

Renewable Energy System Project: Modelling Energy Systems with PyPSA

1. [PyPSA \(Python for Power System Analysis\)](#) is written in Python 3 so the first thing to do is to install Python 3 on your computer.
2. If you have never used Python before there are many good courses online. I can recommend the following
<https://www.edx.org/course/introduction-to-python-for-data-science-3>
<https://www.edx.org/es/course/using-python-for-research>

3. Python is a programming language. Packages are built using this language, e.g. pandas, numpy, pypsa.

When we are writing a piece of code we can benefit from functions that are included in packages previously developed by other people. To do that we need to (a) install that package in our computer and (b) import it in our script. One easy way of using Python is through Anaconda because it allows a simple way of installing the packages that we need. Anaconda is available for Windows, Mac OS X and GNU/Linux. You can install it from the following link.

<https://docs.anaconda.com/anaconda/install/>

4. We can create an environment to include a group of packages. Open the Anaconda navigator, select “Environments” and create a new environment with a new name (Figure 1).
5. Installing PyPSA. Select your newly created environment. The window on the right shows the installed packages. Add the channel conda-forge. Selected the option “All” and look for PyPSA. Select the package and “Apply”. (Figure 2).

Alternative way: Click on the "play/pause" button present on the environment name
 Click "Open terminal" from your environment
 In terminal type "conda config --add channels conda-forge" (Figure 3)
 In terminal type "conda install pypsa" (Figure 4)

Additional installing instruction for PyPSA installation on other systems can be found in

<https://www.pypsa.org/doc/installation.html>

6. PyPSA passes optimisation problems for Optimal Power Flow to an external solver. We use Gurobi as solver and we need to get a license for that.

To install Gurobi: Click on the "play/pause" button present on the environment name

Click "Open terminal" from your environment

In terminal type "conda config --add channels <http://conda.anaconda.org/gurobi>" (Figure 5)

In terminal type "conda install gurobi" (Figure 6)

Now, you need to get an academic license to use Gurobi, follow the instruction in the link. You will need to register and log in to get a license.

<https://www.gurobi.com/downloads/free-academic-license/>

7. You have the PyPSA documentation available as webpage or pdf in the following links.

<https://www.pypsa.org/doc/index.html>

<https://pypsa.org/doc/PyPSA.pdf>

8. The first thing that we will do is to run a very simple case to test that everything is working properly.

We will be using a Jupyter notebook for this. Jupyter notebooks are documents in which we can include both code and text (to explain the code). Hence, they are very useful to learn new programs and to show examples.

Save the Jupyter notebook named "testing.ipynb" to your computer. Select "Home" in Anaconda, install and launch Jupyter notebook and open the file.

Follow the instruction in "testing.ipynb" to check that everything is working.

