ENA Open Networks

Common Evaluation Methodology (CEM) Consultation

March 2022

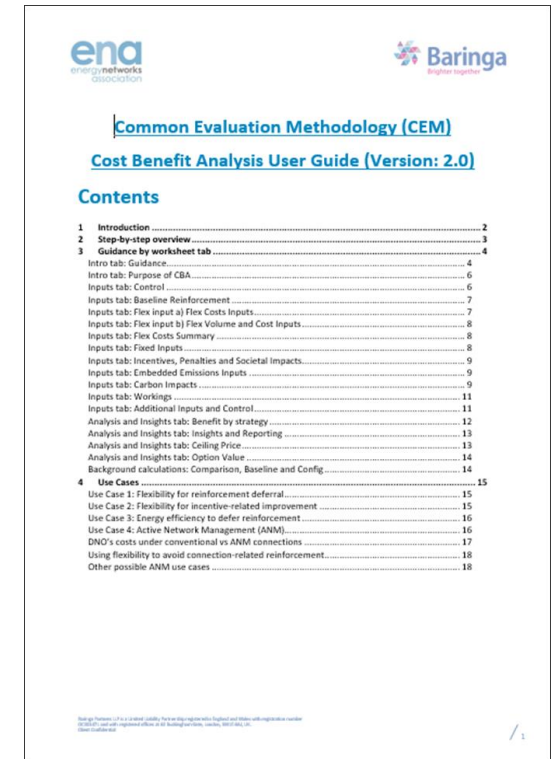# Agenda

▶ **Introduction and background to the Common Evaluation Methodology**

▶ **Modelling flexibility under load growth uncertainty**

▶ **Option value**

▶ **Alternative approaches for calculating option value**

▶ **Consultation and next steps**

History of the CEM

▸ **All GB DNOs committed to 'market testing' potential flexibility solutions as an alternative means of releasing capacity compared to traditional asset reinforcement**

▸ **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**

▸ **This work was progressed within the Open Networks project under Workstream 1A (Flexibility Services) and in 2020 the CEM and associated Tool [Excel model] were created and It has been used by all DNOs from April 2021**

▸ **In 2021 the Product team developed methodologies for:**
  ▸ valuing optionality, and
  ▸ carbon impact

▸ **All CEM materials are available to download from the ENA website:**
  ▸ Methodology Statement, User Guide, Tool, How to use video and Use cases

Introduction to the CEM

▸ **Context**

▸ **The objective was to develop a standard approach for the DNOs and create greater transparency, providing greater visibility and confidence amongst flexibility providers and help stimulate volumes and competition in the market, ultimately reducing costs for network customers**

▸ **The CEM Tool is being used by DNOs 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**

▸ CEM Tool:
  ▸ is designed to evaluate the costs and benefits of DNO solutions
  ▸ is based on the Ofgem CBA
  ▸ provides insights on ceiling price, optimum contract length
  ▸ aids decision making

Modelling flexibility under load growth

How the CEM uses scenarios to frame load growth uncertainty?

Modelling flexibility under load growth

- **Single load growth scenario**

Single, deterministic pathway

Load

Time
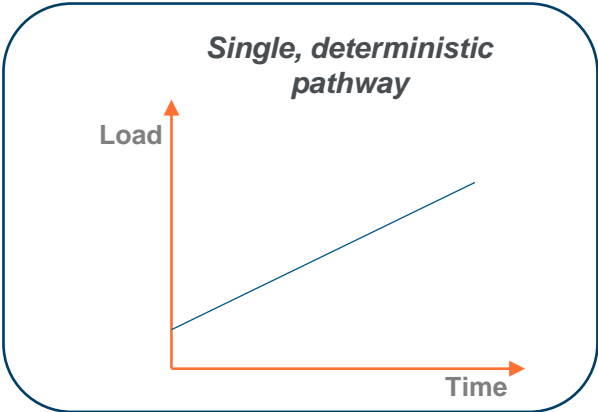
- ▸ **Prior to CEM, evaluation of flexibility typically based on a single scenario**

- ▸ **View of the future was inherently deterministic given no load growth uncertainty was captured by the model**

- ▸ **Value of flexibility based on:**

  - Deferral of reinforcement

  - Losses reduction

  - Carbon benefits

  - Other benefits (e.g. outage risk)

Modelling flexibility under load growth

- **Multiple scenarios as per Future Energy Scenarios (FES)**

Multiple tracks, all originating at a single point representing "today"

Load

Time
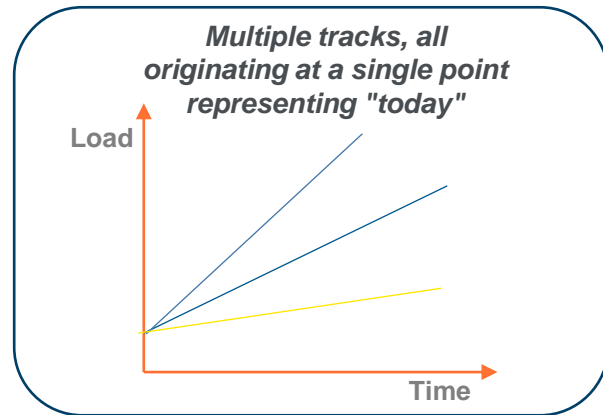
▸ **Multiple load growth scenarios can be considered**

　▸ DFES methodology translates NGESO's FES framework into distribution-level projections, but DNOs can also adopt their own scenarios where appropriate

　▸ DFES intended to represent a **reasonable spread** of possible future outcomes

▸ **Shows how the value of flexibility varies under different scenarios**

▸ **Allows modeller to identify Least Worst Regret strategy or to apply probability weightings**

　▸ Reveals the additional value that flexibility provides when the future is uncertain

▸ **However, uncertainty beyond Year 0 is not represented in this model**

Modelling flexibility under load growth

- **Branching load growth reflecting uncertainty through time**

Multiple tracks that have branches, with tracks splitting "today" and at one or more points in the future.
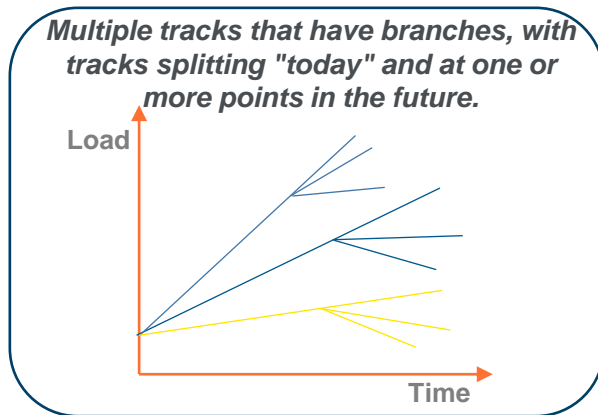
▸ **Load growth uncertainty may be more fully reflected by showing branches into the future**

▸ **Future paths are contingent on what has happened before**

▸ **Could be implemented in a number of ways, e.g:**

  ▸ **Stochastic modelling** of uncertainty (i.e. not scenario-based)

  ▸ **Scenarios for each sub-branch**, each of which is internally consistent

  ▸ **Hybrid**, including scenarios plus stochasticity

Different ways of representing load growth uncertainty

- **It was decided to implement the Common Evaluation Methodology (CEM) tool in line with the Distribution Future Energy Scenarios (DFES) ie with multiple scenarios**
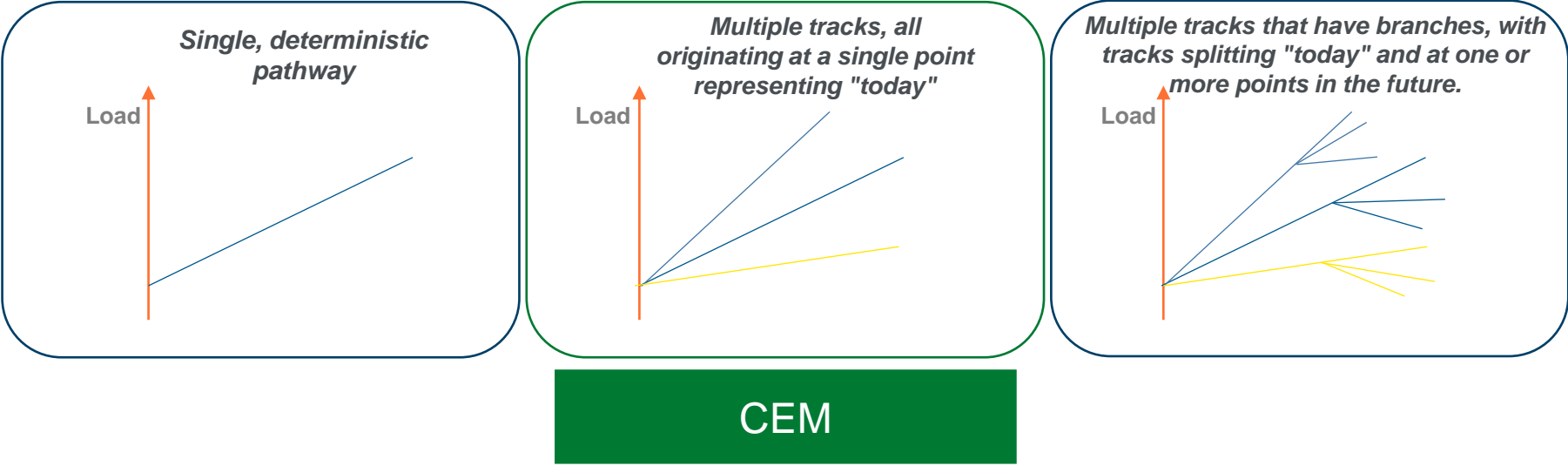
▸ **The purpose of this consultation is to inform whether it is appropriate to consider branching as a method of describing the uncertainty around load growth for calculating the option value**

Option Value

What is option value and how uncertainty is reflected in the CEM Tool and how is this translated into flexibility option value?

