iVN 2022.2.0 – QUICK START GUIDE

November 2022

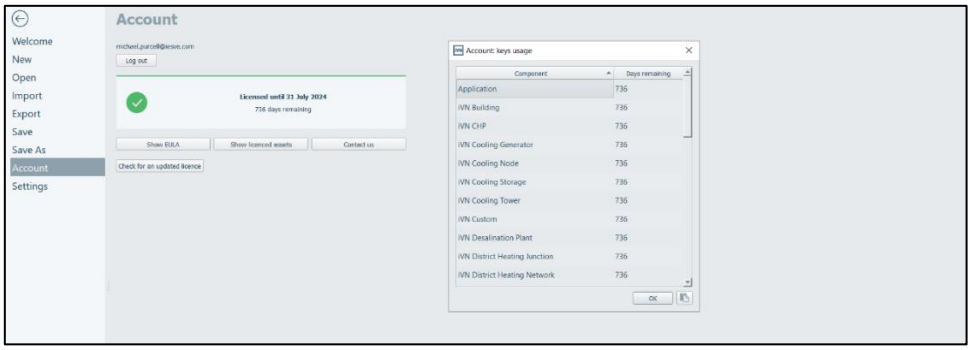
Contents

1 Set up

When creating a new account with iVN you must log in to your account to get access to the tool. This is done within the account tab on the homepage.

Log in using the email and password assigned to your account.

(For any account issues please contact sales@iesve.com)

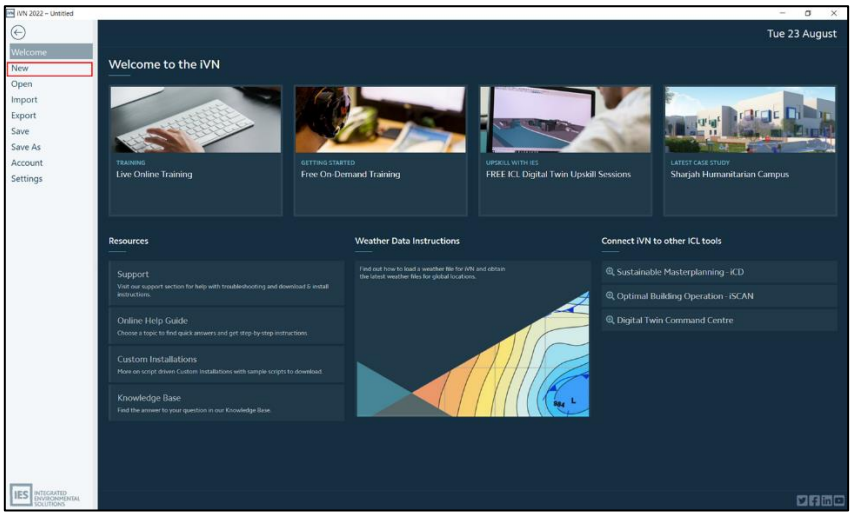


From this login page you will be informed of the active licenses associated with your account.

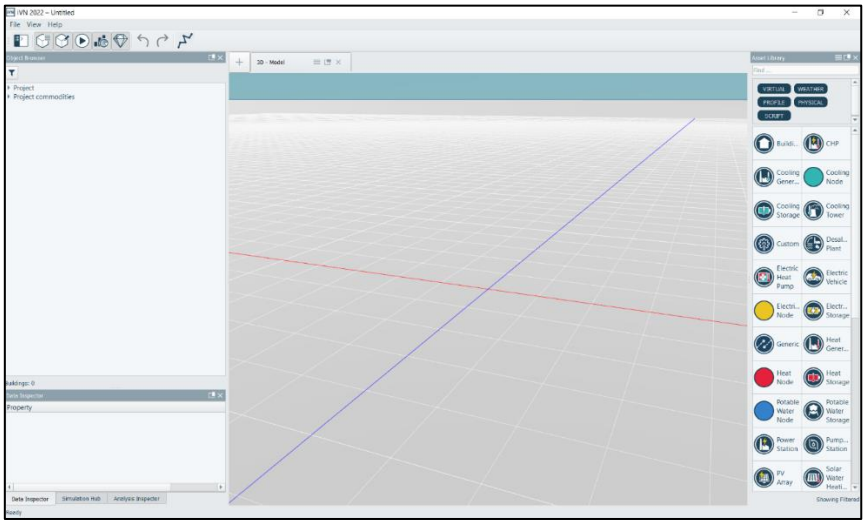
2 New Project: iVN

When opening iVN for the first time you are greeted with the iVN 'Home Page'. This Home page provides useful links to additional resources and learning material along with the most up to date version of the software (including notifications of available updates).

To begin a new project from the home page, click on the 'New' tab located on the left-hand tab column.

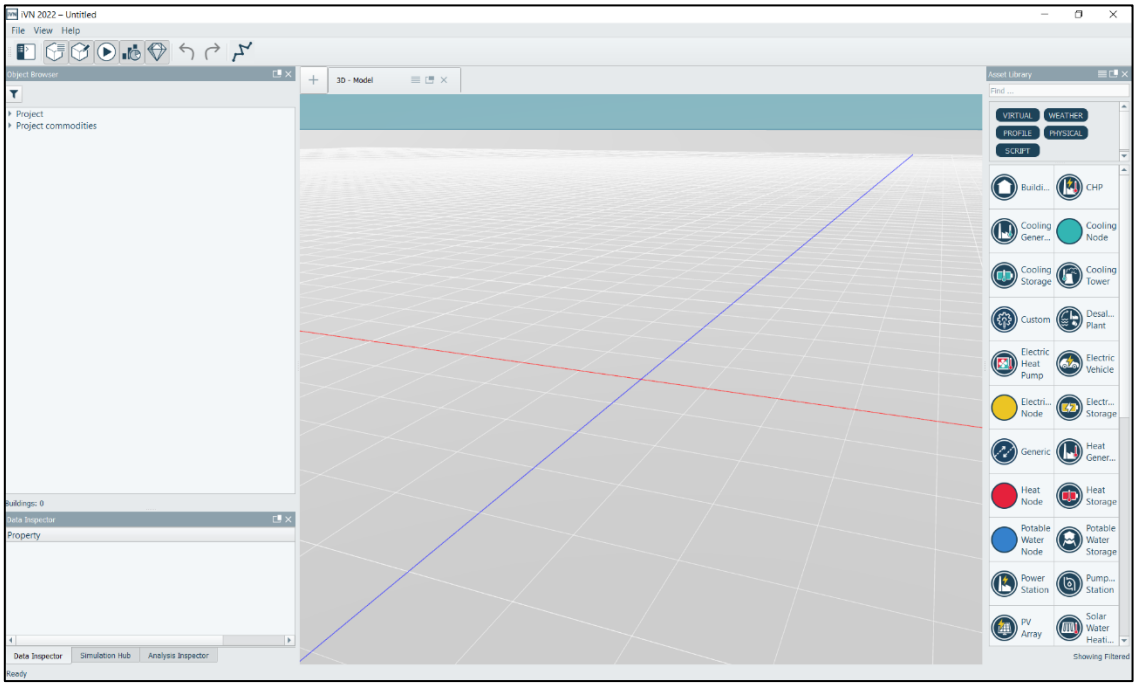


This will open a blank project from where you can start to build your network simulation. The blank project opens the three-dimensional sketching space where you can begin to physically draw or import your infrastructure required for your network set up.



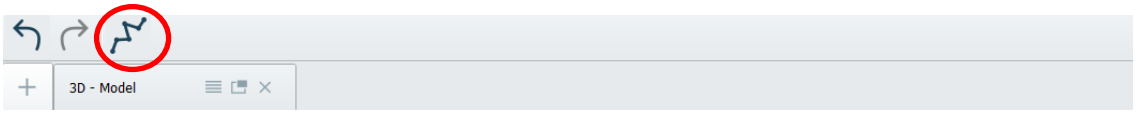
2.1 3D Model Viewer

The 3D model viewer gives you the option to draw buildings/infrastructure to use within the network simulation.

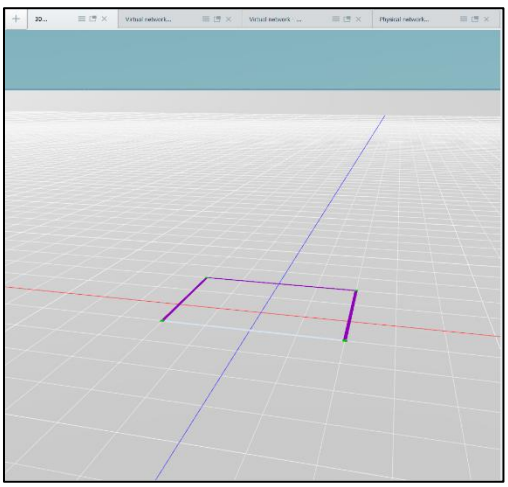


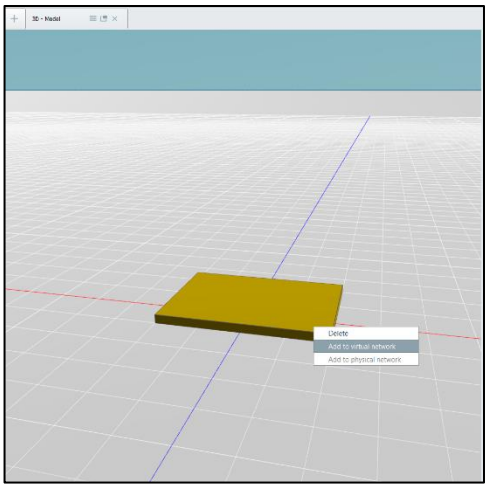
2.1.1 Draw Structures

To begin the sketch mode, select ‘Draw Line’ icon from the tool ribbon.



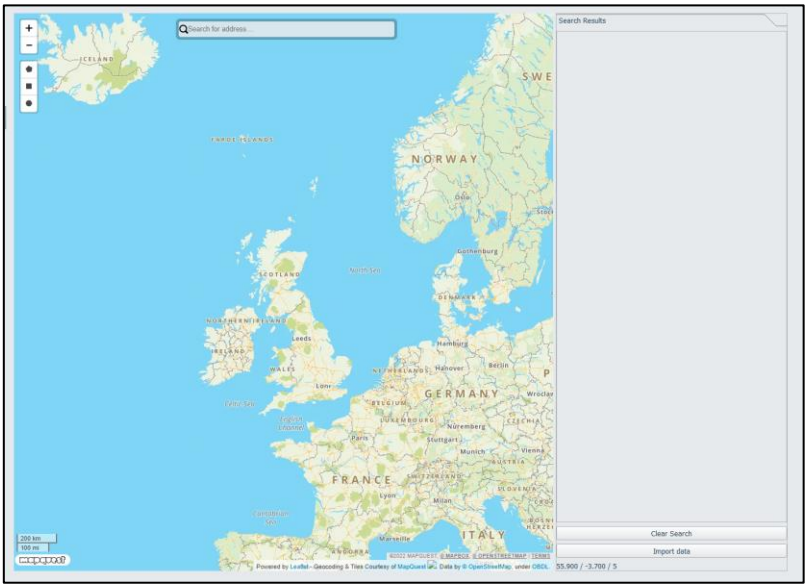
The ‘Draw Line’ tool will draw lines along the chosen plane using the specified points selected by the tool.





