



N4 EnergyManager

powered by  energyvision

User Guide

Version 3.6.0

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Release History

Please refer to this section of the documentation for the **N4 Energy Manager** changelog.

Version Control Changes

Version Control	Changes
3.6.0	<ul style="list-style-type: none"> • Bug fixes: <ul style="list-style-type: none"> • Vertical Menu component crashes with named colour properties in Niagara 4.8 • Issues with multiple Y axes on the line chart • History extension throws duplicate history extension after csv import • Heatmap chart's unit is °C when aggregator's unit is missing • Relativized Bar/Heatmap charts do not work in pop-up views • Bar chart is not printed in PDF from Report/Export Source component • Charts do not work in presence of third-party modules • Infinite and NaN values are used in aggregator calculations • Vertical Menu component's Home button does not work • Inactive and Offline meter count are not shown on the line/pie charts • Energy Comparator component bugs • Gauges/Dials do not support transparent background colour • 5Y period with currency toggled on chart taking longer than expected to load the data. • PDF Report save/load bugs: popup window is removed • Currency sign is not respected in PNG/PDF instant reports • n4EnergyManagerReports module forces Niagara to rebuild the registry at the station start • Niagara 4.13 compatibility issues • Improvements: <ul style="list-style-type: none"> • Total value is displayed in pie chart's tooltip • Custom Period's "Event" and "Period" properties are writable • Aggregator can have up to 150 meters • Line charts display fractional numbers on the y-axis • Energy Comparator has cost-related properties • New features: <ul style="list-style-type: none"> • Weather service (see Weather service) • Anomaly Detection (see Anomaly Model!) • Site component (see Grouping of aggregators) • Service- and meter-level inactive and offline thresholds (see Data-Quality Alarms) • Updated documentation: <ul style="list-style-type: none"> • Energy Comparator (see Energy Comparator) • PDF Report Builder configuration (see Batch Reporting) • Aggregator modes clarification (see Aggregator Mode) • A note on what kind of values is used in aggregator calculations (see Calculated values)

	<ul style="list-style-type: none"> History CSV import clarification (see CSV Import)
<p>3.5.0</p>	<ul style="list-style-type: none"> Bug fixes related to Charts: <ul style="list-style-type: none"> Line chart is not updated correctly for January for weekly/yearly view Offline option in a meter inside an aggregator should return true for history with null reading Formulas disabled in N4EnergyManager invoice spreadsheet Chart Data Binding: Ord popup window cannot load Stacked Bar chart: aggregators are not shown under meters tab of data-config popup Stacked Bar chart: rendering issue when not all bars are toggled on and user selects different time periods Tooltips: correct timestamp formats, they should not be shown for future timestamps Niagara 4.12 compatibility issues New features: <ul style="list-style-type: none"> Background transparency support for vertical menu and charts Ability to have first/last accumulative meter readings for Excel reports Ability to show symbols on top of lines in line charts Ability for aggregators to be in the root of the station Tooltips: colour keys to differentiate values on tooltips Threshold colours for dial gauges, arbitrary colours for LED dial and needle gauges Updated documentation: <ul style="list-style-type: none"> Meter replacement Addition of external database histories Csv Import scheduling Saving data configuration locally
<p>3.4.6</p>	<ul style="list-style-type: none"> Bug fix for Regression chart regression Bug fix for CSV Export on ET Analysis in Niagara 4.11
<p>3.4.5</p>	<ul style="list-style-type: none"> Updated documentation for: <ul style="list-style-type: none"> Degree Days Custom Time Periods (Aggregator) Excel Reporting Batch Reporting Bug fix to support Data Quality alarming Bug fixes related to Charts Chart refresh for Kiosk mode Stability improvements to Batch Reporting
<p>3.4.4</p>	<ul style="list-style-type: none"> Bug fix release to support Niagara 4.11
<p>3.4.3</p>	<ul style="list-style-type: none"> Bug fix to support Pdf Reporting on N4.10

3.4.2	<ul style="list-style-type: none"> • Security Update in response to Log4j2 vulnerability CVE-2021-44228
3.4.1	<ul style="list-style-type: none"> • Bug fix to avoid PX migrations losing layer information
3.4.0	<ul style="list-style-type: none"> • Updated documentation for Energy Temperature Chart Analysis • Addition of FAQ • Tariff Scheduling • White-labelling capabilities • Report printing in Landscape mode • Addition of Energy Comparator section • Updated Demo Station
3.3.1	<ul style="list-style-type: none"> • Security enhancements • License management enhancements • Bound table widget for reporting
3.3	<ul style="list-style-type: none"> • Burger Menu saved settings • Weekly comparison for charts • Lock Ideal time range for chart comparison
3.2	<ul style="list-style-type: none"> • Excel Reports, Maintenance licensing for selected features.
3.1.7	<ul style="list-style-type: none"> • License change to introduce Core /Pro Tier • Product name change to N4 Energy Manager
2.4.1	<ul style="list-style-type: none"> • Last Energy Vision release

Welcome

Welcome to **N4 Energy Manager**. The purpose of this document is to assist in engineering an **N4 Energy Manager** station, explaining the unique features and settings while advising on any tips and tricks to best utilise the software.



N4 Energy Manager has been developed and tested for Niagara version 4.8, 4.9, 4.10, 4.10u1 - 4.10u6, 4.11, 4.12, 4.12u1, 4.12u2 and 4.13u2

Installation

To install **N4 Energy Manager**, follow the steps below. Prior to installation, ensure that the Niagara station and workbench are not running. Additionally, when **N4 Energy Manager** was purchased, download the modules from the partner web. In addition to the modules, a demo station will be provided.

1. Open the module folder received which contains **N4 Energy Manager**.
2. Navigate to the module folder for Niagara > **C:\Niagara\Niagara-4.x.xx.xx\modules** [Version number may differ].
3. Copy and paste the **N4 Energy Manager** modules into the Niagara Module folder.
4. Start Platform Daemon.
5. Restart Station
6. If CSV reporting is to be used, copy the templates into the station file space



To check that **N4 Energy Manager** has installed correctly, open the palette, search for **N4 Energy Manager** and the appropriate components should be listed.

Once these steps have been completed the **N4 Energy Manager** service needs to be added to your station from the Palette.



N4 Energy Manager works best when used in conjunction with a 64-bit Niagara Installation. If you are using a 32-bit Niagara installation it may be worth considering installation the 64-bit version. If this is not possible, please read the notes in the troubleshooting guide.



Due to the differences between **Energy Vision AX** and **N4 Energy Manager**, it is not possible to automatically migrate one to the other. An AX station will need to be re-engineered using **N4 Energy Manager**

White Labelling

Resellers can rebrand the product with their own collateral. To white label **N4 Energy Manager**, please contact your distributor on how to engage with this capability. A new module is required to support your company branding collateral.

The aspects of **N4 Energy Manager** which are covered by white labelling are:

	Branding Information	Description
1	Logo	A logo is a graphic mark, emblem, symbol, or stylized name used to identify a company, organization, product, or brand. Logo must be in a standard web format like jpeg, png or svg etc.
2	Marketing material	Marketing materials include any items for communicating your marketing to customers. It could be brochures or catalogs etc. It must be in a standard web format like jpeg, png or svg.
3	Product name	Product name that needs to be rebranded from n4EnergyManager
4	Pro Licence Button text	The button label prompting users to upgrade. 
6	Company name	Name of Company who is white labelling the product.

Licensing

The **N4 Energy Manager** licensing model has changed to enable users to benefit from a Core tier and a Pro tier, differences in both can be seen in the table below:

	N4 EnergyManager Core	N4 EnergyManager Pro
Included usage	Free with limited features	All Packages Fully Featured
FEATURES		
Energy Benchmarking	✓	✓
Energy Ranking	✓	✓
Advanced Bar Charts	✓	✓
Contribution Analysis	✓	✓
Regression Analysis	✓	✓
Heat Map	✓	✓
Menu Builder	Limited to 10 Menu Items	Unlimited Menu Items
Instant Reporting	Limited to PNG/PDF format	PNG/PDF + CSV & Batch Reporting
Kiosk Mode	Limited to 3 pages	Unlimited pages
Meter Aggregation	Limited to 3 histories	Subject to licence
Weather Service		Subject to licence
Data Integrity		✓
Energy Temp Curve		✓
Tenant Billing / Excel Reporting		✓
Anomaly Detection		✓
<p>Contact us and start building powerful Systems forestrock.co.uk</p>		

Figure 1 - N4 EM LICENSING TABLE

N4 Energy Manager Core

All **N4 Energy Manager** installations require a Core licence. Chargeable new orders will receive a “Pro version” having the “Core Licence” included. For demo installations a Core Licence can be requested free of charge which is bound to the Host ID of your PC. You can request a “Core licence” by sending the following details to your **N4 Energy Manager** Contact or Provider.

- Name of requestor
- Email address
- Telephone number
- Host ID

Once the core licence is enabled on Niagara Central you will need to update the licence of the workbench. A core licence enables you to run **N4 Energy Manager** with real data for 3 meters at no cost.



N4 Energy Manager Core users can trial **N4 Energy Manager** Pro features for a 60-minute period. During this trial period data from aggregators is randomized. A trial can only be activated once without restarting the station.

N4 Energy Manager Pro

The **N4 Energy Manager** Pro package is scalable and provides:

1. Licence based on number of nodes. **N4 Energy Manager** licensing limits the number of **unique histories** that can be used within the **N4 Energy Manager** station.



The number of Aggregators you use is not limited by **N4 Energy Manager** licensing.

2. Default features that are included
 - All charts
 - Menu Builder
 - Data Integrity
 - PNG/PDF batch Reporting
 - Kiosk Mode
 - Energy-Temperature Curve
 - Tenant Billing (Excel Reporting)
 - Anomaly Detection
3. Weather service, which is licensed separately, see [Weather Service licencing](#).

Checking your licence status

It is possible to check how many **unique histories** are being used in the station, and how this corresponds to your licensed amount. Within workbench, load the **spy page's** view on the **N4 Energy Manager Service**. This will provide you with an overview of your licensing status.

Remote Station nav localhost station Services EnergyVision	
Meter Metrics	
Meter limit :	none
Number of unique meters :	17
Meter ORD's	Used
history:/EnergyVisionDemo/CampusPower	4
history:/EnergyVisionDemo/TeachingPowerMeter03	1
history:/EnergyVisionDemo/TeachingPowerMeter02	2
history:/History/CoolMeter	2
history:/EnergyVisionDemo/TeachingPowerMeter10	1
history:/EnergyVisionDemo/LibraryPowerMeter	2
history:/EnergyVisionDemo/TeachingPowerMeter	2
history:/EnergyVisionDemo/TeachingPowerMeter09	1
history:/EnergyVisionDemo/TeachingPowerMeter08	1
history:/EnergyVisionDemo/TeachingPowerMeter07	1
history:/EnergyVisionDemo/TeachingPowerMeter06	1
history:/H_W_CP132A/OustsideAirTemperature	1
history:/History/OAT1	4
history:/History/HeatMeter	2
history:/H_W_CP14a/L THWHeatMeter	2
history:/EnergyVisionDemo/TeachingPowerMeter05	1
history:/EnergyVisionDemo/TeachingPowerMeter04	1

Figure 2 - EXAMPLE OVERVIEW OF LICENCE STATUS

N4 Energy Manager Aggregators

The aggregator is at the core of **N4 Energy Manager**, connecting history data sources to the charts.

An aggregator is a virtual representation of a physical meter in the field. Aggregators also have the option to add external data from a file.

Aggregators normalise data of one or more meters into a 'virtual' meter. For example, 4 sub-meters in the field can be merged into 1 **N4 Energy Manager** aggregator representing a floor. Another example would be subtracting renewable from non-renewables.



Each Aggregator can contain up to 150 meters.



Removing histories or values in histories **will permanently delete** the stored data Energy Manager database.

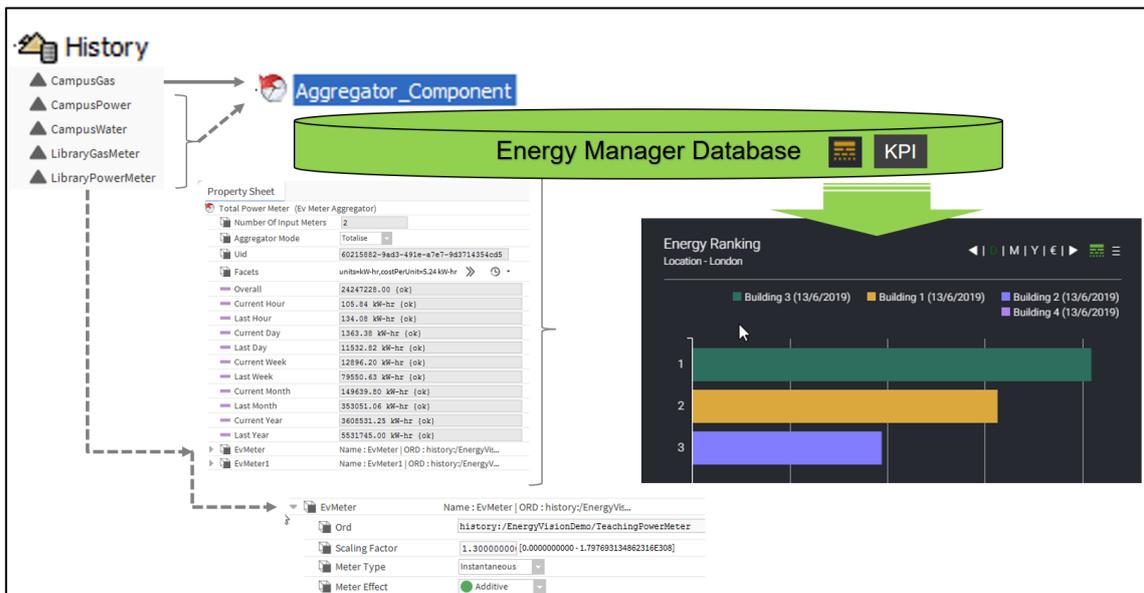


Figure 3 - METER AGGREGATOR OVERVIEW

Creating Aggregators

There are two main ways of configuring and creating aggregators in **N4 Energy Manager**.

1. Manually adding histories to an aggregator
2. By creating the aggregators using the Site Hierarchy

Manually adding histories to aggregators

This method is particularly useful when the user is adding a small number of meters to one page.

1. Open folder in which the aggregator needs to be added.
 - a. **Right Click** on the folder and select **Views > Wire Sheet**.
2. Open the **Palette** ensuring that the **N4 Energy Manager Palette** is opened.
3. **Expand** the folder **Aggregator**.
4. Drag & drop the **Aggregator** component onto the **Wire Sheet**.
5. Double click on the **Aggregator** component.
6. Right-click on the property sheet, select **Actions > Add Meters**.
7. Enter the number of **Meters** that need to be added.
8. Click **OK**.
9. Respective to the number of **Meters** added in step 7, **Meter** (1,2,3 etc....) will be added.
10. Expand **Meter**.
11. The **Ord** line will display **null**.
12. Click the drop-down icon next to the folder icon.
 - a. Select **History Ord Chooser**.
13. Using the pop-up, navigate through your histories selecting the appropriate file.
14. Once selected, click **Ok**.
 To add further, repeat steps **10, 11, 12 (a), 13 & 14**.

Adding histories from remote databases

If a history of a meter is being fetched from SQL or any other external database via a “RdbArchiveHistoryProvider”, one must set the “Max Archive Results Per Query” property to “max” to ensure the proper work of the aggregator.

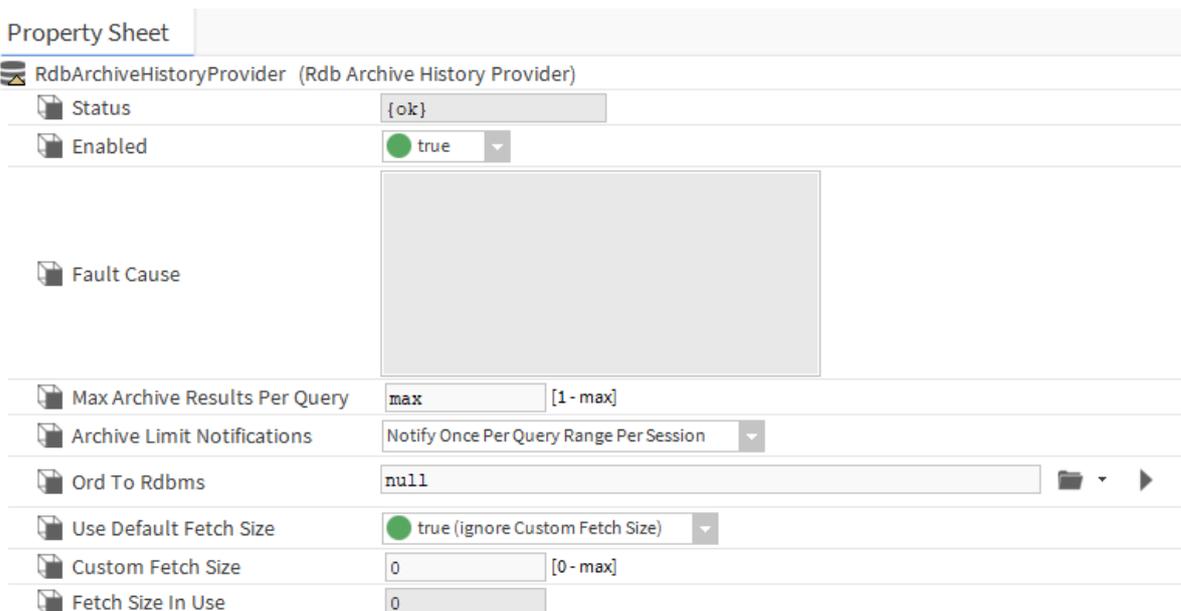


Figure 4 – RDB ARCHIVE HISTORY PROVIDER PROPERTY SHEET

Data Normalisation

Data normalisation can be used to normalise aggregator output to calculate metrics such as “power consumption by area”, “power consumption per employee”. Data Normalisation is the process of applying a scalar operation (add, subtract, divide, multiply) to an aggregator’s output. The normalisation is applied as the final stage in an aggregator’s calculation. If more than one normaliser component is present the normalisation steps would be applied by their order in the slot sheet.

Adding a normalisation step:

- Right-click on normaliser and choose the type of normalisation.
- Set the operand value and the corresponding unit.

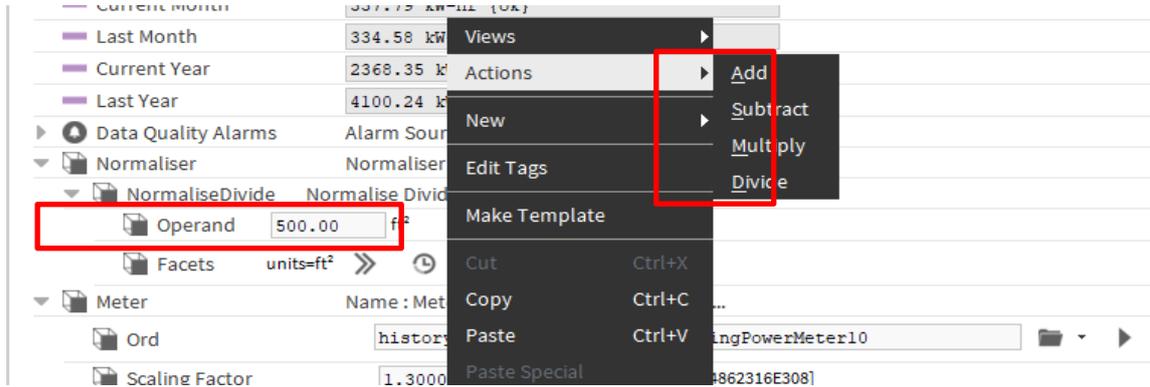


Figure 5 - EXAMPLE OF ADDING A NORMALISATION STEP

Derived Unit:

The unit property on the aggregator is a derived unit based on the base history units and the normaliser units.

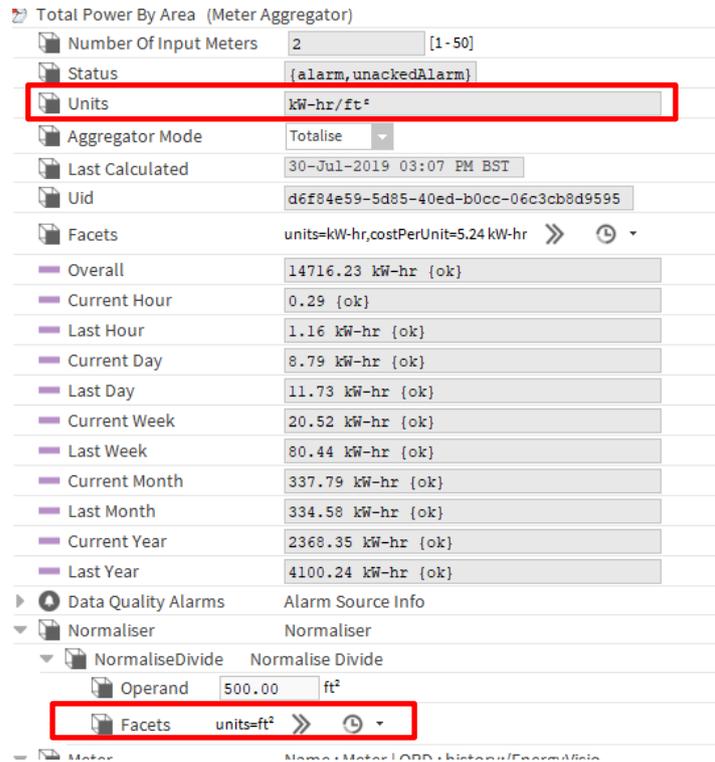


Figure 6 - EXAMPLE OF A DERIVED UNIT

Aggregator Mode

Aggregation mode determines how two meters vales can be combined. The available modes are

- **Totalise** – Meter readings will be added across time intervals and across all the meters linked to that aggregator.
 - E.g. - An aggregator with two meters with history interval of 15 minutes. The last hour reading on aggregator is the sum of all four readings from meter1 taken at 15-minute intervals and four readings from meter2 taken at 15-minute intervals for the last hour.
- **Average** – Meter readings will be averaged across time intervals and across all the meters.
 - E.g. – An aggregator with two meters with history interval of 15 minutes. The last hour reading of the aggregator will be equal to the average of averages from all the meters connected. Four readings from the Meter1 and Meter2 will be averaged and then the final reading on aggregator is the average of outputs from two meters.

Aggregator Facets

The 'Aggregator Facet' is the facet that is used on the aggregator output value and will be displayed in the charts. When adding multiple history files, the aggregator engineering unit must be modified manually. This is achieved by configuring the facets of the Aggregator. In the same

dialog, the cost per unit can be configured. This is used when displaying reports based on cost conversion (for more details please see [Instant Reports](#)).

To manually add a facet

1. Open the Aggregator Property Sheet
2. Click the >> icon in the Facets Property
3. Configure the Units Property
4. Configure the **costPerUnit** Property

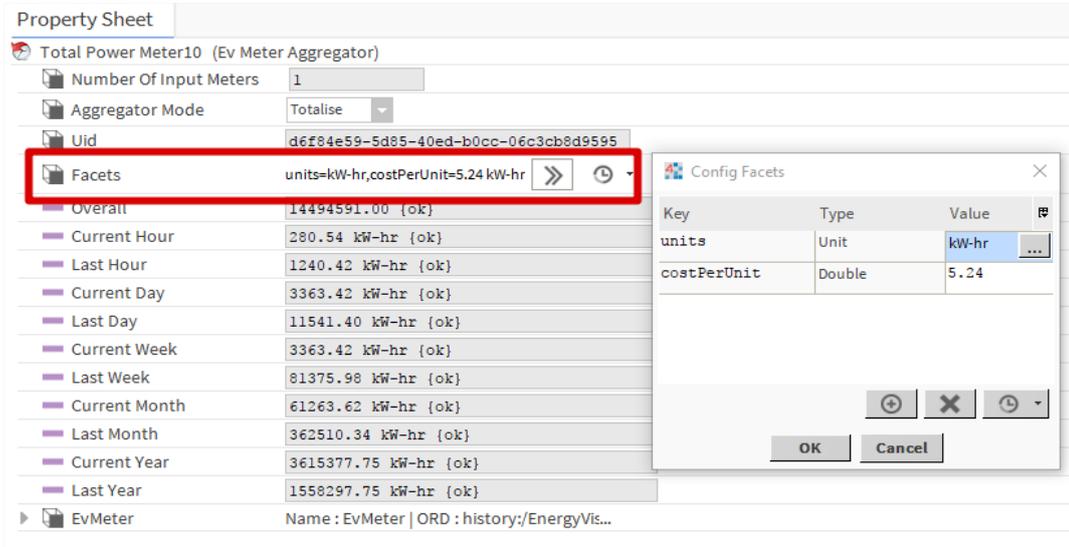


Figure 7 - EXAMPLE OF A FACET



Units for an Aggregator are taken automatically from the assigned history file.

Calculated values

Results for different time periods are calculated by the aggregator on every calculation cycle. Calculations can be triggered manually by triggering the execute action. The default time frames for the calculation are as show in the Figure 8.

If there are values missing, not numerical or infinite for instantaneous meters, a 0 would be used in its place. For a cumulative meter, the previous value would be used to calculate the delta once the next value is recorded. There is no data interpolated should there be gaps in the data.

Facets		units=null,costPerUnit=1.00	>>	🕒	▼
Overall	0.00	{ok}			
Current Hour	0.00	{ok}			
Last Hour	0.00	{ok}			
Current Day	0.00	{ok}			
Last Day	0.00	{ok}			
Current Week	0.00	{ok}			
Last Week	0.00	{ok}			
Current Month	0.00	{ok}			
Last Month	0.00	{ok}			
Current Year	0.00	{ok}			
Last Year	0.00	{ok}			
EvMeter	Name : EvMeter ORD : history:/METO_17...				

Figure 8 – EXAMPLE DEFAULT TIME FRAMES

User Defined Time Periods

In order to use the **User Defined Time Periods** feature of the **N4EnergyManager** aggregator, first an event schedule must be defined within the Aggregator.

The Event schedule is an **optional** property that can be set on an aggregator to calculate and display the Custom Periods. (E.g.: Amount of energy used last week during occupancy hours). Since it is an **optional** function, it does not need to be added and the absence of the Event Schedule will not cause any functionality error.

Requirements.

1. The Event Schedule must be an Enum Schedule type.
2. The schedule **Default Output** must **not be null** and must be an Enum value.
3. The schedule **Facets - range** must be set.

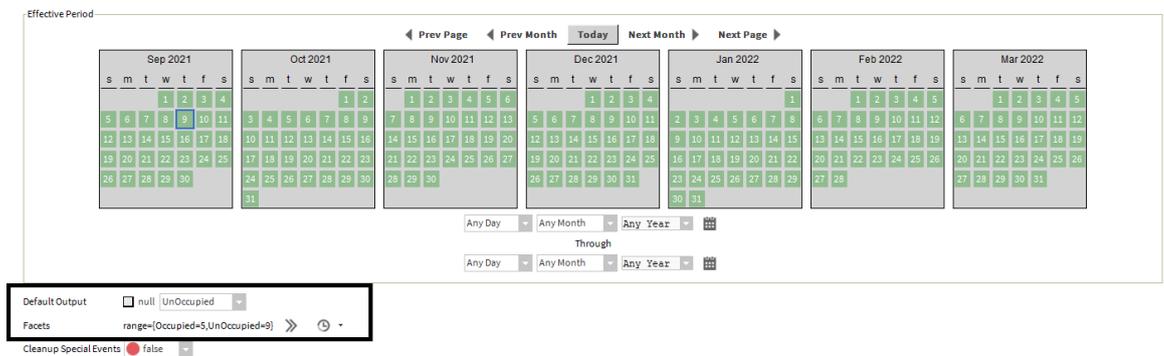


Figure 9 – EXAMPLE EVENT SCHEDULE.



The minimum interval that can be used is no less than 15 minutes to calculate the custom period. The 15 minute or higher minute intervals must start from the hour or 15, 30, 45 minutes after the hour to be able to calculate the cost correctly

Setup Event Schedule

1. Open an aggregator in property sheet view.
2. The Event Schedule Ord line will display null.
3. Click the drop-down icon next to the folder icon.
4. Select Component Chooser. Using the pop-up, navigate through your station hierarchy selecting the appropriate Enum Schedule.
5. Once selected, click Ok.
6. Save aggregator.
7. Open Schedule and click to the Properties Tab (see Figure 9). Click on the >> Chevron beside the Facets / range. On the new window click on the 3 dots ... and on the new popup

window click on the chevron again.

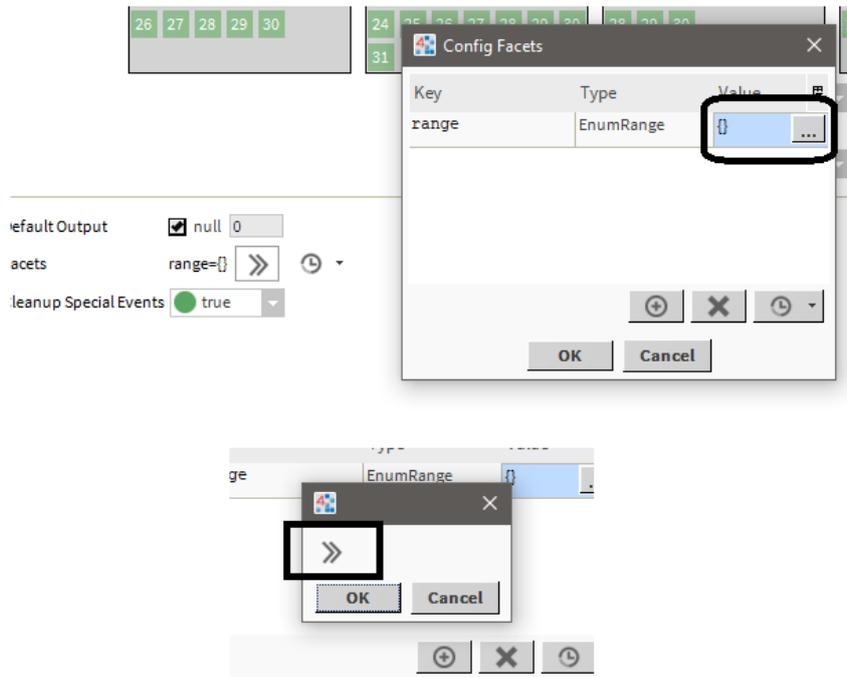


Figure 10 – EXAMPLE CONFIG FACETS

7.1. On the Enum window add the Key/Value pairs for Enums and click to the OK button on all open windows to save the Enum Range

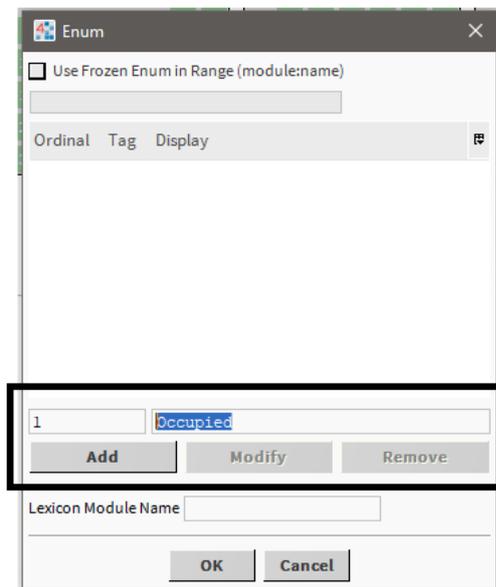


Figure 11 – EXAMPLE ENUM WINDOW

7.2. Uncheck the Default Output null checkbox



Figure 12 – DEFAULT OUTPUT NULL CHECKBOX

7.3. Set Default value from the added Enum List and once complete click save.

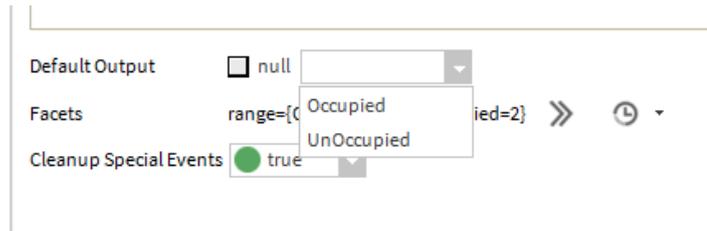


Figure 13 – EXAMPLE DEFAULT VALUE

8. Click on Weekly Schedule Tab. Add the time-period to the required days and set the value for it from the Event Output Drop down Enum List.

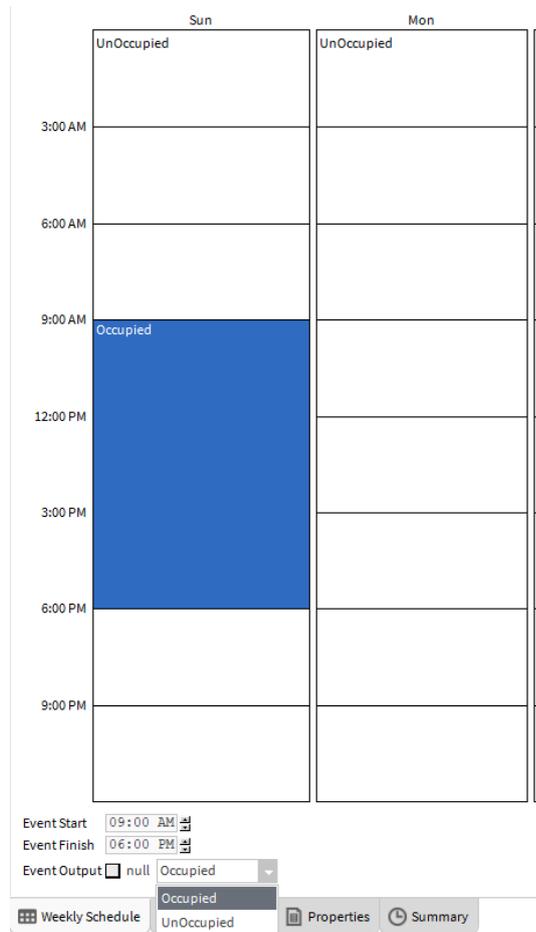


Figure 14 – EXAMPLE WEEKLY SCHEDULE

9. Click to Special Events Tab.
 - 9.1. Add as many special events as required.
 - 9.2. Set priority for Special Events.
 - 9.2.1. If special event dates overlap, the priority order will be used to calculate the cost for a given time.
 - 9.3. If it is required to add special events in past time, the value of *Cleanup Special Events* property needs to be changed to 'False' on the Property Tab.
10. Save the schedule.
11. Open the aggregator and Right Click on the Custom Time Period component.
 - 11.1. Highlight – Actions and Click on the – Add User Defined Time Period - Action.

11.2. The Action will generate and add a new Custom Period object.

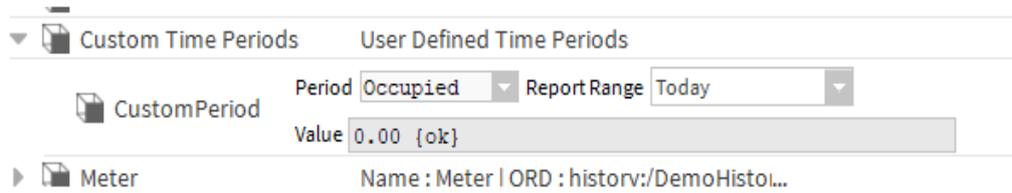


Figure 15 – EXAMPLE CUSTOM PERIOD

11.3. Select period and Report Range.

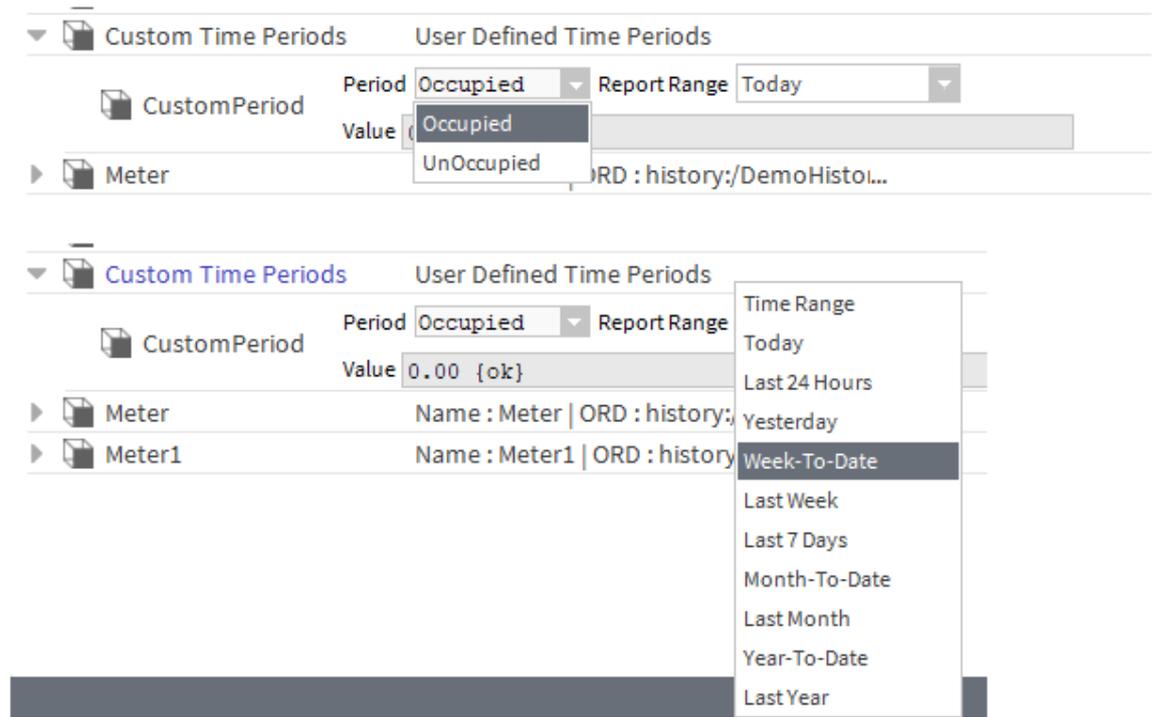


Figure 16 – EXAMPLE CONFIGURATION

11.4. When the aggregator Calculate action is invoked by the system or manually by the user, the selected period in the selected range will be calculated.

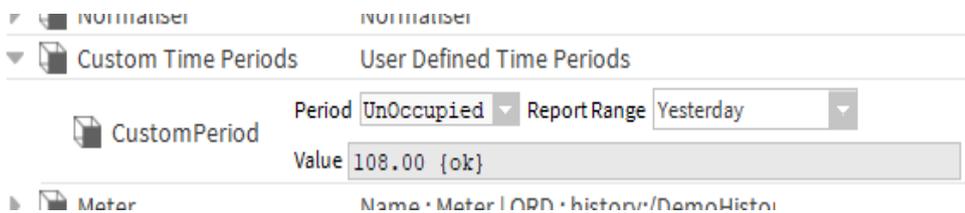


Figure 17 – EXAMPLE CUSTOM PERIOD VALUE



The **N4EnergyManager** Demo Station contains aggregators named Building A – H. These all have **Custom Time Periods** configured as an example.

Setting up Meters

A meter component describes a data source, its characteristics and offers options to configure how to process the data source.

Property Sheet	
Meter (Meter)	
Status	
Ord	history:/H_W_CP132A/OutsideAirTemperature
Scaling Factor	1.00000000 [0.0000000000 - 1.797693134862316E308]
Meter Type	Instantaneous
Units	
Meter Effect	Additive
Meter Roll Over Value	0.00
Meter History Tolerance	2000.00
Interval	15 Minutes
Cov	false
Integrity	86.55 {ok}
Offline	true
Offline Threshold	Inherited from Data Quality Service
Inactive	false
Inactive Threshold	1 Hours

Figure 18 - EXAMPLE AGGREGATOR SET UP

The properties of the Meter as shown in Figure 18 can be described as:

1. **Status** – String to inform user about warning/problems
2. **Ord** - The ord of the Niagara history, to be used as the data source.
3. **Scaling Factor** – A multiplication factor for the history value before it is fed into the aggregator.
4. **Meter Type**
 - a. **Instantaneous** – The data series which is not accumulated over time. E.g. - temperature, frequency
 - b. **Accumulative** -- The data series is a summation of the previous values (always increasing except for meter rollover). E.g.: - kWhr
5. **Meter Effect** – only applicable when more than one meter is used and when meter Aggregator mode is “**Totalise**”.
 - a. **Additive** – the values from this meter will have an additive effect on the result. E.g. - floor1 meter +(Additive) floor2 meter = sum of floor1 and floor 2
 - b. **Subtractive** – The values from this will be removed from the total. E.g.- total power consumption meter –(subtractive) solar power production meter = total non-solar consumption
6. **Meter Roll Over Value** –

- a. Only applicable for accumulative meter
- b. During meter rollover, the delta is calculated as follows
 - $\text{delta} = (\text{rollover} - \text{previousValue}) + \text{currentValue}$

7. Meter History Tolerance

- a. A threshold-based method to remove erroneous values
- b. Any values greater than the threshold will be ignored. **if $\text{abs}(\text{value}) > \text{threshold}$** resulting value is dropped.

8. **Interval** - The auto detected history interval. This interval is used for data quality calculations.

9. **COV** – is the history type **change of value**

10. **Integrity** – Data Integrity of the input history (number of available records/ no of expected records).

11. **Offline** – Flag to indicate that the meter is offline, that is, meter has no reading within the offline threshold.

12. **Offline Threshold** – Time interval used for detecting whether a meter is offline or not.

- a. The interval is a non-negative value with units of seconds, minutes, hours, days, weeks, months, or years.
- b. The interval can be inherited from **Data Quality Service** by setting the status of the value to “null” (see [Data-Quality Alarms](#) for details).

13. **Inactive** – Flag to indicate that the meter is inactive, that is, recent meter values are the same within the inactive threshold.

14. **Inactive Threshold** – Time interval used for detecting whether a meter is inactive or not.

- a. The interval is a non-negative value with units of seconds, minutes, hours, days, weeks, months, or years.
- b. The interval can be inherited from **Data Quality Service** by setting the status of the value to “null” (see [Data-Quality Alarms](#) for details).

Replacing Meters

It's a common occurrence where a meter is replaced in the field due to hardware failure. Depending on whether a new Niagara history is created or not, there are several paths that a user can take to ensure correct behaviour of the correspondent aggregator.

- If Niagara history of the meter is not changed and:
 - the meter is instantaneous, then no adjustment is needed.
 - the meter is accumulative, then the history might start from zero after meter replacement. In this case, the aggregator will have an erroneous delta at the transition time. To alleviate this, the meter rollover value may be set to last value of the failed meter so that the delta at the rollover is calculated correctly. Note that the meter rollover value will apply to all transition times, whether it happened due to a natural meter rollover or due to meter replacement.
- If Niagara history of the meter is or can be changed and:

- the meter is instantaneous, then a user can proceed with the following steps:
 - Add another meter with the new history to the aggregator.
 - Recalculate the aggregator.
- the meter is accumulative, then similar steps can be performed, namely:
 - Add another meter with the new history to the aggregator.
 - Set meter mode to “**Additive**”.
 - Recalculate the aggregator.

Note that adding another unique history can be considered only if the limit of unique histories in N4 Energy Manager license is not reached (see [Checking your license status](#) for details). If no new unique histories can be added to the aggregator, one can import old history into new one using [CSV Import](#) component with **Import policy** = “**Merge with existing history**”. For accumulative meters, the aggregator with merged history might have erroneous delta values at the transition times.

Machine Learning models

A Machine Learning component stores machine learning models that are used to analyse meter aggregator data.

