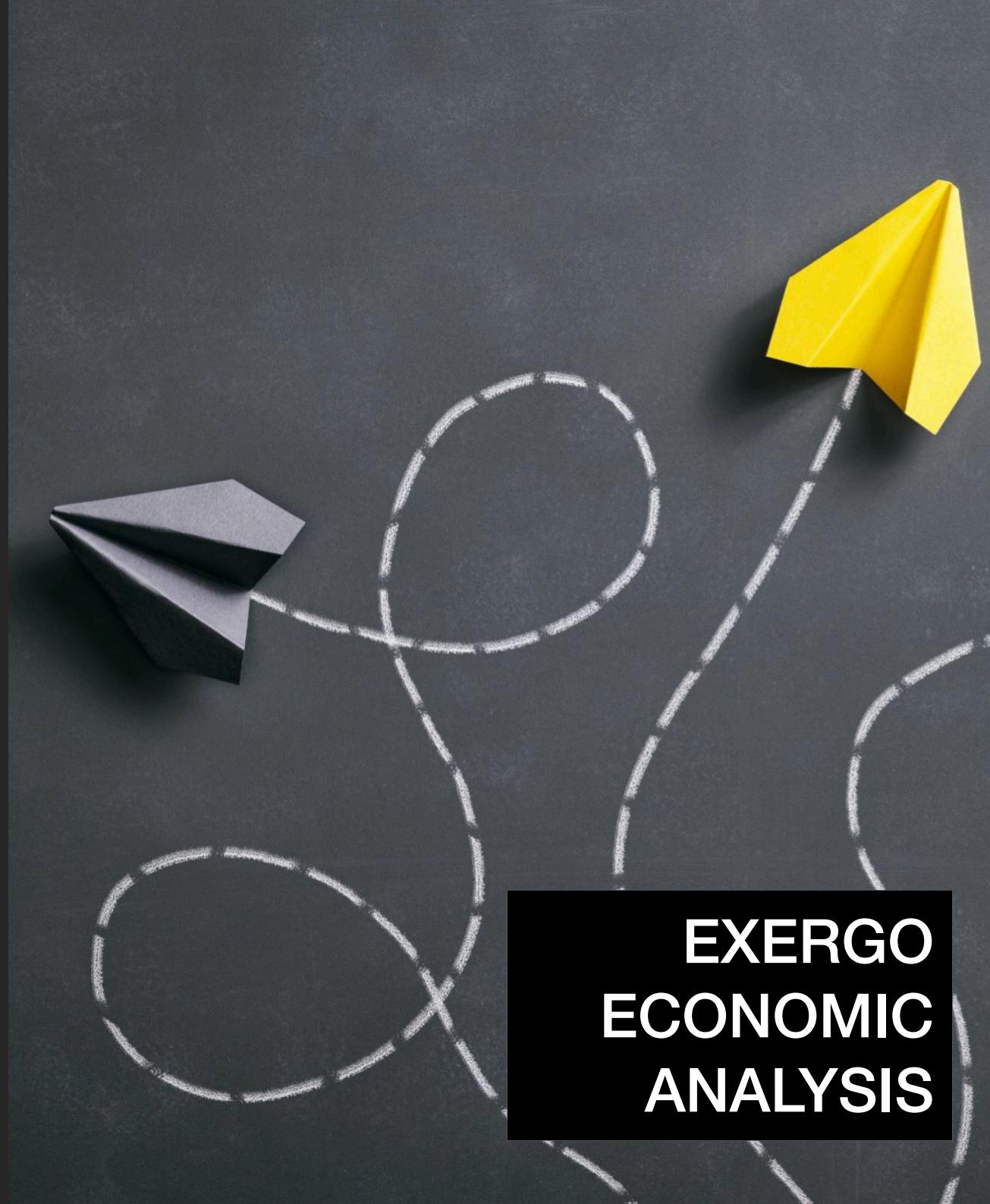


USER GUIDE

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.

