1. Vision

1.1. Summary

1. We believe that the consumer's relationship with suppliers and distributors of energy is a vital component of the successful delivery of a low carbon economy. The relationship will be changed by new technologies, but the successful adoption of those technologies is itself dependent on early development of the right economic frameworks. This will facilitate market-led deployment without recourse to expensive network reinforcement.

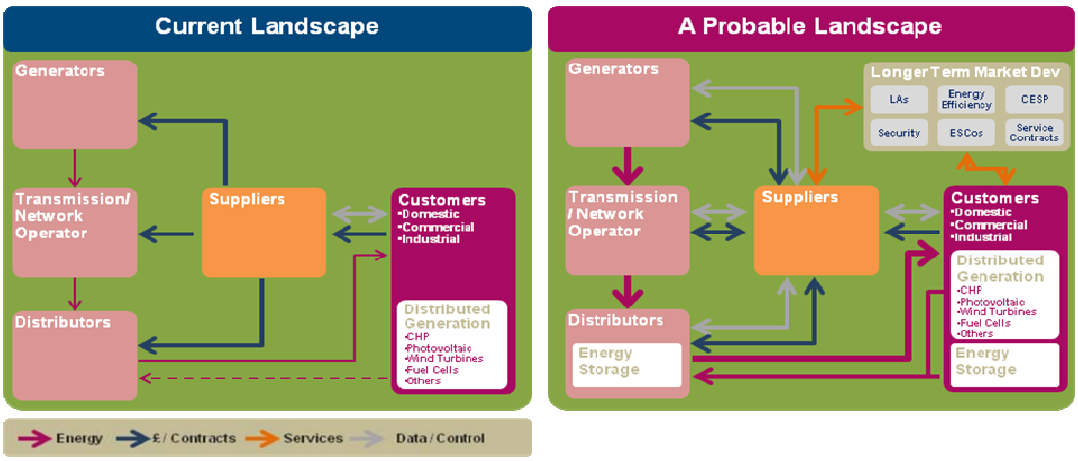
2. This represents a network revolution which we believe will need to be primarily customer-led. If a low carbon economy is to be successful consumers will need to be: enthusiastic for their role in it; engaged in the production and consumption of energy within their home, empowered to make informed choices about their energy production/use and central to the efficient design and ongoing operation of future electricity networks.

3. These new approaches will espouse a collaborative approach that includes all industry parties across the supply chain and society as a whole. This holistic vision of a future integrated energy network means that smarter and more efficient solutions can be identified and deployed with benefits arising for all stakeholders.

4. In order to balance the requirements of all parties, previous research has concluded that new commercial frameworks will be essential to support the development of relationships between generators, network operators, suppliers and customers. Commercial arrangements and regulatory models will need to be in place that both: underpin the low carbon electricity market at a national level by understanding the potential value of distributed energy resources to the wider energy market and; provide necessary incentives for the most efficient use of distributed energy resources within the overall energy value chain.

5. A pictorial overview of the expected changes in interactions between generators, network operators, suppliers and customers is outlined in Figure 1 below.

Figure 1 – Changing Landscape



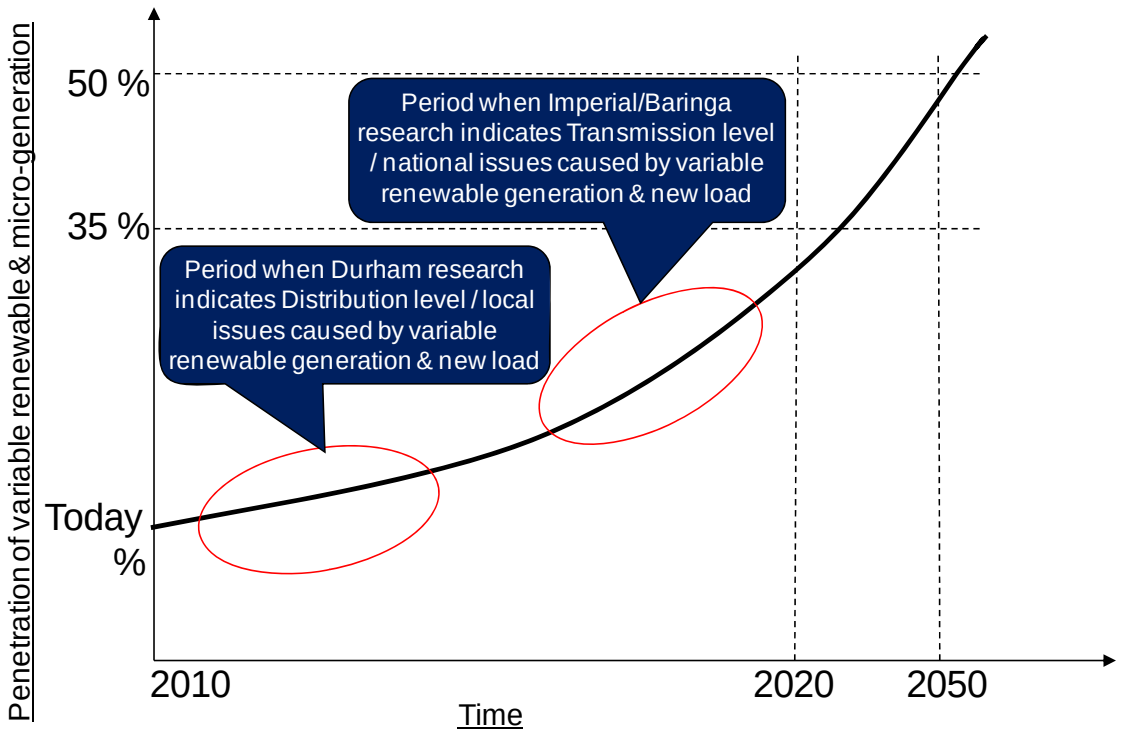
6. Strong relationships will also need to be formed with a range of other key parties such as technology companies and academic institutions in order to reach and realise the full potential benefits of a future low carbon network.

