Using WaterCress-e to determine your cheapest Electrical Provider

Comparing providers using various comparison websites is fine for a basic review however they do not consider the influence of solar panels, batteries, or more particularly how you use energy in your home. Every solar/battery setup is different and when and how much energy you consume is never considered in basic analysis. This process using watercress-e allows you to make an accurate comparison between various energy providers. We provide you with the “myhouse2” project setup to get you started.

Note: This is not a quick click and answer pops out process. It does require that you define your solar/battery system and identify how and when you use energy. It also requires you to set up a data file providing rainfall and sun shading that is relevant to the area you live. The more detail you provide here the more confidence you can have in the result.

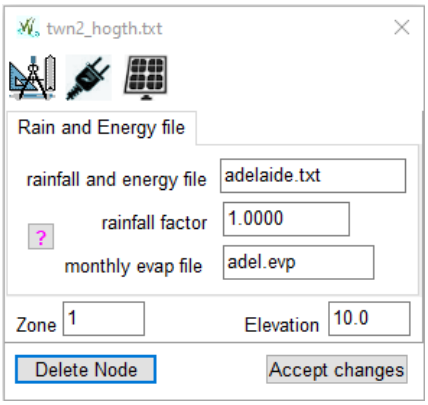
Click on **files** in the top menu and search through the list to select “**myhouse2**”. When selected click the **Accept** button and the project information for this project is displayed.

Note: if you wish to personalise the “myhouse2” name, use explorer to go to the folder c:\watercress and make a copy of the “myhouse2” folder. Rename this copy to what you wish (but don’t make the name too large or include spaces). For example, rename it to something like “18fredstreet”. Before you can use this project, you must close watercress if it was open. Next time you run watercress your new file will be in the existing projects list.

Now click on the menu item **to Project Layout** which takes you to the layout page.

You will now see three nodes displayed. Node 1 is your house, node 2 is the power supply provider and node 3 is the water supply provider. As, in this example, you are just analysing power simply ignore the water supply inputs. While you are learning it is best not to delete a node. You will learn as you go how to build up a project into very complex structures.

More information of this layout and how to input data is provided in the self-sustainable house help file, and this discussion is not fully repeated here.



Start by ensuring **Model components** (RHS menu) is checked and then left click on node 1 (the house). The input window displays the energy and rainfall file required and has 3 picture icons showing. The icons open further windows namely water supply layout, energy demand, and energy generation.

WaterCress-e is designed to provide a detailed assessment of how much energy your house can produce through PV panels and batteries, and based on your defined annual and daily distribution of demand determines how much power must be supplied to your house. This does require significant time series inputs by the user, including:

A **timeseries file** for your area, provided in the correct format. This file may contain the time series data of rainfall, cloud cover and wind run. In this example Adelaide.txt contains rainfall and cloud cover. Evaporation data may also be included in this timeseries file but more often is handled by a separate file as a simple a set of monthly values, and in this example adel.evp.

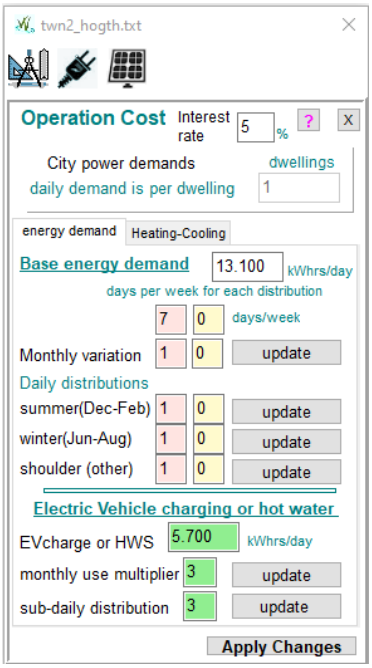
At least one timeseries file is needed to cover the time duration you wish to examine. Details of the format of these files is covered in other help menus. Daily data for these files is readily available in

Australia through the Bureau of Meteorology but requires modification in external programs such as excel or notepad++.

*In addition, you can provide a **calibration file** which contains either your actual power generation, power usage or water usage for comparison with the modelled data. The calibration file can only contain one record at a time. Typically for this exercise you might input the PV generation from your house, if available, which can give assurance of the accuracy of the modelled data. A calibration file does not have to be included.*

Step 1 Identify your Energy Demand.

