

User Tutorial - Mastering SiisolTEA

Techno-Economic Assessment of Green Hydrogen Production

Explore the evaluation of green hydrogen production using solar, wind, or hybrid energy systems, focusing on both technological and economic aspects.

Detailed Sensitivity Analysis

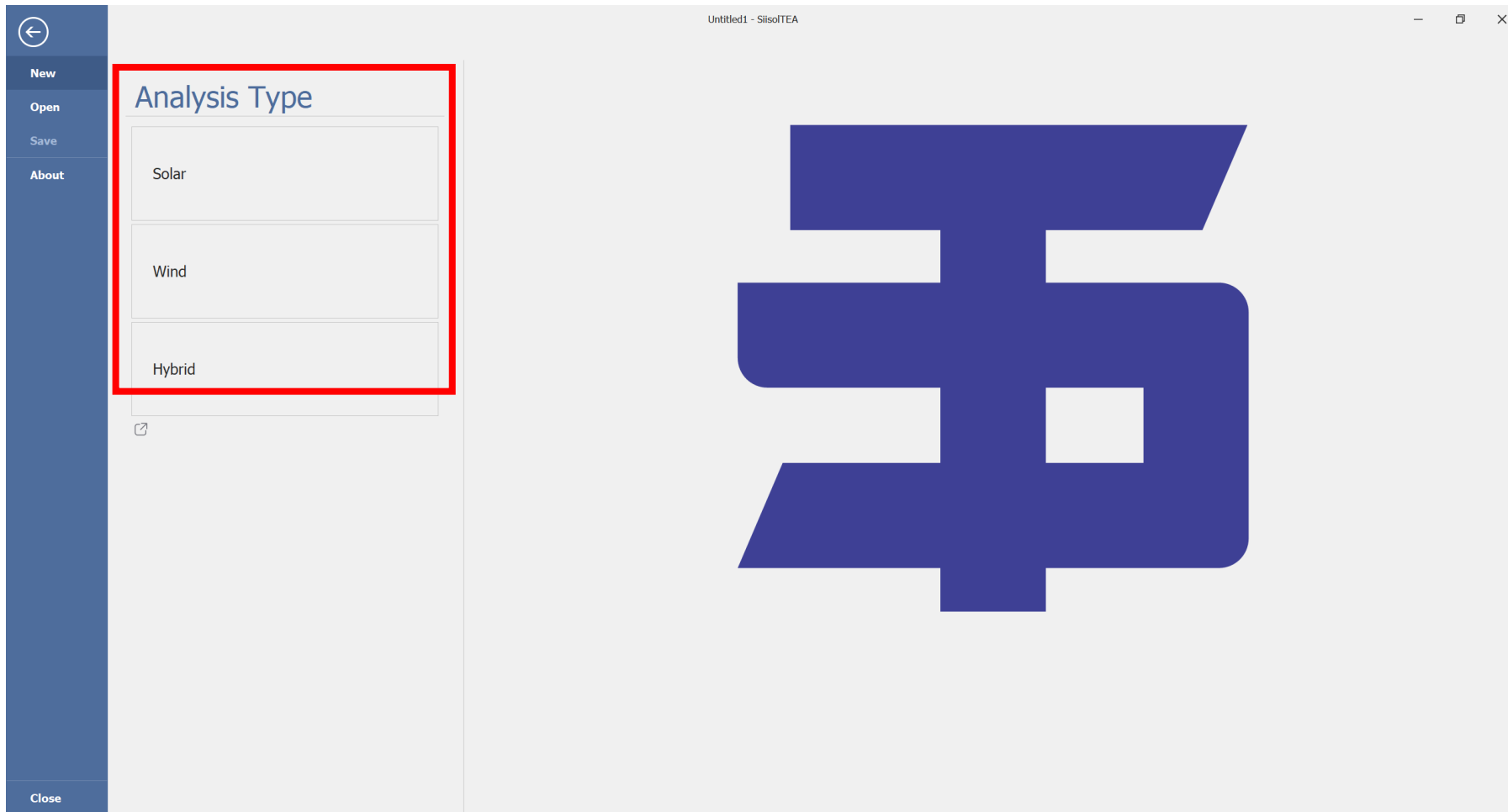
Gain an understanding of how various parameters influence system performance, costs, and viability through comprehensive sensitivity studies.

System Insights and Optimization

Access detailed insights into the integration of renewable resources for hydrogen production and optimize strategies for improved efficiency and cost-effectiveness.



After launching SiisolTEA, you will be prompted to choose the type of analysis according to the renewable energy system you wish to evaluate.

