CEM and Whole System CBA Interactions Report

Open Networks

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The voice of the networks

DOCUMENT CONTROL

Authorities

Version	Issue Date	Authorisation	Comments
1.0	21/4/2022	Open Networks Steering group	

Related documents

Reference 1	Common Evaluation Methodology User Guide
Reference 2	Whole Systems CBA User Guide

Change history

Version	Description
0.1	Draft WS1A P1 (Common Evaluation Methodology) and WS4 P1 (Whole Systems CBA) Interactions report

Distribution

Published on ENA website

Contents

Introduction

About ENA

Energy Networks Association (ENA) represents the owners and operators of licenses for the transmission and/or distribution of energy in the UK and Ireland. Our members control and maintain the critical national infrastructure that delivers these vital services into customers' homes and businesses.

ENA's overriding goals are to promote UK and Ireland energy networks ensuring our networks are the safest, most reliable, most efficient and sustainable in the world. We influence decision-makers on issues that are important to our members. These include:

- Regulation and the wider representation in UK, Ireland and the rest of Europe
- Cost-efficient engineering services and related businesses for the benefit of members
- Safety, health and environment across the gas and electricity industries
- The development and deployment of smart technology
- Innovation strategy, reporting and collaboration in GB

As the voice of the energy networks sector, ENA acts as a strategic focus and channel of communication for the industry. We promote interests and good standing of the industry and provide a forum of discussion among company members.

About Open Networks

Our Open Networks programme is transforming the way our energy networks operate. New smart technologies are challenging the traditional way we generate, consume and manage electricity, and the energy networks are making sure that these changes benefit everyone.

ENA's Open Networks programme is key to enabling the delivery of Net Zero by:

- opening local flexibility markets to demand response, renewable energy and new low-carbon technology and removing barriers to participation
- providing opportunities for these flexible resources to connect to our networks faster
- opening data to allow these flexible resources to identify the best locations to invest
- delivering efficiencies between the network companies to plan and operate secure efficient networks

We're helping transition to a smart, flexible system that connects large-scale energy generation right down to the solar panels and electric vehicles installed in homes, businesses and communities right across the country. This is often referred to as the smart grid.

The Open Networks programme has brought together the nine electricity grid operators in the UK and Ireland to work together to standardise customer experiences and align processes to make connecting to the networks as easy as possible and bring record amounts of renewable distributed energy resources, like wind and solar panels, to the local electricity grid.

The pace of change Open Networks is delivering is unprecedented in the industry, and to make sure the transformation of the networks becomes a reality, we have created six workstreams under Open Networks to progress the delivery of the smart grid.

2022 Open Networks programme Workstreams

- WS1A: Flexibility Services
- WS1B: Whole Electricity System Planning and T/D Data Exchange
- WS2: Customer Information Provision and Connections
- WS3: DSO Transition
- WS4: Whole Energy Systems
- WS5: Communications and Stakeholder Engagement

Our members and associates

Membership of Energy Networks Association is open to all owners and operators of energy networks in the UK. Companies which operate smaller networks or are licence holders in the islands around the UK and Ireland can be ENA associates too; giving them access to the expertise and knowledge available through ENA. Companies and organisations with an interest in the UK transmission and distribution market are now able to directly benefit from the work of ENA through associate status.

ENA members

Cadent Your Gas Network	electricity north west Bringing energy to your door	ESB NETWORKS	gtc
nationalgrid	nationalgridESO	Northern Gas Networks	Northern Ireland Electricity Networks
NORTHERN POWERGRID	Scottish & Southern Electricity Networks	SGN Your gas. Our network.	SP ENERGY NETWORKS
UK Power Networks Delivering your electricity	WALES&WEST UTILITIES	WESTERN POWER DISTRIBUTION Serving the Midlands, South West and Wales	

ENA associates

- Chubu
- EEA
- Guernsey Electricity Ltd
- Heathrow Airport
- Jersey Electricity
- Manx Electricity Authority
- Network Rail
- TEPCO

Executive Summary

Since its inception in 2017 the ENA Open Networks Project has strived to bring standardisation, through collaboration, to the work undertaken day in and day out across the electricity and gas energy sector. There are numerous examples where the Project has delivered commonality, transparency and clarity but one of the most important has been around making clear, transparent and consistent decisions.

In the last two years the ENA Open Network Projects has shown significant leadership by developing two key cost benefit analysis tools. Under Work Stream 1A (Flexibility Services) a Common Evaluation Methodology and associated Tool has been created that allows the user (primarily distribution network operators) to evaluate flexible and non-flexible solution options and provide information and insights to the user for deciding on the appropriate solution. Whilst in Work Stream 4 (Whole System) a whole system CBA has been developed that allows the user to evaluate a range of options from a whole systems perspective.

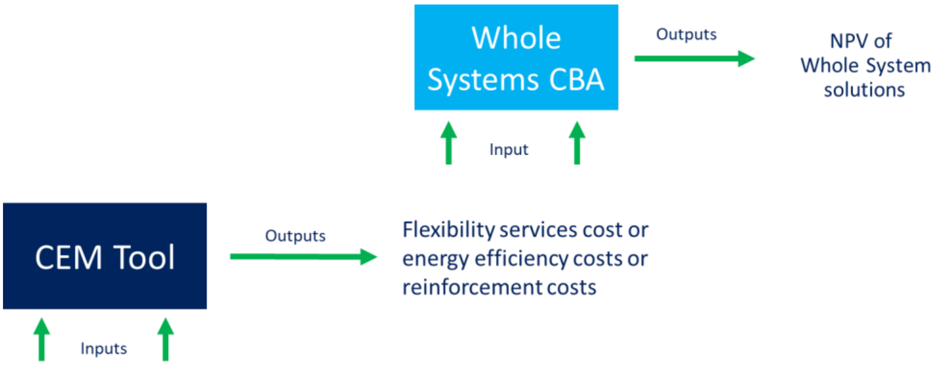
By design these two tools, although developed by different Product teams, have been created in parallel with the same consultancy support and the two Product teams working collaboratively to ensure that the underlying methodologies are consistent and in lock step.