The program then requires that you provide your power supply infrastructure layout and sizing to the accuracy you feel necessary. The more detail you provide the more accurate the analysis.



Power demand is set by clicking on the plug icon, as a combination of electricity demand per day.

The demand per day can be distributed up to 4 ways as **base electricity** demand, **PV or controlled** usage, **heating** and **cooling**. The heating and cooling options are accessed through the heating-cooling tag.

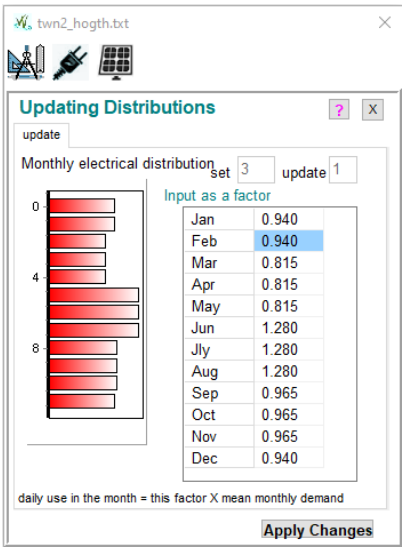
For each of these, demand can be varied month by month and hour by hour. *The example provides a demand structure to view or modify as you wish.*

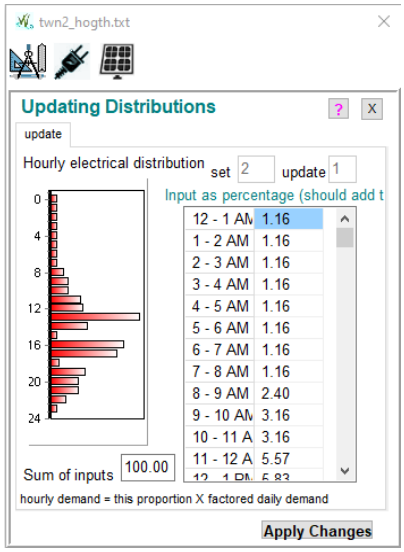
Often the base electricity demand and the accompanying distributions can provide sufficient accuracy of demand usage alone. This is set by defining the base demand in kWhrs/day. This base rate can then be varied across the month and hour as required.

The base demand also allows the distribution to be set for two different periods of the week. For example, the pink column distributions refer to the number of days in the week as set above. This allows for situations where you may have a different usage demand, say between the work week and weekends.

The demand is set by the base energy demand modified by the monthly and daily distribution set. To set the distribution required click on the distribution box you wish to change then click on update distribution button. *Note, there are 10 distributions for each of monthly and sub daily options, and these are saved in a file named "usedistribution.txt" located in the project folder. For each type of distribution there are only 10 allowed for the whole project. Bear in mind that if you change one of these then you change the demand of any other node which uses the same distribution. Also note that you can't update a distribution zero as this is always a constant distribution.*

For a monthly variation the user places a multiplying factor which influences the base rate. Click on the pink box 1 adjacent monthly variation and then click update adjacent to the box. The monthly update window is similar to the one below is now showing. *The factors for Jan to Dec are multiplied by the base demand to give the daily demand for the particular month.*

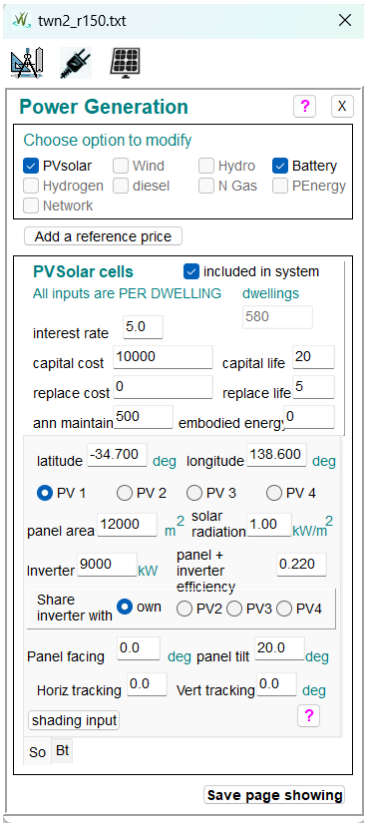




The daily demand is then allocated for each hour of the day for three periods of the year, being summer, winter and spring/autumn (shoulder). For the hourly distribution the number placed is a percentage of the daily demand and note the factors in this case should sum to 100%. *While such detail is not always known it is recommended to at least estimate your usage across the year and day, as this will best determine how your solar panel generation interacts with your usage.*

