

# USER GUIDE

*V3.1 - English*



**EXERGO  
ECONOMIC  
ANALYSIS**

# INTRODUCTION

This is just a quick start guide, it will show the steps that have to be followed in order to launch the calculation. For more information regarding the solution methods please refer to the *component documentation* file that can be opened from the help section of the app.

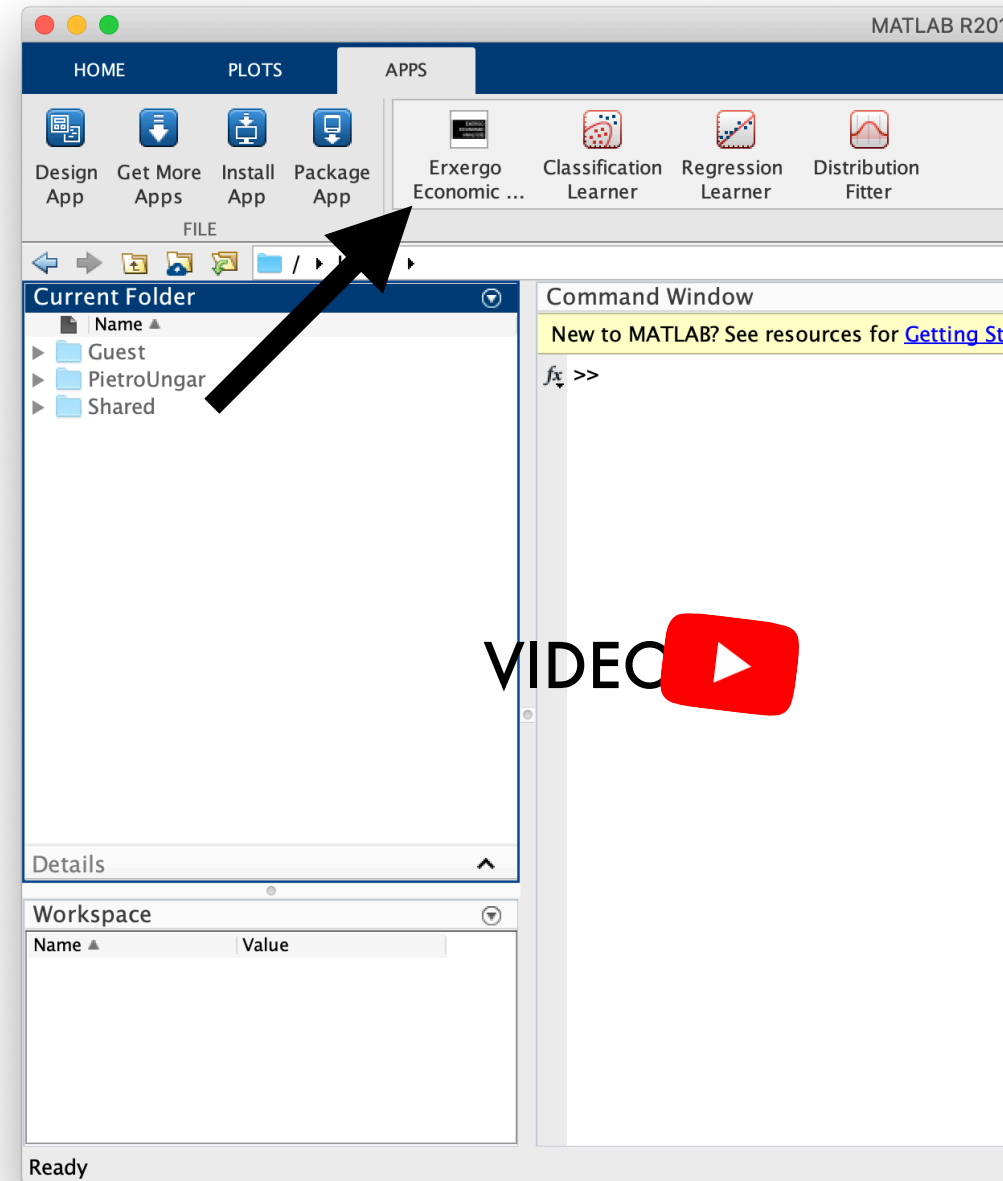
**For each step, there is a link to a video that shows what is explained in the chapter.**

For further explanation or technical issues please contact:

Pietro Ungar  
*pietro.ungar@unifi.it*

# 1. STEP

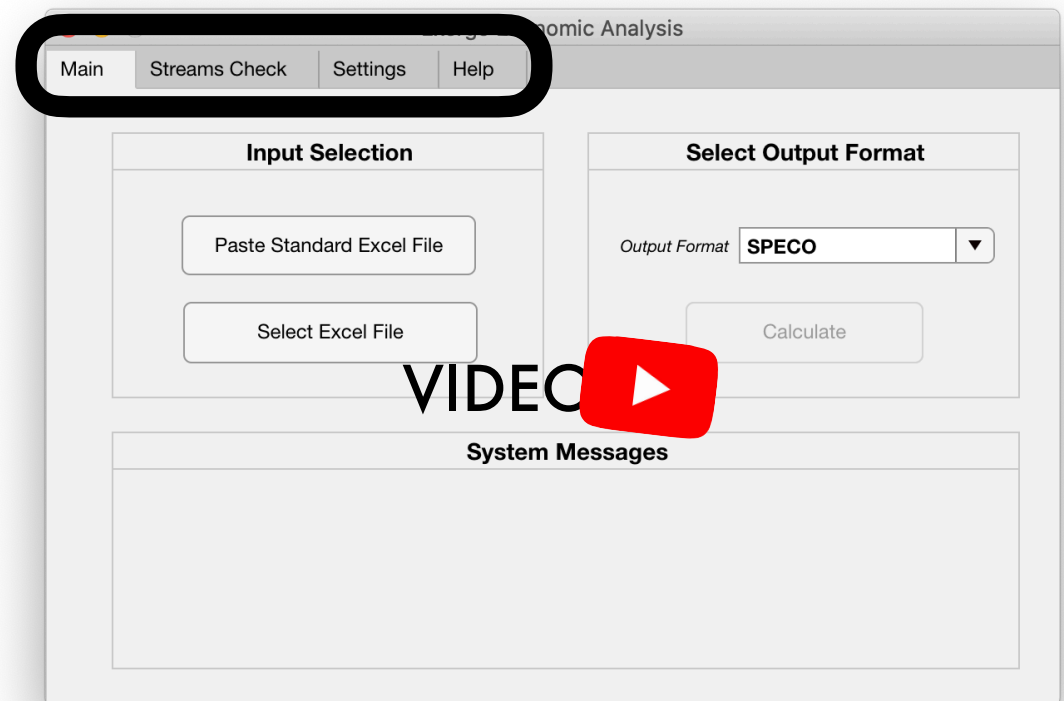
Once installed, the app should be easily found in the *APP* tab of your MATLAB screen as shown in the picture. Click on the icon to open the app.



## 2. STEP

After the launch of the application, the window shown in figure will appear. On the top side of the window a tab selector allow you to switch between pages:

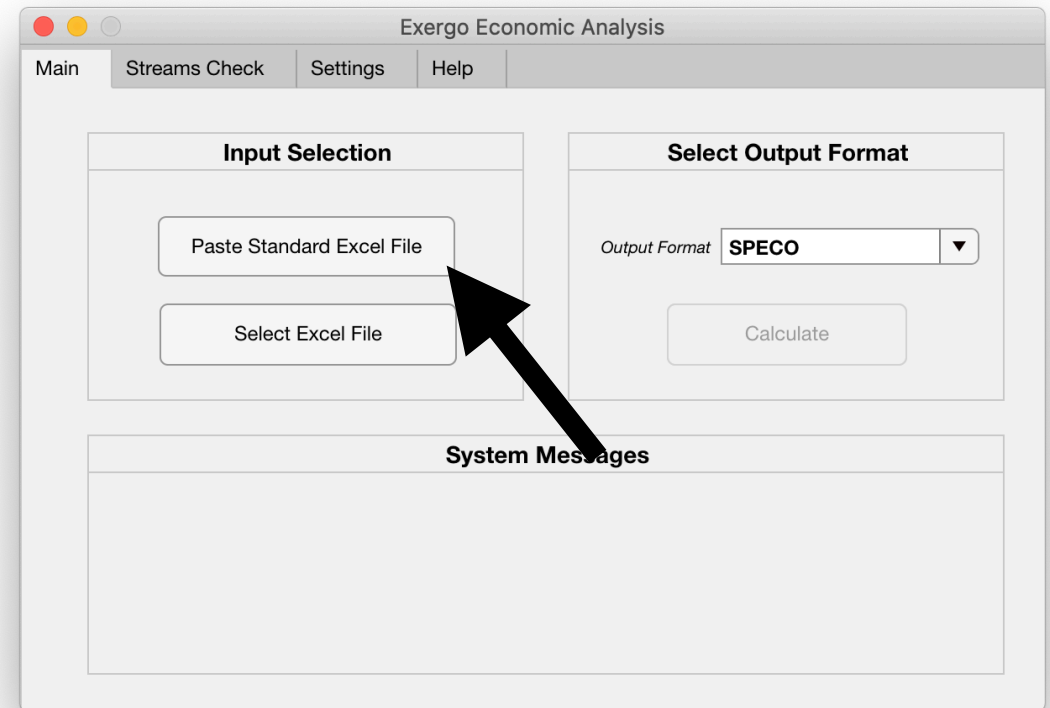
- **Main:** contains everything needed for the calculation process
- **Streams Check:** allow you to check if the connections that you have defined between components are correct (further details in the following steps)
- **Settings:** modify language
- **Help:** Access documentation file





In order to lunch the simulation, the first thing to do is to **create an excel file** that will be used to pass data to the application.

**To do that we recommend to use our default excel file.** This file can be copied everywhere in the computer by pressing the button *Paste Standard Excel File* and selecting the desired destination folder in the pop-up window that'll appear. Once the file has been successfully copied the app will show the message: *"Default Excel File Copied"*



## WARNING

In some cases the operating system could prevent Matlab from copying files in a particular location. This issue can be solved by running Matlab *as administrator*