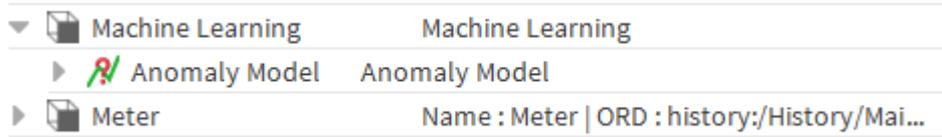


Figure 19 - MACHINE LEARNING COMPONENT OF METER AGGREGATOR

Anomaly Model

The anomaly model’s objective is to identify outliers in meter aggregator data.

This is achieved by training a machine learning model based on the historical baseline data and predicting a range of values that is likely to contain new observations, that is so called a prediction interval. Observations that do not fit within the prediction interval are identified as outliers, and a series of consecutive outliers is called “**anomaly event**”.

The baseline data should represent normal behaviour of the underlying meter in different modes of operation or for different seasons so that the trained model quality is maximised.

Furthermore, if the behaviour of the meter is dependent on the outdoor temperature, then one can use the outdoor temperature aggregator data to train a better model. **N4 Energy Manager version >=3.6.0** provides such outdoor temperature aggregator data as part of the weather service (see [Weather service](#)).

The overall data flow is visualised in Figure 20:

- The historical aggregator and optionally weather baseline data are used to train a model.
- Current data, or more generally any data that was not used in the model training, and thresholds (see **Upper/Lower Bounds** later in the section) are fed into a model.
- Anomaly events are computed.

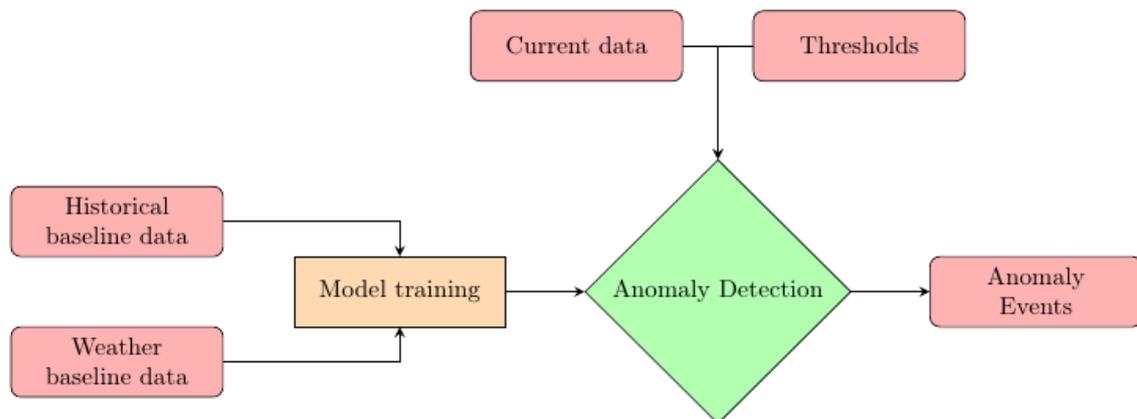


Figure 20 - FLOWCHART OF THE ANOMALY MODEL

The anomaly model utilizes hourly-aggregated data for model training and prediction.

Figure 21 presents the property sheet of the Anomaly Model component.

Property Sheet	
 Anomaly Model (Anomaly Model)	
 Enabled	<input checked="" type="checkbox"/> true
 Status	Time range is ok
 Last Trained	19-Jul-2023 01:45 PM BST
 Is Outdoor Temp Dependent	<input type="checkbox"/> false
 Training Time Range	Time Range 01-Feb-22 12:00 AM GMT to 01-Feb-23 12:00 AM GMT 
 Upper Bound	0.00 % [0.00 - 100.00]
 Lower Bound	0.00 % [-100.00 - 0.00]
 Model Information	very good
 Is Anomaly Event Ongoing	<input type="checkbox"/> false

Figure 21 - ANOMALY MODEL PROPERTY SHEET

The individual slots of the component can be described as follows:

1. **Enabled** – Flag to enable/disable the component.
2. **Status** – String to inform user about the status of the component.
3. **Last Trained** – Last time when the anomaly model was trained.
4. **Is Outdoor Temp Dependent** – Flag to indicate whether to use outdoor temperature data in model training.
5. **Training Time Range** – Dynamic time range for model to be trained on.
6. **Upper Bound** – Percentage of prediction interval to add to its upper value.
7. **Lower Bound** – Percentage of prediction interval to remove from its lower value.
8. **Model Information** – Sub-component containing details and metrics of the trained model (see Figure 24).
9. **Is Anomaly Event Ongoing** – Flag to indicate whether meter aggregator data is in anomaly state since the last hour.



A series of consecutive outliers in the Aggregator's data is called "Anomaly Event". In **N4 Energy Manager**, an anomaly event span across minimum 1 hour since the Anomaly Model operates on hourly aggregator data.

Steps to train an anomaly model

To train a model, one need to go through the following steps (see Figure 22):

- a) Open the Anomaly Model's **Property Sheet**
- b) Enable the model and choose the **Training Time Range** – the time range must cover at least 2 weeks.
- c) If **Status** = "Time Range is ok", then invoke the "Train" action.
- d) If **Status** = "Anomaly events are computed for ..." and **Model Information's** label appeared, then a model is trained and anomaly events are automatically computed the time range between start of the training time range and current time.

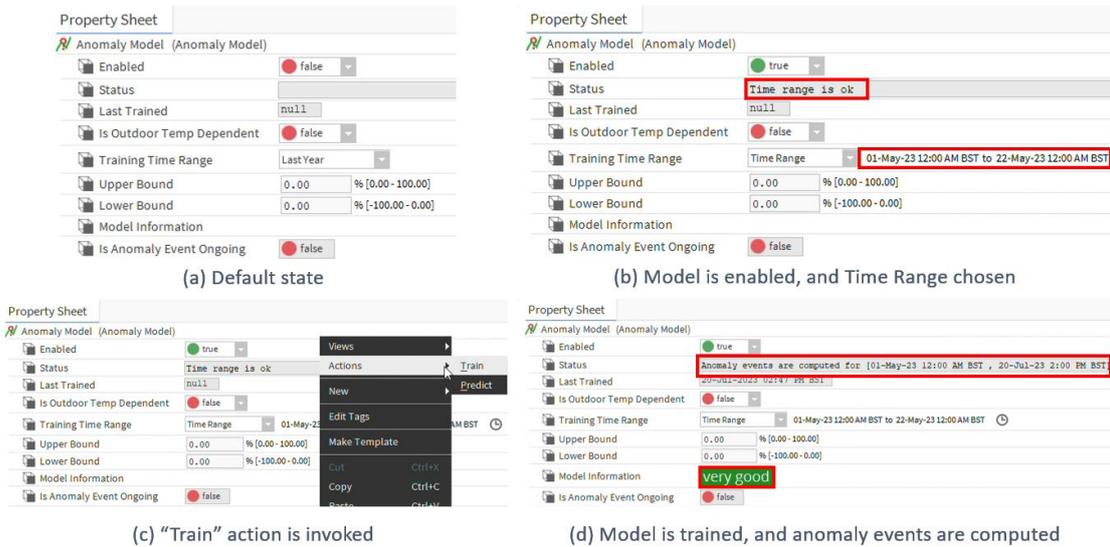


Figure 22 - ANOMALY MODEL ENGINEERING STEPS

Steps to include weather data into a model

To use outdoor temperature data in model training, one need to perform the following steps:

1. Add a **Site** component, define the **Weather Station Ord** and link the current aggregator to the **Site** (see [Grouping of aggregators](#)).
2. Enable the **“Is Outdoor Temp Aggregator”** flag in the Anomaly Model’s property sheet.
3. If **Status** = **“Outdoor Temp Aggregator from weather service is chosen”**, then invoke the **“Train”** action.

Figure 23 shows an example of a setup described above.

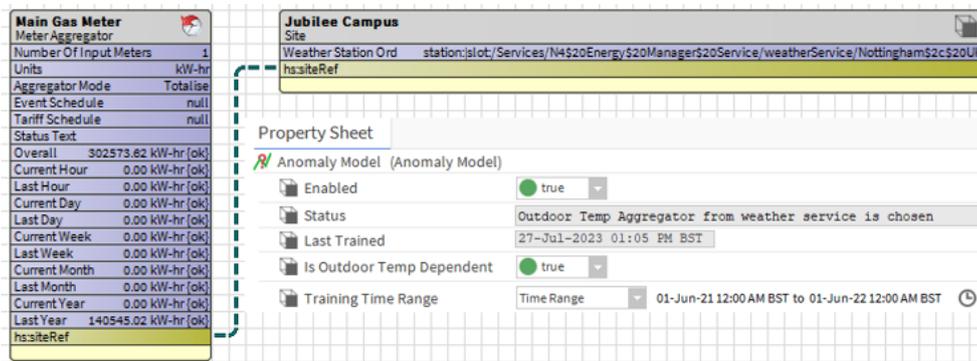


Figure 23 - ANOMALY MODEL WITH WEATHER DEPENDENCE

The weather station can be remote or local (see [Weather station](#) for details). In the case when user has own weather data, one can also unhide the Outdoor Temp Aggregator slot from the Slot sheet and set it to the ord of an aggregator that has weather history.

Post-train actions

After the model is trained, the **Model Information**’s properties are populated (see Figure 24). These include:

1. **Outdoor Temp Aggregator** – Ord of the weather aggregator in the model.
2. **Training Time Range** – the time range that was used for model training.
3. **R2** – the coefficient of determination R^2 .

4. **CVRMSE** – the coefficient of variation of root mean square error.

Property Sheet	
Model Information (Model Info)	
Outdoor Temp Aggregator	null
Training Time Range	Time Range 01-Feb-22 12:00 AM GMT to 01-Feb-23 12:00 AM GMT
R2	0.91
CVRMSE	12.62 %

Figure 24 - MODEL INFORMATION COMPONENT OF ANOMALY MODEL

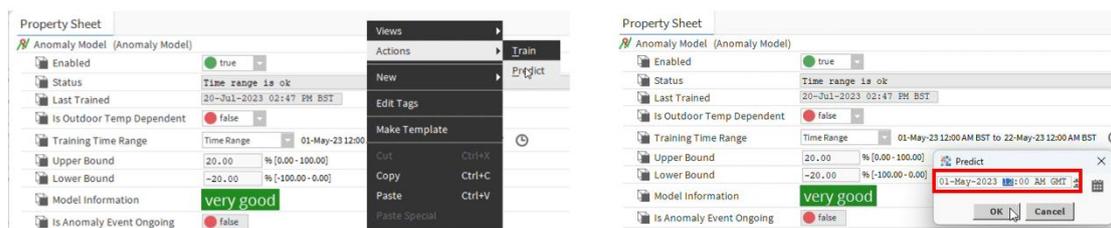
R ² value range	“Model Information” label
$R^2 > 0.9$	very good
$0.9 \geq R^2 > 0.8$	good
$0.8 \geq R^2 > 0.7$	fair
$0.7 \geq R^2$	poor

Table 1 – ASSOCIATION BETWEEN R2 AND MODEL INFORMATION LABEL

The value of the property “R2” drives the label of the property “Model Information”, which represents the quality of the trained model (see Table 1). The better a model is at making predictions, the closer the R² to 1. If model quality is poor, it means that the model is unable to capture patterns within the meter aggregator data. There might be several reasons for it:

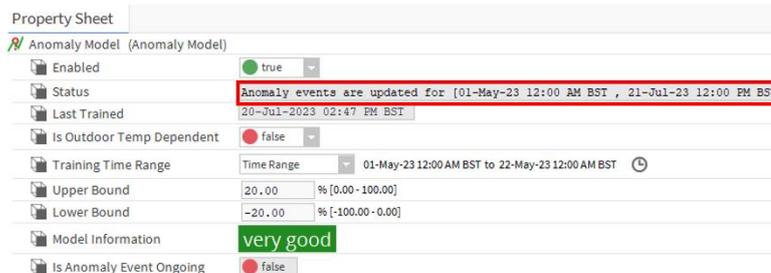
- Too much variation of data within chosen training time range.
- Incorrect setup of meters within the aggregator: e.g. accumulative meter type instead of instantaneous.
- Too short training time range for good model predictions.
- If weather data is included, it might be not correlated with the meter aggregator data.

Together with the trained model, the anomaly events are computed for the parent aggregator. These can be visualised in the Anomaly Console Chart (see [Anomaly Console](#)).



(a) “Predict” action is invoked

(b) Start time of prediction is chosen



(c) Anomaly events are recalculated

Figure 25 - ANOMALY MODEL PREDICT ACTION FLOW



Anomaly events are updated automatically every hour starting from the timestamp of “**Last Trained**” property.

One can trigger recalculation of anomaly events starting from a particular timestamp till current time by invoking a “**Predict**” action (see Figure 25). This action is triggered automatically every hour right after the model is trained.

The “**Upper Bound**” and “**Lower Bound**” properties of the Anomaly model can be set to widen the model’s prediction interval by a certain percentage on the upper and lower boundaries, respectively. These properties are useful for limitation of amount of anomaly events generated and viewed in the Anomaly Console Chart. Once these properties are set, the anomaly events are automatically recomputed with updated bounds (see Figure 26).

Property Sheet	
Anomaly Model (Anomaly Model)	
Enabled	<input checked="" type="checkbox"/> true
Status	Anomaly events are recomputed with upperBound = 20.0 and lowerBound = -20.0
Last Trained	20-Jul-2023 02:47 PM BST
Is Outdoor Temp Dependent	<input type="checkbox"/> false
Training Time Range	Time Range 01-May-23 12:00 AM BST to 22-May-23 12:00 AM BST
Upper Bound	20.00 % [0.00 - 100.00]
Lower Bound	-20.00 % [-100.00 - 0.00]
Model Information	very good
Is Anomaly Event Ongoing	<input type="checkbox"/> false

Figure 26 - UPPER/LOWER BOUND SETUP IN ANOMALY MODEL

Once the desired configuration is set and anomaly events are computed, one can use the Anomaly Console chart to visualise the anomaly events and have them exported in PDF format.

Setting an ongoing event alarm

As discussed previously, the “Is Anomaly Event Ongoing” flag of the property sheet (see Figure 21) indicates whether the aggregator is in the anomaly state or not, that is, the flag is true when there is an anomaly event since the last hour and false otherwise.

This attribute can be used to set up an alarm for the Alarm Console. To do so, it is required to add this attribute via “Composite Editor” to the Aggregator and link it to a **Boolean writable** with **BooleanChangeOfStateAlarmExtension**. Here are the necessary steps:

1. Expose the “**Is Anomaly Event Ongoing**” slot on the aggregator using the **Composite Editor**.
2. Link the **Is Anomaly Event Ongoing** slot to a Boolean writable using the wiresheet view.
3. Add **BooleanChangeOfStateAlarmExtension** on the Boolean writable.

Summary of the data flow

Figure 27 represents the summary of the end-to-end setup of the Anomaly Model with different options available.

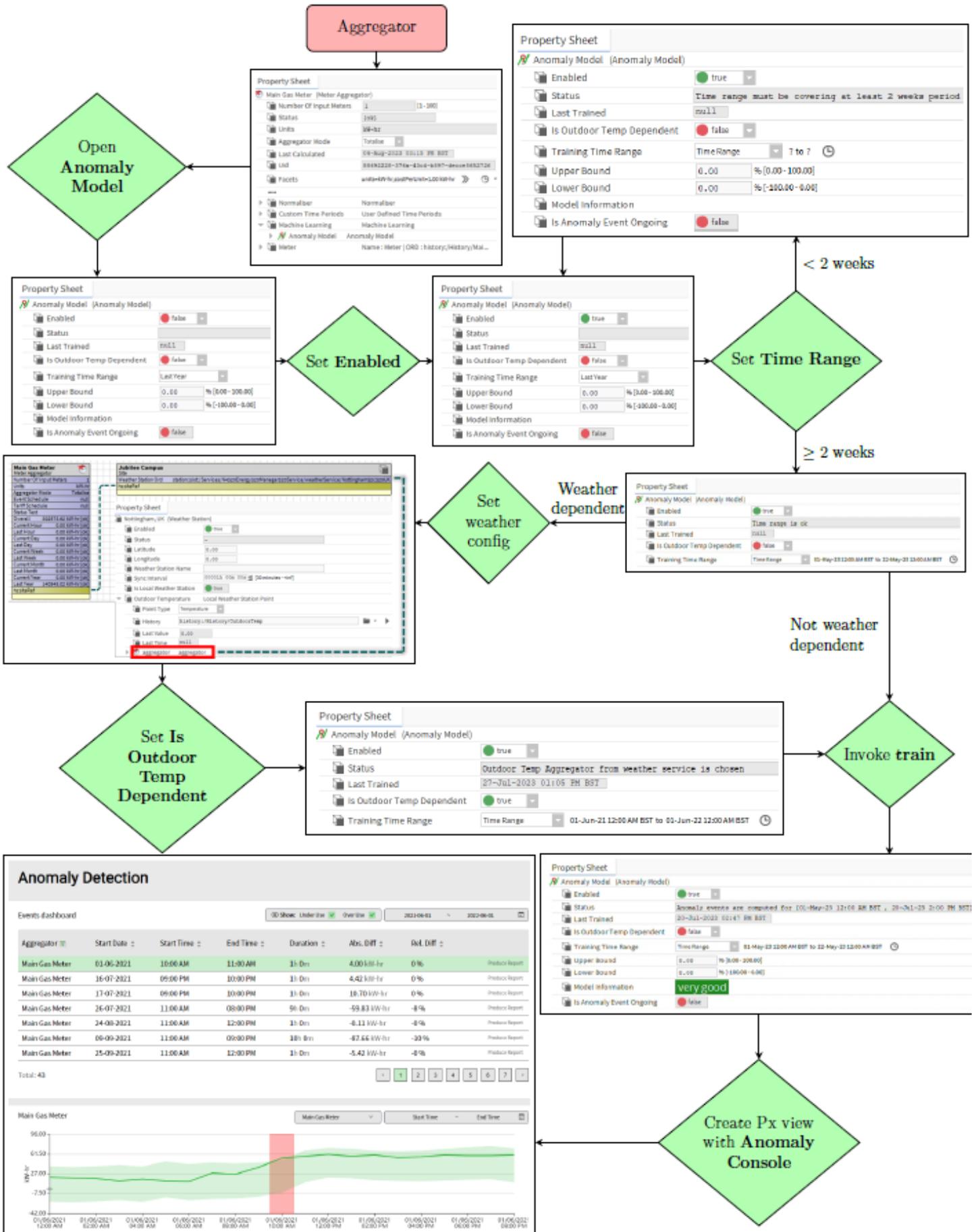


Figure 27 - FLOW CHART OF ANOMALY MODEL

Anomaly Console

The anomaly events computed using the **Anomaly Model** of an aggregator can be visualised using the Anomaly Console chart.

Widget configuration

This widget can be accessed from **N4 Energy Manager** Palette (see [N4 Energy Manager Palette](#) for details). The properties of the widget that can be seen on Figure 28 are common to other charts (see [Common chart properties](#)).

Web Widget	
backgroundCo	██████████ ...
enabled	true ▾
foregroundColor	<input type="text"/> ...
js	view:n4EnergyManager:AnomalyConsoleWidget ...
layer	▾
layout	270.0,0.0,1096.0,768.0 ...
preferredSize	640.0,480.0 ...
subTitle	Events dashboard
title	Anomaly Detection
visible	true ▾
widgetId	6cd4b8b0-2295-4106-998b-b460d0432d17
Chart Data Binding	
degradeBehav	None ▾
requiredPerm	r ...
data	CLICK_HERE_TO_CHOOSE_ORD ...

Figure 28 - ANOMALY CONSOLE WIDGET PROPERTIES

Chart Data Binding can be used to set a list of **Aggregator Ords** which anomaly events are visualised in the Anomaly Console chart (see Figure 29). There are three options:

- **No ords are provided** – Anomaly events of all aggregators that have **Anomaly Model** enabled will be shown.
- **Aggregator ord** – Anomaly events of the chosen aggregator will be shown.
- **Site ord** – Anomaly events of all aggregators linked to the chosen site will be shown.

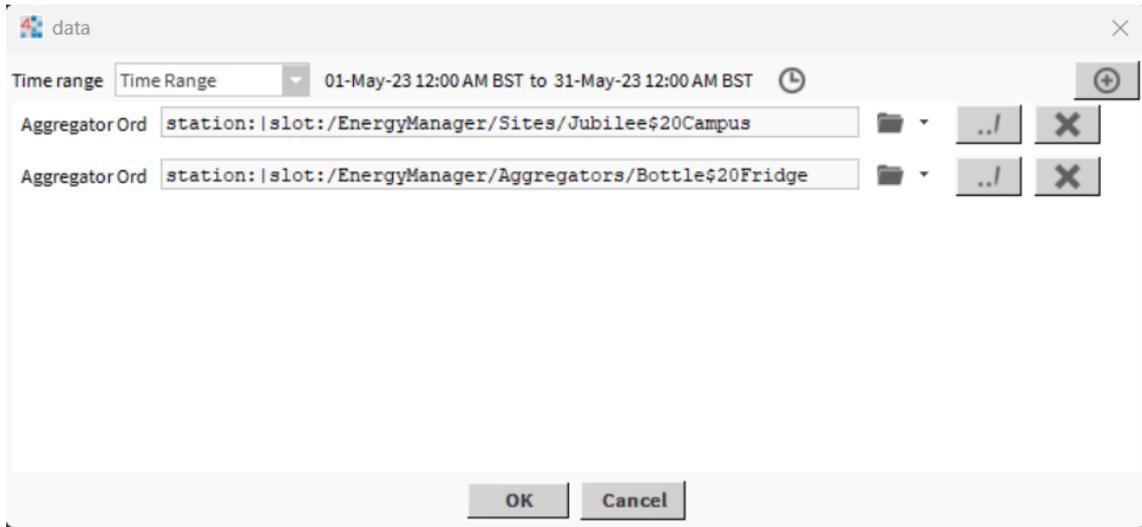


Figure 29 - CHART DATA BINDING OF ANOMALY CONSOLE

Anomaly events are populated for the time range pre-set in the “Time range” property. The default time range is last 30 days.

Anomaly Console Chart

Anomaly Console chart (see Figure 30) helps to view all anomaly Events on one view from all the aggregator that has enabled the machine learning model on which user can have different views by filtering data and sorting the data.

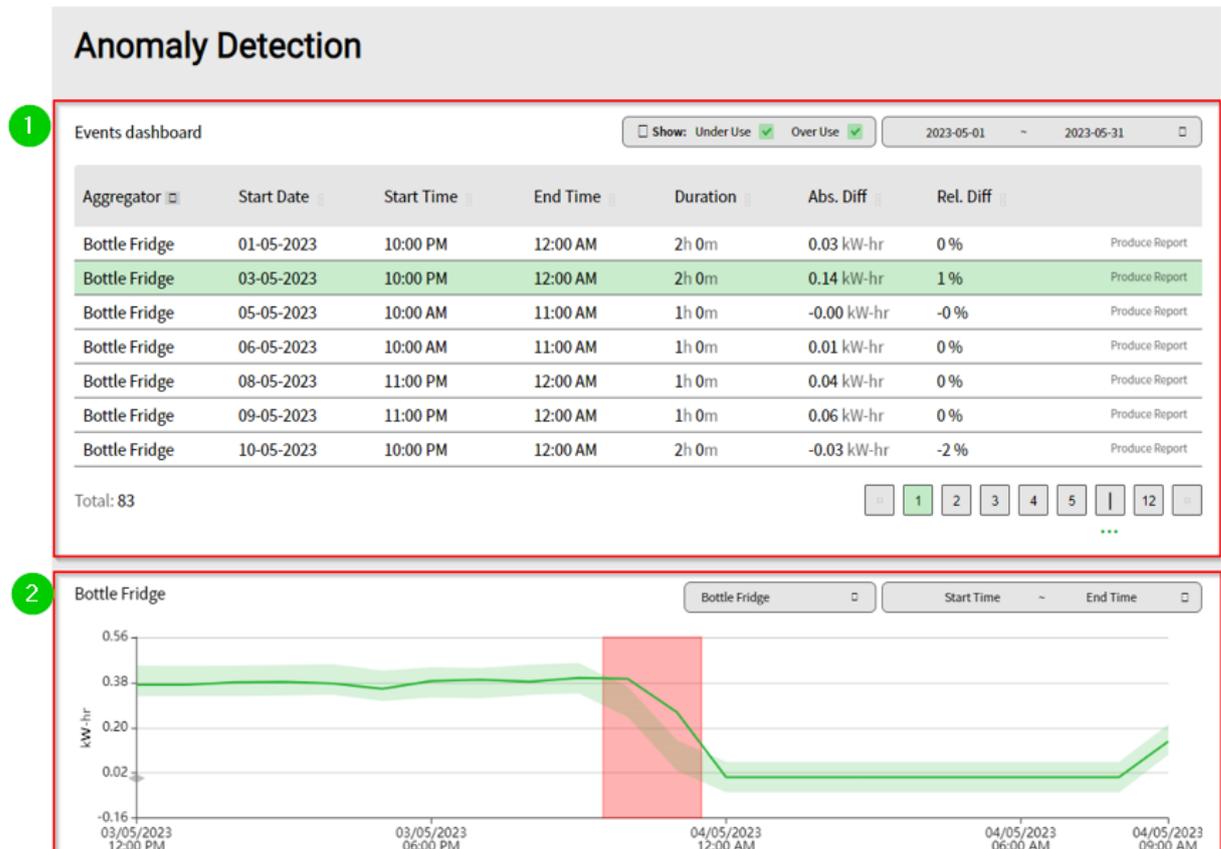


Figure 30 – EXAMPLE OF ANOMALY CONSOLE CHART

1 - **Events Dashboard** - The table reflects the list of all Anomaly events predicted by machine learning model in the chosen time range.

2 – Chart Content

- The chart area displays the selected event (From Table) aggregator’s data with the event time.
- It shows the predicted value and actual value over selected time range and aggregator from the date picker and dropdown.

Events Dashboard

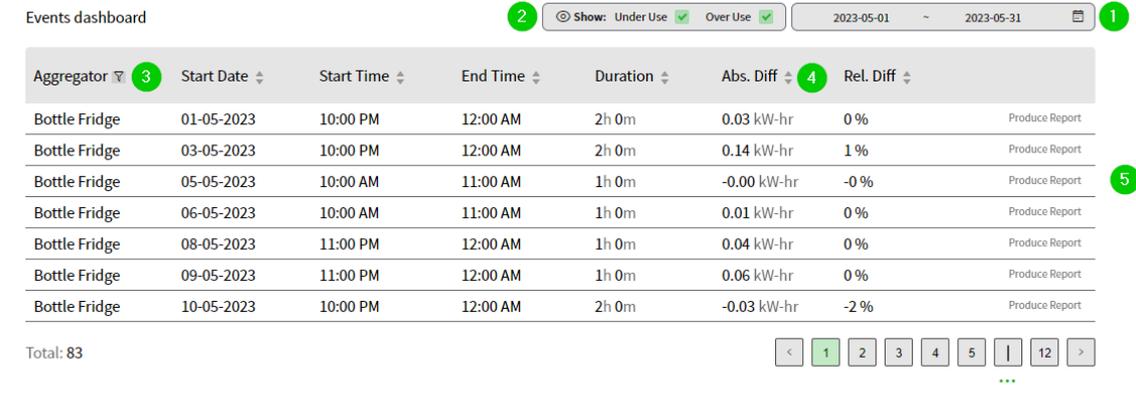


Figure 31 - EXAMPLE OF POPULATED EVENTS DASHBOARD

1 – The user can choose a date range to update the table with a list of anomalies that occurred during that time.

2 – Filter that works on top of the table, to get separate views for anomaly events that overshoot and undershoot the prediction interval, respectively.

3 –Filter that alters the list of events entries in the table based on the selected aggregators.

4 – Individual sorters that sort the dashboard view based on (Start Date, Start Time, End Time, Duration, Absolute Difference, and Relative Difference).

5 – A click on the row highlights it and populates the chart view for a time range = [Event Start Time – 10 hours, Event End Time + 10 hours].



The Chart can be populated by clicking on entries (events) in the table or by selecting the aggregator from the drop-down and selecting the date range from the date picker.

Chart View

Here is some description on the chart view.

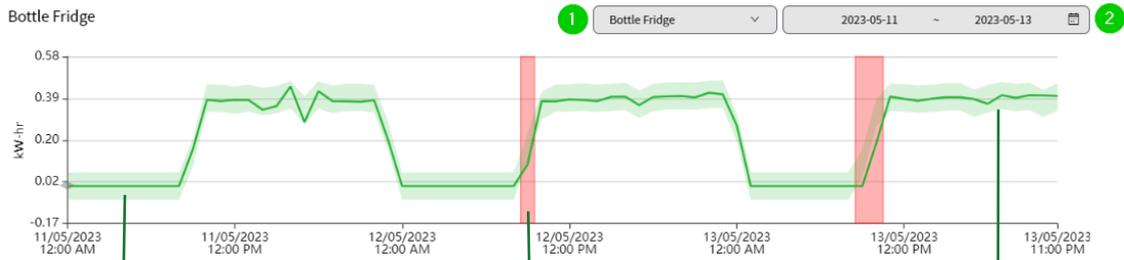


Figure 32 – EXAMPLE OF CHART VIEW IN ANOMALY DETECTION

It shows the aggregator's output over time.

The red bar highlights the event, and you can download the report with a chart view by clicking on it.

Model predictions are represented by green confidence bands.

1. The User can select/change the aggregator in the chart view to see the aggregators output over time along with the upper and lower bound.
2. User can choose a date range with the selected aggregator to populate the chart for the chosen time range even if there are no anomaly events.

 Whenever user clicks on the table row, the existing data on the chart view is replaced by the event data with time range = [Event Start Time – 10 hours, Event End Time + 10 hours]).

Report View

Users can view the Chart view in a separate window, which also allows to export the view to PDF format.

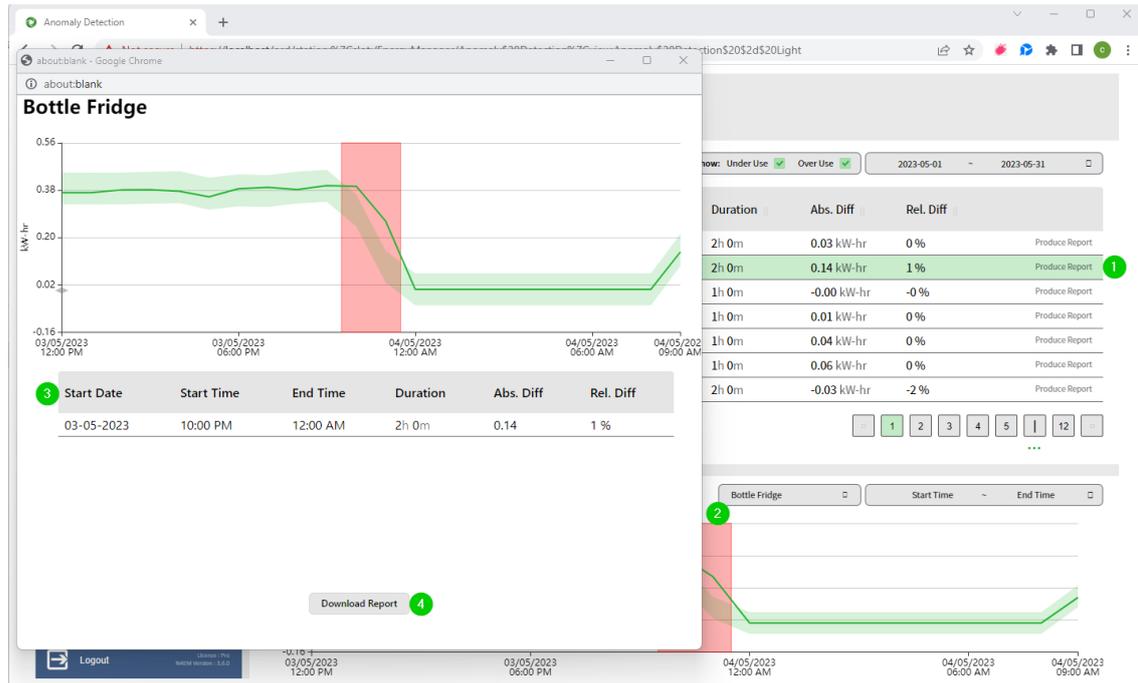


Figure 33 - EXAMPLE OF DOWNLOAD VIEW

Figure 33 describes the report view and how to access it as follows:

1. "Produce report" - button which brings a report pop-up view upon a mouse click.
2. "Red bar" – has the same functionality as above button, brings up the pop-up.
3. All events that appear on the report view are listed in this static table.
4. User can export the view into pdf file by clicking on the Download Report Button.

Grouping of aggregators

When dealing with substantial number of aggregators in the station some of which might share the same location (e.g. meters in a building) or represent instances of a larger component (e.g. chillers of the chiller plant), one can use the site component to group them together. This can be achieved by leveraging Niagara’s “relations” concept. Moreover, the site component can be used to store common site-level information such as weather station used by the site, address, tariff information, area and so on.

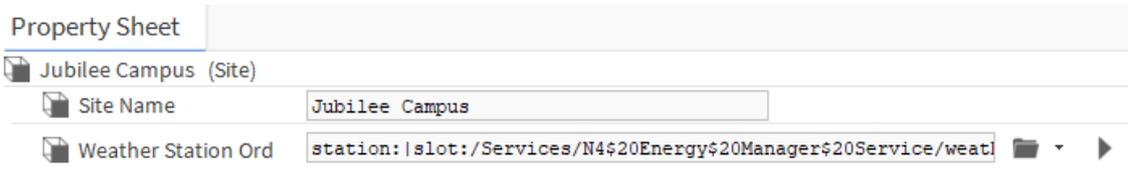


Figure 34 - SITE COMPONENT'S PROPERTY SHEET

In **N4 Energy Manager version 3.6.0**, a site name and a weather station can be set in the site component (see Figure 34).

To link aggregators to a site, a Haystack Dictionary must be added to the **TagDictionaryService** from the Haystack palette (see Figure 35).

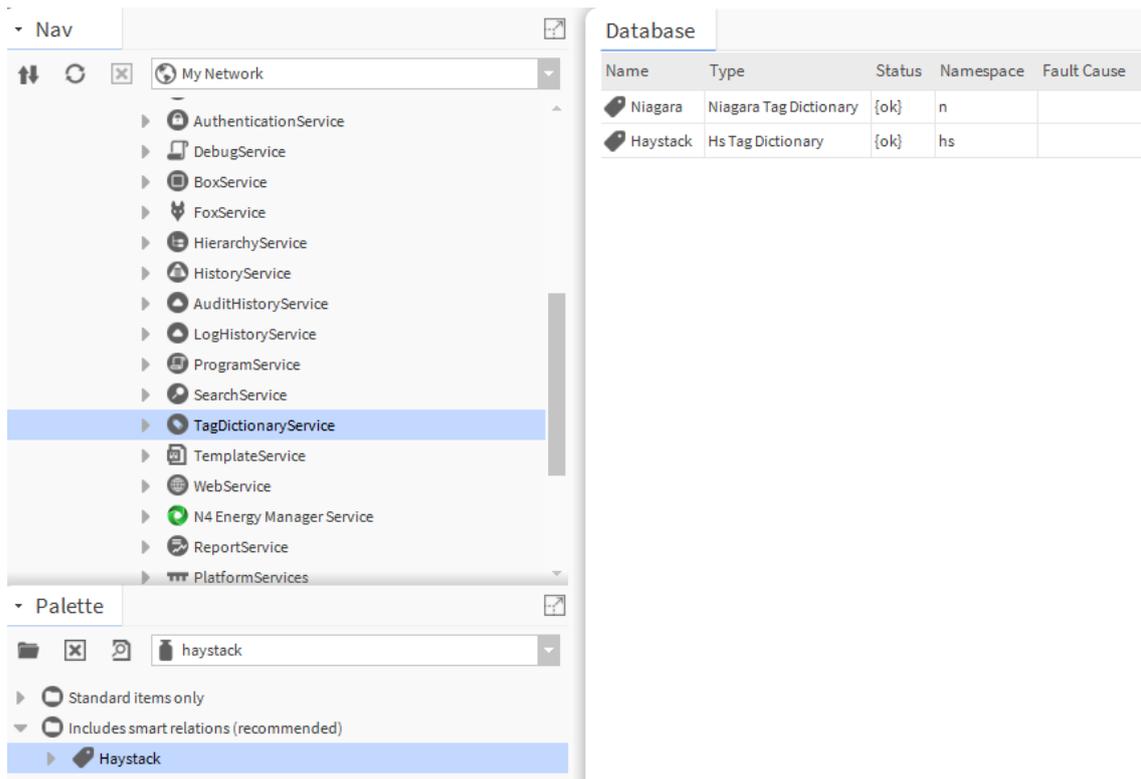


Figure 35 - ADDING HAYSTACK INTO DICTIONARY SERVICE

Steps to engineer a site component:

1. Open folder in which the site needs to be added.
 - a. **Right Click** on the folder and select **Views > Wire Sheet**.
2. Open the **Palette** ensuring that the **N4 Energy Manager Palette** is opened.
3. **Expand** the folder **Utils**.
4. Drag & drop the **Site** component onto the **Wire Sheet**.

5. Set the **Site Name** and **Weather Station Ord**
6. Create inbound relations from site to the aggregators with "relationId" = "hs:siteRef":
 - a. **Select** aggregator(s) to be linked to a site.
 - b. **Right Click** on them and select "**Relation Mark**".
 - c. **Right Click** on the site component and select "**Relate From "agg1", "agg2" ..."**.
 - d. Select "**hs:siteRef**" from the drop-down menu and **Click "Ok"**.
 - e. The Relation sheet of the site component should show all relations (see Figure 36)

Relation Sheet						
Relation Id	Slot	Dir	Type	Other Path	Other Slot	
hs:siteRef	-	◀	baja:Relation	slot/EnergyManager/Aggregators/Main\$20Gas\$20Meter	-	

Figure 36 - SITE COMPONENT'S RELATION SHEET



Niagara help has several topics on how to add a relation between components. One might search for "**Using Relations**" or "**Adding a Relation using Relation Mark**" in the Niagara help's search tab.

Energy Comparator

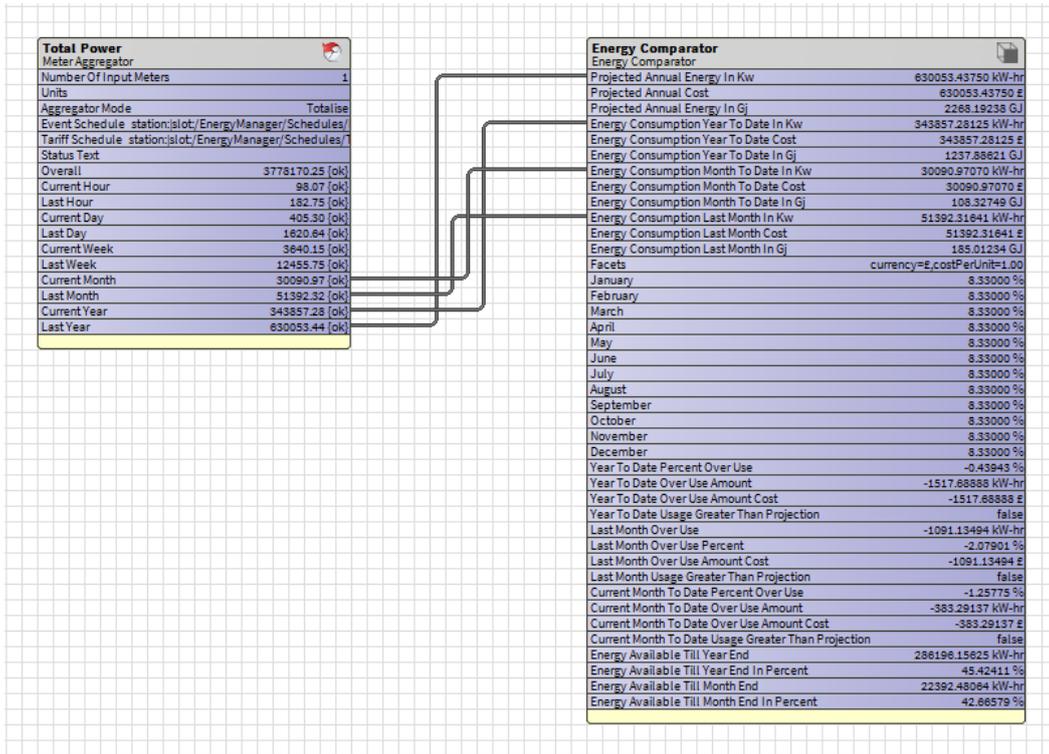


Figure 37 – EXAMPLE ENERGY COMPARATOR WIRESHEET

The energy comparator is used to define monthly and yearly energy targets and assess performance. The following data is required to setup the component:

- The comparator needs to be linked to the *TotalPowerMeter* aggregator already created. Right-click on the home location and select the wiresheet.
- From the EnergyManager palette, drag an Energy Comparator component from the Aggregators menu and drop onto the wiresheet.
- Now link the *TotalPowerMeter* to the aggregator to provide the historical data to the Comparator.
- In the NAV sidebar Right-click the *TotalPowerMeter* and Link Mark Right Click on the comparator and make the following links:

Meter

Current Month Last Month Current Year Last Year

Comparator

*Energy Consumption Month to Date in Kw
 Energy Consumption Last Month in Kw
 Energy Consumption Year To Date in Kw
 projected Annual Energy in Kw*

Once this is linked, the comparator will be populated with data.

Linked Slots:

Projected Annual Energy - Actual energy consumption of last year in the above case.

Energy Consumption Year To Date - Total amount of energy consumed from the beginning of the current year up to the current date.

Energy Consumption Month to Date - Total energy consumed from the beginning of the current month up to the current date.

Energy Consumption Last Month - Total energy consumed in the previous month.

Calculated slots:

Year To Date Percent Over Use - Percentage difference between the actual energy consumption year to date and the projected energy until that date.

Year To Date Over Use Amount - Difference between the actual energy consumption year to date and the projected energy until that date.

Last Month Over Use - Difference between the last month actual usage and projected last month usage.

Last Month Overuse Percent - Percentage difference between the actual energy consumption in the last month and the projected energy consumption for that month.

Current Month to Date Overuse Percent - Percentage difference between the actual energy consumption month to date and the projected energy consumption for the current month to date.

Current Month to Date Overuse Amount - Amount of energy that has been overused in the current month compared to the projected energy consumption up to current date of the current month.

Energy Available Till Year/month End - Actual amount of energy that can be consumed from the current date until the end of the year/month without exceeding the projected annual/monthly energy consumption.

Energy Available Till Year/month End in Percent - Percentage of energy that can be consumed from the current date until the end of the year/month without exceeding the projected annual/monthly energy consumption.

All the slots related to cost are calculated based on the facets provided into the Comparator and respective energy consumption.

 You will notice that all months from January to December have an equal percentage share (100% divided by 12 months = 8.33%). This can be adjusted as required by entering the forecast percentages for that month directly into the comparator or by incorporating a numeric point into the relevant months slot.

N4 Energy Manager Service

There are several Niagara component tools available in the N4 Energy Manager Service (see Figure 38). They help with different tasks related to meter aggregators such as:

- construction of multiple aggregators at once (see [Site Hierarchy](#)),
- configuration of the weather service (see [Weather service](#)),
- setting the preferred chart interval (see [Preferred Chart Interval](#)),
- setting the week start day (see [Weekly Time Range](#)),
- configuration of the Data Quality Settings (see [Data-Quality Alarms](#)).

