



Future Energy System Challenges A Distribution Operator Perspective

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The fundamental challenges have not changed

- Get them on
- Keep them on
- And if they're not on, get them back on

- And do it cheaply, safely, timely, and politely

So why are people talking about energy system transition?

- New users
 - EV
 - Heat
 - Storage
- New / evolving techniques
 - Power electronics and comms enabling more powerful versions
 - Firm/unfirm >>> DSR and AMN
 - Economy 7 >>> time of use tariff
 - Switching staff >>> SCADA >>> Remote Control >>> APRS
 - Cyber

So where are the areas of interest?



- Extra demand from heat and EV
- Timeshift-able demand from heat and EV
- Ability to timeshift other loads with storage
 - Transition from power company to pseudo-energy company
- The next step in reliability and resilience
- Cyber-security, cyber-recovery, cyber-resilience

- The implications of a general move from passive to active systems

- And how do we model it all?

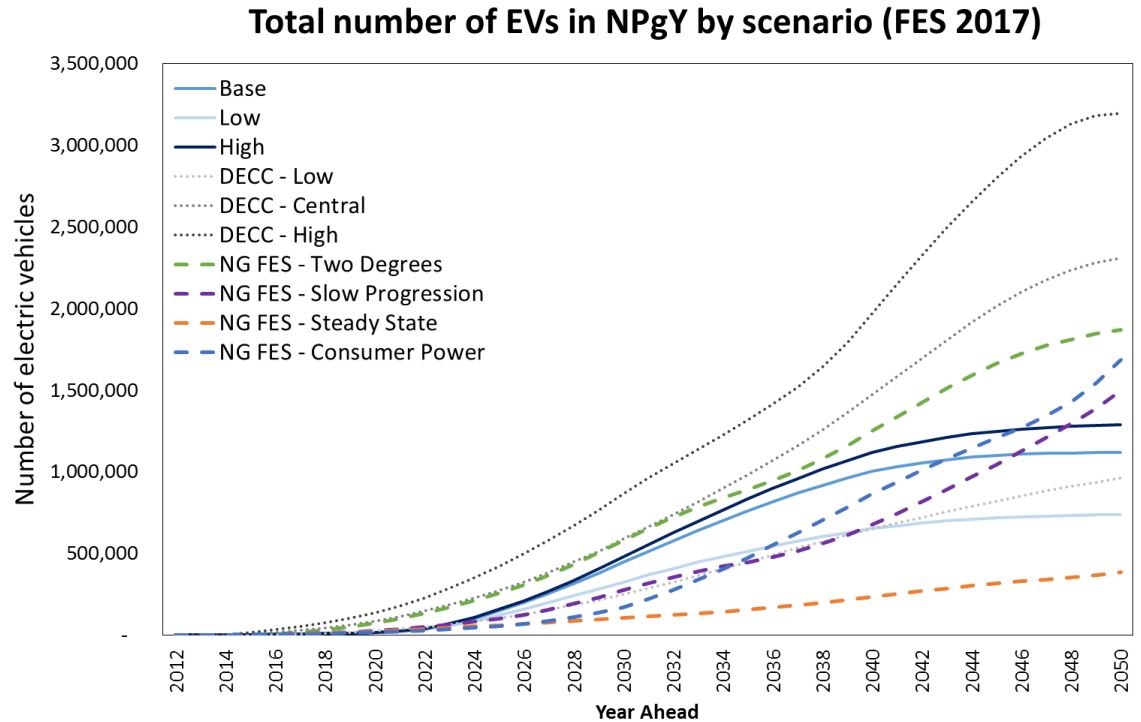


EV Demand Example



Huge uncertainty exists in EV growth projections

- Base, Low, High from Element Energy's model
- DECC scenarios from the RIIO-ED1 Transform model
- NGT FES derived scenarios



Different charging regimes will significantly influence the impact on the grid

- Charging can be defined by four attributes
 - **Energy requirement** – how much energy is required to replenish the battery
 - **Location** – where the charger is located
 - **Speed** – the time available to charge and therefore the kW power rating of the charger
 - **Functionality** – whether the speed can be controlled or charging reversed
- The applications to which the electric vehicle is put, whether solely transportation applications or also grid support or energy arbitrage, will influence what types of charging regime are desirable.
- The desirable speed will also vary with location and functionality.