# 3. STEP

**NOTICE**  
Exel file can be  
renamed

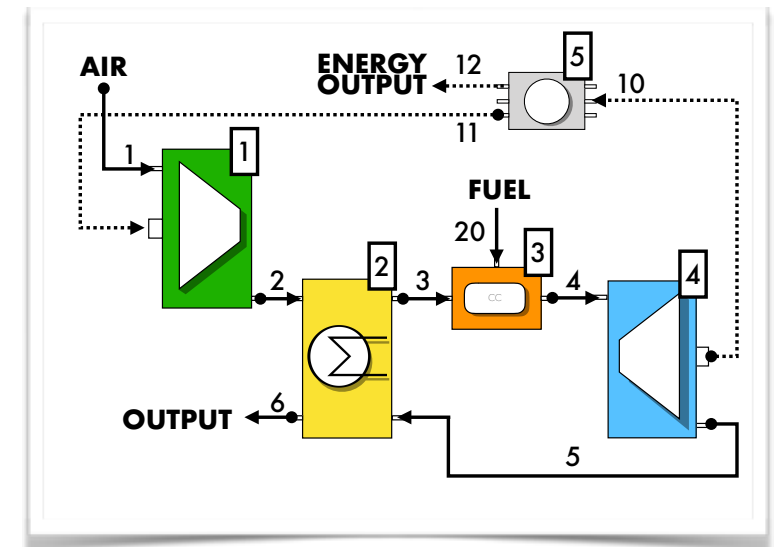
If the file has been successfully copied you can fill it with your input data.

Required input data are:

- **the topology of the system**, that has to be provided as a combination of **components** connected by some **streams**, as depicted in the figure
- **the cost** of each component
- **the exergy value** of the streams.

In compiling the excel file these steps have to be followed:

- Define the **components** of the system (*step 3.1*)
- Set the **connection** (*streams*) between components (*step 3.2*)
- Define **connection's** name and energy value (*step 3.3*)

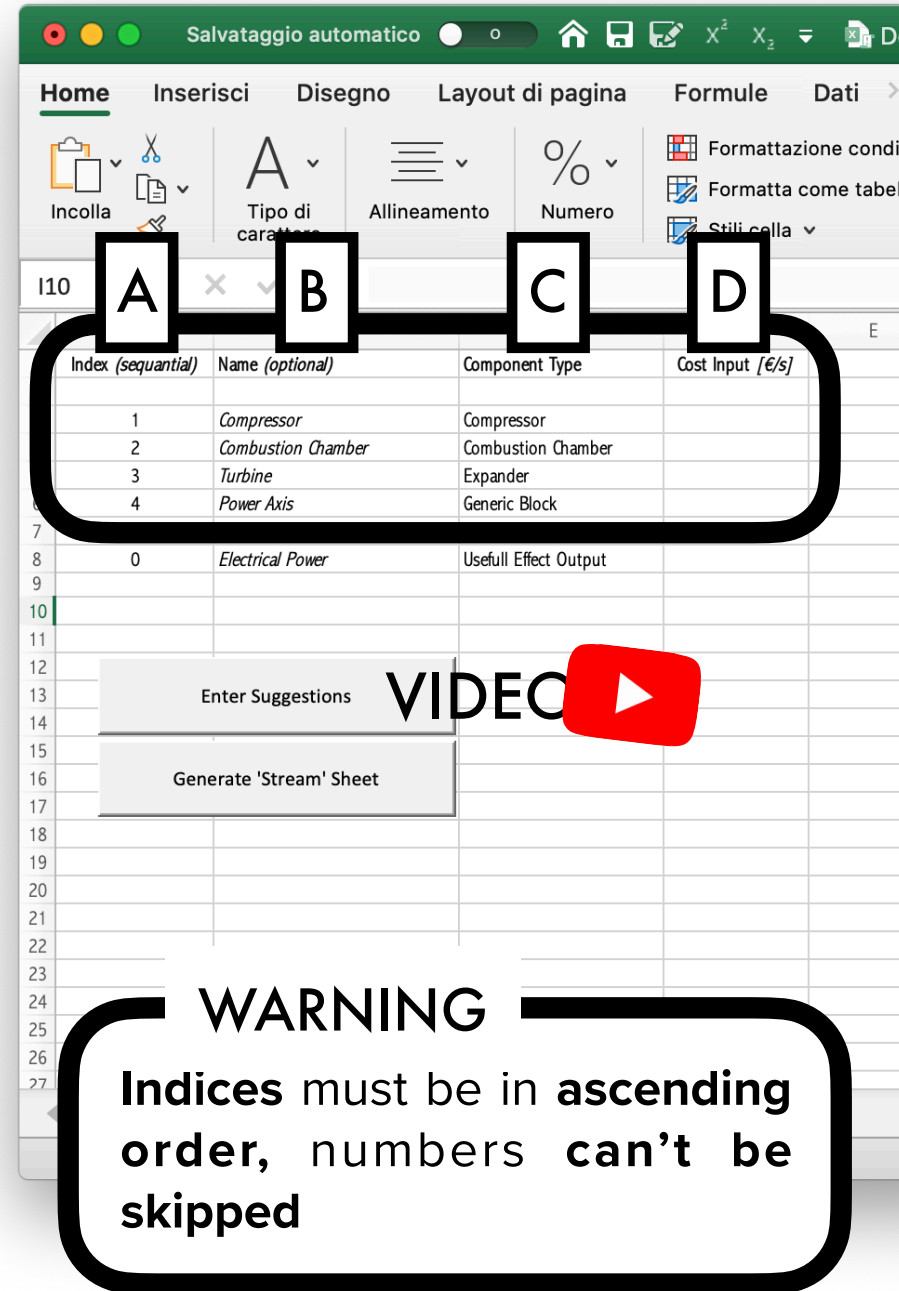


## 3.1 Component Definition

At the beginning, the excel file has only one sheet named “*Componenti*”.

