December 2017

ENA Technical Losses Working Group

Chaired by: Jim McOmish
SP Energy Networks

Technical Losses Working Group

Purpose and Aims:

Improve understanding of technical losses

Develop best practice and sharing for losses strategies and activities

Review technical and regulatory requirements for a fair and effective losses incentive mechanism in ED2

Key Facts:

Convened in March 2016

Chaired by SP Energy Networks and attended by all six DNO Groups plus National Grid

Reports to ENA Electricity Networks and Future Group

Work package commissioned to investigate "The impact of Low Carbon Transition on Technical Losses"

December 2017

Impact of Low Carbon Transition on Technical Losses

Gillian Williamson

Project Aim

The aim is to understand the impact of the low carbon and smart grid transition on network losses by:

1. Consideration of the impact on losses of LCT growth
2. Consideration of the impact of smart reinforcements on losses
3. Influence on losses of customer usage patterns

Recognising that changes are happening in Distribution Networks and how they are being used:

Environmental Targets

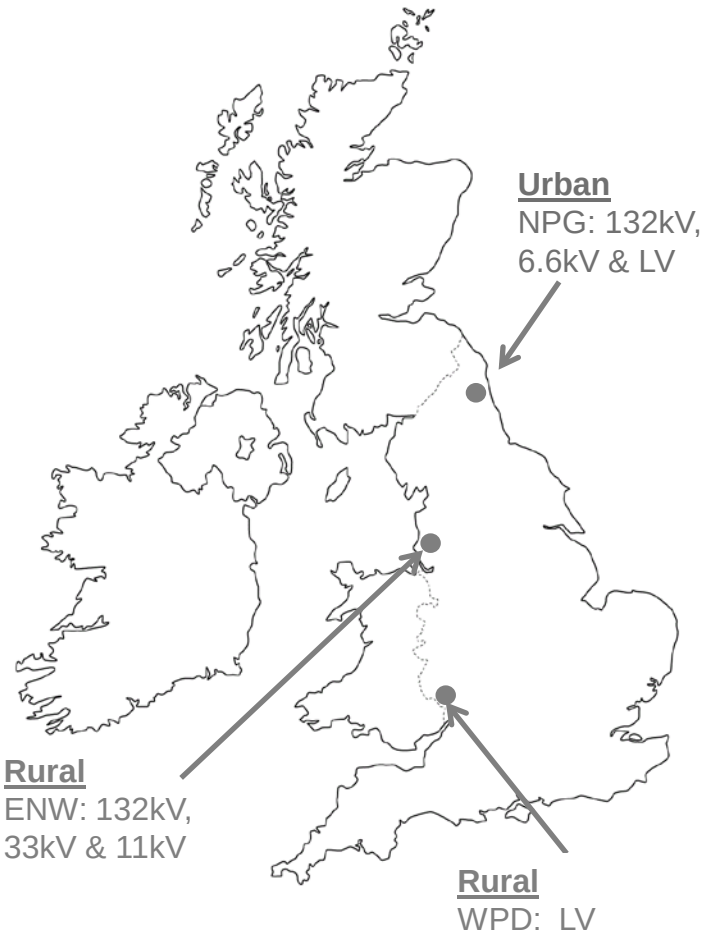
- Reduced use of coal and gas
- More renewable energy
- Electrification of transport
- Electrification of heating

Technological Developments

- Customer empowerment
- Electric vehicles
- Smart solutions
- Energy storage

Provide information to inform DNOs, Ofgem and Government

Methodology



Used representative Urban and Rural network models, derived from real networks; developed in the DS2030 work

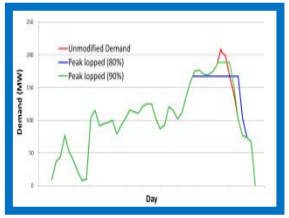
Simulated 2030 uptake of LCT connections; aligned with NGET's Future Energy Scenarios

Year long studies (half hour granularity)

Technical losses evaluated as percentage of energy supplied at each voltage level

Excludes dedicated connection assets

Network energy storage



Change in demand profiles

Generation constraint

Simulations were performed to provide understanding of the individual and combined impact on losses by 2030