What do we mean by 'Option Value'?

- **Term most often used in Financial circles, but has wider applications**

▸ 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.

▸ Flexibility has option value because it allows a DNO to *wait and see* whether reinforcement is required

▸ Arguably, that was not being reflected in the 'old world' where a single scenario was being used

▸ Option Value is created as the future is uncertain

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.

*https://www.baringa.com/en/insights-news/points-of-view/opening-up-options-for-network-operators/

Accounting for uncertainty in the CEM tool

CEM lets the user model multiple scenarios and evaluate strategies <u>across</u> those scenarios

- ‣ CEM allows the user to model **up to 10 load growth scenarios** simultaneously
- ‣ User can see the **optimal flex duration** (e.g. 3 years) and the **benefit** that brings in NPV terms
- ‣ CEM also allows the user to determine the **best strategy given the range of uncertainty**
    - ‣ **NPV:** Reinforce now vs procure flex for at least the minimum contract length
    - ‣ **Ceiling price:** Maximum flex price where deferring reinforcement is justified
- ‣ "Best" strategy depends on what you are trying to optimise
    - ‣ CEM lets the user explore two possibilities:

Least Worst Regret	Weighted Average Benefit
‣ **"Regret"**: difference between the NPV achieved under a scenario and the maximum that could have been achieved ‣ **LWR** calculates the highest regret for each strategy across all scenarios, then chooses the strategy that minimises this ‣ No need to define probabilities, but outcome is largely driven by the extreme scenarios	‣ Calculate the expected benefit of each strategy (flex vs reinforce) across all scenarios ‣ Assign probabilities to scenarios in order to create what the user believes are appropriate weightings ‣ Result is the expected benefit of a strategy ‣ Outcome is highly dependent on the choice of probabilities

Consultation question

Q2. Should there be a common approach to defining probabilities in the common evaluation methodology? If yes, how do you think the probabilities should be reflected in the CEM Tool? Please reference any published work on probabilities that you are familiar with.

Option value in the current CEM tool

Option value is not explicitly mentioned in the CEM tool, but it is represented

- 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
- We think, however, that it is accounted for, at least to some extent, through the use of multiple scenarios
  - Under a 'best view', flexibility may have a moderate benefit by deferring reinforcement
  - Under another scenario, however, it may allow reinforcement to be avoided altogether
- *The value of flexibility (e.g. represented by a ceiling price) increases as load growth becomes more uncertain*

Optimal reinforcement deferral duration by strategy and scenario

■ Optimal length of baseline deferral (years)

NPV of optimal reinforcement deferral by strategy by scenario
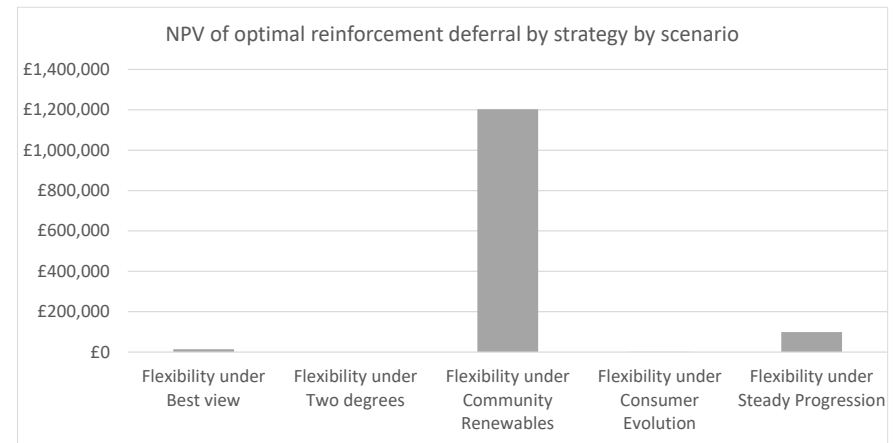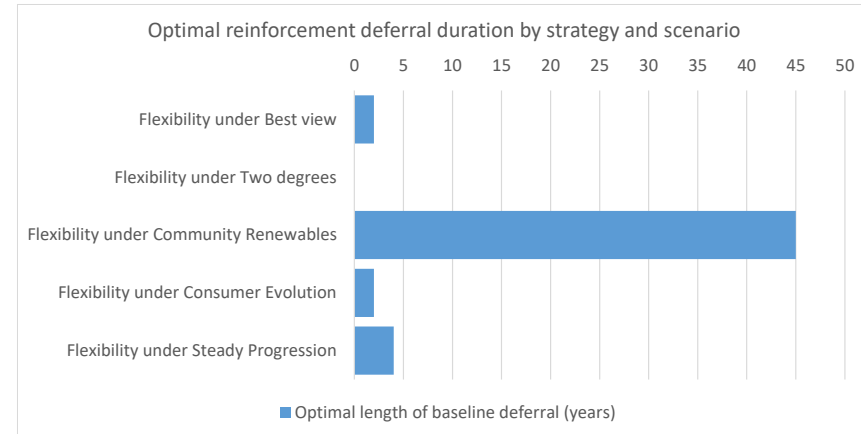
CEM updates to show option value more clearly

- **Option value is already calculated in the CEM, so the tool has been modified to make this more explicit**

In 2021 the CEM tool was updated to make the calculation of option value clearer

Includes new visual, additional functionality, and some improved wording

Modifications include:

Making NPV under 'best view' more explicitly linked to the concept of *'intrinsic benefit'*

Showing the additional value revealed by having multiple scenarios as *'uncertainty benefit'*

Combining these two to show the *'total option benefit'* of flexibility

Illustration of option value of flexibility
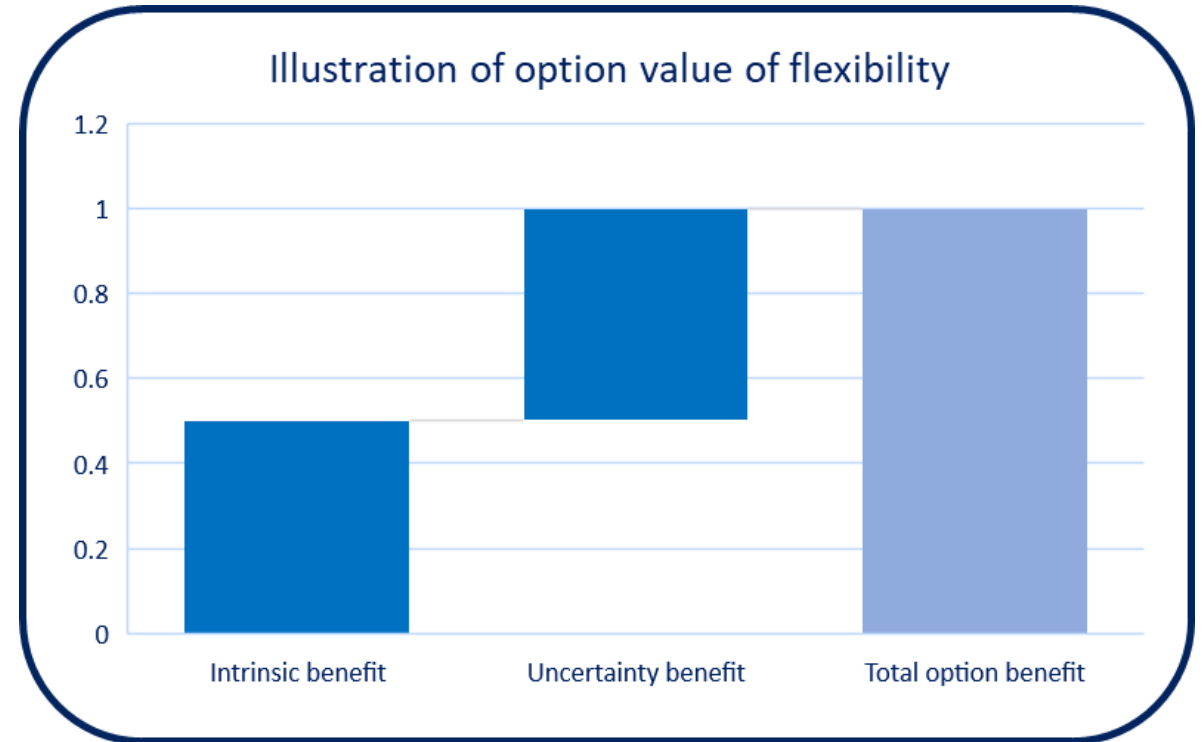
Consultation questions:

Q1A. Do the 2021 revisions to the CEM and Tool deliver what you expected? Please explain.

Q1B. Do the changes related to valuing optionality provide you with a view and understanding of the option value of flexibility? Please explain.

