Common evaluation methodology and tool

CLIENT: Energy Networks Association

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1 Introduction

1.1 Context

All the Distribution Network Operators (DNOs) in Great Britain have committed to 'market testing' potential flexibility solutions as an alternative means of releasing capacity compared to traditional asset reinforcement. In aggregate, DNOs have procured around several hundreds of megawatts of flexibility thus far. Each DNO has developed its own methodology for decision making, and there is currently a lack of standardisation of approach.

The development of a common evaluation methodology will provide transparency on how decisions are made to choose the most suitable solution to meet network needs (between traditional network asset solutions (reinforcement) and procuring flexibility services from generators, storage operators or demand side response. It addresses a key action outlined in the Ofgem and BEIS Open Letter to the Energy Networks Association (ENA)[1] in July 2019.

In October 2019, a joint workshop of the Electricity Regulation Group and Open Networks members committed to developing a common evaluation methodology (CEM) for network investment decisions, to be used by all DNOs from April 2021 for the remainder of RIIO ED1 and beyond. It was agreed that this work would be progressed within the Open Networks project under Workstream 1A (Flexibility Services). The CEM would be used to decide which intervention to procure to mitigate a reinforcement need, whether that be a flexibility service, an asset reinforcement or an alternative innovative solution.

The objective is to develop a standard approach for the DNOs and create greater transparency. In turn, this should provide greater visibility and confidence amongst flexibility providers and help stimulate volumes and competition in the market, ultimately reducing costs for network customers.

1.2 Scope of work

1.2.1 Purpose

The CEM and supporting Excel based tool (**CEM Tool v1.0**) will deliver consistency in how DNOs evaluate network investment options, and supports the ENA's wider goal to facilitate visibility and accessibility and ensure network operators conduct procurement in an open and transparent manner.

1.2.2 Scope of this report

This report contains a description of the framework and key areas that make up the CEM. Table 1 below sets out how the elements of the methodology come together.

The ENA has thus far defined four standard "Flexibility Products" that can meet specific network needs as defined by the ENA[2]). The CEM tool is built to enable DNOs to make investment decisions when

[1] https://www.ofgem.gov.uk/publications-and-updates/open-letter-ena-open-networks-project-ofgem-and-beis

[2] http://www.energynetworks.org/assets/files/ON-WS1A-Product%20Definitions%20Updated-PUBLISHED.pdf

comparing Flexibility Products to traditional network interventions. In the next section, we describe how the methodology and tool can be used to evaluate these Flexibility Products (Sustain, Secure, Dynamic, Restore), as well as options for alleviating export constraints where curtailment of renewables is occurring.

There is some functionality within the methodology and tool that all DNOs will be expected to use consistently through every decision, which is referred to in this report as "core functionality". There is some additional functionality built in the model that is optional for DNOs to use at this stage in time to guide their decision-making, which is referred to in this report as "sandbox functionality". We expect that the degree of commonality will increase over time, as determined by the ongoing governance arrangements, and some of this sandbox functionality may become core. Likewise, there may be greater standardisation of input assumptions across DNOs in the future.

Table 1 - Key areas of the CEM

Key area	Description
Options the model is set to consider	
Outlines the purpose of the methodology and the key use cases for DNOs to put the methodology and tool to use.	
Defining the service requirement	
Load growth scenarios	As DNOs are assessing their network needs, they will utilise a scenario or a set of scenarios to determine what their needs would be. These scenarios are key to determine the volume of flexibility required into the future.
Flexibility requirements	One of the main uses cases for the CEM is the evaluation of flexibility as a network option. There is specific functionality within the tool for DNOs to input their flexibility requirements into the evaluation of options. This can be tied to the load growth scenarios, or can be input manually.
Point of view of economic assessment	
Ofgem CBA	The tool is built on the basis of the Ofgem CBA tool for network investment decisions[3], and as such there is consistency between the tool built and used by DNOs today. There are a number of inputs and values that will remain consistent with the Ofgem CBA, and some areas of the methodology that have been updated as a part of the scope of this project.
Time horizon	The methodology sets out to analyse the discounted cash flow of each solution over the life time of an asset, or 45 years. The discounted cash flow will start at the beginning of the deferral period (given that an alternative solution would be used for the duration of the deferral period), and the discounted cash flow will extend for 45 years from the

[3] https://www.ofgem.gov.uk/ofgem-publications/47147/riioed1sconbusinessplans.pdf