At various times through their creation both Product teams have had similar questions on the uses of the two evaluation tools, their overlap and interactions and independencies. This report has been written to clarify the similarities, differences and interactions between the two evaluation tools.

The table below summaries the key features of the two evaluation tools:

	Scope of costs analysis	Scope of benefits analysis	Evaluation methodology	Primary use case	Outputs
Common Evaluation Methodology Tool	DNO costs only	DNO benefits only	Built on the Ofgem CBA template with fixed parameters	Evaluates flexibility services	Financial analysis of each solution, including optimal contract period, ceiling price and option value
Whole Systems CBA	A range of licensee and third-party costs	A range of licensee and third-party benefits	Built on the Ofgem CBA template with ability to vary fixed parameters	Evaluates a whole system problem	Financial analysis of each solution, including sensitivity analysis, tipping points and distributional impacts

In summary the two tools are built around the Ofgem CBA framework and users will see that there are even similarities in the way the tools are structured in the Excel workbooks. The CEM Tool is designed to be used solely by distribution network operators to aid decision making about network intervention solution; whereas the Whole Systems CBA is a tool for considering a problem through a whole system lens. The two tools can be used in conjunction with the output from the CEM Tool being used as an input to the Whole Systems CBA, as shown in the flowchart opposite.



The two Product teams have considered whether the two tools should be combined into one and have decided against it due to the resulting complexity of the model. The Product teams will continue to work collaboratively to ensure that the underlying methodologies and techniques are consistent where appropriate.

Context

Since its inception in 2017 the ENA Open Network Projects has shown significant leadership by developing and publishing analysis and information on transition to a smart and flexible energy system. In the last few years the ENA Open Networks Project has led the development and use of two key cost benefit analysis tools. Under Work Stream 1A (Flexibility Services) a Common Evaluation Methodology and associated Tool has been created that allows the user (primarily, distribution network operators) to evaluate flexible and non-flexible solution options and provide information and insights to the user for deciding on the appropriate solution. Whilst in Work Stream 4 (Whole Systems) a whole system CBA has been developed that allows the user to evaluate a range of options from a whole systems perspective.

By design these two tools, although developed by different Product teams, have been created in parallel with the same consultancy support and the two Product teams have worked collaboratively to ensure that the underlying methodologies are consistent and in lock step. But in their development both Product teams have had similar questions on the uses of the two evaluation tools, their overlap and interactions and independencies; plus there has been many questions on why should the tools not be combined into a single evaluation tool.

This report has been written to clarify the similarities, differences and interactions between the two evaluation tools. It provides summaries of each of the evaluation tools which draw out the similarities, differences and interactions. In addition, we provide in Annex 1 a review of the Ofgem Cost Benefits Analysis evaluation tool as both the Common Evaluation Methodology and Whole Systems CBA tools have been developed using the framework and methodological approach in the Ofgem tool.

Common Evaluation Methodology

Background

Collectively Britain's distribution network operators (DNOs) have agreed to make flexibility the first option when seeking solutions for all new projects of significant value. This was formalised in December 2018 when the ENA's Flexibility Commitment was launched, and all signatories committed to openly test the market to compare relevant network reinforcement and market flexibility solutions.

In July 2019 the ENA followed up their earlier announcement with additional guidance on the next steps required. The booklet titled "Our six steps for delivering flexibility services" detailed plans and commitments to continue working extensively and inclusively with stakeholders, sharing our flexibility developments, and listening to wide reaching feedback.

The six steps identified were selected to ensure consistent, tangible processes, procedures and agreed working methodologies by all participating electricity networks through the ENA Open Networks Project. These were:

1. Champion a level playing field
2. Ensure visibility and accessibility
3. Conduct procurement in an open and transparent manner
4. Provide clarity on the dispatch of services
5. Provide regular, consistent and transparent reporting
6. Work together towards whole energy system outcomes

Through the ENA Open Networks Project work progressing under Workstream 1A (Flexibility Services) is helping meet these commitments.

Throughout RIIO-ED1 distribution network operators have been experimenting with purchasing demand side response and flexibility instead of reinforcing the distribution network as part of their commitment to 'market test' network intervention solution options fulfilling obligations in the Smart Systems and Flexibility Plan.

In the 2020 Open Networks' Project Initiation Document it was identified that there was need to develop a common methodology for the evaluation of network intervention solution options to provide a consistent approach. That year a Product team was created and with support from Baringa they developed a Common Evaluation Methodology (CEM). At the end of 2020 the ENA Open Networks Project delivered a first version of the CEM and associated Tool (Excel workbook). These were published alongside a User Guide, Worked Examples and a 'How to use video' on the ENA website.

From April 2021 all DNOs committed to using the CEM to evaluate flexibility, a significant milestone in the flexibility journey. This allowed the user to assess the viability of flexible vs non-flexible (i.e. conventional network reinforcement) options to meet their existing and future network needs.

The CEM and Tool was well received by stakeholders and suggestions were made on how the tool could be further enhanced; these included 1) the need for show the option value (especially under conditions of load growth uncertainty) and 2) an expansion on the calculation of carbon impact assessment (i.e. making the inputs and calculations more explicit and standardised).

