



ENSG 'A Smart Grid Routemap' Executive Summary



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February 2010



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Background

The ENSG has established a smart grid working group to produce a UK smart grid vision and routemap. ENSG's 'A Smart Grid Vision' was published in December 2009. The vision has been followed by ENSG's 'A Smart Grid Routemap'. This document is an executive summary of the PowerPoint document 'A Smart Grid Routemap.'

This is a discussion document that reflects the ENSG's discussions over the smart grid routemap. It does not commit any member of ENSG to any specific action.

Ofgem statement

Ofgem has been actively engaged, as joint-chair of the ENSG's SmartGrids Working Group, in the delivery of the routemap. We are very grateful for the time and enthusiasm that the members of the Working Group have committed to this important work and we welcome its publication.

We are now putting in place the £500m Low Carbon Networks Fund (LCNF), an important part of the 5th Electricity Distribution Price Control Review. We think the ideas and momentum created by the Working Group provides a valuable basis for identifying projects that should seek funding from the LCNF and the Innovation Funding Incentive.

We will, with the help and advice of an independent expert panel, be selecting LCNF projects through a competitive process. As we will need to decide which projects the LCNF will fund, we think it is important to make clear that we cannot, given this role, endorse any specific ideas or proposals in the Routemap.

Overview

The routemap is a continuation of the ENSG's 'A Smart Grid Vision', and as such focuses on the ways in which the development of our electricity networks might help the UK meet three high level objectives:

- **Carbon reduction** – enabling and accelerating carbon reduction
- **Energy security** – the cost-effective maintenance or enhancement of energy security as the power system decarbonises and electricity demand changes
- **Economic competitiveness and affordability** – helping deliver a cost effective low carbon transition

The ENSG smart grid vision highlighted the significant uncertainty surrounding the deployment of smart grid technology. It will be important that the smart grid routemap provides an effective opportunity to test the feasibility, costs and benefits of smart grid technology. The development of a smart grid has the potential to play an important role in supporting the UK in meeting these objectives but may involve a number of questions and challenges that we need to explore if we are to understand this role in detail. These need to be fully identified and addressed taking account of the complex interdependencies between smart grid and other investments and policy measures.

In response to this, 'A Smart Grid Routemap' outlines a potential path to test the feasibility, costs and benefits of smart grid technology and the means by which the UK could realise the ENSG smart grid vision. The routemap emphasises the potential role of a smart grid in cost effectively and securely delivering the:

- Integration of inflexible generation as the UK's electricity generation infrastructure is renewed
- Electrification of transport and heating
- Integration and optimisation of Distributed Energy Resources (DER – which includes Distributed Generation (DG), storage and demand-side management)

It is these three roles of the UK's smart grid and an acknowledgement of the critical role of the customer that form the foundations for routemap development.

Executive Summary

The Electricity Networks Strategy Group (ENSG) endorses 'A Smart Grid Routemap' as a high level description of the way in which a UK smart grid could be delivered to contribute to the realisation of Government carbon targets and end-customer benefits.

The ENSG believes that it is critical to deliver a range of well targeted pilot projects between 2010 and 2015 in the expectation that many of them will prove to be technically and economically successful and therefore available for UK wide application from 2015 onwards.

The ENSG believes that any smart grid developments must create the right mix of technical, commercial, industry and regulatory change to overcome a diverse set of challenges.