Key area	Description
	end of the deferral period (given that the asset would be utilised fully from that point in time). There is a transition in the treatment of depreciation in ED1 with a gradual transition to 45-year asset lives, which is complete by 2022/23 but means that depreciation is different in each year. In ED2, this will stay at a 45-year asset life, and is how asset lives are treated within this tool.
Totex treatment	Within the Ofgem CBA, the sharing factor from the Totex Incentive Mechanism (TIM) is applied to all costs. The CEM tool will follow the Ofgem CBA template, and not explicitly include the impact of the TIM sharing factor in cash flows.
Assessment of network intervention options	
Costs	DNOs will input the appropriate costs across the baseline intervention and all alternative network intervention options for all [load growth] scenarios.
Value of reinforcement deferral	A key element of value within the alternative assessment is the value of deferring network reinforcement into the future. When comparing two potential solutions (a baseline and an alternative network intervention), in many cases the alternative solution will involve the option to defer the decision to reinforce the network to some point in the future, and use flexibility in the meantime. Through demonstrating the potential future value across a range of load growth scenarios, this methodology allows DNOs to explore the potential option value that is created in the future by decisions that they would make today. There is a facility within the tool to explore this option value further.
Wider network and societal impacts	The methodology considers some of the wider network and societal impacts of the different network interventions. This includes the impact of network losses, potential asset condition driven changes in CIs and CMLs, carbon emissions, and a range of other impacts measured in the original Ofgem CBA tool. Some of these are required for the core function of the model, and others are included as sandbox functionality for optional use.
Outputs	
The outputs from CEM tool include: • Table and charts showing, for each scenario and for a range of years, the benefit of flexibility at a specified price • Additional insights and reporting: Least Worst Regret and Weighted Average analysis • A table showing the maximum ('ceiling') flexibility price that could be justified given the benefits of deferral • Detailed CBA results for a given number of deferral years for a given scenario	

2 Options the model is set to consider

Consistent with the Ofgem CBA, DNOs must clearly identify the range of solution options that were considered to meet the specific network need. We consider the baseline [load growth] scenario to be that which involves the minimum level of intervention that would be required to remain compliant with all relevant security standards. For each investment decision, the DNO should clearly explain in supporting commentary boxes and tabs in the CEM tool, what assumptions have been used and which regulations the minimum level of intervention relates to, as well as any calculations that have been done external to the tool.

There are no direct benefits (i.e. avoided costs) accrued under the baseline [load growth] scenario and these cells have been blanked out in the CEM tool. Some of the wider and societal impacts will still be accrued under the baseline [load growth] scenario (e.g. losses, carbon) and these should be taken into account when calculating the baseline NPV. The NPV of each of the options identified within the CBA is compared against the Baseline NPV.

We have included a section in the CEM tool for DNOs to identify and clearly list the options they have considered for each investment decision. This list of options should include those that have been considered and rejected before full costing, and the shortlist of those options that have been considered and costed, with a clear rationale for including/excluding them, which is to be summarised (i.e. a few lines or bullets) in the comment box.

One of the primary use cases for this tool will be to evaluate investment in flexibility services. When utilising the methodology for flexibility, the model aligns with the standard definitions for flexibility products as defined by the ENA[4] and shown in Table 2 below. The methodology assumes that the flexibility products are compared to the baseline scenario of network investment.

The model is built as a cost and benefit comparison tool for all DNOs to utilise when making network investment decisions on an asset by asset level basis. Given that some network interventions will meet more than one network need, there may be a need to utilise multiple instances of the CEM tool to complete analysis across multiple network needs.

[4] http://www.energynetworks.org/assets/files/ON-WS1A-Product%20Definitions%20Updated-PUBLISHED.pdf

Table 2 - DNO Flexibility Products and Baselines

Service	Scheduled Constraint Management	Pre-Fault Constraint Management		Post-Fault Constraint Management	Restoration Support
		Manual	Automatic		
Flexibility Product	Sustain	Secure		Dynamic	Restore
Baseline	Reinforcement deferral				Customer Interruptions (CIs)/Customer Minutes Lost (CMLs)/Cost of stand-by generation

3 Defining the service requirements

3.1 Load growth scenarios

As a part of network planning processes, DNOs will have individual approaches to define load growth scenarios, and assess network needs against alternative scenarios.

As well as the Distribution Future Energy Scenarios (DFES)[5] developed by each DNO, they may also have a best view, in some instances called the 'Central Scenario'.

For all flexibility products that have network reinforcement as their baseline[6], these scenarios provide DNOs with a view of what the annual exceedance of the particular asset that is under assessment (i.e. the amount by which electricity flows will exceed capacity), will be for a particular asset across a range of potential outcomes. There are a number of inputs that are required to determine the timeframe and windows for the decision being made. The "current year" is the year in which the decision to reinforce needs to be taken. Within the input section of the tool, DNOs will manually input the current maximum capacity for the asset (e.g. 30 MVA) and the forward-looking peak network load across the range of scenarios that are being considered within the tool. Peak load is then compared to the current asset capacity to determine the exceedance per year per scenario.