This feedback was incorporated into the scope for 2021 and the outcome/deliverable being the publication of the second version of the CEM and Tool in January 2022. In early 2022 we have consulted on the changes made in 2021, seeking to clarify, enhance and/or expand the CEM where required as guided by our stakeholders.

The CEM and Tool are live documents and will continue to evolve.

Purpose of the tool

This primary use case for the CEM and Tool is to allow GB distribution network operators to assess, in a consistent way, the viability of flexibility service vs conventional network reinforcement options to meet their existing and future network needs.

Although the primary purpose of the tool is to allow the user to assess the merits of deferring network reinforcement by employing flexibility solutions for one or more years, it can be used for evaluating a range of intervention options. For example, the User Guide contains the four use cases of:

Use Case 1: Flexibility for reinforcement deferral

Use Case 2: Flexibility for incentive related improvement

Use Case 3: Energy efficiency to defer reinforcement, and

Use Case 4: Active Network Management.

The CEM Tool has been developed around the Ofgem Costs Benefits Analysis (CBA) model within an Excel Workbook for ease of use. However, the CEM Tool is fundamentally an evaluation tool to aid decision making as it allows the user to test different flexibility strategies under different load growth scenarios, whilst providing insights that should help the user to make strategic decisions when uncertain about which network load growth scenarios will outturn.

Inputs needed to operate the tool

For the primary use case of flexibility for reinforcement deferral the following inputs are necessary:

- Existing network capacity
- Costs and timings of reinforcement
- Future load growth for one or more scenarios
- Flexibility volumes (derived by the model or imported by user)
- Flexibility costs, split by availability and utilisation
- Fixed inputs (e.g. financial assumptions applicable to the business such as WACC, discount rate etc)
- Carbon impacts of the options being considered
- Incentives and penalties impacts of the options being considered
- Probabilities of scenarios, if weighted average analysis is being used, and
- Discounts for multi-year flexibility contracts, where applicable.

Outputs

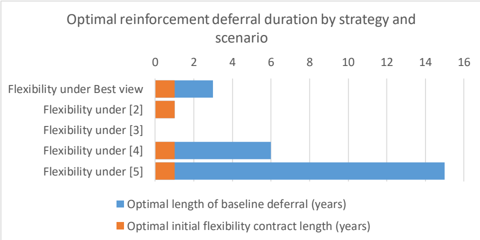
As stated above the CEM Tool is fundamentally an evaluation tool to aid decision making and so have been developed with a range of outputs to provide insights and information to the user.

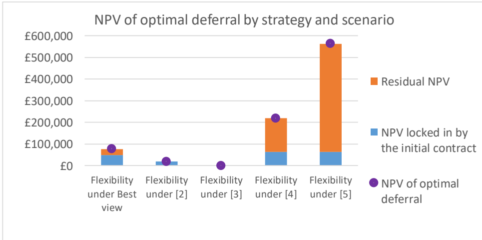
Where the user tests flexibility under different load growth scenarios the corresponding benefits analysis shows the scenarios alongside each other in both charts and number format aiding comparative analysis. As part of this analysis the optimal reinforcement deferral duration (ie the optimal flexibility contract length) for each scenario is calculated and shown, including the NPV of optimal deferral. This analysis is illustrated in the figure below.

Summary: Optimal reinforcement deferral duration for each strategy under each scenario

	Overall NPV of deferral	Optimal length of baseline deferral (years)	NPV of optimal deferral
1	Flexibility under Best view	3	£76,482
2	Flexibility under [2]	1	£18,436
3	Flexibility under [3]	Baseline	£0
4	Flexibility under [4]	6	£218,563
5	Flexibility under [5]	15	£562,642

Overall NPV disaggregated into the initial NPV and the residual NPV	Optimal initial flexibility contract length (years)	NPV locked in by the initial contract	Residual NPV
Flexibility under Best view	1	£49,279	£27,203
Flexibility under [2]	1	£18,436	£0
Flexibility under [3]	Baseline	£0	£0
Flexibility under [4]	1	£64,701	£153,862
Flexibility under [5]	1	£64,701	£497,941





In addition, further insights from the benefits analysis is provided through applying the Least Worst Regrets approach and Weighted Average approach (using manually inputted probabilities) to show the optimal deferral periods and the NPV of optimal deferral. This analysis is illustrated in the figure overleaf.

Analysis: Least Worst Regret method

		Regret (only comparing within each strategy)	Deferral length (years) Baseline	1 Defer by 1 year(s) to 2025	2 Defer by 2 year(s) to 2026	3 Defer by 3 year(s) to 2027
Config	1	Flexibility under Best view	£76,482	£0	£0	£0
Config	2	Flexibility under [2]	£18,436	£0	£12,341	£53,575
Config	3	Flexibility under [3]	£0	£12,408	£62,099	£146,760
Config	4	Flexibility under [4]	£218,563	£0	£0	£0
Config	5	Flexibility under [5]	£562,642	£0	£0	£0
		Worst Regret by strategy				
Strat	1	Flexibility	£562,642	£12,408	£62,099	£146,760

