

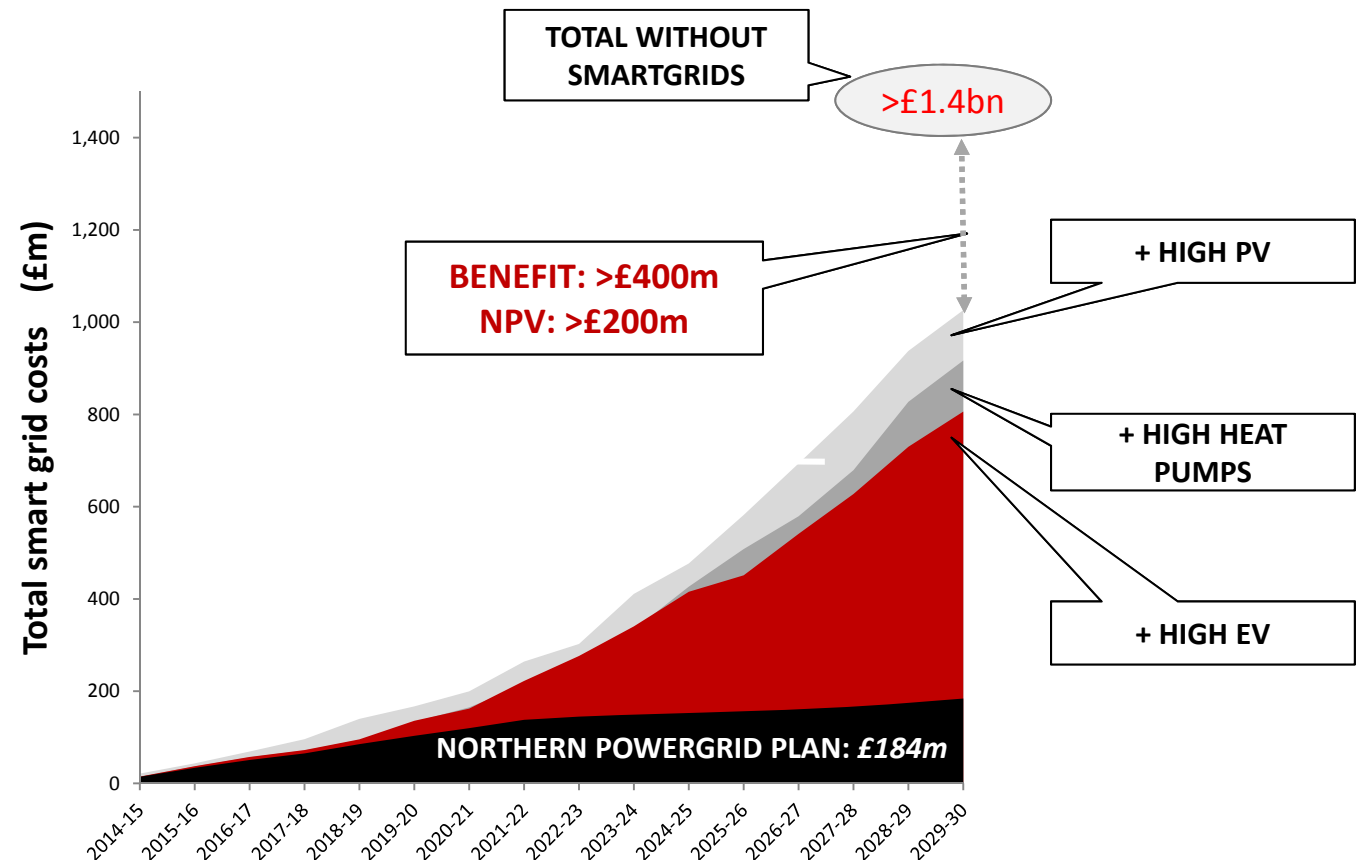
Customer-Led Network Revolution: Second Tier Award

*Ofgem Expert Panel
16 July 2018*



CLNR provided the toolkit to unlock significant benefits for customers

Smart grid solutions use a combination of novel commercial propositions and 'bolt-on' technologies to avoid the cost of replacing or upgrading serviceable assets



