Northern Ireland Smart Meters - Cost Benefit Analysis Report

23 January 2023

For the Department for the Economy

Version for Public Distribution

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Section 1. Terminology

1.1 Glossary of Abbreviations

The following list details abbreviations used across this document.

BCR	Benefit to Cost Ratio
BEIS	Department of Business, Energy, and Industrial Strategy
Capex	Capital Expenditure
CBA	Cost Benefit Analysis
CH	Communication Hub
CIB	Central Information Body
CNMC	Comisión Nacional de los Mercados y la Competencia
CPB	Central Programme Body
CRU	Commission for Regulation of Utilities
CTF	Communications Technically Feasible
DCC	Data Communications Company
DECC	Department of the Environment, Climate and Communications
DfE	Department for the Economy
DNO	Distribution Network Operator
DSM	Demand Side Management
ESBN	Electricity Supply Board Networks
ESM	Electricity Smart Meter
EU	European Union
EUC	EU Commission
EV	Electric Vehicle
GB	Great Britain
GBCS	Great Britain Companion Specification
GCHQ	Government Communications Headquarters
GDPR	General Data Protection Regulation
GMO NI	Gas Market Operator for Northern Ireland
GNI	Gas Networks Ireland
GPRS	General Packet Radio Service
GSM	Gas Smart Meter
HAN	Home Area Network
ICE	Internal Combustion Engine
IHD	In Home Display
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicator
LPWAN	Lower Power Wide Area Network
LRR	Long Range Radio

LRVC	Long Run Variable Cost
MCH	Meter Communication Hub
MHHS	Market-wide Half-Hourly Settlement
MMS	Meter Management System
NCSC	National Cyber Security Centre
net-CONE	Net Cost of a New Entrant
NGESO	National Grid Electricity System Operator
NI	Northern Ireland
NIE Networks	Northern Ireland Electricity Networks
NIEN	Northern Ireland Electricity Networks
NPV	Net Present Value
NSMP	National Smart Metering Plan
Opex	Operational Expenditure
PAYG	Pay-As-You-Go
PID	Project Initiation Document
PLC	Power Line Communication
RMDS	Retail Market Design Service
RoI	Republic of Ireland
SaaS	Software as a Service
SEC	Smart Energy Code
SEM	Single Electricity Market
SLA	Service Level Agreement
SME	Small Medium Enterprise
SMETS	Smart Meter Equipment Technical Specifications
Solar PV	Solar Photovoltaic
SONI	System Operator for Northern Ireland
TOU	Time Of Use
TSO	Transmission System Operator
UK	United Kingdom
UR	Utility Regulator
VfM	Value for Money
WAN	Wide Area Network

Section 2. Executive Summary

2.1 Drivers for Smart Meters

This project is an economic appraisal for a nationwide rollout of Electricity and Gas Smart Meters across Northern Ireland. This research comes at an important moment in Northern Ireland's energy "journey". External drivers which include Climate Change, the Economy, and rising consumer energy costs mean that Northern Ireland's energy system needs to change significantly, and rapidly. In December 2021, DfE released its new Energy Strategy, 'The Path to Net Zero Energy', and subsequently the NI Energy Strategy Action Plan for 2022 which included an action to perform a cost benefit analysis on the viability of the rollout of Smart Metering infrastructure within Northern Ireland. This action was driven by an article of the EU's 2019 Electricity Directive which seeks the introduction of Smart Meters across the EU (subject to an analysis of costs and benefits), and the UK's Net Zero Strategy: Build Back Greener document, which outlines an objective for the installation of Smart Meters across GB. DfE has extended upon this legislative requirement for a CBA to Gas Smart Meters in NI; recognising the important role gas networks will play in achieving net zero ambitions.

The key principles of the Energy Strategy, and how they tie in with Smart Meters, are described as follows:

1. **Placing you at the heart of our energy future**. Smart Meters are a Consumer-focussed technology of relevance to everyone in society that support a Just Transition.
2. **Grow the green economy**. This report highlights how deployment encourages job creation, upskilling and attracts expertise.
3. **Do more with less**. Smart Meters help DNOs understand their networks better. They combat inefficiencies through greater insight and enable more informed strategic planning. Smart Meters also provide Consumers with information that can support the reduction of their energy consumption.
4. **Replace fossil fuels with renewable energy**. Smart Meters provide the TSO with an active understanding of demand which through Demand Side Management enables a more precise forecast and control of supply to bring renewables further into the mix. They also work in tandem with Consumer microgeneration such as Solar Photovoltaics.
5. **Create a flexible, resilient and integrated energy system**. Smart Meters are the demand-side foundation of an integrated and flexible smart grid and are critical in providing end-to-end understanding of energy usage in Northern Ireland.

Whilst Smart Meters fit most naturally into the fifth principle this report explores how they support all five of the principles above.

2.2 Approach

The project assesses Smart Meters for both the qualitative considerations as well as the quantitative elements, the latter of which are built into the Cost Benefit Analysis model. Figure 1 illustrates how information has been collated and insights evolved across this project.

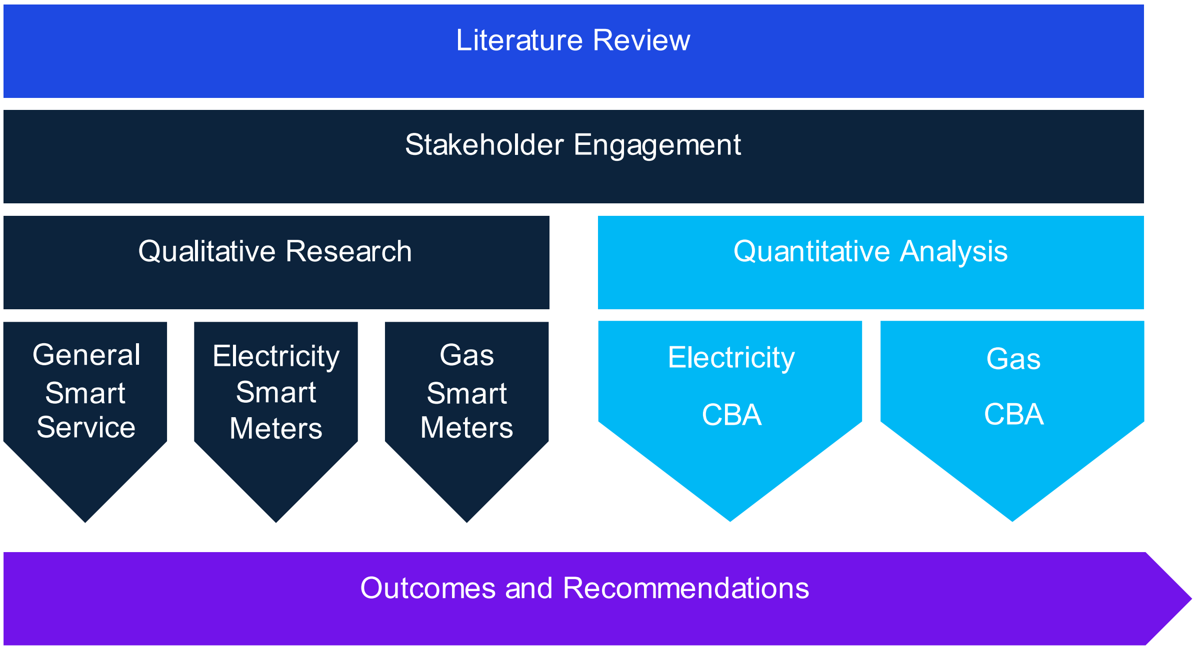

Figure 1 - Information Model for CBA Project

A project initiation stage kickstarted the project in which KPMG and DfE agreed appropriate ways of working covering stakeholder communication, project scope, steering group, and project management.

The preliminary research phase was delivered via a desktop Literature Review. In this phase, KPMG identified information requirements, mapping likely sources of information, stakeholders, and outstanding gaps.

Qualitative research and quantitative data were collated through a combination of stakeholder engagement and further desktop research. KPMG led stakeholder workshops to gather insights from appropriate sector representatives and subsequently issued data requests such that a Cost Benefit Analysis model could be built.

The development of the Cost Benefit Analysis model was an ongoing and iterative process that combined KPMG's expertise with best practice guidance according to the UK Government's Green Book. Further detail on the CBA methodology is provided in section 7.1 of this report.

This report is the final output for this project. It provides detailed and summarised outputs and recommendations based on the qualitative and quantitative findings.

2.3 Qualitative Outcomes

Several fundamental components are required to be established in the provision of a Smart Service appropriate for Northern Ireland. There are various barriers and challenges to be overcome collectively in the development of these components. Appropriate assignment of roles and responsibilities is key in overcoming challenges to deliver a successful deployment.

Challenges have been defined across various phases of a deployment reflecting a general order of actions. Note these challenges do not necessarily equate directly with costs presented in the CBA but reflect the steps required to realise a successful deployment.

2.3.1 Smart Service

In order to deliver the wider benefits, it is critical that any deployment delivers an end-to-end Smart Service and not just Smart Meters. This provision is contingent on multiple factors including service design (meter, IT, Comms), usability, and supporting services offered such as advanced tariffs and Demand Side Management.

2.3.2 Programme Structure and Roles

In conducting research and stakeholder engagement, typical key market roles have been identified for the provision of a Smart Meter deployment, as shown in Table 1. For detail on which bodies fulfil any existing roles please see 5.2 for electricity and 6.2 for gas.

Table 1 - Metering Roles and Descriptions

Role	Description
Consumer	An entity which makes use of the energy.
Utility Regulator	The regulator is an independent non-ministerial government department that holds utility entities to account on standards, costs, and licensing.
Policy Setter	The government body that sets energy policies, including the need for a Smart Metering programme.
Transmission System Operator (TSO)	The TSO is responsible for planning and operating of Northern Ireland's transmission grids.
Distribution Network Operator (DNO)	A DNO, also referred to as the Distribution System Operator (DSO), is responsible for the planning and operating of the distribution grids.
Generator	Sources of **electricity** that can be used on demand and dispatched at the request of power grid operators, according to market needs.
Retailer / Supplier	A Retailer buys energy on the wholesale market and sells energy to consumers.
Smart Data Owner	The entity that owns the data gathered by any Smart Meter at any stage of that data's lifetime. Under EU and UK law, this is always the consumer.
Metering Point Administrator	Metering point administrators carry out the task of reading, validating and submitting meter data.

Metering Programme Owner	The entity that owns and maintains the metering programme including installation, maintenance, and replacement.
Smart Data Manager	The entity that owns and operates the server and database systems to manage smart data.
Communication Service Provider	The entity that provides the communication infrastructure and services that transports smart data between the roles.
Consumer Engagement Body	The entity that designs and disseminates the marketing and education material to encourage consumers to make full use of the smart services offered.

Roles and enterprises are not required to exist on an exclusive basis. A single organisation for example can perform the role of DNO, Meter Owner, and Metering Point Administrator. The final three roles are not required by a traditional, “non-smart” meter programme.

2.3.3 Centralisation

Centralisation across the programme has been identified as a key enabler of cost-reduction, transparency, and efficiency. Centralisation does not deliver additional benefits but can be considered both intra- and inter-utility as a mechanism for saving costs.

2.3.4 Behaviour Change

Consumer behaviour change is key to realising a significant proportion of benefits enabled by a Smart Service. It is therefore critical that an appropriate information campaign is run to inform, encourage, and provide education for the full range of Consumer needs in Northern Ireland.

Consumer engagement drives behaviour change which drives consumption reduction. A comprehensive engagement campaign that encourages, informs and educates is essential for delivering benefits.

2.3.5 Facilitating Innovation

Smart Meters deliver data and information that can drive innovation. Retailers and network companies must innovate and develop solutions (e.g. advanced tariffs) to bring Northern Ireland’s energy eco-system up to the standard set by other countries with successful Smart Service deployments, and beyond to maximise the opportunity for a self-sustained green energy future. The meter must adopt a ‘Thin Client’ design to deliver a platform that is appropriately flexible for facilitating innovation,

2.3.6 Programme Timeline

This report presents a high-level assumption around deployment pace and timelines. Milestones need to be set and an appropriate programme timeline developed that is both driving but also feasible. The approaching deadline imposed on the gas sector by the expiring PAYG meter contract adds a constraint. Other factors include the time required to develop wider programme constructs and roles, design and procure the solution and develop the meter installation capability and capacity.

2.3.7 Programme Management, Oversight, and Resourcing

A significant amount of oversight and regulation is expected by DfE and the regulator. At the design stage, it is considered valuable that DfE gets involved in the specification such that a Smart Service paid for by Consumers is designed to meet Consumer needs. Beyond design and procurement, there is a requirement for legislative change and updates to licenses to reflect the direction of the sector. The UR needs to be involved in the development of the programme to ensure appropriate considerations are made for funding and financing.

To deliver a programme of this magnitude, significant management resource is needed. This capacity does not sit with any one body and collective change is required across parties fulfilling the roles identified in Table 1. A further lesson learned from other jurisdictions is not to underestimate the challenge of managing the interfaces between these parties and it may be necessary that a body facilitates stakeholder management, across the sector including government.

The Department for the Economy must build an appropriately sized and capable team for providing the oversight this programme would require.

2.3.8 Just Transition

A Smart Service support must support a Just Transition and accommodate different socioeconomic groups, particularly those more vulnerable. Consumer Council research (referenced in section 4.12) is valuable in understanding the diverse needs of different groups. Some aspects of these needs are delivered via functional design whilst others via engagement campaigns. A solution should be inclusive of all, not just the majority.

2.3.9 Qualitative Benefits

The high-level qualitative benefits identified are as follows:

1 **Improved Network Planning**
- Supports strategic network upgrades so investment is not wasted on redundant upgrades but can target weakest components of the distribution network
- Facilitates a more direct understanding of demand across local distribution zones to understand capacity for new connections, reducing the amount of investigation required.
- Comprehensive understanding of network makes new connections easier and therefore cheaper for the Consumer.

2 **Demand Side Management**
- DSM helps SONI in managing the power system more efficiently. It facilitates a transition towards a system powered by many microgeneration facilities, rather than just a few large-scale plants, by providing clarity on demand side supply.
- Advanced DSM permits control of certain demand-side (Consumer) components to reduce demand during peak periods. Often these are large-scale Consumers such as factories but may in the future include EVs and Smart Appliances.
- DSM can provide significant benefits for customers in terms of reduced bills and gives them greater control over the energy they use and also produce.

3 **Meter Automation and Accuracy**
- Automation of the meter reading process reduces workload on the networks and Retailers
- Data provided to the DNO via Smart Metering infrastructure avoids the need to purchase load profiling services from third parties as the DNO can produce these themselves.
- Facilitates easier identification of electricity theft.

- Improved metering capability means consumers only pay for what they use as estimated bills are no longer required.

4 Improved Customer Service

- Network monitoring allows networks to identify issues more rapidly. Fixes can be targeted which reduces costs. Overall fault restoration is quicker for the Consumer.

5 Energy Consumption Reduction

- Consumption reduction via provision of usage data to Consumer and tariff reform.
- Peak shifting is encouraged by Time Of Use tariffs and DSM.

6 Renewables and LCT Support

- Smart Meters can integrate with EVs, Heat Pumps, and Microgeneration to facilitate a shift towards Low Carbon Technologies.
- A more accurate view of demand enables incorporation of a greater proportion of renewables generation. Demand shifting may also help in reducing curtailment of renewable generation.

2.4 Quantitative Outcomes

An economic appraisal has been carried out to take account of the estimated costs and benefits of a Smart Meter rollout across NI. Costs considered include the operational and capital expenditure, as well as costs related to installation of Smart Meters. Each scenario will generate benefits which have been quantified where possible. These include benefits arising from reduced consumption, deferred investment, and environmental impacts. Non-quantified costs and benefits have been considered and included in providing final recommendations.

The results of the two CBA models and sensitivities suggest the following outcomes. In conclusion, our analysis estimates that Scenario 1 will deliver the highest value for money. This scenario assumes an active rollout with Smart Meters installed over a 6 year period, starting in 2027. The economic analysis estimated Scenario 1 to have the highest BCR (1.57) and NPV (£301m), driven by the highest overall benefits and the early realisation of benefits. Whilst the costs are also the highest, this is reflective of the faster rollout. When considering the results from the sensitivity tests and non-quantified impacts, our analysis suggests Scenario 1 will reliably deliver the highest benefits compared to the other scenarios analysed.

All three electricity scenarios present a strong case for delivering a rollout of Smart Meters across Northern Ireland, with positive net present value results and Benefit-Cost Ratios above 1. Scenario 3 demonstrates that even a small geographical pilot with a faster rollout is preferable to a completely phased rollout in terms of scale of the benefits delivered (NPV) but is marginally worse in terms of returns on expenditure (BCR). Expanding the trial would increase the benefits, above those delivered by a phased rollout.

Summary results are shown in the table and graph below.

Table 2 Electricity CBA Results

Results	Scenario 1	Scenario 2	Scenario 3
PVC (£m, 2022)	527	421	451
PVB (£m, 2022)	827	492	555
NPV (£m, 2022)	301	71	103
BCR	1.57	1.17	1.23

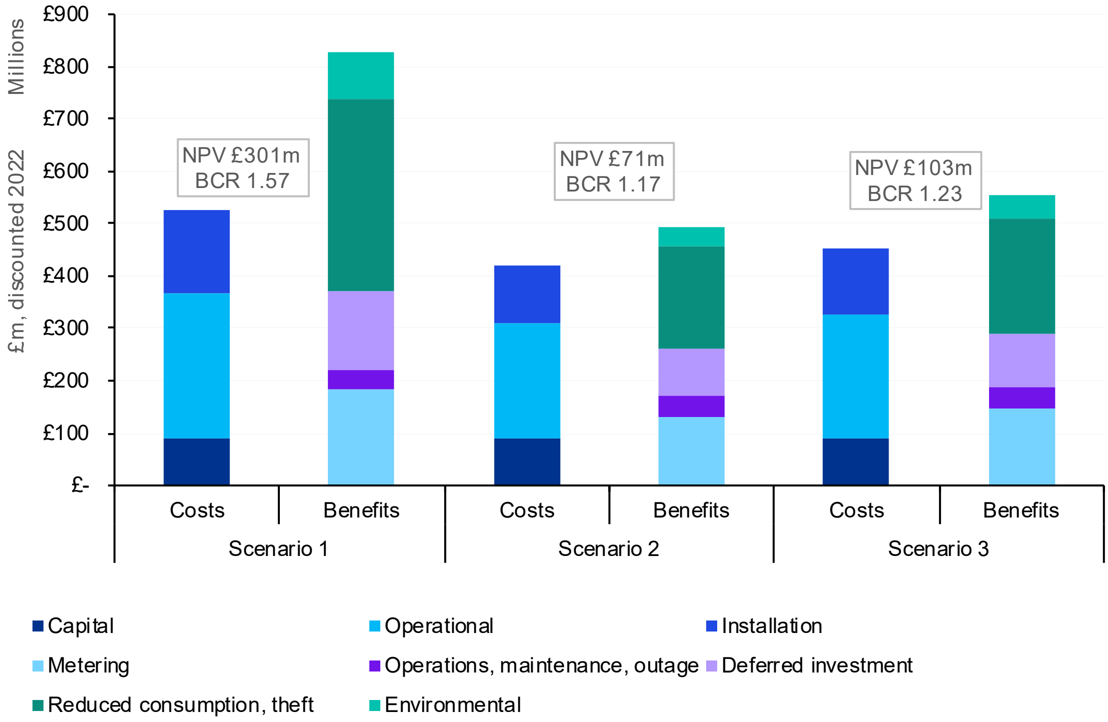

Figure 2 Total Costs and Benefits per Scenario

Sensitivity tests were carried out across a range of input assumptions. These showed that under all variations tested, Scenario 1 remained the preferred option compared to Scenarios 2 and 3. This suggests that it is robust as the preferred option under different circumstances applied equally to all scenarios. Scenario 1 was shown to deliver a BCR above 1 under most sensitivities, except when a 1% behavioural change was applied on consumption of credit meters and 0.5% on PAYG meters (BCR fell to 0.97). The ranking of the options does not change under each of the sensitivities, showing that when assumptions are changed simultaneously Scenario 1 continues to be the preferred and Scenario 2 the least preferred rollout delivery. The core BCR's for Scenarios 2 and 3 are very close (0.06 difference), which is reflective of the trial period as a proportion of total meters.

Our analysis for the impacts of a rollout of Gas Smart Meters across Northern Ireland estimates that Scenario 1 will deliver the highest value for money. This is demonstrated by the highest BCR (1.12) and NPV (£41m), driven by the highest overall benefits and the early realisation of benefits. Whilst the costs are also the highest, this is reflective of the faster rollout. When considering the results from the sensitivity tests and non-quantified impacts, our analysis suggests Scenario 1 will deliver low value for money from the proposed rollout. This shows that whilst returns are positive, the investment will not deliver large benefits above the costs required for the rollout.

Scenario 2 is estimated to deliver a BCR of 0.94, and a negative NPV, meaning that costs outweigh the benefits. Scenario 3 is estimated to deliver a BCR of 1.02, and a marginally positive NPV, showing that the costs and benefits are almost equal. Both of these results would suggest the investment would deliver poor value for money. This shows that when Gas Smart Meters are rolled out on a phased basis, the benefits are not sufficient to outweigh the higher costs involved.

Summary results are shown in the table below.

Table 3 Gas CBA Results

Results	Scenario 1	Scenario 2	Scenario 3
PVC (£m, 2022)	336	289	300
PVB (£m, 2022)	378	273	305
NPV (£m, 2022)	41	-16	5
BCR	1.12	0.94	1.02

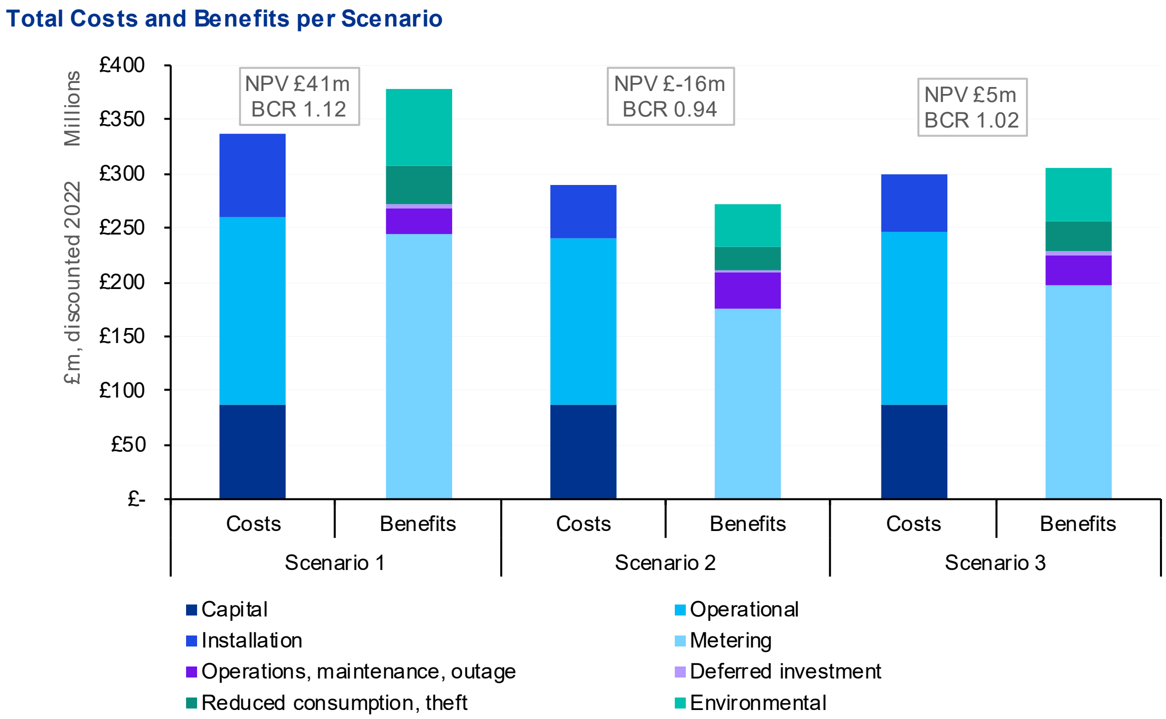

Figure 3 - Total Costs and Benefits per Scenario

Sensitivity tests were carried out across a range of input assumptions. These showed that under all variations tested, Scenario 1 remained the preferred option compared to Scenarios 2 and 3. This suggests that it is robust as the preferred option under different circumstances applied equally to all scenarios. Scenario 1 was shown to deliver a BCR above 1 under most sensitivities, except when a 10% discount rate applied and there was no growth in new gas connections. Additionally, the model was found to be very sensitive to assumptions applied to the time saving benefits from not needing to top-up in person. Assuming consumers top-up during their leisure time reduces the BCR to 0.77, whilst a shorter top-up time reduces the BCR to 0.71. The gas benefits analysis makes assumptions that improvements will be made to reduce greenhouse gas emissions within the sector and is also based on forecast carbon prices. Perversely, should the policy objectives that drive these assumptions not be met and gas does not achieve the planned improvements in greenhouse gas emissions or the price of traded carbon increases, the BCR increases to above 1.20.

The ranking of the three options is consistent across all sensitivity tests. Scenario 1 is preferred, and Scenario 2 least preferred. This shows that having a pilot with a faster rollout (as in Scenario 3) is preferable to the completely phased replacement of meters.

2.5 Conclusions and Next Steps

The results of this economic appraisal suggest Smart Meter deployments can offer a positive net present value to the Consumer, network companies, Retailers, and wider society. These early results should be refined and tested via thorough technical analysis. The CBA model should remain a live project that is iteratively updated as more detailed analysis is conducted.

2.5.1 Conclusions

In both utilities, scenario 1 yielded the greatest Net Present Value. This figure is materially more significant for the electricity sector offering a medium value for money whilst the gas sector results indicate a low (marginal) value for money. There are two further considerations for further development of a gas Smart Service. The first is that there is an urgent need to secure PAYG meter provision for gas consumers beyond 2024 and some work has been completed to date which has opportunity to align with a future Smart Service roll out. The second is that a reduction of costs may be achieved by aligning elements of the gas programme, where appropriate and possible, with an electricity programme.

Beyond the quantitative results for each scenario, in each utility, decisions on deployment structure should consider the practicality of each scenario based on the learnings outlined across this report.

2.5.2 Roadmap

A high-level roadmap of next steps is discussed below and illustrated in Figure 4.

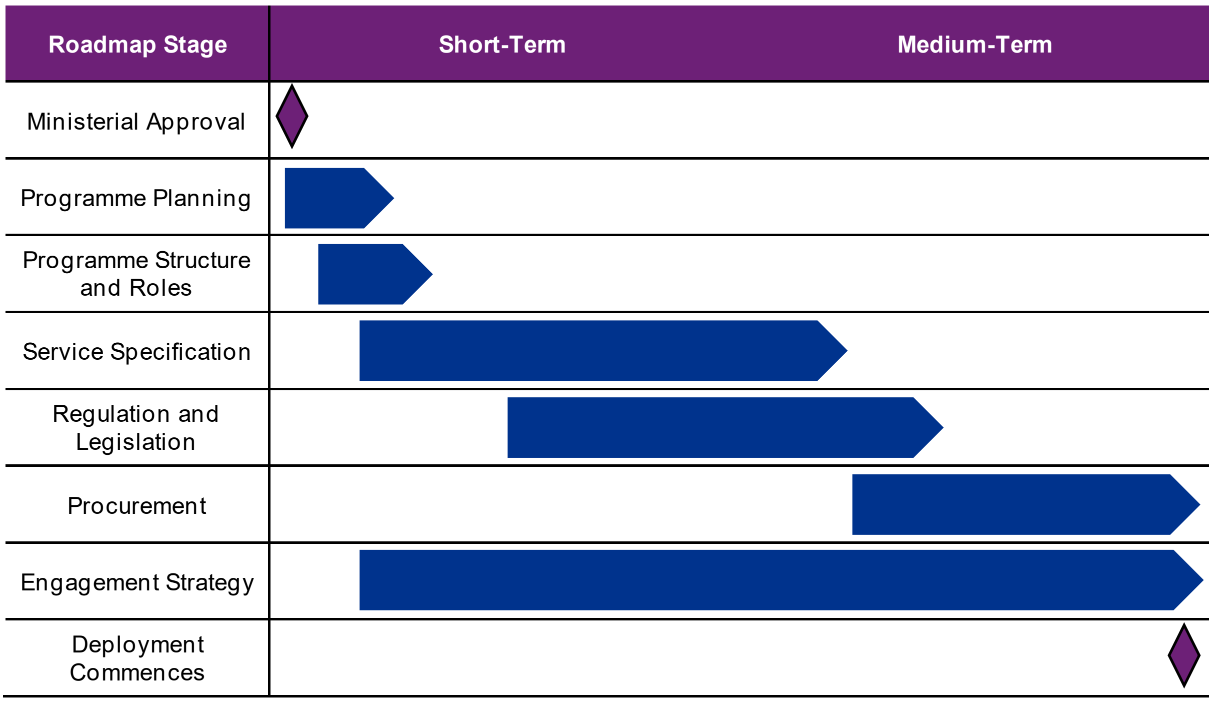

Figure 4 - Roadmap schedule showing indicative programme phases

2.5.3 Programme Planning

The principal step is the further development of this roadmap with the goal of producing a Smart Service Programme Plan. This plan should cover in greater detail the works required to prepare for, procure, and deliver a Smart Service in Northern Ireland. It would be the foundation of the deployment with clear timelines, responsibilities, and milestones.

It is important at this stage that DfE begins developing its programme resource and skill pool to ensure it can provide appropriate management and oversight. DfE should signal the approval to the sector so that relevant parties can appoint resources for engagement.

2.5.4 Programme Structure and Roles

Developing a target delivery model is a critical first step for a deployment with clear roles and responsibilities. The proposed structure should seek to be as streamlined as possible, adopting a principle of centralisation. This structure might be influenced by the available models for centralised IT and Communications systems and therefore technical appraisals of options may be necessary as part of the decision process.

The process must however include relevant stakeholders such that any proposal is considerate of business impact, fair, and legal. In any inter-utility component of the service, there is potential for pushback from an industry which is not well used to cross-utility collaboration. Appraisals should be objective and consider that centralisation of these services now paves the way for future, integrated system operation.

2.5.5 Service Specification

Government should be involved in the Smart Service specification design, like BEIS in GB, to ensure that the end-to-end service is delivered to the benefit of Consumers and society. First on the agenda should be the communication and IT systems which are the two components most likely to be delivered by a new inter-utility, centralised body. Given the time constraints on the gas DNOs, establishing this service should be the priority as not to place Consumer-side gas distribution at risk (due to the unavailability of meters once the current gas meter supply contract ends).

Other areas of the service for specification include the meter and security which may be considered in parallel or sequentially as decided at the programme planning stage.

2.5.6 Regulation and Legislation

The energy sector is heavily regulated by the UR and the likely agents for delivering the programme, the DNOs, are regulated entities and subject to the UR’s price controls. It is imperative that early into the programme’s development, the UR makes pricing provisions to ensure that funding is available as the programme is delivered. The CBA demonstrates that a significant component of the capex, especially in an active rollout, is required early in the programme.

Timely and considered legislation that supports the programme is critical to success, e.g. licensing changes, and data privacy policies. DfE should consider upfront what legislative changes are likely to be required and the likely timelines needed for their implementation.

2.5.7 Procurement

Following the design stage comes procurement. This is a medium-term stage of the programme beyond the scope of detailed consideration for this report.

2.5.8 Engagement Strategy

As highlighted across this report, Consumer engagement drives success in Smart Service deployment. It is critical that DfE, and the established programme bodies, develop an appropriate and active engagement strategy that is educational and transparent.

DfE itself recognises the criticality of the engagement process and advises that it would consider the strategy across the planning, design, and procurement stages.

Section 3. Introduction and Project Overview

3.1 Project Purpose

This research comes at an important moment in Northern Ireland's energy "journey". External drivers which include Climate Change, the Economy, and rising consumer costs mean that Northern Ireland's energy system needs to change significantly, and rapidly. In December 2021, DfE released its new Energy Strategy, 'The Path to Net Zero Energy', and subsequently the NI Energy Strategy Action Plan for 2022 which included an action to perform a cost benefit analysis on the viability of the rollout of Smart Metering infrastructure within Northern Ireland. This action was driven by an article of the EU's 2019 Electricity Directive which seeks the introduction of Smart Meters across the EU (subject to an analysis of costs and benefits), and the UK's Net Zero Strategy: Build Back Greener document, which outlines an objective for the installation of Smart Meters across GB. DfE has extended upon this legislative requirement for a CBA to Gas Smart Meters in NI; recognising the important role gas networks will play in achieving net zero ambitions.

To turn this Strategy into reality, and mitigate the increasing pressures upon the energy network, requires detailed analysis and recommendations, such as those this project aims to deliver. Smart systems, and Smart Meters specifically, have been identified within the Strategy as having a crucial role in influencing the future of energy usage.

This project seeks to assess Smart Meters' role in delivering a dynamic network, the associated benefits, and costs. Evidence collected during development of the Energy Strategy indicated support for Smart Metering in Northern Ireland for reasons which go beyond simple economic justification. These responses found "Good support evidenced for Smart Metering with stakeholders noting, in particular, the value of data (particularly half-hourly data), and the need for time of use tariffs to maximise the benefits of Smart Metering and a smart grid." As such, in addition to providing a quantified indicator of feasibility, the Net Present Value (NPV) for potential Smart Meter roll-out, this CBA should seek to cover two things:

- Encourage exploration of wider strategic benefits of Smart Meter roll-out
- Explore how Smart Meters might be rolled out most effectively in NI, through the use of different scenarios and sensitivity testing

This study should carefully consider the potential opportunities which Smart Metering might open in the future; opportunities which may be invisible at present. For example, the study should consider the hypothetical benefits of richer data about energy consumption across NI, and how this data might be leveraged by energy providers to provide future benefits to consumers. Further to this, it is important to note that this study will go beyond simply focussing on the electricity and gas networks but will also explore how other technologies may interact with a flexible, digitally-enabled network – for example, the interactions with NI's broadband network.

The study will draw extensively upon the lessons learned through Smart Meter roll-out in other jurisdictions. However, it will also focus closely on aspects of the energy system which are specific to the NI context. In particular, the study will; explore the potential propensity of NI consumers to adopt Smart Meters; and examine how consumers from different socioeconomic backgrounds may be impacted by Smart Meter rollout (this will involve exploring high-level consumer protection plans for vulnerable consumers).

Ultimately, NI is aiming to have no imported Fossil Fuels – such self-sufficiency would decouple NI's economy from wider macro-economic pressures and lay the foundation for a strong future society. NI has the potential capacity to do this, and Smart Meters may form a key component of achieving this objective; in particular, by reducing the inefficiency of renewable energy production. For example, currently Northern Irish wind turbines spend significant amounts of time switched off, due (partly) to poor matching of supply and demand.

3.1.1 Key Objectives

Given the purpose outlined above, the following are considered key objectives of the project:

a. To deliver a robust, evidence-based CBA of potential roll-out of Smart Metering in Northern Ireland for Gas and Electricity.

b. To identify key non-quantifiable benefits or challenges associated with the rollout of Smart Meters

c. To understand how Smart Metering will impact different socioeconomic groups, particularly those at risk of fuel poverty

d. To gather information that may inform how Smart Metering might be delivered effectively in Northern Ireland

e. To produce reports that meet a) the EU Directive and legislative requirements with respect to a Smart Metering CBA b) meets the strategic requirements provided by the Energy Strategy

3.1.2 Sector Roles

In conducting research and stakeholder engagement, typical key market roles have been identified for the provision of a Smart Meter deployment, as shown in Table 4. For detail on which bodies fulfil any existing roles please see 5.2 for electricity and 6.2 for gas.

Table 4 - Metering Roles and Descriptions

Role	Description
Consumer	An entity which makes use of the energy.
Utility Regulator	The regulator is an independent non-ministerial government department that holds utility entities to account on standards, costs, and licensing.
Policy Setter	The government body that sets energy policies, including the need for a Smart Metering programme.
Transmission System Operator (TSO)	The TSO is responsible for planning and operating of Northern Ireland's transmission grids.
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Roles and enterprises are not required to exist on an exclusive basis. A single organisation for example can perform the role of DNO, Meter Owner, and Metering Point Administrator. The final three roles are not required by a traditional, “non-smart” meter programme.

3.2 Approach

This section outlines the general approach and project timelines.

3.2.1 Tranches of Work

The project was divided into five principal tranches of work: Project Initiation, Literature Review, Stakeholder Engagement and Research, CBA modelling, and Reporting.

3.2.1.1 Project Initiation

The Project Initiation phase ran from the beginning of August until the 15th August 2022, concluding at the first progress update meeting with the signoff of the Project Initiation Document (PID) deliverable.

This step laid the foundation for the project. By working closely with DfE, we generated a PID which covers: An overall vision of what successful project delivery looks like; Key project risks and mitigations; A detailed approach to project and contract management including governance forums and escalation pathways; An agreed plan of all the steps required to deliver the final project outputs; and Clear timescales and deadlines for reporting.

The PID remained a "live" document subject to change control throughout the delivery of the project. We made use of it as we worked towards the final deliverable, to ensure we were hitting the key outputs and meeting the project objectives.

As part of this phase, we submitted an information request to DfE. This included requests for historic and recent reports relating to existing NIEN and gas-network groups work on the benefits, social and network, of Smart Meters and network-entity proposals relating to costs. Documents of specific importance included the 2011 CBA of Smart Meters in Northern Ireland, and the subsequent update in 2015. We also used our Subject Matter Expert network to identify literature and information sources from the Smart Meter rollouts in GB and Ireland that informed our subsequent steps on building our CBA model and Stakeholder engagement.

3.2.1.2 Literature Review

The Literature Review phase ran from mid-August until mid-September. The focus was on conducting preliminary research of material provided following the Project Initiation phase, identifying information requirements, and mapping these against preferred sources.

The Literature Review was the preliminary research phase. Through consolidation of known information, detailed review of identified documents, and consultation with our Subject Matter Experts we built upon our information requirements first developed as part of the Project Initiation. At a minimum these information requirements and target data points/analyses sought to cover the requirements set out by the EU Commission's 2012/148/EU recommendation paper [1]as required by the tender documents. In addition to the information request, we reviewed publicly accessible documents of relevance such as Ulster University's DfE-sponsored Smart Meters and Flexible demand in Northern Ireland report[2], and Northern Ireland's Energy Strategy 'Path to Net Zero Energy'[3].

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012H0148
[2] *Smart Meters and Flexible demand in Northern Ireland* report
[3] Energy Strategy - Path to Net Zero Energy | Department for the Economy (economy-ni.gov.uk)

A gap analysis and information mapping exercise were conducted. These identified any necessary information which we did not yet have access to and categorised it according to its anticipated source. The output from this exercise was a detailed plan of approach for each individual data point required by the Cost Benefit Analysis which was used to shape subsequent stakeholder engagement. Our Subject Matter Experts informed on data sources. Beyond filling specific data requirements for the CBA, the Literature Review reviewed experiences in other jurisdictions and alternative smart technologies which might affect decisions about, and rollout of, smart data solutions decisions in NI.

3.2.1.3 Stakeholder Engagement and Research

The Stakeholder Engagement phase followed naturally from the Literature Review. It was conducted iteratively with the CBA modelling and the stakeholder engagement and research helped form critical model inputs.

Our stakeholder engagement was conducted via a series of sector workshops, individual meetings with Subject Matter Experts, and clarification meetings with key contributors. In planning, a significant volume of project risks centred around the stakeholder engagement: responsivity of stakeholders, contribution, and timeliness. We designed our workshops to mitigate these challenges by dividing the sector into smaller groups who were more likely to engage. We stepped stakeholders through the process, with full transparency, to help them understand their influence on its success.

Workshops attendance was adequate with representatives from all areas of the sector for both utilities.

In representing the Consumer, we consolidated insights from the Consumer Council, BEIS, DfE, and our own working understanding. A lot of Consumer benefits were raised by stakeholders, some of whom acknowledged the varying degrees of consumer interest in Smart Meters.

Following the workshops, we released Data Requests to the stakeholders to provide a means of contributing with data points that supported CBA inputs as well as an opportunity to provide written response on a Smart Meter rollout in NI. Given how busy the sector is currently with various energy schemes requiring development, we appreciated the efforts of the various organisations who contributed. Most data was provided by the network companies with the Retailers providing qualitative response. In lieu of responses, some assumptions were required as described in Section .

3.2.1.4 CBA Modelling

The approach to CBA modelling is described in detail within Section 7.

3.2.1.5 Reporting

This document provides the output to the Report tranche of works.

A draft of the report was provided to DfE for review in mid-November 2022, with a follow up review meeting to discuss feedback. Subsequent updates and iterations were developed to produce a final report provided to the Department in December 2022.

3.3 Report Structure

This report has been produced for the Department for the Economy (DfE) and is structured to enable readers with a specific interest in either Electricity or Gas Smart Meters to reach research findings and key considerations specifically related to each energy system within standalone sections of this report.

Some aspects of Smart Meter programmes are utility-agnostic and therefore for the sake of brevity, these aspects are explored in Section 4 as being of common relevance.

Section 5 specifically caters to an audience focussed on the rollout of Electricity Smart Meters (ESMs).

Section 6 specifically caters to an audience focussed on the rollout of Gas Smart Meters (GSMs).

Section 7 covers the quantitative CBA which is broken down into subsections for Electricity and Gas.

Section 8 is relevant to both utilities and provides a summary of outcomes.

Table 5 - Document Report Structure

Section	Description	Sector Relevance
Section 3 **Project Overview**	Overview of the structure of this project to produce a Cost Benefit Analysis.	Electricity and Gas
Section 4 **Smart Meter Research Findings**	Findings on Smart Meters as a system without consideration for the nuance of electricity and gas.	Electricity and Gas
Section 5 **Electricity Smart Meters in NI**	Findings, Benefits and Costs concerning ESMs with focus on a qualitative discussion.	Electricity
Section 6 **Gas Smart Meters in NI**	Findings, Benefits and Costs concerning GSMs with focus on a qualitative discussion.	Gas
Section 7 **Cost Benefit Analysis**	Details specific to the Cost Benefit Analysis, focussing on quantitative results.	Electricity and Gas
Section 8 **Results and Recommendations**	Results and Recommendations to provide a clear outcome and thoughts for consideration in a future rollout.	Electricity and Gas

Section 4. Smart Meter Research Findings – Key Programme Considerations

4.1 Introduction to Section

This section provides an overview of research and stakeholder findings on key Smart Meter programme considerations that are equally applicable to an ESM or GSM programme. This section provides information on the topics that have been found to be key components, including specific contextual observations for Northern Ireland where these are energy system agnostic. Focussed discussion on key aspects for ESMs and GSMs in Northern Ireland is contained in Section 5 and Section 6 respectively. Further information on some areas is provided in Appendix A.

4.2 Research Sources

The research and findings within this report are built on information provided by several sources. These fall into three principal areas: Stakeholders, Smart Meter Literature, and Subject Matter Experts.

4.2.1 Stakeholders

In delivering this project, we engaged with all stakeholder groups that have an invested interest in a Smart Meter programme. This included network companies, Retailers, government bodies, Consumer councils, and the Utility Regulator. Detail on which and to what extent stakeholders were contacted is provided in Appendix C.

Note that in order to respect the potential sensitivities of stakeholders, any comments or information provided are referenced anonymously as ‘Stakeholder’.

4.2.2 Literature

Literature as a term is used here to describe written documents such as reports and articles which contribute to the discussion. These are usually referenced via footnotes and a list of all sources is provided in Appendix C.

4.2.3 KPMG Subject Matter Experts

Some insight was provided by KPMG Subject Matter Experts with specific knowledge on the subject of discussion e.g. the GB deployment, and have been treated as stakeholders across this document.

4.3 Defining Smart

Throughout conversations with stakeholders and subject matter experts, a key question asked was *what do we mean by Smart Meter?* For the sake of clarity, in this section we define some key terms that apply across this document and the extent of what we mean by *Smart*.

4.3.1 Standard Meter

Standard Meters, also referred to as Traditional Meters, offer no connectivity to a wider system and perform a simple function of recording energy consumption that must be read manually by a user or technician. These meters currently dominate the NI market both for electricity and gas.

4.3.2 Smart Service

Smart, as a term used in this report, refers to a dynamic, data-led, and intelligently operated system. A Smart Service is the combined and integrated solution that seeks to offer consumers, companies, and public-bodies additional benefits over and above that of a traditional metering programme.

Smart Service does not just refer to the integration of meters, Information Technology (IT) solutions, data management and network communication. The term includes the wider services offered to Consumers by network companies and Retailers such as Dynamic Tariffs, near-real-time[4] usage data, and remote top-up.

4.3.3 Smart Meter

A Smart Meter is a type of meter that can be used to provide a Smart Service. The terms Electric Smart Meter (ESM) and Gas Smart Meter (GSM) are used across this report to define the utility-specific Smart Meter to which the discussion applies.

The reader should note that when Smart is referenced outside of the term Smart Meter in this report, it refers to intelligence services and not just the metering box installed at consumer premises.

A key concept this report seeks to emphasise is that Smart Meters alone offer negligible benefits if they are not connected to a wider Smart Service.

4.3.4 Pay-As-You-Go

A Pay-As-You-Go (PAYG) Meter, also known as a Prepayment or Top-up Meter, is a class of meter to which the consumer adds credit (via a top-up card or otherwise) that can be drawn down from as energy is consumed. There is a periodic billing process associated with a PAYG meter and the consumer can only use energy when their account is in credit[5].

It is important to note that PAYG Meters in this report refer to the PAYG Standard Meters that are widely in use across Northern Ireland. PAYG as a standalone term refers to a

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[4] Near real-time, is a term used across this report which refers to the time resolution of Smart Meters relative to Standard Meters. Regularity is suggested as half-hourly on the electricity side, due to the regular uplink with the communication network whereas on the gas side data is only transmitted on a c.24hour basis according to stakeholders. Near real-time is a subjective term but is used by comparison with the c.3monthly reads under a Standard Meter regime.