Poll and any questions

Illustrative worked example looking at branching

Conceptual discussion on how the CEM could use the technique of branching to frame load growth uncertainty

The value of modelling multiple scenarios

Symmetrical uncertainty around a 'best view' increases the expected value of flexibility
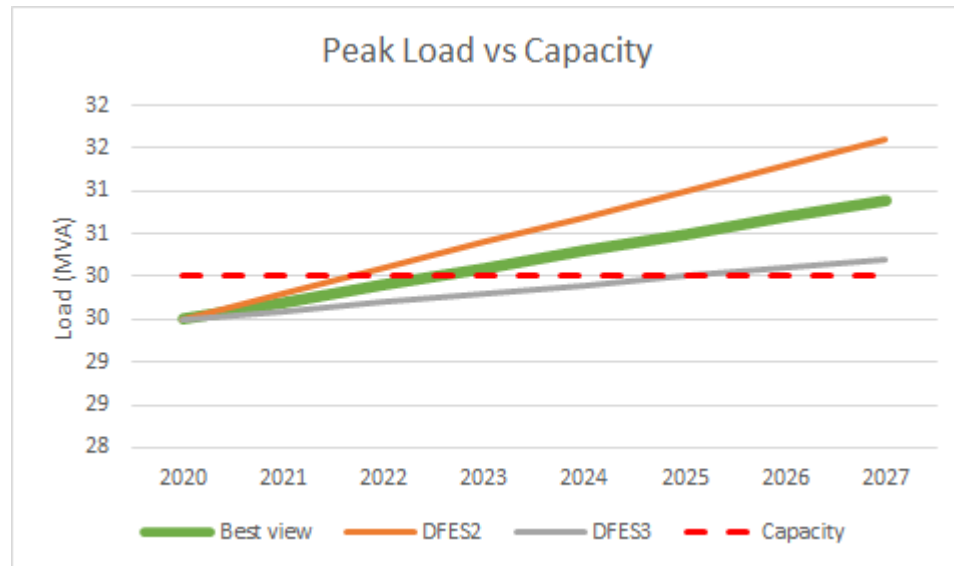
- ▸ **Illustrative example** shows DFES2 and DFES3 centred on "Best View" scenario
  - ▸ **Higher growth** triggers reinforcement earlier, so the downside has a floor
  - ▸ **Lower growth** reveals additional upside from flexibility
- ▸ This ***asymmetry creates additional upside*** to the expected benefit

The value of modelling multiple scenarios

Symmetrical uncertainty around a 'best view' increases the expected value of flexibility

Peak Load vs Capacity
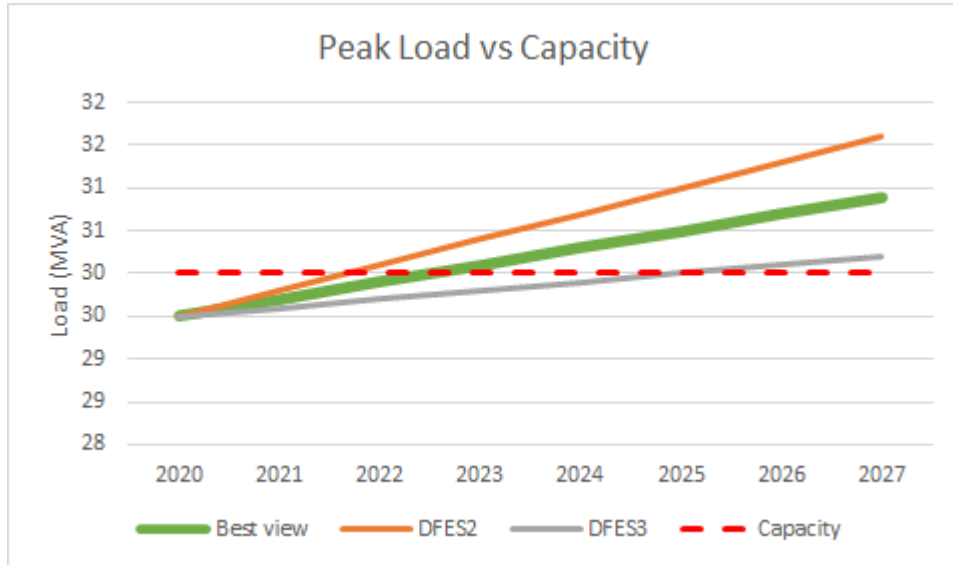
- ▶ **Illustrative example** shows DFES2 and DFES3 centred on "Best View" scenario

  - ▶ **Higher growth** triggers reinforcement earlier, so the downside has a floor

  - ▶ **Lower growth** reveals additional upside from flexibility

- ▶ This **_asymmetry creates additional upside_** to the expected benefit

Cumulative benefit of deferral (excluding benefit from further deferral, but including multi-year discount)	Defer by 1 year(s) to 2024	Defer by 2 year(s) to 2025	Defer by 3 year(s) to 2026	Defer by 4 year(s) to 2027	Defer by 5 year(s) to 2028	Defer by 6 year(s) to 2029	Defer by 7 year(s) to 2030	Defer by 8 year(s) to 2031
Flexibility under Best view	£0	£24,998	£39,490	£44,097	£39,409	£25,982	£4,343	-£25,011	-£61,612
Flexibility under DFES2	£0	£10,182	£5,532	-£13,049	-£44,708	-£88,640	-£144,085	-£210,326	-£286,687
Flexibility under DFES3	£0	£29,937	£58,785	£86,580	£108,862	£125,941	£138,108	£145,641	£148,800

Modelling approach	NPV
Single scenario (1st year deferral only)	£25k
Single scenario (optimal 3-yr deferral length)	£44k
Three scenarios	**£68k**

The value of modelling multiple scenarios

Decision tree shows how flexibility allows you to secure upside whilst avoiding downside

2023	2024	2025	2026	2027	2028	2029	2030	2031

33%
£25k

100%
£14k

100%
£5k

Best View
£44k
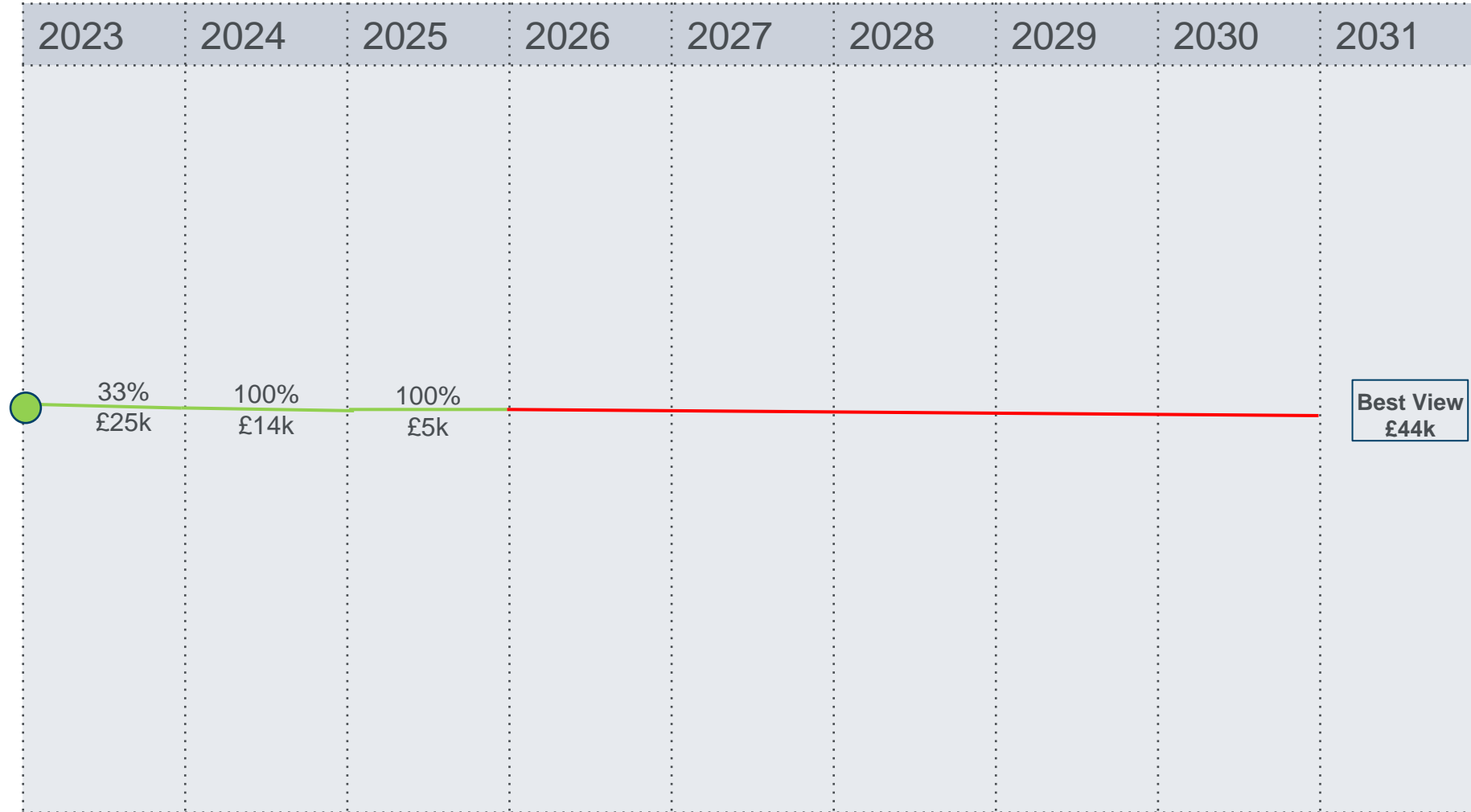
The value of modelling multiple scenarios