Property Sheet	
N4 Energy Manager Service (N4 Energy Manager)	
▶ License Manager	N4 Energy Manager PRO
▶ Aggregator Worker Pool	Meter Aggregator Thread Pool
▶ Web Api	Rest Api
▶ Site Hierarchy	Site Hierarchy
▶ Report Manager	Report Manager
Currency	currency (\$) pounds (£)
Preferred Chart Interval	15 Minutes
Week Start	Sunday
▶ Data Quality	Data Quality Settings
▶ Weather Service	N4 E M Weather Service

Figure 38 - N4 ENERGY MANAGER SERVICE PROPERTY SHEET

The **N4 Energy Manager Service** has the following properties:

1. **License Manager** – Information about the license tier a user has
2. **Aggregator Worker Pool** – Component that controls the amount of worker threads to use in the aggregator calculations. Default is 4.
3. **Web Api** – REST Api that the UI widgets use to get data from the station.
4. **Site Hierarchy** – Component that facilitates the engineering of aggregators.
5. **Report Manager** – Component that controls the automatic reporting feature (see [Batch Reporting](#) for details).
6. **Currency** – global setting for the currency to be used in the cost calculations.
7. **Preferred Chart Interval** – global setting for the rollup interval of the aggregator data to be used to draw charts such as line or bar chart.
8. **Week Start** – global setting for the start day of the week. This is automatically used in the charts when weekly time range is selected.
9. **Data Quality** – Global settings for the data quality.
10. **Weather Service** – Component that can bring the weather data from any station worldwide.

Site Hierarchy

The Task of “Site Hierarchy” is to simplify the creation of an aggregator and its assigned histories.



As a pre-requisite to using the Site Hierarchy function, it is assumed that the folder structure for the station has already been created. We would **strongly recommend** that folders have already been created as this makes bringing in histories easier, allowing the engineer to see the hierarchy of the station.

Discovering histories using Site Hierarchy

1. **Expand** the station in the **Navbar**
2. **Expand** Config → Services → **N4 Energy Manager**
3. **Double Click** on **Site Hierarchy**
4. Now, a new window will have appeared. (This may take a minute or 2 to open depending on the number of histories within the station).
 - a. **Station** – This window is the complete hierarchy of the station.
 - b. **Discovered** – Shows the history structure
 - i. If no histories have been discovered yet, at the bottom of the window click **Discover**. This will now search the network for any histories.
 - c. **Current Path: Slot:/** - This window is the folder structure of the station. This is where the aggregators will be added too.
 - d. **Site Meter Tree** – Once aggregators have been created, they will show in the site meter tree.
5. Using the **Discovered** window, navigate through the histories.

Name	Type	Number Of Input Meters	Facets	Exceeded Met
Total Power Meter	Ev Meter Aggregator	2	units=kW-hr,costPerUnit=5.24	false
Total Power Meter2	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter3	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter4	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter5	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter6	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter7	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter8	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter9	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Total Power Meter10	Ev Meter Aggregator	1	units=kW-hr,costPerUnit=5.24	false
Campus	Folder			
Library	Folder			
BuildingA	Folder			
Heatmap	Folder			

Figure 39 - EXAMPLE OF SITE HIERARCHY

Adding Histories to Aggregators Using Site Hierarchy

Now that histories have been discovered, it is now possible to assign histories to an aggregator

Assign Single History to an Aggregator

1. To bring in a **single history**, ensure the folder that the meter will be added to is open in the **Current Path** window below. This is where the aggregator will be added too.
2. Select the **History**.
3. At the bottom of the window, click **Add**.
4. A pop-up window will now appear. Rename the aggregator if needed; if not, the aggregator will be named after the history it is being linked too.
5. The aggregator, with the history linked to it, will now be added to the folder opened in the **Current Path** window.
6. To add further single histories, repeat steps **1, 2, 3 & 4**.

Assign Multiple Histories to an Aggregator

1. To bring in **multiple histories**, ensure the folder that the meter will be added to is open in the **Current Path** window below. This is where the aggregator will be added too.
2. Select the **Histories**.
3. At the bottom of the window, click **Add Group**.
4. A pop-up window will now appear. Rename the aggregator if needed; if not, the aggregator will be named after the history it is being linked too.
5. The aggregator, with the history linked to it, will now be added to the folder opened in the **Current Path** window.

To add further histories, repeat steps **1, 2, 3 & 4**



It is paramount that the naming of your aggregators is kept relevant in the initial engineering stage. This is due to the fact the charts/graphs/dials/gauges all pull the name of the aggregator through and will be on display. For example, we would **Strongly recommend NOT** naming aggregators *Meter 1, Meter 2, etc...* rather call them something like, *Floor 1, Room 2, etc.* ensuring that they remain specific to data they are processing.

Weather service

Starting from **N4 Energy Manager** version 3.6.0, the **Weather Service** can be used to automatically bring the historical and current weather data into a station (see Figure 40).

One can register a remote weather station and pull weather data provided by **N4 Energy Manager**. Alternatively, a local weather station can be added with user's own weather data, e.g., data from an outdoor temperature sensor. If a remote weather station is added, the historical outdoor temperature data is available starting from January 1st, 2020.

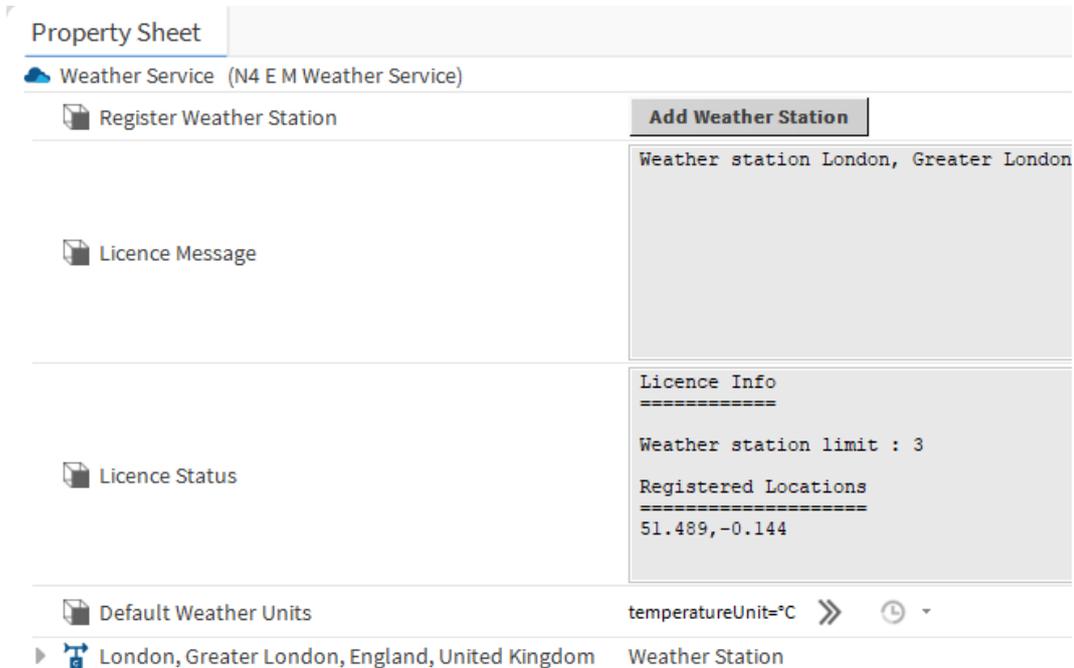


Figure 40 - WEATHER SERVICE PROPERTY SHEET

The Weather Service has the following properties:

1. **Register Weather Station** – Button to add a remote weather station based on the location name.
2. **Licence Message** – Information about the result of weather data fetch.
3. **Licence Status** – Information about the licence and how many remote weather stations can be added. The remote weather station limit is governed by the N4 Energy Manager's Licence.
4. **Default Weather Units** – the unit to use for the temperature history point and the associated aggregator. The default unit is °C.
5. **Name of the station** – Weather Station component that can be added dynamically either through **Register Weather Station** or by dragging and dropping from palette.

Weather service licencing

New customers of **N4 Energy Manager Pro** licence starting from version 3.6.0 get weather service core licence included. For existing customers, the weather service is licensed separately from the **N4 Energy Manager Pro** licence, therefore customers are advised to contact their distributor to purchase weather service licence.

Weather station

The weather station is a component that can hold different weather station points such as outdoor temperature, humidity, cloud coverage. In **N4 Energy Manager version 3.6.0**, only the outdoor temperature data is provided.

Weather station can have two types of weather station points (see Figure 41):

- Remote weather station point
- Local weather station point

They both share the same set of properties, namely:

1. **Enabled** – Flag to enable/disable the weather station.
2. **Status** – The status information about the weather station component.
3. **Latitude** – Decimal number representing the latitude coordinate of the weather station’s location.
4. **Longitude** - Decimal number representing the longitude coordinate of the weather station’s location.
5. **Sync Interval** – period at which the weather data is synced from the weather service. Applicable only for remote weather stations.
6. **Is Local Weather Station** – Flag to inform whether a weather station is remote or local.
7. **Name of the point** – **Weather Station Point** or **Local Weather Station Point** component that is added automatically for remote stations and can be added manually for local stations, respectively.

Property Sheet	
London, Greater London, England, United Kingdom (Weather Station)	
Enabled	<input checked="" type="checkbox"/> true
Status	-
Latitude	51.51
Longitude	-0.13
Weather Station Name	London, Greater London, England, United Kingdom
Sync Interval	00001h 00m 00s [30 minutes - inf]
Is Local Weather Station	<input type="checkbox"/> false
temperature	Weather Station Point

(a) Remote weather station

Property Sheet	
Nottingham, UK (Weather Station)	
Enabled	<input checked="" type="checkbox"/> true
Status	-
Latitude	0.00
Longitude	0.00
Weather Station Name	
Sync Interval	00001h 00m 00s [30 minutes - inf]
Is Local Weather Station	<input checked="" type="checkbox"/> true
Outdoor Temperature	Local Weather Station Point

(b) Local weather station

Figure 41 - EXAMPLES OF REMOTE AND LOCAL WEATHER STATIONS

Remote Weather Station

The remote weather station can be used to fetch weather data from **N4 Energy Manager’s** weather service. This can be added by clicking on “Add Weather Station” button and selecting the location by name (see Figure 42) in the Weather Service.

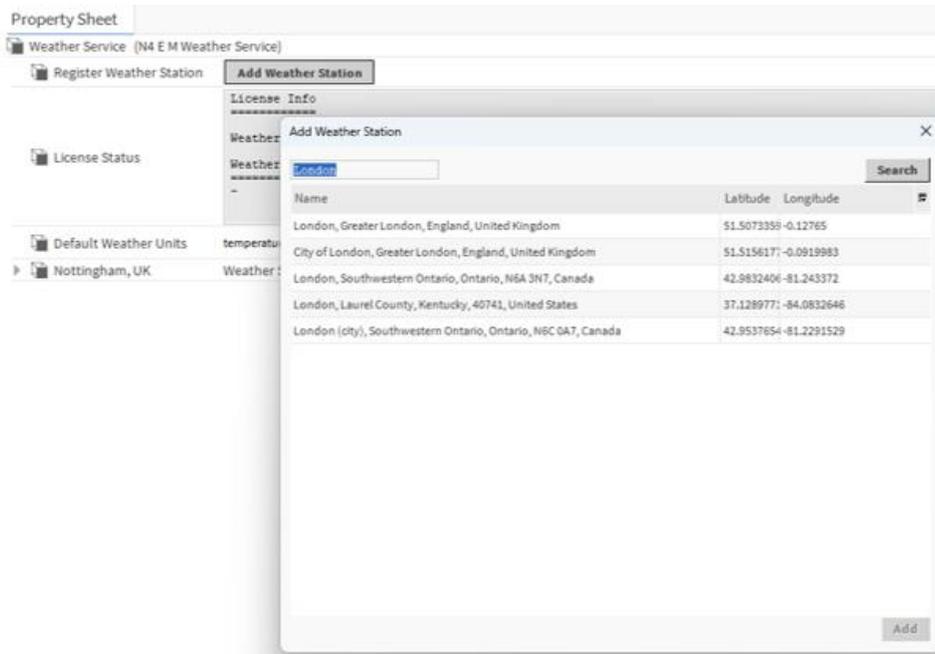
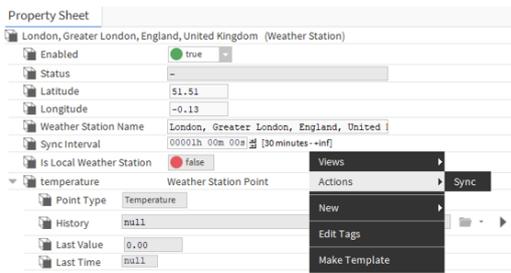
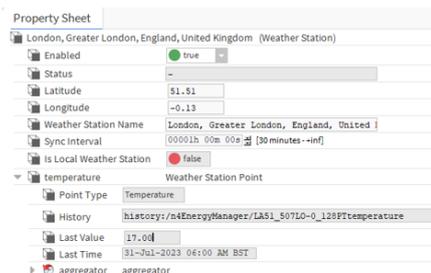


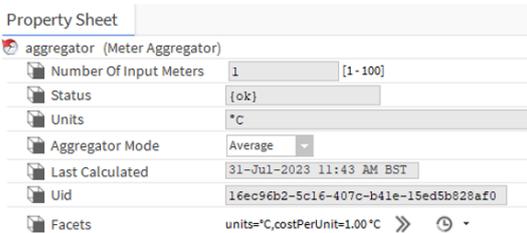
Figure 42 - REMOTE WEATHER STATION ADDING



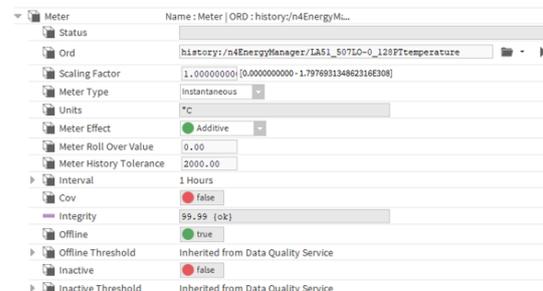
(a) Sync of weather station is being invoked



(b) Sync is successful: history and aggregator are created



(c) Aggregator properties are populated



(d) Meter properties are populated

Figure 43 - ENGINEERING A REMOTE WEATHER STATION POINT

Once a remote weather station is added, the weather station point needs to be configured. Figure 43 describes the process of syncing weather data. Namely, the following steps need to be taken:

- a) Invoke the “Sync” action on the **Weather Station Point** component.
- b) Niagara history is created and the history ord is shown in the **History** property.
- c) Aggregator is created and its properties such as units, aggregator mode and so one are automatically populated.
- d) A meter is added to the aggregator with history that was created above with the properties automatically set.

Local Weather Station

The local weather station point can be added to the Weather Station through slot sheet. A slot of type “LocalWeatherStationPoint” (see Figure 44) must be added.



The user can manually set the history ord of the weather data in the “**History**” property. Once the history ord is added, a single trigger of “**Sync**” action on the **Local Weather Station Point** would automatically create an aggregator under the point.

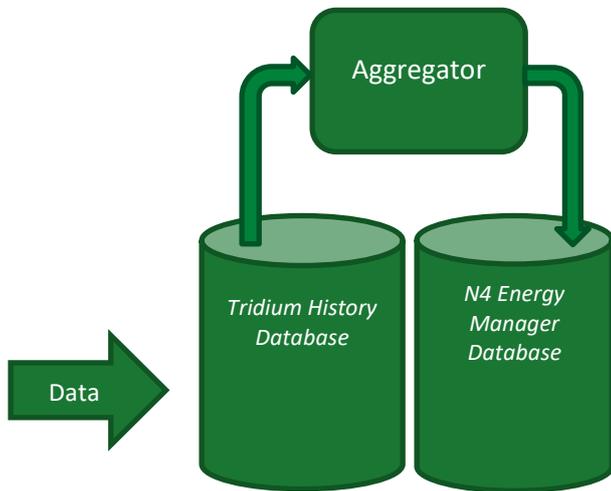
Figure 44 – EXAMPLE OF ADDING LOCAL WEATHER STATION POINT AS A SLOT



A newly created remote or local station can be referenced in the **Site** component which has relations to aggregators that have Anomaly Model enabled. Such aggregators can use the weather data provided by current weather station in the model training and prediction.

File Structure

Working alongside the in-built Tridium database, **N4 Energy Manager's** new proprietary format database is highly compressed and streamlined for optimum performance. Below is a graphical representation of the new database structure.



In the chart to the left is a representation of how the data is brought into **N4 Energy Manager**.

1. Data enters the Tridium history database.
2. Data is processed using aggregators.
3. The aggregator adds a copy of that history into **N4 Energy Manager's** database.
4. The chart will always access the history created by the aggregator in the **N4 Energy Manager** database.

N4 Energy Manager planning

Planning your **N4 Energy Manager** system set up prior to starting is essential for a later operation.

1. **N4 Energy Manager** uses the default Niagara mechanisms that are based on absolute ords. It is therefore important to build up a good folder structure for aggregators and graphics.
2. Some **N4 Energy Manager** functions can only be used in Workbench or the Web Browser. The user will be prompted contextually when a feature is not accessible on a platform.

Recommended Browser

The display of graphics can vary between web browsers. **N4 Energy Manager** is tested using the latest version of Google Chrome so for the best results we recommend using **Google Chrome**.

Accessing N4 Energy Manager via a Web Browser

As with all N4 Niagara Stations, it is possible to view your station via a web browser. Some features of **N4 Energy Manager** are only available when accessed in a web browser and are unavailable in workbench. (There will be a clear indication when this is the case). Below are some steps to ensure that your station will be accessible via a web browser.

1. Ensure the station is running in Niagara. (Platform > Application Director > [STATION NAME] running).
 - a. If it isn't running, click Start in the controls pane below.
2. Allow the station time to start running. Usually 2 minutes (depending on the size of the station).
3. Open the web browser.
4. Type: **localhost** – into the browser
 - a. If the port on which the station is running hasn't been changed the default port number is 80. If the port number has been changed manually, for example, to port 81, type: localhost:81.
5. A login window should now appear. Enter the station's credentials.
6. The station should now be loaded within the web browser.

To change and/or check the port on which the station is running, follow the below instructions:

1. Ensure the station is connected.
2. Expand the **station** → Config → Services
3. Double click on **Web Service**.
4. Check HTTP(S) Port numbers. This will determine which port to access the station.



Ensure the latest version of Google Chrome is installed on the Server (where the **N4 Energy Manager** station is running). **This is critical to report generation.**

N4 Energy Manager Charts

N4 Energy Manager provides pre-defined chart components with individual functions, using a common design. All charts support HTML5 and will resize based on the Web Browser used. Charts can choose from a number of set intervals, Year, Month, Day and Weekly. For Weekly intervals, the starting and ideal ranges can be set by the operator for comparison.

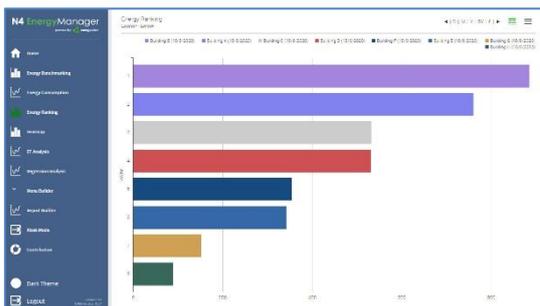


Figure 30 - EXAMPLE ENERGY RANKING CHART

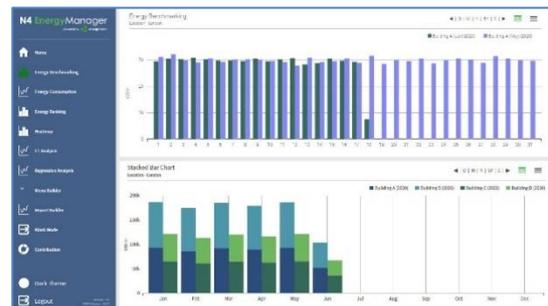


Figure 31 – EXAMPLE BAR/STACKED BAR CHART

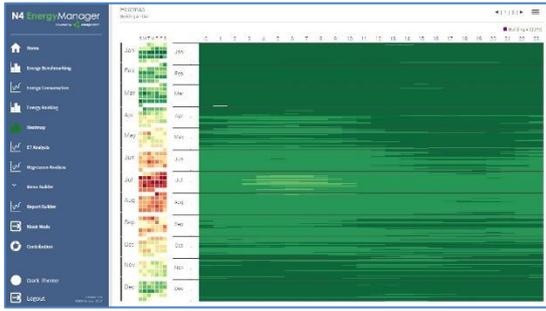


Figure 45 - EXAMPLE HEAT MAP

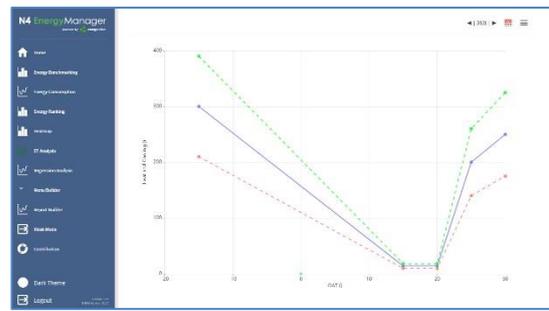


Figure 46 - EXAMPLE ET ANALYSIS CHART

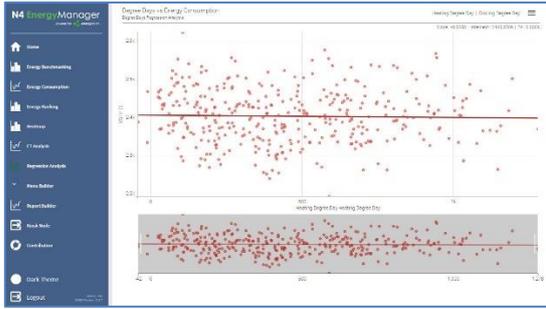


Figure 47 - EXAMPLE DEGREE DAY REGRESSION CHART

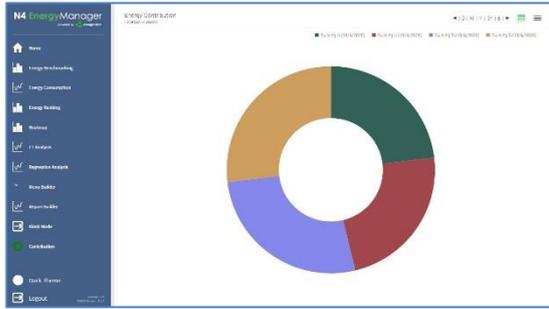


Figure 48 - EXAMPLE ENERGY CONTRIBUTION PIE CHART



Figure 49 - EXAMPLE LINE CHART & GAUGES

Common chart properties

N4 Energy Manager provides default chart templates for faster engineering & intuitive operation. The common features are:

Chart Headings

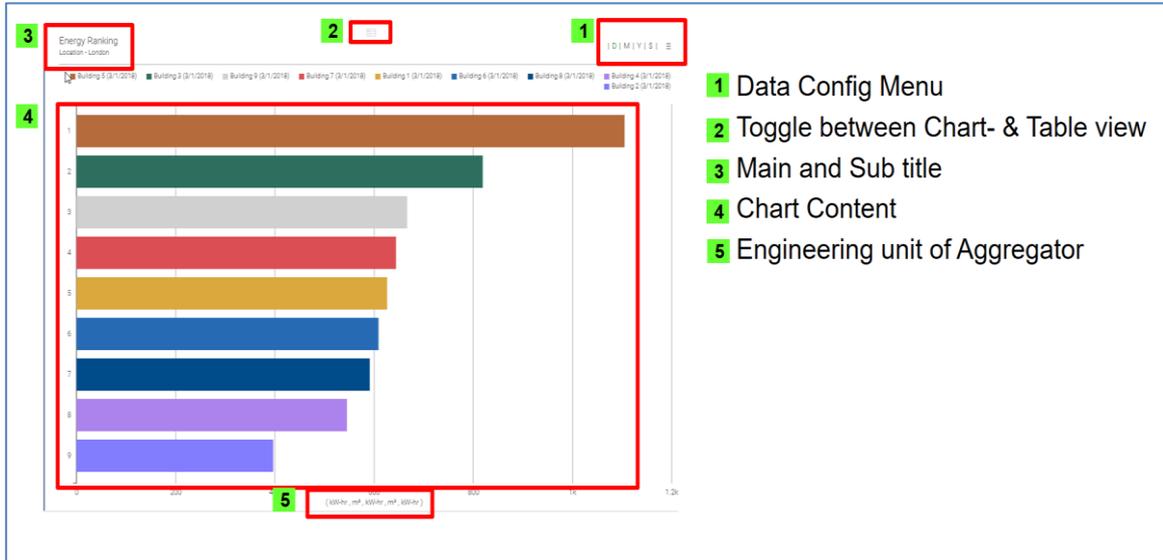


Figure 50 - EXAMPLE CHART HEADINGS

Burger Menu

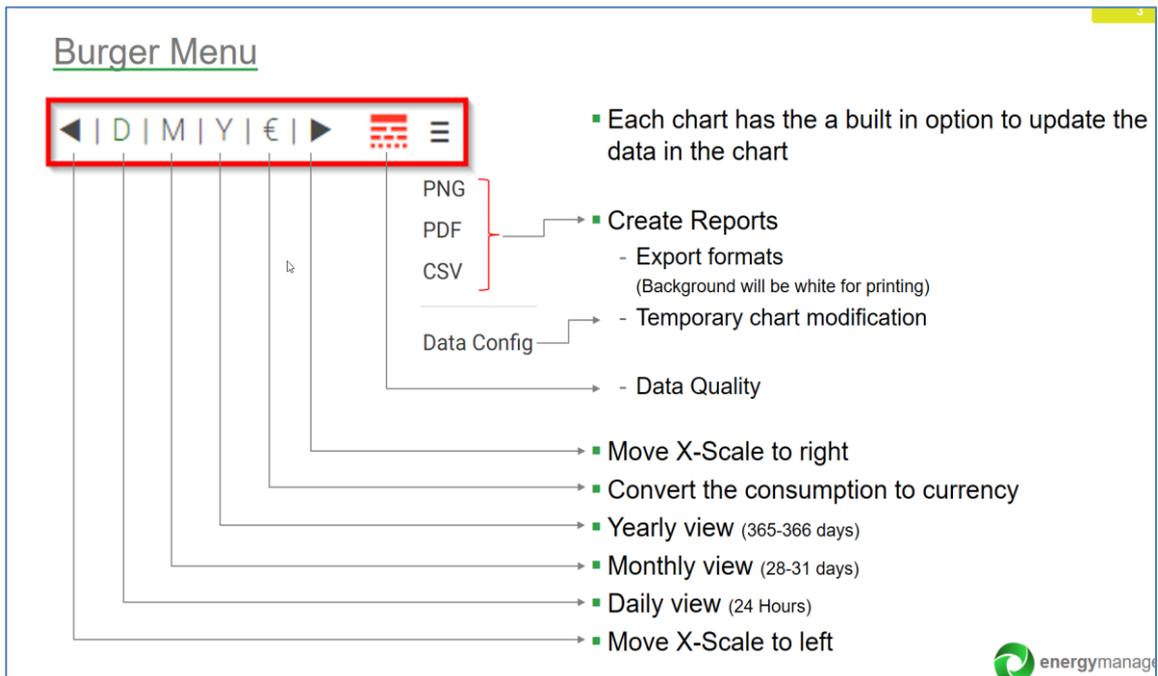


Figure 51 - BURGER MENU EXPLANATION

Data Quality

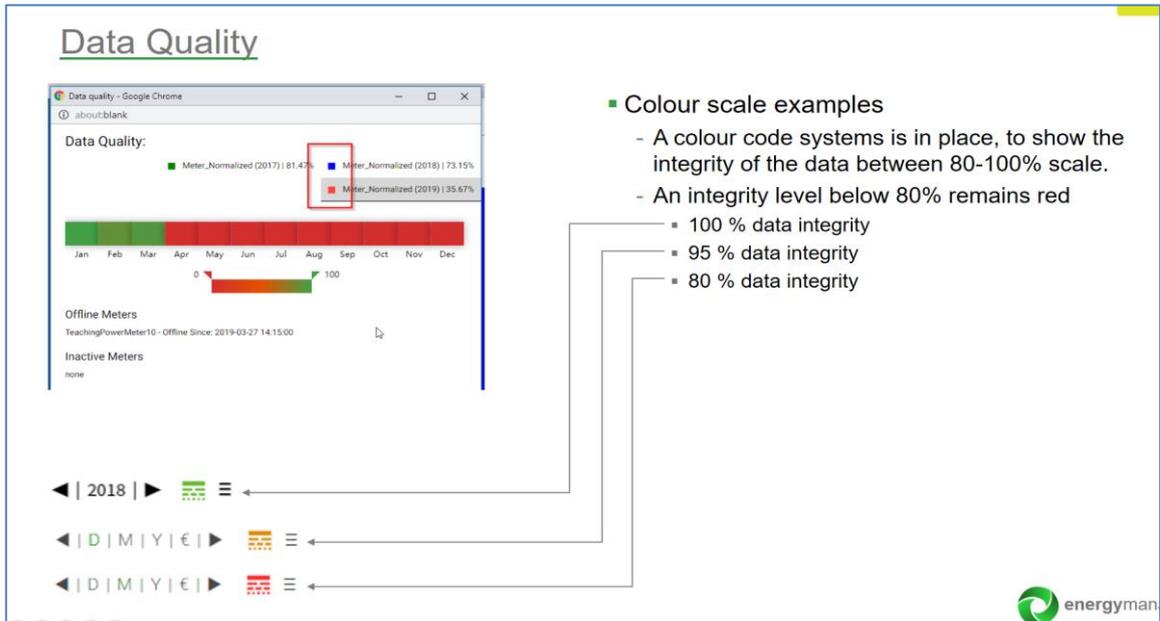


Figure 52 - DATA QUALITY ICON EXPLANATION

Chart & Table View

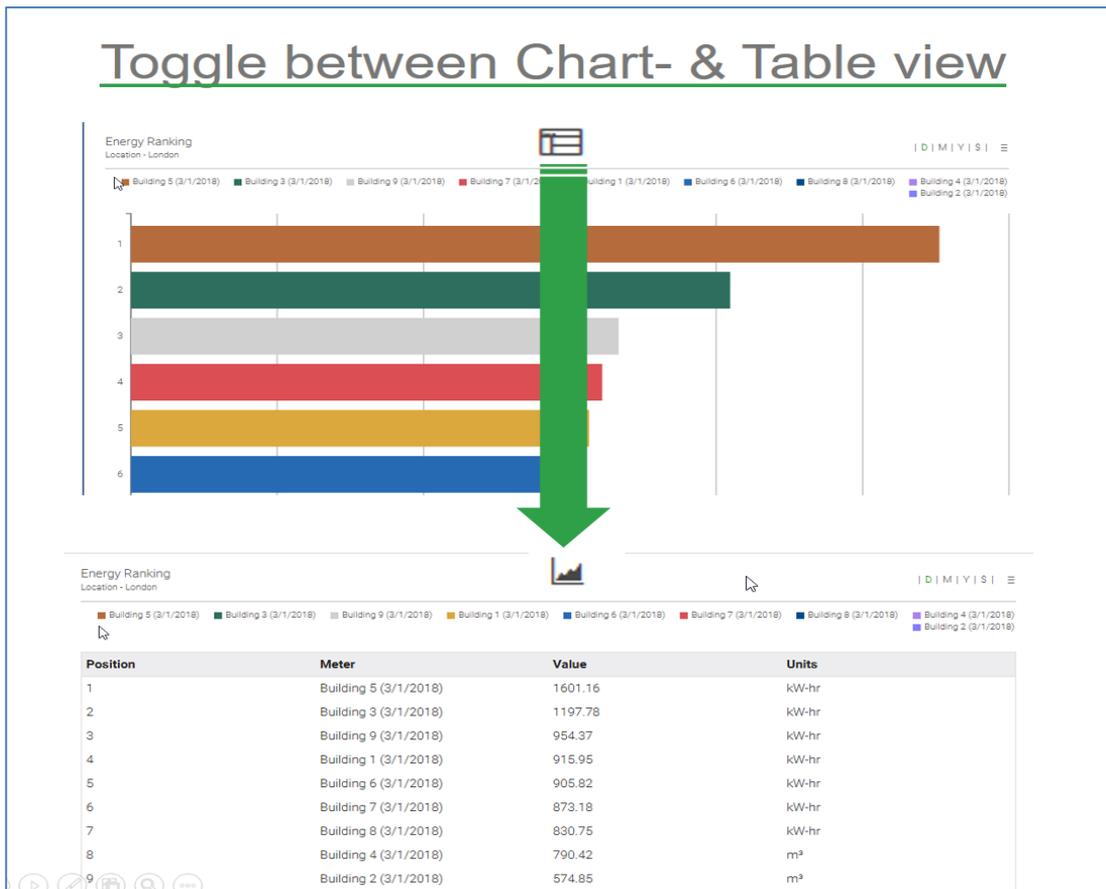


Figure 53 - EXAMPLE CHART & TABLE VIEW

Chart Properties

Energy Ranking
Location - London

Building 5 (3/1/2018)

Property	Value
backgroundColour	
chartSubTitle	Location - London
chartTitle	Energy Ranking
enabled	true
foregroundColour	
js	viewenergy:Vision-RankingChartWidget
layer	
layout	260.0,0.0,1110.0,770.0
timeRange	Day
visible	true
xAxisTitle	
yAxisTitle	
degradeBehavior	None
data	CLICK_HERE_TO_CHOOSE_ORD

- Open graphic in edit mode to access the chart properties
- All properties are listed in the lower right corner
- For all charts the properties are similar
- Common properties are
 - backgroundColour
 - Graphic background colour
 - chartSubTitle
 - The subtitle of the chart
 - chart Title
 - The title of the chart
 - Enabled
 - Enables / disables the chart
 - foregroundColour
 - Covers the text and the chart outline

Figure 54 – (a) EXAMPLE CHART PROPERTIES

All charts support transparent background. User can select “Transparent” colour to achieve this.

Energy Ranking
Location - London

Building 5 (3/1/2018)

Property	Value
backgroundColour	
chartSubTitle	Location - London
chartTitle	Energy Ranking
enabled	true
foregroundColour	
js	viewenergy:Vision-RankingChartWidget
layer	
layout	260.0,0.0,1110.0,770.0
timeRange	Day
visible	true
xAxisTitle	
yAxisTitle	
degradeBehavior	None
data	CLICK_HERE_TO_CHOOSE_ORD

- js
 - NA (Tridium feature)
- layer
 - Defines the layer of the chart (optional)
- layout
 - Chart will be auto resized fitting to the layout setting
 - Chart width & height
 - Position of X-Axis & Y-Axis of the chart
- timeRange
 - defines the default time range loading the chart
- visible
 - Show- / hide chart

Figure 55 - (b) EXAMPLE CHART PROPERTIES

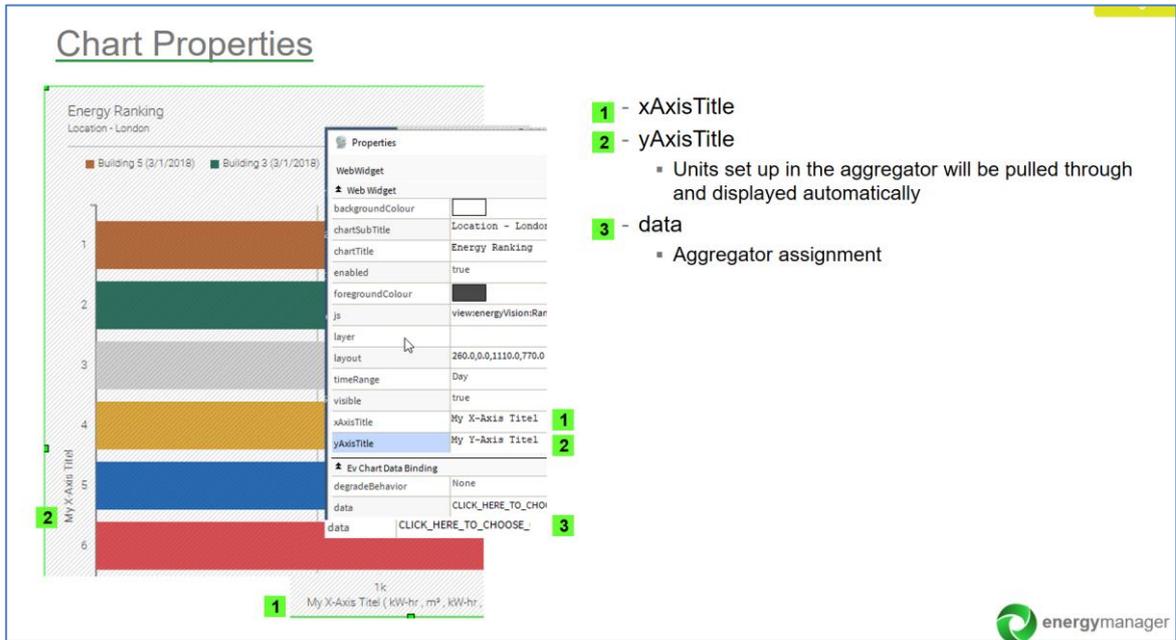


Figure 56 - (c) EXAMPLE CHART PROPERTIES

Data Binding

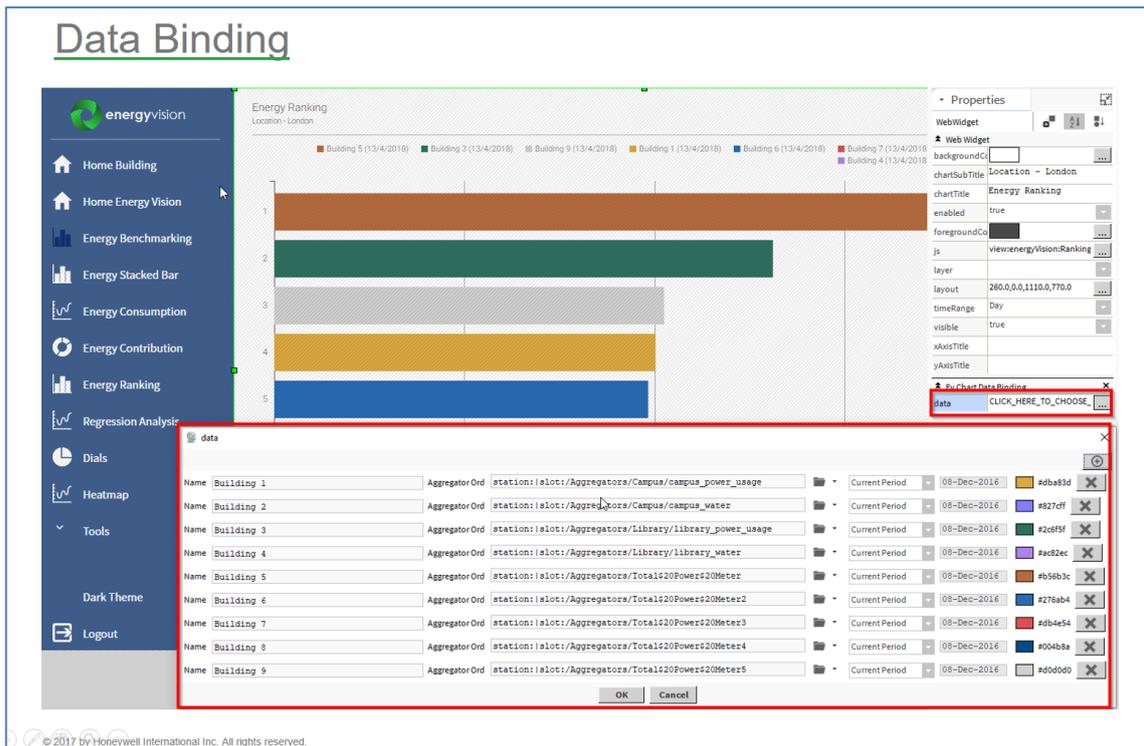


Figure 57 - EXAMPLE DATA BINDING VIEW

Data Binding

Name	Aggregator Ord	station	Current Period	Color
Building 1		/station:/Aggregators/Campus/campus_power_usage	08-Dec-2016	#dba83d
Building 2		/station:/Aggregators/Campus/campus_water	08-Dec-2016	#827c7f
Building 3		/station:/Aggregators/Library/library_power_usage	08-Dec-2016	#2c6f5f

- Alias for Aggregator
- Path of Aggregator Ord
- Value display period
 - Time Range + time Period = Query date time range
 - Day + current period = Today
 - Day + last period = Yesterday
 - Day + custom period = any custom date
 - Month + current period = Current month
 - Month + last period = Last month
 - Month + custom period = any custom month
- Color assignment (can be customized)
- To add further aggregators
- Remove item form list

Figure 58 - DATA BINDING HEADINGS

Line Chart

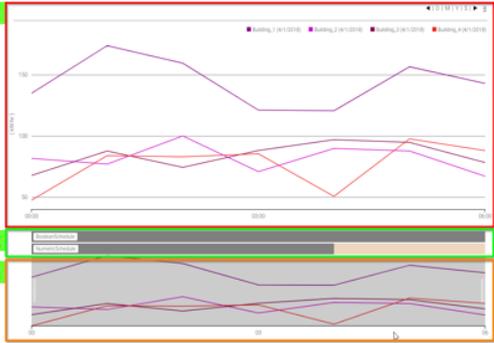
The Line Chart displays aggregator values as a series of points connected by straight lines. A line chart is normally used to show the trend of data over time.

- By enabling **Multiple Y Axis** in the Line Chart Property tab, multiple Y Axis will be drawn for each unique facet found in the Aggregators assigned to the chart.
- By enabling **Show Symbols** in the Data Config|Settings (see [Settings](#)), circles representing data points will be drawn on top of each line.



Figure 59 - EXAMPLE LINE CHART

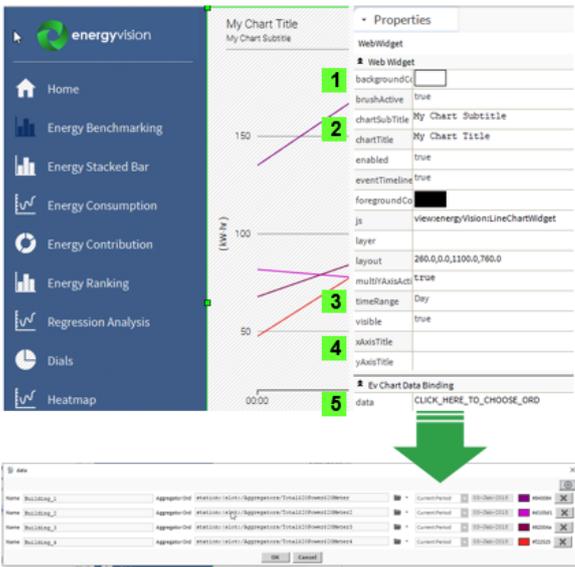
Line Chart



- Line Chart options:
 - 1 - Chart content
 - The Line Chart displays aggregator values as a series of points connected by straight lines
 - It shows the trend of data over time
 - 2 - Schedule
 - Adds a schedule as a bar below the line chart
 - Temporary configuration via “Burger Menu”
 - 3 - Minimap
 - To zoom Chart content

Figure 60 - LINE CHART OPTIONS

Line Chart – How To implement



- Add Line Chart to graphic
 - Open Graphic in “Edit Mode”
 - Open “Energy Vision” Palette
 - Drag & Drop Line Chart to graphic
 - Adjust the Line Chart size
 - Configure Line Chart properties
 - 1 = Background Color
 - 2 = Chart (Sub) Title
 - 3 = timeRange
 - 4 = Optional add x- / y Axis Title
 - 5 = Add Aggregator to chart
 - 6 = Save graphic

Figure 61 - LINE CHART PROPERTIES

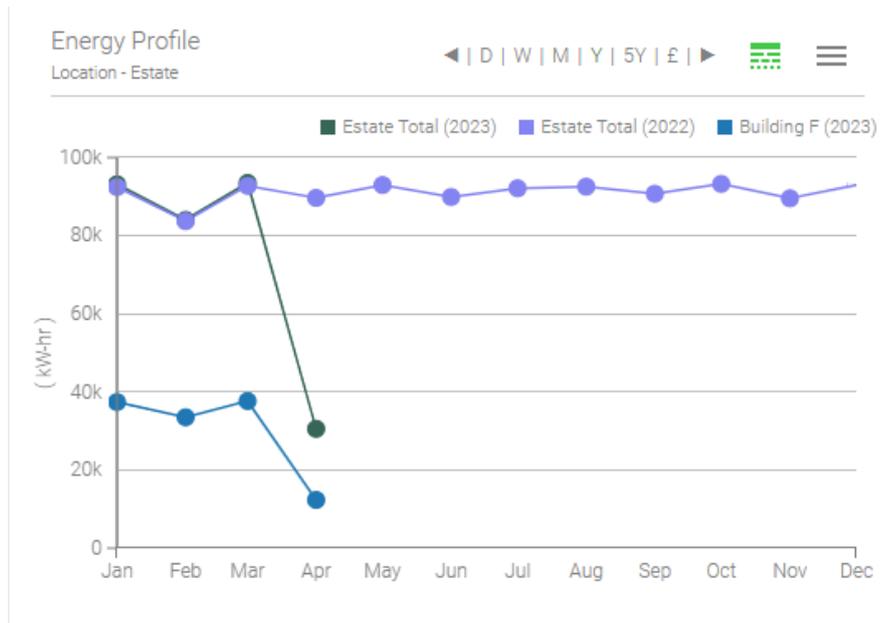


Figure 62 - LINE CHART WITH SYMBOLS

Bar Chart

The bar chart represents the value of the aggregators assigned to it, by the height of bars. This chart is commonly used to show comparisons between different categories of data.

