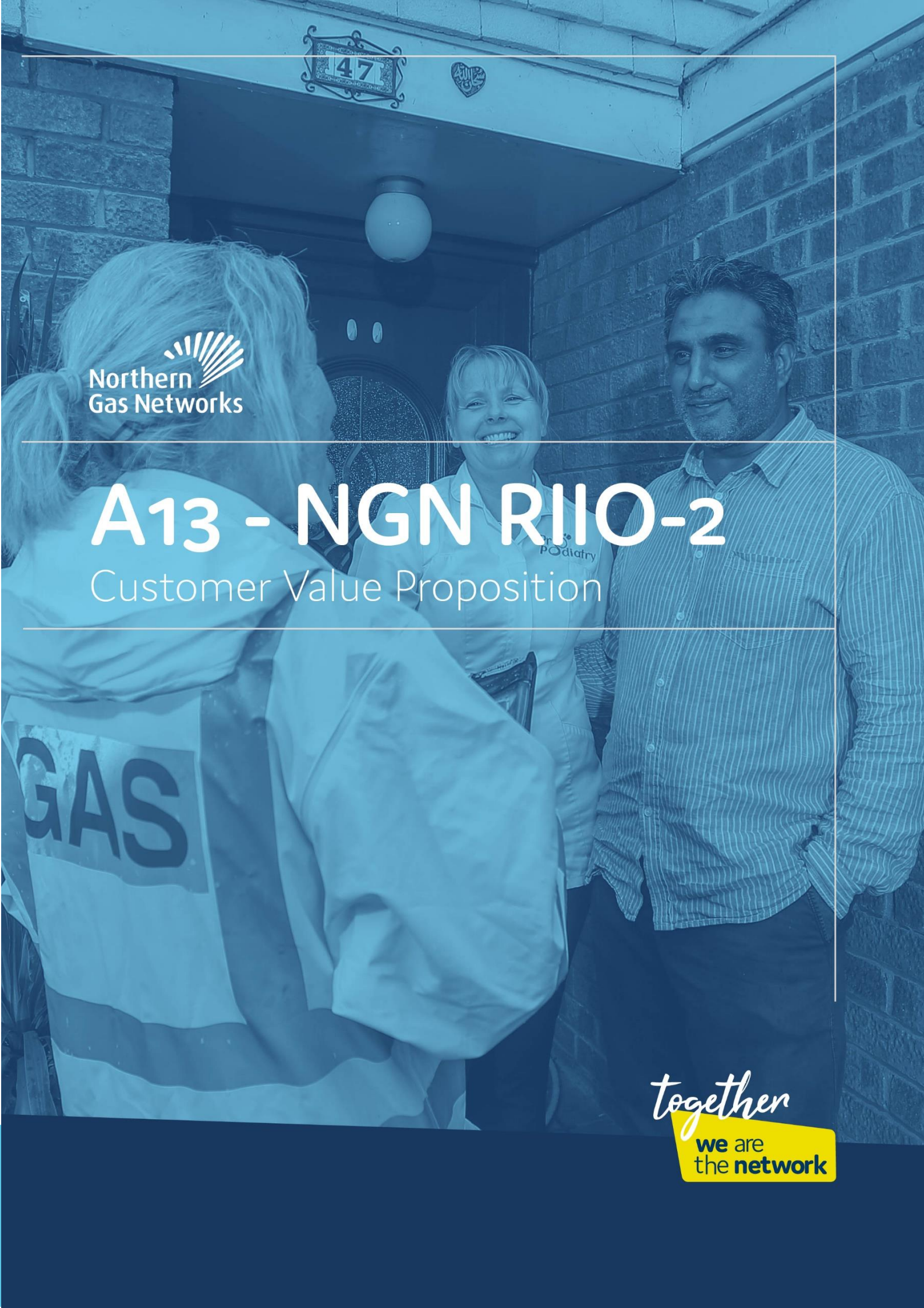


Northern Gas Networks

A13 - NGN RIIO-2

Customer Value Proposition

together we are the network

Contents

1 Executive Summary

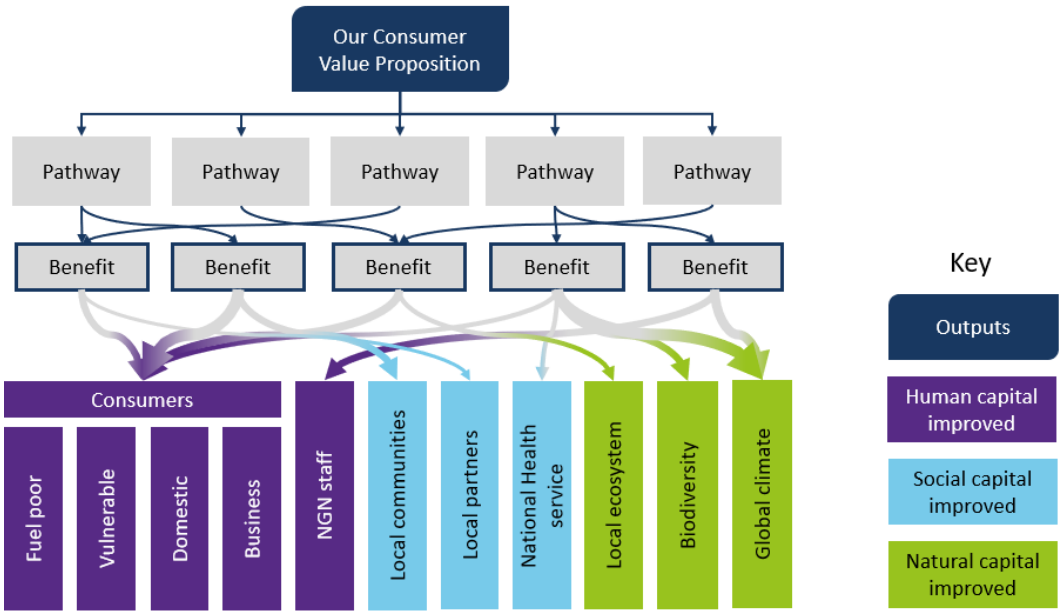
We have developed a Customer Value Proposition (CVP) as part of our RIIO GD-2 Business Plan. It includes twelve areas of activity that deliver additional value to customers and the wider society, beyond the minimum requirements as set out in Ofgem's RIIO-2 Business Plan Guidance and beyond the functions typically undertaken by an energy network company as business as usual.

To develop our Customer Value Proposition, we focussed on the outcomes of our stakeholder engagement activities to identify high priority areas and service levels that customer's value. We shortlisted the outputs that deliver these service levels and priorities and assessed our proposals against the criteria outlined in Ofgem's RIIO-2 Business Plan Guidance. We also discussed our proposals with our Customer Engagement Group (CEG) to determine whether these projects are within CVP scope. We have ensured that we have mapped and valued the benefits that are expected to be realised through our CVP outputs.

This report outlines the approach and methodology used in the qualification and valuation process and presents the monetised values of the benefits anticipated to be delivered by the CVP.

We have used a logic model approach to establish the impact pathways for each CVP activity and produce the benefit impact pathway mapping to articulate the flow from our activities to the outcomes experienced by a range of different beneficiaries. Figure 1 provides an indicative macro view of the benefit mapping and the beneficiaries identified to whom our CVP is delivering added value.

Figure 1: An indictive macro view of our CVP benefit mapping



Once the benefits have been qualified, we have established the quantum of change for each benefit using a mixture of our past performance data, industry data and information from other reputable sources.

We have used our Willingness to Pay (WTP) research where possible, for the valuation of benefits and other industry recognised sources of values such as Network Assessment Risk Metrics (NARMs)[1] and the Ofgem Cost Benefit Analysis template. Where WTP and industry standard sources of value do not exist, other reputable sources have been used, such as HM Treasury, Defra[2], the Department for Business, Energy and Industrial Strategy (BEIS) and Woodland Trust.

This study has taken every effort to ensure transparency of methodology and approach and has highlighted the limitations and opportunity for further improvement, in particular when monitoring and valuing the benefits that are realised in practice.

A summary of the benefit values for each CVP areas are presented in Table 1 below. A more detailed narrative of each CVP and its benefit value can be found in Part 4 of this report.

Table 1: Summary of areas considered for CVP

Ref	CVP Proposal Names	GD-2 Value[3] (£m)	Total Value[3] (£m)
1	Fuel Poor Connections	21.76	83.56
2	Hardship Fund	13.70	49.35
3	Community Partnering Fund	0.47	0.47
4	Customer Vulnerability Competency Framework	0.13	1.90
5	Company Cars	1.43	2.44
6	Tree Planting	0.95	22.69
7	Enhanced Repair for Gas Escapes	8.42	81.02
8	Appointments for Purge & Relight	25.44	25.44
9	Complaint Resolution	6.43	6.43
10	Gas Restorations to Appliance	2.60	2.60
11	Reinstatement	6.16	6.16
12	Citizens' Jury	1.87	1.87
Total		**89.37**	**283.95**

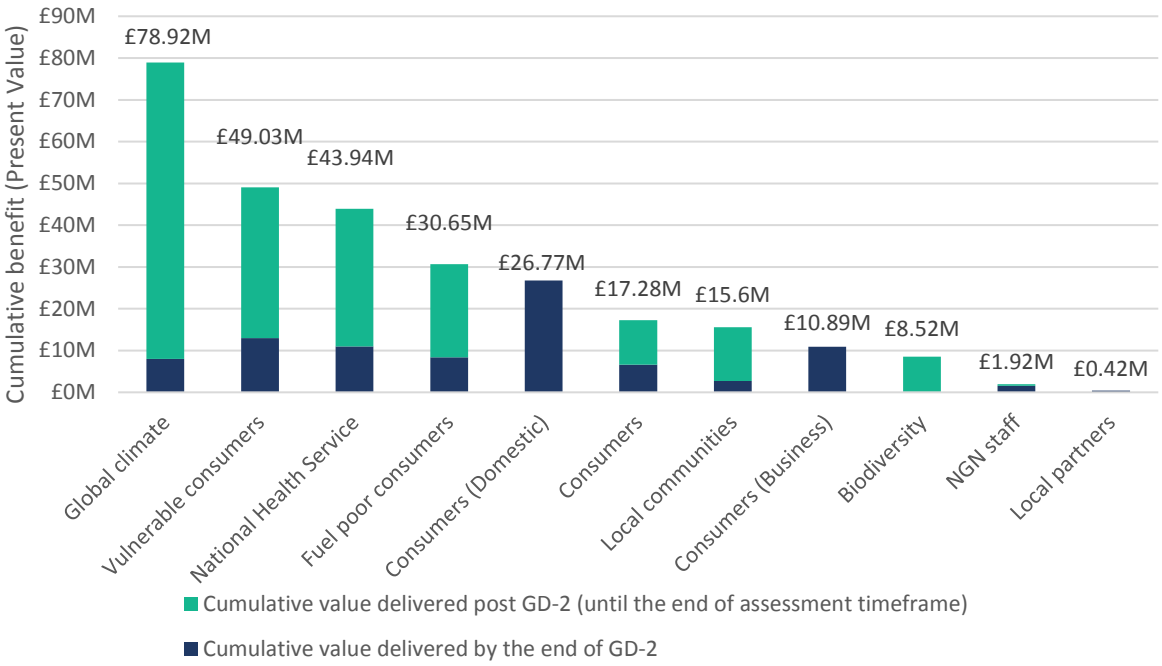
A summary of the cumulative Benefit values at the end of GD-2 and the end of assessment timeframe by beneficiaries is presented in Figure 2.

[1] NARMs also draw on values from HM Treasury and BEIS

[2] Department for Environment, Food and Rural Affairs

[3] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which varies depending on the CVP area. For CVP1-5 and 7, the assessment period is 15 years. For CVP8-12, the assessment period is 5 years. For CVP6, the assessment period is 50 years. The rationale for these is set out in Section 3.2.3 of this report.

Figure 2: Cumulative Benefit values at End of GD-2 and End of Assessment Timeframe by beneficiaries



In addition to the areas included within the core CVP valuation, we are focussing heavily on the future decarbonisation of the whole energy system in the UK, through our involvement in delivering research projects such as H21 and Hydeploy. These projects form the cornerstone of our hydrogen pathway and we consider that successful completion will deliver substantial direct benefits to our customers, in addition to much greater benefits to wider society across the entire UK.

We have presented the benefits we expect to be realised from this work separately to the twelve areas above, in recognition of the fact that our contribution to the decarbonisation of the energy system is being delivered in partnership and that a number of other enabling factors will be required for full transition to a hydrogen economy and the full benefits to be realised. However, we have applied the same methodology in order to indicate the potential scale of benefit that this work could deliver. Our benefit mapping has identified direct benefits (those delivered by us and partners through Hydeploy and H21 project activities) and enabled benefits (those benefits that will be enabled by our work, but also require other factors).

The total value of the **direct benefits** we are able to value are in the order of **£7M** over a 75-year assessment timeframe for NGN supplied areas, and £34M for the rest of UK. Whereas the total value of the **enabled benefits** for NGN supplied areas could be in the order of **£76bn** over this period, and £552bn for the rest of the UK. This equates to around £8.3bn of benefit per year across the UK, compared with UK's GDP of $2.8 trillion[4]. This demonstrates the importance of this investment and the scale of benefit that can be unlocked to our customers and wider society as a result of delivering our hydrogen pathway.

[4] 2018 figure. Source: Tradingeconomics.com / World Bank

2 Introduction

Under the RIIO-GD2, Ofgem has introduced a new Business Plan Incentive (BPI) for the gas distribution, gas transmission and electricity transmission sectors. Stage 2 of the new BPI requires companies to set out the ways in which their plan goes beyond the Ofgem requirements or beyond what would be considered business as usual activity to deliver benefits to customers. It also requires mapping of benefits to the customer who will realise the value. The proposal should also seek to provide a monetised value to customers for each element forming part of the CVP and should be underpinned by robust and substantiated evidence.

In response to Ofgem's requirements, we have developed a Customer Value Proposition to outline the areas of our RIIO-GD-2 activities that deliver additional value to customers and the wider society, beyond the minimum requirements and beyond the functions typically undertaken by an energy network company as business as usual. We have moved away from the term 'Consumer Value Proposition', as our view is that the term 'customer' better encompasses our focus on customer service and delivering the most value to our customers.

To develop areas of our Business Plan to include in the CVP, we have reviewed stakeholder feedback to identify high priority areas and service levels that customer's value and shortlisted projects that deliver these service levels and priorities. We then assessed these projects against the criteria for inclusion, as outlined in Ofgem's RIIO-2 Business Plan Guidance, to determine whether these projects are within CVP scope.

We have worked to value and validate the benefits delivered by our CVP outputs. This report outlines the approach and methodology used in the valuation process and presents the monetised values of the benefits delivered by the CVP.

2.1 Our Customer Value Proposition

Our CVP is set out under Part 4.5 of our Business Plan. We have identified twelve outputs from our suite of RIIO2 outputs that we consider will deliver additional value to customers and will form a part of our CVP. Our full suite of RIIO-2 outputs is discussed in Part 4 of our Business Plan and, also, in the accompanying Outputs Appendix which is Appendix 6 to the main document.

In this document we address only those outputs included in the CVP. Each of these outputs goes beyond minimum Ofgem requirements and represent a change of service offering beyond what we consider business as usual. These areas are outlined in Table 2.

Table 2: Summary of areas considered for CVP

CVP areas	Ref	CVP Proposal Names	Summary
Vulnerability	CVP1	Fuel Poor Connections	The minimum standard for Fuel Poor connections is 1,000 per year. Our proposal for RIIO-2 is to stretch this to deliver 2,000 per year against challenging revised guidelines.

CVP areas	Ref	CVP Proposal Names	Summary
	CVP2	Hardship Fund	We will establish a Hardship fund to support those that who cannot afford repairs/replacement to gas appliances post disconnection in RIIO-2.
	CVP3	Community Partnering Fund	Our Community Partnering Fund will be delivered in partnership with Northern PowerGrid. NGN will contribute £50k to a £100k pot which is accessible to community groups and charities to progress projects in their areas.
	CVP4	Customer Vulnerability Competency Framework	Implementation of a Customer Vulnerability Competency Framework to train NGN staff to recognise vulnerability and manage vulnerable customers.
Environment	CVP5	Company Cars	Implementation of a revised company car policy to include only full electric or hybrid vehicles.
	CVP6	Tree Planting	Voluntary planting of 40,000 trees across our network.
	CVP7	Enhanced Repair for Gas Escapes	Improved repair time for gas escapes through the implementation of 7- and 28-day targets.
Customer service	CVP8	Appointments for Purge & Relight	Provision of an appointments system for purge and relight activities.
	CVP9	Complaint Resolution	60-min standard for Complaint Resolution
	CVP10	Gas Restorations to Appliance	Restoration of gas to appliances within 2hrs of restoring gas to Emergency Control Valve (ECV).
	CVP11	Reinstatement	Reinstatement of a customer's premises (private) within 3 calendar days for planned and unplanned Interruptions, excluding Bank Holidays.
	CVP12	Citizens' Jury	Commitment to an enduring customer engagement mechanism with our Citizen's Jury meeting three times a year.

A further section sets out CVP13 which is our contribution to the delivery of our hydrogen pathway through evidencing the hydrogen transition projects that enable increased hydrogen to 100% in our network, namely H21 and Hydeploy. This is set out in a different section, recognising the differences in the proposal compared to the previous 12 CVP areas. Given the wider inputs and outputs of this project and the fact it is being delivered in partnership, the valuation has a range of assumptions and there are a high number of aspects where data is not available to allow accurate valuation. This has been included within the CVP in order to

indicate the scale of potential benefit that we intend to deliver through our investment in this important project.

2.2 Structure of the Report

This report consists of three primary areas, presented further in Parts 3, 4, 5 and 6 of this report as detailed below.

Part 3 outlines the process undertaken to identify and qualify the activities eligible for inclusion in the CVP, and the logic model used to identify and qualify the likely benefits delivered by the CVP, followed by the approach taken to quantify and value the benefits. It also explains how the results of the valuation are analysed and presented.

Part 4 presents the detailed valuation of the twelve CVP areas. Each CVP section includes a summary of activities being considered, benefit impact pathway mapping, equations used to calculate the value of benefits and presents the value curve over time, as well as a breakdown of the value by beneficiaries and capitals.

Part 5 presents the valuation of our hydrogen pathway, largely driven by our involvement in the delivery of Hydeploy and H21 project. This section sets out the context of this pathway, the benefit impact mapping for direct and enabled benefits, equations used to calculate the value of benefits and a breakdown of the value by beneficiaries and capitals. This section also sets out the assumptions and data gaps.

Part 6 presents the summary results of all CVP areas with a brief discussion on the insight we can draw from the valuation results.

Appendix A presents all the data and assumptions used in the CVP calculations.

3 Our Approach

This section outlines the methodology that has been applied in assessing the CVP areas.

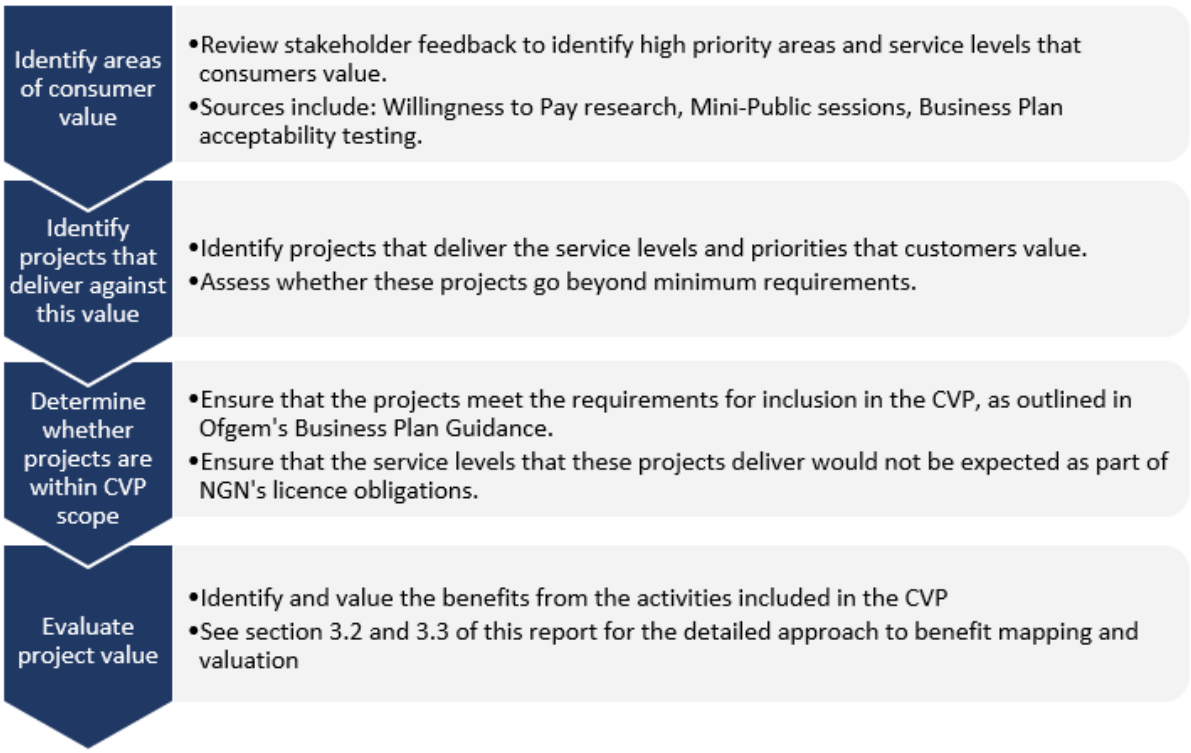
3.1 Identifying CVP Areas

Our proposals have been identified through an assessment of our understanding of Ofgem's minimum requirements for RIIO-2 and where we consider additional value is driven for customers without the burden of additional costs. We have not included any output where we do not exceed the minimum service target or where the service improvement has not been endorsed through our stakeholder and customer research or willingness to pay. We have also considered areas of our Vulnerability Strategy and Environment Action Plan that we consider deliver benefit outside of the business as usual activities of a gas distribution network.

Our approach has also involved consultation with our Customer Engagement Group (CEG) both through direct consultation on the CVP and in the development of our outputs for RIIO-2. The CEG has provided comprehensive challenge to our plan, and through their insight and feedback we have validated those areas that we consider are stretching and would meet the criteria for inclusion in the CVP.

A summary of the process we have followed to determine what to include in our CVP is outlined in Figure 3. We have focused our CVP on the three service areas of Vulnerability, Environment and Customer Service and have identified twelve projects we will deliver, which provide exceptional customer value in these areas.

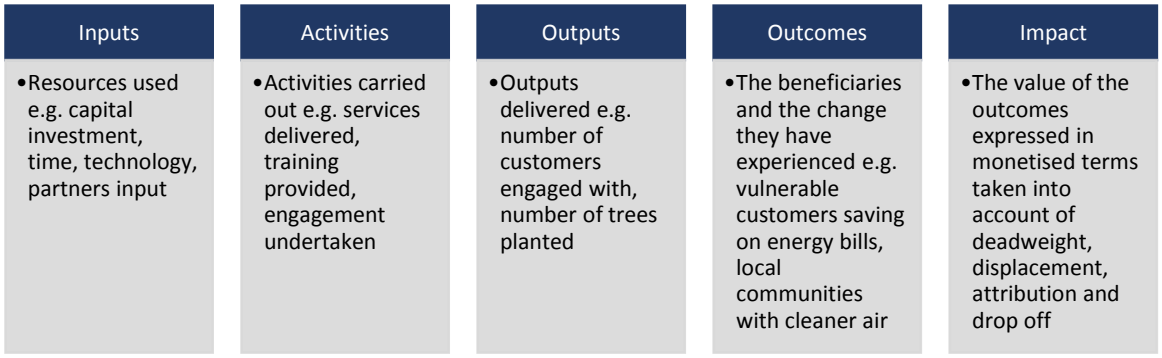
Figure 3: Process to identify CVP areas



3.1 Benefit Mapping Logic Model

We have used an input-output-outcome logic model to map out the anticipated benefits of the proposed CVP. A logic model is a roadmap that displays connections between resources, activities and outcomes within a programme or plan. They are often used to show the impact pathway between investments and results. The logic model used for this study is shown in Figure 4.

Figure 4: Logic model



Inputs describe the resources required from us and other involved parties to deliver the activities, such as our investment and time from customers.

Activities describe the actions taking place, such as benefits advisors supporting vulnerable customers, and Emergency & Repair engineers undertaking training on Purge & Relight.

