

Getting started with Simulis® Pinch Energy module

Use Case 1: Energy integration of an esterification
process - First steps with Simulis Pinch Energy

Release Simulis Pinch 2.0.0

Software & Services In Process Simulation

We guide You to efficiency






ProSim

Introduction

This getting started shows you the basics of Simulis Pinch Energy in order to perform an energy integration of a process.

This example is linked with the ProSimPlus application example named "Energy analysis of an esterification process from vegetable oil."

This guide presents the following parts:

-  Step 1: Data generation in MS-Excel
-  Step 2: Definition of the energy target
-  Step 3: Design of a heat exchanger network

Step 1: Data generation in MS-Excel

The data, necessary to perform the analysis, can be generated directly from a ProSimPlus simulation.
In ProSimPlus, open the file **PSPS_E30_Esterification Process.pmp3**

Add a module « **Energy pinch analysis** »

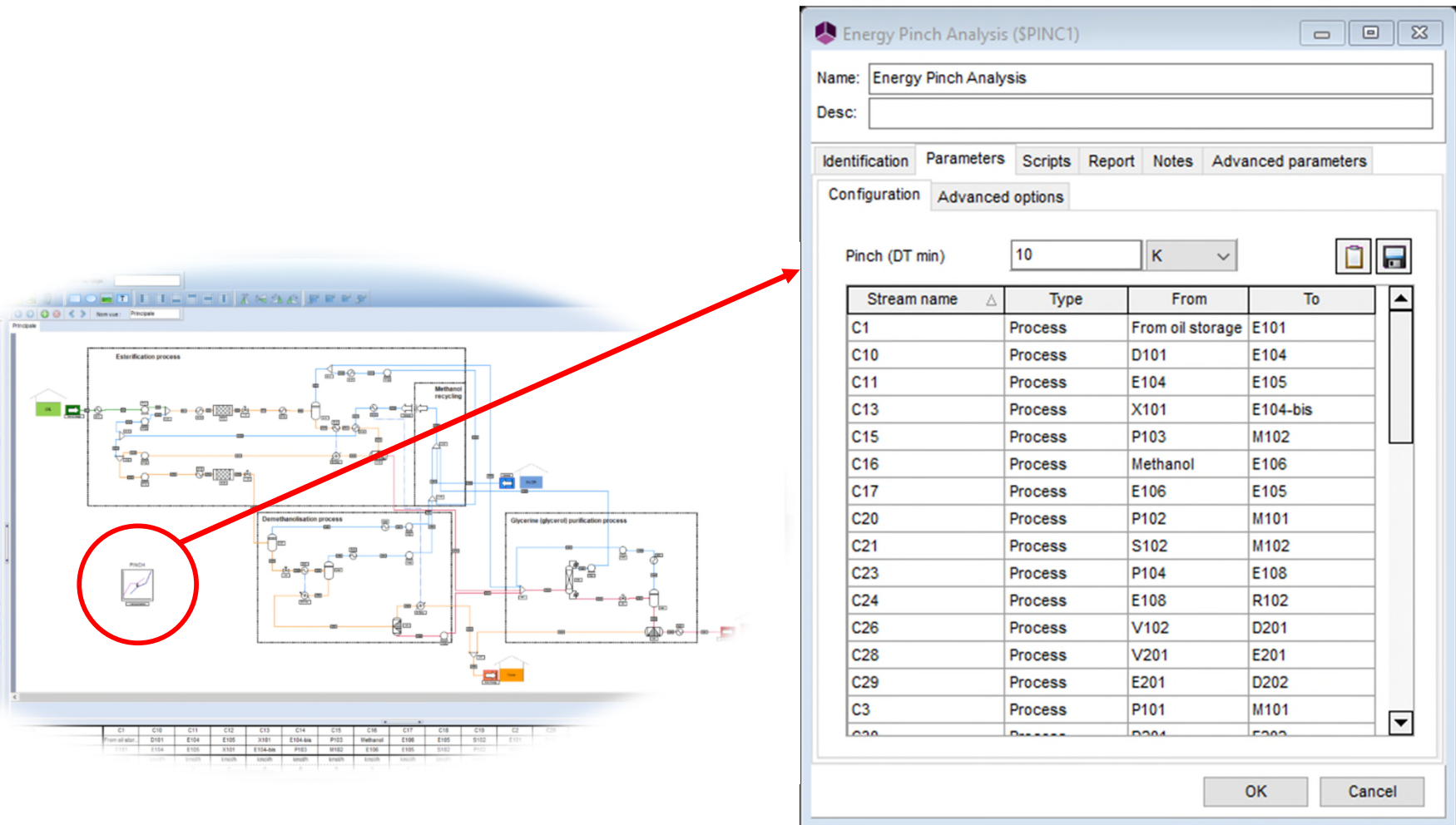
The screenshot shows the ProSimPlus Standard software interface. On the left, a library pane lists various process modules. The 'Energy efficiency' section is expanded, and the 'Pinch analysis' module is highlighted with a red circle and a red arrow. The main window displays a process flow diagram for an esterification process, including units like reactors, distillation columns, and heat exchangers. The bottom of the screen shows a data table with streams and partial flows.

