keynes North

Iain Stewart MP
Milton Keynes South

GE Energy

Lauder House
Almondvale Business Park
Livingston
West Lothian
EH54 6BX
T 01506 591 200
F 01506 591 201

25th August 2010

To whom it may concern,

RE: Low Carbon Network Fund - MKSmart2020

GE Digital Energy and EON Central Networks has signed a strategic agreement to work together in support of the Milton Keynes Low Carbon Living Programme. Under this agreement GE Digital Energy is directly supporting EON Central Networks in the development of their MKSmart2020 bid for Ofgem Low Carbon Networks Fund (LCNF).

The Milton Keynes programme has already built significant momentum and aspires to be Europe's leading low carbon city. From General Electric's perspective the programme offers a number of unique benefits:

1. Creates a '2020 representation' of emerging low carbon challenges *(electric vehicles, heat pumps providing a low carbon way to heat homes and communities, energy efficiency and generation connected at the distribution network level)* providing an opportunity to test what is needed to deliver a smarter network future. This will allow industry to learn from firsthand experience how low carbon energy technologies can be integrated into a reliable distribution network, and how energy users will interact with these new technologies.
2. Working with partners and the local community, test, learn and explore how the electricity network needs to change and, in turn, how to manage that change.
3. Through analysis evaluate the current state of the electricity network, the problems expected in the future, identify and deliver the solutions that are the best value for money, and share the lessons learnt across industry and with consumers.
4. Provide increased visibility allowing real time network information via smart meters to be evaluated within the context of a smart grid, providing more "active management", increased flexibility, efficiency and better detection of network faults.
5. Increased customer interaction regarding energy consumption and home energy generation.

GE is fully committed to supporting EON's MKSmart2020 bid as in addition to the above benefits we also believe the network challenges and opportunities identified in Milton Keynes are representative of what can be expect across the UK during the transition to a low carbon energy future.

Yours sincerely

K. Redfearn.

Keith Redfearn
General Manager GE Digital Energy

IGE Energy Services (UK) ltd

University Centre MILTON KEYNES

28th August 2010

Dr Robin Bidwell
Chair - Low Carbon Network Fund Panel
Ofgem
9 Millbank
London
SW1P 3GE

Dear Dr Bidwell

Letter of Support for MKSmart2020

It gives me great pleasure to write to offer enthusiastic support for the MKSmart2020 bid to the Low Carbon Network Fund.

I write as Dean of the University Centre Milton Keynes (UCMK) which is one of the research partners in the bid. In addition to our own research activities (which include: the built environment; leadership of place; signal processing; and 3D visualisation), UCMK will be hosting the city's Low Carbon Data Repository, which will service all of the city's low carbon programmes, and which will form a key unified data source for the research partners. UCMK will also provide the venue for the Discovery Centre that will be a key component of the Public Engagement programme, and, in partnership with the Open University, will provide online resources for Public Engagement across all low carbon programmes.

As you will read in the formal bid documentation, MKSmart2020 is a key element of Milton Keynes' Low Carbon Living Prospectus, which offers a great opportunity for us to work together with Milton Keynes Council and our other partners to deliver the proposed "smart city" project. Milton Keynes has already built significant momentum behind the programme and aspires to be Europe's leading low carbon city. The Low Carbon Living Programme will enable us to test what is needed to deliver a smarter network future and will allow industry to learn from first-hand experience how low carbon energy technologies can be integrated into a reliable distribution network, and how consumers will interact with these new technologies.

The project plan has been conceived and developed by a synergistic and committed partnership involving Central Networks, Milton Keynes Council, Milton Keynes Partnership, Cranfield University, the Open University and UCMK. The partners bring a rich combination of practical and theoretical experience to the project and have an established track record of effective partnership working.

A division of Milton Keynes College

Dean: Professor Keith Straughan
Principal & Chief Executive: Rob Badcock
Chair of Governors: Francesca Skelton

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University Centre MILTON KEYNES

The project will look at the current state of the electricity network, evaluate the problems expected in the future, identify and deliver the solutions that are the best value for money, and share the lessons learnt across industry and with consumers. The project will investigate smart grid solutions involving wide scale deployment of smart meters and more "active management" of the network, allowing for increased flexibility and efficiency.