Outputs summarises what has been achieved through the activities, for example, number of additional fuel poor connections made, and number of trees planted.

Outcomes are beneficiary-specific. They describe the change experienced by different beneficiaries as a result of the outputs, such as improved financial circumstances for customers with restricted income, and reduced pressure on health services.

And finally, **impact** presents in monetary terms (where possible), the value of the outcomes taking into account deadweight[5], displacement[6], attribution[7] and drop off[8]. For the purpose of valuing the benefits, we have considered the impact factors (deadweight, displacement, attribution, and drop off) as part of the assumptions made for determining the quantum of change and the values used for monetisation. As such, they have not been presented separately.

By applying the logic model approach to the CVP areas, we have produced a series of benefit impact pathway maps to demonstrate the logic chains from the CVP inputs to the anticipated

[5] Deadweight: what would have happened without the activity?
[6] Displacement: has any activities been displaced?
[7] Attribution: Who else contributed to the change?
[8] Drop off: does the outcome drop off in future years?

outcomes and impact. These are presented under the relevant CVP sections under Part 4. The same approach has been applied to the H21 project, presented in Part 5.

3.2 Approach to Valuation

Once the benefits have been qualified through impact pathway mapping, we have followed a two-stage approach to benefit valuation, as outlined below.

3.2.1 Quantification

Firstly, the quantum of change is determined using a data hierarchy, as described in Figure 5.

Figure 5: Data hierarchy for quantification and monetisation

Our own historic performance data has been used where possible, such as the breakdown of existing fuel sources for the fuel poor customers who are being connected to the gas network, and the average number of customers supported by benefits advisors per year.

Where data is not readily available from internal sources, industry standard data has been relied upon, such as the average annual gas consumption per domestic household. Once the options of using internal and industry data have been exhausted, data from other reputable sources has been drawn upon, such as the average density of woodland, and the growth rate of trees.

Where existing data is not available to determine the quantum of change, reasonable and conservative assumptions have been made, for example, the number of NGN staff participating in tree planting, and the number of fossil fuel powered company cars replaced by hybrid and electric vehicles.

All data and assumptions used have been referenced back to source, as detailed in Appendix A.

3.2.2 Monetisation

We have followed a similar data hierarchy to determine the value to use for the monetisation of the benefits.

We commissioned IMPACT Research to carry out Willingness to Pay (WTP) study to support the development of our RIIO GD-2 Business Plan. This study engaged with a diverse range of customers to ensure that robust data was collected across a representative sample of customer segments and produced monetary values from our customers on potential changes to current levels of services.

The WTP values produced by this research have been used in the CVP valuation where applicable. In applying the WTP values, we have ensured that each value has been applied no more than once, to avoid the risk of 'double counting'. Where a transition period is

anticipated to reach the full level of service as offered by the CVP, WTP benefits have only been applied once the full level of service is reached, and no WTP benefit has been applied during the transition period.

Where WTP values are not available, we have prioritised the use of industry data to value the benefits in question, for example, NARMs complaint value, and regulatory year carbon values from the Ofgem GD-2 Cost Benefit Analysis (CBA) template.

Where neither WTP nor industry standard values are available, we have drawn on other reputable sources for valuation, such as:

- National Themes Outcomes and Measures (TOMs) framework for valuing social impact in Public Sector contracts, 2019;
- Valuation of energy use and Greenhouse Gas: supplementary guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government, 2019;
- Woodland Trust economic benefits of woodland, 2017;
- The Health Costs of Air Pollution from Cars and Vans, 2018; and
- Chief Medical Officer (CMO) annual reports, 2009.

A full record of sources used is presented in Appendix A.

3.2.3 Timeframe

We have used three different assessment periods to value the benefits of the CVP. In order to determine the most appropriate assessment period to use, we have followed the following approach:

- For the CVP areas where enduring benefits are anticipated after RIIO -GD2, we have used 15 years as our standard assessment period, to align with the timeframe used in the NARMs BPDT to set GDN targets. This covers all vulnerability-related areas and some of the environment-related areas;
- For the CVP areas where benefits are realised at the point of receiving the service and no enduring benefits can be robustly assumed, a timeframe of 5 years has been used. This covers all customer service-related areas; and
- For tree planting, 50 years has been used as the assessment time period. This is to reflect the time needed for newly planted trees to reach maturity and the longevity of the benefits that can be delivered from such initiatives.

The assessment timeframe used for each CVP area is outlined in Table 3 below.

Table 3: CVP assessment periods

Ref	CVP Proposal Names	Assessment Period Used (years)
1	Fuel Poor Connections	15

Ref	CVP Proposal Names	Assessment Period Used (years)
2	Hardship Fund	15
3	Community Partnering Fund	15
4	Customer Vulnerability Competency Framework	15
5	Company Cars	15
6	Tree Planting	50
7	Enhanced Repair for Gas Escapes	15
8	Appointments for Purge & Relight	5
9	Complaint Resolution	5
10	Gas Restorations to Appliance	5
11	Reinstatement	5
12	Citizens' Jury	5

For hydrogen pathway benefit valuation, we have used an assessment period of 75 years. This is to reflect the timescale needed to deliver a gas network hydrogen transition and to realise the benefits associated with a successful hydrogen economy. We note that the pathway to achieve hydrogen conversion is to 2050. We have extended the valuation beyond this date as we consider further benefits will be unlocked post 2050.

3.2.4 Discount Factors

We have followed the Ofgem business plan CBA template guidance on discount factors. We have used a discount factor of 3.5% for all benefits for 0-30 years and 3.0% for 31+ years, with the exception of health and safety related benefits, where we have used 1.5% for 0-30 years and 1.3% for 31+ years. The discount rate used for each of the benefits are detailed in the data and assumptions tables in Appendix A. We have assumed 2021/2022 as year 0 in our calculations.

3.3 Transparency

To ensure transparency and clarity, we have detailed all methodologies applied, data used, and assumptions made, as well as limitations and opportunities for further improvement.

Round figures have been used to produce the final figures for reporting, so as not to imply misleading levels of accuracy. All CVP calculated benefits have been reported to the nearest £10,000.

For hydrogen pathway benefit valuation, the calculated benefits have been reported to the nearest million (£m).

3.4 Limitations and Opportunity for Improvement

Not all qualified benefits have been valued. Due to the lack of data and robust methodology for quantification and valuation, several benefits have been excluded from the valuation. Where this has been the case, clear distinction has been made on the impact pathway mapping.

This approach allows us to understand and demonstrate the full range of benefits delivered by our CVP activities and leave space for future improvement as data and robust methodology become available to value some of these benefits.

3.5 Categorising Impacts

The RIIO-2 methodology states that "the CVP proposal… should set out how areas of the business plan will lead to benefits for consumers… and the extent to which the monetised benefits associated with the proposal accrue to either current consumers, future consumers and consumers in vulnerable situations. "

CCG feedback states that "… the impact on different groups of consumers should be considered."

In response to the RIIO-2 methodology and CCG feedback, we have categorised the identified impact in two ways, by beneficiaries and capitals. We have used a six-capitals framework to help understand the added value we are delivering. They are human, social, natural, financial, manufactured and intellectual capitals. In our CVP assessment, we have intentionally excluded financial, manufactured and intellectual capitals, as we as a company is the most direct beneficiary from the improvement of these capitals. Conversely, we have focused on human, social and natural capitals, with the customers and wider society being the most direct beneficiaries. The links between beneficiaries and capitals are shown in Table 4. The assessment of benefits of the hydrogen pathway differs slightly from this approach as it also considers intellectual and financial capitals, to recognise the importance of the research elements of this work to the wider energy and transport sectors.

It is recognised that human, social and natural systems are incredibly complex and interlinked. As such, the boundary between 'human', 'social' and 'natural' is arbitrary and has been defined for the sole purpose of categorising and presenting the impact so that we and other interested parties to this study can understand the breakdown of benefits.

Table 4: Links between capitals and beneficiaries

Capitals	Beneficiaries
Human	Customers (domestic)
	Customers (business)
	Fuel poor customers
	Vulnerable customers
	NGN staff
Social	Local communities
	Local partners
	National Health Service
Natural	Global climate
	Biodiversity

Although the RIIO-2 methodology only explicitly mentions benefits to customers, we have qualified benefits to a wider range of beneficiaries. The rationale is that the benefits received by these stakeholders (our staff, local communities, local partners, National Health Service, global climate, and biodiversity) would all contribute to the strengthening of social and natural capitals, improving the society within which customers live and work, now and in the future.

4 Customer Value Propositions

This section details the areas that have been valued under the Customer Value Proposition.

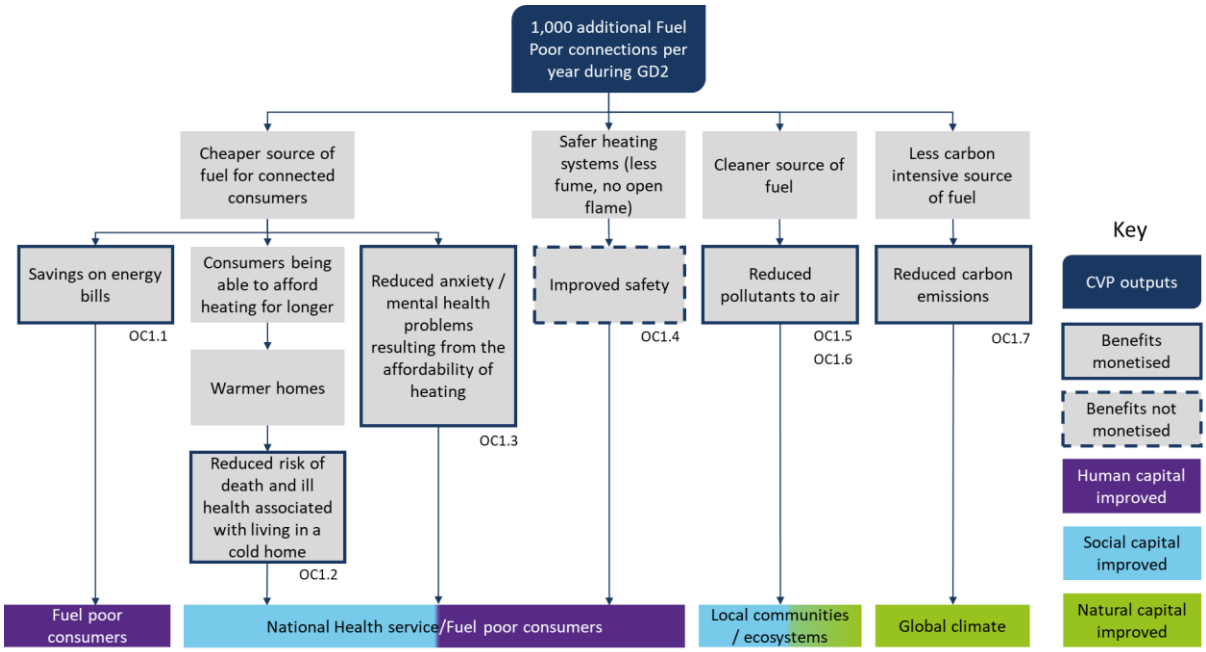
4.1 CVP 1: Fuel Poor Connections

4.1.1 Summary

The minimum standard for Fuel Poor connections is 1,000 per year. Our proposal for RIIO-2 is to stretch this to deliver 2,000 per year. We will target 1,000 customers per annum over the RIIO-2 period and for 50% of those connections, we will only claim the full value of fuel poor allowance if we can prove that homes are more energy efficient once connected to gas. More information can be found in Part 4.2.3 'Help for those who need it most' of our Business Plan for RIIO-GD2.

4.1.2 Benefit Impact Pathway

Figure 6: CVP1 Benefit Impact Pathway



4.1.3 Methodology

The methods of calculation for each outcome are summarised in Table 5. All data and assumptions used for the benefit calculations are presented in Appendix A.

Table 5: CVP1 Methodology

Ref	Outcomes	Methods of Calculation
OC1.1	Savings on energy bills	= annual savings from switching from oil + annual savings from switching from electric + annual savings from switching from solid

Ref	Outcomes	Methods of Calculation
OC1.2	Reduced risk of death and ill health associated with living in a cold home	= investment in alleviating fuel poverty x NHS cost savings per investment
OC1.3	Reduced anxiety/mental health problems resulting from affordability of heating	
OC1.4	Improved safety	Not valued (lacking robust quantification methodology)
OC1.5	Reduced pollutants to air (ecosystem)	Not valued (lacking robust quantification methodology)
OC1.6	Reduced pollutants to air (local communities)	= air quality benefits from switching from oil + air quality benefits from switching from electric + air quality benefits from switching from solid
OC1.7	Reduced carbon emissions	= Total annual tCO2e reduction x price of carbon

4.1.4 Value Curve

The value curve for CVP1 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below. This has been modelled assuming that we achieve the full 1,000 per year during RIIO-GD2.

Figure 7: CVP1 Value Curve

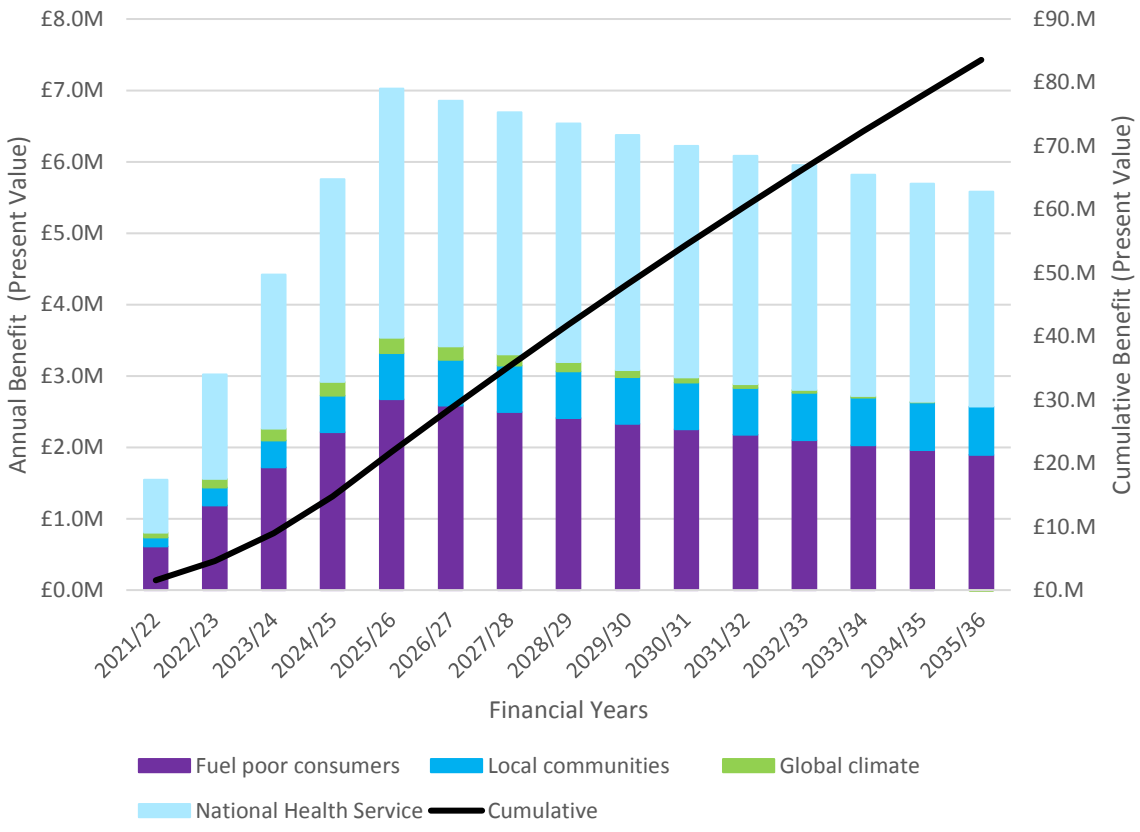


Table 6: Summary of valued benefits for CVP1

Beneficiaries	Benefits	Capitals	GD-2 Value[9] (£m)	Total Value[9] (£m)
Fuel poor customers	OC1.1	Human	8.41	30.65
National Health Service	OC1.2 + OC1.3 [Valued collectively]	Social	10.69	42.89
Local communities	OC1.5	Social	1.91	8.50
Global climate	OC1.7	Natural	0.76	1.52
Total			**21.76**	**83.56**

[9] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 15 years for this CVP area.

4.2 CVP 2: Hardship Fund

4.2.1 Summary

Through our experience in RIIO-1, we occasionally serve customers who are in desperate need of direct financial help and have been unable to identify help through existing funding routes. For these customers, we are seeking to set up a hardship fund, in partnership with existing similar funds. Access to this fund will have a strict set of criteria, to ensure that we are not duplicating any other available funding streams. This is funded at cost to NGN and not through customer bills.

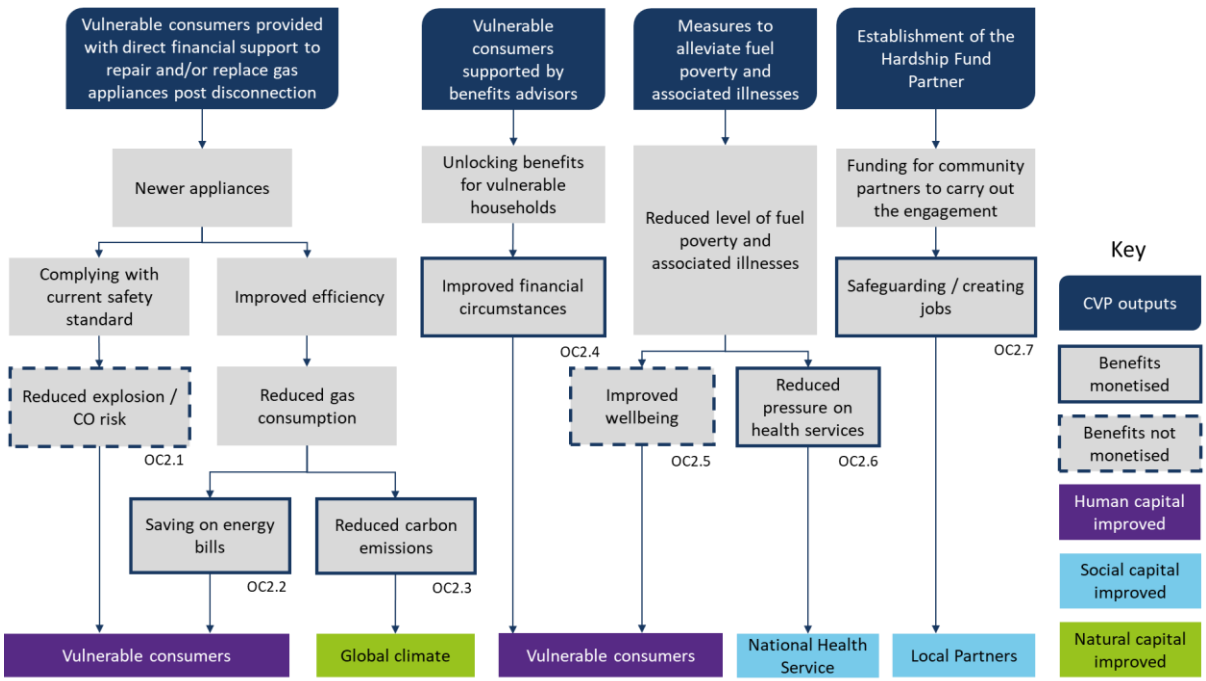
The £150,000 per year fund will be used to fund solutions delivered through community interest partners, and charities, who are close to both impacts of hardship and are aware and able to address the hardship caused. Funding will recognise energy related aspects of hardship, all aspects that will be supported will be subject to meeting the following agreed criteria:

- 60 years old or over and have low household income and/or a disability;
- Under 60 and have a low household income and/or a disability or;
- Considered exceptionally vulnerable by the Home Improvement Agency (HIA).

More information can be found in Part 4.2.3 'Help for those who need it most' of NGN's Business Plan for RIIO-GD2 and the 'Appendix – Customer Vulnerability Strategy'.

4.2.2 Benefit Impact Pathway

Figure 8: CVP2 Benefit Impact Pathway



4.2.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 7: CVP2 Methodology

Ref	Outcomes	Methods of Calculation
OC2.1	Reduced explosion / CO risk	Not valued (lacking robust quantification methodology)
OC2.2	Saving on energy bills	=NGN customer benefitting from the Fund x as saving as a result of efficiency improvement x cost of gas
OC2.3	Reduced carbon emissions	= reduction in carbon emissions x non-traded carbon value
OC2.4	Improved financial circumstances	= number of vulnerable customers with restricted income claiming additional benefits through the support of the benefits advisors x average value per claim
OC2.5	Improved wellbeing	Not valued (lacking robust quantification methodology)
OC2.6	Reduced pressure on health services	= investment in alleviating fuel poverty x NHS cost savings per investment
OC2.7	Safeguarding / creating jobs	= total number of FTE x value of employment per FTE

4.2.4 Value Curve

The value curve for CVP2 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below.

Figure 9: CVP2 Value Curve

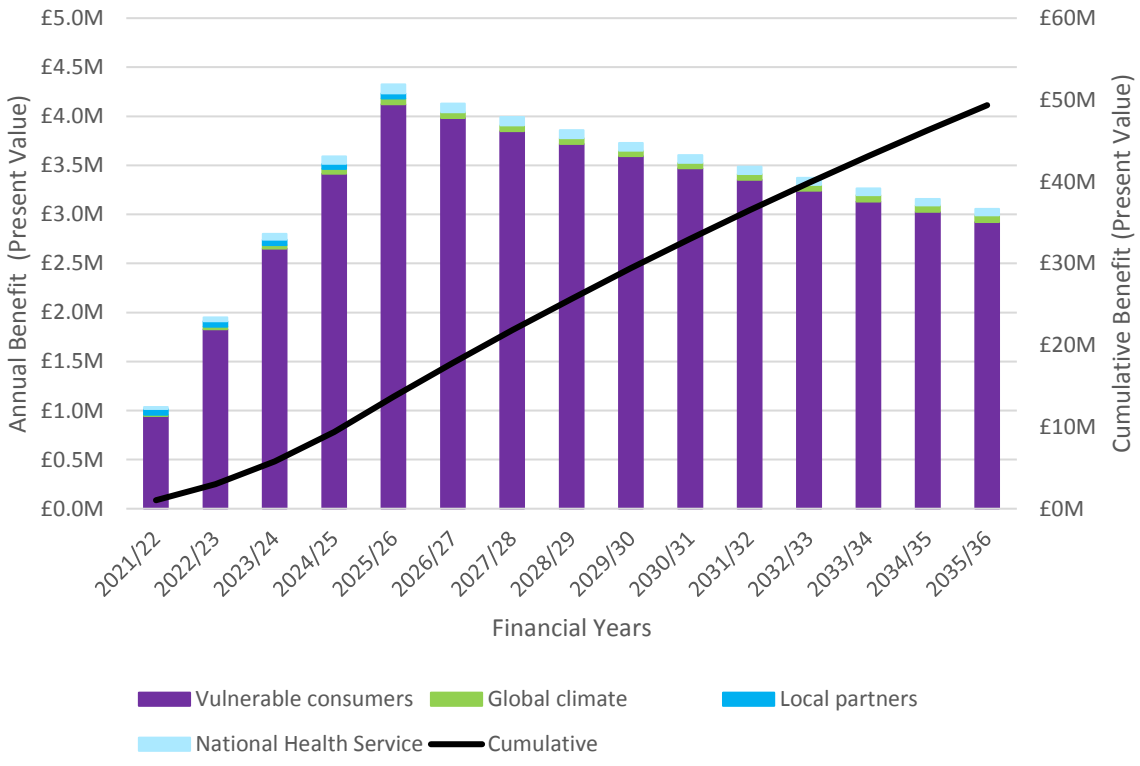


Table 8: Summary of valued benefits for CVP2

Beneficiaries	Benefits	Capitals	GD-2 Value[10] (£m)	Total Value[10] (£m)
Vulnerable customers	OC2.2	Human	0.29	1.06
	OC2.4	Human	12.67	46.19
Global climate	OC2.3	Natural	0.18	0.78
National Health Service	OC2.6	Social	0.29	1.05
Local partners	OC2.7	Social	0.27	0.27
Total			**13.70**	**49.35**

[10] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 15 years for this CVP area.