9. Now we can start with the real exercise. The description is included in the Jupyter notebook named "project.ipynb"

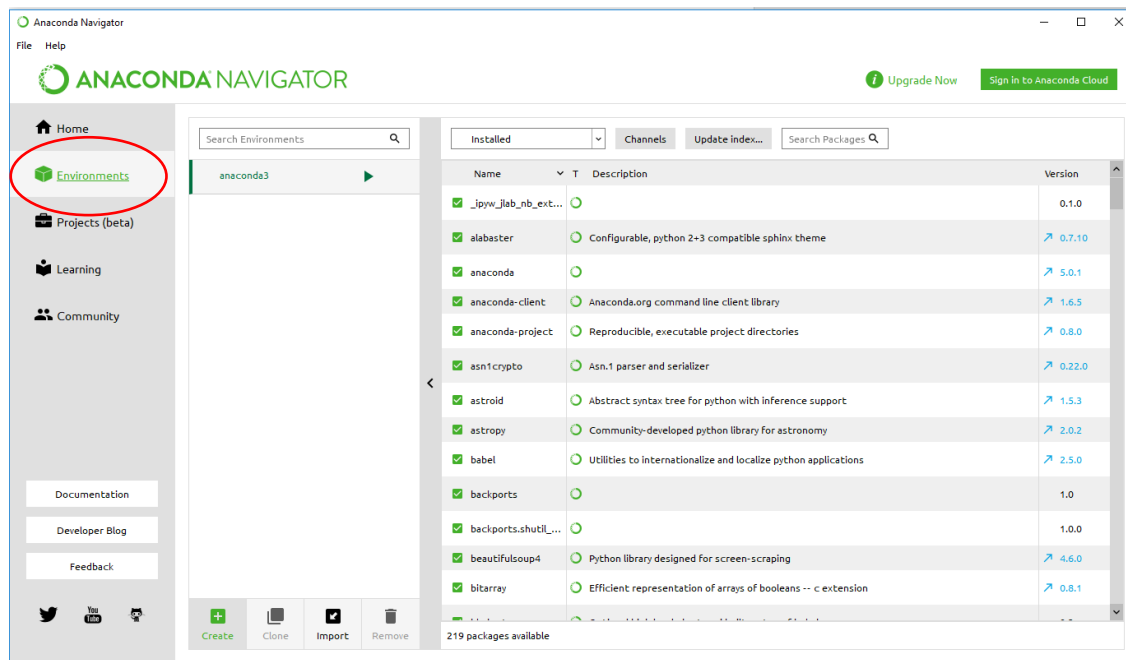


Figure 1. Creating a new environment in Anaconda.

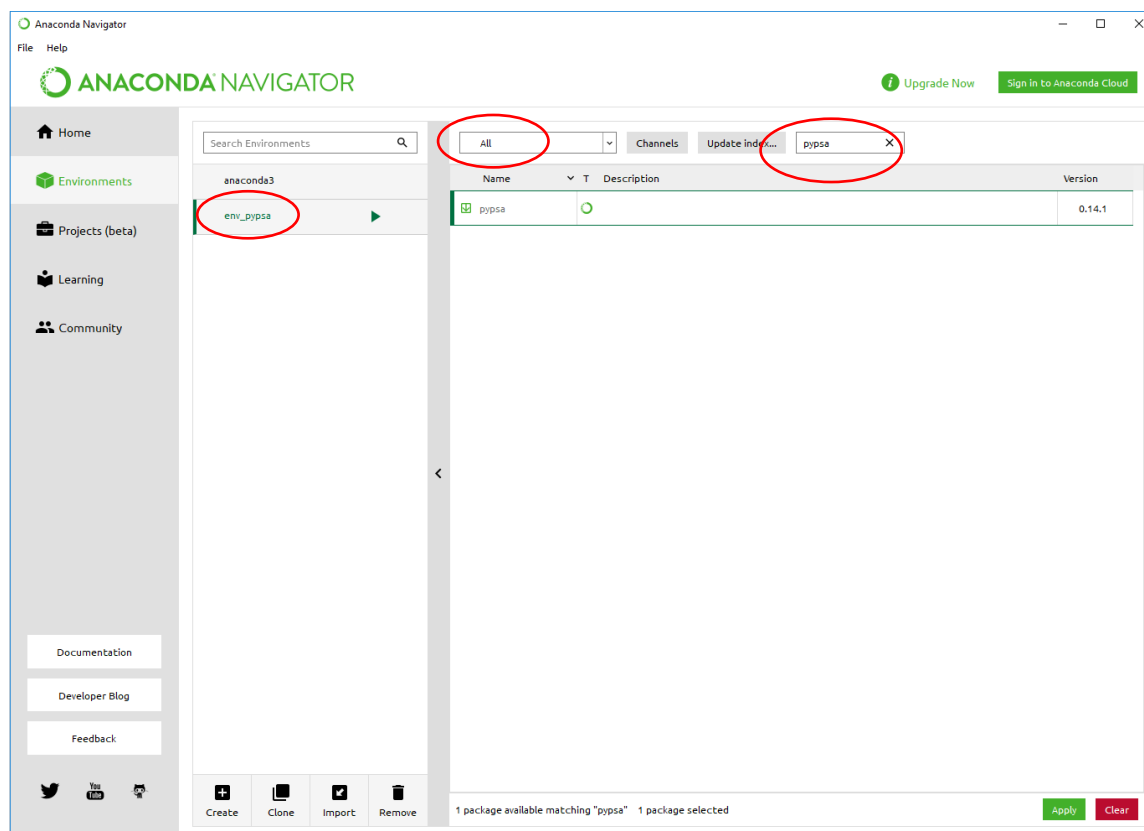
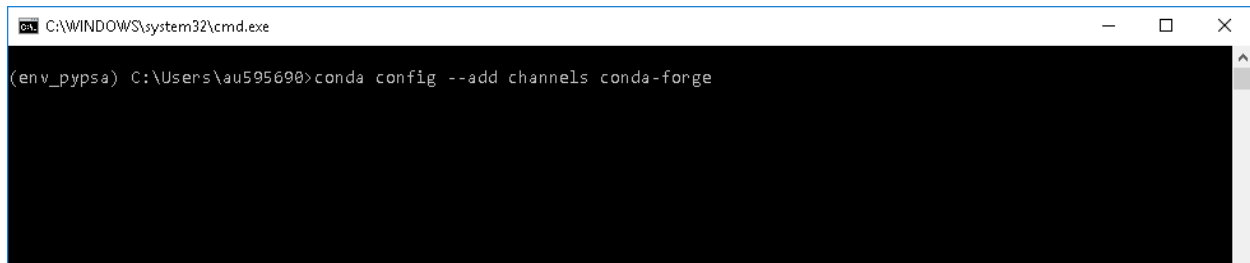


Figure 2. Installing PyPSA in the new environment named “env_pypsa”.