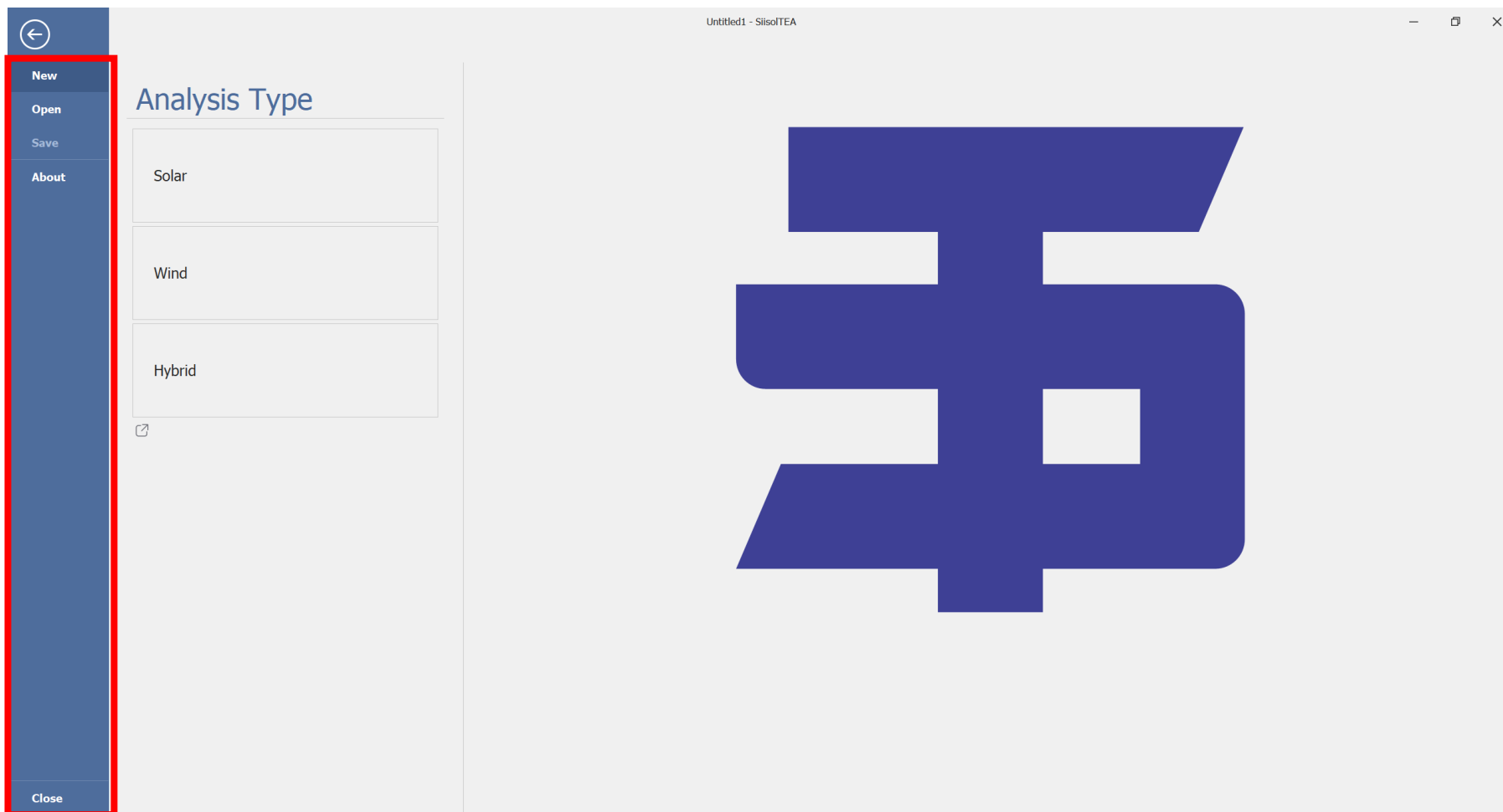


Key





The user can utilize the buttons on the left panel to perform general functions like opening a new window, accessing a saved analysis, saving an ongoing analysis, viewing licensing details, or closing the active window.



Key





Users can utilize the highlighted buttons on the ribbon to access common functions like saving the current analysis, opening a previously saved analysis, launching a new window, and viewing licensing details.

FileHomeOptions

Save AnalysisOpen Analysis

Add Solar DataAdd Wind Data

Open New WindowAbout

FileMeteorological DataApplication

Electrolyzer

Solar PV

Wind

Equipments

Raw Materials

Utilities

Products

TEA Inputs

Product System

Parameter	Values	Unit
Hydrogen flow rate	0	kg/hr
Efficiency of an electrolyzer	0	%
LHV of hydrogen	0	MWh/kg
Operational life of an electrolyzer	0	hr
Capital cost of an electrolyzer	<input checked="" type="checkbox"/> 0	USD/kWh

Electrolyzer: 0/5 inputs filled.8.25

Key

1

2

3

4



Users can utilize the Options ribbon to modify the application's appearance, such as adjusting the theme, color scheme, and font size of the user interface.

FileHomeOptions

Theme Palette

Visual Zoom

Electrolyzer

Solar PV

Wind

Equipments

Raw Materials

Utilities

Products

TEA Inputs

Product System

Parameter	Values	Unit
Hydrogen flow rate	0	kg/hr
Efficiency of an electrolyzer	0	%
LHV of hydrogen	0	MWh/kg
Operational life of an electrolyzer	0	hr
Capital cost of an electrolyzer	<input checked="" type="checkbox"/> 0	USD/kWh

Electrolyzer: 0/5 inputs filled.

8.25

Key

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The user will navigate sequentially through the tabs on the left panel to provide all necessary inputs in their respective units for the analysis.

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Electrolyzer

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Equipments

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Products

TEA Inputs

Product System

Parameter	Values	Unit
Hydrogen flow rate	0	kg/hr
Efficiency of an electrolyzer	0	%
LHV of hydrogen	0	MWh/kg
Operational life of an electrolyzer	0	hr
Capital cost of an electrolyzer	<input checked="" type="checkbox"/> 0	USD/kWh

Electrolyzer: 0/5 inputs filled.8.25

Key

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SiisolTEA includes an integrated database containing renewable energy and AWE electrolyzer cost projections for the years 2025 to 2050, based on data from IEA and IRENA. To utilize this feature, please deselect the boxes next to the capital costs for solar, wind, and electrolyzers.

Key

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FileHomeOptions

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FileMeteorological DataApplication

Electrolyzer

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TEA Inputs

Product System

Parameter

Hydrogen flow rate0

Efficiency of an electrolyzer0

LHV of hydrogen0

Operational life of an electrolyzer0

Capital cost of an electrolyzer☒0USD/kWh

Electrolyzer

Solar PV

Wind

Equipments

Raw Materials

Utilities

Products

TEA Inputs

Product System

Parameter

Inverter efficiency (DC to AC)0

Size of a solar PV module0

Length of a solar PV module0

Width of a solar PV module0

Spacing margin between solar PV modules0

Peak sunshine hours in region0

Capital cost of a solar PV module☒0

Contribution of solar PV module

Electrolyzer

Solar PV

Wind

Equipments

Raw Materials

Utilities

Products

TEA Inputs

Product System

Parameter

Rated power of a wind turbine0

Cut-in velocity of a wind turbine0

Cut-out velocity of a wind turbine0

Rated velocity of a wind turbine0

Swept area of a wind turbine0

Spacing margin between wind turbines0

Capital cost of a wind turbine☒0

Electrolyzer

Solar PV

Wind

Equipments

Raw Materials

Utilities

Products

TEA Inputs

Product System

Project Name

Project Year2025

Description

Calculate

Product System

0MWh/kg

0hr

0USD/kWh

Electrolyzer: 0/5 inputs filled.8.25



Users must supply solar meteorological data when evaluating solar-based infrastructure. This data can be obtained and exported directly through the built-in NASA Power Access feature or entered manually. Additionally, users can reset the input fields at any time by clicking the reset button located in the top right corner of the Solar Data pop-up.

