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# Flexibility Baselining Tool – User Guide Open Networks

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## DOCUMENT CONTROL

### Authorities

Version	Issue Date	Authorisation	Comments
1.0	25/03/2022	Open Networks Steering Group	

### Related documents

Reference 1	<a href="#">Baseline Methodologies Interim Report (30 Jul 2021)</a>
Reference 2	<a href="#">Mathematical Specification (13 Jan 2022)</a>
Reference 3	<a href="#">Functional Specification (21 Feb 2022)</a>

### Distribution

Published on ENA website
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## Introduction

This report provides a detailed User Guide for the Flexibility Baseline tool developed by TNEI and the SSEN TRANSITION innovation project, in collaboration with the ENA Open Networks programme. The TRANSITION project, led by SSEN and with ENWL as a partner, is an Ofgem NIC funded innovation project that aims to inform the development of flexibility markets at scale and support the DNO to DSO transition.

This document is accompanied by a Functional Specification, which outlines the requirements of the tool, and a Mathematical Specification, which defines the algorithms for performing the baselining calculations. A text-only version of the User Guide presented here is also available within the tool itself.

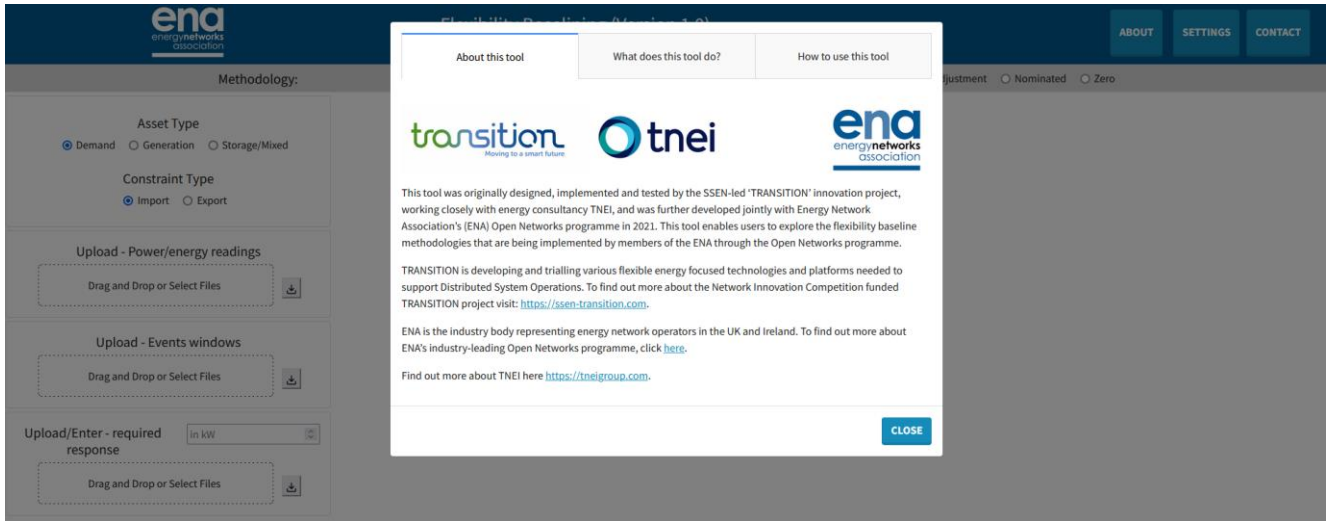
The tool can be accessed here: [https://ena-baselining.herokuapp.com/baselining\\_app/](https://ena-baselining.herokuapp.com/baselining_app/).

Additional information can be found on ENA Open Network's [Flexibility Services](#) page.

Links to the accompanying documentation, and other important reports relating to this project, are included in the Key References section at the end of this document.

## User Guide

The text included in this guide is as it appears in the “About this tool” pop-up on the Flexibility Baseline tool itself, as shown in the figure below.

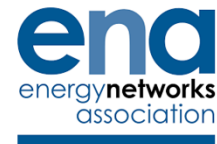


Graphics illustrating the use of the tool have been integrated into this printed version of the report.

There are three sections to this user guide:

- About this tool
- What does this tool do?
- How to use this tool

## About this tool



This tool was originally designed, implemented and tested by the SSEN-led 'TRANSITION' innovation project, working closely with energy consultancy TNEI, and was further developed jointly with Energy Network Association's (ENA) Open Networks programme in 2021. This tool enables users to explore the flexibility baseline methodologies that are being implemented by members of the ENA through the Open Networks programme.

TRANSITION is developing and trialling various flexible energy focused technologies and platforms needed to support Distributed System Operations.

To find out more about the Network Innovation Competition funded TRANSITION project visit [www.ssen-transition@sse.com](mailto:www.ssen-transition@sse.com)

ENA is the industry body representing energy network operators in the UK and Ireland. To find out more about the ENA's industry-leading Open Networks programme, click [here](#).

Find out about TNEI here <https://www.tneigroup.com/>

## What does this tool do?

This tool calculates baselines from data uploaded by the user. It uses the flexibility baseline methodologies that are being implemented by members of the Energy Networks Association through its Open Networks programme.

The tool enables the exploration of the calculated baselines and provides an indicative view of the delivery of the required flexibility. After the user provides their historical site demand/export data a range of baselining methodologies can be applied to generate a corresponding baseline. After a flexibility event, the tool can also be used to verify a user's actual demand or generation profile against the baseline to give an initial view of the success of the service delivery.

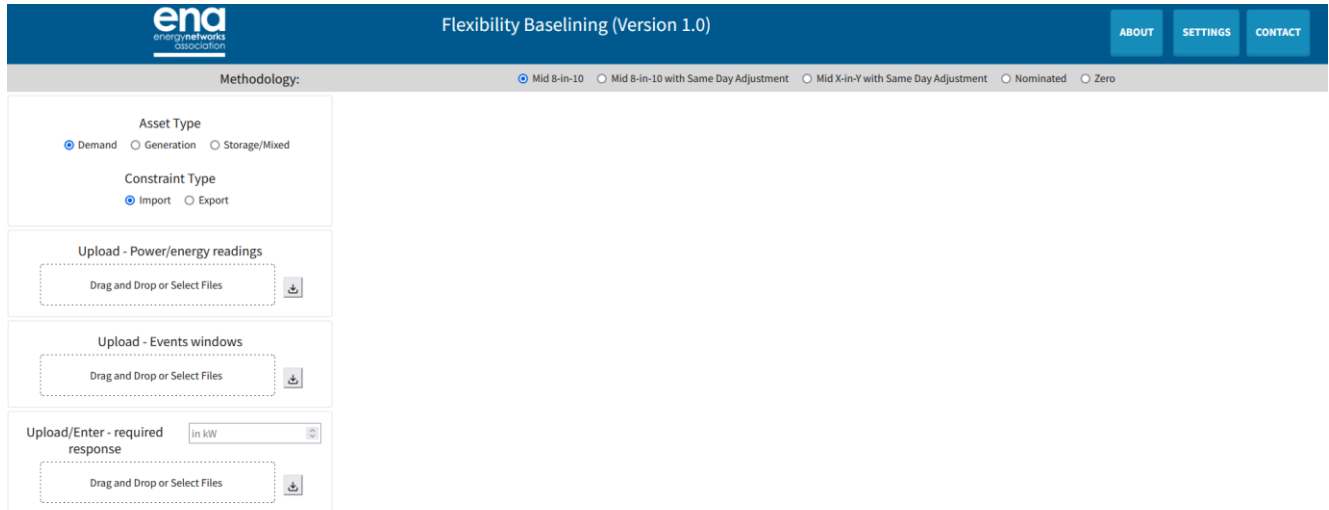
The tool is implemented using the Python scripting language and hosted using Heroku's Platform as a Service, available here: <https://www.heroku.com/platform>.