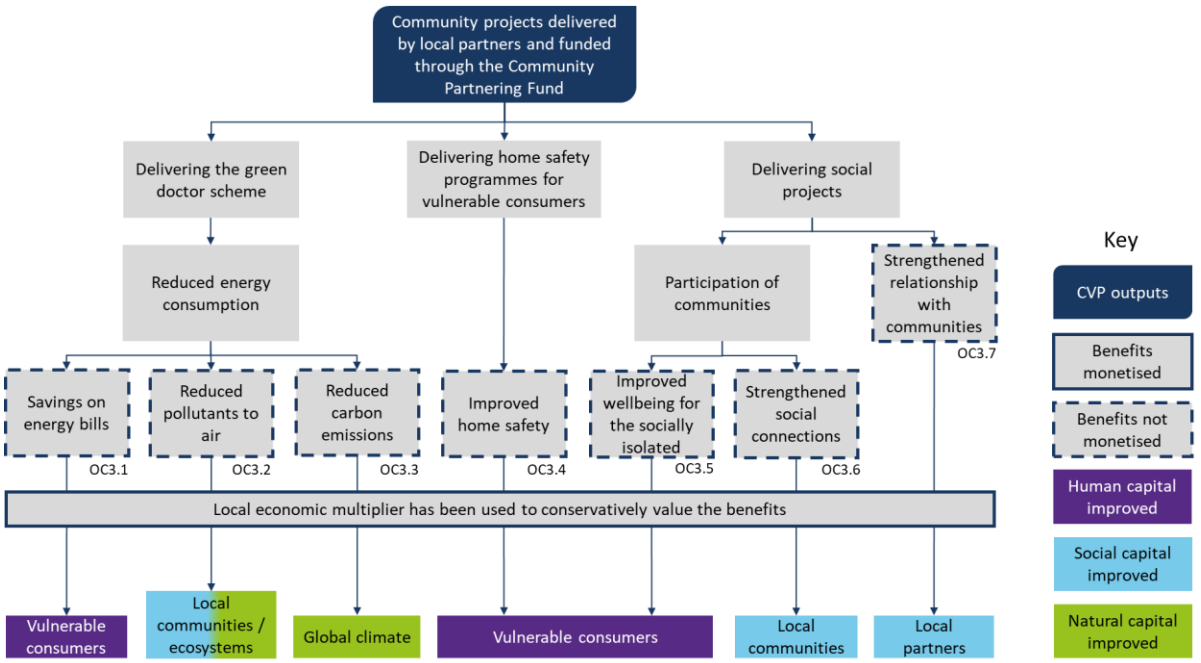
4.3 CVP 3: Community Partnership Fund

4.3.1 Summary

We are proposing a Community Partnering Fund in partnership with Northern PowerGrid. We will contribute £50k to a £100k pot which is accessible to community groups and charities to progress projects and deliver sustainable initiatives that help NGN's reach, educate and support communities and individuals locally. This approach allows us to reach customers through our trusted intermediaries and partners and make a difference to customers who we might not necessarily reach through our day to day activities. More information can be found in the 'Appendix – Customer Vulnerability Strategy'.

4.3.2 Benefit Impact Pathway

Figure 10: CVP3 Benefit Impact Pathway



4.3.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 9: CVP3 Methodology

Ref	Outcomes	Methods of Calculation
OC3.1	Savings on energy bills	= NGN investment x Local economic multiplier for NGN procurement policy & for charity spend
OC3.2	Reduced pollutants to air	
OC3.3	Reduced carbon emissions	
OC3.4	Improved home safety	
OC3.5	Improved wellbeing for the socially isolated	

OC3.6	Strengthened social connections	
OC3.7	Strengthened relationship with communities	

4.3.4 Value Curve

The value curve for CVP3 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below. As a local economic multiplier is used for the valuation of this benefit, the allocation of values to different outcomes, beneficiaries and capitals has not been possible.

Figure 11: CVP3 Value Curve

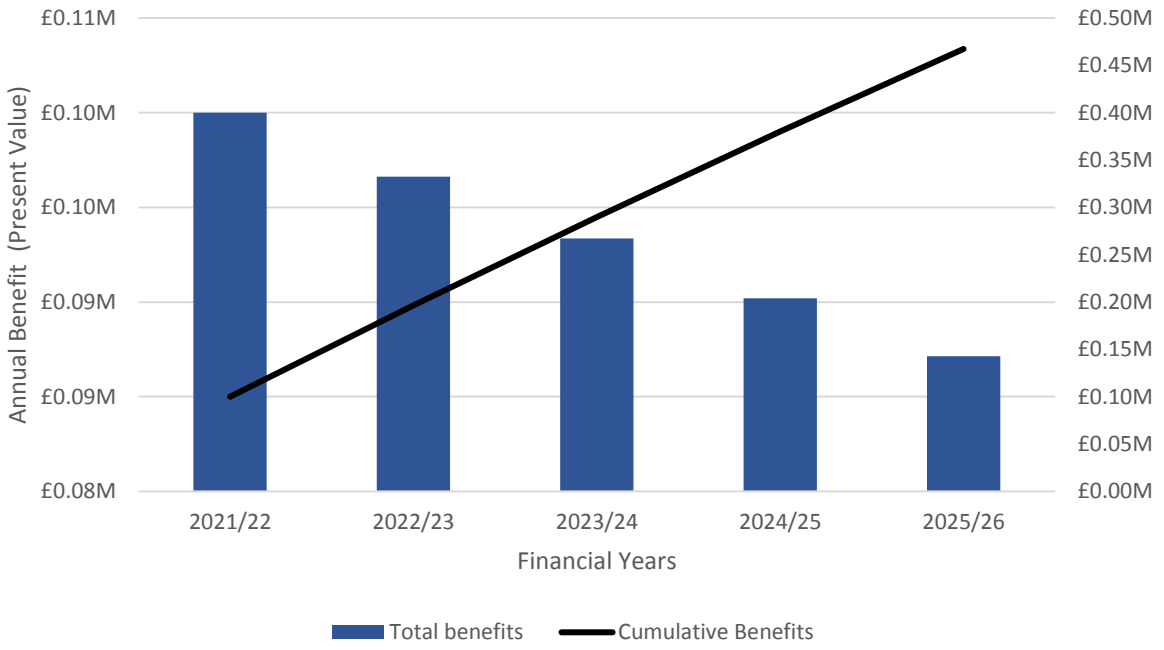


Table 10: Summary of valued benefits for CVP3

Beneficiaries	Benefits	Capitals	GD-2 Value[11] (£m)	Total Value[11] (£m)
Vulnerable customers	OC3.1	Not applicable	0.47	0.47
	OC3.4			
	OC3.5			
Local communities	OC3.2			
	OC3.6			
Global climate	OC3.3			
Local partners	OC3.7			
Total			**0.47**	**0.47**

[11] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 15 years for this CVP area.

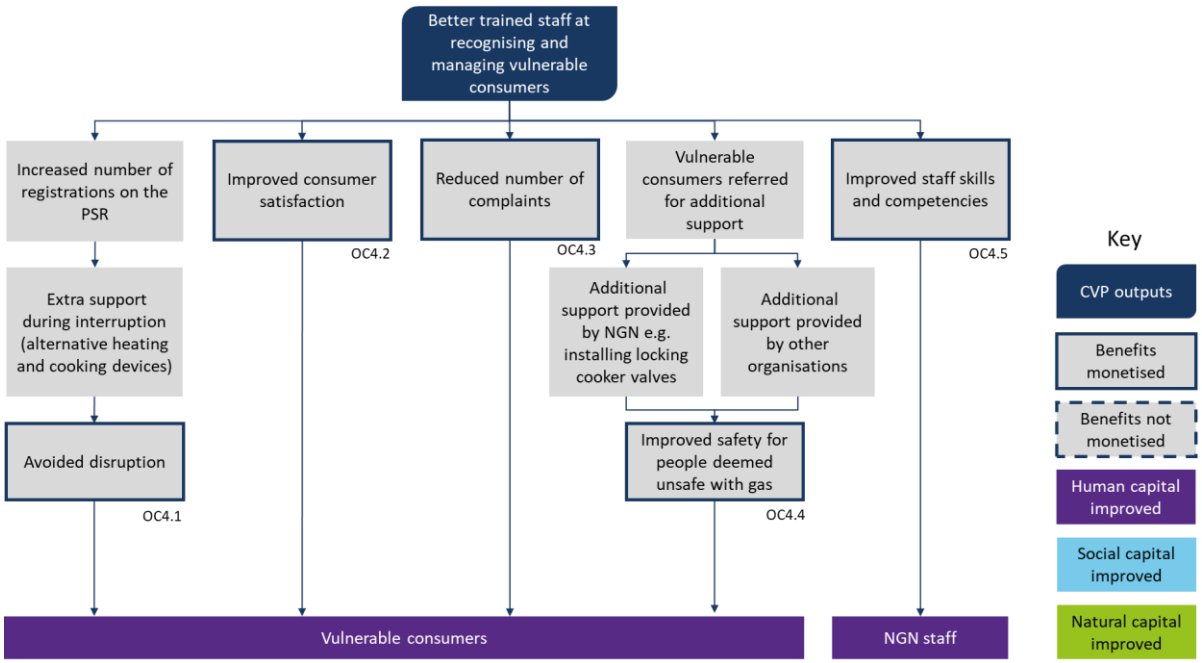
4.4 CVP 4: Customer Vulnerability Competency Framework

4.4.1 Summary

Implementation of Customer Vulnerability Competency Framework to train NGN staff to recognise vulnerability and manage vulnerable customers. More information can be found in the 'Appendix – Customer Vulnerability Strategy'.

4.4.2 Benefit Impact Pathway

Figure 12: CVP4 Benefit Impact Pathway



4.4.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 11: CVP4 Methodology

Ref	Outcomes	Methods of Calculation
OC4.1	Avoided disruption	= total number of customers (domestic) experiencing increased satisfaction x WTP per customer (domestic) (We have assumed that the full level of benefit won't be achieved until the training programme has been completed, therefore, have only applied WTP from 2026/27, after the 'transition period')
OC4.2	Improved customer satisfaction	
OC4.3	Reduced number of complaints	
OC4.4	Improved safety for people deemed unsafe with gas	
OC4.5	Improved staff skills and competencies	= total hours of training taken x value of staff time

4.4.4 Value Curve

The value curve for CVP4 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below. The sudden increase of benefit value after year 2025/26 represent the improved customer service received by vulnerable customers once the training programme has been completed in RIIO-GD2. In reality, the improvement of service would be incremental as more staff undergo training. However, we have taken a conservative approach and only valued the benefits once the training programme has been completed.

Figure 13: CVP4 Value Curve

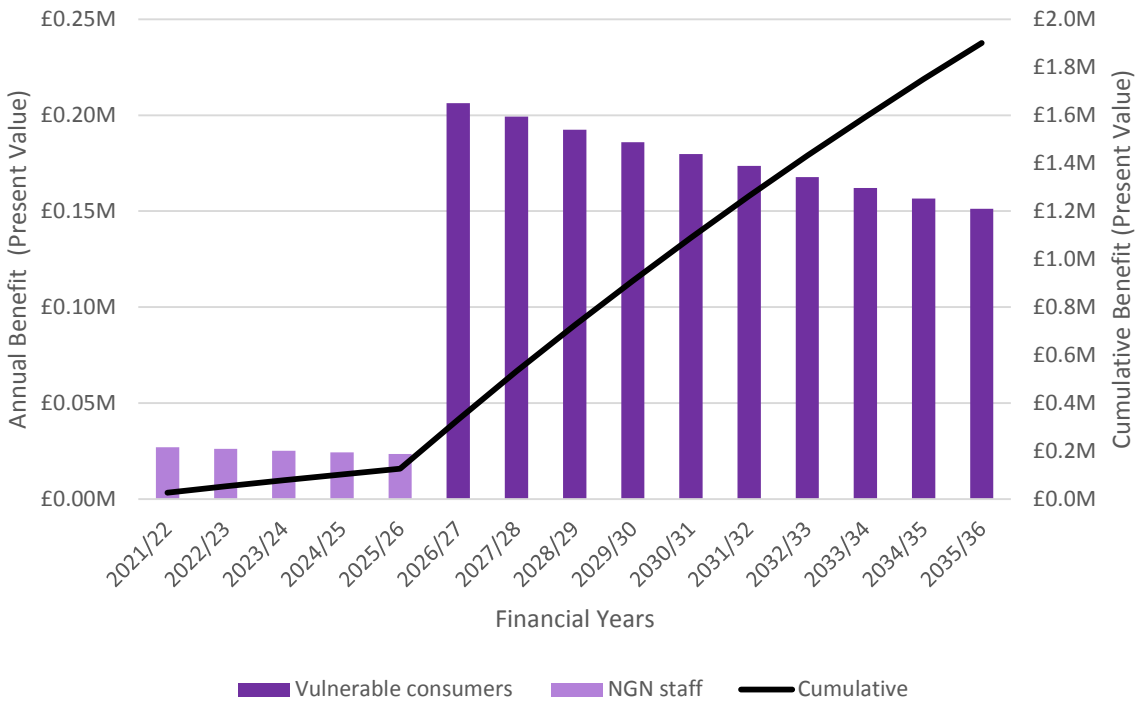


Table 12: Summary of valued benefits for CVP4

Beneficiaries	Benefits	Capitals	GD-2 Value[12] (£m)	Total Value[122] (£m)
Vulnerable customers	OC4.1+OC4.2+OC4.3+OC4.4 [Valued collectively]	Human	0.13	1.77
NGN staff	OC4.5	Human	0.00	0.13
Total			**0.13**	**1.90**

[12] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 15 years for this CVP area.

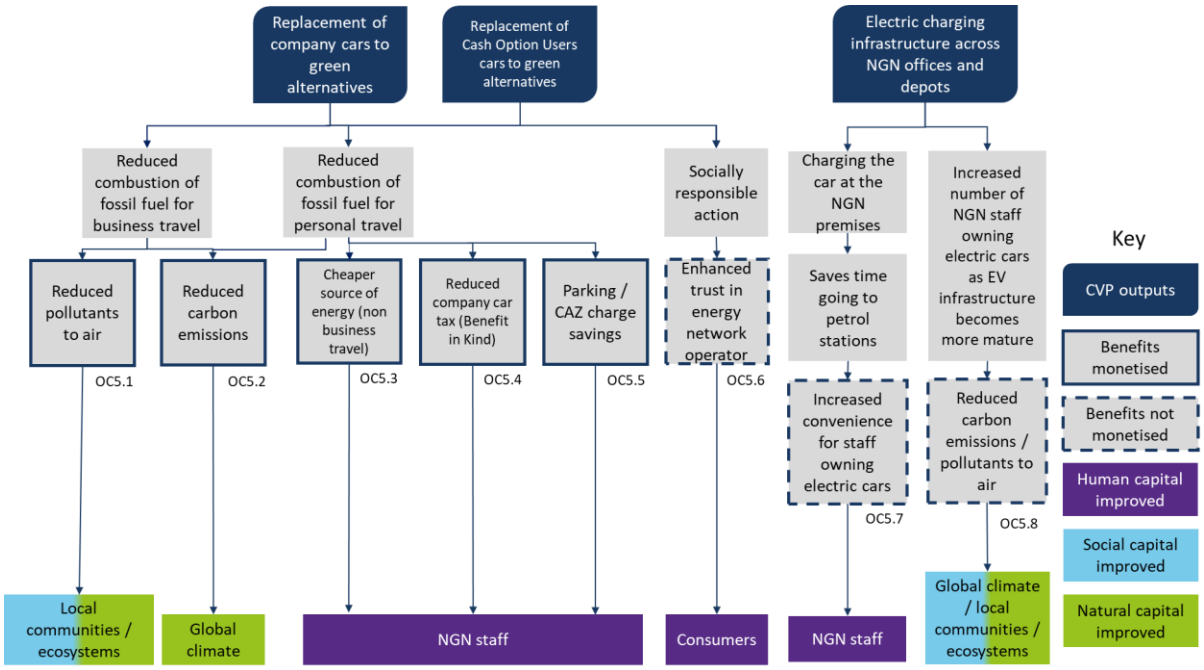
4.5 CVP 5: Company Cars

4.5.1 Summary

NGN operates a fleet of over 100 company cars which are leased by NGN on behalf of individuals who use the vehicles for business and private travel. Company cars are made available to individuals with high business mileage and senior staff. Our future company car policy will include only ultra-low emission vehicles (typically the lease of full electric or hybrid vehicles). More information can be found in 'Appendix – Environmental Action Plan'.

4.5.2 Benefit Impact Pathway

Figure 14: CV5 Benefit Impact Pathway



4.5.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 13: CVP5 Methodology

Ref	Outcomes	Methods of Calculation
OC5.1	Reduced pollutants to air	= Reduced emissions per fossil fuel vehicle replacement x number of vehicles replaced
OC5.2	Reduced carbon emissions	= Reduced carbon emissions from company cars + Reduced carbon emissions from privately owned cars (cash option users)
OC5.3	Cheaper source of energy (non-business travel)	= Reduced annual fuel cost per vehicle replacement x number of vehicles replaced

Ref	Outcomes	Methods of Calculation
OC5.4	Reduced company car tax (Benefit in Kind)	= Number of fossil fuel company car vehicles replaced x Difference in Benefit in kind
OC5.5	Parking / CAZ charge savings	= Number of fossil fuel vehicles replaced x annual saving in charges
OC5.6	Enhanced trust in energy network operator	Not valued (lacking robust quantification and valuation methodology)
OC5.7	Increased staff convenience	Not valued (lacking robust quantification and valuation methodology)
OC5.8	Reduced carbon emissions due to increased NGN staff EV ownership	Not valued (lacking robust quantification methodology)

4.5.4 Value Curve

The value curve for CVP5 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below. The sharp decrease in benefit value post 2025/26 is largely due to the short-term certainty of the tax benefit and Clean Air Zone charge savings.

Figure 15: CVP5 Value Curve

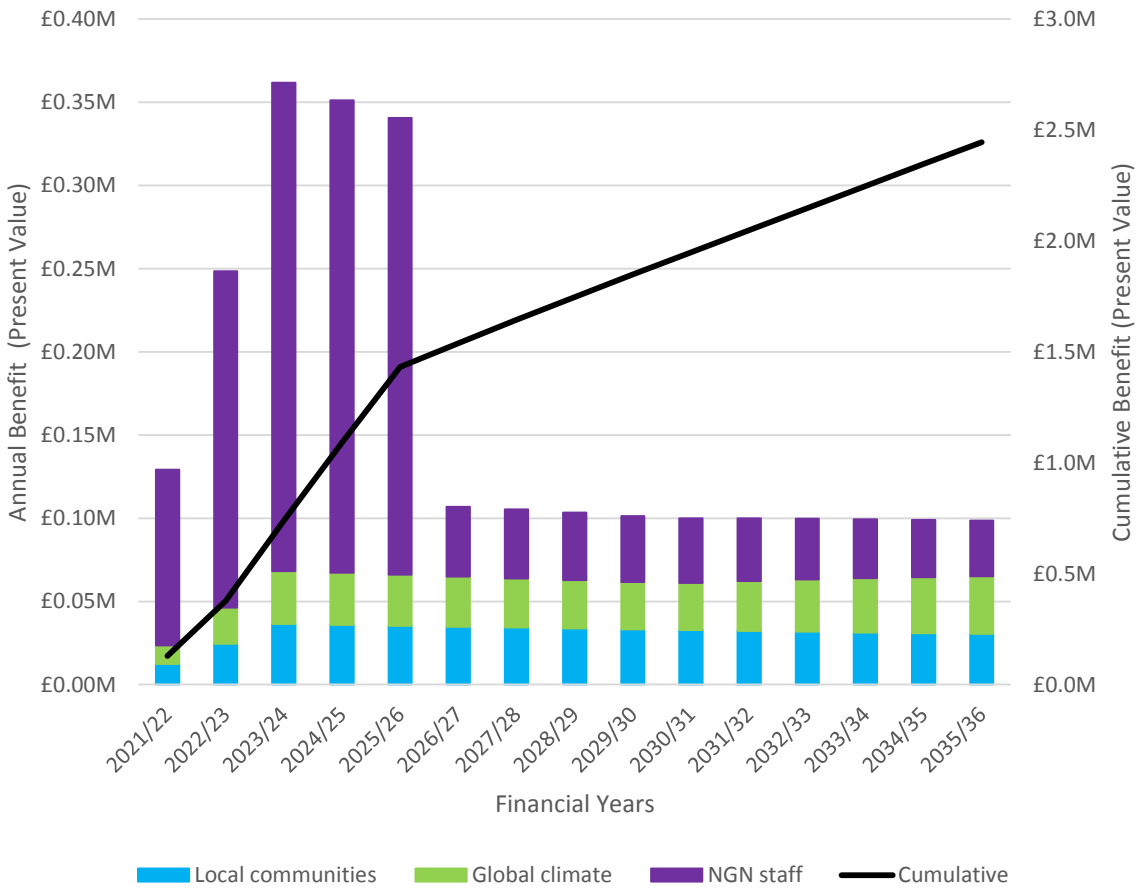


Table 14: Summary of valued benefits for CVP5

Beneficiaries	Benefits	Capitals	GD-2 Value[13] (£m)	Total Value[13] (£m)
Local communities	OC5.1	Social	0.14	0.47
Global climate	OC5.2	Natural	0.13	0.43
NGN staff	OC5.3	Human	0.18	0.56
	OC5.4	Human	0.92	0.92
	OC5.5	Human	0.06	0.06
Total			**1.43**	**2.44**

[13] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 15 years for this CVP area.

4.6 CVP 6: Tree Planting

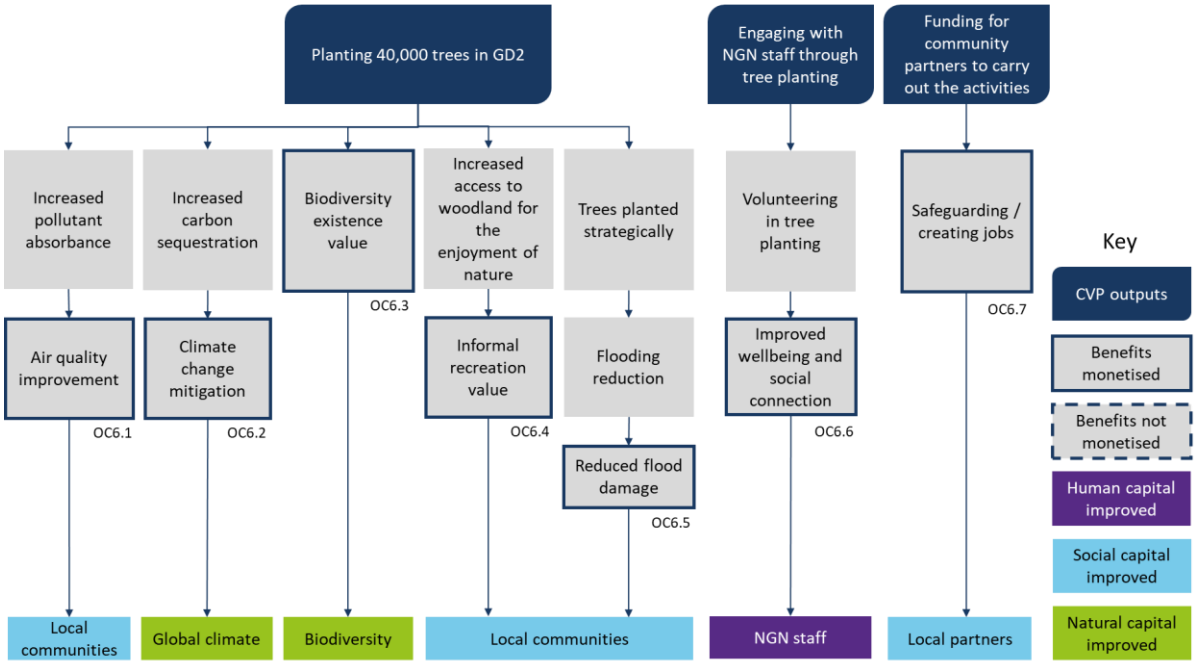
4.6.1 Summary

In recognition of the benefits that tree planting can deliver to air quality within communities and the improved flood risk management that they can deliver to our assets and others, NGN's shareholders are committing to funding (at no cost to our customers) the planting of 40,000 trees in the designated Northern Forest areas in our network area between April 2021 and March 2026.

Between April 2021 and March 2026, 40,000 whips will be planted by local community groups in the designated Northern Forest areas. These will deliver air quality, social, carbon sequestration and biodiversity benefits to the communities that we serve. The tree planting will have a specific focus on urban areas to directly mitigate air quality impacts that we have on the environment in the undertaking of our business activities. The project will be delivered in partnership with the White Rose Forest. More information can be found in 'Appendix – Environmental Action Plan'.