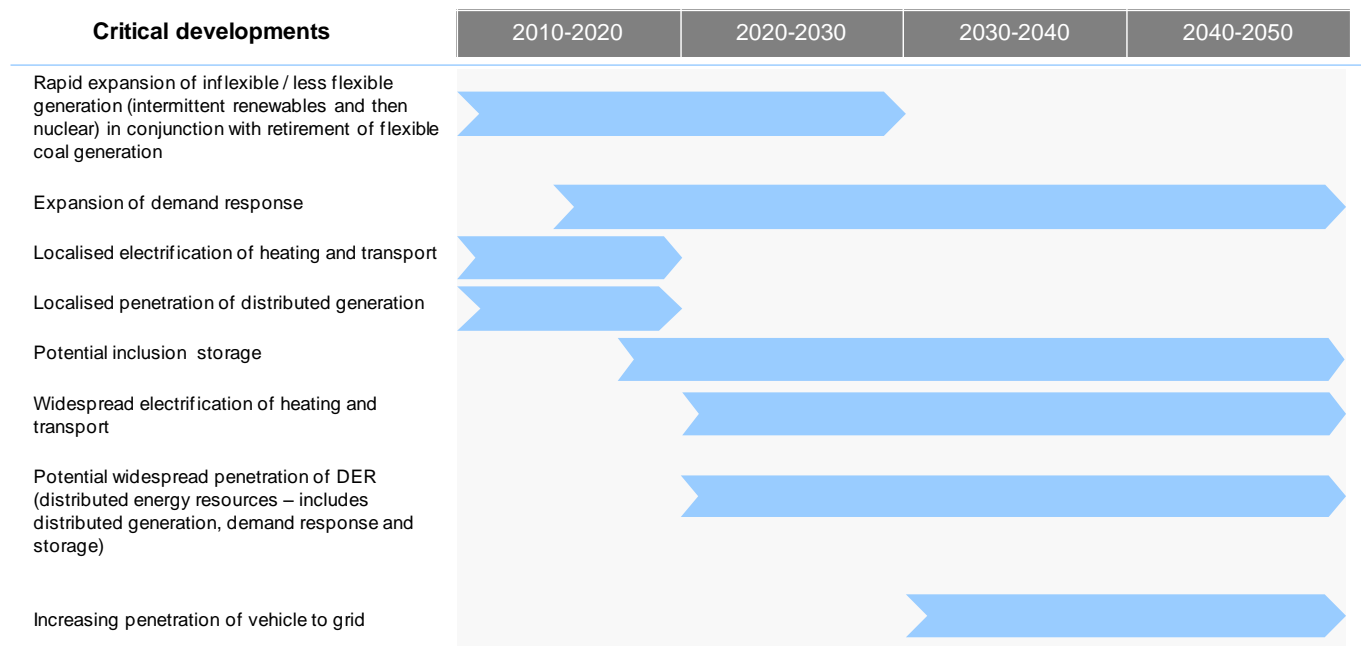
In particular, ENSG would emphasise a prioritised, coordinated and concerted approach to public engagement, security and data privacy, the development of common and open standards and any identified cross industry changes.

To do this effectively requires linkages across Government policy, regulatory development and industry wide change programmes with a particular emphasis upon the relationship between smart metering and wider smart grid developments. The smart grid routemap must recognise the smart meter roll-out programme and respect its timetable.

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Context, requirements and possible smart grid end state

The UK power system will have to evolve in the next 40 years in order to accommodate a number of critical developments – a smart grid has the potential to act as a key enabler.



Illustrative timeline

Ultimately, these can be summarised as – integration of inflexible generation, securely managing the electrification of transport and heating, and integrating and optimising DER, all in a cost-effective way. Each of these has significance towards the low-carbon transition; each could be enabled by the smart grid, and each has significance for the routemap.

The smart grid routemap must recognise the smart meter roll-out programme and respect its timetable. It must also work alongside a series of parallel policy measures and industry programmes e.g. Ofgem's £500m Low Carbon Network Fund, Ofgem's RPI-X@20 and Discovery projects, EU SET funding and the DPCR/TPCR regulatory cycle. These represent opportunities to drive forward the smart grid vision and there is a critical need for a coordinated and joined up approach.

It should be noted that whilst there is a high level view of what a mature smart grid could look like, there remains significant uncertainty over the precise nature of the future energy system. The routemap must acknowledge uncertainty with smart grid investments ideally providing optionality and flexibility.

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Challenges

Delivering the smart grid vision will present a number of potential challenges that need to be fully identified, evaluated and addressed. This has a series of implications for the routemap. It should be noted that addressing these challenges is likely to require work across the industry, Government and Ofgem. Informing and involving customers in particular is an essential element of the low carbon transition with societal engagement seen by the ENSG as key part of the routemap.