[5] Meters offer Emergency Credit which can be used in the absence of standard credit.

service which is not exclusive to PAYG Meters. A Smart Meter can, and generally does, offer PAYG functionality via remote or card top-up.

The opposite of a PAYG Meter is a Credit Meter whereby the consumer consumes as much energy as required and pays the value of that consumption to the Retailer in arrears.

4.4 Smart Meter Programme Structures

The term programme in this section refers to the Smart Meter deployment in each jurisdiction. This section explores the entities that influence a Smart Meter deployment and the wider energy utility parties.

4.4.1 Roles

In defining a programme structure, each of the roles described in section 3.1. should be fulfilled and ownership should be clear.

4.4.2 Centralisation

A lot of these roles are delivered in other jurisdictions by centralised bodies to maximise efficiency of operations and reduce costs. A single body for example might act as a Smart Data Manager, Communication Service Provider, and Meter Point Administrator so that data is wholly managed by one organisation.

Insight into the organisation of key structures in other jurisdictions is available in section A.1.

The above considerations are explored further in Section 5 for the electricity sector and Section 6 for the gas sector.

4.5 Smart Meter Delivery

This section is concerned with mechanisms for delivery or rollout of a Smart Metering programme across a jurisdiction. It seeks to explore the approach taken in the other key jurisdictions of GB and Ireland as well as make considerations for any nuances to a potential rollout in NI based on stakeholder consultation.

This section summarises research presented in detail within section A.2.

4.5.1 Deployment Types

Research suggests two primary considerations in designing a rollout: obligation and pacing.

4.5.1.1 Obligation - Mandatory versus Voluntary

A mandatory deployment is defined as a model where Smart Meters are installed in consumer premises on an opt-out basis. The prevailing assumption is that consumers accept their installation and only those that expressly choose not to are excluded from the programme. The provision of an opt-out process should be considered further but at a high level might reflect a notification to the Consumer ahead of installation and an opportunity for the Consumer to decline.

A voluntary roll-out is consumer driven on an opt-in basis. Only those consumers who expressly request a Smart Meter shall have one installed.

It is evident from section A.2 that in GB and all EU countries, for which data is available, a mandatory roll-out strategy was eventually adopted. Mandatory is a term that implies consumers have no choice but often these programmes were opt-out. In some instances (Italy and Malta) the rollout began on a voluntary basis but evolved into a mandatory roll-out to drive installations.

4.5.1.2 Pacing - Active versus Passive

A further binary aspect of a rollout considered by this report is the active versus passive (sometimes referred to as “Phased”) strategy.

An **active rollout** is more aggressive and tends to realise greater benefits sooner. It involves meters being installed as part of a managed plan within premises regardless of the state of the current meter.

A **passive rollout** is one where the incumbent meter is only replaced with a Smart Meter once it reaches end-of-life i.e. if the incumbent meter is designed to last 20 years, and has been installed for 5 years. It shall not be replaced with a Smart Meter for another 15 years.

Rollouts in other jurisdictions generally follow a targeted, active rollout in order to deliver benefits sooner.

4.5.2 Milestones

Milestones and targets are critical in any large programme for driving delivery and success. Several milestone strategies have been employed in other jurisdictions as per section A.2. These milestones should provide continuous pressure yet remain mindful of that which the industry can reasonably achieve. Being upfront on targets signals to the sector, with appropriate warning, the scale of expected pace such that appropriate planning can take place.

4.5.3 Logistics

Constraints around resources for delivery and availability of supply of the components necessary to build the Smart Service infrastructure is a critical area of consideration in the design and planning of a successful deployment.

4.5.4 Integrated Rollout

There are components of a rollout that apply across the utilities and efficiencies had in other jurisdictions by delivering ESMs and GSMs together. A collaborative deployment may also be relevant in NI.

The above considerations are explored further in Section 5 for the electricity sector and Section 6 for the gas sector.

4.6 IT and Data

Accessibility, availability, and integrity of energy consumption data as represented by an IT solution underpins the service offering presented by Smart Meters. Management of this data is critical to any programme's success. Factors of interface, security, integration, and GDPR must be considered in the delivery of an IT system that complements the meters themselves. Key considerations are summarised as follows.

This section summarises research presented in detail within section A.3.

4.6.1 Centralised MMS

A critical consideration with respect to IT is the degree of centralisation. With deployments spanning electricity and gas, network operators and retailers, there is potential for overlapping systems. A centralised Meter Management System (MMS), a service available to all invested parties, streamlines delivery and saves costs.

More detail can be found in Appendix A which explores IT deployments in other jurisdictions and the components within an MMS.

4.6.2 Data Management and GDPR

General Data Protection Regulation (GDPR) was established by the European Union (EU) in 2018 and following the UK's withdrawal from the EU, remains a binding regulation in GB and NI. Given that the Smart Metering programme concerns the management of consumer (personal) data, GDPR and data management are paramount considerations in the development of any IT system.

Given that GDPR applies to both Great Britain and the Republic of Ireland, the technical details[6] concerning its enforcement can be adopted explicitly from those jurisdictions.

The above considerations are explored further in Section 5 for the electricity sector and Section 6 for the gas sector.

[6] The technical details of GDPR are omitted for brevity information is available at GDPR compliance checklist - GDPR.eu

4.7 Communication Infrastructure

The communication infrastructure is a critical part of any Smart Metering programme. It is fundamentally what allows the consumers and utility companies to make use of the data by connecting the Smart Meter with the IT solution to form an over-arching Smart Service.

This section summarises research presented in detail within section A.4.

4.7.1 Wide Area Network

A Wide Area Network (WAN) connects the Smart Meter to an MMS and is vital for delivering a Smart Service. Selection of an appropriate technology and its ownership/management will a play a significant role in driving success and saving on infrastructure costs. Further information is described in A.4.2.2.

4.7.2 Connectivity and Performance

It is challenging to design a communications network that is suitable for all premises. In rural regions for example, cellular connectivity might be poor or the powerlines incapable of carrying communications signals. Ensuring performance is key for ensuring the success of a communications network and Smart Metering as a whole.

It is therefore critical that appropriate performance indicators and mechanisms are in place to hold the owner of the communications network, and any third parties involved, to account on its performance such as the model used in Ireland with the Communications Technically Feasible (CTF) concept (see section A.4.4.2.1).

4.7.3 Home Area Network

The Home Area Network (HAN), as described in section A.4.2.1, plays an important role in connecting Consumers with their meter data and enabling the full breadth of benefits via integration with other in-home technologies.

The above considerations are explored further in Section for the electricity sector and Section for the gas sector.

4.8 Meter Functionality

This section provides a high-level review of the functional requirements of a Smart Meter solution. Some technical detail is offered in the clarification of key functional requirements, but this is not a technical analysis.

This section summarises research presented in detail within section A.5.

4.8.1 Meter

The Smart Meter should deliver metrological capability of an appropriate standard that in no way reduces its ability to operate as a meter below that of a Standard Meter whilst offering some enhanced functionality like the measurement of auxiliary loads.

4.8.2 Computation

Smart Meters are computers. A prominent feature of discussion is the 'Thin Client' principle discussed in A.5.2.3 which seeks to drive a futureproof design. This and other considerations that include data, payment modes, and interfacing, are critical in the design of a successful meter.

4.8.3 Communication

The design and specification of communication functionality is essential in delivering a meter that can integrate with a WAN and generate a HAN to deliver a total Smart Service.

4.8.4 PAYG

Prepayment meters are abundant in Northern Ireland and stakeholders have expressed that PAYG functionality is retained for any Smart Meter deployment. This is explored further in the utility-specific sections that follow.

The above considerations are explored further in Section for the electricity sector and Section for the gas sector.

4.9 System Security

Cyber security is an essential consideration due to the significant risks posed by the introduction of Smart Meters. This is highlighted further in A.6.

It is fundamental that Northern Ireland consults with DCC, BEIS, NCSC and other appropriate agencies and looks to SMETS2 in its consideration of Smart Meter security.

4.10 Tariffs

4.10.1 Tariffs

Northern Ireland's electricity and gas industries are regulated by the Utility Regulator. Costs associated with the supply of electricity and gas to consumers are subject to price control regulation which includes the setting of tariffs for the purposes of cost recovery.

Traditional electricity and gas tariffs reflect a flat or two-tiered structure offering either a daily or day and night tariff rate respectively. The functional capabilities of Traditional Meters are reflective of these tariff structures. They do not support provision of more complex tariff structures that better reflect the costs associated with provision of energy which varies in real-time throughout the day. Time-of-use (TOU) tariffs better reflect these varying costs by charging higher rates for use of energy when it is more expensive to supply, such as during times of high demand.

By availing of TOU tariffs energy consumers in Northern Ireland can save money on their energy bills by shifting consumption to times when energy is cheaper. TOU tariffs are a key enabler of Northern Ireland's energy transition and will unlock many of the benefits afforded by Smart Metering infrastructure. The EU's Clean Energy Package entitles all energy consumers to a Smart Meter with a prescribed set of minimum functional requirements – it is important that suppliers help to optimise this functionality by offering tariffs that support the integration of indigenous renewable energy sources and drive down the cost of energy for NI consumers.

4.10.1.1 Great Britain

In April 2021, Ofgem published the full business case for market-wide half-hourly settlement[7] (MHHS) detailing the decision to proceed with MHHS over a period of 4 years and 6 months completing in October 2025. MHHS is designed to place the right incentives on retailers to develop and offer new tariffs and innovations that encourage and enable more flexible use of energy, such as time of use tariffs, automation, vehicle to grid solutions and battery storage. The evidence compiled through the business case development phases suggests that MMHS maximises consumer benefit by ensuring that suppliers and retailers face the true cost of providing the services they offer.

Delivery of the MMHS by the mid-2020s is key enabler of GBs Smart Systems and Flexibility Plan[8] which, along with Smart Metering infrastructure and flexible technologies, will incentivise and empower consumers to shift consumption so that clean renewable energy sources can be better utilised thereby helping to achieve the UKs goal of net-zero greenhouse gas emissions by 2050.

An interesting aspect of the decision is to assign responsibility for management and delivery of the implementation of MHHS to industry, with Elexon tasked as the Senior Responsible Owner for the implementation. Ofgem intend to publish details of governance arrangements so that Elexon's progress, and the overall delivery of the program, can be monitored effectively.

[7] https://www.ofgem.gov.uk/publications/electricity-retail-market-wide-half-hourly-settlement-decision-and-full-business-case

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1003778/smart-systems-and-flexibility-plan-2021.pdf

4.10.1.2 Republic of Ireland

The Commission for Regulation of Utilities (CRU), following a public consultation, decided[9] that suppliers must offer time-of-use tariffs to all electricity customers with an installed Smart Meter at a smart 'switch-on' date of Q4 2020. The decision included the introduction of 'time-of-user primers' designed to improve awareness of TOU tariffs available through targeted communications. Standard-smart tariffs are required to be made available as a minimum which involves offering at least one additional time-band to the traditional day and night bands.

In September 2022, the CRU published a fast-tracked decision[9] on tariffs for the period covering October 2022 to October 2023. Developed in response to security of supply issues faced, the changes to tariffs are designed to reduce electricity use during peak times over the 12 month period. Although most of the tariff changes target reduction of Extra Large Energy Users such as data centres, the measures also include increased tariffs during peak times for domestic customers and a request to suppliers to proactively develop products/initiatives for domestic and commercial customers to encourage them to reduce their demand and/or improve their energy efficiency.

The above considerations are explored further in Section for the electricity sector and Section for the gas sector.

[9] Electricity Network Tariffs 2022/23 – National Energy Security Framework Response Proposals - Commission for Regulation of Utilities (cru.ie)

4.11 Funding

Detailed funding and financing approaches are out of scope for this CBA but some insight is captured in A.8.

In summary, the Consumer funds the deployment as required by legislation and this is usually implemented across other jurisdictions via tariffs built into regular Consumer bills.

4.12 Consumers

Smart Meters are a Consumer driven evolution of the energy system in Northern Ireland. It is only through widespread adoption and utilisation of a Smart Service that major change can be achieved.

4.12.1 Consumer Engagement

The EU Commission's (EUC) Smart Meter benchmarking report[10] highlights four key principles for getting the Consumer on board from the beginning of the process:

- set up a communication strategy and information campaign
- earn consumer trust and confidence, for which it is crucial that consumers understand what data is transmitted, and giving them access to it
- use metering data to feed information back to the customer and allow the development of new products and customer-oriented services
- stimulate consumers' involvement by providing them with appropriate, user-friendly tools and mechanisms for making choices, and attractive incentives to reward their participation

This section explores these principles with reference to the discussion on issues encountered in other jurisdictions and lessons to learn (see A).

4.12.1.1 Understanding

Consumers can only use a service they understand. A well-utilised Smart Service has the potential to bring about a significant change in the way Consumers view energy and their personal consumption. To bring about this change, a nationwide information campaign is vital to deliver understanding and mitigate some of the risk raised by rollouts in other jurisdictions.

In GB and Ireland alike, there are suggestions that Consumer understanding is low. Taking for example the issue around half-hourly meter reads raised in Ireland; it is evident that some (if not most) Consumers do not know why ESBN takes readings more regularly than just the billing period start and end dates and consequently there is challenge to this process. It perhaps implies that where information campaigns in the past have focussed on the Consumer, and understanding how Consumers benefit, perhaps future campaigns should also look to explain the wider system benefits. This is in order to provide context around the place Smart Meters have in society and specifically the energy system.

One stakeholder suggested that in GB they got it wrong by claiming "*Smart Meters save you £XXX per year"* but instead a campaign should communicate that it is "*digitising one of the few mechanical systems we have. That without it you cannot do next day switching, you cannot encourage heat pumps, and un-capped top ups"* i.e. walk the consumer through the wider benefits and show them that on the scale of the economy, money can be saved

[10] Benchmarking Smart Metering deployment in the EU-28 (europa.eu)

through half-hourly settlements, tactical network planning, peak shifting, etc. This contrasts a Consumer Council Energy Transition report[11] which suggests Consumer behaviours is more personal-cost centric and that Consumers would only react well to technologies that clearly layout the savings to them. It states "there was little enthusiasm for changing lifestyle to support energy efficiency except if it saved money. Consumers were willing to contemplate small changes only, and again, cost is a factor." Some respondents to the consultation that feeds this paper expressed longer-term thinking with "We would need to know whether the costs outweigh the benefits in the long term."

There is perhaps a depth of information and consideration in the provision of Smart Meters that may overwhelm a Consumer, but these wider benefits should be made available and clear, so Consumers understand where their role and actions sit within our energy society. It should be clear what, and how, they will pay as well as the long-term benefits. Subject Matter Experts in GB suggest not making this "cost savings" piece central to the engagement as Consumers feedback negatively where these savings are not realised (due to poor engagement or programme issues).

A stakeholder suggested that Consumers may also experience a paradox of choice, meaning there are too many tariff options available which can be overwhelming. Provision of information to consumers should be maintained, so that customers who have opted into Smart Services understand how to adjust their energy usage to gain the most benefit from a dynamic or TOU tariff. Consideration for how these tariffs are explained is a factor in their marketing. Another stakeholder commented "*with smart services enabled, we must then consider what is required in terms of delivering the information to the customer. In Ireland, suppliers are required to provide the information to the customer in an understandable format."*

Learning from other jurisdictions, section 1.3 highlights the impact that bringing the Consumer onboard with the programme can have. It is critical that education does not end with the initial deployment's completion but that the Smart Service is used to deliver ongoing benefits to the network, Consumer, and Society through the innovative and intelligent means it enables.

4.12.1.2 Awareness

A communication strategy is key in marketing the rollout to Consumers. The goal of any campaign is to encourage as many Priority 2 Consumers (see section 3.4), those who express an interest in the Smart Service and/or have the supporting LCT technologies to support an energy transition. A successful rollout and communication campaign sees more Consumers requesting to be included. This means the rollout is Consumer driven and not deployed in the hopes of engagement.

The Consumer Council's Impact of Digitalisation[12] suggested that "most Consumers had not heard of Smart Meters" but that when presented with information on how they work "the majority of consumers expressed interest in having one." This reinforces there being an awareness challenge.

Ireland has relied on Retailer and DNO led marketing campaigns and subsequently uptake has been poor. In GB, a dedicated non-profit campaign in Smart Energy GB drives the awareness component and communication strategy. It is considered by stakeholders that awareness and uptake in GB is slightly higher.

[11] "Northern Ireland consumer attitudes to energy transition issues", CCNI, March 2021
[12] "Potential Impact of Digitalisation on Northern Ireland Energy Consumers", CCNI, May 2022

4.12.1.3 Transparency

It is critical that the rollout earns Consumer trust and confidence. Energy schemes historically in NI have faced issues with lasting effects and impressions. Transparency is key in delivering this trust by making it clear the benefits, costs, challenges, and roadmap to delivery.

In Ireland, whilst some information is available, it is not easily accessible, and this has earned backlash concerning data usage. In GB, some consumers have claimed government greenwashing and a campaign designed to eliminate jobs. It is essential to mitigate these potential challenges via an upfront and honest information campaign.

4.12.1.4 Consumer Behaviour

Consumer involvement can be stimulated by providing them with their own data-driven insights and the user-friendly mechanisms to take advantage of the Smart Service. Making a service easy is key to driving its uptake.

One stakeholder commented that "*despite investment in smart services, there may be a certain level of customer inertia to switch over to smart services. What we mean by this, is that the customer may be overwhelmed by choice in the market, and instead of changing behaviour, they will stick to what is comfortable or known, i.e. a 24 hour tariff with no differentials.*" It is critical that this ability to change is easy.

The Consumer Council's Energy Transition report generally indicates significant challenge in facilitating a behaviour change.

4.12.2 Social Value

Consumers will ultimately be paying for any Smart Meter deployment; they must therefore be at the heart of the opportunity it offers.

It is important to recognise, understand and reflect that Consumers are not a single homogenous group. They will want a range of options such that they can decide what meets their needs. Some Consumers will want to become fully immersed, becoming prosumers willing to respond to real-time signals and actively manage their load. Others will want to be informed and have a good understating of their usage while others will not be particularly interested in energy and require protection and confidence in the operation of the market.

"All customers however will be interested in the price they pay for their energy."

Some functional aspects of a Smart Meter solution actively appeal to significant proportions of groups. In its PAYG meter survey[13], the Consumer Council found 88% of respondents "would prefer to top up gas online", an option not currently available to the gas PAYG market in NI. This is encouraging for a digital solution and is generally supported by the Consumer Council's Impact of Digitalisation research where respondents were generally in favour of Smart Meters.

"All customers however will be interested in the price they pay for their energy."

4.12.2.1 Just Transition

Just Transition refers to the need to ensure that those who cannot afford to switch to cleaner LCTs are not left exposed to increasing fuel, and in particular carbon, prices. Policies here

[13] "Research Into Why Some Prepayment Meter Consumers In Northern Ireland Are Self-Rationing Their Energy Consumption", CCNI, May 2022

include government schemes to provide financial supports for vulnerable members of society e.g. government led insulation schemes for social housing.

There is also an employment lens ensuring that industries that will contract or cease because of the transition have pathways to other forms of employment e.g. meter reading workforce transitioning to roles within the Smart Meter space. The extent of such a workforce should be determined via further analysis.

A significant element of consideration should be the vulnerable groups and those experiencing energy poverty. In NI's agenda on transitioning into a low-carbon economy, the opportunity to make change must be available to all irrespective of personal standing. Smart Meters are a universal mechanism that affect all energy users in the country and provides a platform for this cross-demographic, fair transition. The Consumer Council's PAYG meter research found dissatisfaction with the prepayment process from groups with poor mental health, poor physical health, or disability; it is vital that a modern PAYG solution delivered by a Smart Service is more accommodating for these groups.

4.12.2.2 Driving Employment

As highlighted across Section 5, in any Smart Meter implementation, a substantial volume of work would be generated in its design, procurement, and operation. This supports DfE's ambition to Grow a Green Economy as detailed in the Energy Strategy as well as the 10X Strategy[14] and the draft Green Growth Strategy[15] which aim to provide new opportunities for people finding green jobs. Job creation is likely in delivering IT systems, communications, meter deployment, and possibly even manufacture (if meters are assembled locally).

For a hypothetical active rollout, meter installation and technical jobs require ramping up above that which the DNO currently offers. These technicians require several years of training, but work is ensured by the programme for several years. The meter installation qualification covers a standard electrician qualification therefore following deployment, when the numbers of technicians required for maintenance and replacement drop, their skills can be applied directly in a competitive market that is currently short on professionals[16]. Note that it is unlikely that there are presently sufficient technicians to fulfil an active rollout and the parties responsible are required to start building up their workforces during the planning, design, and procurement phases.

4.12.3 Consumer Support

In any deployment of new technology, there is an educational challenge and often Consumers need support in understanding a new technology. It has been suggested by stakeholders that initially, the requirement for *help centre* support (via calls) would rise as Consumers would not understand how to operate their meters. This is particularly the case for those less-interested Consumers who receive a Smart Meters as part of an active rollout without fully understanding it in advance.

Naturally this presents challenge with a requirement to build a support service or call centre to field the higher call rates that are likely. This may be a deployment owner service, or a service offered directly by DfE via its One-Stop Shop. The advantage of this requirement is the creation of jobs. A useful service offering might be remote diagnostic capability such that Consumer issues can be addressed directly without engineer callouts (though some will

[14] 10X Economy - an economic vision | Department for the Economy (economy-ni.gov.uk)

[15] A Green Growth Strategy for Northern Ireland - Balancing our climate, environment and economy | Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)

[16] Northern Ireland's construction trade hit by labour shortages and increased costs - BelfastTelegraph.co.uk

remain necessary) but this service may not be possible for a DfE run service centre. The Consumer Council is a valuable resource in the provision of a Consumer centric deployment and in understanding the areas Consumers most require support. Further consultation is necessary.

Section 5. Key Considerations for Electricity Smart Meters in Northern Ireland

5.1 Introduction to Section

This section discusses an ESM deployment in Northern Ireland building on the key considerations outlined in Section and detailed research reported in Appendix A.

Discussion focuses on key areas of relevance to Northern Ireland and provides the insight used to draft Section .

5.2 Programme Structure in Northern Ireland

This section follows and utilises terminology introduced in section 4.4 and A.1, offering a tailored view for the electric utility in NI.

5.2.1 Meter Deployment

Currently in Northern Ireland, NIE Networks has the role of Metering Programme Owner for traditional meters. Stakeholder discussion indicated preference for a DNO (NIEN) led Smart Meter rollout which aligns with the standard model employed by all European countries except for Great Britain (see A.1).

There was a suggestion amongst stakeholders on the structure of this programme ownership and that within NIEN, the Smart Metering programme be a ringfenced, centralised project management function. This function would operate independently of the core company to coordinate deployment, manage stakeholders, and track milestones. This would resemble the role of Retail Market Design Service (RMDS) in Ireland.

Given the scale of the project and insights offered on RMDS' performance, a dedicated function may indeed be necessary to fulfil a successful deployment.

5.2.2 IT, Data and Communication Services

Currently in NI, NIEN acts as the Metering Point Administrators and Meter Data Managers, making data available to Retailers. They are responsible for meter reading and the storage of consumer consumption data on their own independent systems. Smart Meters to some extent make redundant the role of Metering Point Administrator as this function is inherently absorbed into the communication services. No entity regularly manually reads the meter but rather an automated system gathers and stores the data via the communications network and IT solution.

Stakeholder research indicates that a lot of challenges arise in GB due to the interfaces and intersection of responsibility between the meter, the communication network, and the data storage. Centralisation of these roles into a single entity may offer a solution to streamline these interfaces. This entity would be the singularly responsible for data and its management across the communication and IT infrastructure without the company-company interfaces.

> *Given consumer metering data is maintained as owned by the Consumer, it may be pertinent that this body operates on a public or semi-public basis such that the regulator and government may exert more direct control over its compliance with regulations and Consumer interests.*

In continuing this theme of centralisation, it may be even more efficient if the DNO extends its role to include Communication Services Provider. This would mirror the programme structure in Ireland with ESBN overseen by RMDS.

Interaction between energy sector entities should be considered in the design of any programme structure. It was indicated that a significant component of RMDS' capacity is absorbed by stakeholder engagement i.e. managing the Regulator, Retailers, and the network businesses. This management of interaction between entities is streamlined by the total centralisation of the metering programme within RMDS (it fulfils most roles described) but remains substantial, nonetheless.

5.2.3 Consumer Engagement

Whilst not an explicit role necessary for the delivery of a Smart Meter programme. Consumer engagement has been a key message from stakeholders as being critical in the delivery of a successful programme.

Great Britain's 'Smart Energy GB' and a marketing function within Ireland's ESB Networks, provide a service to engage and educate the consumer with varying success. A body with a similar remit would be required in Northern Ireland to encourage consumers to use the full scope of smart services available to them via a Smart Meter.

A similar plan would be required to develop consumer engagement, education, and marketing components of the rollout in NI. DfE is currently consulting on the development of an Energy "One Stop Shop" as outlined in the Energy Strategy[17].

5.2.4 Summary

Were this total centralisation to take place, the entirety of the programme would sit within one entity's ownership and management; henceforth referred to as the Central Programme Body (CPB). As identified, this offers efficiencies via streamlining. The scale of change across the industry would be significant for any Smart Meter programme and this centralisation isolates the change to one singular, new entity which can receive explicit oversight and regulation.

Table 6 illustrates the indicative role profile for Northern Ireland discussed. This is the basis of assumption for a programme structure in Northern Ireland in the deployment of an ESM programme. This structure is proposed, based on qualitative research, to be assessed by the Cost Benefit Analysis.

[17] Energy "One Stop Shop" Implementation Plan - consultation on policy options | Department for the Economy (economy-ni.gov.uk)

Table 6 - Indicative role profiles for Electricity Smart Meter rollout in Northern Ireland

Role	Description
Consumer	-
Utility Regulator	Utility Regulator
Policy Setter	DfE
Transmission System Operator (TSO)	SONI
Distribution Network Operator (DNO)	NIE Networks
Retailer / Supplier	Various
Smart Data Owner	Consumer
Metering Point Administrator	**Central Programme Body** (Ringfenced component of DNO, NIE Networks)
Metering Programme Owner	
Smart Data Manager	
Communication Service Provider	
Consumer Engagement	

This report and the analysis have been considered from the perspective of the above structure which has been tested with stakeholders.

5.3 Delivery in Northern Ireland

This section follows and utilises terminology introduced in section 5 and section A.2, offering a tailored view for the electric utility in NI. In understanding a delivery model, there are several key themes of discussion including programme ownership, deployment strategy, timescales, logistics, prioritisation, and timescales.

5.3.1 Programme Ownership and Management

As detailed in section 2, the consensus on programme ownership and Smart Meter deployment lands on the DNO, which in the case of Northern Ireland is Northern Ireland Energy Networks (NIENs) as the common services provider. There is a strong suggestion amongst stakeholders however that this needs to be a ringfenced function within the DNO to coordinate deployment, manage stakeholders, and track milestones. As this programme is contingent on a timely deployment, a separate function ensures delivery has dedicated oversight.

Whilst the implementation itself would be owned and managed by the DNOs, its delivery and service performance also impact on Consumer and Retailers. It is therefore critical that the Meter provision contract is aligned with wider programme objectives and any wider Smart Service programme components. DfE and the Utility Regulator should have appropriate recourse to hold the DNOs accountable and incentivise delivery of good performance. It is also critical that DfE and the Utility Regulator have capacity to provide suitable oversight and contract management support to ensure ongoing performance of the service.

5.3.2 Deployment Strategy

This report explores several models for deployment of Smart Meters in NI including consideration of models used in other jurisdictions and stakeholder feedback. These are reflected, and quantified, in the CBA scenarios introduced in Section . Both qualitative and analytical review should be used to inform on a deployment strategy for NI.

As presented in A.2, the consensus across the EU countries, as decided through their own CBAs or otherwise, ultimately landed on active-mandatory (opt-out) rollouts. It is likewise suggested by stakeholders that NI assumes an active, opt-out rollout.

5.3.3 Logistics

Stakeholders raised a challenge around logistics and skills procurement. The DNO is already responsible for the maintenance and replacement of Standard Meters in Northern Ireland. In a passive rollout, the scale of the meter replacement programme itself does not increase and there would be a negligible change in workforce and/or supply chain capacity requirements and so this section on logistics therefore focuses on an active rollout.

The active deployment rates indicated in this report, developed through stakeholder engagement, scenario optimisation, and research into other jurisdictions, are idealisations that seek to consider the capacity of the market for delivery. Capacity considerations are explored across several themes: installation; IT and security; communications; and supply.

5.3.3.1 Installation

In an active rollout, the rate of installation of new meters increases over the current replacement rate delivered by the DNO. Naturally therefore the suite of technicians and engineers available to deliver installations would have to increase. A simple assumption might be that if the volume of installations required increases, the volume of installation staff must therefore also increase at a rate directly proportional. This may be considered the upper bound for costs as it is unlikely that the volumes of engineers would be greater than this.

There may be efficiencies to be had however which reduces the cost on a per installation basis. For example, the rollout may be geographically optimised. Where currently engineers must travel significant distance between installations, with an active rollout, an entire street may be targeted in a batch installation. Travel times become less significant and installation rates increase.

In contrast to these efficiencies, there are aspects of a Smart Meter installation that may increase the time of installation (per meter). Engineers would need to ensure that the communications hub is connected and is demonstrating a suitable CTF-like performance metric (see A.4.4.2.1). This may require the installation of additional antennae in more rural areas.

The increased requirements on the DNO for RP7[18] which impacts on its resourcing as a business should be considered. Significant planning would be required during the Smart Meter procurement stage to optimise deployment and mitigate risk of disruption.

5.3.3.2 IT, Data, and Security

Currently in Northern Ireland, the Networks read and track meter data and make it available to Retailers. If this onus is transferred to a new party, a new management team will be required with the capacity to deliver the data collecting process. This responsibility shift, and capacity requirement, is independent of a Smart Meter rollout as data would have to be collected for Traditional Meters as well as Smart Meters.

If Smart Meters are deployed in parallel, a rapid development of the CPB's IT and security capability to deliver will be required. This skill must be adequate and comprehensive given the challenge posed by the scale of personal data being captured and the modern importance of IT security.

With respect to Retailers, they would have to develop teams to design and maintain their internal databases and the interface/relationship with the CPB and its IT solution.

5.3.3.3 Communications

As part of its role, the CPB would also be managing the communications service connecting meters with a database via a communications network. This is a significant capital and operational undertaking, and it would be necessary to build a team with the appropriate capability (skill and resource) to manage budgets, assets, and the programme generally.

As the infrastructure maintenance would possibly be outsourced to a 3rd party for delivery, there would additionally be required a component of contract management to ensure Service Level Agreements are developed and operated effectively.

[18] RP7 is the upcoming regulatory price control, set by the Utility Regulator in NI, that will set the costs for all consumers of electricity and the revenues for entities within the energy sector.

With the addition of communications infrastructure, there would be a requirement for technical engineers who maintain the communications network specifically. This may be fulfilled by the 3rd party described above as part of the service package or via a maintenance team within the CPB.

5.3.3.4 Material Supply

The EU has recognised a global shortage of materials, in particular technical components like computer chips[19]. Due to this shortage and the impact of COVID-19 on global supply chains, there is a shortage of semi-conductors among other crucial components, which impacts the ability of Meter manufacturers to produce and supply electricity meters[20].

This is a risk that affects the procurement of any meter but Smart Meters in particular which by their nature require more technical components than a Traditional Meter.

Worldwide industries are looking to mitigate this challenge which places all aspects of renewables development at risk. The EU has recently launched its European Chips Act which seeks to invest €43B in the development of EU semi-conductor manufacturing[21]. Nonetheless there will be short term issues concerning the availability of supply that may influence the cost and timeliness of a rollout.

5.3.3.5 Programme Overall

The programme will require a significant redistribution of resources and the creation of new roles. A CPB approach, as described in section .2, sees most of the resourcing concentrated within this new entity with some capacity transferring in (e.g. metering teams) from existing companies.

Programmes of this scale are complex, and a dedicated Programme Management function would have to be developed to ensure the smooth operation of his entity.

To summarise the high-level functions/departments required to deliver on the role responsibilities of a CPB:

- Leadership
- Programme Management
- Meter Point Administration (including traditional meter reading)
- IT and Security
- Communications Infrastructure Management (including Asset Management)
- Contract Management

5.3.4 Prioritisation

A key question raised by stakeholders is concerned with prioritisation of Consumers receiving Smart Meters.

Rollout should be on the basis of focusing on those consumers where there is likely to be a significant benefit i.e. those involved in energy transition activities e.g. Solar Photovoltaics, Electric Vehicles, Heat Pumps, and smart appliances. Ultimately the prioritisation and optimisation should be impact and benefits led.

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[19] European Chips Survey | Shaping Europe’s digital future (europa.eu)

[20] Monitoring of the meter stock shortage, driven by global materials availability and supply chain challenges - Elexon BSC

[21] European Chips Act | European Commission (europa.eu)

A high-level prioritisation and optimisation approach is discussed. Demographics have been prioritised into three groups based on conversations with stakeholders. Note that this hypothetical approach would need to be assessed via an equality impact assessment so that there are no discrimination issues.

5.3.4.1 Priority 1 - Fundamental Groups

Some Consumers require meters and sit above any degree of deployment optimisation. These are the Consumers that absolutely need a meter due to being new connections or because a previous meter needs replacing. This is also the group that would see a Smart Meter installed under a passive rollout.

Each year the DNO currently replaces some of its Traditional Meters due to expiration of the product's service life, which is around 20 years, and due to fault. ESMs also have a shelf life of around 20 years and therefore this ongoing replacement scheme would naturally continue with the only difference being the type of meter that gets installed.

Also, within this group are new connections. For the sake of cost and time efficiency, it would make sense that all new connections are fitted with a Smart Meter rather than a Traditional Meter that would have to be subsequently replaced.

5.3.4.2 Priority 2 – Consumers with Impact

It is required by an EU Directive[22], which also applies to NI, that Member States that do not systematically deploy Smart Metering systems should allow consumers to benefit from the installation of a Smart Meter, upon request. This language does not seem to apply where there is a systematic rollout but, in any case, the CPB might choose to acknowledge the spirit of this statement and make those consumers who specifically request a Smart Meter, a higher priority.

This prioritisation offers tangible benefits. Stakeholders voiced that these *tuned in* Consumers are the ones who are particularly valuable in a Smart Meter deployment as they are typically more interested in their energy consumption and will avail of the full suite of smart services offered. Proper utilisation by invested parties offers significant benefit over and above that of a typical Consumer through consumption reduction.

Another group within this bucket of priority would be those Consumers with low carbon and smart-ready technologies. This would include smart appliances, heat pumps, solar panels and electric vehicles. Technologies that may integrate with or benefit from a Smart Meter deployment. These consumers remain critical because their technologies give them greater capacity to be Smart Service users. They should be a priority for installation but also the marketing and education required to make use of the Smart Services to their maximum potential.

To enable maximum benefits, it is critical that a consumer does not just have the Smart Meter but that they utilise the Smart Service.

There is also a crucial element of ethics and social value. A deployment cannot discriminate against any of the protected characteristics[23] and should be fair in selecting the Consumers that avail of Smart Meters sooner. Covid-19 highlighted some issues concerning vulnerable customers who prefer or are unable to top-up their PAYG meters online. The DNOs and suppliers had to develop temporary and expensive solutions for these Consumers which

[22] DIRECTIVE (EU) 2019/ 944 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 5 June 2019 - on common rules for the internal market for electricity and amending Directive 2012/ 27/ EU (europa.eu)
[23] Protected characteristics | Equality and Human Rights Commission (equalityhumanrights.com)

may have been better facilitated by a Smart Meter design. A Just Transition sees that no groups of Consumers are left behind in the advancement towards a low-carbon economy and Smart Meters are a technology that can support this ethos. Detail on how the meters can be functionally designed to support vulnerable and less technologically able groups is discussed in sections 4.6 and A.5.

5.3.4.3 Priority 3 – Remaining Consumers

Within the bucket of remaining consumers, an optimisation may be carried out such that benefits can be maximised and costs minimised indirectly. This optimisation may be largely geographic in its design but should consider other factors such as customer vulnerability, capacity for delivery, and consumer marketing/engagement.

A deployment might target rural communities as presently these meters are the most expensive to read due to the distances travelled to get readings. On the other hand, greater volumes of meters can be installed more rapidly in urban areas when installations can be clustered and delivered in batches. If there are supply issues however, it may not be possible to reap the full scale of benefits of batch installations, and an optimisation strategy might look for a temporal solution. One strategy could target rural communities when supply is low and urban communities when supply chains are more robust.

5.3.4.4 Summary

In summary, designing a deployment strategy is complex and subject to several factors. A technical, benefits-focussed optimisation should be a priority of the delivering party, the CPB, as part of its deployment planning. Again, the deployment should seek to maximise benefits to the Consumer and other sector entities with respect to significance and time.

5.3.5 Timescales

In further development of the dichotomy of active versus passive rollouts, there are considerations of pace.

5.3.5.1 Passive Rollout

In a passive rollout the pace is implicitly defined as rate of replacement, new connections, and requests for Smart Meters i.e. all Priority 1 Consumers and some of the Priority 2 Consumers.

Rate of replacement is somewhat known by the sector based on current meter asset data i.e. age of the meter.

New Connection rates may be estimated via household forecasts and historic growth rates.

With respect to the volumes of Consumers who specifically request a Smart Meter, this at a high level is a function of consumer knowledge, engagement, and ease of application.

5.3.5.2 Active Rollout

Defining the pace of an active rollout is somewhat more involved. In addition to the installations of a passive rollout, an active rollout delivers the remaining Priority 2 and the Priority 3 Consumers sooner.

Delivery of these additional Consumers, and the overall pace of an active rollout, is largely dictated by the capacity of the deployment. This capacity should balance an appropriate degree of urgency with that which is realistically achievable. It should consider therefore the requirements to build installation capacity and also what follows the deployment i.e. considers what happens to installation engineers once all Smart Meters are deployed and the industry returns to the passive replacement and new connections scale of pace.

Based on rollouts in other jurisdictions, in its first year the NI rollout would exhibit continued installation rates that match current replacement and connection rates, i.e. maintains the DNO's current meter installation rate per annum. This rate would then increase across subsequent years incrementally to deliver the deployment in line with a set of milestones.

In driving a deployment, Spain took the approach of staggered intermediary milestones which provided continuous pressure. As per A.2.1.3, Spain's government permitted DNO's six years to achieve the first 35% of installations, two years for the next 35%, and two years for the final 30%. The first milestone gave DNO's time to lay the foundations for deployment and invest in capital. Subsequent milestones forced a substantial per annum increase in rate utilising the six years spent developing good practice, building capacity, and improving efficiencies.

GB on the other hand has recently set a target of 85% by 31st December 2024 and to achieve this has also defined minimum annual installations for each Retailer. These minimums are calculated using a formula which seeks to 'draw a line' between the current percentage of deployment and the 100% target. It is an adaptive algorithm, with tolerances, that adjusts if a Retailer falls short each year but generally equates to 25% annually. This approach is necessary to account for where Consumers change Retailer which can affect Retailer performance against the minimums. This approach is redundant where Smart Meters are delivered by a single agent, such as the DNO.

As in all programmes, well-considered and staggered milestones are key for driving delivery but in the development of a Smart Meter deployment strategy, it is key to develop milestones that acknowledge realistic capacity. This will involve engaging with parties involved in delivery and being aware of their bias e.g. the company to be held to account to a target will naturally seek more relaxed goals to reduce their own risk.

5.4 IT and Data in Northern Ireland

This section follows section 6, offering a tailored view for the electric utility in NI.

5.4.1 Ownership and Management

As all stakeholders have advocated for a DNO led rollout, it should be considered that the DNO owns and operates a single MMS rather than Retailers operating their own. That being said, Retailers would have to evolve their own IT systems so that they can interface with the MMS to deliver their components of the Smart Service e.g. Tariffs.

It should be considered that the MMS is part of the Smart Service. Whilst the implementation itself would be owned and managed by the DNO, its data is owned by the Consumer and some functions are executed (by request) by Retailers. It is therefore critical that the IT/deployment contract is sufficiently drafted such that DfE has appropriate recourse to hold the DNO accountable and incentivise delivery of good performance. It is also critical that DfE has the capacity to provide suitable contract management to ensure ongoing performance of the service.

5.4.1.1 Project Management

A dedicated team within the responsible party is required to be established, and funded, to procure and subsequently deliver the MMS.

5.4.2 Solution Types

The two principal options, from the perspective of the entity owning the MMS, are a Software as a Service (SaaS)[24] and a self-hosted (sometimes known as on-premises) solution.

Self-hosted software is any software you host on one's own servers rather than a third-party provider. This means that one has complete control over the data and applications, but it also means that one is responsible for keeping everything up and running.

SaaS is a software distribution model in which the software is provided to customers on a subscription basis. SaaS applications are typically accessed via an application, while the underlying software and data are stored on the provider's servers, or 'clouds' with maintenance responsibility outsourced to the provider.

5.4.3 Skill Challenge

Stakeholders have expressed that the energy sector in NI is not well used to modern IT models such as SaaS. Therefore, it may be necessary if a modern solution is procured, that the responsible party procures additional, necessary skills and resources above that which it currently possesses.

[24] Software as a service (SaaS) allows users to connect to and use cloud-based apps over the Internet. Common examples are email, calendaring, and office tools (such as Microsoft Office 365). SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider. It is beneficial in that the party responsible need not have the skills nor resources to manage the solution directly.

5.4.4 Costs

In delivering and maintaining the MMS. There are several areas of management and cost to consider. Areas of cost include project management, back-end solution development, front-end development, data hosting, and security.

5.4.4.1 Capex

Capex cost is solution dependent but generally there would be a requirement to invest in any hardware or development costs associated with the solution. If a SaaS solution is selected, there might be upfront development costs for the provider to design an appropriate system. Significant cost would be consumed in developing the suite of system requirements for this provider.

If a self-hosted solution is preferred, then the party responsible would need to invest in adequate servers and related overheads in addition to the development costs.

5.4.4.2 Opex

There are several areas of Opex of which some are solution dependent.

SaaS solutions being subscription based usually require ongoing funding which covers software maintenance and data-hosting costs. With respect to SaaS data hosting, the client usually pays proportional to the amount of data i.e. as more Smart Meters come online, more data is required to be stored, and therefore data-hosting costs increase.

A self-hosted solution requires the funding of the ongoing maintenance with the party responsible for maintaining the MMS service. Costs might include overheads, security, utilities, and hardware/software developers.

5.4.5 Data

As stated in section , GDPR applies in NI and must be strictly adhered to across a Smart Service.

It is clear from the EU Directive[25], which at present continues to apply to the UK, that the **Consumer owns the data** at all stages of its existence. In the deployment of a Smart Service, there must be a provision of a Data Access Code to which all parties adhere that governs usage, management, and the mechanisms through which the Consumer can own their personal data and that other parties can use the anonymised, non-personal data.

Workshop attendees expressed a specific concern for consumer data management. The referenced anecdote discusses how energy usage trends for a given consumer might be used to determine their lifestyle habits such as when they leave the house (e.g. consumption drops between 8am and 6pm every weekday)[26]. This data may be used maliciously if it is not managed with the strictest of security and access measures.

Stakeholders suggest that deployments in other jurisdictions have been so preoccupied with getting data that they have not paid due consideration to the regulations surrounding it. It is critical that the deployment considers personal data and GDPR upfront.

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[25] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN

[26] Traditional assumptions may not hold up given to flexible working arrangements following Covid-19 pandemic.

The recommendations paper prepared by the EUC[27] suggests that each jurisdiction prepares a Data Protection Impact Assessment which describes operations to mitigate the identified risks in managing personal data. If conforming to EU legislation, this document needs to be produced by the DfE.

5.4.6 Comparing Solutions

It is generally considered that SaaS solutions feature reduced Capex and increased Opex. Whilst the MMS owner is responsible for the MMS service, they can also hold the third-party provider to account on poor performance. The MMS owner need not develop the specific software design and programming skills in-house. From a security perspective, SaaS involves hosting the data on another party's servers which offers a component of risk.

Self-hosted solutions require substantial capital investment and Opex. Responsibility remains within the domain of the MMS owner, but they also have more direct control over costs, security, and software design.

This report does not cover a technical comparison of IT solutions. Further analysis is required to support a thorough procurement exercise that focuses on lifetime costs to the Consumer.

[27] Commission Recommendation of 9 March 2012 on preparations for the roll-out of Smart Metering systems (europa.eu)

5.5 Communication Infrastructure in Northern Ireland

This section follows section 7, offering a tailored view for the electric utility in Northern Ireland. In delivering communication infrastructure, the responsible party is required to make several considerations in procuring a solution.

This section references concepts, data, and terminology defined in A.4.

5.5.1 Procuring a Wide Area Network solution

The principal decision is the communication technology to deliver the WAN. In most cases in Europe, a Power Line Communication (PLC) based solution was prioritised given that it leverages existing infrastructure with known operation and maintenance practices. This solution is the ideal for Northern Ireland given the existence of a single electricity DNO and that all premises that require an ESM by their nature are connected to the distribution network. There is a risk to this assumption however that the distribution network in Northern Ireland, much like in Ireland, is not yet PLC-ready. An analysis would be required by the DNO to understand the steps that would be required, and the associated cost, to bring the distribution network up to this standard.

It is critical to note that 2G and 3G cellular networks will no longer be supported in the UK from 2033. Considering the lifetime of Smart Meters (20 years) and a deployment commencement date around 2026-2030, a cellular technology solution employing these network generations would be unsuitable. A LTE or 4G+ solution would be required but this introduces connectivity and coverage issues in Northern Ireland. As none of the existing sector entities have the infrastructure for a cellular communications network, this would have to be outsourced. This is a source of significant cost in other jurisdictions in terms of Capex (e.g. construction of data collectors) and Opex (e.g. mobile operator and data transmission costs).