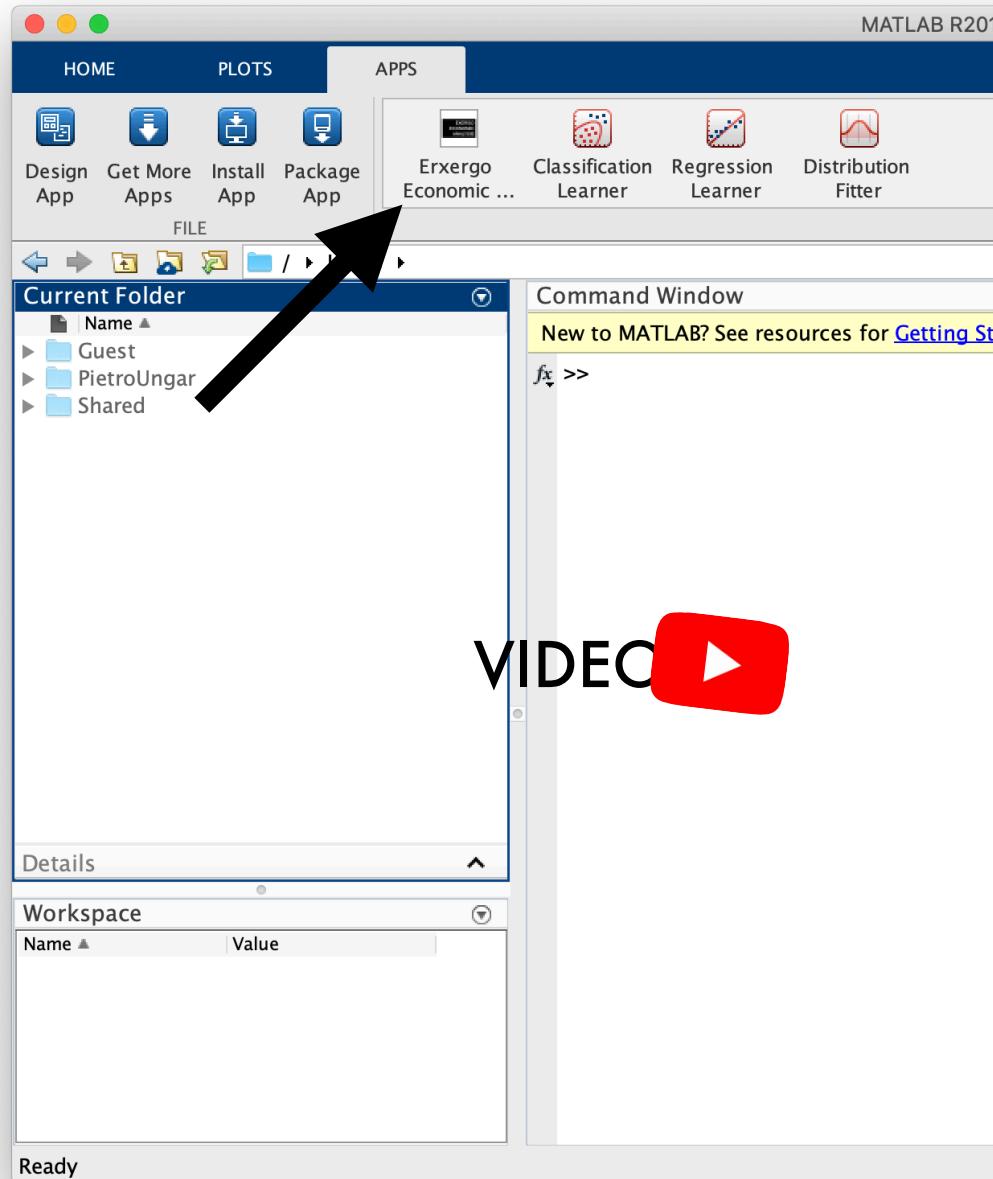
For further explanation or technical issues please contact:

Pietro Ungar

pietro.ungar@unifi.it

1. STEP

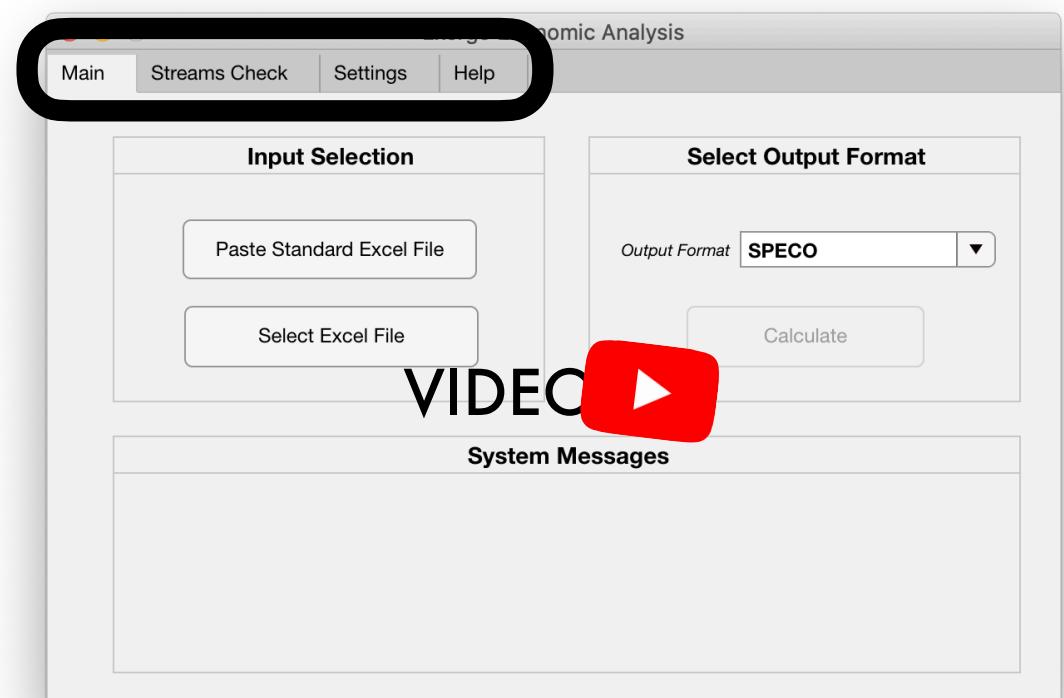
Once installed, the app should be easily found in the *APP* tab of your MATLAB screen as shown in the picture. Click on the icon to open the app.



