



PCDG

Positive Cities and Distribution Grids

PCDG v1.0 User Guide

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Introduction

Deployment of distributed generation technologies, especially solar photovoltaic, have turned regular consumers into active contributors to the local supply of electricity. This development along with the digitalisation of power distribution grids (smart grids) is setting the scene to a new paradigm: Peer to Peer (P2P) electricity trading and the emergence of local flexibility markets. Microgrids, small communities or individual buildings can become net positive producers. This has led to create multiple mathematical models and simulation environments to represent the interactions of positive buildings and distribution grids.

In this regard, Positive Cities and Distribution Grids (PCDG) mod provides a user friendly window to analyse:

- End-user benefits on engaging in P2P trade
- Role of battery storage
- Showcase and quantify P2P trade benefits among buildings
- Analyse the overall benefit for the community

In short, with PCDG, you can analyze your neighborhood's electricity trade, as well as investigate the economic benefits of investing in renewable power generation for your home. To use this app, you need some data from your neighborhood, specifically the electrical demand of each house over a time period and the electricity price in this period. Additionally, you can specify if any houses have installed solar panels or wind turbines as well as their electricity generation in the period. Batteries may also be included.

The model is based on the optimization model developed in **“Local electricity market designs for peer-to-peer trading: The role of battery flexibility „A Lüth, JM Zepter, Pedro Crespo del Grenado, R Egging Applied Energy 229, 1233-1243.**

This document serves as a user guide for the PCDG application. Each chapter will cover the features present in each of the tabs in the application.

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Acronyms

KPI Key Performance Indicator

P2P Peer to Peer

PCDG Positive Cities and Distribution Grids

1 Download and Setup

This section explains steps to download and install the PCDG application on your computer.

1.1 Download

To download the application please visit the **PCDGMModel-LocalCommunities** repository at GitHub by **LocalEnergyMarkets**. The repository would appear as shown in Figure 2. There are two ways to get access to the app. Firstly, you can clone the repository to your computer or **download**¹ the contents as a ZIP file.

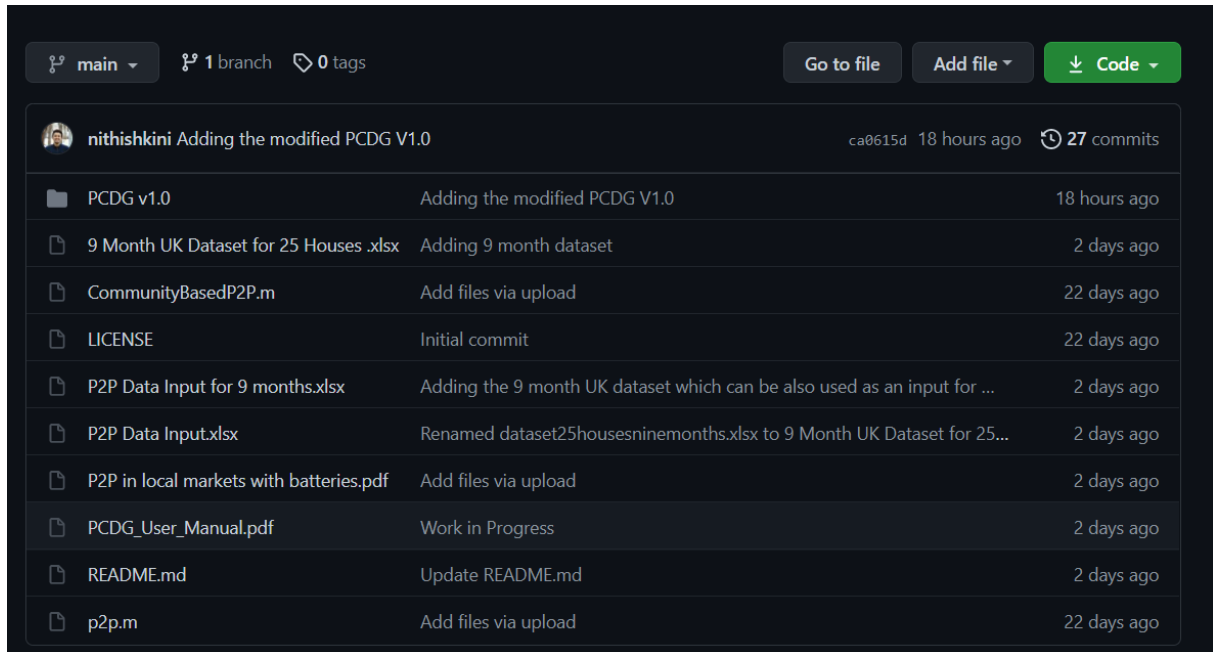


Figure 2: Snapshot: GitHub Repository

¹ Clicking on download will download the ZIP file

1.2 Setup

1.2.1 Step 1- Setting up PCDG on your computer

After cloning the repository or downloading the PCDG app as a ZIP file and extracting the folder, a folder as shown in Figure 3 is created at your desired location.


	PCDGMModel-LocalCommunities	18-04-2021 22:53	File folder
-----------------------------------------------------------------------------------	-----------------------------	------------------	-------------

Figure 3: Snapshot: Local folder

The contents of the folder is shown in Figure 4.











	PCDG v1.0	18-04-2021 22:53	File folder	
	9 Month UK Dataset for 25 Houses .xlsx	17-04-2021 18:30	Microsoft Excel W...	6,967 KB
	CommunityBasedP2P.m	17-04-2021 18:30	MATLAB Code	1 KB
	LICENSE	17-04-2021 18:30	File	2 KB
	P2P Data Input for 9 months.xlsx	17-04-2021 20:05	Microsoft Excel W...	6,206 KB
	P2P Data Input.xlsx	17-04-2021 19:31	Microsoft Excel W...	31 KB
	P2P in local markets with batteries.pdf	17-04-2021 18:30	Adobe Acrobat D...	600 KB
	p2p.m	17-04-2021 18:30	MATLAB Code	2 KB
	PCDG_User_Manual.pdf	17-04-2021 18:35	Adobe Acrobat D...	593 KB
	README.md	18-04-2021 22:51	MD File	6 KB

Figure 4: Snapshot: Contents of the Local folder

The folder PCDGv1.0 contains further folders required to run the PCDG application. The contents are shown in Figure 5.

	Step-1 (non MATLAB users only)	18-04-2021 22:53	File folder
	Step-2	18-04-2021 22:53	File folder

Figure 5: Snapshot: Contents of the PCDGv1.0

1.2.2 Extended Step 1 for non-MATLAB users only

If you do not have any version of MATLAB installed on your computer please click on the folder **Step-1 (non MATLAB users only)** shown in Figure 5. Clicking on the folder will display the installer **MyAppInstaller_web.exe** as shown in Figure 6. Run the .exe file to start the installation of MATLAB Runtime which is necessary for the PCDG application to run on your computer. Please skip to Step 2 if you currently have any version of MATLAB installed.

	MyAppInstaller_web.exe	18-04-2021 22:44	Application	3,050 KB
-------------------------------------------------------------------------------------	------------------------	------------------	-------------	----------

Figure 6: Snapshot: Contents of the Step-1 (non MATLAB users only) folder

1.2.3 Installing Matlab Runtime

Please follow the following steps to install MATLAB Runtime. It is free to download the application and does not require any licences. Double click on the **MyAppInstaller_web.exe** to begin the installation process. The following window appears as shown in Figure 7. To continue with the installation please click on **Next >**.

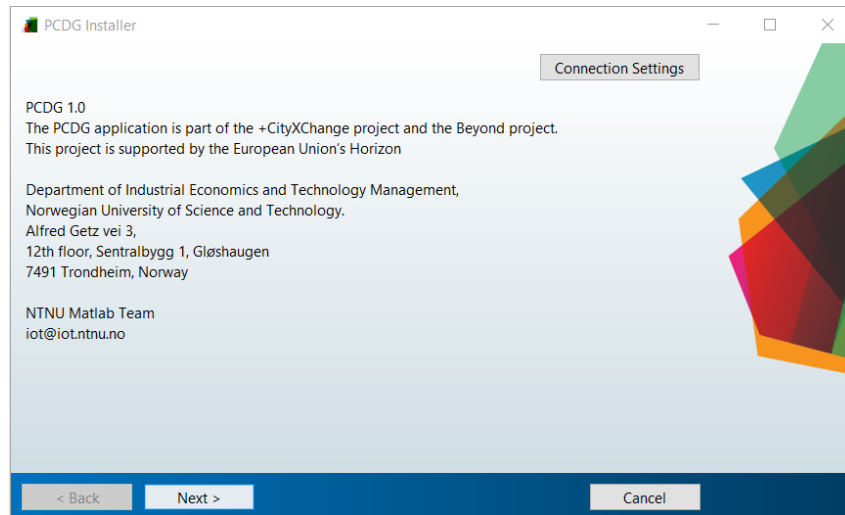


Figure 7: Snapshot: PCDG MATLAB Runtime Installer

On clicking **Next >**, the following window appears as shown in Figure 8. Choose the location where you would install MATLAB Runtime on your computer. Please make sure to change the file from the given default location and then click on next **Next >**.

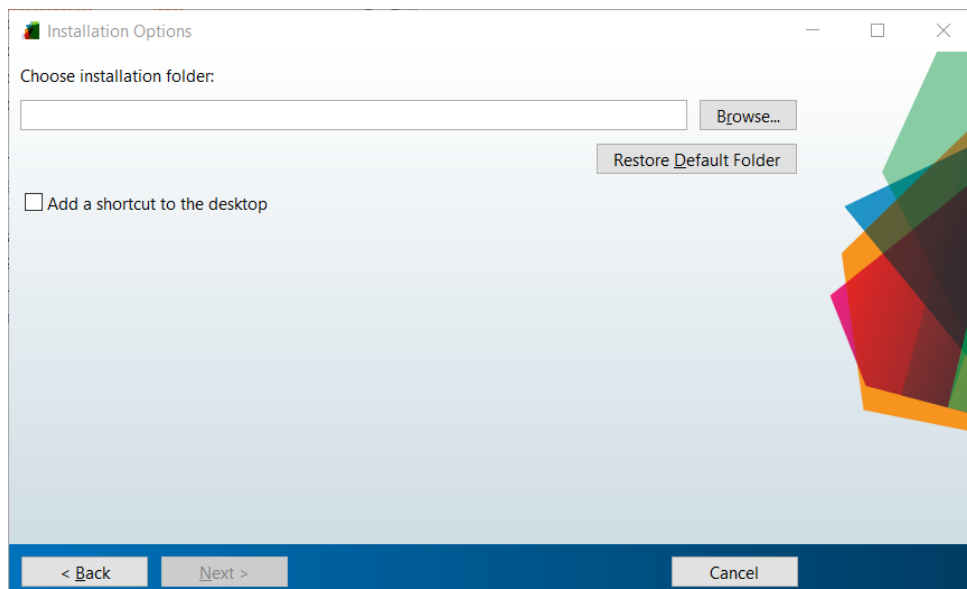


Figure 8: Snapshot: PCDG MATLAB Runtime Installer storage path

On clicking **Next >** again the installation will be carried out and when successful, the following image as shown in 9. Click on **Finish** to conclude the pre-requirements stage for computers which do not have MATLAB installed.