		Regret (only comparing within each strategy)	4 Defer by 4 year(s) to 2028	5 Defer by 5 year(s) to 2029	6 Defer by 6 year(s) to 2030	7 Defer by 7 year(s) to 2031	8 Defer by 8 year(s) to 2032	9 Defer by 9 year(s) to 2033	10 Defer by 10 year(s) to 2034	15 Defer by 15 year(s) to 2039	20 Defer by 20 year(s) to 2044	45 Defer by 45 year(s) to 2069
Config	1	Flexibility under Best view	£19,247	£58,634	£116,931	£192,978	£285,679	£394,001	£516,970	£1,321,275	£1,912,289	£1,912,289
Config	2	Flexibility under [2]	£121,922	£215,700	£333,319	£473,281	£634,171	£814,658	£1,013,486	£1,461,516	£1,461,516	£1,461,516
Config	3	Flexibility under [3]	£264,208	£412,376	£589,318	£793,194	£1,022,274	£1,274,925	£1,274,925	£1,274,925	£1,274,925	£1,274,925
Config	4	Flexibility under [4]	£0	£0	£0	£12,132	£36,644	£72,801	£119,912	£498,161	£1,033,578	£2,083,171
Config	5	Flexibility under [5]	£0	£0	£0	£0	£0	£0	£0	£0	£57,992	£959,616
		Worst Regret by strategy										
Strat	1	Flexibility	£264,208	£412,376	£589,318	£793,194	£1,022,274	£1,274,925	£1,274,925	£1,461,516	£1,912,289	£2,083,171

			Least Worst Regret by strategy	Least Worst Regret Strategy
Strat	1	Flexibility	£12,408	Flexibility for 1 year(s)

Analysis: Weighted Average method

		Strategy / Expected benefit	Time before pausing strategy (years) Baseline	1 Defer by 1 year(s) to 2025	2 Defer by 2 year(s) to 2026	3 Defer by 3 year(s) to 2027
Strat	1	Flexibility	£0	£172,743	£160,336	£135,157
		Identify reference for max expected benefit	-	*1*	-	-

		Strategy / Expected benefit	4 Defer by 4 year(s) to 2028	5 Defer by 5 year(s) to 2029	6 Defer by 6 year(s) to 2030	7 Defer by 7 year(s) to 2031	8 Defer by 8 year(s) to 2032	9 Defer by 9 year(s) to 2033	10 Defer by 10 year(s) to 2034	15 Defer by 15 year(s) to 2039	20 Defer by 20 year(s) to 2044	45 Defer by 45 year(s) to 2069
Strat	1	Flexibility	£94,149	£37,883	-£32,689	-£119,093	-£220,529	-£336,053	-£409,834	-£735,951	-£972,836	-£1,363,079
		Identify reference for max expected benefit	-	-	-	-	-	-	-	-	-	-

			Maximum Expected Benefit by strategy	Maximum Expected Benefit Strategy
Strat	1	Flexibility	£172,743	Flexibility for 1 year(s)
		Across all strategies	£172,743	Flexibility for 1 year(s)

Another useful piece of functionality in the CEM Tool is the calculation of the ceiling price; this is the average annual contract cost for the optimal length of contract. A ceiling price is calculated per scenario and shown in a table for comparative purposes but additionally the ceiling price is calculated for under a Least Worst Regrets and a Weighted Average approach. This analysis is illustrated in the figure below.

Ceiling Price

Note: This tab is only usable if flex_cost_input_type (on the Control sheet) is set to "Flex Costs from Volumes"

This tab shows the maximum ('ceiling') price for flexibility that would justify at least a 1 year flexibility contract (i.e. the minimum contract length).

Maximum justified availability price and annual cost of a 1 year flexibility contract

		Configuration	Availability ceiling price (£/MW/h)	Average annual contract cost ceiling (£)
Config	1	Flexibility under Best view	100	£16,500
Config	2	Flexibility under [2]	50	£24,750
Config	3	Flexibility under [3]	1525+	£1,258,125+
Config	4	Flexibility under [4]	75	£
Config	5	Flexibility under [5]	700	£

Maximum justified availability price and annual cost of a 1 year flexibility contract under LWR and Weighted Average valuation approaches assuming flex volumes corresponding to Best view

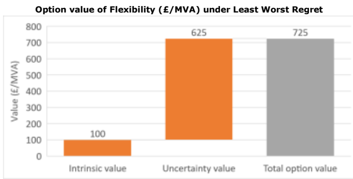
	Availability ceiling price (£/MW/h)	Average annual contract cost ceiling (£)
Least Worst Regret	725	£119,625
Weighted Average	1525+	£251,625+

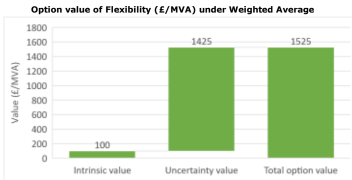
One of the key changes made in 2021 was the addition of functionality to highlight the option value of flexibility. This is shown graphically and in numbers in terms of the ceiling price or NPV (based on a predetermined value of flexibility, £/MVA). This analysis is illustrated in the figure below.

Option value: ceiling price

Option value of Flexibility (£/MVA)

	Intrinsic value	Uncertainty value	Total option value
Least Worst Regret	100	625	725
Weighted Average	100	1425+	1525+





Typical use case(s)

As stated previously the primary use case for the CEM Tool is assessing flexibility services solution options compared with traditional network reinforcement. The User Guide and a set of Worked Examples using the Excel Workbook Tool cover the following additional typical uses of:

Use Case 2: Flexibility for incentive related improvement

Use Case 3: Energy efficiency to defer reinforcement, and

Use Case 4: Active Network Management.

Whole system CBA

Purpose of the tool

The Product team used the following definition of "whole system", based on the definition given by WS4 in their 2019 Final Report[1]:

"Whole system" was interpreted as interactions between the gas and electricity networks and across transmission and distribution boundaries. Broader whole system interactions such as transport, water, waste were noted and it was agreed that these would be considered but not as core focus.