If the use case does not include reinforcement deferral (e.g. using flexibility to reduce CI/CML risk), the user can disable the model logic relating to network exceedance. The user then inputs the flexibility requirements and the Societal Impacts manually.

3.2 Flexibility requirements

For all use cases where DNOs will be evaluating flexibility as a network intervention option, they will be required to input the annual flexibility requirements (MVA) per year per scenario. The model assumes that enough flexibility is procured to cover both the exceedance and any over-procurement required. The user specifies the over-procurement factor (e.g. 10%) which, conceptually, addresses two sources of uncertainty: uncertainty over the peak network load forecast, and uncertainty around the reliability of delivery by the flexibility providers.

There are two options for inputting the required flexibility volume:

1. **Automatic:** The model assumes that flexibility volume is procured to cover the exceedance and the over-procurement factor, or
2. **Manual:** The user specifies the flexibility volume.

In addition, the user needs to input manually, for each scenario and year, the following:

- The number of hours per day the flexibility service will need to be available
- The number of days per year the flexibility service will need to be available
- The number of dispatch (utilisation) events expected each year, and
- The average dispatch (utilisation) duration in hours.

[5] https://www.energynetworks.org/assets/files/WS1B%20Product%202%20Scenarios%20Publication%20Timeline.pdf

[6] The differences for other flexibility use cases have been explained in Table 3.

The user also specifies the proportion of available flexibility they expect to utilise on average. For example, if 1MW of flexibility is available, the DNO may only dispatch only 0.2MW of that flexibility when the exceedance is small, but up to 1MW when the exceedance is at its maximum. This will depend on the way in which the DNO dispatches these assets, and whether there is a non-zero utilisation cost associated with doing so.

There is an empty tab within the model for DNOs to include any justification and/or assumptions around the external calculations for availability and utilisation that are used within the model.

4 Basis of economic assessment

4.1 Standard inputs

The tool that has been developed is built to replicate how costs and benefits are realised by DNOs through the price control framework. As such, it is largely based on the Ofgem CBA tool, and as this framework evolves, the CEM tool should evolve as well.

There are a number of inputs and values that will remain consistent with the original Ofgem CBA, and a few key areas of the methodology that have been updated as a part of the scope of this project.

The standard inputs from the Ofgem CBA that this methodology uses are listed in Table 3. The non-standard inputs (e.g. costs, wider and societal impacts) are explained in detail in Section 5.

Table 3 - Standard inputs from Ofgem CBA

Input	Description
Customer Interruptions (CIs)	In order to evaluate certain asset condition related impacts of network interventions and also to evaluate the 'Restore' flexibility product there is a need to quantify and value CIs. The CEM tool utilises the Ofgem standardised value of £s per interruption. DNOs are able to manually insert the number of interruptions into the tool.
Customer Minutes Lost (CMLs)	In order to evaluate certain asset condition related impacts on network interventions, there is a need to quantify and value CMLs. The CEM tool will utilise the Ofgem standardised value of £s per minute lost. DNOs will be able to manually insert the number of minutes lost into the tool.
Weighted Average Cost of Capital (WACC)	This value will be unique to each DNO, and is used to convert capital costs into annual costs using each individual DNO's cost of capital.
Discount rates	As defined by the Treasury's Green Book[7], this model uses the Social Time Preference Rate (STPR) of 3.5% (less than or equal to 30 years); 3% (greater than 30 years) to discount all costs and benefits, except safety where the Health Discount Rate (HDR) of 1.5% (less than or equal to 30 years); 1.2857% (greater than 30 years) should be used.
Losses value	Where expenditures are justified using the reduction of electricity lost, we have utilised the standardised value for £/MWh lost used within the Ofgem CBA, which is based on average wholesale electricity prices in 2016/17 less the EU Emissions Trading Scheme (ETS) cost of carbon - which we are stripping out of the wholesale price, given carbon is reported separately, as described below.

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

Input	Description
Carbon prices	In order to calculate the cost of carbon associated with losses, the CEM tool utilises the BEIS traded carbon price[8] (in line with the Ofgem CBA). The CEM tool remains consistent with the Ofgem CBA to quantify carbon emissions that result from network losses. This is included as core functionality within the tool, but explicit consideration of carbon emissions of alternative network interventions is included within the sandbox functionality.
Cost per injury/fatality	In some use cases, DNOs may need to quantify benefits associated with reducing or preventing fatalities and injuries. The treatment in the CEM is consistent with the Ofgem CBA and requires DNOs to draw on guidance set out in HM Treasury Green Book[9] and the HSE[10]. However, for the purpose of evaluating flexibility solutions there is no expectation that these sort of inputs would be required for the analysis.
CPIH Index	The tool utilises the CPIH index[11] in line with the Ofgem CBA.