Streams	C1	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C2	C20	C21	C22	C23	C24	C25	C26
From	From oil stor...	D101	E104	E105	X101	E104-bis	P103	M102	E106	E105	S102	P101	M101	M102	P104	E108	R102	V102	D201
To	E101	E104	E105	X101	E104-bis	P103	M102	E106	E105	S102	P102	M101	M102	P104	E108	R102	V102	D201	
Partial flows	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h
Partial flows	0	44 %4	44 %4	44 %4	31 %4	31 %4	31 %4	274 %8	274 %8	274 %8	160 %1	0	160 %1	774 %8	104 %1	104 %1	104 %1	204 %8	204 %8

Step 1: Data generation in MS-Excel

Configure the module **Energy pinch analysis**

The configuration of the module is detailed in a ProSimPlus dedicated getting started document



The screenshot displays the ProSimPlus interface with a process flow diagram on the left and the 'Energy Pinch Analysis (SPINC1)' configuration window on the right. A red circle highlights the 'Pinch' icon in the process flow diagram, and a red arrow points from it to the configuration window.

Energy Pinch Analysis (SPINC1) Configuration Window:

- Name:** Energy Pinch Analysis
- Desc:**
- Identification** | **Parameters** | **Scripts** | **Report** | **Notes** | **Advanced parameters**
- Configuration** | **Advanced options**
- Pinch (DT min):** 10 K

Stream name	Type	From	To
C1	Process	From oil storage	E101
C10	Process	D101	E104
C11	Process	E104	E105
C13	Process	X101	E104-bis
C15	Process	P103	M102
C16	Process	Methanol	E106
C17	Process	E106	E105
C20	Process	P102	M101
C21	Process	S102	M102
C23	Process	P104	E108
C24	Process	E108	R102
C26	Process	V102	D201
C28	Process	V201	E201
C29	Process	E201	D202
C3	Process	P101	M101

OK Cancel

Step 1: Data generation in MS-Excel

Click on the **Start simulation** button



At the end of the simulation, click on the **Excel workbook** button of the last simulation



The screenshot shows the ProSimPlus Standard software interface. The main workspace displays a process flow diagram for an esterification process. The process includes an esterification process, a demethanolisation process, and a glycerine purification process. A data table at the bottom shows stream data for various components.

Streams	C1	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C2	C20	C21	C22	C23	C24	C25	C26
From	From oil stor.	D101	E104	E105	X101	E104-bis	P103	Methanol	E106	E105	S102	E101	P102	S102	M102	P104	E108	R102	V102
To	E101	E104	E105	X101	E104-bis	P103	M102	E106	E105	S102	P102	P101	M101	S102	M102	P104	E108	R102	V102
Partial flows	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h
WFTM4HPI	n	44.94	44.94	44.94	71.68	71.68	71.68	72.18	72.18	72.18	94.1	n	94.1	77.48	94.1	94.1	94.1	74.48	74.48

Step 1: Data generation in MS-Excel

The data needed to do the energy analysis are automatically generated at the end of the MS-Excel report.

The column **Stream** presents the names of the streams involving in a heat transfer in the simulation. These streams can be for example:

- A stream entering into a heat exchanger
- A stream entering into the condenser or into the reboiler of a column
- A stream entering into a separation tank and for which a heat exchange is carried out

