Written evidence submitted by the Renewable Energy Systems Limited (LCN0059)

RES is one of the world's leading independent renewable energy developers working across the globe to develop, construct and operate projects that contribute to our goal of a secure, sustainable and affordable energy future. RES has been an established presence at the forefront of the wind energy industry for over three decades. Our core activity is the development, design, construction, financing and operation of wind and solar PV projects and we are also active in electricity storage, DSM and transmission. Globally, we have built approximately 10GW of renewable energy generation, including approximately 10% of the UK's current wind energy capacity.

RES welcomes the ECCC's recognition of the need for a transition to a smarter and more diverse system, with a greater role allocated to low carbon technologies and distributed energy. We believe this is necessary not only to meet challenges of energy security and climate change, but also of affordability. We hope you find our comments of interest and will be more than happy to assist with any further information and evidence as required.

Consultation Response

The transition towards a smarter, more localised and diverse system brings considerable challenges to an electricity system that is still slowly evolving from its historic past of large centralised generation. Cost-efficiency grounds alone will drive an increasing shift towards low carbon technologies and distributed energy; this undermines the traditional principles of electricity network planning. Evidence from the last decade suggests that large fossil fuel generation will *not* remain cheap, will *not* continue to reduce in price and that demand will *not* grow steadily and linearly. Conversely, as evidenced by the first Contract for Difference (CfD) auction allocation, costs for delivering onshore wind and solar generation are cheaper than large centralised generation, such as new nuclear development at Hinkley Point, even after factoring additional system integration costs as defined by the Committee on Climate Change (CCC)[1].

Electricity network planning solutions need to focus on value for money. This means a redefinition of how we approach network reinforcements with increasing consideration of smart, flexible solutions and better coordination between transmission and distribution systems. As discussed in the answers to individual questions below, some progress has been made - in grid company business plan incentives, in work done by the Smart Grid Forum and

[1] CCC, Oct 2015, https://www.theccc.org.uk/publication/power-sector-scenarios-for-the-fifth-carbon-budget/

in certain Ofgem-owned projects such as *Quicker and More Efficient Connections*. However, many uncertainties and challenges remain.

One overarching issue is the mismatch between network planning timelines, where a large new circuit may take several years to plan and be expected to serve for forty years, versus distributed energy investment timelines, where a project may seek to energise within a year or two of conception. Delivering cost-effective network plans in a rapidly changing environment is very challenging in its own right, but will be impossible without tackling the political uncertainty created by:

- The absence of a clear government procurement strategy for new-build generation
- The lack of a clear strategy for the decarbonisation of the heat and transport sector

In addition, we have identified the following key issues in our answers:

1. The need to create the appropriate regulatory framework to incentivise the *overall* most cost-effective network solutions – considering distribution *and* transmission systems, long-term (new assets) *and* short-term (service-based) options.
2. The need to create an effective framework that allows distribution-connected generators, consumers and electrical storage providers to participate in both local (distribution) and national (transmission) system operation services.
3. The need to improve network planning by measurement and valuation of generation curtailment, particularly at distribution level.

1. What are the limitations of today's electricity infrastructure and how can these limitations be addressed?

At a regulatory level, the traditional revenue frameworks for Transmission Owners (TOs) and Distribution Network Operators (DNOs) have rewarded only straightforward piecemeal physical reinforcement in isolation, with little incentive for strategic planning, considerations of smart or flexible solutions, or cross-boundary (i.e. overall distribution versus transmission) solutions. The more recent "RIIO" TO and DNO business plans[2] open up the ability for more strategic thinking, but do not go far enough. This is evidenced in the volume of uncoordinated Distributed Generation (DG) connections and absence of forward-looking 'least-regrets' distribution system investment for new Distributed Energy Resources (DERs), including DG.

The connection process, particularly at distribution level, presently focuses on a 'first-come-first-served' principle, which minimises risk to network companies but does not deliver timely DER connections – particularly as the timescales for large or complicated network reinforcement can be significantly longer than timescales for DERs themselves – which deters investment and limits competition. See for example the recent open letter published

[2] RIIO-T1 for transmission started April 2013, RIIO-ED1 for distribution started April 2015.

by Western Power Distribution regarding the significant and uncertain delays and costs associated with any new DG connections in the South West.