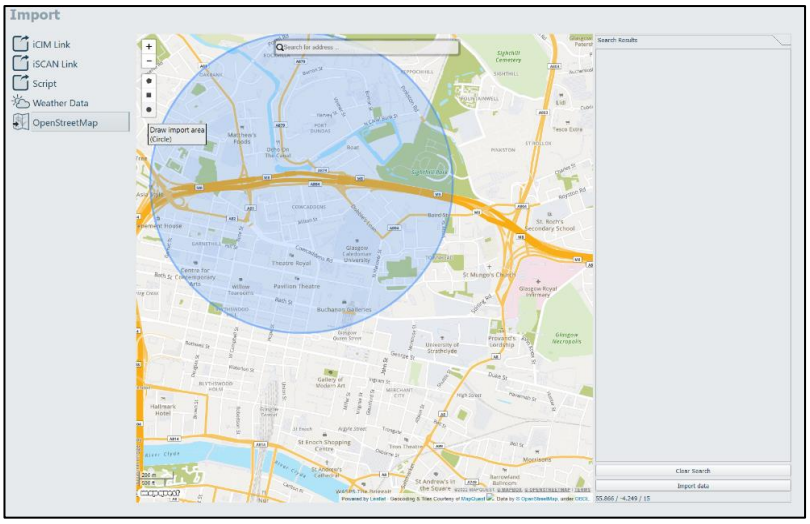
2.1.2 Import from OpenStreetMap

From the welcome screen ‘ ’ the option to import buildings from OpenStreetMap is available from the import tab.



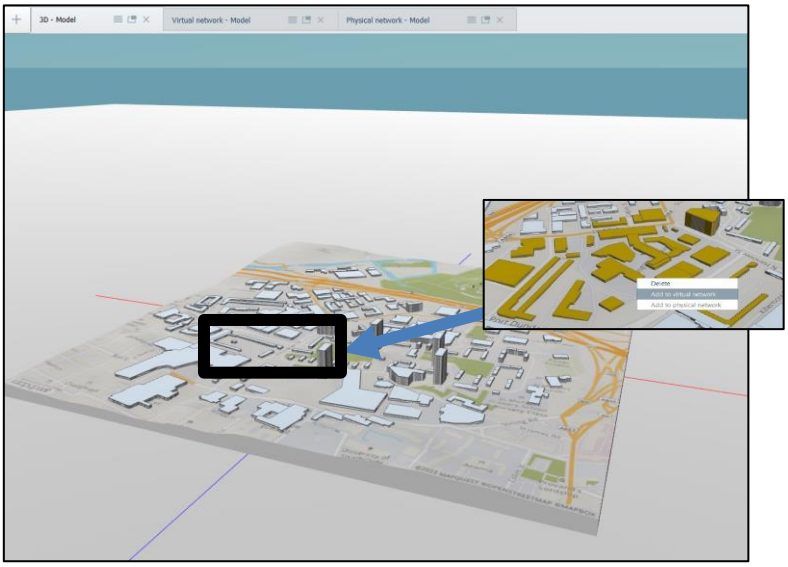
Locate the specific area you wish to import for your network using the OpenStreetMap. Highlight the desired infrastructure using the click and drag function to select the specific area to import (alternative highlighting tools are available in the left-hand corner).

Once the desired area is selected import the data by clicking ‘Import data’ in the bottom left hand corner of the tab.



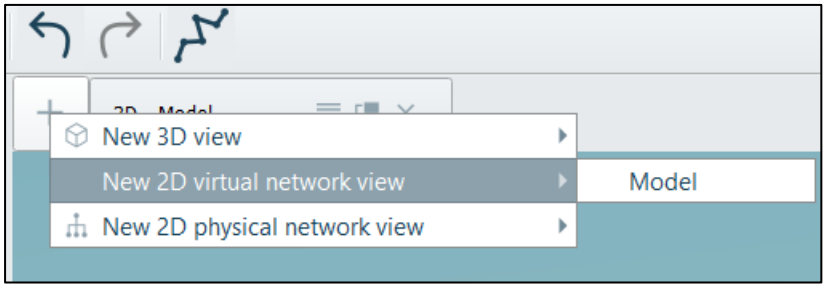
The infrastructure highlighted within the selected area will then be imported into the 3D model viewer of your project.

These buildings are now available to be added to the projects virtual network by selecting and right clicking add to virtual network.

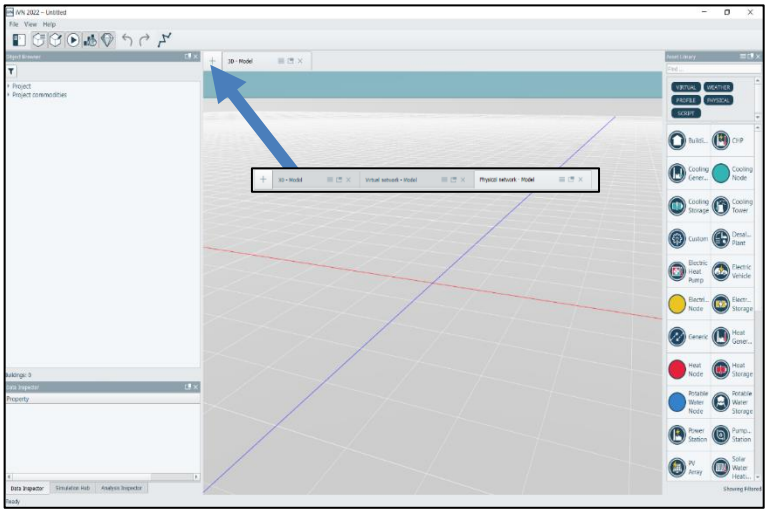


2.2 Virtual network

Creating a 2D virtual network view by clicking on the plus icon in the top right hand corner of the project viewer.



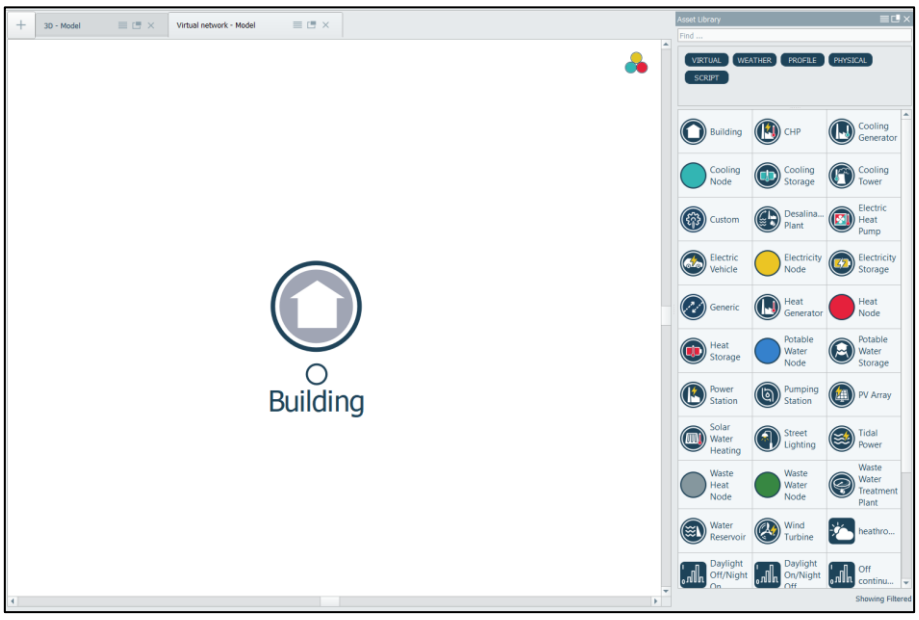
From here multiple views and scenarios can be used for alternative views of the project.



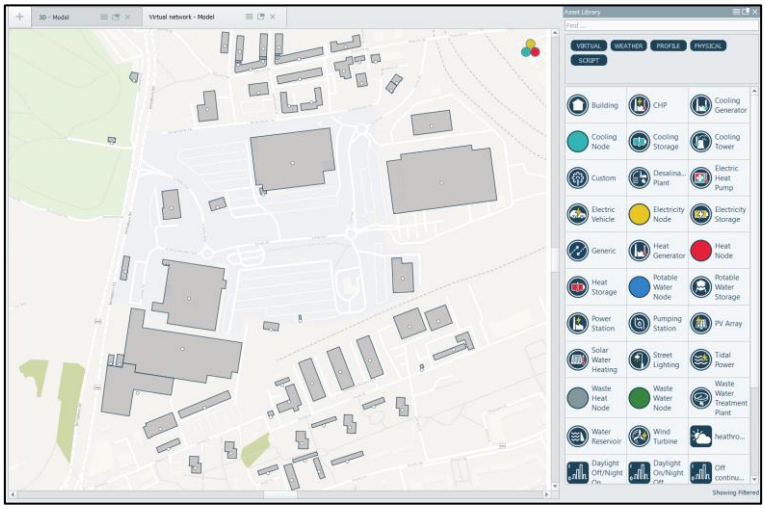
To create multiply scenarios/virtual/physical network views right click on the network located in the object browser and select open in new virtual network view.

2.2.1 Adding Virtual Assets

From the asset library tab located on the right hand of the project viewer, assets can be added by dragging and dropping into the virtual network viewer directly from the asset library.

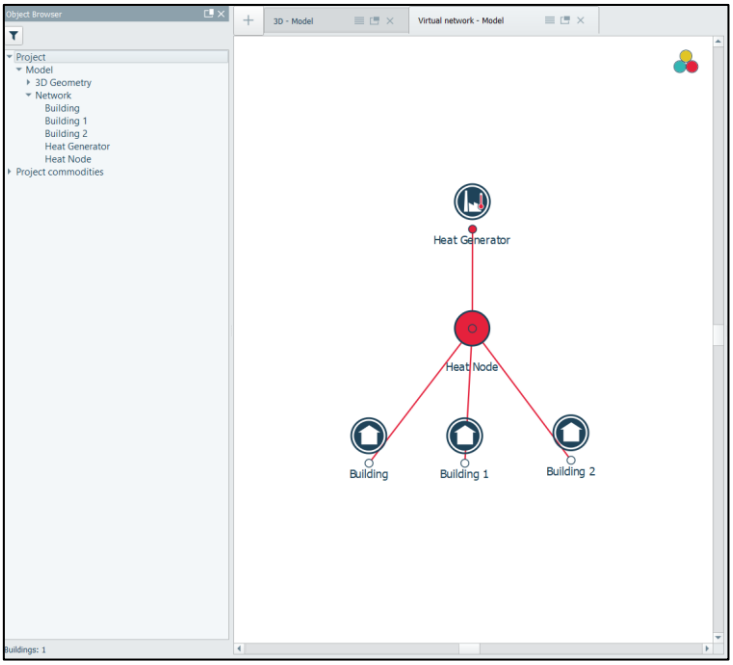


Similarly, when using imported buildings assets can be selected form the asset library and dragged directly into the project space (virtual network viewer).



2.2.2 Creating a Virtual Network

A virtual network can be created by adding assets to the virtual network from the asset library. The network is outlined under the network drop down within the project located in the object browser.

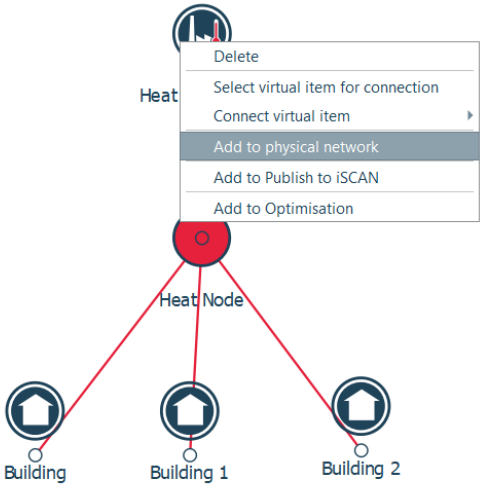


A network is created by linking assets by clicking and dragging on the selected commodity associated with the asset. Complex networks can be created in order to assess the load, demand and capacity of networks.