CLNR Scope: ambitious and far reaching

Customer & Network trials	Scale of participation
Domestic time of use tariffs	<ul style="list-style-type: none">• 680 participants• 9,000 control group
Industrial & Commercial demand-side response	<ul style="list-style-type: none">• 20.5MW in play• 46 calls
Leading edge network technology	<ul style="list-style-type: none">• £13.8m of investment• 2.85MW storage• >200 live control system trials
Electrification of transport	<ul style="list-style-type: none">• 100 Electric vehicles
Electrification of heat	<ul style="list-style-type: none">• 380 Heat pumps
Own-generation	<ul style="list-style-type: none">• 400 rooftop PV
UK first: Direct control of domestic appliances, initiated by DNO control system	<ul style="list-style-type: none">• 100 Smart washing machines• 17 Heat pumps with thermal store
Socially representative demographics	<ul style="list-style-type: none">• Across 20 test cells



Q1: Please tell us, what are the exceptional outcomes from your project (max 3)? Please emphasise the truly exceptional outputs and/or transformational impact of project outputs on GB electricity networks? (making clear comparison with what was expected at time of Project Direction)

Exceptional outcomes (x3) :

1. Learning from one of the most extensive integrated trials of network and customer smart grid technology with the most advanced wide area control system in Europe.
2. Learning from the most comprehensive study of customer energy practices undertaken in GB.
3. Communications and dissemination programme of significant reach, sharing high quality learning and enabling widespread replicability.



Q1: Exceptional outcome #1 - one of the most extensive integrated trials of network and customer smart grid technology with the most advanced wide area control system in Europe

Benefits	Exceptional outputs and transformational impact	Comparison to Project Direction
Whole system demonstrator - provided confidence in and specification of smart grid techniques	<ul style="list-style-type: none"> Low carbon technologies are less disruptive and domestic customers more flexible than previously thought - 13k customers trial I&C demand side response effective - 80% utilisation reliability CLNR-backed techniques could provide 70% of the GB DNO smart grid benefits CLNR solutions incorporated into Transform forecasting model– enabling other DNOs to include these in investment planning Reductions in carbon emissions Release of network capacity Financial benefits to customers, locked into 2015-23 price control Northern Powergrid delivering benefits in ED1 through £83m smart grid enablers programme , updated policies and tools, and rollout of CLNR techniques. 	Planned outputs - already delivering benefits for customers
International interest in CLNR	<ul style="list-style-type: none"> Benefitting UK economic development, enabling sales of products and services Numerous international visitors – regulatory and technical interest in smart grids 	Additional outputs
Shaped investment and follow-on activity by Northern Powergrid, our partners and others in industry	<ul style="list-style-type: none"> Siemens centre for excellence for smart grids Centre for Energy Systems Integration (£20m) Supergen energy networks research hub (£11m) Faraday Institution (£65m) e4Future vehicle to grid projects (£10m) 	Additional outputs
Thought leadership contribution to the development of energy policy and business models	<ul style="list-style-type: none"> Smart Systems and Flexibility Plan, heat, electric vehicles, storage and smart appliances Targeted Charging Review – evidence to feed customer impact assessment New local energy market and commercial services development 	Additional



Q1: Exceptional outcome #2 - most comprehensive study of customer energy practices undertaken in GB

Benefits	Exceptional outputs and transformational impact	Comparison to Project Direction
The power of observation - quantitative data on load and generation profiles and on customer flexibility including its cost	<ul style="list-style-type: none"> Regular domestic customers contribute less to system peak than previously assumed – 42% reduction in standard design assumption Higher solar PV capacity due to diversity of panel orientation - 10% more Electric vehicle or heat pumps (only) double the household peak load – not triple as previously thought Value of flexibility for DNOs – 20p dry white goods, £2 white goods and £15 heat pump or water heating (pa) Time of use tariffs positively received by most customers – up to ca. 10% peak shift with 60% of customers benefitting 	Planned outputs - already delivering benefits for customers
A socio-technical framework for understanding the customer view of the energy system	<ul style="list-style-type: none"> Policy evidence for the deployment of time of use tariffs An increase in the range and number of loads monitored within the premises.- providing enhanced insight into time-shiftable load Fuel poverty strategies and learning - framed questions for follow-on projects on flexible tariffs etc. Evidence to Energy & Climate Change Select Committee on customer engagement implications of the national smart meter programme One of the biggest GB heat pump trials instrumental in advising against wholesale mass deployment Through combining project data sets, a more accurate view of where , when and how network challenges will emerge due to electric vehicle uptake 	Additional



Q1: exceptional outcome #3 - communications and dissemination programme of significant reach, sharing high quality learning and enabling widespread replicability