In order to achieve timely energisation, many DGs are opting for so-called 'flexible' connections, accepting curtailment in abnormal network conditions instead of waiting for a physical network reinforcement to be completed. As yet, there is no incentive for any DNO to record or measure the resulting spilled energy, which could serve as a useful proxy signal to drive optimal network reinforcement, and such constraints may continue indefinitely under existing network planning regulations. We welcome the work by Smart Grid Forum Work Stream 6, which acknowledges this major flaw, and hope to see this issue rectified in parallel with the publication of clear and transparent guidance for flexible connections as a whole. This guidance should cover industry best practice on estimating constraint levels, to better enable users to make relevant commercial decisions and obtain funding.

At a physical level, cost-effective integration of DERs and increasing use of smart and flexible network solutions requires appropriately reliable and widespread communications systems at every level of the network. Such communications systems are not yet prevalent on today's electricity infrastructure and are a necessity for tomorrow's network. This is evidenced by the increasing prevalence of bespoke, high cost communication network upgrade costs being passed by TOs and DNOs directly into the cost of connecting new generation, at both distribution and transmission level[3].

In summary:

1. A need for strategic, holistic, 'least regrets' network planning rules which allow for consideration of both longer-term reinforcement *and* shorter-term smart or flexible network solutions; more joined up thinking across the distribution and transmission boundary
2. A need to measure 'spilled' energy from constrained network connections, and use this measure to drive decisions on efficient network solutions.
3. An urgent need to deliver coordinated communications networks to enable DERs, smart network solutions and flexible network services.

2. What will a low carbon network look like, what are the challenges for Government and other bodies in achieving it, and what benefits will it bring to the UK?

The recently published '*Energy system crossroads - time for decisions*'[4] report provides an excellent overview of the challenge of decarbonising the heat and transport sector and should be considered carefully in the context of this inquiry. We our purposes we will simply highlight that successfully decarbonising these sectors relies in one way or another on major changes to the power sector.

[3] We would be happy to share specific examples on request, subject to permission from the relevant DNO/TO.
[4] Imperial college, October 2015, https://workspace.imperial.ac.uk/icept/Public/Energy%20System%20Crossroads.pdf

Power sector - going smart is beneficial in all credible scenarios

The future of the power network is smart. This is certain because the benefits of a smart system are independent of how fast decarbonisation progresses. In their *Power Sector Scenarios for the Fifth Carbon Budget*, the CCC highlights that even with a grid intensity of 200gCO2/kWh flexibility options provide savings of £2.2 to 2.9 billion per year in 2030[5]. We can no longer afford building more network and generation capacity to cater for rare instances of peak demand when we have more cost-effective ways of dealing with these peaks.

The benefit is even greater in a low carbon economy. The CCC highlights the importance of smart solutions to cost-effectively integrate more distributed generation and enable the cost-effective decarbonisation of the heat and transport sector which also require a decarbonised generation mix.

Power sector - future generation mix

Successful decarbonisation of heat and transport is currently entirely dependent on the future carbon intensity of the power sector which the CCC suggests should be 50-100gCO2/kWh by 2030.

Unfortunately it has become clear that although the wholesale electricity market provides a very efficient dispatch signal it does not generate the necessary investment signal to stimulate the levels of new-build low carbon generation that the UK needs. The Government therefore needs to procure most of the desired generation through the CfD or Capacity Market. The government is therefore in charge of our future energy mix, which can result in a very clear pathway or huge uncertainty. Unfortunately today we are far from a clear pathway. The implication is that the future energy mix is very uncertain and this significantly increases the complexity of network planning and increases the risk of stranded or delayed network investment.

3. How can we ensure that a low carbon network is designed and operated fairly and in a way that helps to minimise consumer bills?

To design cost-efficient networks of this scale and complexity we must start by reducing the level of uncertainties where possible, especially political uncertainties.