2. STEP

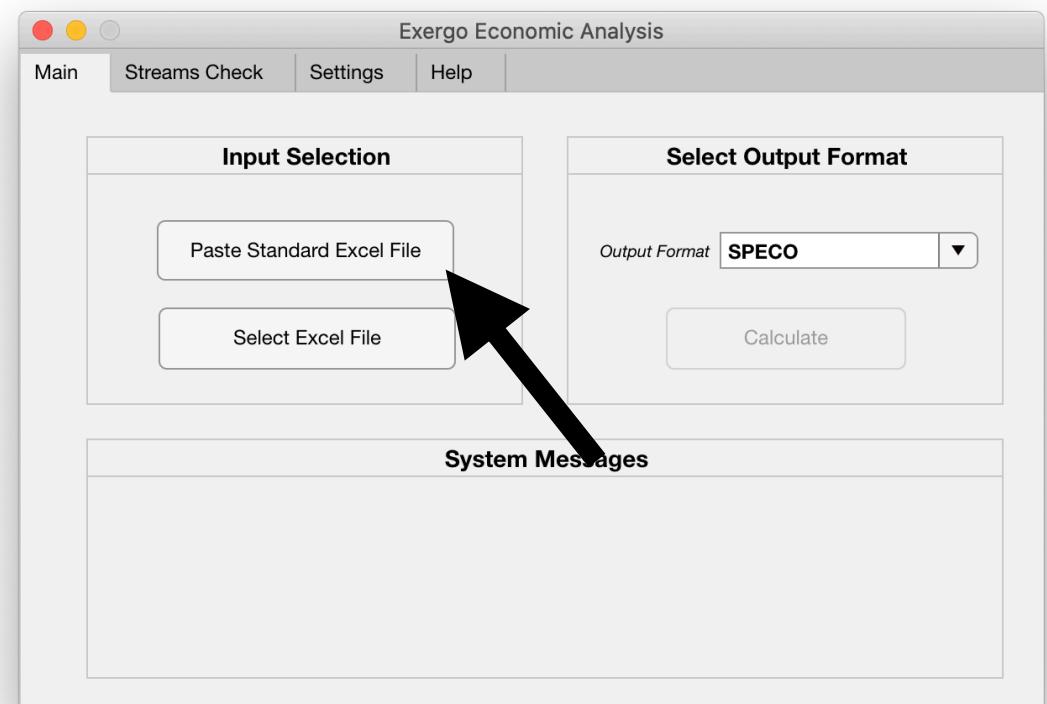
After the launch of the application, the window shown in figure will appear. On the top side of the window a tab selector allow you to switch between pages:

- **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 launch 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*

NOTICE

Exel file can be renamed

3. STEP

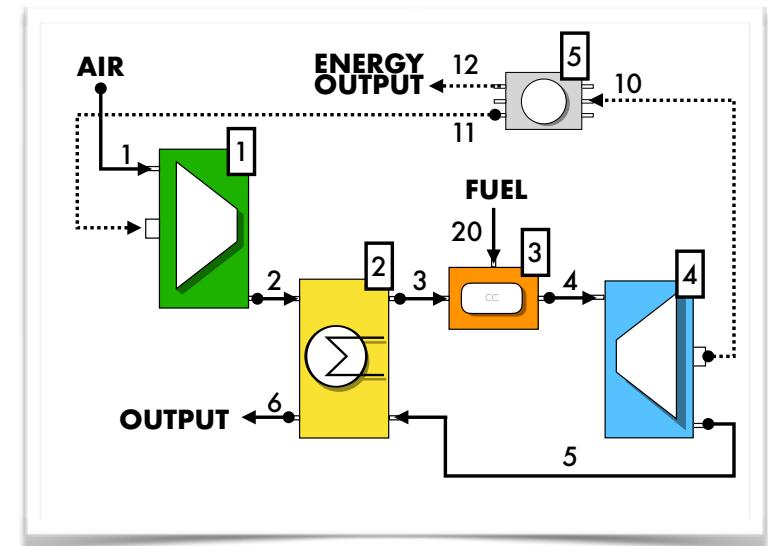
If the file has been successfully copied you can fill it with your input data.

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)

Index (sequential)	Name (optional)	Component Type	Cost Input [€/s]
1	Compressor	Compressor	
2	Combustion Chamber	Combustion Chamber	
3	Turbine	Expander	
4	Power Axis	Generic Block	
7			
8	0	Electrical Power	Usefull Effect Output
9			
10			
11			
12	Enter Suggestions		
13			
14			
15	Generate 'Stream' Sheet		
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			

VIDEO

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**.

	A	B	C	D	E
1	Index (sequential)	Name (optional)	Component Type	Cost Input [€/s]	
2					
3	A	Compressor	Compressor		
4		Combustion Chamber	Combustion Chamber		
5		Turbine	Expander		
6					
7	-1	Natural Gas	Fuel Input		
8	0	Electrical Power	Usefull Effect Output		
9					
10					
11					
12	Enter Suggestions				
13					
14	Generate 'Stream' Sheet				
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					

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 a Microsoft Excel spreadsheet titled "Default Excel Input_eng cop". The spreadsheet contains a table of components and their properties. A callout labeled "1" points to the "Enter Suggestions" button at the bottom of the table. Another callout labeled "2" points to the "Connected Stream" table, which is highlighted with a black border. A third callout labeled "3" points to the "Generate 'Stream' Sheet" button at the bottom.

