Forecast

Load and Generation Forecasting

User's Guide

What's in this guide?

Chapter 1 What is Forecast?

Welcome to the Open Systems International, Inc. (OSI) **Forecast™** product. **Forecast** is a tool that enables you to create accurate load and renewable generation forecasts for periods from 1 day to 35 days. **Forecast** uses the historical archive of area load, renewable generation and weather data and a variety of user-selected algorithms to effectively forecast the load demand and renewable generation.

Forecast lets you compare generated forecasts with actual histories and allows adjustments of forecasted values to increase the accuracy of the forecasts. You can adjust load and renewable generation values by making changes to the base forecast. **Forecast** also includes tools for accepting and saving the forecast and a load-graphing panel; all of which add additional flexibility to enable you to use this software tool effectively.

Forecast enables you to:

- View, analyze and edit historical data
- Get online weather and load parameters from SCADA and issue alarms if actual load deviates from the forecast significantly
- Create load forecasts from 1 day for up to 35 days in length
- Create multiple study load forecasts so you can designate the best forecast to run as an automatic forecast
- Perform a range of comparative forecasting operations to analyze system load and to gain insight into the dynamic behavior of the load and its correlations to weather and other parameters
- View the forecasts in both tabular and graphical format
- Set up forecasts that automatically run periodically
- Prepare operational plans from the forecasts that other applications or departments within your organization can use
- Similar to load forecast, support creation of renewable generation forecast for wind and solar resources

1.1 Forecast Philosophy

1.1.1 Factors Affecting Load Forecasting

Load is a dynamic entity affected by two main factors:

- Time of day (also known as weather independent factor or patterns of daily life)
- Weather dependent factors, such as temperature, wind, light intensity and humidity

The time dependence of the load reflects the existence of a daily load pattern, which can vary for different days, such as weekdays, weekends or holidays. This daily load pattern represents the normal pattern of daily life.

Apart from the day and time, load is also dependent on seasons. Load will be moderate in fall and spring, whereas it may be higher in winter and rise to the peak in summer. Temperature is the primary weather factor that affects load. Humidity (in the summer) and wind speed (in the winter) also influence energy consumption. **Forecast** accounts for all of these factors and allows you to include different weather-related factors in the forecast, such as cloud cover/light intensity and dew point.

1.1.2 Factors Affecting Renewable Generation Forecasting

Renewable generation is a dynamic entity affected by two main factors:

- Installed capacity of renewable generation at a site (weather independent variable)
- Weather dependent factors, such as wind speed, solar irradiance, temperature and air density

Apart from the installed capacity that would define maximum renewable generation from site, renewable generation is also highly dependent on weather conditions. Renewable generation from wind resources is highly dependent on wind speed, wind direction and air density. Renewable generation from solar resources is highly dependent on solar irradiance and solar panel surface temperature. **Forecast** accounts for all of these factors and allows you to include different weather-related factors in the forecast, such as cloud cover/light intensity and dew point.

1.1.3 Forecasting Methodology

Several methodologies for forecasting load and renewable generation have been developed in the industry over the past few years. **Forecast** supports the Regression and Neural Network methods.

Regression Method

The Regression method uses statistical methods to find correlations between load/renewable generation and various parameters that affect load/renewable generation. Using the historical load/renewable generation and weather data, this methodology attempts to calculate a load model and renewable generation model using the regression analysis theory. This method is fairly simple and does not require any adjustments or creation of manual load or renewable generation profiles. You have control over the model used to find the correlations between (1) load and independent parameters and (2) renewable generation, capacity and independent parameters.

Neural Network Method

The Neural Network method is a more advanced methodology that uses a basic pattern recognition model to forecast loads and renewable generations. It is based on a neural network concept of "learn from the past" to "forecast the future." You must train the neural network model periodically to get a more accurate result. See Chapter 4 for more details about neural networks and Chapter 5 for a neural network training guide.

Refer to the *Forecast Design Description* for more details on the forecast methodologies.

Chapter 2 Getting Started with Forecast

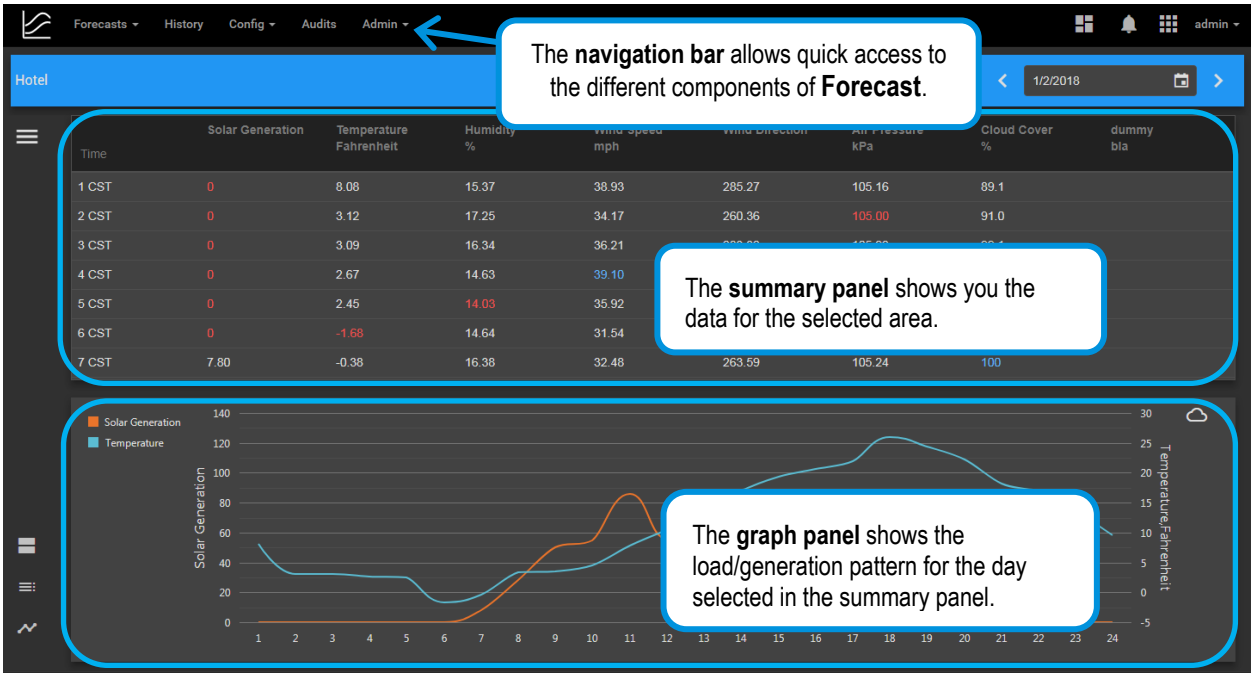
2.1 Starting Forecast

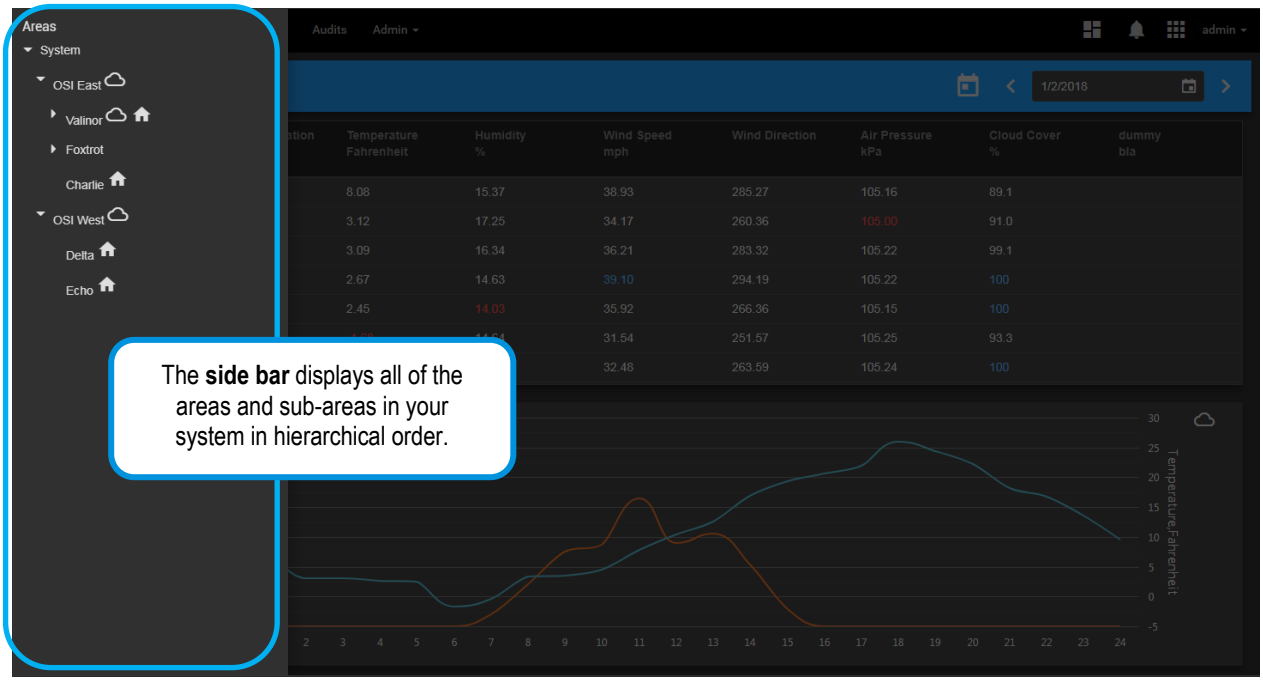
1. To start the application, open a web browser and navigate to your web application server.

2. Enter your username and password and click **Login** (or press Enter).

3. The OSI Web Applications home page will open. Click the **Forecast** icon.

2.2 Understanding the Layout of Forecast





NOTE The data you see depends on what permissions your user has.

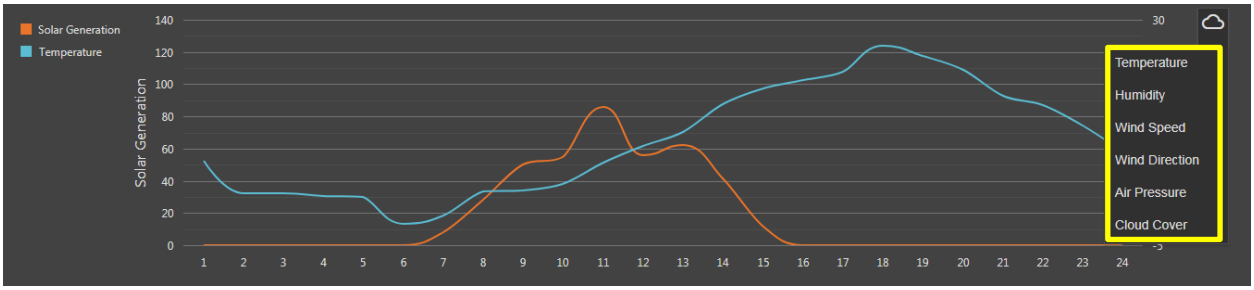
NOTE

Areas that are grayed out do not support the type of data you are trying to view.

2.3 Performing Basic Tasks

2.3.1 Changing the Weather Parameters Shown on the Graph

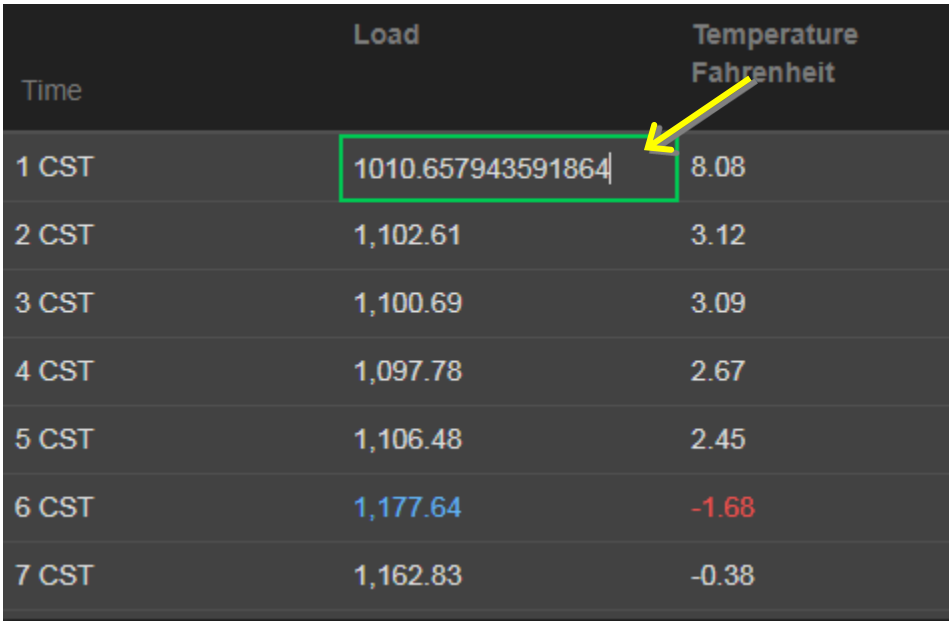
You can change which of the weather parameters that is defined for your system appears on the graph panel with the actual load. Click the cloud icon and select the desired parameter from the list. The graph will automatically update to reflect the new data.



2.3.2 Modifying Data

If you have read/write permissions for an area, you can modify the data values for historical data and for forecasts that have not been accepted if you suspect the data is incorrect.

1. Hover the cursor over a load or weather data field. If the cursor changes to a hand, it means you can edit it.
2. Click the data field and manually enter the new value.



Time	Load	Temperature Fahrenheit
1 CST	1010.657943591864	8.08
2 CST	1,102.61	3.12
3 CST	1,100.69	3.09
4 CST	1,097.78	2.67
5 CST	1,106.48	2.45
6 CST	1,177.64	-1.68
7 CST	1,162.83	-0.38

NOTE

You can set read/write permissions for each area. These permissions provide read/write access to the selected area and its subareas.

2.3.3 Refreshing the Data

Data refreshes automatically every few seconds. You can also refresh your browser or navigate away from and back to the forecast to manually update the data.

2.3.4 Customizing the Forecast Layout

By default, the panels are shown horizontally. You can change their orientation to vertical by clicking the first button in the group in the lower left corner of the display.

You can choose whether you want to view or hide the summary and graph panels using the second and third button, respectively, in the lower left corner of the screen.

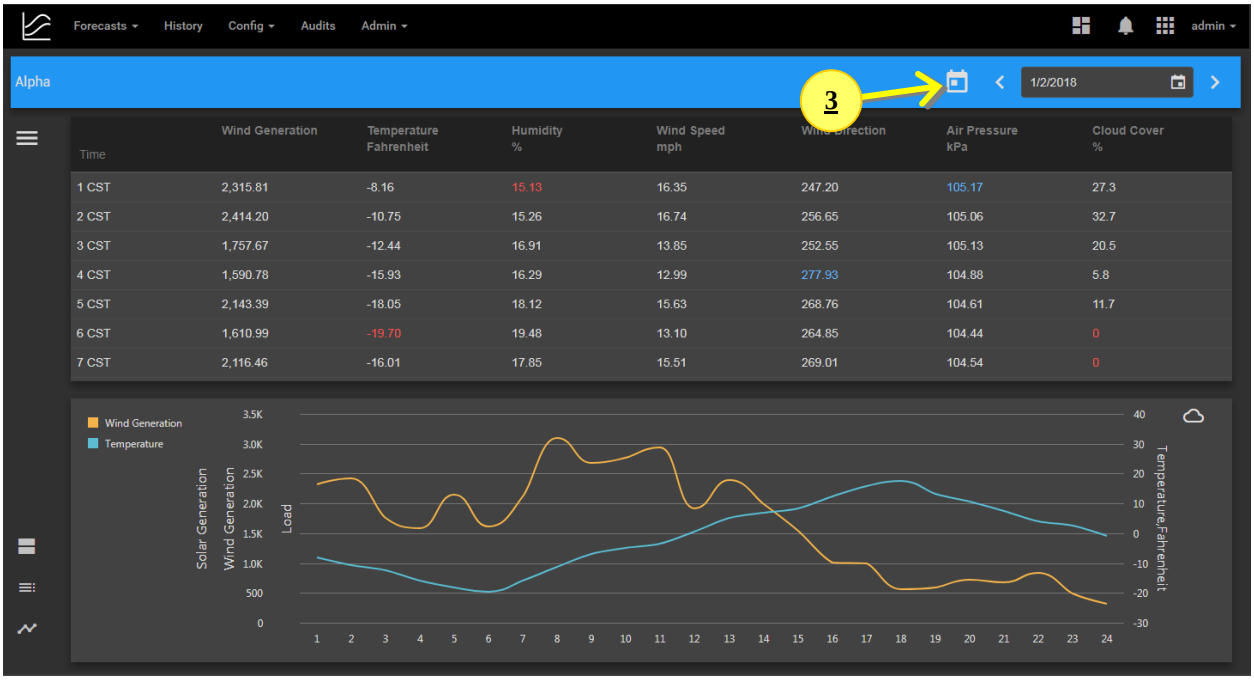
Chapter 3 Historical and Forecasted Weather Data

3.1 Viewing Historical and Forecasted Weather Data

Forecast lets you view past data for an area as well as the weather forecast for an area.