Target outcomes	Potential Challenges	Routemap implications
Develop regulatory and commercial arrangements	1 DNOs may develop their smart grid capabilities at different rates, impacting the service provision offered to Suppliers, customers (non-domestic and potentially domestic), generators and other parties	<ul style="list-style-type: none"> Need to effectively coordinate and share learning and provide degree of centralised coordination and support to simultaneously encourage innovation whilst keeping complexity, costs and service and performance differentials down Early feedback from the LCNF process will be fed in to further development of regulatory mechanisms Demonstrate new business and revenue models and associated regulatory and commercial frameworks that support demand reduction and better energy management Consider changes to settlement to enable DER to grow at pace. Market and balancing issues need to be identified and resolutions developed over time, taking into account respective roles and potential issues with market liquidity and incentives A hierarchy of needs may be required to understand how the use of end to end system control will be prioritised and responsibility and accountability allocated. Commercial and regulatory frameworks will need to be tested to see how they move toward efficient outcomes
	2 Current incentives may prove insufficient to drive scale smart grid investment	
	3 Incentives may be necessary to encourage demand reduction and better energy management (i.e. load shifting)	
	4 There may be challenges associated with balancing, settlement and wholesale markets in relation to DER etc. which need to be assessed and understood	
	5 Frameworks to enable optimised allocation of DER between system balancing and network operation may require development	
Build industry capabilities and capacity	6 Industry will need to build on current smart grid capabilities and capacity for wide scale smart grid change and to address issues relating to an ageing workforce	<ul style="list-style-type: none"> Knowledge capture, sharing and targeted business development are key. May be a need for cross-industry and Government efforts to fill the skills gap Ongoing testing and development of commercial arrangements and where necessary supporting regulatory and policy frameworks
	7 There may be potential challenges in relation to end-to-end integrated optimisation of investment and benefits across power and wider infrastructure	
Inform and involve customers	8 A lack of societal engagement or understanding in relation to smart grid may present challenges	<ul style="list-style-type: none"> Focus on understanding customer behaviour and responses and establishing open and competitive frameworks to drive customer-focused innovation Important to deliver tangible pilots and integrate project delivery with customer education and wider public relations activities
Trial integrated technology at scale	9 Fully integrated end to end technologies are generally not yet fully scale proven	<ul style="list-style-type: none"> Pilots needed to trial and prove end to end technologies and related commercial frameworks at scale Development of standards is a priority to ensure interoperability and to encourage competitive innovation and scale procurement Manage perceptions and build security and resilience into the core of the solution – potential for a degree of centralised security management and ongoing threat / vulnerability evaluation and response
	10 Required technology to meet objectives and commercial and technological integration yet to be defined	
	11 There is an absence of supporting common standards (important for interoperability)	
	12 Security threats and data protection risks may present challenges	

Relevant parties will need to work together to generate, evaluate and prioritise a full set of challenges and then work together toward addressing them. ENSG has developed this list of potential challenges in order to support further evaluation during the smart grid trial phase.

Ofgem RPI-X@20 and Discovery projects are a response to the potential need for change to deliver the UK's future energy system Challenges are not ordered by priority.

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The routemap includes a framework to move from the UK's high level objectives to a set of potential pilot projects. The framework identified that target outcomes will be delivered through a combination of:

- Partnerships and funding (to ensure joined up, co-operative engagement)
- Stakeholder management (to ensure all parties are 'bought in')
- Knowledge and learning management (to store, harness and disseminate gained knowledge)
- Business case development (to understand the financial and operational costs and benefits for implementing smart grid technologies)
- Development of, wherever possible, open access standards to promote competition
- Policy integration (to ensure Government policy is joined up and mutually progressive)

Actions taken by the industry, Government and Ofgem over the next five years should look to support the UK in trialling integrated and large-scale smart grid solutions to establish their technical and economic suitability for wide scale deployment from 2015 onwards. For this to be feasible a number of things will need to be in place; competitive customer focused innovation, cost effective integration of low carbon technology, end to end power system capability and flexibility, customers that play an active role in the supply chain and secure and resilient supply. Delivery will potentially require outcomes across four dimensions:

- Develop regulatory and commercial arrangements
- Build industry capabilities and capacity
- Inform and involve customers
- Trial and prove integrated technology at scale

Approach to identify and assess potential projects to respond to objectives and barriers

Given the challenges and objectives, it may be expected that the UK needs to deliver a mixture of trial projects, industry change and regulatory and commercial developments between 2010 and 2015. These will be heavily supported by Ofgem's Low Carbon Network Fund with other funding opportunities available e.g. EU SET funding and will be closely integrated with the UK smart metering roll out and any proposals stemming from Ofgem's RPI-X@20 and Discovery projects.