User data is temporarily uploaded to the tool's Heroku server, which carries out the necessary calculations and returns results to the user's browser. All locally stored data is cleared when the browser tab is closed, and the tool does not store any cookies or any other identifying information.

TNEI, on behalf of ENA, have taken reasonable precautions to ensure that any data uploaded to this tool is transferred and processed securely. However, TNEI and ENA cannot accept liability for any damage sustained in relation to the tool or as a result of the processing or transfer of any data through the tool, including but not limited to any data loss or incorrect data sharing, and would advise that users take appropriate precautions if uploading any sensitive data. Furthermore, TNEI and ENA would advise users make sure there is no personal data included in anything uploaded to the tool.

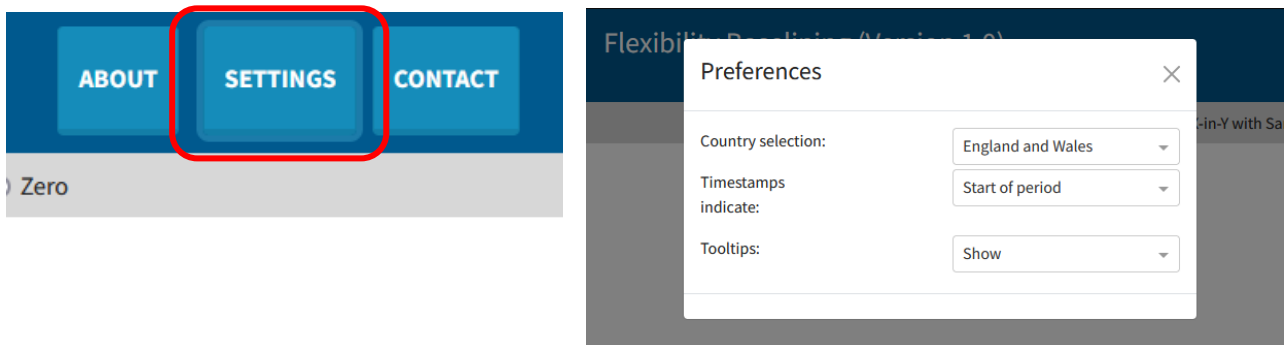
Southern Electric Power Distribution plc (SEPD) commissioned the development of the baseline tool by TNEI solely for the purpose of its TRANSITION trial and not for use by any other third parties. SEPD gives no guarantee of and accepts no responsibility for the suitability or effectiveness of the tool and makes no representation or warranty of any kind, express or implied, as to the suitability of the tool, its fitness for any particular purpose or its freedom from defects. SEPD also gives no guarantee and accepts no responsibility for any information processed by or in relation to the tool or for the process of transfer of information through or in relation to the tool. SEPD makes no representation or warranty of any kind, express or implied, as to the process of information transfer or processing through the tool and/or the suitability, completeness, currentness or accuracy of the information processed or transferred. The tool and the information are provided "as is". SEPD does not accept liability for any damage sustained in relation to the tool or as a result of the processing or transfer of any data through the tool, including but not limited to any data loss or incorrect data sharing. Please do not upload any personal data to the tool.

## How to use this tool



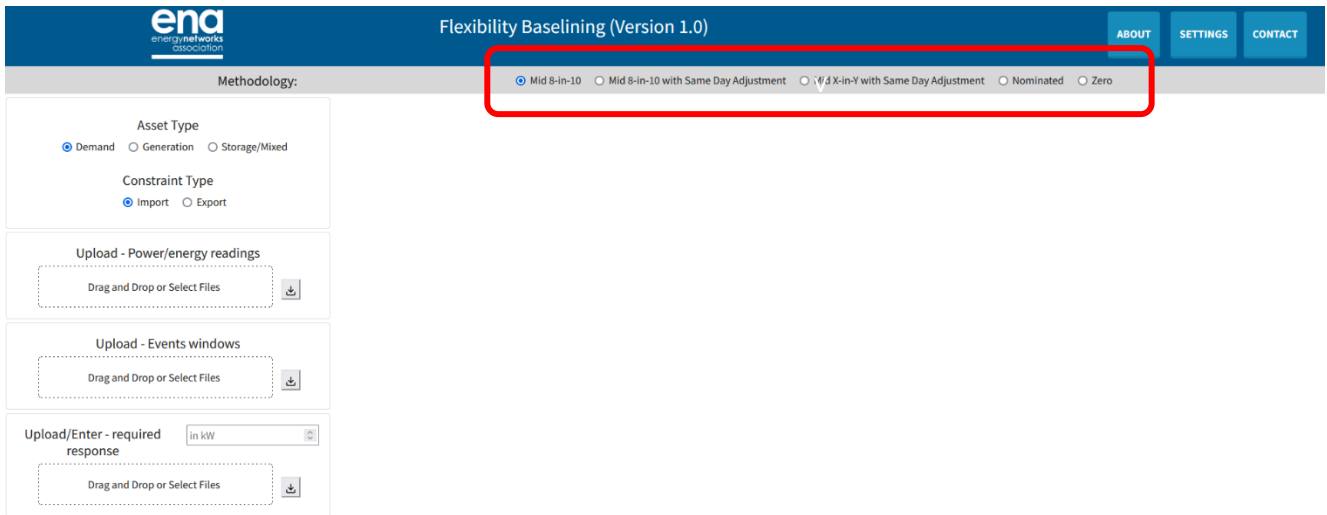
### How to use the tool:

1. Click the “settings” button and modify the preferences.
  - a. By default, the tool will use England and Wales bank holidays when calculating historic baselines, but this can be changed to use Scottish bank holidays.
  - b. The default is for timestamps to denote the *start* of the timestep: an input labelled with 10:30am would (with half hourly data) correspond to the average (or total) from a *start time* of 10:30am until 11am. This can be changed so that they denote the end of the timestep: then, an input labelled with 10:30am would (with half hourly data) correspond to the average (or total) from 10:00am until an *end time* of 10:30am.

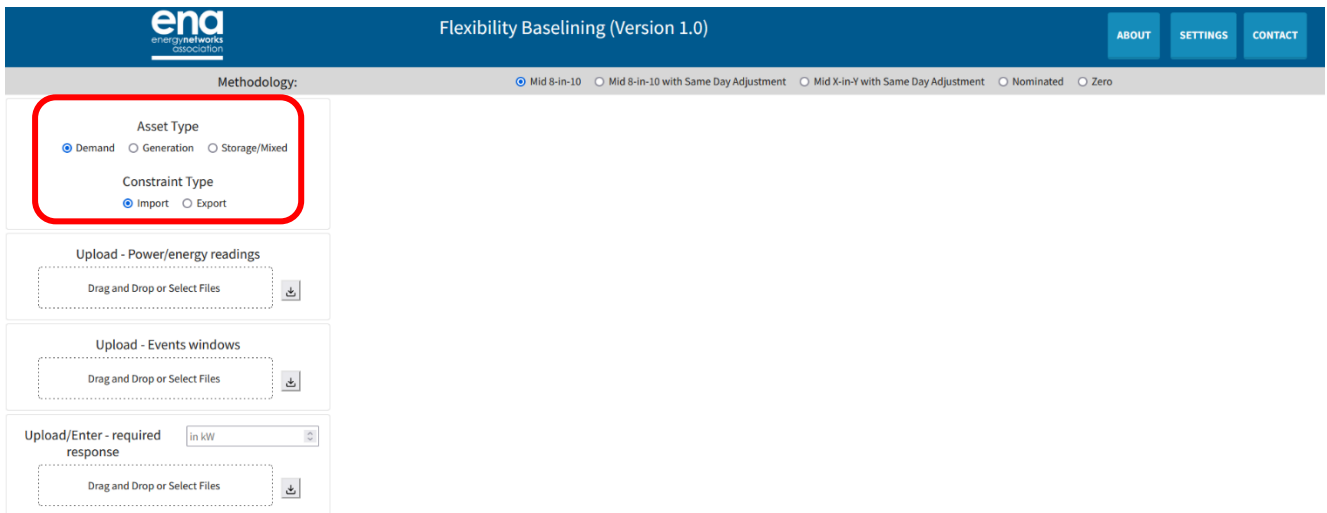


2. Choose which baselining methodology to apply in the grey banner at the top of the tool. The default method is “Mid 8 in 10”.

