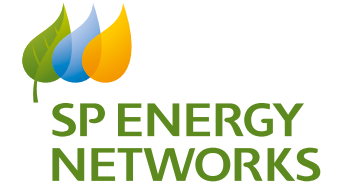


# 2019 A Year of Innovation Projects



# Who are we?

We are SP Energy Networks, part of the Iberdrola Group, leaders in sustainable innovation. As a Distribution and Transmission Network Operator we keep electricity flowing to homes and businesses throughout Central and Southern Scotland, North Wales, Merseyside, Cheshire and North Shropshire.

We do this through the network of overhead lines and underground cables which we own and maintain.

Our three regulated electricity licences are:

- SP Transmission (SPT)
- SP Distribution (SPD)
- SPManWeb (SPM)

Our aim is to deliver a safe and reliable electricity supply **24 hours a day, 365 days a year** whilst providing exceptional value for money.



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# Fusion

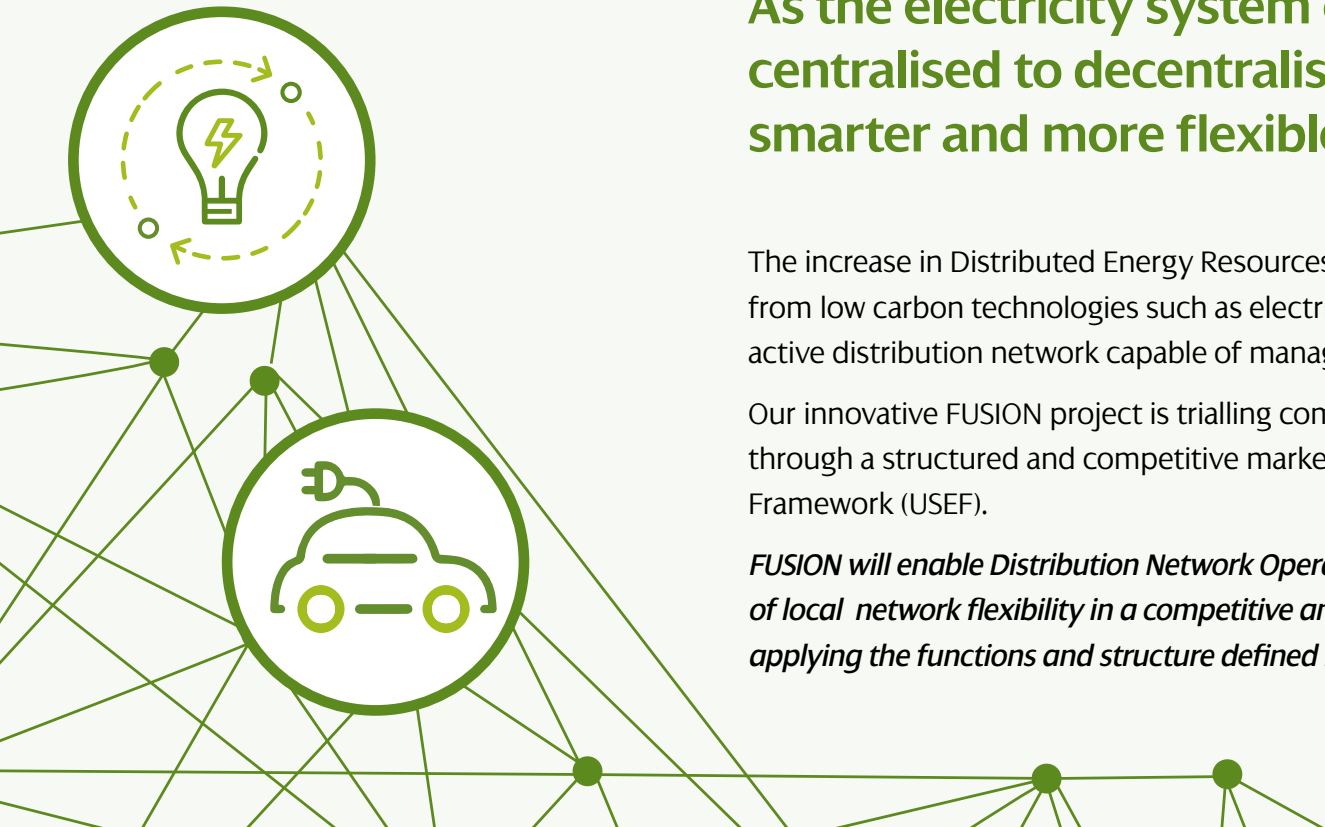
SP Energy Networks is aiming to make the transition to becoming a Distribution System Operator (DSO).