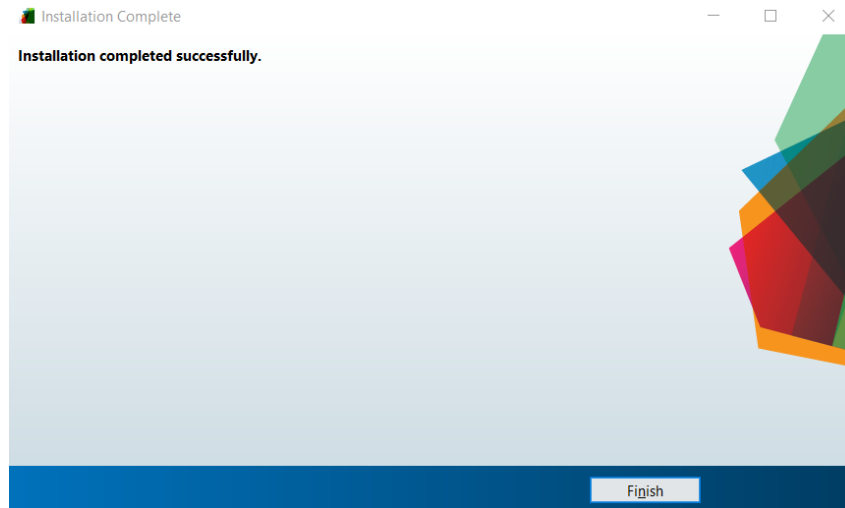


Figure 9: Snapshot: Confirmation of successful MATLAB Runtime installation

1.2.4 Running the PCDG application

As shown in Figure 5, the **Step-2** folder contains the PCDG application. On opening the folder following contents are seen as shown in 10.




 PCDG.exe	18-04-2021 22:44	Application	2,473 KB
 readme.txt	18-04-2021 22:44	Text Document	2 KB
 splash.png	18-03-2020 13:53	PNG File	18 KB

Figure 10: Snapshot: Contents of folder Step-2

Double click on **PCDG.exe** to run an instance of the PCDG application. Wait for a few seconds as the application loads and centers itself on your screen. This is the first of the PCDGv1.0.

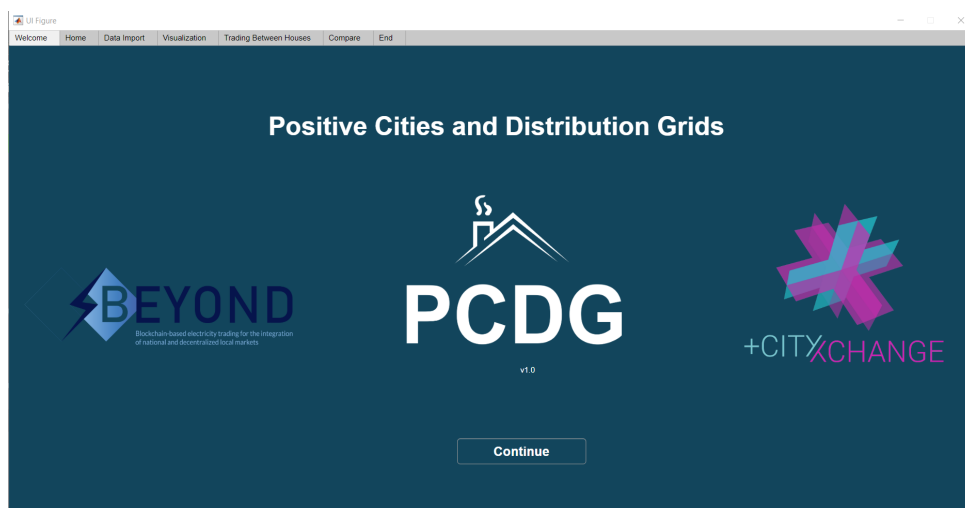


Figure 11: Snapshot: Start-up PCDGv1.0

2 The Welcome & Home Tab

This section describes the elements and functionality of the Welcome and Home tabs.

2.1 Welcome Tab

Figure 12 shows a snapshot of the Welcome Tab which provides information of the partners involved in the PCDG project. The project is a collaboration between **BEYOND - Blockchain-based ElectricitY trading for the integration of National and Decentralized local Markets** and **+CityXchange**.



Figure 12: Snapshot: Welcome Tab

2.1.1 BEYOND

2.1.2 +CityXchange

For further details regarding the partners, please click on the respective logos which will redirect you to the partner websites. You can freely navigate in the app using the tabs provided as shown in Figure 13 at the top or move to the next tab using the continue button.

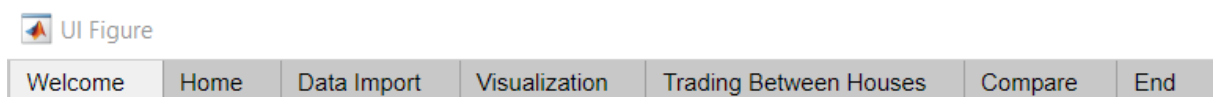


Figure 13: Snapshot: Tabs

2.2 Home Tab

Figure 14 shows a snapshot of the tab which contains basic information about the PCDG application which can also be found in this user guide in the Introduction of this user-guide.

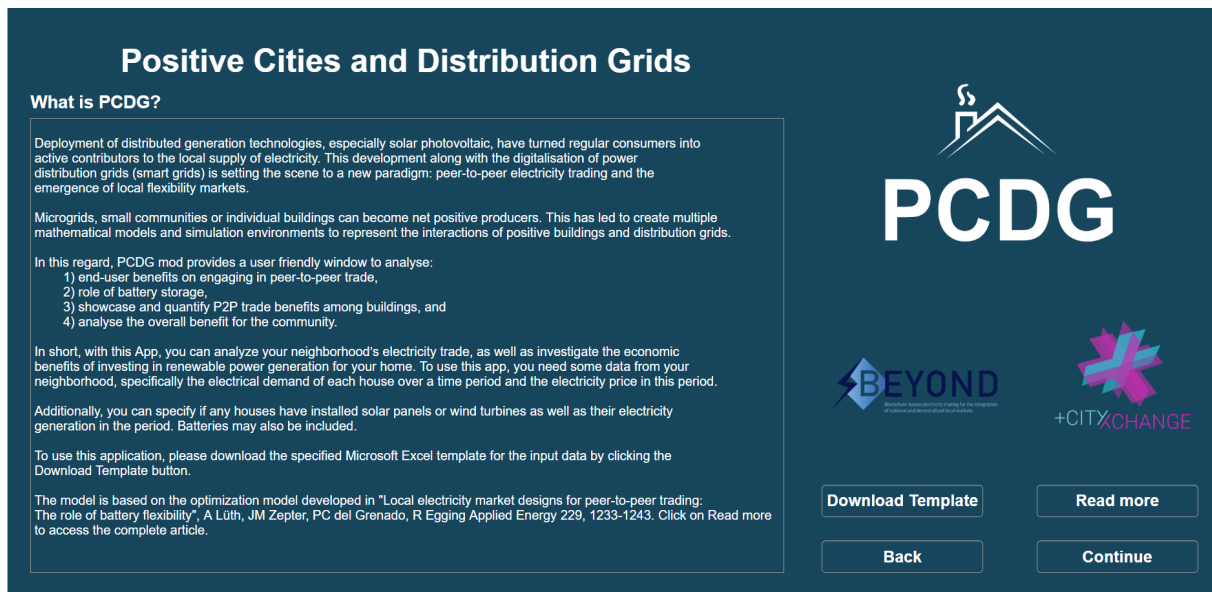


Figure 14: Snapshot: Home Tab

Additionally, there are four options provided at the bottom left corner of the PCDG application namely:

2.2.1 Download Template

Clicking on **Download Template** ² downloads the required template directly and redirects you to the from the GitHub page by **LocalEnergyMarkets** ³ which is to be used as the input data for the PCDG application. The template is pre-filled with example data which is an extract from the **9 month UK Dataset for 25 Houses**. Feel free to populate the template with your own data while maintaining the format of the template or use the existing data in the template to explore the PCDG application.

2.2.2 Read More

Clicking on **Read more** ⁴. Please feel free to also **Download** ⁵ the paper which is the basis of the PCDG application.

2.2.3 Back

Used to navigate to the previous tab in the PCDG application.

2.2.4 Continue

Used to navigate to the next tab in the PCDG application.

² Downloads the input file in the required format

³ Clicking redirects you to the LocalEnergyMarkets git hub repository

⁴ Redirects to the technical paper which is the core of the PCDG application

⁵ Downloads the technical paper which is the core of the PCDG application

3 Data Import Tab

The data import tab in the PCDG application enables you to import the data required for the simulation in to the application. It has a simple layout where all input related parameters appear on the left hand side and the chosen system for the simulation appears on the white display space on the right hand side as shown in the Figure 15. There three buttons which are present at the bottom of the display screen which help you to navigate within the application. The **Help** button in the center would automatically download this user manual for your reference so that you can quickly scroll to the particular section in this user guide to solve your query. Clicking on the logos at the top of the display screen will automatically redirect you to the websites of the respective project partners.

On the left hand side you see two buttons namely **Get Template** and the **Import Data**. Clicking on Get Template automatically downloads the template required for the PCDG software which as described in the previous section is pre loaded with sample data. You can use the same data provided by us or populate the template with your own data keeping in mind the structure of the template. When your data is ready just click on the Import data tab and navigate to the path containing the template similar to a standard upload procedure. At the top left corner, you can also see the guide indicating you to upload the data.