Key Findings

LCT Impact

The uptake of low carbon technologies will significantly impact losses

Network Evolution

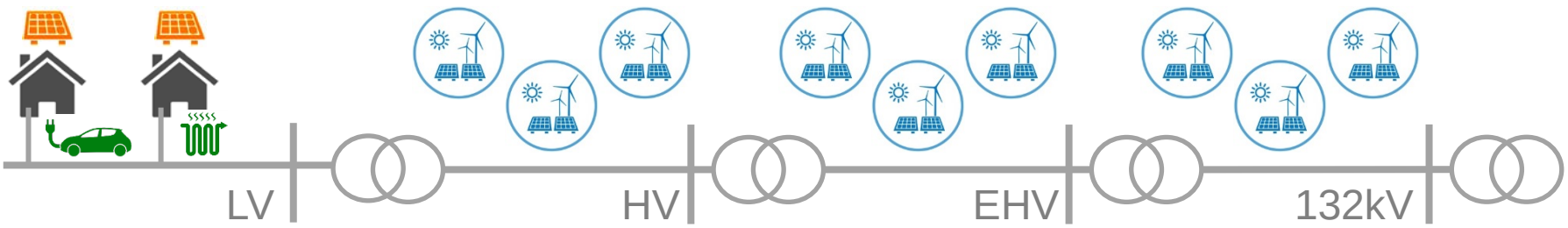
How networks accommodate low carbon technologies will impact losses

Complexity

Losses are complex, difficult to measure and vary based on regional topology

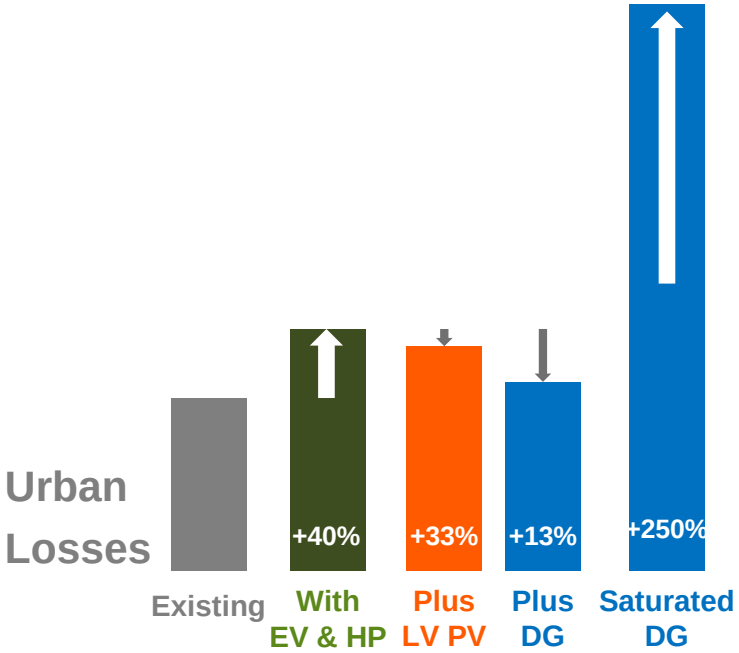
Technical losses will increase as we move to a low carbon future and understanding the impact will inform how losses can be managed

LCT Impact by 2030 – Urban



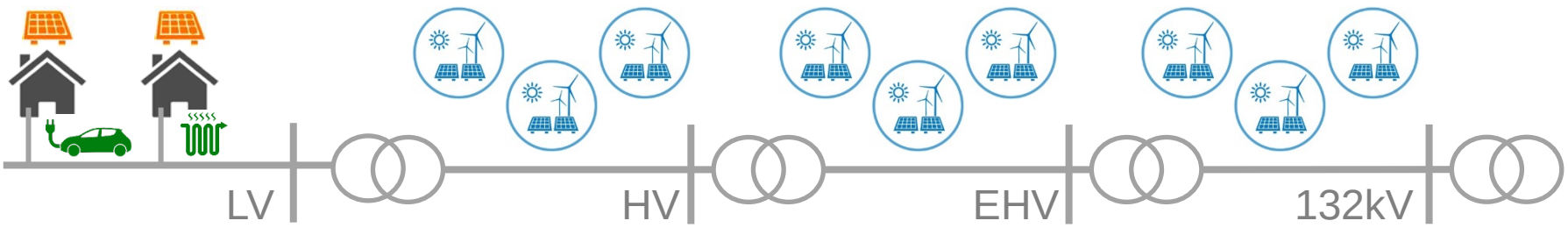
Impact of 2030 LCT uptake in Urban areas (no reinforcement)