7. The Low Carbon Transition (LCT) plan sets out a range of legally binding carbon targets aimed at reducing overall emissions by 34% by 2020 and 80% by 2050 through investment in energy efficiency and clean energy technologies. Meeting these targets will require significant changes for all stakeholders of the energy sector, including:

   - construction and integration of significant amounts of intermittent renewable generation (especially wind);
   - decommissioning and replacement of existing centralised generation;
   - growth in distributed generation; and
   - growth in demand from the electrification of heating and transport.

8. These changes must be managed while maintaining secure and reliable energy supply at stable affordable prices. As has been identified the introduction of large scale variable generation is likely to require significant involvement of customers in demand response programmes by 2017. The LCT plan will be more achievable if the consumer technologies involved in these demand response programmes and consumers' radically different relationship with suppliers and distributors can be first tested and demonstrated.

Chart showing an illustrative view that network reinforcement or new tools and commercial structures will be needed in the next 2-5 years to achieve 2020 targets



9. As identified by the adoption of micro-generation, electric vehicles and heating will place new loads on existing distribution networks. As these networks are typically run with little close management or monitoring equipment, the potential for the distribution level of our grid to become a constraint on the adoption of new low carbon technologies is significant. Existing network planning tools and incentives would overcome these issues with reinforcement, which is necessarily expensive and time consuming.

10. Long before demand response programmes are required to manage national scale generation and demand variability, we believe it can be deployed at the local level to accelerate the deployment of the consumer-side technologies on which a transition to a low carbon economy depends. Doing so will require an early revolution in customers' relationship with energy networks and suppliers.

1.2. Problem Definition

11. The UK's transition to a low carbon economy will present a wide range of challenges to all parties within the energy supply chain, from generators to end users.

12. In particular, the low carbon revolution will present new challenges for electricity networks with the integration of significant amounts of intermittent generation (especially wind), distributed generation and the additional demand from the electrification of heating and transport – while at the same time maintaining secure and reliable supplies at affordable prices. However, it also presents a unique opportunity to radically change the current approach to network design and operation that does not just rely in reinforcing the network to accommodate peak demand, but includes a shift in emphasis towards more flexible networks which are monitored and controlled in real time. Enabled through the rapid deployment of smart meters, these new approaches will engage customers and impact on the dynamics between industry parties across the supply chain, driving commercial and technological innovation. This holistic vision of a future integrated energy network means that smarter and more efficient solutions can be identified and deployed to the ultimate benefit of customers.

13. The anticipated electrification of the energy system is likely to pose some significant challenges for the distribution networks. Whereas the transmission network is already relatively technologically mature to enable it to undertake its more sophisticated system control functions, the distribution networks are not. Distribution networks have traditionally been designed to meet relatively stable and predictable patterns of demand, with largely unidirectional power flows from a grid supply point to the end customer. This means that they currently face challenges with:

    - Limited and antiquated monitoring;
    - Erratic capacity headroom which can be changed quickly by installation of new load; and
    - Design rules and incentives which focus on reinforcement.

14. Indeed, the industry is already experiencing some of these distribution network challenges where the deployment of low carbon technologies (e.g. heat pumps) has been focused in small condensed communities.