Note: assets must first be connected to a network node before connecting to another asset within the network.

2.3 Physical network

In order to add assets to the physical network they first must be present in the virtual network. Once present in the virtual network assets can then be added to the physical network by right clicking and 'Add to physical network'.



Requirements for a Physical network:

In order to create a physical network, additional add-on licenses must be present.

Heat:

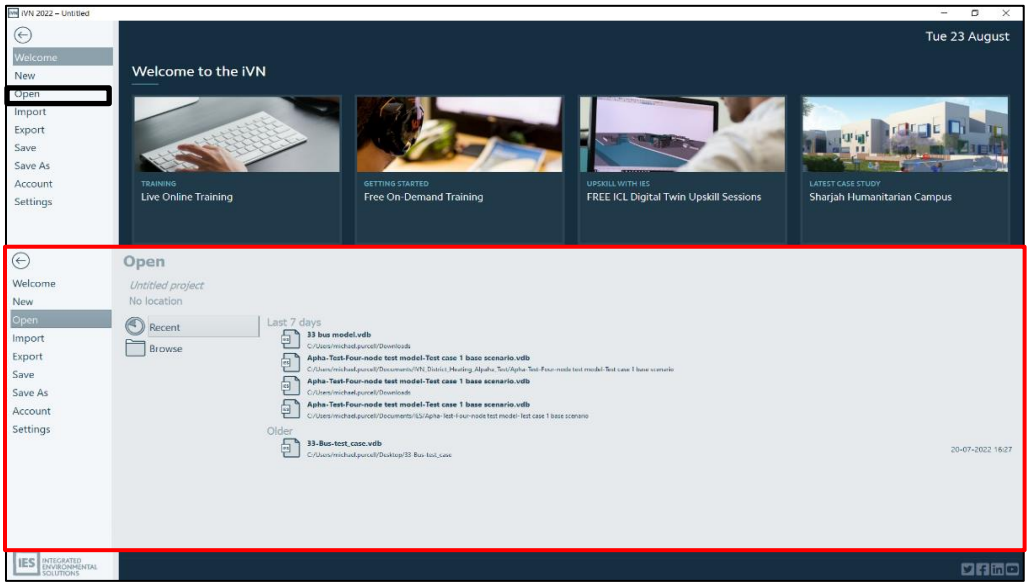
District Heat Network modelling, allowing customers to further evaluate a thermal energy design from a network infrastructure point of view and whether any changes or upgrades are required.

Optimise:

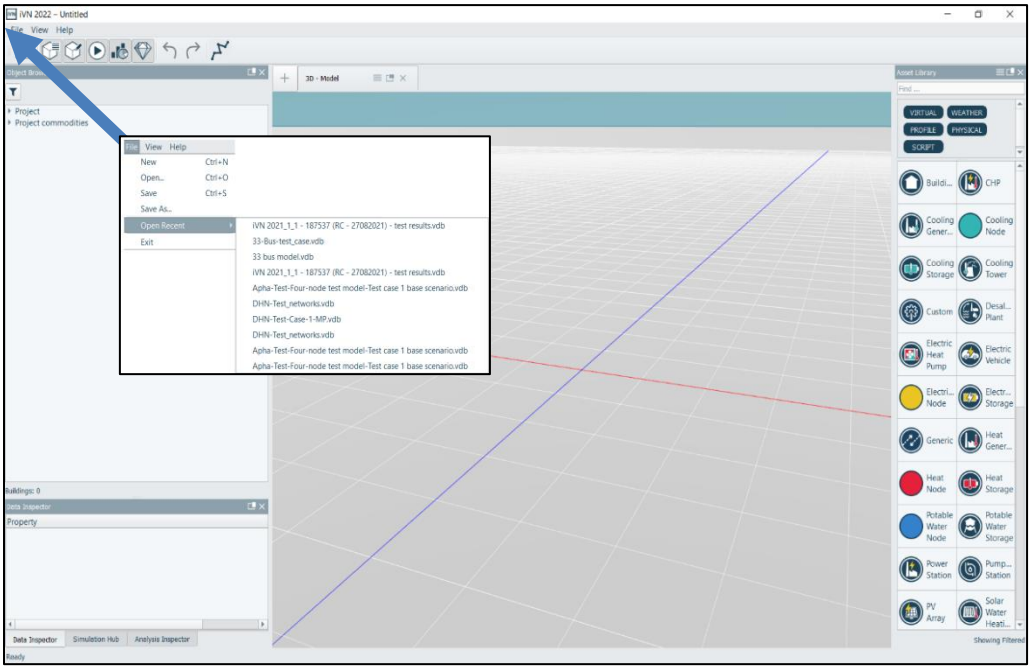
Allows the customer to set up an optimisation problem, defining the objective(s) (e.g. minimise carbon emissions), variables and constraints to automatically give the optimal sizing of all assets in the design that satisfy the energy demand.

3 Open Previous Project

To open a previous project from the welcome page, click on the ‘Open’ tab to open and existing iVN project.



This function is also available from the file drop down menu in the main interface.



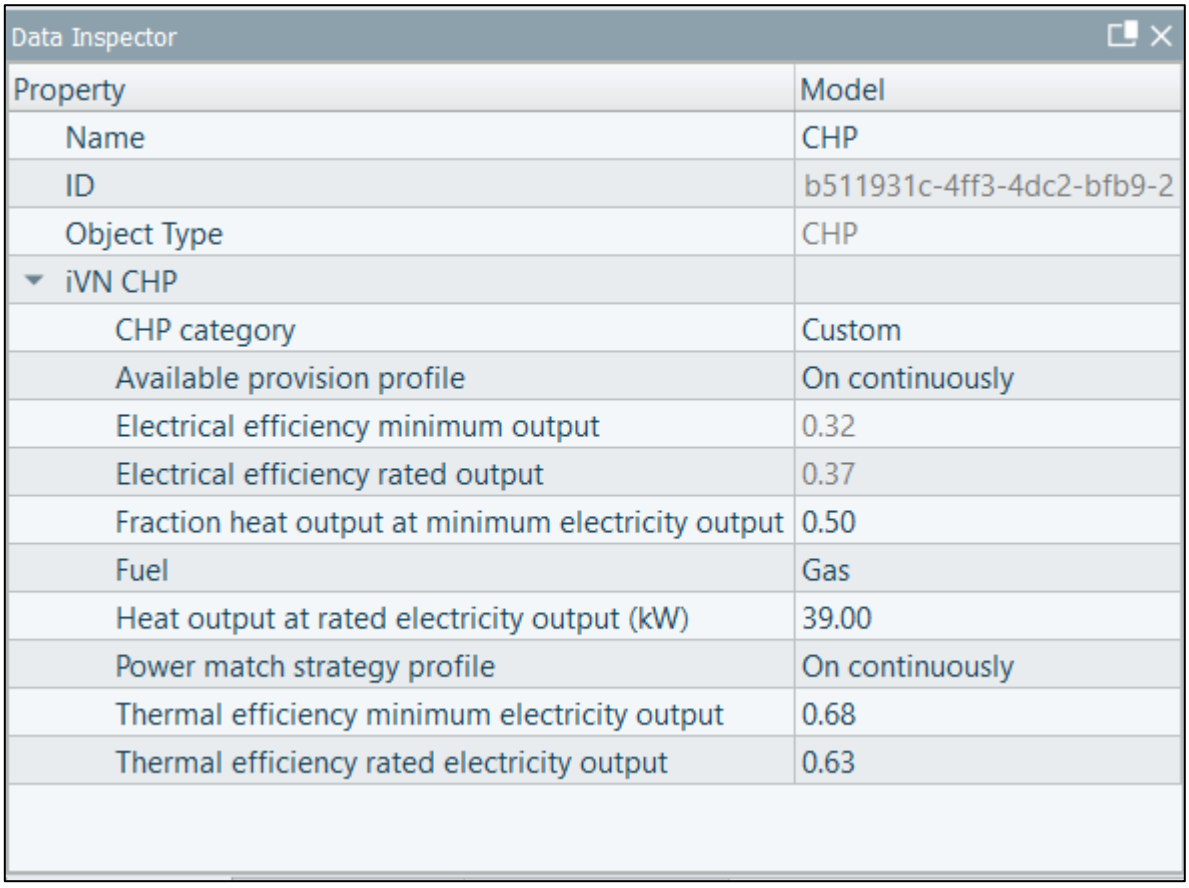
4 Navigate the Interface

The three main components of the interface are the Data inspector, the Simulation Hub and the Analysis Inspector.

4.1 Data inspector

The data inspector is the primary method of inputting data and parameters to the network. Click on an asset within the network either by physically clicking the icon in the project viewer or by selecting it from the list in the project browser.

The parameters of the assets can then be input for the specific network.

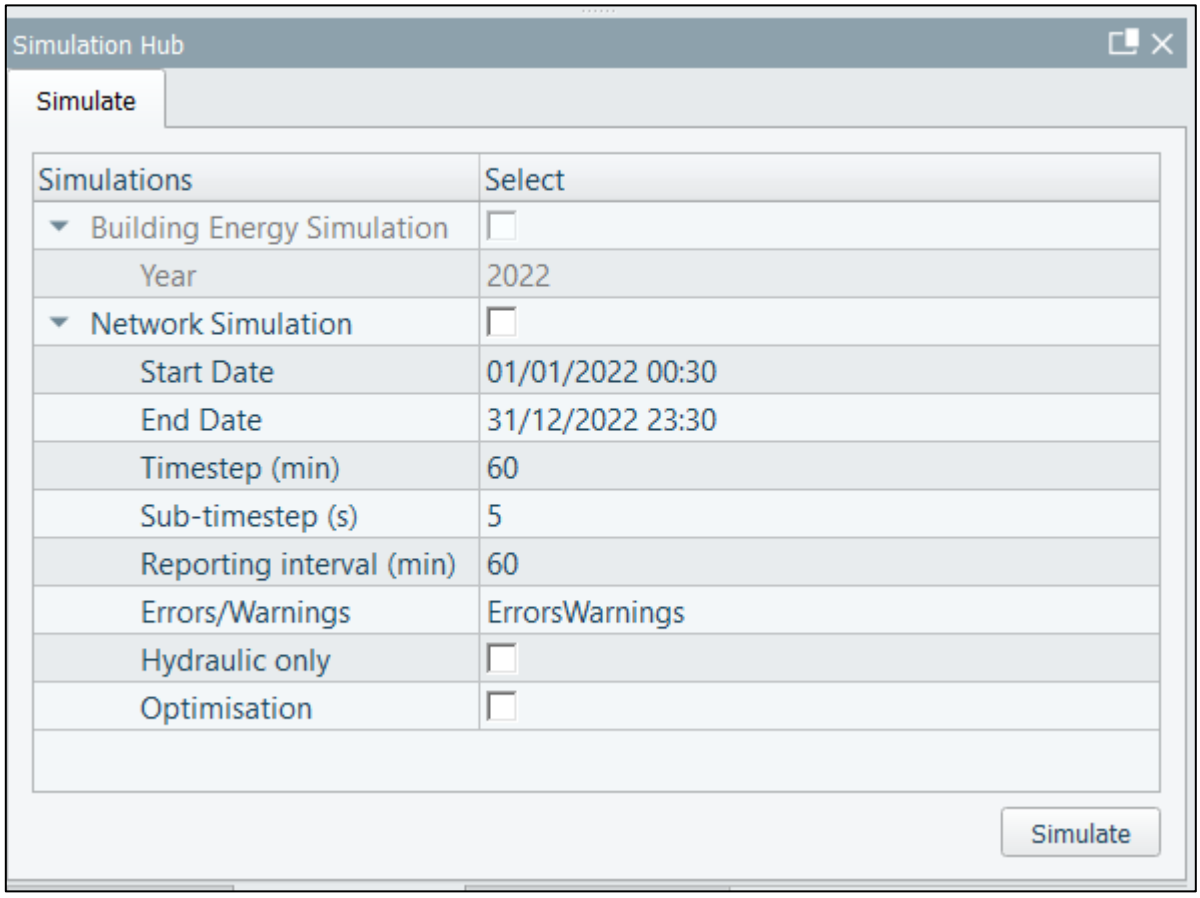


(Image shows and example of a CHP asset parameters)

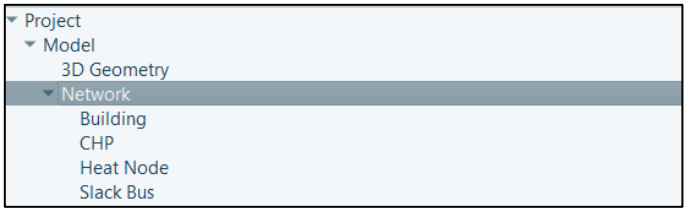
4.2 Simulation Hub

The simulation hub is the input parameters for the specifications of the intended simulation of the network.