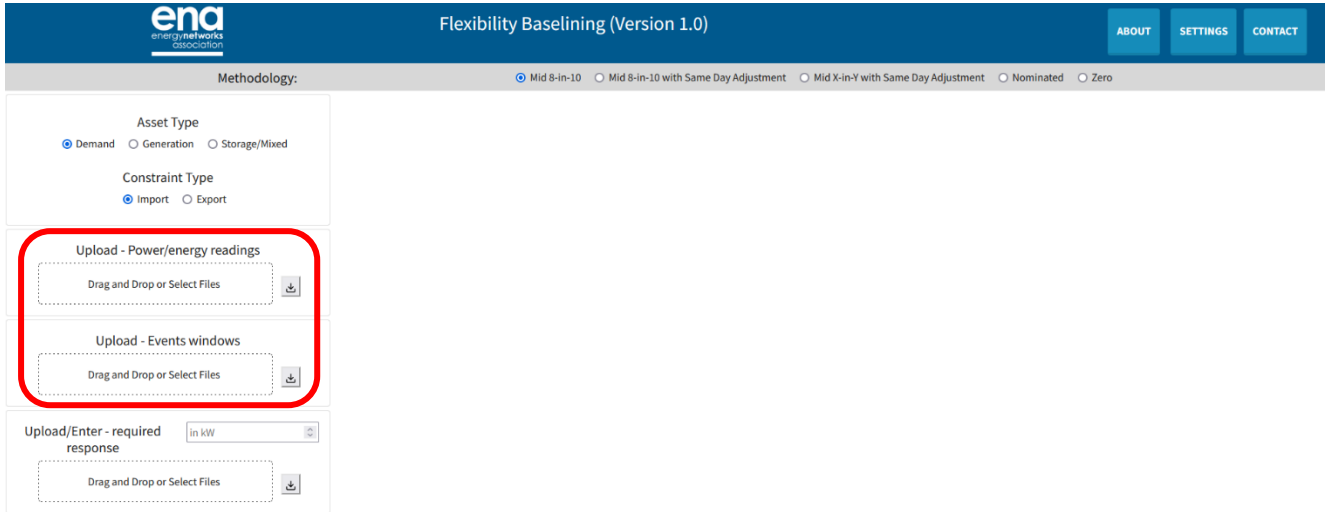




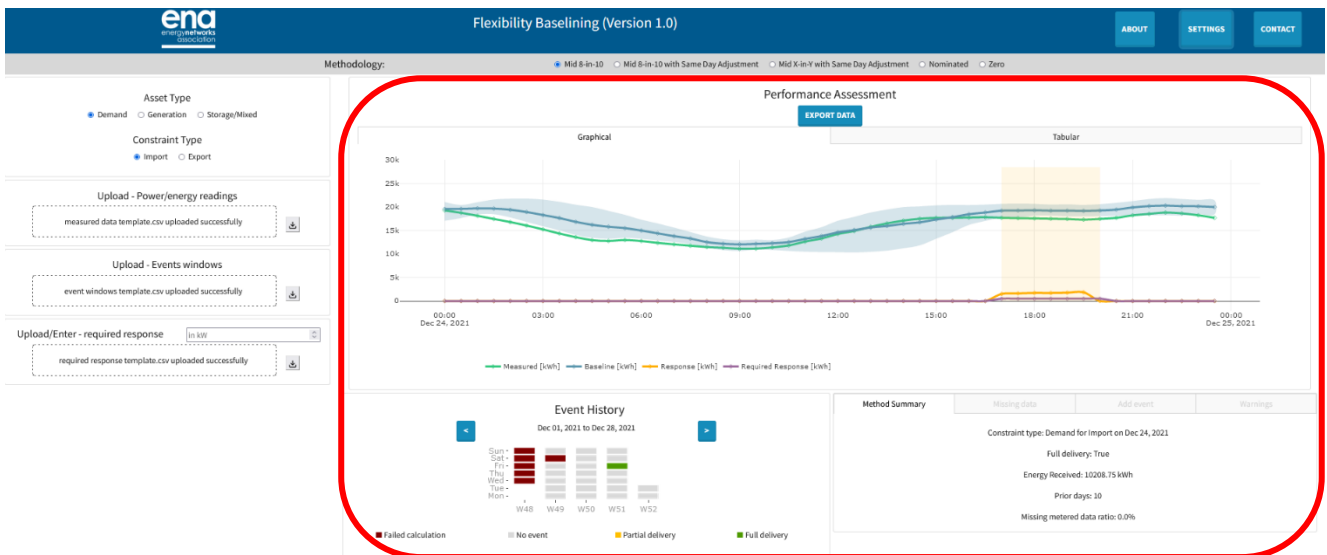
3. Use the “radio” buttons to specify the type of asset (e.g. demand, which should have negative power/energy readings, generation, which should have positive power/energy readings, or a storage or mixed site) and the type of constraint which the flexibility service is addressing (import or export). If there is an inconsistency between the data and the asset type, the tool will raise a warning and no baseline calculations will be performed. The user should then check that both the data and the asset type selected are correct before re-uploading and performing the baselining calculations again.



4. Drag and Drop or Select the required files. At a minimum, power/energy readings and event windows will be required.

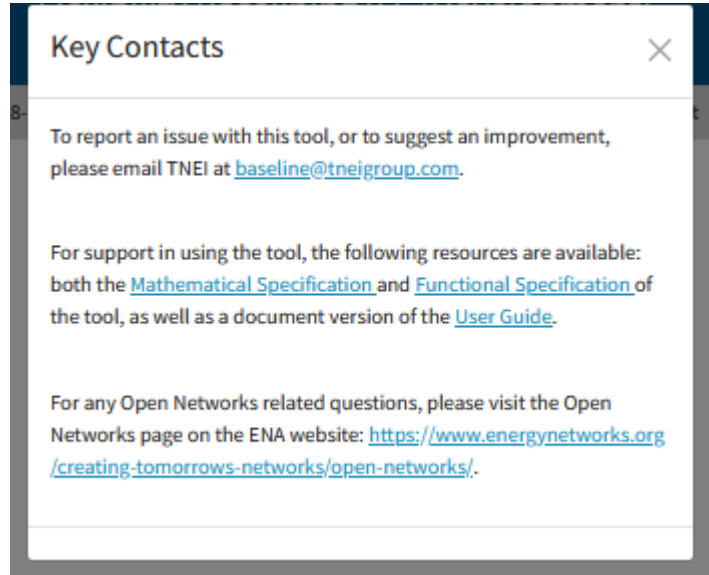


5. Results will then be displayed in the tool.



If the tool page is refreshed, or closed and re-opened, the data will be cleared and the tool will return to the “About this tool” pop-up, and from there can follow this process again to perform any additional baselining calculations.

The “About” button re-opens the “About this tool” pop-up, and the “Contact” button provides links for the key contacts and additional supporting material for the tool.