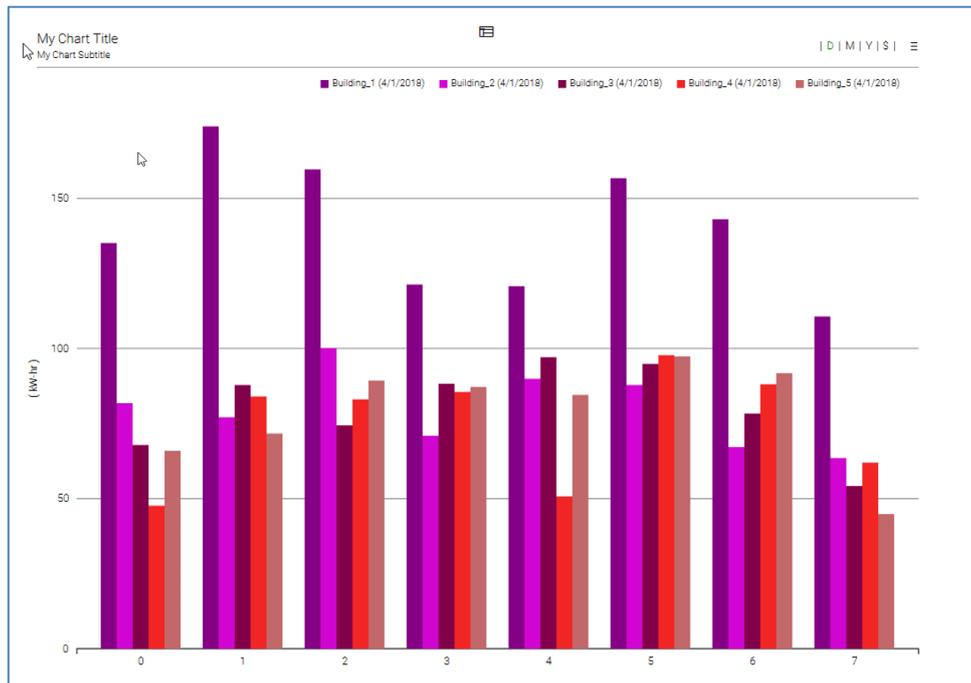


Figure 63 - EXAMPLE BAR CHART

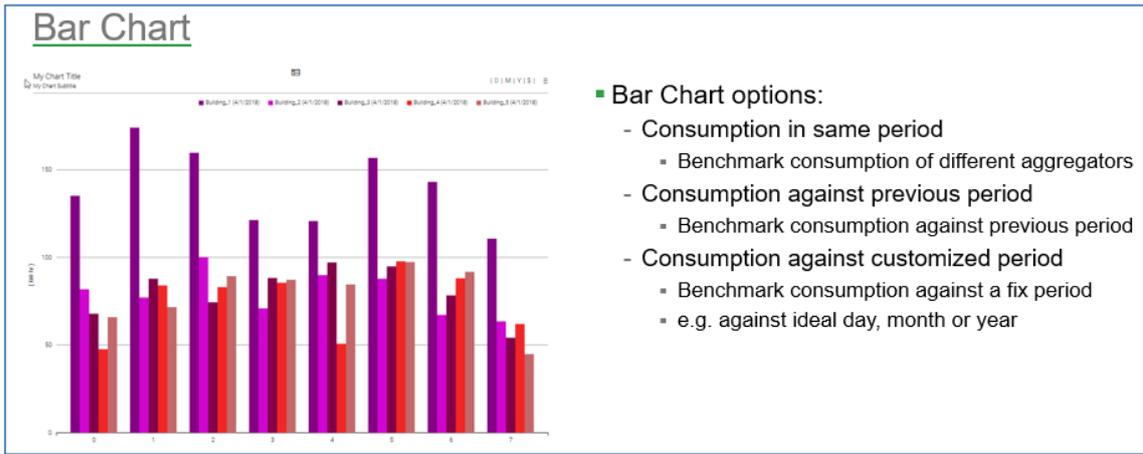


Figure 64 - BAR CHART OPTIONS

Bar Chart – How To implement

1 backgroundCr

2 chartTitle

3 timeRange

4 x/y Axis Title

5 data

- Add Bar Chart to graphic
 - Open Graphic in “Edit Mode”
 - Open “Energy Vision” Palette
 - Drag & Drop Bar Chart to graphic
 - Adjust the Bar Chart size
 - Configure Bar Chart properties

- 1** - Background Color
- 2** - Chart (Sub) Title
- 3** - timeRange
- 4** - Optional add x- / y Axis Title
- 5** - Add Aggregator to chart
- 6** - Save graphic

Figure 65 - BAR CHART IMPLEMENTATION PROCESS

Ranking Chart

The Ranking Chart displays the value of each aggregator assigned to it as a horizontal bar chart. These values are then ranked into order from highest to lowest. This could be used to rank energy usage across multiple sites, ranked to show the most efficient/inefficient.



There is no limit on the number of aggregators that can be added to a Ranking Chart. However, large numbers may reduce performance.

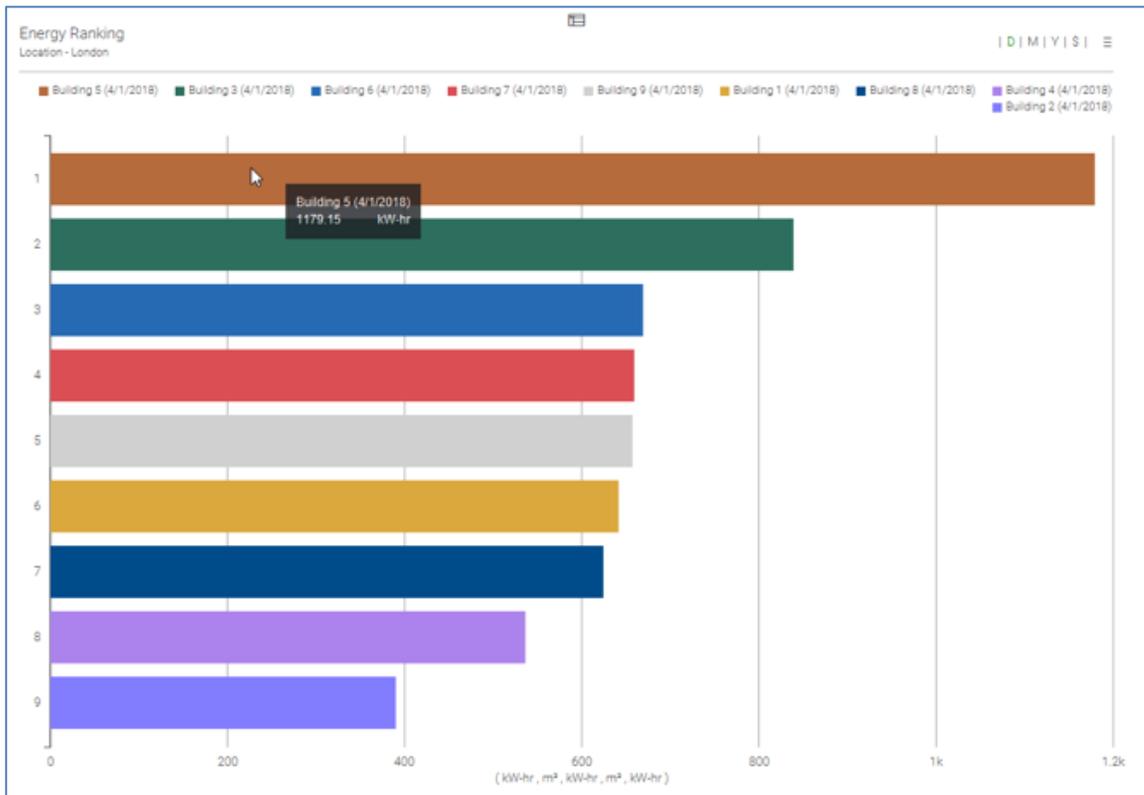


Figure 66 - EXAMPLE RANKING CHART

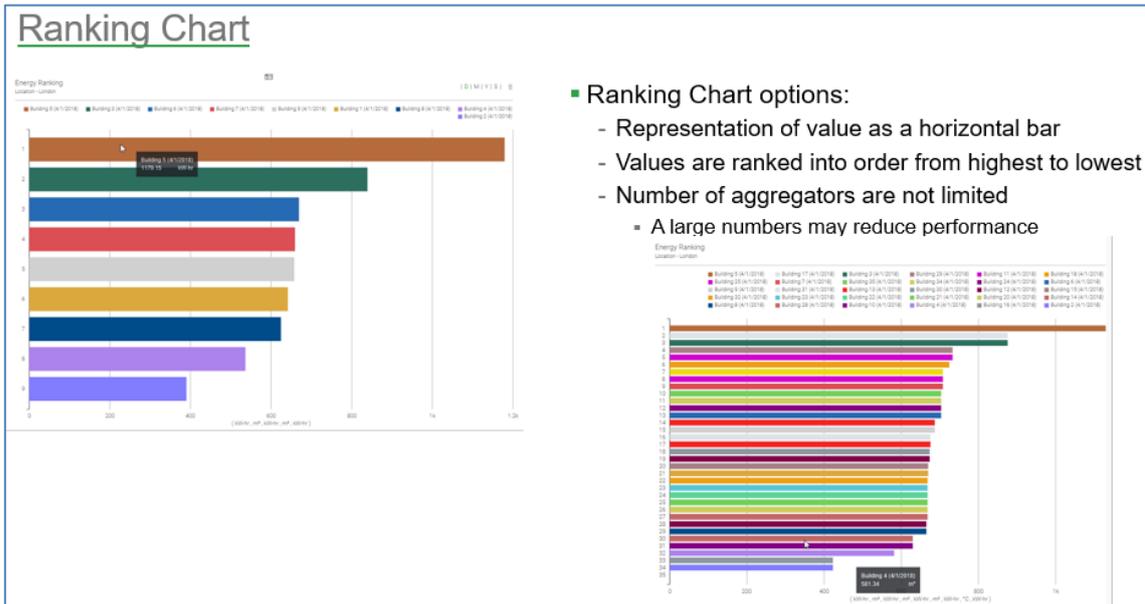


Figure 67 - RANKING CHART OPTIONS

Ranking Chart – How To implement

Ev Chart Data Binding			
Name	Aggregator Ord	Aggregator	Color
Building_1	1	station: slot:/Aggregators/Total420Power420Meter	Current Period 04-Jan-2018 #840084
Building_2	2	station: slot:/Aggregators/Total420Power420Meter2	Custom 04-Jan-2018 #d105d1
Building_3	3	station: slot:/Aggregators/Total420Power420Meter3	Current Period 04-Jan-2018 #82004a

- Add Chart to graphic
 - Open Graphic in “Edit Mode”
 - Open “Energy Vision” Palette
 - Drag & Drop Chart to graphic
 - Adjust the Chart size
 - Configure Chart properties
 - 1 ▪ Background Color
 - 2 ▪ Chart (Sub) Title
 - 3 ▪ timeRange
 - 4 ▪ Optional add x- / y Axis Title
 - 5 ▪ Add Aggregator to chart
 - 6 ▪ Save graphic

Figure 68 - RANKING CHART IMPLEMENTATION PROCESS

Pie Chart

The pie chart displays the total value of all aggregators assigned to it, split into sectors of a circle. The tooltip shows the value of the sector as well as the total value of the circle.

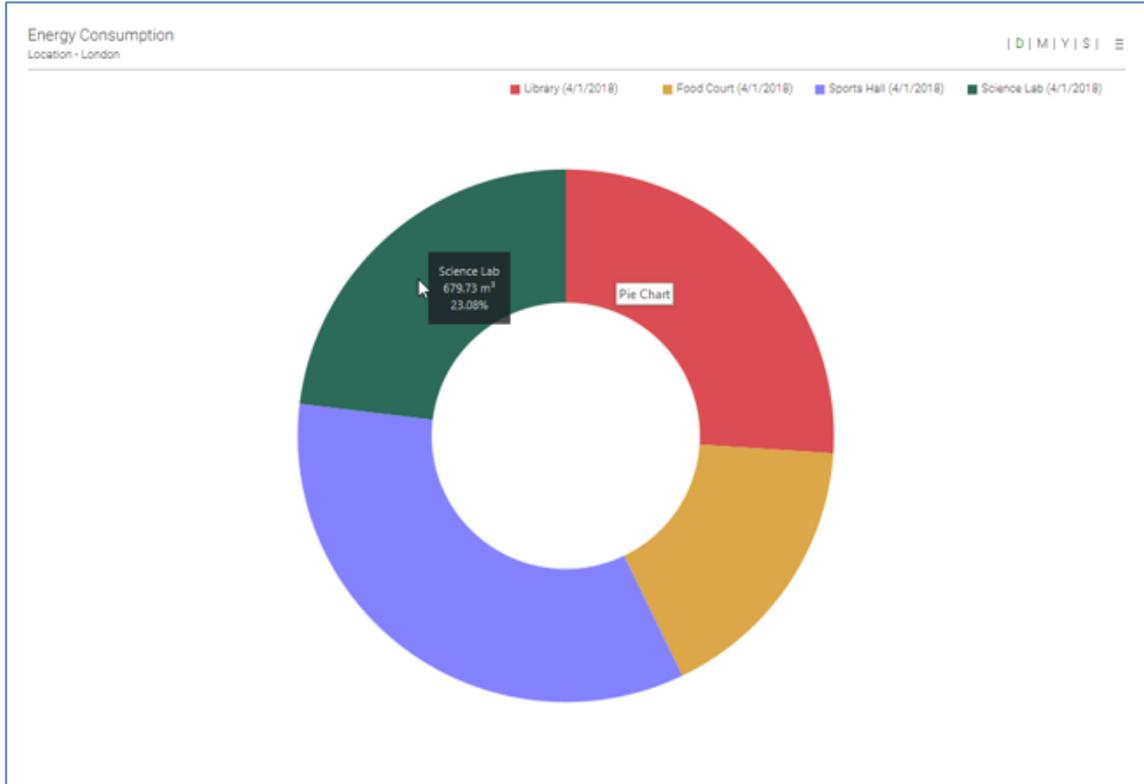


Figure 69 - EXAMPLE PIE CHART

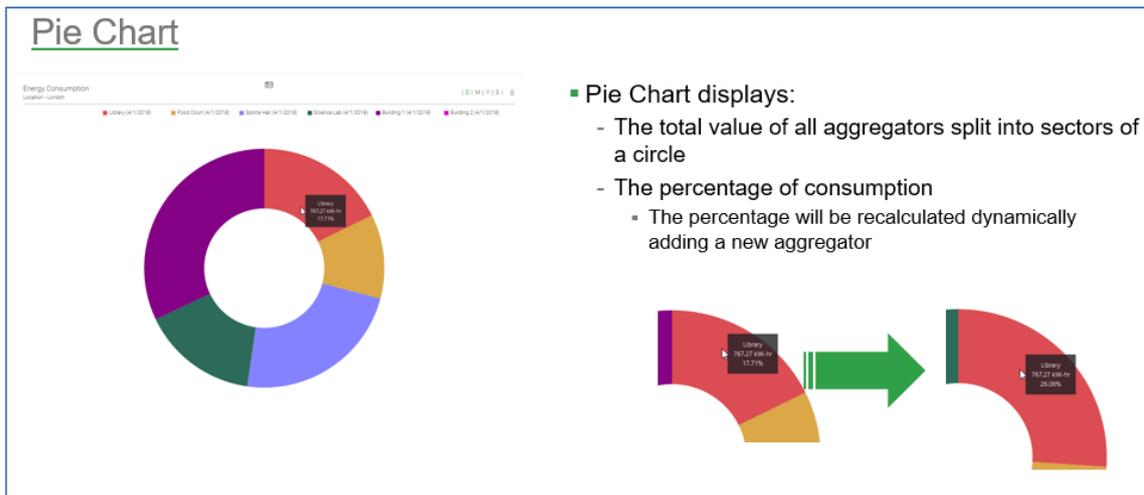


Figure 70 - PIE CHART INFORMATION

Pie Chart – How To implement

1 backgroundCo

2 chartSubTitle Location - London

3 timeRange Day

4 data CLICK_HERE_TO_CHOOSE_ORD

- Add Chart to graphic
 - Open Graphic in “Edit Mode”
 - Open “Energy Vision” Palette
 - Drag & Drop Chart to graphic
 - Adjust the Chart size
 - Configure Chart properties
- 1** = Background Color
- 2** = Chart (Sub) Title
- 3** = timeRange
- 4** = Add Aggregator to chart
- 5** = Save graphic

Name	Library	Aggregator Ord	station: slot:/Aggregators/Campus/campus_power_usage	Current Period	#db4d52	X
Name	Food Court	Aggregator Ord	station: slot:/Aggregators/Campus/campus_water	Current Period	#db4747	X
Name	Sports Hall	Aggregator Ord	station: slot:/Aggregators/Library/library_power_usage	Current Period	#8562ff	X
Name	Science Lab	Aggregator Ord	station: slot:/Aggregators/Library/library_water	Current Period	#2c4e59	X
Name	Building 1	Aggregator Ord	station: slot:/Aggregators/Total1020Power20Meter	Current Period	#840084	X

Figure 71 - PIE CHART IMPLEMENTATION PROCESS

Stacked Bar Chart

The Stacked Bar Chart offers an alternative view to the Bar Chart. Where the Bar Chart offers the user the view of seeing data represented in bars organised side-by-side, the Stacked Bar Chart will group and stack the data on top of each other. For example, if 2 individual meters represent a room, the engineer could group the 2 meters on top of each other. This would indicate the individual meter values whilst showing the combined total of the 2 meters on a bar chart.

Properties

The Stacked Bar Chart data configuration is slightly different. Stacked Bar Chart has an extra option: **Category**. All Aggregators with the same Category will be placed on the same stacked bar. Each category will have its own stacked bar.

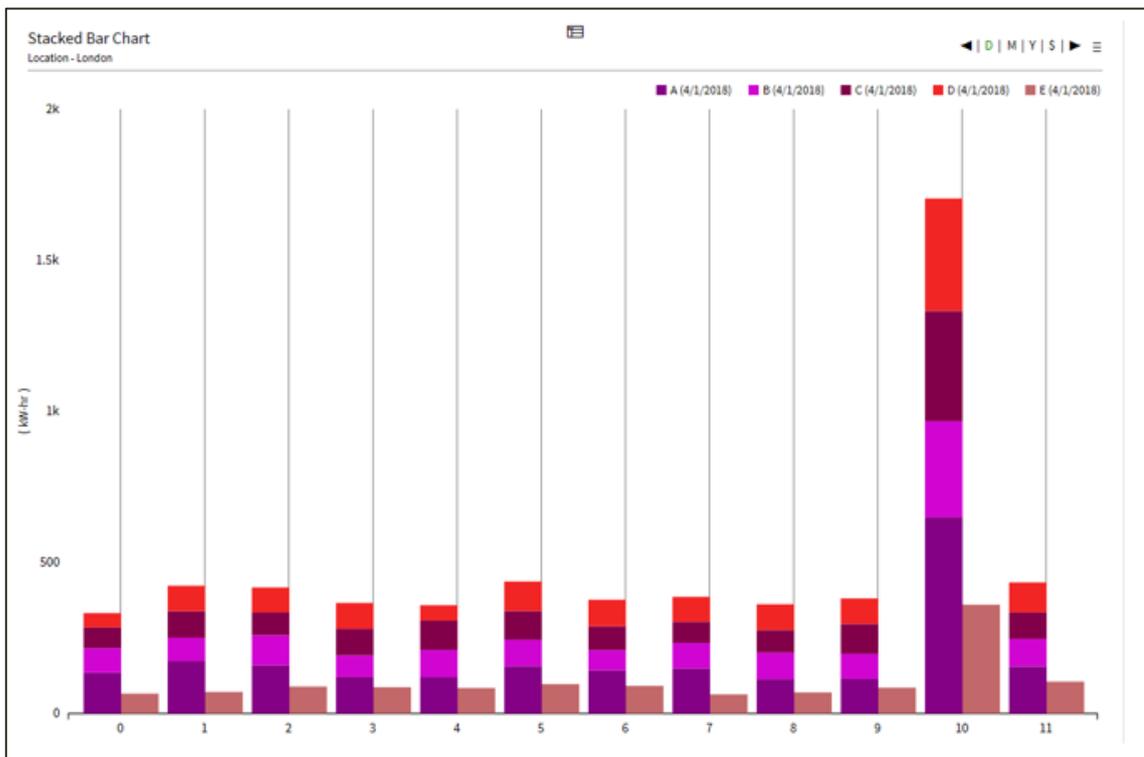


Figure 72 - EXAMPLE STACKED BAR CHART

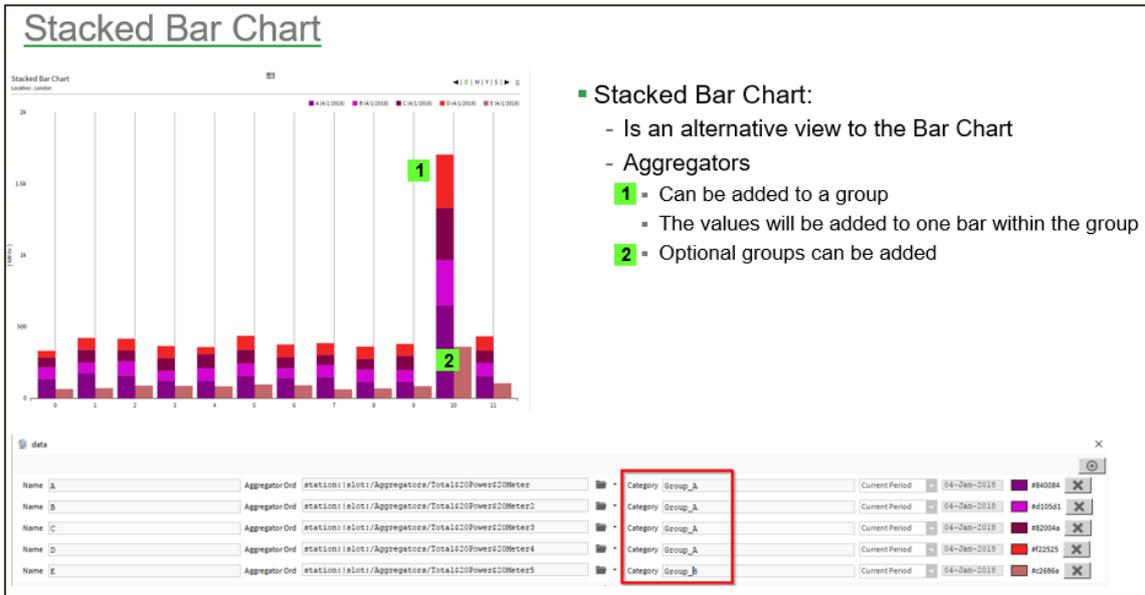


Figure 73 - STACKED BAR CHART INFORMATION

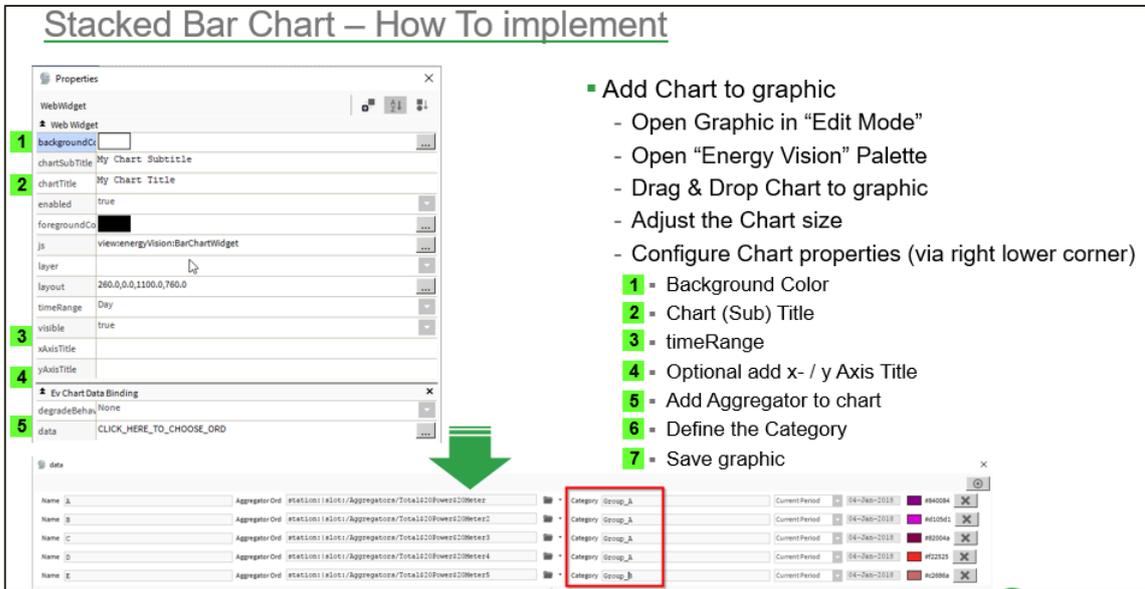


Figure 74 - STACKED BAR CHART IMPLEMENTATION PROCESS

Heatmap

The Heatmap is a widget that allows the yearly data for an aggregator to be represented on a Heatmap chart. The chart will display the value represented by the applicable colour on each day, for each month for the year (if data is available). The Heatmap chart is engineered similarly to the other charts, in that it is directly connected to an aggregator.

How are the Colours Automatically Applied?

The widget will examine the data being added to it for the entire year. It will then apply a Range based on the minimum & maximum value. The minimum value will be assigned the deepest green and the maximum value will be assigned the deepest red.

Using the example below, the chart is representing the OAT (Outside Air Temperature) for a building. It is clear to see when the temperature rises and lowers. The cooler days/month represented in Green are clearly displayed throughout December & January, with the temperature steadily rising until it peaks between June & August, which are represented with deeper Red.

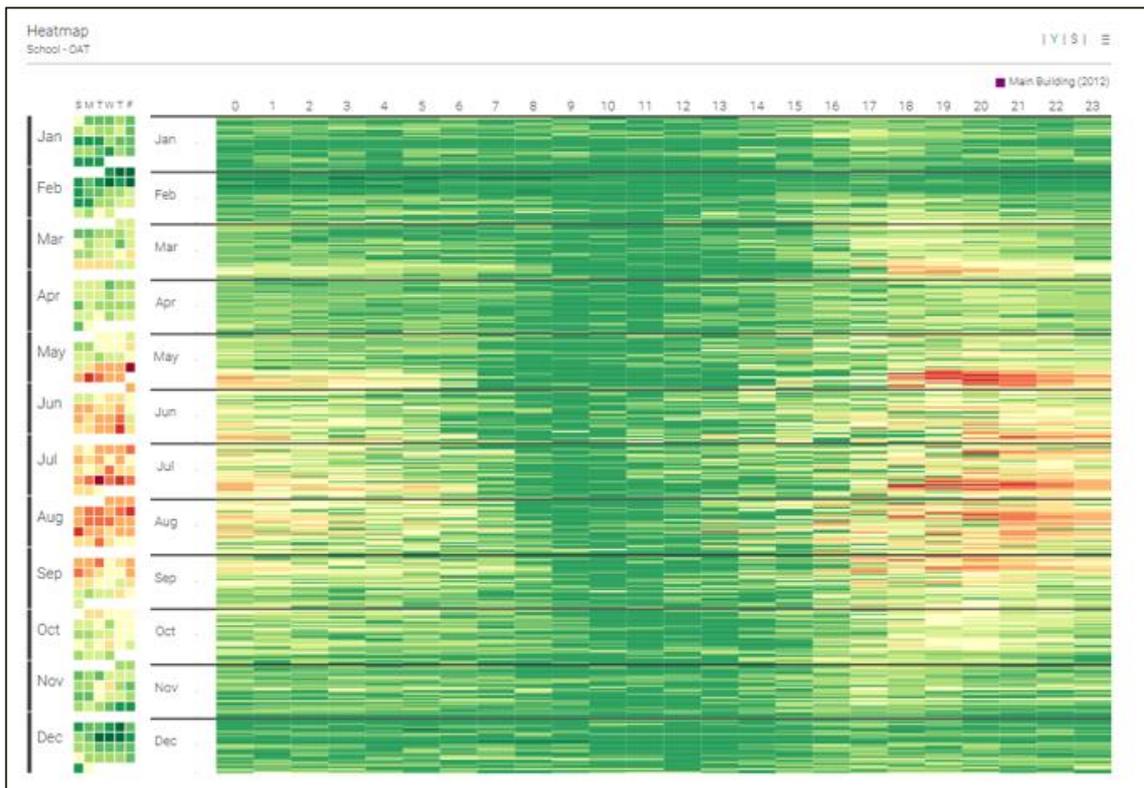


Figure 75 - EXAMPLE HEAT MAP

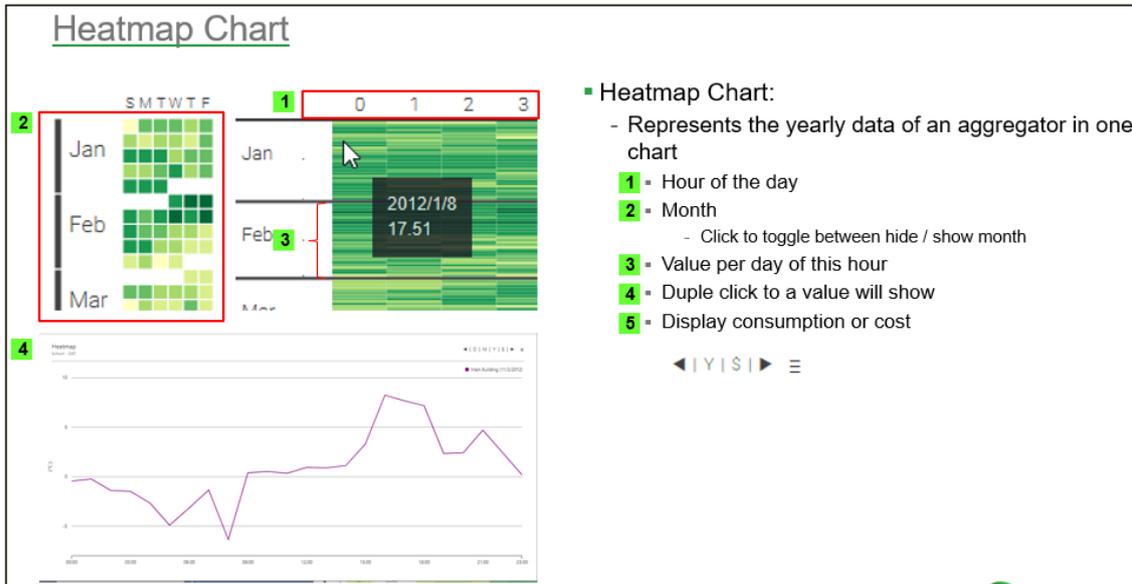


Figure 76 - HEATMAP CHART PROPERTIES

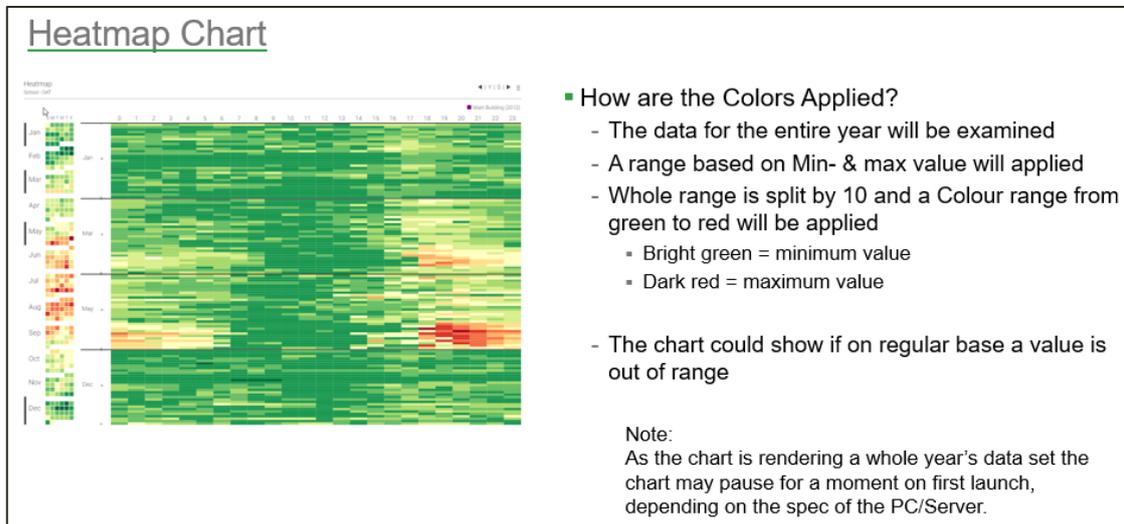


Figure 77 - HEATMAP CHART INFORMATION

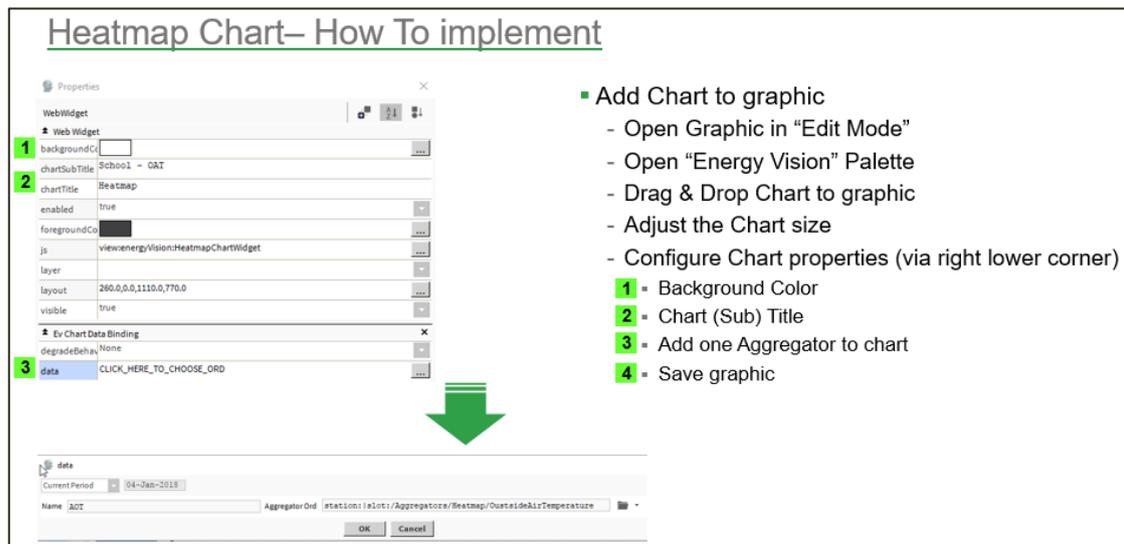


Figure 78 - HEATMAP CHART IMPLEMENTATION PROCESS

The heatmap does not contain a property for setting the time period. Instead, the period is set in the data configuration popup. This is because the graph is designed to show yearly data only, so the data configuration popup lets you define that year period.

Degree Day Regression Chart

The Degree Day Regression Analysis chart is a representation of degree days (Heating Degree Days and Cooling Degree Days) and energy consumption.

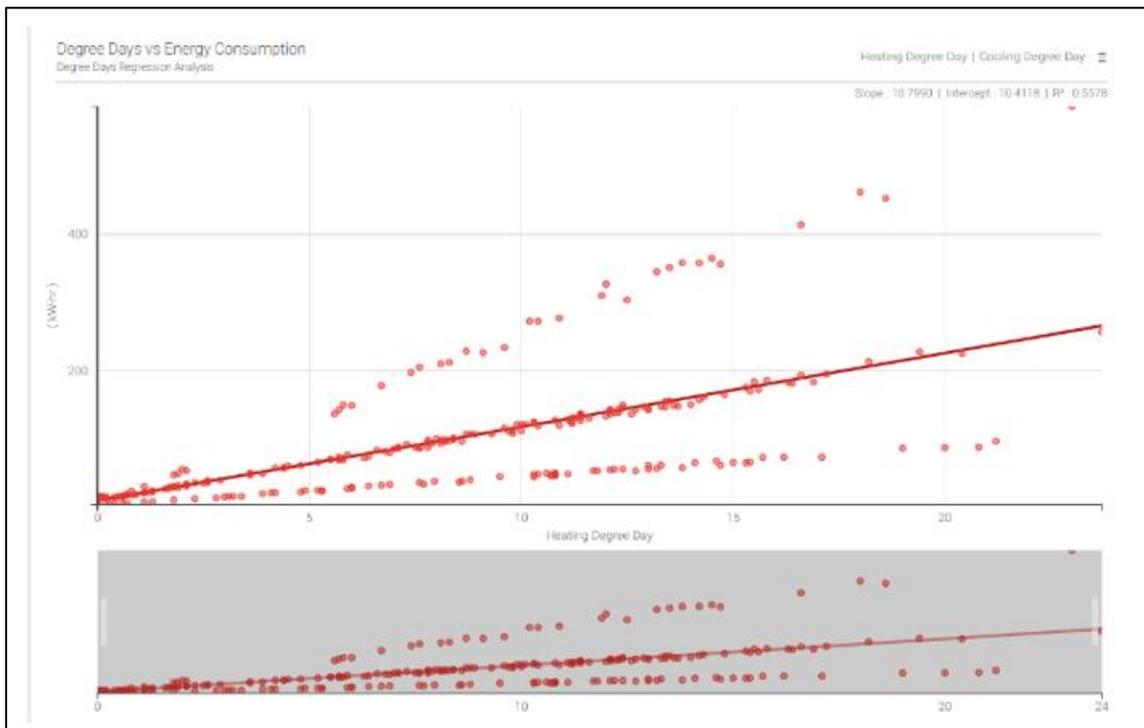
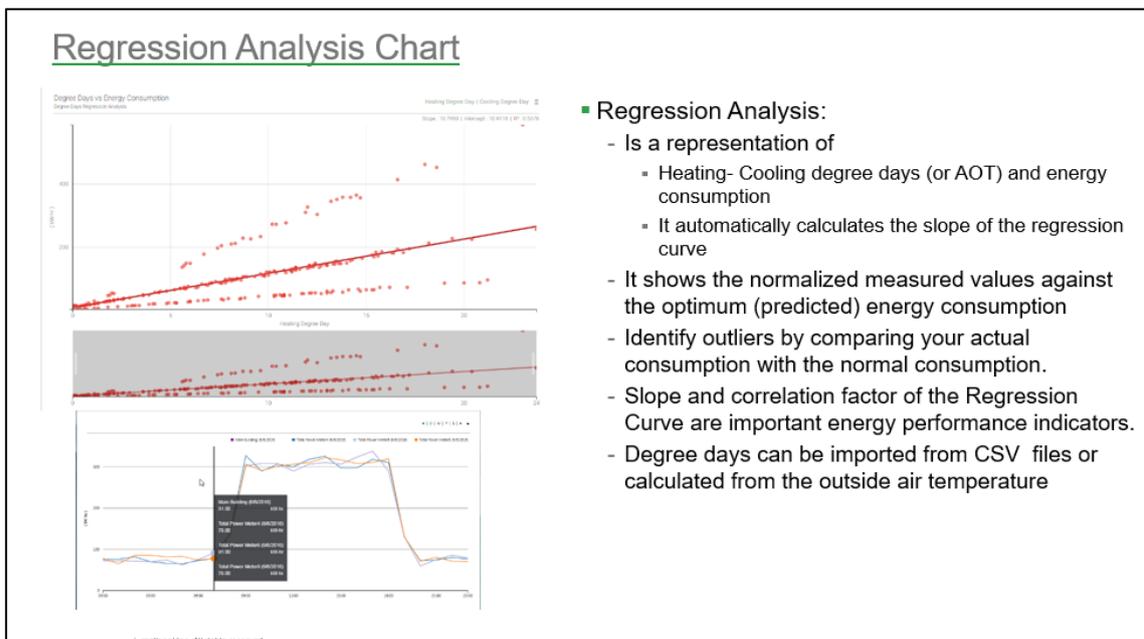


Figure 79 - EXAMPLE DEGREE DAY REGRESSION CHART



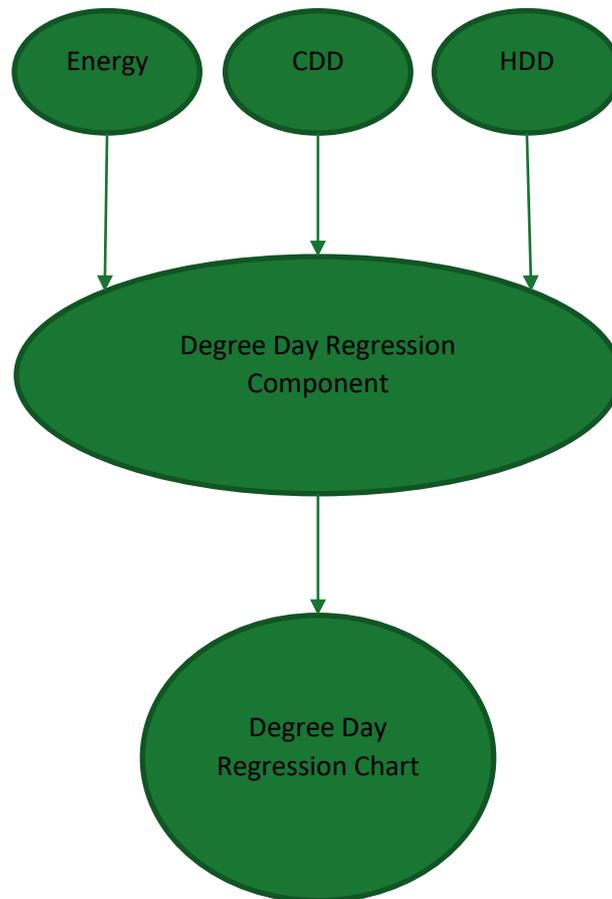
- Regression Analysis:
 - Is a representation of
 - Heating- Cooling degree days (or AOT) and energy consumption
 - It automatically calculates the slope of the regression curve
 - It shows the normalized measured values against the optimum (predicted) energy consumption
 - Identify outliers by comparing your actual consumption with the normal consumption.
 - Slope and correlation factor of the Regression Curve are important energy performance indicators.
 - Degree days can be imported from CSV files or calculated from the outside air temperature

Figure 80 - REGRESSION CHART INFORMATION

The Degree Day Regression chart has three steps to engineer.

1. **Degree Days Aggregators** must be created in the station – these differ from standard Aggregators.
2. The **Degree Day Regression** component must be added to a station. This is where the Aggregators are configured.
3. The **Degree Day Regression Chart** needs to be added to a PX Page. When the data property is configured, the **Degree Day Regression** component will be used as the data ORD.