1. Select **History** on the navigation bar to view historical data and **Forecasts → Weather Forecasts** to view weather forecast data.
2. Select the area you want to view data for from the side bar. If you pick a super area, it will show you a sum of the load values for all of its subareas.
3. Choose the date you want to view data for. Clicking the calendar icon next to the date will jump to the current day.

Data that appears in red text indicates it is the minimum value for that weather/load/generation parameter for the day. Data that appears in blue text indicates it is the maximum value for that weather/load/generation parameter for the day.



If you scroll all the way to the bottom of the summary panel, you will see the minimum, maximum and average values for each parameter.

Time	Wind Generation	Temperature Fahrenheit	Humidity %	Wind Speed mph	Wind Direction	Air Pressure kPa	Cloud Cover %
21 CST	681.56	7.44	21.31	6.13	244.18	104.56	0
22 CST	836.63	4.04	19.86	7.73	228.80	104.68	8.6
23 CST	496.20	2.53	18.68	3.70	246.91	104.52	16.3
24 CST	310.78	-0.88	18.88	0.19	240.99	104.28	0
Min	310.78	-19.70	15.13	0.19	161.28	103.84	0
Max	3,091.69	17.59	23.25	19.20	277.93	105.17	32.9
Average	1,644.39	-0.99	19.88	12.05	222.60	104.44	14.1

3.2 Importing Historical and Forecasted Weather Data

You can manually run the *osii_forecast_import* process to import historical data from **OpenHIS** or the legacy **OpenSTLF™** product.

- To import a CSV file, open a command prompt and run `osii_forecast_import --csv <CSV Filename>`.
- To import **OpenSTLF** data, open a command prompt and run `osii_forecast_import -D <domain name in the RDBMS adaptor> --rdbms <RDBMS alias> --file <location of openstlfengine.jrc file>`

It also has a `--scan` option to periodically scan a given directory for CSV history.

NOTE To see a list of all command line options, run `osii_forecast_import -?`.

NOTE To import data as a weather forecast instead of historical data, run `osii_forecast_import` using the `-w` flag.

Format for the CSV file is as follows:

```
area,              timestamp,              load,       <Weather Param>
<Name of Area>,    <Time Information>,     <Load>,     <Weather Data>
```

- `<Weather Param>` is a list of the names of weather parameters data is being added for.
- `<Name of Area>` is the name of the area the history data is for.
- `<Time Information>` is the time the history data occurred in ISO 8601 format `yyyy-MM-ddTHH:mm:ssX`.
- `<Load>` is the amount of load at that time.
- `<Weather Data>` is the weather data for the associated weather parameter.

The area and timestamp fields are the only two required fields, all other fields are optional.

Below is an example CSV file (using timestamps in UTC):

```
area,       timestamp,                    load,       temperature
Alpha,      2017-06-20T15:00:00+00:00,    16754,      80
Bravo,      2017-06-20T16:00:00+00:00,    14846,      77
```

NOTE

An additional sample file is located at $OSI/samples/Forecast/csv/sample_import.csv.

Chapter 4 Neural Networks

4.1 Introduction

Neural network (NN) models are created and configured through a rich user interface. These models are the correlation between weather, load and generation and are used by the NN algorithm to forecast future load, wind generation and solar generation. **Forecast** uses a different NN model for each interval in a weekday/weekend and within each season to account for the time dependence on load and a single network for forecasting solar and wind generation. To run a forecast using the neural network algorithm, all models for the timespan the forecast covers must be trained and assigned to the forecast.

Untrained is the original state for each NN model. A model's status will also be Untrained if you made configuration changes that affected the model. Examples of this could include:

- Removing a weather parameter from the model/system
- Changing the modeling of neural nets in the Weather Parameter configuration page
- Reorganizing the area hierarchy above or below the model's area

4.2 Network Models

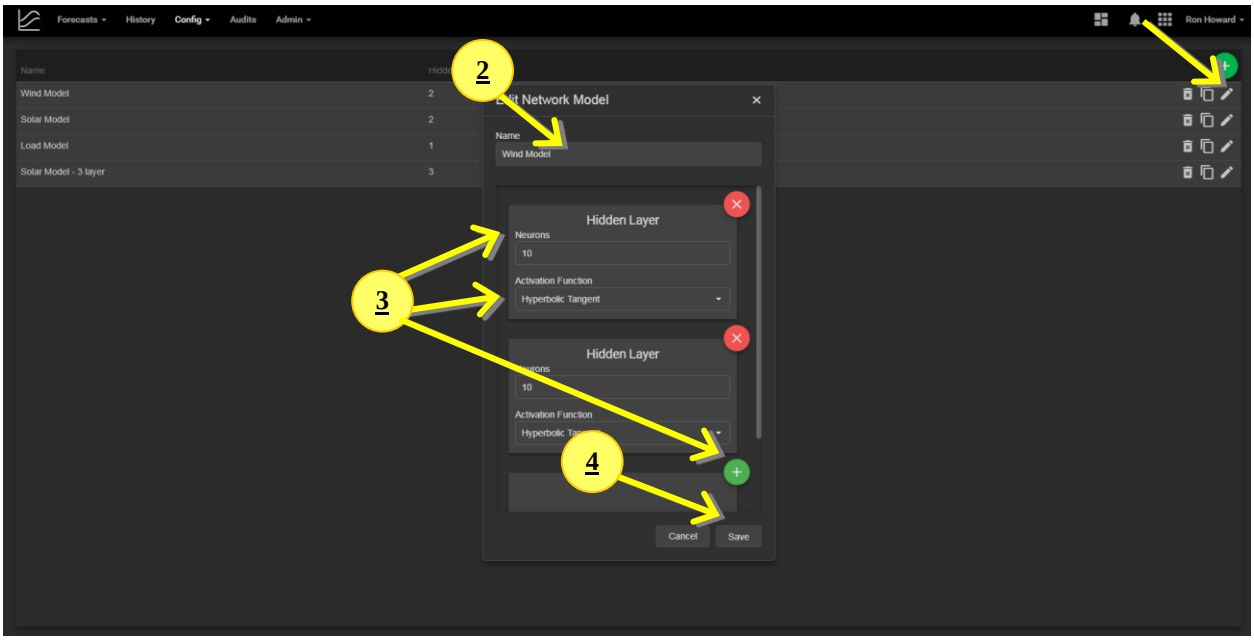
To view network models select **Forecasts → Neural Networks Models** from the navigation bar.

Network models define the structure of a neural network. They are created ahead of time to be used when creating a neural network.

The structure defined by network models consists of many layers of neurons with activation functions leading into the layer. The more neurons that are used, the more possible relationships can be explored but the longer the training will take. Using multiple layers also allows for different class of functions to be modeled but can dramatically increase the training time of a neural network.

To edit network models:

1. Click the edit button in the summary panel.
2. In the Edit Network Model dialog, enter a descriptive name for the neural network.
3. Add/modify the layers, neurons and activation function parameters as desired.
4. Click **Save**.

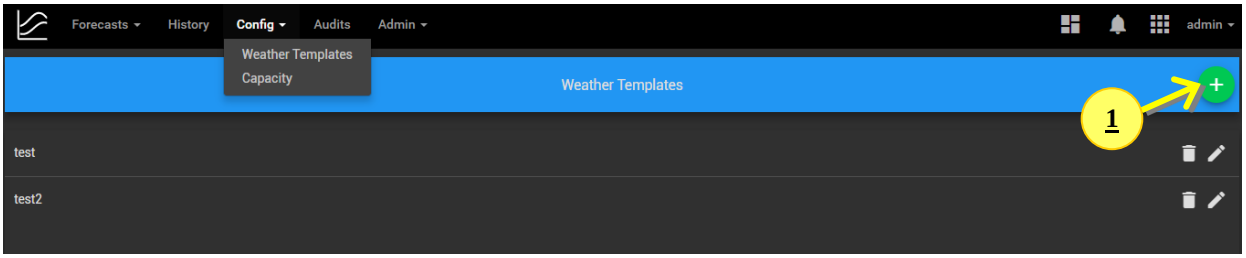


TIP OSI recommends using around 10 neurons per layer and the Hyperbolic Tangent activation function for most basic applications. Using one hidden layer can suffice for most applications, but for more complex relationships two layers may be required.

4.3 Weather Templates

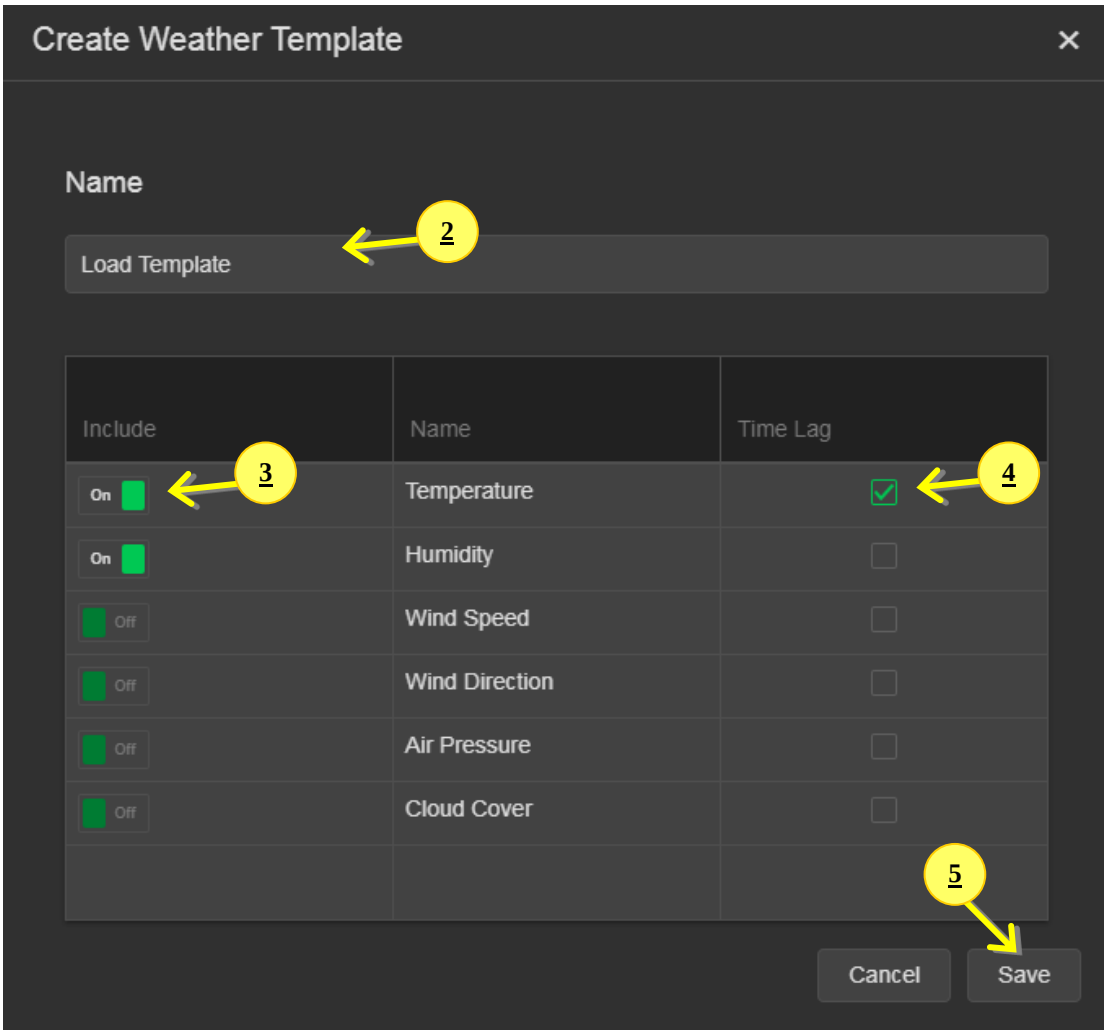
Weather templates are used to ease in creation of neural networks. When a system has many weather parameters to choose from, a template can be created to load in those values quickly rather than selecting them one by one.

To view weather templates select **Config → Weather Templates** from the navigation bar.



To create a weather template:

1. Click the plus button in the summary panel.
2. In the Create Weather template dialog, enter a descriptive name for the template.
3. Set the **Include** flag to **On** for all parameters you want to include in the template.
4. Check the **Time Lag** boxes if you want to include previous data points for the selected weather parameter.
5. Click **Save**.



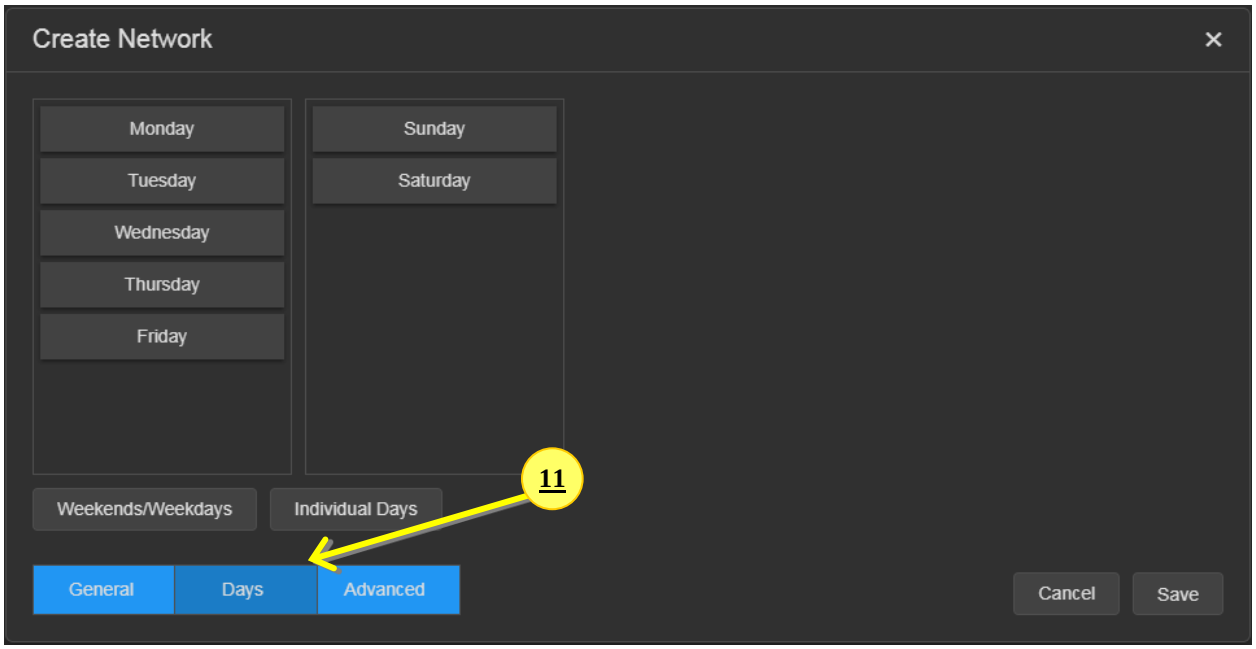
4.4 Creating a Neural Network

1. Select **Forecasts → Neural Networks** from the navigation bar.
2. Click the plus button in the summary panel.
3. In the Create Network dialog, enter a descriptive name for the neural network.
4. Set **Area** to the area you want to train the network in. This cannot be changed after the network has been created.
5. Set **Network Type** to the type of data to train against. The options are: Load, Solar, Wind and DERMS.
6. Select a **Network Model** to use as the structure for the neural network. The options are: Load Model, Solar Model, Wind Model and other models that were configured in Neural Network Models.
7. Check the **Auto?** box to allow the network to be re-trained on a periodic basis (as specified in the **Forecast** settings).
8. Either populate the weather parameters from a weather template or select which weather parameters should be used by the neural network when training.

9. If the network is a solar network and the area it is being trained in has latitude and longitude defined, check the **Computed Irradiance** box to cause **Forecast** to attempt to provide the solar irradiance for that time of day/year and location to the neural network when training.

10. If the network is a DERMS solar network, enter the **Number of Groups** to specify how many groups the solar panels in the area should be broken into. A neural network is created for each group.