Benefits	Exceptional outputs and transformational impact	Comparison to Project Direction
Significant reach	<ul style="list-style-type: none"> Website (>10k hits), events, academic publications, print media 	Planned outputs - scope and scale greatly enhanced
	<ul style="list-style-type: none"> Speaking engagements, email newsletters, videos, social media Dataset publication methods enabling 100 multi-sector international organisations to access data 	Additional
High quality of learning	<ul style="list-style-type: none"> Quality assured by peer review for academic publications By closedown, 12 academic papers published in peer reviewed journals, 5 of 'archival quality', over 80% of these in journal in top half of rankings for impact Enhanced modelling to extrapolate and generalise the learning 	Planned outputs - scope and scale greatly enhanced
Widespread replicability	<p>Poyry rated CLNR 5/5 for information enabling replication.</p> <p>DNO toolkit comprising:</p> <ul style="list-style-type: none"> Operational guidance/training requirements x4 Lessons learned reports x5 Technical recommendations for purchase x7 Training packages x7 	Planned outputs - scope and scale greatly enhanced
	<ul style="list-style-type: none"> Lessons learned from trial recruitment Lessons Learned from customer trial equipment installations Energy Storage Operators Forum: good practice guide 	Additional



Q2: How has the project changed the culture in your organisation? Provide evidence

- External-facing mindset – external collaboration on innovation has become the standard way of operating.
- Customer-first mindset – CLNR has instilled a broader external stakeholder and customer focus to innovation, complementing technological development.
- Deeper executive and senior level engagement in innovation direction and individual projects - leading to greater and deeper engagement in innovation across the whole organisation.
- Deeper engagement innovation across our business – innovation as a competence and mindset, not a department - increased innovation activities now being driven from across a larger part of the organisation – including operations, HS&E and Policy and Markets.
- Organisational innovation competence – recruiting from the CLNR team into engineering positions post project has enhanced the innovative skills and creativity available as part of our workforce renewal – part of the cohort of ca.50 smart grid experts across many organisations created by the project.
- Externally, new business models and start ups have been informed by CLNR experiences – e.g. Cornwall Local Energy Market and Upside Energy.



Q2: How has the project changed the culture in your organisation? Provide evidence

EVIDENCE

- Establishment of an executive level Innovation Steering Group to oversee innovation activities and strategic direction.
- Named executive team sponsorship of every innovation project.
- Inclusion of broader stakeholder drivers in projects (such as Microresilience, Autodesign, Multistorey Communities, Social Impact Calculator).
- A broader collaborator base (Northern Gas Networks, Yorkshire Water, National Energy Action etc.) for innovation activities.
- Step change increase in the number of staff directly engaged in innovation to support broader innovation needs.
- Establishment of a dedicated smart grid implementation section led by a senior manager, tasked with accelerating the implementation of new technologies into business as usual.
- Building on both broader and deeper organisational engagement full utilisation of the Network Innovation Allowance has been delivered for the first time in 2017/18.
- A broad platform of legacy resources has been created in the form of a library of highly relevant reports and raw data for other projects, within and outside Northern Powergrid.
- New services now being trialled – e.g. battery trading with Kiwi Power – selling flexibility services to build competency for the role of distribution system operator.



Q3: How has this Second Tier Reward incentive influenced your project management and operational practices? Provide evidence.

- It took exceptional effort to deliver the CLNR project – it was a major priority for both Northern Powergrid and its partners.
- Since the project has formally completed it has set the foundations for the business changes we are making to implement smart grids , trigger follow-on innovation activity and trade flexibility services as an alternative to network reinforcement..
- There were a number of incentives that caused us to deliver highly effective outcomes from CLNR – both during project delivery and in the period that has followed..
- The Second Tier Reward is just one of these incentives – the other principal incentives being:
 - Reputation/sense of (moral) duty – this was a significant cost to GB DNO customers and we have a duty to both deliver learning from our own project and combine it with learning from others to make a difference for customers.
 - ED1 business planning – the information quality incentive and cost assessment rewards us for offering valued outputs at an efficient cost; including those informed by innovation project learning.
 - Cost sharing through the information quality incentive – is incentivising us since CLNR to find totex efficient solutions to avoid reinforcement (including load management schemes or flexibility trading).
 - Innovation funding governance – in particular the obligations to share the learning with other DNOs.
- These incentives are all strong. It is not possible to apply weighting between them with any degree of accuracy.
- The Second Tier Reward is unique in relation to these other incentives – it provides an opportunity to explicitly earn a return upon exceptional innovation. We consider this an important virtue.



Q3: How has this Second Tier Reward incentive influenced your project management and operational practices? Provide evidence.