**FUSION** represents a key element of that transition. As the electricity system changes from a centralised to decentralised model, it enables a smarter and more flexible network to function.

The increase in Distributed Energy Resources coupled with the increasing load demand from low carbon technologies such as electric vehicles has fuelled a need to create an active distribution network capable of managing modern customers' needs.

Our innovative FUSION project is trialling commoditised local demand-side flexibility through a structured and competitive market, based on the Universal Smart Energy Framework (USEF).

*FUSION will enable Distribution Network Operators and all market actors to unlock the value of local network flexibility in a competitive and transparent manner. This will be enabled by applying the functions and structure defined in the USEF.*



# Project Partners

## Project Partners

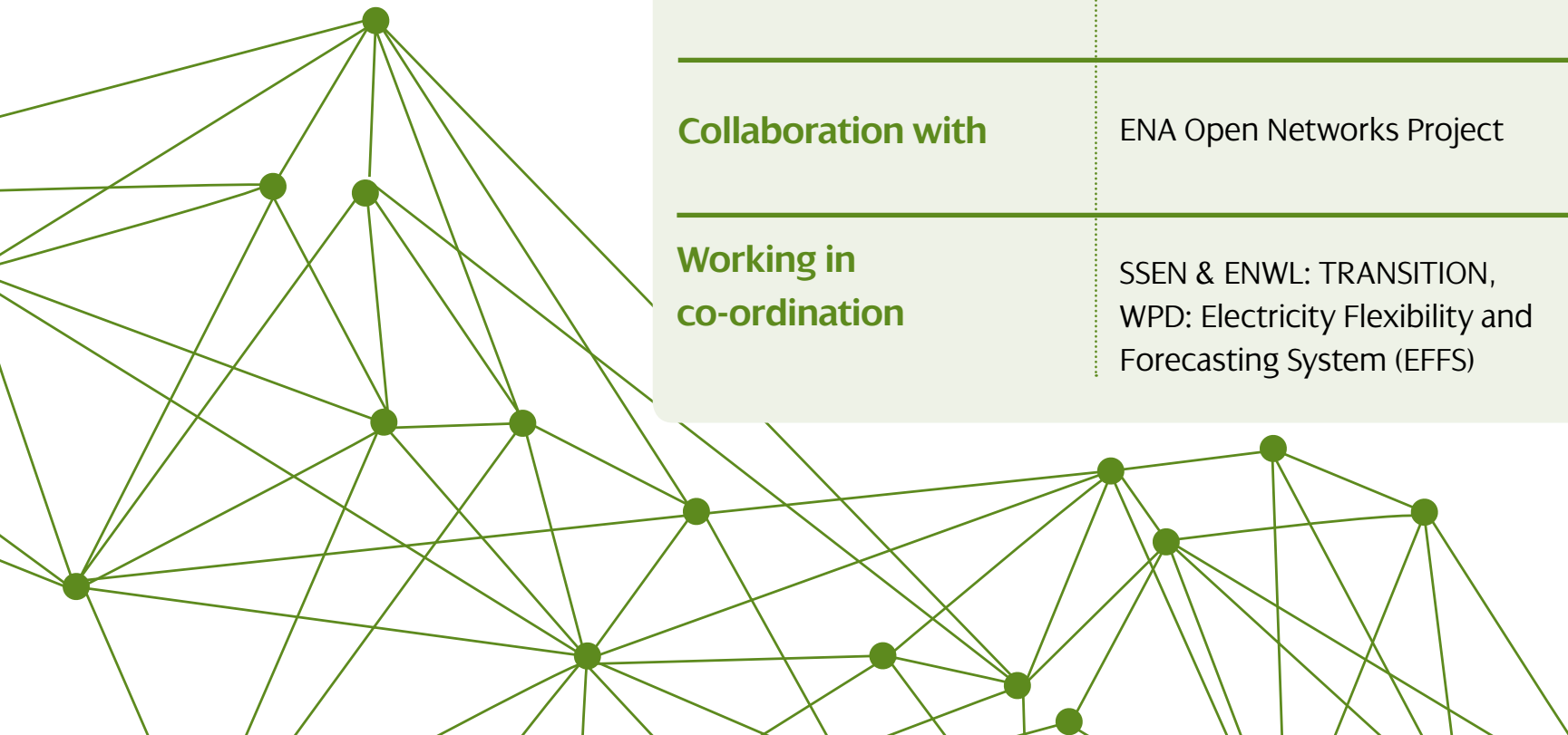
DNV GL, Origami Energy, PassivSystems,  
Imperial College London (Academic partner),  
SAC Consulting, Fife Council,  
The University of St Andrews,  
Bright Green Hydrogen