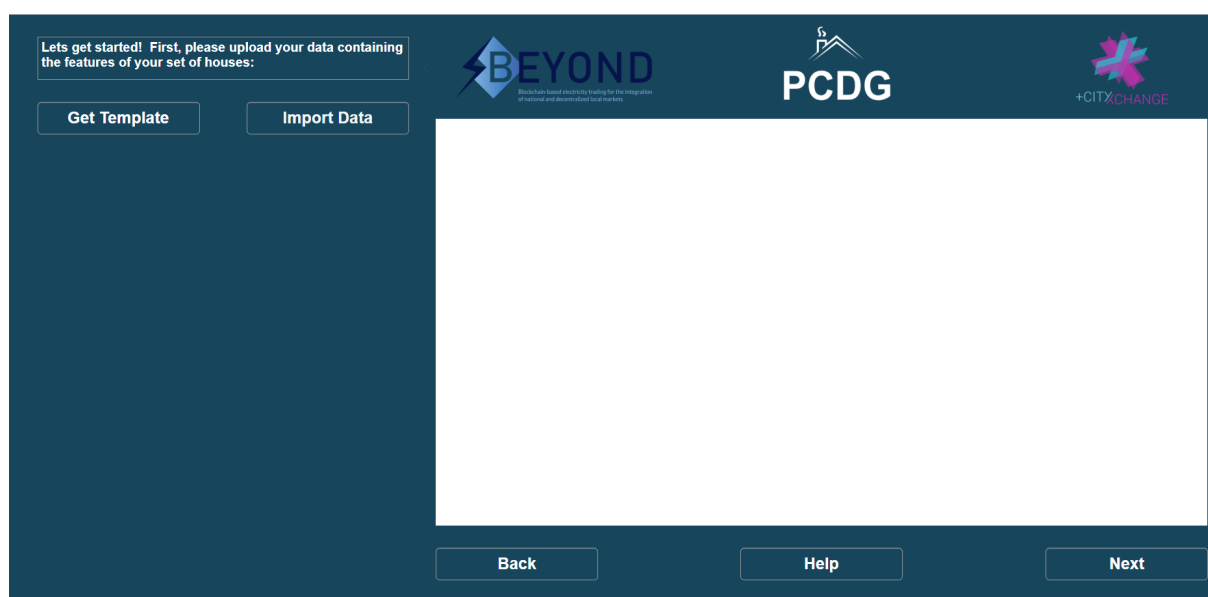


Figure 15: Snapshot: Data Import Overview

Once you upload your data, the left hand side of the screen displays more input parameters as shown in the Figure 16. Firstly, below the two buttons a **dialog box** appears which provides you with some insight of your data. The PCDG application checks your imported data to display the number of houses present in the simulation and the number of readings regarding the demand, PV, wind data etc. you have per house in your data. In the current example being used for this guide, we have used 25 houses and time series readings at 48 intervals of one day. Hence the application displays the text,

“We found Data for **25 houses** and demand data for **48 time periods**,,. It also checks whether all PV and Wind data are as per the required format and if the format has no problems “**PV and Wind Data** is fitting,,is displayed as shown in Figure 16.

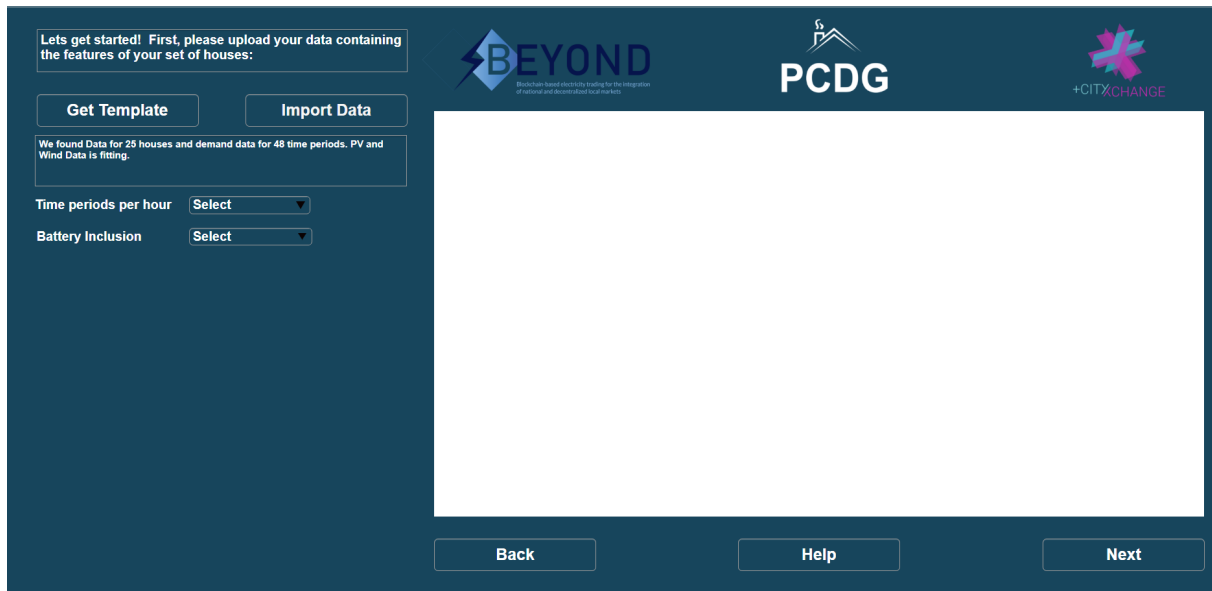


Figure 16: Snapshot: Data Import step-1

3.1 Option-1: Time Periods per Hour

The time period per hour option allows you to divide the hour into number of smaller intervals. The following intervals as shown in the Figure 17 are available in the drop down option. Choose the required time resolution as per your analysis.

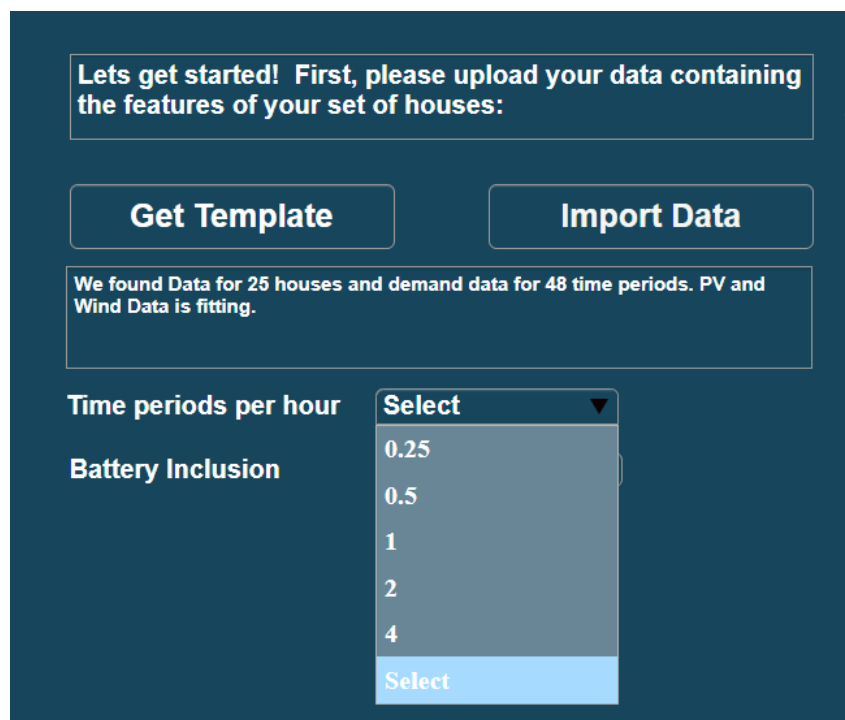


Figure 17: Snapshot: Data Import step-2

For example, in this data there are 48 entries present for the time series data. Selecting **Time periods per hour** option as 2 would result in the application reading the each data point as the value recorded every half our or in other words twice every hour. Similarly selecting **Time periods per hour** as 4 would lead to the data points being treated as data recorded every 15 minutes. A simple formula would be as follows:

$$\text{Data time interval} = \frac{\text{Number of Data points in the dataset}}{\text{Time periods per hour}} \quad (1)$$

3.2 Option-2: Battery Inclusion

At this point you make the first modeling choice in the application which is whether to include battery in your simulation or not. As mentioned in the article the application is based upon, this application demonstrates the potential of including batteries in P2P energy trade setup.

3.2.1 Battery Inclusion - Off

By excluding batteries n the first simulation you can obtain the results of the Key Performance Indicator (KPI) which can be later compared to the case including batteries to see the benefits if including batteries. A drop down option is provided to capture the input as shown in Figure 18

Figure 18: Snapshot: Data Import step-2

In the first simulation if the batteries are kept off the following model as shown in Figure 19 is displayed in the right hand side of the application. Each blue dot represents a house from the imported data set and is numbered as per the input order provided in the template. At this stage you can press the next button at the bottom right corner of the application to move to the next stage of the simulation.

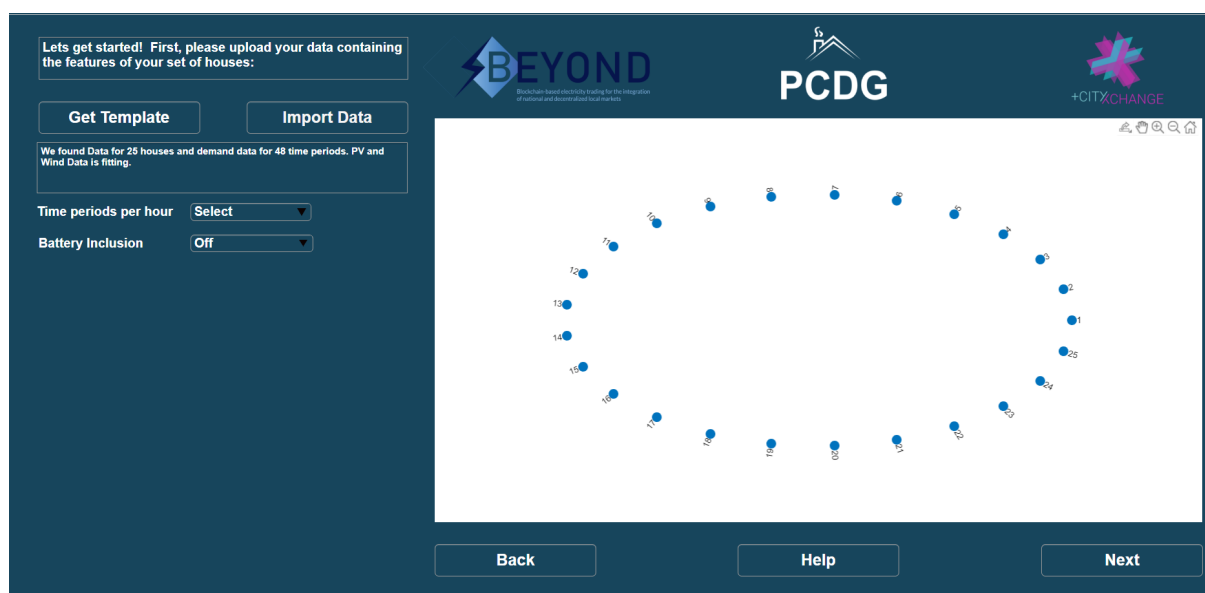


Figure 19: Snapshot: Model setup display when batteries are kept off

3.2.2 Battery Inclusion - On

As mentioned earlier realizing the real benefits of involving batteries is the goal of the application and this is achieved by selecting the **Battery Inclusion** option as on as shown in the Figure 20.