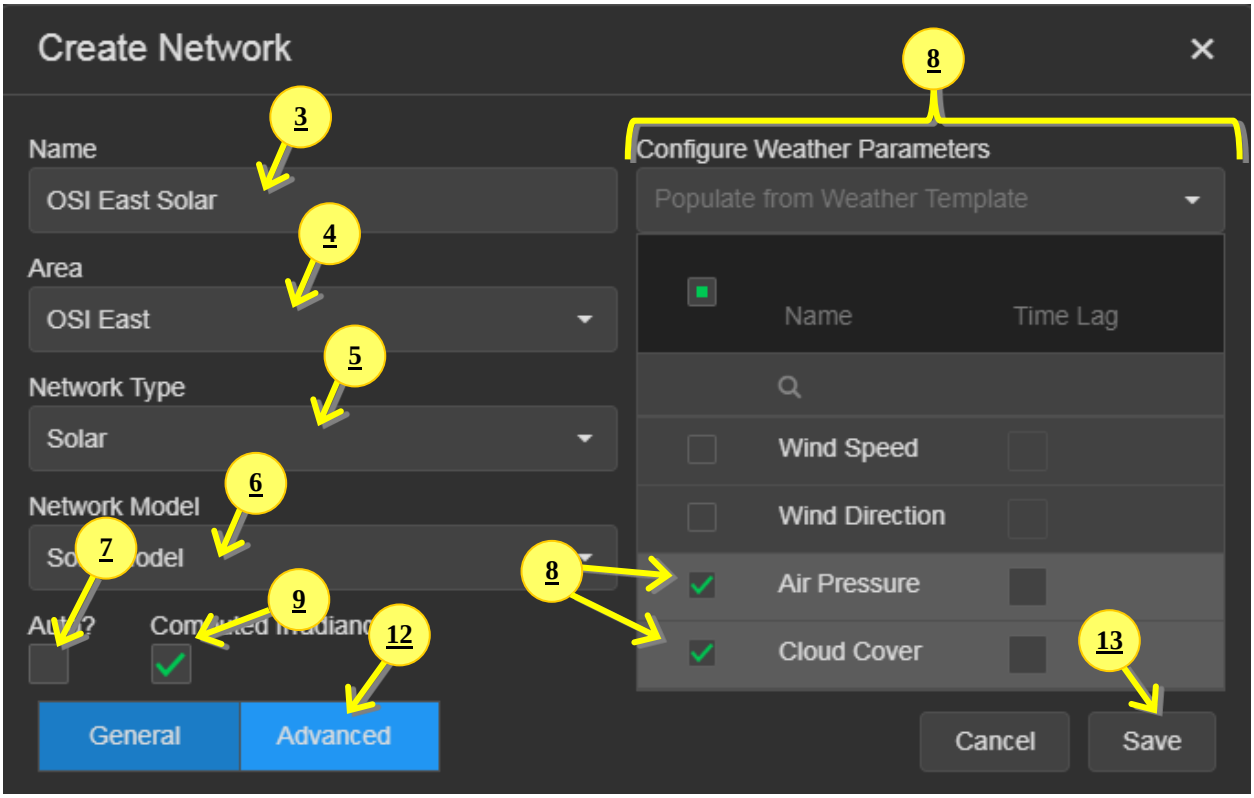
11. If the network is a load network, click on the Days button to configure how days are grouped for forecasting (Weekends/Weekdays or Individual Days).



12. Select the **Advanced** button to view more advanced network settings, including:

- Max Iterations – How many iterations to perform before training should stop
- Max Previous Days – How many days of historical data to use when training
- Minimum Error – What error should be used to stop training at
- Regularization Coefficient – Property used by neural networks to help with overfitting data
- Training Method
    - Default – 10% of the data is reserved for validation.
    - Early Stop – The network will attempt to stop training early if it detects overfitting of data.
    - K-Fold Cross Validation – The training data will be separated into *k* groups (specified in the Value of K field). The model is trained using *k* - 1 groups of data, and the remaining group is used as validation data. Each group is used equally as a validation set over the course of the training.
- Enable Error Snapshots – Forecast takes periodic snapshots of error data during training. You can specify how frequently to take snapshots using the Iterations Between Snapshots field. This data can then be graphed so that you can see the development of the neural network over the course of the training period.

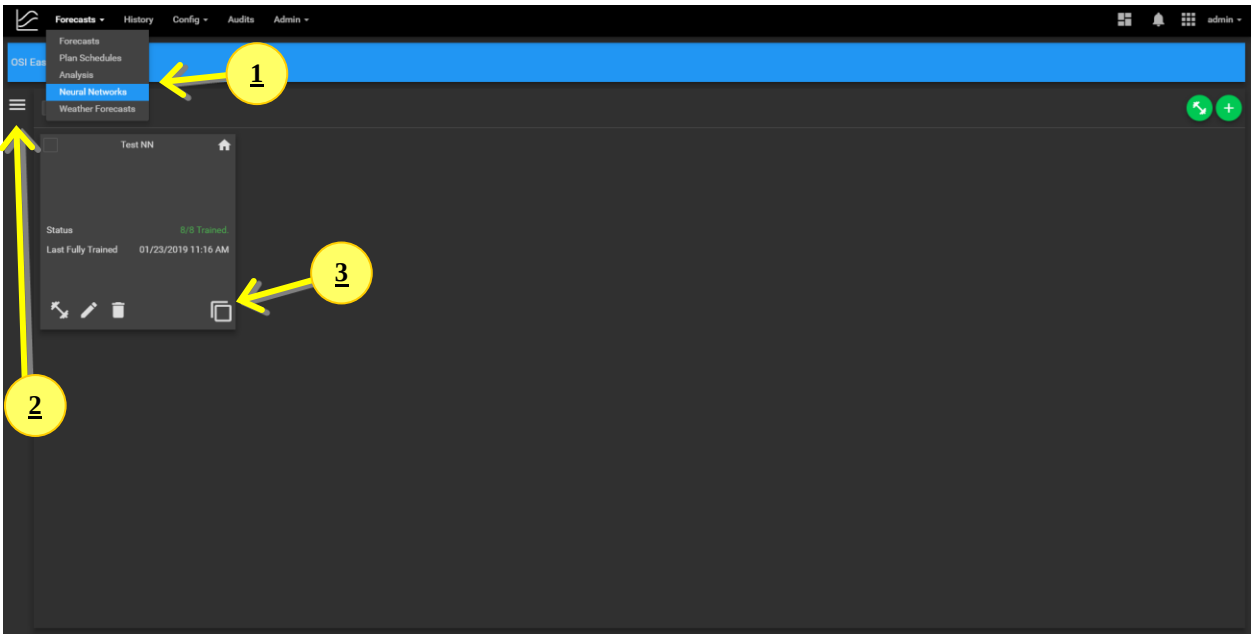
13. Click **Save**.



NOTE If no explicit settings are defined in the advanced network settings, **Forecast** uses the default settings from Admin → Forecast Settings.

4.5 Viewing Neural Networks

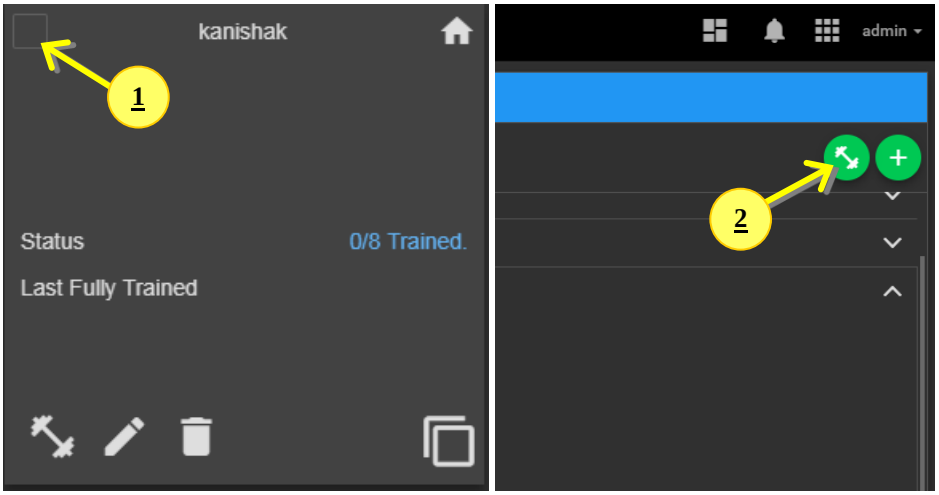
1. Select **Forecasts → Neural Networks** from the navigation bar.
2. Click on the sandwich menu to view a list of areas. Select an area to see networks configured for that area. Networks are displayed on cards and show the following information:
   - The name of the neural network
   - The type of the neural network
   - The neural network status
     - Trained – the network has been trained and is ready to use
     - Untrained – the network has not been trained yet. The network goes into this state when network is modified.
     - Error – The network encounters an error while training. To see more information about the error, hover your cursor over the error text.
   - When the network was last trained
   - Training and Cross-validation Root Mean Square Error (RMSE)
3. Load neural networks can be expanded by clicking the squares in the lower right corner of the card.



4.6 Training Neural Networks

You can train a network by selecting the train button on the card. To train multiple networks simultaneously:

1. Check the box in the upper left corner of the card for each one you want to include.
2. Select the global train button in the upper right hand corner.

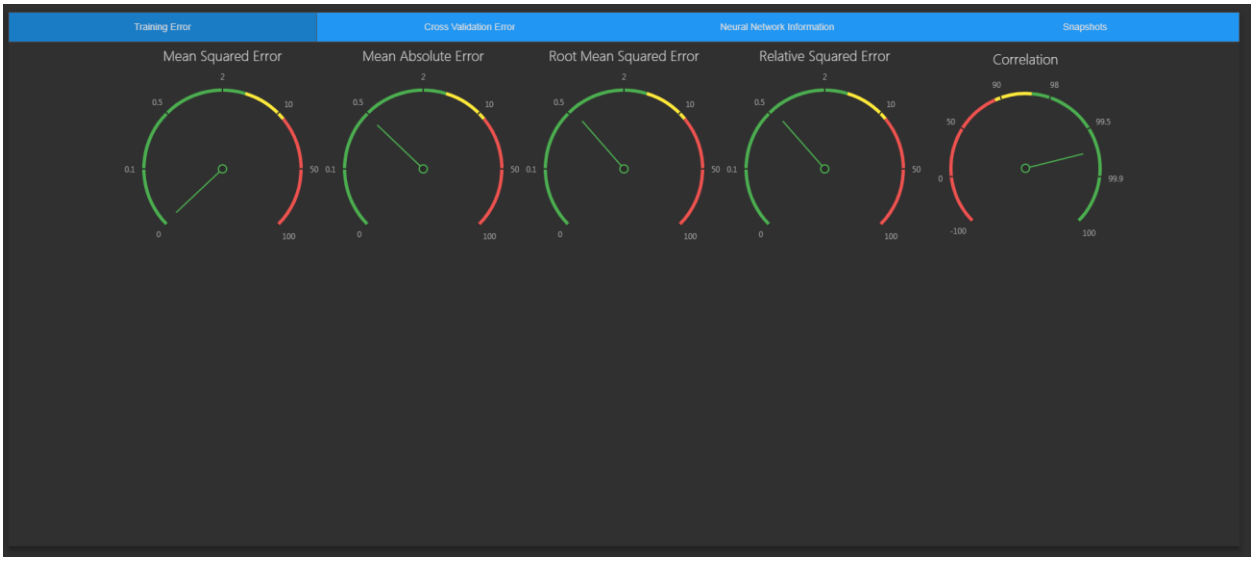


4.6.1 Viewing Training Details

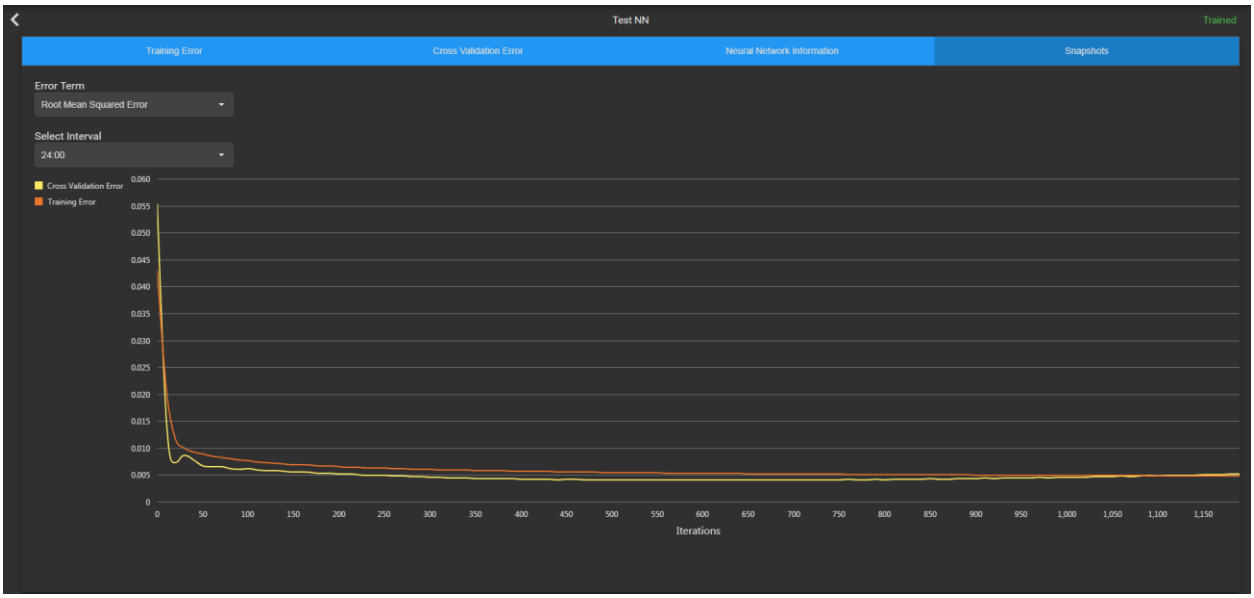
To view the neural network training details click on the info button located on the network's card.

This will open a dialog showing the five number summary for both the training error and the cross validation error of the neural network for the last time it was trained. The five number summary is broken down into the following statistics.

- Mean Squared Error – Error metric that is weighted by the higher error values
- Mean Absolute Error – Error metric that is less affected by higher error values
- Root Mean Squared Error – Tries to normalize Mean Squared Error
- Relative Squared Error – Compares the results to the original data rather than the trained data
- Correlation – How closely the network matches the trends of the data.



Clicking on the Snapshots tab will show the error snapshot data collected during training (if the Enable Error Snapshots option was enabled). The graph below shows results for a neural network that was trained for 1000 iterations, with snapshots taken after every 10 iterations.

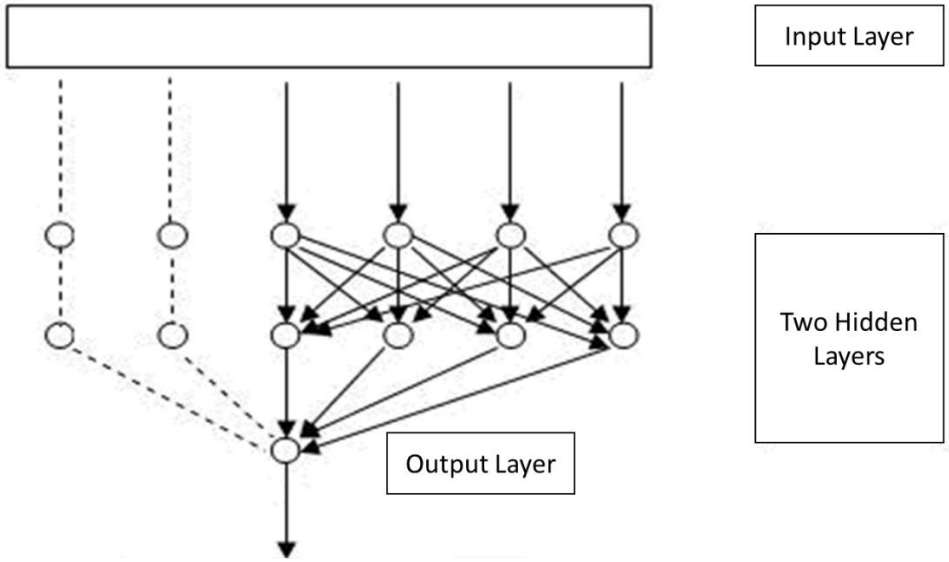

Test NN
Trained
Training Error
Cross Validation Error
Neural Network Information
Snapshots
Error Term
Root Mean Squared Error
Select Interval
24:00
Cross Validation Error
Training Error
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1,000
1,050
1,100
1,150
Iterations

Chapter 5 Neural Network Training Guide

5.1 Introduction to Neural Networks

Neural networks are, as the name suggests, a network of neurons. These neurons are arranged in layers and are fully connected to adjacent layers. All neural networks must have at least two layers—an input and an output layer.