The diagram below represents the data flow that allows the Degree Days Regression Component to calculate and then be used in the Degree Day Regression Chart.



Degree Day Aggregator

The Degree Day Aggregator inputs outside air temperature (OAT) and the baseline temperature of the building and outputs the Degree Days calculation.



The Degree Day Aggregator needs to be bound to an OAT (Outside Air Temperature).



What is the baseline temperature of the building?

For heating degree days (HDD), the base temperature of a building is the outside air temperature below which that building needs heating. Cooling degree days (CDD) are the opposite, so the base temperature of a buildings is the outside air temperature above which the building needs cooling.

For example, a building manager may want to only turn on the AC when the outside temperature goes above 20 degrees, whereas they may want to turn on the heating when the outside temperature is only 15.5 degrees. So, in this example, the CDD base temperature would be 20 degrees, and the HDD would be 15.5 degrees.

This a simplified explanation for the base temperature, calculating this can be quite complicated. It takes into factors such as thermal properties of the building, heating schedules, solar heat gain etc.

The table below gives a commonly used range of values for HDD base temperatures based on building type.

Building Standard	HDD Base Temperature
Existing Building	15.0 °C
Low-Energy Houses	12.0 °C
Passive Houses	10.0 °C

Property Sheet

The screenshot shows a 'Property Sheet' for a 'DegreeDay (Degree Day)' component. The fields are as follows:

- Uid:** 6019cfad-1ddb-4917-ba1e-6f9df891da40
- Facets:** units=null, costPerUnit=1.00
- Overall:** - {null}
- Current Hour:** - {null}
- Last Hour:** - {null}
- Current Day:** - {null}
- Last Day:** - {null}
- Current Week:** - {null}
- Last Week:** - {null}
- Current Month:** - {null}
- Last Month:** - {null}
- Current Year:** - {null}
- Last Year:** - {null}
- Degree Day Type:** Heating Degree Day
- Base Temperature:** 15.50
- EvMeter:** Exception in Ord: null
- Ord:** null

Figure 81 - DEGREE DAY COMPONENT PROPERTY SHEET (NOT CONFIGURED)

- **Facets** – The unit of the data.
- **Degree Day Type** – Switch between Heating and Cooling Degree Days.
- **Base Temperature** – Enter the base temperature of the building.
- **Meter**
 - **Ord** – Link to the OAT (Outside Air Temperature) aggregator.



To calculate the Cooling Degree Days value the Degree Day Aggregator uses the following formula:

For each hour of the day, ((average temperature for the hour – base temperature) ÷ 24)

(The hourly value is only added to the total for the if the average temperature for the hour is above the threshold temperature).



To calculate the Heating Degree Days value the Degree Day Aggregator uses the following formula:

For each hour of the day, ((base temperature - average temperature for the hour) ÷ 24)

(The hourly value is only added to the total for the if the average temperature for the hour is above the threshold temperature).

How to Engineer the Degree Day Aggregator Component

1. **Drag and drop** the Degree Day Component from the Palette into the wiresheet on which the chart will be displayed.
2. **Double click** on the component.
3. The first setting to change is **Ord**.
 - a. **Click** the drop-down arrow next to the **Folder Icon**.
 - b. **Select** Component Chooser.
 - c. **Navigate** to the OAT (Outside Air Temperature) aggregator.
 - d. **Select** it.
 - e. **Click OK**.
4. Enter the **Base Temperature** for the building.
Ensure the correct **Degree Day Type** has been selected.

Degree Day Regression Component

The Degree Day Regression component is used to feed data to the Regression Chart. It combines heating and cooling degree day data, energy consumption data and defines the period that will be shown on the chart.

How to Engineer Degree Day Regression Component

1. **Drag & drop** the component in the page folder.
2. **Double click** on the component to open the property sheet (Figure 82).
3. The **Ord** link fields will appear **null**.
 - a. **Heating Degree Day** – Use the drop-down icon next to the folder icon
 - i. select **Component Chooser**
 - ii. Navigate to the **Heating Degree Day** aggregator
 - iii. Click **OK**.
 - b. **Cooling Degree Day** – Use the drop-down icon next to the folder icon
 - i. select **Component Chooser**
 - ii. Navigate to the **Cooling Degree Day** aggregator
 - iii. Click **OK**.
 - c. **Energy** – Use the drop-down icon next to the folder icon
 - i. select **Component Chooser**
 - ii. Navigate to the **Total Energy** aggregator
 - iii. Click **OK**.
4. Using the drop-down menu, select the **Time Range**.
5. Click **Save**.
6. Open the Px Page the **Degree Day Regression Chart** will appear on.
7. Select **Edit Mode**.
8. **Drag & Drop** the **Degree Day Regression Chart** onto the **Px Page**.
9. **Double Click** on the chart.

10.

Property Sheet	
Degree Day Regression (Degree Day Regression)	
Heating Degree Day	station: slot:/Degree\$20Days/Heating\$20Degree\$20Days
Heating Energy	station: slot:/Degree\$20Days/Heating\$20Kwhr
Cooling Degree Day	station: slot:/Degree\$20Days/Cooling\$20Degree\$20Days
Cooling Energy	station: slot:/Degree\$20Days/Cooling\$20\$20kwhr
Time Range	Last Year

Figure 82 - DEGREE DAY PROPERTY SHEET

1. **Heating Degree Day** – A link to the Aggregator for Heating Degree Day.
2. **Cooling Degree Day** – A link to the Aggregator for Cooling Degree Day.
3. **Energy** – A link to the Aggregator for energy consumption.
4. **Time Range** – Use this setting to define the range of time.



The **Degree Day Regression** components Property Sheet can be accessed via the Workbench or a web browser. If you wish to use a web browser, you will need to have access to the Property Sheet and the File Structure.

How to engineer the Degree Day Regression Chart



The Data Config of this chart works by setting the ORD to a **Degree Day Regression** component as described in the **How to Engineer Degree Day Regression Component** above.

Properties

The Degree Day Regression chart does not have any further unique properties. See [Line Chart](#)

Energy Temperature Curve (ET Curve)

ET Analysis helps determine how the energy consumption of a site varies with temperature. For a given time period, the kWh/m² of a site and temperature can be superimposed onto a graph showing the ideal consumption for the period. It is used to identify energy consumption anomalies and outliers. For example, using less energy on a cold or warm day.

The user can set up for a given temperature range to show what their expectation of usage. The chart below represents outliers which fall out of the area defined by the dotted lines below.

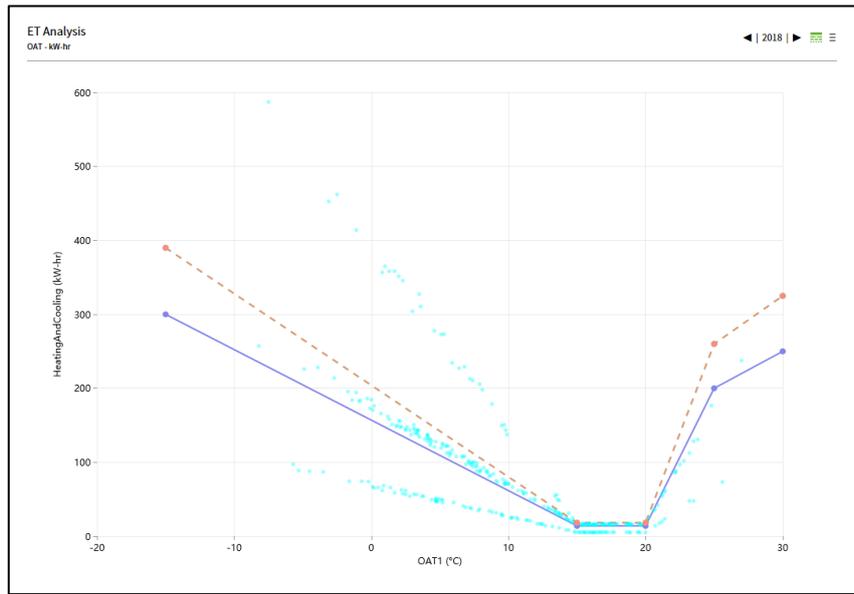


Figure 83 - EXAMPLE ET CURVE CHART

Adding an ET Curve chart

Drag and drop an **Energy Temperature Analysis** component from the Palette into the station and configure the properties.

Energy Temperature Analysis (ET Analysis)		
Status	OK {ok}	
X Axis Aggregator	station:/slot:/Aggregators/OAT1	
Y Axis Aggregator	station:/slot:/Aggregators/HeatingAndCooling	
Energy Start	300.00	
Energy1	14.00	
Energy2	14.00	
Energy3	200.00	
Energy End	250.00	
Temperature Start	-15.00	
Temperature1	15.00	
Temperature2	20.00	
Temperature3	25.00	
Temperature End	30.00	
Upper Bound	30.00	% [0.00 - 100.00]
Lower Bound	30.00	% [-100.00 - 0.00]

Figure 84 - EXAMPLE ET CURVE COMPONENT PROPERTY SHEET



Important, temperatures 1, 2 & 3 must increase in value (Example, Temperature 1 < Temperature 2 etc)

Property description:

- **X Axis Aggregator:** Ord to an Aggregator with temperature data
- **Y Axis Aggregator:** Ord to an Aggregator with energy consumption data
- **Ideal ET profile:** The ideal curve is generated from user-configured temperate, energy and tolerance values.
 - **Temperature:** [Temperature Start, Temperature1, Temperature2, Temperature3, Temperature End] – Temperature range and bands are defined in an increasing order. E.g., [-15,15,20,25,30]
 - **Energy:** [Energy Start, Energy1, Energy2, Energy3, Energy End] – E.g., [300,14,14,200,250]

Drag and Drop the ET analysis chart to the canvas from the palette once the properties have been configured.

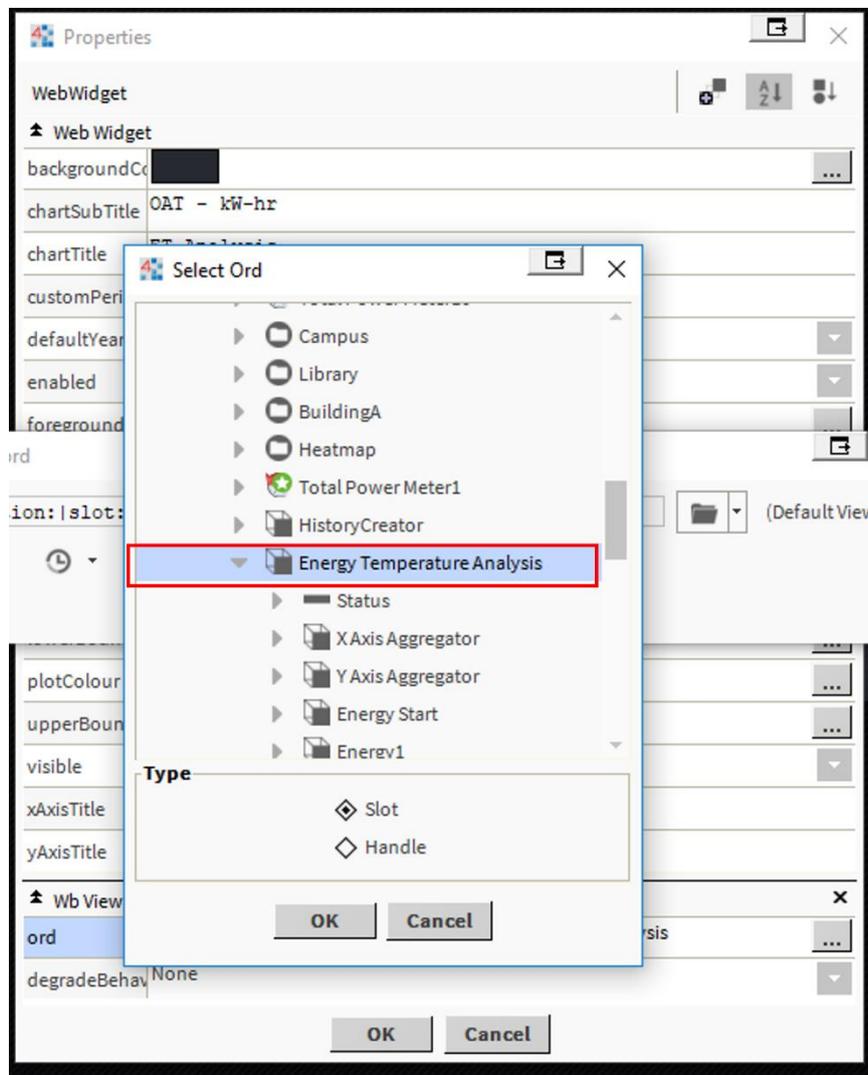


Figure 85 - EXAMPLE OF BINDING TO AN ET COMPONENT

N4 Energy Burger Menu

The burger menu is intended to hide the functionality of the charts until required. It houses the access to instant reports and data quality features. Any configurable option for the chart can be accessed through this menu. Settings made in the burger menu to the configuration of a chart can be saved using the save button in the date config menu. These changes are stored locally and used each time the charts are displayed.

Saving data config locally

- **For existing charts**

Saving of data config only works if chart contains a property named “widgetId”. A Niagara job must be run in order to add the property “widgetId” to existing charts.

Steps for Running a Niagara job:

1. Go to Niagara workbench and click on **config** directory in the station.
2. Then click on **services** directory and select **N4 Energy Manager Service**.
3. Right click on **N4 Energy Manager Service** and go to actions.
4. In actions, click on ‘migrate px files’ job.

Once the job is run successfully, the old charts can persist data config in the browser.

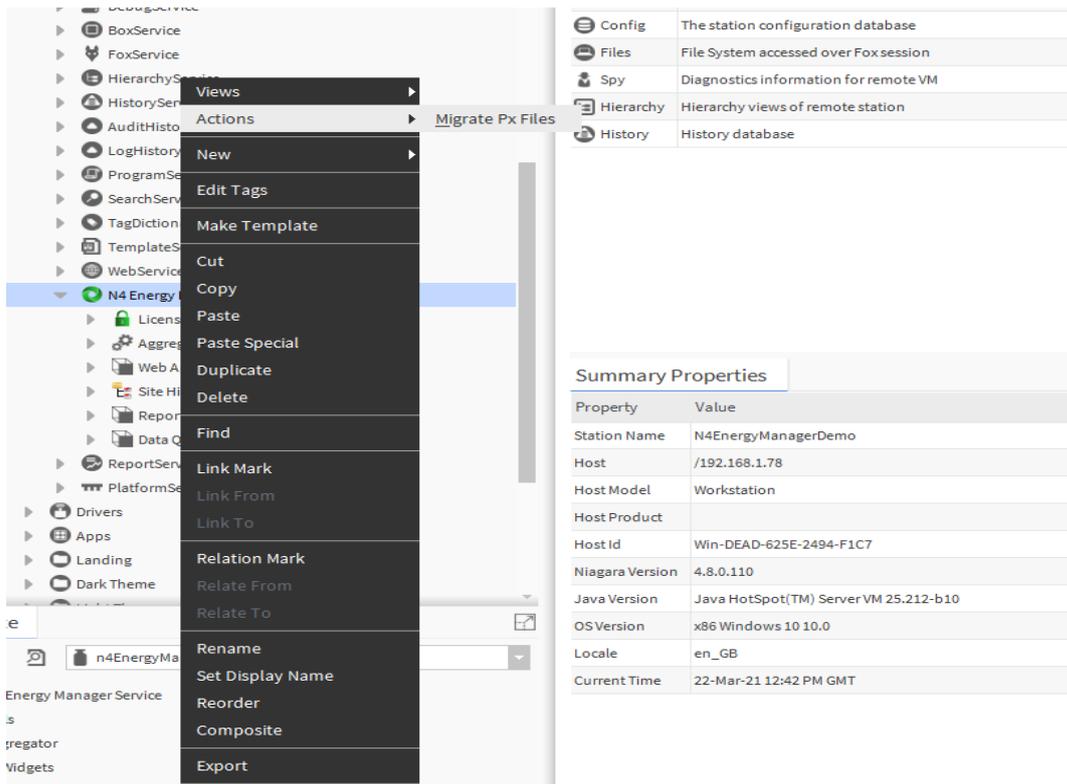


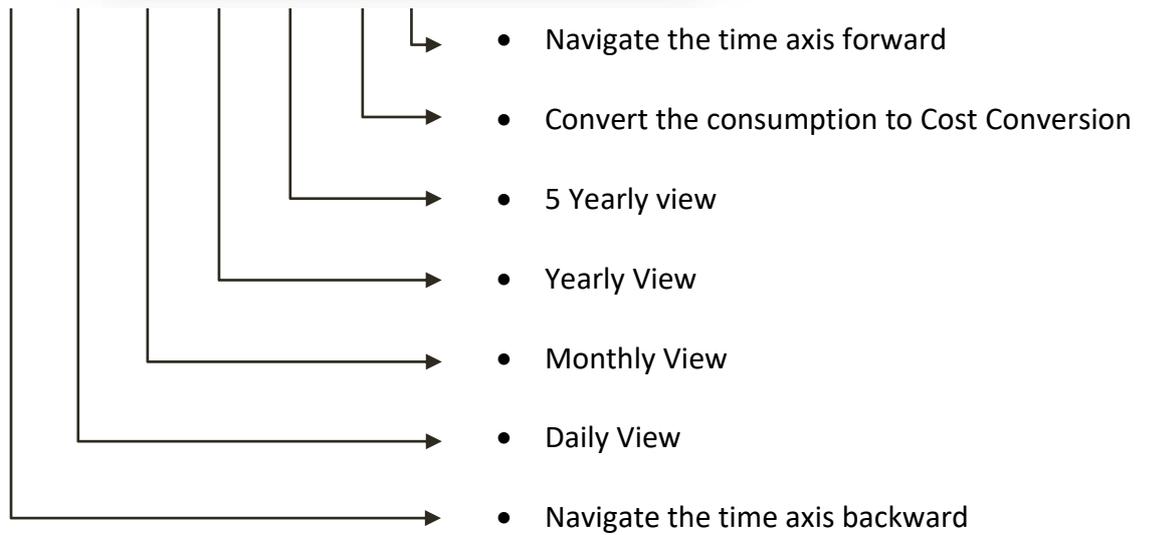
Figure 86 - MIGRATE PX FILES ACTION INVOCATION

- **For new charts**

There is no need to run Niagara job when adding new charts from the palette.

Instant Reports

N4 Energy Manager charts can produce an instant report as a PNG, PDF or CSV file. The diagram below shows the chart controls and their functionality. Google Chrome must be installed on the machine to support this feature.



Daily / Weekly / Monthly / Yearly / 5Y Profiles

The D|M|W|Y|5Y profiles that feature in each of the charting components are interactive buttons allowing the user the view data from a different time period.

For example, if the user is viewing the line chart in 'Daily' mode, they would see the most recent data from that day. Using the arrows ◀▶ the user can navigate forwards and back through the data.

When comparing data, the days are aligned. For example, if the user wants to compare yesterday's data (e.g. 2nd January 2023) then the chart would compare data from the same day last year (2nd January 2022) regardless of whether the actual days (e.g. Monday to Monday) align.

Data Config

The Data Config window can be accessed from the instant report menu.



The chart configuration menu needs to be operated through web browser access. Some of the configuration menu will not work correctly in workbench



Any changes which are made in the Data Config window are not saved and are only visible until the chart is reloaded. (Unless you are using the Data Config menu in the Report Builder – this is explained in the following section.

The Data Config window contains three main tabs:

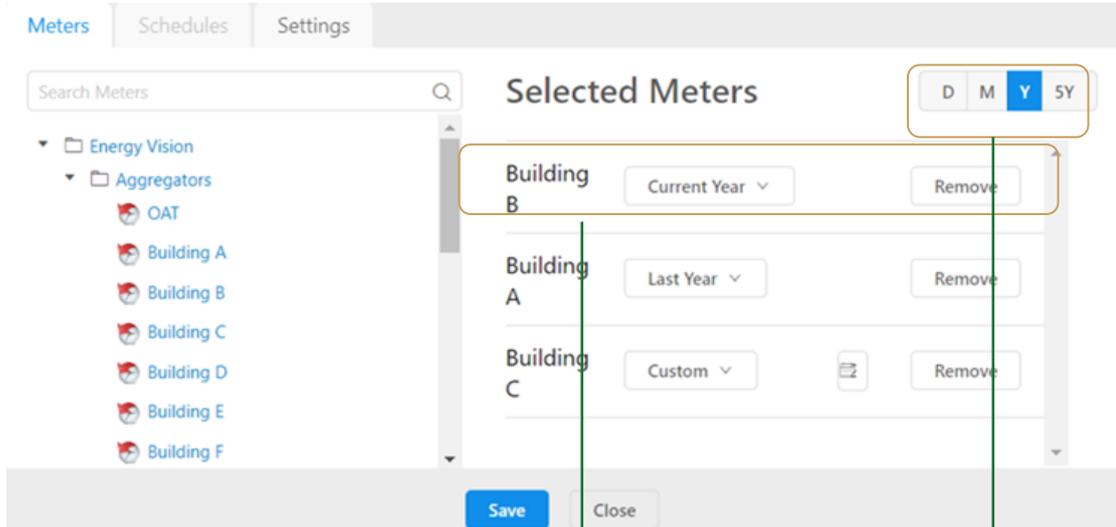
- Meters,
- Schedules
- Settings.

Data Quality

Users can now view the integrity of the data displayed within charts via a 'Data Quality' icon placed to the top right of most charts (not applicable to the Regression and the Heatmap charts). The button's colour changes based on the minimum integrity value returned from the data set being displayed on the chart. Further details on this can be found in the main Data Quality section of the document.

Meters

The **Meters** tab allows configuration of which Aggregators (see [N4 Energy Manager Aggregators](#)) are being displayed on the current chart, along with the selection of custom time periods and time ranges depending on the selected time period (e.g. Day, Week, Month, Year, 5 Years).



One instance of a meter added to the chart. Depending on the selected time period, the drop down enables time range selection.

This is a list of all Aggregators in the station, selecting one of these will add it to the **Selected Meters** list on the right.

Selects the time period the chart will show.

Figure 87 - EXAMPLE METER CONFIGURATION

Change Aggregator Display Name on chart.

Chart data legend display name is the selected data set target Aggregator name by default.

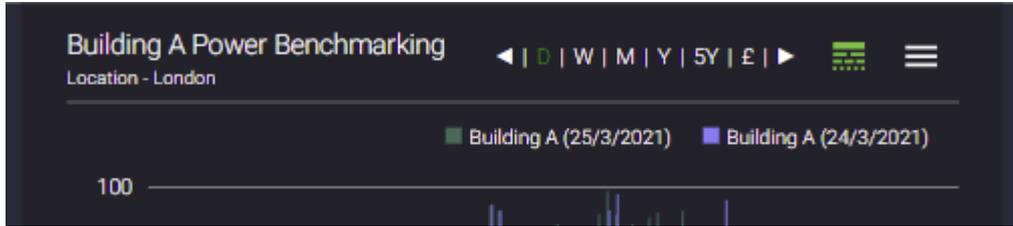
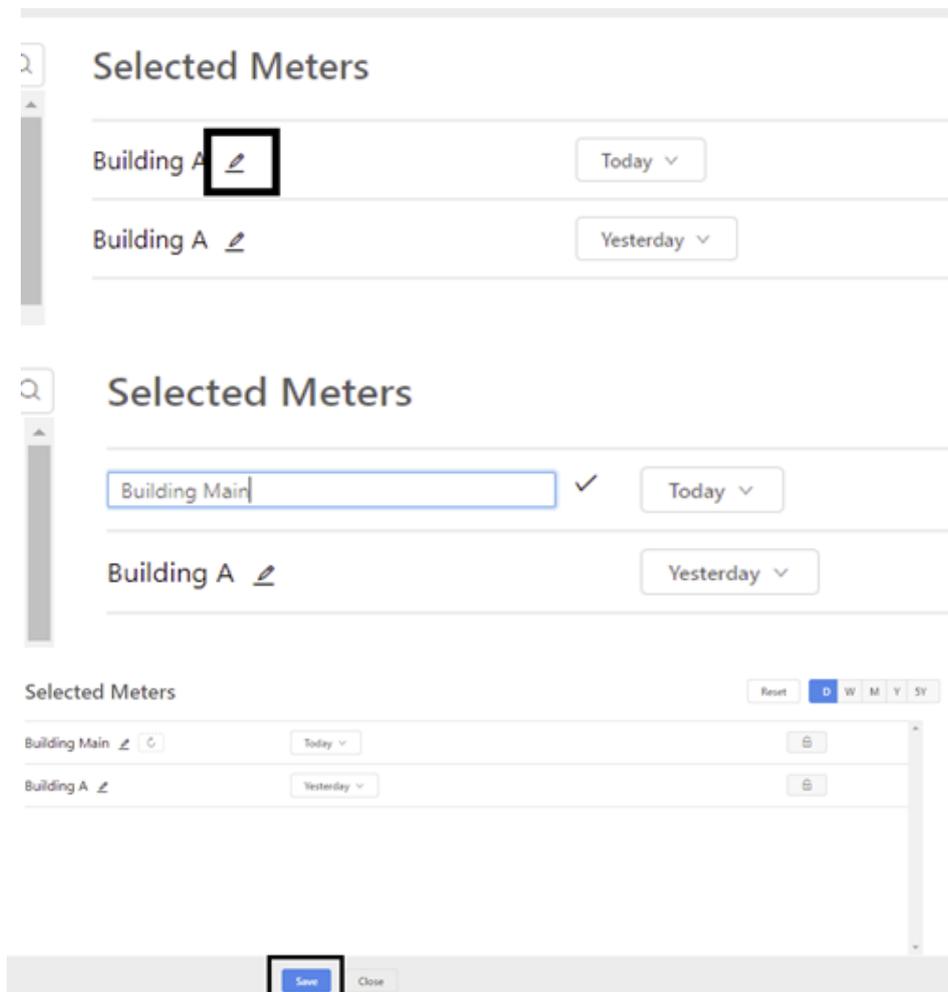


Chart data legend display name on the charts can be changed through the chart Data config menu.

Rename chart data legend name:

- **Open** data config menu.
- **Click** on the Icon beside the Aggregator name.
- **Change** the name in the input box.
- **Click** in the icon or press Enter button.
- **Click Save** button on the Data Config menu.





Data Config menu's **Save** option must be used to save the new display name to the data legend.

On clicking **Reset** button the data config reset to the defaults (Niagara data config).

The changed chart data legend name will be displayed on the chart legend.

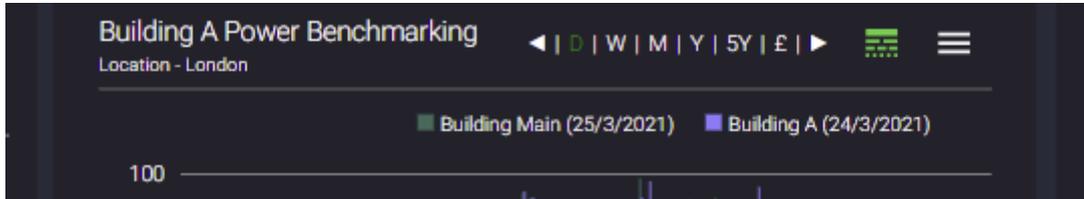
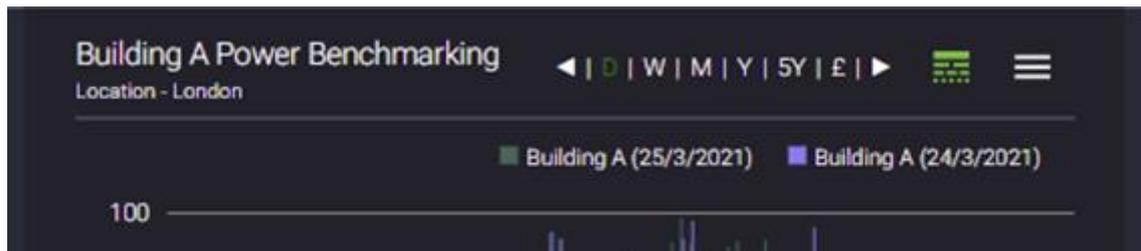


Chart data legend name can be changed many times or Rest to the original name in the Data Config.

Reset data legend name:

- **Open** Data Config menu.
- **Click** on the Reset button beside the Aggregator name or on the right top of the menu.
- **Click Save** button on the data Config menu.

Original Aggregator name will be displayed on the data set legend name after reset.



Save User preference in browser.

The data config allows users to change the behaviour of the charts in a browser. This includes adding additional data points to a chart, changing the time span, updating the name of an aggregator, and chart-specific features such as enabling multiple y-axes on a line chart.

The changes made by the user to a chart are stored locally in the browser cache. These changes remain available between browser refreshes and even when the user logs out and then logs back in. This means the charts are not reset when the page is refreshed or when navigating between pages. To revert the changes, use the reset button.



Figure 88 – RESET USER CHART PREFERENCE.

Since the data is stored in the local browser cache, there are the following limitations:

- The changes are not available across different browsers and machines.
- Preferences are lost when the cache is cleared.

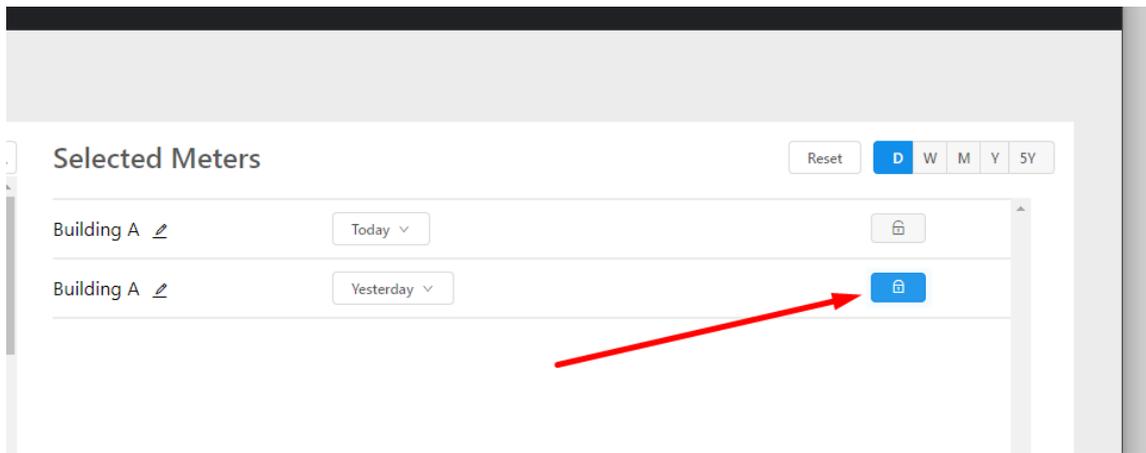
This will be addressed in a later version by syncing the changes to the station.

Lock Ideal time range

- Meters can have ideal time locked for a time range from the data config popup for the charts.
- Meters can be locked from the work bench and can have the default time locked for the ideal time period.

Steps to lock the ideal time range

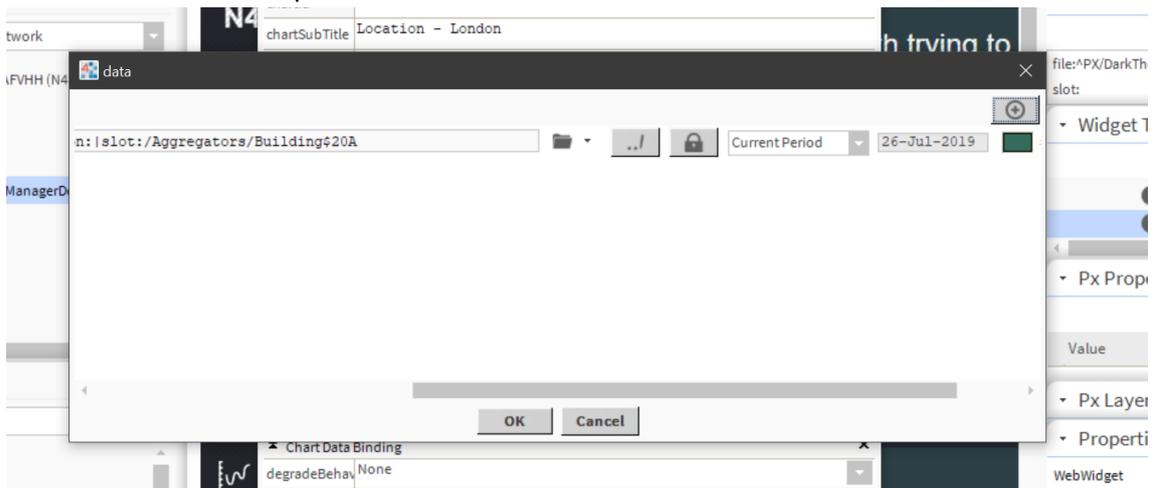
1. Click on the burger menu
2. Lock the selected meter
3. Save



- Locking to default time range can also be achieved by clicking on lock icon on the meter in the data binding.

Steps to lock on the work bench as an engineer

1. Choose a chart
2. Toggle to edit the chart
3. Double to have a menu option
4. Choose Click here to choose ord
5. And lock the required meter



Schedules (special addon for Line Chart)

The **Schedules** tab will only be available within graphical widgets which support the Schedule functionality. The Line Chart supports the Schedule functionality. The **Schedule** function allows the addition of a schedule to the bottom of the chart (e.g. to show occupancy information). Using the drop-down box, select the Schedule you wish to be displayed on the chart.



In case a new created Schedule will not be visible please restart the station or run “Rebuild Site Tree” under **N4 Energy Manager** Service → Site Hierarchy

Settings

The **Settings** tab will contain settings relevant to the chart you are editing.

Show Minimap – If enabled, the slider on the bottom of the chart will be displayed allowing the user to navigate the chart using either a mouse or their finger on a tablet/smartphone.

Show Schedules – If enabled, this will display any added schedules.

Show Symbols – if enabled, this will display circles corresponding to data points on top of lines. This is only available in line charts.

Batch Reporting

Batch Reports give a powerful way to generate customized reports and automatically generate them on a schedule of your choosing. These reports can then be 'pushed' elsewhere by using standard forwarding options from the Reporting Palette (e.g. Email Recipient or File Recipient).

Enabling the automated reporting service

To enable the functionality of automated reporting in your station a few steps must first be carried out to setup the feature.

1. Within Workbench, open the **N4 Energy Manager** Service and expand the **Report Manager**.
 - a. Default is disabled. The service needs to be **Enabled**.
 - b. Server Port default is 9000. If no other servers/services are running on that port, leave as default. If not, you can change this to a port of your choice.



If you are upgrading from a previous version of **N4EnergyManager** it is best practice to delete the **n4em** folder from within your Niagara install directory. This is to ensure the latest version of the packaged Chromium browser is available for PDF Report generation.



The first time you use Batch Reporting in **N4EnergyManager**, Workbench will likely require the certificate to be approved via the **Certificate Manager**. More information can be found in the FAQ section of this guide under **Accepting TLS Certificate**.

Adding an automated report (Workbench configuration)

Before starting to design the report, the initial setup of the automated report must be done in Workbench. You must add a **PDF Report Generator** onto your station and configure the generation period and any forwarding options you want. The following example creates an Automated Report and sends the generated report to a File Recipient.

- Check your license if the Batch reporting feature is enabled
- Enable Report option under Energy Manager Service
- Add the Niagara Report Service into the services section from the Niagara report module
- Create your recipients in Workbench from the Niagara report module
- Create the report template name and recipient in Workbench
- Design the report via Web Browser
- Manual execution / Test of the report

1. Create a new folder under the Station.
 - a. Name it something relevant (e.g. energyReport).
 - b. Open the wiresheet of the folder.
2. Ensure the **N4 Energy Manager** Palette is open in the Palette window.
 - a. Expand **Aggregator**
3. **Drag & Drop** the **PDF Report Generator** onto the wiresheet of the **energyReport** folder.
 - a. Give the component a name (e.g. energyReport)
4. Open the Property Sheet of the **PDF Report Generator**
 - a. Here you can set the trigger mode, frequency and intervals between automatic report generation (Figure 89).
5. In the Palette window, open the **report** Palette.
 - a. Expand **Reporting**.
 - b. **Drag & Drop** the **FileRecipient** component onto the wiresheet.
 - c. **Link** the out slot of the **energyReport** to the **route** slot of the **FileRecipient**.
 - d. Double-click on the component to open the properties. By default, it will save the report in the root of the station. Create a new folder if required and save the report to the desired location (engineers discretion).
 - e. Enable **Append Timestamp**.

Figure 90 shows the wiresheet of this configuration.



You could also use the Email Recipient in the same way as the File Recipient to forward to report to an email address.



Other custom logic could be used to trigger the component using the 'Generate Report' action on the PDF Report Generator component.



Reports can be generated manually by right clicking on the component and selecting actions > generate.



When using the report builder, the user is able to change the names of the selected aggregators using data config popup.



Reports will continuously be generated on the schedule configured. Whether automatic or manual, reports take around 30 seconds to be generated.

Property Sheet	
energyReport (Ev Pdf Report)	
Schedule 2:00 AM {Sun Mon Tue Wed Thu Fri Sat }	
Trigger Mode	Daily
Time Of Day	02:00:00 AM GMT
Randomization	+00000h 00m 00s
Days Of Week	<input checked="" type="checkbox"/> Sun <input checked="" type="checkbox"/> Mon <input checked="" type="checkbox"/> Tue <input checked="" type="checkbox"/> Wed <input checked="" type="checkbox"/> Thu <input checked="" type="checkbox"/> Fri <input checked="" type="checkbox"/> Sat
Last Trigger	null
Next Trigger	04-Nov-2017 02:00 AM GMT
Data	

Figure 89 - AUTOMATED REPORTING PROPERTY SHEET

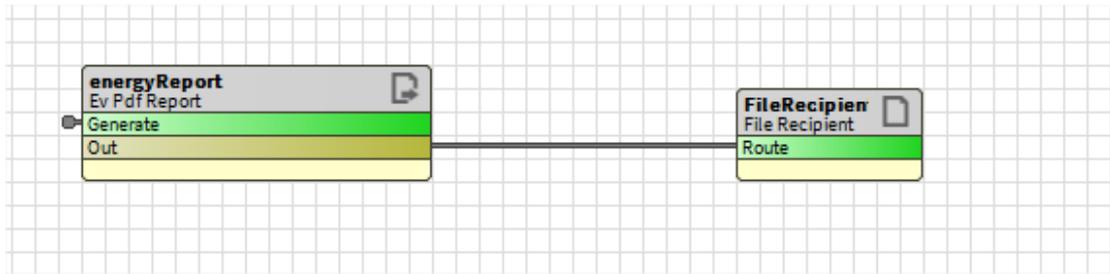


Figure 90 - WIRE SHEET

Designing an automated report (Web Browser configuration)

Once the automated report component has been set up in Workbench, the design phase of the report needs to be done via a web browser. The same automated report component, which was added previously, when viewed in a web browser, will present the tools needed to design the report.

1. Open the web. Login to the station. Use an engineer's login so that the structure of the station can be seen, rather than loading into a graphical PX.
2. Under the folder structure of the station, navigate to the **energyReport** folder.
 - a. Right-click on the **energyReport** component and select **views**.
 - Report Builder** – Responsible for building the reports.
 - Report Viewer** – Responsible for viewing the reports.
 - b. Select **Report Builder**.
 - c. The report designer page will now open.

Figure 91 shows the layout of the report designer and how each section is referred to in the following guide.

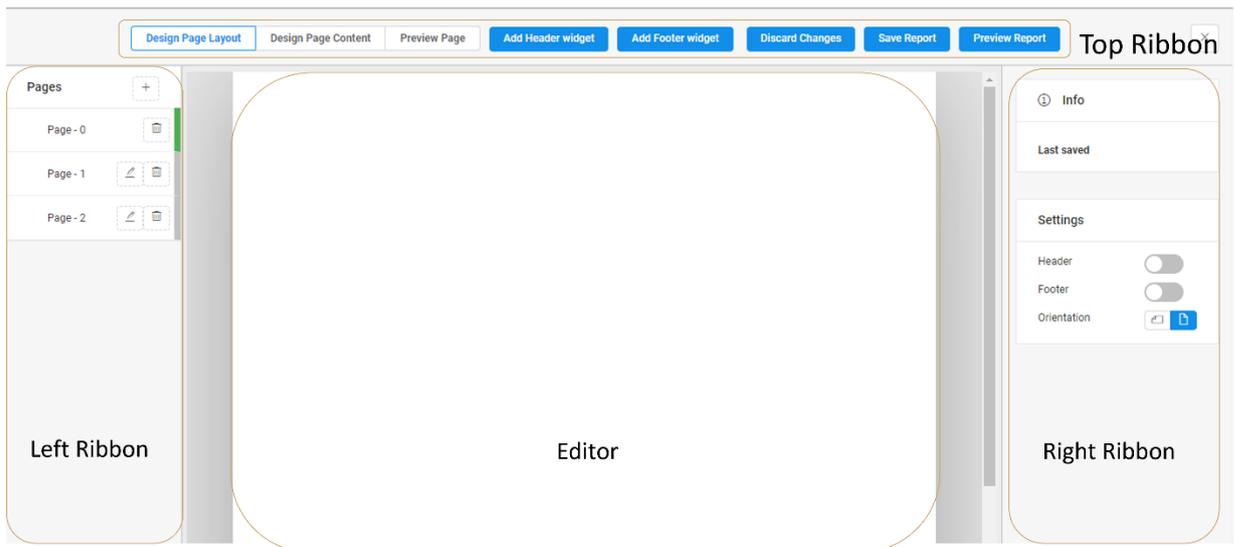


Figure 91 - REPORT DESIGNER

The report designer has three modes: Design Page Layout, Design Page Content and Preview Report. These can be selected using the top ribbon of the report designer (Figure 92).

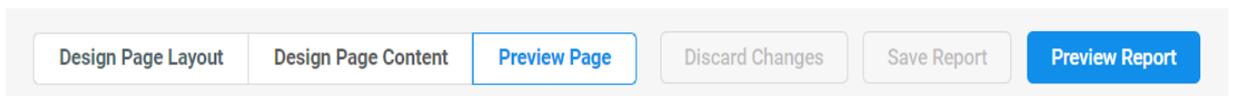


Figure 92 - MODE SELECTION

- **Design Page Layout**
 - Allows the header and footer to be resized and edited.
 - When this is selected, the **Add Header Widget & Add Footer Widget** options will appear.
- **Design Page Content**
 - Allows the content of the page to be resized and edited.
 - When this is selected the **Add Widget** option will appear.
- **Preview Page**
 - Allows the current page to be previewed as it would appear exported.
- **Discard Changes**
 - This will revert back the report to last saved state.
- **Save Report**
 - This will save the report.
- **Preview Report**
 - Allows the report to be previewed as it would appear exported.



It is recommended to periodically save your report using the Save Report button to prevent unintended loss of report configuration.

Design Page Layout

When in **Design Page Layout** mode, it is possible to resize and edit the header and footer of the report. Initially, this is applied to all pages in the report (and any subsequently added pages). This can be overridden per page by using the **Settings** options on the right ribbon (Figure 93).

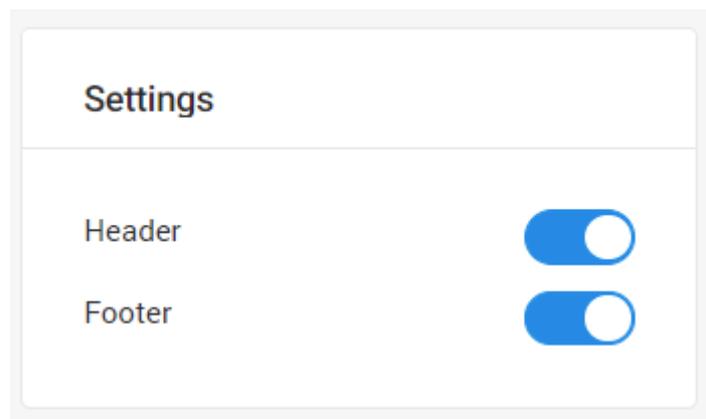


Figure 93 - SETTINGS

In **Design Page Mode** you can use the resize handle on the report page to resize the header and footer.