You can repeat this viewing/modification process for hot water, heating and cooling to provide a comprehensive assessment of how you use energy in the dwelling. *Note in the example provided, the summer, winter and shoulder distributions are all set the same value. Because of this all the months sub-daily distributions will be the same, but variations are, in this case, identified by including the heating and cooling requirements of the house.*

Step 2 Set your Energy Generation and Storage



Your power generation and storage are set by clicking the **solar panel icon** which allows you to set **PVsolar** and **battery** options. Click on **PVsolar** to open the system sizing and cost window. PVsolar or batteries may be turned on by selecting **included in system**.

*Note: there is a small button with a **"?"** located on most input windows and this provides detailed information of the inputs required on the page. Please click this for more detail.*

Here the required information is:

Your **latitude** and **longitude** which enables the solar energy throughout the day to be calculated.

Basic information of the panels such as **area**, **facing angle**, **panel tilt** and **inverter size**. The panel-inverter efficiency is likely to lie between 16 and 20%. *Note: all angles are relative to North (Sth hemisphere) with the angle measured clockwise from North. Sun would rise typically around 90 degrees and travel to zero degrees by mid-day. Post mid-day angles would commence at 360 degrees and reduce until sunset around 270 degrees.*

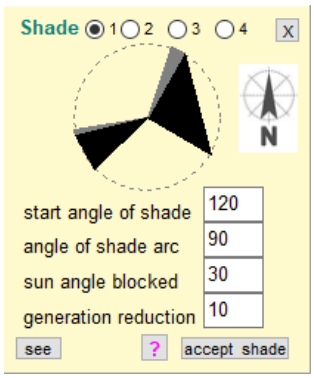
As most house panels are static set the **horizontal** and **vertical tracking** to zero.

If you have panels which are directed at differing angles the options PV1 through PV 4 allow you to set panels in up to 4 configurations

with different shading configurations. *Note: In this example if you select PV1 or PV2 you will note that the panel area and facing changes. The panel areas all sum together (note PV3 and 4 have zero panel area) to make up the total system.* **Share inverter with** refers to defining if each set of panels have a different inverter. Typically, you may have panels on two different faces of your roof, but they share a common inverter. *Note: In this example PV1 has its own inverter with PV2 sharing with PV1*

*Important Note: When you are updating say PV1 (which includes the **shading impact** and ticking **included in system** as detailed below), you must **save page showing** before you move on to change PV2.*

How the panels are shaded can be important but often difficult to quantify. If unknown you can set it to zero but remember this will overestimate your power generation.



An additional program **sunshade.exe** ships with watercress. Running this program in parallel with viewing the suns interaction with your panels (or the roof where you wish to place panels) will help you define any shading influence.

Shading is set in the program clicking on the **shading input** button which raises the adjacent window.

In the example shown the shade set 1 commences at angle 120 degrees then continues for 90 degrees towards north and blocks all sun (value of 10) to an angle of zero to 30 degrees above horizontal. This is shown as the first black triangle. Now clicking on shade 2 shows it commences at angle 30 degrees then continues for 11 degrees towards north and blocks 70% of the sun (value of 7) to an angle of zero to 29 degrees above horizontal. This is the second grey triangle shown.

While complex, this is best done viewing the shading that is occurring and using the angles provided by sunshade.exe and assess whether the blockage is partial or full.

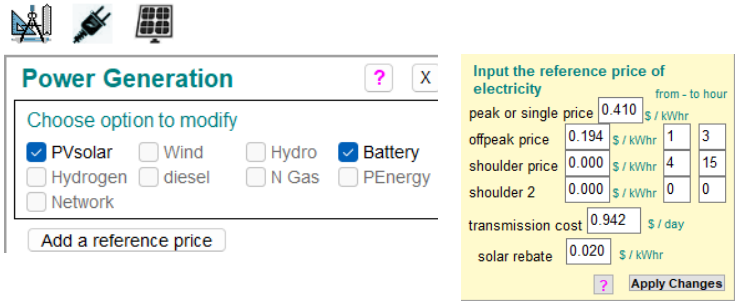
Up to 4 shading arcs (**checking shade 1 to 4**) can be input for each face of PV cells (ie PV1, to PV4). Ensure you **accept shade** after each set of inputs (shade 1 – 4) to register. On accepting shade an arc is displayed on the shading circle. When you have completed adding shade inputs you may click the **X** to close the window, but you must **save page showing** before moving on to the next PV layout.