PINC				
Stream	Physical state	F*Cp (KCAL/HR/K)	T In (C)	T Out (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
C17	L	13172,4	54,0	61,8
C13	L	6140,5	65,0	88,0
C23	L	15527,9	76,6	200,0
C28	LV	12990,1	38,6	70,0
C29	LV	6902,6	70,0	150,0
Rebo.C301	L	12420,4	83,9	136,2
C61	LV	865,0	116,9	140,0
C10	L	7064,3	100,0	80,0
C11	L	6859,1	80,0	65,0
C43	V	86842,1	100,0	82,1
C26	LV	225,0	76,7	76,7
C30	V	42039,9	76,7	25,0
C33	V	5143,6	150,0	25,0
C36	L	5811,4	150,0	79,8
C39	L	5149,4	79,8	57,3
Cond.C301	V	152710,2	48,4	38,5
C52	V	189,7	140,0	11,0
C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0



These automatically generated data are available in the last MS-Excel results file




According to the definition of the decimal separator of your computer, it will be or not necessary to replace points "." by comma ",", so that these values are well interpreted in MS-Excel.

Step 1: Data generation in MS-Excel

The column **Physical state** of the stream indicates :

- **L** for liquid
- **V** for vapor
- **LV** for liquid-vapor (condensation or evaporation)



PINC				
Stream	Physical state	F*Cp (KCAL/HR/K)	T In (C)	T Out (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
C17	L	13172,4	54,0	61,8
C13	L	6140,5	65,0	88,0
C23	L	15527,9	76,6	200,0
C28	LV	12990,1	38,6	70,0
C29	LV	6902,6	70,0	150,0
Rebo.C301	L	12420,4	83,9	136,2
C61	LV	865,0	116,9	140,0
C10	L	7064,3	100,0	80,0
C11	L	6859,1	80,0	65,0
C43	V	86842,1	100,0	82,1
C26	LV	225,0	76,7	76,7
C30	V	42039,9	76,7	25,0
C33	V	5143,6	150,0	25,0
C36	L	5811,4	150,0	79,8
C39	L	5149,4	79,8	57,3
Cond.C301	V	152710,2	48,4	38,5
C52	V	189,7	140,0	11,0
C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0

Step 1: Data generation in MS-Excel

The column **F*Cp** shows the heat duty exchanged divided by ΔT (temperature difference between the inlet and the outlet of the heat exchange), expressed in kcal/hr/K.

The "**F*Cp**" of a stream corresponds to the mass flowrate (F) multiplied by the specific heat capacity at constant pressure (Cp).

In other words, the heat duty exchanged to heat or cool the stream (denoted Q) is equal to:

$$Q = F * Cp * \Delta T = F * Cp * (T_{out} - T_{in})$$

The "**F*Cp**" represents thus the enthalpy difference between the inlet and the outlet divided by ΔT for a single phase fluid (name used in the pinch analysis, although not appropriate to the phase change).

PINC				
Stream	Physical state	F*Cp (KCAL/HR/K)	T In (C)	T Out (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
C17	L	13172,4	54,0	61,8
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C61	LV	865,0	116,9	140,0
C10	L	7064,3	100,0	80,0
C11	L	6859,1	80,0	65,0
C43	V	86842,1	100,0	82,1
C26	LV	225,0	76,7	76,7
C30	V	42039,9	76,7	25,0
C33	V	5143,6	150,0	25,0
C36	L	5811,4	150,0	79,8
C39	L	5149,4	79,8	57,3
Cond.C301	V	152710,2	48,4	38,5
C52	V	189,7	140,0	11,0
C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0

Step 1: Data generation in MS-Excel

The inlet temperature (**T_{in}**) and the outlet temperature (**T_{out}**) are expressed in degrees Celsius.

If temperature increases ($T_{out} > T_{in}$), the stream will be considered as a cold stream (needs to be heated).

If the temperature decreases ($T_{out} < T_{in}$), the stream will be considered as a hot stream (needs to be cooled).

During condensation, evaporation or heat exchange at constant temperature (phase change of a pure substance, for example), the ΔT is automatically set to $\pm 0.01^\circ\text{C}$ and the $F \cdot C_p$ is calculated consequently.

PINC				
Stream	Physical state	F*Cp (KCAL/HR/K)	T In (C)	T Out (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
C17	L	13172,4	54,0	61,8
C13	L	6140,5	65,0	88,0
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C10	L	7064,3	100,0	80,0
C11	L	6859,1	80,0	65,0
C43	V	86842,1	100,0	82,1
C26	LV	225,0	76,7	76,7
C30	V	42039,9	76,7	25,0
C33	V	5143,6	150,0	25,0
C36	L	5811,4	150,0	79,8
C39	L	5149,4	79,8	57,3
Cond.C301	V	152710,2	48,4	38,5
C52	V	189,7	140,0	11,0
C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0

Step 1: Data generation in MS-Excel



Data can come from external sources. For example, the user can generate the Cp missing for one or more streams by using **Simulis Thermodynamics** (the thermodynamic properties calculation server provided by ProSim) directly in MS-Excel environment.