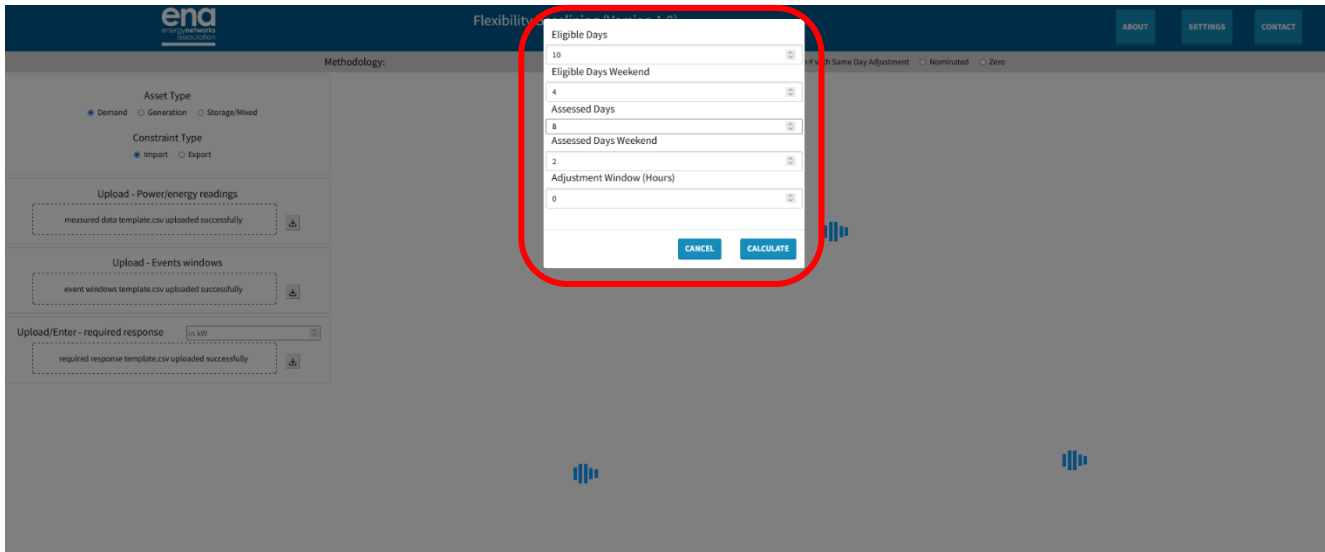


### Available methodologies

There are currently five methodologies available in the tool, which can be selected using the radio buttons at the top of the page. These are:

- **Mid 8-in-10:** A rolling historical baseline which uses data from the “middle” of the last 8 of 10 days.
- **Mid 8-in-10 with Same Day Adjustment:** A rolling historical baseline which uses data from the “middle” of the last 8 of 10 days, but also applies a “same day adjustment”.
- **Mid X-in-Y:** A custom rolling historical baseline, where the user can choose how many days to consider and what length of same day adjustment to use.
- **Nominated:** A nominated baseline, which allows the user to input the self-declared baseline of the asset in advance of the flexibility dispatch event.
- **Zero:** A zero baseline.

If selecting the custom rolling historical baseline, a popup will prompt the user to select the parameters they want to vary and enter appropriate values. The maximum value for assessed and eligible days is 10 days for weekdays and 6 days for weekends. The maximum length of same day adjustment window is 4 hours.



## Input files and settings

To use the tool, it is necessary to upload at least two files:

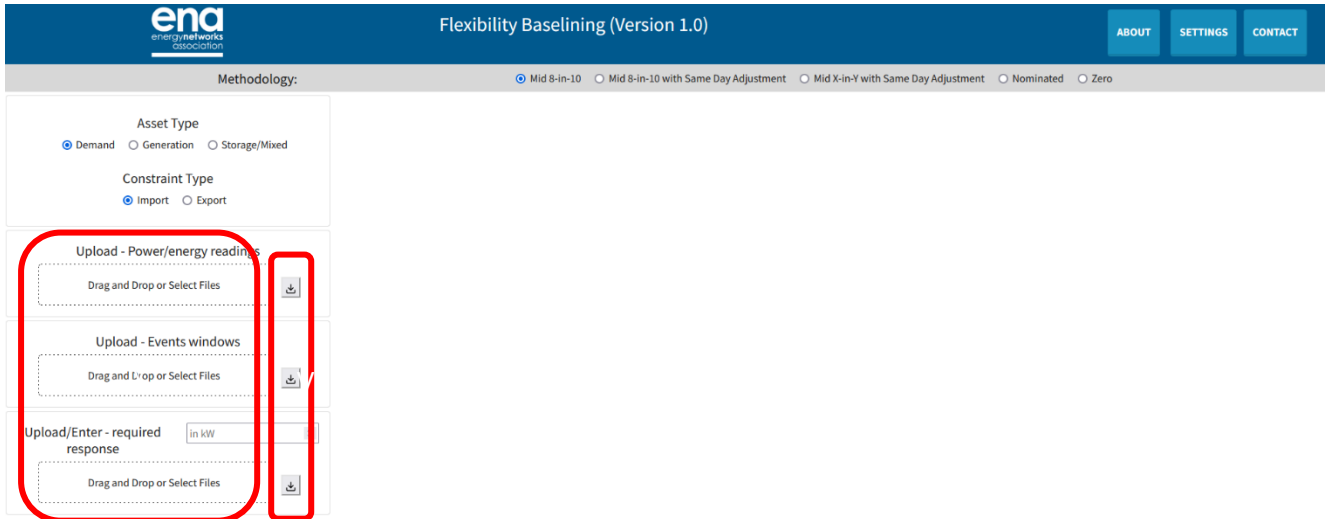
- **Power/energy readings:** this is the data on consumption or production.
- **Event windows:** this defines the start and finish of each flexibility event. This should define the duration of the event, that is the start (inclusive) and end (exclusive) times, and not the start and end periods. For example, if an event runs from 5pm until 8pm, these are the two times needed to define the event window.

The historic rolling baseline methodologies require historic data for the day prior to the flexibility event and, if using a same day adjustment, historic data from the day of the event. However, if a user wishes to examine what their baseline could be in the future, then the tool could be populated with forecast data in place of historic data. The accuracy of any future calculated baselines will then depend on the accuracy of those forecasts.

Depending on the chosen methodology and requirements, two additional files can be uploaded:

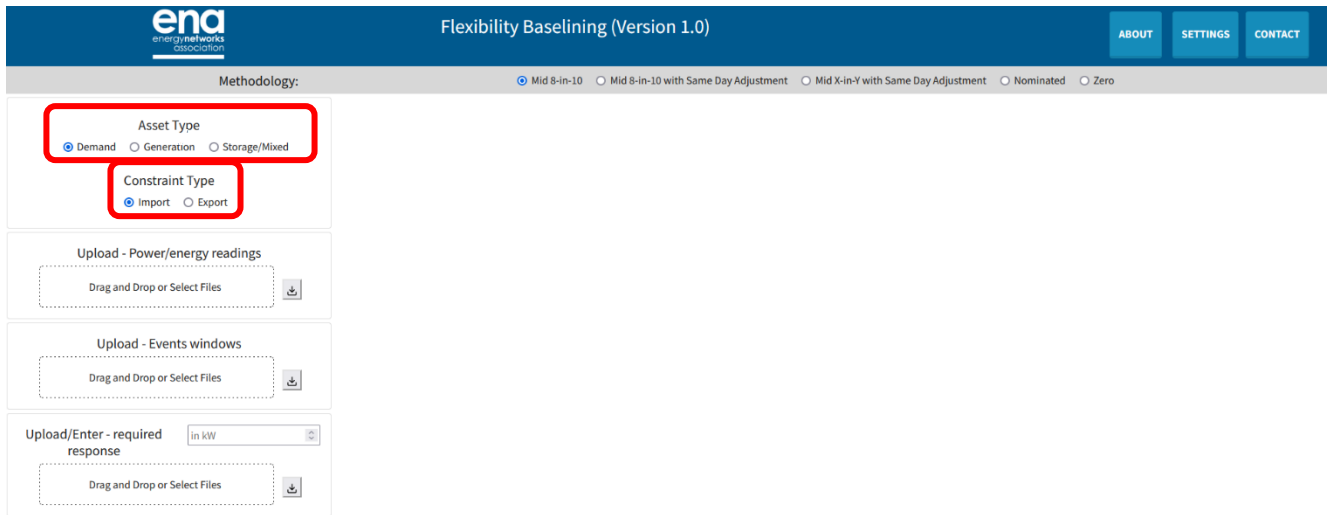
- **Required response:** this is the contracted flexibility requirement, as defined by the relevant DNO for the specific flexibility service.
- **Nominated baseline:** if using a nominated baseline, this file is used to upload that nominated baseline.