Here the length, reporting intervals and timesteps of the intended simulation are specified. From here the simulation is also initiated by the 'Simulate' button.



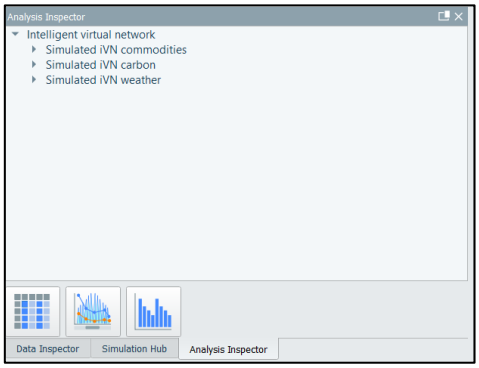
Note: In order to run a simulation, the network must be selected as within the project browser.



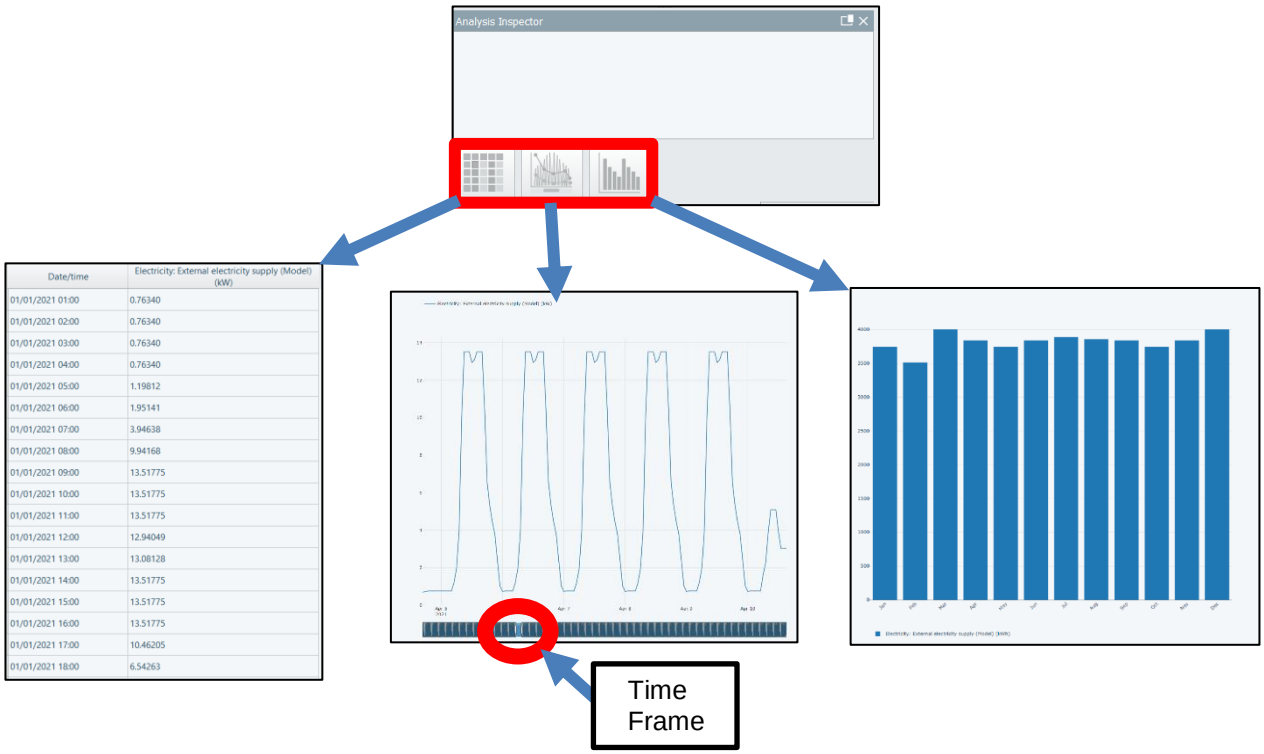
Note: Hydraulic only & Optimisation options are only available with additional corresponding license addons.

4.3 Analysis Inspector

Once a simulation is complete the results of the simulation are now accessible through the analysis inspector.



From the analysis inspector the user can specify the particular set of results they wish to view by selecting them from the drop-down menu and then specifying the desired method of representation from the 'Table Chart', 'Line Chart' or 'Bar Chart' as shown below.



5 Licensing

Current packages available:

iVN Core:

The core functionality of the iVN, including generation asset simulation, virtual network creation, building demand simulation, ICL integration, and energy balancing and aggregation calculations.

iVN Heat:

District Heat Network modelling, allowing customers to further evaluate a thermal energy design from a network infrastructure point of view and whether any changes or upgrades are required.

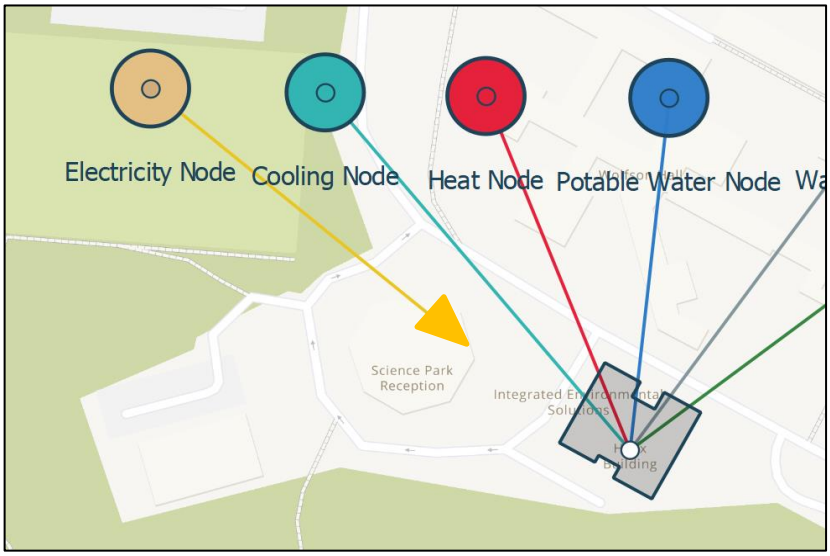
iVN Optimisation:

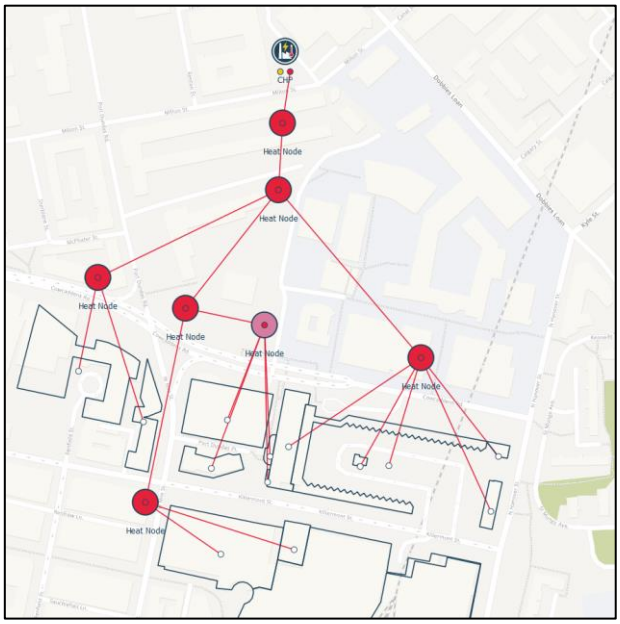
Allows the customer to set up an optimisation problem, defining the objective(s) (e.g. minimise carbon emissions), variables and constraints to automatically give the optimal sizing of all assets in the design that satisfy the energy demand.

6 Setting up and Simulating a Virtual Network

6.1 Setting up a Virtual Network

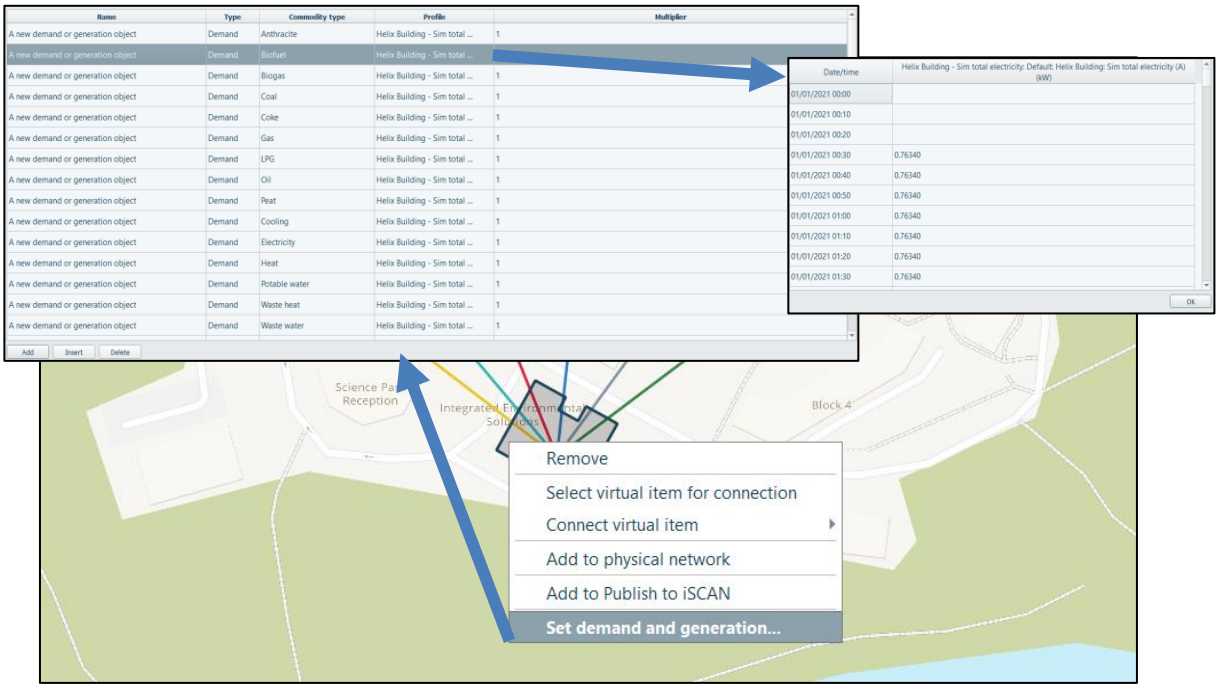
In order for a virtual network to be set up induvial nodes must be added to the network. Each node within the network acts as an aggregation point allowing the network to be inspected and analyzed on several levels.