In order for a neural network to be able to learn, it must also have at least one hidden layer between the input and output layers to perform a transformation on the data.



5.2 Benefit of Neural Networks

When a neural network is created that contains no hidden layers, it performs at the same level as multiple linear regression. The goal with adding hidden layers is to attempt to find a more complex but accurate relationship in the data.

The main issue with multiple linear regression is that it struggles to find relationships that are not linear. To get around this, **Forecast** allows additional inputs to be configured at varying polynomial degrees. This provides a good approximation but is ineffective for complex representations.

Neural networks get around this by transforming the data with a set of interconnections between neurons that weigh the input data and an activation function that is applied to all inputs to a neuron. This activation function performs a non-linear transform on the data and allows the network to be able to model any relationship given enough neurons.

5.3 Activation Functions

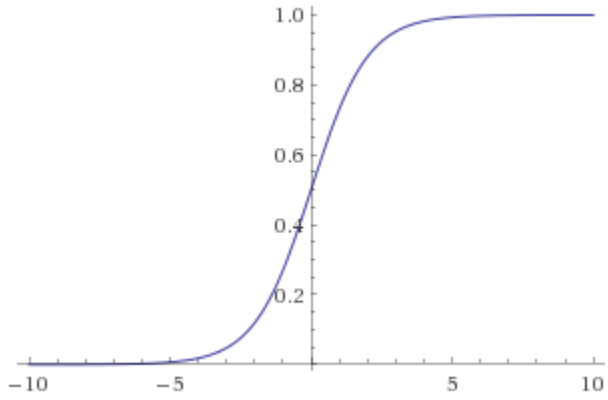
Forecast allows the selection from two activation functions:

- Sigmoid
- Hyperbolic Tangent

These activation functions can be configured on a per-layer basis and will be applied to the input of a layer.

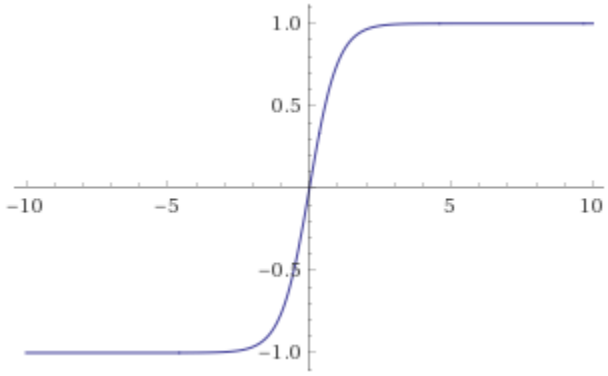
5.3.1 Sigmoid Activation Function

The sigmoid activation produces positive outputs from 0 to 1. This causes connections to always produce either positive or negative values but not both. A potential benefit of this activation function is that it is very easy for a network to get the value of 0 by having a very negative input to a neuron.



5.3.2 Hyperbolic Tangent Activation Function

The hyperbolic tangent activation function produces outputs from -1 to 1. This allows the output of a neuron to produce both positive and negative values depending on the weight of the output edge. It is, however, harder to have a neuron not produce any output as only values close to 0 will produce a 0 value.



5.4 Common Neural Network Issues

Most neural network training issues can be fixed by looking at the neural network training details page. The main takeaway from the details page is that training statistics are compiled against two different data sets, the training data and the validation data.

Training data is a set of data that the neural network was trained on. Good performance on this data shows the network was able to find some pattern in the data during training.

Validation data is a set of data that was held back from the network while training. Good performance on this data shows the pattern holds with data that the network has not seen before.

The details page provides statistics that show how well the network performed on each data set. These statistics include root mean squared error, relative squared error, correlation, mean squared error and mean absolute error. More information on each of these can be found in Section 4.6.1.

5.4.1 Overfitting

If a network shows very good performance on the training set and bad performance on the validation set, it is possible the network is overfitting the data. This is equivalent to "memorizing" the data points and will cause the network to not perform well on values it has not seen before. The solution to this problem depends on how the neural network was trained.

- Try turning on early stopping for the neural network. This will attempt to stop training the network once it starts performing worse instead of better on the validation set.
- Try reducing the number of hidden layers and neurons in each of the hidden layers. Reducing the complexity of the network causes it to have lower pattern recognition capability, making it unable to "memorize" the data.

5.4.2 Under Fitting

If the network shows bad performance on both the training and validation sets, the network is likely not finding the relationship with the data.

- Try training the network with more training iterations. This will allow the network more time to find a relationship in the data.
- Try increasing the number of hidden layers or the number of neurons in each hidden layer. This will give the neural network more power to find patterns in the data and may also need more iterations to train.
- If neither of these solves the issue, it is likely that the input parameters do not contain enough information for an accurate forecast of the data. In this case, try using different weather parameters, adding new weather parameters or decreasing noise by removing some that do not have as large an effect.

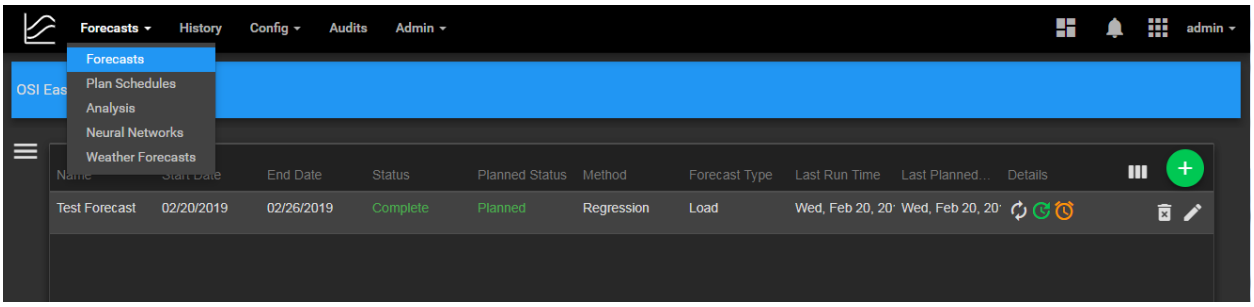
5.4.3 Large Spikes in a Forecast

Large spikes in a forecast usually indicate large weights in the neural network. To reduce the size of weights in the network, you can set the regularization coefficient to a value between 0 and 1. This discourages networks from having large weights while training and will naturally cause the final trained network to have smaller weights.

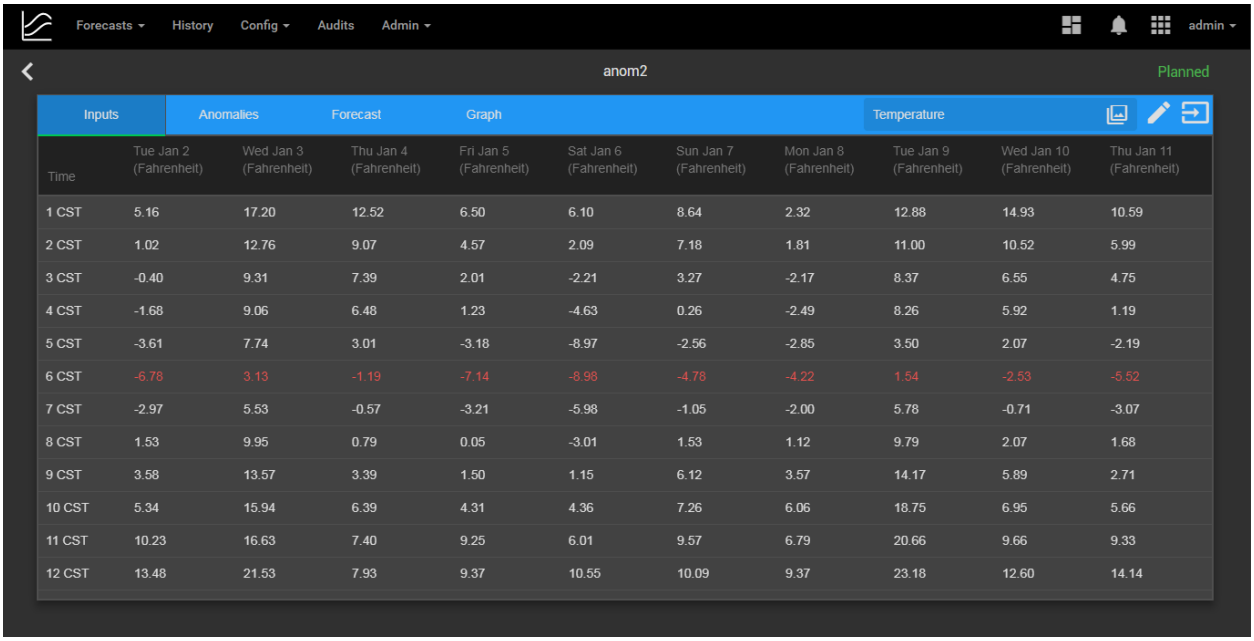
Chapter 6 Forecasts

6.1 Viewing Forecasts

1. Select **Forecasts → Forecasts** from the navigation bar.
2. Select an area from the side bar. You will see all forecasts that currently exist for that area. The grid shows the following information:
   - The name of the forecast
   - The start and end date
   - The forecast status
     - New – forecast has not been run
     - Error – there were issues when the forecast was run and it was not successful
     - Complete – the forecast ran with no issues
   - The forecast's plan status
     - Unplanned – the forecast is not planned
     - Planned – the forecast is currently being planned
     - Planned but Stale – the forecast was planned but its data has since changed
   - The methodology used
   - The type of forecasting that was performed
   - The last time it was run
   - The last time the forecast was planned
   - A selection of possible details icons
     -  - Indicates that the forecast is auto-adjusting.
     -  - Indicates that the forecast is configured on the Plan Schedules page to be automatically accepted as the default area plan whenever it successfully runs and is accepted as the current plan.
     -  - Indicates that the forecast is configured on the Plan Schedules page to be automatically accepted as the default area plan whenever it successfully runs and is not accepted as the current plan.
     -  - Indicates that the forecast is a manual plan which is accepted as the current plan.
     -  - Indicates that the forecast is a manual plan which is not accepted as the current plan.
     -  - Indicates stale data as configured in the forecast settings.
     -  - Indicates that the forecast has an anomaly assigned to it.



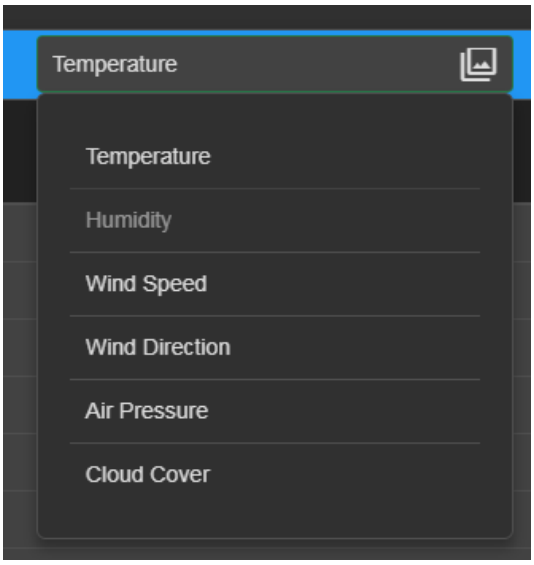
3. Select a forecast from the list. A new page will open showing the inputs and any anomalies associated with the forecast. Once a forecast has been run, you will also see the forecasted load in tabular and graph formats.



Time	Tue Jan 2 (Fahrenheit)	Wed Jan 3 (Fahrenheit)	Thu Jan 4 (Fahrenheit)	Fri Jan 5 (Fahrenheit)	Sat Jan 6 (Fahrenheit)	Sun Jan 7 (Fahrenheit)	Mon Jan 8 (Fahrenheit)	Tue Jan 9 (Fahrenheit)	Wed Jan 10 (Fahrenheit)	Thu Jan 11 (Fahrenheit)
1 CST	5.16	17.20	12.52	6.50	6.10	8.64	2.32	12.88	14.93	10.59
2 CST	1.02	12.76	9.07	4.57	2.09	7.18	1.81	11.00	10.52	5.99
3 CST	-0.40	9.31	7.39	2.01	-2.21	3.27	-2.17	8.37	6.55	4.75
4 CST	-1.68	9.06	6.48	1.23	-4.63	0.26	-2.49	8.26	5.92	1.19
5 CST	-3.61	7.74	3.01	-3.18	-8.97	-2.56	-2.85	3.50	2.07	-2.19
6 CST	-6.78	3.13	-1.19	-7.14	-8.98	-4.78	-4.22	1.54	-2.53	-5.52
7 CST	-2.97	5.53	-0.57	-3.21	-5.98	-1.05	-2.00	5.78	-0.71	-3.07
8 CST	1.53	9.95	0.79	0.05	-3.01	1.53	1.12	9.79	2.07	1.68
9 CST	3.58	13.57	3.39	1.50	1.15	6.12	3.57	14.17	5.89	2.71
10 CST	5.34	15.94	6.39	4.31	4.36	7.26	6.06	18.75	6.95	5.66
11 CST	10.23	16.63	7.40	9.25	6.01	9.57	6.79	20.66	9.66	9.33
12 CST	13.48	21.53	7.93	9.37	10.55	10.09	9.37	23.18	12.60	14.14

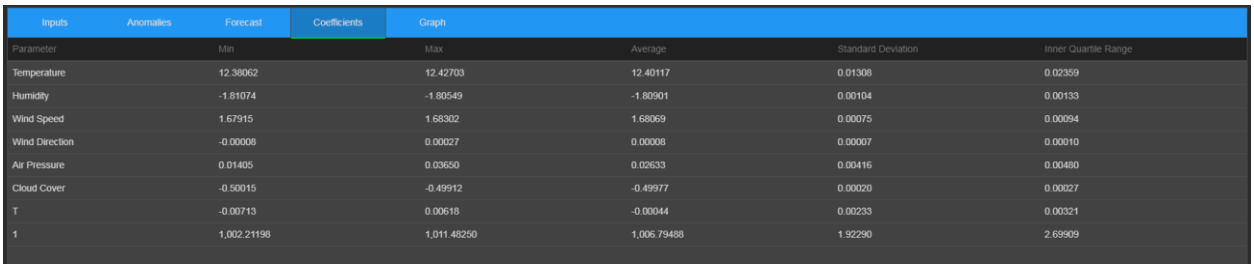
Inputs Section

You can view the input data for the different weather parameters by clicking on the area of the header that shows a name of one of the parameters and selecting the desired one from the list. If the parameter is not configured to be included in the forecast, it will be grayed out. See Additional Options for Regression Forecasts for more details.



Coefficients

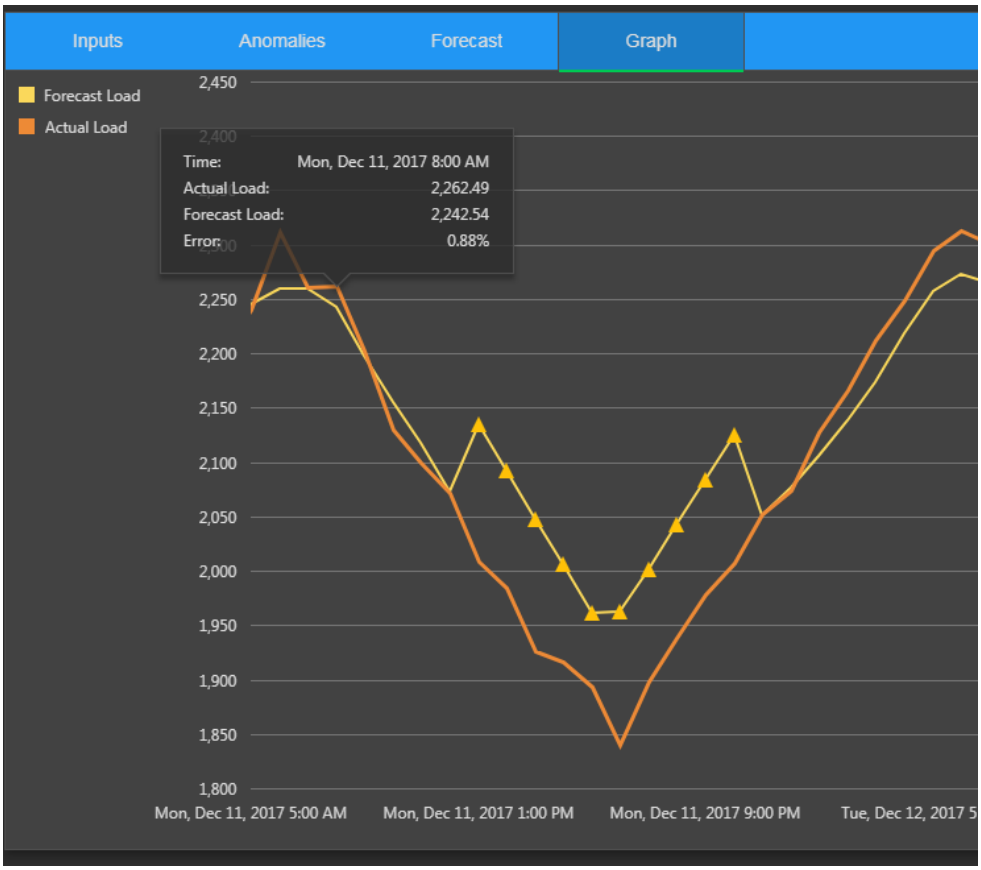
You can view the coefficients for regression forecasts on this tab.