4.2 Time horizon

The methodology sets out to analyse the discounted cash flow of each solution over the life time of an asset, or 45 years. The discounted cash flow will start at the beginning of the deferral period (given that an alternative solution would be used for the duration of the deferral period), and the discounted cash flow will extend for 45 years from the end of the deferral period (given that the asset would be utilised fully from that point in time).

There is a transition in the treatment of depreciation in ED1 with a gradual transition to 45-year asset lives, which is complete by 2022/23 but means that depreciation is different in each year. In ED2, this will stay at a 45-year asset life, and is how asset lives are treated within this tool.

4.3 Totex treatment

Within the Ofgem CBA, the sharing factor from the Totex Incentive Mechanism (TIM) is applied to all costs. The CEM tool follows the Ofgem CBA template, and does not explicitly include the impact of the TIM sharing factor in the evaluation logic, since the TIM is applied equally to the different solution options.

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48184/3136-guide-carbon-valuation-methodology.pdf

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

[10] https://www.hse.gov.uk/economics/eauappraisal.htm

[11] https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/l522/mm23

5 Assessment of options

5.1 Costs

5.1.1 Baseline costs

In order to evaluate the costs and benefits of different network options, the model requires DNOs to input the costs of the baseline [network] intervention. It is assumed that the baseline will usually involve asset reinforcement, but the user can specify other costs (e.g. those associated with losses, CI/CMLs or carbon emissions), provided they can be deferred (or avoided) through the use of flexibility.

5.1.2 Alternative intervention costs

In the assessment of the alternative interventions, input values should reflect the cost to the DNO of the alternative solution that is being assessed. In the case of flexibility, the user can either specify the volume and unit cost of flexibility being assumed, or can input the volume of flexibility required and allow the model to find the maximum price of the flexibility solution, beyond which it is no longer cost effective to defer the reinforcement (i.e. a net cost benefit of zero).

5.2 Value of reinforcement deferral

The value of the Secure, Sustain and Dynamic flexibility products is primarily derived from the time value of money from deferring large capex expenditure associated with network reinforcement. The CEM tool compares the Net Present Value (NPV) of discounted cash flows of the baseline (reinforcement scenario) with the alternative (flexibility solution) scenario. The CEM tool provides a view of the potential outcomes in terms of NPV for each set of forward-looking load growth scenarios. The outcomes of this analysis are demonstrated below in Figures 1 and 2.

Figure 1 - Discounted cash flow charts - baseline vs best view

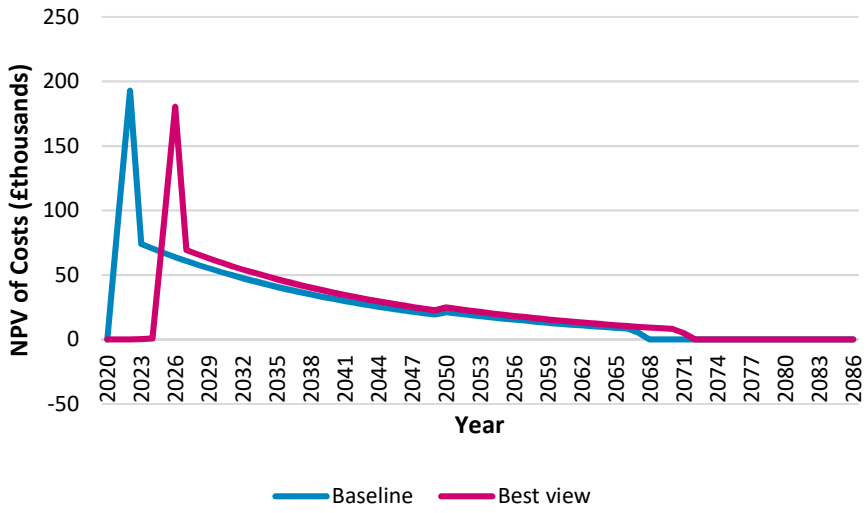
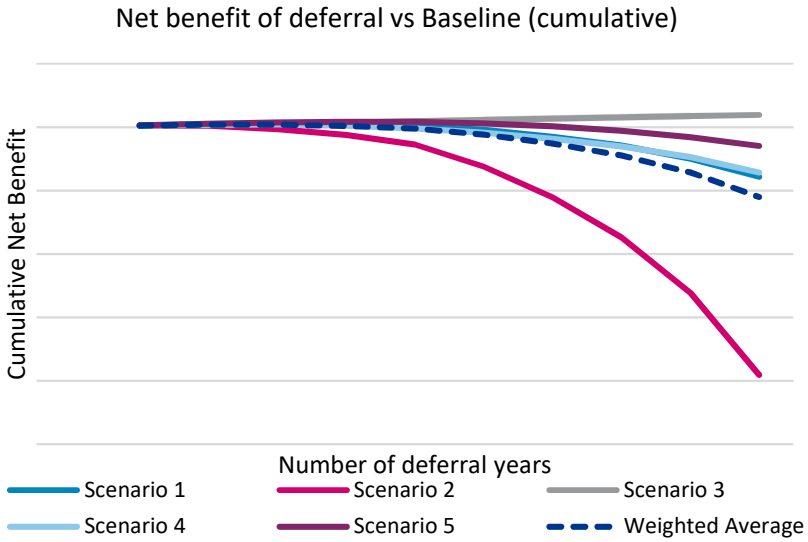