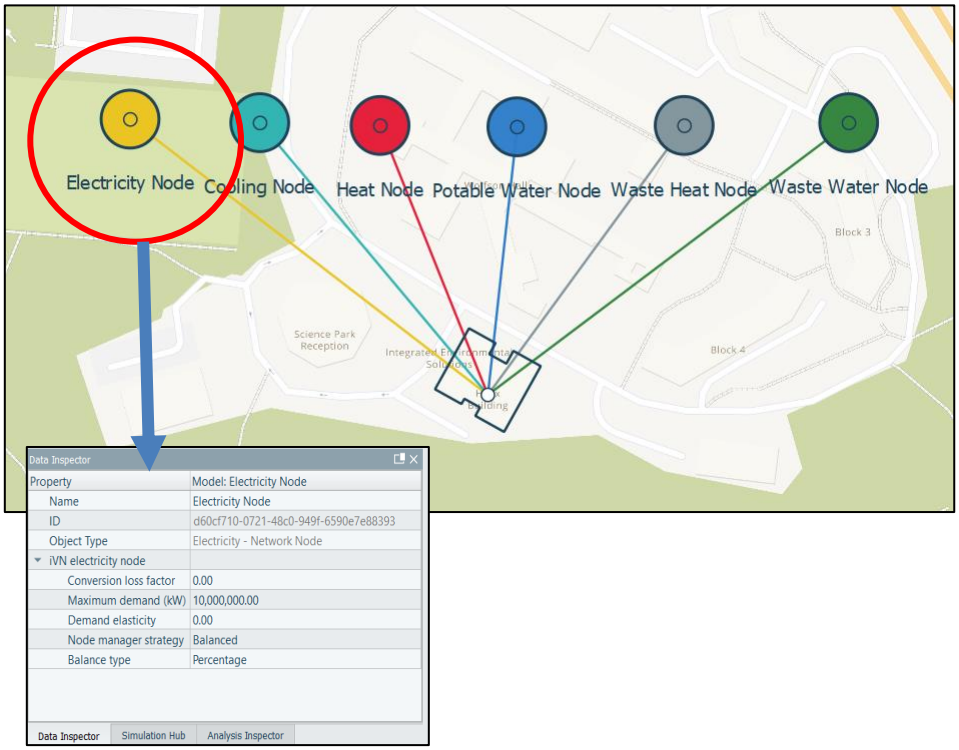


The parameters are then set for the particular assets within the network using the data inspector for each highlighted asset.

The demand and generation profiles can then be set for specific commodities by opening the 'Demand and generation editor' (access the editor by double clicking the asset / right clicking and selecting 'Set demand and generation')



The specific parameters of each node can also be defined using the data inspector.



Once the desired network is constructed and all parameters are inputted correctly a network simulation can be conducted.

6.2 Network Simulation

Once the network is set up correctly, select the network as a whole in the project browser.

Ensure the network parameters are correct using the data inspector.

Set the desired network simulation parameters within the simulation hub tab;

Network Simulation:

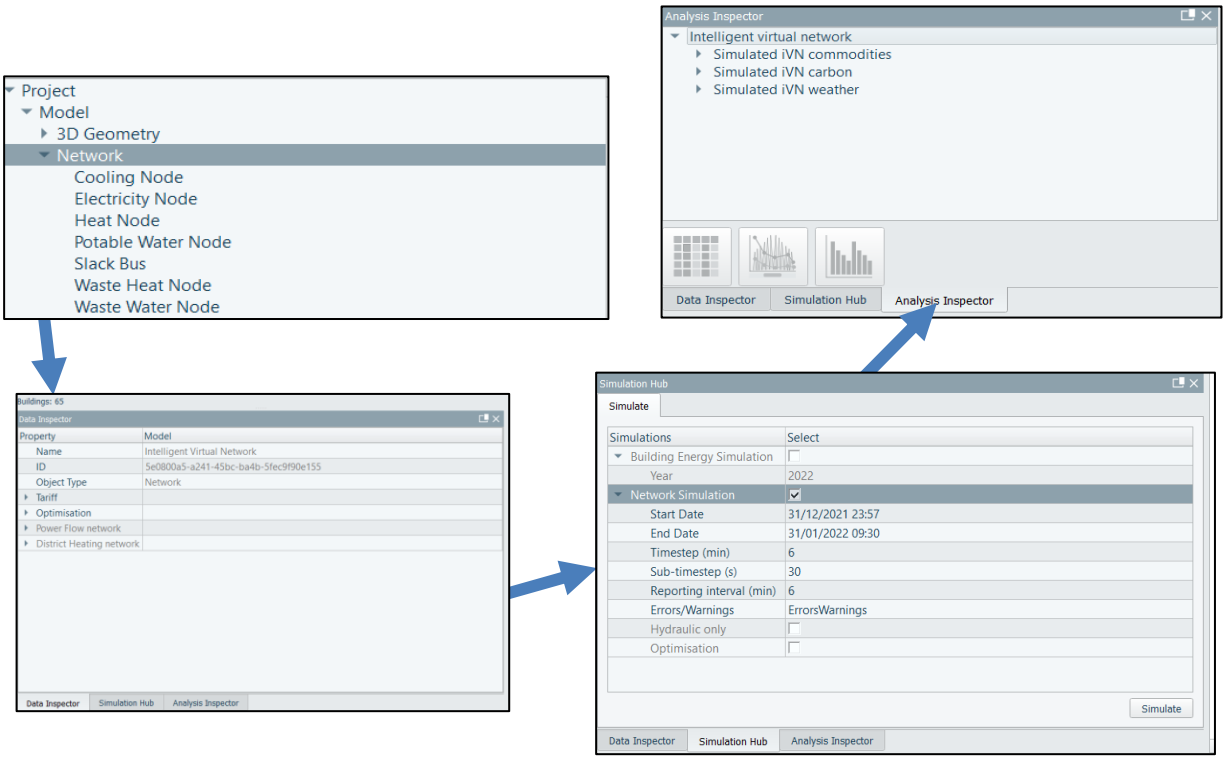
Start date: DD/MM/YYYY 00:00-23:59

End date: DD/MM/YYYY 00:00-23:59

Time step: 1-60

Reporting interval: X ≥ Time step

Errors and Warning preferences.



Once the simulation is complete the results can be viewed using the analysis inspector as outlined previously in section 3.3 Analysis Inspector.

7 Setting up and Simulating a Physical Network

In order to access the physical network set up within iVN the user must have an additional add on package other than iVN Core (iVN Heat/Optimise). The current packages available are outlined in Section 4 Licensing.

Note: If a user imports or opens a previous project containing unlicensed networks/assets it will still be openable as a READ-ONLY file.

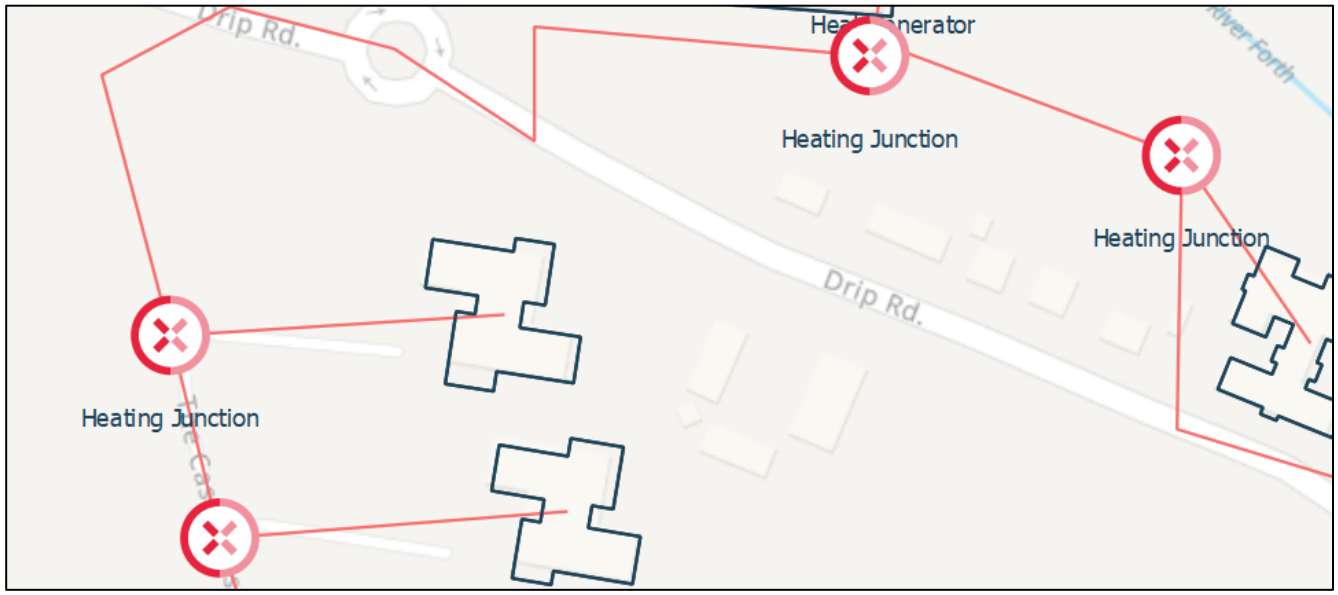
7.1 iVN Heat

7.1.1 iVN Heat Set-up

In order to create a district heating network, the user must have access to an iVN Heat license.

All assets required in the network must first be established within the virtual network of the project. Once the assets are added to the physical network the physical infrastructure of the heat network can now be drawn.

Each length specified consist of a Supply and Return pipe. The specific parameters of these pipes can be defined using the data inspector, a defined length can be implemented using the length override input.



Heating junctions as shown above are used as junction points along the network. Heating junctions are draggable assets available from the asset library. Heating junctions are also used along a district heating network to specify the specific points elevation or the fixed head of a heat network along with the other heating network assets and buildings.

Note: Each heat network must only have one defined point with a fixed head value.

Heating junction data inspector input variables:

Data Inspector

Property	Heating Junction	supplyNode	returnNode
Name	Heating Junction	supplyNode	returnNode
ID	01bc04ec-f5b9-4e2a-b14d-8e25	457c5bbe-a92d-4d9d-b57f-f663	05405702-84c3-4a33-af78-f0293d8bb6b1
Object Type	District Heating Network Object	District Heating Network Object	District Heating Network Object
▾ Node			
Is head fixed		false	false
Fixed head (m)		0.00	0.00
Elevation (m)		0.00	0.00

The data inspector outlines the specific inputs variables required when creating a district heating network for each asset involved. The data inspector below shows the input variables available for a specific run of pipes within a district heating network.

Data Inspector

Property	DHN On Thermal Working (Long Pipes)			DHN On Thermal Working (Long Pipes)
Name	Return Link	Return Pipe	Supply Pipe	Supply Link
ID	61f647cd-ccc5-4fd1-a6c5-025fd8b3a2cc	d31246c1-f77e-4f3a-8c9d-a41d	e2997e03-37f6-4055-841b-6f43	145730cf-bd59-4c40-b5e0-e3c5327c76e9
Object Type	District Heating Network Object	District Heating Network Object	District Heating Network Object	District Heating Network Object
▾ Link				
Maximum volume flow rate override	false			false
Maximum volume flow rate (m^3/h)	258.00			258.00
▾ Pipe				
Diameter (mm)		150.00	150.00	
Length override		true	true	
Length (m)		2,000.00	2,000.00	
Thickness (mm)		50.00	50.00	
Density (kg/m^3)		7,850.00	7,850.00	
Heat capacity (J/(kg·K))		465.00	465.00	
Roughness (mm)		0.0500	0.0500	
Thermal conductivity (W/(m·K))		100.00	100.00	
Thermal transmittance (W/(m^2·K))		0.04	0.04	

Data Inspector | Simulation Hub | Analysis Inspector

The district heating parameters for the network are set when the network as a whole is selected from the project browser. Outlining the maximum volume flow rate (m^3 /h) of the system as well as the initial supply and return temperatures (˚C) of the system.