Using the **Add Header Widget** or **Add Footer Widget** buttons in the top ribbon, you can add text widgets to the respective locations. Once these have been added, the **Text Settings** options appear in the right ribbon. Use these to alter text appearance, and to insert images into the text box (Figure 94).

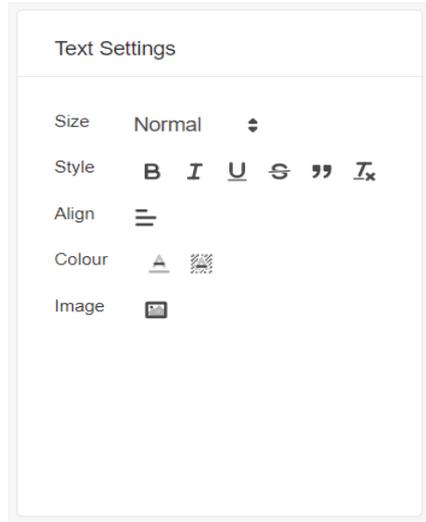


Figure 94 - TEXT SETTINGS

Pages can be configured only in Design Page Layout and Design Page Content operating modes by using the Pages options in the left ribbon. This is also the method to navigate to different pages of the report (Figure 95).

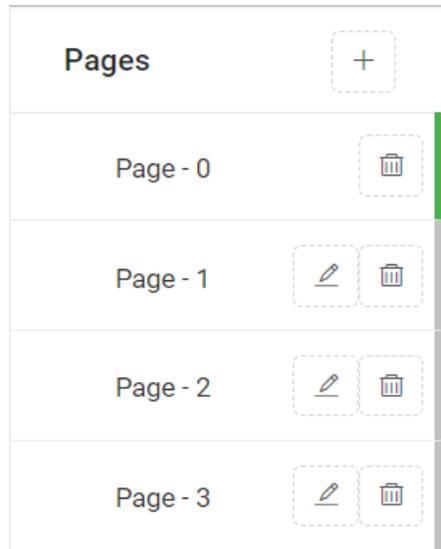


Figure 95 - PAGES

At the top of the Pages tab, the **Add Pages** button will add a blank page to the end of the report.

Each page will have a **Pencil icon**. Clicking this will enable editing of that page.

Each page will have a **Trash Can Icon**. Clicking this will delete the page.



When adding or navigating to a page, there will be a prompt to save any changes made on the current page.

Design Page Content

When in **Design Page Content** mode, a variety of widgets can be added to the body of your report by clicking the **Add Widget** button and selecting the desired widget (Figure 96).

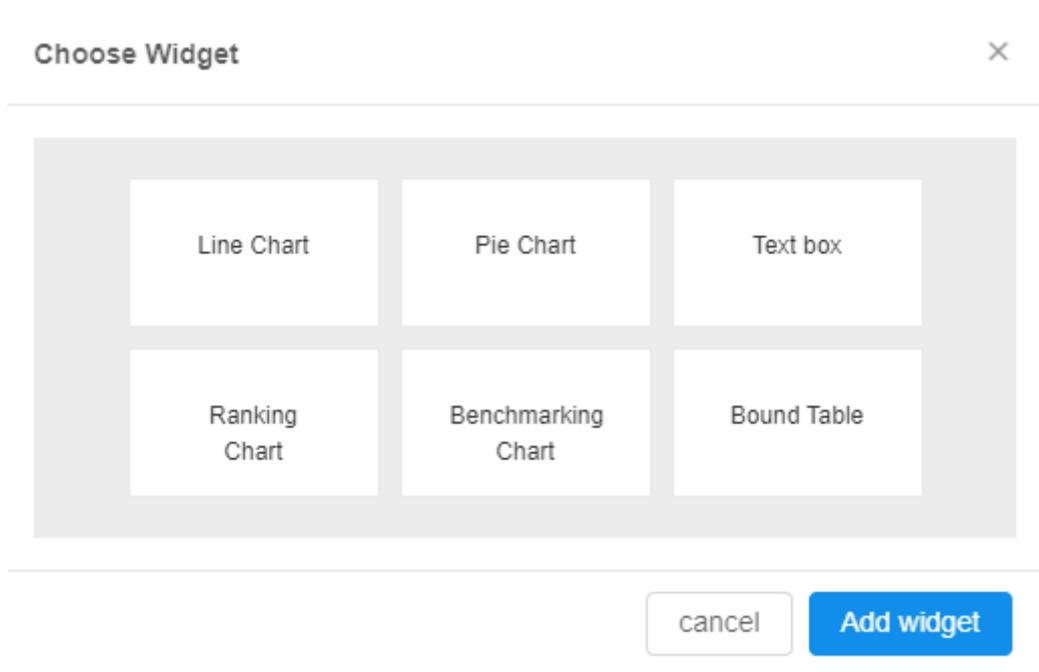


Figure 96 - ADD WIDGET

Once a widget is added to the report, it is configured using the **Data Config** menu, which is explained in the **Instant Reports** section of this manual.



New widgets are always initially added to the bottom of the current page. Using the drag handles you can resize and re-arrange the widgets on the page.

Bound Table widget

It is used to display and format live values from the station within the report. The table is composed of a title, description, and rows. Each row is composed of a label, and a value. In design mode, the row also shows a format field. In

Figure 97 is an example of a bound table, when viewed in **preview** mode.

Bound Table

currentMonth	34581.93 {ok}
currentMonth	34581.93
currentMonth	34581.93 {ok} 15-Jun-21 2:42 PM BST

Figure 97 – BOUND TABLE IN PREVIEW MODE ONCE DATA IS ADDED

Figure 98 is an example of a bound table, when viewed in **design** mode.

<i>Bound Table Title</i>			
currentMonth heating	34436.30 (ok)	%.%	🗑️
currentMonth heating	34436.30	%value%	🗑️
currentMonth heating	34436.30 (ok) 15-Jun-21 2:21 PM BST	%.% %time()%	🗑️

+

Figure 98 - BOUND TABLE IN DESIGN MODE ONCE DATA IS ADDED

To add a bound a table click add widget and select "bound table" (Figure 96). Once the bound table widget is added you will want to add some rows (bound labels).

To add a row

- To add a new row, click on + button at bottom at of widget. (Figure 99)

Bound Table Title ✕

Enter slot path and press enter key to add or Esc key to clos ↵

Please click on (+) icon below to add bound label

+

Figure 99 – ADDING A ROW IN DESIGN MODE

- Once clicked you can see an input box opened (Figure 100).
- Enter the slot path into the input box and press **Enter** key to add or press **ESC** key to Cancel. For example
Ex: station:|slot:/Aggregators/Building\$20A/currentMonth

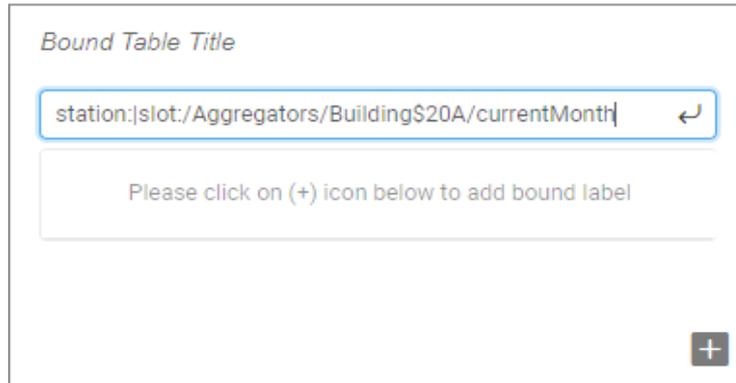


Figure 100 – PUTTING THE SLOT VALUE TO THE INPUT BOX

- Once Enter key is pressed then a row containing 3 columns is displayed (Figure 101). These are: the label, value and format. When hovering on the label then entire slot path is shown in a tooltip.

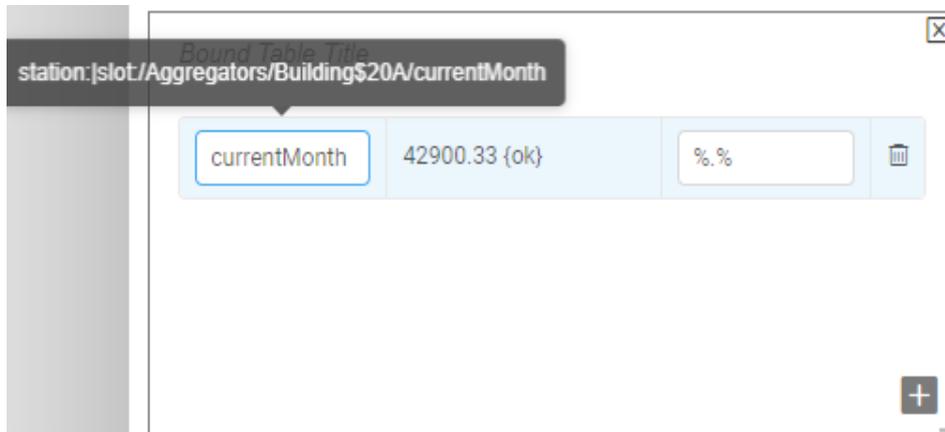


Figure 101 - BOUND LABEL AND VALUE IN THE EDITOR MODE

- The first cell is the label and is editable. It allows you to rename the property.
- The second cell is the value and is not editable. It will show the formatted value.
- The third cell is format and is editable. By default it is %.% which prints the value and the status, e.g. 42900.33 {ok}.
- To add another row click on + button again.
- In preview mode there will be only 2 columns: label and value (Figure 97).



New widgets are always initially added to the bottom of the current page. Using the drag handles you can resize and re-arrange the widgets on the page.

Formatting the Bound label values

Niagara Formatters (see Niagara Help for full documentation) can be used to format the Bound values (Figure 102).

Here are some example formatters:

- default: `%.%`
- units: `%value% %parent.units%`
- time: `%time()%`
- prefix and suffix: **Energy usage is `%.%` for building xxx**

Bound Table Title

currentMonth heating	34436.30 {ok}	%.%	
currentMonth heating	34436.30	%value%	
currentMonth heating	34436.30 {ok} 15-Jun-21 2:21 PM BST	%.% %time()%	

Figure 102 - BOUND TABLE IN CONTENT EDIT MODE



It is recommended to periodically save your report using the Save Report button to prevent unintended loss of report configuration.



When adding or navigating to a page, there will be a prompt to save any changes made on the current page.

Setting Title and Description

The title can be clicked and edited. The space between the title and table is a description free text field (**Error! Reference source not found.**).

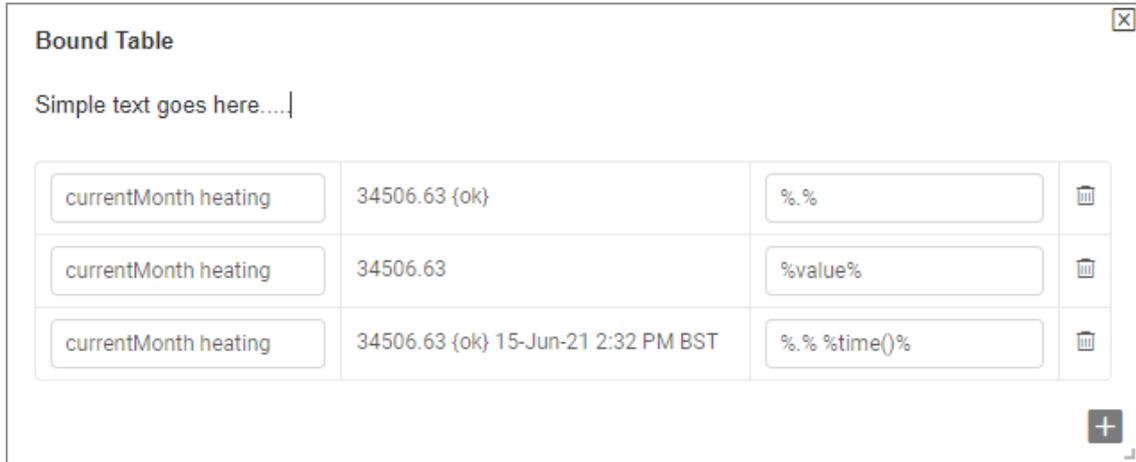


Figure 103 - DESCRIPTION TEXT IN THE DESIGN VIEW

In preview mode the format column is not present, and the value column is wider (**Error! Reference source not found.**).

Bound Table

Simple text goes here.....

currentMonth heating	34506.63 {ok}
currentMonth heating	34506.63
currentMonth heating	34506.63 {ok} 15-Jun-21 2:33 PM BST

Figure 104 - BOUND TABLE IN PREVIEW MODE

Preview Modes

Preview Page

When in **Preview Page** mode, the current page of your report is displayed to check the layout prior to saving.

Viewing the completed Report

Click on the button **Preview Report** to see the complete report in a new tab.

Printing the report

Following the 'viewing the report' steps. Use Chrome's Print to .pdf / print function by pressing Control P or right-click, print.



We recommend using Google Chrome for printing these reports.

Exiting Report Builder

To exit the report designer **SAVE** your report and navigate back to the root of your station, by changing the path entering your local IP address 127.0.0.1.



If you type the original station address into the browsers address bar (this may be localhost/domain name or other IP Address), this will take you back to the root of the station.

Excel Reports & Tenant Billing

N4 Energy Manager allows you to build your reports, or tenant bills using template Excel spreadsheets built using Microsoft Excel. **N4 Energy Manager** will automatically create bills or reports from the templates and generate pdf documents for email or print. This feature can create bill or reports using a variety of time periods, including monthly, weekly or quarterly.

Pre-requisites

The reporting service for Niagara should be installed and activated before this feature is configured and used.

Tariff Schedule

A Tariff schedule can optionally be added to the aggregators to calculate and display the aggregator's corresponding usage in the cost view of charts for a specific time interval. It is an optional feature and does not need to be explicitly added. Where omitted, the cost calculation will fall back to the aggregator facet **costPerUnit** value if set.

Restrictions:

	The minimum interval that can be used is 15 minutes to calculate the cost. The 15 minute or higher minute intervals must be aligned to the hour or 15, 30, 45 minutes past the hour to be able to calculate the cost correctly.
---	---

Tariff requirements:

- The Tariff schedule must be a type of Numeric Schedule.
- The Numeric Schedule default output value must be set to not null. *Figure TF2*
- The default value will be used to calculate the cost if no daily schedule is set in the Weekly schedule.
- If the Numeric Schedule is not set correctly, then the cost calculation will fall back to default value as described above, and an error message will be displayed on the aggregator **Status Text property**.
- If the Tariff Schedule is not set at all, the cost calculation will fall back to default value automatically and message which will be displayed will not cause any functional error.

Setup Tariff schedule:

1. Open the aggregator in property sheet view in which the Tariff schedule needs to be added.
2. The Tariff Schedule Ord line will display null.
3. Click the drop-down icon next to the folder icon on the Tariff Schedule property.
4. Select Component Chooser. Using the pop-up, navigate through your station hierarchy selecting the appropriate Numeric Scheduler (see Figure TF1).

5. Once selected, click Ok.
6. Save aggregator.
7. Open Schedule and click to the Properties Tab (see Figure TF2).
 - 7.1. Uncheck – Default Output null checkbox
 - 7.2. Set default value higher than zero.
8. Click to Special Events Tab (see Figure TF4).
 - 8.1. Add as many special events as required.
 - 8.2. Set priority for Special Events
 - 8.2.1. If special event dates are overlapping the priority order will be used to calculate the cost for a given time.
 - 8.3. If it is required to add Special events in past time, the value of *Cleanup Special Events* property needs to be changed to 'False' on the Property Tab.
9. Click to Weekly Schedule Tab.
 - 9.1. The Default value should be applied as a base value.
 - 9.2. Add as many time periods as required for Weekdays (see Figure TF4).
10. Save the scheduler.
11. Open any N4EnergyManager chart on the station (see Figure TF5).
 - 11.1. Click on the £ symbol to display calculate cost.
 - 11.2. The scheduler corresponding period cost value will be applied to the chart data.

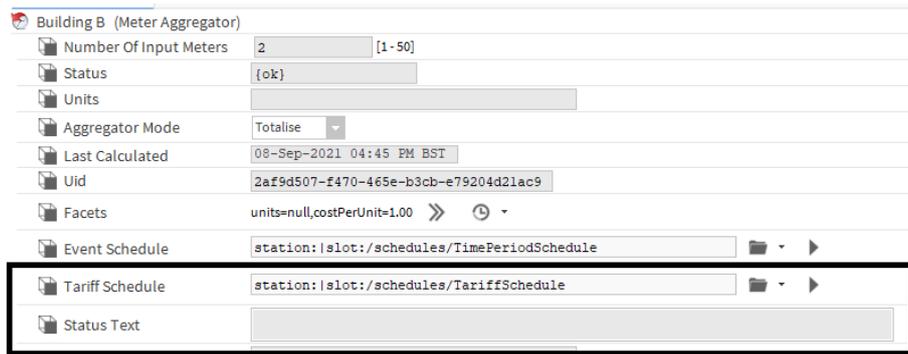


Figure TF1 – ASSIGN NumericSchedule FOR AGGREGATOR

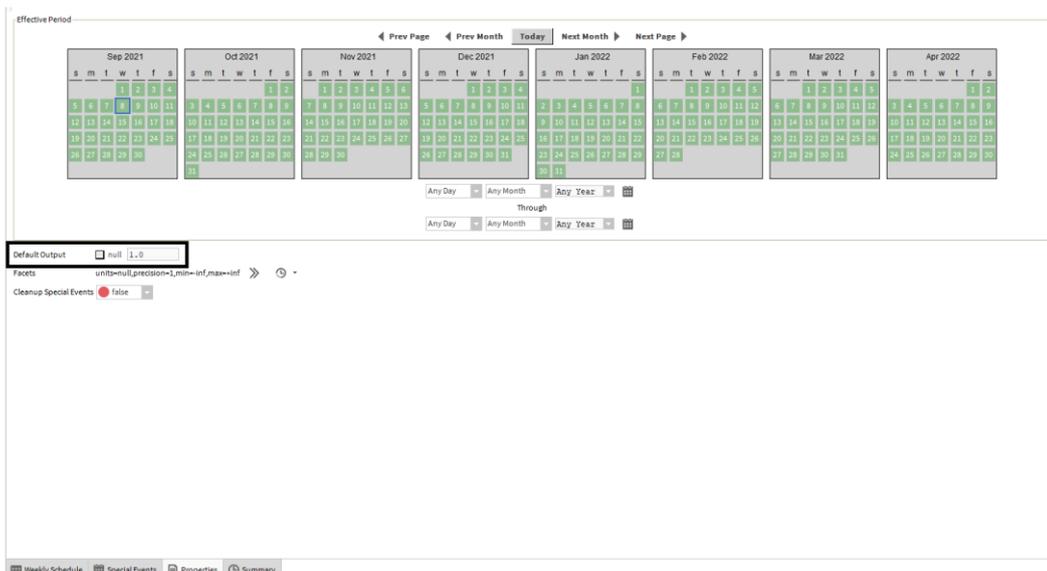


Figure TF2 – TARIFF SCHEDULE DEFAULT VALUE MUST BE NOT NULL AND HIGHER THAN ZERO

Weekly Schedule:

In the Weekly schedule the default value will be used from the default output. To calculate a specific cost at specific time/time range, a new Daily schedule needs to be added and cost value set on it. Any number of Daily schedules can be set with the restriction specified in the requirements.

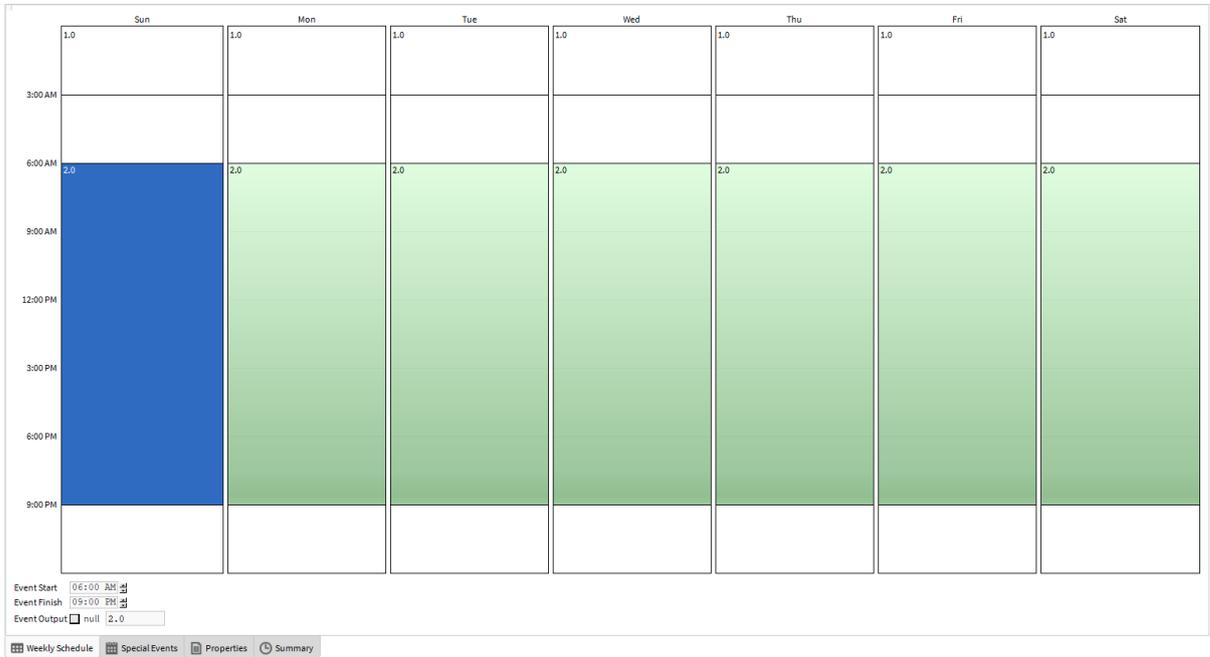


Figure TF3 – WEEKLY/DAILY SCHEDULE COST SETUP

Special events:

Special events will be prioritized and will overwrite the Daily schedule value(s).

There is a priority between the Special events that can be controlled by the scheduler itself.

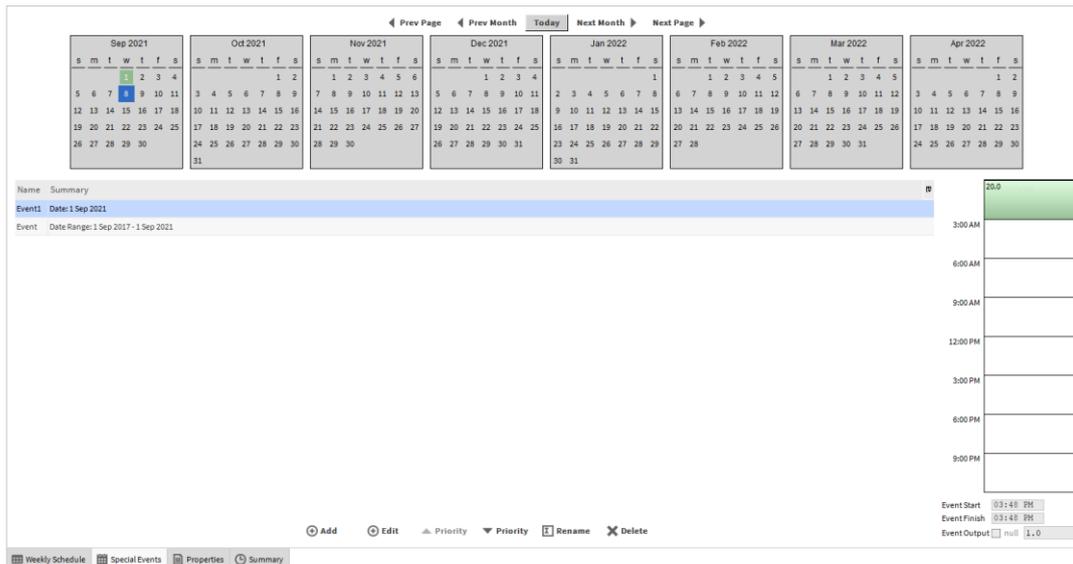


Figure TF4 – SPECIAL EVENTS WILL OVERWRITE DAILY SCHEDULE VALUE. IF THERE IS TIME OVERLAPPING BETWEEN SPECIAL EVENTS, THE USER APPLIED PRIORITY WILL BE USED.

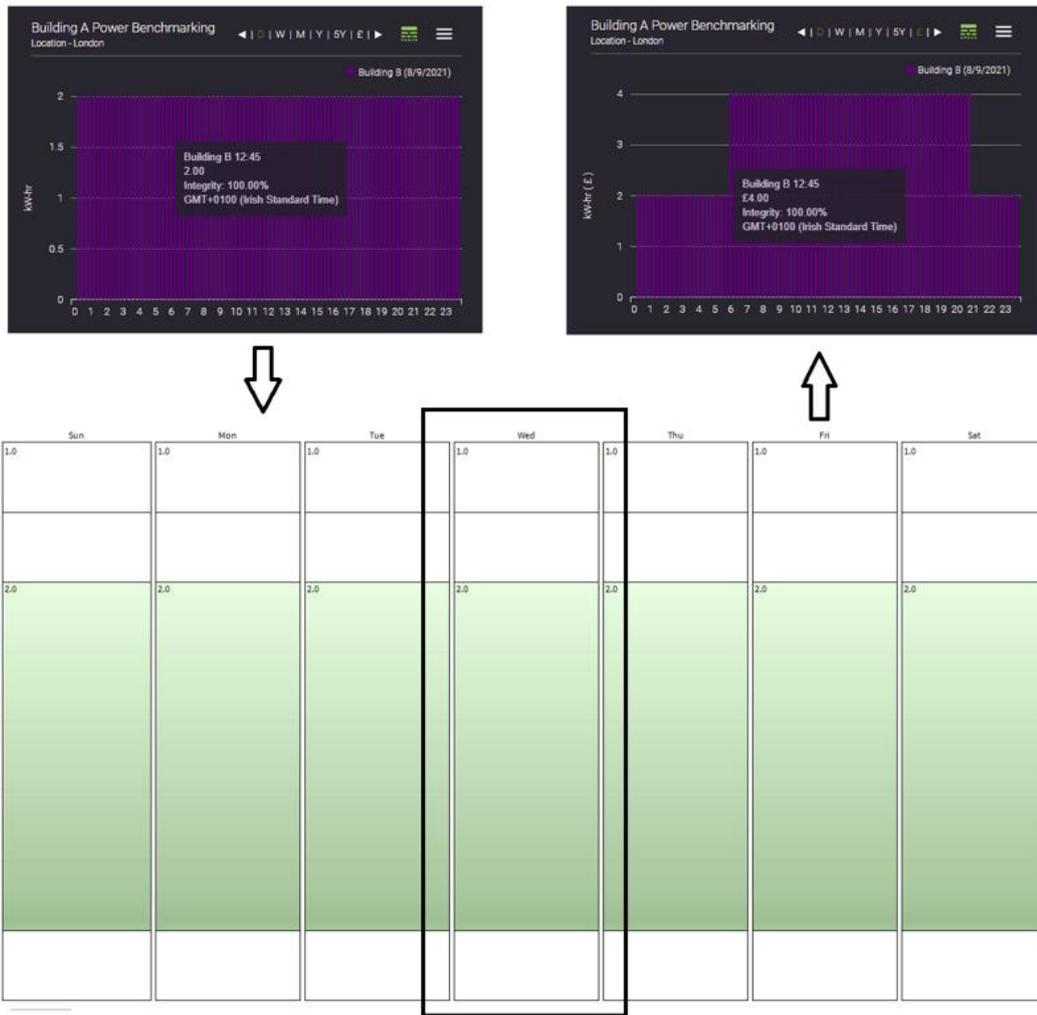


Figure TF5 – COST VALUE APPLIED TO THE DAILY CHART VIEW PERIOD

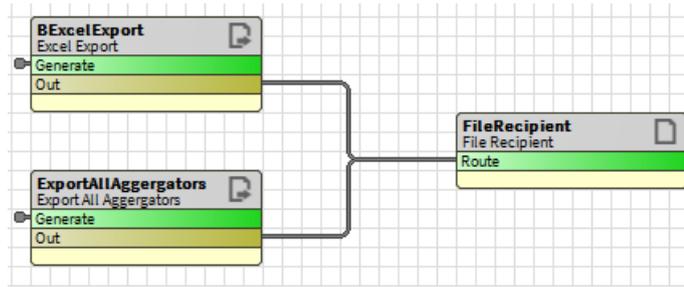
 The tariff data and cost conversion calculation cannot be currently transferred to the Excel report.

Workflow

Microsoft Excel is required to be installed on the PC to allow changes to be made to the templates.

Export all aggregators

- i. Navigate to 'config' and create a new folder (called e.g. All_aggregators) and open the wire sheet.
- ii. From Palette, enter n4EnergyManager expand Utils and add components 'ExportAllAggregators' and 'BExcelExport' to the wire sheet.
- iii. Navigate config>files and create a new folder for file recipient (e.g. ExcelReport)
- iv. Connect the components 'ExportAllAggregators' and 'BExcelExport' to a 'File Recipient' as shown below.



- v. Right click 'ExportAll Aggregators' and select Actions>Generate
- vi. Navigate config>files>ExcelReport (Excel report containing all aggregators with the station should be available under folder.
The report should look like the figure below once open.

1	AggregatorID	AggregatorName	Unit
2	slot:/Aggregators/Building\$20B\$20KPI\$20Normalisation	Building B KPI Normalisation	1
3	slot:/Aggregators/Heating\$20Degree\$20Days	Heating Degree Days	
4	slot:/Testing/Relativised/Charts1/Test	Test	in ²
5	slot:/Aggregators/Building\$20F	Building F	
6	slot:/Testing/Relativised/Charts/Food\$20Court	Food Court	K/s
7	slot:/Aggregators/Building\$20G	Building G	
8	slot:/Aggregators/Building\$20H	Building H	

Figure 105 – EXAMPLE EXPORT OF ALL AGGREGATOR IN A STATION

Report Template (s)

There are two options to use templates for Excel Reporting

- Reuse and modify the default template coming with Energy Manager installation setup
- Manual template creation

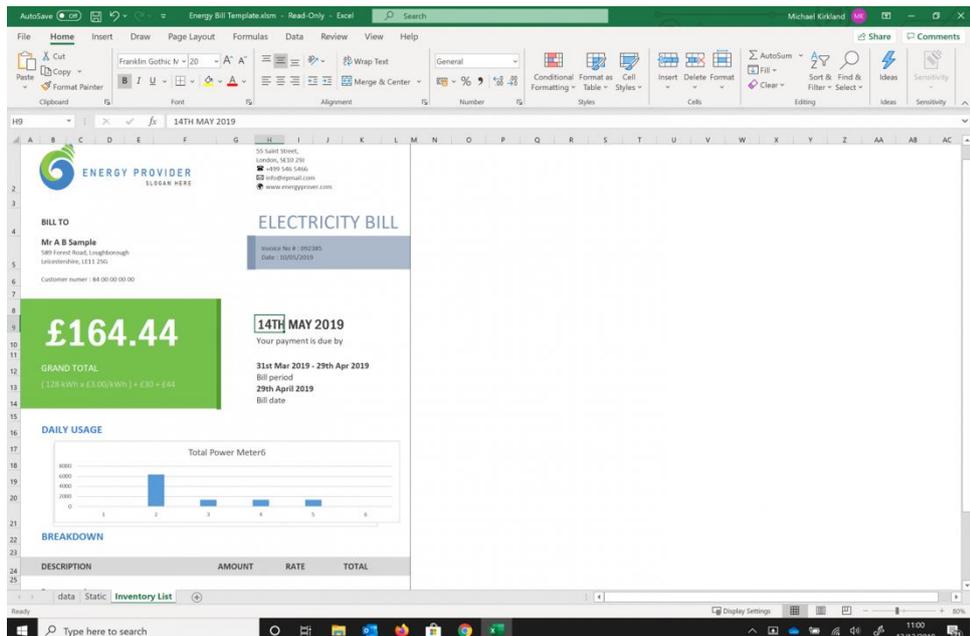
Reuse and modify the default template

Reusing an existing template can be achieved by locating the template in the templates folder of the release and copy it into the station. When a report is run, the template is used by the process to populate the data tab which drives the custom layout of the template itself.

Manual template creation

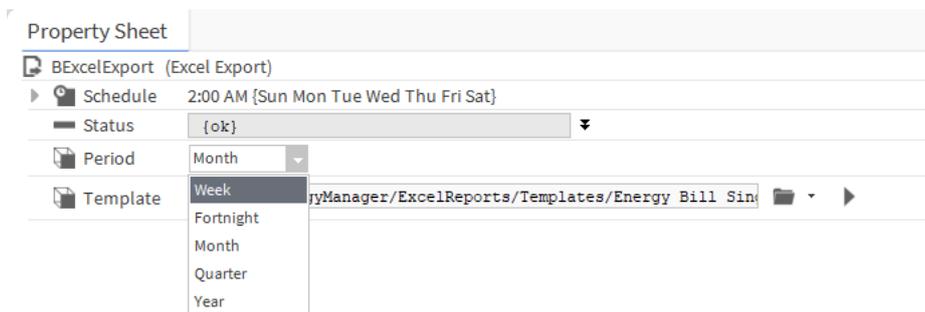
- i. Create excel template with sheet name 'data' using excel template that came with the release or create a new workbook with a tab named "data".
- ii. Add aggregator id's to the excel template (first column) starting from cell 'B1' as shown below and save it under share files.

	A	B
1		slot:/Aggregators/Building\$20B\$20KPI\$20Normalisation
2	name	Building B KPI Normalisation
3	unit	1
4	count	2972
5	tz	Europe/London (+0/+1)
6		
100	01/03/2020 00:00	0
101	01/03/2020 00:15	0.365032136
102	01/03/2020 00:30	0.286787927
103	01/03/2020 00:45	0.948991954
104	01/03/2020 01:00	0.122684613
105	01/03/2020 01:15	1.604724169
106	01/03/2020 01:30	0.338646531
107	01/03/2020 01:45	1.953859568
108	01/03/2020 02:00	0.520954788
109	01/03/2020 02:15	1.155905008
110	01/03/2020 02:30	0.099702001
111	01/03/2020 02:45	0.435257524
112	01/03/2020 03:00	0.11433012
113	01/03/2020 03:15	0.837152839
114	01/03/2020 03:30	1.171193361
115	01/03/2020 03:45	2.099998713
116	01/03/2020 04:00	0.938001096
117	01/03/2020 04:15	0.869348705
118	01/03/2020 04:30	1.220317602
119	01/03/2020 04:45	1.739819884
120	01/03/2020 05:00	0.723166585



Generate report using template

- i. Navigate config>select the folder containing ExcelReport.
- ii. Double click on component 'BExcelExport'
- iii. Import the excel template
- iv. Select the period
 - a. Week – Will generate previous week from time of executing.
 - b. Fortnight – Will generate the previous fortnight from time of executing.
 - c. Month – Will generate for previous month from time of executing.
 - d. Quarter – Will generate for the previous 3 months from time of executing.
 - e. Year – Will generate for previous year.
- v. Right click on the component and select Actions>Generate



Different versions of Excel may behave differently when refreshing the template data. A forced refresh of Excel formula may be needed to display results

Excel reports can also be configured to append the date to the filename ensuring subsequent report runs do not overwrite previous versions. This can be achieved through the properties of the report component.



Reports contain the following information,

- i. Header (name, unit, count and time zone)
- ii. Time zone of the system which generated the report
- iii. Records start from row 100, as row 0-99 is reserved for header values.
- iv. The data for a monthly time range
- v. For aggregators with a single accumulative meter, the first/last meter readings.

Engineering N4 Energy Manager

Sites can be engineered from scratch or by customizing the demo station.

Demo Station

If you are using the provided demo station as a starting point for your own station or to present **N4 Energy Manager**, the login details are:

Username: "admin"

Password: "n4EnergyManager"

Station Passphrase: "n4EnergyManager"



Default Username and Password should be changed in your own station for security.



A prerequisite is that histories have already been brought into Niagara.

N4 Energy Manager Palette

The **N4 Energy Manager** palette is where all the **N4 Energy Manager** components can be accessed from. This includes the Services that provide the **N4 Energy Manager** processing functionality, but also the

To expose the Palette, follow these steps:

1. Click **Window** the top bar.
2. Select **Side Bars**.
3. Select **Palette**.

Now the Palette sidebar is opened, the **N4 Energy Manager** Palette can be accessed.

1. In the Palette window, click the **folder** icon.
2. The **Open Palette** window will now open.
3. In the filter search box, search **N4 Energy Manager**.
4. **Select** N4 ENERGY MANAGER, click **Ok**.
5. The N4 ENERGY MANAGER Palette will now be open in the Palette window.

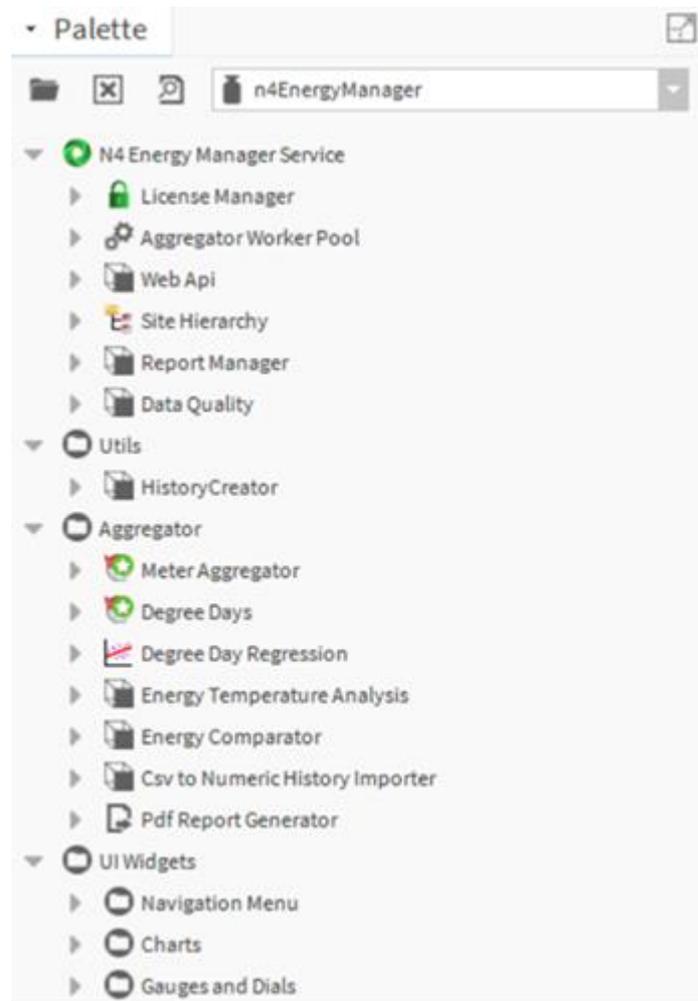


Figure 106 - EXAMPLE PALETTE

- **UI Widgets** – Houses all of the widgets which can be added to a PX Page
 - **Navigation Menu** – The components for the navigation menu.
 - **Charts** – The folder in which all the charts are stored.
 - **Gauges and Dials** – The folder in which all the gauges and dials are stored.
- **N4 Energy Manager Service** – Houses the services on which **N4 Energy Manager** runs.
 - **Licence Manager** – The service that is responsible for managing the licences for **N4 Energy Manager**.
 - **Aggregator Worker Pool** – The service that allows the user the modify the amount of the threads the aggregator can use simultaneously.
 - **Web API** – Allows the user the check, disable & enable the Web API service
 - **Site Hierarchy** – This component allows the histories to be brought into the station as aggregators.
 - **Report Manager** – This component allows the report manager to be enabled/disabled and the port on which it operated to be changed.
- **Aggregator** – Houses the services which allow the user to add the Meter Aggregator & Energy Comparator

- **Meter Aggregator** – Allows the user to access the aggregator component
- **Degree Days** – The aggregator designed specifically for calculating Degree Day data.
- **Degree Day Regression** – The component that combines 3 aggregators, Kwhr, Heating Degree Days & Cooling Degrees Days.
- **Energy Comparator** – The service in which users can input their energy consumption and cost per unit, and the component will output how much the energy consumed has cost.
- **CSV to Numeric History Importer** – A tool to import CSV files into a numeric history.
- **Pdf Report Generator** – Used to create an instance of an Automated Report.

User Interface Widgets

Contained in the **UI Widgets** folder of the **N4 Energy Manager** Palette file are the graphical widgets which can be used to display data within your station. You can combine these with standard Niagara widgets to create a wide range of displays.

Each widget has its own set of properties which can be set in workbench. Some of these are duplicated in some or all the widgets and some are unique to individual widgets.

Selected charts (Ranking / Pie / Benchmarking / Line) can be converted to a tabular CSV view whilst being viewed.

1. Ensure the chart has been configured with the appropriate aggregator.
2. Hover over the top of the chart.
3. A table icon will appear. 
 - a. The table icon is a toggle button. Click once to initiate, click again to deactivate.
4. Click on the table icon to convert the graph to a table view.
5. The chart will now convert to a table.
6. Click on the button again to toggle back to the graphical chart.

Widget Properties

This section will look at the various widgets available in **N4 Energy Manager**, their purpose and information on how to engineer them.



Where Widget Properties are duplicated, they will be described in the first Widget they appear in. Please refer to other previous Widget Property descriptions if one appears to be missing.

When a widget is added from the **N4 Energy Manager** palette to the PX Page in Workbench, the widget properties can be accessed by using the **Properties Tab**.



It is possible to access widget properties by double clicking on the widget. However, we recommend using the Properties Tab to add meters as some properties do not display as expected when using the double click method.

Properties	
WebWidget	
Web Widget	
backgroundColour	<input type="color" value="#000000"/>
chartSubTitle	
chartTitle	Library Power Benchmarking
enabled	true
foregroundColour	<input type="color" value="#FFFFFF"/>
js	view:energyVision:BarChartWidget
layer	
layout	270.0,0.0,1090.0,410.0
timeRange	Month
visible	true
xAxisTitle	
yAxisTitle	

Data Config	
Ev Chart Data Binding	
data	CLICK_HERE_TO_CHOOSE_ORD

Figure 107 - EXAMPLE WIDGET

Properties

The Widget Properties section is divided into two columns: the property name and its value. Depending on the type of property, the value column will allow different types of input – this could be, for example, a colour from a colour picker, an ORD, or a Boolean value.

Data Config

Most **N4 Energy Manager** charts will use the **Chart Data Binding** property to set the data to be displayed. When you click on the value column, you will be presented with the data configuration popup.

Using this popup, you can add Aggregators to the chart. You can further configure the name which will appear in the chart, the time period and an associated colour.

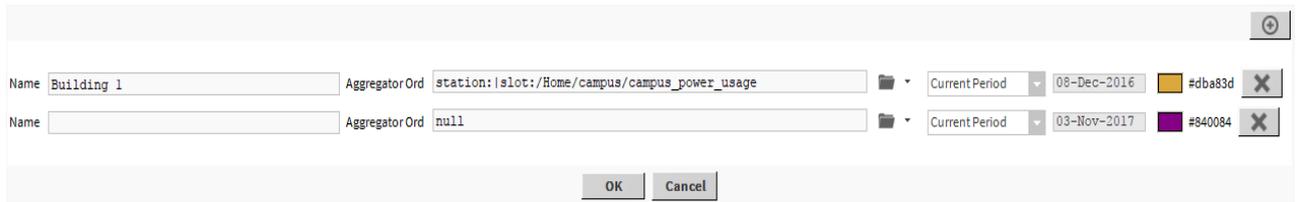


Figure 108 - EXAMPLE CHART CONFIGURATION

1. **Click the drop-down arrow** on the right of the folder icon, **select Component Chooser.**
2. Navigate to the desired **Meter** that needs binding. **Select & Click Ok.**
 - a. To add an additional aggregator to the Line Chart, click the '+' sign in the top right-hand corner of the **data** pop-up. **Repeat steps 5 & 6.**
 - b. Use the **X** button and the end of each entry to remove that aggregator from the current configuration.