EVIDENCE

- Exceptional effort in project management and operational delivery of the project
 - Delivery of project alongside BAU – BG billing system constraints, development of smart meters
 - Estimated £1m of unbilled time
 - NPg Operations Director led installation programme
 - EA Technology – 10% of turnover
- Changes made to our business as a result of CLNR
 - Changes in voltage policy and flexible solutions added to EHV design policy
 - Changes to ADMD design assumptions
 - Smart grid enablers – developing our control and communications capability
 - Transition to the role of distribution system operator including flexibility services
- Changes or evidence already recorded in national policy
 - P5 LV planning standard changes made
 - Ofgem charging reform evidence
 - Network costs impact for EV charging informing OLEV policy
 - Active Network Management best practice
- Lasting positive impact on our follow-on innovation activity
 - Electric vehicles – developing vehicle to grid value proposition for customers
 - Demand and solar storage study – domestic batteries reducing customer bills and local network peaks
 - Activating community engagement – using gamification to enable domestic demand side response
 - Battery trading – re-using large CLNR battery to sell services to the System Operator, developing DSO competencies
 - Resilience – redeploying CLNR batteries with distributed energy resources to investigate run-through capability for local grids; boosting system resilience for the most vulnerable and integrating hybrid generators in fault conditions
 - Integrel – whole system demonstrator – heat and gas/electricity interface



Q4: Please detail any datasets/other IP, generated as part of the project, that has been shared with other DNOs, academia? What efforts did you take to improve access and usability of any such data for interested users (over and above what was proposed in your original full submission and any subsequent project directions, if applicable)?

- Project Direction required publication of datasets, recommendations and other key materials
- We published a range of additional items, all free to download from the project website with more than 10,000 visitors to date

Improving access and usability over and above requirements:

- Learning summarised in three themed reports, with pointers to more detailed supporting information:
 - Developing the smarter grid: the role of domestic and small and medium enterprise customers
 - Developing the smarter grid: the role of industrial & commercial and distributed generation customers
 - Developing the smarter grid: optimal solutions for smarter network businesses
- Promoted the learning through events, social media, email updates, videos and media
- Responded to feedback by improving search facilities in project library and by publishing disaggregated customer data from the customer trials
- Provided access to these additional datasets under Creative Commons ShareAlike licence to maximise reuse, and invited 3rd parties to access the data from the self-service webpage
- The disaggregated customer data has been accessed beyond UK DNOs and academics: downloaded by > 300 individuals in > 100 organisations in > 20 countries including national and international academic institutions, consultancies, energy suppliers, DNOs and technology companies



Q5: Please provide evidence of how CLNR led to the TRANSFORM model? What were the outputs from CLNR that fed into TRANSFORM? What is the level of acceptance and use of TRANSFORM model in GB DNOs (please provide evidence of active current use of the model and where it has triggered tangible investment decisions)? (1 of 3)

How CLNR led to Transform

- The original GB-wide Cost-Benefit Analysis for CLNR was calculated for the bid using a simple spreadsheet methodology.
- EA Technology won the work to develop this method further. Most notably it became the principal means by which DNOs consistently demonstrated the value of using smart grid solutions in the period to 2031. This formed the basis of business plans brought forward at the ED1 price control review.

CLNR outputs fed into Transform

- The Transform model uses a series of solutions templates that feed into its cost benefit analysis to determine when to implement smart solutions.
- The first version of Transform included solution templates with parameters taken from the original estimates of CLNR solution performance. These produced the output for ED1 business plans. Based on the CLNR trials, updated information on the costs and benefits of the CLNR solutions and on the new customer demands were provided in Transform template format. These demonstrated that the original estimates were relatively accurate.
- Similarly, other DNOs have provided updates to the solutions templates from their innovation projects. These have been adopted through the Transform governance process, meaning that learning from CLNR and other innovation project is now embedded in the model for the use of GB DNOs and others to assess strategic planning options.
- CLNR provided 18 new and updated solutions templates for Real-Time Thermal Rating, Enhanced Automatic Voltage Control and Storage.