Data Inspector

Property	DHN On Thermal Working (Long Pipes): Intelligent Virtual Network
Name	Intelligent Virtual Network
ID	8b12c8a0-e80d-443d-a862-17e6a3c3ecb4
Object Type	Network
▸ Tariff	
▸ Optimisation	
▸ Power Flow network	
▾ District Heating network	
Maximum volume flow rate (m^3/h)	258.00
Initial supply temperature (°C)	75.00
Initial return temperature (°C)	55.00

7.1.2 iVN Heat Simulation

Similarly, to the virtual network the network simulation parameters are specified within the simulation hub tab

Network Simulation:

Start date: DD/MM/YYYY 00:00-23:59

End date: DD/MM/YYYY 00:00-23:59

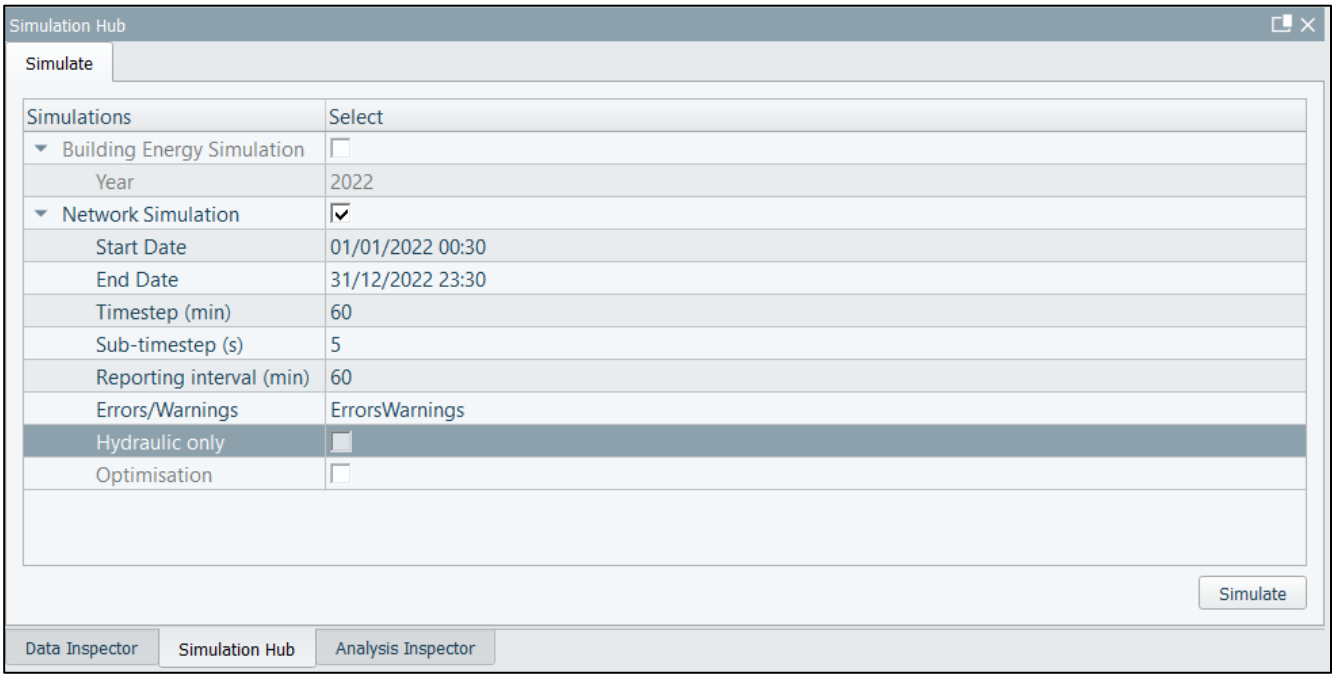
Time step: 1-60

Reporting interval: X ≥ Time step

Errors and Warning preferences.

iVN Heat also has the option to run a 'Hydraulic Only' simulation allowing the user to only calculate a steady-state hydraulic problem to determine the head at each node, and the volume flow rate through each link of the network.

The hydraulic model is used for computing the flow rate and pressure head for each pipe. iVN uses the nodal method in combination with demand-driven analysis to assume a steady-state solution. This involves using the continuity equation- but as water is assumed to be incompressible and its properties are temperature invariant, the problem becomes framed in terms of volume flow rate.



7.2 iVN Optimise

In order to optimise a specific network, the user must have access to an iVN Optimise license.

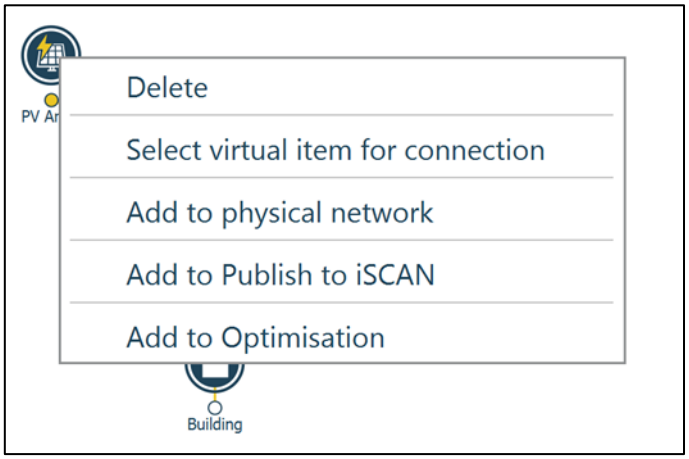
The optimisation feature depends greatly on the IVN model and the input parameters set by the user, the current optimisation capabilities have been purposefully limited to a small set of objective functions. To be specific, the feature currently only supports the minimisation of the external supply of electricity, heat and/or cooling. Consequently, the main use case for the optimisation feature is the sizing of intermittent renewable energy sources based on the input weather data, the rated powers and the total demand.

7.2.1 Setting up an optimisation problem

In order to set up a model for optimisation, the following steps need to be made:

1. Add assets to be optimised using the 2D virtual network view
2. Set optimisation parameters in the optimisation dialog

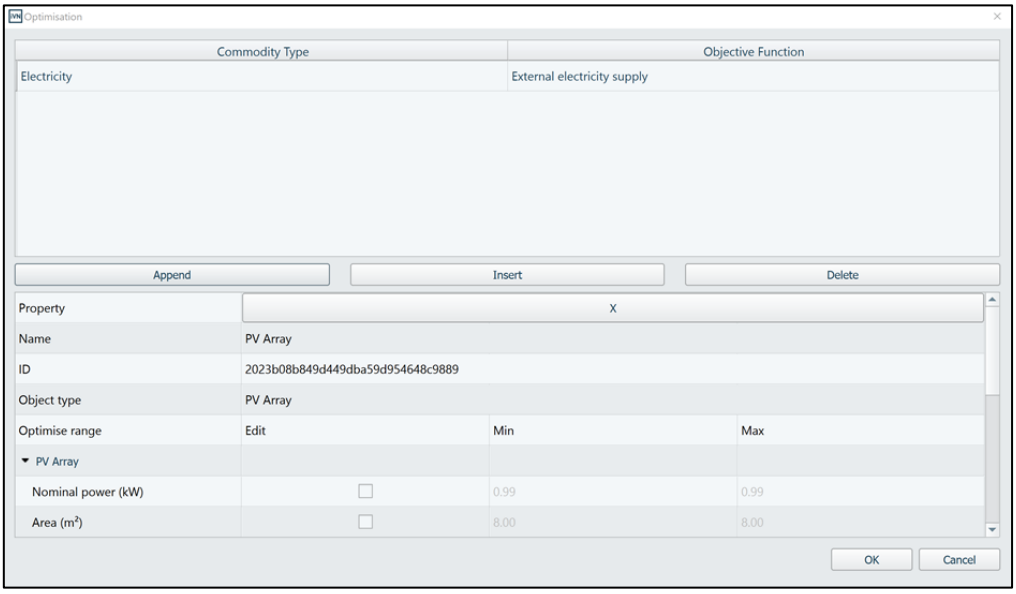
To achieve step 1, right-click on any asset you wish to optimise in the 2D virtual network view and choose “Add to Optimisation”.



This will add the asset to the list of assets that can be configured in the optimisation dialog.

To open the optimisation dialog, select “network” in the object browser and then click the cell “Set optimisation” twice. This cell is to the right of the “Setup” property of the optimisation category, as shown in the diagram below:

A button will appear allowing the user to open the optimisation dialog.



If the bottom section is empty, make sure to do step 1 above, which will add assets to the optimisation dialog.

At the top of the panel there is a list of objective functions. Click “Append” or “Insert” to add a new objective function to the list. Click “Delete” to remove an objective function. The objective functions are used to determine the overall aim of the optimisation algorithm. For example, if “External electricity supply” is chosen as an objective function, the optimisation algorithm will try to optimise the parameters in such a way as to minimise the external electricity demand.

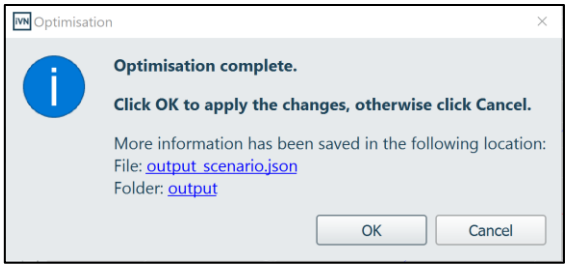
The list of objective functions to choose from is currently limited, but as the IVN continues to be developed, this list will expand to include more objective functions.

At the bottom of the panel there is a list of assets that have been added to the optimisation dialog. To remove an asset from the optimisation, click the “X” button. For each asset, select which parameters are going to be optimised and, consequently, become decision variables for the optimisation algorithm by clicking the check boxes under the “Edit” column. For each parameter the minimum and maximum values that the optimisation algorithm will consider can be set

7.2.2 Optimisation Results

The end result of an optimisation is an individual with the best fitness score. Because the fitness score is a direct representation of the ability of the model to minimize or maximize particular variables of interest to the user, the decision vector for the optimal result can be used.