In all cases, the user must ensure to maintain the same format:

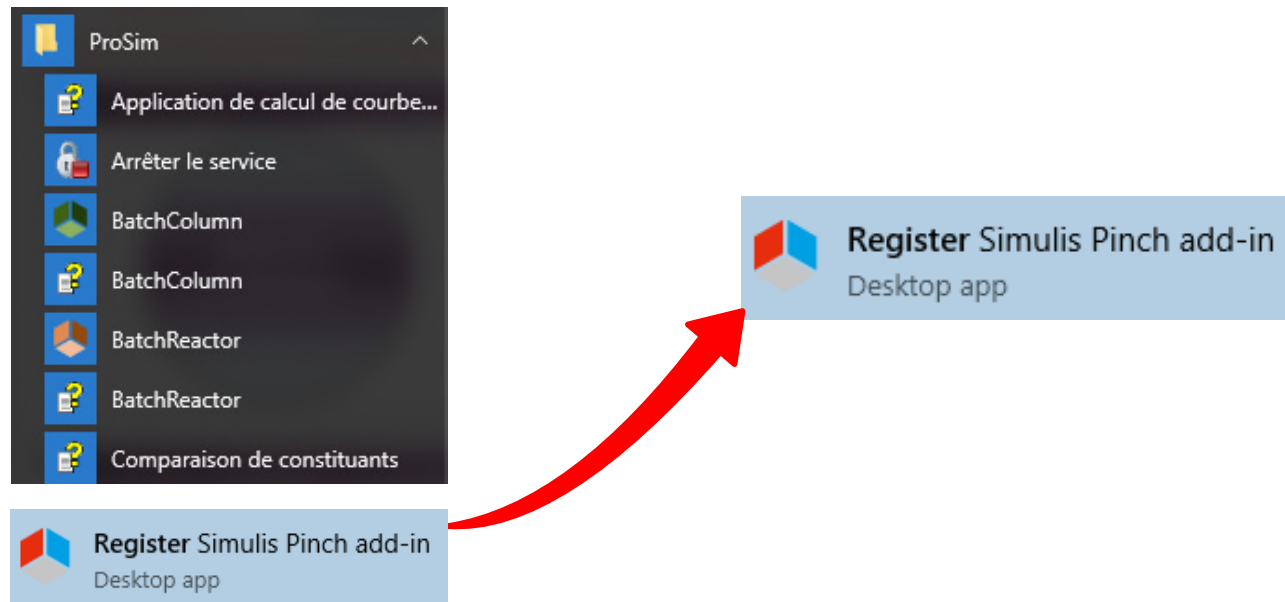
- 1st column: Stream name
- 2th column: Physical state
- 3th column: F*Cp
- 4th column: Tin
- 5th column: Tout

PINC				
Stream	Physical state	F*Cp (KCAL/HR/K)	T In (C)	T Out (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
C17	L	13172,4	54,0	61,8
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C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0

Step 2: Definition of the energy target

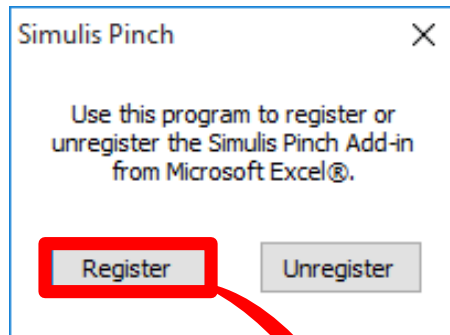
After installing Simulis Pinch, the tool has to be registered in MS-Excel® using the dedicated ProSim tool with one of the two following methods:

1. In the "ProSim" application folder, click on "Register Simulis Pinch add-in"
2. Find directly the tool "Register Simulis Pinch add-in" on your computer (using the search bar)