Aggregators must be individually named.

Currency symbol

The currency symbol on the chart headers can be configured using the currency option under services in the station.

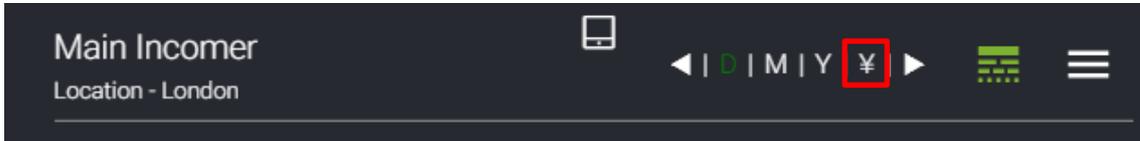


Figure 109 - EXAMPLE OF YEN CURRENCY ON A CHART

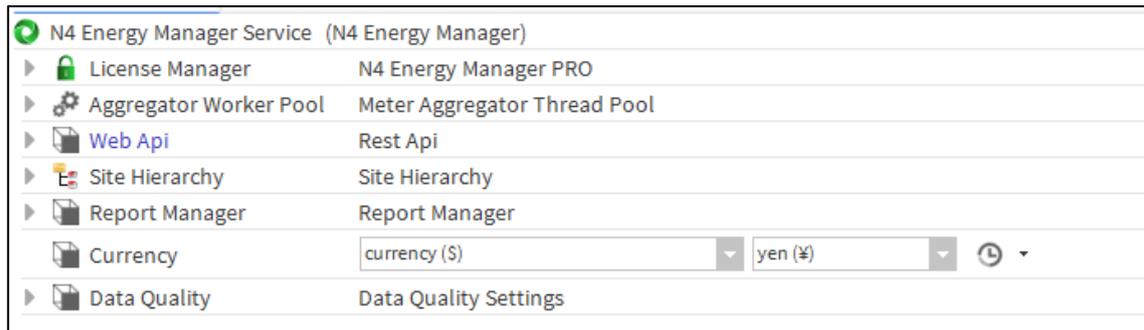


Figure 110 - EXAMPLE CURRENCY SELECTOR IN ENERGY MANAGER

Preferred Chart Interval

This feature provides the ability to configure the time interval for the charts globally. The chosen interval is used by the charts when displaying hourly information. E.g.: *A choice of 30 Minutes would force the charts to display two data points for every hour*

Precondition:

- Config>Services> **N4 Energy Manager Service**
- Set 'Preferred Chart Interval' to e.g. 15 minutes

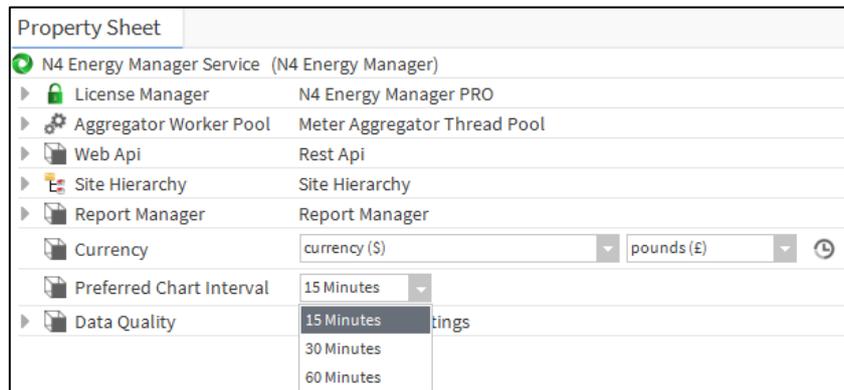


Figure 111 - PREFERRED CHART INTERVAL OPTIONS IN THE PROPERTY SHEET

Steps to create charts with e.g. 15 minutes time interval

1. Navigate to defined PxPage under Station>config>Select the PxFolder
2. Toggle to PxEditor mode
3. Add new Line or Bar Chart
4. Double click on the chart.
5. Select Ord to connect aggregator to the chart for current period, last period and custom.
6. Set time range to Day and click 'OK'
7. The chart should be displayed with 15 minutes interval.

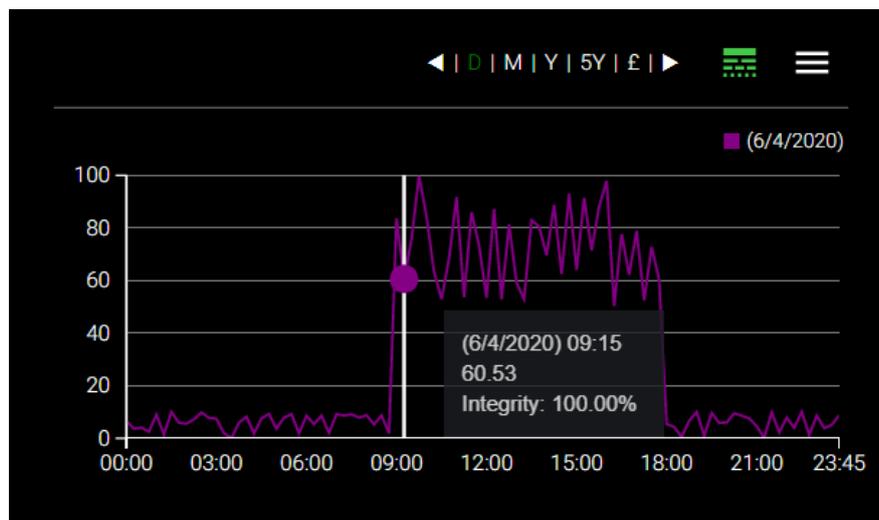


Figure 112 - EXAMPLE LINE CHART WITH 15MIN TIME INTERVAL



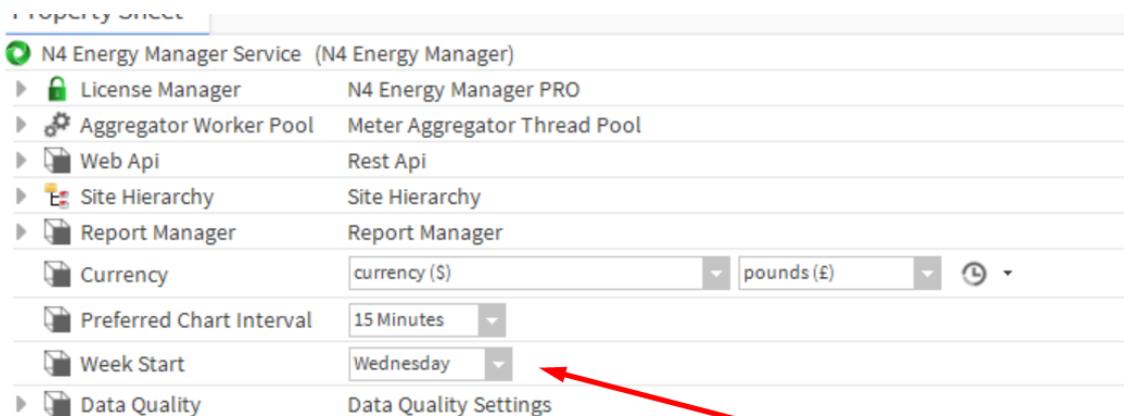
The time interval for the line chart in the pop-up window of the Heatmap chart is forced to be 60minutes when displaying hourly information.

Weekly Time Range

User can choose a weekly time range on all applicable charts. Weekly chart with the start of week can be configured from the n4Energymanager service *Week Start* property.

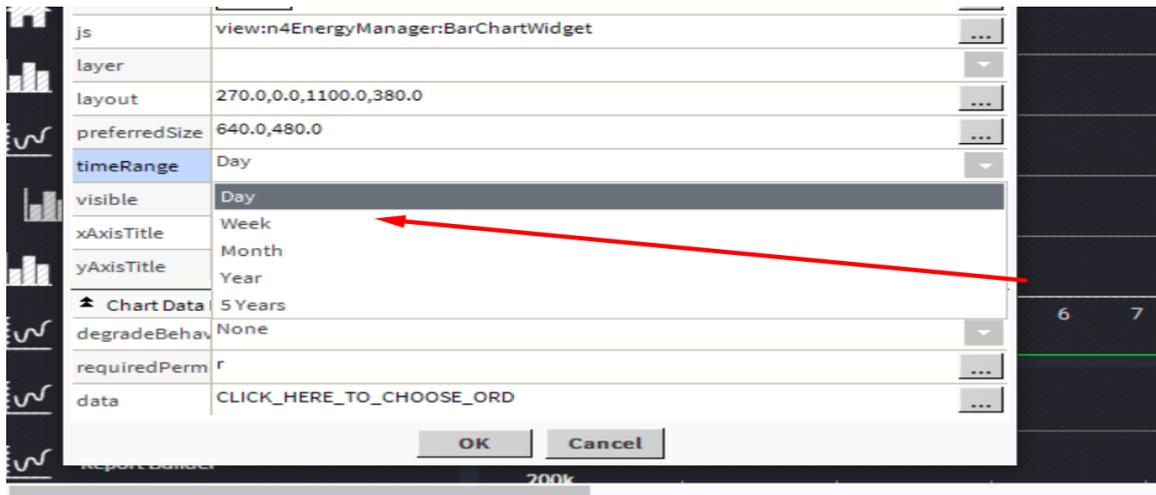
Steps to choose start of week.

1. From the station navigate to n4Energymanager service
2. Choose the week from the drop named *week start*.
3. Save the changes
4. Choosing weekly chart would draw the chart for the week start chosen above.



Steps to choose week as default interval

1. Toggle Px page to edit mode.
2. Add Line, Bar, Ranking or Pie chart
3. Double click on the chart.
4. Set the time range to week
5. Save



5 Year Time Range

Users can choose a five year time range on all applicable charts. The 5Y along with lastPeriod can be used to display past data up to a 10-year period.

Steps to create charts with 5 years interval

1. Toggle Px page to Edit mode
2. Add Line, Bar, Ranking or Pie Chart
3. Double click on the chart
4. Set the 'timeRange' to 5 years

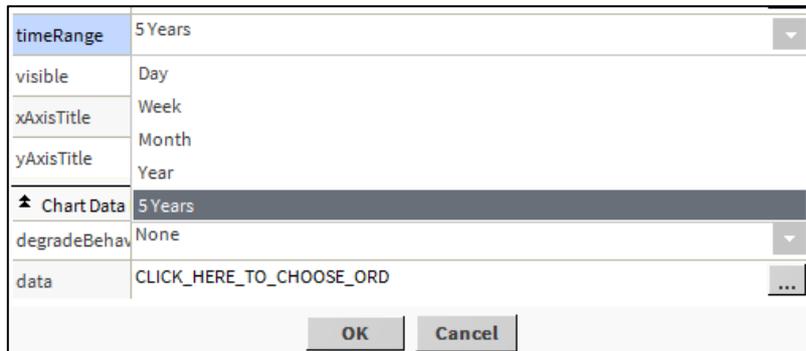


Figure 113 - EXAMPLE OF THE TIME RANGE BEING SET

5. Select the 'ord' to add aggregator to the chart
6. Click 'OK' to save the changes and toggle the page to view mode
 - a. The chart should display the data in 5 years' time range as shown below in the Bar chart

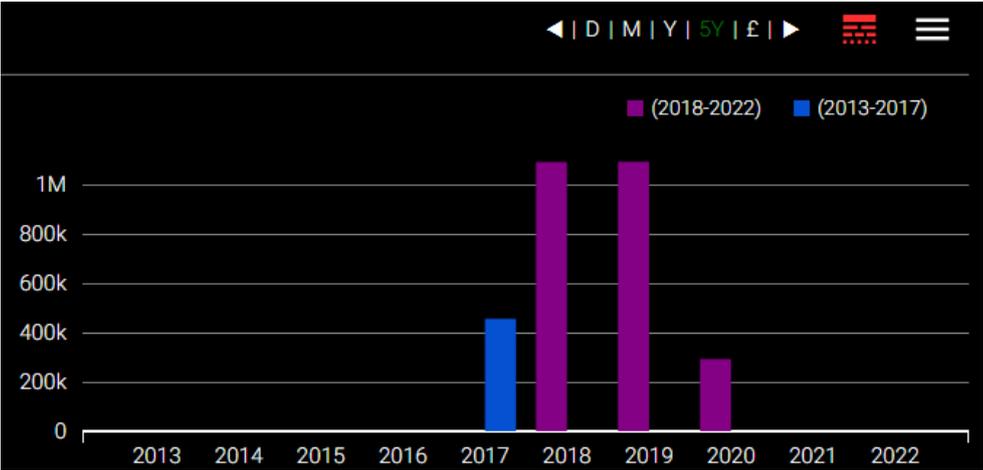


Figure 114 - EXAMPLE OF A BAR CHART DISPLAYING A 10YEAR PERIOD

Chart Relativization

Relativization is a process of binding Niagara widgets to relative ORD's following a naming convention. It is possible to design a common px page template with relativized ORD's and assign it as a view on multiple folders, to avoid duplication and reduce errors.

N4 Energy Manager charts can be bound to relative and absolute aggregator ORD's. ORD's could be relativized manually or by using chart data binding popup

Precondition:

- Create new folder (called e.g. Relativize) with px view
- Ensure aggregators for the charts site under the folder

Steps to create relativize chart:

1. Add line, bar, pie, ranking and stacked bar chart to the px page.
2. Double click on each of the charts.
3. Select the ORD chooser
4. Add aggregators to the chart.
5. Click on the 'relativize' button and select 'OK' to save changes.

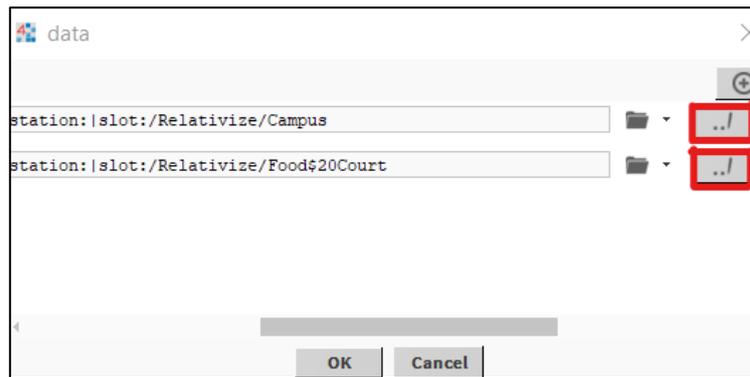


Figure 115 - EXAMPLE RELATIVIZED FOLDER

6. Navigate config>Relativize folder
7. Duplicate the folder
8. Change e.g. the units on any of the aggregators from the original folder

The changes to the aggregator unit should only apply to the charts in original folder.

Kiosk Mode

The Kiosk Mode is a full-page widget that allows predefined pages to carousel with a predefined timer. The widget needs to be engineered on its own full page, with the width & height of the widget slightly larger than the PX pages to avoid scroll bars.

Engineering the Kiosk Mode

1. In the station, create a new folder for the Kiosk Mode.
2. On the Kiosk Mode folder, create a new view.
3. Ensure edit mode is enabled, double click on the PX page and make the width and height of the page 15 pixels higher and wider than the other PX pages in the station.
4. Open the **N4 Energy Manager** palette.
5. Drag & drop the Kiosk widget onto the page.
6. Resize the widget to the full width & height of the page.
7. Double click on the component to access the property sheet.
8. Starting from kioskPage01, begin selecting the ord of the pages to be displayed.
 - a. Use the '...' button next to the field – select the folder with a view already assigned.
9. In the property sheet, ensure other settings are accurately set up. For example, ensure that the timer field (measured in seconds) correct.
10. Click Ok.

Properties

WebWidget	
Web Widget	
backgroundCo	[Color Picker] ...
enabled	true ▾
foregroundCo	[Color Picker] ...
js	view:energyVision:KioskWidget ...
kioskPage01	station: slot:/LightTheme/Home ...
kioskPage02	station: slot:/LightTheme/Home/Energy\$20Benchmarking/Library ...
kioskPage03	station: slot:/LightTheme/Home/Energy\$20Stacked\$20Bar\$20Chart ...
kioskPage04	station: slot:/LightTheme/Home/Energy\$20Contribution ...
kioskPage05	station: slot:/LightTheme/Home/Dials ...
kioskPage06	...
kioskPage07	...
kioskPage08	...
kioskPage09	...

Figure 116 - EXAMPLE PROPERTY SHEET

- **KioskPage01-20** – select the ORD of the view you wish to be displayed on each Kiosk Page
- **ShowArrows** – show the arrows to manually move between kiosk pages
- **Timer** – the duration of each kiosk page



A Kiosk Page is not designed to be interacted with or navigated from. We recommend loading the Kiosk Page and once it is no longer needed closing that browser page or tab.

Gauges & Dials

Gauges & Dials differ from the previous Charts in a fundamental way: they are **not** linked directly to aggregators. Instead, they are linked to a **numeric writeable**. That, in turn, is linked to an aggregator and placed on the **wiresheet** of the **Px Page** it resides on.

In the property sheet, as with the Chart Widgets, the gauge or dial display properties will be displayed first, with the values in the left column and the configurable value in the column on the right. In the **Wb View Binding** section below, the ORD value needs to be set to the **numeric writable** discussed above.

How to Engineer the Gauges & Dials

1. On the **Px Page wiresheet** where the Gauge / Dial is being placed, place a **Numeric Writeable**.
2. **Link** the **Numeric Writeable** to the desired output of the aggregator.
3. The **Numeric Writeable** should now be displaying data from the aggregator.
4. Go back to the **Px Page** where the Gauge / Dial is placed.
5. **Double Click** on the Gauge / Dial to open the **Property Sheet**.
6. Populate the customisable fields (as explained above).
7. In the **ord** field, click **Null**.
8. An **ord** selection box will now appear.
9. Click the **drop-down arrow** next to the folder.
10. Select **Component Chooser**.
11. Navigate to the **Numeric Writeable** that has just been to the aggregator. **Select it**.
12. Click 3x **Ok** prompts.
13. The Gauge / Dial will now be displaying the data being pulled through from the aggregator via the numeric writeable.



Gauges & Dials support transparent background. User can select "Transparent" colour to achieve this.

Segments Dial

The Segments dial displays a numeric value on a circular gauge split into a calculated number of segments. The segments are coloured by assignment of a low, medium and high colours. The thresholds at which these colours start are also configurable. The result is a dial where it possible to see when a value is reaching pre-defined limits.

Properties

WebWidget	
Web Widget	
backgroundCo	 ...
enabled	true
foregroundCo	 ...
js	view:energyVision:GaugeWidget ...
layer	
layout	295.0,430.0,203.0,230.0 ...
maxValue	15000.00
minValue	1.00
thresholdColo	 ...
thresholdColo	 ...
thresholdColo	 ...
thresholdHigh	80.00
thresholdMed	50.00
units	kWh
visible	true
Wb View Binding	
ord	station:/Aggregators/Campus/campus_power_usage/lastDay ...

Figure 117 - EXAMPLE PROPERTY PAGE

- **MaxValue** – The maximum value the dial will show, allows the dial to scale correctly.
- **MinValue** – The minimum value the dial will show, allows the dial to scale correctly.
- **ThresholdColourHigh** – The colour of the high threshold value segments.
- **ThresholdColourLow** – The colour of the low threshold value segments.
- **ThresholdColourMedium** – The colour of the medium threshold value segments.
- **ThresholdHighPercentage** – Percentage of the maximum value at which the high threshold will start.
- **ThesholdMediumPercentage** - Percentage of the maximum value at which the medium threshold will start.
- **Units** – Alters the Si Unit type measured on the dial.
- **Ord** – Link to the numeric writeable.

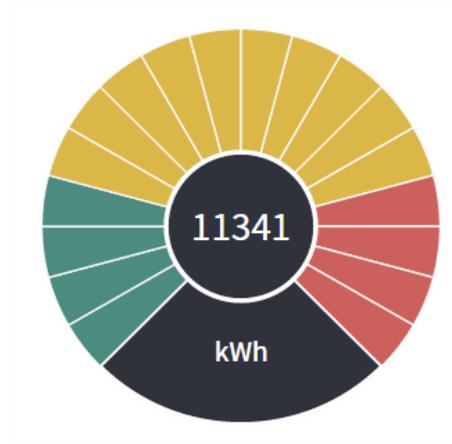


Figure 118 - EXAMPLE SEGMENT DIAL

Bar Gauge

The Bar Gauge displays a numeric value on a horizontal bar. The minimum and maximum value are configurable, along with the number of segments in the bar. The threshold colouring and limits can also be set the same as the segments dial.

Properties

- **NumberOfSegments** – the number of segments in the dial
- **Text** – the text to show under the gauge

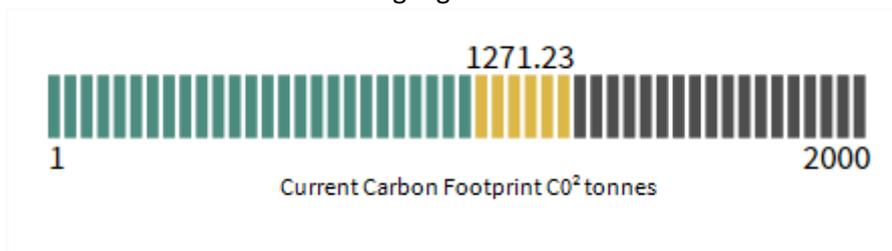


Figure 119 - EXAMPLE BAR GAUGE

Needle Gauge

The needle gauge displays a numeric value on a circular gauge with the value shown in its numeric form within the gauge. The minimum and maximum value are configurable, along with the unit type – which is displayed within the dial.

There are three Needle Gauge's available in the **N4 Energy Manager** palette file: Needle Gauge Green, Needle Gauge Yellow and Needle Gauge Red. These offer the same functionality, but the background colours of the dial are the respective colour contained within the widget name (i.e. Green, Yellow and Red).

Properties

- **DialColour** – The colour of the dial part of the widget

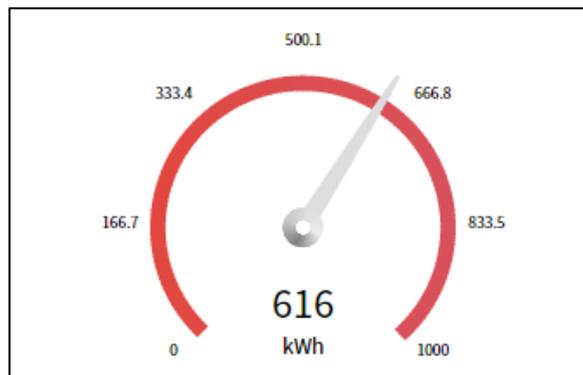


Figure 120 - EXAMPLE NEEDLE GAUGE

LED Dial

The LED Dial displays a numeric value in a circular gauge. The gauge is split into small segments and each one is 'lit' up to give an LED effect when the value is passed.

There are three pre-defined LED Dials available in the **N4 Energy Manager** palette file: LED Dial Green, LED Dial Yellow and LED Dial Red. Users also can use set the dial colour in the property sheet. These offer the same functionality but the LED segments of the dial are the respective colour contained within the widget name (i.e. Green, Yellow and Red).

Properties

The LED Dial does not have any further unique display properties (See Segments Dial and Line Chart for those).

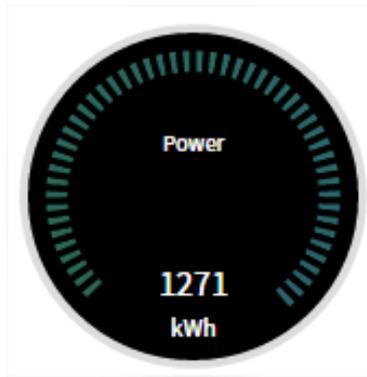


Figure 121 - EXAMPLE LED DIAL

CSV Import

The CSV Import function enables your historic meter data to be imported into **N4 Energy Manager** to manipulate the data into functional graphs and charts.

The CSV importer allows you to :

- Import data from CSV files into a new Niagara history
- Merge data from CSV files with an existing history
- Run CSV imports on a schedule periodically.

The CSV importer does not support:

- Creating a history by importing data from CSV files and then later attaching it to the history extension.

As a workaround, a user can enable the history extension first and then import the data from a CSV file.

Steps to setup csv importer and import csv file

Precondition:

1. Ensure the time zone on the csv Importer component matches time zone on Niagara platform.
2. Ensure the time format on the csv Importer component matches the time format on the csv file.

Steps:

1. Navigate to config and create a **new folder** called 'csv import'.
2. From the palette, search for 'n4EnergyManager' and expand **Aggregator folder**
3. Add '**CSV to Numeric History Importer**' component to the csv import folder created in step 1.
4. Navigate to **files** and create a new folder called 'csv'.
5. **Copy** the csv file to import to the csv folder in step 4.
6. Navigate config>csv import and **double click** on 'CSV to Numeric History Importer'

The property sheet page for the component should be open as shown.

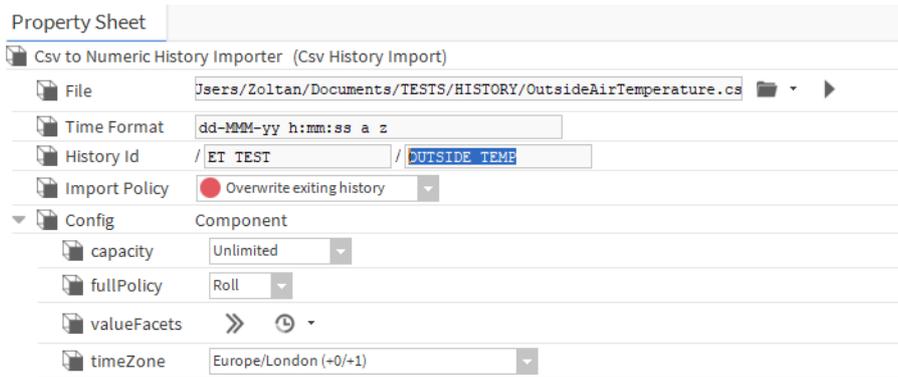


Figure 122 - EXAMPLE PROPERTY SHEET

7. Select the file from the PC -> use **File Ord Chooser** from the drop-down menu
 - i. Set **Time Format** to match the time format on the csv import file.
 - ii. Set 'timeZone' to match the timeZone on the Niagara platform.
 - iii. Click on 'Save' to save the changes.
 - iv. **Right click** – Actions – execute
 - v. The csv file should be imported successfully, and the import data can be found under the following path. Station/History/parent/child
EG: (EnergyManager actual running station)/History/ET TEST/OUTSIDE_TEMP

How to run CSV imports periodically?

A link between a Niagara Trigger Schedule and the import action must be created.

Steps:

1. From Palette->Schedule, add 'TriggerSchedule' to folder containing csv history import component.
2. Link Trigger from TriggerSchedule to Execute (Csv History Importer).
3. Double click on the TriggerSchedule and add trigger event.

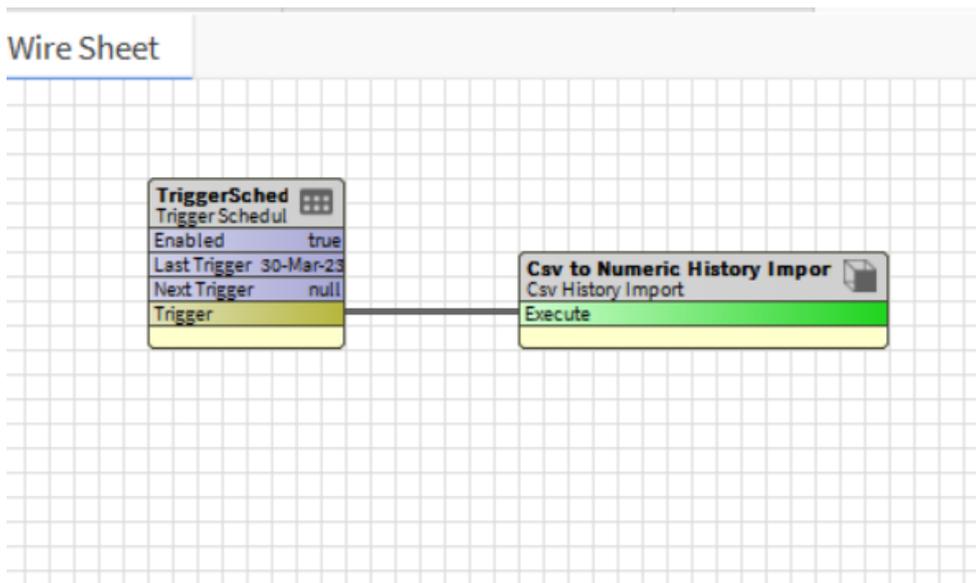


Figure 123 - EXAMPLE TRIGGER SCHEDULE FOR CSV HISTORY IMPORT

Navigation Menu

The Navigation Menu folder in the **N4 Energy Manager** Palette contains two widgets: the **Vertical Menu** and the **Menu Builder**.

Vertical Menu

The Vertical Menu can be used for navigation within your station, between defined PxPages.



The Vertical Menu widget should be added to a single PxPage and configured. You can then use this as a PxInclude page on any page you wish to see the Navigation Menu.

Properties

- **IconDefaultColour** – The default colour for icons.
- **IconSelectedColour** – The colour of the icon once selected.
- **MenuItemHeight** – The individual height of each menu item.
- **MenuStyle** – Choose display from both **Icon and Text**, just **Icon** or just **Text**.

The data configuration is different from the other Chart Widgets. Instead of being presented with the data configuration popup, you need only select a .menu file.



.menu file contains the definition for your menu hierarchy, naming, icons, and link destinations. It is a JSON format which you could create yourself using the demo stations menu as a starting point. Alternatively, the Menu Builder will create this file for you through a graphical interface.



When copying the demo stations menu, the editor profile must be in **Ax Text Editor**. To achieve this, in the top right-hand corner the default editor would be **Text Editor**, click this and select **Ax Text Editor**.

How to Engineer the Menu

1. Create a folder in the **Files** folder called **Menu**.
2. Open the **Menu** folder, right-click & select **New** -> **TextFile.txt**.
3. Name that **TextFile.txt** -> (InsertName).**menu**.
4. Below is an example of the demonstration's menu structure.
5. **Edit** the menu & menu structure depending on project requirements.
6. **Save** the newly edited menu structure.
7. Open up the **Px Page** on which the menu will be placed.
8. **Drag & drop** the menu widget from the **N4 Energy Manager Palette** onto the **Px Page**.
9. **Double-click** the **menu widget** on the **Px Page**.
10. **Click** on the **ord** field.
11. A pop-up will appear. **Click** on the **folder**.
12. **Navigate & select** the **.menu** file.
13. **Click Open**.
14. **Click Ok**.
15. **Click Ok**.

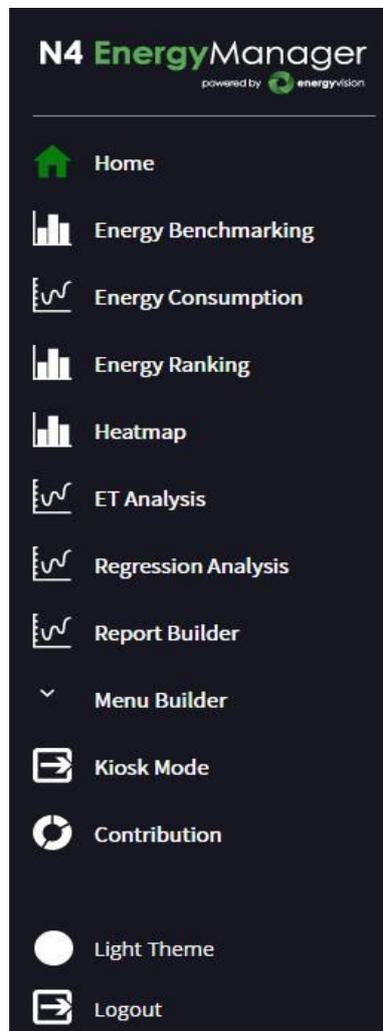


Figure 124 - EXAMPLE MENU

Menu Builder

The Menu Builder has been designed to allow engineers to build a menu structure, without the need for any coding experience. The Menu Builder is a widget, the same as the other widgets of **N4 Energy Manager** and resides in the **N4 Energy Manager** Palette.



Although the widget can be used in a browser, Centraline recommend creating a Px Page within Workbench, engineering the Menu using the Menu Builder, saving the file, then deleting the Px Page. We recommend this because, although the Menu Builder can be used to reorganise the Menu structure in a browser, individual end users could change the hierarchy of the menu which could complicate the setup of a finished station.



The Menu Builder will create the necessary code to enable to Vertical Menu widget to work and a Menu hierarchy to be built, however, the .menu file still needs to be manually created. Once the blank .menu file has been created, the Menu Builder can start to implement the code as the engineer starts to build the Menu.

How to Engineer the Menu Builder

1. Create a temporary Px Page in your Px folder. Ensure that the width of the Px Page matches the width of the Px Include as the Menu Builder is a large widget.
2. In the **Menu** folder (created in the previous Menu Section) ensure there is either a blank .menu file in there or an existing .menu file is in there (if using an existing .menu file, ensure the .menu file is complete and valid, if the code isn't correctly engineered, the Menu Builder will not work).
3. With the Px Page in edit mode, **drag & drop** the Menu Builder widget onto the Px Page.
4. The Widget will now display **Please add an ord to the menu file.**
5. **Double Click** on the widget to open the property sheet.
6. At the bottom of the Property Sheet, **find the Ord** field.
 - a. **Click** either the **null** field or the ... at the end of the **Ord** row.
 - b. The **Ord Chooser** will open.
7. Using the **drop-down** arrow located next to the **folder icon**, select **File Ord Chooser**.
8. In the **File Ord Chooser** pop-up, navigate to your .menu file.
 - a. Select the file & open.
9. Click **Ok**. Click **Ok**.
10. The Menu Builder will now appear.
 - a. **If an empty .menu file was used:** The Menu Builder will appear with 3 items in the menu structure.
 - b. **If a pre-coded .menu file was used:** The Menu Builder will open with the structure of the .menu file.
 - c. **If an incorrectly coded pre-coded .menu file was used:** The Menu Builder would not load.

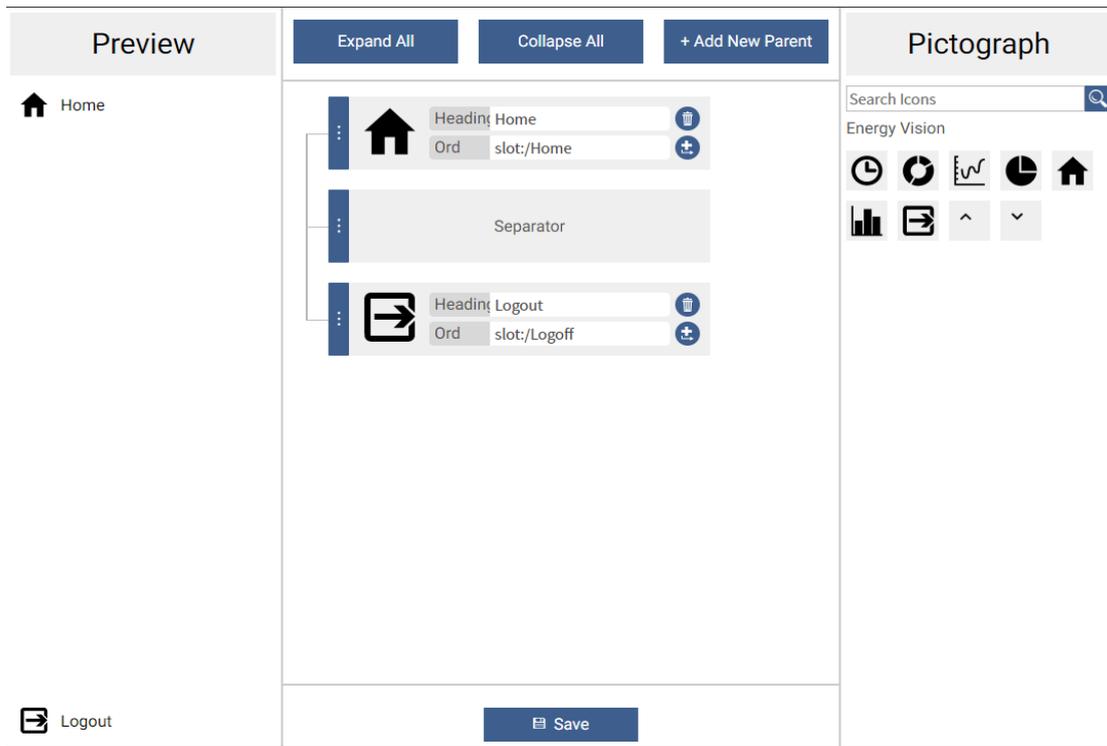


Figure 125 - MENU BUILDER WITH A BLANK .menu FILE

Preview: The Preview window gives the engineer a live preview of what the menu will look like when in a station. The preview window will react immediately to any changes made to the menu. The hyperlinks in the preview window have been disabled so users do not accidentally move away from page prior to saving. However, the engineer can still explore child menu items when clicking on the parent menu item.

Expand All: The Expand All button will expand all the menu items.

Collapse All: The Collapse All button will collapse all the menu items.

+ Add New Parent: The + Add New Parent button will add a new parent menu item to the menu.

Trash Icon: The Trash Icon will delete the menu item.

+--> (Below Trash Icon): This button will add a new child menu item to that menu item.

Separator: The separator will split the menu items above and below it, placing the item below it to the bottom of the menu. For example, the Log Out button.

Pictograph: The library of icons available to use within the menu.

Save: Save the changes to the .menu file.

Using the Menu Builder

The Menu Builder has been engineered around the Drag & Drop principle. To reorganize the Menu structure, drag & drop the menu item to the desired location in the menu and the Preview window will update accordingly.

Adding an Icon

To add an image, choose an image from the Pictograph and drag & drop it onto the square to the left of the **Heading & Ord** field.

Creating a Child Menu Item

Drag & Drop the Parent Menu Item (the Menu Item to become a Child) under the Parent Menu Item.

Or, click the +-> (under the Trash Icon) and a Child Menu Item will be added.

Adding a Heading & Ord

In the Workbench view, ensure the folder structure is visible in the navigation window. Now, drag & drop the Folder into the box to the left of the **Heading & Ord** field. Both fields will now be automatically populated.

If only the **Heading**, or **Ord**, names/link need to be added, drag & drop the folder onto the respective field.

Data Quality

Users can now view the integrity of the data displayed within charts via a 'Data Quality' icon placed to the top right of most charts (not applicable to Regression and the HeatMap charts). The button's colour changes based on the minimum integrity value returned from the data set being displayed on the chart.

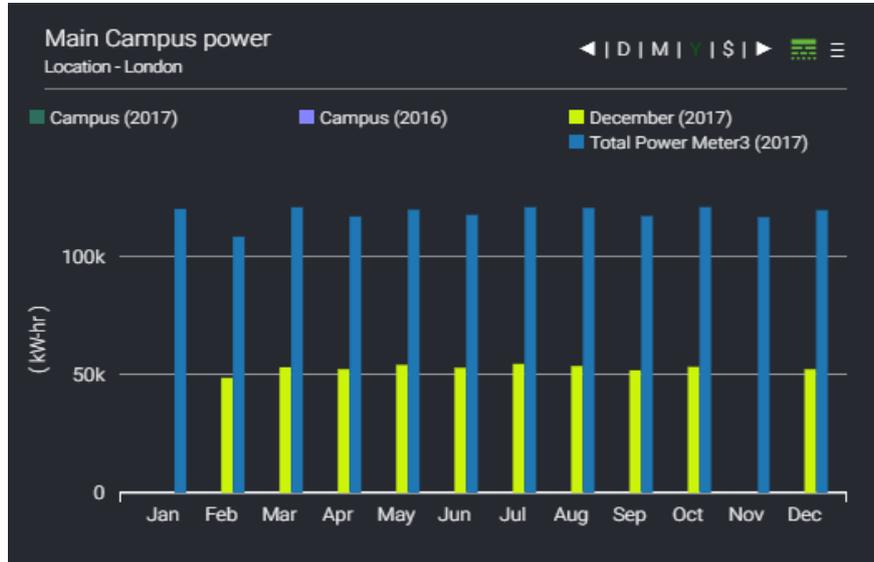


Figure 126 - EXAMPLE DATA QUALITY ICON

A simple colour code system [red, amber, green] is used to show the integrity of the data between 80-100% scale. An integrity level below 80% remains red.

Colour scale example:



Figure 127 - EXAMPLE DATA QUALITY COLOUR SCALE



Data Quality can only be calculated where the Meters are linked to **Interval** histories. Change of Value histories will not calculate a Data Quality Value and will remain Grey.

Hovering over the Data Quality button will display a tooltip. This contains the following information:

- The minimum integrity from the series currently displayed
- The number of Offline Meters
- The number of Inactive Meters

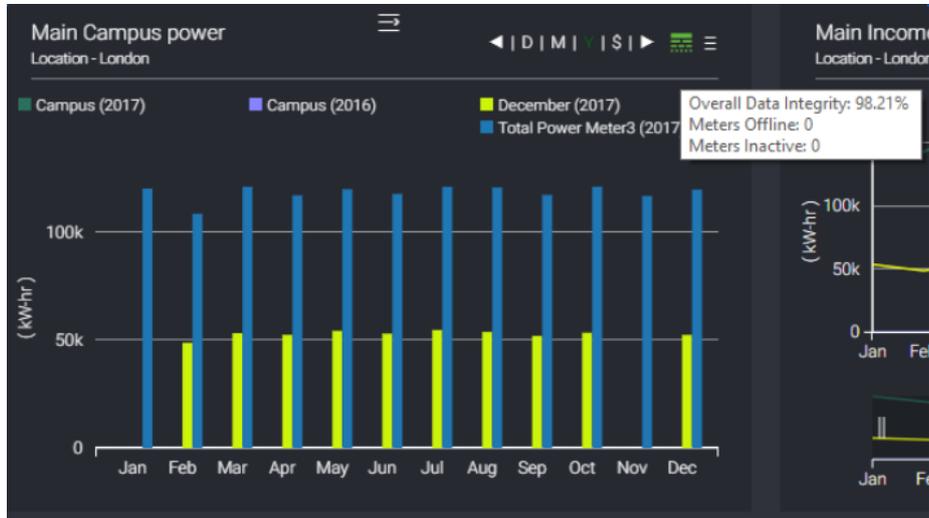


Figure 128 - EXAMPLE DATA QUALITY HOVER OVER

Data-Quality Popup

Clicking on the Data Quality button will bring up another window containing more in-depth information regarding the integrity of the data. Users will see a tab for each series in the chart, with each tab displaying a graph of the integrity, broken up over a more detailed time period. For example, if the main chart is set to 'year', the integrity chart will show the data broken down by month, if the main chart is set to 'month' data will be shown in days and if the main chart is set to 'day' mode then the integrity chart will show the integrity broken down into hours.