The following dialog will appear:

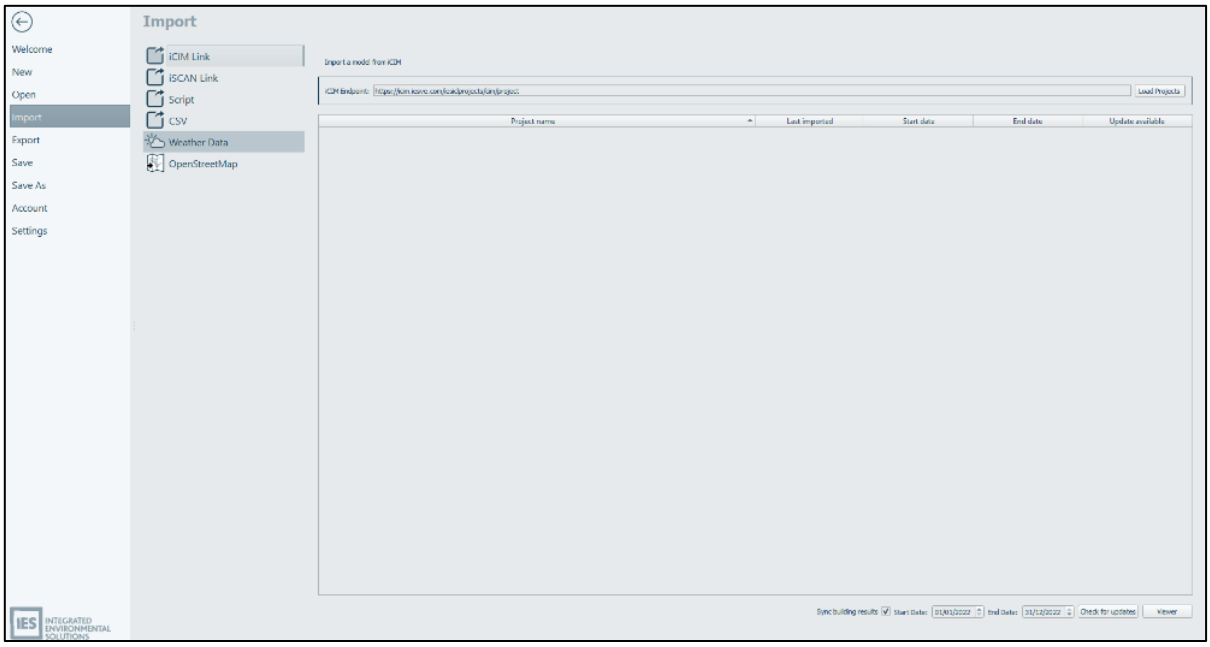


The files generated by the optimisation algorithm can be probed in order to look at more detailed results.

Clicking OK will replace the parameters in the model which were set to be decision variables to those calculated as the optimal solution. Clicking cancel will keep the parameters as they were before the optimisation was initiated.

8 Import Function

The ‘Import’ tab located on the ‘Home Page’ provides the user with several options to import data into the iVN.



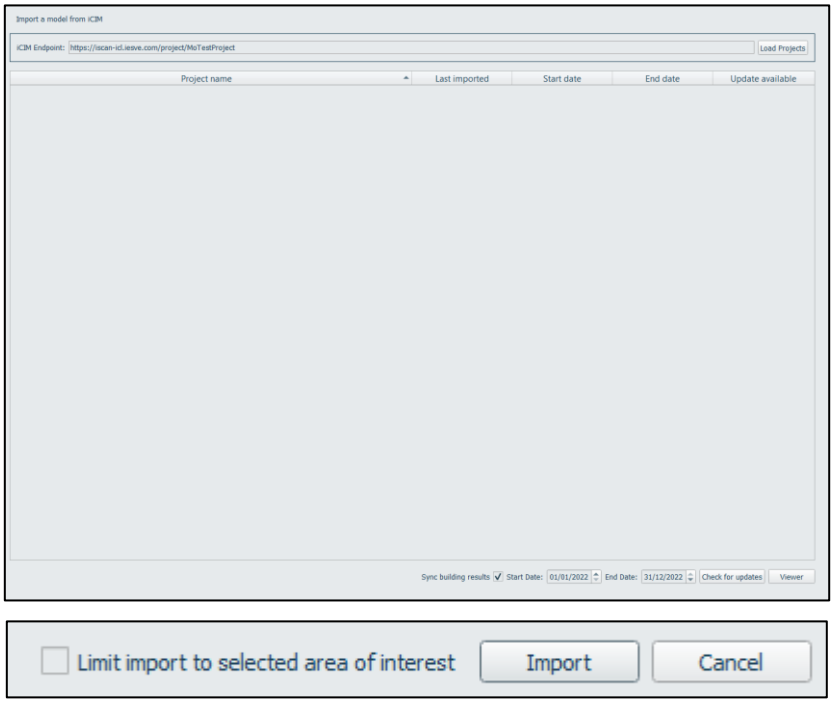
8.1 iCIM Link

Import a model from iCIM by loading the projects specific URL; import from selected and specified start and end date.

It is important to note that the iCIM endpoint to be copied and pasted into the import section shown below is as follows:

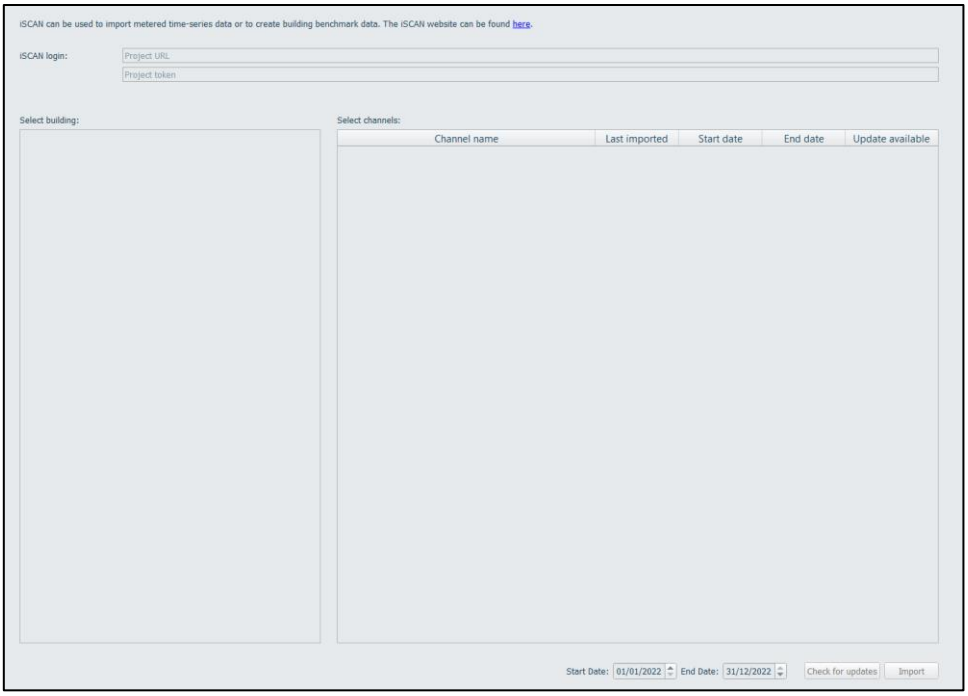
https://icim.iesve.com/iesiclprojects/cim/project

Once this is done a prompt will pop up to enter iCIM log in details. From there then the list of iCIM projects will be selectable in list form. A project can be selected from the list and then the “Viewer” button is clicked and a pop up will appear that will show the area captured by the iCIM project. There is an option then to either select an area of interest to import in the same way that is done for the OSM import, or the entire area can be imported.

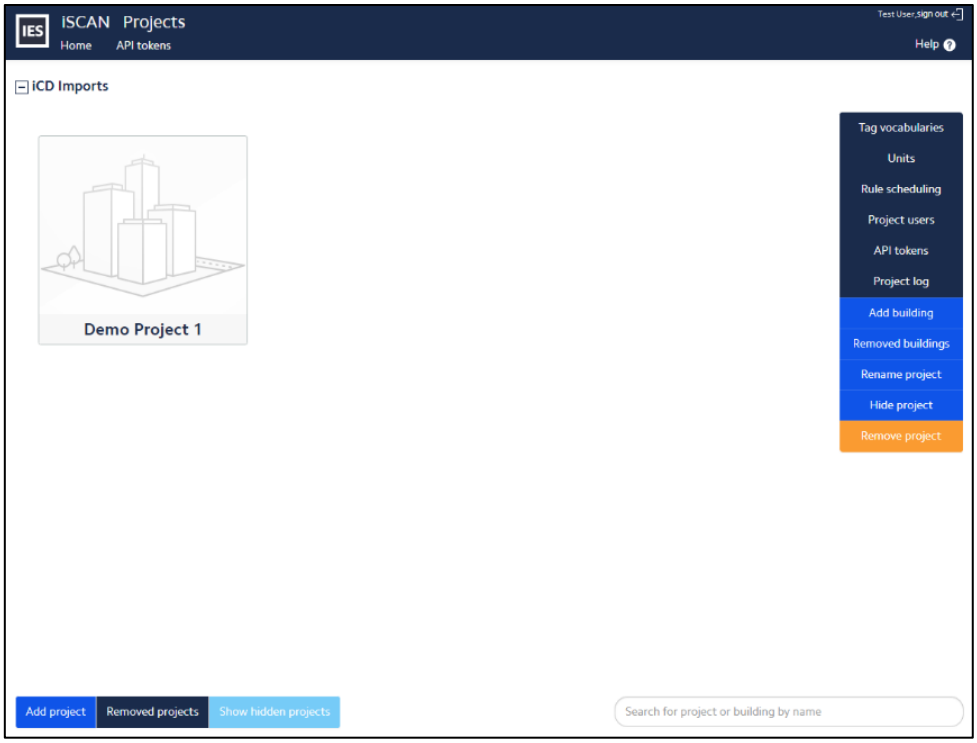


8.2 iSCAN Link

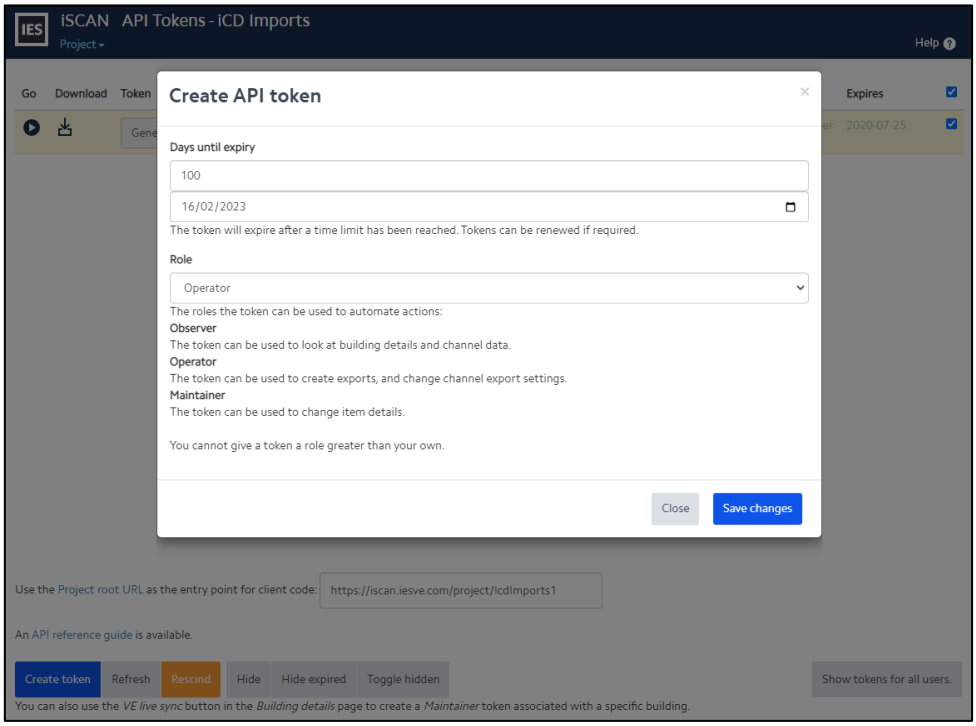
iSCAN can be used to import metered time-series data or to create building benchmark data. To import time series data, the project URL and project API token links are required to be copied and pasted into the section shown below. Once this is done, log in to the iSCAN account through the pop-up dialogue. A list of channels will then appear and can be selected to import data between the dates defined in the bottom right corner.