## Collaboration with

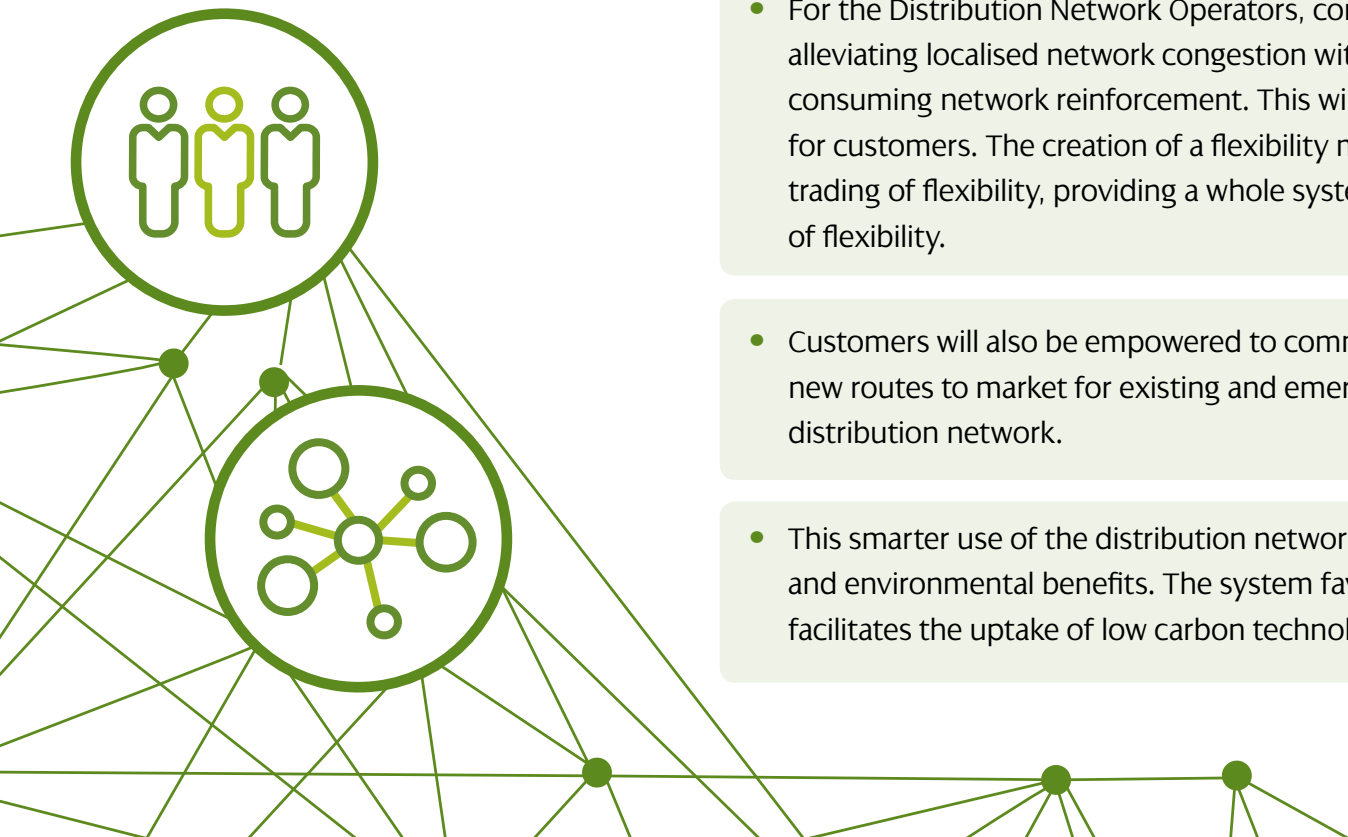
ENA Open Networks Project

## Working in co-ordination

SSEN & ENWL: TRANSITION,  
WPD: Electricity Flexibility and  
Forecasting System (EFFF)