Combined these uncertainties mean that, the impact on the grid of transitioning to EVs is unclear

- While some scenarios do indicate a 60% increase in peak demand, which would require significant reinforcement, it is equally possible to construct an EV future with little or no reinforcement requirement. In practice reality will probably be somewhere between these extremes.
 - Day and night time charging – 60% >>> 30%
 - Load used to be 15% higher 10 years ago – 30% >>>15%
 - Cars come over 20-30 years – 15% >>> 0.5-0.75% per annum
 - Asset replacement will create free reinforcement – de minimis problem?
- Realistically the electrical network is going to be able to accept the likely growth from EVs, with some smart charging and the slightest touch of reinforcement.

However...

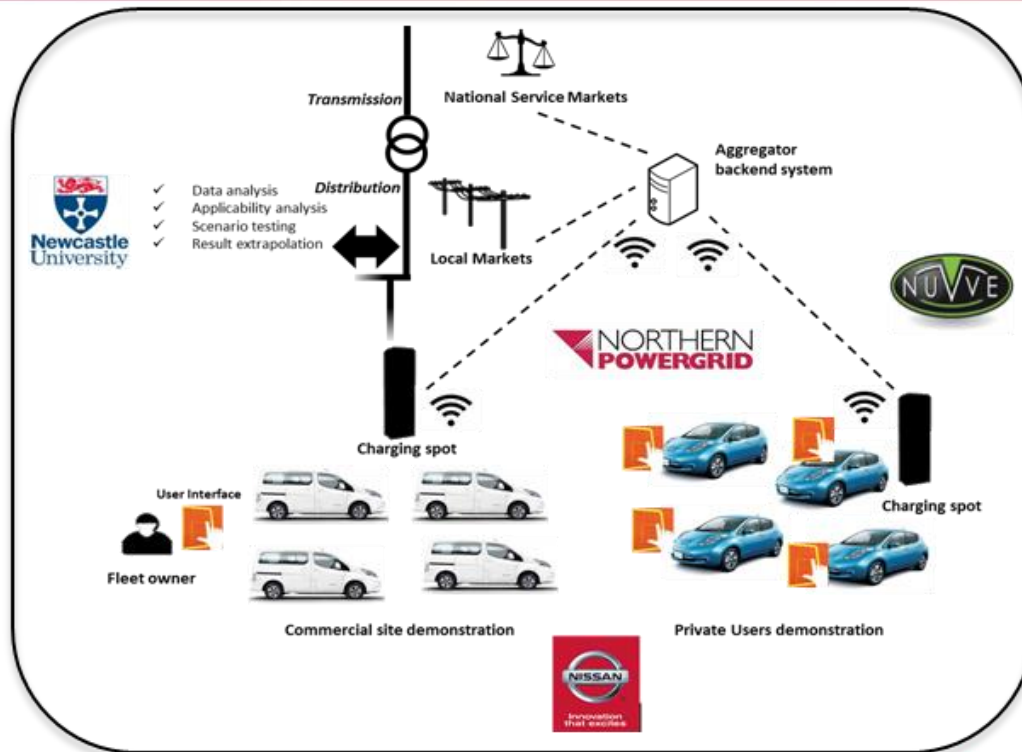
- Merely coping with the impact should be seen as failure.
 - How do we improve the experience for customers?
 - How do we reduce the cost of networks?
 - How do we reuse batteries at the end of life?
 - And the opportunity to use the huge amount of “free” electrical storage should not be missed.