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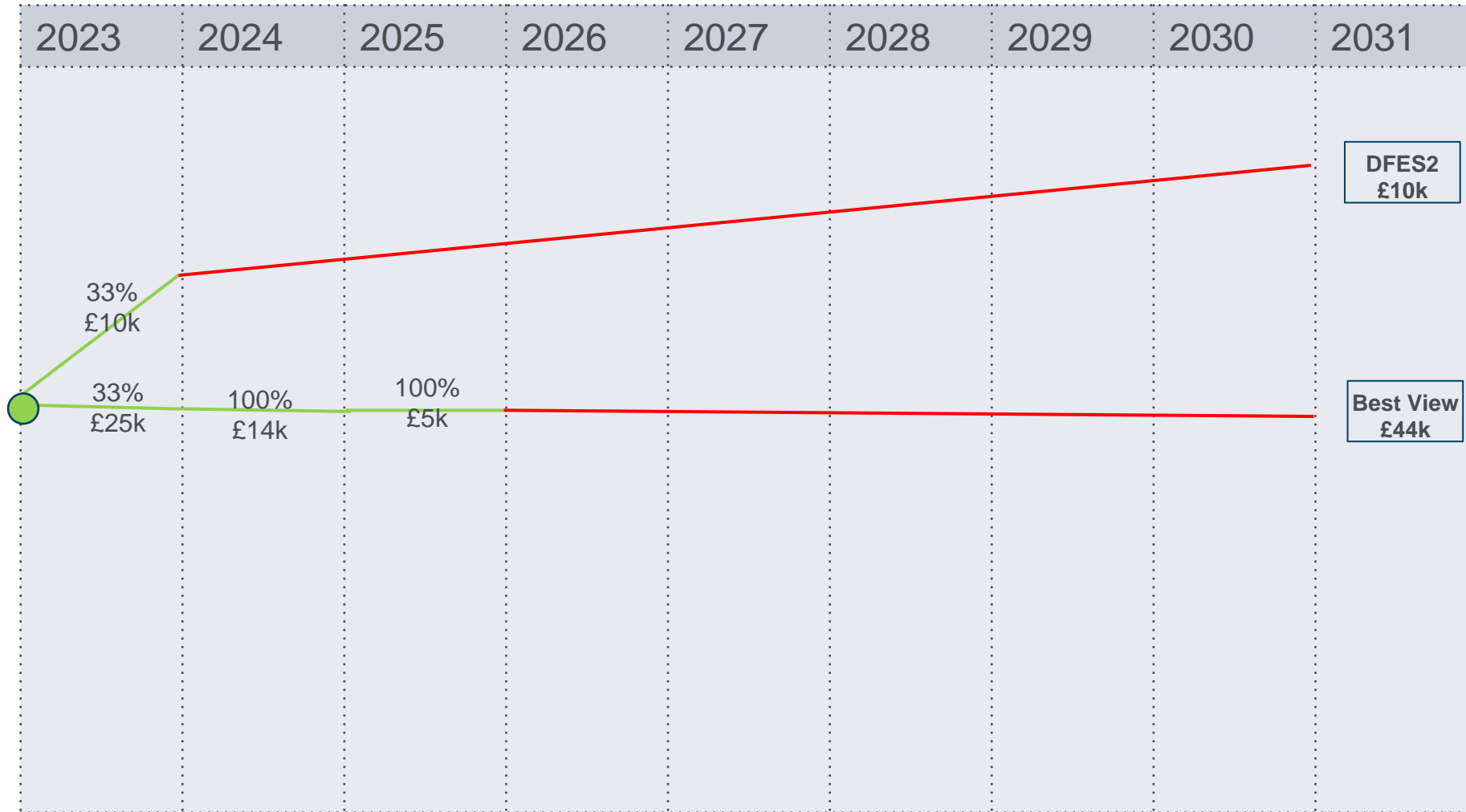
Decision tree shows how flexibility allows you to secure upside whilst avoiding downside

How would additional branches change the outcome?

Implication is that additional branches would better represent future uncertainty

Peak Load vs Capacity
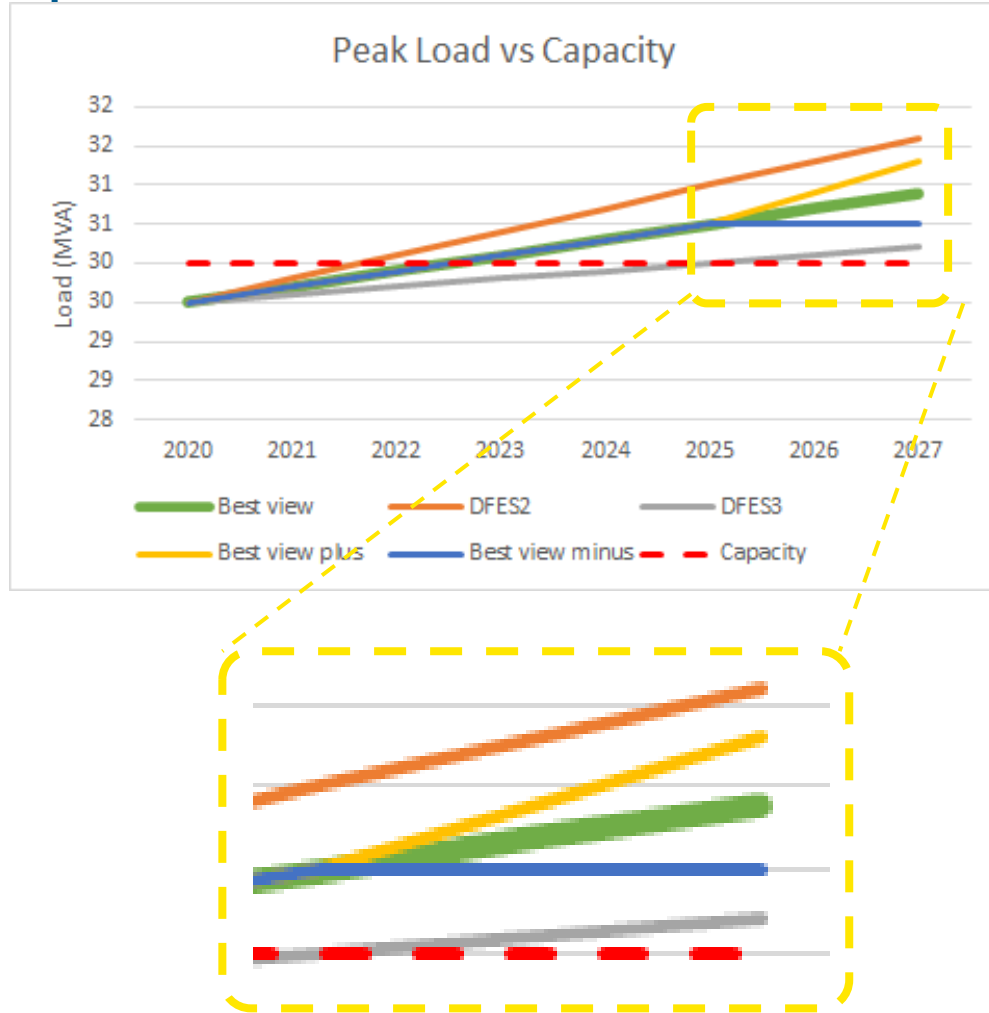
- ▶ Alternative modelling approaches (SSEN/Frontier model) model future uncertainty through branching

- ▶ It had been argued that this approach more fully reflects the option value of flexibility

  - ▶ In CEM scenarios are effectively deterministic from year 2 onwards

- ▶ Simplest way to do this is to imagine these as new scenarios in their own right

  - ▶ The higher spread leads to further upside to the expected benefit

  - ▶ But this is still just modelling these as deterministic scenarios

Modelling branching as 5 independent paths

We could simply model the additional 2 paths as new scenarios in their own right

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2023	2024	2025	**2026**	2027	2028	2029	2030	2031