# Benefits for customers



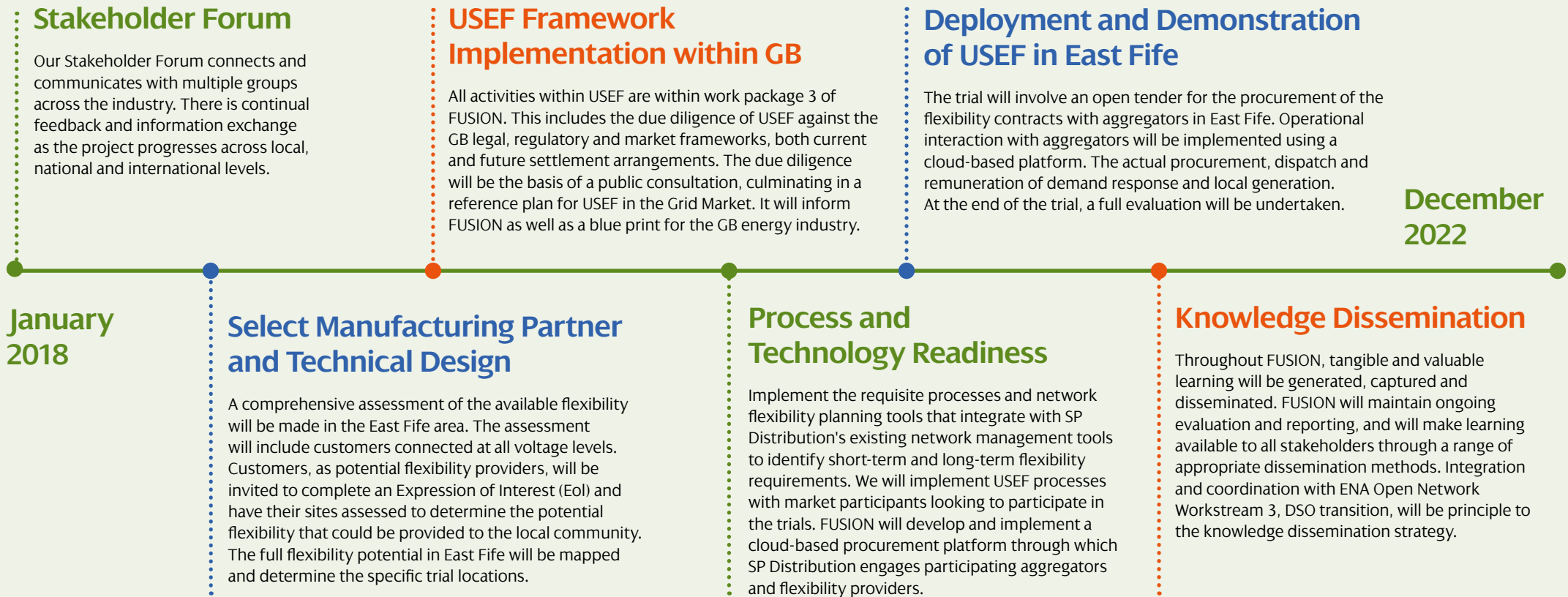
- FUSION will unlock flexibility in the distribution network: this means it can be procured by a range of market actors. Aggregators will be able to operate to aid the development of the flexibility market. By facilitating this neutral market, network flexibility will be accessible to all parties.

- For the Distribution Network Operators, constraint management will be trialled, alleviating localised network congestion without requiring costly and time consuming network reinforcement. This will provide excellent value for money for customers. The creation of a flexibility market will go beyond existing bilateral trading of flexibility, providing a whole systems approach to realising the value of flexibility.

- Customers will also be empowered to commoditise their flexibility thanks to new routes to market for existing and emerging flexibility providers in the distribution network.

- This smarter use of the distribution network assets means significant carbon and environmental benefits. The system favours renewable energy sources and facilitates the uptake of low carbon technologies.