Files can be dragged and dropped into the upload windows. Alternatively, clicking on the upload window will open a file browser which allows you to navigate to and select the files you want to use.



These files should either be comma separated value (.csv) files, or lossless zip-compressed comma separated files (.zip). Next to each upload window there is a download button – clicking this will download a file template. Each of the templates show the data format requirements. They also contain some example data derived from GB National Demand, available from National Grid ESO, that can be used for exploring the tool. This example data is for a demand asset responding to an import constraint.

There is a limit on the size of each file that can be uploaded. These limits are 1MB for uncompressed files, and 250kB for compressed files.



It is necessary to indicate flexibility **asset type** (demand, generation, or mixed/storage). This defines whether the input data is expected to be positive (generation), negative (demand) or both (either storage or a mixed site with both generation and demand). If the uploaded data is not consistent with this convention, the tool will raise an error.

Note that the methodology of the calculations does not change depending on the asset type, however the asset type must be selected to allow the tool to confirm if the data uploaded matches the sign convention expected for that asset type.

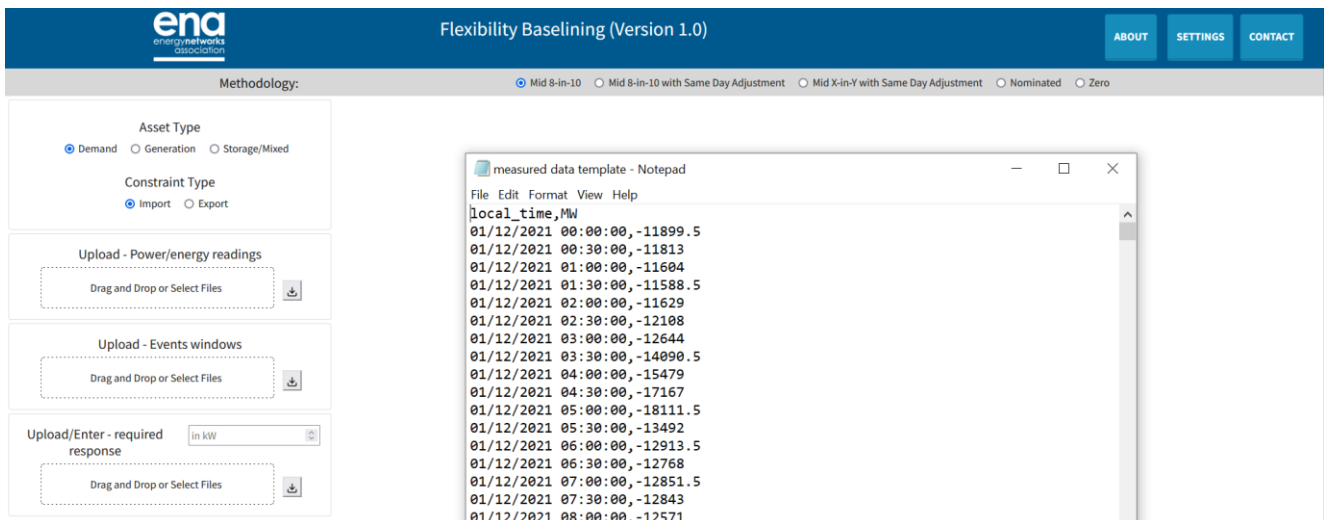
It is also necessary to select the **constraint type** (import or export) which the flexibility is trying to address.

## POWER/ENERGY READINGS

This is the data on historic (or forecast) consumption or production. This should be a time-series, with two columns:

- One column should be called “local\_time” and should contain appropriate formatted dates and times with consistent timestamps. The format for these dates and times is `dd/mm/yyyy hh:mm:ss`.  
The tool expects data to be uploaded in local time, and will automatically adjust for clock changes. That means the tool expects an hour to be skipped when the clocks go forward, and an hour to be repeated when they go back.
- The second column should contain power or energy readings, with a header that corresponds to the units of measurement (i.e. W, kW or MW for power, or Wh, kWh or MWh for energy). The tool can accept either power or energy data, and will convert it if required before performing the calculations.

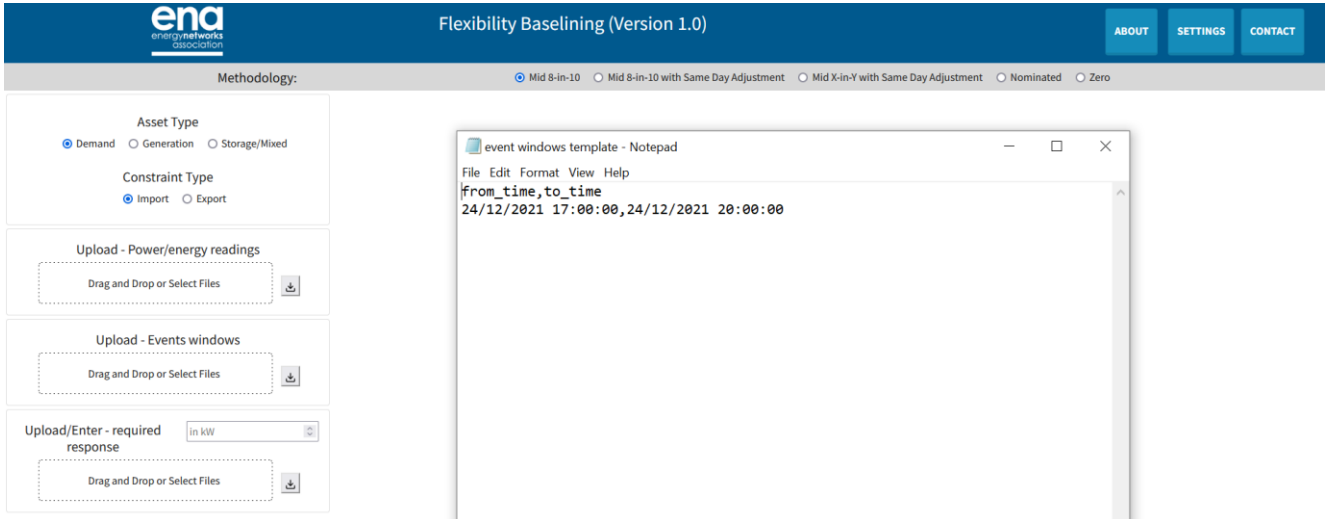
The tool can accommodate readings with time steps of 1 minute, 2 minutes, 3 minutes, 5 minutes, 6 minutes, 10 minutes, 15 minutes and 30 minutes. The tool will convert all uploads to 30-minute averages for calculating the results.



## EVENT WINDOWS

At least one flexibility event needs to be defined within this file. This should have two columns, labelled `from\_time` and `to\_time`. The start and finish times of the flexibility event should be defined in these two columns, for each event window, using the same datetime format as the power/energy data.

The tool currently requires the start and finish time of a flexibility event to be on the same day and can only accommodate a single event on each day.