33%
£10k

Expected BV value beyond 2026
$NPV_{2026+}=£47k$

DFES2
£10k

33%
£25k

100%
£14k

100%
£5k

etc…

BV+
£44k

Best View
£44k

Best Views £91k

BV-
£185k

33%
£30k

100%
£29k

100%
£28k

etc…

DFES3
£149k

Modelling branching as 5 independent paths

We could simply model the additional 2 paths as new scenarios in their own right

2023	2024	2025	**2026**	2027	2028	2029	2030	2031

33%
£10k

33%
£25k

33%
£30k

100%
£14k

100%
£29k

100%
£5k

100%
£28k

Expected BV value beyond 2026
$NPV_{2026+}=£47k$

etc…

etc…

DFES2
£10k

BV+
£44k

Best View
£44k

BV-
£185k

DFES3
£149k

Best Views £91k

Modelling approach	NPV
Single scenario (1st year deferral only)	£25k
Single scenario (optimal 3-yr deferral length)	£44k
Three scenarios	£68k
Five scenarios (2 of which are off-branches)	**£83k**
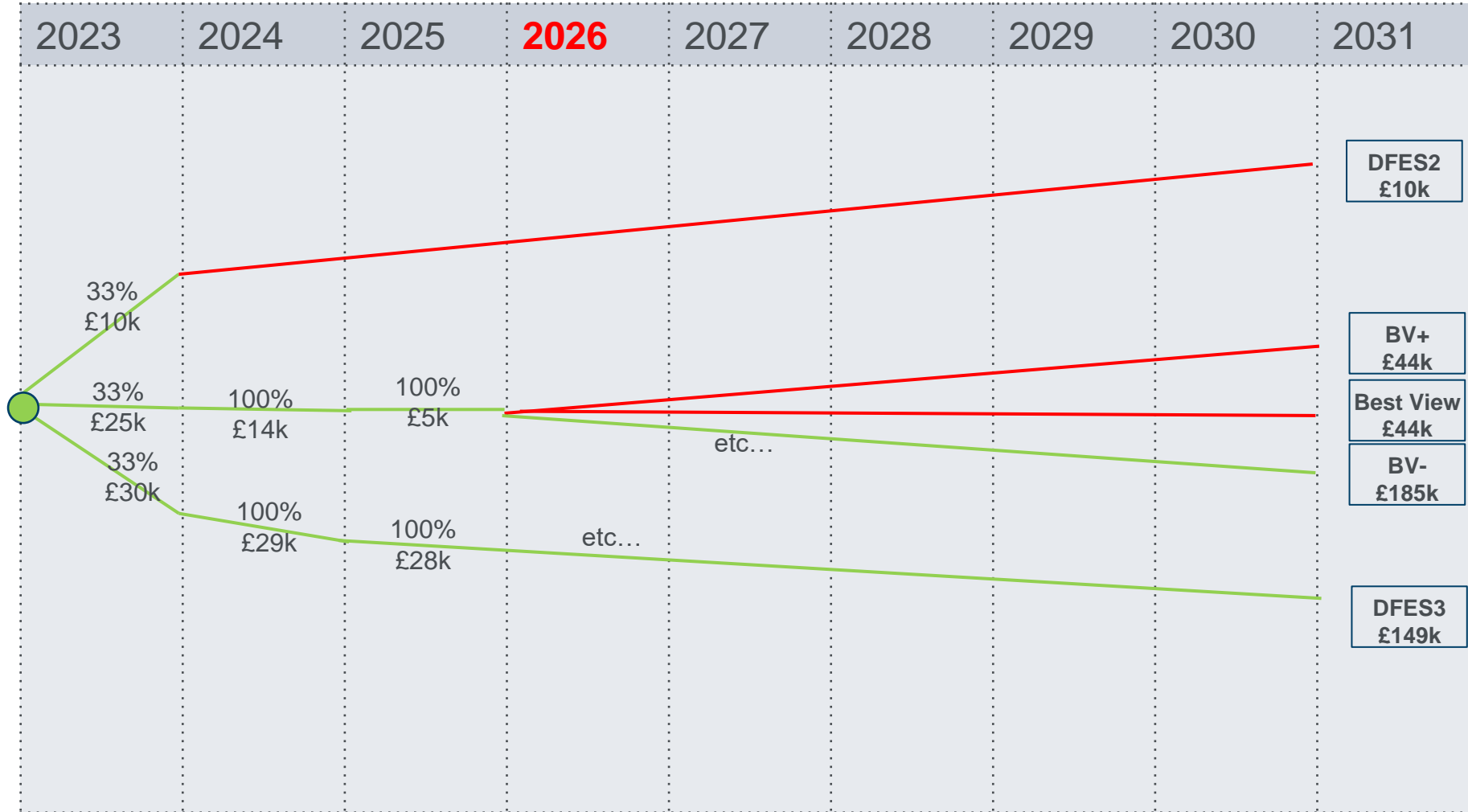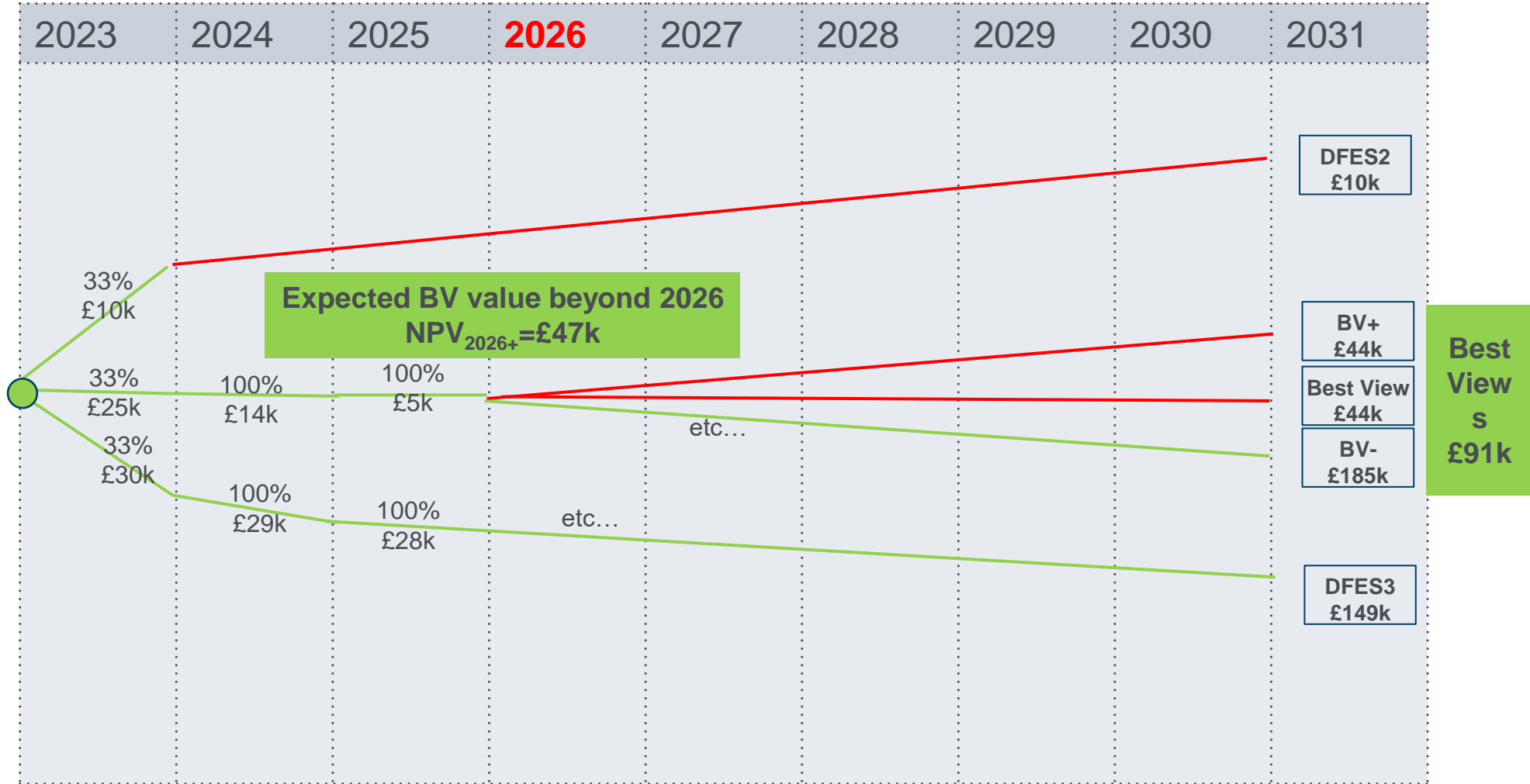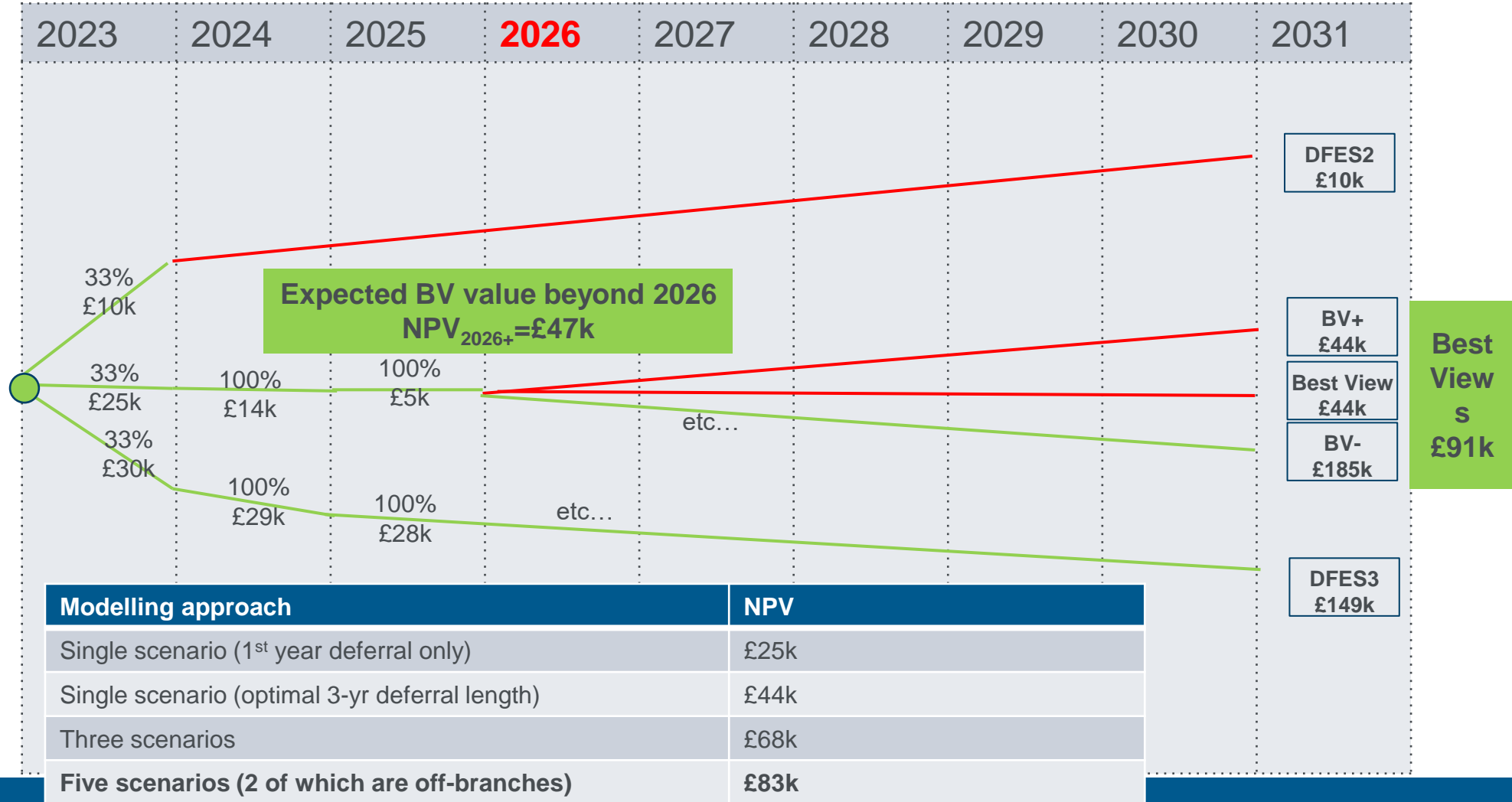
What is wrong with modelling as 5 independent paths?