The definition of whole system is used as one of the three tests of when a whole system CBA should be used. This is discussed in a later section.

The whole system CBA has been developed to meet the following vision:

1. A whole system CBA should **evaluate options to help achieve net-zero**. This includes assessing the wider societal impacts of different options, considering both current and future consumers and developing a consistent approach to appraise options.
2. **Consumer impacts should be at the heart of decision making**. A whole system CBA should capture the varied ways benefits can be delivered. The whole system CBA process should be transparent and understood both inside and outside of regulated energy networks. Key stakeholders should support it, including BEIS, Ofgem, the energy networks, other industry participants and other statutory bodies.
3. The whole system CBA should be used to **articulate the benefits the energy industry delivers**. With growing political and regulatory scrutiny of costs and activities, a whole system CBA can be a key tool to demonstrate that energy networks are acting in the best interests of consumers.
4. **Help deliver a secure network at optimal value for money to consumers**. This includes considering the needs of both present and future consumers, and wider society.

5. Support **objective, technology neutral and transparent decision making.** It will enable costs and value to be drawn out, explicit for all to see.
6. The whole system CBA should be **one element of a decision-making toolkit.** In any investment decision, several factors need to be considered, some of which may not be suitable for a whole system CBA.
7. Supporting regulatory frameworks that allow **sharing of the surplus value** generated from allowing another company to provide a more net beneficial solution.

Used by

The Whole System CBA has been published and is available to be used at no charge to any interested parties. Typically, users will be the energy networks, local authorities, BEIS and consultants engaged in innovative projects to move the future of energy debate forward.

Inputs needed to operate the tool

The user should consider a wide range of capex costs, opex costs and societal costs and benefits. Where possible, these should be monetised. The model and this document provide further guidance and structure to monetising inputs.

To aid transparency, standardisation and effective comparison of strategies, several rules should be followed:

- All monetised inputs and outputs must be in the same price base and ignore inflation / real price effects. The start of the depreciation period should also be set to that year. The user guide indicates how to set this in the model and can also output costs in a different year to that inputted, if necessary.
- All data should be entered either in absolute (gross) terms or in marginal terms against the reference strategy across the entire tool. Use one throughout – do not mix and match. In general, it is preferable to use absolute values and allow the model to "net-off" against the reference strategy.

Costs: Capex

Capital expenditure (capex) is spending on investment in long-lived network assets, such as overhead lines, underground pipes and cables, ground equipment such as substation and compressor stations and IT systems. It can include the cost of designing, purchasing, building, installing and dismantling equipment. Capex is expressed in Pounds and should be determined, quantified and monetised for each year over the asset lifetime for each strategy under each scenario.

Capex costs can include, but are not limited to:

- Network reinforcement and replacement costs
- Installations costs of alternative heat and power generation – e.g. wind, solar, gas peaking plants, tidal
- Installation costs of alternative heat and power networks – e.g. heat networks
- Installation costs of new appliances in people's homes – e.g. hybrid heating systems
- WACC – this will vary across Network companies and non-regulated companies. The model will provide a default where this is not known
- Avoided costs, although if data is being entered in absolute terms these should not be entered separately.

Costs: Opex

Operational expenditure (opex) is spending on operating and maintaining the network. This can include fault repair, tree cutting, inspection and maintenance and engineering and business support costs. Opex is expressed in Pounds and should be determined, quantified and monetised for each year of the project for each strategy under each scenario.

Opex costs can include, but are not limited to:

- Network operation costs – gas, electricity and heat – to include maintenance and emergency response
- Customer appliance maintenance costs
- Training and recruitment – e.g. recruitment for hybrid heating system installers, house insulators
- Procurement costs
- Avoided costs, although if data is being entered in absolute terms these should not be entered separately.

Societal impacts

Societal impacts should be considered for each strategy under each scenario. They will vary depending on the use case but may include some or all of the below. The parameters inbuilt in the model and pointed to in the input depository provide a range of societal impacts that can be considered; the user can also input ones outside of this.

Benefit category	Examples
Safety	• Fatalities • Non-fatal injuries • Site safety • Public safety
Environmental	• Losses • Carbon emissions • Leakage • SF6 emissions • Shrinkage • Biodiversity and natural capital • Air quality
Transport	• Number and type of vehicle • Disruption
Electricity consumer	• Complaints • Customer interruptions • Energy not supplied • Guaranteed standards of performance
Gas consumer	• Complaints • Customer interruptions • Energy not supplied • Guaranteed standards of performance
Other	• Social factors (e.g. visual amenity) • Economic factors (e.g. jobs) • Health factors (e.g. air pollution or impact of an interruption to heating) • Vulnerability – impact on those most vulnerable in our community

To aid effective comparison between different strategies and scenarios, benefits should be monetised in pounds for each year of the project for each strategy under each scenario. Where this is not possible, qualitative benefits can be considered, and can be compared in, for example, a RAG status. The user should make it clear how these are weighted in the overall decision-making process.

Some benefits will have common values (e.g. carbon price), others may be user inputted. The parameters library can be used to help quantify benefits and ensure standardisation.

Outputs

Role of the Whole System CBA in decision making

The whole system CBA can only ever act as a guide to inform decisions. It is not necessarily the case that the highest NPV option should always be chosen, or that a negative NPV option can never be selected. To guide decision making, the model will output:

- Net-present value of different options, both in comparison to the reference strategy and gross
- Least worst regrets
- Sensitivity analysis and tipping points
- The cost impact on different parties, and how these might be recovered/socialised.