Long Range Radio might be an appropriate WAN technology that is currently operating in Scotland that would require infrastructure investment in Northern Ireland. No sector entities currently have the infrastructure to support LRR and therefore this system would likely require outsourcing.

Some stakeholders expressed an interest in understanding whether the WAN would integrate and be managed via the DCC in GB. This is a system design decision that should be drawn out as part of any ongoing programme planning.

A thorough technical cost-benefit analysis is paramount in procuring a futureproof communications system and to better understand the costs. It would be prudent that the DNO is heavily involved, if not leads, on this analysis given the possibility of a PLC solution.

5.5.2 Performance

Like the CTF example employed in Ireland, a suite of KPIs would be required in NI to assess installations and the ongoing health of the communication network. If this network is fulfilled by a 3rd party e.g. a cellular network, an appropriate Service Level Agreement (SLA) would be essential to ensure reliability and performance of the network over the lifetime of the Smart Meter. These SLAs which can be procured similarly to a regular telecommunications or IT contract to provide mechanisms of financial clawback where communications performance is inadequate.

The CPB can draw insight on developing SLAs and service contracts from other major telecommunications projects such as DfE's Project Stratum[28].

5.5.3 Procuring a Home Area Network solution

A HAN-capable Smart Meter that uses an industry accepted standard such as Zigbee[29] is fundamental in delivering a Smart Meter network that can leverage the full scope of interconnectivity required for interaction with other Consumer Technologies.

5.5.3.1 Electricity and Gas Interconnectivity

The interaction between the ESMs and GSMs in GB is worth noting. Only one communications hub is required per premise and the two meters are able to exchange data securely via the HAN. This might not be as feasible in NI because the electric and gas meters are not typically installed in proximity. Quite often the gas meter is placed externally. An integrated solution is possible, but a HAN network must be designed that can cope with the range.

Advantages of an integrated system include reduced meter costs (due to a single MCH) and reduced communication and IT costs (due to a single system rather than two/multiple). The challenge of ownership across the electric and gas sectors would be a point of discussion and perhaps in this case a utility-agnostic central body would be beneficial.

5.5.4 Delivery

As implied by the evolution of DCC from contract manager into a company that delivers all the core functions in-house, the management of the communications network is no small task, and its owner must provide services that include programme management, design, assurance, and maintenance.

If the CPB were to deliver the communications network alongside the meter deployment programme and the IT system, there would be a significant requirement for expertise and additional resources.

5.5.5 Regulation and Oversight

The GBCS was developed to provide the specification for the communication network in GB. The SEC was established to provide the multi-party agreement between all sector actors.

Similar standards, contracts, and agreements would be essential in the establishment of an NI programme to hold the involved bodies to account. Significant resource would be required within government and the UR to develop from scratch equivalent agreements or the tailoring of these specific documents for application in NI.

[28] Project Stratum | Department for the Economy (economy-ni.gov.uk)
[29] Zigbee | Complete IOT Solution - CSA-IOT

5.6 Smart Meter Functionality in Northern Ireland

This section follows section 8 offering a tailored view for the electric utility in NI. This section specifically draws attention to areas of Smart Meter functionality considered critical by research into other jurisdictions as well as components of functionality raised by stakeholders. A fundamental step in the consideration of Smart Meters in NI is a full technical review and development of a meter specification.

This section references concepts, data, and terminology defined in A.5.

5.6.1 Pay-As-You-Go (PAYG) Metering

Prepayment Meters are abundant with circa 45% of domestic ESMs being PAYG[30]. Customers can top-up their energy balance and drawn down from this balance as electricity is consumed. This culture of prepayment is somewhat unique in Northern Ireland with most consumers in other countries in the EU adopting a Credit Meter.

No metering deployment in Northern Ireland can succeed without consideration of PAYG. This is a sentiment affirmed by stakeholders. Prepayment Meters are often a preference choice in NI, affording consumers more control over their consumption in financial terms and a reduced opportunity for debt.

5.6.1.1 Types of Prepayment Meter

Several different types of Prepayment meters are available in NI. The two high-level types are the card-based solution and the keypad-based solution. The former makes use of a top-up card, which the consumer can take to a PayPoint terminal in Northern Ireland to add balance. The locations of these terminals are often in areas of convenience such as supermarkets, petrol stations, corner shops, etc. The keypad solution generally involves the consumer generating a code, either via a PayPoint terminal or online, which is entered into the keypad to redeem the balance on the meter.

5.6.1.1.1 Approaching Smart

Some Retailers are already piloting versions of the keypad meter which realise some of the benefits of a Smart Meter. Recent products use a dedicated application that connects with an advanced keypad meter via Bluetooth. This offers a form of remote top-up, the option to view one's balance, notifications when the balance is running low, and basic consumption tracking[31].

[30] Statistics from Utility Regulator's May 2021 Transparency Report

[31] Worth noting is that the mobile device must be within Bluetooth range (akin to that of a HAN) of the meter to be connected. The Consumer cannot avail of any of these benefits outside of this range which according to the Bluetooth website is c.30m indoors.

These meters offer a Time Of Use (TOU) Tariff, Economy 7 with distinct rates for day and night. There is no suggestion that these meters can offer other dynamic tariffs e.g. Hour-by-Hour, EV-specific Rates, etc.

The functionality of these meters including data and communication protocols is unknown as the design specification is not publicly available.

5.6.1.2 Prepayment Meter Issues

The PAYG system is not without flaw. Covid-19 presented an issue with some consumers unable to travel to PayPoint locations for topping-up their cards and meter balance. Solutions were developed, at cost, to the Retailers and Network entities to provide consumers with a balance, but the process remains somewhat manual. Even if you top up online, you have to manually update the meter via input of a code or card.

Another event that challenged NI's current PAYG Meters was a shortage of top-up cards. Suppliers of the original card discontinued their products such that there were none available for new meters or replacements. Fortunately, PayPoint were able to change their systems to accept a new type of top-up card which would work for existing meters. It was not made clear who financed this update.

Worth noting is that Prepayment Meters cost c.175% more than Credit Meters due to the additional hardware required to track balances, rates, and deliver PAYG as a function.

Despite these issues, PAYG as a service is fundamental in the procurement of a Smart Metering solution in NI. Any solution might consider more innovative approaches to deliver PAYG, but these must accommodate all demographics (including those less affiliated with modern technology such as mobile applications or web platforms). Also, that substantial deviation from current Prepayment methods might cause Consumer lifestyle changes and therefore incur pushback.

5.6.2 Obsolescence

An imminent issue to already face the gas Prepayment meter market is the availability of meters and this may also impact existing electricity Standard Meters. The original contract guaranteeing supply of PAYG Meters, which is a joint contract shared by the three gas DNOs, did not originally apply beyond December 2022 although this has since been delayed to 2024. Whilst this specific case applies only to gas, it may become relevant to the electricity sector before 2050.

With nearly all of Europe implementing Smart Meter programmes, there is a significant risk that local manufacturers will stop producing Traditional Meters. Looking further afield for the supply of these Traditional Meters, may increase costs.

5.6.3 Functionality

The following subsections outline the core functionalities of a Smart Meter solution in NI as raised by stakeholders and through research.

5.6.3.1 Design and Core Functions

The Smart Meter should be aligned with some fundamental design principles.

Standard Meter Functions

Principally, the Smart Meter should be capable of delivering all functionality currently offered, and used, by Standard Meters in NI.

Just Transition

The design should drive the Just Transition agenda by enabling all Consumers to transition to a more climate change aware usage of energy and not leave any group behind.

Ease of Use

The design should cater to all demographics with heavy consideration for vulnerable customers, those less familiar with modern technology, and those experiencing energy poverty.

Thin Client

The meter should tend towards a Thin Client design to minimise cost and maximise futureproofing.

PAYG

Meters should have the fundamental elements to deliver prepayment functionality as per section .

Disconnection and Reconnection

Meters should be capable of remotely disconnecting and subsequently reconnecting supply of electricity.

Supplier Switching

Design should permit the automated changing of Consumer's electricity supplier without any loss of functionality.

5.6.3.2 Metrology and Core Functions

The Smart Meter should deliver an extended metrology capability.

Accurate and Regular Reading

The market is currently settled on a half-hourly basis. The meter should support this by delivering readings on a matching timescale. This benefits Retailer and Network entities.

The meter should be appropriately precise in its measurements.

Fault Identification

The meter should be able to offer an enhanced capability for identifying faults i.e. loss of power from distribution network. This benefits Consumers (earlier identification of faults) and Networks (for gauging the coverage of power loss and isolating the root cause).

Energy Theft

Meter readings should be such that they can contribute to the identification of energy theft i.e. identifying precisely what the premise claims to use versus that which the distribution network provides. This benefits all parties. The design of the SMETS2 meter in GB, as an example, has been specifically engineered in collaboration with the NCSC to prevent tampering.

Auxiliary Loads

The meter should be able to measure and control auxiliary loads. This is the ability to measure where the electricity goes within the premise i.e. general electricity usage is tracked separately from heat pump or EV usage. This is the hardware functionality of the meter that primarily benefits Consumers by facilitating advanced dynamic tariffs e.g. a special tariff for heating.

Stakeholders have claimed that no specification currently delivers this capability however GB's SMETS2 does require Auxiliary Load measurement functionality (see Table 60 of Appendix B).

Quality of Supply

The meter can be designed to measure voltage quality which may support the DNO in maintaining the grid and the TSO in its supply/generation of energy.

5.6.3.3 Software and Smart Services

Some elements of functionality are delivered via the Computational Unit and its software.

Multiple and Dynamic Tariffs

Meter should be capable of tracking multiple tariffs. Meter should be capable of tracking dynamic tariffs i.e. those that vary with time or with type of consumption (e.g. electricity used for heat via auxiliary loads).

Data

Meter should be able of recording and securing all constant, internal, configuration, and operational data (see Table 60 of Appendix B).

Payment Mode

Via software, hardware, and configuration data, the meter should be able to change its payment mode i.e. Credit and Prepayment.

Debt Recovery

The meter should facilitate flexible debt-recovery and emergency credit mechanisms.

Meter Display

The Meter itself must offer a basic display and interface for inputting commands or reviewing data.

5.6.3.4 Interface

The Smart Service might offer some additional user-friendly interface for reporting on data points e.g. consumption, estimated spend, etc. Solutions to consider are an In-Home Display, a web application, or a mobile application. There may be other solutions proposed by the market.

This interface need not be attached to the meter but communicate over an internet download from the MMS or interface with the meter directly via a HAN. Some form of Consumer-oriented interface is critical in connecting consumers to their data and driving a societal behaviour change.

5.6.3.5 Connectivity

To deliver a complete Smart Service, the meter should be connected to the wider network. This functionality is delivered via the MCH element of the Smart Meter.

WAN

Meter should be capable of connecting to the WAN. If the overall WAN solution requires it, the MCH should be capable of adopting various configurations e.g. PLC encoder, Cellular antennae, etc.

HAN

The MCH should be capable of generating a HAN, using technology understood by the industry (e.g. ZigBee) of a standardised but secure configuration, to facilitate integration with other Consumer technologies.

Where an integrated ESM and GSM solution is designed, the HAN might be required to facilitate a service comparable to the SMETS2 Gas Proxy Function (see Table 60 of Appendix B).

MMS

The MCH should be able to interpret and receive commands from the MMS.

5.6.3.6 Security

Security of the Smart Meter is paramount.

Physical

The meter should be tamper-resistant and be able to record interference events to the MMS.

Software and Local Data

The internal software and locally-stored data must be secure, encrypted, and resistant to attack per standards set by the NCSC.

Data and Communication

Communication should be encrypted and resistant to attack per standards set by the National Cyber Security Centre (NCSC). Authorisation control is essential in controlling which external devices can interact with the Smart Meter to prevent unauthorised access.

5.6.4 Developing an NI Specification

It is critical that any specification used is developed and tailored specifically for Northern Ireland. Most electricity-sector Stakeholders expressed that SMETS2 is a good starting point which may require appropriate adjustments for a different communication solution. Some stakeholders pointed out that this GB standard is overly prescriptive whilst others noted that the level of detail it gives is essential for delivering a consistent, Consumer-benefiting rollout.

GB stakeholders pointed out that BEIS was heavily involved in the development of SMETS2, even at a technical level, and that a similar level of involvement in NI would be required of the government to ensure the rollout maximises Consumer benefits.

With growing public sentiment questioning how personal data is used by the government and sector bodies, transparency of the design specification and requirements is key.

5.7 Other Technologies

This section of the report is concerned with innovative technology solutions identified as part of the research process as well as the Consumer Technologies that are supported by the implementation of a Smart Service network.

5.7.1 Communication Network Technologies

Internet of Things (IoT) has been identified as an innovative application of technology to mitigate issues with a cellular-based WAN. See section A.4.3.1.3 for more detail.

5.7.2 Other Consumer Technologies

There are a range of technologies that can integrate with a Smart Service to deliver advanced functionality beyond the scope of the Smart Meter itself. These are explored at a high-level in this section.

5.7.2.1 Heat Pumps

Heat Pumps are modern electrical devices used to provide low carbon heating offering as an alternative to the traditional gas, oil, or electric boiler methods of central heating. In the right premise, they offer an energy efficient pathway that eliminates the direct use of fossil-fuels and when supplied with electricity from clean sources, eliminate emissions completely during operation. Heat Pumps are seen as a means for decarbonising heat in the UK[32] as a whole including Northern Ireland but have struggled with uptake due to high capital costs and lack of incentive due to energy prices.

Heat Pumps benefit from integration with a Smart Service where with appropriate products from Retailers (see 8) and meter functionality (see 6), special tariffs can be applied to reduce operational costs in an effort to incentivise uptake.

In a truly dynamic system, built on trust between Networks, Retailers and Consumers, even more advanced benefits may be possible such as the remote switching-on of Heat Pumps by network operators during periods of curtailment in order to provide Consumers with free heat and avoid curtailment costs.

5.7.2.2 Microgeneration

Consumer microgeneration is becoming more prevalent with the uptake of such technologies as domestic Solar Photovoltaics (Solar PV). These technologies benefit substantially from integration with a Smart Meter that can facilitate and track the export of spare electricity back into the network.

From the network's perspective, integration with the Smart Service facilitates Demand Side Management (DSM) (see 4.10).

Worth noting is that in Ireland, if a customer with microgeneration refuses a Smart meter, they are not renumerated at all for their supply to the grid. It is possible that this could be replicated in Northern Ireland to promote uptake, but it should be considered how this may block uptake of microgeneration if Smart Meter supply is challenging.

[32] Five reasons to get a heat pump - GOV.UK (www.gov.uk)

5.7.2.3 Electric Vehicles

From 2030, Consumers will not be able to purchase new internal combustion engine vehicles driving a shift towards Electric Vehicles (EVs) [33]. This will place significant demand on the distribution network reinforcing the need for Smart Meters which can be used to track this demand and understand consumption patterns for managing the networks.

From the Consumer perspective, like Heat Pumps, EVs may avail of dedicated tariffs and Smart Meter functionality for cheaper electricity. This is even more applicable where EVs can be programmed to charge at night during off-peak hours in order to reduce running costs[34].

Electric Vehicles also play a role in DSM offering energy storage capacity that under an advanced network can be utilised to support the grid during peak demand e.g. Consumers who plug their EV in at home may give network operators permission to draw energy from the vehicle (up to a threshold) to support demand elsewhere and in return receive compensation for the energy used.

5.7.2.4 Smart Appliances

Smart Appliances refer to in-premise devices that can benefit from TOU tariffs or wider integration with a Smart Service. An example is a Smart Dishwasher which is programmed to operate during off-peak hours, utilising cheaper electricity rates. Naturally products that can integrate via the HAN and utilise the Smart Service in this way are of benefit to the Consumer.

They may also benefit the network companies through DSM where, with permissions, networks can disengage certain appliances during period of high load and reengage them after to protect the grid from excessive demand.

One stakeholder suggested consideration of integration with home technology devices such as Amazon’s Alexa. Whilst possible, there is substantial consideration to be made for Consumer data protection and the uncertainty surrounding the loss of ownership when data is surrendered to private, unregulated businesses.

[33] Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030 - GOV.UK (www.gov.uk)

[34] This is less applicable for Heat Pumps where Consumers generally look to have their heating on during waking hours.

5.8 Tariffs in Northern Ireland

Responses[35] to a call for evidence on tariff reform in Northern Ireland demonstrates support for a review of tariff structures and that timely decisions on tariffs are required to support energy transition efforts. The timing of this tariff review offers potential opportunities in the context of a Smart Meter rollout as reforms may be introduced in advance of or in parallel with the rollout.

The majority of domestic customers in NI fall into the standard domestic premises group which means that they pay one unit charge on all units of electricity consumed. There are some domestic customers on day/night rates which offer reduced unit rates for consumption overnight. This differs to other neighbouring jurisdictions, such as GB and ROI, which already offer more flexible time-of-use tariffs for those customers who have a Smart Meter installed. It is clear from the literature review and feedback provided that more flexible tariff offerings, such as time-of-use, are required to realise Smart Metering benefits.

There are some smart services offered in NI at present. As part of the Keypad metering solution, Power NI developed a TOU tariff - Keypad Powershift. Uptake of this offering has been restricted to c.1,200 customers potentially due to the high rates charged for use during peak time. This is valuable experience and learning of how customers react to a time of use tariff.

In August 2021 Power NI launched 2 new tariffs exclusively for customers who own or lease an electric vehicle (EV) and charge at home. Power NI's customer proposition for EV owners was developed based on engagement with EV users and the options available within the current tariff and metering arrangements. Power NI offer two tariffs, one single rate (EV Anytime) and one 2-rate (EV Nightsaver). Uptake of the tariff has been positive with over 1,300 customers to date registered. Of these 96% are registered for the 2-rate tariff.

Insights from GB and ROI show that the uptake of TOU tariffs rely on tailored awareness and communications campaigns which notify customers with Smart Meters of the range of offerings available and the benefits of switching to flexible tariffs. Media reports in ROI suggest the uptake of TOU tariffs has been low due to lack of tariffs offered and consumer awareness of benefits[36]. This is despite measures such as the TOU primers campaign and so realisation of some benefits of a relatively fast rollout of Smart Meters may be lower than expected.

Phased introduction of TOU tariffs in other jurisdictions involved an initial standard smart tariff which offers a third band over a standard day and night. This offers some potential benefits in regard to shifting from peak times. However, in the absence of the effective communications campaign standard smart tariffs may result in consumer concern relating to higher day rates when compared to traditional rates. This is particularly important if the use of initial standard smart tariffs results in higher costs for an average consumer when compared to traditional tariffs. In other words, if standard smart tariffs or TOU tariffs only

[35] https://www.uregni.gov.uk/files/uregni/documents/2021-12/electricity-tariff-reform-call-for-evidence-responses-report.pdf

[36] Electricity Ireland: Almost a million Smart Meters not being used in €1.2bn scheme - Independent.ie

provide a saving if demand is effectively shifted away from peak times consumer must be made aware of this before switching. This is especially important for consumers with inelastic demand which cannot be easily shifted. Learnings from the Power NIs Keypad Shift suggest that well informed consumer will not switch to a TOU tariff unless there is a net saving on their electricity bill.

5.9 Electricity Sector Qualitative Considerations

This sub-section presents an overview of key qualitative impacts and considerations of a Smart Meter rollout across the electricity sector, from the perspectives of the network, Retailer, and Consumers.

5.9.1 Generation, Transmission, and Distribution

The following are positive impacts and challenging considerations explicitly cited by stakeholders that a successful Smart Service deployment would deliver for network companies.

Improved and more efficient network planning

Consumer-side usage data helps the DNO map usage and peaks across the network. Data provided by Smart Metering infrastructure can help target areas with the greatest reinforcement needs. This data will also assist with development of models representing the Low Voltage network, and help to address arising from the roll-out of low carbon technologies such as heat pumps and electric vehicles.

Improved demand side management

Demand Side Management (DSM) involves users of electricity having the capability to change their usage from their normal or current consumption patterns. It can provide significant benefits for customers in terms of reduced bills and gives them greater control over the energy they use and produce[37].

It also helps the network companies manage the power system efficiently; encouraging reduced or greater consumption to match generation. i.e. if renewable generation drops, networks can request Consumers reduce their consumption rather than ramp-up generation through fossil fuels.

Improved planning for new connections

By understanding how the local network uses electricity at a granular level informed by Smart Meters, the DNO can better understand whether that local network is already appropriately designed for a new connection or whether an upgrade is necessary.

Avoidance of load-profile purchase (concerting quarterly figures into a half-hourly settlement)

The wholesale electricity market is settled on a half-hourly basis. The Retailers and network companies currently have to convert the more irregular meter reads (c.1-3 months) into half-hourly estimates. This conversion process is outsourced to a third-party which incurs costs and as an imperfect process it inevitably produces conversion losses.

[37] Demand Side Management (eirgridgroup.com)

Improved visibility and more accurate reporting of network performance

A near Realtime view of usage helps the DNO understand the network and report on performance issues more accurately. Smart meter data can be leveraged to develop more detailed network models, including models of low-voltage distribution networks.

Monitoring voltage levels including safety implications

Smart Meters will assist in monitoring the quality of supply to electricity consumers helping to ensure that key power quality limits, such as voltage levels, are met. Smart meter data has been used in other jurisdictions to identify potential safety hazards, such as faulty LV neutral cables.

Facilitates tariff reform

A component of the Consumer's energy bill is the network usage fee for covering the costs of the DNO and distribution. In addition to Retailers, the DNO can offer dynamic and TOU tariffs to facilitate better utilisation of the network infrastructure. Tariff reform is expected to incentivise the Consumer to reduce consumption at peak times which benefits the DNO by minimising the need for network reinforcement.

Note, this requires product development and investment by the DNO.

Supports a flexible, resilient and integrated energy system

One of the five key principles of the DfE's Energy Strategy is to create a flexible, smart and digitised energy system that integrates renewables across heat, power and transport, creates value for consumers and enhances security of supply. Smart Meters and the Smart Service are the demand-side enabler of this system.

Earlier fault notification and restoration of supply

Smart Meters provide a near Realtime uplink for the DNO to be notified of faults. A network of Smart Meters even maps the fault pattern and allows DNO's to target the root cause rapidly allowing them to restore supply sooner.

Reduced manual meter reading

Smart Meters remove the requirement for regular, manual meter reads which provides a cost saving to the current Meter Point Administrators, the Retailers. Note, that periodic manual readings are still required for safety and compliance but this at a substantially reduced frequency.

5.9.2 Retailers

The following are positive impacts and challenging considerations explicitly cited by stakeholders that a successful Smart Service deployment would deliver for Retailers.

Reduced electricity theft

Smart Meters in combination with distribution monitoring terminals can be used to isolate cases of energy theft which is a source of loss for Retailers.

Avoidance of load-profile purchase (concerting quarterly figures into a half-hourly settlement)

The wholesale electricity market is settled on a half-hourly basis. The Retailers and network companies currently have to convert the more irregular meter reads (c.1-3 months) into half-hourly estimates. This conversion process is outsourced to a third-party, which costs, and it is not perfect, so it inevitably produces conversion losses.

Facilitates tariff reform

Smart Meters enable dynamic and TOU tariffs via their capacity for more regular readings and differentiation between main and auxiliary loads. This does not directly benefit the Retailer and in fact investment and planning would be necessary for the Retailer to produce new tariff products.

Indirectly, Retailers can use advanced tariff products to attract new customers.

5.9.3 Consumers

The following are positive impacts and challenging considerations explicitly cited by stakeholders that a successful Smart Service deployment would deliver for Consumers.

Improved customer service

A Smart Service facilitates the identification of the worst served customers by such example metrics as duration of power loss. Smart Meters provide a near Realtime uplink for the DNO to be notified of faults. A network of Smart Meters even maps the fault pattern and allows DNO's to target the root cause rapidly allowing them to deliver restorations of supply sooner.

In some cases, it may even be possible for remote restoration of supply without a visit from an engineer.

Potential for financial benefits for consumers through Demand Side Management

From the Consumer perspective, DSM is implemented by offering Consumer's incentives to change their patterns of use to support the network. This may be the accrual of credit where Consumers reduce their usage during peak times or even the offering of discounted electricity during times of excess VRES generation which would otherwise lead to VRES dispatch-down[38].

Reduced costs of new connections

By understanding how the local network utilised electricity at the granular level offered by Smart Meters, the DNO can better understand whether that local network is already appropriately designed for a new connection or whether upgrade is necessary. Savings accrued through this planning can be passed on to new Consumers.

Facilitates tariff reform

Smart Meters enable dynamic and TOU tariffs. These products specifically offer Consumers the opportunity to reduce their costs through demand shifting. This means that in time, as more consumers are educated on consumption and their

[38] Dispatch-down means a deliberate reduction in a generator's energy production. In this case dispatch-down occurs due to oversupply, whereby available VRES exceeds local demand.

personal demand profile, demand can begin to be shifted away from typical peak hours, i.e. between 5pm-7pm.

This raises the challenge of education, behaviour, and learning. It will take time to see a macroscopic shift in energy demand profiles and it will require dedicated engagement from the government and body delivering the rollout.

Data that supports consumption reduction

The Smart Service provides Consumers with their energy usage data. It helps then understand sources of higher usage, and cost. With the right support, this encourages a reduction in consumption overall which reduces emissions, supporting the fight against climate change, as well as their finances.

Smart Meters, and the constant awareness of consumption, promotes a behavioural change that allows Consumers to make a contribution to a greener society.

A reduction in consumption may support the reduction of fuel poverty.

Enabling renewables

It means that more renewables can be integrated onto the system if consumer sentiment begins to lean towards more conscientious consumption of energy. A Smart Service rollout can serve as a steppingstone to decarbonisation. As we electrify heat and transport, e.g. EV's, TOU tariffs are integral for driving Consumer utilisation of electricity at off-peak hours.

Just Transition

Energy transitions are about people: the ones who make the decisions and the ones affected by those decisions. A Just Transition approach ensures that the affected people are considered by those making decisions. It is critical that any rollout is mindful of vulnerable groups and inclusive of all demographics.

Reduced requirement for meter reading and more accurate billing

Consumers need not submit meter readings as part of a well-performing Smart Service. Bills are more accurate and reflect real information rather than estimates.

Supports Low Carbon Technologies

A lot of LCTs such as Heat Pumps, Electric Vehicles, and microgeneration, benefit from installation alongside a Smart Meter. For example, Heat Pumps and Electric Vehicles can avail of specific auxiliary-load based tariffs or even be involved in Demand Side Management (e.g. EV charging can be paused if network demand is high).

Supports integration with Smart Appliances

Smart Meters can integrate with the HAN to produce a truly dynamic system of Consumer energy use.

Consumer sentiment

An expected challenge is customer sentiment around costs, customer engagement, and GDPR considerations. The government and programme owner must be transparent at all stages of the process.

Consumer Engagement

The consumer should be made aware of the most effective way to benefit from a Smart Service, e.g. opting onto a Time of Use tariff, and adjusting usage in order to make savings.

Data Ownership

The consumer should also be made aware of the way in which their usage data will be used, and who will be privy to that information i.e. Retailer and network companies.

Section 6. Gas Smart Meters in Northern Ireland

6.1 Introduction to Section

This section discusses a GSM deployment in Northern Ireland building on the key considerations outlined in Section and detailed research reported in Appendix A.

Discussion focuses on key areas of relevance to Northern Ireland and provides the insight used to draft Section .

6.2 Programme Structure in Northern Ireland

This section follows and utilises terminology introduced in section 4 and A.1, offering a tailored view for the gas utility in NI.

6.2.1.1 Transmission, Distribution, and Retail

The Gas Market Operator for Northern Ireland (GMO NI) operates the natural gas transmission market in NI on behalf of the four gas transmission operators, GNI(UK), Premier Transmission Limited, Belfast Gas Transmission Limited, and West Transmission Limited. There are three gas DNOs which cover three areas of Northern Ireland:

1 Greater Belfast Area is managed by Phoenix Natural Gas with 78.6% market share[39].
2 Ten Towns area is managed by Firmus Energy with 20.5% market share.
3 West area is managed by SGN Natural Gas with 0.9% market share.

There are 8 gas retailers operating in the gas market in Northern Ireland in both the domestic and commercial sectors. These suppliers operate on a geographical basis similar to the DNOs.

6.2.1.2 Meter Deployment

Currently in Northern Ireland, the DNOs have the role of Metering Programme Owner for traditional meters. Each is responsible for its own jurisdiction, but procurement is a joint exercise with the three DNOs sourcing Standard Meters under one contract.

Stakeholder discussion indicated preference for DNOs to also lead on a Smart Meter rollout which aligns with the standard model employed by all European countries (except for Great Britain). It might therefore be likely that again the DNOs would procure Smart Meters under a single contract.

6.2.1.3 IT, Data and Communication Services

Currently in NI, Retailers act as the Metering Point Administrators and Meter Data Managers. They are responsible for meter reading and the storage of consumer consumption data on their own independent systems. Smart Meters to some extent make redundant the role of Metering Point Administrator as this function is inherently absorbed into the communication services. No single entity reads the meter but rather an automated system gathers and stores the data via the communications network and IT solution.

Stakeholder research indicates that a lot of challenges arise in GB due to the interfaces and intersection of responsibility between the meter data, the communication network, and the data storage. Consolidation of these roles may offer a solution to streamline these interfaces i.e. one entity that acts as Meter Point Administrator, Data Manager, and Communication Services Provider. One entity could be responsible for data and its management across the communication and IT infrastructure without inter-company interfaces.

Given consumer metering data is maintained as owned by the consumer, it may be pertinent that this body operates on a public or semi-public basis such that the regulator and

[39] 260922 Q2 2022 QREMM (Final)_1.pdf (uregni.gov.uk)

government may exert more direct control over its compliance with regulations and consumer interests.

A nuance to any gas deployment is there being multiple DNOs that would traditionally procure metering products via one contract. Continuing this procurement model makes sense as it leverages the entirety of NI's purchasing power rather than each individual network. Complexities ensue with a Smart Meter deployment however as now there are components of IT and communication. Questions arise on ownership of the Smart Data Manager role and whether each DNO would have its own data management function or there be provided a centralised, external service available to all three. Stakeholders have indicated that there are already talks of transferring the role of Metering Point Administrator away from Retailers.

Three models are explored below to provide solutions to the challenge of IT, data, and communications services. Please note that these are not formal recommendations and extensive consultation is required between all involved parties in developing a model appropriate for the sector.

6.2.1.3.1 Central Information Body Model 1

A centralised entity that is independent of each DNO might be a sensible, consolidation of roles that minimises duplication of function (and costs) across each network operator. Were this total centralisation to take place, the entirety of the IT and communications programme would sit outside of any one DNO's ownership; this combined role is henceforth referred to as the Central Information Body (CIB). As identified, this offers efficiencies via streamlining. The scale of change across the industry would be significant for any Smart Meter programme, this centralisation isolates the change to one singular, new entity which can receive explicit oversight and regulation.

A true CIB approach sees one body that serves all three DNOs as shown in Table .

Table 7 – Central Information Body Model Indicative Programme Structure

<table>
<tr><th>Role</th><th colspan="3">Description</th></tr>
<tr><td>Consumer</td><td colspan="3">-</td></tr>
<tr><td>Utility Regulator</td><td colspan="3">Utility Regulator</td></tr>
<tr><td>Policy Setter</td><td colspan="3">DfE</td></tr>
<tr><td>Transmission System Operator (TSO)</td><td colspan="3">GMO NI</td></tr>
<tr><td>Distribution Network Operator (DNO)</td><td rowspan="2">Phoenix Natural Gas</td><td rowspan="2">Firmus Energy</td><td rowspan="2">SGN Natural Gas</td></tr>
<tr><td>Metering Programme Owner</td></tr>
<tr><td>Retailer / Supplier</td><td colspan="3">Various</td></tr>
<tr><td>Smart Data Owner</td><td colspan="3">Consumer</td></tr>
<tr><td>Metering Point Administrator</td><td colspan="3" rowspan="4">Central Information Body

(Service available to each DNO and Retailer)</td></tr>
<tr><td>Smart Data Manager</td></tr>
<tr><td>Communication Service Provider</td></tr>
<tr><td>Consumer Engagement</td></tr>
</table>

6.2.1.3.2 Intra-DNO Consolidation Model 2

An alternative is a network area-based model, shown in Table , whereby each DNO operates the functions entirely for their own network and there is no overlap. DNOs may still procure a metering solution together but three separate implementations take place. This maximises DNO ownership and control but potentially triples the cost.

Table 8 - Intra-DNO Consolidation Model 2 Indicative Programme Structure

Role	Description		
Consumer	-		
Utility Regulator	Utility Regulator		
Policy Setter	DfE		
Transmission System Operator (TSO)	GMO NI		
Retailer / Supplier	Various		
Smart Data Owner	Consumer		
Distribution Network Operator (DNO)	Phoenix Natural Gas	Firmus Energy	SGN Natural Gas
Metering Point Administrator			
Metering Programme Owner			
Smart Data Manager			
Communication Service Provider			
Consumer Engagement			

6.2.1.3.3 Consolidated Communications, Independent Data Model 3

A third model proposed blends Model 1 and Model 2, partially consolidating roles as shown in Table . Components in common such as the Communication network can remain consolidated within a Central Information Body whilst the Meter Point Administrator and Data Manager (which includes the development of an MMS system) roles are isolated for each DNO. This permits the procurement of a single communication system alongside the meter procurement.

Table 9 - Indicative Programme Structure – Consolidated Communications, Independent Data Model 3

<table>
<tr><th>Role</th><th colspan="3">Description</th></tr>
<tr><td>Consumer</td><td colspan="3">-</td></tr>
<tr><td>Utility Regulator</td><td colspan="3">Utility Regulator</td></tr>
<tr><td>Policy Setter</td><td colspan="3">DfE</td></tr>
<tr><td>Transmission System Operator (TSO)</td><td colspan="3">GMO NI</td></tr>
<tr><td>Retailer / Supplier</td><td colspan="3">Various</td></tr>
<tr><td>Distribution Network Operator (DNO)</td><td rowspan="5">Phoenix Natural Gas</td><td rowspan="5">Firmus Energy</td><td rowspan="5">SGN Natural Gas</td></tr>
<tr><td>Smart Data Manager</td></tr>
<tr><td>Metering Point Administrator</td></tr>
<tr><td>Metering Programme Owner</td></tr>
<tr><td>Consumer Engagement</td></tr>
<tr><td>Smart Data Owner</td><td colspan="3">Consumer</td></tr>
<tr><td>Communication Service Provider</td><td colspan="3">Central Information Body
(Service available to each DNO and Retailer)</td></tr>
</table>

6.2.1.3.4 Comparing Models

In comparing the models, Model 1 offers the most streamlined solution with the procurement of a single meter solution, communication network, and MMS that serves all three DNOs and is managed by an independent body, CIB. The CIB owns and maintains the IT and communications components on behalf of DNOs, ensuring that data is made available to each as required. Given the centralisation, it may further increase efficiency if this body is also responsible for managing Consumer Engagement. The Meter Point Authority role would transfer from Retailers to the CIB. Note that this would likely be a UR regulated body with potential for additional DfE oversight.

Model 2 is explored to demonstrate an entirely opposing approach with DNOs operating independently with respect to IT and communication. This model provides DNOs with more control but involves duplication of IT and communication systems (Capex and Opex). It likely therefore encourages higher costs for the Consumer.

Model 3 is like Model 1 but gives control of independent MMSs directly to the DNOs to own and manage. It resembles the GB programme structure where the DCC serves only as a 'messaging' service and cannot interact with the data it transfers. Like Model 2, there is a duplication of MMS systems which must each be maintained incurring costs for the Consumer.

Stakeholder responses suggest Model 2 and Model 3 are not ideal and the DNOs would seek to procure meter, communication, and MMS solutions collaboratively. Stakeholders did not make clear their vision of ongoing management and whether the joint exercise was for the procurement stage only or if they saw the delivery as consolidated as well i.e. Model 1. Extensive consultation is required.

6.2.1.4 Consumer Engagement

Whilst not an explicit role necessary for the delivery of a Smart Meter programme. Consumer engagement has been a key message from stakeholders as being critical in the delivery of a successful programme.

Great Britain's *Smart Energy GB* provides a service to engage and educate the consumer with varying success. A body with a similar remit would be required in Northern Ireland to encourage consumers to use the full scope of smart services available to them via a Smart Meter.

6.2.1.5 Summary

The CBA assumes a Model 1 rollout based on the discussion above and stakeholder feedback. The other models are evaluated via sensitivity testing.

Even if the data and communications roles are consolidated outside of the DNOs, the ownership of meters would likely remain within their domain given the longstanding history and expertise in their maintenance. If meter ownership was taken away from the DNOs, it would be necessary for substantial consideration on how meter maintenance should be managed e.g. what happens if a meter breaks down in the Ten Towns area and the West area, which area is prioritised and is this seen as discriminatory? For the sake of reduced management and the avoidance of challenge, it would be critical that meter ownership remains within the domain of DNOs irrespective of the IT and communications ownership.

Interaction between energy sector entities should be considered in the design of any programme structure. It was indicated that a significant component of RMDS' capacity in Ireland is absorbed by stakeholder engagement i.e. managing the Regulator, Retailers, and the Network business. This management of interaction between entities is streamlined by the total centralisation of the metering programme within RMDS (it fulfils most roles described) but remains substantial, nonetheless.

With the proposed Model 1 CIB managing all data, information, and communication aspects of the Smart Meter programme (i.e. Smart Service), it would make sense that this body delivers the other cross-network components of consumer engagement, education, and marketing as well.

6.3 PAYG Gas Meter Procurement 2022

6.3.1 NI PAYG Gas Meter Situation

The three Gas DNOs have an urgent need to seek a new provision for PAYG meters for NI. The primary reason for this is that contractual cover for the ongoing supply of meters only extends to 2024 having been extended from December 2022. Since the previous meter contract procurement, there is a global situation where traditional meters are not widely available as they are considered obsolete and there are also availability challenges with meters of all types impacted by global issues such as shortages in microchip supply.

Given the obsolescence challenges with a like for like meter provision, the three gas DNOs initiated a procurement in 2022 to source a new supplier of PAYG gas meters for NI. This exercise sought to address the fundamental availability needs and also to deliver more advanced meters over the existing models to realise a more modern gas network. The procurement was managed collaboratively and divided into three separate lots covering the Meter, the MMS, and a Front-end Payment System. Whilst this procurement process has encountered difficulties, the drivers for the procurement remain and there is opportunity to align this procurement with a wider provision for a Gas Smart Service in NI.

6.3.2 Drivers for the procurement

The procurement was driven by several factors.

1 The first is the lack of contractual guarantees for the provision of existing Prepayment Meters by the manufacturer beyond December 2022. The original contract expires and there was no guarantee of ongoing supply of meters for replacements or new installations. Fortunately, this December 2022 deadline was delayed by two years (December 2024). Engagement did not raise any mitigation measures for post-2024.
2 Aging technology – existing PAYG Standard Meters use older technologies, and the GNOs are seeking to embrace smart solutions that offer their Consumers more advanced capability. These solutions approach a Smart Meter level of functionality.
3 The Covid-19 pandemic and supply issues highlighted the potential for some Consumers to have difficulty topping up at a retail outlet (e.g. PayPoint).

6.4 Delivery in Northern Ireland

This section follows and utilises terminology introduced in section 5 and A.2, offering a tailored view for the gas utility in NI. In understanding a delivery model, there are several key themes of discussion programme ownership, deployment strategy, timescales, logistics, prioritisation, and timescales.

6.4.1 Programme Ownership and Management

The consensus on programme ownership and GSM deployment lands with the three DNOs for their respective geographic areas. This is the same for electricity as detailed in section 2.

Whilst the implementation itself would be owned and managed by the DNOs, its delivery and service performance also impact on Consumer and Retailers. It is therefore critical that the Meter provision contract is aligned with wider programme objectives and any wider Smart Service programme components. DfE and the Utility Regulator should have appropriate recourse to hold the DNOs accountable and incentivise delivery of good performance. It is also critical that DfE and the Utility Regulator have capacity to provide suitable oversight and contract management support to ensure ongoing performance of the service.

6.4.2 Deployment Strategy

This report explores several models for deployment of GSMs in NI. This section discusses models identified from review of other jurisdictions and feedback from stakeholders. These are reflected, and quantified, in the CBA scenarios introduced in Section 7. Both qualitative and analytical review should be used to inform a deployment strategy for NI.

As presented further in A.2, the consensus across the EU countries, as decided through their own Electricity-utility CBA or otherwise, ultimately landed on active-mandatory (opt-out) rollouts. It is likewise suggested by stakeholders that NI assumes an active, opt-out rollout.

6.4.3 Logistics

A challenge raised by stakeholders centred around logistics and skills procurement.

Stakeholders raised a challenge around logistics and skills procurement. The DNO is already responsible for the maintenance and replacement of Standard Meters in Northern Ireland. In a passive rollout, the scale of the meter replacement programme itself does not increase and there would be a negligible change in workforce and/or supply chain capacity requirements and so this section on logistics therefore focuses on an active rollout.

The active deployment rates indicated in this report, developed through stakeholder engagement, scenario optimisation, and research into other jurisdictions, are idealisations that seek to consider the capacity of the market for delivery. Capacity considerations are explored across several themes: installation; IT and security; communications; and supply.

6.4.3.1 Installation

In an active rollout, the rate of installation of new meters increases over the current replacement rate delivered by the DNO. Naturally therefore the suite of technicians and engineers available to deliver installations would have to increase. A simple assumption might be that if the volume of installations required increases, the volume of installation staff must therefore also increase at a rate directly proportional. This may be considered the upper bound for costs as it is unlikely that the volumes of engineers would be greater than this.

There may be efficiencies to be had however which reduces the cost on a per installation basis. For example, the rollout may be geographically optimised. Where currently engineers must travel significant distance between installations, with an active rollout, an entire street may be targeted in a batch installation. Travel times become less significant and installation rates increase.

In contrast to these efficiencies, there are aspects of a Smart Meter installation that may increase the time of installation (per meter). Engineers would need to ensure that the communications hub is connected and is demonstrating a suitable CTF-like performance metric (see A.4.4.2.1). This may require the installation of additional antennae in more rural areas.

Any new requirements on the DNOs which impacts on its resourcing as a business should be considered in future Price Control reviews. The next DNO Price Control is due to begin in January 2023, therefore any decision on additional resourcing required for Smart Meters will need to be considered with some urgency in the planning for the next Price Control. Significant planning would be required during the Smart Meter procurement stage to optimise deployment and mitigate risk of disruption.

Underlying any upskilling and development of installation capacity, is the technician training period. Stakeholders report that it takes c.3yrs to train and certify Gas Safe[40] engineers. This should be factored into any capacity planning and deployment timelines.

Significant planning would be required during the procurement stage to optimise deployment and mitigate risk of disruption through advanced installation of technicians.

6.4.3.2 IT, Data, and Security

Currently in Northern Ireland, the retailers read and track their own meter data. If this onus is transferred to a new authority (CIB or DNO), there will be required a new management team and the capacity to deliver the data collecting process. This responsibility shift, and capacity requirement, is independent of a Smart Meter rollout as data would have to be collected for Traditional Meters as well as Smart Meters. Stakeholders have expressed that this transfer of responsibility is already undergoing talks with the Utility Regulator.

If Smart Meters are deployed in parallel a rapid development of IT and Security capability will be required. This skill must be adequate and comprehensive given the challenge posed by the scale of personal data being captured and the modern importance of IT security.

With respect to Retailers, they would have to develop teams to design and maintain their internal databases and the interface/relationship with the authority responsible for the communication network and MMS solution.

6.4.3.3 Communications

As part of the role shift, either the CIB or DNOs would also be managing the communications service connecting meters with a database via a communications network. This is a significant capital and operational undertaking, and it would be necessary to build a

[40] Gas Safe is a certification and registration for gas engineers who are licensed to operate on natural gas equipment in the UK.

team with the appropriate capability (skill and resource) to manage budgets, assets, and the programme generally.

As the infrastructure maintenance would likely be outsourced to a 3rd party for delivery, there would additionally be required a component of contract management to ensure Service Level Agreements are developed and operated effectively.

With the addition of communications infrastructure, there would be a requirement for technical engineers who maintain the communications network specifically. This may be fulfilled by the 3rd party described above as part of the service package or via a maintenance team within the party responsible.

6.4.3.4 Supply

The EU has recognised a global shortage of materials, in particular technical components like computer chips[41]. Due to this shortage and the impact of COVID-19 on global supply chains, there is a shortage of semi-conductors among other crucial components, which impacts the ability of meter manufacturers to produce and supply gas meters[42].

This is a risk that affects the procurement of any meter but Smart Meters in particular which by their nature require more technical components than a Traditional Meter.

Worldwide industries are looking to mitigate this challenge that places all aspects of renewables development at risk. The EU has recently launched its European Chips Act which seeks to invest €43B in the development of EU semi-conductor manufacturing[43]. Nonetheless there will be short term issues concerning the availability of supply that may influence the cost and timeliness of a rollout.

6.4.3.5 Overall Programme

The programme will require a significant redistribution of resources and the creation of new roles. A CIB approach, as described in section , sees most of the resourcing concentrated within this new entity with some capacity transferring in (e.g., metering teams) from existing companies.

Programmes of this scale are complex, and a dedicated Programme Management function would have to be developed to ensure the smooth operation of his entity. To summarise the high-level functions/departments required to deliver on the role responsibilities of a CIB:

- Leadership
- Programme Management
- Meter Point Administration (including traditional meter reading)
- IT and Security
- Communications Infrastructure Management (including Asset Management)
- Contract Management

These requirements become amplified if an independent DNO model is selected whereby each of these functions must be fulfilled for each of the three network companies.

6.4.4 Prioritisation

A key question raised is concerned with prioritisation of Consumers receiving Smart Meters.