Figure 2 - Net benefit of reinforcement deferral vs the baseline (cumulative)



Through demonstrating the potential outcomes across a range of scenarios, this methodology allows DNOs to explore the potential option value that is created in the future by decisions that they would make today. There is functionality within the CEM tool that enables DNOs to further explore this option value, by applying probabilities to each load growth scenario, basing decisions on an expected result rather than a single scenario. In following this probabilistic approach, DNOs are able to better understand what future option value they might be able to access through an investment decision made today, or to be used as a part of a lowest expected cost strategy. However, applying probabilities to scenarios involves a degree of subjectivity which needs to be recognised.

In the core functionality of the model, DNOs input the number of years of reinforcement deferral that is possible through flexibility solutions. There is an additional option within the sandbox functionality that provides a view of the optimal number of years of deferral based on network costs across the range of scenarios.

5.3 Wider network and societal impacts

5.3.1 Impact on losses

Different network interventions will have an impact on the amount of electricity lost whilst transporting through the network. The tool accounts for this by utilising the value that is standardised and set by Ofgem in £/MWh, and allowing for DNOs to manually input the volume of losses that they would face with the specific network intervention that is being assessed. The Ofgem input for the £/MWh losses is included in the fixed inputs tab.

DNOs are required to input the expected reduction in losses for the baseline scenario as well as all alternative scenarios. The change in expected losses is therefore factored into the assessment of alternative flexibility solutions.

5.3.2 Impact on asset health

In some cases, asset condition related replacement will need to happen. It is assumed that reinforcement cannot be put off indefinitely, and as such the model allows for reinforcement deferral to be limited to a specific date, at which point it will be assumed that flexibility is no longer an option and reinforcement occurs.

DNOs can choose whether to use this functionality within the model, depending on the circumstance. They can do so by inputting the date that condition related replacement would be required.

In other cases, there is an option in the model for when DNOs would want to do a like for like asset replacement at some point in the future. There is no calculation captured within the model to quantify the CIs and CMLs, and it was agreed that DNOs would work together in parallel to agree a common approach to quantifying this.

In order to quantify CIs and CMLs (in the method appropriate for the use case being considered, as explained in Table 4), DNOs are expected to manually input the CIs and CMLs that are associated with asset reinforcement into this section of the model. To account for this, there is a placeholder in the model for DNOs to account for the increase in CIs and CMLs that would be expected from not reinforcing early on, and instead reinforcing down the line. The CEM tool captures the time period between the baseline (reinforcing early) and the alternative (reinforcing down the line), and can account for the increase in CIs/CMLs between the two. The value of CIs/CMLs is based on the Ofgem values.

In some specific cases, there will be an interaction between network reinforcement and asset replacement activities that should be reflected in the model. There may be some instances in which qualitative judgments are made as to how to plan network reinforcement in a coordinated way. These instances would be limited to exceptional cases (e.g. larger, more complex reinforcement programmes) and should be documented clearly, demonstrating how and why the approach might deviate from a standard reinforcement approach. The guidance on how to document this would be to first complete a check on whether the asset needs replacing in the near future. If so, complete a check on the benefits of reinforcing at the same time. This analysis would be completed in parallel to the commercial analysis, and recorded for transparency and completeness.

Whilst the interaction between reinforcement and replacement can be complex, the model allows aspects to be represented quantitatively, as discussed below.