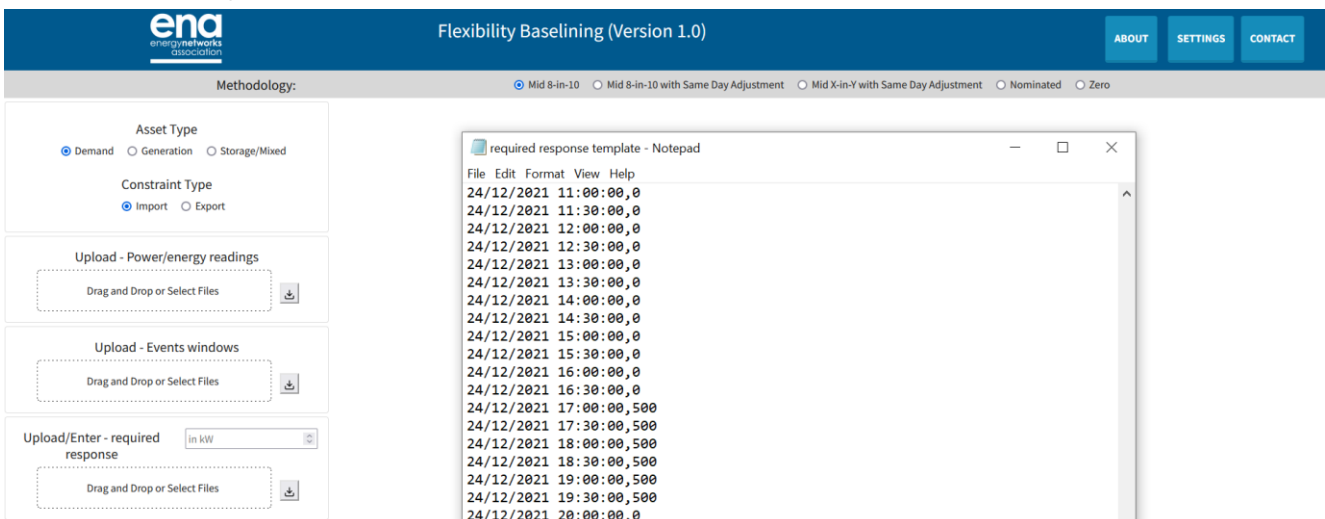


Each flexibility event should align with the other uploaded data (i.e., if using a rolling historical baseline, it should be possible to calculate a baseline for each event using the uploaded data; if using a nomination baseline, a nominated baseline should have been uploaded for this event).

In the event that the user is trying to calculate a forecasted rolling historic baseline, using forecasted power or energy readings, then they can upload a file with an event window defined for a period in the future consistent with the forecast data that has been provided (e.g. for forecasting the baseline for 30 days in the future, forecast power/energy readings for the 10 preceding days will need to be provided).

### REQUIRED RESPONSE

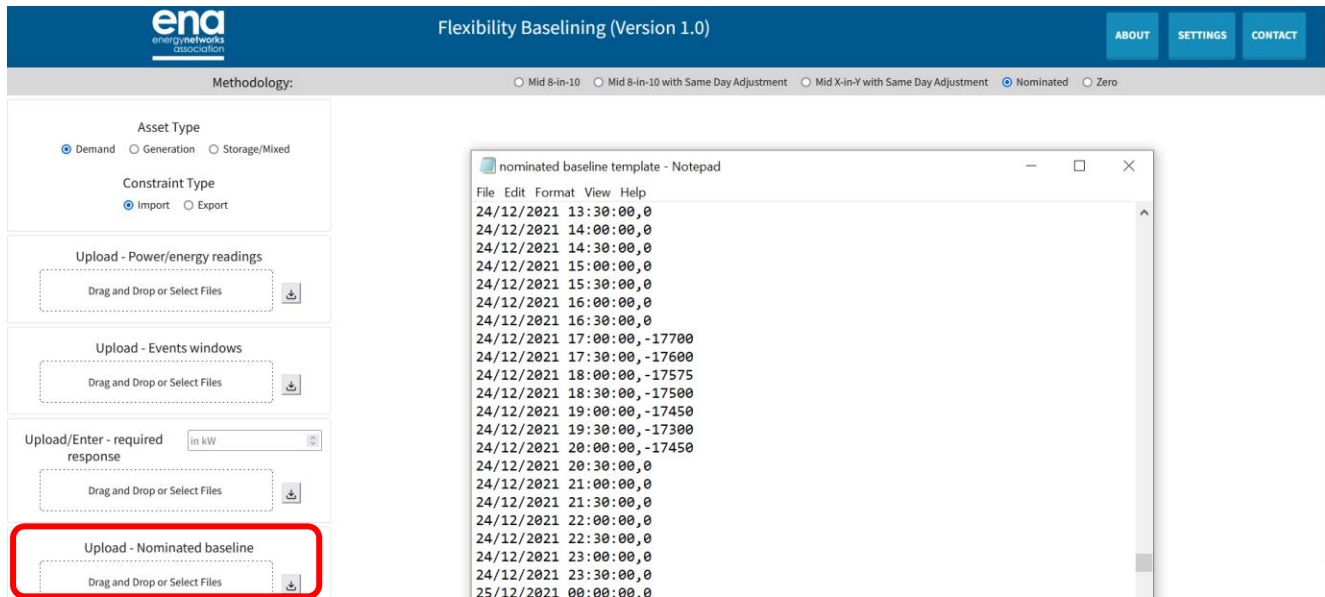
This is the data describing the DNO's required flexibility response. The format is the same as the power/energy readings file. The tool can work with different granularities of timesteps, but will ultimately convert everything to a 30-minute average.





## NOMINATED BASELINE

This is the data describing the nominated baseline. The format is the same as the power/energy readings file. As above, the tool can work with different granularities of timesteps, but will ultimately convert everything to a 30-minute average.



The screenshot shows the Flexibility Baseline Tool (Version 1.0) interface. The 'Methodology' dropdown is set to 'Nominated'. The 'Upload - Nominated baseline' section is highlighted with a red box. An inset window shows a 'nominated baseline template' in Notepad with the following data:

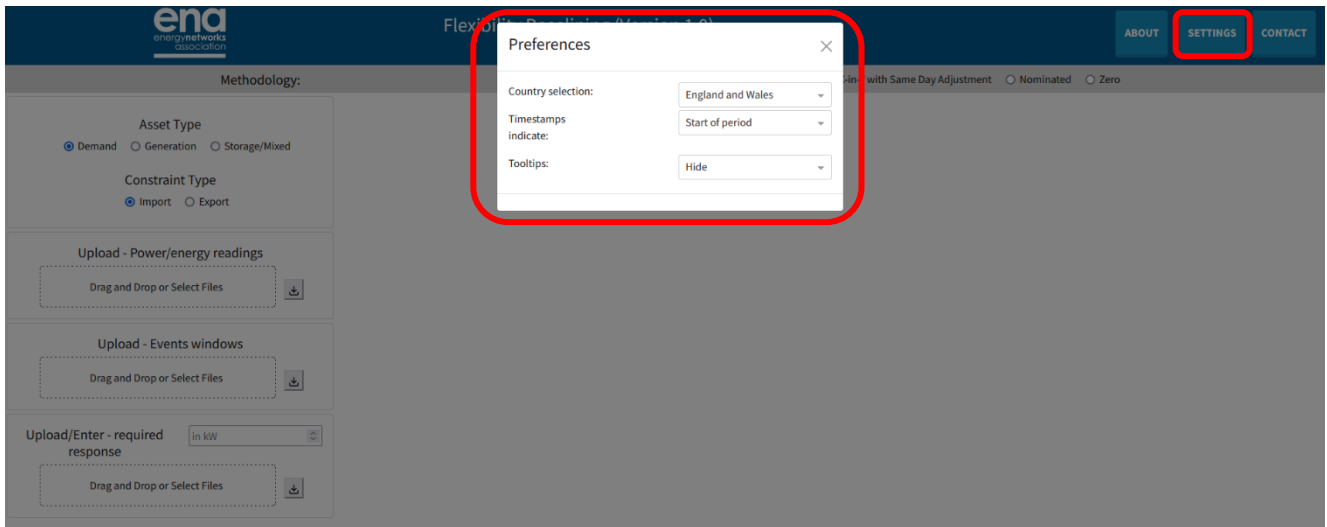
```

File Edit Format View Help
24/12/2021 13:30:00,0
24/12/2021 14:00:00,0
24/12/2021 14:30:00,0
24/12/2021 15:00:00,0
24/12/2021 15:30:00,0
24/12/2021 16:00:00,0
24/12/2021 16:30:00,0
24/12/2021 17:00:00,-17700
24/12/2021 17:30:00,-17600
24/12/2021 18:00:00,-17575
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24/12/2021 22:30:00,0
24/12/2021 23:00:00,0
24/12/2021 23:30:00,0
25/12/2021 00:00:00,0
  