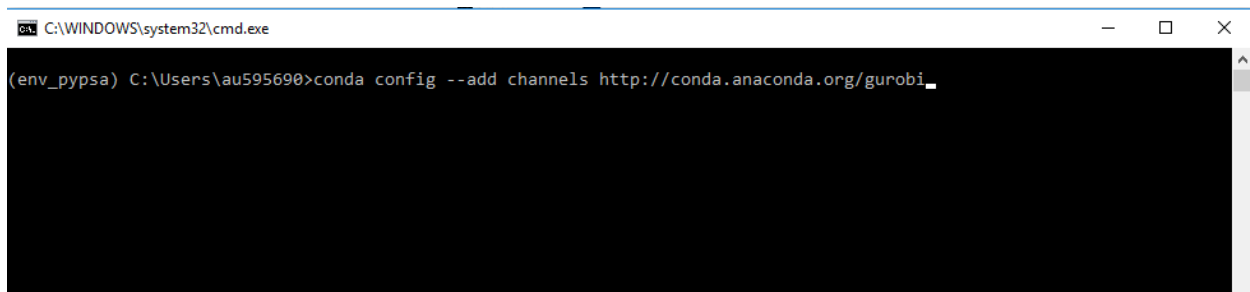
```
C:\WINDOWS\system32\cmd.exe
(env_pypsa) C:\Users\au595690>conda config --add channels conda-forge
```

Figure 3. Adding the conda-forge channel.



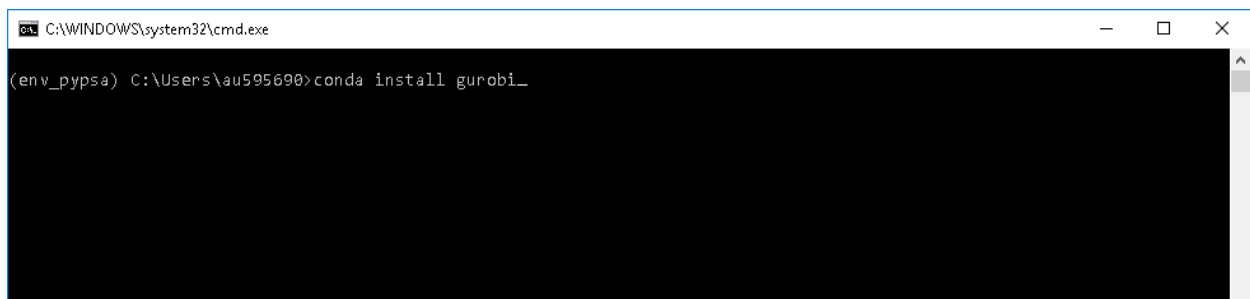
```
C:\WINDOWS\system32\cmd.exe - conda install pypsa
(env_pypsa) C:\Users\au595690>conda install pypsa
```

Figure 4. Installing PyPSA in the new environment using the terminal.



```
C:\WINDOWS\system32\cmd.exe
(env_pypsa) C:\Users\au595690>conda config --add channels http://conda.anaconda.org/gurobi_
```

Figure 5. Adding the channel to the new environment to install Gurobi.



```
C:\WINDOWS\system32\cmd.exe
(env_pypsa) C:\Users\au595690>conda install gurobi_
```

Figure 6. Installing Gurobi in the new environment.

```
Command Prompt
Microsoft Windows [Version 10.0.17134.829]
(c) 2018 Microsoft Corporation. All rights reserved.

U:\>grbgetkey 635cc1ce-a3c1-11e9-be3b-02e454ff9c50
info : grbgetkey version 8.1.1, build v8.1.1rc0
info : Contacting Gurobi key server...
info : Key for license ID 335207 was successfully retrieved
info : License expires at the end of the day on 2020-07-10
info : Saving license key...

In which directory would you like to store the Gurobi license key file?
[hit Enter to store it in C:\Users\au595690]:

info : License 335207 written to file C:\Users\au595690\gurobi.lic

U:\>
```

Figure 7. Installing Gurobi academic license in your computer.