The left hand side of the application as seen in Figure 20 has more input options. A dialog box is displayed indicating you to fill in the required input parameters for the simulation.

Battery Parameters Currently, the model allocates the same battery type to all houses. This means that the battery parameters being selected will be common for all houses for which batteries will be included. You are free to choose any battery parameters suiting your analysis. Be mindful about the units when you enter the values, the necessary units are displayed at the right of each parameter. For example, Efficiencies are percentage values which means this can be any number between 1-100. For this simulation we will use the battery parameters are considered in the article.

Select House The select house feature enables you to choose the houses to which you want to allocate the batteries to. Clicking on the number allocated to the house would be sufficient to select a particular house. If you made an error during selecting the houses, to deselect a wrongly picked house click on the number again and it will be deselected.

After you have input all the required values to the parameters and made the selection of the houses the application view would look like as shown in Figure 21. The houses to which the batteries are allocated to are highlighted with green. The houses with no battery allocation remain as blue dots. This completes the data import to the PCDG application.

Lets get started! First, please upload your data containing the features of your set of houses:

[Get Template](#) [Import Data](#)

We found Data for 25 houses and demand data for 48 time periods. PV and Wind Data is fitting.

Time periods per hour

Battery Inclusion

Please select the houses with batteries and input the Battery parameters.

Battery Parameters	
Battery Capacity Value	<input type="text" value="0"/> kWh
Charging Efficiency	<input type="text" value="0"/> %
Max Charging Rate	<input type="text" value="0"/> kW
Discharging Efficiency	<input type="text" value="0"/> %
Max Discharge Rate	<input type="text" value="0"/> kW
Initial Battery Charge	<input type="text" value="0"/> kWh

Select House

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16

Figure 20: Snapshot: Parameters when battery inclusion is on

Lets get started! First, please upload your data containing the features of your set of houses:

[Get Template](#) [Import Data](#)

We found Data for 25 houses and demand data for 48 time periods. PV and Wind Data is fitting.

Time periods per hour

Battery Inclusion

Please select the houses with batteries and input the Battery parameters.

Battery Parameters	
Battery Capacity Value	<input type="text" value="4"/> kWh
Charging Efficiency	<input type="text" value="98"/> %
Max Charging Rate	<input type="text" value="1.2"/> kW
Discharging Efficiency	<input type="text" value="100"/> %
Max Discharge Rate	<input type="text" value="1.2"/> kW
Initial Battery Charge	<input type="text" value="1"/> kWh

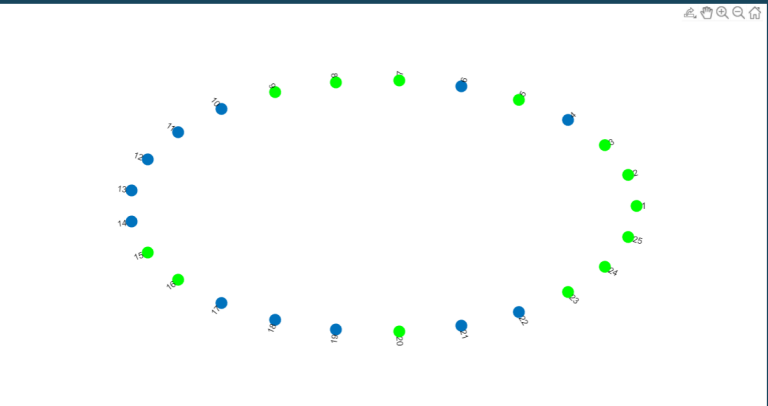
Select House

- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25

BEYOND Blockchain based electricity trading for the integration of national and decentralized local markets

PCDG

+CITYXCHANGE



[Back](#) [Help](#) [Next](#)

Figure 21: Snapshot: view of the application with all input parameters

4 Visualization Tab

The Visualization tab focuses on interpretation of the input data to identify underlying patterns and calculate the KPIs. Initially in the Visualization tab would appear as shown in Figure 22. The tab has a similar structure as the Data Import page. To the right of the screen you can see the space for visualisation and to the left is the **Run Simulation** button along with a lamp. When the lamp is red, it would mean that you have not run any instance of a simulation during this session.

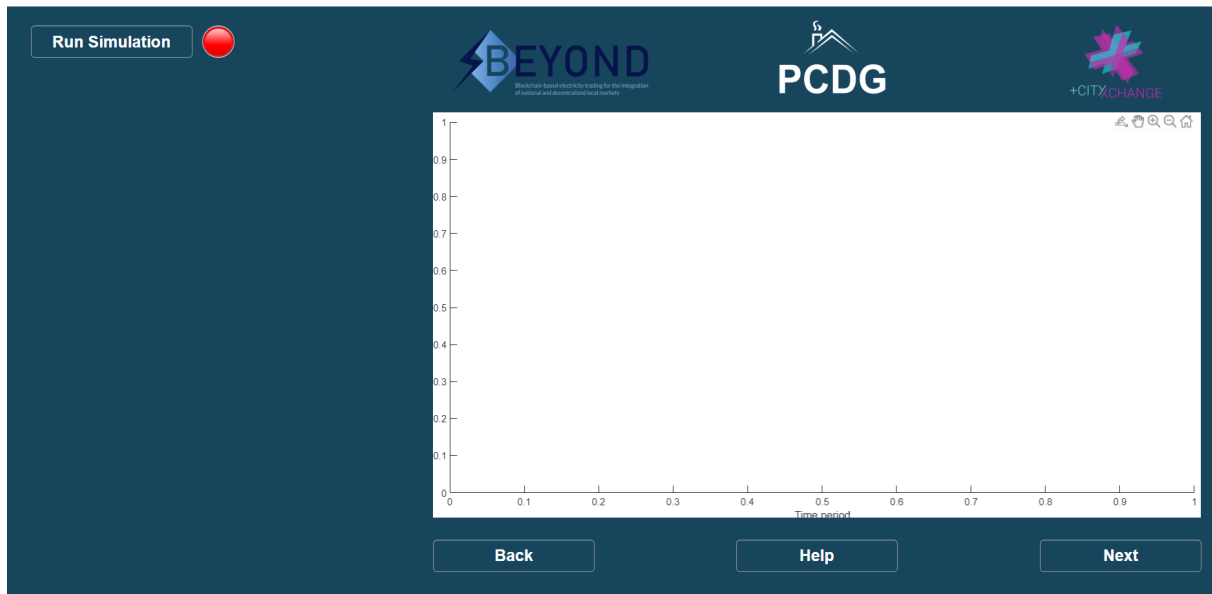


Figure 22: Snapshot: First look of the Visualisation Tab

After clicking on the **Run Simulation** button the lamp changes its color to yellow which signifies the calculations are running and a dialog box would appear indicating the status. This is shown in Figure 23.

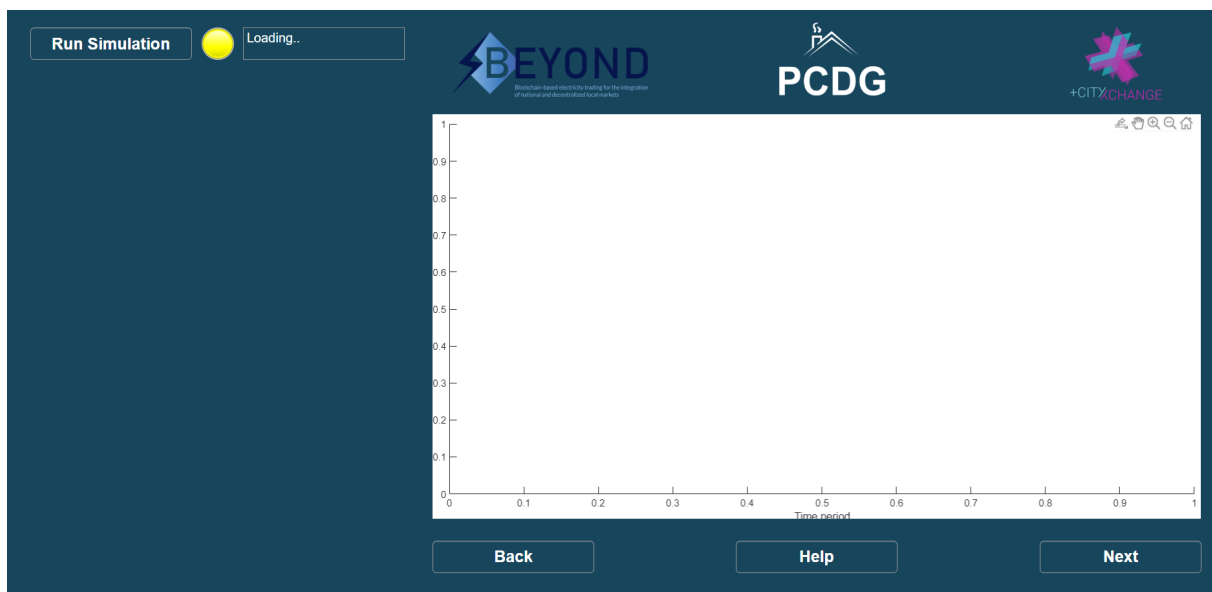


Figure 23: Snapshot: Processing the Visualisations

When the calculations are completed, the lamp turns green and the screen is populated with graphs on the right and the values of several KPIs to the left. In addition to this, several options are activated to interpret the calculations. This is shown in Figure 24