Parameter	Min	Max	Average	Standard Deviation	Inner Quartile Range
Temperature	12.38062	12.42703	12.40117	0.01308	0.02359
Humidity	-1.81074	-1.80549	-1.80901	0.00104	0.00133
Wind Speed	1.67915	1.68302	1.68069	0.00075	0.00094
Wind Direction	-0.00008	0.00027	0.00008	0.00007	0.00010
Air Pressure	0.01405	0.03650	0.02633	0.00416	0.00480
Cloud Cover	-0.50015	-0.49912	-0.49977	0.00020	0.00027
T	-0.00713	0.00618	-0.00044	0.00233	0.00321
1	1,002.21198	1,011.48250	1,006.79488	1.92290	2.69909

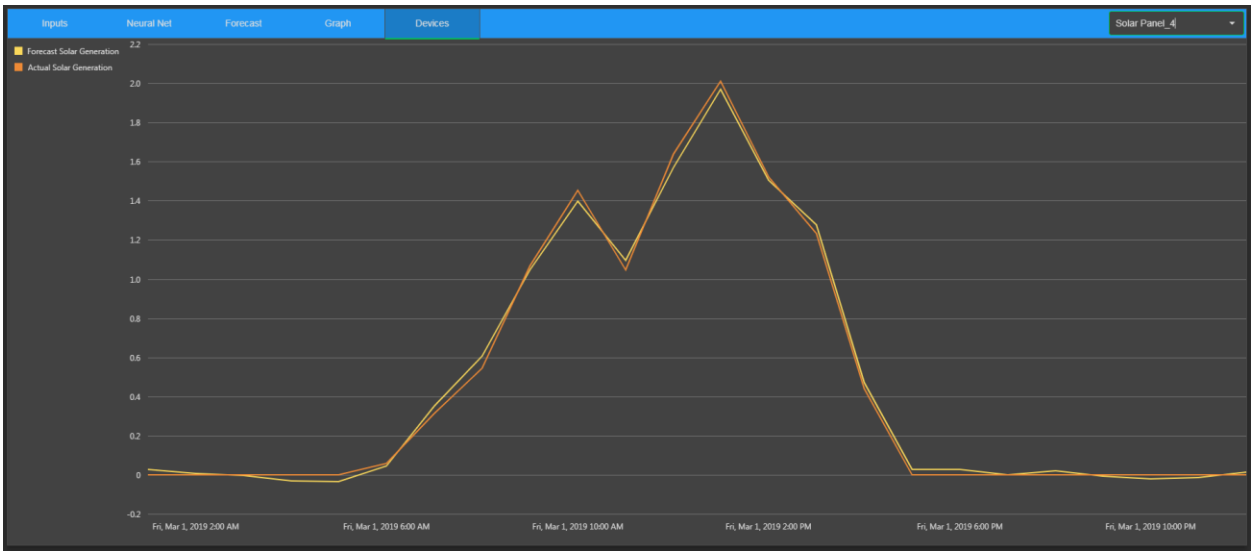
Graph Section

If you hover over an area of the graph, you will see the details for that point in time.



Devices

On this tab, you can view forecasts for individual devices in a DERMS forecast. Select a device using the drop-down in the upper-right corner.



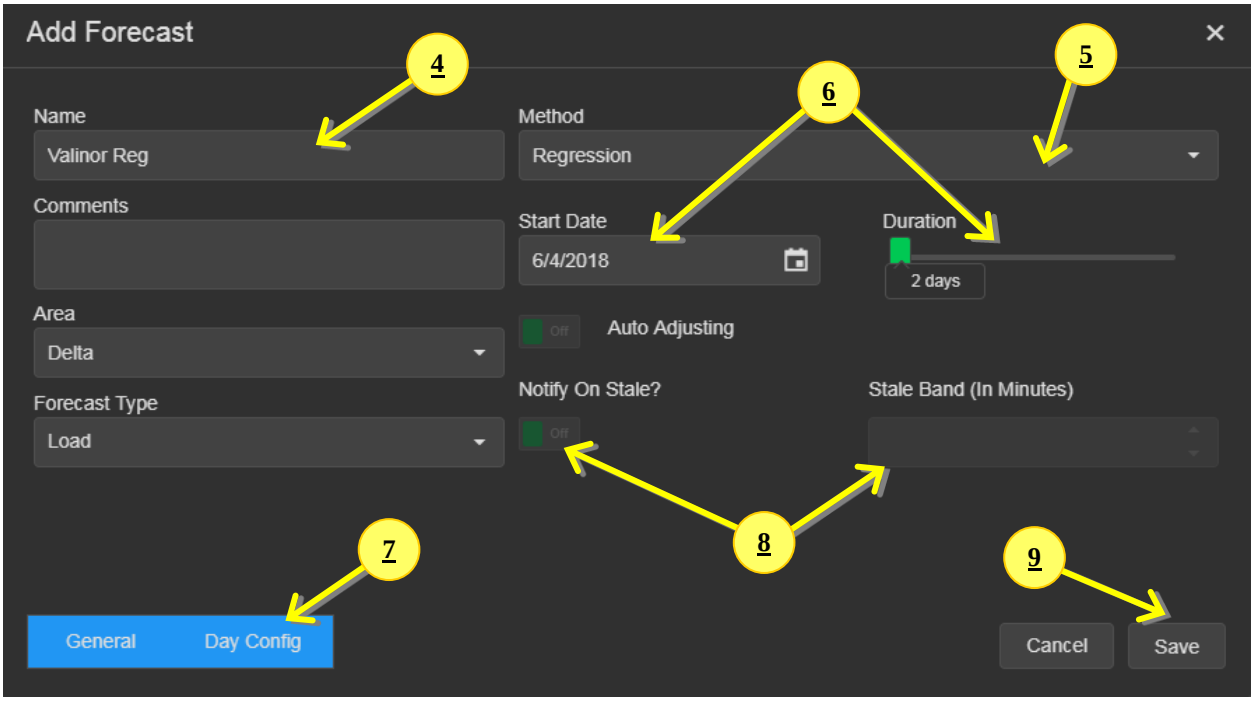
6.2 Creating a Forecast

1. Select **Forecasts → Forecasts** from the navigation bar.
2. Select the area you want to create the forecast for.
3. Click the plus button in the summary panel.
4. In the Add Forecast dialog, enter a descriptive name for the forecast.
5. Set **Method** to the forecasting methodology you want to use for this forecast. See Section 1.1.3 for a description of the available methods.

NOTE

You must train the Neural Network model before using the Neural Net method.

6. Select a start date and duration for the forecast. The maximum duration is 35 days. You can choose past dates if you would like to review how accurate your forecasting methods have been.
7. If the forecast type is Load and you are using the Regression method, you can configure how **Forecast** groups the days of the week in the **Day Config** tab.
8. If you would like to be notified whether a forecast has not been run for a set period of time, turn on the **Notify On Stale** option and set **Stale Band** to the time (in minutes). For instance, set **Stale Band** to **120** for **Forecast** to notify if it has not run for two hours.
9. Click **Save**.



NOTE

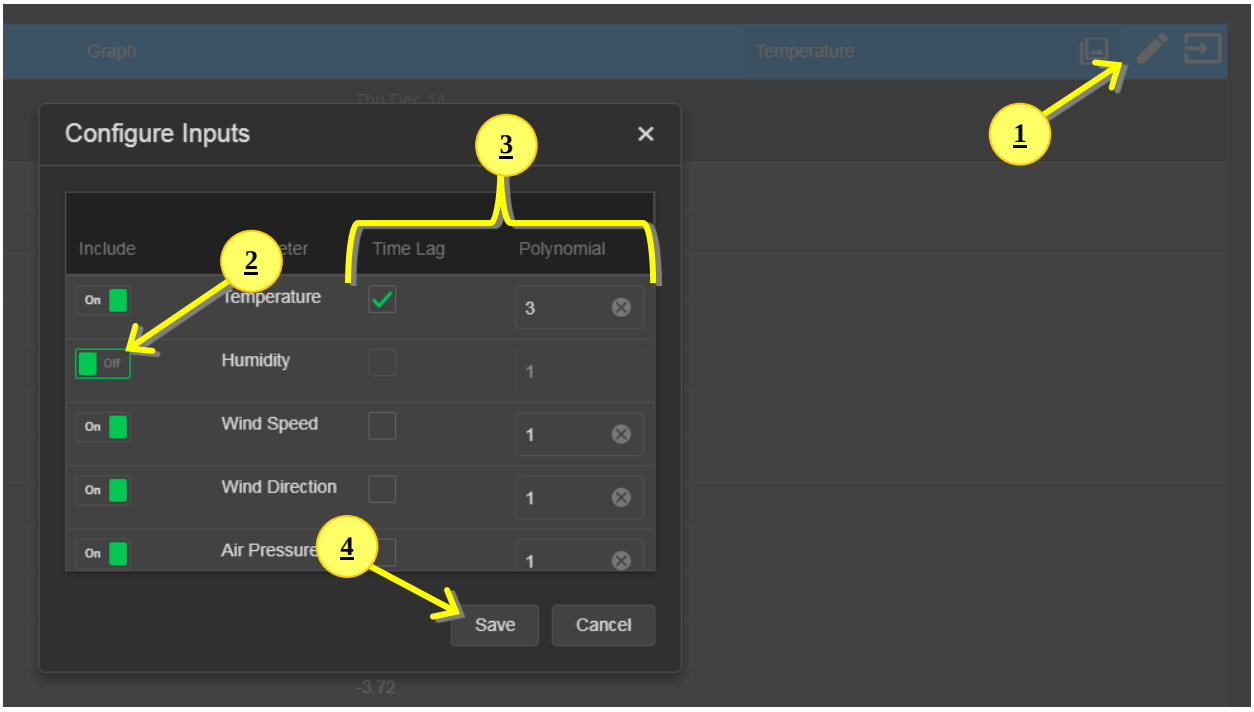
The **Auto Adjusting** flag can only be turned on after the forecast has been run at least once.

Additional Options for Regression Forecasts

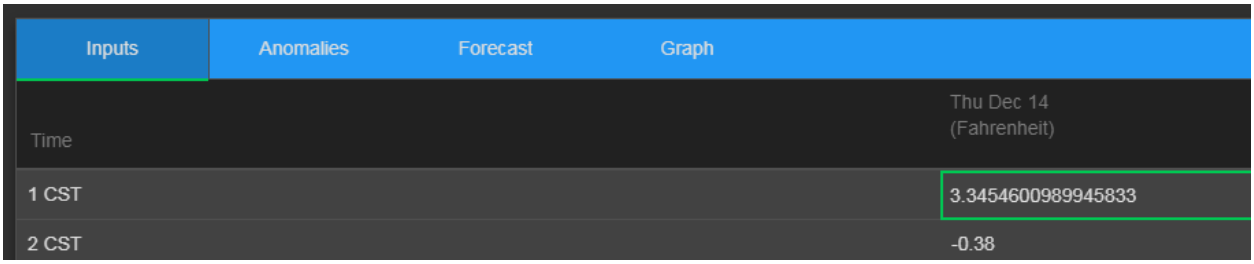
For regression forecasts, you can choose which weather parameters you want to include.

1. Click the pencil icon in the header of the lower panel.
2. In the Configure Inputs dialog, turn off the flags for each weather parameter you want to exclude from the forecast.
3. You can also configure what kind of model you want to use for translating the weather parameter into load. Generally, if you believe the relationship between the weather and the load is more than just a strict linear term, you should consider the higher order polynomial type. If you believe the change from past values impacts the load, you should include time lags.
4. Click **Save**.

TIP If using temperature, OSI recommends setting up the temperature weather parameter with a polynomial degree of 3 and using time-lagged deltas as part of the load model.



You can also modify the input values for each weather parameter if you feel that the forecasted values are incorrect.

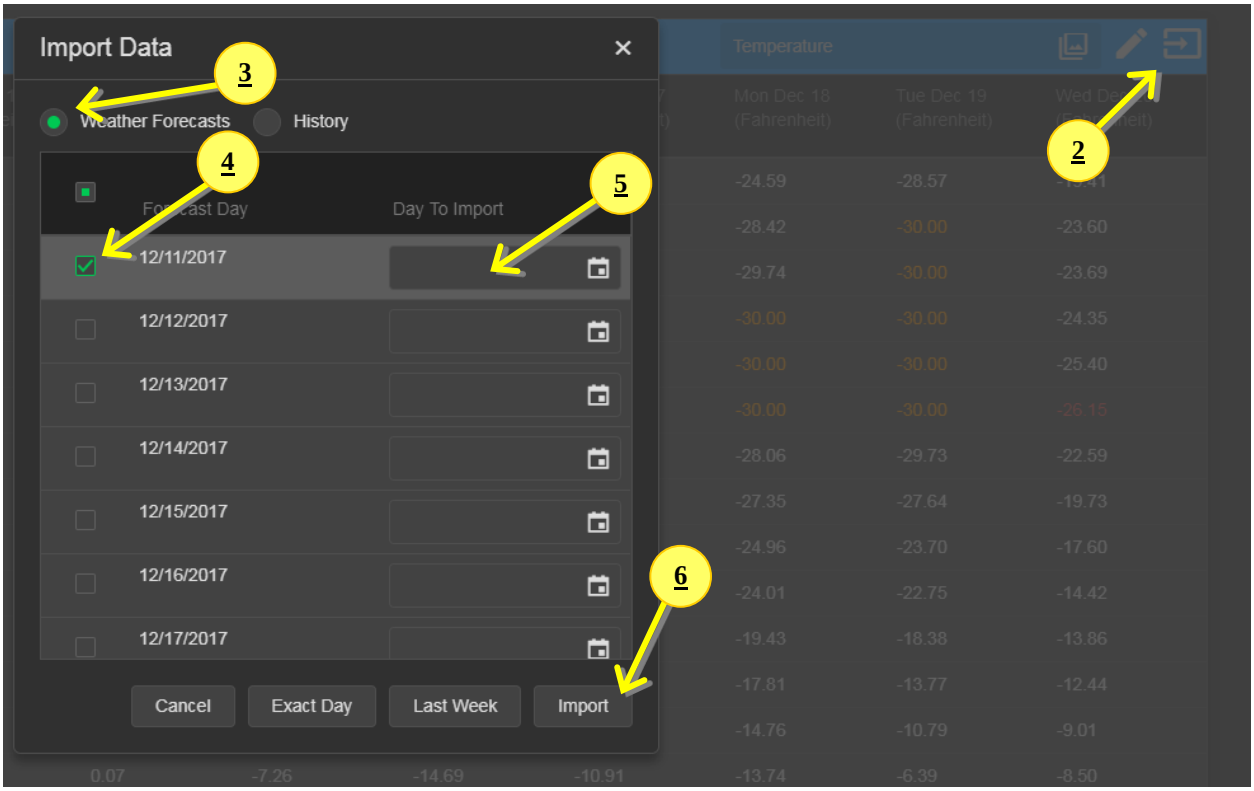


6.3 Importing Data from History

When a forecast is initially created, it is populated with weather forecast data from the dates over which it is forecasting. The import history feature allows you to re-import those days (in the case you made a change to the historical data) or import entirely different days (say last week's historical data). If you extend the forecast range, you will want to use this to grab historical data.

NOTE Auto-adjusting forecasts always pull data from the corresponding historical day's data, so in this way they have an "auto-import" feature.

1. Select the forecast you want to import data for from the list.
2. Click the **Import from History** button in the header of the lower panel.
3. Choose which collection to import data from, History or Weather Forecasts.
4. Check the boxes next to the forecast dates whose data you want to update.
5. Click the **Day to Import** field to select the date with the data you want to use. Alternatively, you can click the **Exact Day** or **Last Week** buttons to fill in the fields automatically.
6. Click **Import**. The values shown in the lower panel will update to reflect the new data.

