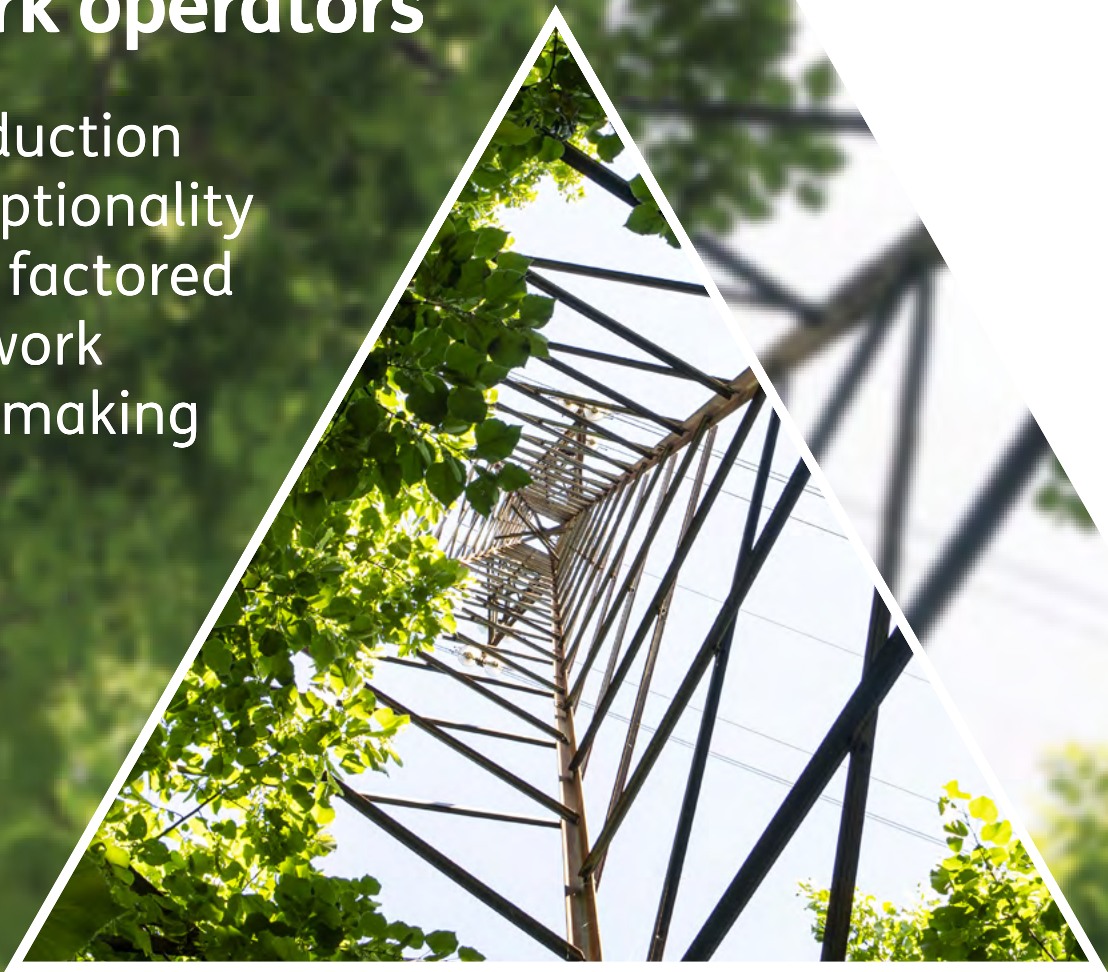
Opening up options for network operators

An introduction to how optionality could be factored into network decision making



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A Common Evaluation Methodology

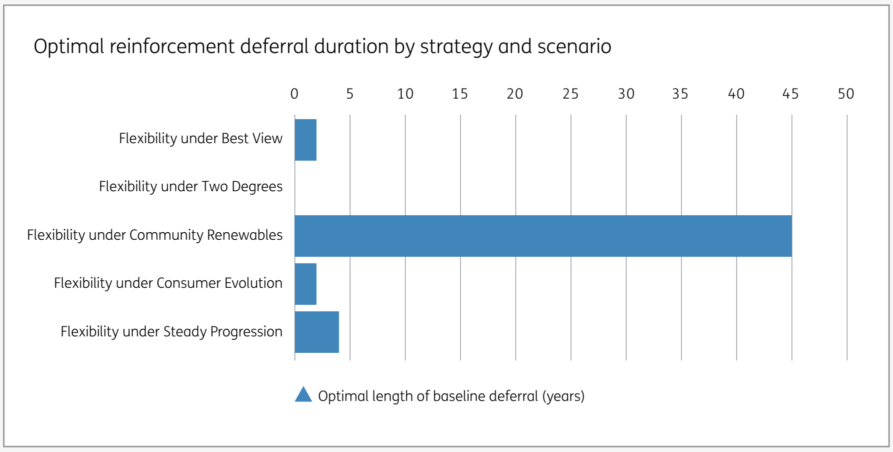
Baringa has co-developed a common approach for Distribution Network Operators to evaluate their options in releasing network power capacity.