Overall, the decision should be made through an evaluation of:

- Economic appraisal (ie the above)
- Stakeholder feedback
- Commercial, technical and engineering judgement, including:
    - Risks and mitigations
    - How the economic outputs vary across scenarios
    - Credibility of options and solutions.

Reporting metrics

To aid comparison of options and aid decision making, the model will output a number of charts and tables. These include:

- Outputs for all strategies under the reference scenario, in absolute terms
- Outputs for all strategies relative to the reference strategy under the reference scenario
- A summary outputs table

Outputs are presented on an overall basis and on a per stakeholder basis, including the customer monetised impact. The customer monetised impact is accounted for by distributional analysis.

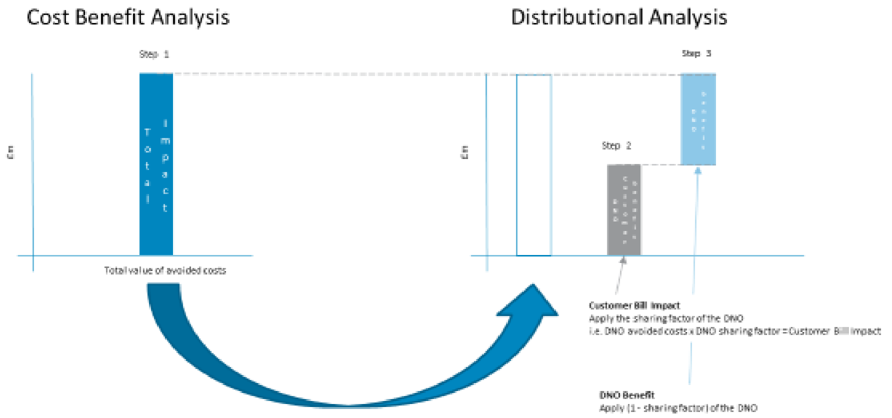
Distributional analysis

Distributional analysis refers to cash flows between stakeholders and their customers and/or society. This can account for regulatory concepts such as sharing factors or incentive rewards or penalties that transfer costs and benefits between stakeholders. To enable this, the user can select the sharing factor and incentive reward/penalty rates in the model.

To show how the model accounts for this, two examples are provided below.

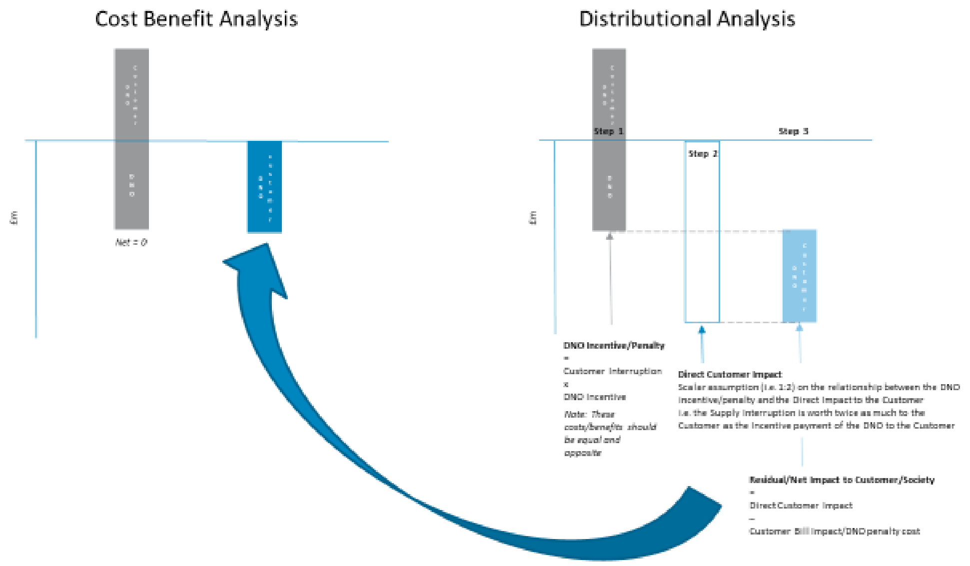
Distributional analysis example (1)

An example of how the model will account for the cash flows between stakeholders and their customers/society, when a DNO avoids reinforcement costs



Distributional analysis example (2)

An example of how the model will account for the impact of a supply interruption to a DNO Customer, taking into account the cost to the DNO of the incentive value on Customer Interruptions



Typical use case(s)

The three tests for a whole system CBA

Three conditions must be met to determine whether a whole system CBA is appropriate.

1. **Are there whole system interactions, or is there potential for it?** If the only realistic options are within an individual network an appropriate sector-specific CBA should be used.
2. **Could a whole system CBA drive you to make a different decision?** A whole-system CBA needs to be carried out in good-faith with the genuine aim of considering and accepting a range of options. As we discuss below, regulatory changes may be needed to encourage this behaviour. The whole system options considered need to be plausible, but there is also likely to be a de minimis value.
3. **Is a whole system CBA reasonable?** CBA is complex. It can be difficult to estimate costs and benefits. There are limits on the number of factors that can reasonably be considered. A whole system CBA needs to be proportionate, transparent and understandable. Especially at first, this may limit some of the use cases.

Several use cases of a whole system CBA have been identified, all of which meet the three tests. These have been developed for two reasons. Firstly, to aid the development of the methodology and model, through enabling discussion about parameters they must incorporate. Secondly, to show a range of plausible situations the whole system CBA could be used in. It is important to note that these are by no means the only areas in which the whole system CBA can be used.