Accordingly, four tiers of projects and trials have been identified, with increasing customer interaction, value chain integration and commercial/regulatory development required, as the projects types move from tier 1 to tier 4. The four tiers are:

1. Individual technology (e.g. dynamic line rating)
2. Multiple integrated technologies (e.g. network monitoring, control and optimisation)
3. Customer and technology integration (e.g. DG and Ultra Low Carbon Vehicles implementation)
4. End-to-end integration (e.g. intelligent combustion linking all elements of the value chain)

Given the UK's requirements there are a series of key messages for pilots and other changes:

- Implement objective driven trials that clearly contribute to delivering the UK's cost effective and secure low carbon transition
- Coordinate and operate trials across the value chain
- Explore and realise smart meter / grid coordination benefits where possible whilst not undermining the smart meter delivery timeline
- Review and potentially develop industry structures (settlement, wholesale markets and balancing)
- Consider developing certain supporting industry structures centrally rather than as a part of any one pilot project e.g. changes to settlement
- Prepare for business change to be an important part of the solution

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Potential projects

The ENSG has identified an illustrative set of projects that could work together to support the UK's low carbon transition and prepare for scaling of the smart grid vision from 2015 onwards. These projects would need to work together steadily building learning and capabilities. ENSG does not suggest that the UK necessarily pursues this particular project set – they are intended to support project development.

Sample projects	CBA benefit evaluation	Transport / heating electrification	Core smart capability development	Inflexible generation integration	DER integration	Commercial development	Customer engagement
Active Dynamic Rating	●	●		●	●		
Active Voltage Control				●	●		
Super-Conducting Fault Current Limiters			●		●		
Smart meter communications pilots (HAN, LAN and WAN)			●				●
Active network monitoring	●	●			●		
Active DG Curtailment			●		●	●	
Power Electronic Applications			●				
Embedded Storage			●	●	●		
Integrated Active Network Mgmt.	●		●	●	●		
Smart asset management	●		●				
Demand side management trials	●	●		●	●	●	●
Integrated smart meter / smart grid trials		●					●
Scheduling and dispatch of DER / DER commercials / value evaluation / customer	●	●	●		●	●	●
Network integration of smart appliance / smart home – commercials / allocation		●			●	●	●
Security, resilience and data protection			●				●
Trialling of new network charging regimes		●	●	●	●	●	
Smart grid city							
Intelligent city							
Rural smart grid							
Island smart grid							
End to end integration of intermittent renewables							

Dependent upon scope but should look to cover majority of objectives in a fully integrated way

● Very high ● High ● Medium ● Low ○ Very low

This is an illustrative list of projects. ENSG is not suggesting that the UK should necessarily deliver this particular set of projects or that these projects if delivered would achieve all the target outcomes.