- Losses significantly increase due to future load growth from EVs & HPs
- LV photovoltaic can reduce losses
- At low uptakes generation can reduce losses
- High penetrations of generation can dramatically increase losses



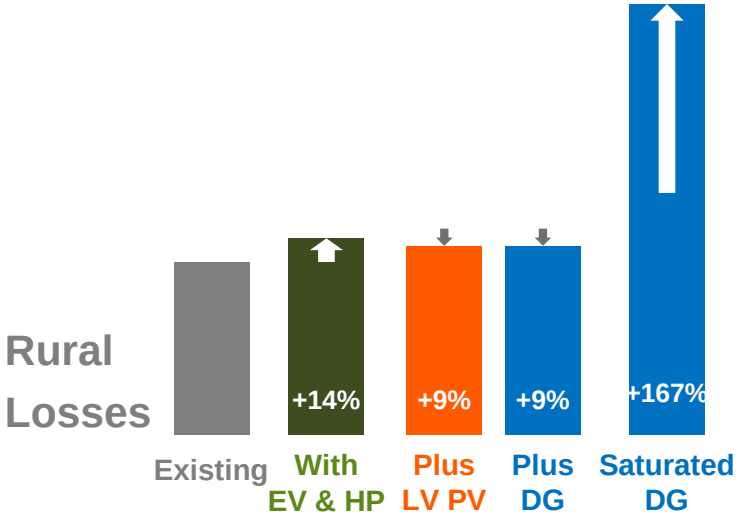
The uptake of low carbon technologies will significantly impact losses

LCT Impact by 2030 - Rural



Impact of 2030 LCT uptake in Rural areas (no reinforcement)

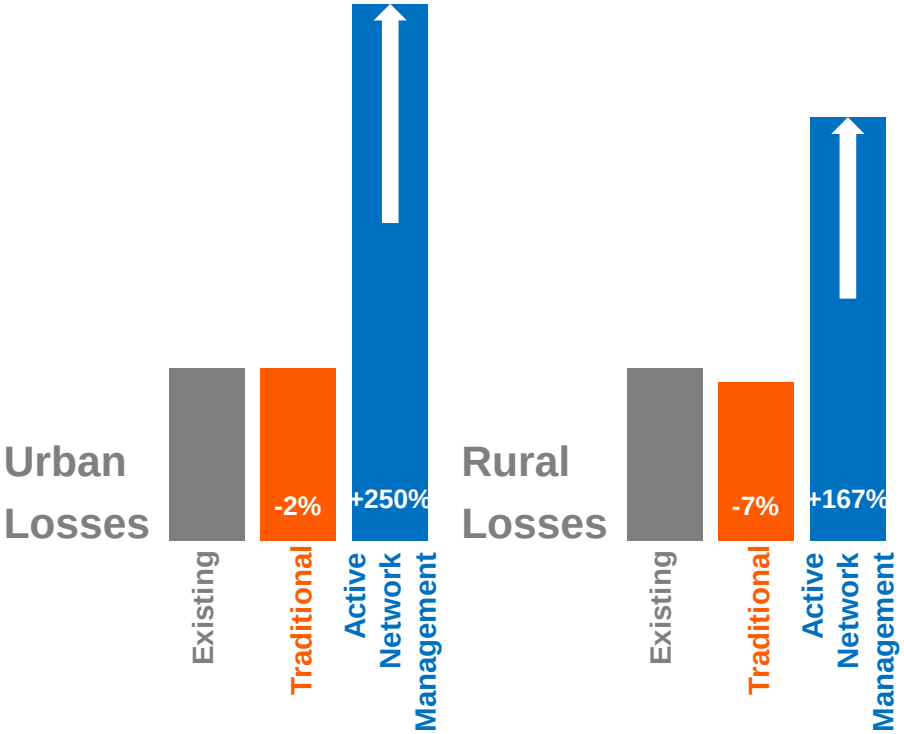
- Losses impact is very sensitive to network characteristics and regional variations
- LCT clustering will significantly affect losses
- DNOs have little influence on customers' uptake of LCTs