A	B	C	D	E
Index (sequential)	Name (optional)	Component Type	Cost Input [€/s]	Connected Stream (insert Stream index)
1	Compressor	Compressor		11 1 2
2	Regenerator	Heat Exchanger		2 Fuel Input Flow Output
3	Combustion Chamber	Combustion Chamber		Power Output Flow Input Inputs (positive) Fuel Input Useful Effect Output
4	Turbine	Expander		Flow Output Flow Output ...
5	Power Axis	Generic Block		...
-1	Natural Gas			-1000
0	Electrical Power	Fuel Input		-1000

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.

Index	Name (Optional)	Exergy [kW]
1	Air Input	
2	Compressor Output	
3	Combustion Chamber Input	
4	Turbine Input	
5	Turbine Output	
6	Regenerator Output	
10	Turbine Power Output	
11	Compressor Power Output	
12	Electrical Power Output	
20	Fuel Input	
13		
14		
15		
16		

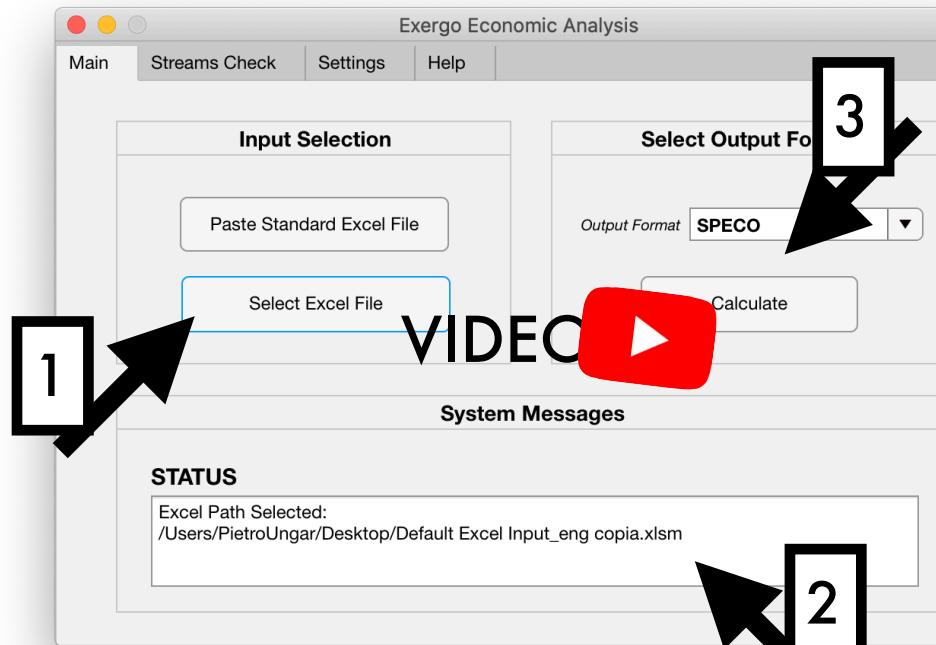
4. STEP

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”.