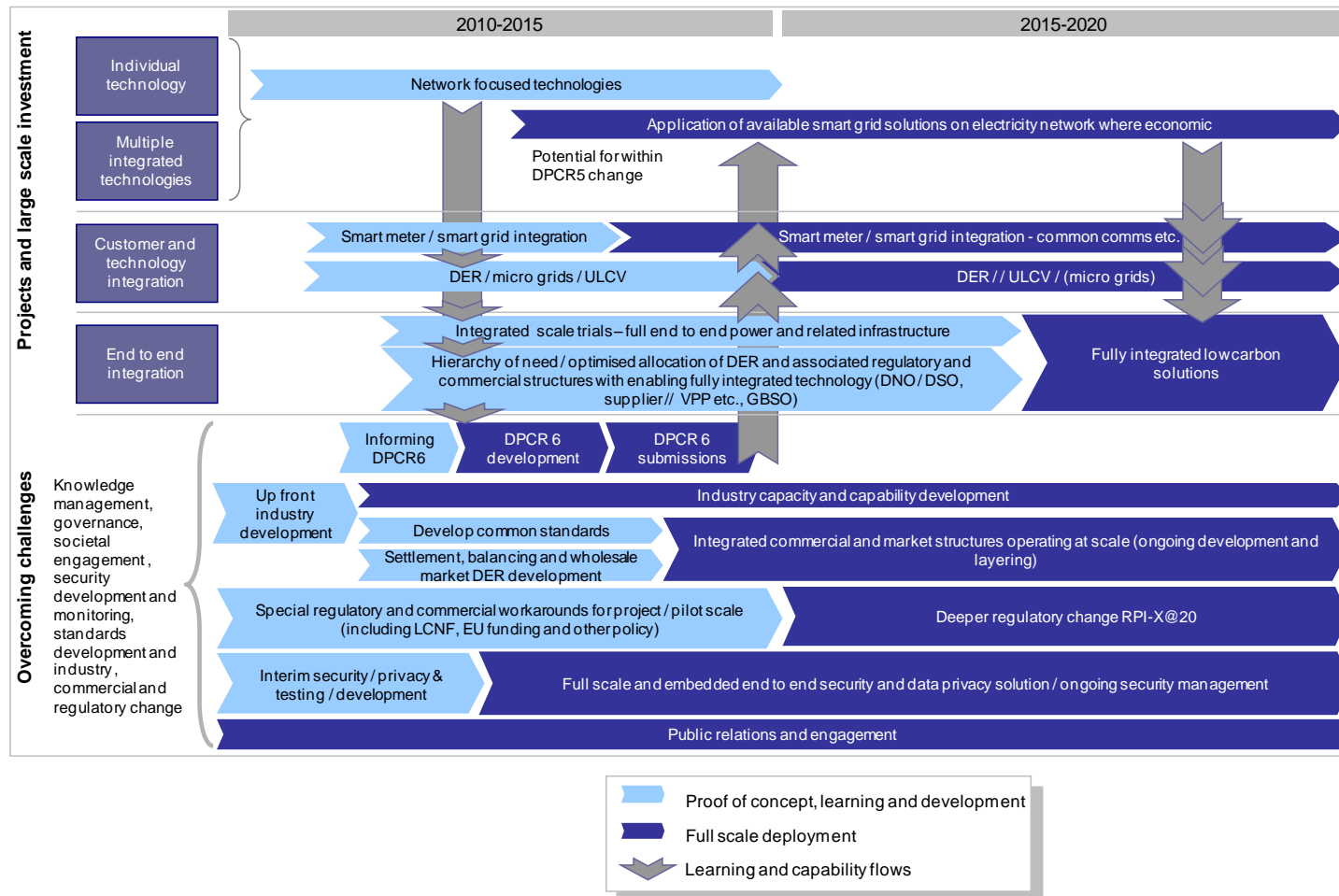
The capacity of any given project to deliver against these objectives will be dependent upon the specifics of project scope and the way in which the project is delivered.

Other objectives (as per slide 16) will be worth pursuing – the table has been prioritised and simplified for clarity