Key

1

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The screenshot displays the SHISOL software interface. The main window has a menu bar with 'File', 'Home', and 'Options'. Below the menu bar is a toolbar with icons for 'Save Analysis', 'Open Analysis', 'Add Solar Data' (highlighted with a red box and labeled '1'), 'Add Wind Data', 'Open New Window', and 'About'. The main content area is divided into a sidebar on the left and a central table. The sidebar lists various input categories: Electrolyzer, Solar PV, Wind, Equipments, Raw Materials, Utilities, Products, TEA Inputs, and Product System. The central table has three columns: 'Parameter', 'Values', and 'Unit'. It lists parameters for Solar PV, Wind, and Equipments. A 'Solar Data' pop-up window is open in the foreground. This window has a title bar with a sun icon and a close button. It contains a section for 'Solar data from NASA Power Access' with fields for 'Start Year' (2024), 'End Year' (2025), 'Longitude' (0), and 'Latitude' (0). There are 'Get Data' and 'Export Data' buttons. Below this is a section for 'OR' with a 'Peak sun shine hours' field (0) and a 'Proceed' button. A blue box labeled '2' highlights the 'Get Data' button, and a purple box labeled '3' highlights the 'Proceed' button. A blue box labeled '4' highlights the 'Reset' button (a circular arrow icon) in the top right corner of the pop-up window. The status bar at the bottom left says 'Solar: 1/9 inputs filled.' and the bottom right shows the version '8.25'.

Parameter	Values	Unit
Inverter efficiency (DC to AC)	0	%
Size of a solar PV module	0	W
Length of a solar PV module	0	m
Width of a solar PV module	0	m
Spacing margin between solar PV modules	0	%
Peak sunshine hours in region	0	hr
Capital cost of a solar PV module	0	USD/kWh
Contribution of solar PV system	0	%
Operational life of a solar PV module	0	hr



When analyzing wind-based infrastructure, users must supply wind meteorological data. This data can be obtained and exported directly through the built-in NASA Power Access feature or entered manually. Additionally, users can reset the data at any time by clicking the reset button located in the top right corner of the Wind Data pop-up.

Key

1

2

3

4

The screenshot displays the SHISOL software interface. The main window has a menu bar with 'File', 'Home', and 'Options'. Below the menu bar is a toolbar with icons for 'Save Analysis', 'Open Analysis', 'Add Solar Data', 'Add Wind Data', 'Open New Window', and 'About'. The 'Add Solar Data' icon is highlighted with a red box (1). The main workspace is divided into a left sidebar with categories like 'Electrolyzer', 'Solar PV', 'Wind', 'Equipments', 'Raw Materials', 'Utilities', 'Products', 'TEA Inputs', and 'Product System'. The 'Wind' category is selected. The main area shows a table with columns 'Parameter', 'Values', and 'Unit'. The 'Wind Data' pop-up window is open, showing options to 'Wind data from NASA Power Access' or 'Browse CSV'. The 'Wind data from NASA Power Access' section has fields for 'Start Year' (2024), 'End Year' (2025), 'Longitude' (0), and 'Latitude' (0). There are 'Get Data' and 'Export Data' buttons. A blue box (2) highlights the 'Get Data' button. A blue box (3) highlights the 'Export Data' button. A blue box (4) highlights the 'Reset' button (circular arrow icon) in the top right corner of the pop-up window. A purple box (5) highlights the 'Browse CSV' button. A note at the bottom of the pop-up window states: 'User CSV file must contain hourly wind data in the range 41.98760'.

Parameter	Values	Unit
Inverter efficiency (DC to AC)	0	%
Size of a solar PV module	0	W
Length of a solar PV module	0	m
Width of a solar PV module	0	m
Spacing margin between solar PV modules	0	%
Peak sunshine hours in region	0	hr
Capital cost of a solar PV module	0	USD/kWh
Contribution of solar PV system	0	%
Operational life of a solar PV module	0	hr



SiisolTEA includes default entries for the equipment needed for the analysis, with no cost inputs required for these items. However, users have the option to add or remove equipment using the + and – buttons in the top right corner. Any equipment added by the user will require associated cost inputs.

File

Home

Options

Save Analysis

Open Analysis

Add Solar Data

Add Wind Data

Open New Window

About

File

Meteorological Data

Application

Electrolyzer

Solar PV

Wind

Equipments

Raw Materials

Utilities

Products

TEA Inputs

Product System

Name	Installed Cost
Electrolyzers	0.00
Wind turbines	0.00
Solar PV modules	0.00

+

-

Equipments: 3/3 inputs filled.

8.25

Key





SiisolTEA initially includes entries for the raw materials needed for the analysis. However, users have the option to add or remove items as necessary by using the + and - buttons located in the top right corner. All quantity and cost fields must be completed.

FileHomeOptions

Save AnalysisOpen AnalysisAdd Solar DataAdd Wind DataOpen New WindowAbout

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ElectrolyzerSolar PVWindEquipmentsRaw MaterialsUtilitiesProductsTEA InputsProduct System

Raw Material Name	Quantity [unit/hr]	Cost [USD/unit]
Delonized water	0	0
KOH/NaOH	0	0
Steam	0	0
Nitrogen	0	0

+ -

Raw Materials: 0/4 inputs filled.