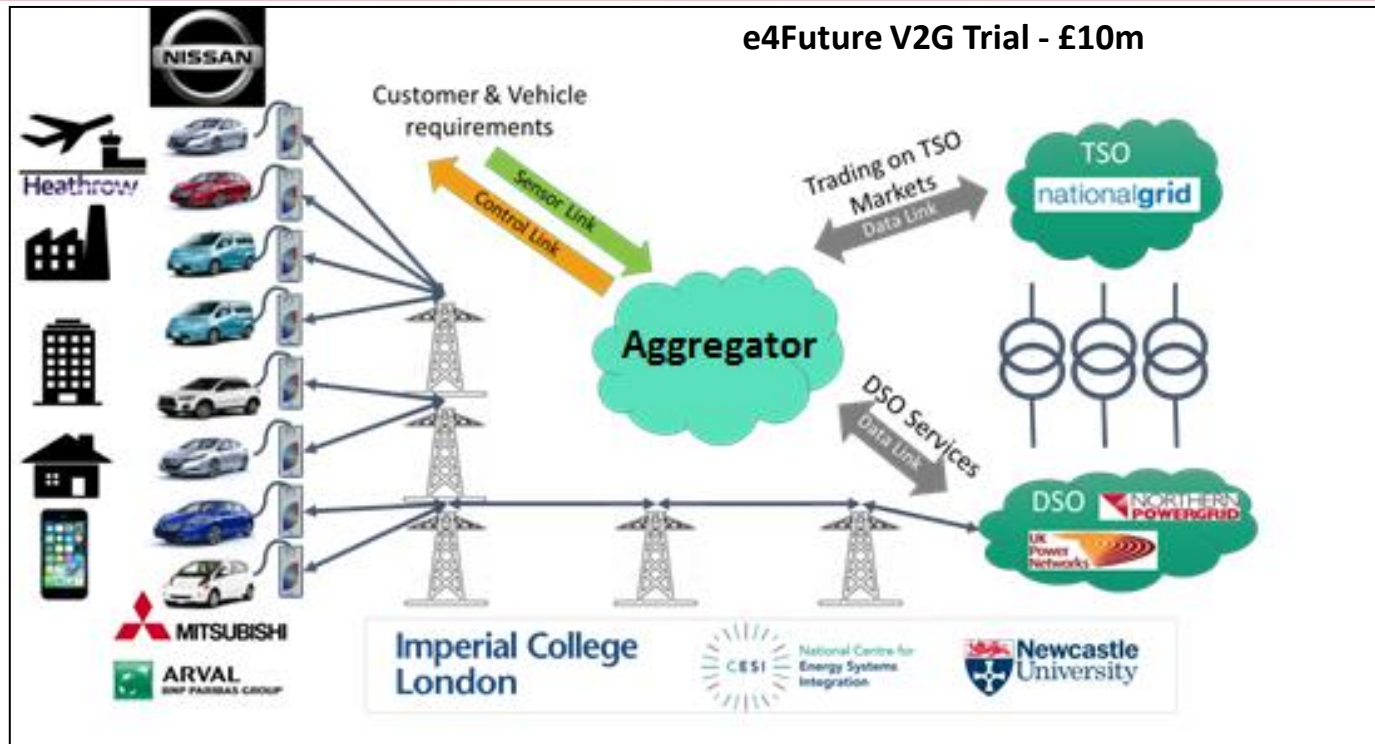
Responding to the challenges



V2G – Proving the technicalities



E4 Future – Commercial Viability



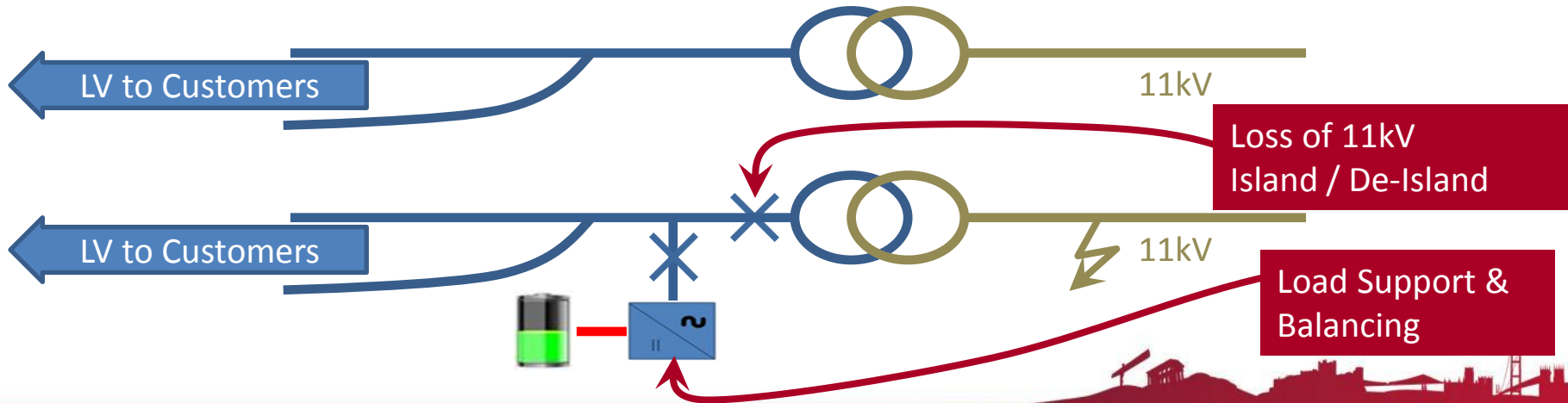
Gen Drive



- Gamification for consumer engagement in V2G services
- Development of GenGame, a game based DSR application with aggregated prizes (over 2000 participants)
- Extends the thinking into V2G services using Innovate UK funding