To define a new component, **add a new line** in the table shown in picture. Each component needs 4 entries:

- A. **Index:** an integer that identify the component
- B. **Name:** the name of the component (*optional*)
- C. **Type:** the type of the component, (selected from *a dropdown list*). For further information refers to the *Component Documentation*
- D. **Cost:** the cost of the component in [€/s] (e.g. the total cost of the component divided by the expected lifetime)



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Incolla Tipo di carattere Allineamento Numero Formattazione condizionale Formatta come tabella Stili cella

Index ( <i>sequential</i> )	Name ( <i>optional</i> )	Component Type	Cost Input [€/s]
1	Compressor	Compressor	
2	Combustion Chamber	Combustion Chamber	
3	Turbine	Expander	
4	Power Axis	Generic Block	
0	Electrical Power	Usefull Effect Output	

Enter Suggestions VIDEO

Generate 'Stream' Sheet

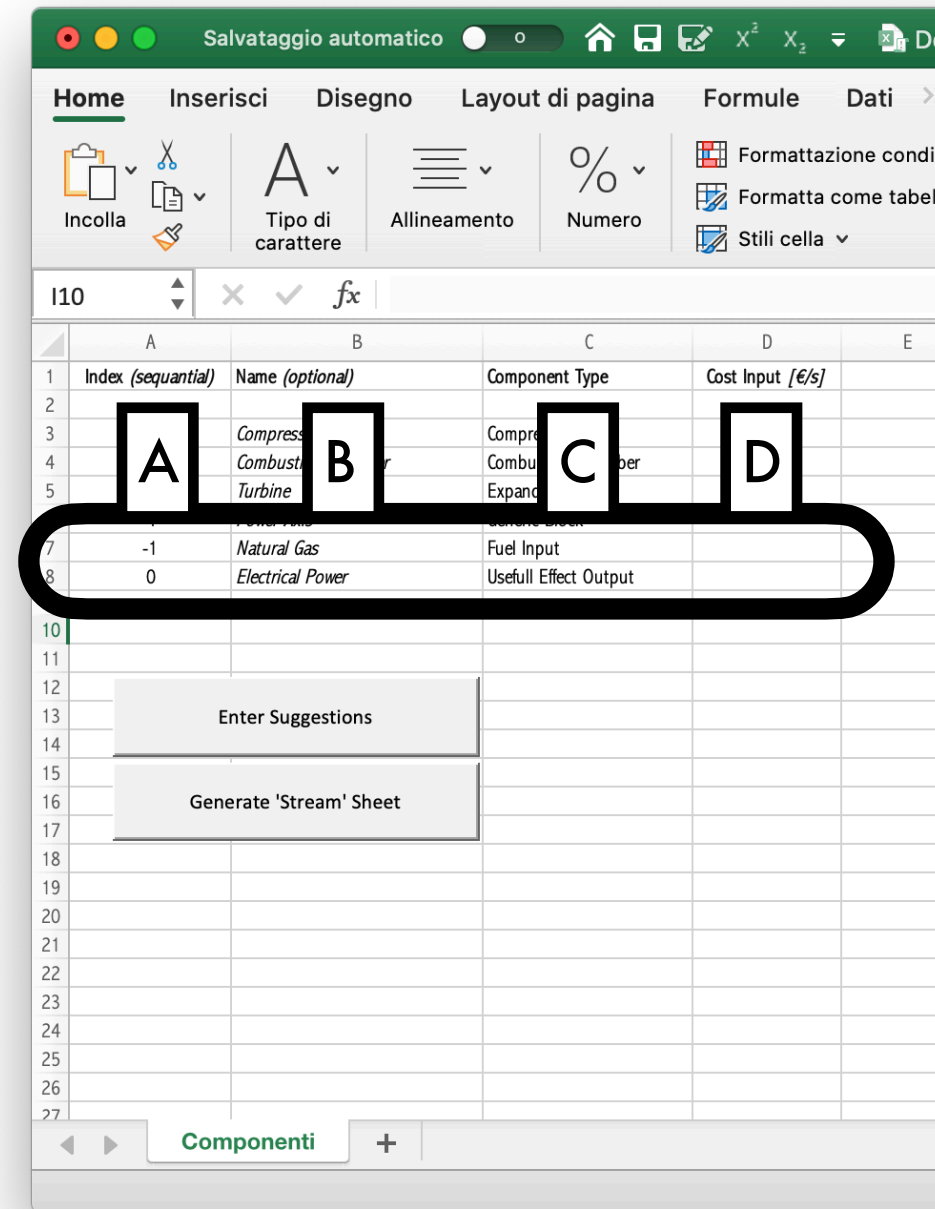
**WARNING**

**Indices** must be in **ascending order**, numbers **can't be skipped**

**Support components** have to be defined below the component table as shown in figure.

In this app there are two types of support components:

- **Input Fuel Components:** each **exergy stream** entering in the system (e.g. *the methane entering into the gas turbine's combustion chamber*) has to be connected to an input fuel component **otherwise its cost will be set to zero**. Important notice on this component:
  - **Stream cost** has to be set in **column D**
  - **Component Index** has to be **negative**
- **Useful Effect Component:** Every **output stream** (e.g. *the energy produced in a power plant*) has to be connected with this block otherwise the app will consider it an **exergy loss**. **Component Index has to be 0**, **cost column is neglected**.



## 3.2 Set Connection Between Components

Each *component type* has its own way of defining which streams are connected to it (please refers to *Component Documentation* for further information).