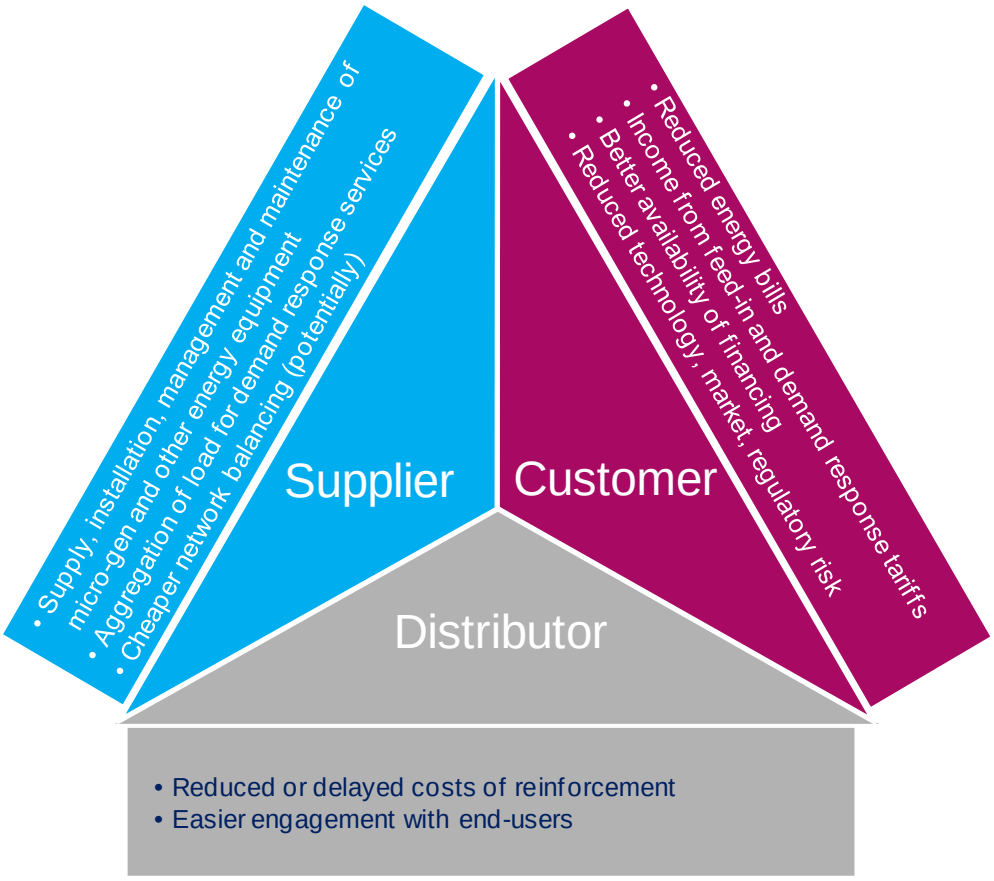
15. Whilst network reinforcement may ultimately be inevitable, avoiding or delaying this activity leads to cost efficiencies and may accelerate the take-up of low-carbon technologies and avoid networks becoming a bottleneck to their adoption. It is suggested that the industry can mitigate the need for reinforcement through the efficient use of distributed energy resources (electricity storage, generation, demand response). However, many of these resources also have value to other parties within the energy supply chain. For example, they may also be used for energy and system wide balancing especially with the growth of intermittent renewable or for ancillary services by the system operator. The value to the different parties may also change over time. Suitable economic and regulatory frameworks are required to encourage the provision of demand and network management services and to ensure, through competition between industry participants, that its value is efficiently allocated across the supply chain to minimise the cost of electricity to customers.

16. Effective deployment of commercial and regulatory frameworks require robust assessment and market testing to ensure they reflect network design rules and will be accepted by all industry participants. Therefore, whilst international experience provides a useful building block for development, an assessment of suitability to meet GB's needs must be conducted. For example, conclusions from US experience might not meet GB requirements because:

    - At least four different parties are involved in deploying distributed energy resources: distributors, suppliers, customers and the system operator; and

    - These approaches have not been deployed in GB and are not therefore 'approved' for network design and regulation – they need to be demonstrated at scale, including customer response, to be trusted by distribution network management.

Illustration: The opportunity for value-sharing in Energy Distribution



Example of the changing operational and commercial relationships between suppliers and DNOs:

If additional loads (EVs, heat pumps etc.) continue to be connected to distribution networks in an unconstrained manner (up to the capacity of the service connection) it is likely that over time this will cause both voltage and thermal issues to appear at a local level.

Whereas if suppliers and DNOs were obligated to liaise prior to the connection being made, the relative value to the DNO of a supplier offering propositions to their customer that ensures that they operate in a "smart" way that avoids increasing system peaks, and avoids system reinforcement, could be established. For example, a 7kW increase to system peak is valued at around £350/pa in network reinforcement costs.

Therefore controlling load so that it avoids additional reinforcement for increased peak demand has a real value that could be passed back to customers as part of their overall product offering (potentially as an equipment subsidy or as an incentive payment).

This would not only require a change in the relationship between suppliers and DNOs but would also require new commercial frameworks to guarantee the enduring availability of the smart solution and changes within current regulatory structures to support this type of transfer payment.