4.6.2 Benefit Impact Pathway

Figure 16: CVP6 Benefit Impact Pathway



4.6.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 15: CVP6 Methodology

Ref	Outcomes	Methods of Calculation
OC6.1	Air quality improvement	=Number of hectares of trees planted x value per hectare per annum
OC6.2	Climate change mitigation	=Number of hectares of trees planted x value per hectare per annum
OC6.3	Biodiversity existence value	=Number of hectares of trees planted x value per hectare per annum
OC6.4	Informal recreation value	=Number of hectares of trees planted x value per hectare per annum
OC6.5	Reduced flood damage	=Number of hectares of trees planted x value per hectare per annum
OC6.6	Improved wellbeing and social connection	=number of volunteering hours x value of volunteering per hour
OC6.7	Safeguarding / creating jobs	=number of FTE x value of employment

4.6.4 Value Curve

The value curve for CVP6 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below.

Figure 17: CVP6 Value Curve

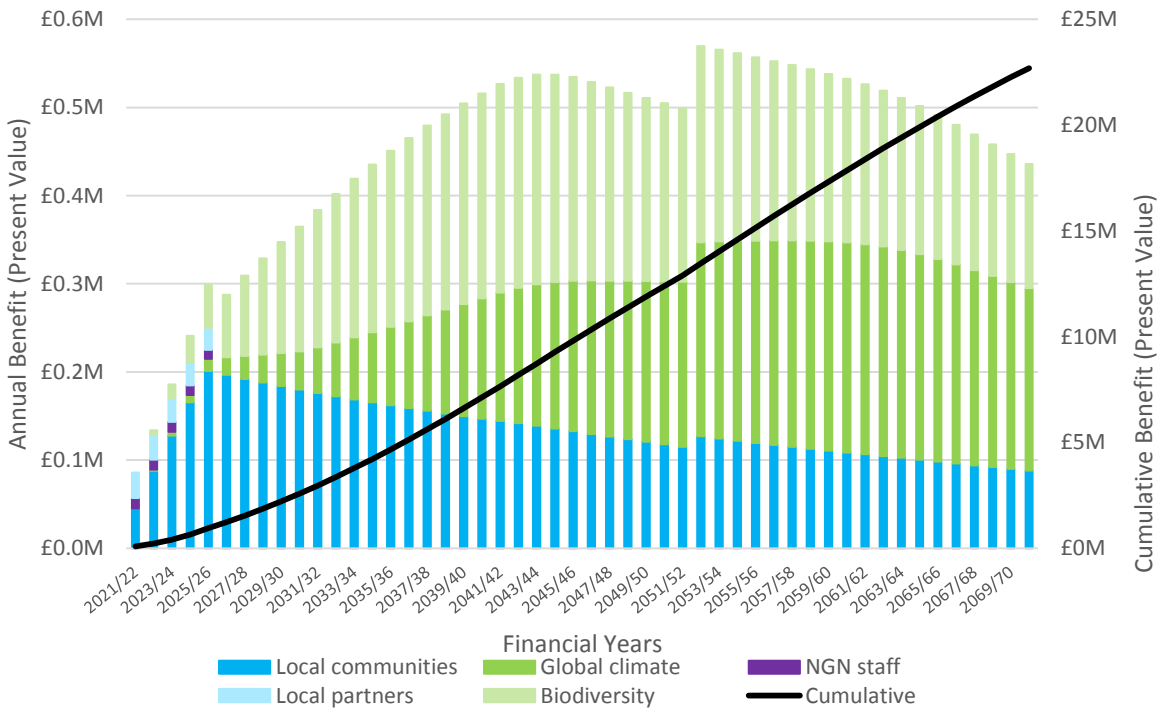


Table 16: Summary of valued benefits for CVP6

Beneficiaries	Benefits	Capitals	GD-2 Value[14] (£m)	Total Value[14] (£m)
Local communities	OC6.1	Social	0.01	1.65
	OC6.4	Social	0.62	4.99
	OC6.5	Social	0.00	0.00
Global climate	OC6.2	Natural	0.03	7.34
NGN staff	OC6.6	Human	0.06	0.06
Local partners	OC6.7	Social	0.13	0.13
Biodiversity	OC6.3	Natural	0.10	8.52
Total			**0.95**	**22.69**

[14] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 50 years for this CVP area.

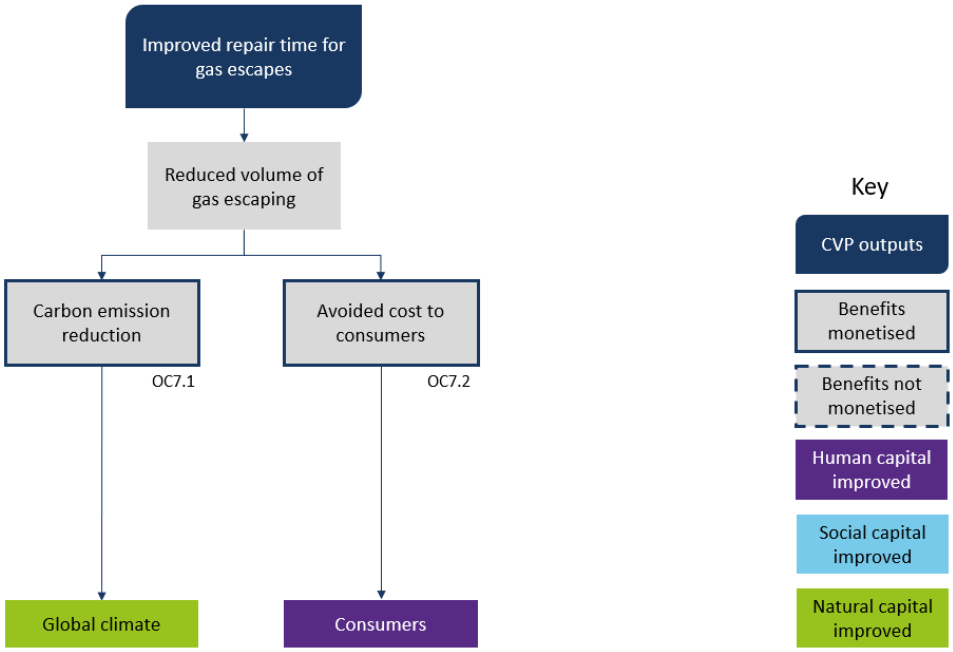
4.7 CVP 7: Enhanced Repair for Gas Escapes

4.7.1 Summary

We have set stretching targets in RIIO-GD2 to complete repairs on outstanding gas escapes within 7 and 28 days in order to reduce leakage from the network and carbon impact associated with this. More information can be found in Part 4.2.2 'Gas there when you need it – Emergency and Repair' of our Business Plan for RIIO-GD2.

4.7.2 Benefit Impact Pathway

Figure 18: CVP7 Benefit Impact Pathway



4.7.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 17: CVP7 Methodology

Ref	Outcomes	Methods of calculation
OC7.1	Carbon emission reduction	= tonnes of carbon emission reduced per year x value per tonne of carbon
OC7.2	Avoided cost to customers	= volumes of gas leak avoided x price of gas per volume

4.7.4 Value Curve

The value curve for CVP7 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below.

Figure 19: CVP7 Value Curve

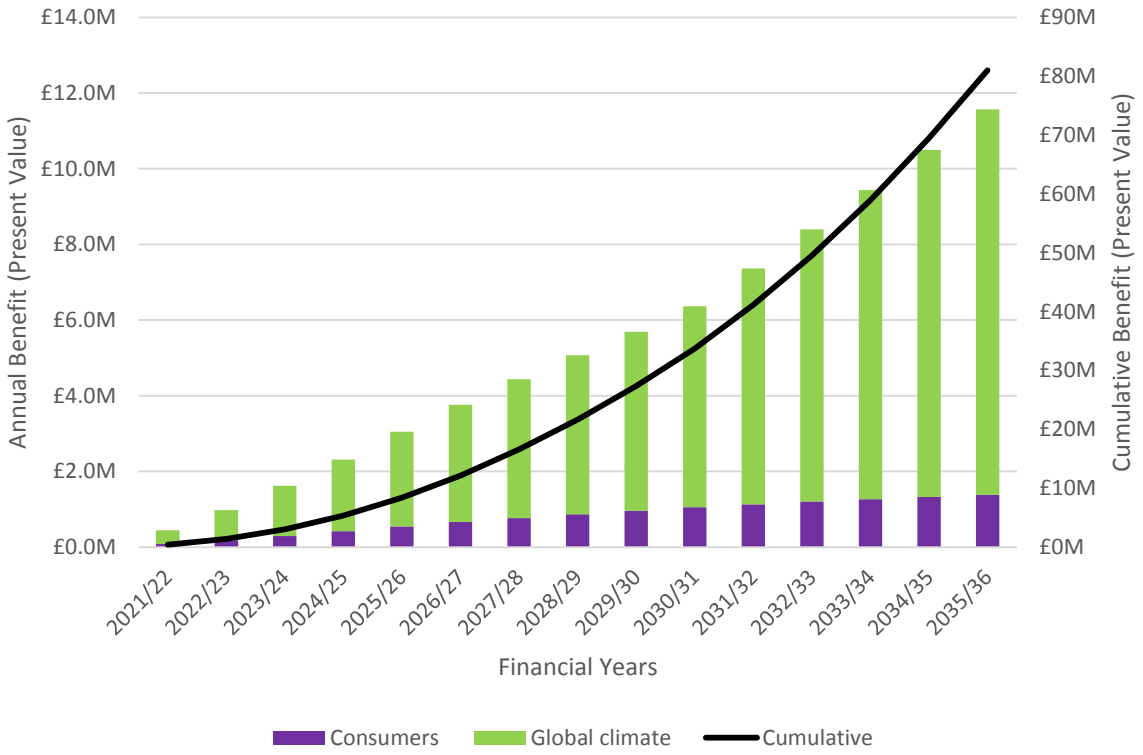


Table 18: Summary of valued benefits for CVP7

Beneficiaries	Benefits	Capitals	GD-2 Value[15] (£m)	Total Value[15] (£m)
Customers	OC7.2	Human	1.53	12.18
Global climate	OC7.1	Natural	6.90	68.85
Total			**8.42**	**81.02**

[15] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 15 years for this CVP area.

4.8 CVP 8: Appointments for Purge & Relight

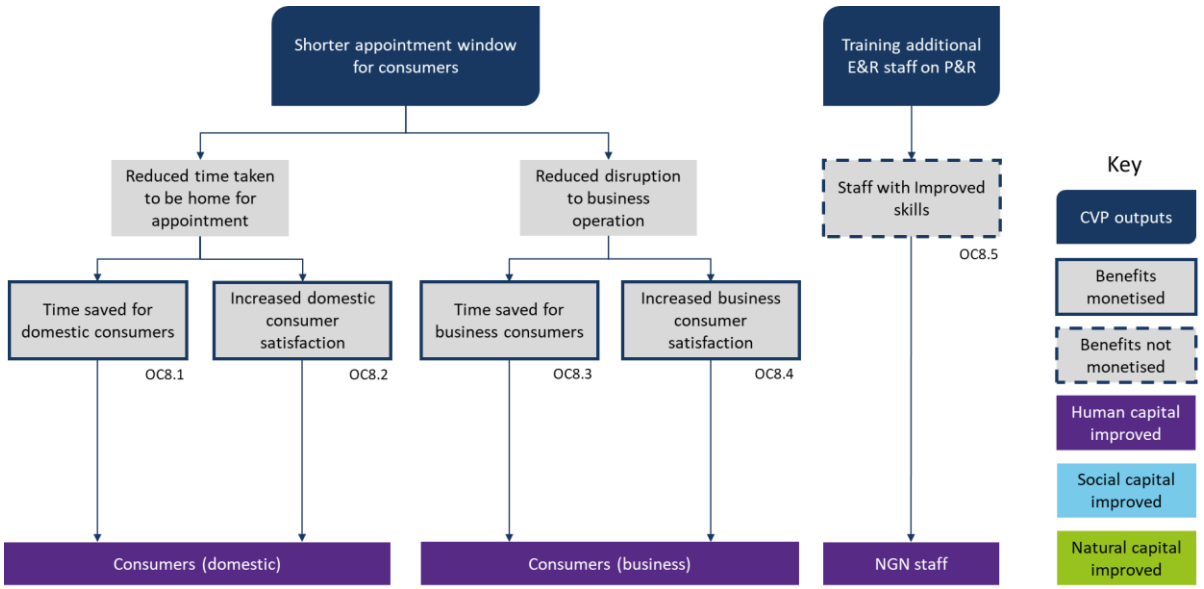
4.8.1 Summary

This CVP refers to the provision of an appointments system for purge and relight activities. In addition to delivering our planned improvements, we will create a cross-flex team consisting of colleagues who can lay both services (connection to the ECV) and carry out purge and relight jobs (connection to the appliance). This approach is linked to our workforce planning strategy and offering multi skilled teams to deliver enhanced benefit to our customers. Prior to the implementation of cross-flex teams, customers were subjected to visits from two separate specialist teams to get our customer back on gas again.

More information can be found in Part 4.2.2 'Gas there when you need it – Supply Interruptions' of NGN's Business Plan for RIIO-GD2.

4.8.2 Benefit Impact Pathway

Figure 20: CVP8 Benefit Impact Pathway



4.8.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 19: CVP 8 Methodology

Ref	Outcomes	Methods of Calculation
OC8.1	Time saved for domestic customers	= total number of customers (domestic) offered 2-hour appointment slot x WTP per customer (domestic)
OC8.2	Increased domestic customer satisfaction	
OC8.3	Time saved for business customers	= total number of customers (business) offered 2-hour appointment slot x WTP per customer (business)
OC8.4	Increased business customer satisfaction	

Ref	Outcomes	Methods of Calculation
OC8.5	Staff with Improved skills	Not valued here to avoid double counting, as this benefit is calculated under CVP10

4.8.4 Value Curve

The value curve for CVP8 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below.

Figure 21: CVP8 Value Curve

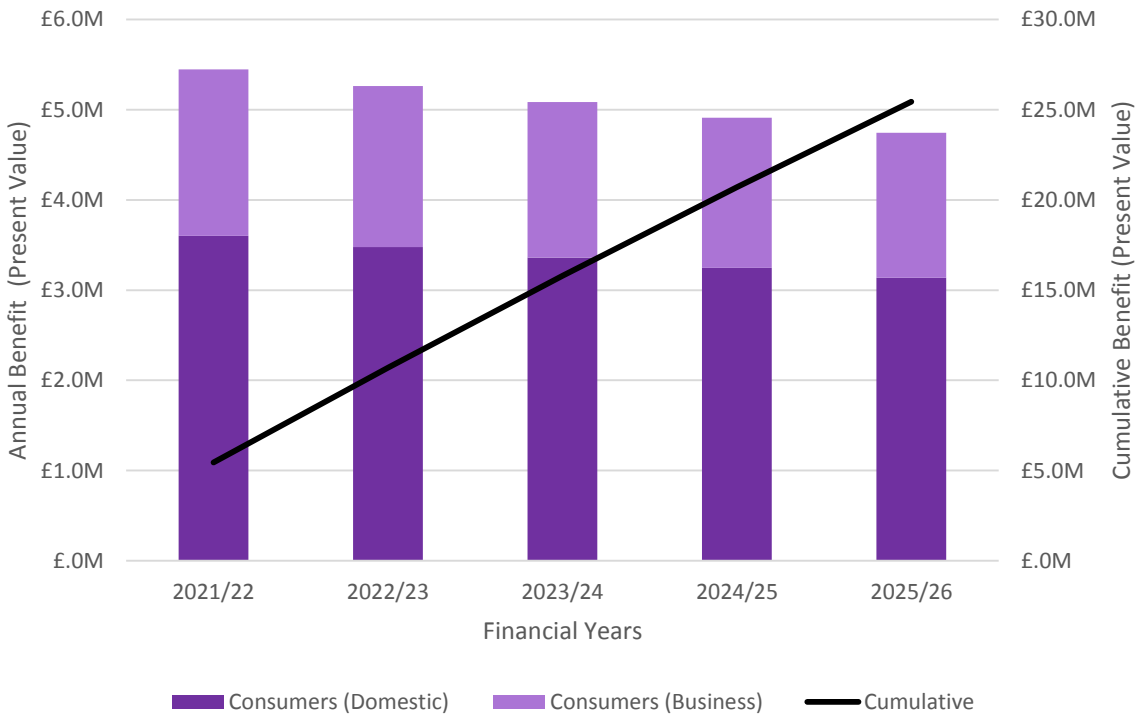


Table 20: Summary of valued benefits for CVP8

Beneficiaries	Benefits	Capitals	GD-2 Value[16] (£m)	Total Value[16] (£m)
Customers (Domestic)	OC8.1+OC8.2 [Valued collectively]	Human	16.82	16.82
Customers (Business)	OC8.3+OC8.4 [Valued collectively]	Human	8.62	8.62
Total			**25.44**	**25.44**

[16] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 5 years for this CVP area.

4.9 CVP 9: Complaint Resolution

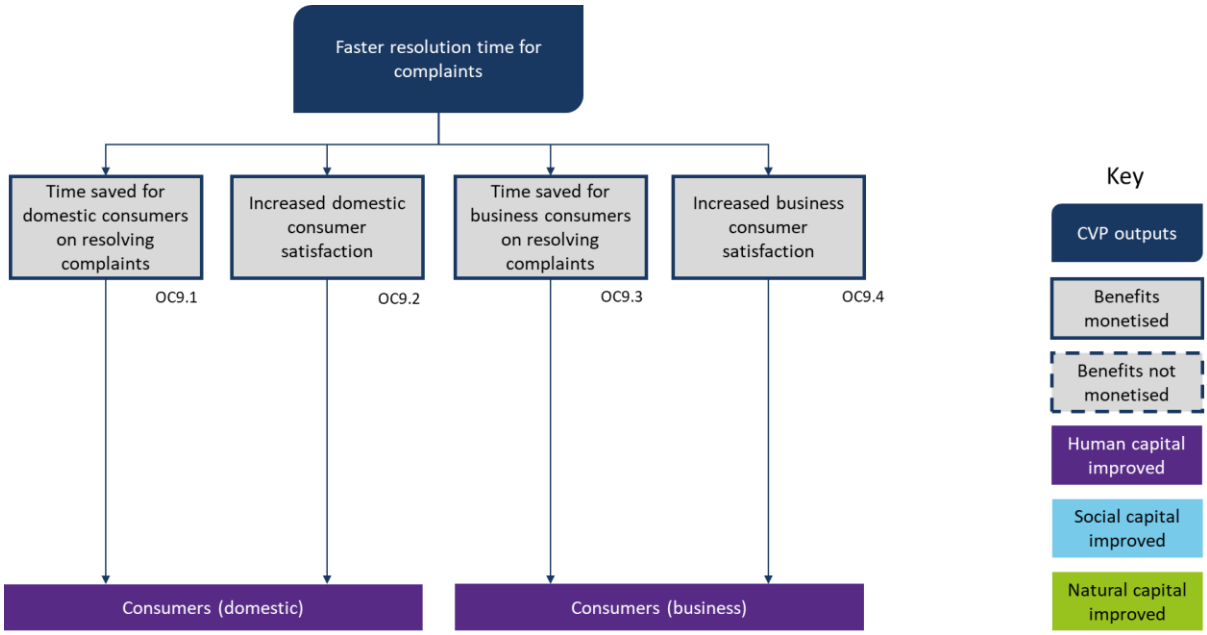
4.9.1 Summary

This CVP refers to the 60-min standard for Complaint Resolution to improve customer satisfaction. We aim to agree a resolution to a complaint within an hour, even on weekends.

More information can be found in 'Part 4.2.1 - A truly great customer experience for everyone' of NGN's Business Plan for RIIO-GD2.

4.9.2 Benefit Impact Pathway

Figure 22: CVP9 Benefit Impact Pathway



4.9.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 21: CVP9 Methodology

Ref	Outcomes	Methods of Calculation
OC9.1	Time saved for domestic customers on resolving complaints	= total number of customers (domestic) having their complaints resolved within 60mins x WTP per customer (domestic)
OC9.2	Increased domestic customer satisfaction	
OC9.3	Time saved for business customers on resolving complaints	= total number of additional customers (business) potentially having their complaints resolved within 60mins x WTP per customer (business) (WTP is only applied after the transition period)
OC9.4	Increased business customer satisfaction	

4.9.4 Value Curve

The value curve for CVP9 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below. The effort to agree a resolution within an hour would need to be balanced against customer needs. Therefore, the % agreed resolution within the hour would increase over RIIO-GD2, reaching the full-service level increase to 85% by mid-GD2. Therefore, to provide a conservative calculation, we have only applied WTP from year 2023/24, when the maximum service improvement is delivered to customers.

Figure 23: CVP9 Value Curve

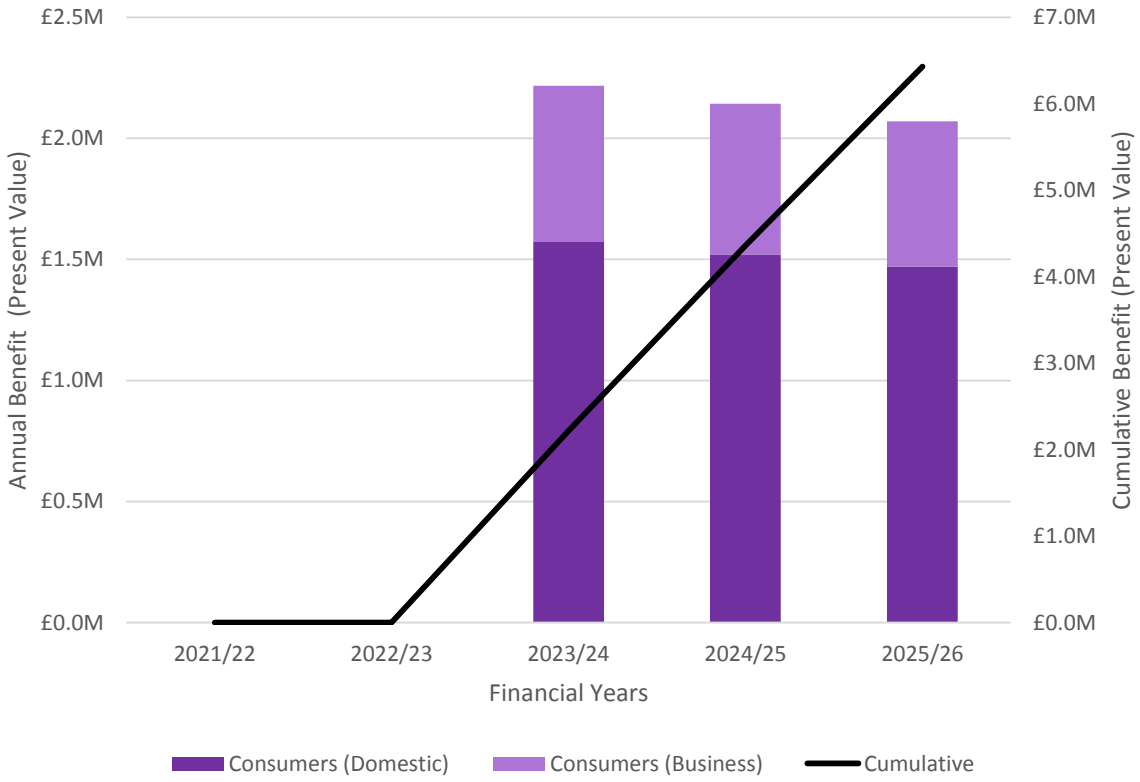


Table 22: Summary of valued benefits for CVP9

Beneficiaries	Benefits	Capitals	GD-2 Value[17] (£m)	Total Value[17](£m)
Customers (Domestic)	OC9.1+OC9.2 [Valued collectively]	Human	4.56	4.56
Customers (Business)	OC9.3+OC9.4 [Valued collectively]	Human	1.87	1.87
Total			**6.43**	**6.43**

[17] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 5 years for this CVP area.