The use cases, and how they meet the three tests, are summarised in the table below. Further details are in Appendix 1.

Use Case	Test 1: Are there whole system interactions, or is there potential for it?	Test 2: Could a whole system CBA drive you to make a different decision?	Test 3: Is a whole system CBA reasonable?
Asset Intervention: Suppose a gas pipe feeding a small town is reaching the end of its asset life. Is it better to replace the pipe like-for-like, convert the town to electric heating or install a biomethane plant and upgrade the gas network?	Potential for interactions across gas and electricity.	The options appear feasible and potential benefits could be in tens to hundreds of millions	A number of factors should be considered, for example: Whether consumers are willing to switch to electric heating? Whether the local electricity network can manage increased demand?
Investment Planning: Suppose an electricity line is heavily constrained. From a whole system perspective, what is the best solution?	There may be opportunities to expand the range of options to include demand, service or looking to hydrogen in longer term.	Assuming the right regulatory mechanisms and incentives are there. Benefits could be in the billions.	Before proceeding with CBA confirmation of stakeholder buy-in to secure necessary data will be required
Embedded Generation: farmer wants to build a biogas plant running on agricultural	New connections have the option to connect and provide services to either	The options appear feasible and potential benefits could be in tens to hundreds of millions	This is a reasonably classic use case for a CBA.

waste. Should it generate electricity or enter the heat network?	the gas or electricity networks.		
Local Authority Planning: A local authority has been given £50 million funding from central government to support decarbonisation in their area. How should they spend it?	Any local area energy plan would interact heavily with gas and electricity networks, and would focus strongly on power, transport and heat.	Given the variety of potential options and the trade-offs between them, a whole system CBA would be a valuable tool.	Given the large number of potential options, so shortlisting based on commercial, technical and engineering judgement and stakeholder feedback would be necessary first.
Strategic Planning: What is the best way for the UK to meet its net-zero target?	By definition	Given the variety of potential options and the trade-offs between them, a whole system CBA would be a valuable tool.	Given the large number of potential options, so shortlisting based on commercial, technical and engineering judgement and stakeholder feedback would be necessary first.

Table 1 – Summary of use cases

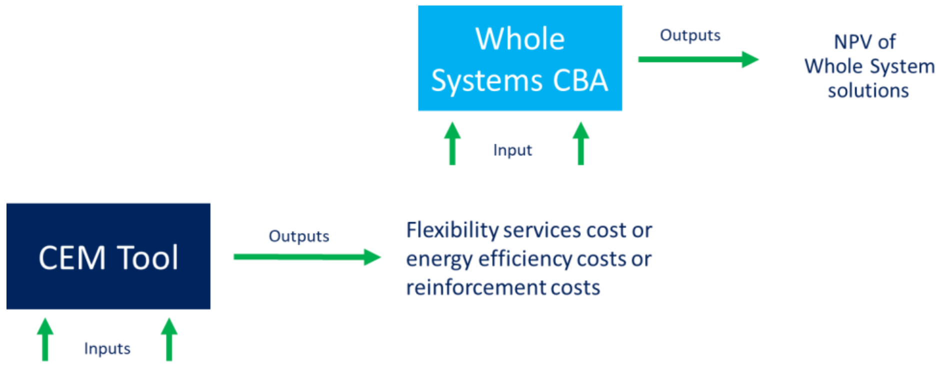
Conclusion

The review of Common Evaluation Methodology and the Whole Systems CBA shows that they are both fundamentally evaluation tools that are used in the decision-making process. Both are built around the framework and methodology from the Ofgem CBA with the CEM Tool more aligned to the Ofgem CBA at is only takes into account the costs and benefits of the DNO user, using the same fixed parameters e.g. WACC as seen in the Ofgem CBA. Whereas the Whole Systems CBA has been developed to take into consideration a range of costs and benefits from across multiple parties, both licensees, non-licensees and other third parties, as would be expected from a whole systems evaluation tool. To model the costs and benefits across potentially a diverse range of parties the user has the flexibility to set some of the parameters, otherwise fixed in the Ofgem CBA tool.

The table below summaries the key features of the two evaluation tools, drawing out the similarities and differences:

	Scope of costs analysis	Scope of benefits analysis	Evaluation methodology	Primary use case	Outputs
Common Evaluation Methodology Tool	DNO costs only	DNO benefits only	Built on the Ofgem CBA template with fixed parameters	Evaluates flexibility services	Financial analysis of each solution, including optimal contract period, ceiling price and option value
Whole Systems CBA	A range of licensee and third-party costs	A range of licensee and third-party benefits	Built on the Ofgem CBA template with ability to vary fixed parameters	Evaluates a whole system problem	Financial analysis of each solution, including sensitivity analysis, tipping points and distributional impacts

In the development of the two evaluation tools the Product teams collaborated to ensure that the methodological approaches were consistent, and any developments were undertaken together. As each tool was published and explained to stakeholders the Product teams evidently received questions on their uses and their interactions. This report has been written to help our stakeholders understand the use cases for each model and more importantly to clarify how they can be used together. The two tools can be used in conjunction with the output from the CEM Tool being used as an input to the Whole Systems CBA, as shown in the flowchart below.



The two Product teams have considered whether the two tools should be combined into one and have decided against it due to the resulting complexity of the model. The Product teams will continue to work collaboratively to ensure that the underlying methodologies and techniques are consistent where appropriate.

Annex 1: Ofgem CBA tool

Overview/Purpose of the tool

This tool is part of the RIIO regulatory toolkit. It is owned by Ofgem and mandated for use in Price Control business plan submissions.