MicroResilience

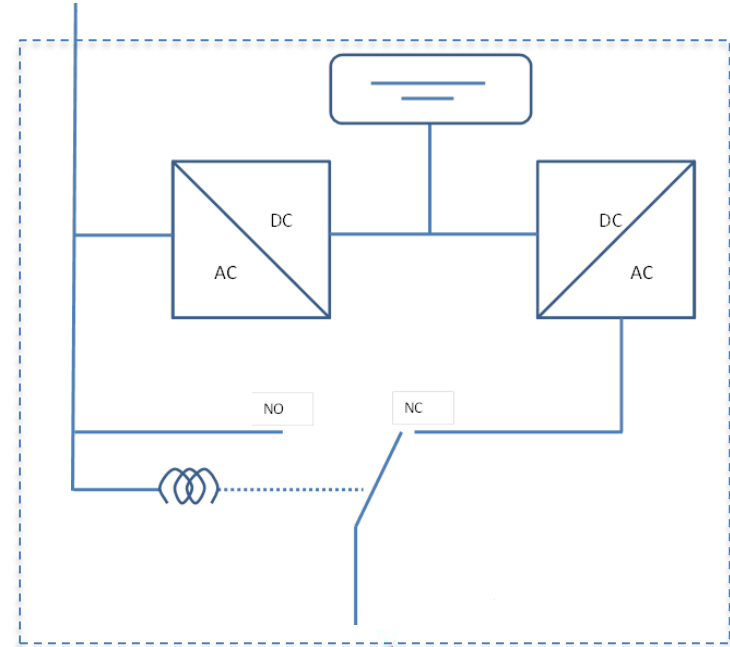


Silent Power



Resilient Homes

- Simple, crude, but effective battery based resilience for medically electrically dependent customers



And responding with practicality



- Replacing our pool cars with EVs
- Around 40 chargers being installed in depots
- Silent Power based on an EV not a diesel van