4.10 CVP 10: Gas Restorations to the Customer Appliances

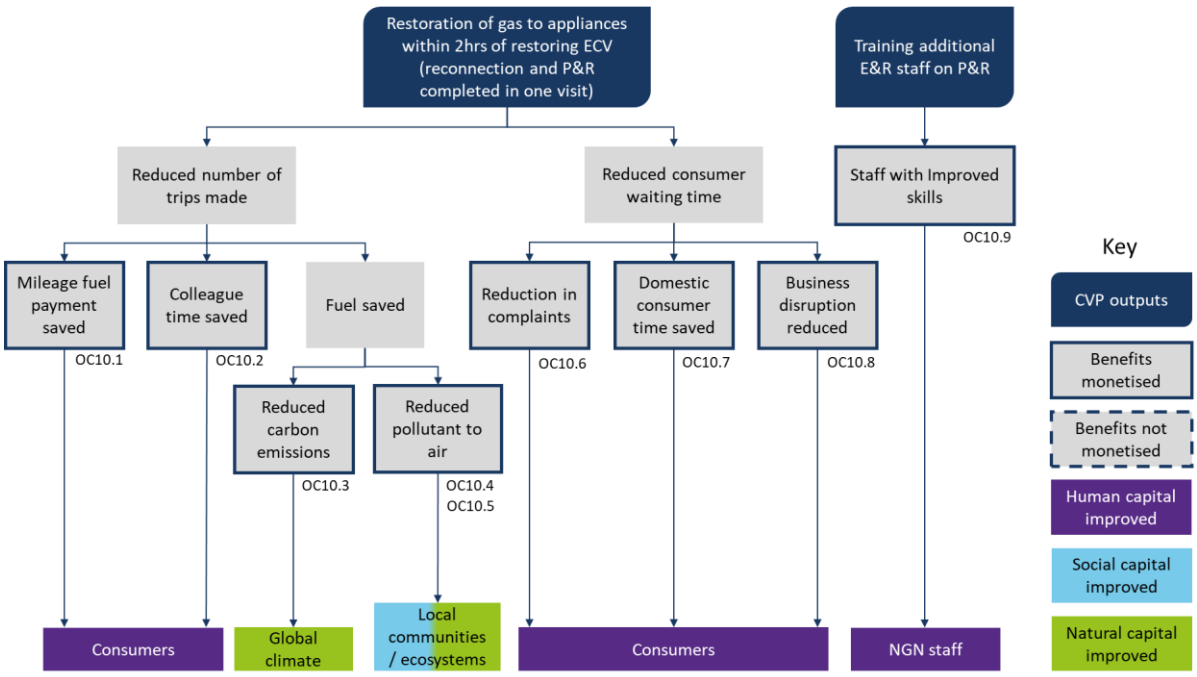
4.10.1 Summary

This CVP refers to managing customer interruptions and specifically the restoration of gas supply to customer appliances within 2hrs of restoring gas to the Emergency Control Valve (ECV).

More information can be found in Part 4.2.2 'Gas there when you need it – Supply Interruptions' of NGN's Business Plan for RIIO-GD2.

4.10.2 Benefit Impact Pathway

Figure 24: CVP10 Benefit Impact Pathway



4.10.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 23: CVP10 Methodology

Ref	Outcomes	Methods of Calculation
OC10.1	Mileage fuel payment saved	= Volume of fuel saved per year × Cost of fuel
OC10.2	Colleague time saved	= Total hours of staff time saved per year × Cost of staff time per hour
OC10.3	Reduced carbon emissions	= Volume of fuel saved per year × Carbon conversion factor per volume of fuel
OC10.4	Reduced pollutant to air	= Volume of fuel saved per year × Air quality damage per volume of fuel

Ref	Outcomes	Methods of Calculation
OC10.5	Reduced ecosystem damages	Not valued (lacking robust quantification methodology)
OC10.6	Reduction in complaints	= Total number of complaints reduced per year × Cost per complaint
OC10.7	Domestic customer time saved	= Total hours of customer time saved per year × Value of customer time per hour
OC10.8	Business disruption reduced	= Total hours of business disruption reduced per year × GVA per hour worked
OC10.9	Staff with Improved skills	= Total hours of training taken x value of staff time per hour

4.10.4 Value Curve

The value curve for CVP10 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below. The sharp increase in benefit value in the last year of RIIO-GD2 represents the improved customer service received by customers once the training programme has been completed in RIIO-GD2. In reality, the improvement of service would be incremental as more staff undergo training. However, we have taken a conservative approach and only valued the benefits to customers once the training programme has been completed.

Figure 25: CVP10 Value Curve

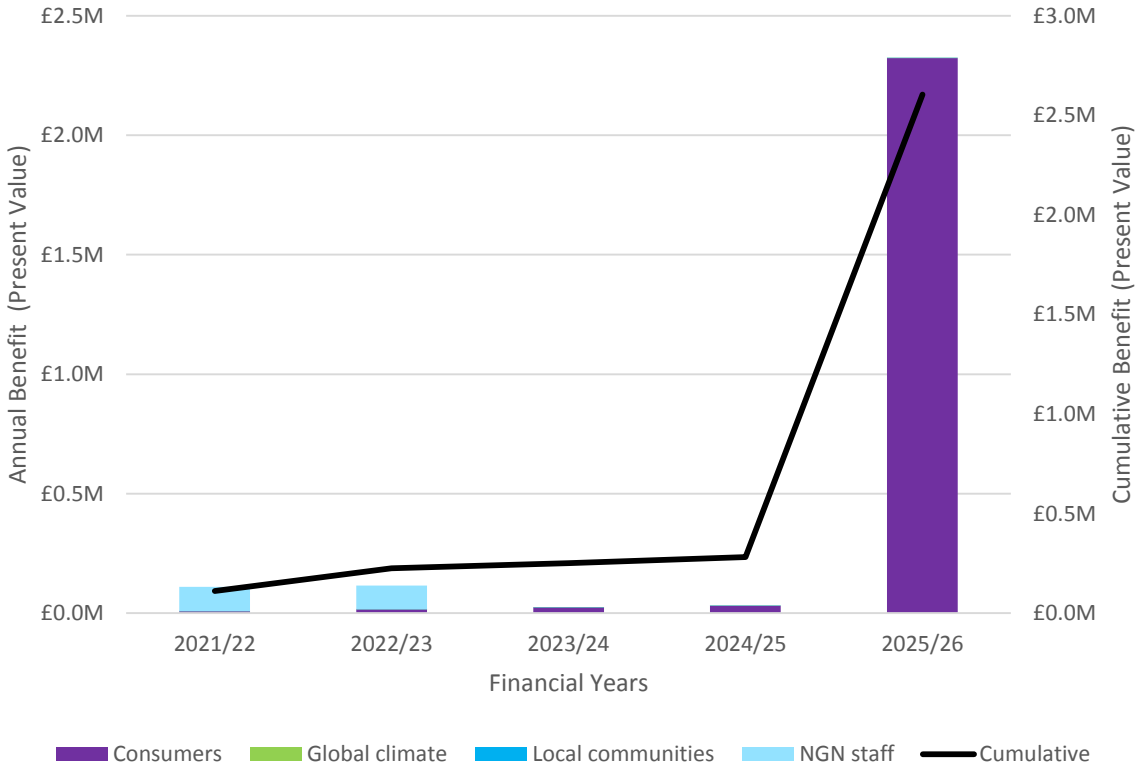


Table 24: Summary of valued benefits for CVP10

Beneficiaries	Benefits	Capitals	GD-2 Value[18] (£m)	Total Value[18] (£m)
Customers	OC10.1	Human	0.01	0.01
	OC10.2	Human	0.09	0.09
	OC10.7+OC10.8 [Valued collectively]	Human	2.29	2.29
	OC10.6	Human	0.02	0.02
Global climate	OC10.3	Natural	0.00	0.00
Local communities	OC10.4	Social	0.00	0.00
NGN staff	OC10.9	Human	0.20	0.20
Total			**2.60**	**2.60**

[18] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 5 years for this CVP area.

4.11 CVP 11: Reinstatement

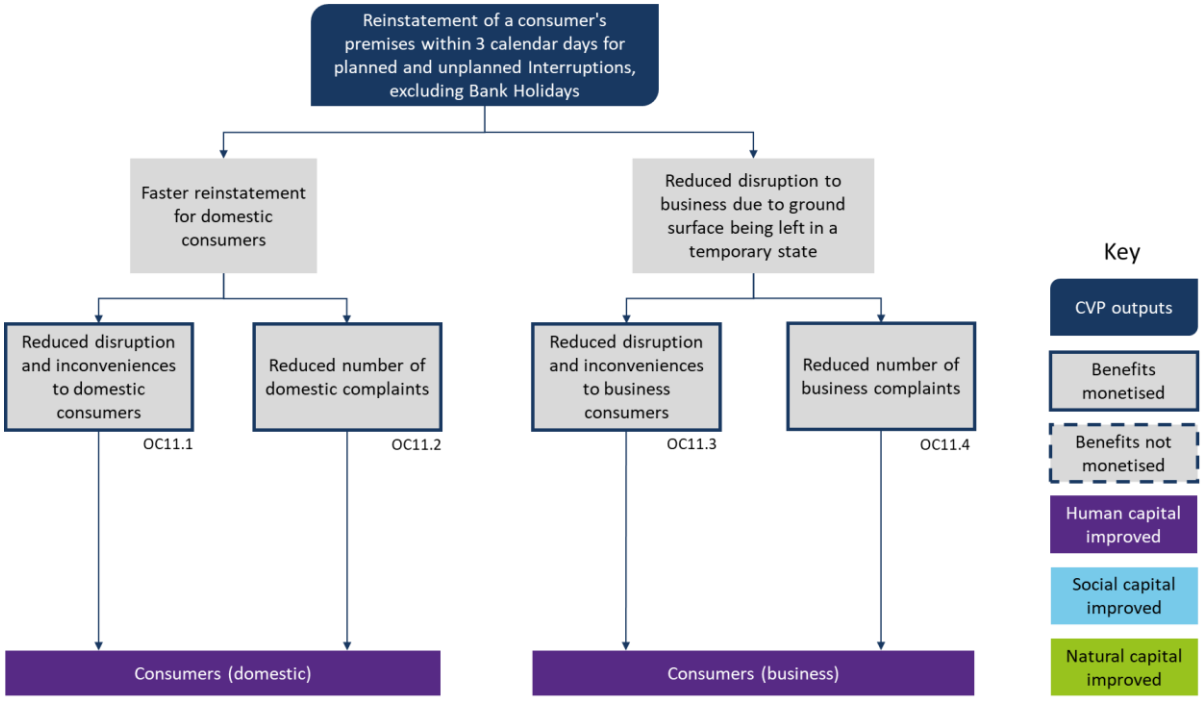
4.11.1 Summary

This CVP refers to the reinstatement of a customer's premises (private land) within 3 calendar days for planned and unplanned Interruptions, excluding Bank Holidays. The Ofgem minimum standard is 5 working days, meaning that we are offering an additional 97 days to customers to complete this work.

More information can be found in Part 4.2.2, 'Gas there when you need it – Supply Interruptions,' of our Business Plan for RIIO-GD2.

4.11.2 Benefit Impact Pathway

Figure 26: CVP11 Benefit Impact Pathway



4.11.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 25: CVP11 Methodology

Ref	Outcomes	Methods of Calculation
OC11.1	Reduced disruption and inconveniences to domestic customers	= total number of customers (domestic) receiving reinstatement within 3 working days x WTP per customer (domestic) (WTP is only applied after the transition period)
OC11.3	Reduced disruption and inconveniences to business customers	= total number of customers (business) receiving reinstatement within 3 working days x WTP per customer (business) (WTP is only applied after the transition period)

Ref	Outcomes	Methods of Calculation
OC11.2	Reduced number of domestic complaints	= total number of complaints reduced per year x cost per complaint
OC11.4	Reduced number of business complaints	

4.11.4 Value Curve

The value curve for CVP11 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below.

Figure 27: CVP11 Value Curve

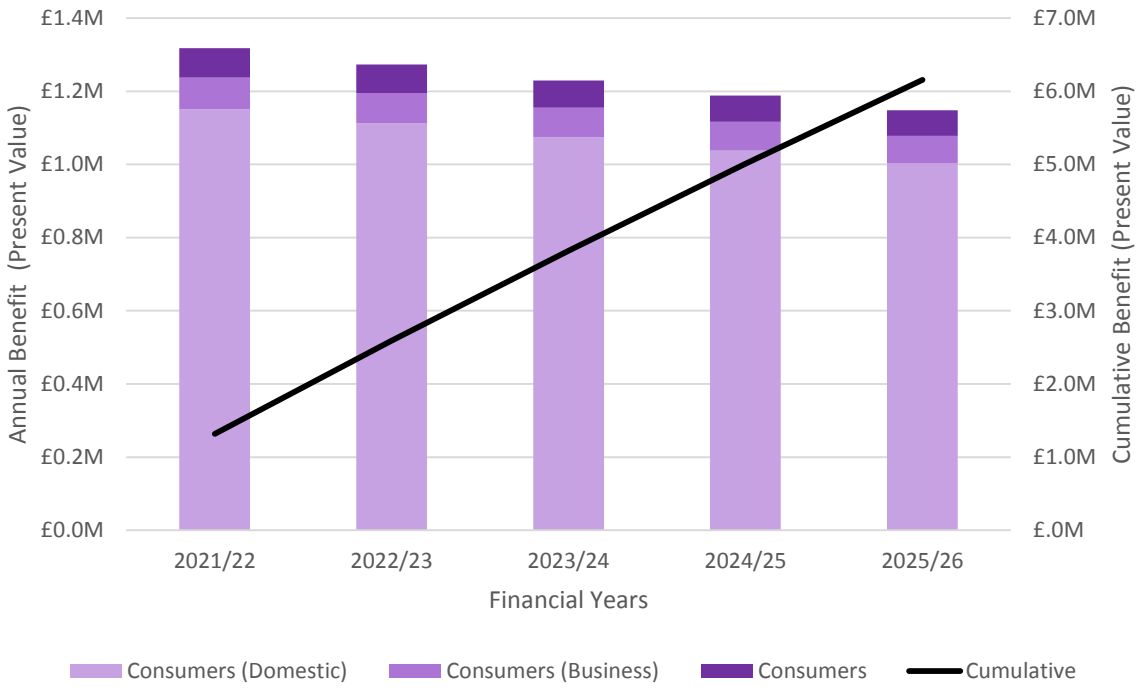


Table 26: Summary of valued benefits for CVP11

Beneficiaries	Benefits	Capitals	GD-2 Value[19] (£m)	Total Value[19]£m)
Customers (Domestic)	OC11.1	Human	5.38	5.38
Customers (Business)	OC11.3	Human	0.40	0.40
Customers	OC11.2+OC11.4 [Valued collectively]	Human	0.37	0.37
Total			**6.16**	**6.16**

[19] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 5 years for this CVP area.

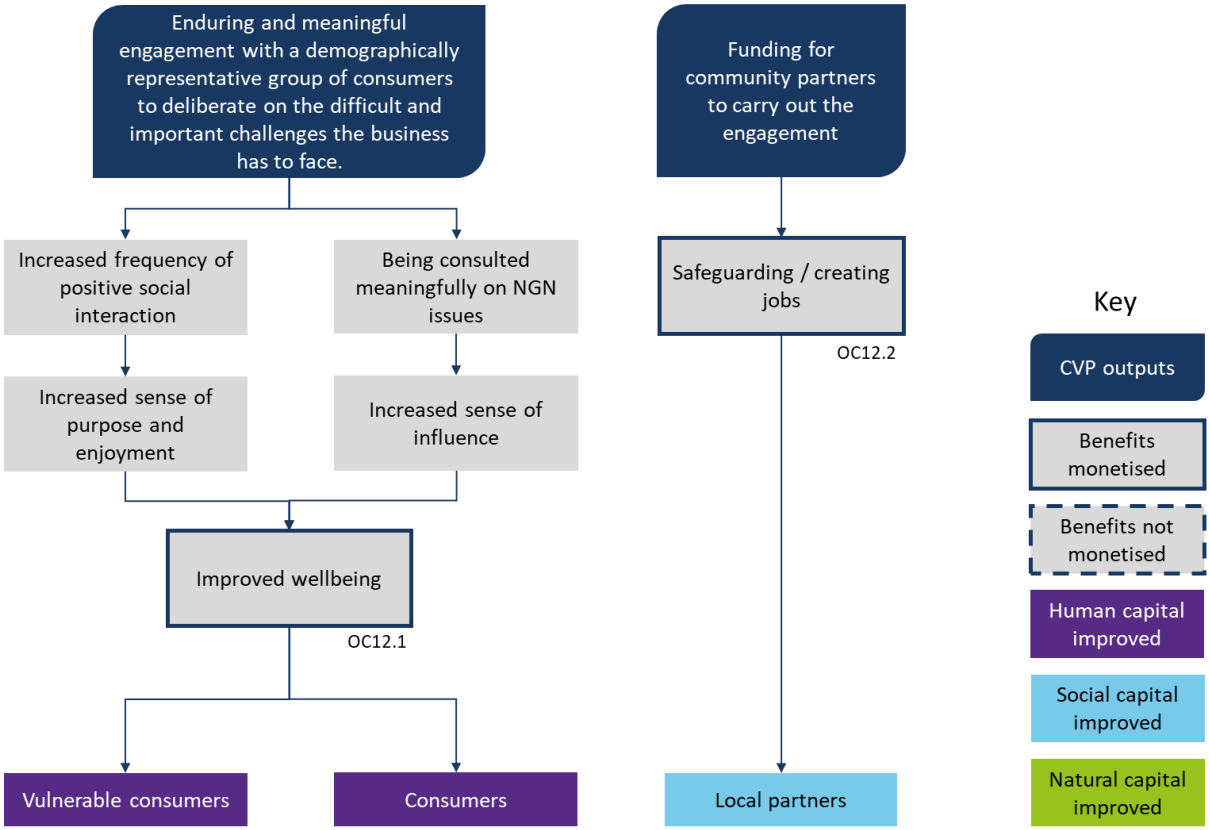
4.12 CVP 12: Citizens' Jury

4.12.1 Summary

The Citizen's Jury was created in 2019, composed of a 50-strong, demographically representative group of customers who deliberated on key decisions on our Business Plan. During RIIO-GD2, we will create an enduring role with the Citizen's Jury meeting three times a year to deliberate on the difficult and important challenges the business faces. More information can be found in Section 3.4.3 of the Business Plan.

4.12.2 Benefit Impact Pathway

Figure 28: CVP12 Benefit Impact Pathway



4.12.3 Methodology

The methods of calculation for each outcome are summarised below.

Table 27: CVP12 Methodology

Ref	Outcomes	Methods of Calculation
OC12.1	Improved wellbeing	= number of customers actively participating in Citizens' Jury x wellbeing improvement value for actively participating in a formal social group per person per annum
OC12.2	Safeguarding / creating jobs	= total number of FTE safeguarding / creating per year x value of employment per FTE

4.12.4 Value Curve

The value curve for CVP12 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised below.

Figure 29: CVP12 Value Curve

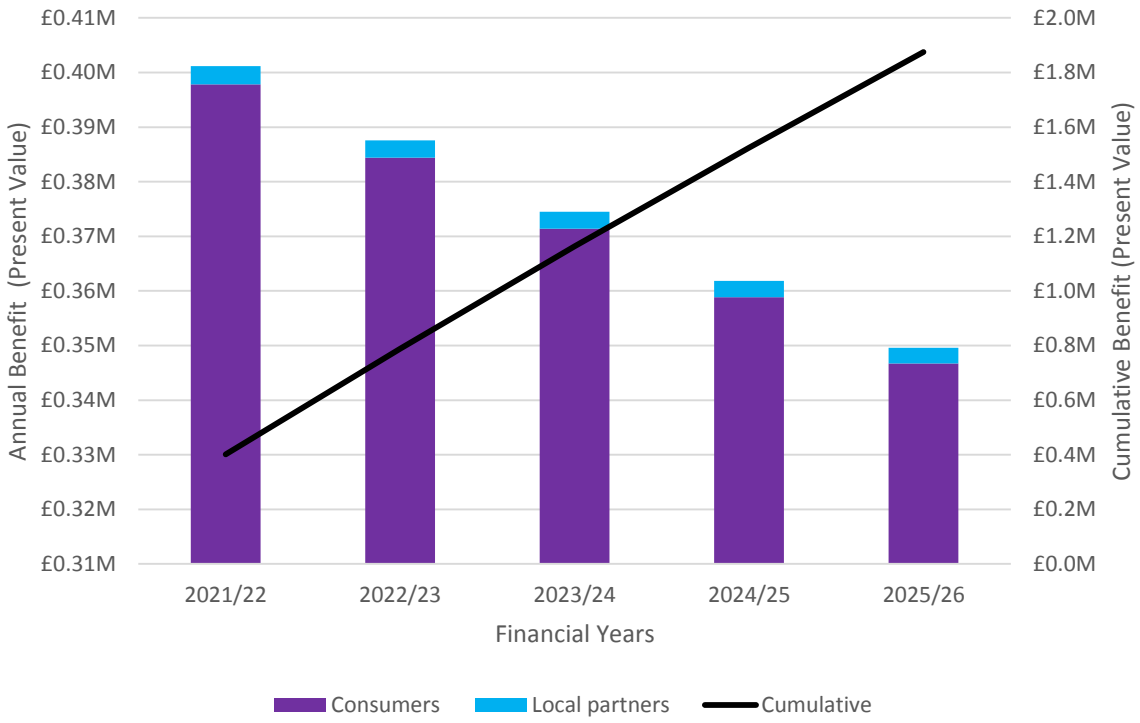


Table 28: Summary of valued benefits for CVP12

Beneficiaries	Benefits	Capitals	GD-2 Value[20] (£m)	Total Value[20]£m)
Customers	OC12.1	Human	1.86	1.86
Local partners	OC12.2	Social	0.02	0.02
Total			**1.87**	**1.87**

[20] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 5 years for this CVP area.

5 CVP13: Benefit Valuation for Hydrogen Pathway

5.1 Summary

Our hydrogen pathway focuses on our H21 and HyDeploy projects as key enablers to achieving hydrogen conversion of our networks and facilitating the development of a hydrogen economy. These projects provide blueprint research to prove the technical feasibility and economic viability of converting the UK's gas distribution networks from natural gas to 100% hydrogen. Heat contributes close to a third of the UK's annual CO_2 emissions, and hydrogen as an alternative fuel has the potential to significantly reduce carbon emissions across the heat, electricity and transport sectors.

We have been at the forefront of the research and development work undertaken to date to facilitate this transformational change. Within the RIIO-2 period we will be taking a key role, funded through the NIC, in demonstrating the safety case for use of hydrogen in the gas distribution system. This is a key step in unlocking the potential of hydrogen, facilitating the required policy changes and enabling significant investments.

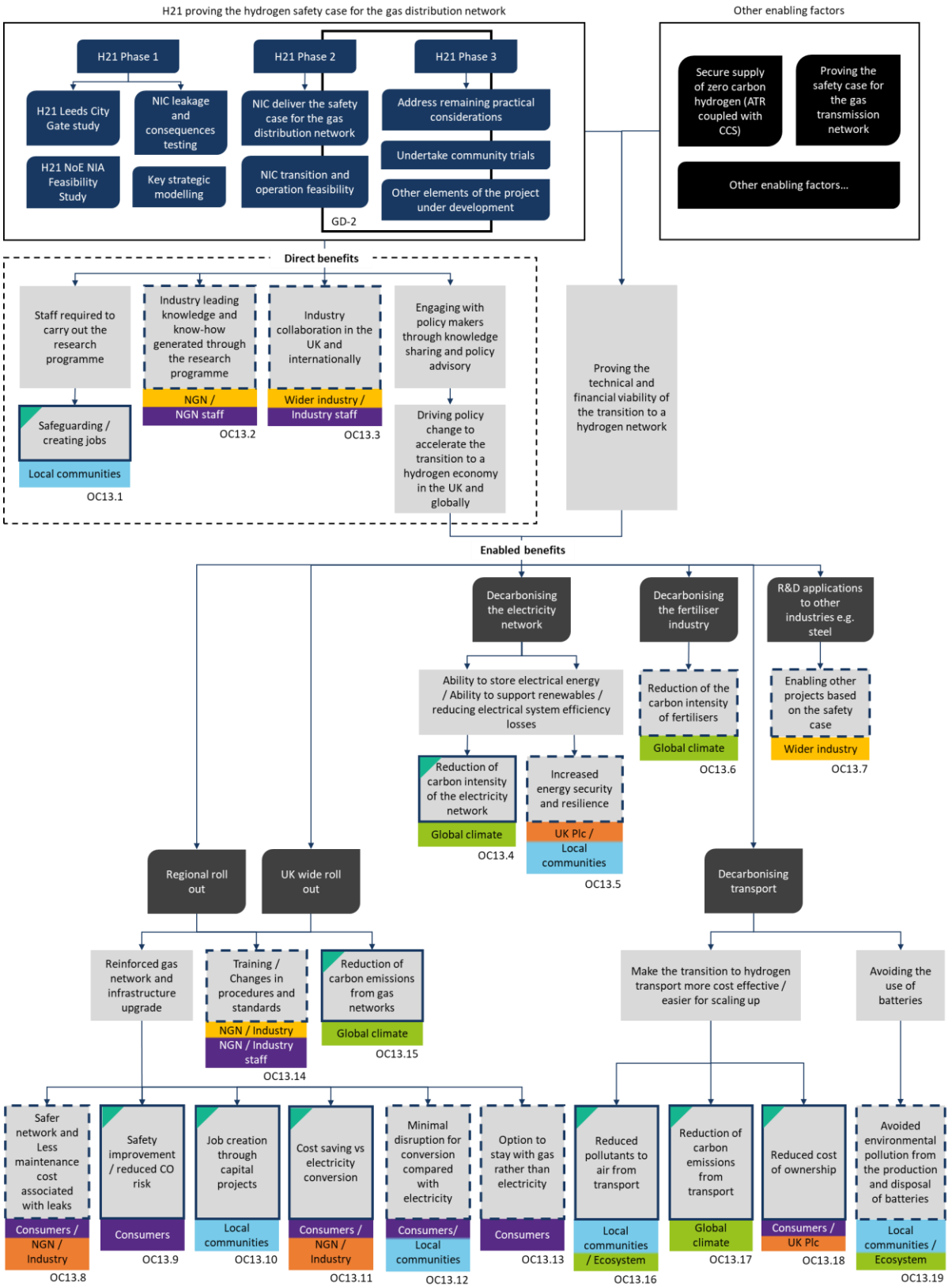
The delivery of this work will deliver significant immediate and long-term benefits to our customers, as well as substantial benefits to wider society. Therefore, we have valued the benefits associated with delivering our pathway utilising our CVP approach. We recognise that there are a number of factors required to facilitate this whole system transformational change, many of which are being delivered by other organisations, and as such our valuation is included to provide an illustration of the scale of benefits possible and will not be included as a part of our CVP for our RIIO-2 Business Plan submission. This assessment seeks to recognise and, where possible, value the direct benefits of the work we are undertaking to our customers, as well as recognising the much wider benefits that our work will contribute to through enabling a nationwide transition and catalysing the hydrogen economy within the UK.