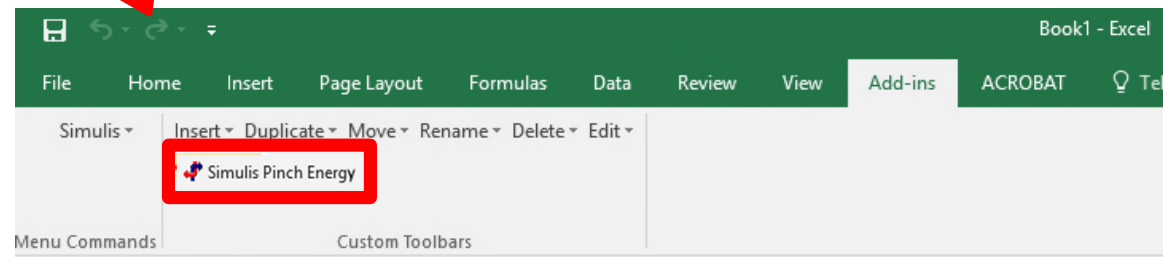


Step 2: Definition of the energy target

Register Simulis Pinch by clicking on “Register”:

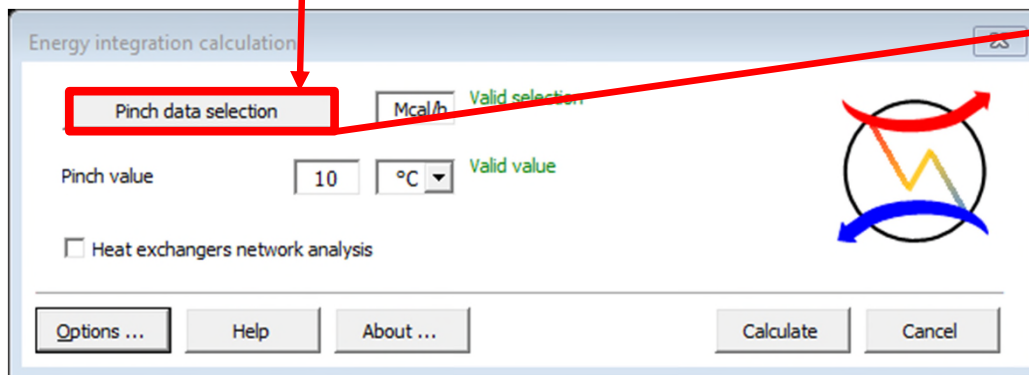
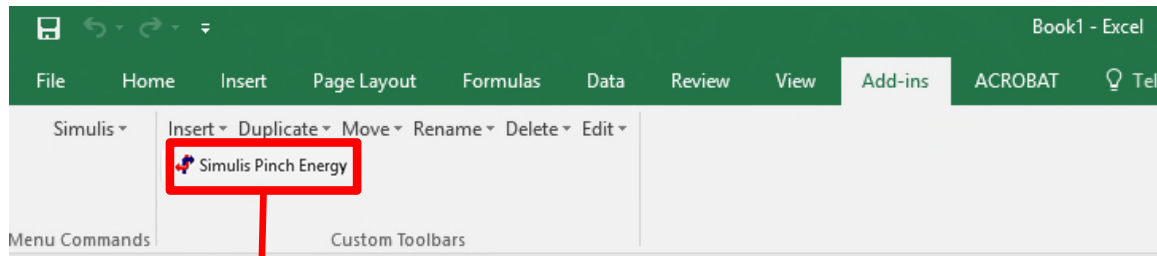


When Simulis Pinch is registered, it's available in MS-Excel® in the “Add-Ins” tab



Step 2: Definition of the energy target

1. Run Simulis Pinch Energy
2. Select the columns $F \cdot C_p$, T_{in} and T_{out} (only numerical values, not the column headings, as shown in the screenshots below)



PINC				
Stream	Physical state	$F \cdot C_p$ (KCAL/HR/K)	T_{in} (C)	T_{out} (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
C17	L	13172,4	54,0	61,8
C13	L	6140,5	65,0	88,0
C25	L	15527,9	76,6	200,0
C28	LV	12990,1	38,6	70,0
C29	LV	6902,6	70,0	150,0
Rebo.C301	L	12420,4	83,9	136,2
C61	LV	865,0	116,9	140,0
C10	L	7064,3	100,0	80,0
C11	L	6859,1	80,0	65,0
C43	V	86842,1	100,0	82,1
C26	LV	225,0	76,7	76,7
C30	V	42039,9	76,7	25,0
C33	V	5143,6	150,0	25,0
C36	L	5811,4	150,0	79,8
C39	L	5149,4	79,8	57,3
Cond.C301	V	152710,2	48,4	38,5
C52	V	189,7	140,0	11,0
C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0

Step 2: Definition of the energy target



Simulis Pinch Energy can also be run from the context menu (right click) after you select the input data:

1. Select the 3 columns F*Cp, Tin and Tout (only numerical values, not the column headings, as shown in the screenshots below)
2. Right-click to access the context menu

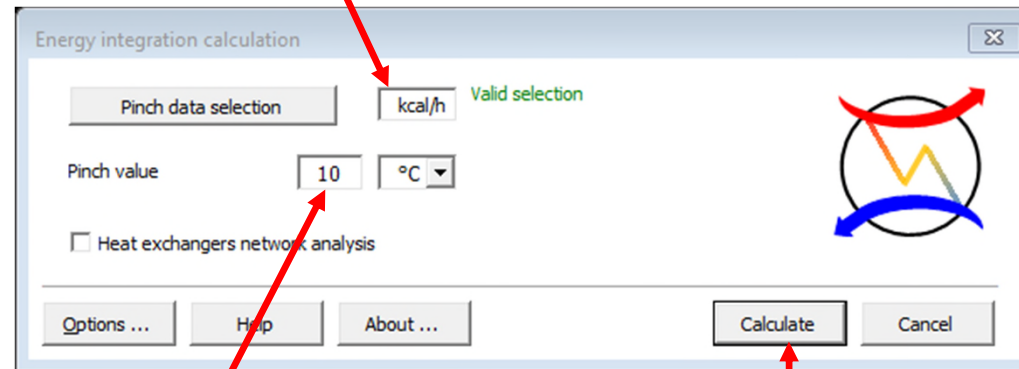
PINC				
Stream	Physical state	F*Cp (KCAL/HR/K)	T In (C)	T Out (C)
C1	L	5598,5	25,0	135,0
C16	L	12863,6	45,0	54,0
C4	L	17535,5	96,0	200,0
C7	LV	53389,9	90,8	100,0
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C23	L	15527,9	76,6	200,0
C28	LV	12990,1	38,6	70,0
C29	LV	6902,6	70,0	150,0
Rebo.C301	L	12420,4	83,9	136,2
C61	LV	865,0	116,9	140,0
C10	L	7064,3	100,0	80,0
C11	L	6859,1	80,0	65,0
C43	V	86842,1	100,0	82,1
C26	LV	225,0	76,7	76,7
C30	V	42039,9	76,7	25,0
C33	V	5143,6	150,0	25,0
C36	L	5811,4	150,0	79,8
C39	L	5149,4	79,8	57,3
Cond.C301	V	152710,2	48,4	38,5
C52	V	189,7	140,0	11,0
C62	L	4952,8	57,7	20,0
C51	L	623,5	70,0	20,0
C50	L	701,4	140,0	70,0



- Cut
- Copy
- Paste Options:
 - Paste Special...
- Smart Lookup
- Insert...
- Delete...
- Clear Contents
- Quick Analysis
 - Filter
 - Sort
- Insert Comment
- Format Cells...
- Pick From Drop-down List...
- Define Name...
- Link
- Simulis Pinch Energy**
- Simulis Pinch Water