Cost of panels can also be added on this page by inputting **capital**, **replacement**, and **maintenance** cost. This information along with the interest rate defines the daily cost of the system and then a cost per kWh can be calculated. *Note this cost is the cost of all the panels together.*

Step 3 Now once these values are set the comparison between providers can be made in the following manner.

To set up the comparison of tariffs.

Firstly, input the new tariff you wish to compare. Click on house node 1 and the click solar panel icon. Set a reference price by clicking the **add a reference price** button. For this exercise, this is the new price of energy to be compared with what your current provider charges.



Clicking on reference price raises a supply tariff window where the price structure is divided into up to 4 periods being peak, off-peak, shoulder and PV-recharge (shoulder2).

A cost input is required for peak or single price which becomes the base price of the power. If the house has a smart meter, then energy may be charged in relation to time it is taken, hence the off-peak, shoulder costs and PV recharge can be added. If the tariff is not time of use, these values should be set at zero.

The transmission cost is the cost per day charged for the poles and wires connection fee and the solar rebate is the amount paid back to you for feeding your excess energy to the grid.

Next, input your existing tariff from your current provider. This done by clicking on node 2 the **power supply node** and access the input data by selecting the plug icon. For this exercise you are not interested in how the power node supplies power but only how much it charges users for this energy. So, none of the generation options, for example, **PVsolar** or **battery** need to be selected. **Network** will always be selected which can be viewed as the constant generator of power.

For this exercise all that is needed is to update the supply price. I suggest you refer to the help for power generation to see how this node operates if you wish to explore power generation beyond the scope of this example.

Clicking on **update supply price** raises a supply price window identical to the one for reference price. Update the pricing information from your existing provider.

Now Run the program. Click **to output** on the upper menu then **run/run** on the upper menu.

Note, the "myhouse2" project has the outputs pre-set to provide the comparisons needed for this example. To modify the output, refer to the help files provided.

Once the run is completed click the close window and the spreadsheet will be filled. Initially it will be filled with monthly values. Click **annual** in the top menu to display annual data. If you haven't changed the output options, you will see columns labelled 2 through 14 with the following explanation:

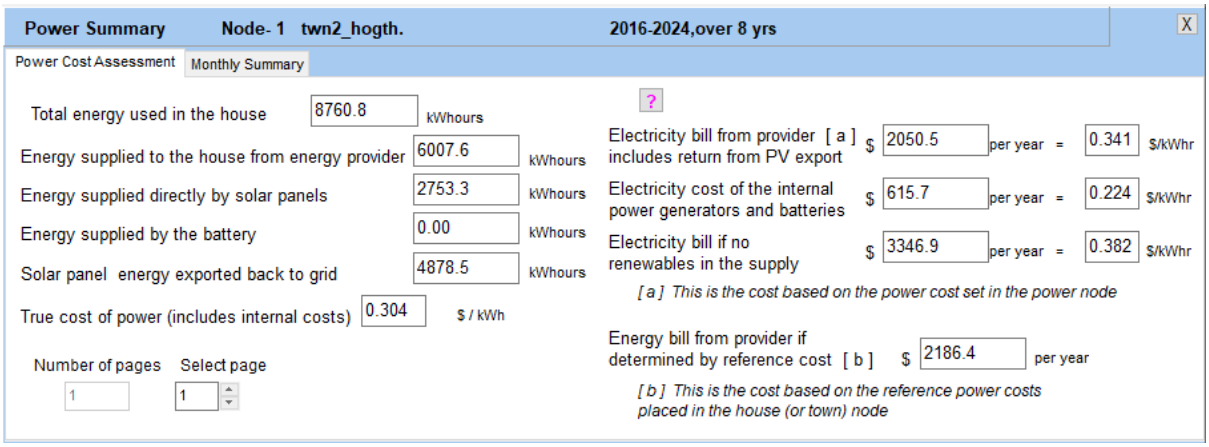
Current project name - myhouse2

File Run Hourly Daily Monthly Annual Summary Graph Additional spreadsheet

	2	3	4	5	6	7	8	9	10	11	12	13	14
date	1_TotalEner	1_PVtotal	1_PVdirect	1_Solar Xpo	2_EnergyFr	1_NRGsupp	1_RefEnerg	1_NRGsupp	1_RefEnerg	1_EnergyC	1_PV Xport	1_IntnEnerg	1_TotalNRG
units	kWh	kWh	kWh	kWh	kWh	AU$	AU$	$/kWh	$/kWh	AU$	AU$	AU$	AU$
mean value	8761.00	7631.75	2753.27	4878.50	6007.38	2050.46	2186.50	0.234	0.364	2245.62	195.14	615.65	2666.12
2016	8782.00	7595.00	2748.82	4846.00	6033.00	2061.80	2197.00	0.235	0.364	2256.00	193.84	618.60	2680.50
2017	8754.00	7498.00	2727.60	4771.00	6026.00	2062.30	2196.00	0.236	0.364	2253.00	190.83	619.40	2681.70
2018	8754.00	7542.00	2728.67	4814.00	6025.00	2060.10	2195.00	0.235	0.364	2253.00	192.55	617.70	2677.80
2019	8754.00	7937.00	2795.85	5141.00	5958.00	2020.20	2161.00	0.231	0.363	2226.00	205.63	604.60	2624.80
2020	8782.00	7576.00	2760.83	4815.00	6021.00	2058.30	2193.00	0.234	0.364	2251.00	192.60	619.90	2678.10
2021	8754.00	7721.00	2764.21	4956.00	5989.00	2040.20	2178.00	0.233	0.364	2238.00	198.25	612.00	2652.20
2022	8754.00	7416.00	2730.89	4685.00	6023.00	2064.40	2197.00	0.236	0.365	2252.00	187.40	622.80	2687.20
2023	8754.00	7769.00	2769.28	5000.00	5984.00	2036.40	2175.00	0.233	0.363	2236.00	200.01	610.20	2646.70

- **1_TotalEnergy** is the houses total energy demand for the year.
- **1_PV total** is energy that the solar panels produce
- **1_PV direct** is the solar energy that can meet the house demand directly
- **1_Solar Export** is the excess energy that is returned to the grid
- **2_EnergyFrom** is the energy supplied to the house from the external supplier.
- **1_ElectCost $** is the cost of energy charged by the external supplier.
- **1_ElecRef $** is the cost of energy based on the reference price.
- **1_ElectCost $/kWh** is the cost of energy charged by the external supplier.
- **1_ElecRef $/kWh** is the cost of energy based on the reference price.
- **1_Energy Cost $** is the cost of energy imported.
- **1_PV export $** is the value of the export tariff returned to the house.
- **1_Intn Energy $** is the cost of house infrastructure to produce energy.
- **1_TotalNRG $** is the cost of all energy.

Alternatively, select **summary/provider cost assessment** to see a summary page of the comparison. Click on the "?" button on this window to see a full description of this page.



Note: The summary page is based on whole years and therefore the annual outputs may not always equate to the summary values. If they don't you will probably find (looking at the monthly spreadsheet) that there are additional months included.

The summary page is the quickest review of the results. To the left is the total energy used in the house and where it draws it from. On the right-hand side, the two important outputs are at the top and bottom of the page. On the top is the calculated electricity bill based on your current providers tariffs. Below is the bill if you changed to the new provider (the reference costs added earlier). Both take into account any credits provided for solar rebates back to the grid.

Therefore, from the summary page, when you compare the electricity bill from your provider against the energy bill based on the reference cost you can determine which supplier you should go with.

In addition, estimates are also provided for the cost of your own generation system which is based on the systems costs you inputted earlier. On the lower left area, the true cost of power identifies the total cost to you including the provider supply plus your infrastructure. Ideally this cost should be less than your electricity bill if there were no renewables available (shown on the RHS).

Once set up, you have done all the hard work, now you can now easily tweak your system to optimise its value. Add more PV panels add various size batteries or change how you use electricity.