For that reason, once each component has been defined, click the “*Enter Suggestions*” button ( 1 ). This will add hints in the *connected stream* table ( 2 ) that could be useful in inserting the connection number. Replace hints with stream indices in the table, then click *Generate ‘Stream’ Sheet* ( 3 ).

### WARNING

After the hints replacement, table (2) **should be filled only whit numbers**. Take care not to forget some text (like “...”) in it!!

The screenshot shows an Excel spreadsheet with the following data:

Index (sequential)	Name (optional)	Component Type	Cost Input [€/s]
1	Compressor	Compressor	
2	Regenerator	Heat Exchanger	
3	Combustion Chamber	Combustion Chamber	
4	Turbine	Expander	
5	Power Axis	Generic Block	
-1	Natural Gas	Fuel Input	
0	Electrical Power	Output	

The 'Connected Stream (insert Stream index)' table is as follows:

11	1	2	
1	2	Fuel Input	Fuel Output
20	Flow Input	Flow Output	
Power Output	Flow Input	Flow Output	
Inputs (positive)	Outputs (negative)	...	-1000
Fuel Input	...	-1000	
Usefull Effect Output	...	-1000	

Arrows indicate the following steps:

- Clicking the 'Enter Suggestions' button (labeled 1).
- Clicking the 'Generate Stream Sheet' button (labeled 2).
- Clicking the 'Enter Suggestions' button again (labeled 3).



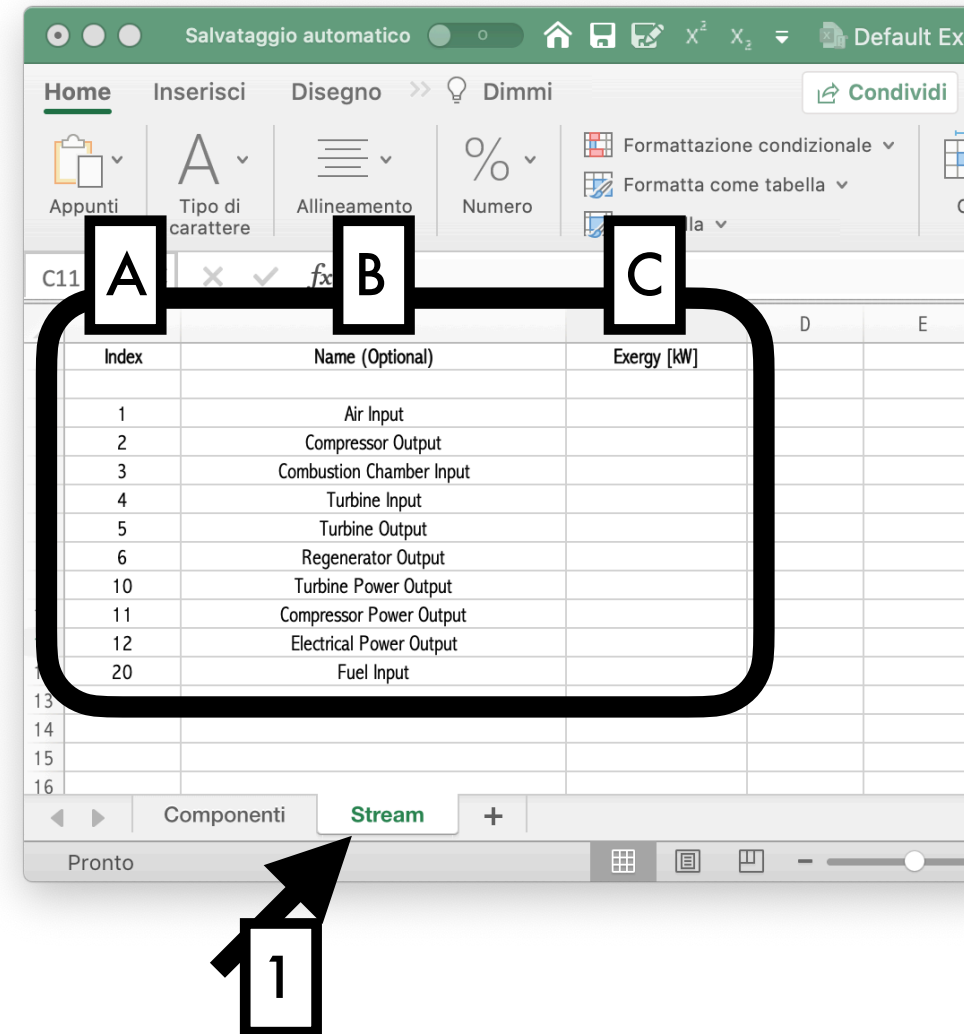
### 3.3 Define Connection Name and Exergy

Clicking *Generate 'Stream' Sheet* will create a new sheet in your excel file called “*Stream*” (1).

Open it and fill the table represented in the figure:

- A. **Index:** an integer that identify the stream (fixed by the program according to the connections defined in the “*Componenti*” sheet - **DO NOT MODIFY**)
- B. **Name:** Stream’s name (*optional*)
- C. **Exergy:** The exergy value of the stream (in kW)

Once the table has been filled **save and close** the Excel file. Then return to the Matlab app.