Used by

To be used by network companies, gas and electricity.

Inputs needed to operate the tool

The weighted average cost of capital (WACC) input should be NETWORK-specific and consistent with each NETWORK's assumed average WACC for RIIO-GD2.

The capitalisation rate should be as follows:

- Repex = 100%
- Capex and Opex = NETWORK-specific assumption consistent with each NETWORKs expected Totex spend profile, excluding repex costs, over RIIO-GD2.

The assumptions for both the WACC and the capitalisation rate are subject to future revisions based on any changes to the methodology of the Business Plan Financial Model (BPFM) ahead of the Business Plan submission in December.

SOCIETY BENEFITS AND THE TREATMENT OF NON-MARKETED GOODS

NETWORKs should consider societal benefits (i.e. indirect avoided costs) associated with each option. For consistency we have standardised the assumptions and calculations for the valuation of societal benefits and safety benefits. We have entered default parameters in the CBA template for these non-marketed items; where NETWORKs amend these assumptions, full justification should be supplied to support the move from the default parameters. For the benefits associated with preventing fatalities and injuries, we require NETWORKs to draw on guidance set out in HM Treasury Green Book[7] and the HSE[8].

We have included input lines for societal benefits resulting from reductions in leakage and shrinkage. The calculation of the value of these benefits is consistent with the NARM methodology, based on the volume of avoided emissions.

There may be further non-marketed items where a fixed assumption or calculation methodology has not been provided in the CBA model. NETWORKs can include these benefits in the rows provided but should clearly set out in the workings section of the model the assumptions and valuation methodology used.

NETWORKs should also set out within the wider investment appraisal any non-marketed impacts or factors that cannot easily be monetised.

Outputs

A NPV calculation that can be considered over multiple timeframes. This is output taking each decision on its own cost and benefit but also in comparison to a base case scenario.

Typical use case(s)

This tool should be used for network investment decisions that are specific to an individual company. Typically, these will cover investment to manage asset health and risk.

Annex 2: Other Assessment tools (OPTIONAL TBA)

1. Network Options Assessment (NOA)

Overview/Purpose of the tool

The purpose of the Network Options Assessment (NOA) is to facilitate the development of an efficient, coordinated and economical system of electricity transmission consistent with the National Electricity Transmission System Security and Quality of Supply Standard and the development of efficient interconnection capacity. At the same time, the NOA process supports efficient development of the system in support of the Electricity System Operator (ESO)'s ambitions and government net zero targets.

The Network Options Assessment (NOA) process is set out in National Grid Electricity Transmission Standard Licence Condition C27. A detailed description of the NOA methodology is available on National Grid Electricity System Operator (NGESO) website[1].

The NOA Methodology document provides an overview of the aims of the NOA and details the methodology which describes how the ESO assesses the required levels of network transfer, the options available to meet this requirement and recommends options for further development. It is important to note that whilst the ESO recommends progressing options in order to meet system needs, any investment decisions remain with the Transmission Owners (TOs) or other relevant parties as appropriate.

In order to recommend options, the ESO uses the established investment recommendation process. This ultimately leads to the selection of recommended options based upon their capital investment and constraint savings across a range of scenarios as well as forecast earliest in-service date. Constraint costs are a factor of bid/offer prices and the amount of generation constrained. Both factors vary across the scenarios resulting in no one scenario necessarily seeing higher constraint costs than another.

Figure 1 gives an overview of the NOA process. This methodology describes how the ESO, working with the TOs and other relevant parties, carries out these activities.

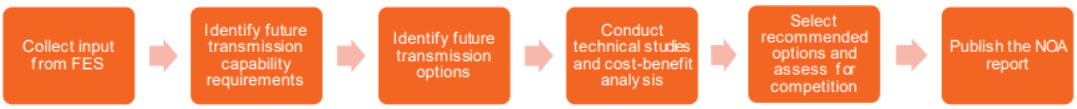


Figure 1: Overview of the NOA process

Collect input from FES

The relevant set of scenarios as required by Electricity Transmission Standard Licence Condition C11, is used as the basis for each annual round of analysis. These provide self-consistent generation and demand scenarios which extend to 2050. The FES document is consulted upon widely and published each year as part of a parallel process[2].

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[1] https://www.nationalgrideso.com/research-publications/network-options-assessment-noa/methodology

[2] https://www.nationalgrideso.com/future-energy/future-energy-scenarios

Identify future transmission requirements

For every boundary, the future capability required under each scenario and sensitivity is calculated by the application of the NETS SQSS chapter 4 Economy and Security planning methodologies.

Identify future transmission options

At this stage, all the high-level transmission options which may provide additional capability across a system boundary requiring reinforcement are identified (against economic and security criteria), including a review of any options considered in previous years.

Conduct technical studies and cost benefit analysis

Cost-benefit analysis compares forecast capital costs and monetised transmission benefits over the project's life to inform this investment recommendation. The NOA provides investment recommendations based on the Single Year Regret Decision Making process. The purpose of the Single Year Regret Decision Making process is to inform investment recommendations regarding wider transmission works for the coming year. The main output of the process is a list of recommended wider works reinforcement options to proceed with or to delay in the next year.

NGESO uses its Pan European Market Model, BID3, developed by AFRY for calculating constraint costs and uses a range of spreadsheet-based tools for calculating the cost benefit analysis, including calculating net present values and single year least worst regret.

Typical use case(s)

The CBA tools developed for NOA have evolved over several years and are only suitable for the NOA process.

2. Cost to Customer (Gas Goes Green)

Overview/Purpose of the tool

Typical use case(s)

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