Milton Keynes presents a fascinating and rich context in which to ask these important questions. It is clear that the network challenges and opportunities identified in Milton Keynes are representative of what we can expect to see across he UK during th transition to a low carbon energy future.

The project provides an excellent opportunity for us, working with our partners and the local community, to test, learn and explore how the electricity network needs to change and, in turn, how to manage that change.

UCMK is committed fully to this project and the parallel programmes under the Milton Keynes' Low Carbon Living Prospectus. I am happy to confirm our enthusiastic support and to assure that Panel that UCMK will commit its resources and best endeavours to ensure the success of the MKSmart2020 project.

Yours sincerely,

Prof Keith Straughan
Dean

A division of Milton Keynes College

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Appendix 12: MK*Smart*2020 - Derogations

Introduction

Tariff structures will be trialled via customers' retailers. The customers will be those who live in the Milton Keynes' Low Carbon Living Programme's Homes Demonstrator properties.

This appendix describes Central Networks view on our expected derogation requirements around the MK*Smart*2020 project.

Understanding the challenges

We believe that the most appropriate tariff signal for the purposes of this arrangement would be half hourly or hourly tariffs. It provides us with an appropriate market-based view of how customers would change their behaviour to accommodate increased wholesale prices and DUoS charging.

As MK*Smart*2020 is an early mock-up of a green world scenario in 2020, we would use a pricing signal to the house that would be proportionate to the avoided capex in relation to the uptake of EV and heat pumps which we anticipate in the region in 2020. This avoided capex is then translated into a pricing signal. This price signal would be sent directly to the customer via the smart meter. The customers would be charged differently to other customers and we would require derogations from the current SLC13A and SLC13B charging methodology licence condition to do so but we would also ensure that the overall impact on the customer is neutral through payment at outturn.

Our requirements

The licence conditions which we believe we would require a derogation from are:

- SLC13A obliges our Use of System charging methodology to comply with the CDCM in relation to HV and LV customers
- SLC13B obliges our Use of System charging to comply with the EDCM in relation to EHV customers (once the EDCM comes into force).

Our SLC13, Charging methodologies for use of system and connections requires us to:

- Have in force an approved charging methodology for Use of System (UoS) and connection
- Review the methodology once a year
- Comply with a number of relevant objectives

For our MK*Smart*2020 project, we would require a section in our SLC13 methodology statement that relates to how we would charge for Milton Keynes and have derogations for SLC13A and SLC 13B which allowed us to charge some CDCM and potentially EDCM designated properties in accordance with the MK methodology in the SLC 13 statement rather than the CDCM and EDCM methodology in the SLC13 statement.

Assessment of the derogation requirements

We understand from OFGEM that our requirements would be assessed using a set criteria which we would aim to meet once we apply for the derogation if funding is granted for the project.

In our consideration of the requirements, we have taken into account the impact on the following as per OFGEM's 'Guidance on licence derogation requests':

- Customers – We would endeavour for the scheme to be cost neutral to the customers of Milton Keynes. For any additional penalties they might have incurred during the month on the 2020 prices due to behaviour, we would settle at outturn.
- Competition – we would engage with all retailers to ensure that competition in the market is not undermined and these propositions be available through any supplier. The Homes Demonstrator trial which involves 60 homes would be carried out by the Council who would include this requirement in their lease agreements.
- Sustainable development – We believe that the wide spread uptake of more advanced tariffs by customers in the future would ensure that we are able to minimise the cost of the low carbon economy for the end customer through a reduction in demand at peaks as well as reduced network reinforcement requirements. We believe that this would give rise to lower carbon emissions.
- Health and Safety – We do not anticipate any health and safety implications to the scheme
- Other parties affected – As part of this trial project, we will involve retailers, GBSO , aggregators and customers throughout the length of the project as per our project plan and commercial sections. Any considerations will be taken into account and ensure that all views are taken before a derogation is submitted.