Losses impact will depend on location of uptake and customer behaviour

Active Network Management

- Large amounts of generation can be accommodated by Active Network Management (Flexible Connections)
- Non-firm connections actively constrain generation when network reaches limits
- Simulated by **saturating** the 33kV networks without reinforcement
- Network utilisation and **losses increase significantly**
- Active Network Management avoids the capital cost of network reinforcement



Increased network utilisation associated with embedded generation will significantly impact losses

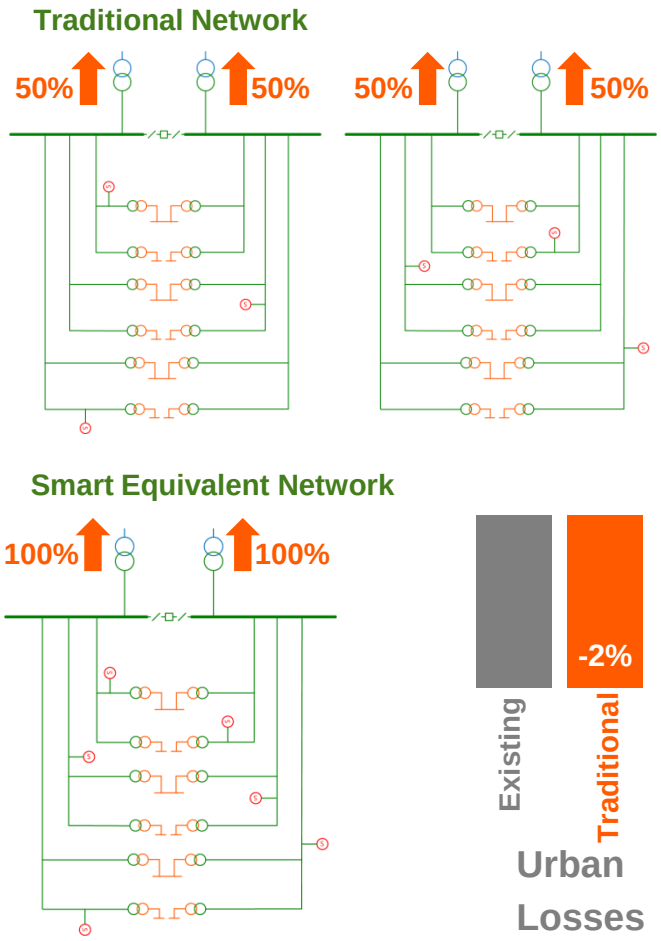
Network Evolution

Traditional Reinforcement

- Accommodating low carbon generation and demand through traditional means would require wide scale reinforcement
- Traditional reinforcement investment needs by 2050 estimated at £35-£50Bn*
- Losses would broadly be maintained near existing levels

**Transform model*

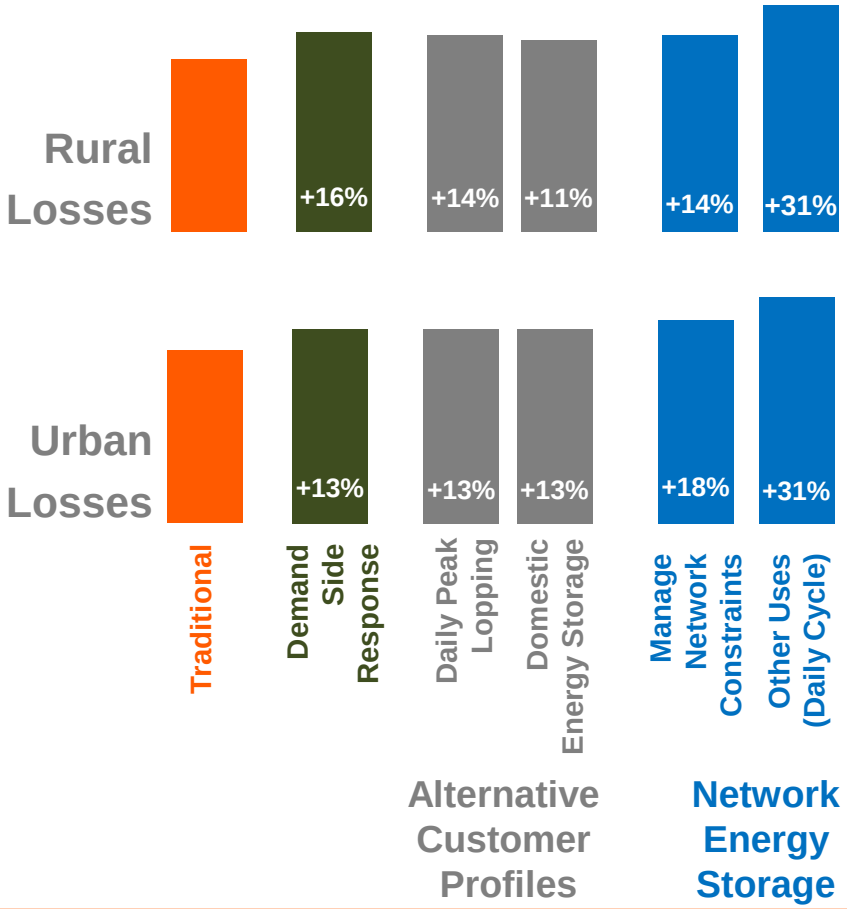
- Alternatively low carbon generation and demand could be accommodated through smart networks at a reduced cost
- Inevitable increase in losses