8.25

Key

1

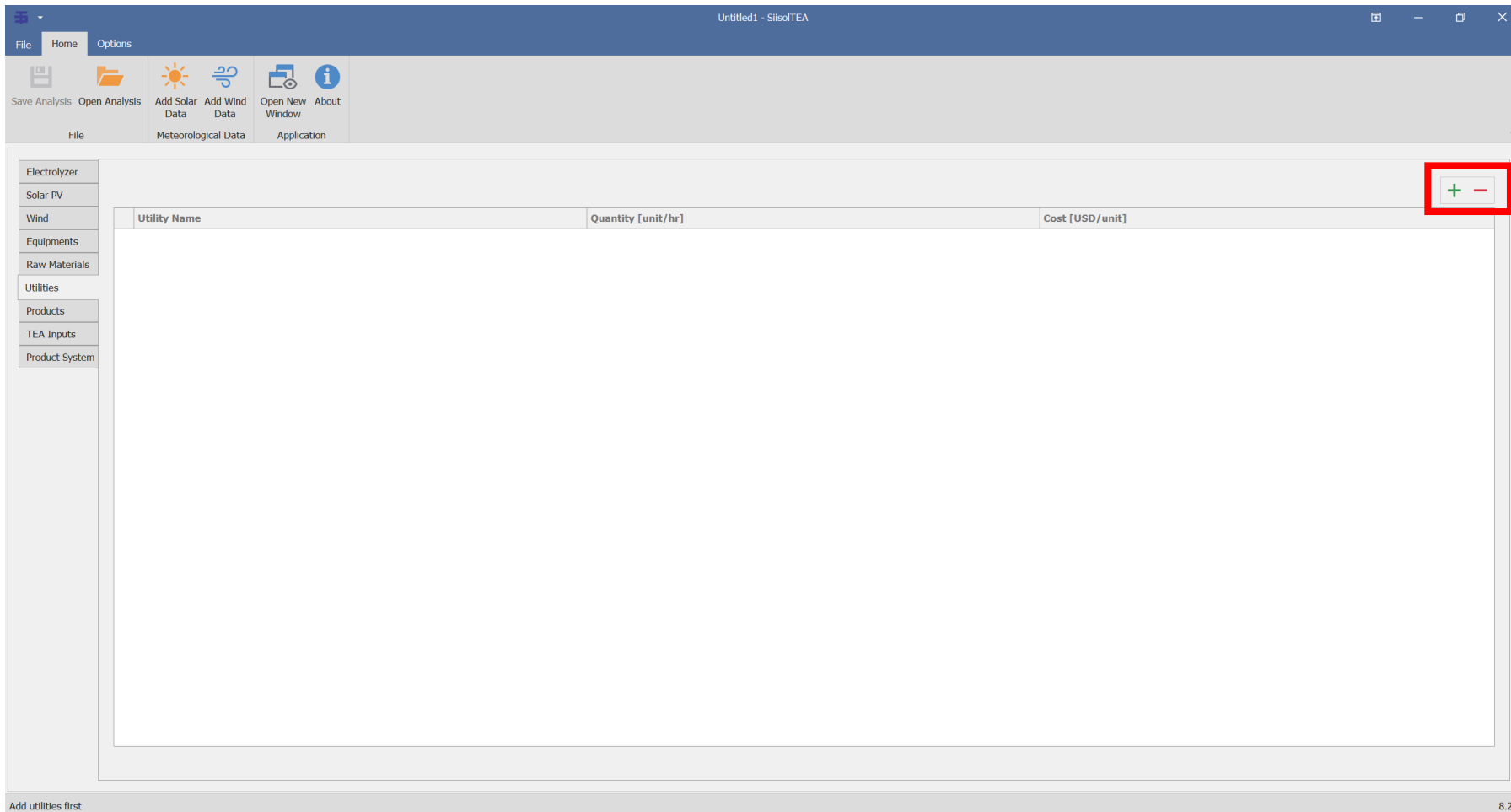
2

3

4



Like raw materials, users can add or remove utilities as needed by using the + and - buttons located in the top right corner. All quantity and cost fields must be filled in.



Key

1

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SiisolTEA includes default entries for the products obtained for the analysis. Users have the option to add or remove items as necessary using the + and - buttons located in the top right corner. The software calculates the quantities of hydrogen and oxygen based on the previously defined hydrogen demand, requiring only cost inputs for these products.

Key

1

2

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4

FileHomeOptions

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ElectrolyzerSolar PVWindEquipmentsRaw MaterialsUtilitiesProductsTEA InputsProduct System

Product Name	Quantity [unit/hr]	Selling Price [USD/unit]
Hydrogen	0	0
Oxygen	0	0

+ -

Products: 0/2 inputs filled.8.25



SiisolTEA enables users to evaluate the system based on profit margins. Just select the highlighted checkbox, choose the desired product, and enter the margin percentage.

FileHomeOptions

Save AnalysisOpen AnalysisAdd Solar DataAdd Wind DataOpen New WindowAbout

FileMeteorological DataApplication

ElectrolyzerSolar PVWindEquipmentsRaw MaterialsUtilitiesProductsTEA InputsProduct System

Parameter	Values	Unit
Annual operating hours	0	hr
Tax rate	0	%
Discount rate	0	%
Profit margin	<input type="checkbox"/> 0	%
Depreciation years	<input type="checkbox"/> 0	yr
Salvage value	0	USD
Project life	0	yr
Plant start-up year	0	yr
Capital cost approach for equipments	Lowest	-

ElectrolyzerSolar PVWindEquipmentsRaw MaterialsUtilitiesProductsTEA InputsProduct System

Parameter	Values
Annual operating hours	0
Tax rate	0
Discount rate	0
Profit margin	<input checked="" type="checkbox"/> Hydrogen 0
Depreciation years	<input type="checkbox"/> 0
Salvage value	0
Project life	0
Plant start-up year	0
Capital cost approach for equipments	Lowest

TEA Inputs: 4/8 inputs filled.

8.25

Key

1

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SiisolTEA enables users to analyze the system using either straight-line depreciation or accelerated depreciation. By default, the software applies the straight-line depreciation method; to switch to accelerated depreciation, simply select the highlighted checkbox.

Untitled1 - SiisolTEA

File Home Options

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Parameter	Values	Unit
Annual operating hours	0	hr
Tax rate	0	%
Discount rate	0	%
Profit margin	<input type="checkbox"/> - 0	%
Depreciation years	<input checked="" type="checkbox"/>	yr
Salvage value	0	USD
Project life	0	yr
Plant start-up year	0	yr
Capital cost approach for equipments	Lowest	-

TEA Inputs: 4/8 inputs filled.

8.25

Key

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If the user selects the capital cost for solar, wind, or electrolyzer from the software database, this field will request the cost methodology, based on the ranges specified by IEA and IRENA.