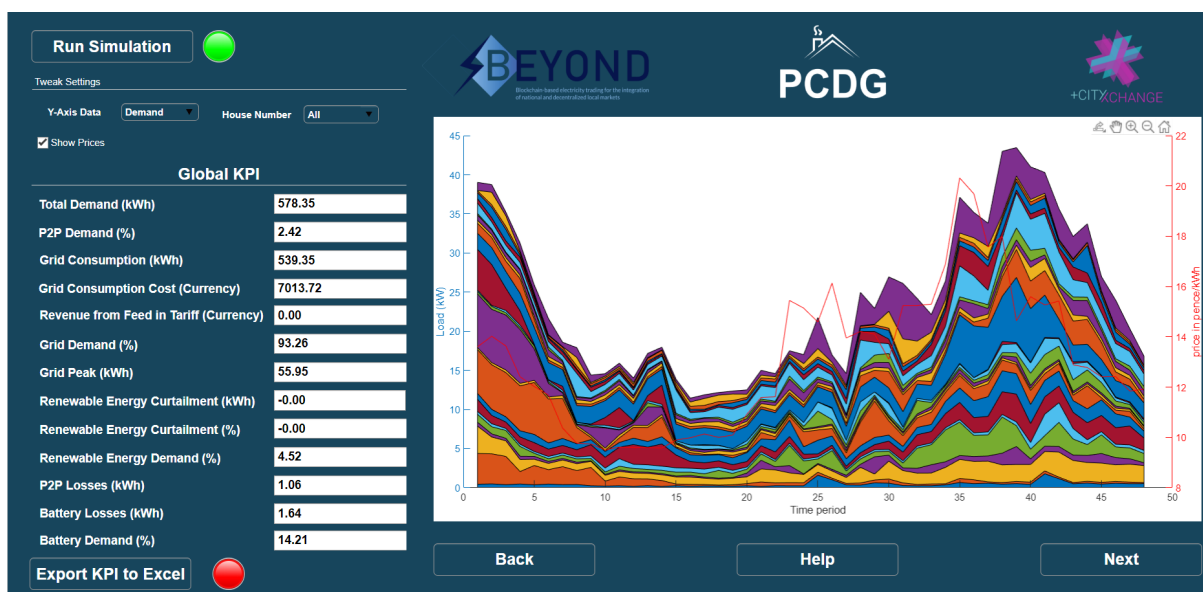


Figure 24: Snapshot: Visualisation tab with batteries included

4.1 Key Performance Indicators

Before we move to various graphs that we see to the right, we need to define the KPI. This will help you get a better insight to understand the values of the KPI.

- **Total Demand**

The total demand KPI is the sum of all the load values throughout the simulation period. This value is nothing but the sum of all the values in the **Demand** tab in the input data file in kWh.

- **P2P Demand**

The P2P demand refers to the part of the total amount of energy demand that is satisfied by P2P energy transactions. In the example the value is only around 2.5 % because the data used is from a typical day in winter with very less sunlight and wind.

- **Grid Consumption cost**

Usage of electricity leads to consumption cost, the price for each unit of electricity is set by the utility you are subscribed to. In the template provided for importing the data, there exists a separate tab named **Price** where you can set the prices based on your per unit cost of electricity. This price can be constant at all time periods or also vary during each time interval. Hence, the grid consumption cost would be the total cost borne by all the houses present in the simulation corresponding to the total amount of electricity bought from the grid. This does not include the cost or gain from P2P transactions.

- **Revenue from Feed-in-Tariff**

In some countries there is an option of Feed-In-Tariff. A Feed-In-Tariff refers to a fixed monetary payment per unit of electricity provided by the utility to deliver power back to the grid. This option is also present in the template under the **Grid Tariff**. In this example we have not included any tariff and set it at zero during all time intervals. Hence, the value seen is zero.

- **Grid Demand**

Grid demand refers to the amount of total required energy in the community being supplied by the utility. A simple formula can make things more clearer for you.

$$\text{Total Demand} = \text{Grid Demand} + \text{Renewable Energy Demand} + \text{P2P Demand} \quad (2)$$

- **Grid Peak**

Grid peak refers to the highest amount of power in kWh required during any particular time step of the input data.

- **Renewable Energy Curtailment**

Renewable energy curtailment is the amount of energy from renewable sources which is restricted from production due to inability to use or store it at that instance of time. This is a good indicator of battery sizing. If a significant amount of energy is being curtailed, it would be an indicator that a battery with higher capacity or power rating could improve the outcome of the simulation.

- **Renewable Energy Demand**

The amount of demand that is satisfied from renewable energy sources for self consumption is defined as the renewable energy demand.

- **P2P Losses**

Distributing energy from one location to another in a community would lead to physical which in this cases is termed as P2P losses. Please note that these losses only occur due to the interactions of the houses within the community and are not the losses from the distribution of power by the utility. In the example we have manually set the losses due to P2P transactions to 7.6% of the total P2P demand.

- **Battery Losses**

All batteries possess charging and discharging efficiencies. Due to these whenever a battery is charged or discharged will result in small amounts of losses. In this case we have considered the

charging efficiency to be 98% and discharging efficiency to be 100%. These parameters can be varied by the user as per requirement in the data import tab.

- **Battery Demand**

The amount of demand that is satisfied from P2P transactions which are made possible by the batteries is defined as the battery demand.

Please note that the KPIs depend upon the set up of the simulation in the data import tab. For example if in the Data import tab, the battery selection is switched off, then all the parameters which specifically refer to the batteries being in the system (ex. Battery Losses, Battery Demand) will not be displayed as they are equal to zero. This is shown in the Figure 25.

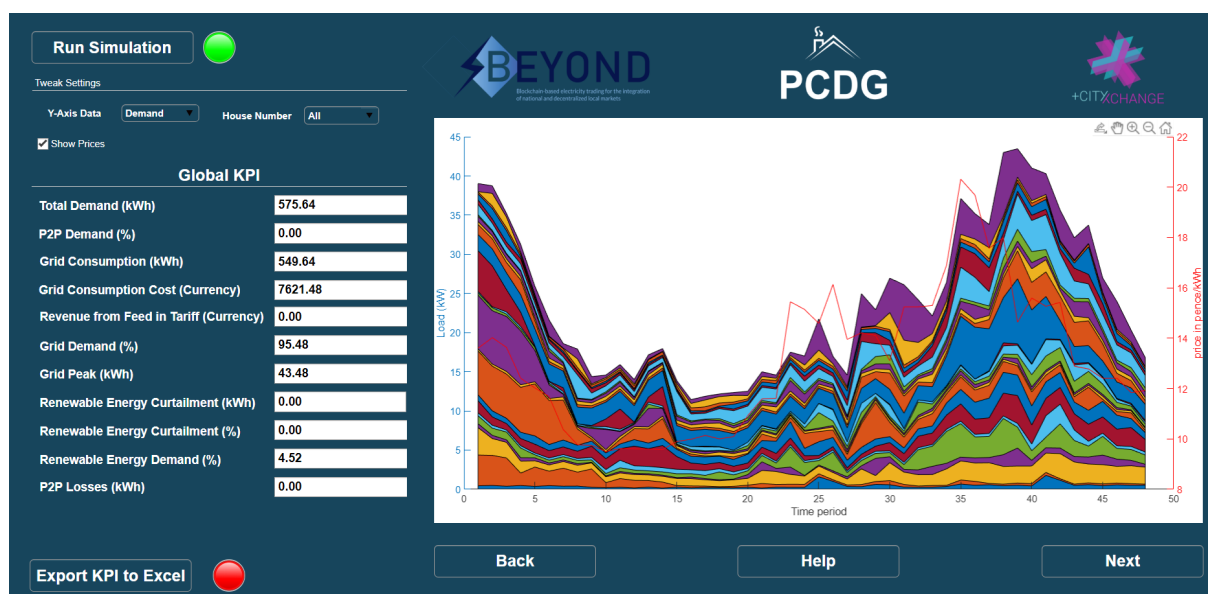


Figure 25: Snapshot: Visualization tab with batteries not included

4.2 Export KPI to Excel

In Figure 24 and in Figure 25, towards the bottom of the screen, there is another button which reads **Export KPI to Excel** with a lamp placed beside it. On clicking the button the KPIs that are displayed on the left will be exported to a CSV file and stored in the same location where the PCDG app launcher is present. The lamp turns green once the file is successfully stored at the location. This file is used as an input again in the **Compare** Tab which enables you to compare two simulations.

4.3 Tweak Settings

With all the KPIs defined now, it would make more sense to look at the visualisations available in the PCDG application. On the top left of the screen a panel named **Tweak Settings** is visible which contains several options pertaining to the visualisations. Options are provided to change the content of the graph with the help of the **Y-Axis Data** and **House Number**.

4.3.1 Y-Axis Data

The Y-axis refers to the axis to the left of the visualization which is marked in blue. The significance of the Y-axis changes according to the value selected in the Y-axis drop down. The contents of the Y-Axis Data drop down change in a simulation depending upon the battery inclusion. If the simulation is carried including the batteries in the model the following options as shown in Figure 26 can be seen.

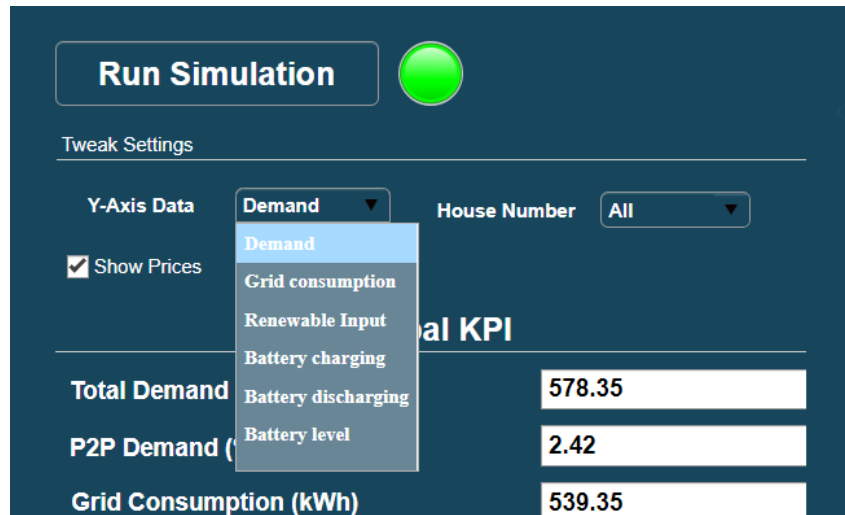


Figure 26: Snapshot: Options in Y-Axis Drop down with batteries included

If the batteries are not included then the options shown in Figure 27 can be seen.

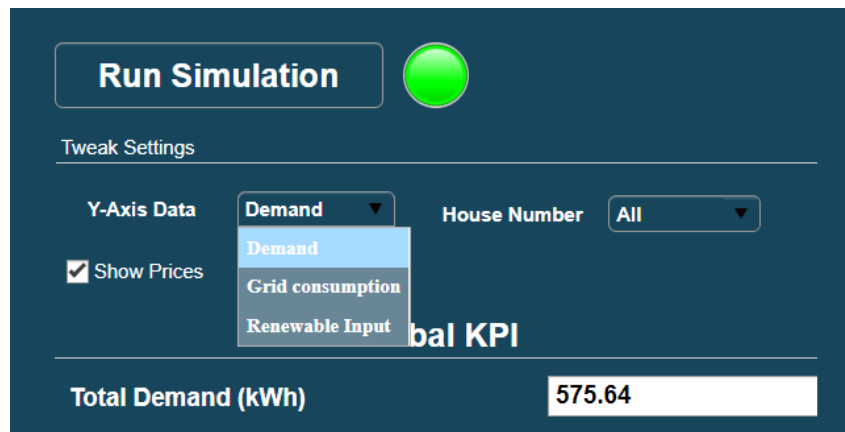


Figure 27: Snapshot: Options in Y-Axis Drop down with batteries included

Each option gives a different insight about the imported data and on choosing any of the options the graph at the right of your screen changes. By default demand data is plotted on the first instance of run simulation.