[41] European Chips Survey | Shaping Europe’s digital future (europa.eu)

[42] Monitoring of the meter stock shortage, driven by global materials availability and supply chain challenges - Elexon BSC

[43] European Chips Act | European Commission (europa.eu)

Rollout should be on the basis of focusing on those consumers where there is likely to be a significant benefit i.e. those involved in energy transition activities e.g. smart appliances. Note there are few Consumer technologies which can integrate and avail of a gas Smart Service. Ultimately the prioritisation and optimisation should be impact and benefits led.

A high-level prioritisation and optimisation approach is discussed. Demographics have been prioritised into three groups based on conversations with stakeholders. Note that this hypothetical approach would need to be assessed via an equality impact assessment so that there are no discrimination issues.

6.4.4.1 Priority 1 - Fundamental Groups

Some Consumers require meters and sit above any degree of deployment optimisation. These are the Consumers that absolutely need a meter due to being new connections or because a previous meter needs replacing. This is also the group that would see a Smart Meter installed under a passive rollout.

Each year the DNOs currently replace a portion of their Traditional Meters due to expiration of the product’s service life, which is around 20 years, or due to fault. GSMs also have a shelf life of around 20 years and therefore this ongoing replacement scheme would naturally continue with the only difference being the type of meter that gets installed.

Also, within this prioritisation group are new connections. For the sake of cost and time efficiency, it would make sense that all new connections are fitted with a Smart Meter rather than a Traditional Meter which would have to be subsequently replaced.

6.4.4.2 Priority 2 – Consumers with Impact

The deployment might choose to make those consumers who specifically request a Smart Meter, a higher priority or otherwise the industrial/commercial consumers who use more energy per capita.

This prioritisation offers tangible benefits. Stakeholders voiced that these *tuned in* consumers are the ones who are particularly valuable in a Smart Meter deployment as they are typically more interested in their energy consumption and will avail of the full suite of Smart Services offered. Proper utilisation by invested parties offers significant benefit over and above that of a typical consumer.

It is critical that a consumer does not just have the Smart Meter but that they utilise the Smart Service.

There is also a crucial element of ethics and social value. A deployment cannot discriminate against any of the protected characteristics[44] and should be fair in selecting the Consumers that avail of Smart Meters sooner. Covid-19 highlighted some issues concerning vulnerable customers who were unable to top-up their PAYG meters. The DNOs and suppliers had to develop temporary and expensive solutions for these Consumers, solutions that would be mitigated by any remote top-up solution. A Just Transition sees that no groups of Consumers are left behind in the advancement towards a low-carbon economy and Smart Meters are a technology that can support this ethos.

6.4.4.3 Priority 3 – Remaining Consumers

Within the bucket of remaining consumers, an optimisation may be carried out such that benefits can be maximised and costs minimised indirectly. This optimisation may be largely

[44] Protected characteristics | Equality and Human Rights Commission (equalityhumanrights.com)

geographic in its design but should consider other factors such as customer vulnerability, capacity for delivery, and consumer marketing/engagement.

A deployment might target rural communities as presently these meters are the most expensive to read due to the distances travelled to get readings. On the other hand, greater volumes of meters can be installed more rapidly in urban areas when installations can be clustered and delivered in batches. If there are supply issues however, it may not be possible to reap the full scale of benefits of batch installations, and an optimisation strategy might look for a temporal solution. One that targets rural communities when supply is low and urban communities when supply chains are more robust.

6.4.4.4 Summary

In summary, designing a deployment strategy is complex and subject to several factors. A technical, benefits-focussed optimisation should be a priority of the party responsible, be it a DNO or a CIB, as part of its deployment planning. Again, the deployment should seek to maximise benefits to the consumer and other sector entities with respect to significance and time.

6.4.5 Timescales

In further development of the dichotomy of active versus passive rollouts, there are considerations of pace.

6.4.5.1 Passive Rollout

In a passive rollout the pace is implicitly defined as rate of replacement and new connections i.e. all Priority 1 Consumers.

Rate of replacement is somewhat known by the sector based on current meter asset data i.e. age of the meter.

New Connection rates may be estimated via household forecasts and historic growth rates.

6.4.5.2 Active Rollout

Defining the pace of an active rollout is somewhat more involved. In addition to the installations of a passive rollout, an active rollout delivers the remaining Priority 2 and the Priority 3 Consumers sooner.

Delivery of these additional Consumers, and the overall pace of an active rollout, is largely dictated by the capacity of the deployment. This capacity should balance an appropriate degree of urgency with that which is realistically achievable. It should consider therefore the requirements to build installation capacity and what follows the deployment i.e. considers what happens to installation engineers once all Smart Meters are deployed and the industry returns to the passive replacement and new connections scale of pace.

Based on rollouts in other jurisdictions, in its first year the NI rollout should consider an installation rate that matches current replacement and connection rates. I.e. maintains the DNO's current rate of meter installation per annum. This rate should increase across subsequent years incrementally to deliver the deployment in line with a set of milestones.

In driving a deployment, Spain took the approach of staggered intermediary milestones which provided continuous pressure. As per A.2.1.3, Spain's government permitted DNO's six years to achieve the first 35% of installations, two years for the next 35%, and two years for the final 30%. The first milestone gave DNO's time to lay the foundations for deployment and invest in capital. Subsequent milestones forced a substantial per annum increase in rate utilising the six years spent developing good practice, building capacity, and improving efficiencies.

GB on the other hand has recently set a target of 100% by 31st December 2024 and to achieve this has also defined minimum annual installations for each Retailer. These minimums are calculated using a formula which seeks to 'draw a line' between the current percentage of deployment and the 100% target. It is an adaptive algorithm, with tolerances, that adjusts if a Retailer falls short each year but generally equates to 25% annually. This approach is necessary to account for where Consumers change Retailer which can affect Retailer performance against the minimums.

This approach is perhaps relevant here where Smart Meters are delivered by multiple DNOs and serves as a means of the government regulating installations.

As in all programmes, well-considered and staggered milestones are key for driving delivery but in the development of a Smart Meter deployment strategy, it is key to develop milestones that acknowledge realistic capacity. This will involve engaging with parties involved in delivery and being aware of their bias e.g. the company to be held to account to a target will naturally seek more relaxed goals to reduce their own risk.

6.4.5.3 Constraints

A notable constraint with the gas deployment of a Smart Metering solution is that which drove the 2022 PAYG meter procurement; the expiration of the contract to supply current Standard Prepayment Meters. The gas sector has a requirement to have a product ready and in place by December 2024 such that the replacement of existing meters is not disrupted. Given the safety concerns around gas, the impact of this risk if breached is severe.

Also, the constraint of technician training. As discussed, it takes c.3yrs to train and certify new Gas Safe engineers for the installation of meters. Poor planning of this capacity might delay any target installation pace.

6.5 IT and Data in Northern Ireland

This section follows section 6, offering a tailored view for the gas utility in NI.

6.5.1 Ownership and Management

As all stakeholders have advocated for a DNO led rollout, it should be considered that the DNOs own and operates the MMS(s) rather than Retailers operating their own. That being said, Retailers would have to evolve their own IT systems so that they can interface with the MMS to deliver their components of the Smart Service e.g. Tariffs.

It should be considered that the MMS is part of the Smart Service. Whilst the implementation itself would be owned and managed by the DNOs, its data is owned by the Consumer and some functions are executed (by request) by Retailers.

With their cancelled procurement, the DNOs were designing their own requirements and procuring their own solution without the involvement of DfE or significant input from the UR. In driving a Consumer-driven and regulated procurement that covers the PAYG meter replacement and Smart Meters, it is essential that these bodies become more involved. It is critical that the IT/deployment contract is sufficiently drafted such that DfE has appropriate recourse to hold the DNOs accountable and incentivise delivery of good performance. It is also critical that DfE has the capacity to provide suitable contract management to ensure ongoing performance of the service.

A dedicated team within the responsible party (or parties) is required to be established, and funded, to procure and subsequently deliver an MMS.

6.5.2 Solution Types

The two principal options, from the perspective of the entity owning the MMS, are a Software as a Service (SaaS)[45] and a self-hosted (sometimes known as on-premises) solution.

Self-hosted software is any software you host on one's own servers rather than a third-party provider. This means that one has complete control over the data and applications, but it also means that one is responsible for keeping everything up and running.

SaaS is a software distribution model in which the software is provided to customers on a subscription basis. SaaS applications are typically accessed via an application, while the underlying software and data are stored on the provider's servers, or 'clouds' with maintenance responsibility outsourced to the provider.

6.5.3 Skill Challenge

Stakeholders have expressed that the energy sector in NI is not well used to modern IT models e.g. SaaS. Therefore, it may be necessary, depending on the procured solution, that

[45] Software as a service (SaaS) allows users to connect to and use cloud-based apps over the Internet. Common examples are email, calendaring, and office tools (such as Microsoft Office 365). SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider. It is beneficial in that the party responsible need not have the skills nor resources to manage the solution directly.

the responsible party procures additional, necessary skills and resources above that which it currently possesses.

6.5.4 Costs

In delivering and maintaining an MMS. There are several areas of management and cost to consider. Areas of cost include project management, back-end solution development, front-end development, data hosting, and security.

6.5.4.1 Capex

Capex is solution dependent but generally there would be a requirement to invest in any hardware or development costs associated with the solution. If a SaaS solution is selected, there might be upfront development costs for the provider to design an appropriate system. Significant cost would be consumed in developing the suite of system requirements for this provider.

If a self-hosted solution is preferred, then the party responsible would need to invest in adequate servers and related overheads in addition to the development costs.

6.5.4.2 Opex

There are several areas of Opex of which some are solution dependent.

SaaS solutions being subscription based usually require continuous financing which covers software maintenance and data-hosting costs. With respect to SaaS data hosting, the client usually pays proportional to the amount of data i.e. as more Smart Meters come online, more data is required to be stored, and therefore data-hosting costs increase.

A self-hosted solution requires the funding of the ongoing maintenance with the party responsible for maintaining an MMS service. Costs might include overheads, security, utilities, and hardware/software developers.

6.5.5 Data

As stated in section 4.6.2, GDPR applies in NI and must be strictly adhered to across a Smart Service.

It is clear from the EU Directive[46], which remains to apply to the UK, that the **Consumer owns the data** at all stages of its existence. In the deployment of a Smart Service, there must be a provision of a Data Access Code to which all parties adhere that governs usage, management, and the mechanisms through which the Consumer can own their personal data and that other parties can use the anonymised, non-personal data.

Workshop attendees expressed a specific concern for consumer data management. The referenced anecdote discusses how energy usage trends for a given consumer might be used to determine their lifestyle habits such as when they leave the house (i.e. consumption drops between 8am and 6pm every weekday). This data may be used maliciously if it is not managed with the strictest of security and access measures.

Stakeholders suggest that deployments in other jurisdictions have been so preoccupied with getting data that they have not paid due consideration to the regulations surrounding it. It is critical that the deployment considers personal data and GDPR upfront.

[46] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN

6.5.6 Comparing Solutions

It is generally considered that SaaS solutions feature reduced Capex and increased Opex. Whilst an MMS owner is responsible for an MMS service, they can also hold the third-party provider to account on poor performance. An MMS owner need not develop the specific software design and programming skills in-house. From a security perspective, SaaS involves hosting the data on another party's servers which offers a component of risk.

Self-hosted solutions require substantial capital investment and Opex. Responsibility remains within the domain of the MMS owner, but they also have more direct control over costs, security, and software design.

This report does not cover a technical comparison of IT solutions. Further analysis is required to support a thorough procurement exercise that focuses on lifetime costs to the Consumer.

6.6 Communication Infrastructure in Northern Ireland

This section follows section .7, offering a tailored view for the gas utility in NI. In delivering communication infrastructure, the responsible party is required to make several considerations in procuring a solution. This section is not specific to any of the models presented in 5.2 and its considerations apply to all.

This section references concepts, data, and terminology defined in section A.4.

6.6.1 Procuring a WAN solution

The principal decision is the communication technology to deliver the WAN. Unlike for the electricity network (section .5.1), the gas meters cannot as easily avail of a PLC-based solution, and the associated benefits, unless GSM WAN communication is fulfilled by an ESM. The advantages of integration are briefly considered below in section .

GSMs cannot generally be connected to a mains power source, for safety reasons, and therefore must use a battery. The Smart Meter must conserve power and therefore tends to 'wake up' and connect to the WAN (or HAN) once per day. This component of power consumption should be considered in the procurement of a WAN solution and low power networks may be key as described in section A.4.

It is critical to note that 2G and 3G cellular networks will no longer be supported in the UK from 2033. Considering the lifetime of Smart Meters (20 years) and a deployment commencement date around 2026-2030, a cellular technology solution employing these network generations would be unsuitable. An LTE or 4G+ solution would be required but this introduces connectivity and coverage issues in Northern Ireland. As none of the existing sector entities have the infrastructure for a cellular communications network, this would have to be outsourced. This is a source of significant cost in other jurisdictions in terms of Capex (e.g. construction of data collectors) and Opex (e.g. mobile operator and data transmission costs).

Long Range Radio might be an appropriate WAN technology that is currently operating in Scotland that would require infrastructure investment in Northern Ireland. No sector entities currently have the infrastructure to support LRR and therefore this system would likely require outsourcing.

Some stakeholders expressed an interest in understanding whether the WAN would integrate and be managed via the DCC in GB. This is a system design decision that should be drawn out as part of any ongoing programme planning.

A thorough technical cost-benefit analysis is paramount in procuring a futureproof communications system and to better understand the costs. It would be prudent that this analysis explores both utilities.

6.6.2 Performance

Like the CTF example employed in Ireland, a suite of KPIs would be required in NI to assess installations and the ongoing health of the communication network. If this network is fulfilled by a 3rd party e.g. a cellular network, an appropriate Service Level Agreement (SLA) would be essential to ensure reliability and performance of the network over the lifetime of the Smart Meter. These SLAs which can be procured similarly to a regular telecommunications or IT contract to provide mechanisms of financial clawback where communications performance is inadequate.

The CPB can draw insight on developing SLAs and service contracts from other major telecommunications projects such as DfE's Project Stratum[47].

6.6.3 Procuring a HAN solution

A HAN-capable Smart Meter that uses an industry accepted standard such as Zigbee[48] is fundamental in delivering a Smart Meter network that can leverage the full scope of interconnectivity required for interaction with other Consumer Technologies.

6.6.3.1 Electric and Gas Interconnectivity

The interaction between the ESMs and GSMs in GB is worth noting. Only one communications hub is required per premise and the two meters are able exchange data securely via the HAN. This might not be as feasible in NI the electric and gas meters are not typically installed in proximity. Quite often the gas meter is placed externally. An integrated solution is possible, but a HAN network must be designed that can cope with the range.

Advantages of an integrated system include reduced meter costs (due to a single MCH) and reduced communication and IT costs (due to a single system rather than two/multiple). The challenge of ownership across the electric and gas sectors would be a point of discussion and perhaps in this case a utility-agnostic central body would be beneficial.

6.6.4 Delivery

As implied by the evolution of DCC from contract manager into a company that delivers all the core functions in-house, the management of the communications network is no small task, and its owner must provide services that include programme management, design, assurance, and maintenance.

If a CIB approach according to Model 1 in section 2.1.3.1, the significant requirement for expertise and additional resources would isolate to a single body.

6.6.5 Regulation and Oversight

The GBCS was developed to provide the specification for the communication network in GB. The SEC was established to provide the multi-party agreement between all sector actors.

Similar standards, contracts, and agreements would be essential in the establishment of an NI programme to hold the involved bodies to account. Significant resource would be required within government and the UR to develop from scratch equivalent agreements or the tailoring of these specific documents for application in NI

[47] Project Stratum | Department for the Economy (economy-ni.gov.uk)
[48] Zigbee | Complete IOT Solution - CSA-IOT

6.7 Meter Functionality in Northern Ireland

This section follows section 8, offering a tailored view for the gas utility in NI.

This section specifically draws attention to areas of Smart Meter functionality considered critical by research into other jurisdictions as well as components of functionality raised by stakeholders. A fundamental step in the consideration of Smart Meters in NI is a full technical review and development of a meter specification.

6.7.1 Pay As You Go Meters

Prepayment Meters are abundant with 67% of domestic gas meters being PAYG[49]. Customers can top-up their energy balance and drawn down from this balance as gas is consumed. This culture of prepayment is somewhat unique in Northern Ireland with most consumers in other countries in the EU adopting a Credit Meter.

No metering deployment in Northern Ireland can succeed without consideration of PAYG. This is a sentiment affirmed by stakeholders. Prepayment Meters are often a choice in NI, affording consumers more control over their consumption in financial terms and a reduced opportunity for debt.

6.7.1.1 Prepayment Meter Issues

The PAYG system is not without flaw. Covid-19 presented an issue with some consumers unable to travel to PayPoint locations for topping-up their cards and meter balance. Solutions were developed at cost to the Retailers and Network entities to provide consumers with a balance, but the process remains manual.

Another event that challenged NI's current PAYG Meters was a shortage of top-up cards. Suppliers of the original card discontinued their products such that there were none available for new meters or replacements. Fortunately, PayPoint were able to change their systems to accept a new type of top-up card which would work for existing meters. It was not made clear who financed this update.

Worth noting is that Prepayment Meters cost c.175% more than Credit Meters due to the additional hardware required to track balances, rates, and deliver PAYG as a function.

Despite these issues, PAYG as a service is fundamental in the procurement of a Smart Metering solution in NI. Any solution might consider more innovative approaches to deliver PAYG, but these must accommodate all demographics (including those less affiliated with modern technology such as mobile applications or web platforms). Also, that substantial deviation from current Prepayment methods might cause Consumer lifestyle changes and therefore incur pushback.

6.7.2 Obsolescence

An imminent issue to already face the gas Prepayment meter market is the availability of meters. The original contract guaranteeing supply of PAYG Meters, which is a joint contract

[49] Statistics from Utility Regulator's May 2021 Transparency Report

shared by the three gas DNOs, did not originally apply beyond December 2022 although this has since been delayed to 2024.

This issue triggered the cancelled procurement described in in section 3.

6.7.3 Functionality

The following subsections outline the core functionalities of a Smart Meter solution in NI as raised by stakeholders and through research.

6.7.3.1 Design and Core Functions

The Smart Meter should be aligned with some fundamental design principles.

Standard Meter Functions

Principally, the Smart Meter should be capable of delivering all functionality currently offered, and used, by Standard Meters in NI.

Just Transition

The design should drive the Just Transition agenda by enabling all Consumers to transition to a more climate change aware usage of energy.

Ease of Use

The design should cater to all demographics with heavy consideration for vulnerable customers, those less familiar with modern technology, and those experiencing energy poverty.

Thin Client

The meter should tend towards a Thin Client design to minimise cost and maximise futureproofing.

PAYG

Meters should have the fundamental elements to deliver prepayment functionality as per section .

Disconnection and Reconnection

Meters should be capable of remotely disconnecting and subsequently reconnecting supply of gas.

Supplier Switching

Design should permit the automated changing of Consumer’s gas supplier without any loss of functionality.

6.7.3.2 Metrology and Core Functions

The Smart Meter should deliver an extended metrology capability.

Accurate and Regular Reading

The gas market is currently settled on a daily basis. The meter should support this by delivering readings on a matching timescale, but the more granular the data the better. This benefits Retailer and Network entities.

The meter should be appropriately precise in its measurements also.

Energy Theft

Meter readings should be such that they can contribute to the identification of energy theft i.e. identifying precisely what the premise claims to use versus that which the distribution network provides. This principally benefits Retailers and Networks.

6.7.3.3 Software and Smart Services

Some elements of functionality are delivered via the Computational Unit and its software.

Data

Meter should be able of recording and securing all constant, internal, configuration, and operational data (see Table 60 of Appendix B).

Payment Mode

Via software, hardware, and configuration data, the meter should be able to change its payment mode i.e. Credit and Prepayment.

Debt Recovery

The meter should facilitate debt-recovery and emergency credit mechanisms.

Meter Display

The Meter itself must offer a basic display and interface for inputting commands or reviewing data.

6.7.3.4 Interface

The Smart Service might offer some additional user-friendly interface for reporting on data points e.g. consumption, estimated spend, etc. Solutions to consider are an In-Home Display, a web application, or a mobile application. There may be other solutions proposed by the market.

This interface need not be attached to the meter but communicate over an internet download from the MMS or interface with the meter directly via a HAN. Some form of Consumer-oriented interface is critical in connecting consumers to their data and driving a societal behaviour change.

6.7.3.5 Connectivity

To deliver a complete Smart Service, the meter should be connected to the wider network. This functionality is delivered via the MCH element of the Smart Meter.

WAN

Meter should be capable of connecting to the WAN. If the overall WAN solution requires it, the MCH should be capable of adopting various configurations e.g. Cellular antennae, etc.

A GSM, for the avoidance of a mains electricity connection (safety), uses a battery power source. This is an important consideration in designing the WAN hardware.

HAN

The MCH should be capable of generating a HAN, using technology understood by the industry (e.g. ZigBee) of a standardised but secure configuration, to facilitate integration with other Consumer technologies.

Where an integrated ESM and GSM solution is designed, the HAN might be required to facilitate a service comparable to the SMETS2 Gas Proxy Function (see Table 60 of Appendix B).

MMS

The MCH should be able to interpret and receive commands from the MMS.

6.7.3.6 Security

Security of the Smart Meter is paramount.

Physical

The meter should be tamper-resistant and be able to record interference events to the MMS.

Software and Local Data

The internal software and locally-stored data must be secure, encrypted, and resistant to attack per standards set by the NCSC.

Data and Communication

Communication should be encrypted and resistant to attack per standards set by the NCSC. Authorisation control is essential in controlling which external devices can interact with the Smart Meter to prevent unauthorised access.

6.7.4 Developing an NI Specification

It is critical that any specification used is developed and tailored specifically for Northern Ireland. Gas stakeholders described SMETS2 as overly prescriptive and would prefer a softer specification. This is reflected in the cancelled procurement where the DNOs were flexible on requirements and allowed the market to dictate the suite of functionalities by offering existing off-the-shelf solutions.

GB stakeholders pointed out that BEIS was heavily involved in the development of SMETS2, even at a technical level, and that a similar level of involvement in NI would be required of the government to ensure the rollout maximises Consumer benefits.

With growing public sentiment questioning how personal data is used by the government and sector bodies, transparency of the design specification and requirements is key.

6.8 Tariffs in Northern Ireland

Gas networks are generally designed to meet firm winter peak demand and have capacity to meet a severe cold winter day that is statistically likely to occur once every twenty years (1-in-20), in the case of NI and GB, and once every fifty years (1-in-50) in the case of Ireland. Demand for gas is typically driven by temperatures, i.e. the colder it is the higher the demand for gas. This demand is not as flexible as the demand for electricity, which can be shifted to times of lower demand more easily, especially when incentivised by lower unit rates. There are negligible benefits for the gas DNOs if gas demand is shifted during the day due to how the gas network is operated.

From our research into the GB gas market, there is currently no smart or time of use gas tariffs available. Gas is sold at the same price throughout the day and night.

It is not likely that a smart tariff structure would be introduced in Northern Ireland for the gas network.

6.9 Gas Sector Considerations

In this summarising section is presented an overview of the qualitative aspects of any impacts and considerations of a Smart Meter rollout across the gas sector, from the network, Retailer, and Consumer perspectives.

6.9.1 Generation, Transmission, and Distribution

The following are positive impacts and challenging considerations explicitly cited by stakeholders that a successful Smart Service deployment would deliver for network companies.

Improved and more efficient network planning

Consumer-side usage data helps the DNO map usage across the network in more granular detail. This can assist in network planning and operations.

Improved visibility and more accurate reporting of network performance

A near Realtime view of usage helps the DNO better understand demand on the network.

Improved safety around meter tampering, early detection of meter faults and quicker restoration of supply

Smart Meters would provide DNOs improved visibility of meter points, and they would be able to detect issues with meters including potential meter tampering cases. This alongside remote isolation could improve the overall safety of the network.

6.9.2 Retailer

The following are positive impacts and challenging considerations explicitly cited by stakeholders that a successful Smart Service deployment would deliver for Retailers.

Reduced meter reading

Smart Meters remove the frequency for regular, manual meter reads which provides a cost saving to the current Meter Point Administrators, the Retailers. Note, that periodic manual readings are still required for safety and compliance but this at a substantially reduced frequency.

Reduced gas theft

Smart Meters in combination with distribution monitoring terminals can be used to isolate cases of gas theft which is a source of loss for Retailers. Reducing theft benefits Consumers who ultimately pay for losses.

6.9.3 Consumer

The following are positive impacts and challenging considerations explicitly cited by stakeholders that a successful Smart Service deployment would deliver for Consumers.

Improved customer service

A Smart Service facilitates a more informed and data-driven customer service. With enhanced capability, network operators would be able to remotely help consumers without the need to send a technician to the premises in some cases. There is likely an initial increase in consumer support required given the implementation of a new technology but as this becomes the norm, the overall quality of service increases.

Data that supports consumption reduction

The Smart Service provides Consumers with their gas usage data. It helps them understand periods of higher usage, and cost. With the right support and data, this encourages a reduction in consumption overall which reduces emissions, supporting the fight against climate change, as well as their finances.

Smart Meters, and the constant awareness of consumption, promotes a behavioural change that allows Consumers to make a contribution to a greener society.

A reduction in consumption may support the reduction of fuel poverty.

In a GSM trial in Ireland (2011) demand reduction of between 2.2% and 3.6% were achieved by participants with Smart Meters. The more data the consumer was provided with (In Home Display and a detailed energy statement with their bi-monthly bill) the greater the reduction in demand.

Enabling renewable gases

Smart Meters on the gas network can help with the integration of renewable gases onto the grid and ensure accurate billing for consumers due to different calorific values of gases.

Just Transition

Energy transitions are about people: the ones who make the decisions and the ones affected by those decisions. A Just Transition approach ensures that the affected people are considered by those making decisions.

It is critical that any rollout is mindful of vulnerable groups and inclusive of all demographics.

Reduced requirement for meter reading and more accurate billing

Consumers need not submit meter readings as part of a well-performing Smart Service. Bills are more accurate and reflect real information rather than estimates.

Consumer sentiment

An expected challenge is customer sentiment around costs, customer engagement, and GDPR considerations. The government and programme owner must be transparent at all stages of the process.

Consumer Engagement

The consumer should be made aware of the most effective way to benefit from a Smart Service.

Data Ownership

The consumer should also be made aware of the way in which their usage data will be used, and who will be privy to that information i.e. Retailer and network companies.

Section 7. Cost Benefit Analysis

7.1 Methodology

7.1.1 Cost-Benefit Analysis Introduction

The economic appraisal assesses the desirability of a project from a societal perspective. This form of appraisal differs from a financial appraisal, which is undertaken from the perspective of a particular stakeholder e.g. Sponsoring Agency or the Exchequer. The economic appraisal takes a wider view and considers non-market impacts. The options are evaluated on both a quantitative and qualitative basis, paying particular attention to the change in costs that would arise from introducing Smart Meters, the change in energy demand and the external impacts associated with this change. Economic appraisals typically consider the external or non-financial impacts of short-listed options, evaluated from the perspective of society. This Cost-Benefit Analysis (CBA) has been prepared in accordance with HM Treasury's Green Book.

In cases where identified costs or benefits cannot be reasonably valued, a qualitative description has been provided. Whilst every effort has been made to quantify costs and benefits, there are some for which data is not currently available to make robust assumptions and to carry out analysis. These benefits (which could not be reasonably measured) have not been included in the Benefit-Cost Ratio (BCR) calculation but have been considered as part of final results and recommendations.

Valuing economic benefits can be subjective and therefore a BCR should not be used as the sole factor when comparing and prioritising rollout options. The introduction of Smart Meters in Northern Ireland (NI) will have long-lasting impacts, not all of which can be captured in a cost-benefit analysis. Therefore, consideration should be given to the wider strategic, political, and financial implications. The economic analysis presented here should be considered within the wider context of a Smart Meter rollout.

In determining the preferred rollout scenario, consideration is given to each scenario's quantified costs and benefits, as well as unquantifiable impacts. Results are presented as a Net Present Value (NPV) and a BCR. The NPV comprises discounted benefits and revenues minus discounted costs and expenditure and provides an indication of the scale of the impact and whether benefits are greater than costs (indicated by a positive NPV). The BCR presents the discounted benefits divided by the discounted costs, giving an indication of the relative scale of the benefits compared to the costs involved. Typically, a positive NPV and a BCR above 1.5 are considered to deliver "medium" value for money (VfM).

7.1.2 CBA Approach

The CBA has followed several key steps, set out below. The process included drawing on expertise from electricity and gas market subject matter experts, consultation with industry stakeholders to understand impacts and to provide data inputs, and review of previous similar studies to learn lessons and to test methodologies. A bespoke model has been designed to capture the key considerations identified as part of our research and raised during the stakeholder engagement sessions.

7.1.2.1 Meter Connections Forecast

To determine the total scale of the Smart Meter rollout it has been assumed that electricity connections will continue to grow annually throughout the model lifetime. For the electricity market, a combined annual growth rate of 0.7% has been applied to total domestic (credit and prepayment connections) and Small Medium Enterprise (SME) electricity connections out to 2052, based on historical utility connections growth rates, local Council Development Plans, housing stock forecasts and KPMG market intelligence. This accounts for expected growth in population over the appraisal period as new buildings are developed for homes and SMEs, requiring connections and meters. For the gas market, growth rates have been estimated using forecast total number of connections in 2030 and 2050 in the Energy Strategy and scaling them linearly to apply an annual growth rate.

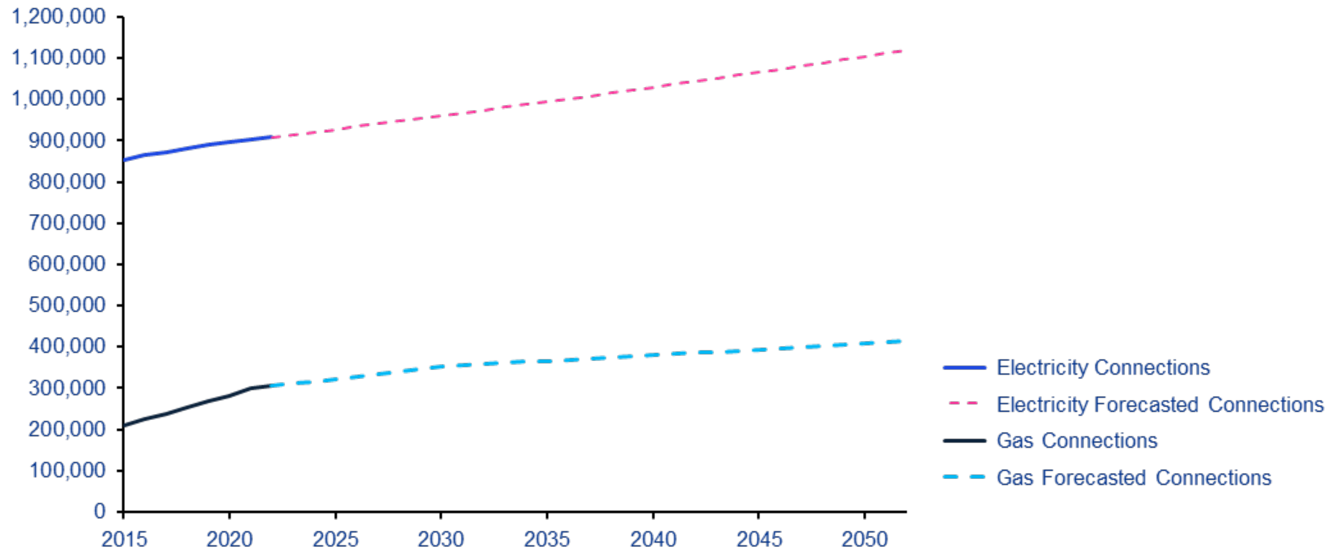

Figure 5 - Electricity and Gas Connections Forecast for Domestic and SME customers to 2052

Current meter connections have been inputted into the model to determine the number of existing traditional meters and forecast growth in meters, the number of Smart Meters installed, and the remaining rollout required to take place in each year. In 2021 there are 827,551 domestic electricity meter connections and 74,309 Small Medium Enterprises (SME) connections in NI, giving 901,860 total connections. For gas, in 2021 there were 288,661 domestic connections and 10,357 SME connections. Whilst the SME connections are very few in comparison to domestic connections, they account for approximately half of the gas volume used. Smart Meters and Traditional Meters are both assumed to have an expected life of 20 years, after which they need replacement. This occurs in the final few years of the appraisal period under core scenarios assessed. Additionally, for gas meters it is assumed that they will be battery operated, with the battery requiring replacement after 12 years.

7.1.2.2 Defining Scenarios

There are an infinite number of permutations for Smart Meter rollout which could be considered. Variables include the technology deployed for Smart Meters, the way the rollout is carried out and responses to Smart Meters from both consumers and suppliers.

Initial consideration was given to different characteristics that could influence overall costs and benefits of a Smart Meter rollout, based on previous CBAs and consultation with stakeholders and the Department. Characteristics considered are shown in Table 10.

Table 10 - Scenario Characteristics Considered

Area	Characteristic

Rollout	Speed of rollout Organisation responsible for rollout Cost of installation Take-up across population
Functionality	SMETS2 Frequency of data points Energy markets covered Cost per unit
Consumer response	Tariffs Total energy usage Peak reduction and shifting

Three scenarios have been developed to take account of variations to a Smart Meter rollout in Northern Ireland. These are intended to present a range of potential outcomes and support the Department in identifying next steps for a rollout. The analysis presents results for what is likely to happen under the defined circumstances.

Key scenario assumptions have been set based on the Department for Economy's NI Energy Strategy scenarios described as Roadmap to 2030, Power Play 2050 and Flexible Fit 2050. These have been adjusted to include specific assumptions for introducing Smart Meters taken from:

- Findings from the Literature Review, including previous Smart Meter rollout studies,
- Input from subject matter experts, including DfE's Smart Meter CBA steering group, and
- Expertise from industry stakeholders, including energy suppliers and networks.

The CBA model has been designed to be able to analyse a range of scenarios, capturing different assumptions and potential outcomes. More detail is provided on each scenario in the relevant electric and gas sections of this report.

Table 11 - Summary of defined scenarios

Scenario	Definition
Counterfactual	The continuance of business-as-usual activities without a Smart Meter rollout. Traditional meters will continue to be replaced at end of life, with a high proportion of NI customers relying on pre-pay metering. Smart Meters would not be rolled out.
Scenario 1	The 'fast' rollout is the most ambitious rollout to replace all traditional meters including those not at end of life with Smart Meters in a set period. An active marketing strategy would accompany rollout, encouraging large shifts in behaviour to reduce energy consumption, and geographical coordination could occur to reduce installation costs from travelling between areas.
Scenario 2	The 'phased' approach is an ongoing replacement of traditional meters at their end of life with a Smart Meter. This occurs over a longer time period until all traditional meters are replaced with Smart Meters. Replacement will likely occur disparately across geographical locations.
Scenario 3	A combination of fast and ongoing rollout, including a fast implemented trial in two local Government district areas (Mid-Ulster and Newry, Mourne and Down) and a phased rollout once meters reach end of life.

7.1.2.3 Data Collection

To determine inputs into the CBA model, data was collected from a range of sources. An initial non-exhaustive list of costs and benefits was prepared, and inputs were gathered from publicly available information, CBAs discussed in the Literature Review and subject matter experts.

To ensure the relevancy of data to Northern Ireland, specific inputs were discussed in stakeholder workshops with energy networks and suppliers. The list of data inputs required were collated in a Microsoft Excel data request and issued to stakeholders for completion. As well as the quantitative data request, qualitative responses were requested from the same groups as an opportunity to provide insights in relation to, for example, who should own and manage the data, benefits, and costs expected for consumers, and technical functionality requirements of the Smart Metering systems that should be considered.

The final inputs into the model cover a range of data provided by stakeholders, assumptions aligned with previous relevant CBAs and findings from Smart Meter rollouts internationally.

Following this process, some gaps in data remained. This was often due to specific data points required which are not typically collected by industry stakeholders or publicly available. In preparation for any future evaluations mid-rollout, we suggest that data is collected over time, as the rollout proceeds. These would allow some impacts to be assessed at a more granular level, such as reductions in the frequency of connection failures. Where reliable data was not available, associated impacts have not been modelled.

7.1.2.4 Calculation Methodology

A bespoke model was developed using Microsoft Excel to estimate the costs and benefits of installing Smart Meters across Northern Ireland compared to the current traditional meters. Figure 6 shows how this was developed over time.

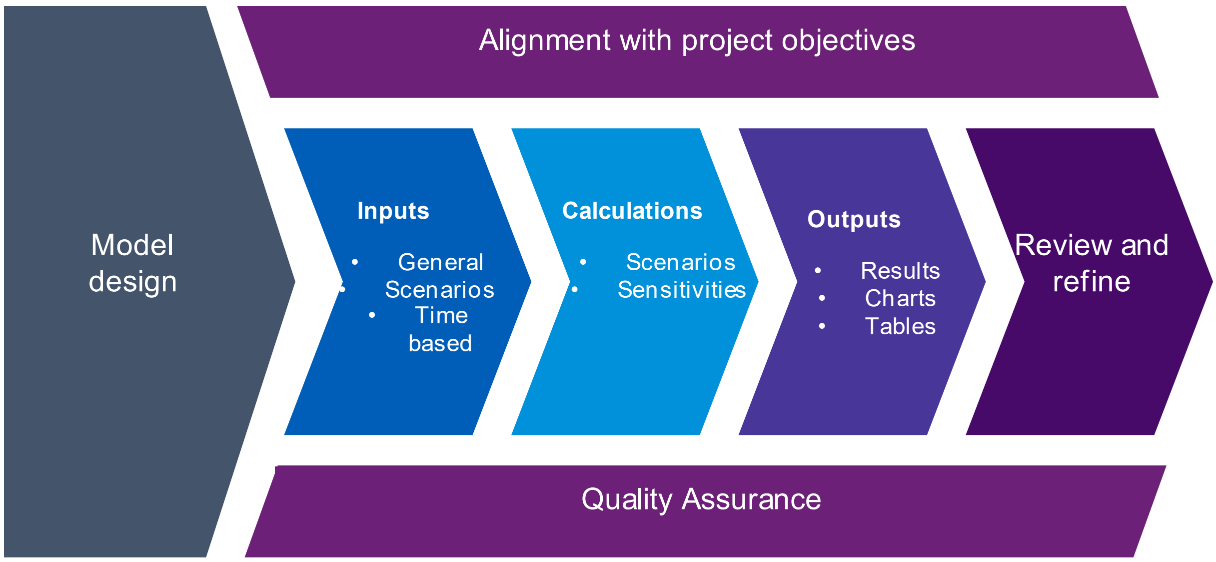

Figure 6 Development of Cost Benefit Analysis Model

The model used the data gathered, general appraisal assumptions in line with HM Treasury Green Book where relevant, and input from subject matter experts to calculate impacts identified which could arise from a Smart Meter rollout. Where available, Northern Ireland specific data, assumptions and calculations were used.

For each impact identified, an individual calculation was developed, based on a number of sources – European Commission recommendations, UK Government appraisal guidance, subject matter expert calculations and economic principles.

The European Commission set out a recommendation[50] on the preparation for the rollout of Smart Metering systems in 2012. The recommendation included a non-exhaustive list of formulae for quantification of benefits in the case of electricity. Where data was available, the approach deemed relevant for NI and the analysis was proportionate to the expected impact, benefits have been calculated based on formulae provided in the EU Smart Meters Recommendation paper. Some impacts assessed using these formulae are reduced cost of theft, reduced cost of meter readings and reduced billing cost.

Analysis has also drawn on UK Government appraisal guidance, using approaches outlined in HM Treasury Green Book, BEIS guidance on valuing greenhouse gas emissions and DEFRA values for emissions carbon intensity factors. This guidance is based on best available research and presents robust methodologies to follow. Where possible, this approach was combined with values from DAERA to use Northern Ireland specific values, such as for the carbon intensity of electricity consumed.

For the remaining formulae, including those impacts identified for which there was no EU recommendation, or which require a NI specific approach (e.g. due to the high proportion of pre-pay meters), we have applied core economic principles, reviewed previous CBAs for their approach and logic to estimate the impact, using the data collected. Each of these formulae have been reviewed. Examples of impacts include jobs created during installation, reduced cost of topping up pre-pay meters and cost of estimating load profiles.

Individual formulae used to calculate each impact are shown in Appendix D. A summary of each approach is shown in the table below. Benefits which are only applicable to the electricity market have been indicated as such.

Table 12 Approach for Impacts Assessed

Impact Assessed	Approach
Costs	
Capital Costs	
IT costs	Difference in costs for IT systems between Smart Meters and traditional meters, annual value
Project management costs	Difference in costs for project management systems between Smart Meters and traditional meters, annual value
Total transmission costs	Difference in transmission costs between Smart Meters and traditional meters – assumed no change
Total distribution costs	Difference in distribution costs between Smart Meters and traditional meters – assumed no change
Avoided investment in conventional meters	Investment saving once 50% of the market operates using Smart Meters, annual value
Operational Costs	
IT maintenance costs	Difference in costs for IT maintenance between Smart Meters and traditional meters, annual value
Network management and front-end costs	Difference in costs for network management between Smart Meters and traditional meters, annual value

[50] Official Journal of the European Union: Commission Recommendation of 9 March 2019 on preparations for the roll-out of Smart Metering systems (2012/148/EU)

Communication/data transfer costs (inc. GPRS, radio communications.)	Difference in communication costs between Smart Meters and traditional meters, applied to the number of meters of each
Replacement/failure of Smart Metering systems (incremental)	Replacement costs of installation and new units for Smart Meters which fail, incremental to traditional meters failing
Distribution and Transmission O&M	Difference in distribution and transmission operation and maintenance costs between Smart Meters and traditional meters – assumed no change
Cost of consumer engagement programmes	Additional cost of engagement during Smart Meter rollout, per meter installed
Additional costs of operating two systems in parallel until full transfer	Uplift on operating costs to account for running two systems in parallel, assumed zero in core analysis
GB load profiles no longer produced, would require NI estimates if stay on traditional meters	Annual cost saving of not needing to calculate NI load profiles once Smart Meters reach 25% market – *electricity only*
Installation Costs	
Cost of installation	Difference in installation costs for traditional and Smart Meters, applied per Smart Meter installed. Cost includes labour costs and are higher for Smart Meters to account for additional stages required to ensure connections. *For gas – installation and unit costs combined to one value*
Cost of meter units	Difference in unit costs for traditional and Smart Meters, applied per Smart Meter installed. *For gas – installation and unit costs combined to one value*
Project management costs of rollout - procurement, planning, implementing	Project management cost of Smart Meter rollout, applied annually in years where rollout occurs
Training costs	Annual training cost required, based on number of meters installed each year compared to previous year and the number of additional engineers therefore required. Expected to require approximately two years of training per engineer.
Sunk costs of previously installed (traditional) meters	Sunk costs incurred when replacing traditional meter before end of life. Uses the life expectancy of meter, assumed age of the meter being replaced and the unit cost of Smart Meters to reflect their value, applied to number of Smart Meters installed
Billing system upgrade for suppliers	Difference in investment costs for billing, annual value
Cost of installation for replacement meters	Difference in installation costs for traditional and Smart Meters, applied per replacement Smart Meter installed once reach end of life. *For gas – installation and unit costs combined to one value*
Cost of meter units for replacement meters	Difference in unit costs for traditional and Smart Meters, applied per replacement Smart Meter installed once reach end of life
Benefits	
Metering	
Reduced meter operations costs	Difference in meter operations costs between traditional and Smart Meters, minus the additional cost required from Smart Meters communications failures
Reduced meter reading costs	Cost saved per meter reading, applied to frequency of meter reads and number of Smart Meters installed
Reduced billing costs (including introduction of digital billing)	Difference in billing costs for smart and traditional meters, applied to the number of Smart Meters installed. Some billing costs remain for Smart Meters, but lower than traditional meters
Reduced call centre/customer care costs	Difference in total customer care costs currently, and costs applied to smart and traditional meters. Assumes a higher cost per meter under Smart Meters due to increased queries, results in a negative impact overall

Reduced top-up effort	Time saving for consumers from reduced effort to top-up, uses an assumption for time taken per top-up, value of time, applied for a proportion of households with PAYG meters. This proportion accounts for the fact that not all consumers will benefit from the time saving, e.g. if they already top-up online, will continue topping-up in person or top-up as part of another trip.
Reduced callouts for customers switching supplier	With Smart Meters, companies will no longer need to visit properties to switch suppliers. This benefit is estimated by assumed % of households who switch supplier each year, the cost per call out and number of Smart Meters
Operations, maintenance and outage	
Reduced maintenance costs of assets (including chip replacement)	Difference between cost of maintenance for traditional meters and cost of maintenance for Smart Meters, applied to the number of each
Reduced costs of equipment breakdowns	Difference in cost of breakdowns for traditional meters and Smart Meters, applied annually
Jobs created during installation	Wage gained from employment opportunities created by additional installations needed
Faster restoration of supply	Reduced customer minutes lost (CML) due to faster post-fault restoration of supply. The networks value of lost load is used to determine the monetary value of the reduced CML – *electricity only*
Reduction in OPEX to fix faults	Fault crews and operator will locate faults more quickly due to enhanced visibility of the distribution network. This leads to savings in fault maintenance costs - *electricity only*
Deferred investment	
Avoided distribution capacity investments	Achieved due to reduced peak demand thereby limiting the level of load growth related reinforcement of the distribution network.
Avoided transmission capacity investments	Achieved due to reduced peak demand thereby limiting the level of load growth related reinforcement of the transmission network.
Deferred generation investments for peak load plants	Peak demand reduction minimises the need to procure generation capacity in the capacity market thereby providing a saving to consumers. This benefit is only accrued for customers on time of use tariffs. - *electricity only*
Consumption	
Consumption reduction	Assumed reduction in residential energy consumption which is applied to the long run variable cost for electricity. Lower reductions are assumed for PAYG customers. *For gas, higher reductions are assumed for SME connections.*
Peak energy shifting	Shifting of demand energy away from peak time returns a saving to consumers due to lower off-peak tariffs. This benefit is only accrued for customers on time of use tariffs - *electricity only*
Reduction of technical losses of electricity	Reduced energy consumption limits the amount of losses on the distribution and transmission networks. - *electricity only*
Reduced cost of client indemnification	Difference in cost of client indemnification incurred for traditional and Smart Meters, applied to proportion of Smart Meters in market - *electricity only*
Reduced electricity theft	Difference in estimated cost of theft incurred for traditional and Smart Meters, applied to number of Smart Meters. Theft assumed lower in Smart Meters as will be more noticeable when energy is consumed without being recorded on the meter
Recovered revenue relating to 'contracted power' fraud	Difference in estimated cost of contracted power fraud incurred for traditional and Smart Meters, applied to number of Smart Meters. Current value is assumed very low - *electricity only*
Recovered revenue relating to incremental 'contracted power	Difference in estimated cost of incremental power fraud incurred for traditional and Smart Meters, applied to number of Smart Meters. Current value is assumed very low - *electricity only*
Environmental Benefits	

Reduced CO_2e emissions - energy efficiency	Emissions savings resulting from reduced energy consumption, applies a value for emissions per unit of electricity generated, carbon traded price, applied to the volume of energy reduced
Reduced CO_2e emissions - technical losses	Emissions savings from reduced losses from transmission and distribution, applies a value for emissions per unit of electricity generated, carbon traded price, applied to the volume of energy reduced

7.1.2.5 Quality Assurance

KPMG has a robust and reliable process for quality assurance of analysis. We take care when developing models to ensure they are functioning correctly, free from errors and use the best available data to inform inputs. The following steps have been taken to review and provide assurance on this model:

1. Multiple analysts were involved in developing the model, reviewing formulae as it progressed and challenging the approaches involved to identify the best method
2. Regular sense checks took place by the project team and subject matter experts on key assumptions, impacts being assessed and overall flow of model
3. Independent review of the model was conducted by an expert modeller not previously involved with the analysis or project
4. Model was presented to analysts in DfE to provide overview of functionality, detail on key calculations and allow chance to challenge any approaches or inputs

We are confident that the analysis completed for the purpose of informing DfE on the future of Smart Metering in Northern Ireland is fit for purpose and proportionate to the decision being taken. This model and the associated analysis should not be used for any other purpose than that stated in the contractual agreement between KPMG and DfE.