Step 2: Definition of the energy target

1. Change the unit to match the specified unit in the MS-Excel workbook (kcal/h in this case)



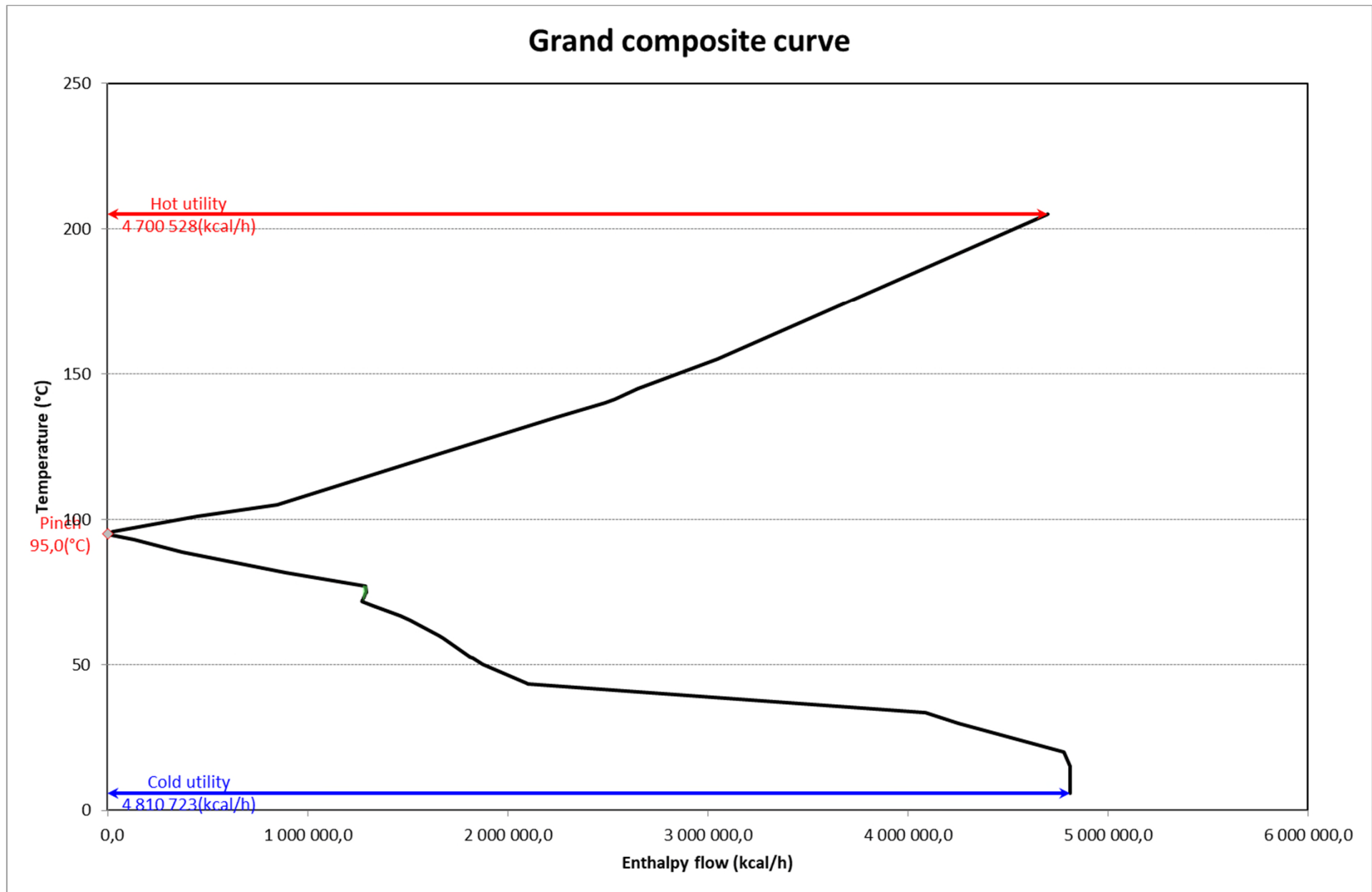
2. Provide the value of the pinch (that is to say the temperature difference at the pinch)

3. Click on **Calculate**



1. The grand composite curve
2. The hot and cold composite curves
3. The streams (hot streams and cold streams)
4. The results of the energy pinch analysis (data and summary of results)