4.3.2 House Number

The data that is being visualised in the first instance is aggregated for all the houses in the simulation. The House number Tab allows you to specifically visualize the attributes of a particular house. The House number drop down has a list of all houses present in the simulation. An example is shown in

the Figure 28.



Figure 28: Snapshot: Options in House number drop down

In Figure 26, 27, and in 28 we see a tick box for **Show Prices**. Enabling this plots a red colored line graph in the visualisation space which indicates the price with respect to the time periods. The values can be read from the axis to the right of the graph which is also in red.

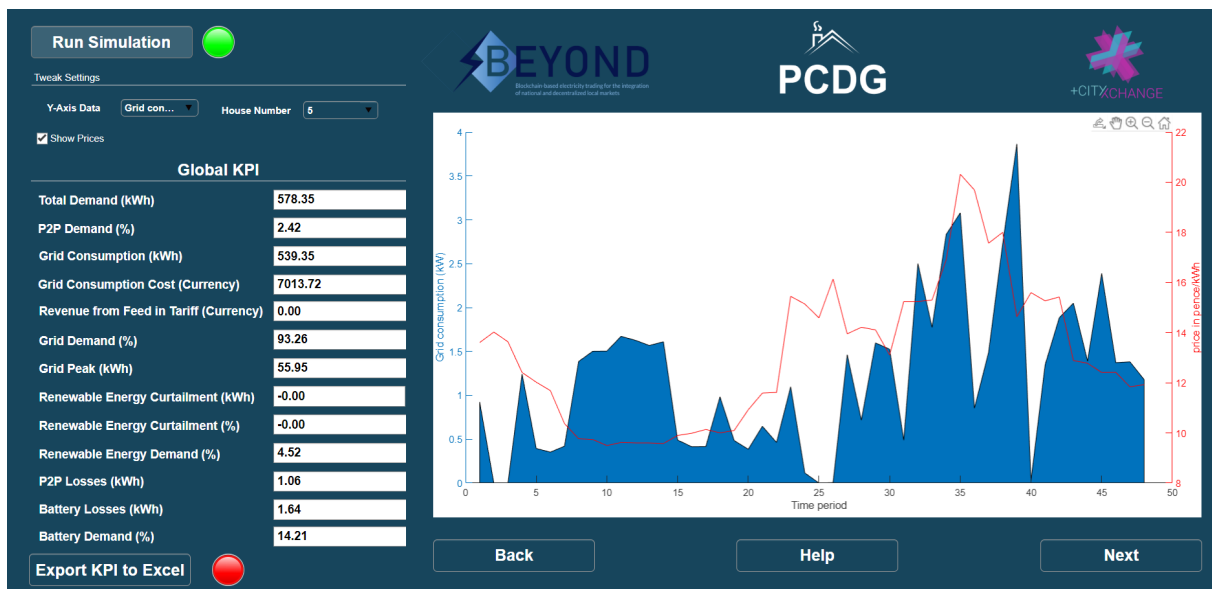


Figure 29: Snapshot: Example of Grid Consumption visualization for House number 5

As an example, grid consumption for house 5 is plotted in the visualization area, by selecting **Grid Consumption** option from the **Y-Axis Data** drop down and selecting **house number 5** from the **House Number** drop down. Observe the change in the visualization area compared to the Figure 29.

5 Trading Between Houses Tab

The Trading Between Houses tab is a visualization of the potential of P2P energy trading. The best case scenario for this is the use of batteries which significantly increases the number of P2P transactions compared to the case where no batteries are used in the community/neighbourhood. Hence, all the examples in this section are based on the case where batteries have been included in the simulation. An overview of the trading between houses tab is as shown in Figure 30.

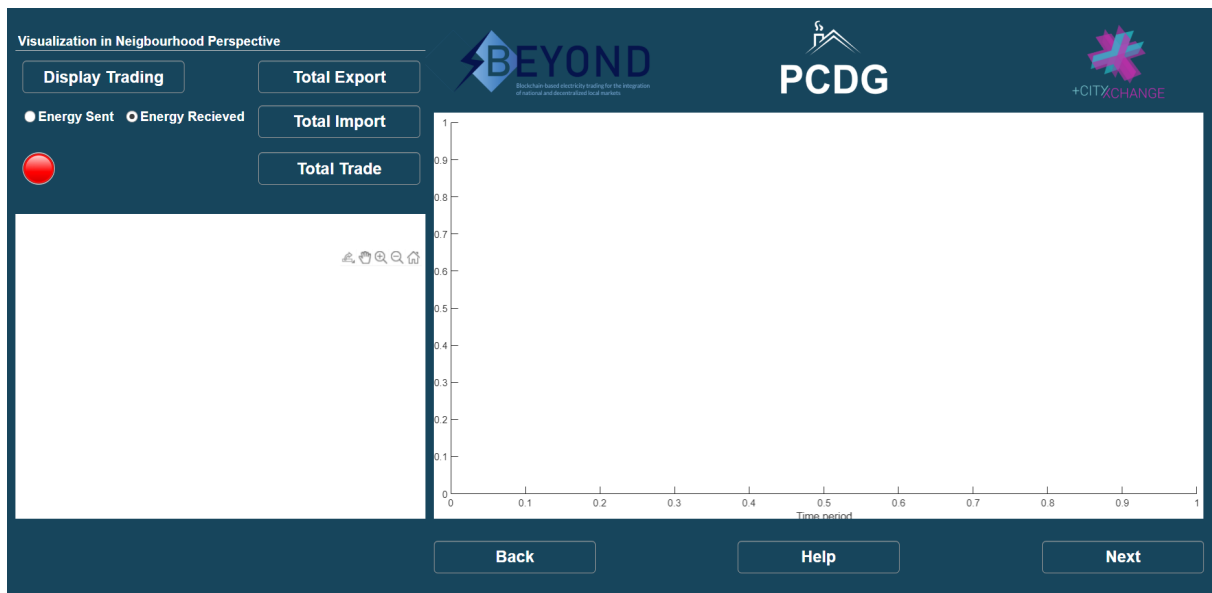


Figure 30: Snapshot: Overview of the Trading Between Houses tab

As seen from Figure 30, just as the previous tabs the screen can be divided into visualization space and input space. The only difference in this tab layout is that there are two visualization spaces. Towards the bottom left of the screen there is a smaller visualization space which displays trading between the houses as a line graph. The bigger visualization space on the right creates a matrix which displays trading in the form of a matrix. The goal to have two visualization spaces in this tab is to stress on the importance of P2P distribution of electricity and visualize it in different methods. In the top left corner there are parameters which decide what content will be displayed in the visualization spaces.

- **Display Trading**

The display trading button on the left is used to display the trading in the smaller visualization space. As there are inherent losses present in the system during P2P transmission, the energy set from a household is not exactly equal to the energy received by another household. Hence, there is an option to visualize both separately. The option is provided by the selection box namely **Energy Sent** and **Energy Received**. By default energy received has been selected for you. Choose any of the options you wish to visualize and click on the button **Display Trading**. A graph similar to as shown in Figure 31 will appear in the smaller visualization space. Please wait till the lamp above the screen turns green for the results to appear.

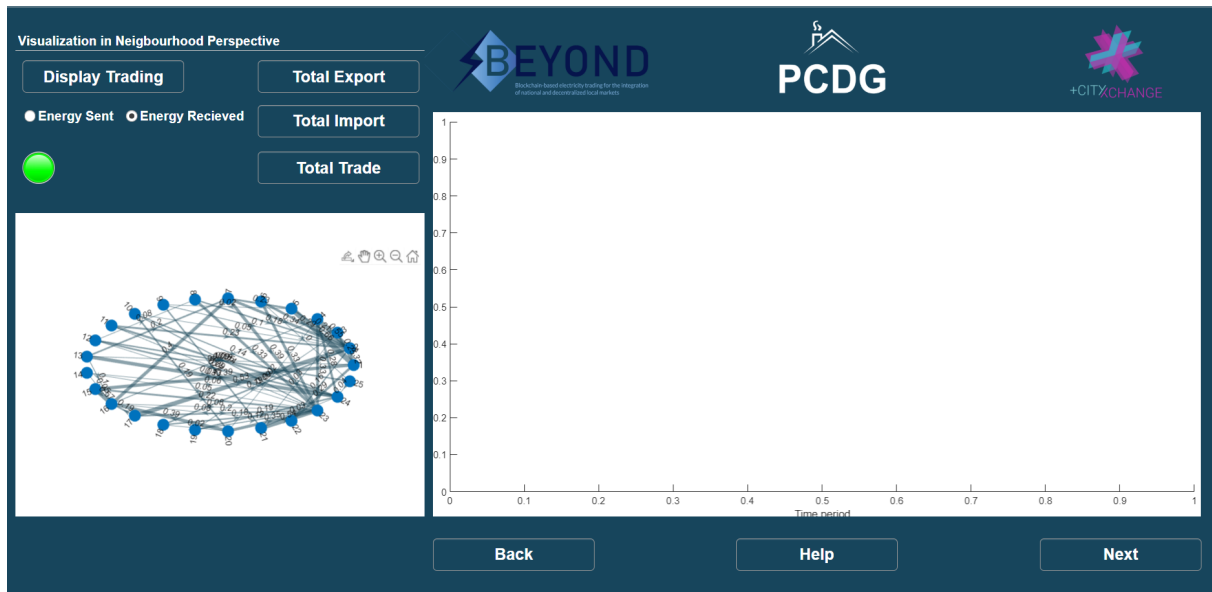


Figure 31: Snapshot: An example of the Display Trading visualization

- **Total Export**

The Total Export button as mentioned before, displays the amount of energy exported from the houses. As this feature is exclusively constructed for tracing export of energy the houses importing the energy will have no values assigned to them. If a house is importing and exporting energy, then only the exports corresponding to the house is displayed. The display corresponding to this button is the bigger visualization space on the right. An example is shown in Figure 32. Also, please wait for the lamp to turn green which signifies that the output is ready.