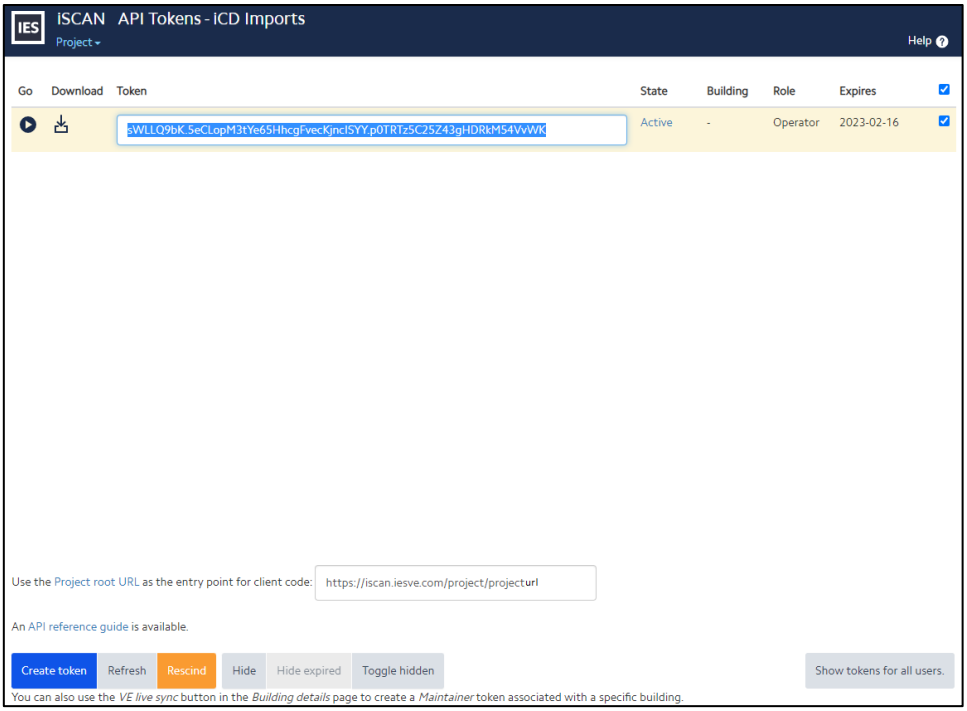
To generate the iSCAN API token and get the project URL, log in to iSCAN and navigate to the desired project, and select “API tokens” in the menu on the right of the screen.



Click “Create Token” on the next screen, and when creating it ensure that the expiry date is long enough in the future that is suitable, and that the “Operator” role is selected. The import will not work if these options are incorrect.



Once created, the API token link to the top and the project URL on the bottom of the screen can be copied and pasted into the iVN as described previously.



8.3 Weather Data

iVN Energy simulations require reference weather data for the location of the building. A set of standard simulation weather files are included within the iVN installation or it can read any *.fwt or *.epw simulation weather file. Resources are provided here to give routes to acquire additional weather files that may be used in simulations.

To load a weather file from the install set, click on Homepages >> Import >> Weather Data then click the Browse icon. This looks initially at any files saved inside the iVN weather files folder, but you may browse to a new file you have saved anywhere else on your local machine.

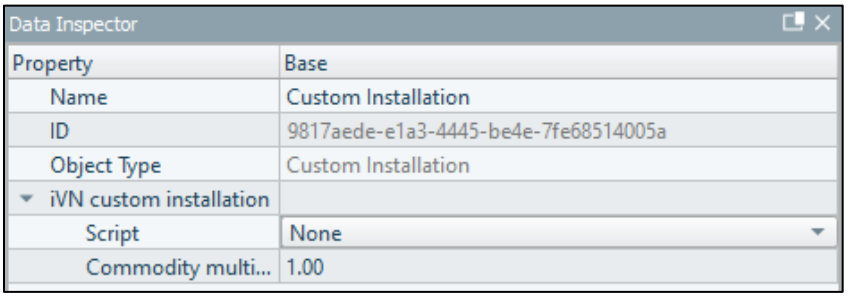
When the desired file is set you can then click Import to bring it into the project ready for simulation.

When you wish to use a new weather file in the project it can be chosen form the Model Location Properties.

8.4 Script

The import of python scripts is done in much the same way as the weather installations. Default python scripts are available on the IES website, or the user can create their own.

These python scripts can be used to simulate the behavior of specific assets not available as standard in the iVN asset library. Once a script has been imported, it can be used through the custom installation asset in the virtual network. A custom installation is added to the virtual network, and the python script can be selected through the data inspector when the custom installation in question is highlighted.



8.5 OpenStreetMap

Outlined in section 1.1.2 OpenStreetMap

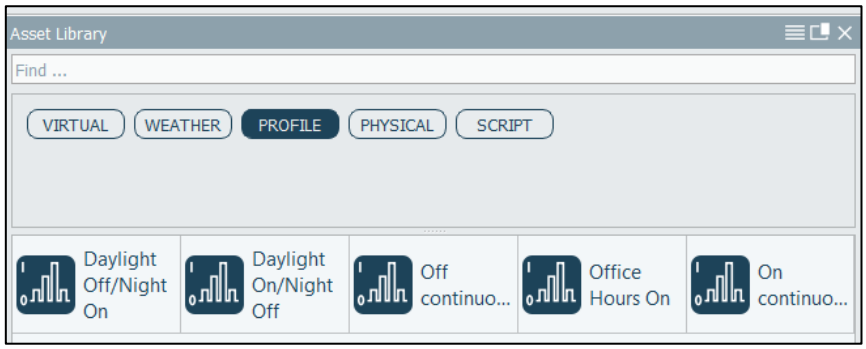
8.6 CSV Import

Ability to import a timeseries profile in csv format into iVN. The Timeseries can be utilised by the system and set as a profile to demand and supply units

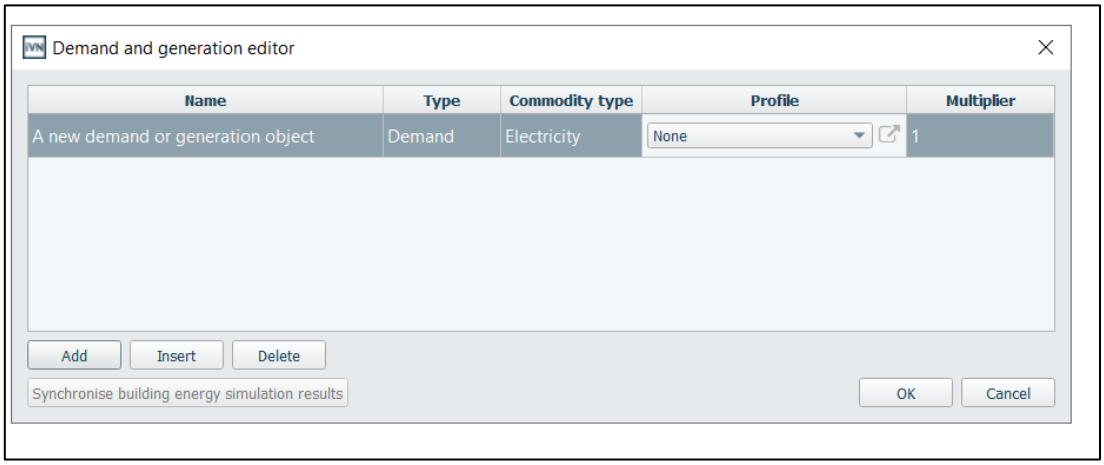
When selecting a specific set of time series data in CSV format the structure of the time series must be that of a row per profile structure shown below;

	A	B	C	D	E	F	G	H	I	J	K	L
1	name	start_year	start_month	start_day	end_year	end_month	end_day	timestep_minutes	values			
2	Test_Case_1	2022	1	1	2022	12	31	10	1	2	3	4

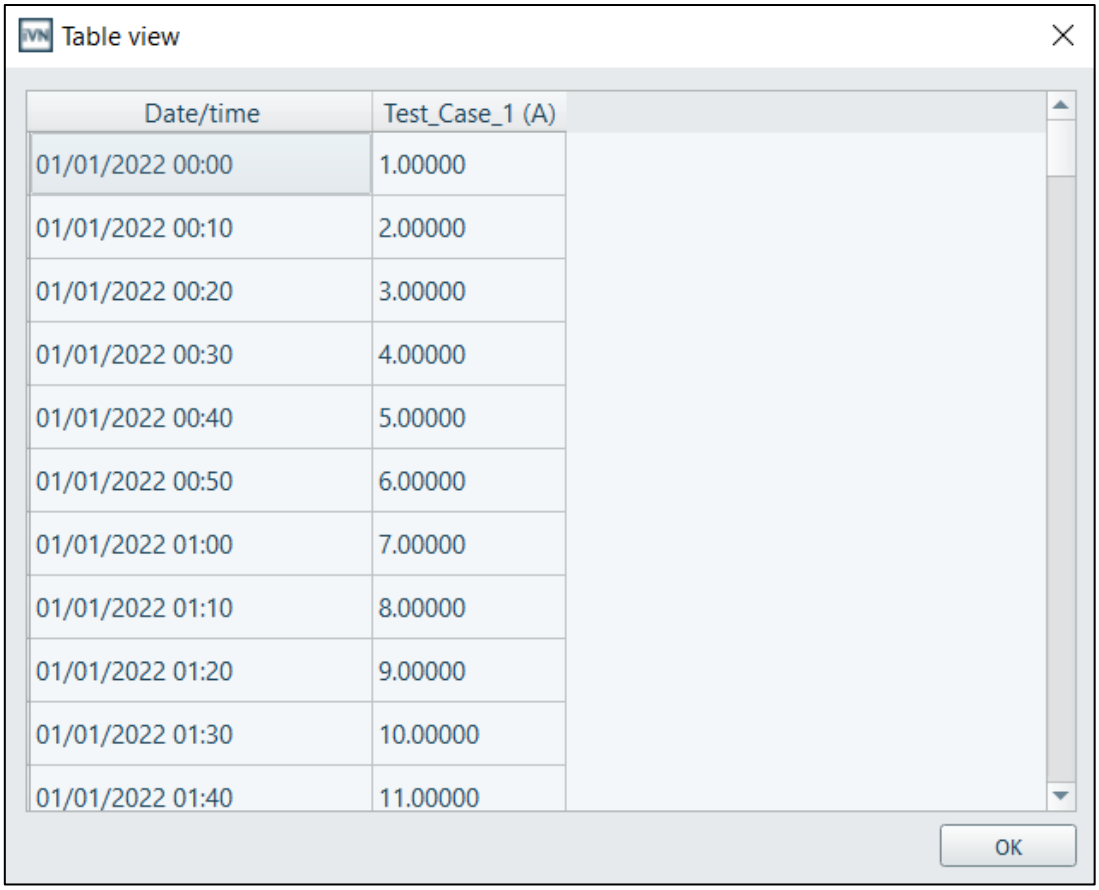
Once the profiles have been imported they are then available to be specified as time series data for demand/supply assets within an iVN Network.



By double clicking the desired asset or by right clicking the asset and selecting ‘Set demand and generation’ a profile can be added and the parameters set for its intended use within the ‘Demand and generation editor’.



The profile selected can then be previewed in order to ensure the correct profile is being assigned.



9 Additional Resources

iVN Support Page:

https://www.iesve.com/support/ivn

License Keys and Configuration:

https://www.iesve.com/support/guides/ivn/ivn-installation-guide-licence-configuration-1119.pdf

If you do not have this access yet then please contact your Account Manager or else keys@iesve.com to request it.

Online help guide:

https://help.iesve.com/ivn2022/

FAQs:

https://www.iesve.com/support/ivn/knowledgebase_faq

On-Demand Training:

https://distance-learning.iesve.com/courses/category/community-energy-and-renewables