```

## USER SETTINGS

A number of user settings can be defined by pressing the “settings” button on the navigation bar:

- **Bank holiday selection:** the calculation of historical rolling baselines considers the timing of bank holidays. This setting allows a user to indicate whether the asset being considered should use bank holidays for England & Wales or Scotland.
- **Timestamp convention:** Users can indicate whether timestamps refer to the start of the timestep or the end of the timestep.
- **Tooltips:** Users can control whether or not tooltips should be displayed. Tooltips are a pop up description of an element of the user interface – when the user hovers over a component of the tool, a description of that component will be displayed.



## Outputs

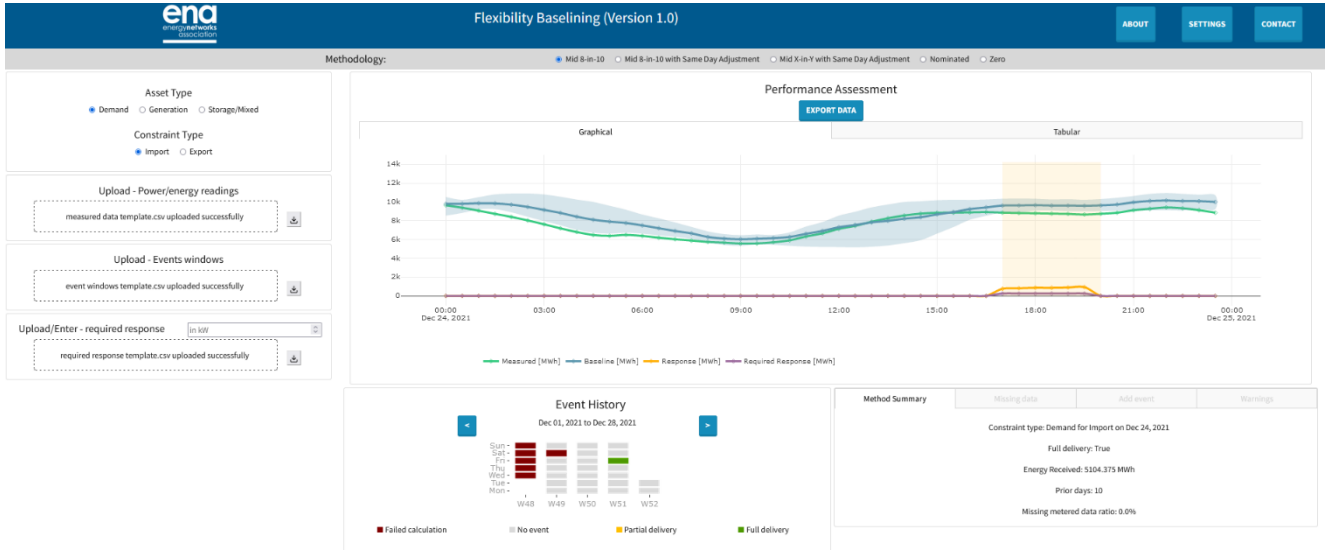
There are three principle sets of outputs provided in the tool:

- **Performance Assessment** gives a graphical time-series display showing the baseline results for a specific day, alongside the measured data for the provider and any resulting flexible response.
- **An Event History** calendar heatmap which summarises results for a month's worth of days and allows users to select the specific day for which they want to see detailed results.
- **Information tabs** which provide additional information about the calculations and data.

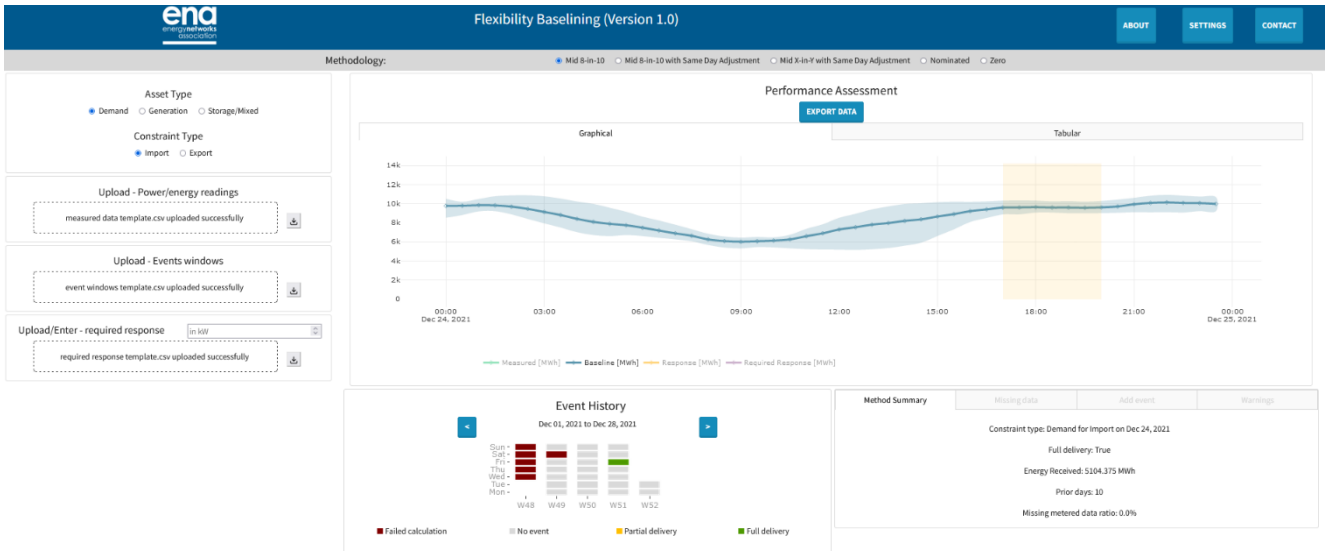
## PERFORMANCE ASSESSMENT

Baseline results for a single day are provided in a time-series figure on the "Graphical" tab. This shows each timestep within the day, and the following four traces:

- **Measured (green):** this is the actual measured power/energy for each timestep on that day.
- **Baseline (blue):** this is the baseline for each timestep on that day. Where appropriate, a shaded range gives some indication of the variability around this baseline.
- **Baseline range (blue envelope):** this envelope shows the range of the data (minimum and maximum) that has been used in calculating the baseline.
- **Response (yellow):** this is the difference between the measured and the baseline data, set to zero for all times outside of the flexibility event window.
- **Required response (purple):** this is the defined required response for the flexibility event.



The figure is interactive. Traces can be enabled or disabled by clicking on the legend, and it is possible to hover over traces to get specific values, or to zoom in on specific parts of the figure.