With greater electrification seen as a key enabler on the path to Net Zero, the companies that own and operate Britain's power infrastructure, Distribution Network Operators (DNOs), are seeking new ways to release electricity network capacity to accommodate low carbon technologies rapidly, that do not involve the reinforcement of existing network infrastructure.

To this end, Baringa has been working with the Energy Networks Association (ENA) to develop a Common Evaluation Methodology (CEM). This approach will harmonise the way DNOs assess the benefits of reinforcement versus procuring flexibility services from generators or storage operators, when planning and managing their networks. A standardised approach should create greater visibility and confidence among the providers of flexibility services, stimulating the market, competition, and ultimately reducing costs.

While there is a range of possible use cases for flexibility services, a key application is flexibility in lieu of conventional network reinforcement – reducing the network load when it is at its peak in order to defer or avoid costly capital expenditure. Based on a range of inputs assumptions (in particular network-load growth scenarios, reinforcement costs and flexibility costs), the model indicates, for each scenario:

1. The time-period for which it would be economic to procure flexibility to manage a network constraint;
2. The value of flexibility (expressed as a Net Present Value, or NPV) over that period of time.



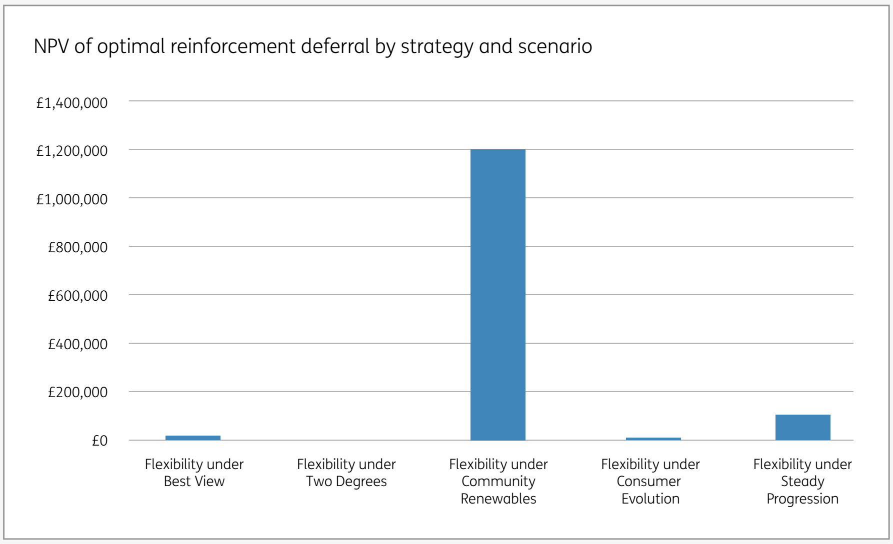
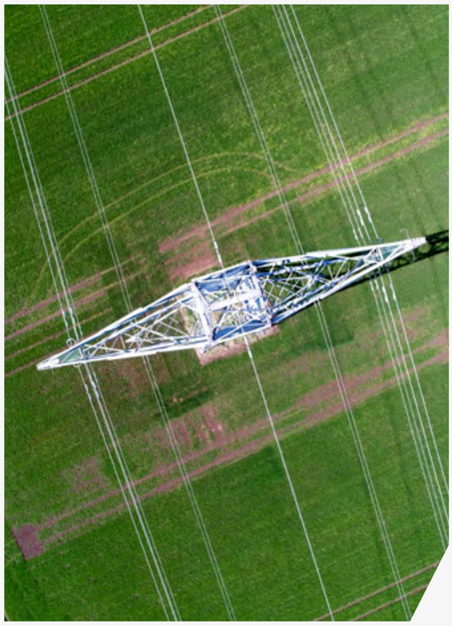


Figure 1

Illustrative outputs from the CEM tool: optimal flexibility strategy and associated NPV



Treatment of uncertainty

Prior to the CEM, the majority of DNOs assessed flexibility on the basis of its performance under a single-load growth scenario. By its nature, a single-scenario model is deterministic, and does not reflect uncertainty about the future. This is an issue, particularly when comparing flexibility with conventional reinforcement, because not only may it be cheaper, but it keeps a DNO's options open prior to committing to an expensive capital solution (such as upgrading a transformer with a 45+ year economic life), should load growth turn out different to that expected.

This is particularly pertinent given the different potential pathways to Net Zero. The dynamics of load flows on the distribution networks are becoming more complex and uncertain, with increasing demands from electrification being offset to some degree by efficiency improvements, load shifting and the increasing deployment of distributed generation. Never have DNOs had to plan their networks in the face of so much uncertainty.

The CEM allows DNOs to explore this uncertainty by modelling simultaneously up to 10 different load growth scenarios. Rather than looking only at a single "central" or "best view" case, a DNO can identify situations where flexibility might be either more or less valuable. This gives a better sense of the range of possible outcomes, but it also allows the DNO to develop a more dynamic strategy.

Option value

One of the concerns raised during the CEM's consultation phase was that the 'option value' associated with flexibility was not being taken into account. There are various different definitions of 'option value', but conceptually it refers to the value associated with having the right to do something rather than the obligation to do it.