# Timescale



# LV Engine

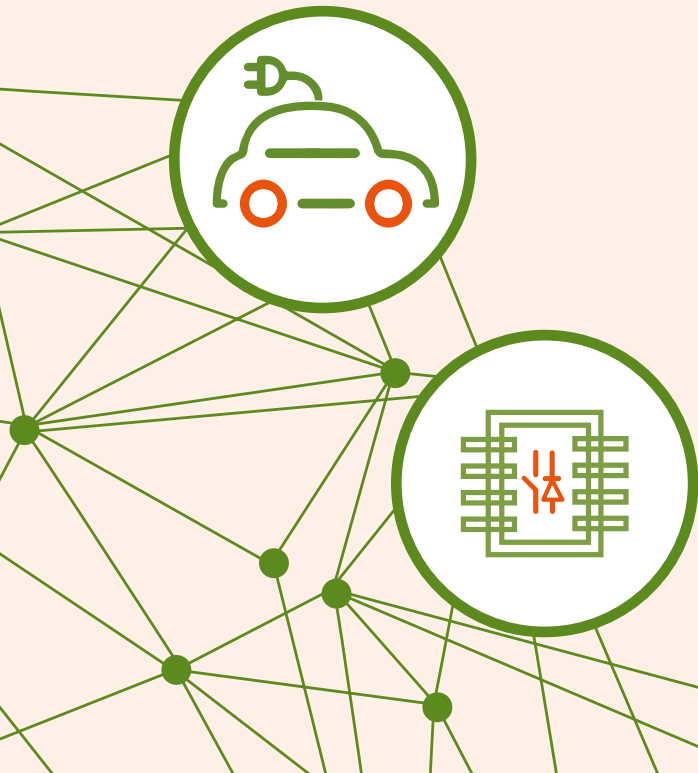
We are changing the way we generate, distribute and use electricity. SP Energy Networks recognises the need to facilitate the uptake of Low carbon Technologies (LCTs) such as, electric vehicles, heat pumps, photovoltaics.

LV Engine is a flagship £8.3m innovation project funded via Ofgem's Network Innovation Competition (NIC). The project will carry out a globally innovative network trial of Smart Transformers to facilitate the connection of LCTs whilst representing value for money for our customers. This innovation is in line with the UK Government's CO<sub>2</sub> reduction targets which are driving the increase in electrification of both heat and transport.

Conventionally, electricity networks provide an Alternating Current (AC) supply. However, many LCTs operate on a Direct Current (DC) voltage which requires conversion from AC.

LV Engine intends to design a Smart Transformer which can provide a LV DC supply to our customers for the first time whilst maximising the use of our existing AC network.

*These will bring a number of valuable functionalities to the 11kV and Low Voltage (LV) networks allowing us to maximise the use of our existing assets.*

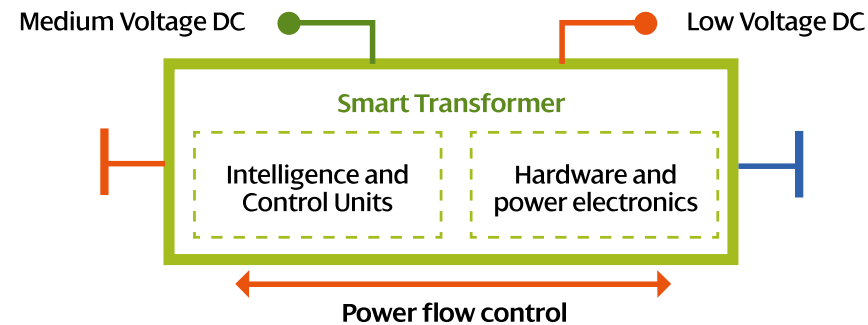




# Smart Transformer

A Smart Transformer (ST) - also known as a Solid State Transformer (SST) due to the use of power electronic switches - works as a digitally controlled power electronics converter. It provides multiple functionalities over and above the standard voltage conversion of conventional 11kV /0.4kV transformers.

These functionalities allow the Distribution System Operator (DSO) to operate the distribution network more efficiently by improving power quality and maximising the use of existing infrastructure.

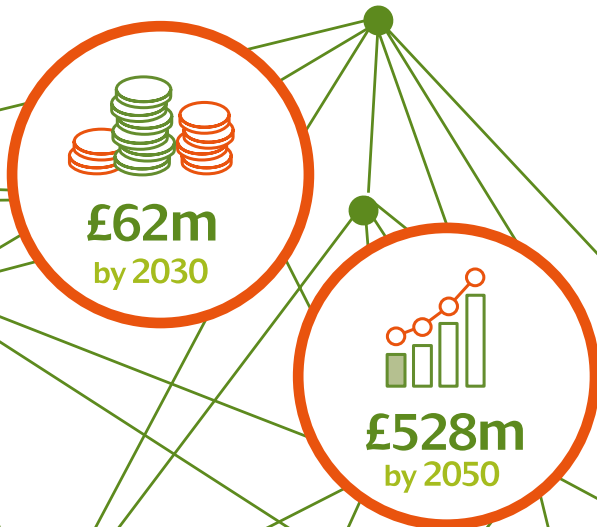


**The functionalities provided by a Smart Transformer include:**

- Intelligent LV feeder voltage regulation
- Power flow control and transformer load sharing
- Active harmonic filtering
- Reactive power compensation to the 11kV network
- Access to a low voltage DC customer supply.