There is a second tab titled “Tabular” which presents the data in a table.

index	measured [MWh]	baseline [MWh]	response [MWh]	required response [MWh]	required responsee [MWh]	date	required
17:00:00	-8852.75	-9607.438	754.688	500	250	2021-12-24	250
17:30:00	-8812.25	-9622.875	810.625	500	250	2021-12-24	250
18:00:00	-8788.25	-9648.781	860.531	500	250	2021-12-24	250
18:30:00	-8752	-9610.312	858.312	500	250	2021-12-24	250
19:00:00	-8721.25	-9611.25	890	500	250	2021-12-24	250
19:30:00	-8655	-9585.219	930.219	500	250	2021-12-24	250

The results can be downloaded using the “export data” button. This is file will be in .csv format. NB, this button will export the results data for the currently selected baseline method only. Baselines can be recalculated by selecting a different methodology, and the results data using that methodology can then be downloaded.

### EVENT HISTORY HEATMAP

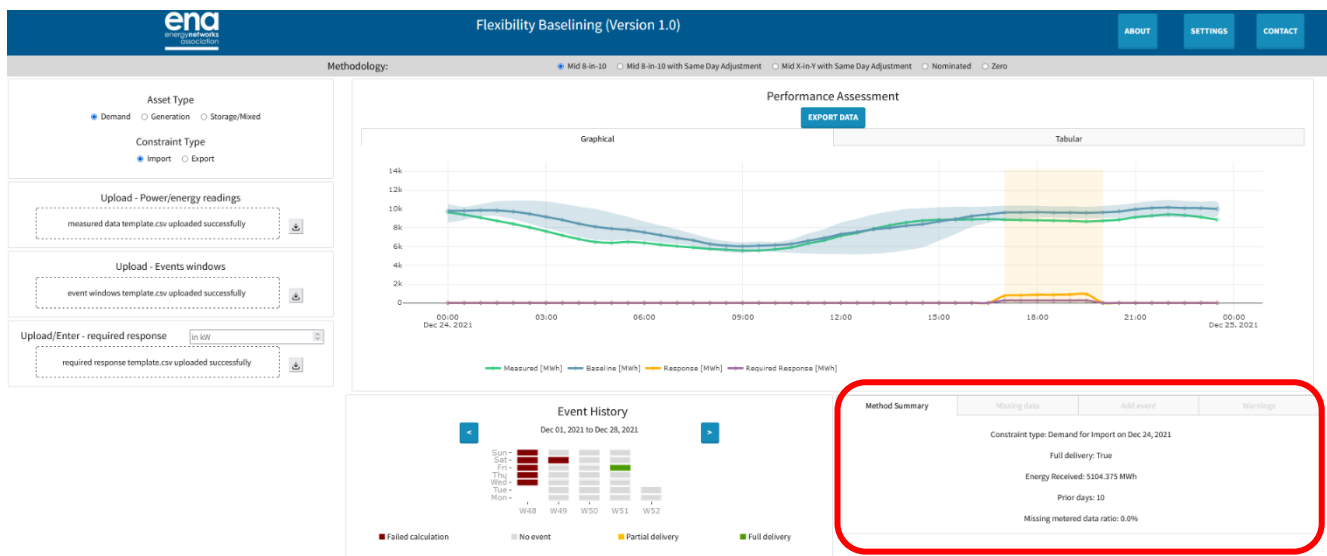
The Event History calendar heatmap summarises the baseline results for 28 days’ worth of inputs at one time, indicating whether the **flexibility event was successful (green)**, whether there **was partial delivery (amber)**, or whether it has been **impossible to calculate the baseline (red)** due to insufficient data. Days with **no flexibility events (grey)** can also be examined to see what their baselines would be. Arrows allow users to navigate between different blocks of 28 days. If using the tool with forecast power/energy data to forecast a baseline for the future, then users can navigate to that future day.

The screenshot shows the 'Performance Assessment' section with a line graph comparing Measured [MWh], Baseline [MWh], Response [MWh], and Required Response [MWh] over time. Below the graph is an 'Event History' heatmap for Dec 01, 2021 to Dec 28, 2021, with a red box around it. The heatmap uses color coding: red for failed calculation, grey for no event, yellow for partial delivery, and green for full delivery.

## INFORMATION TABS

In the bottom right of the screen there are four information tabs available:

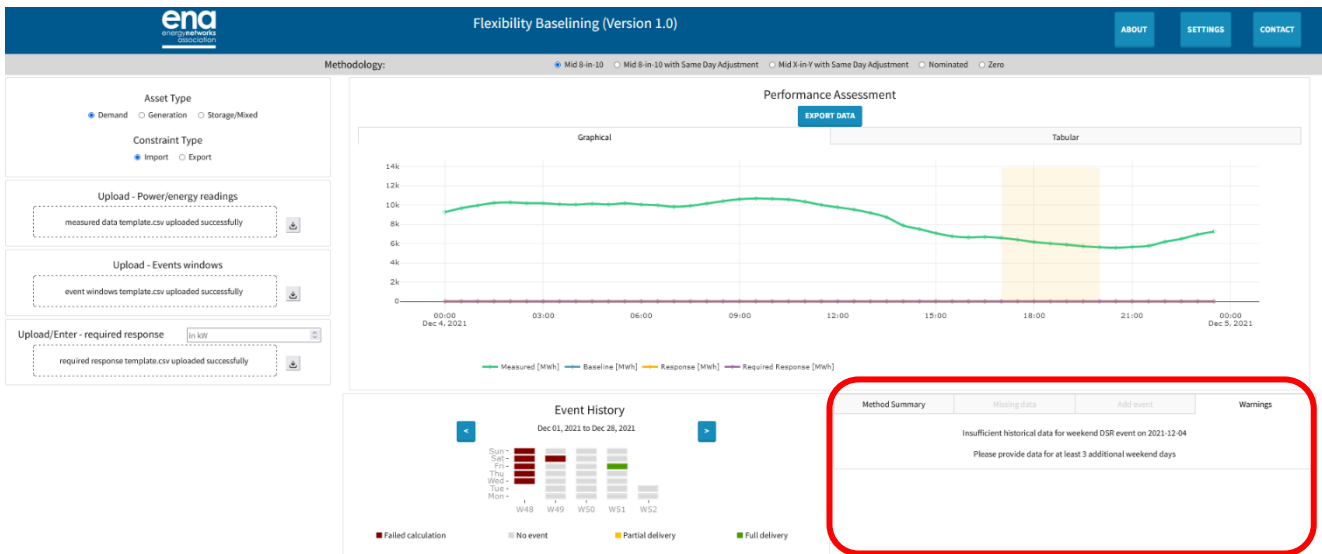
- **Method summary:** this summarises the calculation including whether there was a full or partial delivery of a flexibility response, the volume of energy delivered, the number of days used in the calculation of a historical baseline, what proportion of uploaded power/energy data is missing etc.



- **Missing data:** this displays all the windows during which there is missing data in the power/energy readings file.
- **Add event:** on days where there is no flexibility event, this allows users to add an event with a specific start and finish time. This means that users can add additional flexibility events on these days in order to examine what the baseline calculation would have been. This tab can only be selected after a day with no event has been selected from the Event History calendar heatmap.

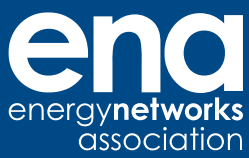


- **Warnings:** if it has not been possible to calculate a baseline, this tab provides warning messages which summarise why.



## Key References

1. [Flexibility tool \(direct link\)](#)
2. Additional information on the Flexibility Tool can be found on ENA Open Network's [Flexibility Services](#) page.
3. [SSEN TRANSITION project website](#)
4. [ENA Open Networks programme website](#)
5. DNV-GL report to ENA Open Networks, "[Baseline Methodology Assessment](#)"
6. Flexibility Tool [Functional Specification](#) – outlining the requirements of the tool
7. Flexibility Tool [Mathematical Specification](#) – defining the algorithms for performing the baselining calculations.
8. [Open Networks P7 Baselining Methodologies Final Report](#)



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