Untitled1 - SisoTEA

File Home Options

Save Analysis Open Analysis Add Solar Data Add Wind Data Open New Window About Window

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Parameter	Values	Unit
Annual operating hours	0	hr
Tax rate	0	%
Discount rate	0	%
Profit margin	<input type="checkbox"/> <input type="text"/> - 0	%
Depreciation years	<input type="checkbox"/> 0	yr
Salvage value	0	USD
Project life	0	yr
Plant start-up year	0	yr
Capital cost approach for equipments	Lowest	-

TEA Inputs: 4/8 inputs filled. 8.25

Key

1

2

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Users have the ability to assign unique project names to each analysis and utilize the description box for comprehensive notes. Selecting the appropriate Project Year is essential when capital costs for solar, wind, or electrolyzer are sourced from the software's database.

The screenshot displays the SHISOL software interface. The title bar reads "Untitled1 - ShisolTEA". The ribbon menu includes "File", "Home", and "Options". The "Options" tab is active, showing icons for "Save Analysis", "Open Analysis", "Add Solar Data", "Add Wind Data", "Open New Window", and "About". Below the ribbon, there are three main sections: "File", "Meteorological Data", and "Application". The "Application" section is expanded, showing a list of equipment types: "Electrolyzer", "Solar PV", "Wind", "Equipments", "Raw Materials", "Utilities", "Products", "TEA Inputs", and "Product System". The "Equipments" section is selected, and a red box highlights the input fields for "Project Name", "Project Year" (set to 2025), and "Description". A blue "Calculate" button with a refresh icon is located below the description field. The bottom right corner of the window shows the version number "8.25".

Key

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After entering all the required inputs, click the Calculate button to obtain the results. Once the results are displayed, users will no longer be able to modify any inputs unless they click the reset button located to the right of the Calculate button.

Key

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Untitled1 - SHISOLTEA

File Home Options

Save Analysis Open Analysis Add Solar Data Add Wind Data Open New Window About Window

File Meteorological Data Application

Electrolyzer
Solar PV
Wind
Equipments
Raw Materials
Utilities
Products
TEA Inputs
Product System

Project Name

Project Year

Description

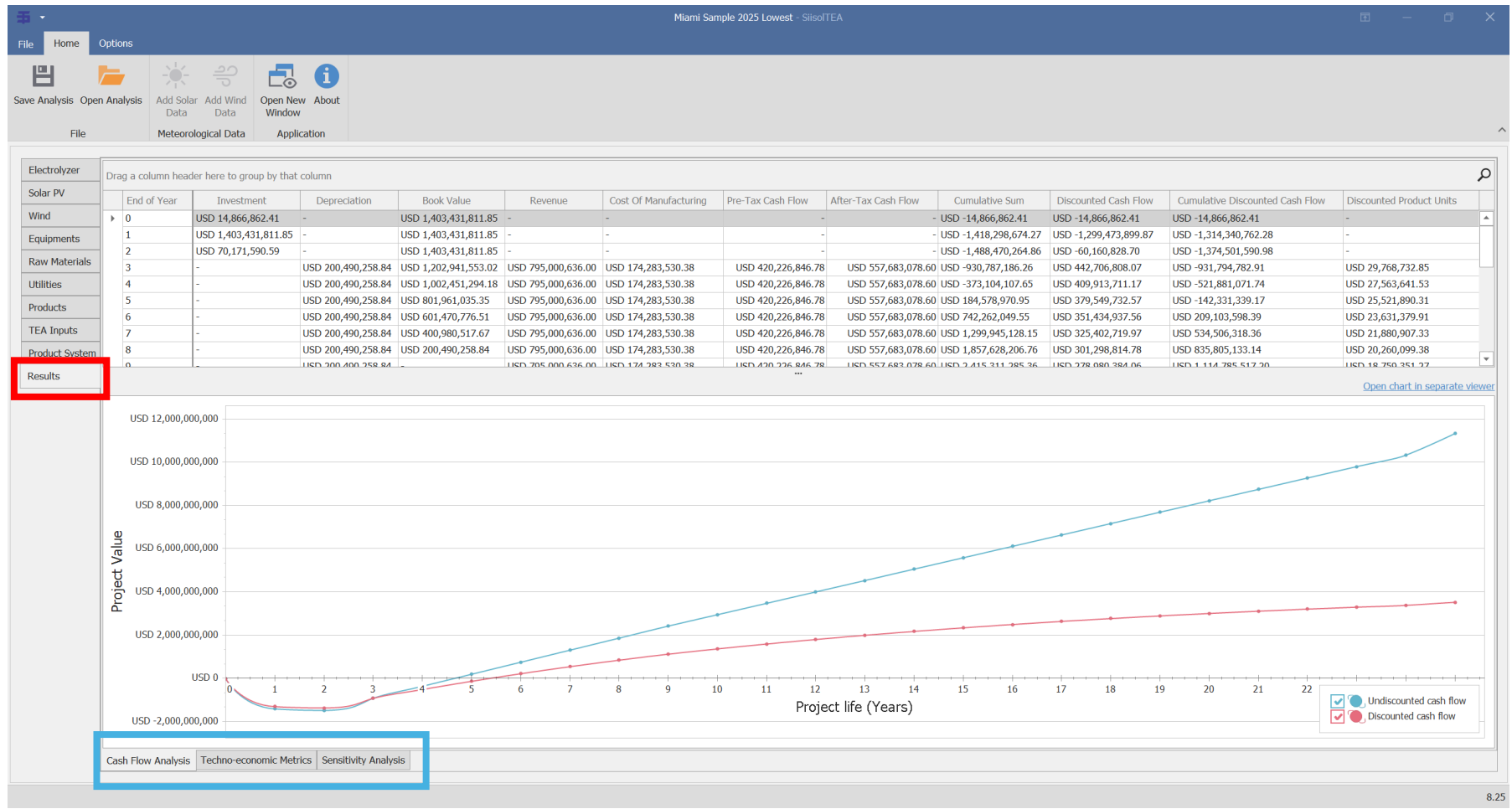
Calculate

Reset

8.25



After the results are generated, a new Results tab will appear in the left panel. Within this tab, three additional tabs will be displayed just above the status bar.