Financial options: a useful framework

Financial options, where the term 'option value' is most typically used, give the bearer the right to buy ('call') or sell ('put') an underlying product in the future, at a 'strike price' set today. The full option value in this case comes from two elements:

1. **Intrinsic value**: If the market price for a product is higher than the option strike price, that option has ***intrinsic value*** – you can profit by buying at the lower price and selling at the higher price.
2. **Extrinsic value**: The future is uncertain, so the forward market price for a commodity tends to vary over time as expectations of supply and demand change. If the market price moves up the value of a call option will go up, and the higher it goes the more valuable it will be. If the market price goes down the value of the option goes down but if it goes below the strike price, the bearer has a right to walk away. This asymmetry gives an option extrinsic value, and the more volatile prices are (or the more time there is for them to evolve) the higher the ***extrinsic value*** tends to be.

'Option value' in the context of flexibility services

Flexibility services have some instructive parallels to financial options (see box). If a DNO is faced with a need to reinforce in 2023, a flexibility contract can allow it to delay that reinforcement to 2024. Deferral in this case has some inherent "intrinsic" value. By the time that 2024 rolls around, however, the DNO will have a new set of load-growth projections, which may indicate that flexibility can be deferred further or, perhaps, that it is no longer required. Flexibility has not just delayed the need to reinforce, but given the DNO the option not to reinforce at all.

The value of that optionality relates to how uncertain or how variable the future load growth on the network is. If the future is relatively certain, the "extrinsic" value of flexibility is limited.

However, if the DNO is unsure whether network load will grow more rapidly or fall, the "extrinsic" value of flexibility increases. In the more rapid growth scenario the DNO may need to procure more flexibility than it expected. In the falling load scenario, however, the DNO may be able to avoid reinforcement altogether.

Measuring option value

Given that flexibility has option value above its 'intrinsic' value, it is fair to say that current methods for assessing non-networks solutions for network needs may be undervaluing flexibility services. The question remains: how should the full value of flexibility be evaluated? We see three possible approaches as set out in Table 1 below.

	Approach	Description	Pros	Cons
1	Standard financial option pricing tools	Use established closed form option pricing tools deployed for valuing financial options[1]	▶ Established practice ▶ Transparent ▶ Availability of existing tools	▶ Effectiveness of solution is a function of observable market data ▶ Assumes continuous variables which is not always the case with scenarios ▶ Assumes one degree of uncertainty whereas the FES and DFES are a combination of multiple variables
2	Scenario-based approach to identify 'indifference price'	Identifies the additional premium that would equate flexibility with the next best strategy across a range of scenarios based on a specific evaluation methodology, for example Least Worst Regrets	▶ Consistent with scanario-based planning ▶ No need to assign probablilities ▶ Transparent and simple to calculate	▶ Outcomes sensitive to scenarios used – requires scenarios to span a balanced spread of potential outcomes ▶ Does not recognise how the range of uncertainty evolves over time
3	Tree-based probability approach to identify 'indifference price'	Identifies the additional premium that would equate flexibility with the next best strategy when evaluated through a branching structure of future pathways for load evolution, assigning probabilities at each decision making node.	▶ Fully accounts for optionality at each decision-making point	▶ Little empirical evidence on which to base probability assumptions, and at odds with the DFES approach currently being used by network companies to explore uncertainty ▶ Not well suited to multiple variables given the computational challenges involved ▶ Could be very opaque

[1]Simulation-based approaches with multiple variables can also be employed

The CEM is well suited to deploying the second approach for estimating extrinsic option value from Table 1, since it can evaluate strategies across multiple scenarios, and identify optimal strategies using established methodologies like Least Worst Regrets, which is adopted by National Grid ESO in its approach to Network Options Analysis (NOA).

Assuming using flexibility is the optimal solution, the user can increase the flexibility cost iteratively to find the point at which the network company would be indifferent between the flexibility solution and the next best solution. The difference between the indifference price and the base cost of flexibility gives a good proxy for the extrinsic option value.

Given that scenarios are a firmly established method for describing uncertain futures in energy, and all the DNOs adopt or produce Distribution Future Energy Scenarios (DFES) for their business planning, a scenario-based approach for assessing the option value of flexibility seems like a good starting point.

The limitation of the scenario approach is that it represents a snapshot of future uncertainty, as perceived today, but will not be how uncertainty looks to a decision maker in one, two or five years' time. In theory a comprehensive approach to valuing optionality would require consideration of every potential future pathway and decision. That would lead to the third approach shown in the table above: tree based probability.

However, assigning appropriate probabilities to all the branches is very difficult, made even more complex if future uncertainty is multi-dimensional, i.e. not just associated with one variable, as is the case.

For now, we believe adopting a scenario-based approach, incorporating a Least Worst Regret-type method for determining the optimal strategy, is a good basis for estimating option value from flexible solutions. This provides the platform to evolve to more sophisticated approaches in due course, once the concepts become more established and the quality of input data warrants it.

Baringa Partners

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