5.2 Benefit Mapping

The intellectual insight and knowledge generated through our pathway could have far reaching benefits, from decoupling economic growth and prosperity from fossil fuels, to transitioning our society towards a hydrogen economy and unlocking new opportunities.

In our benefit impact pathway mapping, we have captured both direct and enabled benefits. **Direct benefits** are those outcomes realised in the short to medium term, and as a direct consequence of the activities carried out as part of the deployment of our pathway, including outputs of the H21 and HyDeploy projects. **Enabled benefits** are activities and outcomes which would depend on us successfully proving the viability of transitioning the gas distribution network to hydrogen to be realised. However, these activities and outcomes would also rely on other enabling factors to materialise.

Figure 30: CVP13 Benefit Impact Pathway



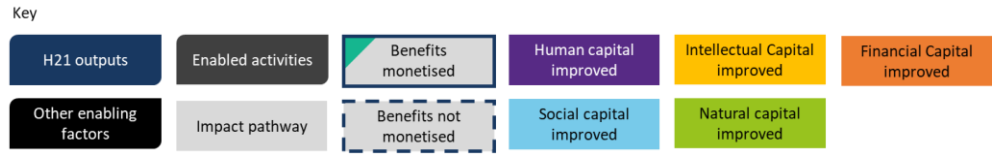


Figure 31 presents an indicative view of the likely timeline when each one of the identified benefits is likely to be realised. As direct benefits are consequences of HyDeploy and H21 activities, these are likely to be realised in the short-term, during or straight after the successful completion of these projects. Whereas enabled benefits would require other enabling factors and are therefore anticipated in the medium to long term.

Figure 31: CVP13 Timeline of benefits across assessment period

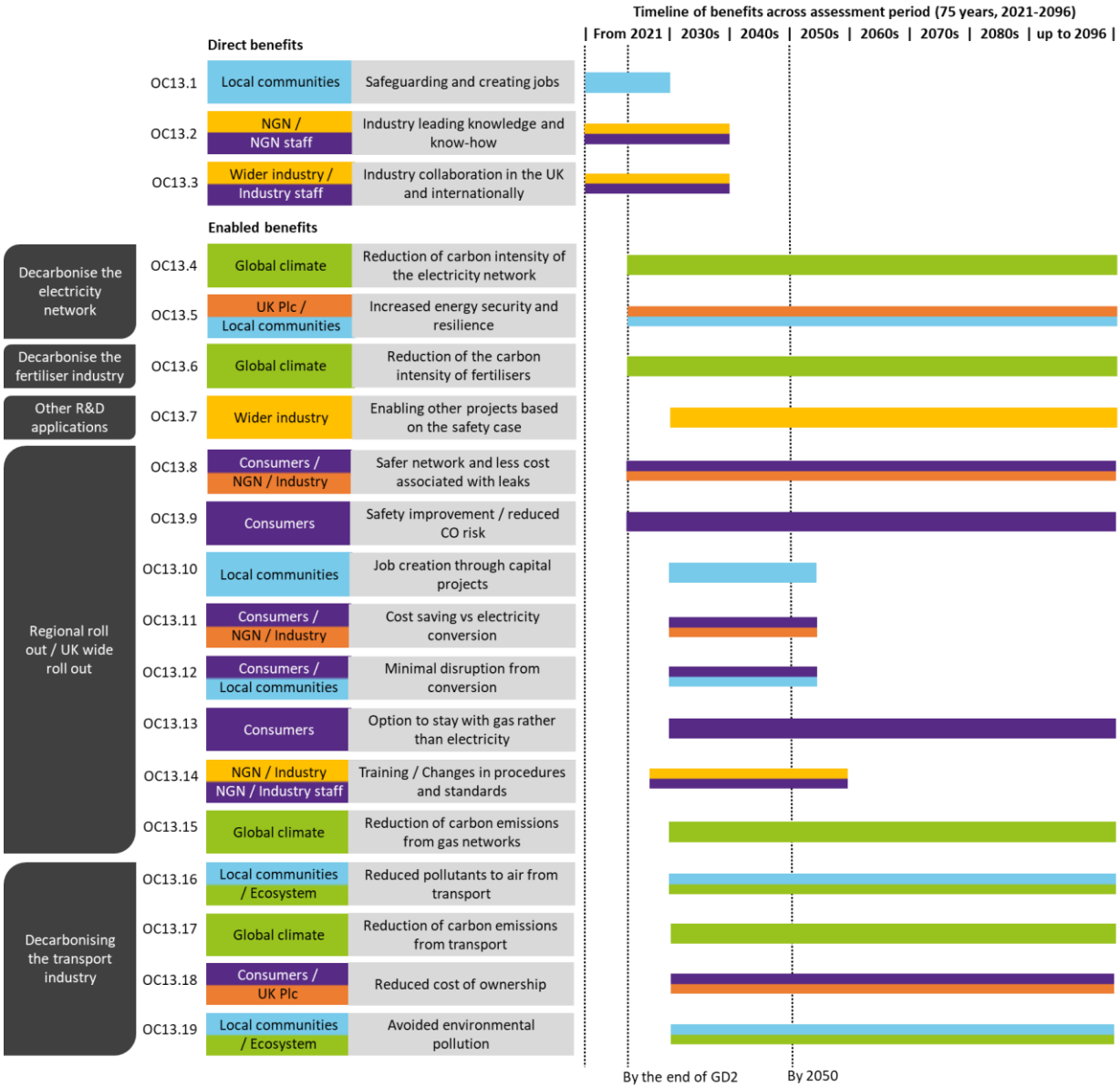


Table 29 presents the direct benefits we have identified that would be realised from the roll out of our net zero pathway. We have provided a summary for each benefit to explain the rationale as to why we have qualified these benefits.

Table 29: CVP13 Direct Benefits and Rationales for Qualification

Ref	Outcomes	Rationales for Qualification	Valuation
OC13.1	Safeguarding and creating jobs	The investment made to deliver the hydrogen economy would directly support employment.	Valued
OC13.2	Industry leading knowledge and know-how generated through the research programme	Intellectual capital[21] generated through the research programme of HyDeploy and H21.	Not valued (due to lack of data at present)
OC13.3	Industry collaboration in the UK and internationally	Intellectual capital generated through the research programme.	Not valued (due to lack of data at present)

Table 30 presents the enabled benefits we have identified, with a summary of the rationales we have followed to qualify the benefits.

Table 30: CVP13 Enabled Benefits and Rationales for Qualification

Ref	Outcomes	Rationales for Qualification	Valuation
OC13.4	Reduction of carbon intensity of the electricity network	**Increasing the proportion of renewables in our energy mix:** Hydrogen can be produced through electrolysis, stored and transported. It therefore presents an opportunity as a method for 'storing' excess electricity when renewables are producing more energy than there is demand for. The energy can then be released back through gas fired power stations as a further renewable energy source. This would create additional revenue for renewable electricity investments (rather than having this electricity generation constrained), supporting additional investments in renewable electricity generation. **Conversion of gas-fired power generation:** There will continue to be increasing gas power generators on our network, which are currently supplied with natural gas to provide base load of electricity at times when renewable electricity is not being generated. As our network converts over to 100% hydrogen, this will enable conversion of these power stations, providing a reliable zero emission base load electricity generation source to complement increasing renewable electricity generation.	Part-valued (valuation includes potential additional revenue for renewable energy generation but does not account for conversion of power stations onto hydrogen or increased investment in renewables, for which data is not currently available for valuation)

[21] Intellectual capital is the group of knowledge assets that are attributed to an organisation and most significantly contribute to an improved competitive position of this organisation by adding value to defined key stakeholders (Marr and Schiuma, 2001, Defining key performance indicators for organisational knowledge assets)

Ref	Outcomes	Rationales for Qualification	Valuation
OC13.5	Increased energy security and resilience	Conversion of the network to hydrogen has the potential to support the electricity network through increased security and resilience: **Use for Energy Storage** Hydrogen can be produced when there is excess electricity, stored and used to generate electricity when needed, for instance as seasonal storage or for demand response purposes. **Rapid Response to Output Variation** Electrolysers can be turned on/off immediately, responding quickly to variations in generation output. They can consume excess renewable energy when available and defer to other loads when generation output is low. This can enable more renewable energy generation on the system and provide an offtake to otherwise curtailed energy. As large electrical users, electrolysers can be rapidly ramped up and down to provide frequency control services and other system services for electricity systems, stabilising the system and providing resilience.	Not valued (due to lack of data at present, though work is currently underway by the Carbon Trust to understand the potential scale of value hydrogen can provide to the electricity system through these types of benefits)
OC13.6	Reduction of the carbon intensity of fertilisers	Ammonia is produced using the Haber-Bosch process, converting hydrogen and nitrogen using high temperature and a catalyst. Not only is this a highly energy intensive process, it currently relies on natural gas as a feedstock. Considering both the energy and feedstock, ammonia accounts for 1.5% of global CO2 emissions and production is increasing by 3% per year. The conversion of the distribution network to hydrogen will enable a substantial increase in the production and distribution of hydrogen, making the production of hydrogen for ammonia more cost efficient and driving the switch to 'green' hydrogen (from electrolysis of water) rather than 'blue' hydrogen (from natural gas, requiring carbon capture and storage to reduce emissions) thus reducing the CO2 emissions of the fertiliser industry.	Not valued (due to lack of data at present)
OC13.7	Enabling other projects based on the safety case	Proving the viability of the safe conversion of the distribution network to hydrogen will lead to R&D applications across the wider energy systems and in many other sectors, leading to improved intellectual capital.	Not valued (due to lack of data at present)
OC13.8	Safer network and less maintenance cost associated with leaks	The reinforcement of the existing gas network will result in a safer network that will reduce the likelihood and severity of incidents. Hydrogen also disperses quickly and is less likely to result in explosive build up and has no climate impact, so smaller leaks can be left if not cost-effective to fix. Both of these would potentially lead to a lower operational maintenance requirement.	Not valued (due to lack of data at present)

Ref	Outcomes	Rationales for Qualification	Valuation
OC13.9	Safety improvement / reduced CO risk	Hydrogen gas does not contain carbon, therefore, no carbon monoxide can be formed. This removes the risk of CO poisoning for customers.	Valued
OC13.10	Job creation through capital projects	The regional and UK wide roll-out will generate jobs both directly and through the supply chain.	Valued
OC13.11	Cost saving vs electricity conversion	Converting the existing gas network over to 100% hydrogen is a lower cost pathway to net zero by 2050, than electrifying the energy currently delivered by gas networks in the UK. As a result, converting gas networks to hydrogen will avoid incurring unnecessary costs to meet our net zero target by 2050.	Valued
OC13.12	Minimal disruption for conversion compared with electricity	Since the hydrogen network will be using the natural gas infrastructure currently in place, customers will be less impacted by the disruptions caused by network upgrades (e.g. road traffic disruption, underground pipework).	Not valued (due to lack of data at present)
OC13.13	Option to stay with gas rather than electricity	Offering customers the choice to remain with gas for cooking and heating if it is their preferred option.	Not valued (due to lack of data at present)
OC13.14	Training / Changing in procedures and standards	NGN and industry-wide training will be required to upskill the industry. At the same time, new procedures and standards will need to be developed for the operation of a hydrogen network.	Not valued (due to lack of data at present)
OC13.15	Reduction of carbon emissions from gas networks	The conversion to hydrogen will result in a significant reduction in carbon intensity of the gas networks, delivering a system-level decarbonisation for the UK gas networks.	Valued
OC13.16	Reduced pollutants to air from transport	If the H21 project provides evidence for the safety case for hydrogen, and a conversion from natural gas to hydrogen for heat occurs, it will lead to hydrogen being produced at large scale and from renewable sources. If zero emission hydrogen is available at large scale this will make hydrogen more cost-effective to supply, which may lead to an acceleration in the uptake of hydrogen vehicles, therefore, contribute to the decarbonisation of the transport sector. In addition, a number of heavy transport polluters do not have an electric alternative, such as garbage trucks, HGVs and other larger industrial vehicles. Converting these to hydrogen (or initially natural gas) will have a significant beneficial impact on air quality by removing NOx and particulate matter emissions from these vehicles as well as reducing carbon emissions.	Valued
OC13.17	Reduction of carbon emissions from transport		Valued

Ref	Outcomes	Rationales for Qualification	Valuation
OC13.18	Reduced cost of vehicle ownership	Available evidence[22] indicates that owning and operating a hydrogen fuelled vehicle is cheaper than an electric or diesel alternative. The conversion of the distribution network to hydrogen could facilitate more hydrogen fuelling stations and cheaper hydrogen, allowing more people to take advantage of this reduced cost of vehicle ownership and further reducing the cost of hydrogen as a fuel source.	Valued
OC13.19	Avoided environmental pollution associated with the production and disposal of batteries	Using hydrogen as a potential transport fuel will reduce the need for car batteries, in turn, reducing the environmental pollution associated with the production and disposal of batteries.	Not valued (due to lack of data at present)

5.3 Valuation Methodology

We have undertaken an initial benefit valuation for the NGN net zero pathway based on the successful completion of the H21 and HyDeploy projects, focusing on the areas where we currently have sufficient data and robust methodology. We have included nine benefits in this valuation. The methods of calculation used are presented in Table 31.

For a number of the enabled benefits the calculation methodologies incorporate broad assumptions around the extent to which conversion of the distribution network to hydrogen will facilitate development of other industries, and assumptions that other enabling factors will align. For some, proxies are also used to facilitate valuation of all or part of the potential benefit. These enabled benefits valuations are therefore presented as an indication of the scale of wider benefits the project could enable.

Table 31: CVP13 Valuation Methodology

Benefit Type	Ref	Outcomes	Methods of Calculation
Direct and enabled	OC13.1 + OC13.10	Safeguarding and creating jobs / creating jobs through capital projects (both benefits valued together)	*= Number of FTE x Value of employment* We have based the projection of additional jobs from the transition to a hydrogen network on the 'evolution of gas' scenario developed in the KPMG Energising the North report[23], and have assumed a linear increase up to 2050.

[22] Progressive Energy (2019) HyMotion: Network-supplied Hydrogen Unlock Low Carbon Transport Opportunities. Available from https://hynet.co.uk/app/uploads/2019/06/15480_CADENT_HYMOTION_PROJECT_REP.pdf [last accessed 26/11/2019]

[23] KPMG (2017) Energising the North: an evaluation of the economic contribution of the energy sector to the North of England, a report for Northern Gas Networks.

Benefit Type	Ref	Outcomes	Methods of Calculation
Enabled	OC13.4	Reduction of carbon intensity of the electricity network	*= Value of non-constrained wind energy generation* We have used the projection of UK wind energy generation[24] and the value of constraint payments[25] as a proxy for the value of removing this constraint through the provision of an established hydrogen market.
Enabled	OC13.9	Safety improvement/reduced CO risk	*= Number of fatalities and non-fatalities reduced x cost per fatality/non-fatality* To calculate the number of fatalities and non-fatalities reduced, we have used HSE data[26] and have assumed a reversed correlation between the reduction of CO incidents and the percentage conversion of the UK's gas network to hydrogen.
Enabled	OC13.11	Cost saving vs electricity conversion	*= UK infrastructure cost savings from Balanced scenario compared with the Electrified scenario* We have based the projection of cost saving from the conversion to a hydrogen network compared with electrifying the energy currently supplied by gas on the scenarios developed in the ENA Pathways to Net-Zero report[27].
Enabled	OC13.15	Reduction of carbon emissions from gas networks	*= Tonnes of carbon avoided x Price of carbon* The reduction from gas networks has been calculated based on the penetration pathway of hydrogen we have developed for NGN, which aligns with the ENA Pathways to Net-Zero report[27] and assumes the conversion of our whole network will be completed by 2050. We have assumed a similar pathway for the rest of the UK.
Enabled	OC13.16	Reduced pollutants[28] to air from transport	*= Tonnes of NOx avoided x damage cost of NOx* To estimate the number of hydrogen vehicle uptake as a result of network-supplied hydrogen, we have developed a UK-wide hydrogen vehicles uptake trajectory based on the Progressive Energy HyMotion report[29].

[24] UK Government, Offshore Wind Sector Deal, March 2019, https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal
[25] Renewable Energy Foundation Balancing Mechanism Wind Farm Constraint Payments. Available from https://www.ref.org.uk/constraints/indextotals.php [last accessed 28/11/19]
[26] HSE (2019) Reporting of injuries, diseases and dangerous occurrences regulation (RIDDOR) statistics. Available from http://www.hse.gov.uk/statistics/tables/ridgas.xlsx [last accessed 28/11/2019]
[27] ENA (2019) Pathways to Net-Zero: decarbonising the gas networks in Great Britain. Available from: http://www.energynetworks.org/gas/futures/gas-decarbonisation-pathways/pathways-to-net-zero-report.html [last accessed 28/11/19]
[28] Excluding carbon emissions. Carbon emissions reductions from transport is considered under OC13.17
[29] Progressive Energy (2019) HyMotion: Network-supplied Hydrogen Unlock Low Carbon Transport Opportunities. Available from https://hynet.co.uk/app/uploads/2019/06/15480_CADENT_HYMOTION_PROJECT_REP.pdf [last accessed 26/11/2019]

Benefit Type	Ref	Outcomes	Methods of Calculation
Enabled	OC13.17	Reduction of carbon emissions from transport	*= Tonnes of carbon avoided x price of carbon* To estimate the number of hydrogen vehicle uptake as a result of network-supplied hydrogen, we have developed a UK-wide hydrogen vehicles uptake trajectory based on the Progressive Energy HyMotion report[29].
Enabled	OC13.18	Reduced cost of ownership	*= Cost of ownership reduction from cars + Cost of ownership reduction from vans + Cost of ownership reduction from buses + Cost of ownership reduction from HGVs* We have used the same hydrogen vehicles uptake trajectory as described for OC13.17 and OC13.18 for this benefit and have developed the cost of ownership for different vehicle types using information provided in the Progressive Energy HyMotion report[29].

5.4 Value Curve Table 32 provides a summary of the valued benefits for CVP13. We have separated out the benefits we have estimated for NGN supplied areas and the rest of the UK. The majority (over 99%) of the value presented below are enabled benefits, with the exception of OC13.1. This demonstrates the importance of the enabling role of the hydrogen pathway and all the related research activities we are undertaking.

Table 32: Summary of valued benefits for CVP13

Beneficiaries	Benefits	Capitals	GD-2 Value[30] (£m)	Total Value[30] (£m)
NGN benefits				
Local communities	OC13.1 + OC13.10 (valued together)	Social	3	67
	OC13.16	Social	26	17,381
Global climate	OC13.4	Natural	5	347
	OC13.15	Natural	253	28,398
	OC13.17	Natural	29	15,859
Customers	OC13.9	Human	1	255
	OC13.11	Human	379	7,490
	OC13.18	Human	27	6,533
NGN Total			**722**	**76,329**
Rest of UK benefits				
Local communities	OC13.1 + OC13.10 (valued together)	Social	13	339
	OC13.16	Social	130	88,314
Global climate	OC13.4	Natural	23	1,764
	OC13.15	Natural	2,603	307,937
	OC13.17	Natural	148	80,579
Customers	OC13.9	Human	12	2,304
	OC13.11	Human	1,925	38,059
	OC13.18	Human	135	33,194
Rest of UK Total			**4,990**	**552,490**
Total UK benefits (= NGN benefits + rest of UK benefits)				
Local communities	OC13.1 + OC13.10 (valued together)	Social	16	405
	OC13.16	Social	156	105,695
Global climate	OC13.4	Natural	28	2,112
	OC13.15	Natural	2,856	336,335
	OC13.17	Natural	177	96,438
Customers	OC13.9	Human	13	2,559
	OC13.11	Human	2,304	45,549
	OC13.18	Human	161	39,727
UK Total			**5,711**	**628,820**

The value curve for CVP13 over time, as well as a breakdown of the value by beneficiaries and capitals are summarised in Figure 32. The figure shows that a large proportion of the benefits

will be delivered by the decarbonisation of the gas network and the knock-on effect of this on the decarbonisation of electricity and transport sectors.

The noticeable increase in global climate benefits from 2051/52 is due to the change in carbon intensity of blue hydrogen used in our calculations. We have assumed a carbon intensity of 14,473 tCO_2e/TWh for blue hydrogen before 2050 and a carbon intensity of 0 tCO_2e/TWh post 2050.

The noticeable decrease in customer benefits from 2051/52 is due to the completion of network conversion by 2050, and an end to the cost saving benefit (OC13.11).