7.1.3 General Assumptions

Some assumptions are consistent across the appraisal for installation of both gas and electric Smart Meters. These are standard assumptions used in economic appraisal and, where relevant, taken from or aligned with HM Treasury Green Book guidance. Some assumptions have also been made which are specific to the project. These are based on consultations with industry stakeholders and KPMG's experience in conducting analysis.

General assumptions used are shown in the table below. A full list of input assumptions is included in Appendix D.

Table 13 - Summary of General Assumptions

	Assumption	Value	Source
Timing	Model Start Date	01/01/2023	Project assumption
	Model End Date	31/12/2052	Project assumption
	Duration	30 years	Project assumption
	Discount rate	3.5% for first 30 years, 3% 31-75 years	Green Book Guidance
Project Assumptions	Domestic electricity connections base case (2021)	827,551	Utility Regulator
	SME electricity connections base case (2021)	74,309	Utility Regulator
	Proportion of households currently on electricity PAYG meters	45%	Utility Regulator

7.2 Electricity Cost Benefit Analysis

This section discusses the cost benefit analysis carried out on the rollout of Smart Meters for electricity. It provides detail on the scenarios assessed, the costs and benefits measured, and the overall results for electricity.

7.2.1 Scenarios

We considered a long list of factors which could influence the overall costs and benefits of rollout, reviewed previous CBAs to understand which ones are likely to have the biggest impact and discussed scenarios based around these factors with stakeholders and the Department to identify three scenarios to assess in detail. Detail on the wider characteristics is discussed above in Section 7.1.2.2. This process identified the speed of the rollout as a key determinant of the costs and benefits. Therefore, three scenarios have been developed where the main difference is on how fast Smart Meters are installed:

1. Scenario 1 – Fast rollout
2. Scenario 2 – Phased rollout, as meters reach end-of-life
3. Scenario 3 – Phased rollout with trial area

A summary comparison of the rollout of the three scenarios analysed is shown in Figure 7, with further detail provided in the individual scenario explanations below.

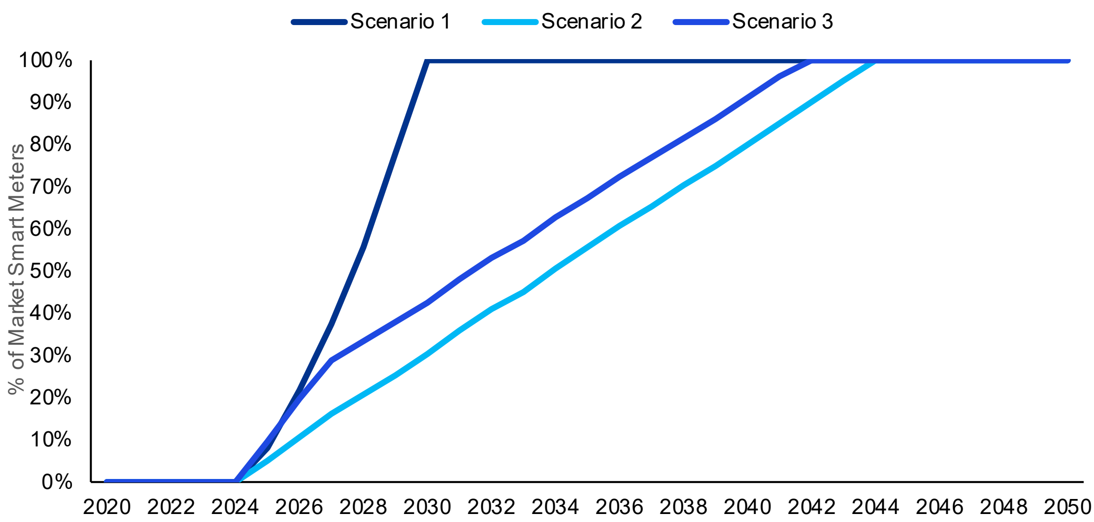

Figure 7 - Comparison of cumulative rollout across scenarios

7.2.1.2 Counterfactual

Each scenario is measured against the counterfactual within the calculations. Input values are taken as the difference between the counterfactual and the scenario, or between traditional and Smart Meters where appropriate.

The counterfactual assumes a “business as usual” approach with minimal change to current operations. Naturally, some changes will be needed as external circumstances change. This includes the implications from the rollout of Smart Meters in Great Britain, resulting in some information used to currently estimate bills in NI no longer being available. In the counterfactual where NI continues to use traditional meters, load profiles would need to be estimated in order to issue bills to customers.

Traditional meters are assumed to continue to replace current meters when they reach the end of their useful life, with the same proportion of customers remaining on prepayment meters as currently.

A summary of assumptions used in the counterfactual is show below.

Table 14 - Assumptions in the Counterfactual

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	0%	Project assumption
	Age profile of meters being replaced	20 years	Project assumption
	Installations per worker per day	7	Project assumption
CAPEX	Unit cost per traditional meter and installation	[Commercially Sensitive]	Stakeholder input, Confidential
	% Households networks facing difficulty/ unable to replace meters	[Commercially Sensitive]	Stakeholder input, Confidential
	Failure of meter systems (% of total installed)	[Commercially Sensitive]	Stakeholder input, Confidential
OPEX	Cost of consumer engagement programmes	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of profile procurement	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost per meter lost to theft	[Commercially Sensitive]	Stakeholder input, Confidential
	Average non supplied minutes/year	6.1	Stakeholder input, Confidential
Metering	Cost per local meter reading	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of meter operations	[Commercially Sensitive]	Stakeholder input, Confidential
	Billing cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Customer care cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Communications failure rate	[Commercially Sensitive]	Stakeholder input, Confidential

7.2.1.3 Scenario 1

Scenario 1 has the most ambitious ‘fast rollout’. Smart Meters will be deployed at a rate of 8% of total traditional meters for domestic and SME connections in the first year of rollout of Smart Meters, reaching 100% of total meters for domestic and SME connections being Smart Meters by the end of 2032.

This 6 year rollout period assumes that 100% of traditional meters will be replaced with a Smart Meter, including those that have not yet reached their end of life. Any new connections have been assumed to be smart and have been included in the rollout.

Traditional meters that are being replaced have been assigned an age profile of 16.7 years across the 6 year rollout period to calculate the residual value of these replaced meters. This captures the impact of meters being replaced when they still have useful life in them, and the associated economic cost of replacing meters early.

The model duration is 30 years from 2023. Smart Meters have an assumed life expectancy of 20 years, therefore Smart Meters installed between 2027-2032 will need replacing from 2047-2052. The costs of these 973,785 replacement meters have been included in the CBA.

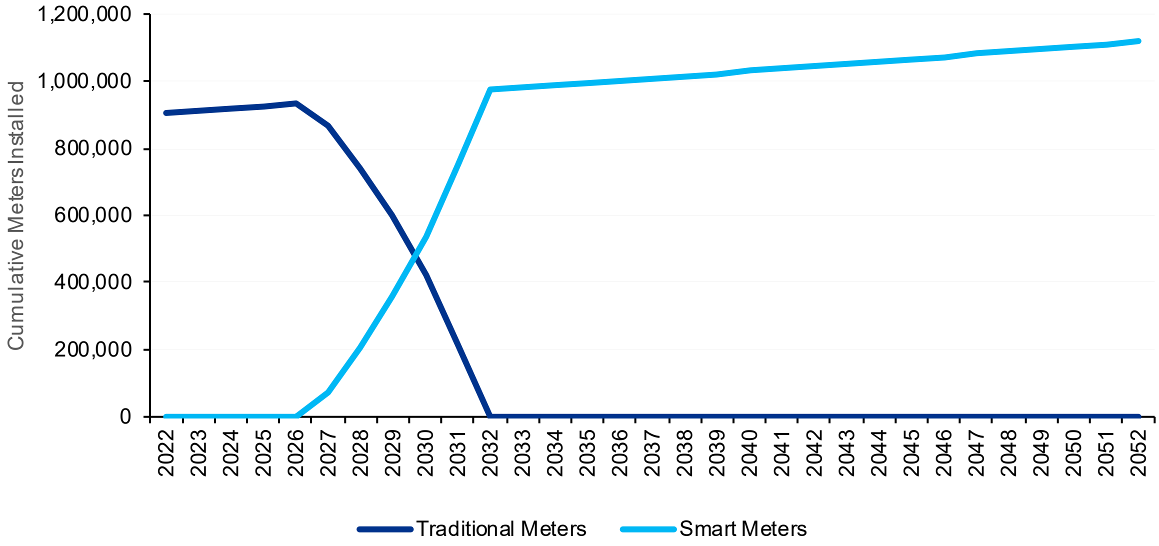

Figure 8 - Cumulative Rollout Profile in Scenario 1

Energy savings have been assumed in Scenario 1 to be 3.5% from Smart Metering in credit meters and 3% with PAYG meters. This captures the impact of consumers reducing their energy consumption because they have additional information on the cost of their usage, helping them to reduce inefficiencies and change behaviour. Scenario 1 assumes this change to be higher than other scenarios due to a fast rollout attracting more marketing to encourage behavioural change, a “joint effort approach” from Northern Ireland to reduce electricity usage, and publicity around supporting climate change mitigation through lower electricity usage. The behavioural change assumption is a conservative estimate from consumer surveys following Smart Meter installations. A higher spend on communications and marketing is assumed in this scenario to account for more marketing to encourage consumers to reduce their consumption. Customers may also switch to using more electricity in the off-peak period when cheaper tariffs are available, or incentives provided by the suppliers to help reduce peak requirements. This is measured separately.

Scenario 1 is intended to be ambitious. It is acknowledged that Northern Ireland may not reach 100% of households and SMEs using a Smart Meter due to difficulties in accessing meters and challenges from consumers not wanting to switch.

Table 15 - Assumptions in Scenario 1

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	3.5% Credit meters, 3% PAYG meters	Project assumption
	Age profile of meters being replaced	16.7 years	Project assumption

	Installations per worker per day	7	Project assumption
	Value of job created	£29,621 per person	NISRA
	Training costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Rollout duration	6 years (2027-2032)	Project assumption
	Project management costs of rollout (procurement, planning, implementing)	£8.3m per annum	Project assumption, based on stakeholder input
CAPEX	Unit cost per Smart Meter and installation	[Commercially Sensitive]	Stakeholder input, Confidential
	% Households networks facing difficulty/ unable to replace meters	[Commercially Sensitive]	Stakeholder input, Confidential
	Total IT costs	£3.5m per annum	Project assumption, based on stakeholder input
	Project management costs	£1.6m per annum	Project assumption, based on stakeholder input
	Potential for avoided investment in conventional meters once 50% market Smart Meters	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Billing system upgrade	[Commercially Sensitive]	Project assumption, based on stakeholder input
OPEX	Total IT maintenance costs	£4m per annum	Derived from ROI CBA
	Total network management and front-end costs	£2.25m per annum	Derived from ROI CBA
	Total communication/ data transfer costs	£5.95 per meter per annum	Derived from ROI CBA
	Failure of Smart Meter systems (% of total installed)	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Call centre costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of consumer engagement programmes	£1.5 per meter	Project assumption
	Cost of profile procurement	[Commercially Sensitive]	Stakeholder input, Confidential
	Decrease in outage time	20%	Based on BEIS CBA
Metering	Cost per local meter reading	[Commercially Sensitive]	Stakeholder input, Confidential
	Billing cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Customer care cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Communications failure rate	[Commercially Sensitive]	Stakeholder input, Confidential

7.2.1.4 Scenario 2

Scenario 2 is the most gradual rollout. Traditional meters will be replaced with Smart Meters when they reach end of life. Assuming the lifespan of both traditional meters and Smart Meters are 20 years, this rollout will take 20 years, with 100% of Smart Meters installed between 2027-2046. Smart Meters will be deployed at a rate of 5%. Any new connections have been assumed to be smart and have been included in the rollout.

The age of traditional meters being replaced each year during the rollout is assumed to be 20 years old, therefore no residual value is extracted from the traditional meters.

Smart Meters installed between 2027-2032 will reach their end of life from 2047-2052 as Smart Meters have an assumed lifespan of 20 years. These meters (297,543 in total) will be replaced at the same rate they were deployed and have been included in the CBA.

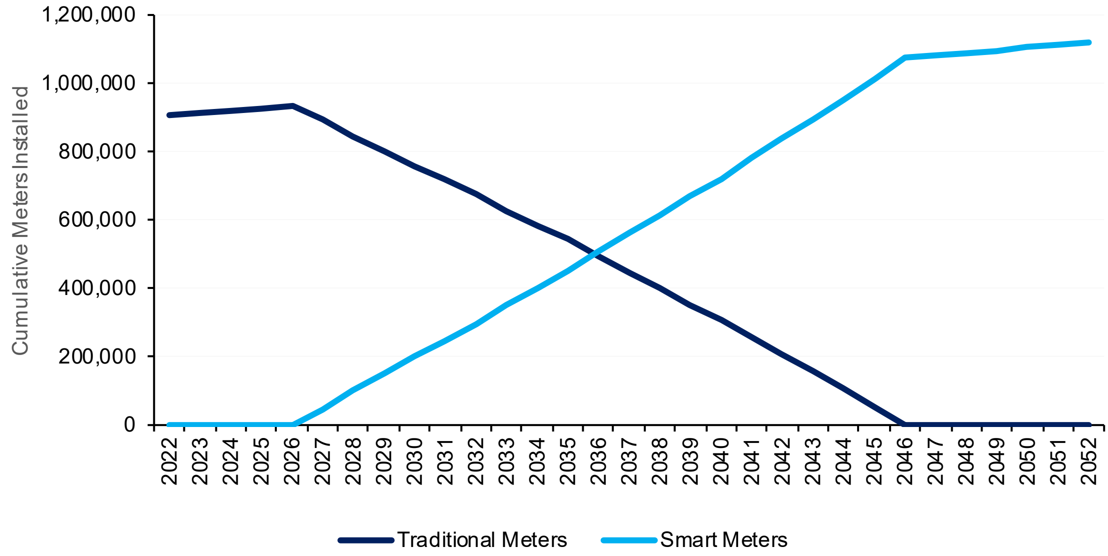

Figure 9 - Cumulative Rollout Profile in Scenario 2

Energy savings have been assumed to be 2.5% from Smart Metering with a credit meter and 2% with PAYG meters. Scenario 2 assumes a lower saving than Scenario 1 as marketing campaigns and focused efforts are likely to be less impactful over a 20 year rollout period compared with a 6 year rollout period in Scenario 1. Scenario 2 also carries the likelihood that consumers are less educated around the purpose and benefits of their Smart Meter when their traditional meter has been replaced at end of life. Consumers may request a Smart Meter prior to their traditional meter being end of life, however this has not been modelled specifically.

BEIS's 2019 Cost Benefit Analysis on the deployment in GB, which updates the initial analysis with actuals data, provides an extensive sample for modelling consumption reductions[51]. 3% is their assumed value based on retailer data to date cross-referenced against international pilots.

Table 16 - Assumptions in Scenario 2

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	2.5% credit meters, 2% PAYG	Project assumption
	Age profile of meters being replaced	20 years	Project assumption
	Installations per worker per day	7	Project assumption
	Value of job created	£29,621 per person	NISRA
	Training costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Rollout duration	20 years (2027-2046)	Project assumption

[51] Smart meter roll-out: cost-benefit analysis 2019 - GOV.UK (www.gov.uk)

	Project management costs of rollout (procurement, planning, implementing)	£2.5m per annum	Project assumption, based on stakeholder input
CAPEX	Unit cost per Smart Meter and installation	£154	Project assumption, based on stakeholder input
	% Households networks facing difficulty/ unable to replace meters	[Commercially Sensitive]	Stakeholder input, Confidential
	Total IT costs	£3.5m per annum	Project assumption, based on stakeholder input
	Project management costs	£1.6m per annum	Project assumption, based on stakeholder input
	Potential for avoided investment in conventional meters once 50% market Smart Meters	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Billing system upgrade	[Commercially Sensitive]	Project assumption, based on stakeholder input
OPEX	Total IT maintenance costs	£4m per annum	Derived from ROI CBA
	Total network management and front-end costs	£2.25m per annum	Derived from ROI CBA
	Total communication/ data transfer costs	£5.95 per meter per annum	Derived from ROI CBA
	Failure of Smart Meter systems (% of total installed)	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Call centre costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of consumer engagement programmes	£1 per meter	Project assumption
	Cost of profile procurement	[Commercially Sensitive]	Stakeholder input, Confidential
	Decrease in outage time	20%	Based on BEIS CBA
Metering	Cost per local meter reading	[Commercially Sensitive]	Stakeholder input, Confidential
	Billing cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Customer care cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Communications failure rate	[Commercially Sensitive]	Stakeholder input, Confidential

7.2.1.5 Scenario 3

Scenario 3 combines elements of Scenario 1 and Scenario 2 and is the middle ground in terms of rollout duration with 100% of traditional meters replaced with Smart Meters between 2027-2044. As with Scenario 2, traditional meters are assumed to have a lifespan of 20 years and will be replaced at end of life, assumed to be at a rate of 5%. Included in this rollout will also be a high-speed rollout trial in the Mid-Ulster and Newry, Mourne and Down districts. The high-speed trial will include replacement of traditional meters that have not yet reached their end of useful life. It is assumed the approximately 130,000 connections in these areas will have 100% Smart Meters connections between 2027-2029. The trial is assumed to occur simultaneously to the phased rollout. However, insight from the trial could be used to improve later rollouts or replicated in other geographical areas. Any new connections have been assumed to be smart and have been included in the rollout.

Similar to Scenario 2, the age of the traditional meters being replaced are assumed to be 20 years old for meters replaced as part of the phased rollout and the meters installed in the two trial areas between 2027-2029 are assumed to be 16.7 years old to calculate residual value. In the same way as Scenario 2, there is no residual value from those meters that have reached their end-of-life period. 416,230 meters require replacement over the 30 year appraisal period.

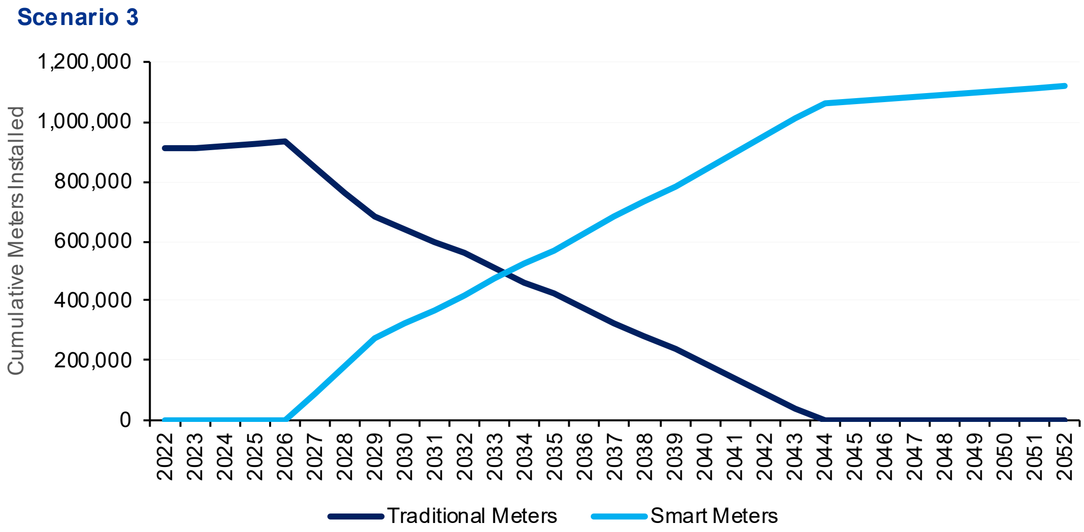

Figure 10 - Cumulative Rollout Profile in Scenario 3

Energy savings are assumed to also be 2.5% for credit meters and 2% for PAYG. This is because the majority of the rollout is gradual as in Scenario 2. The trial areas are likely to achieve higher levels of energy savings given the marketing and consumer behaviour changes that will occur during these years of the rollout. However, the trial area is only a small proportion of the overall rollout and unlikely to influence the total behavioural change.

Table 17 - Assumptions in Scenario 3

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	2.5% credit, 2% PAYG	Project assumption
	Age profile of meters being replaced	20 years	Project assumption
	Installations per worker per day	7	Project assumption
	Value of job created	£29,621 per person	NISRA
	Training costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Rollout duration	18 years (2027-2044)	Project assumption
	Project management costs of rollout (procurement, planning, implementing)	£2.8m per annum	Project assumption, based on stakeholder input
CAPEX	Unit cost per Smart Meter and installation	[Commercially Sensitive]	Stakeholder input, Confidential
	% Households networks facing difficulty/ unable to replace meters	5%	Project assumption, based on stakeholder input
	Total IT costs	£3.5m per annum	Project assumption, based on stakeholder input
	Project management costs	£1.6m per annum	Project assumption, based on stakeholder input
	Potential for avoided investment in conventional meters once 50% market Smart Meters	[Commercially Sensitive]	Project assumption, based on stakeholder input

	Billing system upgrade	[Commercially Sensitive]	Project assumption, based on stakeholder input
OPEX	Total IT maintenance costs	£4m per annum	Derived from ROI CBA
	Total network management and front-end costs	£2.25m per annum	Derived from ROI CBA
	Total communication/ data transfer costs	£5.95 per meter per annum	Derived from ROI CBA
	Failure of Smart Meter systems (% of total installed)	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Call centre costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of consumer engagement programmes	£1 per meter	Project assumption
	Cost of profile procurement	[Commercially Sensitive]	Stakeholder input, Confidential
	Decrease in outage time	20%	Based on BEIS CBA
Metering	Cost per local meter reading	[Commercially Sensitive]	Stakeholder input, Confidential
	Billing cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Customer care cost per client	[Commercially Sensitive]	Stakeholder input, Confidential
	Communications failure rate	[Commercially Sensitive]	Stakeholder input, Confidential

7.2.2 Benefits

Quantified benefits estimated for each scenario are presented in Table 18 and discussed in more detail below. These values cover the full appraisal period and are discounted to 2022 prices. They do not include impacts which have not been quantified, which are discussed separately in Section 7.2.2.8.

Table 18 Estimated Electricity Benefits

Benefits, £m 2022	Scenario 1	Scenario 2	Scenario 3
Meter benefits	183	131	148
Operations and maintenance benefits	31	39	37
Avoided investment	150	90	104
Reduced consumption	349	181	205
Reduced theft benefits	20	13	15
Outage savings	5	3	3
Environmental benefits	90	35	43
Total benefits	**827**	**492**	**555**

The graph below shows annual benefits per scenario, discounted and in 2022 prices. For this reason, annual benefits gradually decrease each year as benefits further away in time are valued lower than benefits closer in time. Once all meters have been replaced with Smart Meters, the benefits no longer increase but remain steady in nominal terms or decrease in real terms. As can be seen, annual benefits for Scenario 1 are higher in each year, especially in the early years of the appraisal period where more Smart Meters have been rolled out earlier. Scenario 1 will realise benefits earlier on in the appraisal period, compared to the other scenarios.

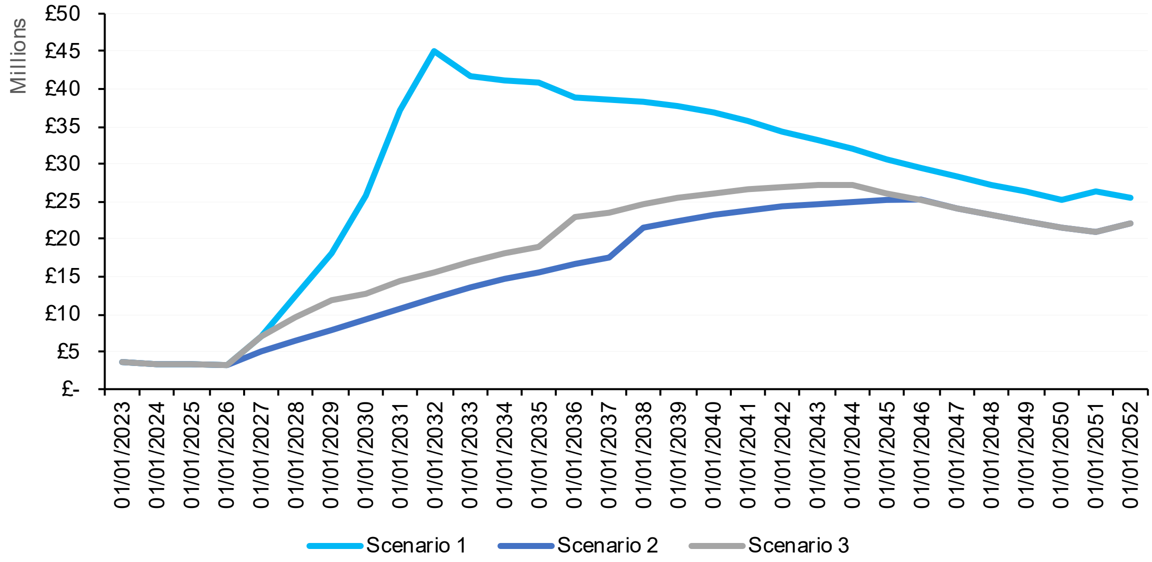

Figure 11 Annual Benefits per Scenario, Discounted

The graphs below show the breakdown of costs and benefits estimated for each scenario. As can be seen, the highest costs come from operational expenditure, with the largest benefits arising from reduced consumption. This is true for all scenarios, although the scale of costs and benefits differs. Whilst some benefits increase with the number of Smart Meters installed; others are estimated to provide a constant annual benefit over the appraisal period.

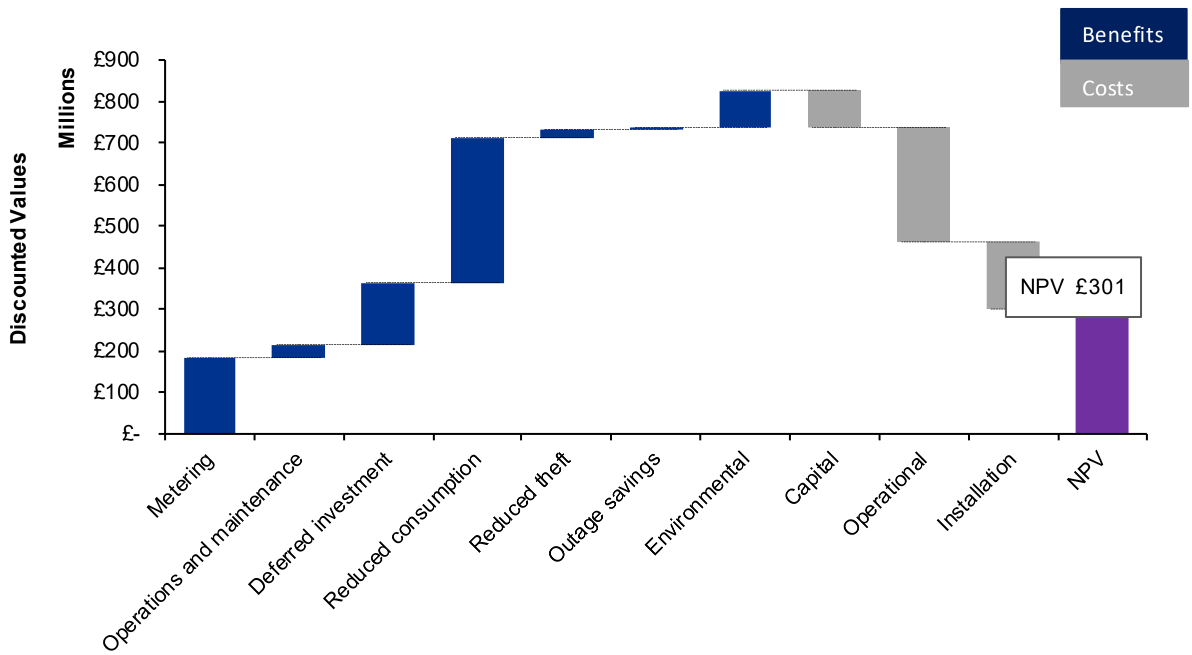

Figure 12 Discounted Costs and Benefits for Scenario 1

Table 19 Results of Scenario 1 - Electricity

Results	Scenario 1
PVC (£m, 2022)	527
PVB (£m, 2022)	827
NPV (£m, 2022)	301
BCR	1.57

As shown in Figure 12 and Table 19, in Scenario 1, the benefits outweigh the costs over the total appraisal period, shown by a positive Net Present Value (NPV). Benefits occur across a range of categories, with the largest impacts being reduced consumption, metering benefits and deferred investment. This represents the range of user groups who would benefit from the rollout of Smart Meters.

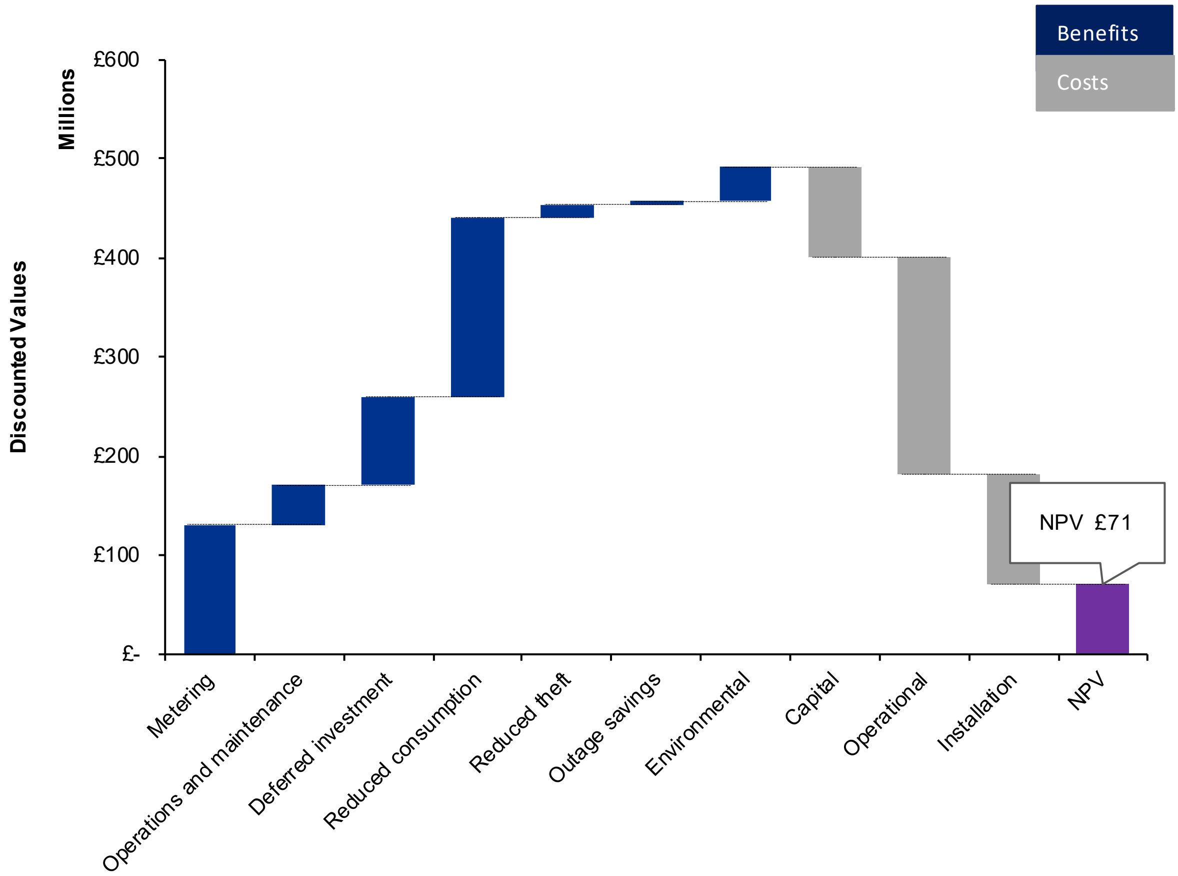

Figure 13 Discounted Costs and Benefits for Scenario 2

Table 20 Results of Scenario 2 - Electricity

Results	Scenario 2
PVC (£m, 2022)	421
PVB (£m, 2022)	492
NPV (£m, 2022)	71

BCR	1.17

As seen in Figure 13 and Table 20 in Scenario 2, the benefits outweigh the costs over the total appraisal period, shown by a positive Net Present Value (NPV). As with Scenario 1, the top three benefit categories are reduced consumption, metering and deferred investment.

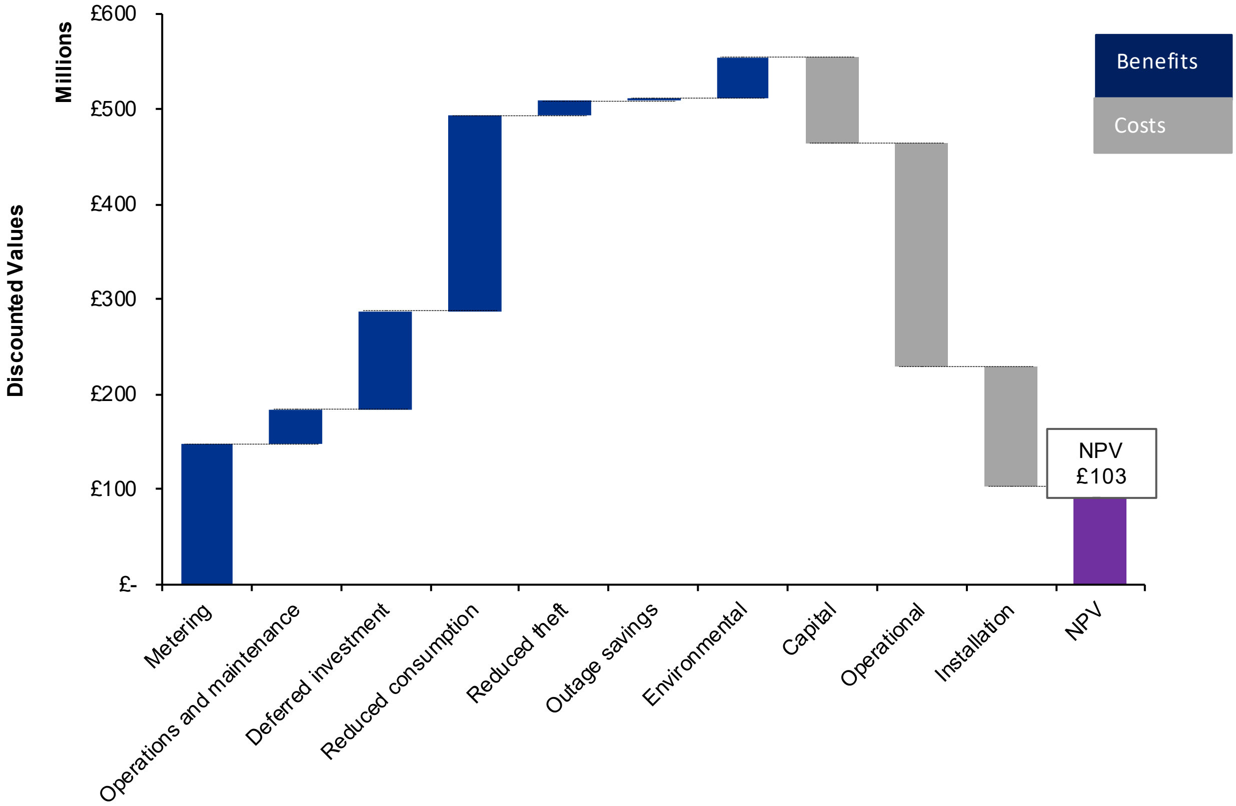

Figure 14 Discounted Costs and Benefits for Scenario 3

Table 21 Results of Scenario 3 - Electricity

Results	Scenario 3
PVC (£m, 2022)	451
PVB (£m, 2022)	555
NPV (£m, 2022)	103
BCR	1.23

As seen in Figure 14 and Table 21 in Scenario 3, the NPV is also positive, demonstrating the benefits outweigh the costs over the appraisal period. Scenario 3 presents higher benefits than Scenario 2, but also higher costs. The resulting BCR's are very similar between the two scenarios. Scenario 3 is marginally better than Scenario 2, demonstrating the benefits of additional Smart Meters being installed as part of an earlier trial.

7.2.2.1 Metering benefits

These are benefits which are realised due to improved technology arising from Smart Meters and more flexibility for operators. They include:

- Reduced meter operation costs
- Reduced meter reading costs
- Reduced billing costs (including introduction of digital billing)
- Reduced call centre/customer care costs
- Reduced top-up effort for consumers, and
- Reduced callouts for customers switching supplier

These benefits are linked to the number of Smart Meters installed and increase over the appraisal period as the cumulative number of Smart Meters in operation increases. The exception is reduced meter operation costs which are assumed to be an annual value and reduced top-up effort. The latter is the benefit to consumers who are currently on prepayment meters and who no longer need to spend time topping up at physical premises. This was particularly important during the COVID-19 pandemic when access to shops was restricted. It is assumed that with Smart Meters, more customers will choose to top-up online and the time required to top-up will be shorter. The prepayment functionality will still exist and be included in any specification of Smart Meters in Northern Ireland due to the high proportion of customers currently using pay as you go services. This monetised time benefit also captures the inconvenience of needing to top-up and uncertainty around when a top-up may be required.

7.2.2.2 Operations and maintenance benefits

It is expected that Smart Meters will be cheaper to operate and maintain compared to traditional meters. This is due to the ability to conduct some tasks remotely, such as reconnecting meters to the network, therefore reducing the need for engineers to visit sites as often. Benefits specifically estimated are:

- Reduced maintenance costs of assets (including chip replacement)
- Reduced costs of equipment breakdowns, and
- Jobs created during installation

The installation of Smart Meters will require additional engineers to install meters. This is captured through the salary earned by skilled engineers installing Smart Meters. The analysis has not included a disbenefit of people currently employed in installation or meter readings for traditional meters as they are assumed to continue working in the industry in other roles. Whilst this is a simplification, it reflects the viewpoint of stakeholders who highlighted the shortages of skilled engineers in the industry, potential for relocation once the rollout of Smart Meters is completed in Northern Ireland and the ongoing role for engineers to maintain safety regulatory requirements. This benefit also assumes there are people available who are willing and able to train as engineers in NI. Separately, a cost for training the engineers has been included.

7.2.2.3 Reduced infrastructure investment

Smart Meters are expected to facilitate changes in electricity consumption patterns over time. By providing consumers with more data relating to their energy use and associated impacts to their bills, Smart Meters and the services they support are expected to enable reduced demand at peak times. Reductions in demand at peak time minimises transmission and distribution infrastructure investment needs, and procurement of additional peak generation capacity.

We assume that transmission and distribution network investment driven by load growth reduces by 5% and 7.5%[52] per annum respectively. These reductions accrue once 60%[53] Smart Meters coverage is achieved.

Avoided investment in generation capacity is calculated based on an overall peak demand reduction of 4%. This aligns with assumptions for the median electricity demand forecast in Ireland[54] following roll-out of the Smart Meter program. We have assumed that peak demand reduces pro rata with the Smart Meter and time-of-use tariff roll-out: maximum Smart Meter coverage and time-of-use tariff take up returns a 4% peak demand reduction. The monetary value of this benefit is calculated using the net cost of a new entrant (net-CONE)[55] into the Single Electricity Market (SEM).

7.2.2.4 Reduced consumption and shifting

Smart Meters provide detailed information in relation to electricity use compared to traditional meters. This information can be used by consumers to better understand their consumption and how this impacts their bills. This awareness and visibility are expected to support behavioural change including a reduction in overall energy use. Results of international trials suggest that consumption reduction, or energy efficiency gains, unlocked by Smart Meters can range from 2% to 10% per annum[56]. Cost benefit analyses of Smart Meters in neighbouring jurisdictions have assumed the lower end of this scale including 3% in Great Britain[57] and 2.6% to 2.9% in Ireland[58]. We recognise that trials or pilots may tend to overestimate benefits in some cases as participants are more likely to proactively engage over short time periods. For instance, it is appropriate to assume that consumption reductions of 10% would be difficult to sustain over the long-term. A UK based study[59] suggests that the observed energy efficiency benefits from Smart Meters were closer to 2% when monitored outside of a trial or pilot-based environment.

Northern Ireland has a relatively high proportion of pay-as-you-go electricity customers. These customers must top-up their accounts so that they can continue to use electricity. The need to top-up drives an increased awareness of electricity use when compared to credit customers whose accounts are paid automatically on a set frequency. There are varying assumptions in GB and IE relating to this affect. In GB, BEIS have assumed that efficiency gains for Smart Meters are the same for PAYG and credit customers. However, in Ireland it is assumed that credit customers achieve efficiency gains 0.5% higher than PAYG customers.

Electricity prices in Northern Ireland have experienced significant levels of growth in 2022 caused by global energy supply constraints driven by several factors most notably the war in Ukraine. It appears that these high prices have exerted downward pressure on electricity volumes in Northern Ireland as consumers sought to reduce the impact of higher prices on their electricity bills. This price responsiveness highlights the potential value of time-of-use tariffs enabled by Smart Meters – consumers can be more targeted in terms of electricity use changes when they are provided enhanced information and incentivised via price reflective tariffs. Consumption reductions in 2022 may also diminish the potential efficiency benefits afforded by Smart Meters as some consumers may continue to use electricity efficiently after prices return to what can be considered normal levels in the future. It should be noted that

[52] BEIS, Smart meter roll-out CBA, 2019
[53] BEIS, Smart meter roll-out CBA, 2019
[54] SONI, All-Island Generation Capacity Statement 2022-2031
[55] SEM Committee, Capacity Remuneration Mechanism, 2022
[56] EC, Benchmarking Smart Metering deployment in the EU-28, 2020
[57] BEIS, Smart Meter Roll-Out CBA, 2019
[58] CRU, Smart Metering CBA, 2017
[59] Fredicks et al, A decade on, how has the visibility of energy changed, 2020

current prices and those seen in 2022 are considerably higher than recent historic averages and it is possible that significant cohorts of consumers may revert to less efficient use patterns if, or when, prices fall. This is important considering the costs and benefits of Smart Metering infrastructure is assessed over the period to 2050.

Considering all the information above, we have assumed baseline consumption reduction assumptions as per Table 22. These are applied to total demand per household, following installation of a Smart Meter. SMEs are included as credit meters. In Scenario 1 it is assumed that a faster rollout accompanied by an effective information campaign leads to comparatively higher levels of consumer engagement and behavioural change which is sustained over the study period. Avoided energy is calculated using average historic domestic demand[60] and forecasts for residential based low carbon technology demand from electric vehicles and heat pumps from SONI's accelerated ambition scenario[61]. This avoided energy is monetised using the Green Book's advice on applying long run variable cost of energy (LRVC)[62].

Table 22 Consumption Reduction Assumptions per Scenario

	Credit meters	PAYG meters
Scenario 1	3.5 %	3.0 %
Scenario 2	2.5 %	2.0 %
Scenario 3	2.5 %	2.0 %

Lower electricity consumption reduces losses on transmission and distribution networks as less power is transferred across these networks from generators to consumers. Avoided losses are calculated using transmission[63] and distribution[64] loss factors and monetised using the LRVCs.

Smart Meters facilitate the use of time-of-use (TOU) tariffs which better reflect the cost of serving electricity at different times of the day. These tariffs incentivise consumers to use electricity when it is cheaper to do so, such as during the night. Shifting demand in this way provides a saving to consumers as they avail of lower, off-peak electricity prices.

We have used the DfE energy strategy Energy Transition Model[65] to quantify the amount of residential energy that could be shifted due to the use of Smart Meters. We have assumed that demand available for shifting is confined to domestic appliances and does not include electric heating demand or demand for lighting and cooking which is considered largely inelastic and likely to occur at peak time irrespective of Smart Metering infrastructure. We have assumed that Smart Meters facilitate SONI's smarter electric vehicle charging profile[66] assisting EV owners to save money by charging their vehicles at home during night-time hours availing of lower electricity prices.