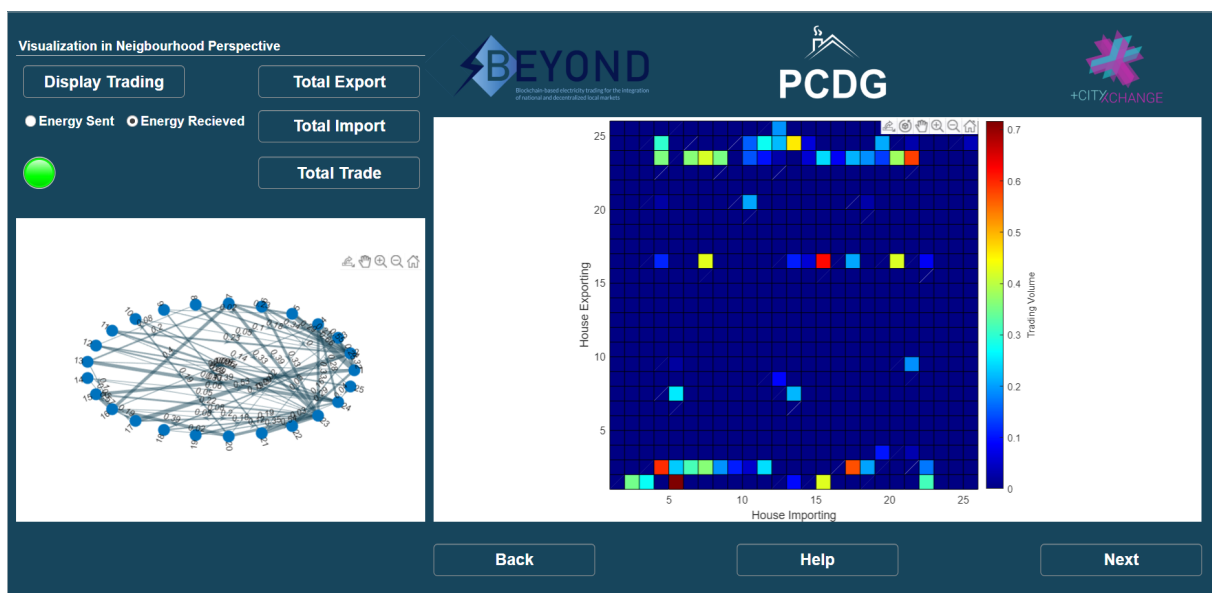


Figure 32: Snapshot: An example of the Total Export visualization

- **Total Import**

The Total import button acts similar to the export button, it displays the amount of energy

imported to the houses. As this feature is excursively constructed for tracing import of energy the houses exporting the energy will have no values assigned to them. If a house is importing and exporting energy, then only the imports corresponding to the house is displayed. The display corresponding to this button is the bigger visualization space on the right. An example is shown in Figure 33. Also, please wait for the lamp to turn green which signifies that the output is ready.

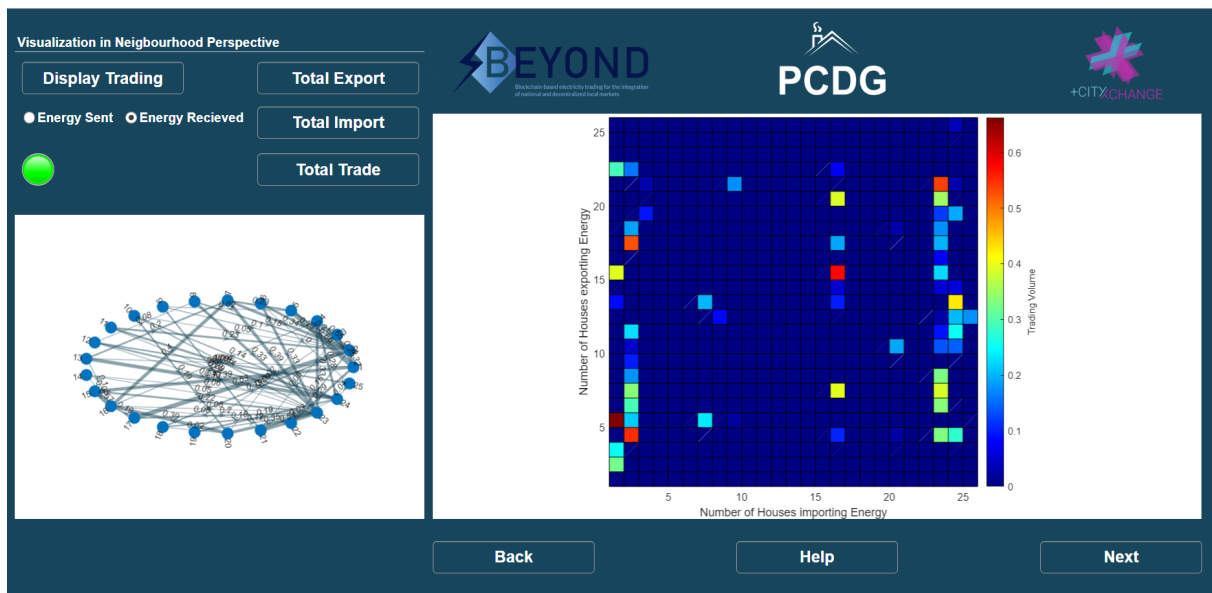


Figure 33: Snapshot: An example of the Total Import visualization

- **Total Trade**

In both the previous visualizations only import and export of energy were focused upon. But, in reality, a house with a battery is capable of importing and exporting energy based on the need of the house. This flexibility is captured by assessing the total trade status of each house which is nothing but the net energy position of each house. In simpler words it is the difference between the import and export of energy carried by each house. The visualization adds an extra layer which helps you to track the energy flow so as to who received or sent the energy. The display corresponding to this button is the bigger visualization space on the right. An example is shown in Figure 34. Also, please wait for the lamp to turn green which signifies that the output is ready.

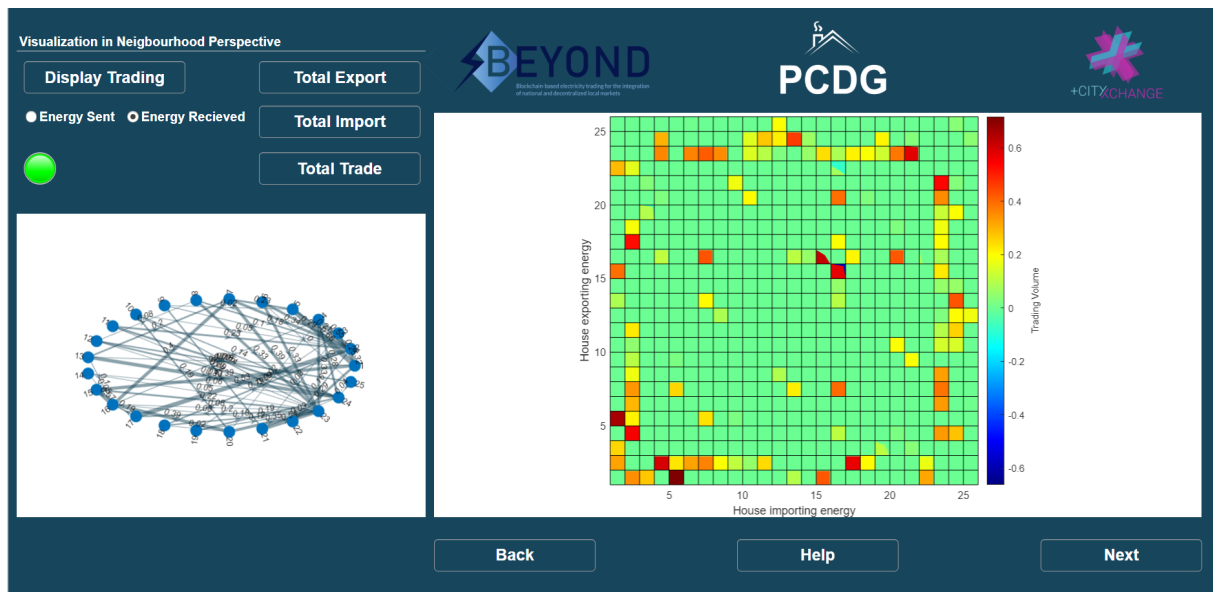


Figure 34: Snapshot: An example of the Total Trade visualization

6 Compare Tab

The Compare Tab is used to graphically compare the Global KPIs from the visualization tab. The **Export KPI to Excel** button in the visualization tab enables you to download the KPIs as mentioned before. Now, in this tab you can compare any two instances of your previous simulations. Please note that exactly **two** exported KPI files are required to use this tab. The overview of the compare tab can be seen in the Figure 35.

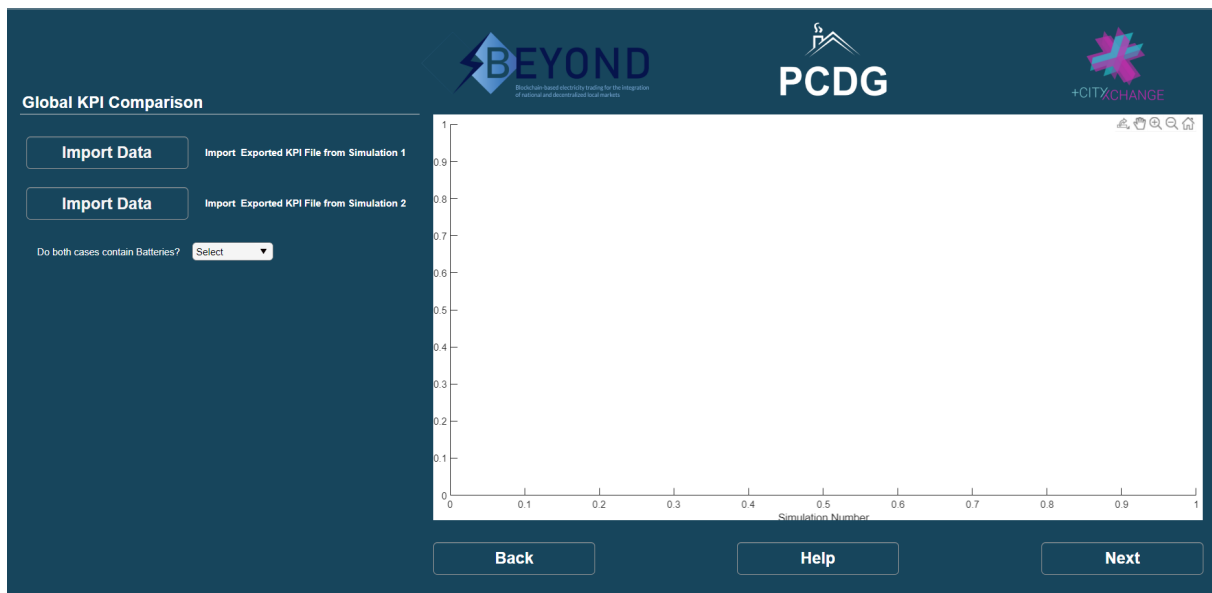


Figure 35: Snapshot: Overview of the Compare tab

As seen in the previous tabs, the visualization area is to the right of the screen along with navigation control in the application. The visualization area in this tabs creates simple bar graphs to compare the KPIs from two simulations. The content displayed in the graph changes according to the selection made to the left of the screen.