Key

1

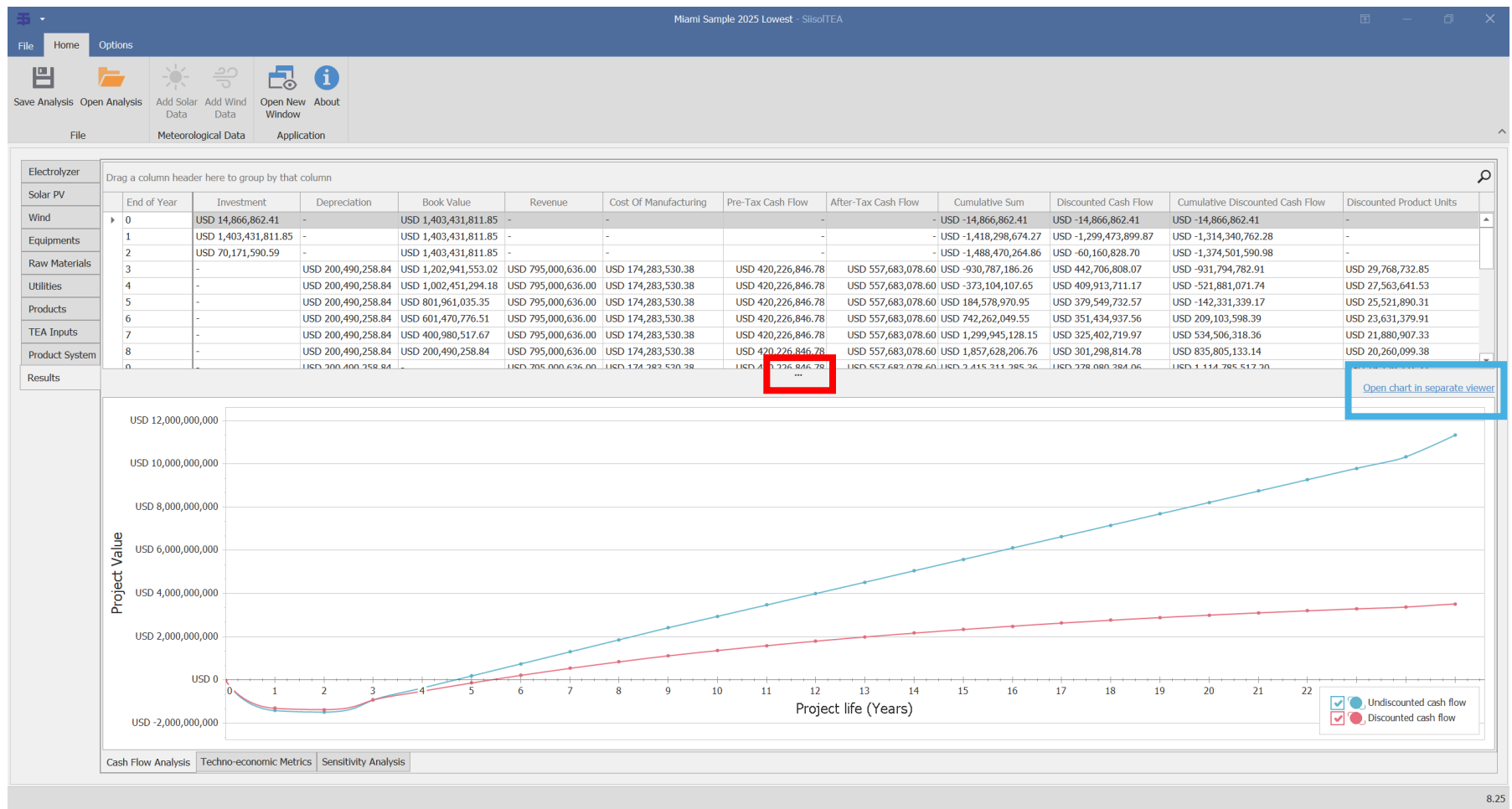
2

3

4



Users can drag the separator vertically to adjust the size of each panel (highlighted in red). Additionally, hovering over the graph displays the values at each data point. Users also have the option to open the chart in a separate viewer for a more detailed view.



Key

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The chart viewer enables users to personalize charts by selecting the type and adjusting the appearance. Additionally, users can export charts in high-quality formats like SVG, ensuring they remain sharp and clear when included in presentations or documentation.