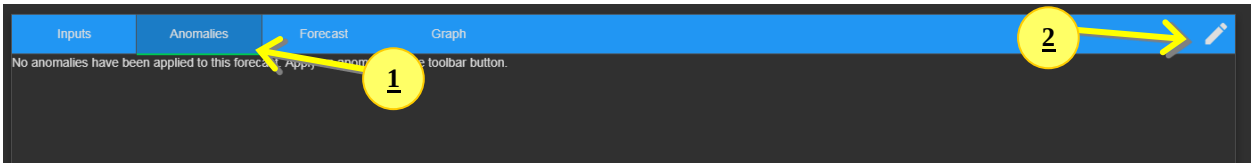


6.4 Assigning an Anomaly to a Forecast

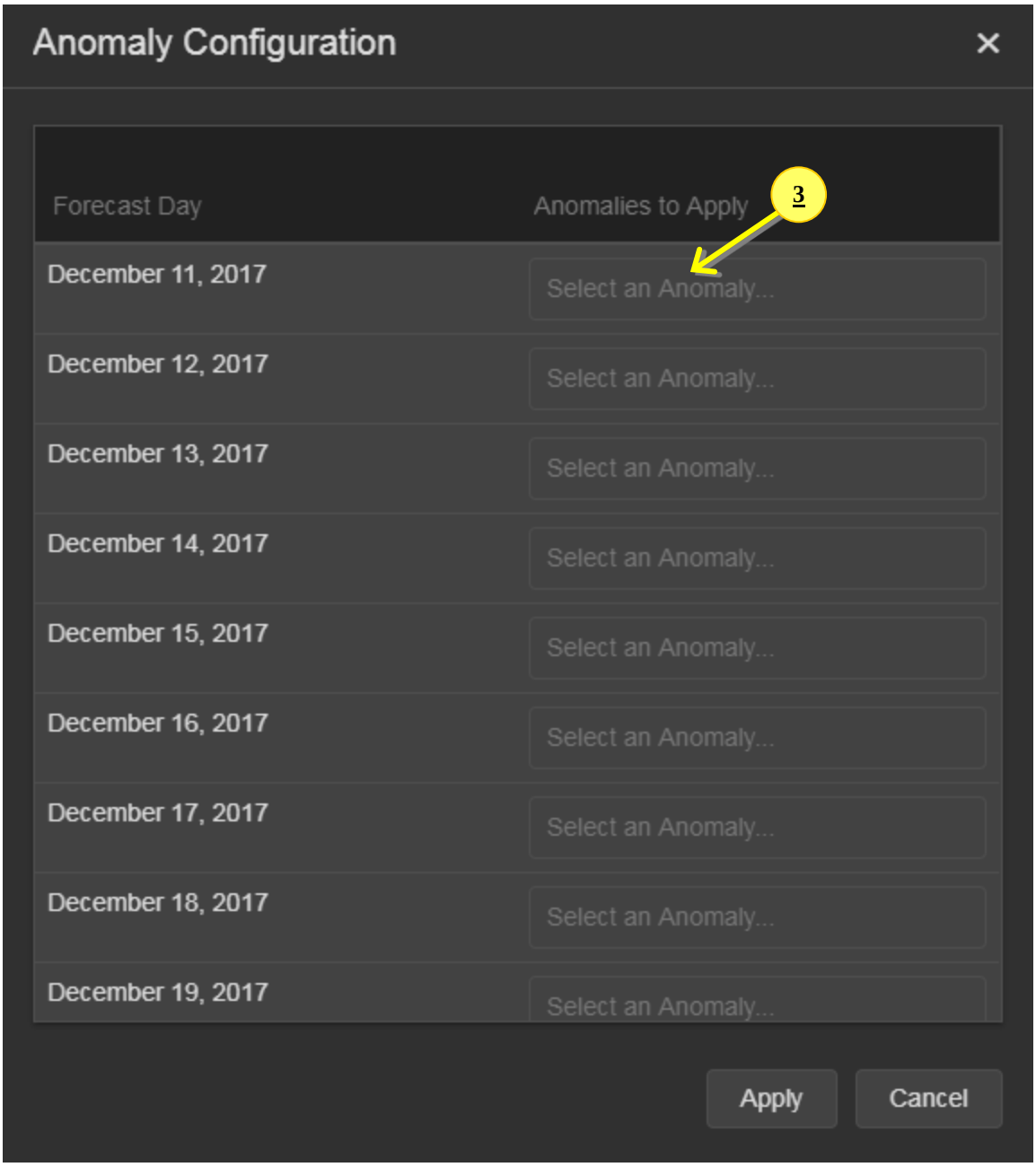
An anomaly is a non-conforming load that appears occasionally and changes (increases or decreases) the usual load demand abruptly. For example, if a special event, such as a convention occurs, load may increase drastically. For

this reason, **Forecast** enables you to assign an anomaly to a forecast. See the *Forecast Configuration Guide* for information on configuring an anomaly in the system.

1. Select **Anomalies** from the lower panel header.
2. Click the pencil icon.



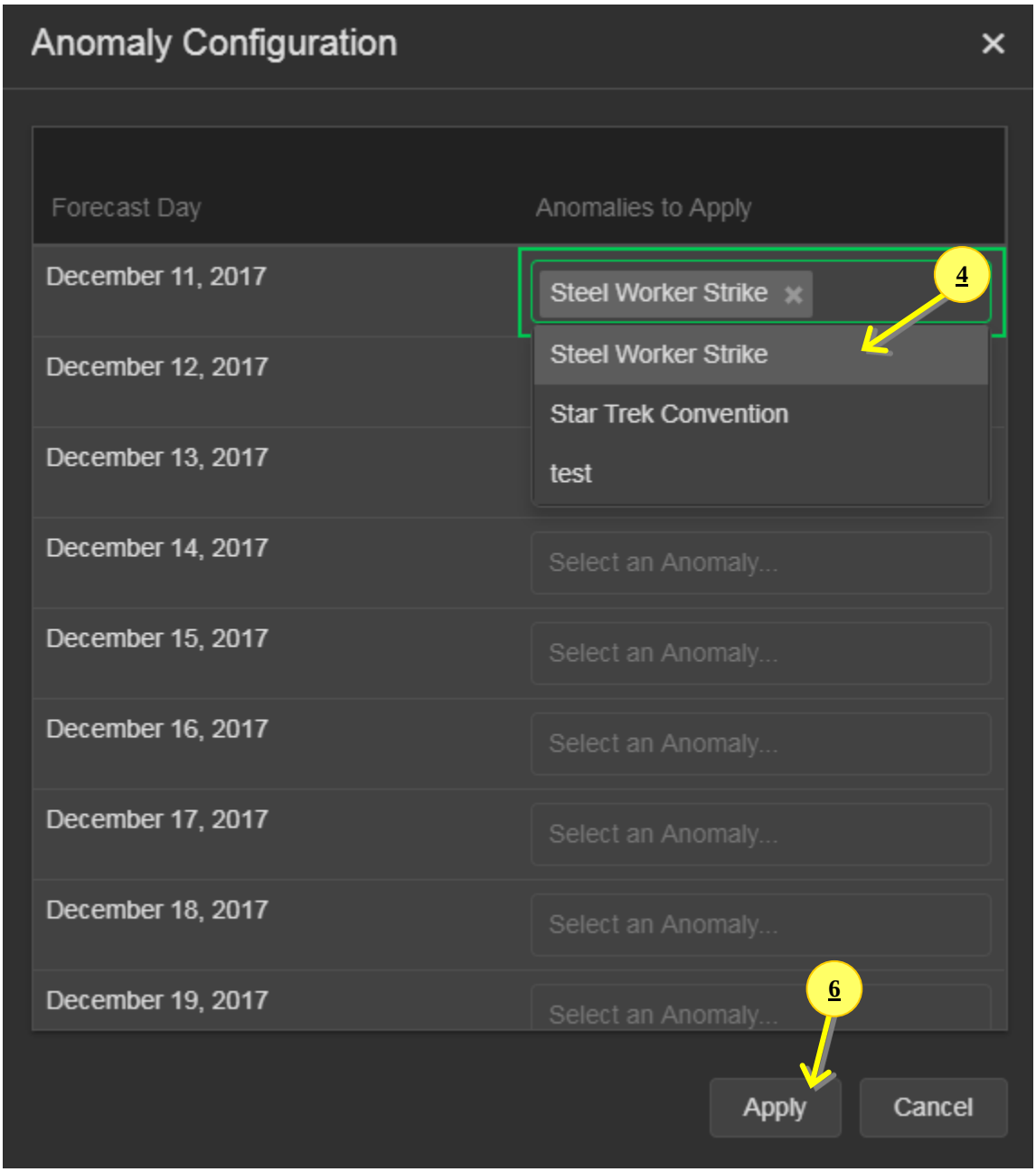
3. In the Anomaly Configuration dialog, click in the field for the date you want to apply the anomalies to.



4. Check the anomaly you want to apply to this forecast day. Multiple anomalies can be selected and assigned to this forecast day by repeating Step 3.

5. Repeat Steps 3-4 for each date that will be affected by the anomaly.

6. Click **Apply** on the Apply Anomaly box.

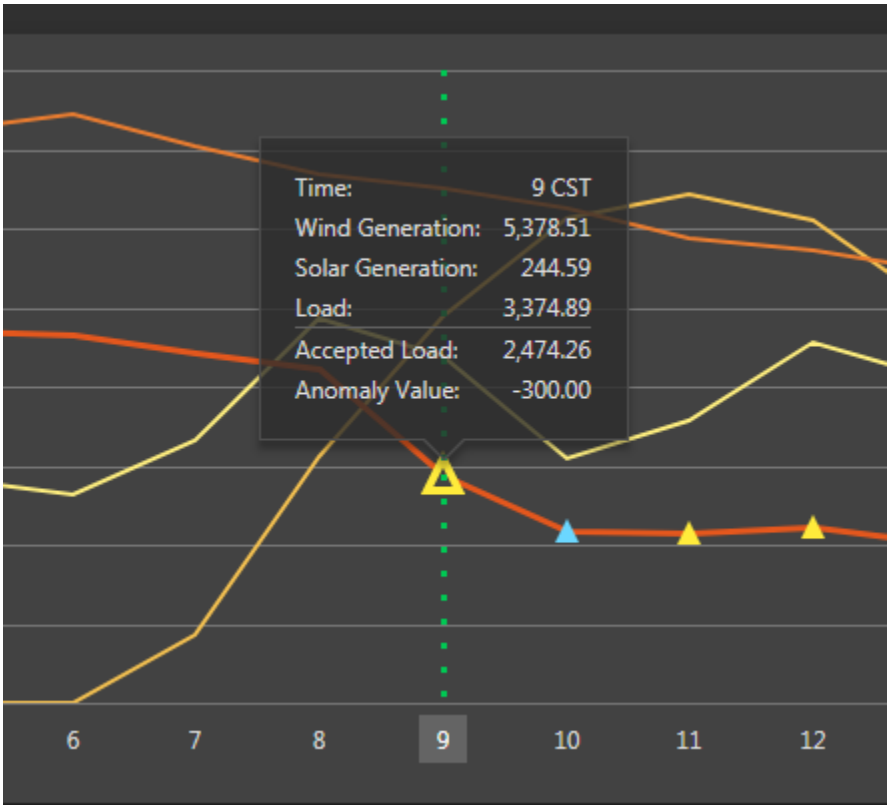


The data in the Anomalies section will update to reflect the increase or decrease in load, as configured by the applied anomaly. Yellow triangles will appear where there is data affected by an anomaly.

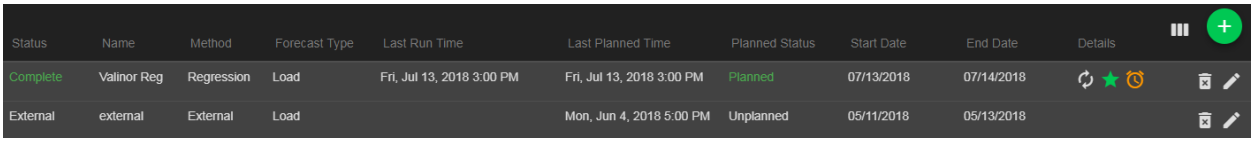
Column Headers and Interval Data on Analysis Page

Load	Accepted Load
3,493.91	2,884.72
3,562.05	2,926.00
3,611.38	2,912.55
3,506.44	2,857.17
3,421.62	2,808.31
3,374.89	2,474.26
3,312.80	2,293.68
3,221.38	2,290.76
3,178.85	2,308.15

Graph View on Analysis Page

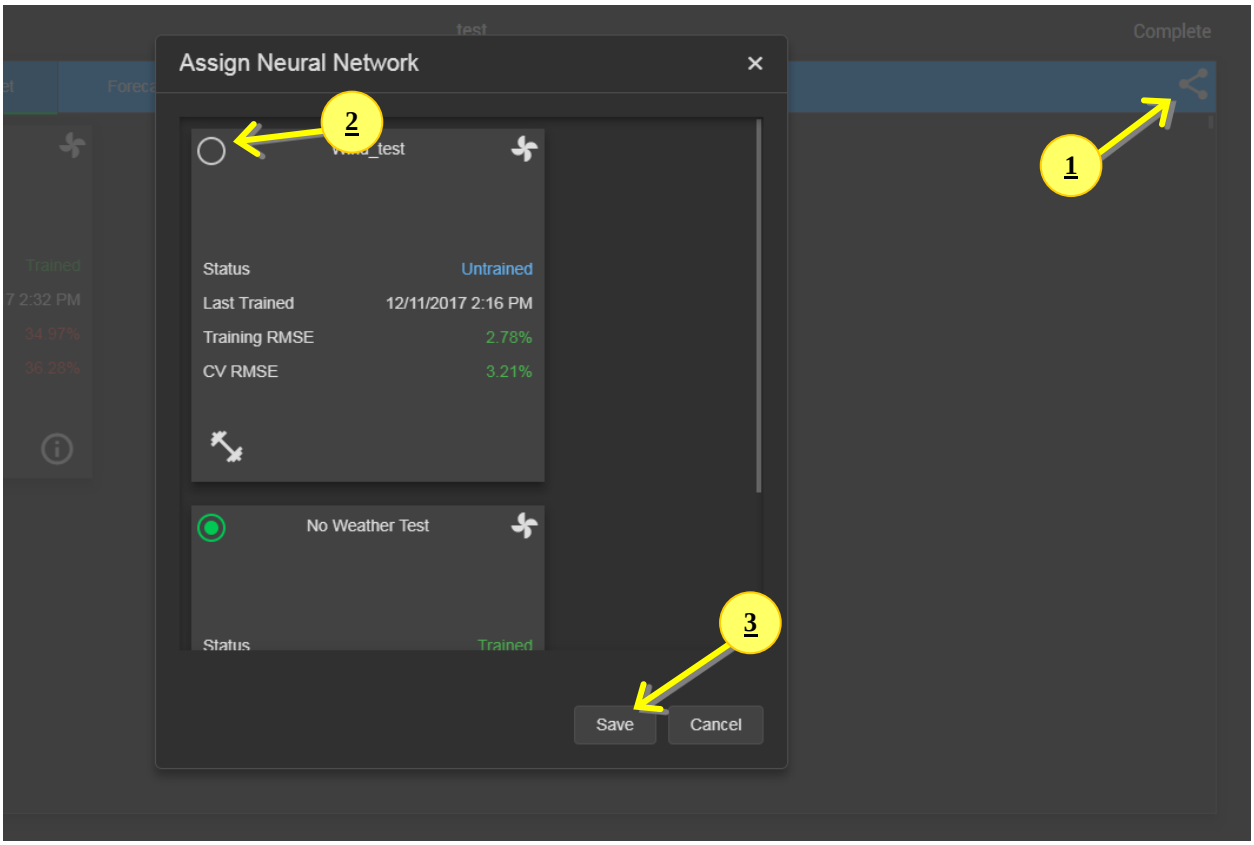


Details Column on Forecasts Page



6.5 Assigning a Neural Network to a Forecast

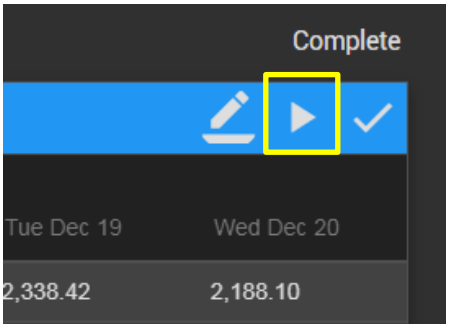
1. To assign a neural network to a forecast, select the **Neural Net** option from the header of the lower panel and click the **Assign** button.
2. Use the radio button in the upper left of the card to select the network you want to use.
3. Click **Save** to save the changes.