6.1 Importing files for comparison

As seen in Figure 35 there are two **Import Data** buttons present. The first button is used to import the Excel file containing the first set of the KPI whereas the second button is used for the second data set. When you download the KPI files from the visualisation tab they get stored in the same folder which contains the launcher of the application (Folder named Step-2). Each exported file will have a time stamp which can be used to differentiate between two simulations. To import the files click on the respective import data buttons and specify the path. An example is shown in Figure 36.

Once you have successfully uploaded both the required input files, the next thing to do is answer the question displayed below the import buttons. The question that is asked is that whether both simulations consider batteries. This means if both the exported KPI files were simulations in which batteries were included. If yes, then select the option **Yes**. If no, which means one of the simulations

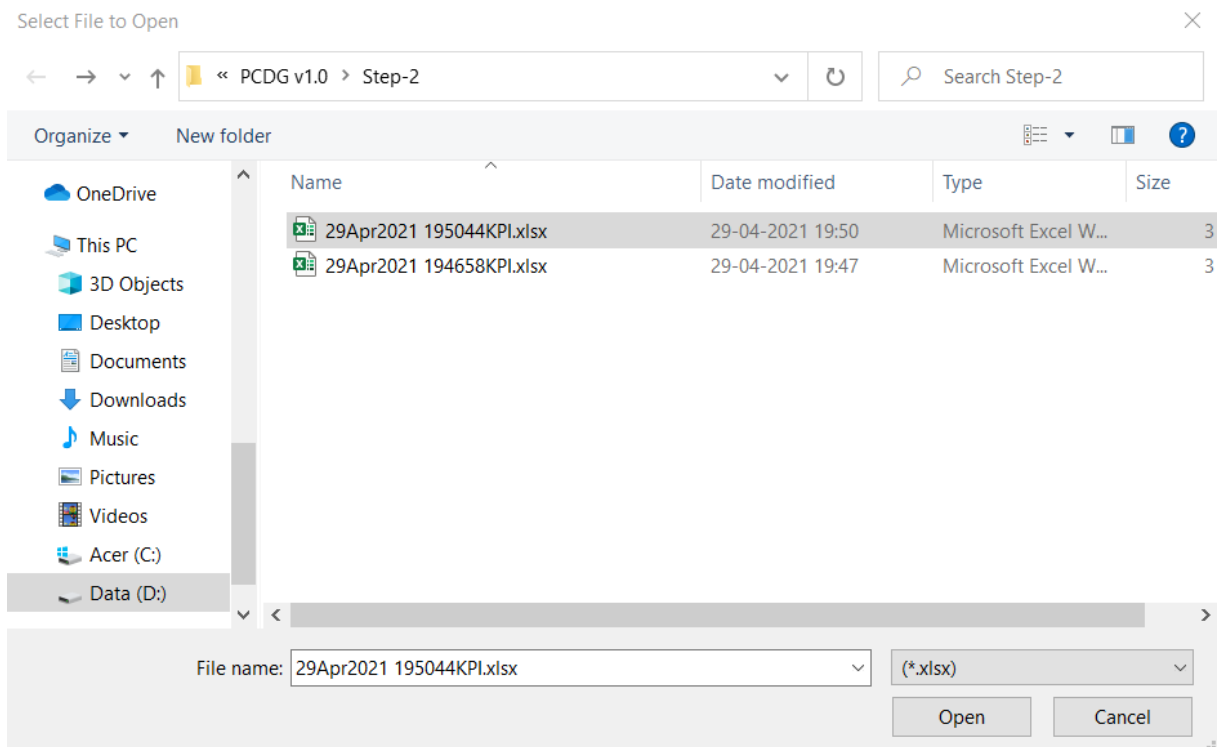
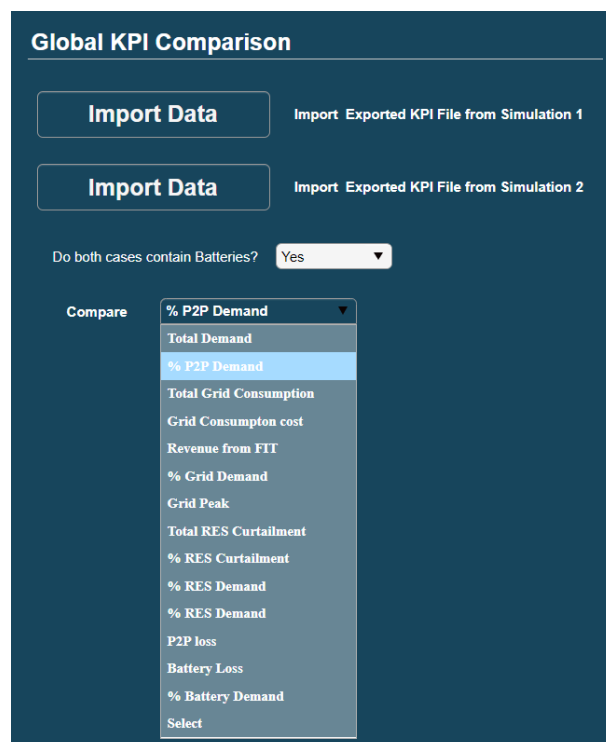


Figure 36: Snapshot: Importing files for comparison

did not contain batteries then please select **No**. After selecting the appropriate option a drop down option named compare appears below the the tick box. This drop down contains KPIs which can be compared with each other from different simulations. The result will be displayed as bar graphs in the visualization space. Examples of the drop down option are shown in Figure 37 and Figure 38.

Figure 37: Snapshot: Compare drop down when **Yes** selected as the answer

Global KPI Comparison

Import Data

Import Exported KPI File from Simulation 1

Import Data

Import Exported KPI File from Simulation 2

Do both cases contain Batteries?

Yes

Compare

% P2P Demand

Total Demand

% P2P Demand

Total Grid Consumption

Grid Consumption cost

Revenue from FIT

% Grid Demand

Grid Peak

Total RES Curtailment

% RES Curtailment

% RES Demand

% RES Demand

P2P loss

Battery Loss

% Battery Demand

Select

Figure 38: Snapshot: Compare drop down when No selected as the answer

7 End Tab

The end tab is as shown in the Figure 39. This page provides the contact information of the project contributors and developers. If you as a user of PCDG have any comments or suggestions which could help us improve the application further, you can send us an email or also contact us through the Github platform **LocalEnergyMarkets**. Similar to the Welcome page in section 1.2.4, clicking on the logos displayed redirects you to the websites of the project partners where you can read about other new and interesting projects. In addition to this, there are four buttons present at the bottom of the screen as seen in Figure 39.

7.1 Download Template

Clicking on **Download Template** ⁶ downloads the required template directly and redirects you to the from the GitHub page by **LocalEnergyMarkets** ⁷ which is to be used as the input data for the PCDG application. The template is pre-filled with example data which is an extract from the **9 month UK Dataset for 25 Houses**. Feel free to populate the template with your own data while maintaining the format of the template or use the existing data in the template to explore the PCDG application.

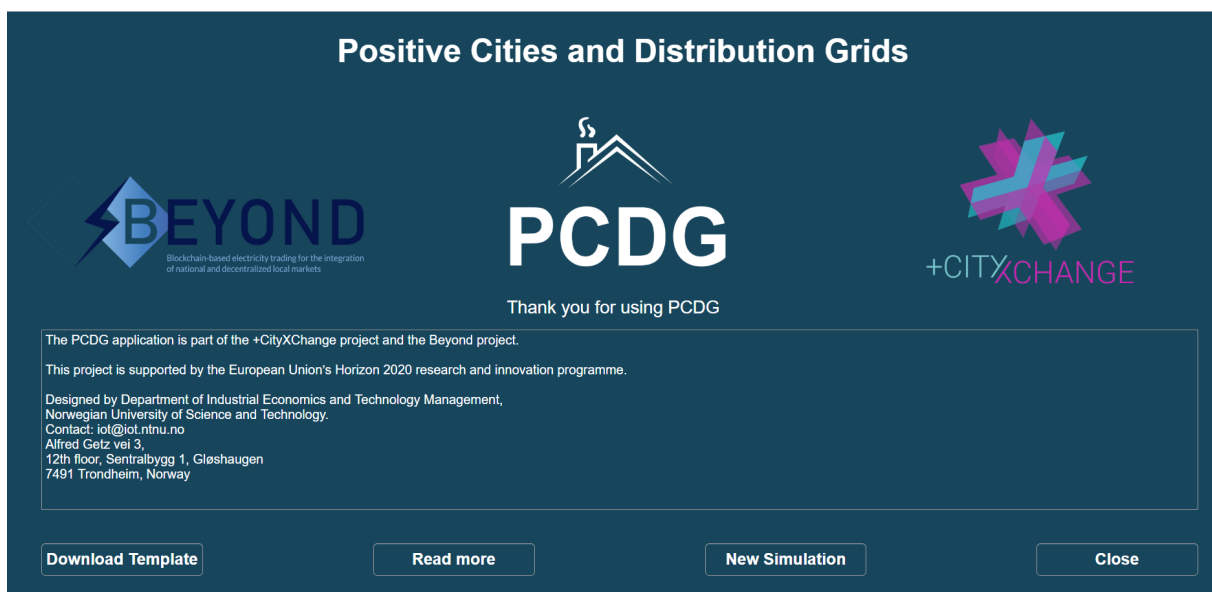


Figure 39: Snapshot: End Tab

7.2 Read More

Clicking on **Read more** ⁸. Please feel free to also **Download** ⁹ the paper which is the basis of the PCDG application.

⁶ Downloads the input file in the required format

⁷ Clicking redirects you to the LocalEnergyMarkets git hub repository

⁸ Redirects to the technical paper which is the core of the PCDG application

⁹ Downloads the technical paper which is the core of the PCDG application

7.3 New Simulation

Clicking on **New Simulation** will close the current instance of the application and will re-open the PCDG application beginning from the home page ready for a new simulation. You would be using this button to generate the second instance of output of KPIs from different simulations for comparison in the compare tab. During any simulation, this button can be also used to restart the application.

7.4 Close

The **Close** button ends the current running instance of the PCDG application.