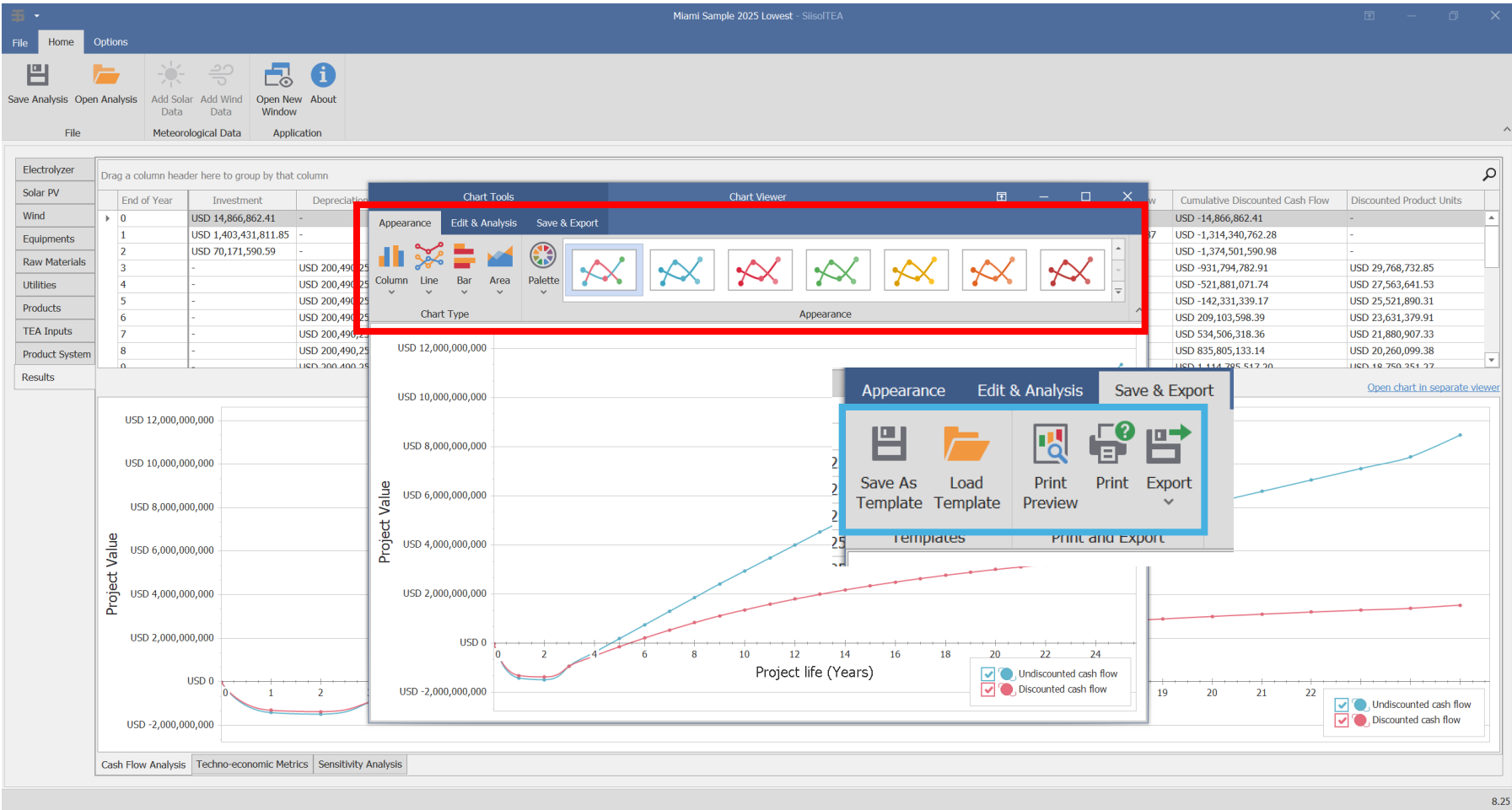
Key

1

2

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4





The findings encompass comprehensive techno-economic indicators can be found in the Techno-economic Metrics tab..

File

Home

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Results

Technical Metrics

Drag a column header here to group by that column

Parameter Name	Value	Unit
Size of electrolyzer	261.90	MW
Size of solar PV farm	176.60	MW
Number of solar PV modules	318,196.00	-
Area of solar PV farm	0.98	km^2
Size of wind farm	235.71	MW
Number of wind turbines	66.00	-
Area of wind farm	0.89	km^2
Total area for hybrid farm	1.87	km^2

Economical Metrics

Drag a column header here to group by that column

Parameter Name	Value	Unit
Net present value (NPV)	4,221,556,121.56	USD
Total capital investment (TCI)	1,488,470,264.86	USD
Net annual profit before taxes	620,717,105.62	USD
Net annual profit after taxes	527,609,539.78	USD
Payback period	5.41	yr
Return on investment (ROI)	35.45	%
Internal rate of return (IRR)	28.95	%
Net present value per unit capital investment	2.84	USD
Discounted lifecycle cost	2,487,517,968.87	USD
Discounted lifecycle production	333,431,945.83	kg
Levelized cost	7.46	USD/kg

Cash Flow Analysis

Techno-economic Metrics

Sensitivity Analysis

8.25

Key





In addition to comprehensive techno-economic and cash flow evaluations, SiisolTEA offers an in-depth sensitivity analysis feature. Users can access this by navigating to the Sensitivity Analysis tab within the Results section, where they can choose variables and specify percentage variations.

File

Home

Options

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File

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Results

Select Variables

Sensitivity Analysis - Variable Selection

Variables

▼ Electrolyzer

Drag a column header here to group by that column

Parameter Name	Select for Analysis	Base Value	Minimum Variation [%]	Maximum Variation [%]
Electrolyzer efficiency (%)	<input checked="" type="checkbox"/>	70	0	0
Hydrogen flow rate (kg/hr)	<input checked="" type="checkbox"/>	5555.56	0	0
LHV of hydrogen	<input checked="" type="checkbox"/>	0.033	0	0
Operational life	<input checked="" type="checkbox"/>	80000	0	0
Capital cost (\$/kW)	<input checked="" type="checkbox"/>	500	0	0

> Solar

> Wind

> Equipments [Installed cost]