5.3.3 Carbon emissions

The CEM tool remains consistent with the Ofgem CBA to quantify carbon emissions that result from network losses. This is included as core functionality within the tool.

The option for DNOs to explicitly include the carbon value of different network solutions is included as sandbox functionality in the tool. In some use cases, there may be additional carbon emissions from alternative network interventions (e.g. using a diesel generator for flexibility). There is a series of manual input options for DNOs to incorporate into the model at a point in time when there is an agreed methodology for DNOs to follow when quantifying carbon emissions of different network interventions.

5.3.4 Other societal impacts

There is a range of other societal impacts that are included in the Ofgem CBA template, and captured in the CEM tool. These are unlikely to be affected by the choice of network solution, and hence are not expected to be used. However, there is an empty tab within the model for DNOs to include any justification and/or assumptions around the external calculations for all societal impacts where appropriate.

5.4 Key differences in assessment of options

Through discussions with DNOs, there is an understanding that the primary use case for this methodology and tool will be for DNOs to compare traditional network investment to the use of Flexibility Products where network reinforcement would be the baseline scenario (i.e. the Sustain, Secure and Dynamic Flexibility Products). As such, the methodology and report have been developed with this in mind. However, this methodology and tool can also be used to test alternative investment use cases, such as the Restore Flexibility Product, and alternatives for managing export constraints/curtailment. The differences in the ways that these examples would be applied to the methodology have been explained in Table 5 below.

Table 4 - Additional use cases for CEM methodology

Use Case	Key differences in application of methodology

Flexibility – Sustain, Secure and Dynamic products
Using flexibility to defer network reinforcement
	• Base case is reinforcement, triggered by, for example:
	  ○ Expected demand growth in an import-constrained area
	  ○ Expected net export growth (e.g. fall-off in local I&C demand) in an export-constrained area.
	• Model allows up to 5 network load growth scenarios to be tested
	• Model shows the benefit of deferring that reinforcement by procuring flexibility for 1 or more years, along with associated benefits (e.g. losses, carbon, CI/CML)
	• User specifies the flexibility that would need to be procured to achieve each year of deferral
	• Output shown in two ways:
	  ○ ***Net benefit of deferral*** by n years given a pre-specified flexibility price (availability and utilisation). User can see both the benefit of deferring **by n years** and the benefit of deferring by **each additional year**
	  ○ ***Maximum flexibility price*** that can be justified by reinforcement and associated costs/benefits. Again, this can be seen as the maximum price for, say, a 3-year contract, or the maximum price that can be justified in the 3rd year of deferral.

Flexibility – Restore product *Using flexibility to manage the re-energisation of the network, reducing the number and duration of customer interruptions*	• The key difference for the Restore product is that the counterfactual/baseline scenario is the cost of CIs/CMLs and/or the cost of stand-by generation, rather than the cost of network reinforcement • Because this product does not relate to network reinforcement, there is no input required into the load growth scenarios • Manual inputs would be required to determine the flexibility requirements, because the flexibility requirements are not driven by the network asset exceedance • There would be zero capex for the baseline approach • For CIs/CMLs inputs – there are two approaches the user could take 1) input zero for the baseline and the incremental change in CIs/CMLs in the alternative, or 2) input the absolute number of CIs and CMLs in the baseline and alternative

Use Case	Key differences in application of methodology
Flexible connections – current charging regime *Generators connecting to export-constrained networks incur reinforcement costs up to 2 voltage levels above the point of connection, but the DNO incurs any additional costs. The assumption is that this would be facilitated through ANM, where ANM curtails export at network peak loads, allowing faster and cheaper connections*	• The CEM tool should only be used to evaluate options against the DNO's share of reinforcement costs • The baseline is network reinforcement, driven by an export constraint and the connection of exporting assets (e.g. Distributed Generation or batteries) • The user will need to enter the revised DNO-attributable reinforcement cost profile under the ANM scenario(s) • All other inputs within the model would remain the same, assuming that the TIM would be applied in the same way.
Flexible connections – shallow charging regime *As above, but assume the DNO incurs all reinforcement costs above Point of Connection, and has to compensate for curtailment*	• As above, except for the following changes: ○ DNO incurs more/all reinforcement costs in the baseline and (if any) in the ANM scenario ○ DNO incurs flexibility costs corresponding to the expected bids for curtailment.
Future technology (e.g. dynamic network reconfiguration)	• The CEM tool is able to accommodate any consideration of future technology applications, and provides options for users to input the appropriate costs into the CEM tool.