Benefits associated with peak energy shifting are assumed to be exclusive to customers on TOU tariff. This means that the CBA model only shifts demand for consumers with both a Smart Meter and a TOU tariff arrangement. We have assumed that a maximum TOU tariff uptake of 95% is achieved in all scenarios by 2030. It should be noted that TOU tariff uptake in Ireland for consumers with Smart Meters has been low to date, and that a TOU tariff uptake of 95% by 2030 in Northern Ireland will rely on an effective program of consumer engagement. This program should focus on increasing consumer awareness relating to TOU

[60] UR, RP6 Final Determination – Annex L, 2017
[61] SONI, Tomorrow's Energy Scenarios, 2020
[62] BEIS, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, 2021
[63] SONI, TLAFs, 2022/23
[64] NIEN, Statement of charges, 2021
[65] Roadmap to 2030, Flexible Fit 2050, Power Play 2050
[66] SONI, Tomorrow's Energy Scenarios 2020, 2020

tariff and placing requirements on suppliers to promote their use amongst consumers including an end to flat-tariffs for Smart Meter consumers. The energy shift facilitated by Smart Meters is monetised using the Green Book's retail price projections[67] assuming a peak-to-night shifting pattern. The peak-to-night price differential is set at 42% based on tariffs currently offered in Northern Ireland and Ireland.

7.2.2.5 Reduced theft benefits

Currently, electricity suppliers encounter a small proportion of theft due to persons accessing electricity without it being included in a meter reading. This is not always noticed due to infrequent meter readings. Smart Meters will make theft much more difficult due to continuous monitoring of electricity use. The CBA model assumes a nominal theft reduction benefit per meter is achieved for each Smart Meter installed. There are also revenue recovery benefits relating to power not recorded and/or paid that are realised through the use of Smart Meters.

7.2.2.6 Outage savings

Customer minutes lost (CML) is a key metric used to monitor the performance of the distribution networks in Northern Ireland. Improvements in network reliability and availability benefits consumers by reducing CML. Smart Meters assist in delivering such benefits by providing system operators a more detailed view of the network. This enhanced visibility and improved data quality will enable engineers to identify and respond to faults more quickly thereby reducing post-fault restoration times. We have assumed that annual CML will be reduced by 20% once a Smart Meter coverage rate of 60% is achieved[68]. This reduction is applied against the ten-year average of CML for LV customers in Northern Ireland[69] and monetised using the Networks-Value of Lost Load[70].

Locating faults will be more efficient following widespread coverage of Smart Meters due to enhanced network visibility for system operators. This enhanced fault detection capability is expected to reduce opex related to fault restoration as patrol times for fault crews will be minimised. It is assumed that a saving of £50 per fault will be achieved following a Smart Meter coverage rate of 60%[71]. This saving is applied to the 10 year average of LV faults[72] to determine an annual monetary benefit.

7.2.2.7 Environmental benefits

Energy efficiency is a key enabler of Northern Ireland's strategy for net zero emissions. Reduced electricity consumption through the use of Smart Meters results in avoided green-house gas emissions by minimising run hours of fossil fuel fired generation plant. We have assumed that the emissions intensity of electricity supply reduces over time to zero by 2050 in line with the net-zero emissions target. We recognise this is a conservative assumption as a net zero energy system will require a net zero electricity system in advance of 2050.

The base line emissions intensity for electricity is based on Northern Ireland's carbon intensity indicators 2022[73]. The benefit of avoided emissions is calculated using the central traded carbon values published in the Treasury's Green Book supplementary guidance[74]. The same approach is taken in determining the avoided emissions and associated benefits

[67] BEIS, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, 2021
[68] BEIS, Smart Meter Roll-Out CBA, 2019
[69] NIEN, Transmission and Distribution System Performance Report 2021/22, 2022
[70] UR, Reliability incentive final determination, 2017
[71] BEIS, Smart Meter Roll-Out CBA, 2019
[72] NIEN, Transmission and Distribution System Performance Report 2021/22, 2022
[73] DAERA, Northern Ireland carbon intensity indicators 2022, 2022
[74] BEIS, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, 2021

through reduced losses on the transmission and distribution networks achieved through reduced electricity consumption.

7.2.2.8 Unquantified benefits

Some benefits have not been quantified for use in the CBA model due to a lack of robust information. These potential benefits are factored into the recommendations made in this report and are discussed in more detail below.

7.2.2.8.1 Increased flexibility and renewable integration

The energy strategy for Northern Ireland sets out a roadmap for decarbonising the electricity system. Smart Meters, and the smart services they facilitate, will play an important role in delivering this ambition including 80% renewable electricity (RES-E) by 2030 and net zero emissions by 2050. Reduced electricity consumption can drive increases in RES-E % outturn. This is because overall VRES is a numerator, and the overall demand is a denominator in the formula used to calculate RES-E%[75] meaning that reductions in overall demand for the same VRES output results in higher RES-E%. However, reduced demand may increase levels of VRES oversupply which occurs when there is not enough demand to harness available VRES. Maximising VRES output therefore also relies on demand becoming more flexible and shifting of demand to times when there are VRES surpluses. Flexible energy systems of the future will require improved visibility of demand and energy sources in real-time and near real-time. Better data and systems will form the foundation of such flexibility. Smart Meters are key to driving flexibility in the electricity system and associated reforms to electricity markets. Although the need for flexibility will increase overtime it already exists today as seen in Northern Ireland's recent levels of dispatch down.

In 2021, wind and solar PV output in Northern Ireland was dispatched down by 7.8% and 2.9% respectively. Dispatch down involves 'turning-down' of VRES output so that operational constraints set by the system operator are met and network elements, such as power lines, are not overloaded. There are economic impacts associated with dispatch down as wind and solar PV farm operators seek to recover costs either through compensation from the TSO or by passing these on to customers via higher renewable energy bid prices. An all-island study by EirGrid and SONI assumed a compensation rate of £57.8/MWh and £62.9/MWh [76] for onshore wind and solar PV respectively, using these values Northern Ireland's VRES dispatch down costs can be approximated at almost £11 million in 2021. Demand side management, enabled by Smart Meters, is not alone expected to reduce VRES curtailment significantly[77]. However, demand side flexibility coupled with TOU tariff can facilitate reductions in network congestion[78] by shifting demand in specific network areas when beneficial to do so. Studies performed by SONI[79] suggest that increasing demand in areas of high VRES penetration, such as the North-West of Northern Ireland, minimises network constraints, limits the needs for network reinforcements and increases the RES-E% output.

Smart Meters can also help to optimise the use of microgeneration, such as rooftop PV, and small-scale battery storage. Consumers can use data collected by their Smart Meter to optimise self-consumption of the power generated or stored. Similarly, consumers can use the information to determine when to export surplus power back to the electricity grid. This capability extends to electric vehicles and vehicle to grid (V2G) exports.

[75] Eurostat, SHARES Tool Manual, 2014
[76] EirGrid Group, Shaping Our Electricity Future Roadmap, 2021
[77] Paul Blount et. al., Identifying the relative and combined impact and importance of a range of curtailment mitigation options on high RES-E systems in 2030 & 2040
[78] Ulster University, Design, Valuation and Comparison of Demand Response Strategies for Congestion Management, 2020
[79] EirGrid and SONI, Shaping our electricity future consultation, 2021

7.2.2.8.2 Reduced system marginal price

Changes in consumption patterns driven by Smart Meters are expected to reduce the system marginal price of electricity. This is because reduced energy and peak demand requires more expensive plant to run less often thereby reducing the average price across the year. Quantifying this benefit requires complex market model simulations which was out of scope for this CBA. A CBA of Smart Meters in Ireland quantified this reduction to be 1.3% for the Single Electricity Market (SEM) if all customers see the benefit of Smart Meters.

7.2.2.8.3 Sector coupling and low carbon technologies (LCT)

Sector coupling is an important aspect of Northern Ireland’s Energy Strategy. Electrification of heat and transport are examples of sector coupling whereby the electricity system is used to meet transport and heating needs. Smart metering provides benefits by empowering consumers that switch to LCT to optimise their use. For instance, TOU tariffs facilitated by Smart Meters enable shifting of electric vehicle demand away from more expensive peak times. Smart Meters can assist with configuration of heat pump-based system so that hot water storage demand occurs when electricity is cheaper. This capability may drive uptake in LCT through increased consumer confidence.

Reduction in peak electricity demand can benefit the gas system due to associated reduced peak demand for gas. A significant proportion of gas demand is driven by electricity generation; a trend which is expected to continue as the use of coal and oil-fired generation declines. Reductions in peak gas demand due to smart electricity meters may provide some opportunity to reduce the need to reinforce the transmission gas network in the future.

7.2.2.8.4 System services

System services are required to maintain the stability of the power system; examples of system services include frequency and voltage control services. As Northern Ireland’s electricity system continues to decarbonise it must cater for increased levels of non-synchronous VRES driving the need for more system services. Residential demand side response does not currently participate in the system services market[80]. However, this may change over time as the need for enhanced flexibility and congestion-based solutions increases. Smart Meters may enable residential demand response to participate in the system services market in the future. However, the potential benefits of this have not been quantified in the CBA model.

Additional unquantified benefits are listed in Table .

Table 23 - Summary of Unquantified Benefits

Unquantified Benefits
— Compliance with EU Directive requirements and EU Clean Energy Package — Improved air quality benefits which are not quantified through lower carbon emissions as a result of lower energy usage. — Continued supply of meters. There is a risk in procuring traditional meters given that nearly all of Europe are implementing Smart Meter programmes — Potential for increased rate of installation of Smart Meters in Scenario 1 and Scenario 3 with less significant travel times between sites

[80] EirGrid and SONI, DS3 system services tariffs consultation, 2022

— Increased functionality and flexibility for consumers including the ability to track consumption providing consumers with more control during uncertain energy price times

— Additional reliability of data and efficiency and improved visibility for networks and suppliers which can be used in maintenance, future planning, and regulatory reporting

— Improved safety implications via improved monitoring of voltage levels

— Smart Metering systems will increase flexibility of the energy system supporting smart grid development and smart cities

— Smart Metering systems will support tariff reform

— Improved quality of customer service with more accurate information and remote operations

7.2.3 Costs

Costs estimated for each scenario are presented in Table 24 and discussed in further detail below.

Table 24 Estimated Electricity Costs

Costs, £m 2022	Scenario 1	Scenario 2	Scenario 3
Capital costs	90	91	90
Operational costs	276	219	235
Installation costs	162	111	126
Total costs	**527**	**421**	**451**

The graph below shows the annual costs per scenario, discounted to 2022 prices. As can be seen, the costs are higher during periods of faster rollout and replacement of meters. This is especially noticeable in Scenario 1 when costs for the fast rollout period are higher than the other two scenarios. Towards the end of the appraisal period, costs increase for all scenarios as meters initially installed require replacement.

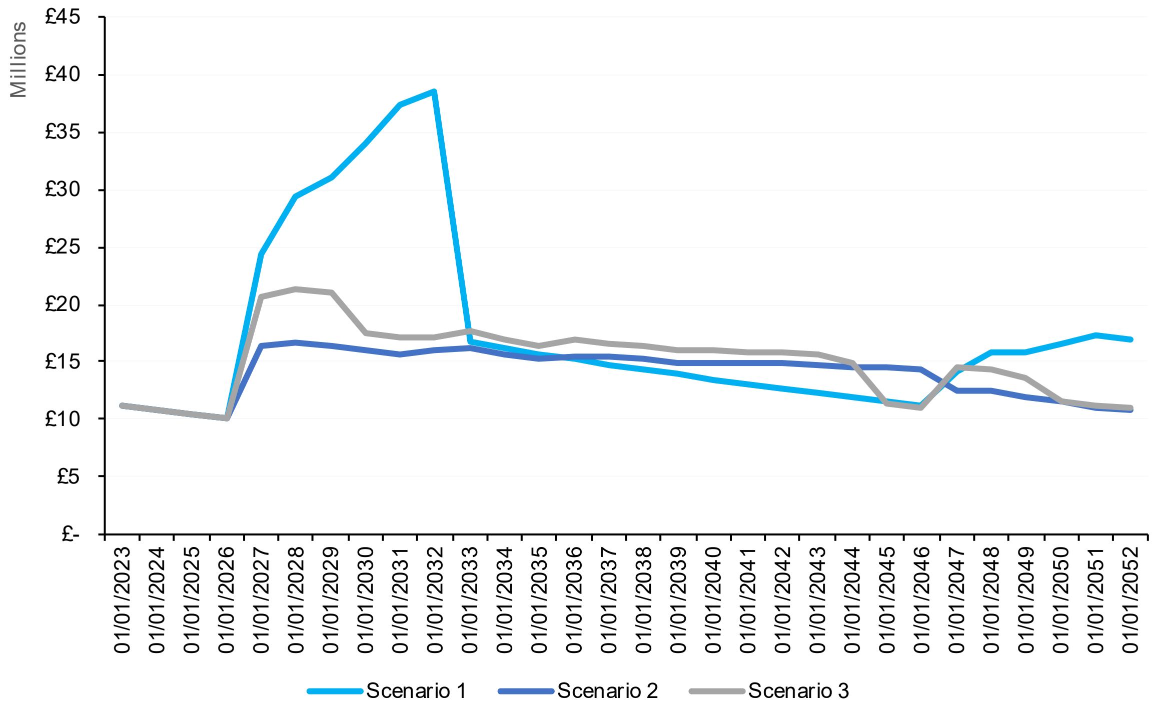

Figure 15 Annual Costs, discounted

7.2.3.1 Capital Costs

This includes the additional capital expenditure that would be required to use Smart Meters compared to traditional meters. Specifically, this includes:

- IT
- Project management
- Total transmission
- Total distribution
- Avoided investment in conventional meters (cost saving)

These costs are generally an annual cost which will be incurred when Smart Meters are rolled out and is constant over the appraisal period.

7.2.3.2 Operational Costs

This includes the ongoing expenditure incurred from using Smart Meters instead of traditional meters. Costs include:

- IT maintenance
- Network management and front-end
- Communication/data transfer costs (inc. GPRS, radio communications, etc.)
- Replacement/failure of Smart Metering systems (incremental)
- Distribution and Transmission operation and maintenance
- Cost of consumer engagement programmes
- Additional costs of operating two systems in parallel (smart and traditional meters)
- NI estimates of load profiles

Northern Ireland currently uses load profiles produced for Great Britain (GB) to estimate bills for customers. GB is in the process of rolling out Smart Meters and expected to complete the rollout by 2024. Once this happens, GB will no longer need to produce load profiles, and NI will no longer be able to use them. If NI continued with traditional meters, the industry would need to produce its own load profiles. Therefore, switching to Smart Meters would remove the need for this cost. Once 25% of the market is operating on Smart Meters, this cost saving is assumed to occur.

Most operational expenditure is dependent on the number of Smart Meters and traditional meters in operation.

7.2.3.3 Installation Costs

This includes all the costs associated with installation of Smart Meters and the replacement meters towards the end of the appraisal period. Specifically, costs have been estimated for:

- Cost of installation
- Cost of meter units
- Project management of installation
- Training customer care and installation personnel
- Sunk costs of previously installed meters
- Billing system upgrade for suppliers
- Cost of installation for replacement meters
- Cost of meter units for replacement meters

The costs are mostly associated with the number of Smart Meters installed each year, with some annual costs also used.

7.2.3.4 Unquantified Costs

Additional costs were raised as part of stakeholder engagement and initial research but have not been quantified due to a lack of data available as well as some costs and benefits being non-monetary. These costs are still an important consideration in the rollout of Smart Metering systems and include:

Table 25 - Summary of Unquantified Costs

Unquantified Costs
— Potential supply issues for a bulk order in the fast rollout Scenario 1, depending on the complexity of Smart Meter unit functionalities and manufacturing specifications
— Potential for installation of additional antennae in more rural areas as communications hubs will need to be connected and demonstrate a suitable CTF-like performance metric
— Challenges in agreeing on Smart Meter unit specification and market design. Timely decision-making processes with expertise required
— Challenges in procurement of meters and systems across logistics and skill shortages
— Adapting to change for all stakeholders involved

7.2.4 Sensitivity Analysis

Whilst effort has been made to forecast future demand, consumer responses to Smart Meters and macroeconomic conditions, there remains some inherent uncertainty around future outcomes. Sensitivity tests are carried out to understand the impact of changes to assumptions or circumstances on outcomes. Whilst one rollout scenario may be preferred in some conditions, under different assumptions a different rollout may be preferred.

Sensitivity analysis can also help demonstrate the robustness of modelling and demonstrate where certain input assumptions have significant impacts or otherwise on results. These inputs can then be further researched, validated or risks communicated to decision makers.

A wide range of sensitivity tests have been carried out. These test changes to assumed consumer behaviour in response to Smart Meters being installed, different rollout assumptions and changes in key assumptions in the economic appraisal. Under the tests carried out, Scenario 1 always remains the preferred option and in most cases continues to deliver a positive net present value. A full list of tests carried out is included in Appendix E, along with the results of each variation.

Sensitivity testing demonstrated that the model is robust to the overall conclusion that Scenario 1 is the preferred rollout option. However, the scale of benefits relative to costs which can be realised is sensitive to a few key assumptions. Specifically:

- Behavioural change from consumers in response to Smart Meters,
- The cost of Smart Meter units and installation, and
- Efficiency improvements in electricity consumption.

Additionally, Scenarios 2 and 3, with elements of a phased rollout, are more sensitive to assumptions on the length of the appraisal period, overall operating costs, and overall installation costs.

Results from key sensitivities are discussed below.

7.2.4.1 Consumption Reduction

The extent to which consumers will adjust their behaviour to reduce consumption and benefit from the functionality a Smart Meter offers is unknown. Studies have been carried out to show ranges of 0.5% to 10% in consumption reduction, whilst a Great Britain-based report suggests that consumption reductions of 2% have been observed. This is expected to differ between PAYG meters and credit meters, given that PAYG meters already offer some functionality for monitoring spend on electricity. For this reason, we have included a conservative estimate in the core results and presented both a higher and lower sensitivity here. Additionally, some consumers may initially reduce consumption, but the impact is short-lived for various reasons including reduced retail electricity prices, improved macro-economic conditions, or disciplined and efficient use of electricity declines. This was found to be a key sensitivity in the model, driving a range of results from small changes to the assumed behaviour. When developing the specification of Smart Meters, it should be considered how to maximise the behavioural change from consumers to ensure maximum benefits can be realised.

Table 26 - Consumption Sensitivity Tests

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.57*	*1.17*	*1.23*
2% credit / 2% PAYG consumption reduction	1.34	1.17	1.23

4.5% Credit / 4% PAYG consumption reduction	1.80	1.56	1.65
1% Credit / 0.5% PAYG consumption reduction	0.97	0.86	0.89
Decreasing consumption reduction over time	1.16	0.81	0.85

This CBA captures the impacts to society of installing Smart Meters. Many PAYG customers currently visit a shop to top-up their meter, obtain a voucher and input the code into their meter to install the credit. Smart Meters are expected to speed up this process, by encouraging more customers to top-up online, or shortening the time required to top-up. Additionally, the time saving monetised captures the inconvenience of needing to top-up and the uncertainty surrounding when this will be required. The core scenario assumes 50% of PAYG customers top-up 10 times per year, taking 15 minutes per time and top-up during work time (using a value of time equivalent to the median hourly wage in NI). Results are shown below of flexing these assumptions.

Table 27 - Time to top-up Sensitivity Tests

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.57*	*1.17*	*1.23*
4.5 minutes to top-up	1.46	1.07	1.13
Leisure value of time	1.47	1.09	1.14

7.2.4.2 Costs

The costs of Smart Meters relative to traditional meters currently used is unknown. Whilst other jurisdictions can provide some indication of expected costs, the procurement of meters, local labour market and safety regulations required will be specific to Northern Ireland. Similarly, the costs required to plan the rollout, update IT operating systems, develop communication systems have been estimated but are uncertain. The table below shows results from a 10% increase or decrease to the overall capital, operating and installation costs individually. Separately, changes to the cost of Smart Meter units and installation were also tested. The combination of meter unit and installation costs had a larger impact on results compared to a change in only the cost of units.

Table 28 Costs Sensitivity Tests

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.57*	*1.17*	*1.16*
Higher capital costs	1.54	1.14	1.21
Higher operating costs	1.49	1.11	1.17
Higher installation costs	1.52	1.14	1.20
Lower capital costs	1.60	1.19	1.25
Lower operating costs	1.66	1.23	1.30
Lower installation costs	1.62	1.20	1.26
Lower cost of Smart Meter and installation	2.22	1.55	1.66
Higher cost of Smart Meter and installation	1.43	1.08	1.13

7.2.4.3 Environmental

The CBA includes a benefit from reduced greenhouse gas emissions arising from improvements to energy efficiency, reduced consumption and reduced technical losses. These calculations use a carbon traded price, a conversion factor for the amount of CO2 equivalent emissions from electricity consumption and a long run variable cost of energy supply. The values for these used in the core scenarios are the best available for NI. They are based on long term evidence and forecasted ranges. Therefore, whilst they are the most up to date available, they are not overly influenced by current market influences. Given uncertainty around the assumptions, potential changes to climate change policy and the risk of efficiencies not arising, each of these assumptions has been tested.

Table 29 Environmental Assumptions

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.57*	*1.17*	*1.23*
Carbon intensity constant over time	1.96	1.44	1.50
Carbon intensity net zero by 2040	1.63	1.21	1.27
High LRVC of energy supply	1.66	1.21	1.28
High carbon traded price	1.47	1.11	1.17

7.3 Gas Cost Benefit Analysis

This section discusses the cost benefit analysis carried out on the rollout of Smart Meters for gas. It provides detail on the scenarios assessed, the costs and benefits measured, and the overall results for electricity.

7.3.1 Scenarios

A long list of factors was considered which could influence the overall costs and benefits of rollout, previous CBAs were reviewed to understand which ones are likely to have the biggest impact and scenarios based around these factors were discussed with stakeholders and the Department to identify three scenarios to assess in detail. The wider list of considerations is discussed in more detail in Section 7.1.2.2. This process identified the speed of the rollout as a key determinant of the costs and benefits. Therefore, three scenarios have been developed where the main difference is on how fast Smart Meters are installed. Broadly, these are:

1. Scenario 1 – Fast rollout
2. Scenario 2 – Phased rollout
3. Scenario 3 – Phased rollout with additional fast rollout in a trial area

A summary comparison of the rollout of the three scenarios analysed is shown in Figure 16, with more detail provided in each of the scenario descriptions below.

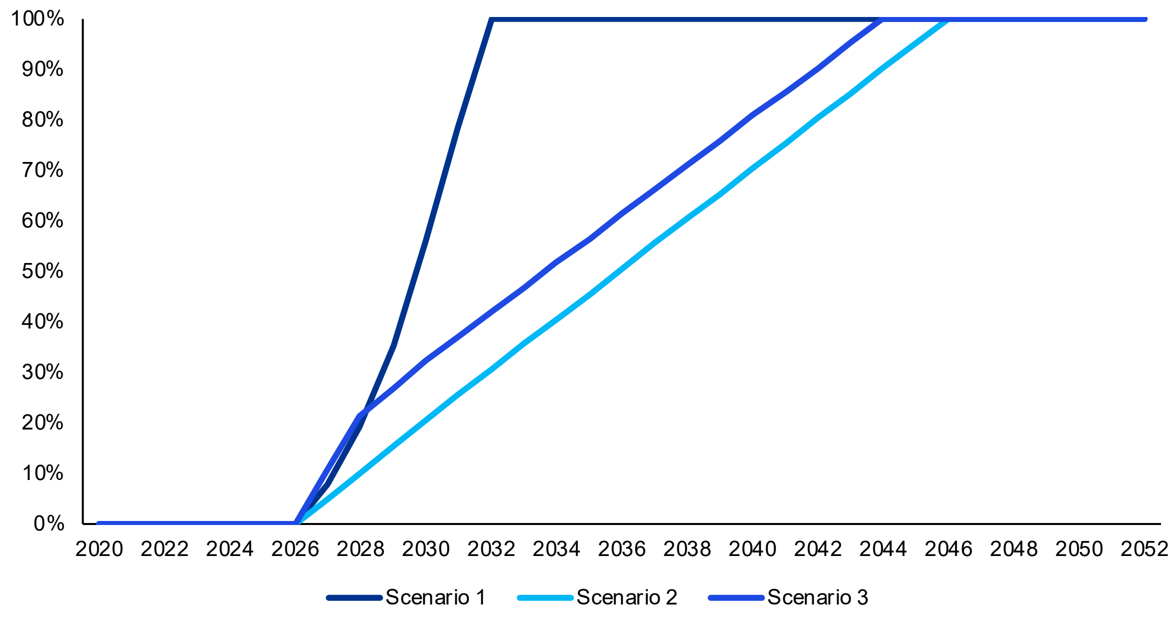

Figure 16 - Comparison of cumulative rollout across Scenarios

7.3.1.2 Counterfactual

Each scenario is measured against the counterfactual within the calculations. Input values are taken as the difference between the counterfactual and the scenario, or between traditional and Smart Meters where appropriate.

The counterfactual assumes a “business as usual” approach with minimal change to current operations. Naturally, some changes will be needed as external circumstances change. Guidance from the UK Department for Transport Value for Money Framework[81] recommends the counterfactual includes “proposals for which implementations are planned and / or resource has already been allocated”. The counterfactual assumes that traditional meters will continue to be available for procurement in NI for the duration of the model. We recognise that the future supply of gas meters currently used is uncertain. As other jurisdictions move away from traditional meters, procurement of those currently used has become more difficult as suppliers move to producing other types. However, following discussion with stakeholders in the gas industry, there was not enough certainty over the meters which would be used instead to include in the counterfactual. Similarly, the gas DNO’s have started to consider procuring Smart Meters for future use. When beginning the analysis for this project and defining the counterfactual, the procurement of new gas meters was not considered to be sufficiently committed, planned, or funded to be included.

This analysis is focussed on assessing the costs and benefits of a rollout of Smart Meters in Northern Ireland. If DNO’s chose to start installing Smart Meters of their own accord, or meters which deliver some of the same functionality, this would reduce the cost and benefit difference between the counterfactual and each scenario.

Traditional meters are assumed to continue to replace current meters when they reach the end of their useful life, with the same proportion of customers remaining on prepayment meters as currently.

A summary of assumptions used in the counterfactual is show below. Some values have been provided by multiple respondents; in which case an average has been used.

Table 30 - Assumptions in the Counterfactual

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	0%	Project assumption
	Age profile of meters being replaced	20 years	Project assumption
	Installations per worker per day	8	Project assumption
CAPEX	Unit cost per traditional meter and installation	£177	Project assumption, based on stakeholder input
	% Households networks facing difficulty/ unable to replace meters	7.85%	Project assumption, based on stakeholder input
	Failure of meter systems (% of total installed)	2%	Project assumption
	IT costs	£323,305 per annum	Project assumption, based on stakeholder input
OPEX	Cost of consumer engagement programmes	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost per meter lost to theft	[Commercially Sensitive]	Project assumption, Confidential
Metering	Cost per local meter reading	[Commercially Sensitive]	Project Assumption, confidential
	Cost of meter operations	[Commercially Sensitive]	Project Assumption, confidential

[81] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918479/value-for-money-framework.pdf

	Billing cost per client	[Commercially Sensitive]	Project Assumption, confidential
	Customer care cost per client	[Commercially Sensitive]	Project Assumption, confidential
	Communications failure rate	0%	Project Assumption

7.3.1.3 Scenario 1

Scenario 1 has the most ambitious 'fast rollout'. Smart Meters will be deployed at a rate of 8% of total traditional meters for domestic and SME connections in the first year of rollout of Smart Meters accounting for 100% of total meters for domestic and SME connections by the end of 2032.

This 6 year rollout period assumes that 100% of traditional meters will be replaced with a Smart Meter, including those that have not yet reached their end of life. Any new connections have been assumed to be smart and have been included in the rollout.

Traditional meters that are being replaced have been assigned an age profile of 16.7 years across the 6-year rollout period to calculate the residual value of these replaced meters. This captures the impact of meters being replaced when they still have useful life in them, and the associated economic cost of replacing meters early.

The model duration is 30 years from 2023. Smart Meters have an assumed life expectancy of 20 years, therefore Smart Meters installed between 2027-2032 will need replacing from 2047-2052. The costs of these 358,490 replacement meters have been included in the CBA.

The battery life of a GSM has been assumed as 12 years based on stakeholder correspondence and desktop research. Battery replacement costs have been included which begin to occur yearly from 2039. 379,499 batteries will be replaced throughout the duration of the model.

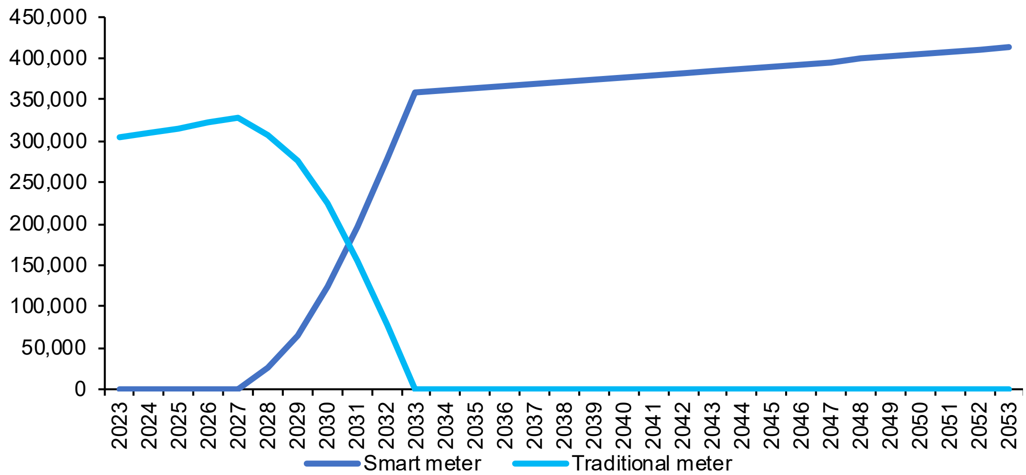

Figure 17 - Cumulative Rollout Profile in Scenario 1

Energy savings have been assumed in Scenario 1 to be 0.7% in PAYG meters, 2.4% in credit meters and 3.6% in SME meters. This captures the impact of consumers reducing their energy consumption because they have additional information on the cost of their usage, helping them to reduce inefficiencies and change behaviour. SMEs are more price sensitive to changes in gas prices and are therefore thought to be more incentivised to reduce their consumption with a Smart Meter. Scenario 1 assumes this change to be higher than other scenarios due to a fast rollout attracting more marketing to encourage behavioural change, a "joint effort approach" from Northern Ireland to reduce gas usage, and publicity around supporting climate change mitigation through lower gas usage. The behavioural change assumption is a conservative estimate from pilot surveys following Smart Meter installations. A higher spend on communications and marketing is assumed in this scenario to account for more marketing to encourage consumers to reduce their consumption.

Scenario 1 is intended to be ambitious. It is acknowledged that Northern Ireland may not reach 100% of households and SMEs using a Smart Meter due to difficulties in accessing meters and challenges from consumers not wanting to switch.

Table 31 - Assumptions in Scenario 1

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	0.7% PAYG, 2.4% credit, 3.6% SME	Project assumption
	Age profile of meters being replaced	16.7 years	Project assumption
	Installations per worker per day	8	Project assumption
	Value of job created	£29,621 per person	NISRA
	Training costs	[Commercially Sensitive]	Project assumption
	Rollout duration	6 years (2027-2032)	Project assumption
	Project management costs of rollout (procurement, planning, implementing)	£8.3m per annum	Project assumption, based on stakeholder input
CAPEX	Unit cost per Smart Meter and installation	£199.05	Project assumption, based on stakeholder input
	Battery replacement cost in Smart Meters	[Commercially Sensitive]	Stakeholder input, Confidential
	% Households networks facing difficulty/ unable to replace meters	7.85%	Project assumption, based on stakeholder input
	Total IT costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Project management costs	£1.6m per annum	Project assumption, based on stakeholder input
	Billing system upgrade	[Commercially Sensitive]	Stakeholder input, Confidential
OPEX	Total IT maintenance costs	[Commercially Sensitive]	Derived from ROI CBA
	Total network management and front-end costs	[Commercially Sensitive]	Derived from ROI CBA
	Total communication/ data transfer costs	[Commercially Sensitive]	Derived from ROI CBA
	Failure of Smart Meter systems (% of total installed)	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Call centre costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of consumer engagement programmes	£1.5 per meter	Project assumption
Metering	Cost per local meter reading	[Commercially Sensitive]	Project assumption

	Billing cost per client	[Commercially Sensitive]	Project assumption
	Customer care cost per client	[Commercially Sensitive]	Project assumption
	Communications failure rate	1%	Project assumption

7.3.1.4 Scenario 2

Scenario 2 is the most gradual rollout. Traditional meters will be replaced with Smart Meters when they reach end of life. Assuming the lifespan of both traditional meters and Smart Meters are 20 years, this rollout will take 20 years, with 100% of Smart Meters installed between 2027-2046. Smart Meters will be deployed at a rate of 5%. Any new connections have been assumed to be smart and have been included in the rollout.

The age of traditional meters being replaced each year during the rollout is assumed to be 20 years old, therefore no residual value is extracted from the traditional meters.

Smart Meters installed between 2027-2032 will reach their end of life from 2047-2052 as Smart Meters have an assumed lifespan of 20 years. These meters will be replaced at the same rate they were deployed and have been included in the CBA.

Battery life is assumed to be 12 years and beginning in 2039, 267,165 batteries will be replaced throughout the duration of the model.

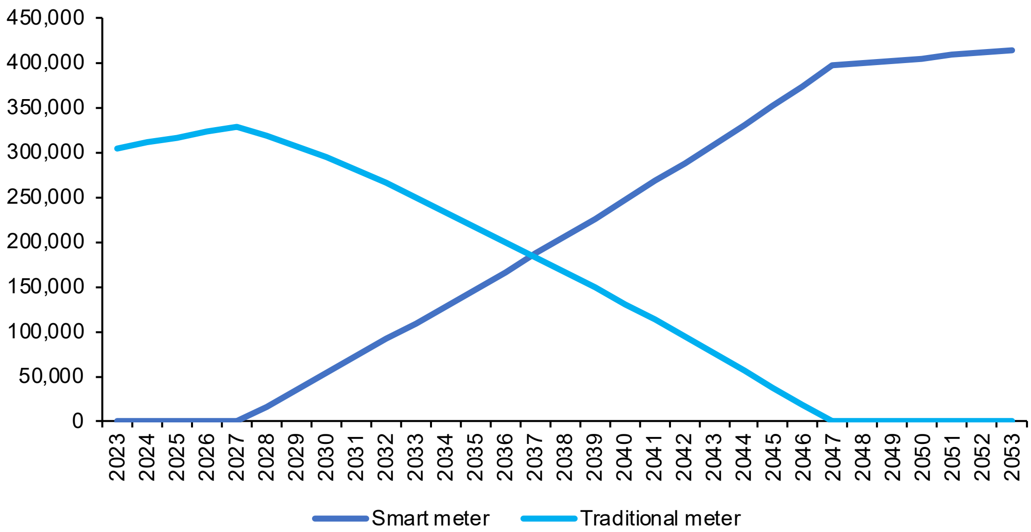

Figure 18 Cumulative Rollout Profile in Scenario 2

Energy savings have been assumed to be 0.5% for PAYG meters, 2.2% for credit meters and 3.4% for SME meters. As with Scenario 1, the behavioural change from SMEs is expected to be higher than domestic households due to being more price sensitive. Scenario 2 assumes a lower saving than Scenario 1 as marketing campaigns and focused efforts are likely to be less impactful over a 20 year rollout period compared with a 6 year rollout period in Scenario 1. Scenario 2 also carries the likelihood that consumers are less educated around the purpose and benefits of their Smart Meter when their traditional meter has been replaced at end of life. Consumers may request a Smart Meter prior to their traditional meter being end of life, however this has not been modelled specifically. Customers who specifically request a Smart Meter are likely to change their behaviour more, and hence if these households were prioritised in the rollout consumption reduction benefits would likely be higher.

Table 32 - Assumptions in Scenario 2

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	0.5% PAYG, 2.2% credit, 3.4% SME	Project assumption
	Age profile of meters being replaced	20 years	Project assumption
	Installations per worker per day	8	Project assumption
	Value of job created	£29,621 per person	NISRA
	Training costs	[Commercially Sensitive]	Project assumption
	Rollout duration	20 years (2027-2046)	Project assumption
	Project management costs of rollout (procurement, planning, implementing)	£2.5m per annum	Project assumption, based on stakeholder input
CAPEX	Unit cost per Smart Meter and installation	£199.05	Project assumption, based on stakeholder input
	Battery replacement cost in Smart Meters	[Commercially Sensitive]	Stakeholder input, Confidential
	% Households networks facing difficulty/ unable to replace meters	7.85%	Project assumption, based on stakeholder input
	Total IT costs	[Commercially Sensitive]	Project assumption
	Project management costs	£1.6m per annum	Project assumption
	Billing system upgrade	[Commercially Sensitive]	Stakeholder input, Confidential
OPEX	Total IT maintenance costs	[Commercially Sensitive]	Derived from ROI CBA
	Total network management and front-end costs	[Commercially Sensitive]	Derived from ROI CBA
	Total communication/ data transfer costs	[Commercially Sensitive]	Derived from ROI CBA
	Failure of Smart Meter systems (% of total installed)	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Call centre costs	[Commercially Sensitive]	Project assumption
	Cost of consumer engagement programmes	£1 per meter	Project assumption
Metering	Cost per local meter reading	[Commercially Sensitive]	Project assumption
	Billing cost per client	[Commercially Sensitive]	Project assumption
	Customer care cost per client	[Commercially Sensitive]	Project assumption
	Communications failure rate	1%	Project assumption

7.3.1.5 Scenario 3

Scenario 3 combines elements of Scenario 1 and Scenario 2 and is the middle ground in terms of rollout duration with 100% of traditional meters replaced with Smart Meters between 2027-2044. As with Scenario 2, traditional meters are assumed to have a lifespan of 20 years and will be replaced at end of life, assumed to be at a rate of 5%. Included in this rollout will also be a high-speed rollout trial in the Mid-Ulster and Newry, Mourne and Down districts. These areas were chosen as combined they offer opportunity for a good-sized trial;

they are geographically close and already have gas connections in the area. The high-speed trial will include replacement of traditional meters that have not yet reached their end-of-life period. It is assumed the approximately 36,580 connections in these areas will have 100% Smart Meters connections between 2027-2029 with 18,290 Smart Meters installed each year in the trial period areas. The trial is assumed to occur simultaneously to the phased rollout. However, insight from the trial could be used to improve later rollouts or replicated in other geographical areas. Any new connections have been assumed to be smart and have been included in the rollout.

Like Scenario 2, the age of the traditional meters being replaced are assumed to be 20 years old for meters replaced as part of the phased rollout and the meters installed in the two trial areas between 2027-2029 are assumed to be 16.7 years old to calculate residual value. In the same way, as Scenario 2, there is no residual value from those meters that have reached their end-of-life period. Battery life is assumed to be 12 years with 306,485 batteries replaced in the modelling period.

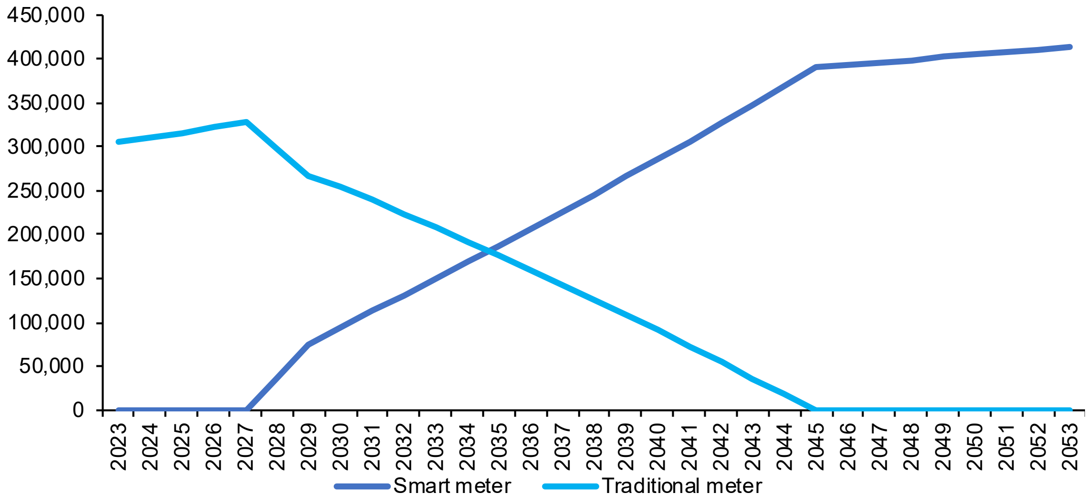

Figure 19 Cumulative rollout profile in Scenario 3

Energy savings are assumed to also be 2.5% for credit meters and 2% for PAYG. This is because the majority of the rollout is gradual as in Scenario 2. The trial areas are likely to achieve higher levels of energy savings given the marketing and consumer behaviour changes that will occur during these years of the rollout. However, the trial area is only a small proportion of the overall rollout and unlikely to influence the total behavioural change.

Table 33 - Assumptions in Scenario 3

	Assumption	Value	Source
Rollout	Estimated % of consumption reduction with rollout	4%	Project assumption
	Age profile of meters being replaced	20 years	Project assumption
	Installations per worker per day	7	Project assumption
	Value of job created	£29,621 per person	NISRA
	Training costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Rollout duration	18 years (2027-2044)	Project assumption

	Project management costs of rollout (procurement, planning, implementing)	£2.8m per annum	Project assumption, based on stakeholder input
CAPEX	Unit cost per Smart Meter and installation	[Commercially Sensitive]	Stakeholder input, Confidential
	Battery replacement cost in Smart Meters	[Commercially Sensitive]	Project assumption, based on stakeholder input
	% Households networks facing difficulty/ unable to replace meters	[Commercially Sensitive]	Stakeholder input, Confidential
	Total IT costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Project management costs	£1.6m per annum	Project assumption
	Billing system upgrade	[Commercially Sensitive]	Stakeholder input, Confidential
OPEX	Total IT maintenance costs	[Commercially Sensitive]	Derived from ROI CBA
	Total network management and front-end costs	[Commercially Sensitive]	Derived from ROI CBA
	Total communication/ data transfer costs	[Commercially Sensitive]	Derived from ROI CBA
	Failure of Smart Meter systems (% of total installed)	[Commercially Sensitive]	Project assumption, based on stakeholder input
	Call centre costs	[Commercially Sensitive]	Stakeholder input, Confidential
	Cost of consumer engagement programmes	£1 per meter	Project assumption
Metering	Cost per local meter reading	[Commercially Sensitive]	Stakeholder input, Confidential
	Billing cost per client	[Commercially Sensitive]	Project assumption
	Customer care cost per client	[Commercially Sensitive]	Project assumption
	Communications failure rate	1%	Project assumption

7.3.2 Benefits

Quantified benefits estimated for each scenario are presented in Table 34 and discussed in more detail below. These values cover the full appraisal period and are discounted to 2022 prices. Unquantified benefits are considered separately in section 7.3.2.7.

Table 34 Estimated Gas Benefits

Benefits, £m 2022	Scenario 1	Scenario 2	Scenario 3
Meter benefits	245	176	196
Operations and maintenance benefits	22	32	29
Deferred investment	5	3	4
Reduced consumption	34	21	25
Reduced theft benefits	1	1	1
Environmental benefits	71	40	49
Total benefits	**378**	**273**	**305**

The graph below shows annual benefits per scenario, discounted and in 2022 prices. For this reason, annual benefits gradually decrease each year as benefits further away in time are valued lower than benefits closer in time. As can be seen, annual benefits for Scenario 1 are higher in each year, especially in the early years of the appraisal period where more Smart Meters have been rolled out earlier. Scenario 1 will realise benefits earlier on in the appraisal period, compared to the other scenarios.

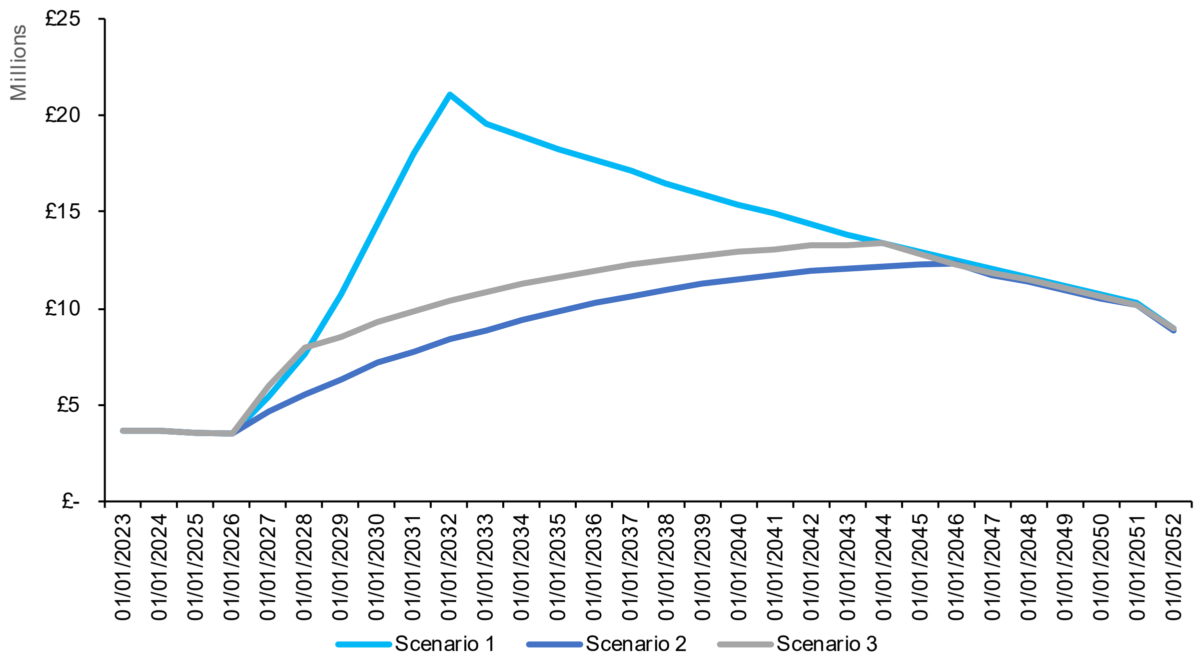

Figure 20 Annual Benefits per Scenario, Discounted

The graphs below show the breakdown of costs and benefits estimated for each scenario. As can be seen, the highest costs come from operational expenditure, with the largest benefits arising from metering benefits. Metering benefits includes the time saving from easier top-ups, the lower costs from needing to read meters, and cost savings from billing or customer enquiries. The benefit from reduced consumption is small, especially in comparison to benefits from electric Smart Meters in this area. This is because gas meters have not been shown to drive the same behaviour change in reducing consumption, due largely to the nature of purposes which gas is used for (for example heating gas boilers or homes is only used when needed). Similarly, for gas there are no peak shifting benefits for either the network or consumers. The benefits are discussed in more detail following the graphical results.