Increasing network losses to accommodate Low Carbon Transition can be justified compared to traditional reinforcement costs

Smart Solutions

- Smart solutions increase network utilisation and therefore losses
- Simulations considered:
  - Demand Side Response
  - Alternative Customer Profiles
  - Grid Energy Storage
- Comparisons of losses against network with traditional reinforcement applied

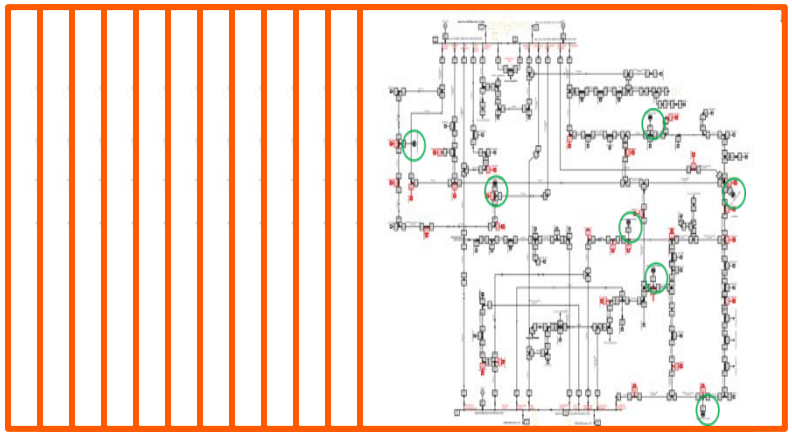


Smart Solutions increase losses, reinforcement choices must adequately consider losses

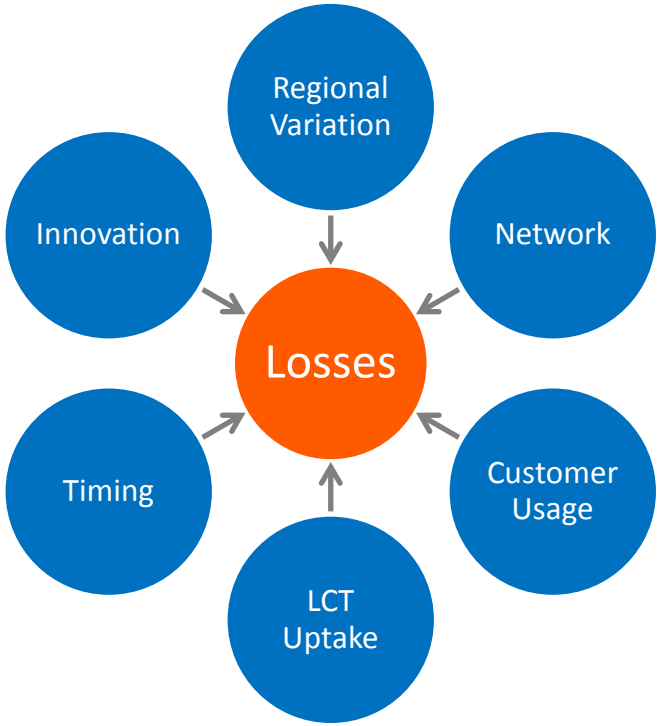
Complexity

Assessing a limited number of scenarios on **<1%GB** networks required over **1 million power flow simulations**.

Complete models for all GB not feasible.