# Benefits for customers

## A potential saving off



- We are working to keep costs low and stable for customers. The successful rollout of LV Engine in Great Britain is expected to represent a saving of £62m by 2030 and £528m by 2050.
- The introduction of innovative Smart Transformers on the distribution network will pave the way for a low carbon future for customers.
- Deliver significant financial savings if deployed across all electricity networks.
- Demonstrate a low voltage Direct Current (DC) connection for low carbon technologies including Electric Vehicles (EV).
- The project will stimulate a competitive marketplace for power electronics and Smart Transformers, contributing to improving productivity within the economy.

# Timescale

## Technical Requirements

We are creating an understanding of the technical requirements for Smart Transformer Design. This includes the requirements of functionalities such as voltage regulation, power flow control and harmonic filtering.

January  
LV 2018

## Select Manufacturing Partner and Technical Design

We will be selecting our Manufacturing Partner through a competitive tender process, all project partners will work alongside the selected manufacturer to design a fit-for-purpose Smart Transformer. Health and Safety matters to us, so we will be testing and manufacturing the Smart Transformer in a laboratory to ensure it meets all the health and safety requirements as well as the technical.

## Test in Network Integration Facilities

The prototype Smart Transformers will be tested within a network integration facility to acquire network integration certificate and confirm that the Smart Transformer can be reliably used on the Great British (GB) Grid without risking customer supply.

## Trial in our Electricity Network

We will undertake live trials at 6 different locations within both our SP Manweb and SP Distribution licence areas. Here we will record performance data at various sites under different network conditions. We will then be able to compare LV Engine Smart Transformers to the conventional transformers so we can complete an evaluation and identify the benefits LV Engine will bring to customers.

## Develop the Best Operational Practice

We are going to develop the best operational practice and best policy documents which can be used as guidance for selecting appropriate cost effective LV Transformers. We are enabling the development of a road map for Business as Usual (BaU) adoption throughout GB.

## Dissemination

We will be effectively disseminating our knowledge of the lessons learnt from LV Engine to other DNO's to ensure we can create smarter, flexible networks for all customers. This will allow efficient replication of LV Engine in all locations and help the UK achieve its targets as together we make the move to a low carbon economy.

December  
2022

# Dumfries & Galloway

**Dumfries and Galloway has among the UK's highest proportion of connected renewable generation relative to its demand for energy.**

That can present difficulties when it comes to exporting renewable energy back to the electricity grid and connecting new projects.

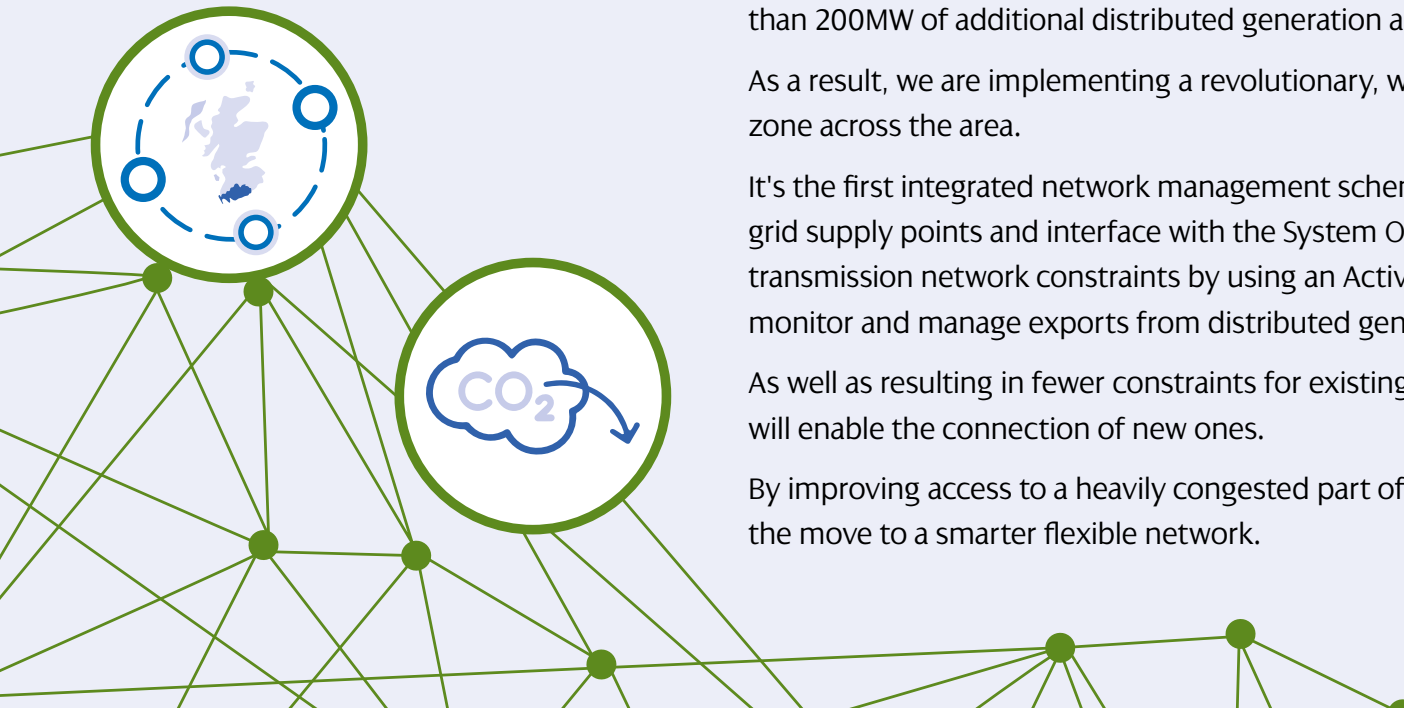
Currently, 90MW of distributed generation are connected in Dumfries and Galloway, while more than 200MW of additional distributed generation are contracted to connect in the future.