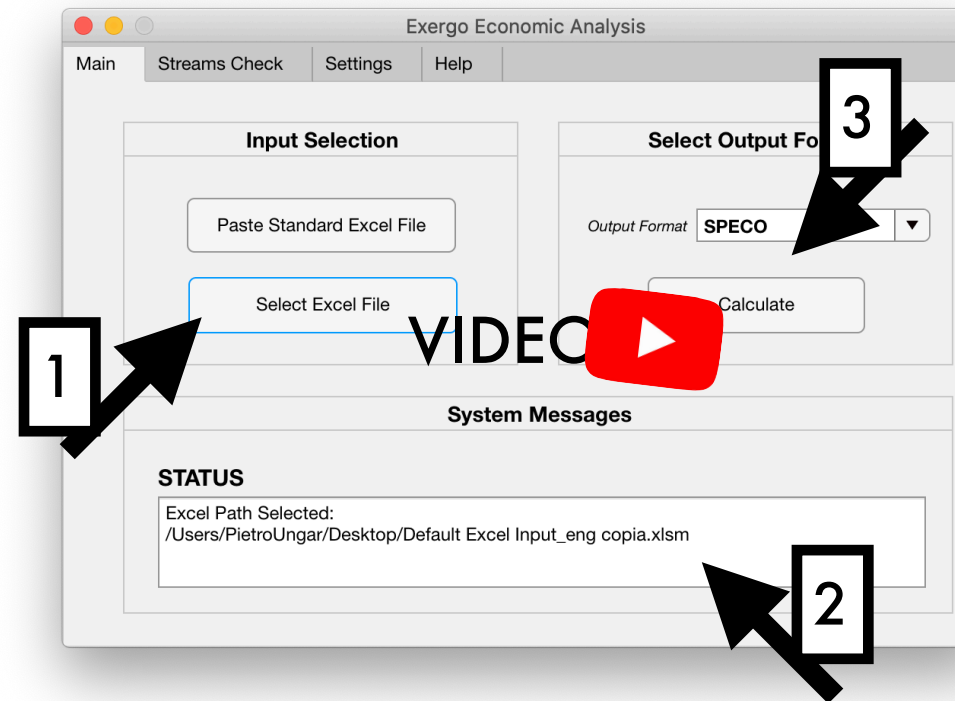
## 4. STEP

Now the input file is ready so it's time to launch the calculation!

These are the steps needed:

1. Open the app and click "*Select Excel Path*"
2. Select the input file from the dialog box that'll appear (if the file has been successfully selected the system will display the message "*Excel Path Selected*")
3. Select the output format from the dropdown list and press "*Calculate*".

If the calculation succeeded the system will display the message "*Calculation Completed*"

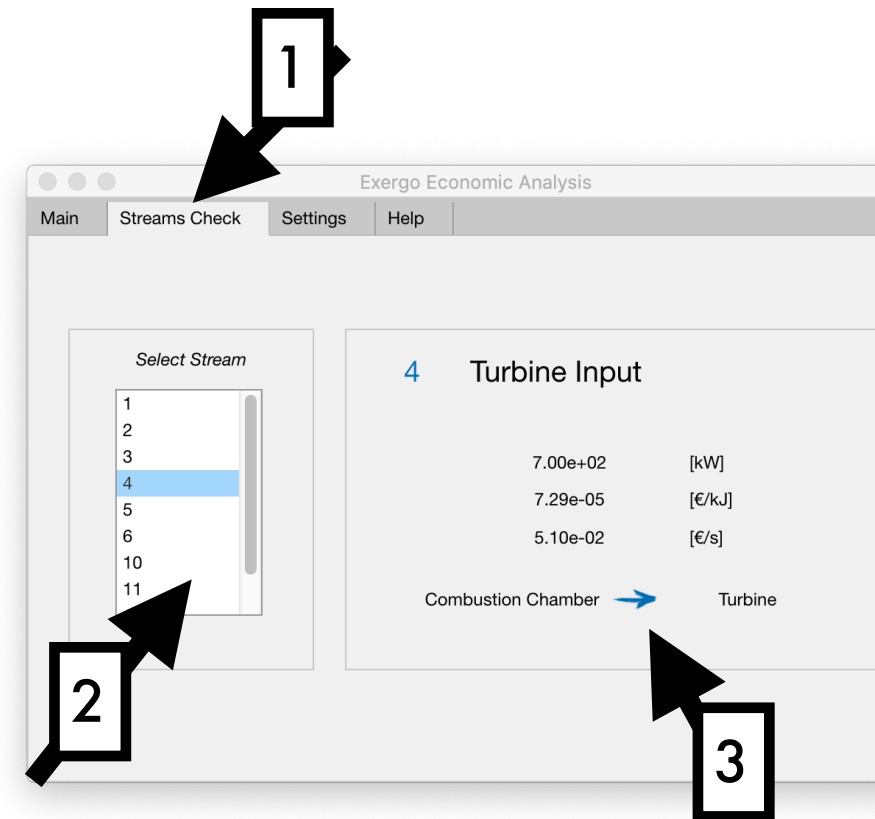


### WARNING

**Close Excel file** before launching the calculation, otherwise Matlab'll not be able to write the output sheets

After the calculation it's possible to use the “Streams Check” tool:

1. Select the “*Streams Check*” tab
2. On the left side of the window you can select the stream that you want to check (the numbers are the same as defined in the excel file)
3. On the right side information regarding such stream are reported:
  - At the top are displayed **name and index** of the stream
  - In the center are reported the values of (from top to bottom) **Exergy, Relative Cost and Absolute Cost** for the selected stream
  - Finally, at the bottom are shown **the names of the components connected by the stream**, in this way you can identify possible connection issues.