6 Outputs

6.1 Results

The CEM tool displays results in four ways:

1. **Benefit by strategy:** For a given set of baseline costs, and a user-specified cost of flexibly (availability, utilisation and annual fixed cost), the model shows the net benefit of the flexibility solution over the baseline.
2. **Insights and Reporting**: As well as providing a summary tables relating to the ***Benefit by strategy*** results, additional analysis is also provided to allow comparisons of strategies across different scenarios. Two types of analysis are carried out: ***Least Worst Regret*** and ***Weighted Average Benefit***.
3. **Ceiling price:** For a given set of baseline costs, the model shows the maximum cost of the flexibility solution before it becomes less economic than the traditional asset solution.
4. **Summary CBA:** Although not a key output, the user can inspect the detailed CBA calculations being carried out by the tool.

Appendix A Consultation issues raised

A.1 Purpose and use case for the CEM

The focus of the product is to standardise the approach that DNOs will follow when assessing network options and make it transparent to stakeholders. The DNOs are the users of the tool, and will use the CEM to analyse various network options (e.g. flexibility, ANM).

A.2 Consideration of option value within the CEM

We discussed as a group a range of options for incorporating option value into the CEM. Ultimately we landed on an approach that balances simplicity, consistency and use of data available across all of the DNOs.

It was noted in a number of the responses to the Flexibility consultation that the CEM tool does not calculate the "option value" associated with flexibility solutions. There were concerns that, as a result, the value of flexibility would not be adequately reflected by DNOs. One of the advantages of using flexibility as opposed to conventional reinforcement is that, after the initial flexibility contract has expired, the DNO has the option to procure further flexibility, to reinforce, or to pursue some other strategy. By contrast, if a DNO initially reinforces the network, these subsequent options are no longer available.

Whilst it is true that option value is not calculated directly, the CEM tool does provide DNOs with the ability to test the benefit of using flexibility across a range of market scenarios. The optimal path will depend on which market scenario outturns, which cannot be known from day 1. Previous Cost Benefit Analysis tools used by the DNOs have tended to focus only on one central scenario – an approach that does not show how well an initial flex vs reinforcement decision stands up if future network load growth is faster or slower than initially anticipated.

In order to address some of the concerns raised in the consultation responses, we have done two things:

1. We have adjusted some of the NPV calculations to show more clearly that the value of flexibility extends beyond the initial contract, even where the initial procurement is of a short duration e.g. 1 year, and

2. We have expanded the Insights and Reporting tab, and adjusted the Ceiling Price calculations in order to show how a DNO might think about flexibility in the context of scenario uncertainty.

We highlight some of the key reporting metrics from the tool in more detail here.

- **Recap of overall logic:** The primary Use Case for the tool assumes that peak load is approaching network capacity and that, conventionally, reinforcement is required on that part of the network (this forms the Baseline strategy). The model assumes that flexibility can be used to defer that reinforcement by managing the exceedance, e.g. through Demand Side Response. In addition, there may be other secondary impacts on, for example, losses, outages or emissions. The tool cycles through different flexibility contract lengths and reports the NPV of that strategy (e.g. x-years flexibility contract) vs the Baseline reinforcement strategy.

- **Distinguishing between the immediate value of deferred reinforcement vs the residual value:** We have adjusted the way in which NPVs are reported, particularly where the model is considering shorter contract lengths. For example, if under a given scenario the optimal strategy is to defer reinforcement for 3 years (after which the cost of flexibility outweighs the value of deferred reinforcement), what is the value of a 1-year flexibility contract? We report this in three parts:

    1. Value locked in by the initial strategy decision: i.e. in the example above, this is simply the immediate value of deferring reinforcement by 1 year
    2. Residual value that can be secured after the initial strategy decision: Having done 1 year of flexibility, this enables the DNO to do a further 2 years of deferral – this is the "residual value" of this initial flexibility decision
    3. Total value of the strategy: This is the sum of elements 1 and 2.

    Note that under this framework, even if it makes sense under a given scenario to defer for a large number of years, the optimal strategy will often be to procure a short flexibility contract. Because we are accounting for the residual value, such short contracts do adversely affect the total value secured. If, however, longer flexibility contracts can be secured at a lower price (an option which the tool allows the user to examine) these longer contracts may be optimal.

- **DNO decision-making using CEM tool results:** The purpose of the CEM tool is to provide consistency in the way that DNOs assess flexibility options. It is not, however, intended to result in a completely standardised decision-making process. That said, the Insights and Reporting tab has been expanded to facilitate this decision-making. In particular, we highlight that a Least Worst Regrets analysis has been added to the tool, along with the ability to combine scenarios on a Weighted Average basis. These may help a DNO to consider the merits of different contracting options in the light of the scenario uncertainty.