Q5: Please provide evidence of how CLNR led to the TRANSFORM model? What were the outputs from CLNR that fed into TRANSFORM? What is the level of acceptance and use of TRANSFORM model in GB DNOs (please provide evidence of active current use of the model and where it has triggered tangible investment decisions)? (2 of 3)

Level of acceptance, current use of Transform and triggering of investment decisions

- Transform was sponsored by Ofgem / DECC and was jointly developed by EA Technology with the DNOs to model the potential network investment impact of the growth in LCTs, using the DECC scenarios, to determine the potential savings that could be delivered from different approaches to the implementation of smart grid solutions.
- Transform was supported by all the GB DNOs and subject to a governance process that keeps it up to date with learning from innovation projects and changes to the energy landscape.
 - For instance the latest updates have incorporated the National Grid Future Energy Scenarios, constraint management for generators and behind the meter battery storage. The next iteration of the model will be available in August 2018.
- Since the planning for RIIO-ED1, the Transform model has been used by several GB DNOs to justify expenditure on innovation projects during the submission and approval process. It has also been used outside GB, by Northern Ireland Electricity when developing its plans during its last price control and developing its innovation portfolio.
- At the ED1 price control review, GB-wide benefit was locked in by Ofgem's development and use of the Transform model to compare and benchmark all DNOs' plans.
- These savings were subsequently included within the cost allowances for RIIO-ED1.



Q5: Please provide evidence of how CLNR led to the TRANSFORM model? What were the outputs from CLNR that fed into TRANSFORM? What is the level of acceptance and use of TRANSFORM model in GB DNOs (please provide evidence of active current use of the model and where it has triggered tangible investment decisions)? (3 of 3)

How Transform is used now and how could it be used at the forthcoming ED2 price control review

- Transform is a macro-level planning tool - estimating the number of issues and the number of solutions deployed by solution type per network.
- Our current modelling is required for more micro-level planning purposes – i.e. identifying geographically where the issue arises or where smart solutions could be best deployed.
- For that reason, we have been developing alternative demand forecasting models for the higher voltage networks that produce views of individual substation capacity in specific geographies using different scenarios of growth in low carbon technologies in those areas. The model provides us with a high level investment requirements but it also allows us to pinpoint bottom up the pinch points geographically and electrically from where we can do a more in depth study of the potential options on a case by case basis.
- We do not expect to actively use Transform (or its successor) until there is a need to re-run our business plan. This will provide important detail on our low voltage networks that are not included in our other modelling activity.
- We expect discussion at the Energy Networks Association this year to agree on a common method for incorporating results from innovation and developing consistent forecasts. In the meantime, we continue to update Transform so that it remains available for that purpose.



Q6: Please explain the £800m of smart grid savings credited to the CLNR? How did CLNR lead to these savings? How does this align with the challenge from NPG on level of smart grid savings applied at the time of RIIO-ED1 settlement?

- We do not claim that CLNR led to this £800m of benefits quoted by Ofgem. Rather, CLNR informed savings in DNO plans through the use of the Transform model. (See para 103 of our Second Tier Reward submission.)
- The £800m represents the scale of potential GB-wide savings for consumers from smart grids during ED1. These benefits were locked into DNOs' revenues for the 2015-23 ED1 period, securing this value for customers.
- It is based on Ofgem's statement that, 'at minimum, a total saving of £798m will be delivered to customers by slow-track DNOs' [from smart grid solutions and wider innovation over the eight years].
- CLNR improved DNOs' confidence that smart grid savings could be delivered. The expectations of the benefits (compared to the counterfactual of traditional solutions) were included in the DNOs own forecast modelling from Transform (see response to Q5).
- These figures provide Ofgem's estimate at a point in time of the smart grid benefits available in the ED1 period.
- A number of factors could have caused Ofgem to have changed its assessment of smart benefits within the ED1 period since the slow-track decision – not just limited to Northern Powergrid's price control appeal.
- Benefits from CLNR were included in our business plan for the 2015-23 period and the Northern Powergrid price control appeal did not seek to reverse (or actually reverse) these locked in customer benefits.



Q7: Please compare the network capacity released by the project against the estimated capacity release at the time of project funding?

- Network capacity release was not an explicit consideration at the time of project funding in 2010.
- The low carbon networks fund was primarily about accelerating the uptake of LCT to support decarbonisation. The focus on capacity released has increased since 2009/10 when the project bid was prepared.
- The additional 10.6GW of capacity released through voltage reduction, informed by CLNR, was neither foreseen nor included at bid stage. (See paras 131 and 138 of the Second Tier Reward submission.)



Location of evidence requested

Question	Evidence requested	Evidence in slides	Supporting material in evidence pack
1. Exceptional outcomes	No		
2. Innovation culture	Yes	Yes	Yes
3. Second Tier Reward incentive	Yes	Yes	Yes
4. Shared IP, access and usability	No	Yes	Yes
5. Transform	Yes	Yes	Yes
6. Smart grid savings	No		
7. Network capacity released	No		