▶ Modelling as 5 independent paths implies **perfect foresight** for each of the three "Best view" variants

    ▶ In reality, in 2026 you won't know which future path you will be on

▶ You need to make a **decision under uncertainty**, incurring the downside if you end up on either "Best View" or "BV+"

▶ To represent this correctly, we need to model:

    ▶ What **decision** we would take in 2026

    ▶ What **value** we expect to lock in through that decision

▶ We have to do flex for 1 year to **reveal which path** we are on. The three outcomes are:

    ▶ Best View: Incur NPV of minus £5k (then reinforce)

    ▶ BV+: Incur NPV of minus £14k (then reinforce)

    ▶ BV-: Lock in £4k of NPV plus all the future NPVs, totalling £140k

Accounting for uncertainty at the branching point

Strictly, we should model how future decision-making will occur

Accounting for uncertainty at the branching point

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Accounting for uncertainty at the branching point

Strictly, we should model how future decision-making will occur

2023	2024	2025	**2026**	2027	2028	2029	2030	2031

33%
£10k

33%
£25k

33%
£30k

100%
£14k

100%
£29k

100%
£5k

100%
£28k

Further flex >>
NPV$_{2026+}$=£41k

etc…

etc…

DFES2
£10k

BV+
£44k

Best View
£44k

BV-
£185k

DFES3
£149k

Overal l NPV of Best View £84k

Decision: Pursuing the 'weighted average' method, we would do 1 more year of flex

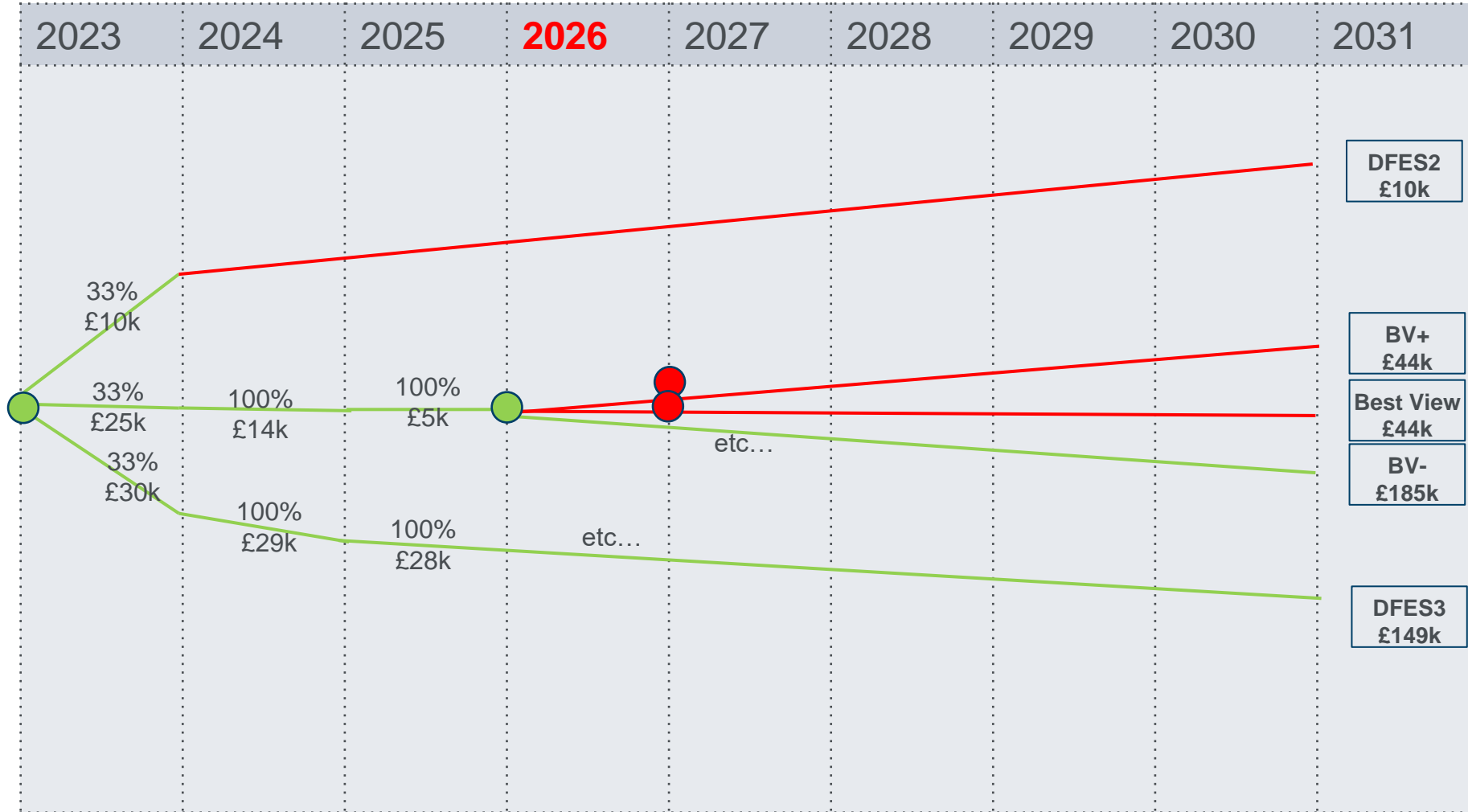**Value:** The expected benefit from 2026 onwards (assuming equal weighting) is £41k

Accounting for uncertainty at the branching point

Strictly, we should model how future decision-making will occur

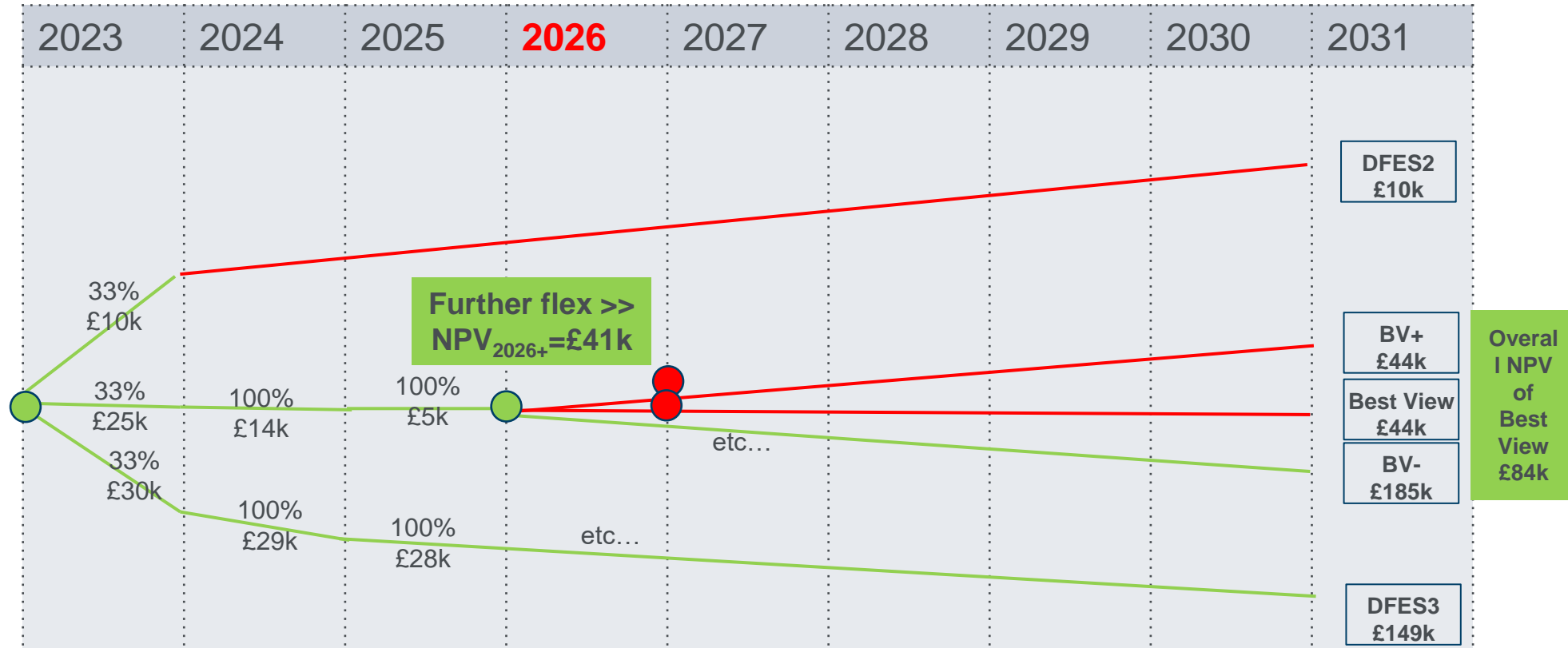| 2023	2024	2025	**2026**	2027	2028	2029	2030	2031