Figure 32: CVP13 Value Curve by beneficiaries

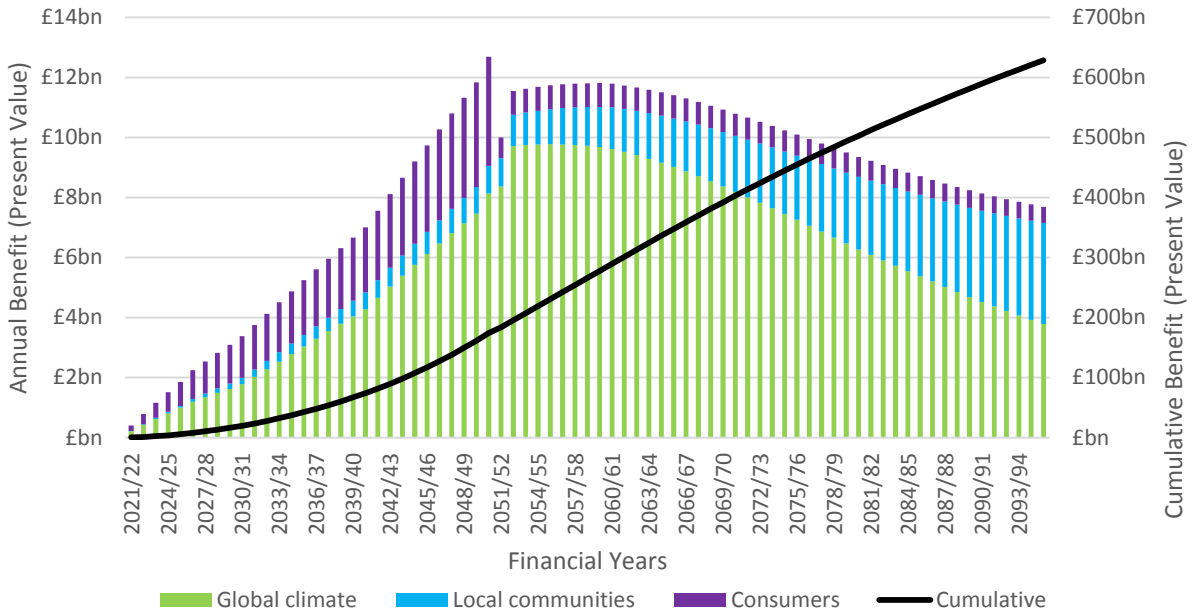
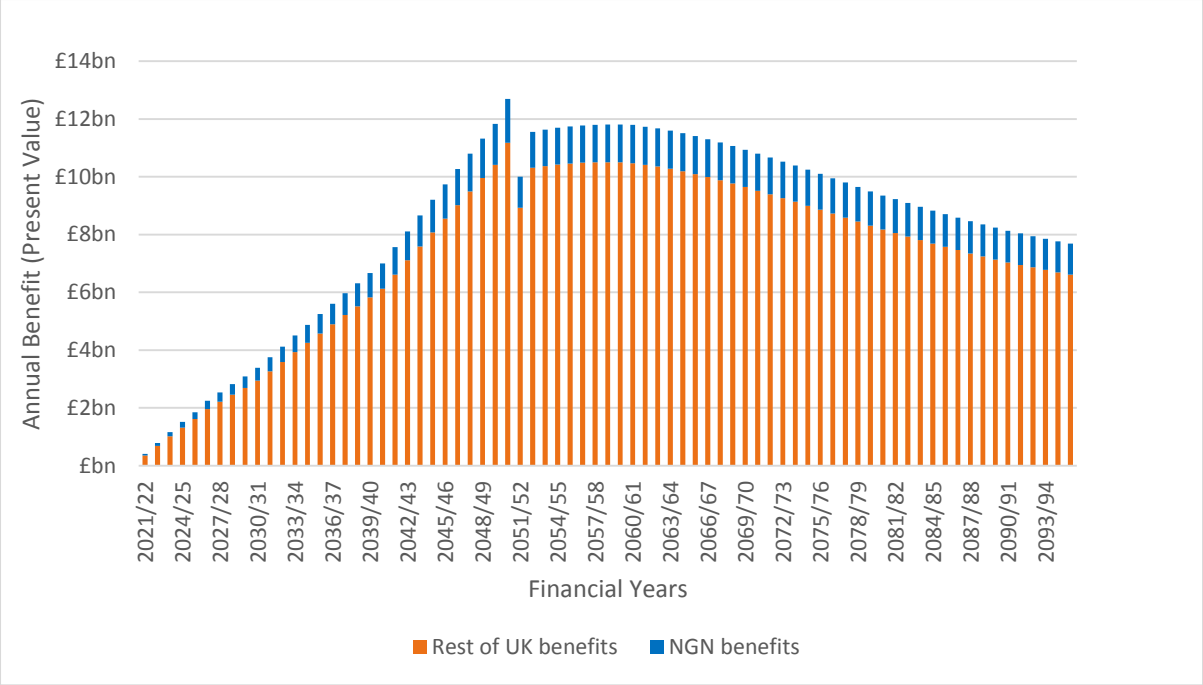


Figure 33 shows the split of benefits between NGN serviced areas and the rest of the UK, demonstrating that once the viability of the hydrogen pathway is proven, the benefits of this work would reach far beyond the customers and communities we service and extend to the whole of the UK.

It is also likely that benefits will be realised internationally, as other countries continue to progress their own focus on conversion of gas networks over to hydrogen. For the purposes of this exercise, we have not attempted to map out or estimate these benefits.

[30] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which is 75 years for this CVP area.

Figure 33: CVP13 Value Curve – NGN / rest of the UK split



6 Benefit Values Summary

6.1 Summary of Benefits of CVP1-12

A summary of the benefit values for each CVP area is presented in Table 33 and Figure 34. A summary of the cumulative Benefit values at the end of GD-2 and the end of assessment timeframe by beneficiaries is presented in Figure 35.

Table 33: Summary benefit value of areas considered for CVP

Ref	CVP Proposal Names	GD-2 Value[31] (£m)	Total Value[31] (£m)
1	Fuel Poor Connections	21.76	83.56
2	Hardship Fund	13.70	49.35
3	Community Partnering Fund	0.47	0.47
4	Customer Vulnerability Competency Framework	0.13	1.90
5	Company Cars	1.43	2.44
6	Tree Planting	0.95	22.69
7	Enhanced Repair for Gas Escapes	8.42	81.02
8	Appointments for Purge & Relight	25.44	25.44
9	Complaint Resolution	6.43	6.43
10	Gas Restorations to Appliance	2.60	2.60
11	Reinstatement	6.16	6.16
12	Citizens' Jury	1.87	1.87
Total		**89.37**	**283.95**
13	Hydrogen pathway	722	76,329

The CVP area delivering the highest value for the assessed time period is CVP1 Fuel Poor Connections, at a cumulative total of £83.56m (present value). This is mainly due to the health benefit from alleviating fuel poor customers from fuel poverty and the associated savings for the National Health Service.

This is followed by CVP7 Enhanced Repair for Gas Escapes, at £81.02m. This is reflecting the cumulative carbon savings as a result of quicker repair and the projected increase of non-traded carbon price.

The CVP with the third highest benefit value is CVP2 Hardship Fund, at £49.35m. The main value contributor to this CVP is the Benefits Advisor Service which provide support to vulnerable customers on making benefit claims.

Although CVP3 is showing as delivering the smallest benefit value, at £0.47m, this is considered a conservative calculation as an economic multiplier was used. This is due to the uncertainty in the allocation of the fund and the projects it will deliver in RIIO-GD2. It is

[31] Both are discounted values. Total value is the cumulative value at the end of the assessment time frame, which varies depending on the CVP area. For CVP1-5 and 7, the assessment period is 15 years. For CVP8-12, the assessment period is 5 years. For CVP6, the assessment period is 50 years.

anticipated that the benefits this CVP area will deliver would be higher than the ones calculated for our CVP valuation.

Figure 34: Cumulative Benefit value at End of GD-2 and End of Assessment Timeframe by CVP area

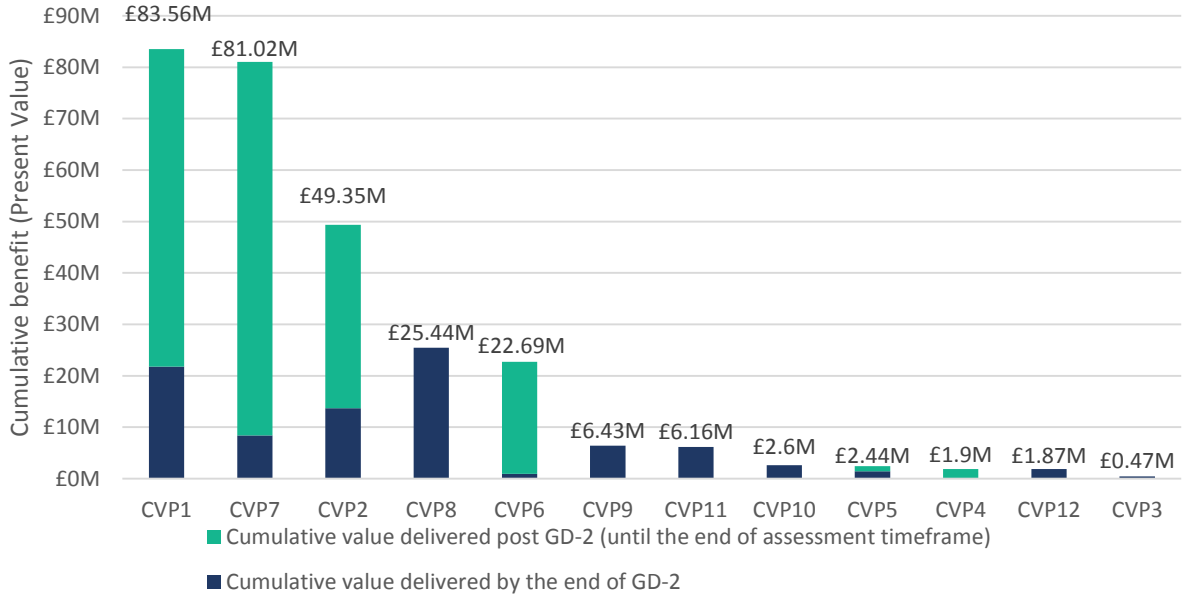
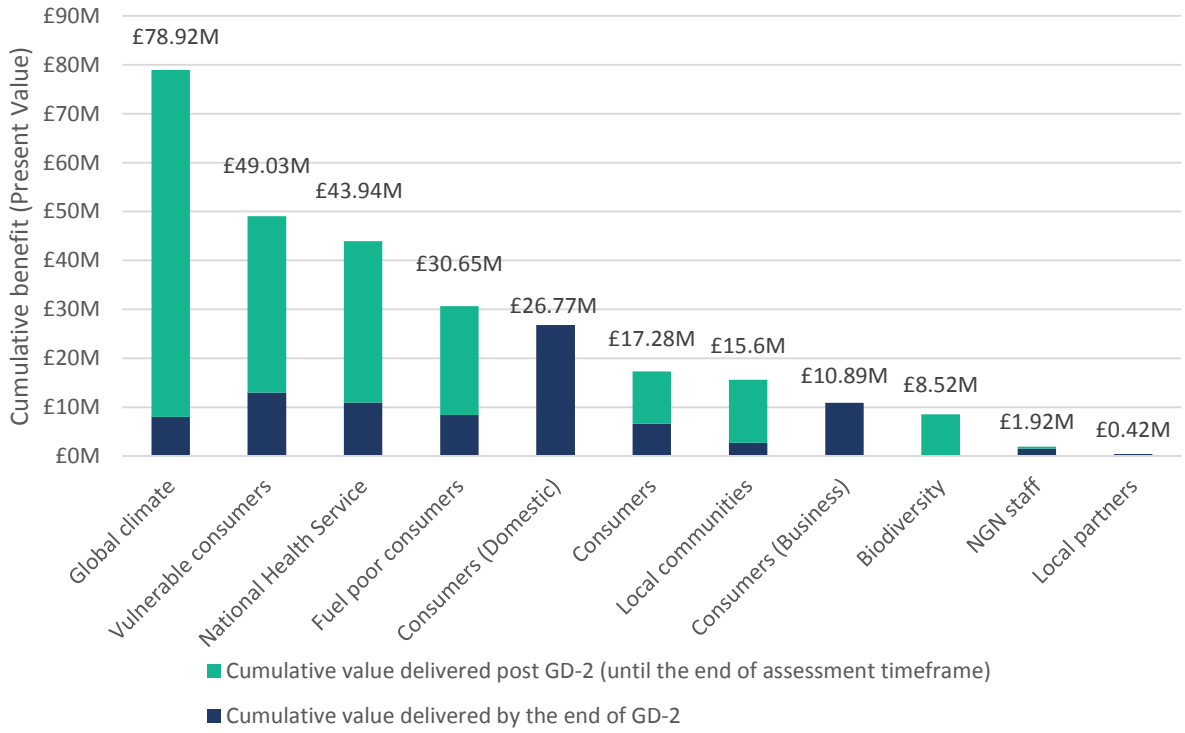


Figure 35: Cumulative Benefit value at End of GD-2 and End of Assessment Timeframe by beneficiaries[32]



[32] For the purpose of this graph, we have attributed the benefit value from CVP3 to customers.

Figure 35 shows the cumulative benefit values by beneficiaries. Global climate is the biggest beneficiary due to the carbon reduction delivered by our CVP. Customers feature prominently in the top five most benefited stakeholders, with vulnerable and fuel poor customers benefitting the most. There is also significant benefit value being delivered to the National Health Service, as a result of the wellbeing improvement by lifting people out of fuel poverty.

6.2 Summary of Benefits from CVP13: Hydrogen Pathway

In addition to the areas included within the core CVP valuation, we have applied the same methodology to our net Zero pathway, based on the outputs of Hydeploy and H21 projects to capture the benefits this work can deliver. Our benefit mapping has identified both direct benefits (those delivered by us through project activities) and enabled benefits (those benefits that will be enabled by our work, but also require other factors).

The total value of the **direct benefits** we are able to value is in the order of **£7M** over a 75-year assessment timeframe for NGN supplied areas, and £34M for the rest of UK. Whereas the total value of the **enabled benefits** for NGN supplied areas could be in the order of **£76bn** over this period, and £552bn for the rest of the UK. This equates to around £8.3bn of benefit per year across the UK, compared with UK's GDP of $2.8 trillion[33]. This demonstrates the importance of this investment and the scale of benefit that can be unlocked to our customers and wider society as a result of delivering our hydrogen pathway.

[33] 2018 figure. Source: Tradingeconomics.com / World Bank

Appendix A: Data and Assumptions for all CVP Areas

Table 34: Data and Assumptions for CVP1 Fuel poor customers

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Typical Annual Household Consumption - Gas	Ofgem Typical Domestic Consumption Values (TDCVs) for gas (medium value) is used.	12,000	kWh	Ofgem Typical Domestic Consumption Values (TDCVs)	OC1.1, OC1.5, OC1.7
Number of additional customers benefitting from connection to gas per year	Stretched target is 1,000 fuel poor connection per year	1,000	# of customers	NGN Business Plan	OC1.1, OC1.5, OC1.7
Proportion of gas consumption for water and space heating		98	%	House of Parliament, carbon footprint of heat generation, Post Note 523, 2016	OC1.1, OC1.5, OC1.7
Carbon factors for gas combustion- including well to tank emissions		0.20676	kgCO2e/kWh	Defra conversion factor 2019	OC1.7
Carbon factors for oil combustion- including well to tank emissions		0.29805	kgCO2e/kWh	Defra conversion factor 2019	OC1.7
Carbon factors for solid combustion- including well to tank emissions		0.39449	kgCO2e/kWh	Defra conversion factor 2019	OC1.7
Oil heating system efficiency		75	%	NGN CBA, based on literature review	OC1.7
Gas heating system efficiency		75	%	NGN CBA, based on literature review	OC1.7
Solid heating system efficiency		75	%	NGN CBA, based on literature review	OC1.7
Electric heating system efficiency		90	%	NGN CBA, based on literature review	OC1.7
Grid electricity carbon intensity		Varies over time	kgCO2e/kWh	DBEIS	OC1.7
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC1.7
% of fuel poor customers using oil fuel		44	%	NGN, based on literature review	OC1.1, OC1.5, OC1.7
% of fuel poor customers using electricity		44	%	NGN, based on literature review	OC1.1, OC1.5, OC1.7
% of fuel poor customers using solid fuel		12	%	NGN, based on literature review	OC1.1, OC1.5, OC1.7

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Air quality damage cost - gas		Varies over time	p/kWh	DBEIS	OC1.5
Air quality damage cost - oil		Varies over time	p/kWh	DBEIS	OC1.5
Air quality damage cost - electricity		Varies over time	p/kWh	DBEIS	OC1.5
Air quality damage cost - solid		Varies over time	p/kWh	DBEIS	OC1.5
Gas price including taxes and levies	No future trend has been assumed as energy markets are volatile and difficult to predict.	0.046	£/kWh	DBEIS National Statistics	OC1.1
Oil price including taxes and levies	No future trend has been assumed as energy markets are volatile and difficult to predict.	0.056	£/kWh	https://www.confusedaboutenergy.co.uk/index.php/domestic-fuels/fuel-prices	OC1.1
Electricity price including taxes and levies	No future trend has been assumed as energy markets are volatile and difficult to predict.	0.18	£/kWh	DBEIS National Statistics	OC1.1
Solid price including taxes and levies	No future trend has been assumed as energy markets are volatile and difficult to predict.	0.063	£/kWh	https://www.confusedaboutenergy.co.uk/index.php/domestic-fuels/fuel-prices	OC1.1
Average cost per fuel poor connection over GD1, including uplifts		1,765	£/connection	NGN	OC1.2, OC1.3
Study showed that investing £1 in keeping homes warm saved the NHS 42 pence in health costs		0.42	£/£ investment	CMO annual report 2009	OC1.2, OC1.3
Discount factor		3.5	%	HM Treasury, Green Book	OC1.1, OC1.7
Discount factor (for H&S benefits)		1.5	%	HM Treasury, Green Book	OC1.5

Table 35: Data and Assumptions for CVP2 Hardship Fund

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Number of NGN customers replacing boiler as a result of the Hardship Fund per year during the GD2 period		125	customers	NGN	OC2.2, OC2.3
Typical Annual Household Consumption - Gas	Ofgem Typical Domestic Consumption Values (TDCVs) for gas (medium value) is used.	12,000	kWh	Ofgem Typical Domestic Consumption Values (TDCVs)	OC2.2, OC2.3
Proportion of gas consumption for water and space heating		98	%	House of Parliament, carbon footprint of heat generation, Post Note 523, 2016	OC2.2
Band F boiler efficiency		70	%	https://www.homeheatingguide.co.uk/efficiency-tables	OC2.2
Band boiler efficiency		92	%	https://www.homeheatingguide.co.uk/efficiency-tables	OC2.2
Quarterly Energy Prices in the UK for Quarter 2 (April-June) 2019, for domestic gas prices.	No future trend has been assumed as energy markets are volatile and difficult to predict.	0.05	£/kWh	DBEIS National Statistics	OC2.2
Carbon emissions of old gas boilers (low efficiency boilers)	The range Is 300-380gCO2e/kWh. An average value was used.	340	gCO2e/kWh	Carbon emissions of heat generation, Parliament UK	OC2.3
Carbon emissions of new gas boilers (high efficiency boilers at least A or B)	The range Is 210-230gCO2e/kWh. An average value was used.	220	gCO2e/kWh	Carbon emissions of heat generation, Parliament UK	OC2.3
Gas price including taxes and levies	No future trend has been assumed as energy markets are volatile and difficult to predict.	0.046	£/kWh	DBEIS National Statistics	OC2.2
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC2.3
# of funding partner staff jobs safeguarded/ created	Assumption that 2 full time benefits advisors are funded per year	2	FTE	NGN	OC2.7
Value of employment	National average	28,758	£/FTE	National TOMs framework, 2019 figure	OC2.7

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
# of vulnerable customers to make benefit claims through the help of the benefits advisors	Expected outcomes based on previous engagement	250	# of customers	NGN	OC2.4
Monetary benefit per claim made through the benefits advisors	Average value	3,700	£/year	NGN historic data	OC2.4
NGN investment in alleviating fuel poverty during GD2		50,000	£/year	NGN	OC2.6
NHS cost savings from investment that keeps homes warm		0.42	£/£ investment	CMO annual report 2009	OC2.6
Discount factor		3.5	%	HM Treasury, Green Book	OC2.2, OC2.3, OC2.4, OC2.6, OC2.7

Table 36: Data and Assumptions for CVP3 Community Partnering Fund

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
NGN Community Partnering Fund annual contribution	Contribution from 2021/22 to 2025/26	50,000	£	NGN Business Plan	OC3.1, OC3.2, OC3.3, OC3.4, OC3.5, OC3.6, OC3.7
Local economic multiplier for NGN procurement policy & for charity spend	A conservative multiplier of 2 has used (use of local contractors)	2	#x (multiplier)	Local Multiplier 3 (LM3), https://www.lm3online.com/	OC3.1, OC3.2, OC3.3, OC3.4, OC3.5, OC3.6, OC3.7
Discount factor		3.5	%	HM Treasury, Green Book	OC3.1, OC3.3, OC3.4, OC3.5, OC3.7
Discount factor (for H&S benefits)		1.5	%	HM Treasury, Green Book	OC3.2, OC3.6

Table 37: Data and Assumptions for CVP4 Customer Vulnerability Competency Framework

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
NGN staff offered relevant training during GD2	Estimated	300	# per year	NGN	OC4.5
Training uptake by NGN staff	Estimated	50	%	NGN	OC4.5
Training hours per NGN staff		7.5	Hours	NGN	OC4.5
Cost of NGN staff time	Total cost	24	£/hour	NGN	OC4.5
Number of NGN domestic customers	This is NGN customer number (domestic) at the time the WTP study was undertaken	2,449,000	# of customers	NGN	OC4.1, OC4.2, OC4.3, OC4.4
WTP (domestic) for increased customer satisfaction	Applicable after the transition period; from 2026/27	0.1	£ WTP (on top of annual bill /customer)	NGN WTP research 2019	OC4.1, OC4.2, OC4.3, OC4.4
Discount factor		3.5	%	HM Treasury, Green Book	OC4.1, OC4.2, OC4.3, OC4.4, OC4.5

Table 38: Data and Assumptions for CVP5 Company Cars

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Number of diesel fuel company cars replaced by EVs and hybrids	A total of 105 diesel fuel company cars to be replaced by EVs and Hybrids over a period of 3 years	35	# of cars /year	NGN	OC5.1, OC5.2, OC5.3, OC5.4, OC5.5
Number of petrol fuel company cars replaced by EVs and hybrids	A total of 10 petrol company fuel cars to be replaced by EVs and Hybrids over a period of 3 years	3.3	# of cars /year	NGN	OC5.1, OC5.2, OC5.3, OC5.4, OC5.5
Number of fossil fuel cars (cash option users) replaced by EVs and hybrids	A total of 147 Cash Option Users cars to be replaced by EVs and Hybrids over a period of 3 years. It has been assumed that 60% of privately-owned cars are petrol and 40% are diesel.	49	# of cars /year	NGN Department for Transport, Licensed cars by propulsion or fuel type: Great Britain and United Kingdom, 2018 (updated in September 2019)	OC5.1, OC5.2, OC5.3, OC5.5
Annual health costs from pollutants to air - EVs	An average health cost by vehicle type approach has been used to calculate the air quality improvement benefit of this CVP, in the absence of company car mileage data (for both business and personal use).	13	£/year	Dr Christian Brand, University of Oxford and UK Energy Research Centre | Dr Alistair Hunt, University of Bath, The health costs of air pollution from cars and vans	OC5.1
Annual health costs from pollutants to air - Hybrid and petrol cars		37	£/year		OC5.1
Annual health costs from pollutants to air - diesel cars		258	£/year		OC5.1
Percentage of fossil fuel vehicles (company cars and Cash Option Users) replaced by EVs		20	%	NGN	OC5.1, OC5.2, OC5.3, OC5.4
Percentage of fossil fuel (company cars and Cash Option Users) replaced by hybrids		80	%	NGN	OC5.1, OC5.2, OC5.3, OC5.4
Average total annual mileage of company cars		22,617	miles /year	NGN	OC5.2, OC5.3
Average total annual mileage of privately owned cars		7,400	miles /year	RAC Foundation (2018), https://www.racfoundation.org/motoring-faqs/mobility#a25	OC5.2, OC5.3

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC5.2
Carbon factors for EV cars - including UK electricity T&R	For average EV car	0.09689	kgCO2e /mile	Defra conversion factor 2019	OC5.2
Carbon factors for hybrid cars	For average hybrid car	0.18464	kgCO2e /mile	Defra conversion factor 2019	OC5.2
Carbon factors for diesel cars	For average diesel car	0.27901	kgCO2e /mile	Defra conversion factor 2019	OC5.2
Carbon factors for petrol cars	For average petrol car	0.29103	kgCO2e /mile	Defra conversion factor 2019	OC5.2
Fuel cost - electricity	Retail electricity prices projection. Price for commercial use (central projection) has been used.	Varies over time	p/kWh	Appraisal guidance on valuing energy use and GHG emissions Mar 2019	OC5.3
Fuel cost – diesel	Retail road fuel prices projection. Price for diesel (central projection) has been used.	Varies over time	p/litre	Appraisal guidance on valuing energy use and GHG emissions Mar 2019	OC5.3
Fuel cost - petrol	Retail road fuel prices projection. Price for petrol (central projection) has been used.	Varies over time	p/litre	Appraisal guidance on valuing energy use and GHG emissions Mar 2019	OC5.3
EV car fuel consumption	For Kia Soul EV 2018	23.01	kWh/100 miles	NEDC figures	OC5.3
Hybrid car fuel consumption	EPA figures for Toyota Prius	68.4	mpg	Autoexpress, https://www.autoexpress.co.uk/toyota/prius/mpg	OC5.3
Diesel car fuel consumption	UK average new car fuel consumption for diesel cars	61.2	mpg	RAC Foundation, www.racfoundation.org/motoring-faqs/environment	OC5.3
Petrol car fuel consumption	UK average new car fuel consumption for petrol cars	51.7	mpg	RAC Foundation, www.racfoundation.org/motoring-faqs/environment	OC5.3
Average P11D value for an EV car	For Kia Soul EV 2019	37,240	£	https://ev-database.uk/car/1154/Kia-Soul-EV-64-kWh	OC5.4
Employee's income tax rate	Figure is for high income tax payer	40	%	HMRC	OC5.4