Reducing political uncertainty: Generation mix

Investment in future low carbon generation is now dependent on the CfD mechanism and LCF budget trajectory. The LCF budget trajectory is a goal-seeking policy and the goal is low-cost low carbon generation. It is therefore sensible that the LCF should be set in line with the CCC's recommended carbon intensity target for the power sector. Such a target can also help manage uncertainty in heat and transport sectors. For instance, fixing the LCF to a 50g/tCO2 by 2030 but with the ability to modify this to 100g/tCO2 if significant progress is achieved in the heat and transport sectors means the quantity of low carbon generation

[5] CCC, Oct 2015, https://www.theccc.org.uk/publication/power-sector-scenarios-for-the-fifth-carbon-budget/

that needs to be delivered will fluctuate less. It is also appropriate to ensure that the mature technology auctions do not exclude cost-effective low carbon technologies from participating in auctions. Auction dates and budgets for pot 1 also need to be set a number of years in advance in order to appropriately incentivise investment in project development and thereby inform related electricity network planning.

Distribution System Solutions

The cost-effective network design will only emerge if flexibility is properly valued. We believe that one of the key enablers is going to be the implementation of access to 'system operation' costs and services for all stakeholders at the distributed level. This will necessitate active *system operation* at a distribution level, whether by extending the role of existing DNOs or the existing TSO.

In the short term, cost-effective network solutions can be enabled as explained in our answer to Q1; at the DNO level in summary this requires:

a) Permitting traditional and non-traditional electricity network solutions to compete at both distribution and transmission levels.
b) Measurement and valuation of constrained energy is an important signal to inform decisions on grid reinforcement (or other smart solution).

Despite having 'future networks' teams, the culture of DNOs might not be changing at the pace that matches our decarbonisation ambitions – we see this in the very limited and piecemeal roll-out of so-called 'flexible' connections, including 'active network management' solutions, which presently differ hugely in implementation and cost between DNOs. DNOs must do much better at sharing and implementing best practice, otherwise further regulatory reform is required.

4. How can we ensure that grid connections are readily accessible across the country and that costs are fair?

We have identified three key challenges to deliver readily accessible and cost-effective grid connections:

1. Strategic, coordinated network investment to facilitate both new generation (particularly distributed generation) and the decarbonisation requirements of heat and transport sectors.
2. Elimination of barriers to grid access for electric storage.
3. Stabilisation and harmonisation of network charges between the distribution and transmission networks.

These three points are expanded below. Grid connections are heavily regulated processes and so improvements will require relevant industry codes and methodologies to change in kind; this is traditionally a very lengthy process (the recent review of transmission network charging, so-called Project TransmiT and the 'CMP213' modification, took *several years* to

conclude) and so a broader fundamental obstacle is the ability of Ofgem and code governors to meet the necessary pace of required change.

Strategic, coordinated investment

WPD's open letter regarding the South West of England[6] and UKPN's capacity guidance for the East and South East regions of England[7] both point to huge regional bottlenecks for grid access (similar bottlenecks can be seen in Wales and across the whole of Scotland). The present connection charging methodologies heap almost 100% of the cost of a regional reinforcement onto a single distribution-connecting development which just exceeds the available capacity[8] – this could for example apply the costs, risks and timing of a c.100km new overhead line onto a single 1MW generation project. One critical point is of timing – whereas new small generators can achieve planning and build-out within 12-24 months, new large overhead lines for DNOs or TOs may take several years to plan and construct.

Presently, DNOs are not correctly incentivised to plan for strategic, scenario-based, "least-regrets" solutions in the way National Grid does at TO level, and this is clearly a missed opportunity for efficiency. Even if certain DNOs show initiative in this regard, there is no apparent incentive or framework for the overall solution to be coordinated with transmission solutions. We welcome Ofgem's '*Quicker and more efficient connections*' project which looks at some options to rectify this inefficiency and hope to see solutions in place during 2016. Beyond the DNOs themselves, we would like to see an overarching body which can take decisions on the best *overall* network solution, encompassing coordinated options at transmission *and* distribution level, considering traditional *and* smart options. We also believe that DNOs should be encouraged to make better use of temporarily 'flexible' connections to enable timely, if constrained in the short term, connections which will help build a more robust needs case for regional reinforcement work. In this vein, we welcome the work done by Smart Grid Forum Work Stream 6 on clarifying the nature of flexible connections and highlighting where these can be used to support the case for reinforcement works (or other network solutions, as appropriate). Not all generation developments will succeed (considering for example WPD's present 8.5GW[9] of contracted but unbuilt generation, but even with extremely high levels of project attrition some reinforcement works are no-regret options; and if some of these user-connections can be advanced before reinforcement completion with short-term export-management in place, then this will only support the case for specific local network reinforcement solutions.