> Raw materials

Allowed minimum variation: 99%, Allowed maximum variation: 42%

OK

Cash Flow Analysis

Techno-economic Metrics

Sensitivity Analysis

Key

1

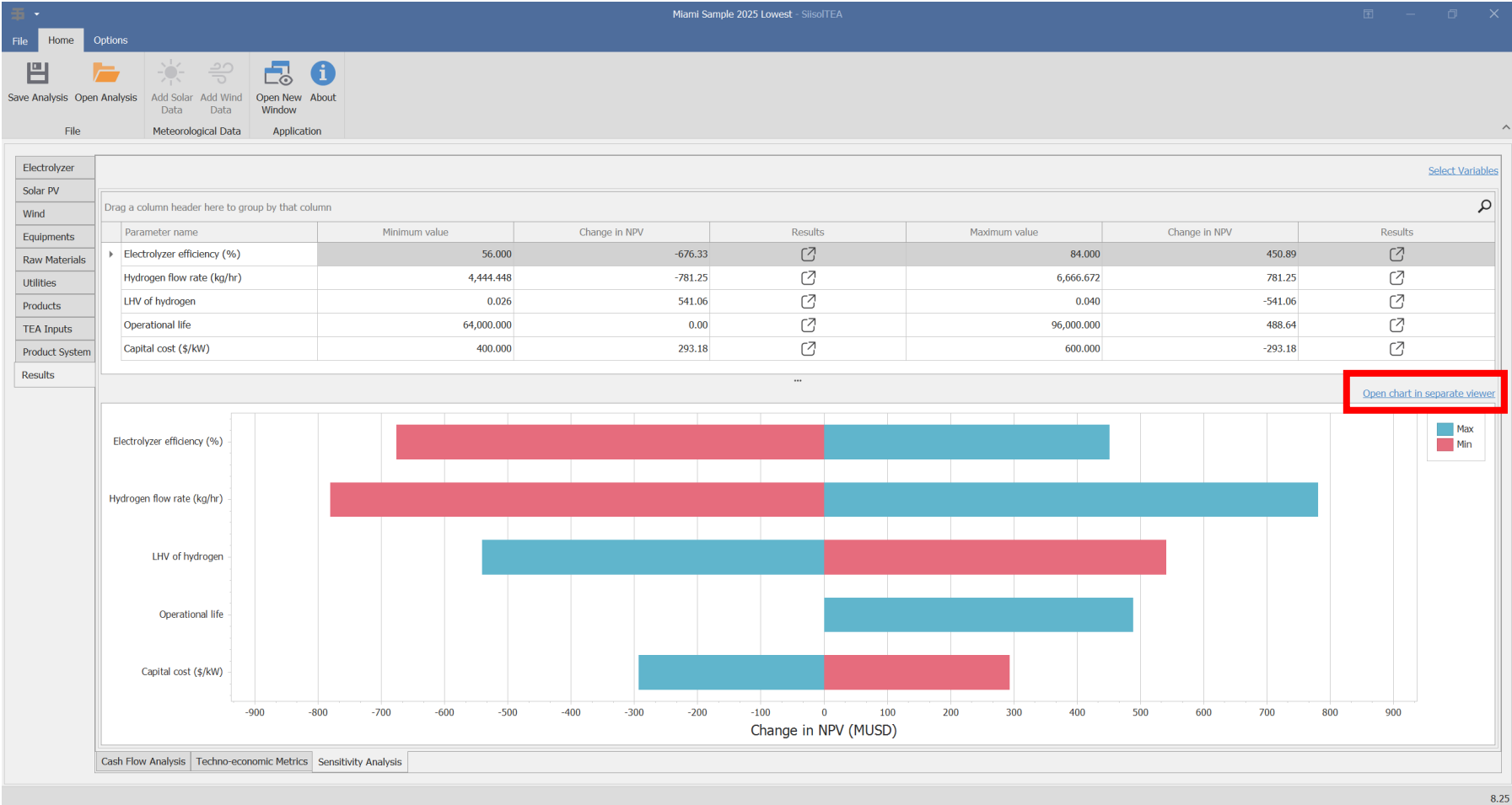
2

3

4



After the results are produced, the user can view the impact of the change as the Change in NPV of the project, presented both numerically and graphically. The chart, similar to cashflow chart, is customizable and exportable using the Chart Viewer.



Key

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In addition to estimating the change in the system's NPV, the Sensitivity Analysis provides comprehensive techno-economic and cash flow details for each variation. Simply click the links in the results column to open a new window displaying the detailed results.

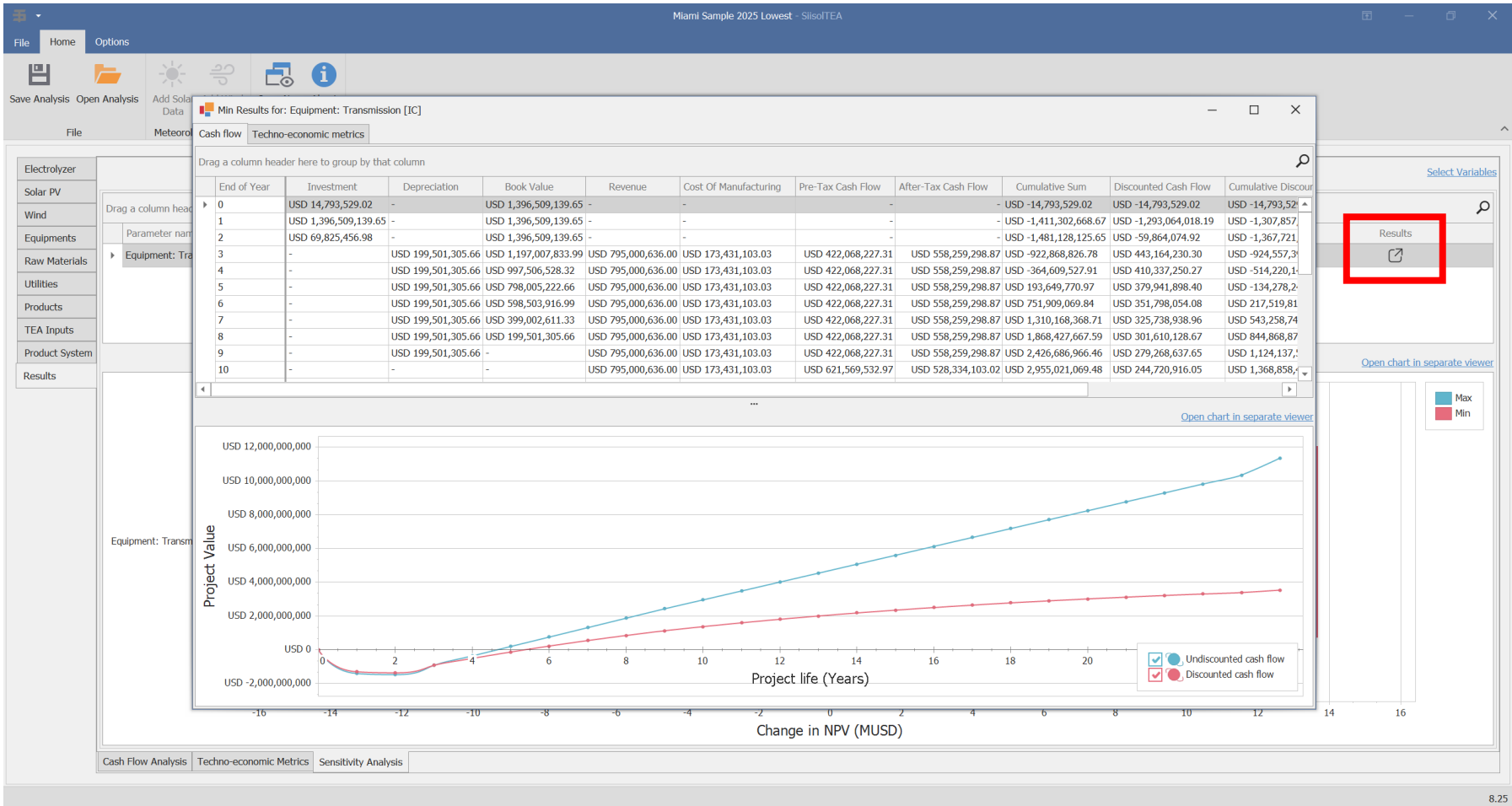
Key

1

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The End

Thank you!