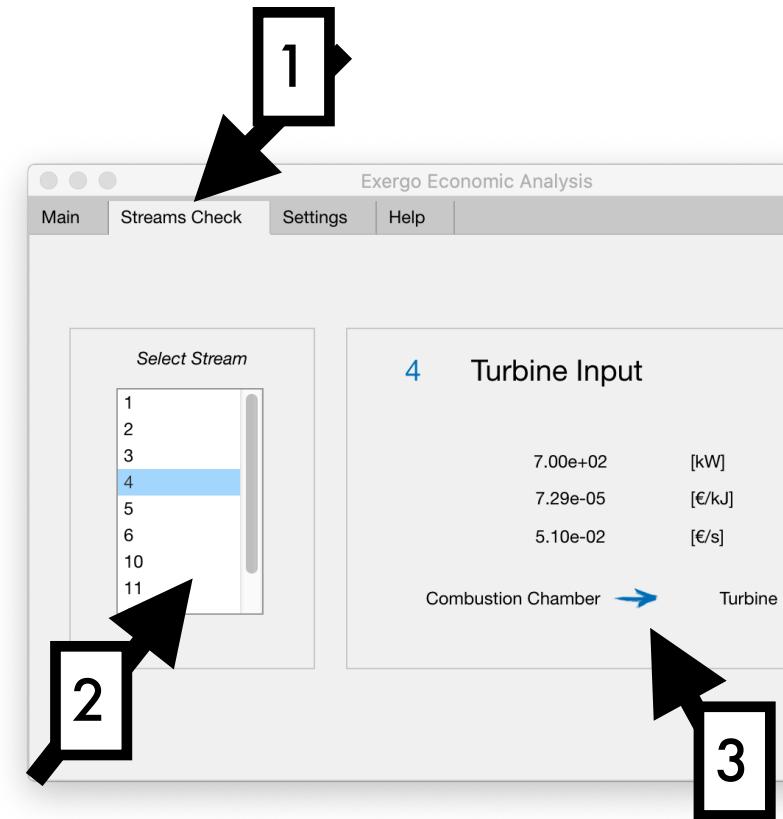
If the calculation succeeded the system will display the message “Calculation Completed”



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])

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
10	Turbine Power Output	330	0,000944375	0,31164375
11	Compressor Power Output	170	0,000944375	0,16054375
12	Electrical Power Output	160	0,000944375	0,1511
20	Fuel Input	500	0,0001	0,05

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

- Exergy destruction and loss balance
- SPECO indices

Salvataggio automatico Default Excel Input_eng copia

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A B C D E F G H I J K L M

G10

	Name	Energy [kW]	Relative Cost [Euro/M]	Relative Cost [Euro/NWh]	Tot Cost [Euro/s]
direct ETA [-]	0,32				
indirect ETA [-]	0,32				
Electrical Power Output	160	0,000944375			3,99975
					0,1511

Componenti Stream Stream Out - 06 Nov - 14.40 Comp Out - 06 Nov - 14.40 Eff Out - 06 Nov - 14.40 + 100%

Salvataggio automatico Default Excel Input_eng copia

Home Inserisci Disegno Layout di pagina Formule Dati Revisione Visualizza Sviluppo Dimmi Condividi Commenti

I11

A B C D E F G H I J K L M

	index	Component Name	EXDL [kW]	Energy Distribution [kW]	Energy Loss [kW]
2	1	Compressor	20	20	0
3	2	Regenerator	300	10	290
4	3	Combustion Chamber	0	0	0
5	4	Turbine	20	20	0
6	5	Power Axis	0	0	0

r_k [-]	eta_k [-]	f_k [-]	y_k [-]
0,486300463	0,882352941	0,725821085	0,117647059
0,200458639	0,833333333	7,6434E-05	5
0,02	1	1	0
0,26328739	0,942857143	0,769810242	0,057142857
-1,14806E-16	1		

Componenti Stream Stream Out - 06 Nov - 14.40 Comp Out - 06 Nov - 14.40 Eff Out - 06 Nov - 14.40 + 100%

- **Eff Out**, sum up the efficiency calculation and the cost of the output exergy stream:
 - Efficiency calculation
 - Cost of streams identified as useful effects

APPENDIX

Common Error Messages:

Error

MATLAB: xlsread: WorksheetNotFound
Worksheet 'Stream' not found.

Solution

Open excel file, save it and try again

Developed by:



Website



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