33%
£10k

33%
£25k

33%
£30k

100%
£14k

100%
£29k

100%
£5k

100%
£28k

Further flex >> NPV$_{2026+}$=£41k

etc…

etc…

DFES2
£10k

BV+
£44k

Best View
£44k

BV-
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Overal l NPV of Best View £84k

DFES3
£149k

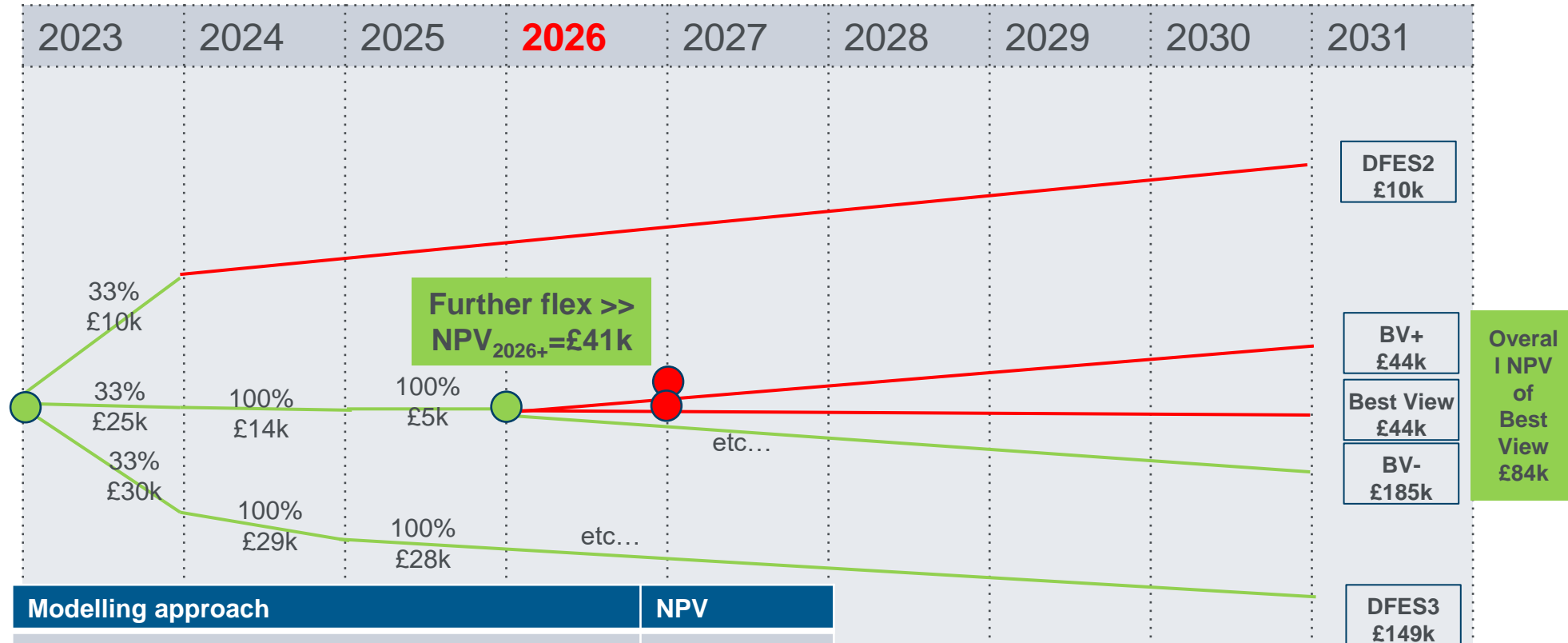| Modelling approach	NPV
Single scenario (1st year deferral only)	£25k
Single scenario (optimal 3-yr deferral length)	£44k
Three scenarios	£68k
Five scenarios (2 of which are off-branches)	£83k
Three scenarios (1 of which has 2 off-branches)	**£81k**

Decision: Pursuing the 'weighted average' method, we would do 1 more year of flex

Value: The expected benefit from 2026 onwards (assuming equal weighting) is £41k

Why does uncertainty reduce the value?

Need to decide: Is 1 year more of flex worth it to see whether there is upside?

etc...
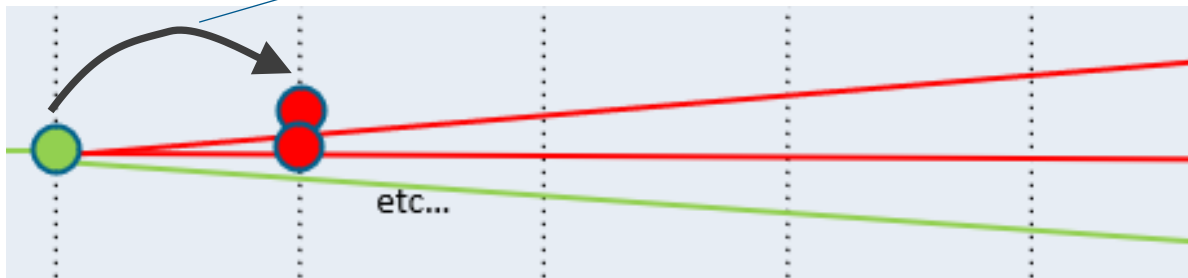
A note on Least Worst Regret: A LWR strategy will only reject the "1 more year of flex" decision if the cost is higher than the overall upside of the green line. This is very unlikely to occur. i.e. LWR will get skewed by the presence of upside scenarios

- ▸ Where there is **significant upside**, the future decision will be to do flex for another year, even if the most likely outcome is negative
  - ▸ Modelling independent scenarios does not show that cost since the model has perfect foresight
- ▸ Where there is **modest upside**, the future decision will be to reinforce, losing that potential upside
  - ▸ Modelling independent scenarios does not rule out that potential upside

In summary:
1. **Adding branches increases the spread, and hence option value**
2. **Modelling as a decision tree reduces that upside**

What model enhancements would be needed to implement this logic?

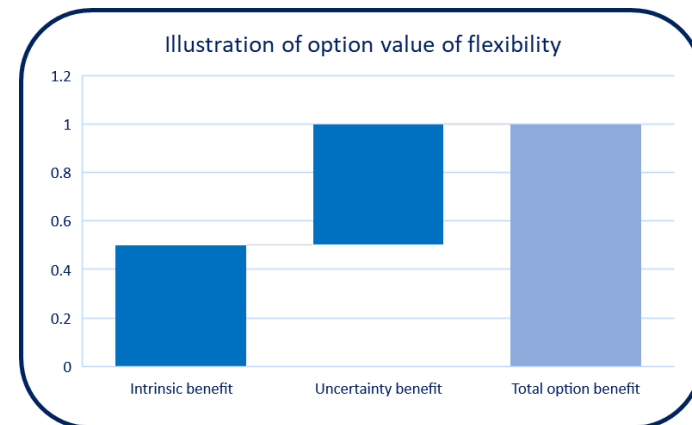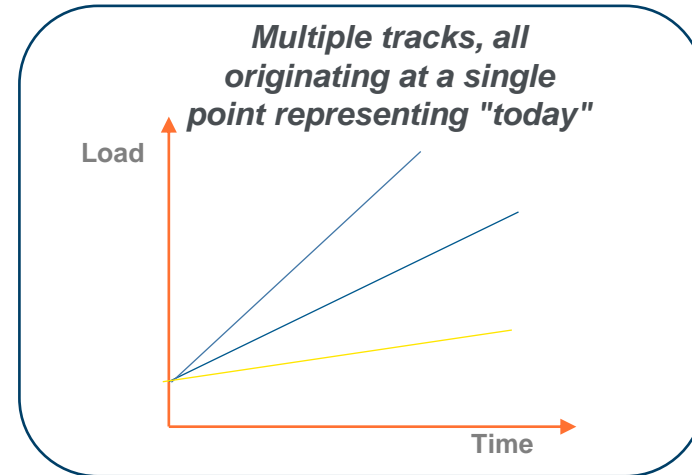| Modelling approach	Compatibility
Single scenario (1st year deferral)	
Single scenario (optimal deferral)	
Multiple scenarios (up to 10)	Current CEM tool
Branching scenarios (treated as independent)	Compatible with current CEM
Branching scenarios, modelling decisions at branch points	Enhancement: Method 1 Method 2

Increasing complexity

- ▶ Modelling multiple scenarios already reveals significantly more value than showing only a central 'best view' scenario
  - ▶ Opting for flexibility gives you access to the upside scenarios
  - ▶ Reinforcing in Year 1 would close off that opportunity
- ▶ It has been argued that we should model uncertainty beyond Year 1
  - ▶ Adding branches tends to increase spread (and hence value), which is probably not our intent
  - ▶ Modelling decision-making on those future branches reduces flex value
- ▶ If we are to model branches, two viable approaches have been identified

Potential development of the CEM tool

Seeking feedback on what steps to take, if any, in the development of the CEM and Tool

Current method

- **Multiple scenarios branching from Year 0 only**

  ▸ **One option is to leave the CEM tool in its current form, including the 2021 updates**

    ▸ Multiple scenarios branching from Year 0

    ▸ Ability to calculate net benefit of flex and/or ceiling price for flexibility

    ▸ Ability to test value of flexibility under uncertainty via Least Worst Regret and/or probability-weighted averages

  ▸ **This approach accounts for uncertainty, and demonstrates the option value of flexibility**

  ▸ **Spread of possible futures is represented by scenarios, and has a well-established methodology**

Multiple tracks, all originating at a single point representing "today"