As a result, we are implementing a revolutionary, wide-scale integrated network management zone across the area.

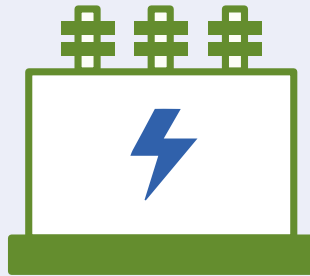
It's the first integrated network management scheme of its kind in the UK and will span 11 grid supply points and interface with the System Operator. The project will help manage transmission network constraints by using an Active Network Management (ANM) system to monitor and manage exports from distributed generation on SPEN's network.

As well as resulting in fewer constraints for existing distributed energy resources, the system will enable the connection of new ones.

By improving access to a heavily congested part of the network, we are directly supporting the move to a smarter flexible network.



# Integrated Network Management

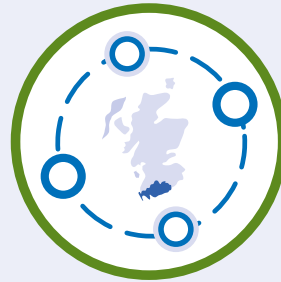


An area that has amongst  
the **highest proportion**  
of **renewable generation**  
connected within the UK

=



relative to its own  
local energy demand

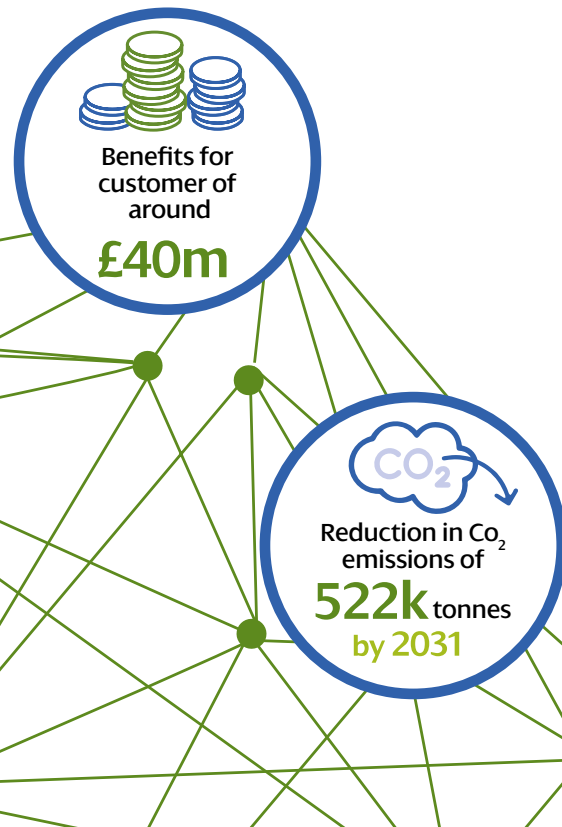


**200MW**  
of additional distributed  
generation is contracted  