NOTE You must have a trained neural network assigned to the forecast before you can use the neural net algorithm.

6.6 Running a Forecast

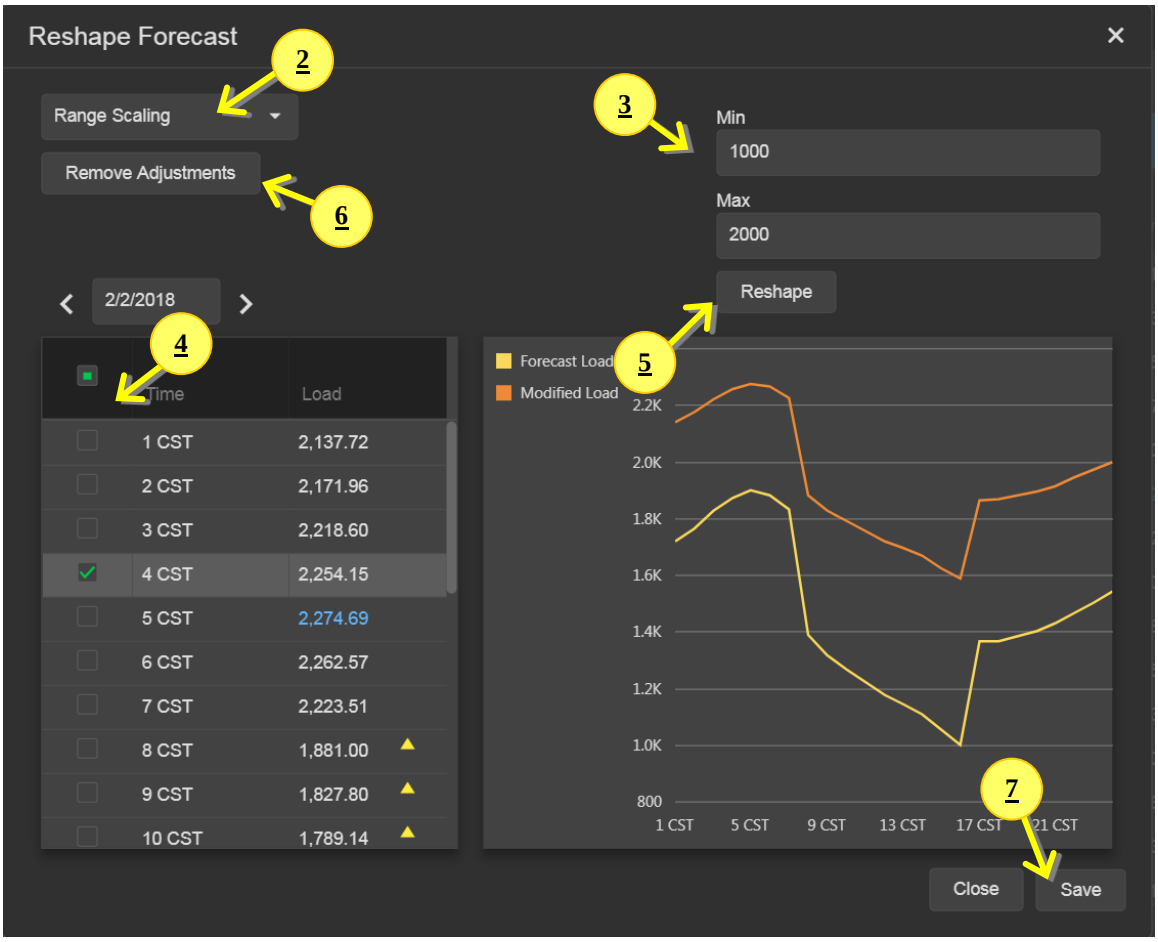
To run a forecast, select the **Forecast** option from the header of the lower panel and click the play button.



6.7 Reshaping a Forecast

Reshaping a forecast allows you to modify multiple intervals at the same time using one of the methods listed below. These methods offer convenient functions for the most common adjustments to a forecast.

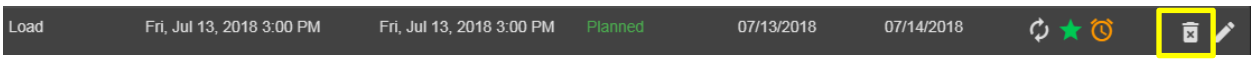
1. To reshape a forecast, click on the forecast then navigate to the **Forecast** tab and select the **Reshape** button.
2. Select a method from the list of reshape methods the options are.
    - Bias Offset – Shifts the selected intervals by the specified amount
    - Scaling Factor – Scales the selected intervals by the specified percentage
    - New Peak-Offset – Shifts the selected intervals so the maximum value is at the specified amount
    - New Peak-Scaling – Scales the selected intervals so the maximum value is at the specified amount
    - Range Scaling – Scales the selected intervals so the maximum and minimum values line up with the specified values
    - Load Factor Scaling – Scales the average value to the specified percentage of the maximum value
3. Enter the required values (value or percent or maximum and minimum) for the chosen reshape method.
4. Select every interval you would like the reshape to be applied to.
5. Click **Reshape**.
6. To clear out any modifications to a value that have been made select the corresponding interval and select **Remove Adjustments**.
7. Click the **Save** button after all changes have been finalized.



Yellow triangles will appear where there is data affected by reshaping.

6.8 Deleting a Forecast

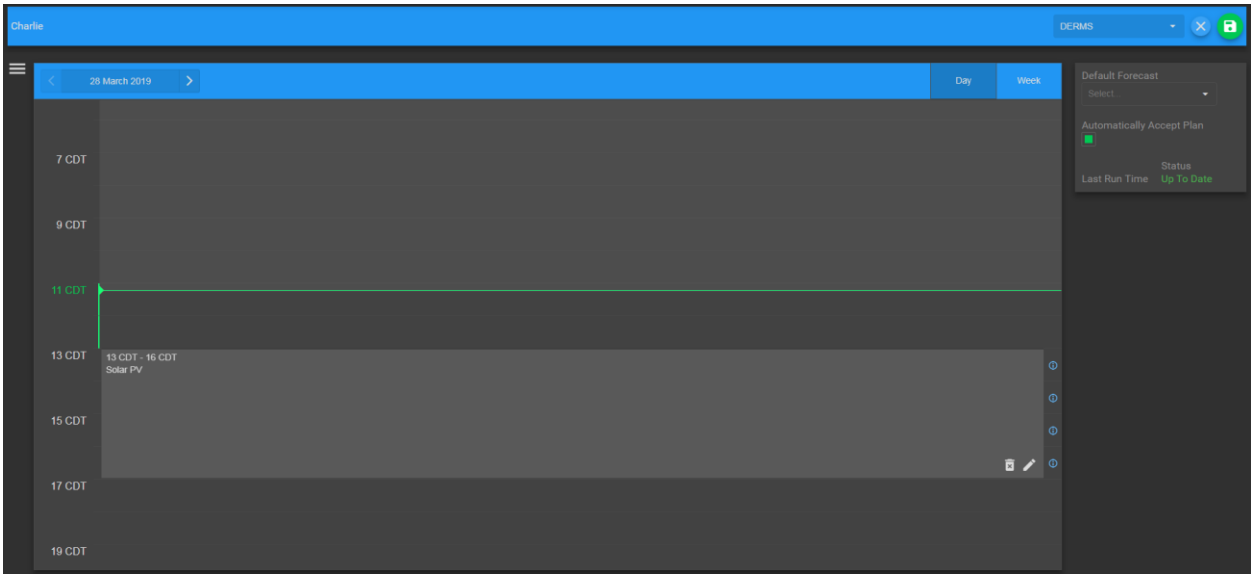
To remove a forecast from an area, click the trash can icon next to the forecast and confirm the delete action.



Chapter 7 Plan Schedules

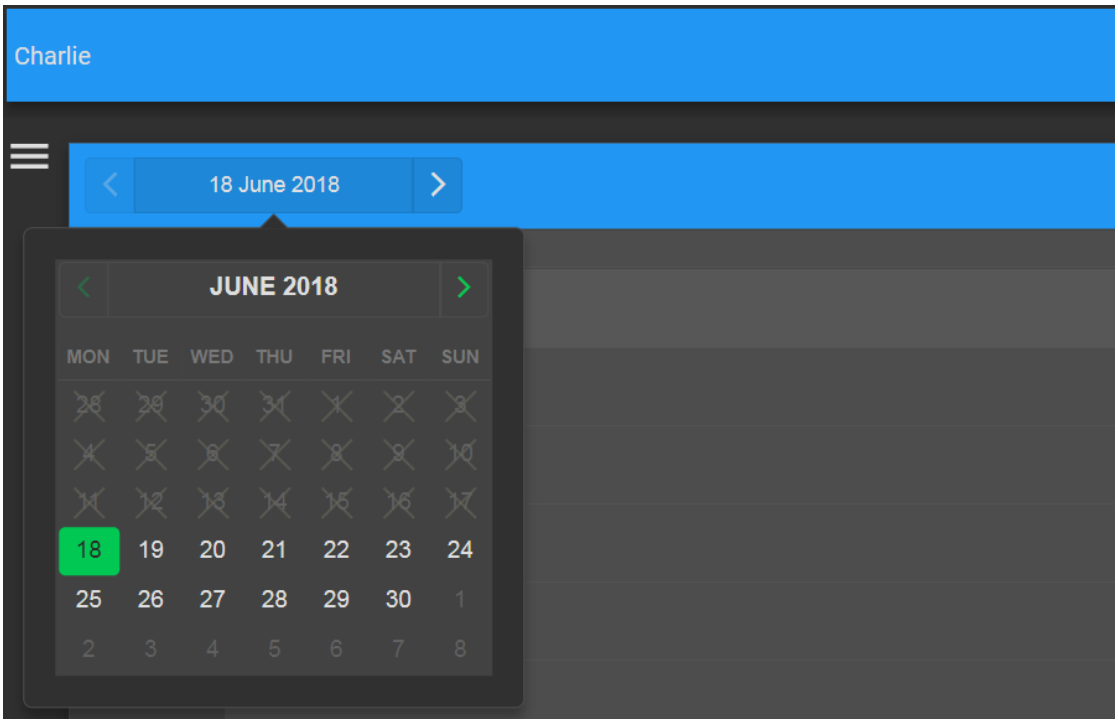
7.1 Plan Schedules

Select **Forecast → Plan Schedules** from the navigation bar. Here, you can create a planned forecast schedules at different points in time. The page provides a calendar for easy viewing of the schedule for planned forecasts and provides a default forecast for auto adjusting forecasts.

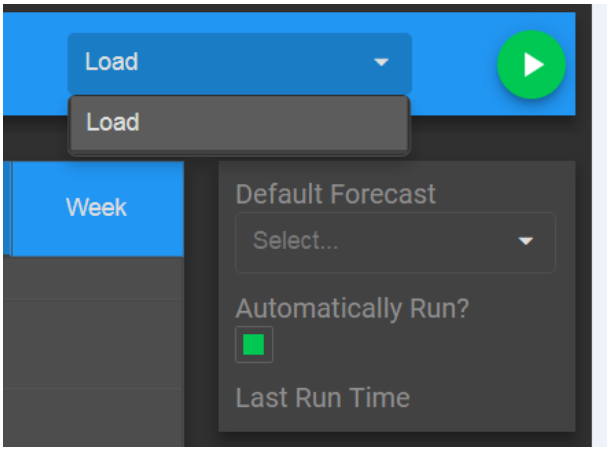


7.2 Viewing Planned Forecasts

You can select the date you want to view planned forecasts schedule for using the date and arrows in the upper left corner. Additionally, you can switch between a day view and a week view. Clicking the date will bring up a calendar that lets you choose a specific date. The arrow buttons will move you forward or backward one day at a time.



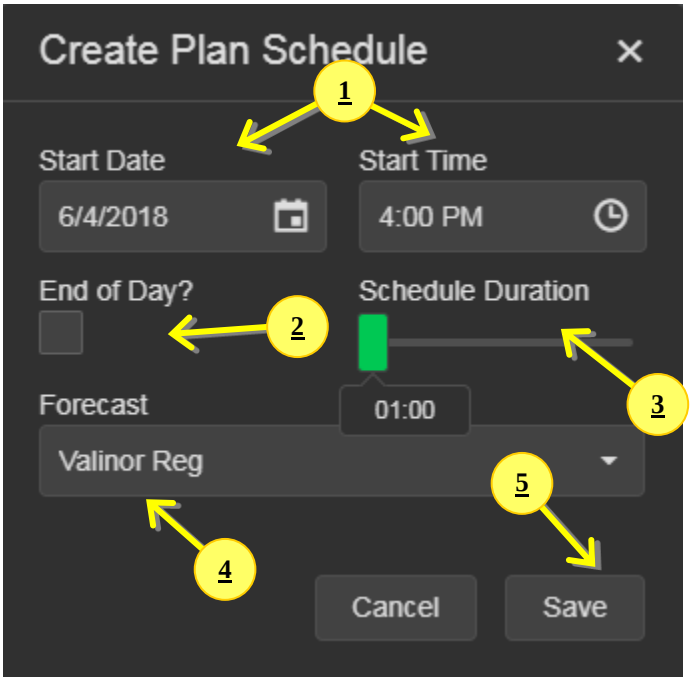
There is a drop-down menu in the upper right of the screen to switch the currently visible forecasting type.



7.3 Scheduling a Forecast to be Planned

1. To schedule a forecast at a point in time on the calendar, double-click on the time you would like to schedule. This will bring up a configuration dialog. The Start Date and Time will be populated with the information for the day/time you double-clicked on.
2. Check the **End of Day** box if you would like to automatically schedule the forecast to run at the end of the current day.
3. Set **Schedule Duration** to how long the forecast should run for.
4. Set **Forecast** to the forecast you would like to run as part of this plan schedule.

5. Click **Save** to schedule the forecast.



To save all changes made to a plan schedule, click on the **Save** button in the upper right corner. It will re-appear if changes are made.

NOTE If you need to edit an existing schedule, simply double-click on it.

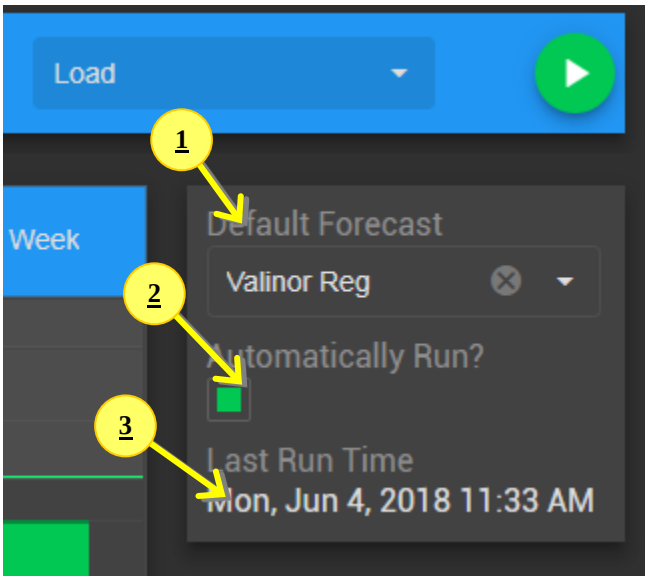
7.4 Deleting a Scheduled Forecast

To delete a schedule forecast, click on the entry and press the <Delete> key.