Yearly integrity popup Year example:

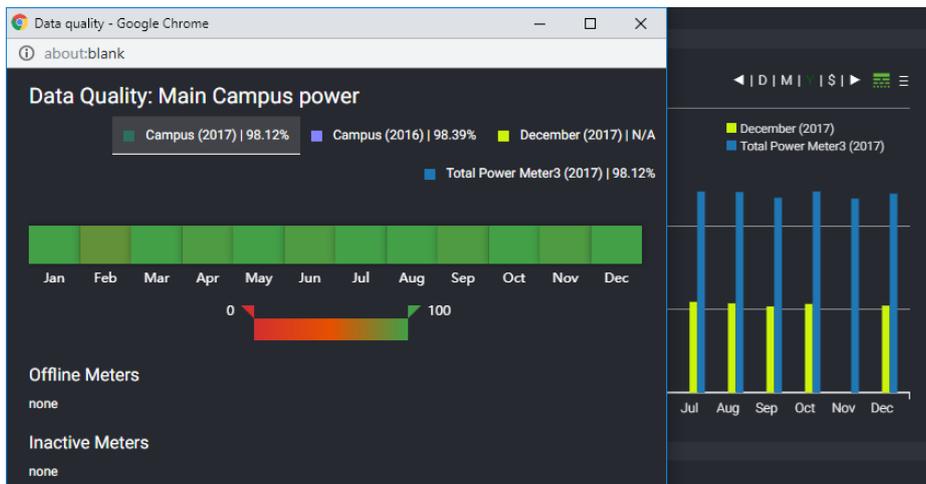


Figure 129 – EXAMPLE DATA INTEGRITY POP UP

Data quality popups include an adjustable slider that can be used to show or hide the data entry on the chart. It can be set between 0 and 100 to analyse the daily, monthly or yearly data integrity on the selected data-set.

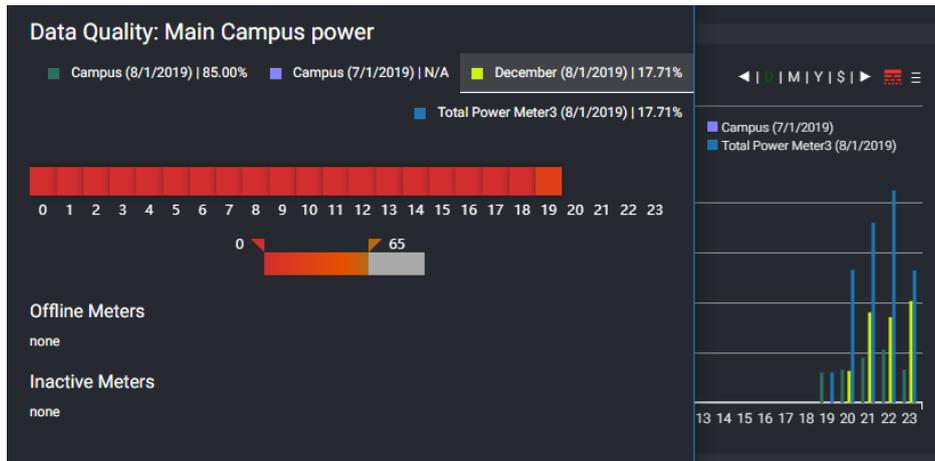


Figure 130 - ADJUSTABLE SLIDER BAR

In addition to this, inactive or offline meters are also displayed.

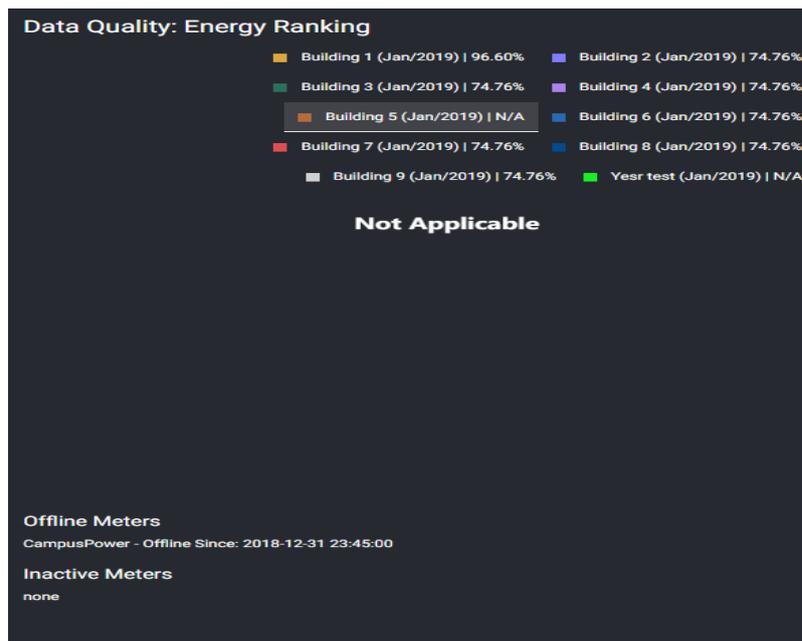


Figure 131 - DISPLAY OF INACTIVE / OFFLINE METERS



Data Quality can only be calculated where the Meters are linked to **Interval** histories. Change of Value histories will not calculate a Data Quality Value and will remain Grey.

Data-Quality Alarms

The aggregators can be setup to raise alarms when a meter is detected as offline, or the data integrity falls below a percentage. The default percentage is 80 %. The alarms status is evaluated every time an aggregator calculates.

An alarm is raised if any of the following conditions are fulfilled,

- Data integrity value is less than a threshold.
- If a meter is currently offline – no reading within the offline threshold.
- If a meter is inactive –meter values within the inactive threshold have not changed.

The offline and inactive thresholds can be set globally at a service level or individually at a meter level. By default, these thresholds are set to 1 hour in the **Data Quality Settings** and individual meter thresholds are inherited from the Data Quality Service (see Figure 132). When inherited, the status of the **Amount** property is set to “null”. If user wants to overwrite the threshold, the “null” flag should be removed.

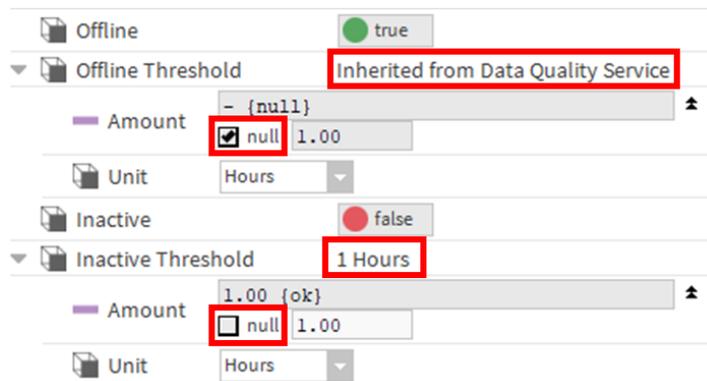


Figure 132 - OFFLINE/INACTIVE THRESHOLDS OF A METER

Like the thresholds, the alarms feature can be controlled at a service level and at an individual aggregator level. All alarms can be turned off globally or alarms from individual aggregators can be disabled using the “Data Quality Alarms” section in the aggregator property sheet.

A global inhibition period can be applied to pause the alarm generation on station start up for a certain time (see Figure 133). This helps to avoid a flood of alarms on station start-up.

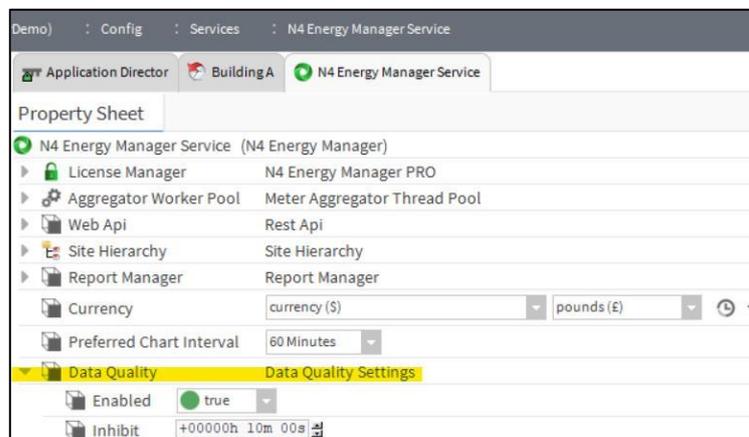


Figure 133 - EXAMPLE OF THE ALARM SERVICE DQ SETTINGS

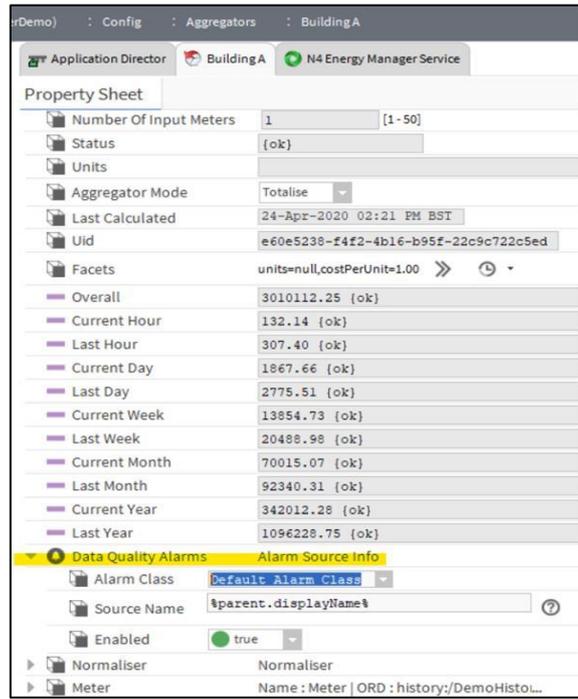


Figure 134 - EXAMPLE AGGREGATOR ALARM SETTING

To handle special cases (e.g., having a heating- / cooling aggregator) that are not reading data over a period of time, it is possible to enable / disable the data quality via a datapoint (see Figure 134). To do so, it is required to add this attribute via “Composite Editor” to the Aggregator. Here are the necessary steps:

4. Expose the enabled slot on the aggregator using the composite editorLink.
5. Link the **Enabled** slot to a Boolean writable using the wiresheet view.
6. Add additional wiresheet logic to enable / disable data quality alarms dynamically.

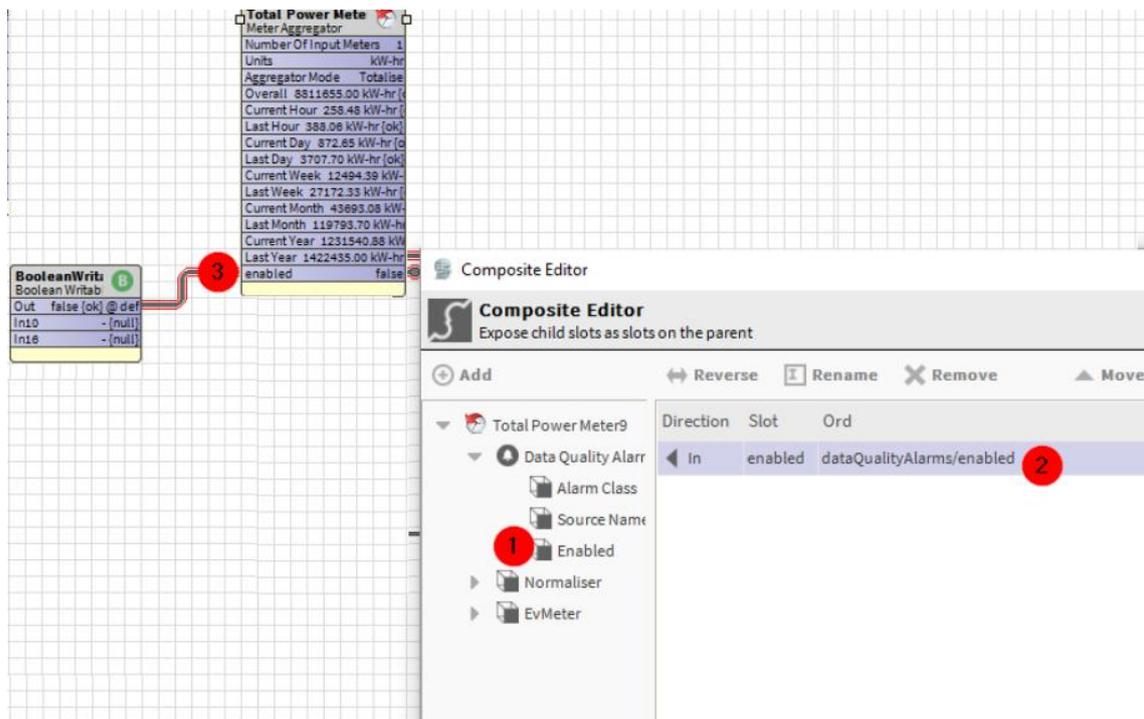


Figure 135 - DATA QUALITY ALARM ENABLING CUSTOMISATION

N4 Energy Manager Migration Pathways

Summary – Energy Vision and Energy Manager versions

The original **Energy Vision** software was created for Niagara AX. There were several versions. After the release of Niagara 4, **Energy Vision** was migrated under the same name to run in N4. As with any station being upgraded from Niagara AX to Niagara 4 the station must be migrated using a tool provided by Tridium themselves. Once this has been performed the **Energy Vision** software will require manual re-engineering in order run correctly in Niagara 4. This user guide focuses on **N4 Energy Manager**, so if you are considering upgrading a Niagara AX **Energy Vision** station to Niagara 4, please contact support@forestrook.co.uk so that we can advise on the best way forward.

- A later major update saw the software renamed from **Energy Vision** to **N4 Energy Manager**. This began in the earlier versions of Niagara 4. For migrating from **Energy Vision** to **N4 Energy Manager** one should use the **migration tool** (see [Upgrade Process 1 – Energy Vision -> N4 Energy Manager](#)) and **migrate px files** (see [Upgrade Process 2 – N4 Energy Manager \(below v3.3.1\) -> latest release](#)).
- **N4 Energy Manager version 3.3.1** (2021-04-15) introduced charting preferences – allowing users to store custom chart configurations in the browser. Upgrading from earlier versions than 3.3.1 requires a migration of all PX files engineered prior to this release. The migration is performed using the “**migrate Px files**” action in the **N4 Energy Manager service**. Please see [Upgrade Process 2 – N4 Energy Manager \(below v3.3.1\) -> latest release](#).
- Modern versions of **N4 Energy Manager** (3.3.1+) do not require any migration. Only stations built before 3.3.1 will need a px migration. However, if a user applies the migration tool to a more recent release it will not have any negative impact on the station. Moving from the previous release to the latest release can be done by simply updating the **N4 Energy Manager** modules and starting the station again. No further work is required.

Table 2 summarizes the actions needed for migration depending on the source version of the product. Energy Vision is abbreviated as “EV”, and N4 Energy Manager is abbreviated as “EM”.

Source version	Use migration tool	Migrate px files
EV any version	yes	yes
EM version < 3.3.1	no	yes
EM version ≥ 3.3.1	no	no

Table 2 - DIFFERENT MIGRATION PATHS

Upgrade Process 1 – Energy Vision -> N4 Energy Manager

This process uses the bundled migration tool to convert Niagara 4 stations using **Energy Vision** modules to use **N4 Energy Manager**.

The tool will convert all Energy Vision components to their N4 Energy Manager counterparts, retaining all user configuration and product features.

Prerequisites:

- Install **energyVisionN4EnergyManagerMigrator.jar** module (included in latest software bundle)
- The station folder and the workbench used for migration are required to be present on the same machine.
- Create a backup of the station to be migrated. If the station is present on a JACE, transfer the station to a supervisor machine.

Migration Steps:

Open the migration tool available under the workbench Tools option (see Figure 136). The migration is performed on a copy of the input station, The source station files would remain untouched once the migration is complete.

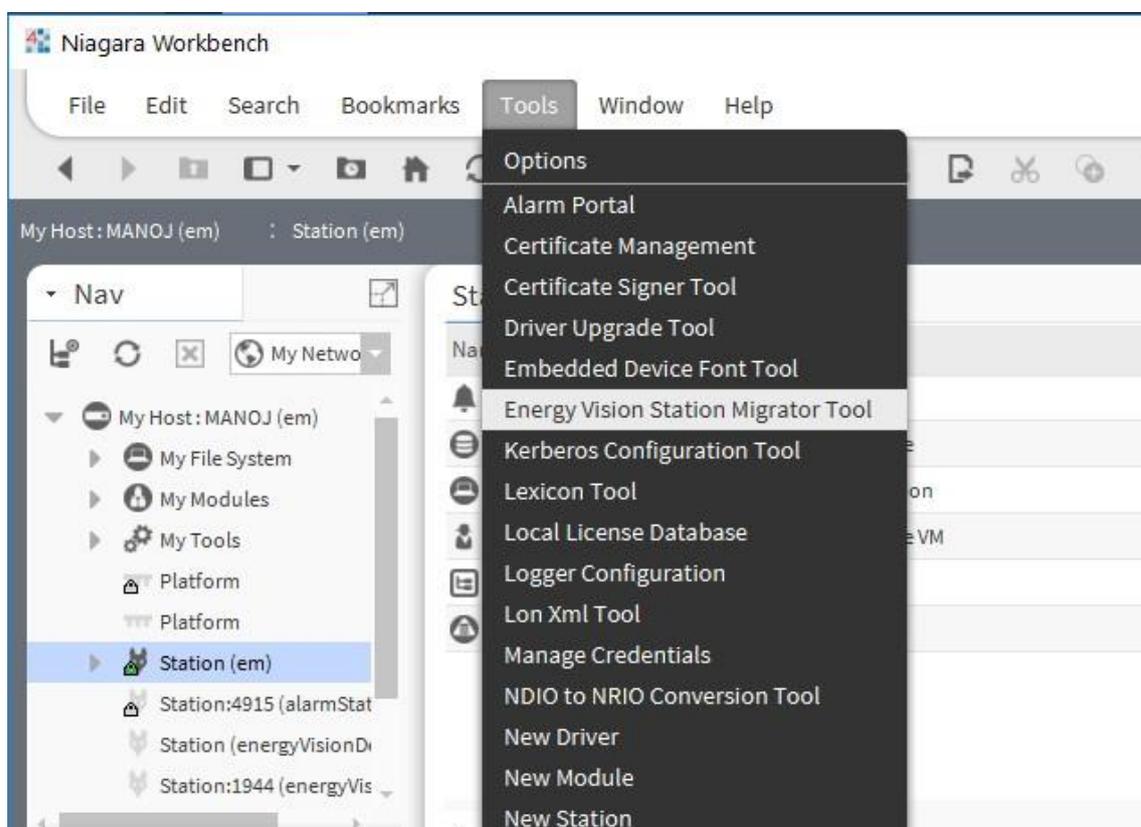


Figure 136 – OPENING MIGRATION TOOL

The migration tool has the following properties (see Figure 137):

- **Input Station (directory):** Path to the input station directory - The station to be migrated
- **Output Station Home:** Path to the directory where a new migrated station folder would be created.
- **Output Station Name:** Name of the new migrated station.

Click **Migrate to n4EnergyManager** to run the migration. On successful migration, a new station with user-specified **Output Station Name** would be created under **Output Station Home** folder. On successful migration, a log detailing the migrated components is created in the Niagara User Home (see Figure 138).

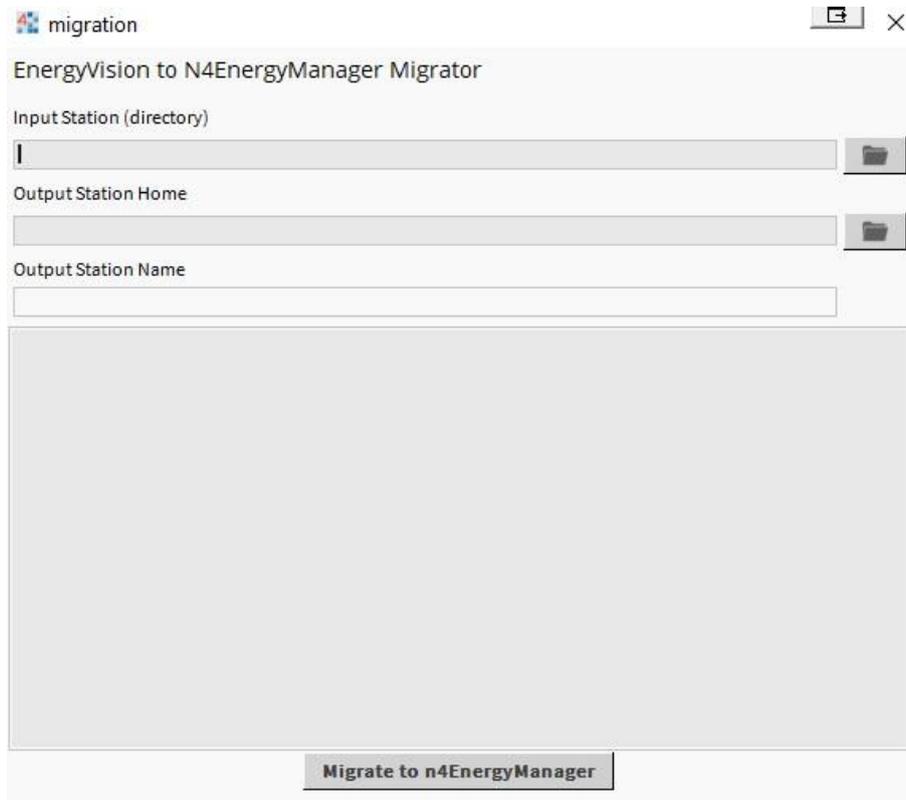


Figure 137 - MIGRATION TOOL

Running the migrated station:

- Rename the migrated station to the to match the source station name if needed. (This step could be performed during the station transfer process if using station copier)
- Uninstall all energyVision related modules.
 - energyVision-[rt,ux,wb].jar
 - energyVisionResources-[rt-ux].jar
 - energyVisionReports.jar
- Ensure correct N4EnergyManager modules are installed
- Start the station using the application director and perform tests on the station to ensure its normal operation.
 - Test if histories have been migrated over
 - Tests if *.px have been migrated and are accessible.

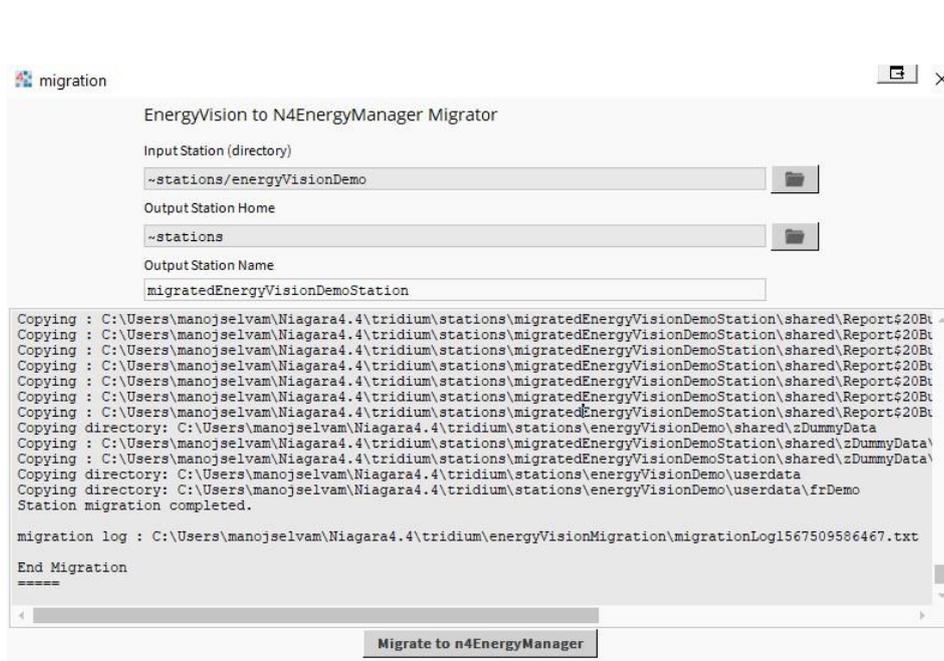


Figure 138 - EXAMPLE OF A SUCCESSFUL MIGRATION

Upgrade Process 2 – N4 Energy Manager (below v3.3.1) -> latest release

Starting from **N4 Energy Manager version 3.3.1**, users are able to store custom chart configurations in the browser.

To upgrade from earlier versions of N4 Energy Manager, a migration of all previously engineered px files is required. To achieve this, one can invoke the “**migrate Px files**” action in the **N4 Energy Manager Service** (see Figure 139).

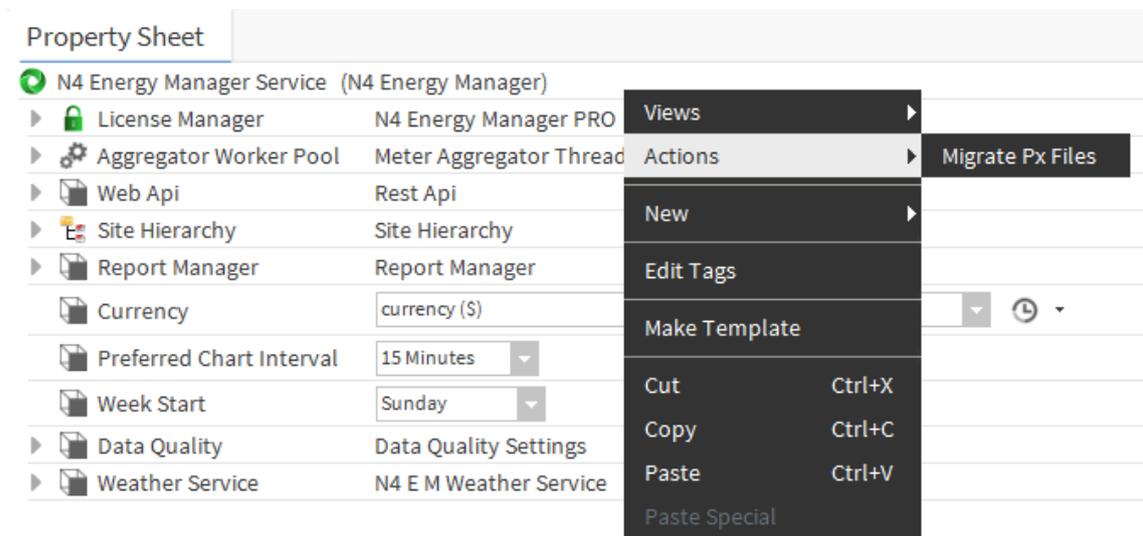


Figure 139 - MIGRATE PX FILES ACTION OF N4 ENERGY MANAGER SERVICE

Activating the 60 minute Pro trial

To activate pro features for a 60 minute period:

1. Run a work bench with 'N4 Energy Manager core license'
2. Navigate Config>Services> N4 Energy Manager Service.

The page below should be displayed with N4 Energy Manager Core (Free)

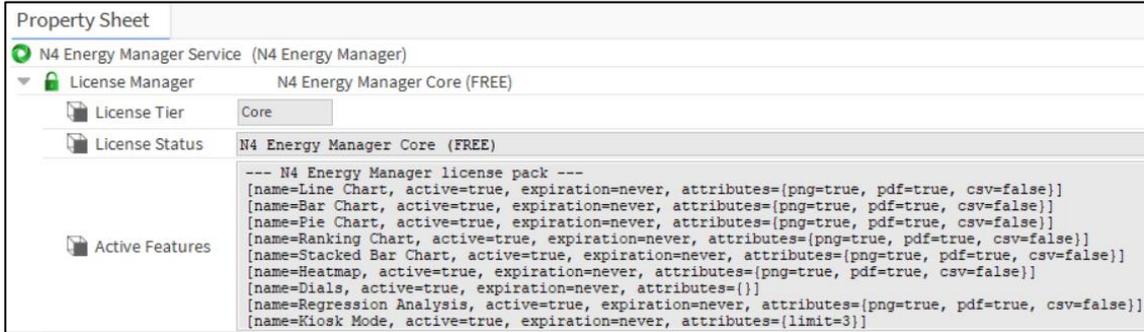


Figure 140 - EXAMPLE PROPERTY SHEET – CORE LICENSE

3. Right click on 'License Manager' and select Action>Enable Trial

60 minutes trial for Pro features should be activated as shown below.

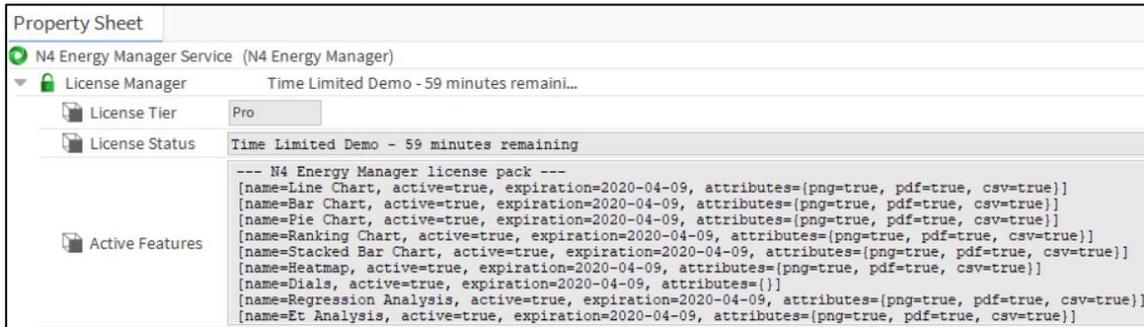
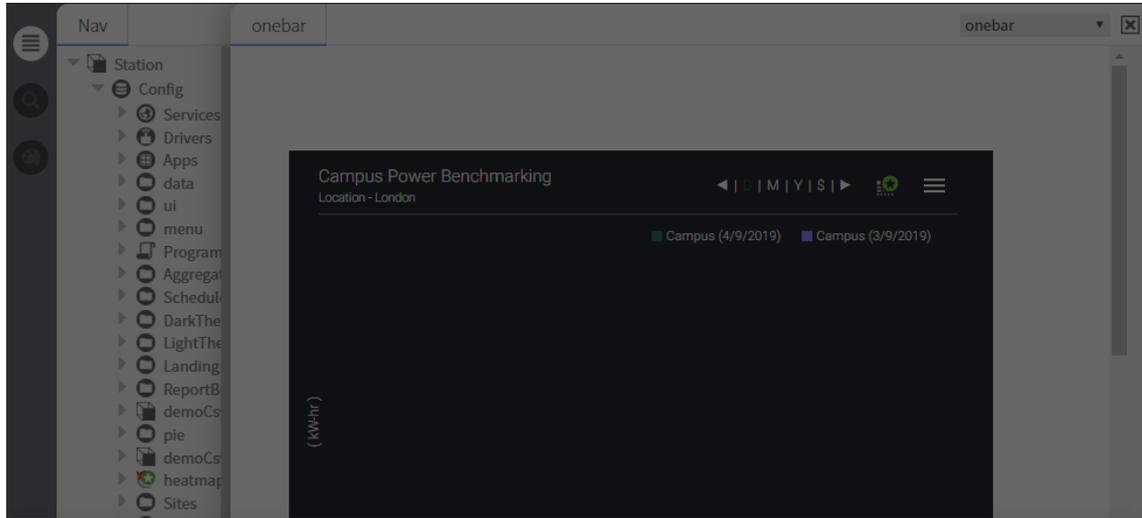


Figure 141 - EXAMPLE PROPERTY SHEET - 60 MIN PRO TRIAL

Error Logging and Usage Analytics

We collect anonymised error logs and usage analytics to improve the quality of the product and fix issues proactively. The feature is disabled by default for all users and enabled only when the user has provided consent. The users will be presented with an option to provide consent when they visit a px page with an **N4 Energy Manager** widget.



Do you consent to Forest Rock collecting anonymous usage data to enable us to improve, test, and monitor the effectiveness of N4 Energy Manager, for more information see our [privacy policy](#).

Figure 142 - DIALOG REQUESTING USER CONSENT

User preferences could be changed on station, through the N4EnergyManagerPrivacy options available under every user in user services.

Properties:

Accepted: Has the user accepted the privacy consent

Request Consent: If set to True the user will be presented with the consent dialog in the browser.

Last Updated At: Last Time the settings were updated.

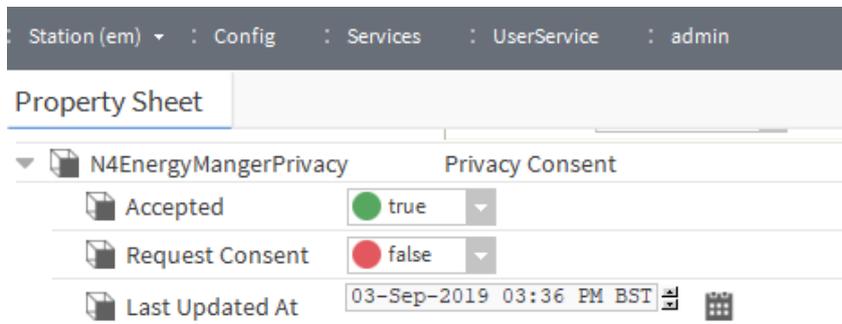


Figure 143 - EXAMPLE OF A USER WHO HAS ACCEPTED THE PRIVACY CONSENT

The privacy consent can be reset for a user using the Reset Action.

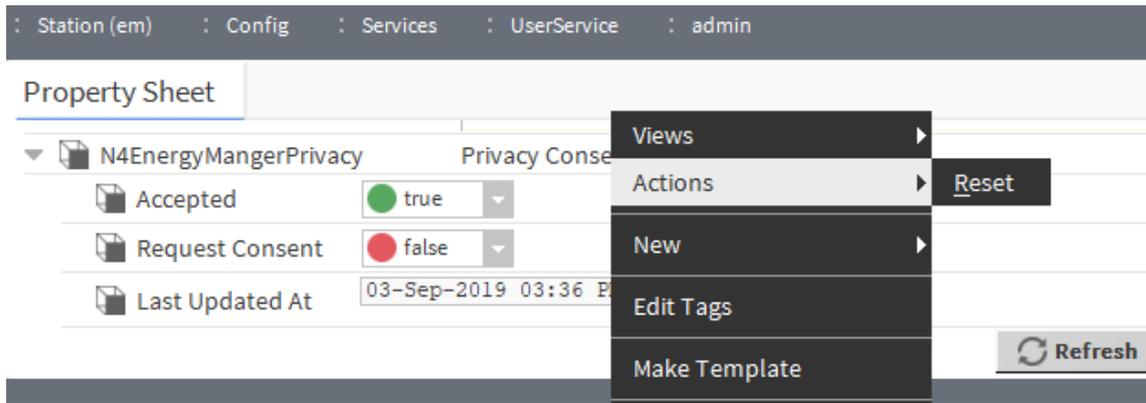


Figure 144 - OPTION TO RESET USER CONSENT

FAQ

I am using a 32-bit Installation of Niagara and N4 Energy Manager does not load as expected. What can I do other than installing the 64-bit version of Niagara?

These issues are ultimately caused by 32-bit applications having access to less memory than their 64-bit counterpart. The best option would be to install the 64-bit version of Niagara wherever possible. However, following these steps will help alleviate issues caused by a 32-bit installation.

1. Locate the '**nre.properties**' file in your Niagara installation directory. It will be inside the **defaults** folder in the root of the installation directory. This will typically be **C:\Niagara\Niagara-4.x.xx.xx\defaults**.
2. Locate the property identified by '**wb.java.options=**' and, if not already present' append **-Xms512M** to the end. It will look like this:

```
#####
#
# File: nre.properties
#
# This file contains properties which used
# the NRE launch executable
#
# Revision History
# 17 Feb 04 Brian Original
#
#####
# The list of options separated by spaces to pass thru to the VM
station_java_options=-Dfile.encoding=UTF-8 -Xss512K -Xmx6000M -Xms2000M -agentlib:jdwp=transport=dt_socket,server=y,suspend=n,address=6789
wb.java.options=-Dfile.encoding=UTF-8 -Xss512K -Xmx1024M -Xms512M
```

3. Locate the '**system.properties**' file. This will be in the same folder as the file from step 1. Add the following text to the end of this file: **niagara.jxbrowser.disable=false**
4. Restart the station and workbench.



These actions require editing Niagara properties files. We recommend backing up these property files before editing them so that they can be reverted if any errors occur.

I am not seeing the same popups in Workbench as I am when viewing my station in a web browser. Why is this?

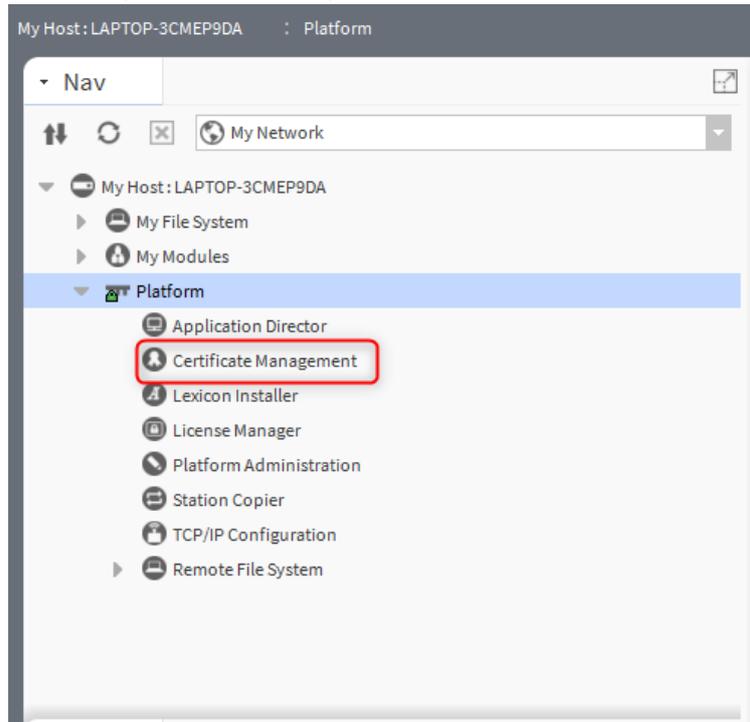
Some of the features will not work as fluently within Niagara as they do in an actual browser. The Niagara web browser is limited in its functionality. It is expected some of the UI elements behaviours are slightly degraded within the workbench for the above reason. E.g- The popup menus are disabled within the workbench. Previewing in Google Chrome will allow the pop-up to work correctly.

When connecting to my station running N4 Energy Manager via localhost, I am getting unexpected behaviour. Is there anything else I can try?

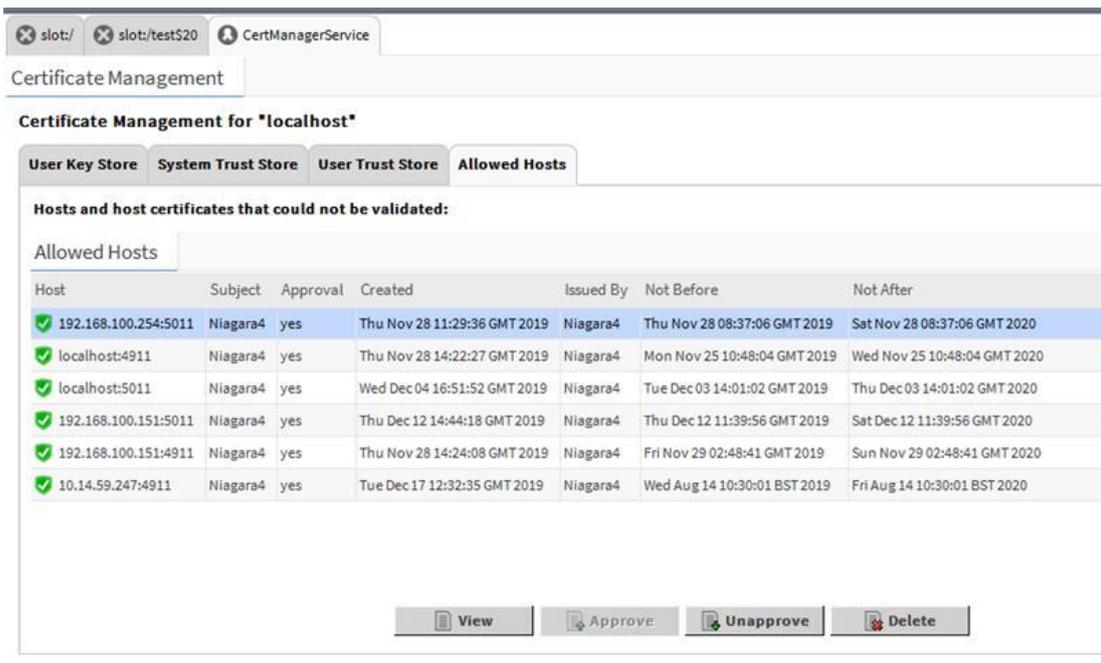
If your **N4 Energy Manager** widgets are not rendering as expected when accessing the station via localhost, try alternatively connecting via **127.0.0.1** or the actual IP Address of the station.

Accepting TLS Certificate

Within workbench open the relevant platform and look for 'certificate management'



1. Navigate to the 'allowed hosts' tab
2. Search for 'localhost' and left mouse click to highlight it
3. Select the 'Approve' button
4. After you have completed this you should see the below.



What is the difference between Energy Vision and N4 Energy Manager?

Energy Vision has now been rebranded to **N4 Energy Manager**. The key difference being the introduction of a free version (core) and a paid-for version (pro) and the latest new features. Customers wishing to buy **Energy Vision** will now purchase **N4 Energy Manager**.

Can I still engineer a project using Energy Vision?

This is possible if you already have an **Energy Vision** installation up to Niagara N4.2. However new customers wishing to use Niagara v4.4 or higher will only be able to purchase **N4 Energy Manager**

What's the difference between N4 Energy Manager Core and N4 Energy Manager Pro licenses?

The pro version has all the well-known **Energy Vision** features, as well as the latest new features that are not available in core such as:

1. **(Pro) Data Integrity** – Users can see a % integrity score for the data in charts and drill down to identify offline and inactive meters.
2. **(Pro) Energy Temperature curve** – Users can see the effect variations in outside air temperature has on a building's energy consumption
3. **Advanced reporting / Tenant Billing** – automatically create monthly bills or reports from templates and generate pdf documents for email or print.

N4 Energy Manager Core is limited to 3 histories, Menu is limited to 10 Menu Items, there is no automated PDF reporting and Kiosk mode is limited to 3 pages only.

I already have Energy Vision in Niagara 4, how do I upgrade to N4 Energy Manager Pro?

To purchase a Pro licence please contact your **N4 Energy Manager** Contact or Provider.

Use the provided migration tool to upgrade **Energy Vision** in Niagara 4 to **N4 Energy Manager**. The migration tool works with all versions of **Energy Vision** in Niagara 4 and is included in your distribution. Please note that an AX to N4 migration is a manual process that will require your project to be re-engineered, the **Energy Vision** to **N4 Energy Manager** migration tool is an N4 to N4 only tool. For more information, see [N4 Energy Manager Migration Pathways](#).

I'm interested in evaluating the N4 Energy Manager Pro features before I decide to buy, can I do this before I purchase?

Yes, new customers using **N4 Energy Manager** on a Core license can activate a 60 min demo of the pro features. During this 60 minute period, data is randomised but features are fully functional. The weather service feature is not part of the 60 min demo. Users wishing to retain the Pro features after 60 minutes will either need to restart their station and activate another 60 min demo, or purchase a Pro licence.

Are there any limitations to running N4 Energy Manager on a JACE?

Yes, the Automated PDF reporting and excel reporting functionality is only available on a supervisor installation.

I'm interested in receiving N4 Energy Manager Training, are there any courses?

Yes, training is available, to arrange this please contact your **N4 Energy Manager** Contact or Provider.

To use N4 Energy Manager pro do I need a one-time license only or is there an annual renewal process?

Pro licenses are a perpetual license, no annual subscription is required.

I've upgraded my N4 Energy Manager modules and now some of the features have stopped working.

Upgrading of modules is a manual process so it is important to check that all the modules have been copied correctly as part of the upgrade process.

When I run PDF Reports, I see that some pages are left blank, how do I fix this?

When a PDF report contains a high number of pages the report can sometimes be generated before the report data is ready. It is possible to configure a reporting property to extend the time before a report is generated. Doing this will enable all the correct data to be displayed.

I want to use the new external database feature of Niagara 4.11 to store histories, can Energy Manager support this?

Starting from **N4 Energy Manager v3.5.0**, this feature is supported, see [Adding histories from remote databases.](#)

The weather service's "Add Weather Station" action does not find any location.

There might be an issue with the TLS configuration or firewall settings of the network. If the issue persists, please contact your **N4 Energy Manager** Contact or Provider for investigation.