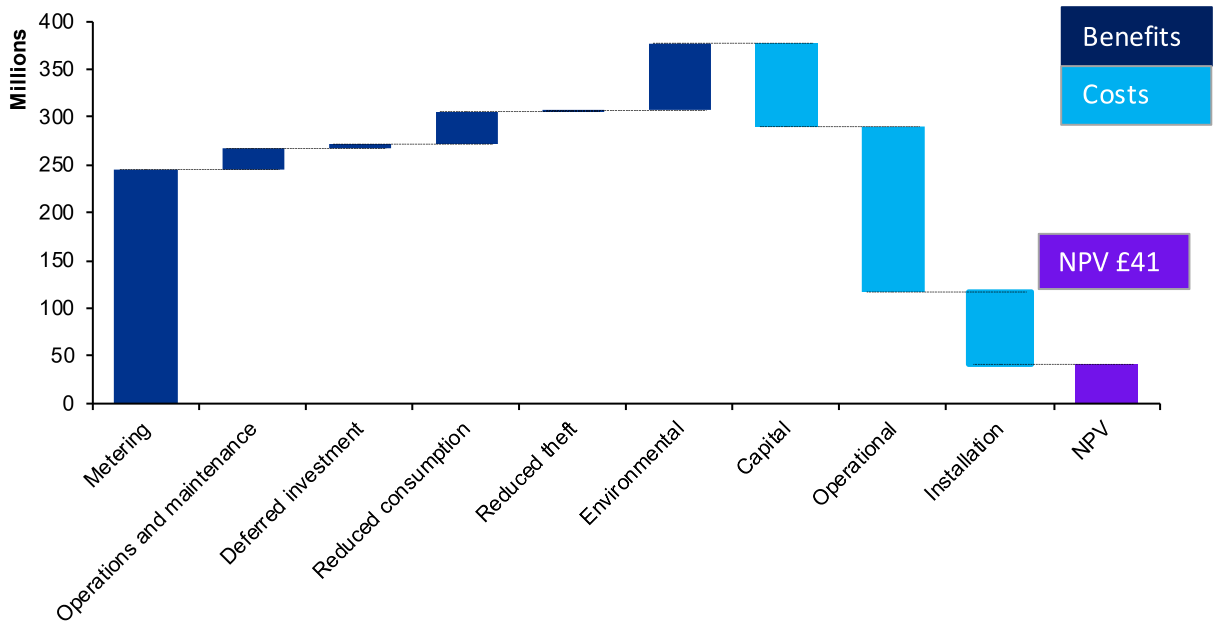

Figure 21 Discounted Costs and Benefits for Scenario 1

Table 35 - Results of Scenario 1 - Gas

Results	Scenario 1
PVC (£m, 2022)	336
PVB (£m, 2022)	378
NPV (£m, 2022)	41
BCR	1.12

In Scenario 1, the benefits outweigh the costs over the total appraisal period, shown by a small but positive Net Present Value (NPV) of £41m and a BCR of 1.12. The largest benefits are from reduced metering costs and the largest benefit comes from reduced operational costs.

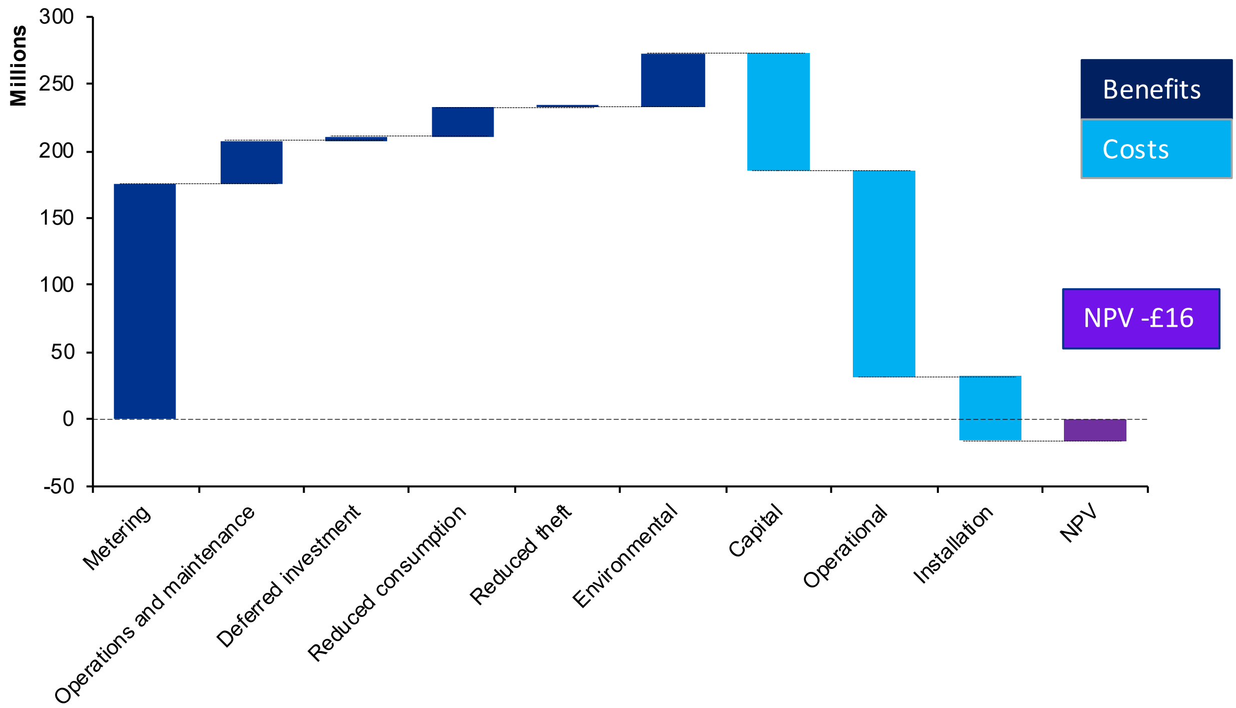

Figure 22 Discounted Costs and Benefits for Scenario 2

Table 36 - Results of Scenario 2 - Gas

Results	Scenario 2
PVC (£m, 2022)	289
PVB (£m, 2022)	273
NPV (£m, 2022)	-16
BCR	0.94

In Scenario 2, the costs outweigh the benefits over the total appraisal period, shown by a negative Net Present Value (NPV) of -£16m and BCR of 0.94. The lower benefits from a phased rollout are not sufficient to outweigh the costs involved.

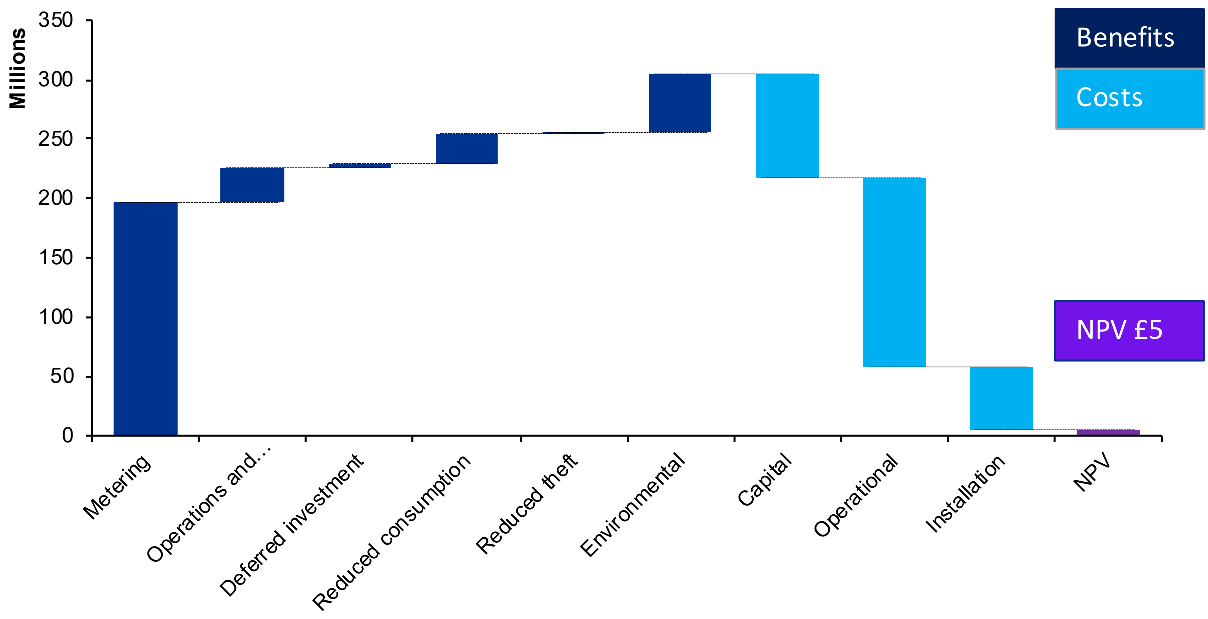

Figure 23 Discounted Costs and Benefits for Scenario 3

Table 37 - Results of Scenario 3 - Gas

Results	Scenario 3
PVC (£m, 2022)	300
PVB (£m, 2022)	305
NPV (£m, 2022)	5
BCR	1.02

In Scenario 3, the NPV is marginally positive of £5m and BCR of 1.02, demonstrating the benefits outweigh the costs over the appraisal period. This is likely from the trial area increasing the benefits compared with Scenario 2.

7.3.2.1 Metering benefits

These are benefits which will occur due to improved technology arising from Smart Meters and more flexibility for operators. They include:

- Reduced meter operation costs
- Reduced meter reading costs
- Reduced billing costs (including introduction of digital billing)
- Reduced call centre/customer care costs
- Reduced top-up effort for consumers
- Reduced callouts for customers switching supplier

These benefits are closely linked to the number of Smart Meters installed and typically increase over the appraisal period as the cumulative number of Smart Meters in operation increases. The exception is reduced meter operation costs which are assumed to be an annual value and reduce top-up effort. The latter is the benefit to consumers who are currently on prepayment meters and no longer need to spend time topping up. This was particularly important during Covid when access to shops was limited. It is assumed that with

Smart Meters, more customers will choose to top-up online and the time required to top-up will be shorter. The prepayment functionality will still exist and be included in any specification of Smart Meters in Northern Ireland due to the high proportion of customers currently using pay as you go services. Gas has a high proportion of customers on PAYG meters, and not all suppliers offer the option to top-up online currently. Therefore, it is assumed that if the online top-up function became available with Smart Meters, a large proportion of customer would take this option up.

7.3.2.2 Operations and maintenance benefits

It is expected that Smart Meters will be cheaper to operate and maintain compared to traditional meters. This is due to the ability to conduct some tasks remotely, such as reconnecting meters to the network, therefore reducing the need for engineers to visit sites as often. Benefits specifically estimated are:

- Reduced maintenance costs of assets (including chip replacement)
- Reduced costs of equipment breakdowns
- Jobs created during installation

The installation of Smart Meters will require additional engineers to install meters. This is captured through the salary earned by skilled engineers installing Smart Meters.

7.3.2.3 Reduced infrastructure investment

Smart Meters are expected to facilitate changes in gas consumption patterns over time. By providing consumers with more data relating to their energy use and associated impacts to their bills, Smart Meters and the services they support are expected to marginally reduce demand. As the introduction of Smart Meters will reduce demand, thus reducing the level of growth on the distribution network in volume terms, this may delay investments in network reinforcement. Based on the CBA carried out in Ireland, we have assumed a benefit of £1 per Smart Meter installed per annum. Other international comparisons are not particularly helpful in this instance as the savings depend very much on the characteristics of the networks, and especially on the current spare peak capacity available. As the NI network is similar to the gas network in Ireland i.e., all PE piping and relatively new, we felt that this assumption was comparable.

7.3.2.4 Reduced consumption

Smart Meters provide detailed information in relation to energy use compared to traditional meters. This information can be used by consumers to better understand their consumption and how this impacts their bills. This awareness and visibility are expected to support behavioural change including a reduction in overall energy use. Results of international trials suggest that consumption reduction, or energy efficiency gains, unlocked by Smart Meters can range from 2% to 10% per annum[82]. Cost benefit analyses of Smart Meters in neighbouring jurisdictions have assumed the lower end of this scale including 3% in Great Britain[83] and 2.6% to 2.9% in Ireland[84]. We recognise that trials or pilots may tend to overestimate benefits in some cases as participants are more likely to proactively engage

[82] EC, Benchmarking Smart Metering deployment in the EU-28, 2020
[83] BEIS, Smart Meter Roll-Out CBA, 2019
[84] CRU, Smart Metering CBA, 2017

over short time periods. For instance, it is appropriate to assume that consumption reductions of 10% would be difficult to sustain over the long-term. A UK based study[85] suggests that the observed energy efficiency benefits from Smart Meters were closer to 2% when monitored outside of a trial or pilot-based environment.

Northern Ireland has a relatively high proportion of pay-as-you-go gas customers. These customers must top-up their accounts so that they can continue to use gas. The need to top-up drives an increased awareness of gas use when compared to credit customers whose accounts are paid automatically on a set frequency. There are varying assumptions in GB and IE relating to this affect. In GB, BEIS have assumed that efficiency gains for Smart Meters are the same for PAYG and credit customers. However, in Ireland it is assumed that credit customers achieve efficiency gains 0.5% higher than PAYG customers.

Small and medium enterprises (SME) form a small number of the total gas connections, but a high proportion of overall gas used. They are also assumed to be more price sensitive to changes in gas, and therefore more incentivised to reduce usage where possible. For this reason, SMEs are assumed to improve efficiency and reduce consumption by more than domestic households. Additionally, the behavioural change expected from gas meters is lower than that assumed for electricity due to the nature of which gas is used in domestic properties. Typically, gas is used for heating homes or cooking for which there is less ability to reduce consumption overall.

Considering all the information above, we have assumed baseline energy efficiency assumptions as shown in Table . In Scenario 1 it is assumed that a faster rollout accompanied by an effective information campaign leads to comparatively higher levels of consumer engagement and behavioural change which is sustained over the study period. Avoided energy is calculated using average historic domestic demand[86]. This avoided energy is monetised using the Green Book's advice on applying long run variable cost of energy (LRVC)[87].

Table 38 Behavioural Change in Gas Scenarios

	Credit meters	PAYG meters	SME
Scenario 1	0.7%	2.4%	3.6%
Scenario 2	0.5%	2.2%	3.4%
Scenario 3	0.6%	2.3%	3.5%

Lower gas consumption reduces losses on transmission and distribution networks as less gas is transported across these networks to consumers. Avoided losses which includes Own Use Gas are calculated using assumptions from the 2011 Smart Meter CBA in Ireland, due to similar characteristics of the networks and monetised using the LRVCs.

7.3.2.5 Reduced theft benefits

Currently, gas suppliers encounter a small proportion of theft. This is because customers are able to access gas without it being included in a meter reading. Due to infrequent meter readings, this is not always noticed when some usage is still recorded. Smart Meters will make theft much more difficult due to the technology involved and more frequent readings. This benefit also reflects the improved safety by reduced incentives to try and obtain gas without going through the meter.

[85] Fredicks et al, A decade on, how has the visibility of energy changed, 2020

[86] UR, RP6 Final Determination – Annex L, 2017

[87] BEIS, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, 2021

7.3.2.6 Environmental benefits

Energy efficiency is a key enabler of Northern Ireland's strategy for net zero emissions. Reduced gas consumption by domestic and commercial consumers will lead to reduced CO_2 emissions in NI. We have assumed that the emissions intensity of gas supply reduces over time to zero by 2050 in line with the net-zero emissions target.

The base line emissions intensity for gas is based on DEFRA's published carbon intensity indicators 2022[88]. The benefit of avoided emissions is calculated using the central traded carbon values published in the Treasury's Green Book[89]. The same approach is taken in determining the avoided emissions and associated benefits through reduced losses on the transmission and distribution networks achieved through reduced gas consumption.

7.3.2.7 Unquantified benefits

Some benefits have not been able to be reliably quantified due to a lack of robust information. These are listed below and have been considered as part of the final recommendations. It is expected that the unquantified benefits will increase proportionally to the number of Smart Meters installed, and hence Scenario 1 will see the largest improvement from benefits which have not been quantified.

Table 39 – Summary of unquantified benefits

Unquantified Benefits
— Environmental benefits which are not quantified through lower carbon emissions as a result of lower energy usage e.g. improved air quality — Continued supply of meters. There is a risk in procuring traditional meters given that nearly all of Europe are implementing Smart Meter programmes, particularly the continuance of PAYG functionality in gas meters — Potential for increased rate of installation of Smart Meters in Scenario 1 and Scenario 3 with less significant travel times between sites — Increased functionality and flexibility for consumers including the ability to track consumption providing consumers with more control during uncertain energy price times — Additional reliability of data and efficiency and improved visibility for networks and suppliers which can be used in maintenance, future planning, and regulatory reporting — Smart Metering systems will increase flexibility of the energy system supporting smart grid development and smart cities — Improved quality of customer service with more accurate information and remote operations — Supports growth of Low Carbon Technologies such as hydrogen and biomethane

88 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022
89 BEIS, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, 2021

— Improved system services

— Competition related benefits to consumers with consumers being better informed and increased ability to identify better tariff deals and switch suppliers

— Consumer investment related benefits. Consumers may make better informed decisions relating to energy efficient investments in their home e.g. boiler upgrade or improving insulation

7.3.3 Costs

Costs estimated for each scenario are presented in Table 40 and discussed in further detail below.

Table 40 Estimated Gas Costs

Costs, £m 2022	Scenario 1	Scenario 2	Scenario 3
Capital costs	88	88	88
Operational costs	173	154	159
Installation costs	76	48	53
Total costs	**336**	**289**	**300**

The graph below shows the annual costs per scenario, discounted and in 2022 prices. As can be seen, the costs are higher during periods of faster rollout and replacement of meters. This is especially noticeable in Scenario 1 when costs for the fast rollout period are higher than the other two scenarios. Costs for Scenario 2 are higher than the other two scenarios towards the end of the rollout period. This is because Scenarios 1 and 3 will complete their rollout earlier, meaning that between 2044 and 2047 only Scenario 2 is still installing new Smart Meters.

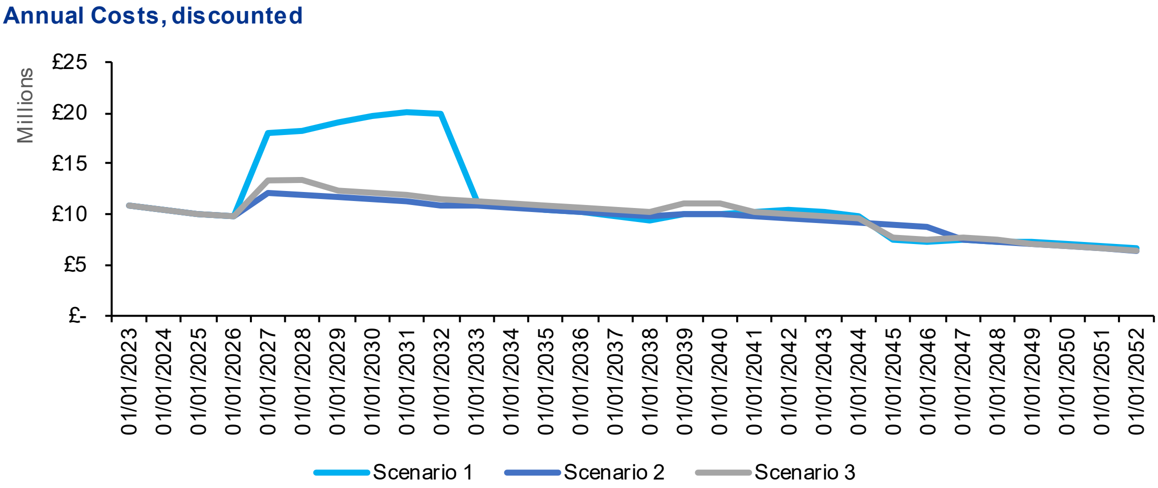

Figure 24 Annual Costs, discounted

7.3.3.1 Capital Costs

This includes the additional capital expenditure that would be required to use Smart Meters compared to traditional meters. Specifically, this includes:

- IT
- Project management
- Total transmission
- Total distribution
- Avoided investment in conventional meters (cost saving)

These costs are generally an annual cost which will be incurred when Smart Meters are rolled out and is constant over the appraisal period.

7.3.3.2 Operational Costs

This includes the ongoing expenditure incurred from using Smart Meters instead of traditional meters. Costs include:

- IT maintenance
- Network management and front-end
- Communication/data transfer costs (inc. GPRS, radio communications, etc.)
- Replacement/failure of Smart Metering systems (incremental)
- Distribution and Transmission operation and maintenance
- Cost of consumer engagement programmes
- Additional costs of operating two systems in parallel (smart and traditional meters)

Most operational expenditure is dependent on the number of Smart Meters and traditional meters in operation.

7.3.3.3 Installation Costs

This includes all the costs associated with installation of Smart Meters and the replacement meters towards the end of the appraisal period. Specifically, costs have been estimated for:

- Cost of installation
- Cost of meter units
- Project management of installation
- Training customer care and installation personnel
- Sunk costs of previously installed meters
- Billing system upgrade for suppliers
- Cost of installation for replacement meters
- Cost of meter units for replacement meters

The costs are mostly associated with the number of Smart Meters installed each year, with some annual costs also used.

7.3.3.4 Unquantified Costs

Additional costs were raised as part of stakeholder engagement and initial research but have not been quantified due to a lack of data available as well as some costs and benefits being non-monetary. These costs are still important considerations in the rollout of Smart Metering systems and include:

Table 41 - Summary of Unquantified Costs

Unquantified Costs
— Potential supply issues for a bulk order in the fast rollout Scenario 1, depending on the complexity of Smart Meter unit functionalities and manufacturing specifications — Challenges in agreeing on Smart Meter unit specification and market design. Timely decision-making processes with expertise required — Challenges in procurement of meters and systems across logistics and skill shortages — Adapting to change for all stakeholders involved

7.3.4 Sensitivity Analysis

Whilst effort has been made to forecast future demand, consumer responses to Smart Meters and macroeconomic conditions, there remains some inherent uncertainty around future outcomes. Sensitivity tests are carried out to understand the impact of changes to assumptions or circumstances on outcomes. Whilst one rollout scenario may be preferred in some conditions, under different assumptions a different rollout may be preferred.

Sensitivity analysis can also help demonstrate the robustness of modelling and demonstrate where certain input assumptions have significant impacts or otherwise on results. These inputs can then be further researched, validated or risks communicated to decision makers.

A wide range of sensitivity tests have been carried out. These test changes to assumed consumer behaviour in response to Smart Meters being installed, different rollout assumptions and changes in key assumptions in the economic appraisal. Under the tests carried out, Scenario 1 always remains the preferred option and in most cases continues to deliver a positive net present value. A full list of tests carried out is included in Appendix E, along with the results of each variation.

Sensitivity testing demonstrated that the model is robust to the overall conclusion that Scenario 1 is the preferred rollout option. However, the scale of benefits relative to costs which can be realised is sensitive to a few key assumptions. Specifically:

- Behavioural change from consumers in response to Smart Meters
- Time taken to top-up
- Energy efficiency over time in gas

Additionally, scenarios are sensitive to assumptions on the length of the appraisal period and discount rates.

Results from key sensitivities are discussed below.

7.3.4.1 Consumption Changes

The extent to which consumers will adjust their behaviour to reduce consumption and benefit from the functionality a Smart Meter offers is unknown. Pilots have been carried out to show ranges of up to 10% in consumption reduction, whilst longer term data from jurisdictions which have delivered Smart Meters have reported consumption reductions of 2.2% for gas credit and 0.5% for PAYG. This is known to differ between PAYG meters and credit meters, given that PAYG meters already offer some functionality for monitoring spend on gas. For this reason, we have included a conservative estimate in the core results and presented both a higher and lower sensitivity here. A larger behaviour reduction has been assumed for SME's given their level of gas demand being larger than domestic consumers. Additionally, some consumers may initially reduce consumption, but the impact is short-lived as the novelty wears off, the Smart Meter display is lost, or they become accustomed to paying higher bills.

Table 42: Consumption Sensitivity Tests

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.12*	*0.94*	*1.02*
1% PAYG / 3% credit / 4% SME consumption reduction	1.17	1.00	1.07
0.5% PAYG / 2% credit / 3% SME consumption reduction	1.07	0.92	0.98
0.6% PAYG / 2.3% credit / 2.3% SME consumption reduction	1.03	0.90	0.95
1.5% PAYG / 3% credit / 3.6% SME consumption reduction	1.17	0.99	1.06
Decreasing consumption reduction over time	1.09	0.92	0.99

This CBA captures the impacts to society of installing Smart Meters. PAYG customers currently visit a shop to top-up their meter, obtain a voucher and input the code into their meter to install the credit. Smart Meters are expected to speed up this process, by encouraging more customers to top-up online, or shortening the time required to top-up. Additionally, the time saving monetised captures the inconvenience of needing to top-up and the uncertainty surrounding when this will be required. The core scenario assumes 80% of PAYG customers top-up 20 times per year, taking 15 minutes per time and top-up during work time (using a value of time equivalent to the median hourly wage in NI). Results are shown below of flexing these assumptions. The gas results are particularly sensitive to this assumption, given that metering benefits are a large proportion of the overall benefits.

Table 43: Time to top-up Sensitivity Tests

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.12*	*0.94*	*1.02*
4.5 minutes to top-up	0.71	0.62	0.66
Leisure value of time	0.77	0.66	0.71

7.3.4.2 Costs

The costs of Smart Meters relative to traditional meters currently used is unknown. Whilst other jurisdictions can provide some indication of expected costs, the procurement of meters, local labour market and safety regulations required will be specific to Northern Ireland. Similarly, the costs required to plan the rollout, update IT operating systems, develop communication systems have been estimated but are uncertain. The table below shows results from a 10% increase or decrease to the overall capital, operating and installation costs individually. Separately, changes to the cost of Smart Meter units and installation were also tested. The combination of meter unit and installation costs had a larger impact on results compared to just a change in the cost of units. Scenario 1 continues to deliver a BCR above 1 under all changes to costs, showing that a fast rollout could still deliver value for money if costs increase.

Table 44 Costs Sensitivity Tests

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.12*	*0.94*	*1.02*
Higher capital costs	1.09	0.92	0.99
Lower capital costs	1.15	0.97	1.05
Higher operating costs	1.07	0.90	0.97
Lower operating costs	1.18	1.00	1.07
Higher installation costs	1.10	0.93	1.00
Lower installation costs	1.15	0.96	1.03
Higher cost of Smart Meter units and installation	1.05	0.89	0.96
Lower cost of Smart Meter units and installation	1.17	0.97	1.05

7.3.4.3 Environmental

The CBA includes a benefit from reduced CO2 emissions arising from improvements to energy efficiency and reduced technical losses. These calculations use a carbon traded price, a conversion factor for the amount of CO2 equivalent emissions from gas consumption and a long run variable cost of energy supply. The values for these used in the core scenarios are taken from DEFRA because there was not a gas specific value available for NI. Given uncertainty around the assumptions, potential changes to climate change policy and the risk of efficiencies not arising, each of these assumptions has been tested.

Table 45 Environmental Assumptions

	Scenario 1	Scenario 2	Scenario 3
Baseline BCR	*1.12*	*0.94*	*1.02*
Carbon intensity constant over time	1.27	1.07	1.15
High LRVC of energy supply	1.17	0.98	1.06
High carbon traded price	1.23	1.01	1.10

7.3.4.4 Unquantified costs

Additional costs were raised as part of stakeholder engagement and initial research but have not been quantified due to a lack of data available as well as some costs and benefits being non-monetary. These costs are still important considerations in the rollout of Smart Metering systems and include:

Table 46 – Summary of unquantified costs

Unquantified Costs
— Potential supply issues for a bulk order in the fast rollout Scenario 1, depending on the complexity of Smart Meter unit functionalities and manufacturing specifications

- Challenges in agreeing on Smart Meter unit specification and market design. Timely decision-making processes with expertise required
- Challenges in procurement of meters and systems across logistics and skill shortages
- Adapting to change for all stakeholders involved
- Increased cyber security issues
- Inconvenience to consumers during replacement process

7.4 Results

This economic appraisal takes account of the estimated costs and benefits of a Smart Meter rollout across NI. Costs considered include the operational and capital expenditure, as well as costs related to installation of Smart Meters. Each scenario will generate benefits which have been quantified where possible. These include benefits arising from reduced consumption, deferred investment, and environmental impacts. Non-quantified costs and benefits have been considered and included in providing final recommendations.

7.4.1 Electricity

In conclusion, our analysis estimates that Scenario 1 will deliver the highest value for money. This is demonstrated by the highest BCR and NPV, driven by the highest overall benefits and the early realisation of benefits. Whilst the costs are also the highest, this is reflective of the faster rollout. UK Transport Appraisal Guidance[90] provides value for money categories for use when considered investments. The primary advantage of these categories is to reduce reliance on a single BCR value, as the category takes into consideration potential impacts from sensitivity tests and non-quantified benefits, as well as the quantified results. A BCR above 1.5, as estimated for Scenario 1, is considered to deliver medium value for money on the investment. When considering the results from the sensitivity tests and non-quantified impacts, our analysis suggests Scenario 1 will deliver medium value for money from the proposed rollout.

All three scenarios present a strong case for delivering a rollout of Smart Meters across Northern Ireland, with positive net present value results and Benefit-Cost Ratios above 1. Scenario 3 demonstrates that even a small geographical pilot with a faster rollout is preferable to a complete phased rollout in terms of scale of the benefits delivered (NPV) and all returns on expenditure (BCR). Expanding the trial would increase the benefits further.

Summary results are shown in the table below.

Table 47 Electricity CBA Results

Results	Scenario 1	Scenario 2	Scenario 3
PVC (£m, 2022)	527	421	451
PVB (£m, 2022)	827	492	555
NPV (£m, 2022)	301	71	103
BCR	1.57	1.17	1.23

90 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918479/value-for-money-framework.pdf

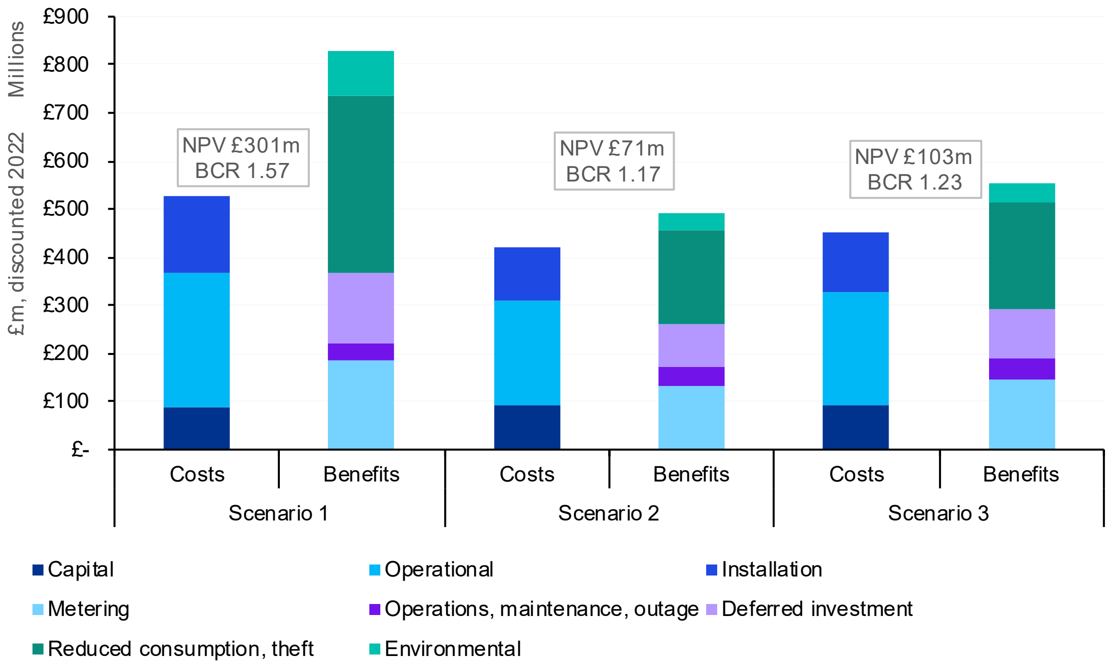

Figure 25 Total Costs and Benefits per Scenario

Sensitivity tests were carried out across a range of input assumptions. These showed that under all variations tested, Scenario 1 remained the preferred option compared to Scenarios 2 and 3. This suggests that it is robust as the preferred option under different circumstances applied equally to all scenarios. Scenario 1 was shown to deliver a BCR above 1 under most sensitivities, except when a 1% behavioural change was applied on consumption of credit meters and 0.5% on PAYG meters (BCR fell to 0.97). This is a low behavioural change compared to evidence from other rollouts and it is considered that a well-planned, marketed and conducted rollout of Smart Meters in Northern Ireland could deliver behavioural changes above this, particularly in the current energy crises where consumers are more aware of energy usage than they were previously. If electricity does not achieve the planned improvements in greenhouse gas emissions, the cost of Smart Meters and installation is equal to current meters, or behavioural change is 1% higher than the core scenario, the BCR approaches 2 or above for Scenario 1.

The ranking of the options does not change under each of the sensitivities, showing that when assumptions are changed simultaneously Scenario 1 continues to be the preferred and Scenario 2 the least preferred rollout delivery. The core BCR's for Scenarios 2 and 3 are very close (0.06 difference), which is reflective of the trial period as a proportion of total meters.

7.4.1.1 Comparing with Historic Electricity CBAs

As part of the analysis of this CBA, comparison has been made across CBAs undertaken previously and in other jurisdictions to sense check and compare results. A summary of the high-level findings across the preferred options identified in these CBAs is considered below, with headline results presented in Table .

Table 48 - Comparison of results across previous CBAs – Electricity

CBA	Scenario	NPV (£m)	Cost (£m)	Benefit (£m)	BCR
NI CBA 2011	Electricity PLC	2	293.8	295.8	1.01
	Electricity Broadband	8	287.8	295.8	1.03
NI CBA 2016	Electricity GPRS	-15.3	335	319.7	0.95
RoI CBA 2017	Electricity IT as sunk costs	106	-	-	-
BEIS CBA 2019	Electricity	5,977	13,480	19,457	1.44
RoI CBA 2011	Electricity Monthly Billing PLC-RF	282	-	-	-

7.4.1.1.1 Northern Ireland

A cost benefit analysis was undertaken by KEMA in 2011 commissioned by the Utility Regulator detailing costs and benefits of a Smart Metering rollout in Northern Ireland across six Smart Meter deployment scenarios. The six scenarios explored electricity only options, electricity and gas, and electricity, gas and water meters with PLC and Broadband. Each of the above scenarios produced a positive NPV, except for scenarios with water meters.

This CBA stands as a good comparison tool and provides additional insights into inputs for the CBA. KEMA aligned meter functionality to the current GB Smart Metering model and aligned equipment and service costs sourced accordingly. The preferred option was an ESM only broadband solution, with an estimated NPV of £8m, within an overall cost of -£288m, reflecting a low benefit/cost ratio of 1.03. The top two preferred options were both electricity only options, therefore the results were not materially affected by whether communication was based on broadband or PLC. Across the 6 scenarios assessed, 4 scenarios estimated a positive NPV with the largest being £56.3m and 2 showed a negative NPV with the lowest being -£113.1m. Benefit Cost Ratios ranged from 0.71 to 1.25. The effects of carbon benefits and financing costs were included to provide a balanced assessment which resulted in only 2 marginally positive NPVs of £2m and £8m in electricity only options. In general, the customer received the most benefit in the CBA with distributors bearing the greatest costs. Key differences in assumptions are:

- lower 25 year project duration
- lower €84 cost of meter & installation
- higher lifetime of traditional meters of 25 years
- lower lifetime of Smart Meters of 15 years
- reduction in energy consumption 3%
- higher peak load reduction of 5%.

Additionally, project management costs are applied as a percentage basis of 8% for project management and 15% for project management IT instead of set figures.

In 2016 a cost benefit analysis was published by the Department for the Economy as a reassessment of 2011's Smart Meter CBA commissioned by the Utility Regulator. The reassessment considers electricity only given the EU Directive timeframe with a gas CBA to be reassessed at a later date. The 2016 CBA found a negative NPV of -£15.3m and a BCR of 0.95. The model assumed consumer demand falls by 2.3% in line with NIE trials and peak demand will fall by 9% in line with Ireland assumptions & NIE's 'shift and save trial'. A reduction of 10.9% or greater would be needed to turn the NPV positive. The majority of costs and benefits were unknown at the time of assessment and data from other jurisdictions was relied on and extrapolated to fit NI circumstances. The 2016 CBA identified that it would be prudent to wait until definite lessons and concrete data emerges from other countries which have rolled out Smart Meters before they are introduced in Northern Ireland, likely to be 2021 and beyond.

7.4.1.1.2 Republic of Ireland

In 2011 the Commission for Energy Regulation undertook a CBA for national ESM rollout in Ireland. The CBA assessed 12 options covering a variety of monthly and bi-monthly billing, comm’s options and in house display options. The total net present values for the rollout options were generally positive. NPV’s ranged from -€181m to €282m. Of the 12 options NPV’s ranged from -€388m to €58m by network component with 2 options having a positive impact on the networks. Supplier NPV ranges from €140m to €1m with an even 50% split between positive and negative NPV for suppliers across the options. All 12 options had a positive NPV for the generation component between €97m-€144m. The residential usage NPV component was also positive across all 12 scenarios ranging from €176-€207. Assumptions of reduction in energy demand were made between 2-3% similar to KPMG and peak load reduction 9%, larger than KPMG’s assumption.

The Commission for Regulation of Utilities in Ireland’s CBA in 2017 is an electricity only CBA with the intention to deliver a Smart Meter upgrade for gas in 2024. The CBA covered 2 scenarios: the base case and the winter package counterfactual with a fast rollout of all Smart Meters between 2019-2024. The base case had a negative NPV of -€36m, however given the EU legislation ‘Clean Energy Package’ obligation that customers should be able to request a Smart Meter when desired, the IT systems to support Smart Metering must be in place irrespective of national Smart Metering rollout. The CBA was re-run with IT system costs treated as sunk costs as they were occurred irrespective of rollout, resulting in a positive NPV of €106m in the winter package counterfactual. Energy reduction in consumption were assumed to be 2.86%. NPV’s have been estimated for each group within the industry by identifying relevant costs and benefits. The discounted NPV attributable to networks was -€358m with networks being negatively impacted by a rollout. Suppliers are also negatively impacted with a -€200m NPV. Several of the costs are assumed to fall to suppliers, such as IT systems enhancement, staff training costs and costs related to consumer queries. At the same time, suppliers will only benefit from some of the benefits, such as fewer calls relating to bills, consumer debt costs or consumers switching suppliers. The generation impact is positive with a €230m NPV impact. Consumers will also be positively impacted with €314m NPV.

7.4.1.1.3 United Kingdom

The Department for Business, Energy & Industrial Strategy CBA in 2019 CBA covers both electricity and gas Smart Metering. Energy consumption reductions were assumed to be 3% in electricity, 2.2% in gas and 0.5% for gas prepayment connections. The CBA had a positive NPV of almost £6bn. Total costs were £13,480m with the installation of meters (24%), DCC external service provider costs (18%) and meters & IHDs (16%) bearing the largest costs. Total benefits were £19,457m of which energy savings (32%), avoided site visits (12%), reduced GHG emissions (8%) and time savings (7%) were the largest.

7.4.2 Gas

Our analysis for the impacts of a rollout of GSMs across Northern Ireland estimates that Scenario 1 will deliver the highest value for money. This is demonstrated by the highest BCR and NPV, driven by the highest overall benefits and the early realisation of benefits. Whilst the costs are also the highest, this is reflective of the faster rollout. UK Transport Appraisal Guidance[91] provides value for money categories for use when considered investments. The primary advantage of these categories is to reduce reliance on a single BCR value, as the category takes into consideration potential impacts from sensitivity tests and non-quantified benefits, as well as the quantified results. A BCR between 1 and 1.5, as estimated for Scenario 1, is considered to deliver low value for money on the investment. When considering the results from the sensitivity tests and non-quantified impacts, our analysis suggests Scenario 1 will deliver low value for money from the proposed rollout. This shows that whilst returns are positive, the investment will not deliver large benefits above the costs required for the rollout.

Scenario 2 is estimated to deliver a BCR of 0.94, and a negative NPV, meaning that costs outweigh the benefits. Scenario 3 is estimated to deliver a BCR of 1.02, and a marginally positive NPV, showing that the costs and benefits are almost equal. Both of these results would suggest the investment would deliver poor value for money. This shows that when GSMs are rolled out on a phased basis, the benefits are not sufficient to outweigh the higher costs involved.

Summary results are shown in the table below.

Table 49 Gas CBA Results

Results	Scenario 1	Scenario 2	Scenario 3
PVC (£m, 2022)	336	289	300
PVB (£m, 2022)	378	273	305
NPV (£m, 2022)	**41**	**-16**	**5**
BCR	**1.12**	**0.94**	**1.02**

91 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918479/value-for-money-framework.pdf

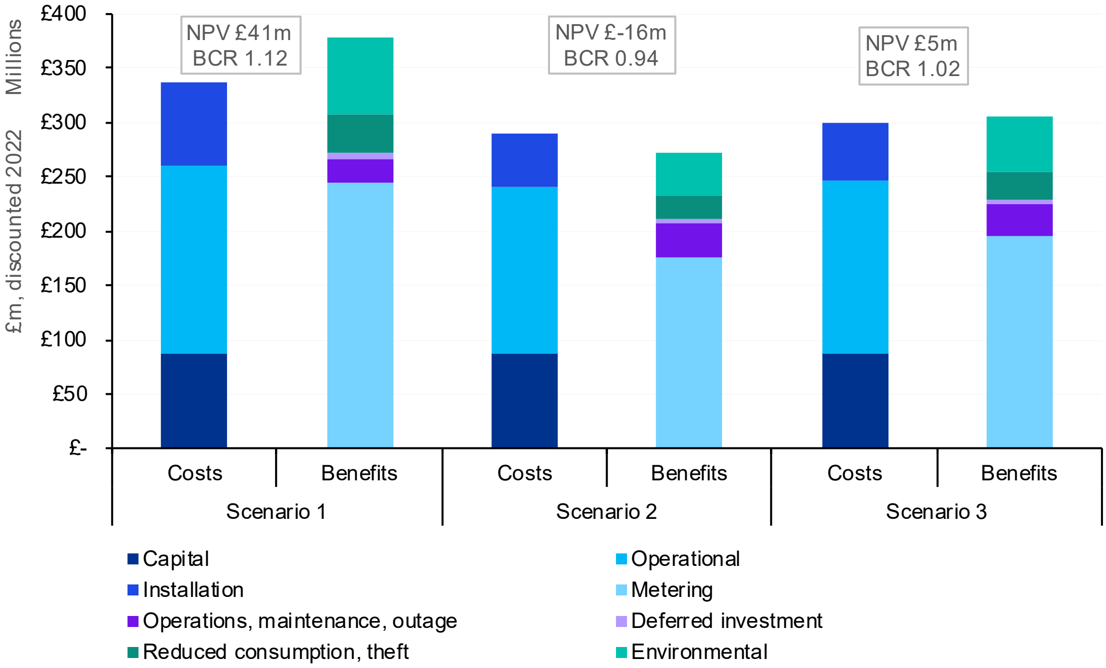

Figure 26 - Total Costs and Benefits per Scenario

Sensitivity tests were carried out across a range of input assumptions. These showed that under all variations tested, Scenario 1 remained the preferred option compared to Scenarios 2 and 3. This suggests that it is robust as the preferred option under different circumstances applied equally to all scenarios. Scenario 1 was shown to deliver a BCR above 1 under most sensitivities, except when a 10% discount rate applied and there was no growth in new gas connections. Additionally, the model was found to be very sensitive to assumptions applied to the time saving benefits from not needing to top-up in person. Assuming consumers top-up during their leisure time reduces the BCR to 0.77, whilst a shorter top-up time reduces the BCR to 0.71. If gas does not achieve the planned improvements in greenhouse gas emissions or the price of traded carbon increases, the BCR increases to above 1.20.

The ranking of the three options is consistent across all sensitivity tests. Scenario 1 is preferred, and Scenario 2 least preferred. This shows that having a pilot with a faster rollout (as in Scenario 3) is preferable to the completely phased replacement of meters.