Losses depend on many factors including:



Losses are complex, difficult to measure and vary based on regional topology

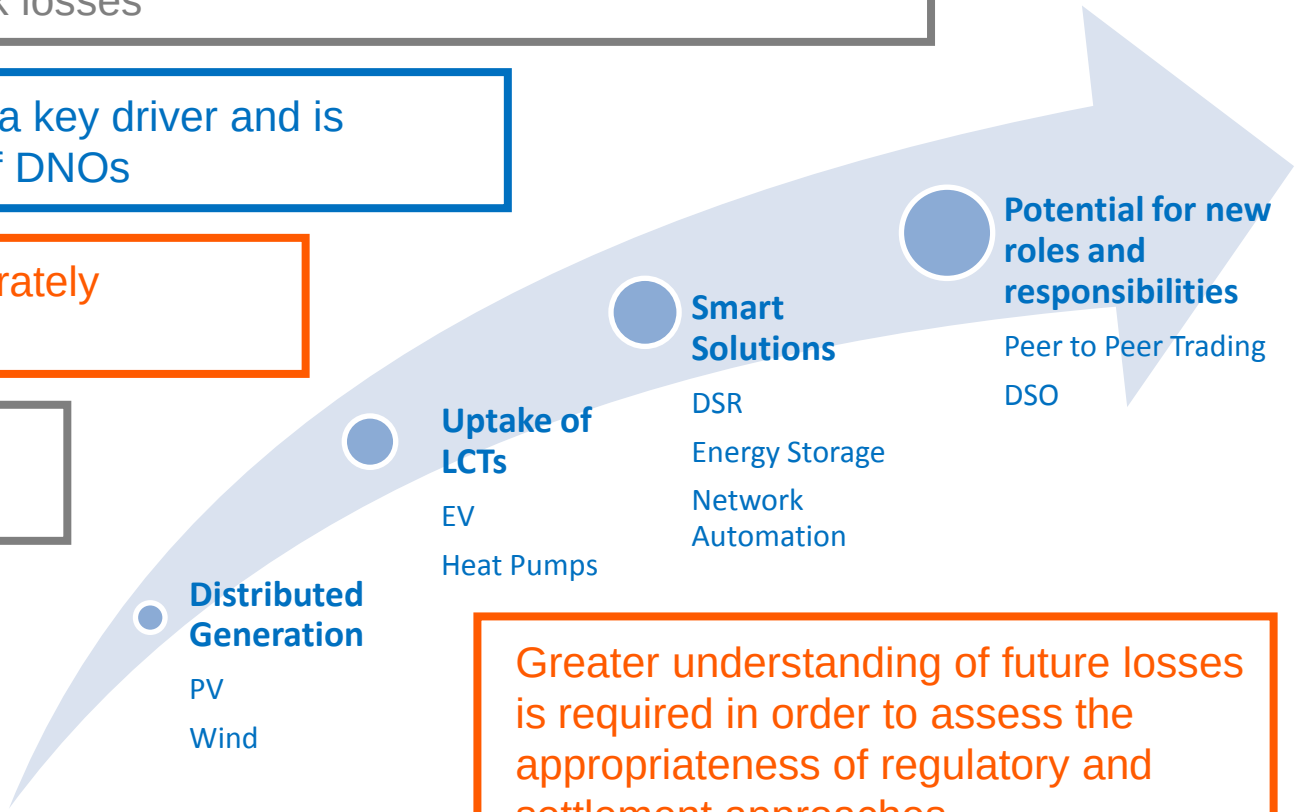
Uncertainty

The move to a low carbon future will significantly impact transmission and distribution network losses

Customer behaviour is a key driver and is outside of the control of DNOs

Losses cannot be accurately measured currently

Losses are sensitive to regional topologies



Greater understanding of future losses is required in order to assess the appropriateness of regulatory and settlement approaches

Losses are difficult to quantify and subject to significant uncertainty

Conclusion

The study provides a number of benefits including:

1. Informs the industry about the scale of uncertainty around future loss increases due to the uptake of LCTs and smart solutions
2. Demonstrates the limited degree to which DNOs can manage losses (a key consideration for the development of any future incentives)
3. Demonstrates that increasing network losses to accommodate Low Carbon Transition can be in customers' interests

The finalised report will be published on the ENA website for consultation in early 2018.

For further information please contact LossesTeam@SPEnergyNetworks.co.uk