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The Routemap

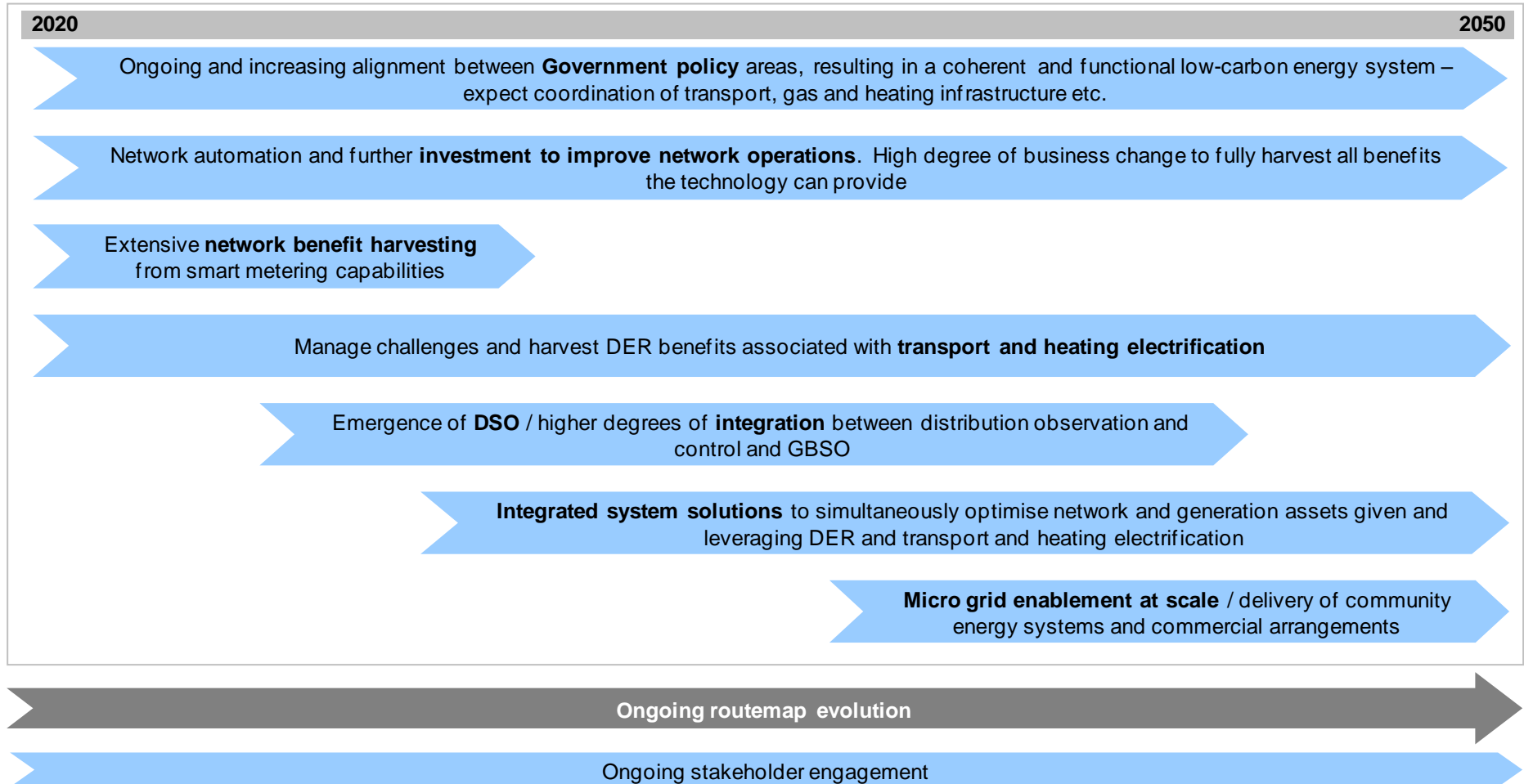
Drawing from the objectives and project thinking ENSG has developed a high level integrated smart grid routemap out to 2020. It is fully recognised that this is ambitious. However, it is not intended to be a detailed smart grid plan. It designed to help support ongoing discussion, decisions and actions. It is very important that routemap activities are delivered in a coherent way.



Illustrative timeline

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While there is significant uncertainty in the future, it is important to map out a potential routemap beyond 2020, and ENSG presents indicative activities and timescales out to 2050 to give a sense of the long term routemap. These activities are significantly less certain.



Illustrative timeline

Concluding remarks and next steps

There are a series of important considerations stemming from the smart grid routemap:

- A high degree of coordination across overlapping policy and the end to end energy value chain
- An emphasis on getting the customer on board as a key participant
- Common open standards and open access to drive a high degree of customer focused innovation
- A think-big, start-small and scale-fast approach
- Ongoing engagement between Government (local and central), Ofgem, industry and customer representatives
- Robust, thorough and embedded end to end security and data privacy solution with a degree of ongoing centralised management and enhancement

Following on from this are the high level concluding remarks and next steps:

Concluding remarks	<ul style="list-style-type: none"> • 'A Smart Grid Routemap' provides a high level view of the steps that need to be taken to progress the ENSG's smart grid vision • Uncertainty remains over the precise nature of the UK's future end to end energy system, meaning that any vision or routemap will need to evolve over time • This document and the ENSG smart grid vision provide the foundations for this evolutionary process
Next steps	<ul style="list-style-type: none"> • The right governance structure needs to be put in place to provide consumer representation and engagement and a coordinated joint approach between Government, Ofgem, industry and other stakeholders • It is critical that the governance structure supports coordination between smart grid, smart metering and other relevant Government programmes e.g. Digital Britain

For further detail on the ENSG's smart grid routemap see the full PowerPoint document 'A Smart Grid Routemap.'