Load

Time

Illustration of option value of flexibility

Potential alternatives: Method 1

- **Branching off multiple scenarios**

  ▸ **How it would work**

    ▸ Existing multi-scenario approach retained

    ▸ Branches added to each scenario

    ▸ Overall spread kept as constant as possible

      ▸ i.e. outer scenarios branch 'inwards' to counteract increased spread of central scenarios

      ▸ Has the advantage of retaining scenario-based approach

      ▸ However, this approach will create large numbers of branches, and is difficult to calibrate
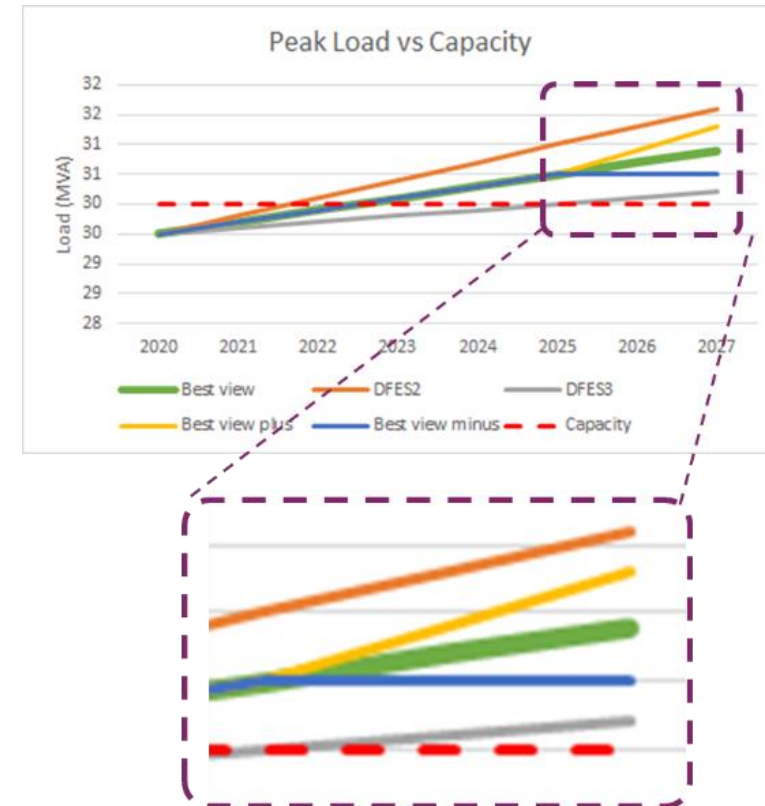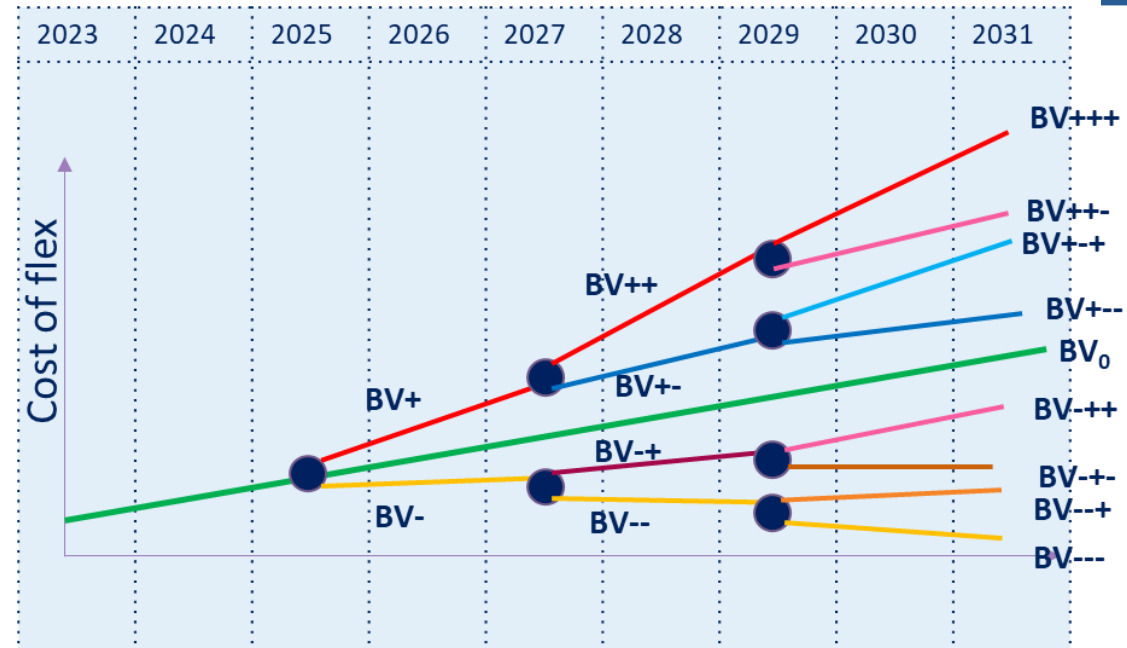
Potential alternatives: Method 2

▸ **Branching around a single scenario**

▸ **How it would work**

1. User defines "Best View" load growth, and calculates corresponding flex costs

2. User defines:

"Node years", where a branch occurs

The spread that occurs at each node, and the probability of each branch occurring

▸ Creates 9 branches:
- ▸ BV_0 (the central scenario)
- ▸ BV+++, BV++-, BV+-+, BV+--
- ▸ BV-++, BV-+-, BV--+, BV---

▸ User can easily modify the degree of spread to calibrate against scenarios or to test the impact of uncertainty on flex valuation

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Consultation questions

Q3. Do you think the Product team should take forward one of these options? If yes, which approach do you think the Open Networks Product team should take forward? If no, please explain.

Q4. Are there any other approaches to calculating optionality that you think are better suited to the CEM and Tool? Please reference any published work on optionality that you are familiar with.

Poll and Questions

Consultation and next steps

Seeking feedback on what steps to take, if any, in the development of the CEM and Tool

Consultation

- **Seeking views on 2021 updates to CEM and next steps**

  - **We have published a "Consultation on valuing optionality in the WS1A Common Evaluation Methodology"**

  - **Consultation closes on Friday 8 April 2022**

  - **Send consultation responses to opennetworks@energynetworks.org**

  - **We will summarise and publish the consultation responses alongside the next steps in late May/early June 2022**

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Open Networks Project
Consultation on valuing optionality in the WS1A Common Evaluation Methodology

8 March 2022 | Version 1.0

The voice of the networks
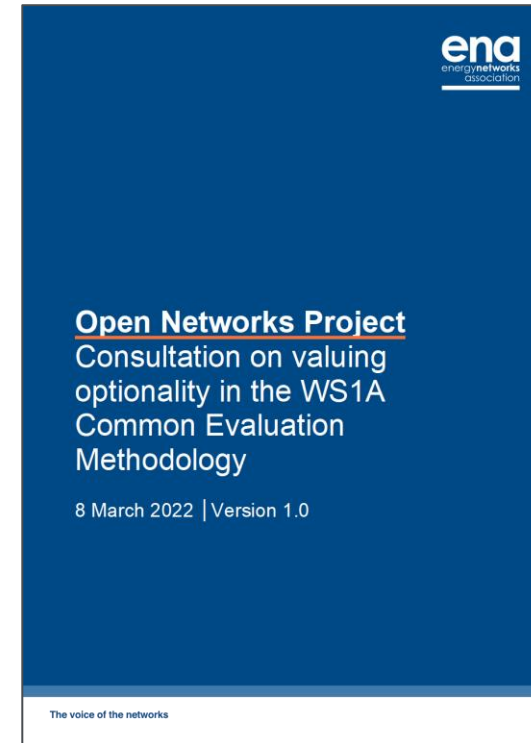
Consultation questions

Q5. The CEM and Tool have been operational since July 2021, are you happy with the current scope and functionality of the revised CEM and Tool? Please explain.

Q6. The Product team has scheduled from July to December 2022 to develop the CEM and Tool further, what development, revision or update is most important to you. Please explain.

Q7. Are there any additional revisions or updates to the CEM and Tool that you believe the Product team should consider as part of their 2022 workplan? Please rank any suggestions in order of priority.

Consultation questions

General

Please tell us about your organisation and the type of industry party you are.

Scope of second CEM and Tool

Q1A. Do the 2021 revisions to the CEM and Tool deliver what you expected? Please explain.

Q1B. Do the changes related to valuing optionality provide you with a view and understanding of the option value of flexibility? Please explain.

Probabilities

Q2. Should there be a common approach to defining probabilities in the common evaluation methodology? If yes, how do you think the probabilities should be reflected in the CEM Tool? Please reference any published work on probabilities that you are familiar with.

Optionality approaches

Q3. Do you think the Product team should take forward one of these options? If yes, which approach do you think the Open Networks Product team should take forward? If no, please explain.

Q4. Are there any other approaches to calculating optionality that you think are better suited to the CEM and Tool? Please reference any published work on optionality that you are familiar with.

Next Steps

Q5. The CEM and Tool have been operational since July 2021, are you happy with the current scope and functionality of the revised CEM and Tool? Please explain.

Q6. The Product team has scheduled from July to December 2022 to develop the CEM and Tool further, what development, revision or update is most important to you. Please explain.

Q7. Are there any additional revisions or updates to the CEM and Tool that you believe the Product team should consider as part of their 2022 workplan? Please rank any suggestions in order of priority.
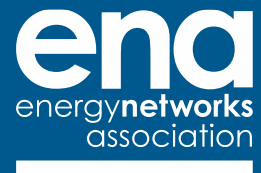
Useful Links

ON Programme Scope for 2022	CEM Tool	CEM Methodology	CEM User Guide	CEM Consultation Document

We welcome feedback and your input at Opennetworks@energynetworks.org

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