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Benefit on kind rate – diesel car	Based on 2.0 litre diesel engine car with 110-114g CO2/km emissions. We have assumed non-RDE2 compliant diesel cars i.e. 4% has been added to the rate.	31	%	HMRC	OC5.4
Benefit on kind rate – hybrid car	Based on Toyota Prius with emissions of 78g CO2/km	20	%	Driving Electric, www.drivingelectric.com/toyota/prius/312/toyota-prius-mpg-co2-emissions	OC5.4
Benefit on kind rate – EV car	Assumes 2% rate remains post 2022; the benefits have been calculated for planning period only	Varies over time	%	HMRC	OC5.4
Number of charges avoided per vehicle annually	1 charge per month; benefit assumed to be only for business planning period	12	# of charges / year	NGN	OC5.5
Average cost per parking and CAZ charge	£5 per charge; benefit assumed to be only for business planning period	5	£ / charge	NGN	OC5.5
Discount factor		3.5	%	HM Treasury, Green Book	OC5.2, OC5.3. OC5.4, OC5.5
Discount factor (for H&S benefits)		1.5	%	HM Treasury, Green Book	OC5.1

Table 39: Data and Assumptions for CVP6 Tree Planting

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Total number of trees planted		40,000	# of trees	NGN Business Plan	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Number of silver birch trees to be planted	Linear growth rate assumed	20,000	# of trees	NGN Business Plan	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Silver birch - ultimate height		66	Feet	www.lovethegarden.com	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Silver birch - time to ultimate height		20	Years	www.lovethegarden.com	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Decay rate	Percentage of trees that do not reach maturity (20 years)	10	%	NGN	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Number of scots pine trees to be planted		20,000	# of trees	NGN Business Plan	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Scots pine - ultimate height		60	Feet	CBS News, https://www.cbc.ca/news2/background/environment/trees_lifespan.html	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Scots pine - time to ultimate height		40	Years	Arbor Day Foundation, https://www.arborday.org/trees/treeguide/TreeDetail.cfm?ItemID=902	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Decay rate	Percentage of trees that do not reach maturity (40 years)	10	%	NGN	OC6.1, OC6.2, OC6.3, OC6.4, OC6.5
Economic benefits of woodland – air quality	£6,800 uplifted using a 3.5% uplift factor	8,359	£/hectare	Woodland Trust, 2013 uplifted to 2019 values	OC6.1
CO2 absorption by woodland		272	Tonnes CO2 /hectare	Woodland Trust, 2013	OC6.2
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC6.2
Economic benefits of lowland native broadleaves forest – improved biodiversity	£77,770 uplifted using a 3.5% uplift factor	95,599	£/hectare/ year	Woodland Trust, 2013 uplifted to 2019 values	OC6.3
Economic benefits of lowland conifer forest – improved biodiversity	£30,550 uplifted using a 3.5% uplift factor	37,554	£/hectare	Woodland Trust, 2013 uplifted to 2019 values	OC6.3

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Woodland with public access	Estimate	80	%	NGN	OC6.4
Economic benefits of woodland – recreational value	£23,000 uplifted using a 3.5% uplift factor	28,273	£/hectare/ year	Woodland Trust, 2013 uplifted to 2019 values	OC6.4
Woodland in flood prone areas	Estimate	10	%	NGN	OC6.5
Economic benefits of woodland – flood prevention	£150 uplifted using a 3.5% uplift factor	184	£/hectare/ year	Woodland Trust, 2013 uplifted to 2019 values	OC6.5
Number of voluntary hours	Assume 5% of NGN's 2,000 staff will volunteer for 1 day of 8 hours for the year	800	hours/ year	NGN	OC6.6
Value of volunteering		£14.80	£/voluntar y hour	National TOMs Framework, 2019	OC6.6
# of jobs created	A full-time urban forester will be employed to manage the programme for 5 years	1	FTE	NGN	OC6.7
Value of employment	National average	28,758	£	National TOMs framework, 2019 figure	OC6.7
Discount factor	For years 0-30	3.5	%	HM Treasury, Green Book	OC6.2, OC6.3, OC6.4, OC6.5, OC6.6, OC6.7
Discount factor	For years 31+	3.0	%	HM Treasury, Green Book	OC6.2, OC6.3, OC6.4, OC6.5, OC6.6, OC6.7
Discount factor – H&S	For years 0-30	1.5	%	HM Treasury, Green Book	OC6.1
Discount factor – H&S	For years 31+	1.3	%	HM Treasury, Green Book	OC6.1

Table 40: Data and Assumptions for CVP7 Enhanced Repair for Gas Escapes

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
# of mains repair per year (<7 days)	Forecast repair baseline based on BPDT	Varies over time	# of mains repair	NGN BPDT	OC7.1, OC7.2
# of mains repair per year (>7 & <28 days)	Forecast repair baseline based on BPDT	Varies over time	# of mains repair	NGN BPDT	OC7.1, OC7.2
# of mains repair per year (>28 days)	Forecast repair baseline based on BPDT	Varies over time	# of mains repair	NGN BPDT	OC7.1, OC7.2
Average of gas escape time for repairs <7 days	Forecast repair baseline based on BPDT	20	Hours	NGN BPDT	OC7.1, OC7.2
Average of gas escape time for repairs >7 & <28 days	Forecast repair baseline based on BPDT	302	Hours	NGN BPDT	OC7.1, OC7.2
Average of gas escape time for repairs >28 days	Forecast repair baseline based on BPDT	1659	Hours	NGN BPDT	OC7.1, OC7.2
Service Pipes – Proportion of leaks	Baseline (pre CVP) assumption	67.1	%	NGN historic data	OC7.1, OC7.2
Low Pressure Pipes - Proportion of leaks	Baseline (pre CVP) assumption	29.1	%	NGN historic data	OC7.1, OC7.2
Medium Pressure Pipes - Proportion of leaks	Baseline (pre CVP) assumption	3.5	%	NGN historic data	OC7.1, OC7.2
Intermediate Pressure Pipes - Proportion of leaks	Baseline (pre CVP) assumption	0.2	%	NGN historic data	OC7.1, OC7.2
Service Pipes – mains leakage rates		0.18	m3/hour	NARMs Model Assumption	OC7.1, OC7.2
Low Pressure Pipes – mains leakage rates		0.86	m3/hour	NARMs Model Assumption	OC7.1, OC7.2
Medium Pressure Pipes – mains leakage rates		5.77	m3/hour	NARMs Model Assumption	OC7.1, OC7.2
Intermediate Pressure Pipes – mains leakage rates		22.40	m3/hour	NARMs Model Assumption	OC7.1, OC7.2
Leakage hours per year post CVP	Reduction is maintained post 2025/26	Varies over time	hours	NGN	OC7.1, OC7.2
Conversion Factor m3 gas leaked to tCO2e		0.0144	tCO2e/m3	NARMS models	OC7.1
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC7.1
Gas price of leaks avoided		0.24	£/m3	NARMs Model Assumption	OC7.2

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Discount factor		3.5	%	HM Treasury, Green Book	OC7.1, OC7.2

Table 41: Data and Assumptions for CVP8 Appointments for Purge & Relight

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Average annual interruptions	Average annual forecast unplanned interruptions	Varies over time	# of interruptions	Forecast unplanned interruptions from BPDTs	OC8.1, OC8.2, OC8.3, OC8.4
Total number of NGN customers (domestic)	This is NGN customer number (domestic) at the time the WTP study was undertaken	2,449,000	# of customers	NGN	OC8.1, OC8.2
Total number of NGN customers (business)	This is NGN customer number (business) at the time the WTP study was undertaken	91,000	# of customers	NGN	OC8.3, OC8.4
WTP (domestic) for 2 hour appointment slot		1.47	£ WTP on top of annual bill / customer	NGN WTP research 2019	OC8.1, OC8.2
WTP (business) for 2 hour appointment slot (mean)		20.27	£ WTP on top of annual bill / customer	NGN WTP research 2019	OC8.3, OC8.4
Discount factor		3.5	%	HM Treasury Green Book	OC8.1, OC8.2, OC8.3, OC8.4

Table 42: Data and Assumptions for CVP9 Complaint Resolution

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Average annual complaints	Rounded number	2,000	# of complaints	NGN historic data	OC9.1, OC9.2, OC9.3, OC9.4
Percentage of complaints reaching resolution within 60 mins by the end of GD2	The effort to agree a resolution within an hour would need to be balanced against customer needs. Therefore, we have assumed that the % agreed resolution within the hour would increase over GD2, reaching the full-service level increase to 85% by mid-GD2.	85	%	NGN Business Plan	OC9.1, OC9.2, OC9.3, OC9.4
Total number of NGN customers (domestic)	This is NGN customer number (domestic) at the time the WTP study was undertaken	2,449,000	# of customers	NGN	OC9.1, OC9.2
Total number of NGN customers (business)	This is NGN customer number (business) at the time the WTP study was undertaken	91,000	# of customers	NGN	OC9.3, OC9.4
WTP (domestic) for 95% of general enquiries resolved within 2 hours	This input is used as a proxy. The actual benefit for agreeing a resolution within 60mins would be higher, but we are using the 2hrs for a conservative estimate.	0.81	£ WTP on top of annual bill / customer	NGN WTP research 2019	OC9.1, OC9.2
WTP (business) for 95% of general enquiries resolved within 2 hours (mean)	This input is used as a proxy. The actual benefit for agreeing a resolution within 60mins would be higher, but we are using the 2hrs for a	8.91	£ WTP on top of annual bill / customer	NGN WTP research 2019	OC9.3, OC9.4

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
	conservative estimate.				
Discount factor		3.5	%	HM Treasury, Green Book	OC9.1, OC9.2, OC9.3, OC9.4

Table 43: Data and Assumptions for CVP10 Gas Restorations to Appliance

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
# of interruptions	Average annual forecast unplanned interruptions	Varies over time	# of interruptions	Forecast unplanned interruptions from BPDTs	OC10.1, OC10.3
% of interruptions re-connected within 2 hours (baseline)	Assumed baseline performance (interruptions re-connected within 2 hours) based on historic data	65%	% of interruptions re-connected within 2 hours (baseline)	NGN historic data	OC10.1, OC10.3, OC10.4
% of interruptions re-connected within 2 hours (post CVP)	Can't achieve 2 hrs when meter move is required, this happens in 9% of cases so 85% is the best NGN can achieve	85%	% of interruptions re-connected within 2 hours (post CVP)	NGN historic data	OC10.1, OC10.3, OC10.4
Total P & R mileage	Baseline data (from trip analysis), assume that a maximum of 20% could be saved to hit the 2-hour standard (85%-65%)	24,573.99	miles/year	NGN historic data	OC10.1, OC10.3, OC10.4
Assumed fuel consumption of NGN vehicles		15	Miles /gallon	DfT average heavy goods vehicle fuel consumption: GB 2016 data	OC10.1, OC10.3, OC10.4
CO2 emissions from diesel fuel vehicles	For diesel (average biofuel blend) including well to tank emissions	3.2112	kg CO2e/litre	Defra Conversion Factors 2019	OC10.1, OC10.3
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC10.1, OC10.3
Diesel fuel price	Retail road fuel prices DERV (central projection)	Varies with time	£/litre	Green book appraisal guidance on valuing energy use and greenhouse gas (GHG) emissions Mar 2019	OC10.1, OC10.3
Air quality damage costs for LGV diesel vehicles		20.96	p/litre	Green book appraisal guidance on valuing energy use and greenhouse gas (GHG) emissions Mar 2019	OC10.4
Uplift of air quality damage cost	This is to reflect increases in	1.02	%	Defra Air Quality Damage Cost Guidance 2019	OC10.4, OC10.5

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
	willingness to pay for avoided health outcomes over time				
Average speed and delay on local 'A' roads and Strategic Road Network in England, 12 months rolling average	Assuming majority of escapes are in urban areas (80%) and some will be on higher speed roads (20%)	32.12	miles / hour	DfT, June 2019	OC10.2
Cost of NGN staff time	Total cost including overhead	24	£/hour	NGN average 2018/19 prices	OC10.2, OC10.9
Time saving per additional job under 2 hours	Job is now done by E & R team instead of P & R engineer	0.5	hours	NGN	OC10.2
Time saving P & R now under 2hrs due to customer not waiting for different team		1	hour	NGN	OC10.7, OC10.8
Total number of NGN customers (domestic)	This is NGN customer number (domestic) at the time the WTP study was undertaken	2,449,000	# of customers	NGN	OC10.7, OC10.8
Total number of NGN customers (business)	NGN customer number (business) at the time the WTP study was undertaken	91,000	# of customers	NGN	OC10.7, OC10.8
WTP (domestic) for reduced duration of unplanned interruptions from 18 hours (current) to 12 hours	As the highest rate of re-connection within 2 hours achievable is 85%, the WTP has only been applied to 85% of total customer numbers.	1.2	£ WTP on top of annual bill / customer (domestic)	NGN WTP research 2019	OC10.7, OC10.8
WTP (business) for reduced duration of unplanned interruptions from 18 hours (current) to 12 hours (mean)	As the highest rate of re-connection within 2 hours achievable is 85%, the WTP has only been applied to 85% of total customer numbers.	1.62	£ WTP on top of annual bill / customer (business)	NGN WTP research 2019	OC10.7, OC10.8
Percentage reduction in complaints related to Time Taken	Based on % improvement (linked to % of	Varies over time	%	NGN	OC10.6

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
	interruptions re-connected within 2 hours). We have assumed that there are no complaints for Time Taken for P & R when a team stays and completes the job all at once.				
Number of complaints related to Time Taken	95 P & R complaints p.a. and approximately 2/3 related to Time Taken	63	# of complaints	Data from CSAT returns	OC10.6
Value of complaints	Uplifted to 2018/2019 prices	499	£/complaint	NARMs Complaint Value	OC10.6
Number of E&R staff trained	We have assumed that training will be rolled across two years	104	# of E&R staff	NGN	OC10.9
Duration of P&R training session		2	hours	NGN	OC10.9
Discount factor		3.5	%	HM Treasury, Green Book	OC10.1, OC10.2, OC10.3, OC10.6, OC10.7, OC10.8, OC10.9
Discount factor		1.5	%	HM Treasury, Green Book	OC10.4, OC10.5

Table 44: Data and Assumptions for CVP11 Reinstatement

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Average annual reinstatements	Rounded number	10,000	# of reinstatements	NGN historic data	OC11.1, OC11.3
Percentage reinstatements carried out within 3 calendar days (pre-CVP)	Assumed baseline performance	20	% of reinstatements	NGN historic data	OC11.1, OC11.2, OC11.3, OC11.4
Percentage reinstatements carried out within calendar 3 days (post-CVP)	Assume that 100% reinstatement can be carried out within 3 calendar days from year 1 of GD2	100	% of reinstatements	NGN Business Plan	OC11.1, OC11.3
Total number of NGN customers (domestic)	This is NGN customer number (domestic) at the time the WTP study was undertaken	2,449,000	# of customers	NGN	OC11.1, OC11.3
Total number of NGN customers (business)	This is NGN customer number (business) at the time the WTP study was undertaken	91,000	# of customers	NGN	OC11.1, OC11.3
WTP (domestic) for improving reinstatement time from 5 to 3 working days		0.47	£ WTP on top of annual bill / customer	NGN WTP research 2019	OC11.1, OC11.3
WTP (business) for improving reinstatement time from 5 to 3 working days (mean)		0.95	£ WTP on top of annual bill / customer	NGN WTP research 2019	OC11.1, OC11.3
Complaints related to reinstatement activities	Average number of complaints is 2,000 per year. We assumed that 10% is related to time taken for reinstatement	200	# of complaints	NGN	OC11.2, OC11.4
Reduction of complaints for reinstatement	We have assumed that there are no complaints where a reinstatement is completed within 3 working days	80	%	NGN	OC11.2, OC11.4
Value of complaints	Uplifted to 2018/2019 prices	499	£/complaint	NARMs Complaint Value	OC11.2, OC11.4

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Discount factor		3.5	%	HM Treasury Green Book	OC11.1, OC11.2, OC11.3, OC11.4

Table 45: Data and Assumptions for CVP12 Citizens' Jury

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Number of customers engaged with through Citizens' Jury		50	# of customers	NGN	OC12.1
Wellbeing improvement value	Wellbeing improvement value for actively participating in a formal social group per person per annum	7,957	£/person	HACT Social Value Bank V4.0, 2018	OC12.1
# of funding partner staff jobs safeguarded/ created	£16k per workshop for the external facilitation of the workshop. Assume each workshop would require the time of 2 community partner staff x 3 weeks	0.12	FTE	NGN	OC12.2
Value of employment	National average	28,758	£	National TOMs framework, 2019 figure	OC12.2
Discount factor		3.5	%	HM Treasury Green Book	OC12.1, OC12.2

Table 46: Data and Assumptions for H21

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
UK total - Natural gas quantities	Values for years 2020, 2021, 2026, 2030, 2040, 2050 and 2096 were provided. The values for other years were extrapolated from the data.	Varies over time	TWh/year	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.9, OC13.4, OC13.11
Carbon intensity - natural gas		184,164	tCO2e/TWh	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.15
Carbon intensity - Blue hydrogen	Value before 2050, after 2050 goes to 0	14,473	tCO2e/TWh	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.15
Carbon intensity - Green hydrogen (tCO2e/TWh)		0	tCO2e/TWh	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.15
Non-Traded Carbon Value		Varies over time	£/tCO2e	DBEIS & Ofgem	OC13.15, OC13.17
NGN - Blue hydrogen (with CCUS)	Values for years 2020, 2021, 2026, 2030, 2040, 2050 and 2096 were provided. The values for other years were extrapolated from the data.	Varies over time	TWh/year	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.9, OC13.4, OC13.11
NGN - Green hydrogen (with renewables)	Values for years 2020, 2021, 2026, 2030, 2040, 2050 and 2096 were provided. The values for other years were extrapolated from the data.	Varies over time	TWh/year	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.9, OC13.4, OC13.11
Rest of UK - Blue hydrogen (with CCUS)	Values for years 2020, 2021, 2026, 2030, 2040, 2050 and 2096 were provided. The values for other years were extrapolated from the data.	Varies over time	TWh/year	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.9, OC13.4, CO13.11
Rest of UK - Green hydrogen (with renewables)	Values for years 2020, 2021, 2026, 2030, 2040, 2050 and 2096 were provided. The values for other years were extrapolated from the data.	Varies over time	TWh/year	Navigant report, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain	OC13.9, OC13.4, OC13.11
Number of jobs increased up to 2050 compared with 2021	Based on KPMG's report Energising the North, the projected jobs (direct and indirect) in gas networks	Varies over time	cumulative # jobs	KPMG report Energising the North	OC13.1, OC13.10

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
baseline year (direct and indirect)	under the 'evolution of gas' scenario increase by 486 (3,738-3,252) by 2050. Under the 'diversified energy sources' scenario gas networks jobs decrease by 1,308 (3,252-1,944) by 2050. These jobs will be safeguarded with the conversion to hydrogen. Therefore, the net jobs created or safeguarded linked to hydrogen conversion is assumed to be 486+1,308. This is a conservative assumption due to the lack of data to calculate supply chain jobs related to hydrogen conversion. In this calculation, we have assumed a linear increase up to 2050.				
Number of CO fatalities		2	# of fatalities /year	HSE Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) reporting, fatalities due to carbon monoxide poisoning, 2018/19 figure	OC13.9
Number of CO non-fatalities		193	# of non-fatalities /year	HSE Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) reporting, non-fatalities due to carbon monoxide poisoning, 2018/19 figure	OC13.9
Cost per fatality	Uplifted to 2021 price from 2016/17 base year	19.10	£m/fatality	Ofgem CBA template	OC13.9
Cost per non-fatality	Uplifted to 2021 price from 2014/15 base year	0.22	£m/non-fatality	Ofgem CBA template	OC13.9
Projection of constrained wind	Assuming an increase to installed UK wind capacity from 22GW in 2019 to	Varies over time	MWh	https://www.gov.uk/government/publications/offshore-	OC13.4

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
energy generation in the UK	43.5GW by 2030. This is driven by the increase to installed offshore capacity to 30GW by 2030. Onshore wind capacity has been assumed to be the same as in 2019 (13.5GW). For the purpose of the report we have assumed that the wind farm constrained capacity is in line with the UK wind farm capacity increase. The increase has been assumed to happen linearly between 2019 and 2030. The UK wind capacity is assumed to remain stable after 2030.			wind-sector-deal/offshore-wind-sector-deal	
Reduced constraints as a result of hydrogen network	We have assumed that the availability of a hydrogen network, once fully converted in 2050, will reduce 50% of the total wind energy constraints in the UK. For the years leading up to 2050, we have assumed that the % reduction in wind energy constraints will follow the % completion of UK gas network conversion i.e. % of gas consumption being met by hydrogen.	Varies over time	MWh	NGN	OC13.4
Energy price	Average value of wind farm constrained payment (£/MWh) for the period 2015-2019	71.36	£/MWh	Renewable Energy Foundation, Balancing Mechanism Wind Farm Constraints Payment, https://www.ref.org.uk/constraints/indextotals.php	OC13.4
Balanced scenario Infrastructure costs	Only infrastructure costs were included in the calculation	30	£bn/year in 2050	Balanced scenario Infrastructure costs - Navigant, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain, Appendix D	OC13.11

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Electrified scenario Infrastructure costs	Only infrastructure costs were included in the calculation	38	£bn/year in 2050	Electrified scenario Infrastructure costs - Navigant, Pathways to Net-Zero: Decarbonising the Gas Networks in Great Britain, Appendix E	OC13.11
UK hydrogen cars uptake as a result of a hydrogen network	An average between high and low is used to represent the transport pathway as a result of network hydrogen	Varies over time	Total number of hydrogen cars per year	Cadent Hymotion project report	OC13.16, OC13.17, OC13.18
UK hydrogen vans uptake as a result of a hydrogen network	An average between high and low is used to represent the transport pathway as a result of network hydrogen	Varies over time	Total number of hydrogen vans per year	Cadent Hymotion project report	OC13.16, OC13.17, OC13.18
UK hydrogen buses uptake as a result of a hydrogen network	An average between high and low is used to represent the transport pathway as a result of network hydrogen	Varies over time	Total number of buses per year	Cadent Hymotion project report	OC13.16, OC13.17, OC13.18
UK hydrogen HGVs uptake as a result of a hydrogen network	An average between high and low is used to represent the transport pathway as a result of network hydrogen	Varies over time	Total number of hydrogen HGVs per year	Cadent Hymotion project report	OC13.16, OC13.17, OC13.18
Proportion of the hydrogen cars uptake displacing diesel incl. biodiesel	We assume the rest is displacing EV	Varies over time	%	Navigant Pathway to Net-Zero report, Energy supply by source, Electrified Scenario	OC13.16, OC13.17, OC13.18
Proportion of the hydrogen vans uptake displacing diesel incl. biodiesel	We assume the rest is displacing EV	Varies over time	%	Navigant Pathway to Net-Zero report, Energy supply by source, Electrified Scenario	OC13.16, OC13.17, OC13.18
Proportion of the hydrogen buses uptake displacing diesel incl. biodiesel	We assume the rest is displacing EV	Varies over time	%	Navigant Pathway to Net-Zero report, Energy supply by source, Electrified Scenario	OC13.16, OC13.17, OC13.18
Proportion of the hydrogen HGVs uptake displacing diesel incl. biodiesel	We assume the rest is displacing EV	Varies over time	%	Navigant Pathway to Net-Zero report, Energy supply by source, Electrified Scenario	OC13.16, OC13.17, OC13.18

Input	Assumptions	Value	Unit	Source	Used for Benefit Calculation
Air quality damage costs for NOx (2017 price)		6,199	£/tNOx	Defra Air quality damage cost guidance 2019	OC13.17
Uplift of air quality damage cost to reflect increases in willingness to pay for avoided health outcomes over time		1.02	%	Defra Air Quality Damage Cost Guidance 2019	OC13.17
Discount factor	For years 0-30	3.5	%	HM Treasury, Green Book	OC13.1, OC13.10, OC13.4, OC13.11, OC13.15, OC13.17, OC13.18
Discount factor	For years 31+	3.0	%	HM Treasury, Green Book	OC13.1, OC13.10, OC13.4, OC13.11, OC13.15, OC13.17, OC13.18
Discount factor – H&S	For years 0-30	1.5	%	HM Treasury, Green Book	OC13.9, OC13.16
Discount factor – H&S	For years 31+	1.3	%	HM Treasury, Green Book	OC13.9, OC13.16