7.4.2.1 Comparing with Historic Gas CBAs

As part of the analysis of this CBA, comparison has been made across CBA's undertaken previously and in other jurisdictions to sense check and compare results. A summary of the high level findings across the preferred options identified in these CBAs is considered below with headline results presented in Table .

Table 50 Comparison of results across CBAs - Gas

CBA	Scenario	NPV (£m)	Cost (£m)	Benefit (£m)	BCR
RoI CBA 2011	Fast rollout with Bimonthly ES + IHD + VT	51.6 (€59.9)	-	-	-

RoI CBA 2014	Gas fast leveraging electricity infrastructure	4.4 (€5.1)	69.9 (€81.3)	74.2 (€86.4)	1.06
NI CBA 2011	Electricity and Gas PLC	-32.6	334.8	302.3	0.90
	Electricity and Gas Broadband	-26.6	328.8	302.3	0.92

7.4.2.1.1 Northern Ireland

A cost benefit analysis was undertaken by KEMA in 2011 commissioned by the Utility Regulator detailing costs and benefits of a Smart Metering rollout in Northern Ireland across six Smart Meter deployment scenarios. The six scenarios explored electricity only options, electricity and gas, and electricity, gas and water meters with PLC and Broadband. Each of the above scenarios produced a positive NPV, except for scenarios with water meters.

As discussed above, the effects of carbon benefits and financing costs were included to provide a balanced assessment which resulted in only 2 marginally positive NPVs of £2m and £8m in electricity only options with gas electricity and gas options having an NPV of -£32.6m and -£26.6m.

7.4.2.1.2 Republic of Ireland

The Commission for Energy Regulation in 2011 conducted a gas Smart Metering rollout CBA following on from the CER electricity Smart Metering CBA in 2011. A key assumption is that the GSM leverages the infrastructure that would be in place for electricity Smart Metering, only costs incremental to those already included in the electricity CBA are included in the gas CBA. The CBA considered two deployment scenarios - fast with all Smart Meters installed between 2015-2018 and phased with rollout by 2030, each under four functionality options. The CBA analysis indicates the rollout of gas Smart Metering has the potential to provide a positive net benefit to the Irish gas market and consumers. The NPVs are generally more favourable for energy saving scenarios based on the fast rollout scenario compared to the phased rollout scenario. The energy saving scenario with the strongest NPVs, especially for the fast rollout scenario, is the combination of energy statement with an In-House Display (IHD) and variable tariff. NPVs range from €0.9m- €59.9m in the fast scenarios and -€13.9 to €34m in the phased scenarios. Consumer behaviour assumptions in usage reduction range from 2.2% - 3.6% across the scenarios. Across all options the network component is strongly negative with NPV ranging between -€58m to -€67m. The customer impact is positive ranging from €63m to €122m. Supplier impact is mostly marginally negative ~€1m, except for in the Smart Metering monthly billing option which ranges to -€38m.

The 2014 CBA was undertaken by PwC, commissioned by CER to update the cost benefit analysis (electricity and gas prepared in 2011. The CBA highlights the main benefits of a Smart Meter rollout for the gas sector. A pessimistic, central, and optimistic scenario were run. In electricity the overall NPV was only positive in the optimistic scenario, for the gas the NPV was positive in both central and optimistic scenarios. With both electricity and gas combined, the overall NPV was positive in only the optimistic scenario with €127m and was negative in the central scenario of -€54m. It should be noted that the gas case is not stand alone and places a significant dependence on infrastructure put in place for the electricity programme, Consumers were the main beneficiaries with reduced gas usage benefits amount to €86m over the 18 year period. The consumer benefit is one of the main reasons the CBA for GSM rollout is positive along with the fact that the GSMs were going to leverage investment made initially on the rollout of ESMs, by utilising the communications infrastructure put in place. Smart Meters had a negative impact on gas suppliers of -€2.4m and -€79m on networks driven mostly by IT costs. The model assumed an estimated 94% of households with Smart Meters are assumed to realise a reduction of 3.6% in their annual gas consumption as a result of the SM and IHD, with this percentage held constant as a share of a modestly declining consumption demand for the duration of the CBA model.

Section 8. Results and Conclusions

8.1 The Drivers for Smart Metering

Existing and developing policies across the UK and locally are driving an interest in the rollout of Smart Meters across Northern Ireland. In this section we explore how these marry internal, sector-specific drivers. To be clear, these are aspects of government policy, strategy, and risks across the Northern Ireland energy sector that prompt a Smart Meter rollout and not just this Cost Benefit Analysis.

8.1.1 Policy Drivers

The UK has set a goal of Net Zero by 2050[92]. The "Build Back Greener" strategy[93] specifically calls for a market-wide Smart Meter rollout as a means of understanding the GB energy system and driving down consumption. The process of achieving Net Zero is not just about renewables generation and large-scale government projects but encouraging a reduction in Consumer demand. Smart Meters facilitate both a mechanism for reducing network inefficiencies (power losses contribute to the overall demand) and provide a tool to educate the Consumer around their usage habits. This UK ambition is already being realised in GB due to the long undergoing rollout of SMETS Smart Meters.

DfE's Energy Strategy for Northern Ireland[94] and the accompanying Action Plan for 2022 set out an ambition for Northern Ireland to contribute to the UK's overall target, actively and significantly. The output of the preceding analysis demonstrates how a Smart Meter deployment supports all five of the key principles from the Energy Strategy for Northern Ireland as follows:

1. **Placing you at the heart of our energy future**. Smart Meters are a Consumer-focussed technology of relevance to everyone in society that supports a Just Transition.
2. **Grow the green economy**. This report highlights how, particularly an active, deployment encourages job creation, upskilling, and attracts expertise.
3. **Do more with less**. Smart Meters help DNOs understand their networks better and combat inefficiencies through strategic planning. They also specifically provide Consumers with the insight necessary to reduce their consumption.
4. **Replace fossil fuels with renewable energy**. Smart Meters provide the TSO with an active understanding of demand which through DSM enables a more precise forecast and control of supply to bring renewables further into the mix. They also work in tandem with Consumer microgeneration such as Solar PV.
5. **Create a flexible, resilient and integrated energy system**. Smart Meters are the demand-side foundation of an integrated and flexible smart grid and critical in providing end-to-end understanding of energy usage in Northern Ireland.

With respect to the Action Plan for 2022, this report addresses action 20 to carry out a cost benefit analysis of electricity and gas Smart Meters and other technologies in order to access half-hourly and daily consumption information. Another of relevance would be action

[92] UK's path to net zero set out in landmark strategy - GOV.UK (www.gov.uk)
[93] net-zero-strategy-beis.pdf (publishing.service.gov.uk)
[94] Energy Strategy - Path to Net Zero Energy | Department for the Economy (economy-ni.gov.uk)

19 which is to prepare a Northern Ireland Smart Systems and Flexibility Plan. It is understood that this plan will directly consider the outputs of this CBA exercise.

Legislation from the EU also suggests that in the absence of a formal rollout, a state must offer to its Consumers the facility of a fully enabled Smart Service (and Smart Meter) upon request[95]. Therefore, provided NI is required to abide to this EU legislation, a lot of the infrastructure required to deliver a formal deployment is required anyway.

8.1.2 Indirect Policy Drivers

Indirect drivers impact those technologies which this report associated with Smart Meters and therefore for which a Northern Ireland deployment would benefit. As identified across this report, Smart Meters integrate with a number of technologies including Electric Vehicles, Heat Pumps, and Microgeneration. These benefits apply only to the electricity sector.

8.1.2.1 Decarbonisation of Transport

The UK in its Net Zero strategy and wider legislation is driving the decarbonisation of transport through electrification. Sales of Internal Combustion Engine (ICE) vehicles, those that use fossil fuels, are banned from 2030[96]. In order to facilitate this action, appropriate infrastructure must be in place to support a significant uptake in EVs.

Smart Meters support these developments directly by providing a platform for advanced tariffs that encourage peak shifting and the charging of EVs just periods of generally reduced demand. DSM is a key concept that Consumers can opt-into that enables the TSO to use an EV network to support the grid and generation during peak periods. Indirectly, Smart Meters provide NIEN with the data to support strategic network planning. The current network is not suitable for the significant increase in electricity demand that an electrification of transport produces, and the additional planning insights Smart Meters facilitate are critical in planning network upgrades.

8.1.2.2 Decarbonisation of Heat

In its ambition to decarbonise domestic and commercial heating, the government is looking towards alternatives which include Heat Pumps. These are a significant capital investment for Consumers and the lack of current TOU or heat-specific electricity tariffs impacts negatively on the operational savings the technology proposes. Smart Meters enable these advanced tariffs vital for driving an uptake in Heat Pumps.

8.1.2.3 Microgeneration

More and more Consumers are installing local microgeneration facilities such as Solar PV or wind turbines to offset their energy bills and improve their carbon footprints. Smart Meters support these Consumers by offering a platform for tracking energy sold back to the grid and also by providing the TSO with the insight to manage thousands of distributed generation micro-assets rather than the traditional model of a smaller number of large power generation facilities.

8.1.3 Sector Drivers

Outside of the political landscape, the sector itself is driving the installation of Smart Meters and establishment of a Smart Service. There is an urgent need to secure the provision of gas meters of any sort, as discussed in section 6.3, and the risk of obsolescence and

[95] gov.ie - Directive (EU) 2019/944 and Regulation (EU) 2019/943 on the internal market for electricity (recasts) (www.gov.ie)

[96] Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030 - GOV.UK (www.gov.uk)

availability challenges may affect both sectors. Response to engagement suggests that the market has shifted to a point where the majority of meters offered by manufacturers are Smart Meters. Gas DNOs are ready engaged in a process to secure for a new procurement to ensure supply of meters from 2024. The specification for meters in this cancelled procurement are already bordering on offering a Smart Service and therefore there is anticipation of substantial infrastructure costs irrespective of whether a Smart Service is formally deployed.

8.2 Summary of Key Considerations and Required Enablers

Several fundamental components are required to be established in the provision of a Smart Service appropriate for Northern Ireland. There are various barriers and challenges to be overcome collectively in the development of these components.

Challenges have been defined across various phases of a deployment reflecting a general order of actions. Note these challenges do not necessarily equate directly with costs presented in the CBA but reflect the steps required to realise a successful deployment.

8.2.1 Centralisation

Centralisation across the programme has been identified as a key enabler of cost-reduction, transparency, and efficiency. Centralisation can be considered both intra- and inter-utility.

8.2.1.1 Intra-Utility Centralisation

With each sector, electricity and gas, there are multiple roles as defined in section 4. As discussed across this report, there is scope to consolidate multiple roles within the remit of fewer parties e.g. one entity could deliver an end-to-end IT and communications system, managing the MMS, Communications infrastructure, security, and availability of data.

Examples models of centralisations are shown in section 2 and section 2 for electricity and gas respectively each with varying degrees of complexity.

8.2.1.2 Inter-Utility Centralisation

For further cost-effectiveness, it may be prudent that a centralised party delivers services across the two utilities e.g. one entity provides IT and communications for both ESMs and GSMs. It has been suggested in preparation of the CBA that significant components of system Capex and Opex are fixed (independent of volumes of meters) therefore it would make sense that a single system delivering overarching functionality would be cheaper than multiple. Considering the multiple gas DNOs, a centralised end-to-end system managed by one company for all is a significant possibility anyway, it is possible that adding support for ESMs onto this minimises costs to Consumers overall.

An obvious challenge to this idealisation is that of ownership, and due consideration must be made via engagement and consultation on how such an entity could exist. It would perhaps be the first step towards a more integrated, dynamic, and intelligent energy system of the future with a combined system operator view.

8.2.2 Smart Service

It is critical that any deployment delivers a Smart Service and not just Smart Meters for which the added benefits are not realised. This provision is contingent on multiple factors including service design (meter, IT, Comms), usability, and supporting services offered such as advanced tariffs and Demand Side Management.

This service should not reduce functionality below that which is already available to Consumers in Northern Ireland, although the way in which this function is offered may evolve. PAYG is a key example of essential functionality which is particularly critical in Northern Ireland.

8.2.3 Behaviour Change

Consumer behaviour change is key to realising a significant proportion of benefits enabled by a Smart Service. It is therefore critical that an appropriate information campaign is run to inform, encourage and also provide education for the full range of Consumer needs in Northern Ireland.

Consumer engagement drives behaviour change which drives consumption reduction. A comprehensive engagement campaign that encourages, informs, and educates is essential for delivering benefits.

8.2.4 Facilitating Innovation

Smart Meters deliver data and intelligence that can drive innovation such as modern PAYG solutions and advanced tariffs but they also have the potential to act as an enabler to wider innovation. Retailers and network companies must innovate and develop solutions to bring Northern Ireland's energy eco-system up to the standard set by other countries with successful Smart Service deployments and beyond to maximise the opportunity for a self-sustained green energy future. Companies should be encouraged (and incentivised where necessary) to produce even more advanced solutions that have not yet been thought of.

Other jurisdictions are beginning to explore artificial intelligence driven solutions for managing the energy system and providing Consumers with a tailored experience. A Smart Service deployment in Northern Ireland paves the way for future innovation in this area.

8.2.5 Programme Timeline

This report presents a high-level assumption around deployment pace and timelines based on the deployments of other jurisdictions. Milestones need to be set and appropriate programme timeline developed to meet them that is both driving and feasible.

The approaching deadline imposed on the gas sector by the expiring PAYG meter contract adds a constraint and puts at risk the possibility of cross-utility services. Other factors include the time required to develop the meter installation capability, design, and procure the solution, and logistics challenges.

An Active *opt-out* deployment is recommended for both utilities instead of a passive rollout. These are just two scenarios tested and further consultation may reveal an alternative pathway, ideally one that produces services common to both utilities.

8.2.6 Oversight and Regulation

A significant amount of oversight and regulation is expected across any deployment. At the design stage, it is considered valuable that DfE (and UR) is involved in the specification such that Smart Service paid for by Consumers is designed to meet Consumer needs. The cancelled gas PAYG procurement is evidence that sector bodies require guidance/oversight. This is especially important considering the possibility of centralisation and the degree of security considerations required. BEIS in GB specifically advised that DfE steers the programme and gets involved in the detail such that the market does not dictate the deployment.

Beyond design and procurement, there is a requirement for legislative change and updates to licenses to reflect the direction of the sector.

The UR needs to be involved in the development of the programme to ensure it understands the project from funding, financial, and economic perspectives.

8.2.7 Resourcing and Skills

Demand across the sector for resources and new skills is critical to a successful delivery. Research suggests there are significant knowledge and skills gaps, due to a lack of necessity to date, in modern IT, communications, and cyber security (national-scale). These skills will be required across both government and networks/retailers. It is common for large scale capital programmes to underestimate the resourcing requirements which negatively affects delivery performance and costs.

The Department for the Economy must build an appropriately sized and capable team for providing the oversight this programme would require.

With respect to programme deployment, substantial resourcing would be required to provide appropriate management and oversight.

In an active rollout, the required increase in installation capacity (resources) and time for training, should be planned for in advance.

8.2.8 Time

Perhaps the most significant challenge is that of the time available to address all of the above. Resourcing, technical analysis, documentation, consultation, decision-making, and legislation are each substantial tasks that have generally taken years of development in other jurisdictions. Given the constraints imposed by various drivers, there is a risk that the sector lacks the time to commence a rollout in an appropriate timeframe.

8.2.9 Just Transition

A Smart Service support must support a Just Transition and accommodate different socioeconomic groups, particularly those more vulnerable. Consumer Council research referenced in section 4.12 is valuable in understanding the diverse needs of different groups. Some aspects of these needs are delivered via functional design whilst others via engagement campaigns. A solution should be inclusive of all, not just the majority.

8.3 Summary of Benefits

In Table 51 are summarised the high-level categories of qualitative benefits as described across this report, and how these apply to network companies, Retailers, and Consumers.

Table 51 - Summary Benefits Matrix

Benefit Area	Networks	Retailers	Consumers
Improved Network Planning	Supports strategic network upgrades so investment is not wasted on redundant upgrades but can target weakest components of the distribution network Facilitates a more direct understanding of demand across local distribution zones to understand capacity for new connections, reducing the amount of investigation required.		Comprehensive understanding of network makes new connections easier and therefore cheaper for the Consumer.
Demand Side Management	DSM helps SONI in managing the power system more efficiently. It facilitates a transition towards a system powered by multiple microgeneration facilities, rather than just a few large-scale plants, by providing clarity on demand side supply. Advanced DSM permits control of certain demand-side (Consumer) components to reduce demands during peak periods. Often these are large-scale Consumers such as factories but may in the future include EVs and Smart Appliances.		DSM can provide significant benefits for customers in terms of reduced bills and gives them greater control over the energy they use and produce. It provides an avenue for Consumers to earn credit by offering demand-side services to the network operators. TOU tariffs are a basic component of DSM.
Metering Automation and Accuracy	Automation of the meter reading process reduces workload on DNO (electricity electricity). Granular consumption profiles avoid requirement for load-profile purchase which is outsourced to 3rd party who use GB data, which increases	Automation of the meter reading process reduces workload on Retailers (gas benefit). Smart Meters can be designed to avail of technological advances since the Standard Meter design to improve precision.	Smart Meters can be designed to avail of technological advances since the Standard Meter design to improve precision, so Consumers only pay for what they use. Live view facilitates easier identification of electricity theft.

	accuracy for Northern Ireland profiles. Automation and communications offer a live view of the network for health and fault monitoring. Live view facilitates easier identification of electricity theft.	Granular consumption profiles avoid requirement for load-profile purchase which is outsourced to 3rd party who use GB data which increases accuracy for Northern Ireland profiles. Live view facilitates easier identification of electricity theft.	
Improved Customer Service	Network monitoring allows DNOs to identify issues more rapidly. Fixes can be targeted which reduces costs. Overall fault restoration is quicker.	Network monitoring allows DNOs to identify issues more rapidly. Fixes can be targeted which reduces costs. Retailers face less issues with Consumer power loss.	Network monitoring allows DNOs to identify issues more rapidly. Fixes can be targeted which reduces costs. Overall fault restoration is quicker for Consumer.
Energy Consumption Reduction	Smart Service enables consumption reduction via provision of usage data to Consumer and tariff reform. Peak shifting is encouraged by TOU tariffs and DSM. Consumers can understand their usage via live data feedback to generally reduce consumption.		Consumers can understand their usage via live data feedback in order to generally reduce consumption. Advanced tariffs offer Consumers a pathway to save money, if appropriate products are made available. Encourages a personal consumption reduction.
Renewables and LCT Support	Smart Meters integrate with EVs, Heat Pumps, and Microgeneration to facilitate a shift towards LCTs. The more accurate view of demand-side enables incorporation of a greater proportion of renewables generation. Demand shifting may also help in reducing curtailment.	EVs promote a general increase in electricity consumption for Retailers per capita as Consumers shift away from ICE (electricity benefit).	Smart Meters integrate with EVs, Heat Pumps, and Microgeneration to facilitate a shift towards LCT uptake. Reduces personal emissions and potential for running cost reduction.

8.4 Summary of CBA

This economic appraisal takes account of the estimated costs and benefits of a Smart Meter rollout across NI. Costs considered include the operational and capital expenditure, as well as costs related to installation of Smart Meters. Each scenario will generate benefits which have been quantified where possible. These include benefits arising from reduced consumption, deferred investment and environmental impacts. Non-quantified costs and benefits have been considered and included in providing final recommendations.

The results of the two CBA models and sensitivities suggest the following outcomes.

8.4.1 Electricity

In conclusion, our analysis estimates that Scenario 1 will deliver the highest value for money. This scenario assumes an active rollout with Smart Meters installed over a 6 year period, starting in 2027. The economic analysis estimated Scenario 1 to have the highest BCR and NPV, driven by the highest overall benefits and the early realisation of benefits. Whilst the costs are also the highest, this is reflective of the faster rollout. UK Transport Appraisal Guidance provides value for money categories for use when considered investments. The primary advantage of these categories is to reduce reliance on a single BCR value, as the category takes into consideration potential impacts from sensitivity tests and non-quantified benefits, as well as the quantified results. A BCR above 1.5, as estimated for Scenario 1, is considered to deliver medium value for money on the investment. When considering the results from the sensitivity tests and non-quantified impacts, our analysis suggests Scenario 1 will deliver medium value for money from the proposed rollout. Scenarios 2 and 3 consistently fall into the low value for money category under core results and different sensitivities.

All three scenarios present a strong case for delivering a rollout of Smart Meters across Northern Ireland, with positive net present value results and Benefit-Cost Ratios above 1. Scenario 3 demonstrates that even a small geographical pilot with a faster rollout is preferable to a complete phased rollout in terms of scale of the benefits delivered (NPV) but is marginally worse in terms of returns on expenditure (BCR). Expanding the trial would increase the benefits, above those delivered by a phased rollout.

Summary results are shown in the table below.

Table 52 Electricity CBA Results

Results	Scenario 1	Scenario 2	Scenario 3
PVC (£m, 2022)	527	421	451
PVB (£m, 2022)	827	492	555
NPV (£m, 2022)	301	71	103
BCR	1.57	1.17	1.23

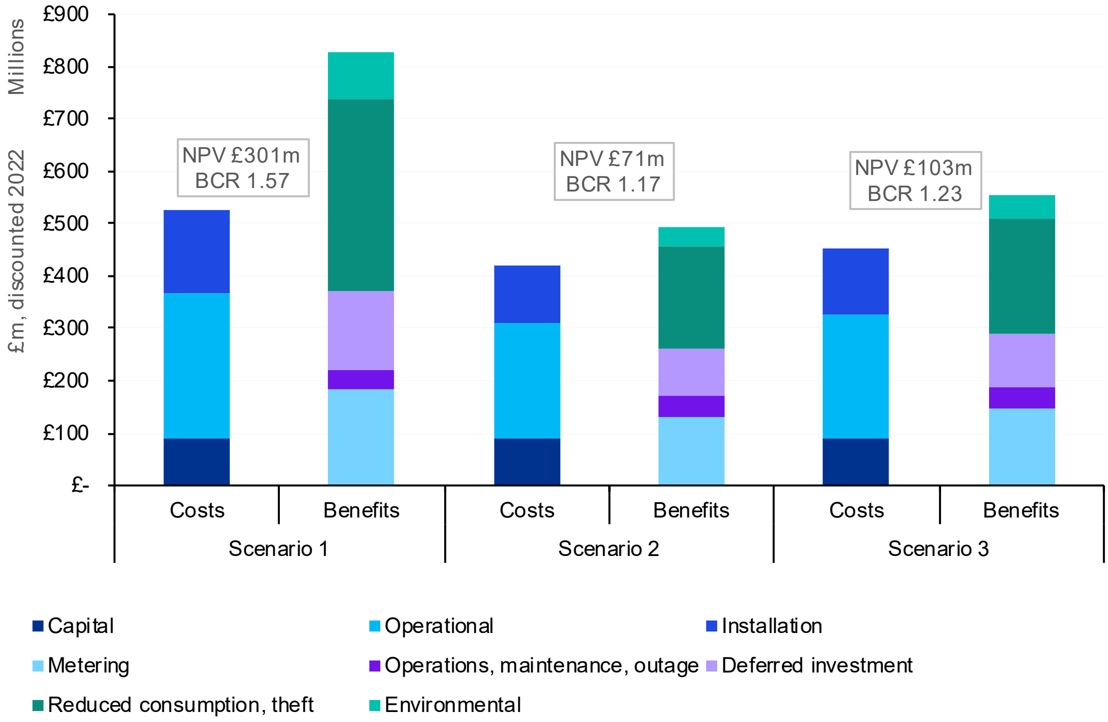

Figure 27 Total Costs and Benefits per Scenario

Sensitivity tests were carried out across a range of input assumptions. These showed that under all variations tested, Scenario 1 remained the preferred option compared to Scenarios 2 and 3. This suggests that it is robust as the preferred option under different circumstances applied equally to all scenarios. Scenario 1 was shown to deliver a BCR above 1 under most sensitivities, except when a 1% behavioural change was applied on consumption of credit meters and 0.5% on PAYG meters (BCR fell to 0.97). This is a low behavioural change compared to evidence from other rollouts and it is considered that a well-planned, marketed and conducted rollout of Smart Meters in Northern Ireland could deliver behavioural changes above this, particularly in the current energy crises where consumers are more aware of energy usage than previously. If electricity does not achieve the planned improvements in greenhouse gas emissions, the cost of Smart Meters and installation is equal to current meters, or behavioural change is 1% higher than the core scenario, the BCR approaches 2 or above for Scenario 1. Results for sensitivity tests of Scenario 1 are shown in the graph below.

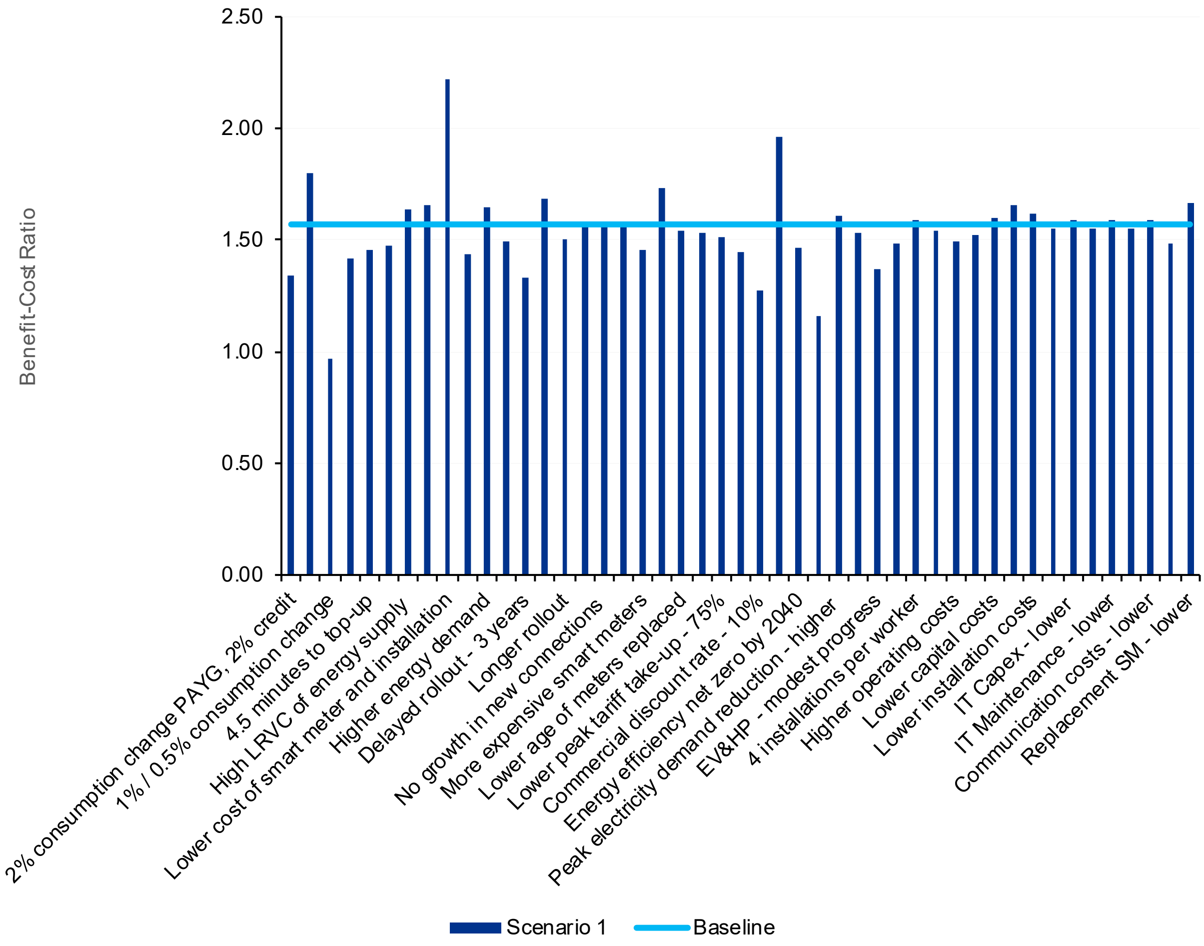

Figure 28 Sensitivity Test Results – Electricity, Scenario 1

The ranking of the options does not change under each of the sensitivities, showing that when assumptions are changed simultaneously Scenario 1 continues to be the preferred and Scenario 2 the least preferred rollout delivery. The core BCR's for Scenarios 2 and 3 are very close (0.06 difference), which is reflective of the trial period as a proportion of total meters.

8.4.2 Gas CBA Outcomes

In conclusion, our analysis for the impacts of a rollout of GSMs across Northern Ireland estimates that Scenario 1 will deliver the highest value for money. This is demonstrated by the highest BCR and NPV, driven by the highest overall benefits and the early realisation of benefits. Whilst the costs are also the highest, this is reflective of the faster rollout. UK Transport Appraisal Guidance provides value for money categories for use when considered investments. The primary advantage of these categories is to reduce reliance on a single BCR value, as the category takes into consideration potential impacts from sensitivity tests and non-quantified benefits, as well as the quantified results. A BCR between 1 and 1.5, as estimated for Scenario 1, is considered to deliver low value for money on the investment. When considering the results from the sensitivity tests and non-quantified impacts, our analysis suggests Scenario 1 will deliver low value for money from the proposed rollout. This shows that whilst returns are positive, the investment will not deliver large benefits above the costs required for the rollout.

Scenario 2 is estimated to deliver a BCR of 0.94, and a negative NPV, meaning that costs outweigh the benefits. Scenario 3 is estimated to deliver a BCR of 1.02, and a marginally positive NPV, showing that the costs and benefits are almost equal. Both of these results would suggest the investment would deliver poor value for money. This shows that when GSMs are rolled out on a phased basis, the benefits are not sufficient to outweigh the higher costs involved.

Summary results are shown in the table below.

Table 53 Gas CBA Results

Results	Scenario 1	Scenario 2	Scenario 3
PVC (£m, 2022)	336	289	300
PVB (£m, 2022)	378	273	305
NPV (£m, 2022)	41	-16	5
BCR	1.12	0.94	1.02

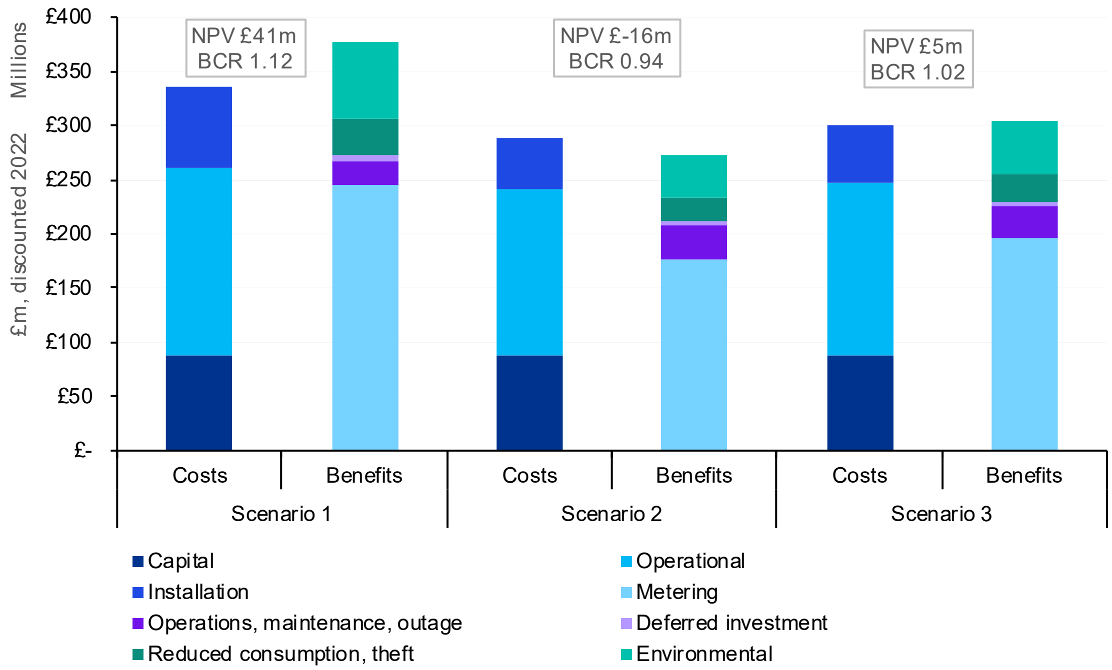

Figure 29 - Total Costs and Benefits per Scenario

Sensitivity tests were carried out across a range of input assumptions. These showed that under all variations tested, Scenario 1 remained the preferred option compared to Scenarios 2 and 3. This suggests that it is robust as the preferred option under different circumstances applied equally to all scenarios. Scenario 1 was shown to deliver a BCR above 1 under most sensitivities, except when a 10% discount rate applied and there was no growth in new gas connections. Additionally, the model was found to be very sensitive to assumptions applied to the time saving benefits from not needing to top-up in person. Assuming consumers top-up during their leisure time reduces the BCR to 0.77, whilst a shorter top-up time reduces the BCR to 0.71. If gas does not achieve the planned improvements in greenhouse gas emissions or the price of traded carbon increases, the BCR increases to above 1.20.

The ranking of the three options is consistent across all sensitivity tests. Scenario 1 is preferred, and Scenario 2 least preferred. This shows that having a pilot with a faster rollout (as in Scenario 3) is preferable to the completely phased replacement of meters.

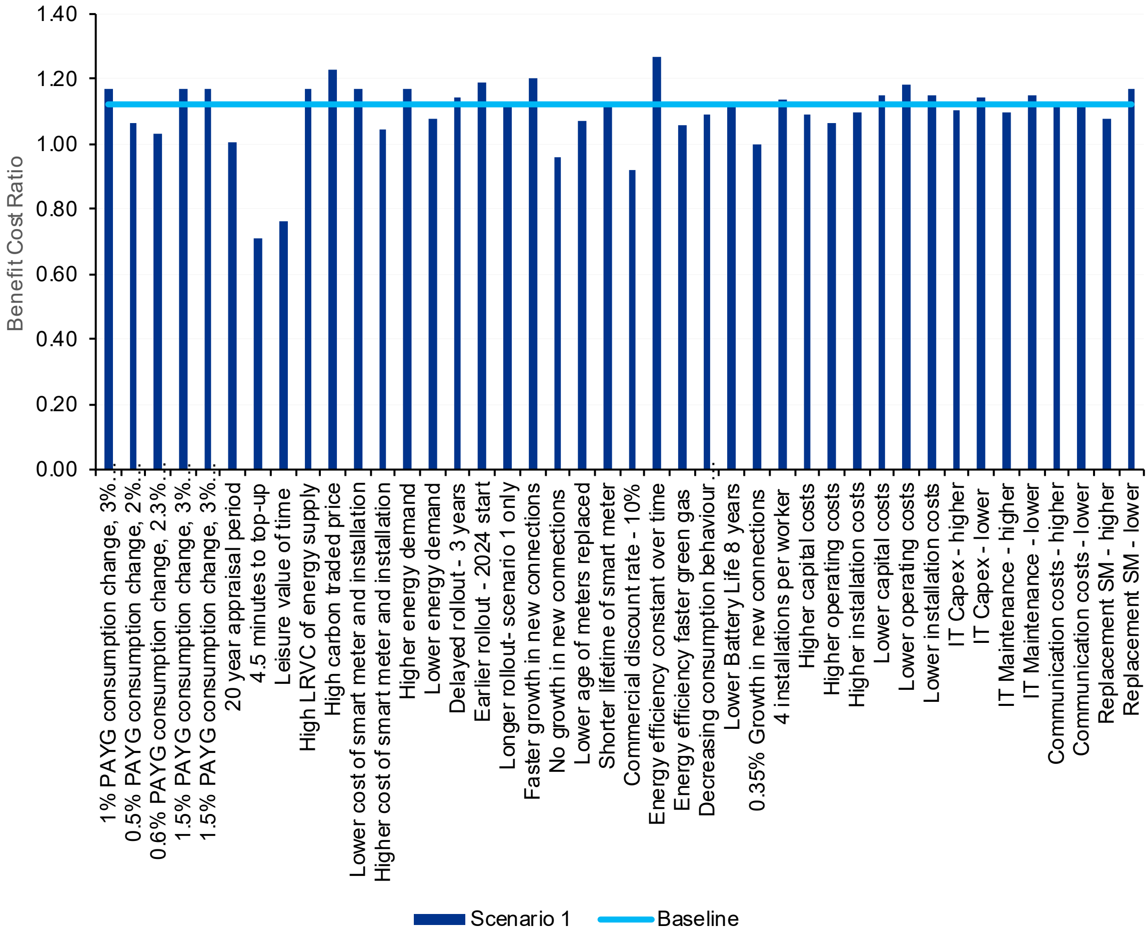

Figure 30 Sensitivity Test Results – Gas, Scenario 1

8.4.3 Potential savings through inter-utility integration

We have identified that at a high-level there are some areas of potential overlap in investment and where inter-utility collaboration could reduce overall costs to the Consumer e.g. shared Communication infrastructure.

8.5 Conclusions

Based on the results above, conclusions can be drawn for each sector.

8.5.1 Electricity

All three scenarios indicate at this stage a positive value for money, and it may therefore be considered at a high-level that all of these scenarios are viable in Northern Ireland, pending appropriate planning, specification, procurement, and delivery phases.

Scenario 1, an active rollout, suggests the highest value for money however it also requires the largest capex investment. Furthermore, this capex is upfront and delivered across a short span of time which presents delivery challenges and pressures.

Scenarios 2 and 3 offer similar results delivering materially less value for money than Scenario 1 but for reduced costs and pressure.

Whilst Scenario 1 at a CBA level presents the best value for money, future analysis should delve into the practicality of this type of deployment further. Considerations for non-quantitative market drivers, resourcing (network-side and government-side), and what is right for Northern Ireland should be made.

8.5.2 Gas

For a standalone gas roll-out, only Scenario 1, a fast active roll out, indicates a material value for money with Scenario 2 resulting in a negative NPV and Scenario 3 being marginally positive. In Scenarios 1 and 3, the low BCRs indicate a generally low value for money which yields a riskier deployment by comparison to the electricity CBA.

Two further key considerations exist for a gas Smart Meter service in addition to the pure CBA results. The first consideration is the status of the gas sector with the current and urgent need to secure PAYG meters, the dominant meter solution in NI, of any type in order to provide metering services to PAYG customers from 2024. As the market is generally only offering Smart Meters, this procurement is likely to incur significant costs on a business-as-usual basis. These costs should be weighed against the quantitative assessment above in deciding on next steps. It is also worth noting that gas DNOs have already begun work on a specification and progress in this area may support a more rapid design and procurement stage. It is critical that DfE reviews this specification and ensures it covers the full suite of necessary functional requirements, end to end, if these meters are to support a Smart Service at some point in time.

The second consideration is the degree of which elements of a Gas Smart Service programme could be shared with an Electricity Smart Service programme. These shared costs would reduce the net cost to gas consumers and where the BCRs and NPV on a standalone basis are not considered high, there would be some improvement in value for money.

8.5.3 Integrated Smart Service Programme

As discussed above, the electricity sector may also benefit from a degree of integration. This may provide collective cost savings but there is also potential for enhanced delivery through knowledge sharing and risk reduction between sectors. Where capital investments cannot be shared, there may still be scope for economies of scale savings due to skills and knowledge support.

8.5.4 Impact of a Smart Service on consumers

Consumers are the biggest beneficiary of a Smart Service overall and Smart Meters have the potential to provide greater control over energy expenditure to those that need it most. However, a Smart Service support must support a Just Transition and accommodate different socioeconomic groups, particularly those more vulnerable. Consumer Council research referenced in section 4.12 is valuable in understanding the diverse needs of different groups.

8.5.5 Key enablers

In order to successfully deliver a Smart Service programme and ultimately deliver the benefits, there are a number of important learnings that can be taken from other jurisdictions. By any measure, a successful Smart Service deployment is a big and complex programme. This will require significant management resource and capability to develop the programme and agree a funding approach (noting that significant capital will be required), through to the delivery of key activities including Smart Service Design, meter and associated technology procurement and through to roll out and the provision of Smart tariffs. Work to ensure alignment between all parties in order to bring Smart tariffs to market and to protect consumers and their data from security and cyber threats are all essential.

Consumers are the largest beneficiary of a Smart Service programme and Consumer behaviour is the key driver to benefits overall. It is therefore critically important that an engagement campaign that informs, encourages and educates consumers of all types and needs is developed.

8.6 Roadmap and Next Steps

On the assumption of progression and ministerial approval, this section provides a high-level roadmap in the development of Smart Service deployments in Northern Ireland. Some components run in parallel whilst others have dependencies as indicated in Figure 31. Note, this roadmap is indicative, and re-evaluation is required following ministerial approval.

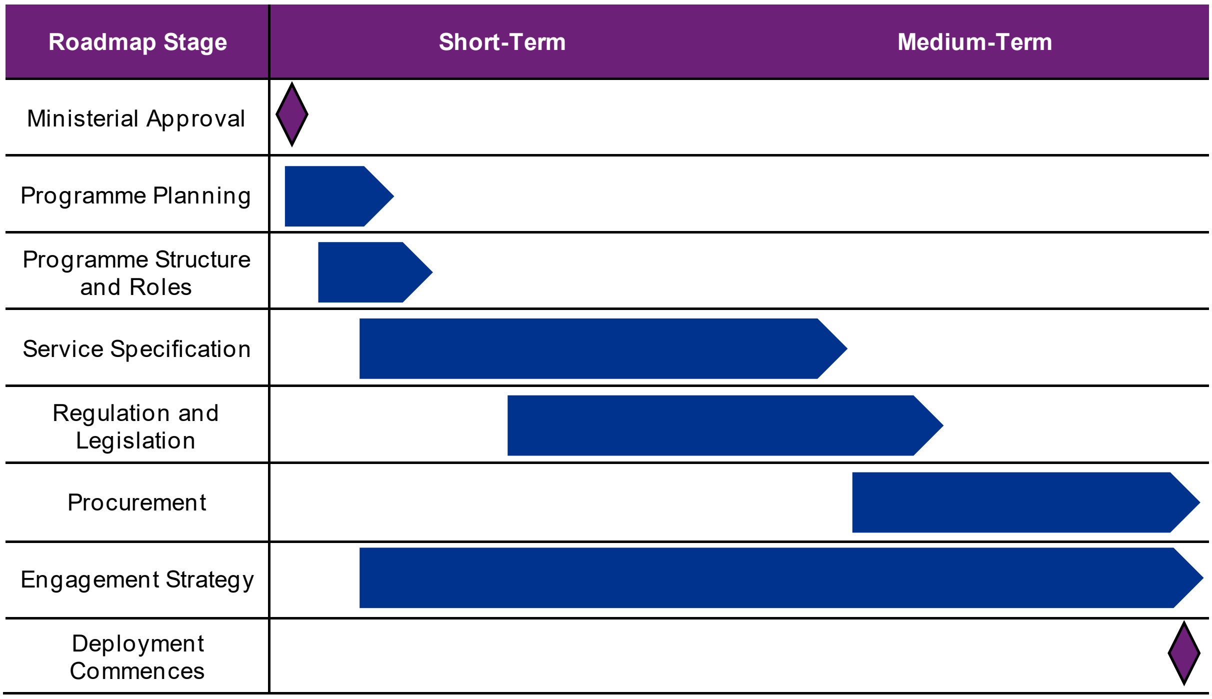

Figure 31 - Roadmap schedule showing indicative programme phases

8.6.1 Programme Planning

The principal step, following approval, is the further development of this roadmap with the goal of a Smart Service Programme Plan. This plan should cover in greater detail the works required to prepare for, procure, and deliver a Smart Service in Northern Ireland. It would be the foundation of the deployment with clear timelines, responsibilities, and milestones.

It is important at this stage that DfE begins developing its programme resource and skill pool to ensure it can provide appropriate oversight. DfE should signal the approval to the sector, with relevant parties appointing resources for engagement.

8.6.2 Programme Structure and Roles

Developing a target delivery model is a critical first step for a deployment with clear roles and responsibilities. The proposed structure should seek to be as streamlined as possible, adopting a principle of centralisation. This structure might be influenced by the available models for centralised IT and Communications systems and therefore technical appraisals of options might be necessary as part of the decision process.

The process must however include relevant stakeholders such that any proposal is considerate of business impact, fair, and legal. In any inter-utility component of the service, there is potential for pushback from an industry which is not well used to cross-utility collaboration (in Northern Ireland). Appraisals should be objective and consider that centralisation of these services now paves the way for future, integrated system operation.

8.6.3 Service Specification

Government should be involved in the Smart Service specification design, like BEIS in GB, to ensure that the end-to-end service is delivered to the benefit of Consumers and society. First on the agenda should be the communication and IT systems which are the two components most likely to be delivered by a new inter-utility, centralised body. Given the time constraints on the gas DNOs, establishing this service should be the priority as not to place Consumer-side gas distribution at risk (due to the unavailability of meters once the supply contract ends).

Other areas of the service for specification include the meter and security which may be considered in parallel or sequentially as decided at the programme planning stage.

8.6.4 Regulation and Legislation

The energy sector is heavily regulated by the UR and the likely agents for delivering the programme, the DNOs, are regulated entities and subject to the UR’s price controls. It is imperative that early into the programme’s development, the UR makes pricing provisions to ensure that financing is available as the programme is delivered. The CBA demonstrates that a significant component of the capex, especially in an active rollout, is early in the programme.

Timely and considered legislation that supports the programme is critical to success, e.g. licensing changes, and data privacy policies. DfE should consider upfront what legislative changes are likely to be required and the timelines for their implementation. There is a component of risk associated given the recent absences of ministerial government in Northern Ireland.

8.6.5 Procurement

Following the design stage comes procurement. This is a medium-term stage of the programme beyond the scope of detailed consideration for this report.

8.6.6 Engagement Strategy

As highlighted across this report, Consumer engagement drives success in Smart Service deployment. It is critical that DfE, and the established programme bodies, develop an appropriate and active engagement strategy that is educational and transparent.

DfE itself recognises the criticality of the engagement process and advises that it would consider the strategy across the planning, design, and procurement stages.