Much of the uncertainty around deployment of new-build generation and network investment plans can be mitigated by the CfD mechanism. This is because this mechanism provides a high degree of certainty around the capacity to be deployed well in advance of commissioning. Indeed over 90% of the entire CfD round 1 budget was allocated to capacity

[6] Available from WPD's website
[7] Available from UKPN's website
[8] The Common Distribution Connection Charging Methodology – see section on "high-cost cap".
[9] WPD's Connection Capacity Register, available from WPD's website.

with target delivery dates in or after 2018/19, or ~4 years ahead, which provides better alignment with the necessary network investment spend[10].

Storage

Grid connection and charging rules need to be adapted in order for electricity storage to be implemented successfully. Present connection rules are predicated on peak output at exactly the worst moment – e.g. peak generation at the point of lowest demand –conditions that many storage solutions may be procured to avoid. Network planners should consider time-of-use profiles to enable more cost-reflective connection solutions. More significant, however, are the charging rules as presently applied to storage devices. At the moment storage on the distribution network is treated as both a consumer and a generator depending on the instantaneous power flow, resulting in an unduly discriminatory penalty of having to pay retail prices and associated network and levy charges for importing power but receiving wholesale prices and paying associated worst-case network charges for exporting power.

We believe that electricity storage requires a separate regulatory categorisation in order to enable more cost-reflective regulation and realise the opportunities.

Network Charging

Presently, the TSO and the DNOs apply their own, wholly separate and disjointed charging rules to recover the costs of operating and managing the electricity system at transmission and distribution level respectively. This has led to wholly disjointed market signals which can lead to non-optimal engineering solutions and potentially therefore a poorer deal for consumers. This situation is only exacerbated by the practice of defining the boundary between distribution and transmission differently in Scotland compared to England and Wales. The rise of DERs, as detailed elsewhere in this paper, will lead to increasing bidirectional and dynamically changing power flows, calling into question the purpose of distinguishing between distribution and transmission. A more efficient, and overall lower cost, network could be facilitated by a move towards harmonising and stabilising these operational charging methodologies.

5. What are the key technologies available today and how effectively do Government and Ofgem incentivise innovation and development of the grid and grid technologies?

Optimal network plans will include a mix of smart, service-based and traditional, physical-build network solutions, such is the conclusion of *Smart Grid Forum's Work Stream 7*. RES has actively participated in the SGF work and supports swift implementation of the work stream's recommendations.

Strategic, coordinated network planning is not taking place effectively, as discussed in our answer to Q4, which also highlights the need for associated industry codes to be revised far

[10] CUSC 15 – Enduring User Commitment.

quicker than has been the case historically, in order to deliver the changes discussed to address relevant targets.

6. What impact will changes to the electricity system – including distributed energy generation/storage, demand response and interconnection – have on the role of National Grid and the Distribution Network Operators?

An efficient network needs commercially engaged system operation services at distributed level, as explained in our answers to Q1 and Q3, and this is effected by either extending the role of the existing TSO or of each of the existing DNOs. This results in either a much-expanded *universal system operator* (at distribution and transmission level), which may be driven by the increasingly redundant need for the relatively arbitrary distribution/transmission barrier; or the introduction of a specific *distribution system operator* working alongside and in parallel with the existing DNOs, driven by the DNOs' closer relationships with and better understanding of the great number of smaller users at a distribution level. In both cases, this requires appropriate safeguards for cost-efficiency and the enabling of overarching decisions on optimal network solutions. We have yet to see evidence that clarifies which of these solutions will be optimal, but hope that such evidence is forthcoming in order to deliver on the issues highlighted above. In terms of the needs case for an overarching view, we point to the work done by the IET on system architecture[11].

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[11] Available from: http://www.theiet.org/factfiles/energy/brit-power-page.cfm