to connect in the future



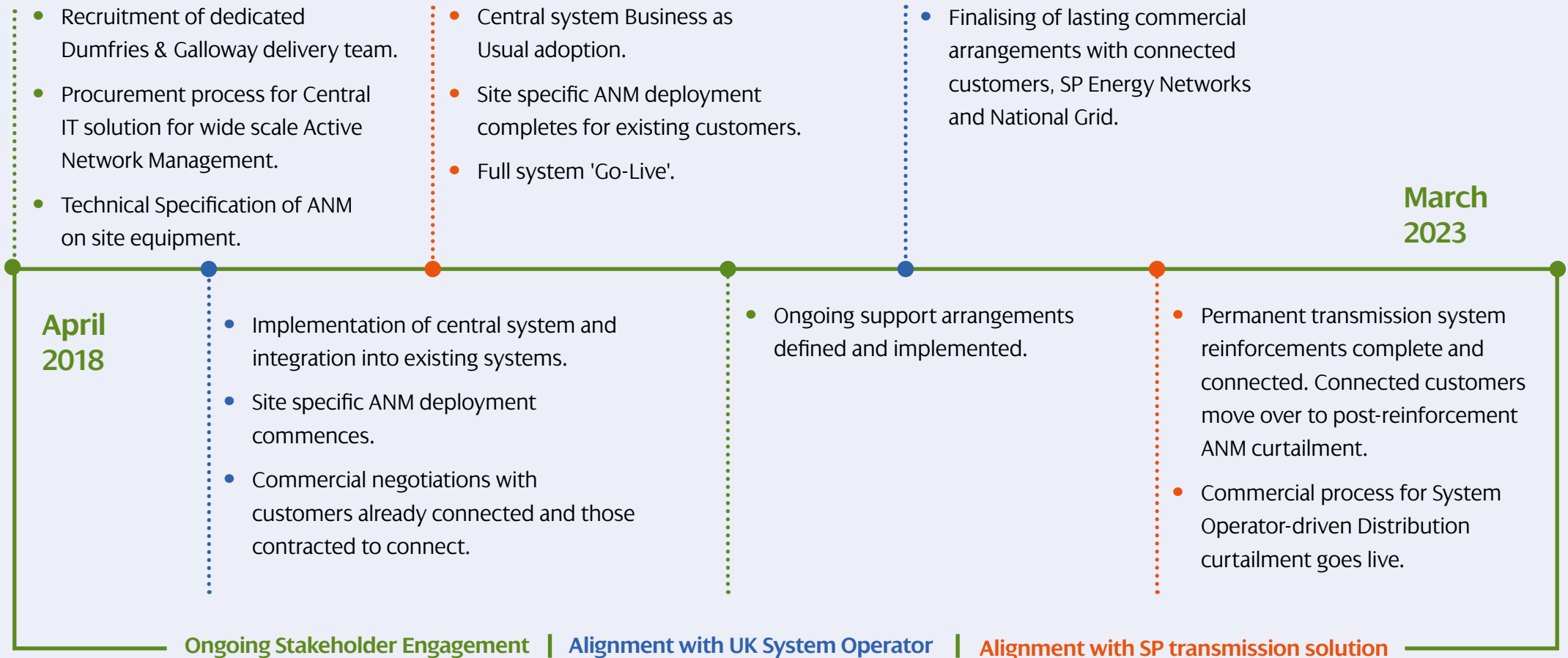
and **11**  
Grid Supply Points  
interfacing with the  
system Operator

# Benefits for customers



- Improve the service we provide to our customers by reducing constraints on connections.
- More Renewable Generation will be connected to the Electricity Network, bringing benefits of £40m to customers.
- Facilitate the connection of more zero carbon generation. That will contribute to a reduction in CO<sub>2</sub> emissions of 522k tonnes by 2031 - the same amount of carbon created by the consumption of 58m gallons of petrol - and advance the transition to a low carbon economy.
- Ensure the Electricity Distribution Network is ready to respond with pace to new customer requirements as we move to a low carbon economy.
- Utilise our existing network assets more efficiently, reducing costs for customers.

# Timescale



-  [www.spenergynetworks.co.uk](http://www.spenergynetworks.co.uk)
-  [facebook.com/SPEnergyNetworks](https://facebook.com/SPEnergyNetworks)
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