- **Ceiling Price calculation and the value of flexibility under uncertainty:** As noted above, the CEM tool does not explicitly calculate option value. However, that is not to say that it cannot be used to account for the value of uncertainty. For example, if the tool is used to consider just a Central ("Best View") load growth scenario, the Ceiling Price tab can be used to indicate what the maximum total price for which flexibility is viable (vs conventional reinforcement). We note that by expanding the analysis to consider multiple scenarios (centred around the Best View) increases that maximum total price under both the LWR and the Weighted Average approaches. The reason for this is that the analysis accounts for the fact that flexibility has very high value in scenarios in which load growth does not materialise – something that the Best View case does not reveal. There can be considerable value in delaying a reinforcement decision by one or two years if it keeps open the option of delaying reinforcement for a longer period under such a scenario, or avoiding it altogether.

A.2.1 Next steps on option value

This approach is considered appropriate by all the DNOs and Ofgem through engagement on the project as the right starting place for considering option value within the methodology, which will be built upon as we move into 2021.

A.3 Applying the CEM to ANM

It should be noted that this CBA tool is deliberately designed to give the DNO's perspective on its costs and benefits. It is not intended to account for the costs and benefits of a connecting party, for example.

If a customer wishes to connect to a DNO's network, some of the costs of connecting that customer are paid by the connecting party, and some are paid by the DNO. In additional to conventional connection offers, DNOs are increasingly offering Flexible Connections which may include some ANM costs, some reinforcement costs (although smaller than for the conventional connection offer) and an obligation on the connecting party to accept curtailment when the network is constrained.

As with conventional connection, under Flexible Connections there are certain costs that are covered by the DNO rather than the connecting party. These are defined in the as per the Common Connections Charging Methodology (CCCM), and are summarised in Table 1.

Table 5 CCCM cost recovery associated with Flexible Connections

Typical connection components[1]	Type 1A - Single	Type 1B – Multiple	Type 2 – Wide Area
Extension Assets for customer	You fund	You fund	You fund
End user control unit for the customer	You fund	You fund	You fund
Local system management unit	You fund	Shared equally between participants	We fund
Scheme management unit	You fund	Shared equally between participants	We fund
Central management unit	N/A	N/A	We fund
Scheme specific ongoing costs e.g. communications	We fund	We fund	We fund

The DNO can use the CEM CBA tool in a number of ways.

A.3.1 DNO's costs under conventional vs ANM connections

A DNO can use the CBA tool in order to determine the costs and benefits of offering a conventional connection or a flexible connection. Using the CEM CBA tool, the user can determine which strategy (conventional or ANM) yields the highest NPV for the DNO over the whole modelling horizon. Further details for implementing this Use Case can be found within the User Guide embedded in the CEM CBA tool itself.

A.3.2 Using flexibility to avoid connection-related reinforcement

This use case could apply for either conventional or flexible connections. As mentioned above, when a customer connects to a DNO's network, some network reinforcement can be required. The DNO incurs some of the costs associated with that reinforcement. The DNO can use the CBA tool to determine whether it makes sense to avoid or defer that reinforcement through the use of flexibility contracts. This could equally be applicable to conventional or ANM connections, although the reinforcement cost is typically higher in conventional connections.

This use case is no different from the normal flexibility use case except for the fact that ***only the DNO*** share of reinforcement costs is included, rather than the total cost that would be typically included for general reinforcement. Again, the User Guide embedded in the CEM CBA tool includes further details on how to implement this Use Case.

A.3.3 Other possible ANM use cases

It may be possible to use the CEM CBA tool to examine other use cases related to ANM, but a number of those being considered involve accounting for the costs associated with the connecting party. By design, this tool has a DNO lens (with accounting treatment that is specific to the DNOs). Regulations around network access and charging could change in the future, which may change the costs and risks attributable to the DNOs. This could increase the number of use cases for which this tool is suitable, for example addressing:

- Whether it is cheaper for the connecting party to face the opportunity cost of curtailment under ANM or instead to manage the constraint by procuring flexibility services or enacting a local flexibility market.
- Whether the levels of curtailment being faced by ANM customers justifies the reinforcement of a network to alleviate the constraint.

In both these examples, the opportunity cost of curtailment is an important factor, but is one not faced by the DNO. As noted above, these use cases could be addressed through the CEM tool if this were changed by regulatory reforms.

A.3.4 Other associated Open Networks project products

Product 4 within Workstream 4 of the Open Network project is currently developing a Whole System CBA. This product has the potential to consider a range of costs and benefits across multiple parties and so could be an evaluation tool for considering the implications for solutions outside of the single DNO lens that the CEM tool has been developed for.