# 5. STEP

Finally it's possible to find the results of the calculation:

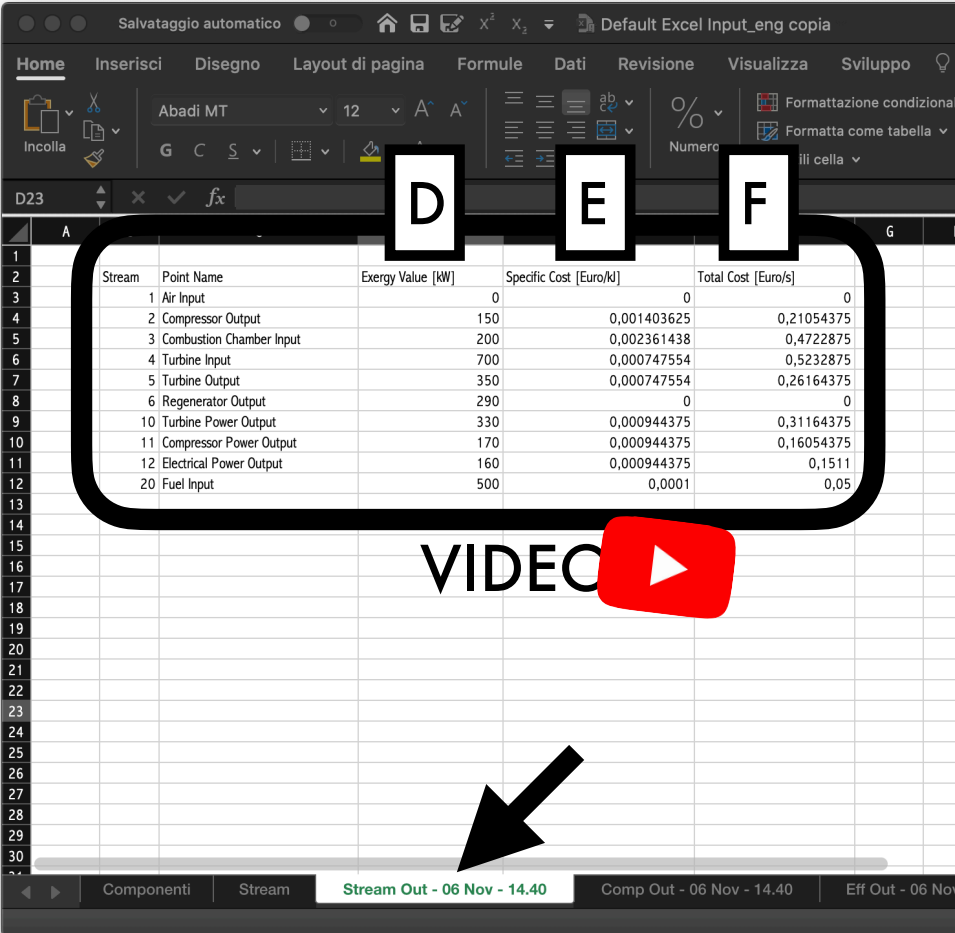
1. Open the excel file
2. You will find three new excel sheets inside the file:

- **Stream Out**, contains the cost of each stream in particular:

D. Exergy value of the stream

E. Specific exergy cost in the stream (in [€/kJ])

F. Total exergy cost (in [€/s])



Salvataggio automatico • Default Excel Input\_eng copia

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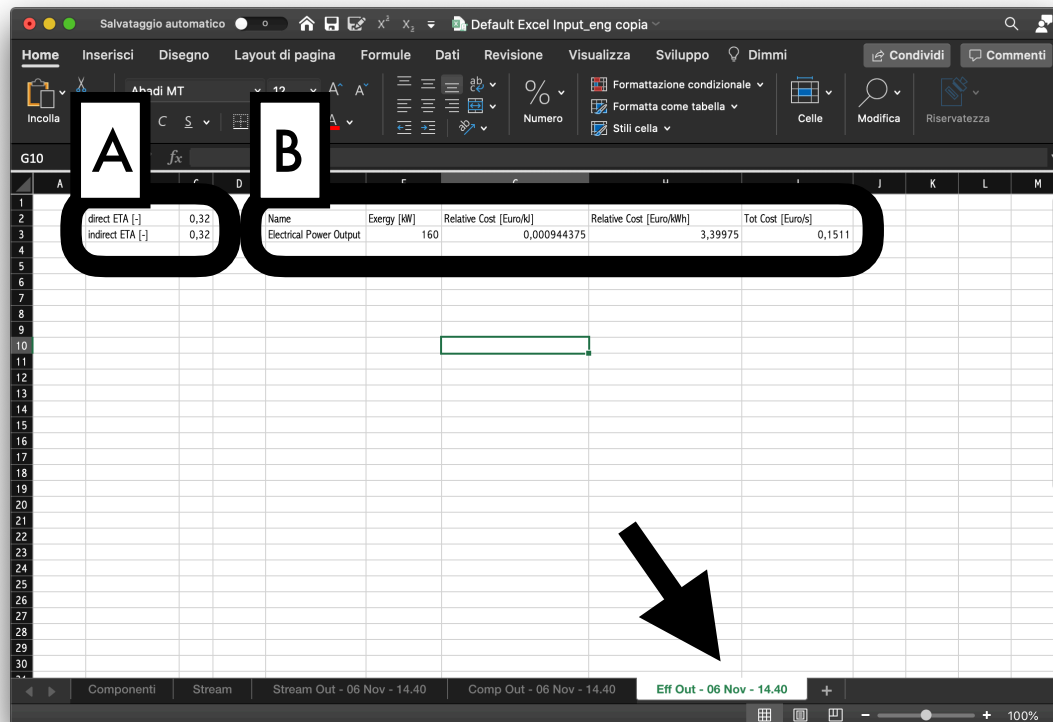
Stream	Point Name	Exergy Value [kW]	Specific Cost [Euro/kJ]	Total Cost [Euro/s]
1	Air Input	0	0	0
2	Compressor Output	150	0,001403625	0,21054375
3	Combustion Chamber Input	200	0,002361438	0,4722875
4	Turbine Input	700	0,000747554	0,5232875
5	Turbine Output	350	0,000747554	0,26164375
6	Regenerator Output	290	0	0
9	Turbine Power Output	330	0,000944375	0,31164375
10	Compressor Power Output	170	0,000944375	0,16054375
11	Electrical Power Output	160	0,000944375	0,1511
12	Fuel Input	500	0,0001	0,05