7.5 Running a Plan Schedule

Plan schedules will automatically run at the top of each interval. To manually run a plan schedule before this, click on the **Run** button at the top right of the screen. There is a details panel to the right of the schedule list that shows details about the Plan Schedule. This includes:

1. **Default Forecast** – The forecast that is planned when nothing else is planned
2. **Automatically Run** – Shows if the Plan Schedule should run whenever a planned forecast is run
3. **Last Run Time** – The last time the Plan Schedule was run


Load
1
Week
Default Forecast
Valinor Reg
2
Automatically Run?
3
Last Run Time
Mon, Jun 4, 2018 11:33 AM

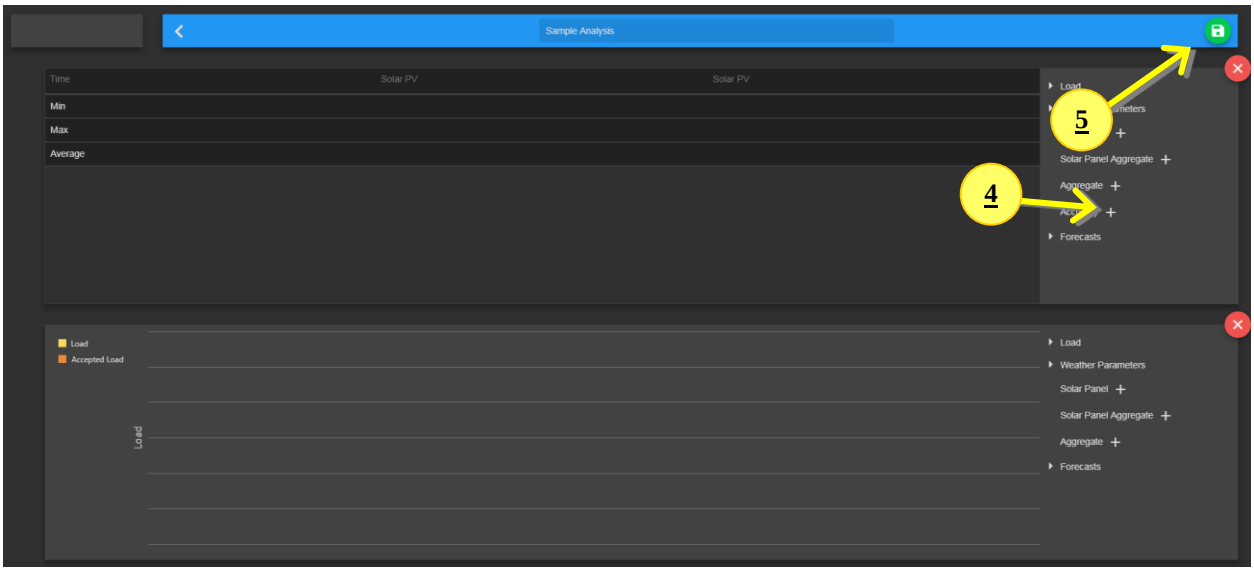
8.1 Forecast Analysis

Select **Forecasts → Analysis** from the navigation bar. Here you can compare the forecast plan results, individual forecasts, historical data, snapshots and computed values of forecast including accuracy and aggregates. The accuracy of a forecast can be compared against historical data and the corresponding errors will be presented as percentages.

You can select the date you want to view data for using the date and arrows in the upper right corner of a created view. Clicking the calendar icon next to the date will jump to the current day. Clicking the date will bring up a calendar that lets you choose a specific date. The arrow buttons will move you forward or backward one day at a time.

8.2 Creating an Analysis View

1. Select **Forecasts → Analysis** from the navigation bar and navigate to an area you would like to create a view in. Click the plus icon in the summary pane to create a new view.
2. Enter a descriptive name for the view in the top bar.
3. Drag grid or gadget widgets from the left side toolbar onto the working area to use the widget. These allow you to view historical or future forecast data inside the analysis view.
4. Click the plus next to a field in the list on the right add the field to the widget.
5. Click on the green save icon to save the view.



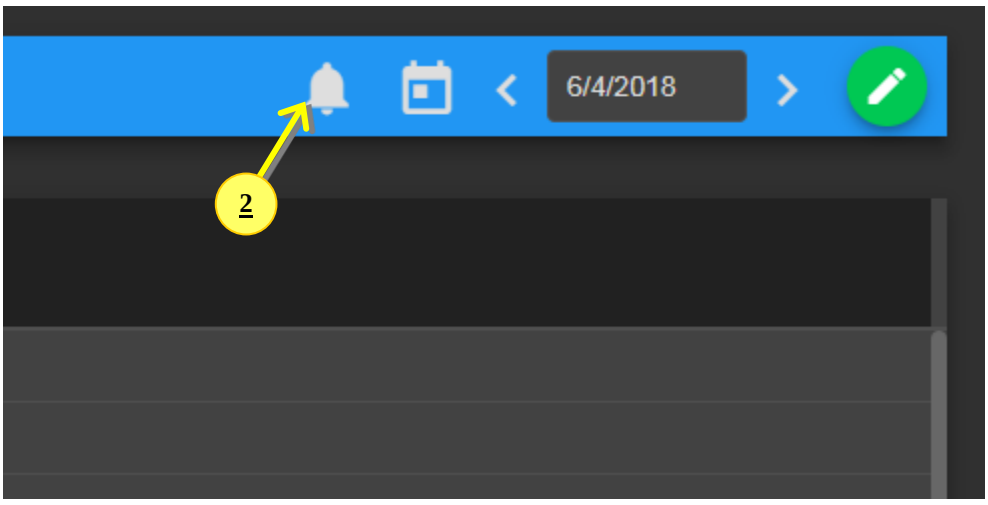
To delete a field from a widget, right-click on the widget, choose the **Delete Series** option and then choose the field you would like to delete.

To delete a widget, click the red x in the upper right corner of the widget. After a widget has been deleted it will retain the information it contains if it is added back in.

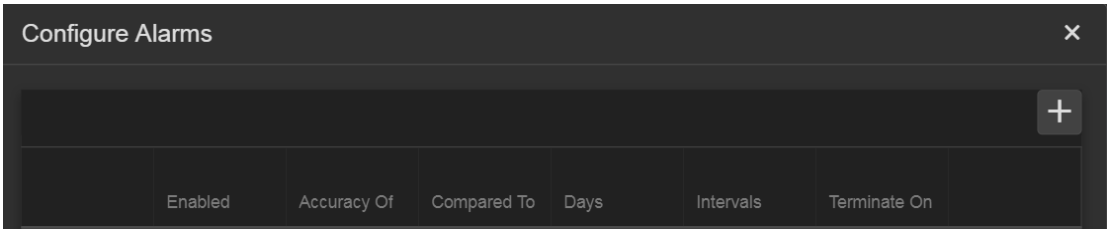
8.3 Configuring Analysis View Alarms

Analysis view alarms are used to notify you when two similar forecasts have difference between the values that are more than a specified amount.

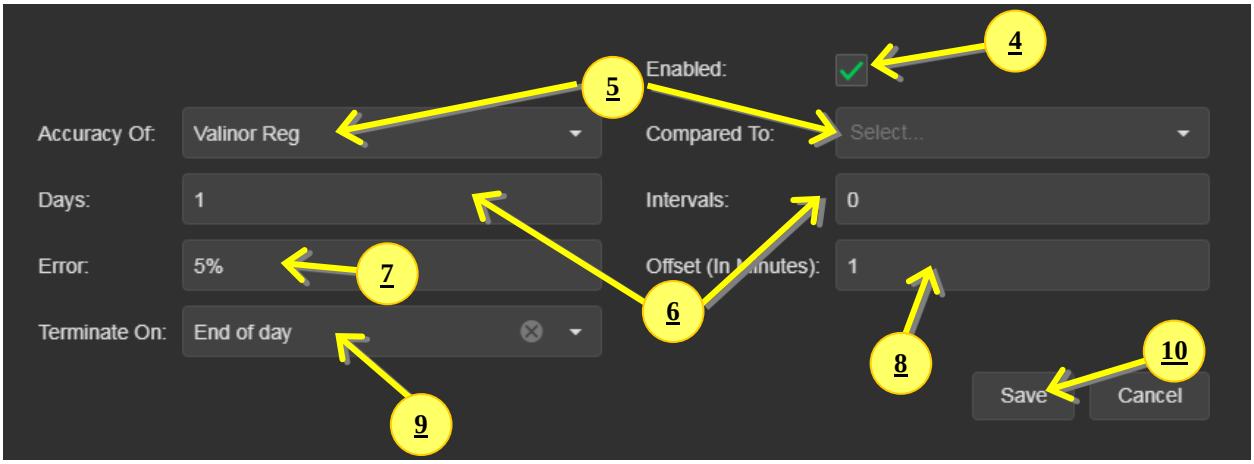
1. Select **Forecasts → Analysis** from the navigation bar and navigate to the area of an analysis view you would like to create an alarm for. Click on the view to open it.
2. Click on the **Bell** icon to configure alarms for the analysis view.



3. To create a new alarm click on the **Plus** icon in the upper right of the screen.

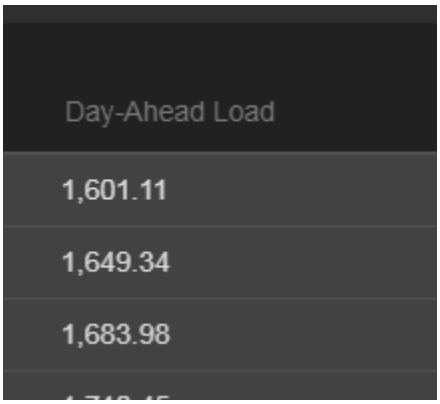


4. Check the **Enabled** box to activate this analysis alarm.
5. Set which fields in the view will be compared in the **Accuracy Of** and **Compared To** fields.
6. Determine how far into the future to check with the **Days** field and the **Intervals** field. The values will be added together. Days will additionally take into account Daylight Saving Time.
7. Set **Error** to the percentage that the values of the specified fields must differ by to generate the alarm.
8. Set **Offset** to the number of minutes to wait after the start of the interval before checking the values.
9. Set **Terminate On** to **End of Day** to cause the check to terminate at the given condition with allowed values included. For example, if the check is set for two days and the check starts halfway on the first day, the check will go for a day and a half.
10. Click **Save**.



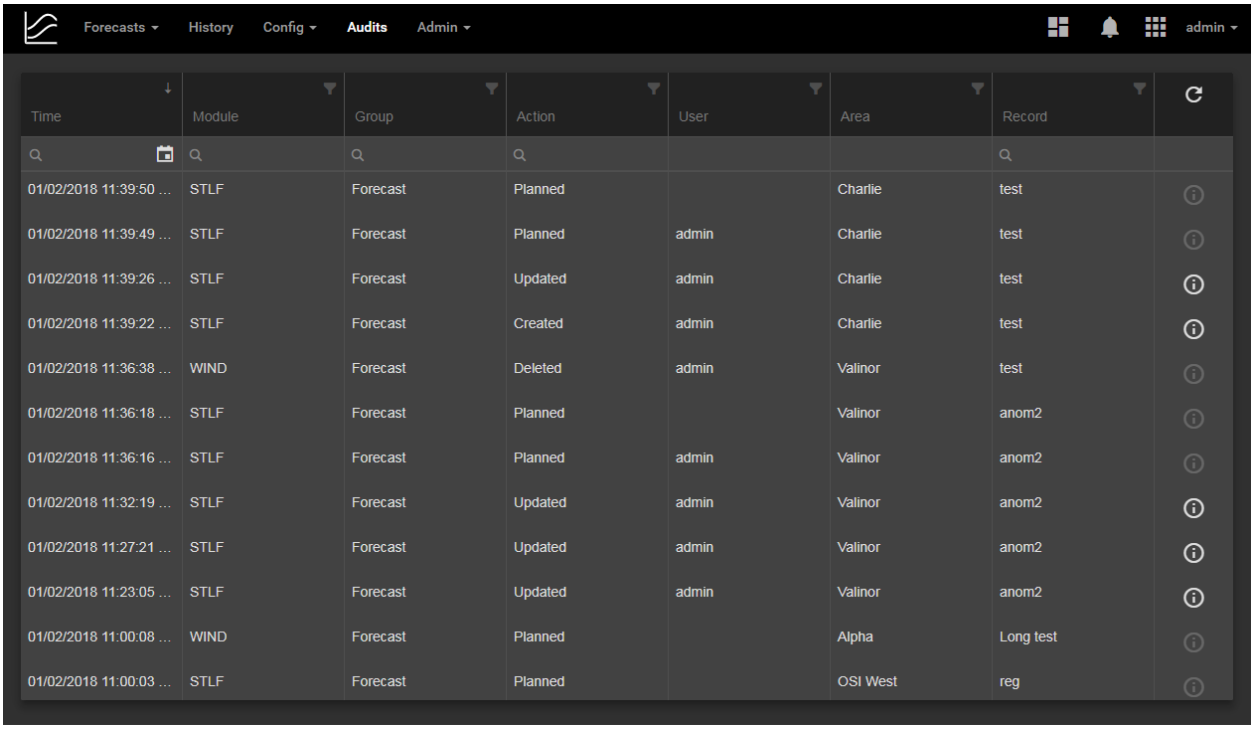
8.4 Snapshot Data

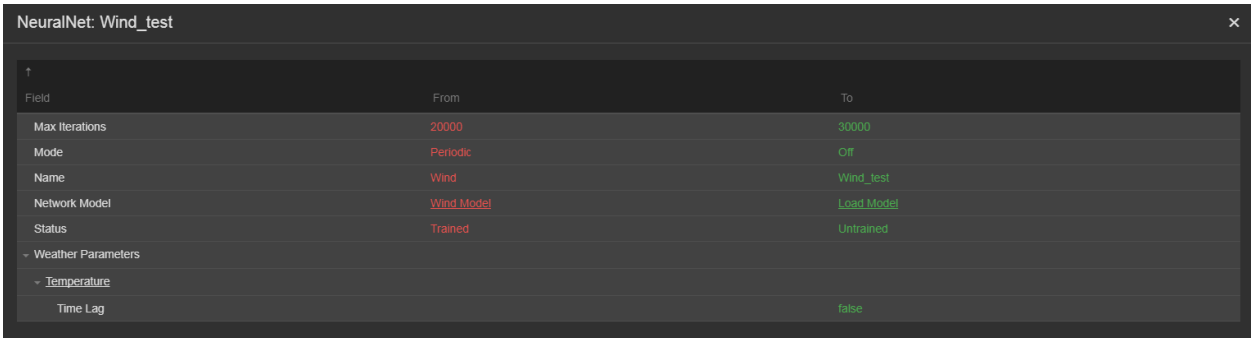
You can configure the system so that areas with accepted forecast plans have their values saved off at defined times. This keeps that data separate from the continuously updating load plan values and allows you to see what the forecast values and accuracy percentages were at the start of the day or week. See the *Forecast Configuration Guide* for more details on configuring day-ahead and week-ahead snapshots.


Day-Ahead Load
1,601.11
1,649.34
1,683.98

9.1 Viewing Audit Information

The Audit display allows you to filter and view changes made to forecast data and historical data. To view this display, select **Audits** from the navigation bar.





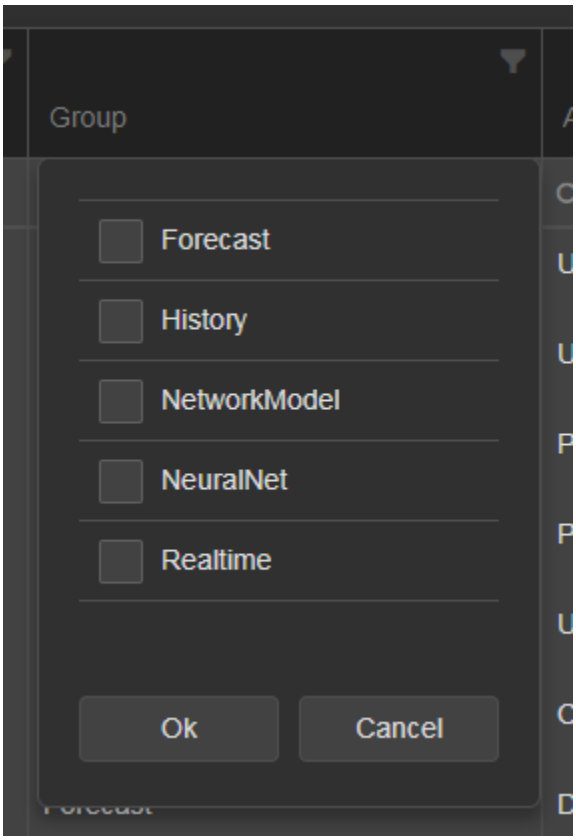
The following information is provided for each entry:

Field	Description
Time	Shows the date and time an change was made to the system (created, deleted or updated)
Module	Shows the module that was selected (Wind, STLF, SOLAR, DERMS)
Group	Shows the type of data that was changed (History, Profile, Forecast, and so on)

Field	Description
Action	Shows what action was performed on the data (Accepted, Created, Deleted or Updated)
User	Shows the name of the user who made the change
Area	Shows the name of the area that the data modified exists in
Record	(Forecasts only) Shows the name of the forecast that was modified
	Shows what was changed by the action.

9.2 Filtering Audit Data

To filter the data by a certain column, click the menu icon in the header and check one or more values that you want to filter by from the list.



Revision History

Date of Change	Rev. #	Details of Change	Author	Approval
31MAR17	1.0	Initial creation	A. Bharadwaj A. Stewart	A. Halimah
08JAN18	2.0	Updates for version 2.0.0.0	G. Line	S. Agarwal
04JUN18	2.1	Adds Neural Network Training Guide and changes for version 2.1.0.0	G. Line	S. Agarwal
28MAR19	2.2	Added K-Fold Cross-Validation, added description of forecast details column, added description of details icons; updated screenshots and displays for 2.2.2.0.	A. Slepak	S. Agarwal