VIDEO

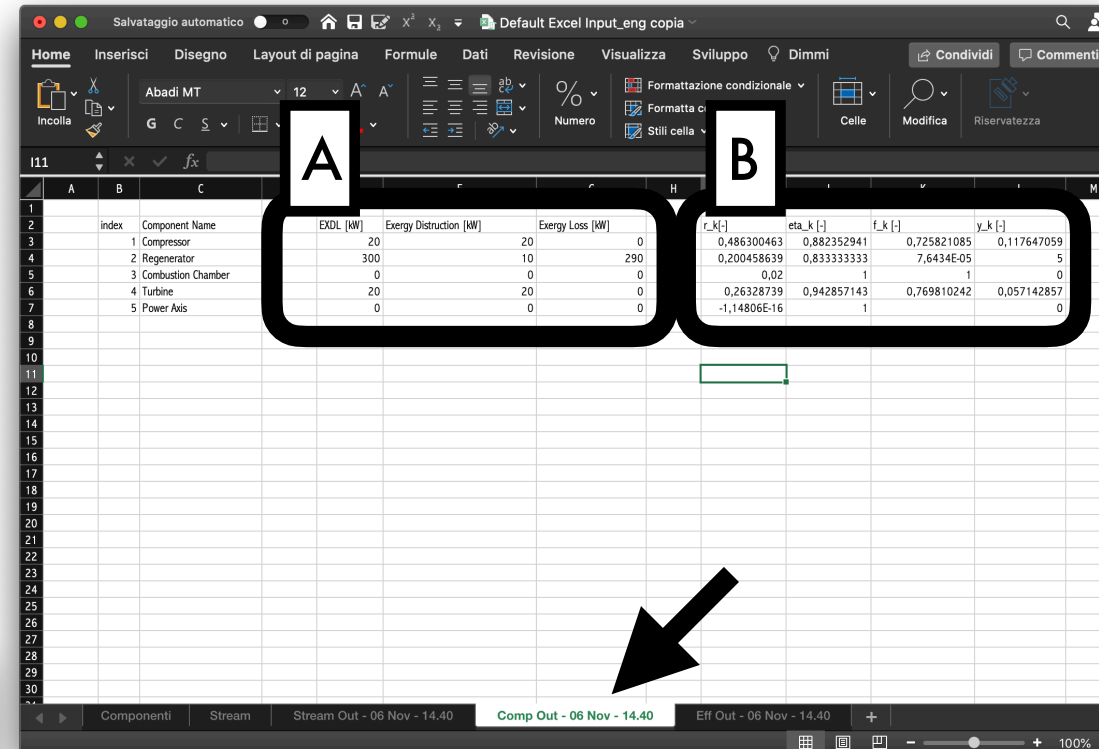
Componenti Stream **Stream Out - 06 Nov - 14.40** Comp Out - 06 Nov - 14.40 Eff Out - 06 Nov - 14.40

- **Comp Out**, contains the description of the exergy loss in each component:

- A. Exergy destruction and loss balance
- B. SPECO indices



A		B				
direct ETA [-]	0,32	Name	Exergy [kW]	Relative Cost [Euro/kJ]	Relative Cost [Euro/kWh]	Tot Cost [Euro/s]
indirect ETA [-]	0,32	Electrical Power Output	160	0,000944375	3,39975	0,1511



A			B					
index	Component Name	EXDL [kW]	Exergy Distruction [kW]	Exergy Loss [kW]	r_k [-]	eta_k [-]	f_k [-]	y_k [-]
1	Compressor	20	20	0	0,486300463	0,882352941	0,725821085	0,117647059
2	Regenerator	300	10	290	0,200458639	0,833333333	7,6434E-05	5
3	Combustion Chamber	0	0	0	0,02	1	1	0
4	Turbine	20	20	0	0,26328739	0,942857143	0,769810242	0,057142857
5	Power Axis	0	0	0	-1,14806E-16	1	1	0

Eff Out - 06 Nov - 14.40

- **Eff Out**, sum up the efficiency calculation and the cost of the output exergy stream:

- A. Efficiency calculation
- B. Cost of streams identified as useful effects



# APPENDIX

## Common Error Messages:

Error	Solution
<b>MATLAB: xlsread: WorksheetNotFound</b> <b>Worksheet 'Stream' not found.</b>	Open excel file, save it and try again

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