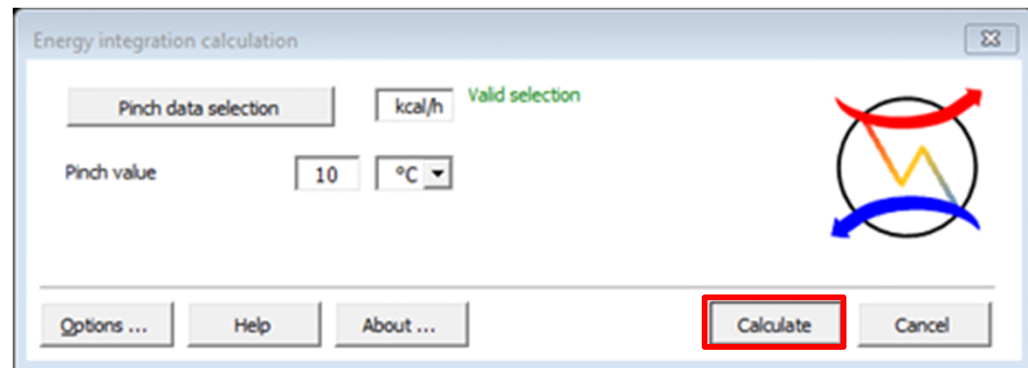
Step 2: Definition of the energy target



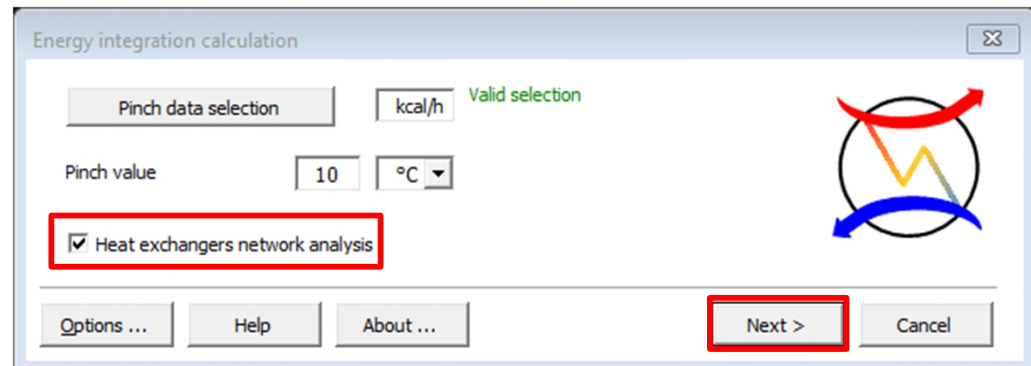
Step 3: Design of a heat exchanger network

If the user has a license for the use of Simulis Pinch, the tool can generate a heat exchanger network which the purpose is to recover a maximum internal energy in the process

Interface **without** Simulis Pinch licence



Interface **with** Simulis Pinch licence



Step 3: Design of a heat exchanger network

1. Change the unit to match the unit specified in the MS-Excel workbook (kcal/h in this case)

2. Provide the value of the pinch (i.e. the temperature difference at the pinch)

The screenshot shows a software dialog box titled "Energy integration calculation". It contains the following elements:

- A "Pinch data selection" button.
- A unit selection field showing "kcal/h" with the text "Valid selection" in green next to it. A red arrow points to this field.
- A "Pinch value" field with the number "10" and a temperature unit dropdown menu set to "°C". A red arrow points to this field.
- A checkbox labeled "Heat exchangers network analysis" which is checked. A red arrow points to this checkbox.
- Buttons at the bottom: "Options ...", "Help", "About ...", "Next >", and "Cancel". A red arrow points to the "Next >" button.
- A circular icon on the right side of the dialog box containing a yellow zigzag line and two curved arrows (one red, one blue).

3. Check the **Heat exchanger network analysis** box

4. Click on **Next**

Step 3: Design of a heat exchanger network

1. Check the box **Heat exchanger network design**



Firstly, the default values will be kept
(**Automatic selection of the heat exchangers**)

2. Uncheck the box **Minimum threshold of energy recovery (%)**.

When this option is unchecked, the software attempts to reach the MER i.e. the Maximum Energy Recovery.

Heat exchangers network analysis

Exchange characterization

Minimum heat duty (kcal/h)

Minimum percentage of energy recovery / MER (%)

Maximum coupling degree

☒ Allow stream division

Utility to preserve
☒ Hot utility
☐ Cold utility

☒ Heat exchangers network design

Selection method: ☒ Automatic ☐ Semi-Automatic ☐ Manual

Criteria for automatic exchangers selection

First criterion

Second criterion

Third criterion

Procedure stop criteria

☒ Multiplication factor of the number of initial streams

☐ Minimum threshold of energy recovery / initial MER (%)

☒ Maximum number of heat exchangers

Graphic options ...

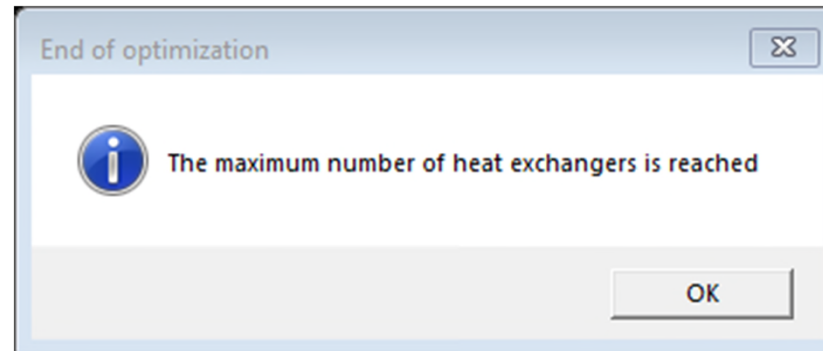
Optional constraints ... Help Default parameters < Return **Calculate** Cancel

3. Click on **Calculate**

Step 3: Design of a heat exchanger network

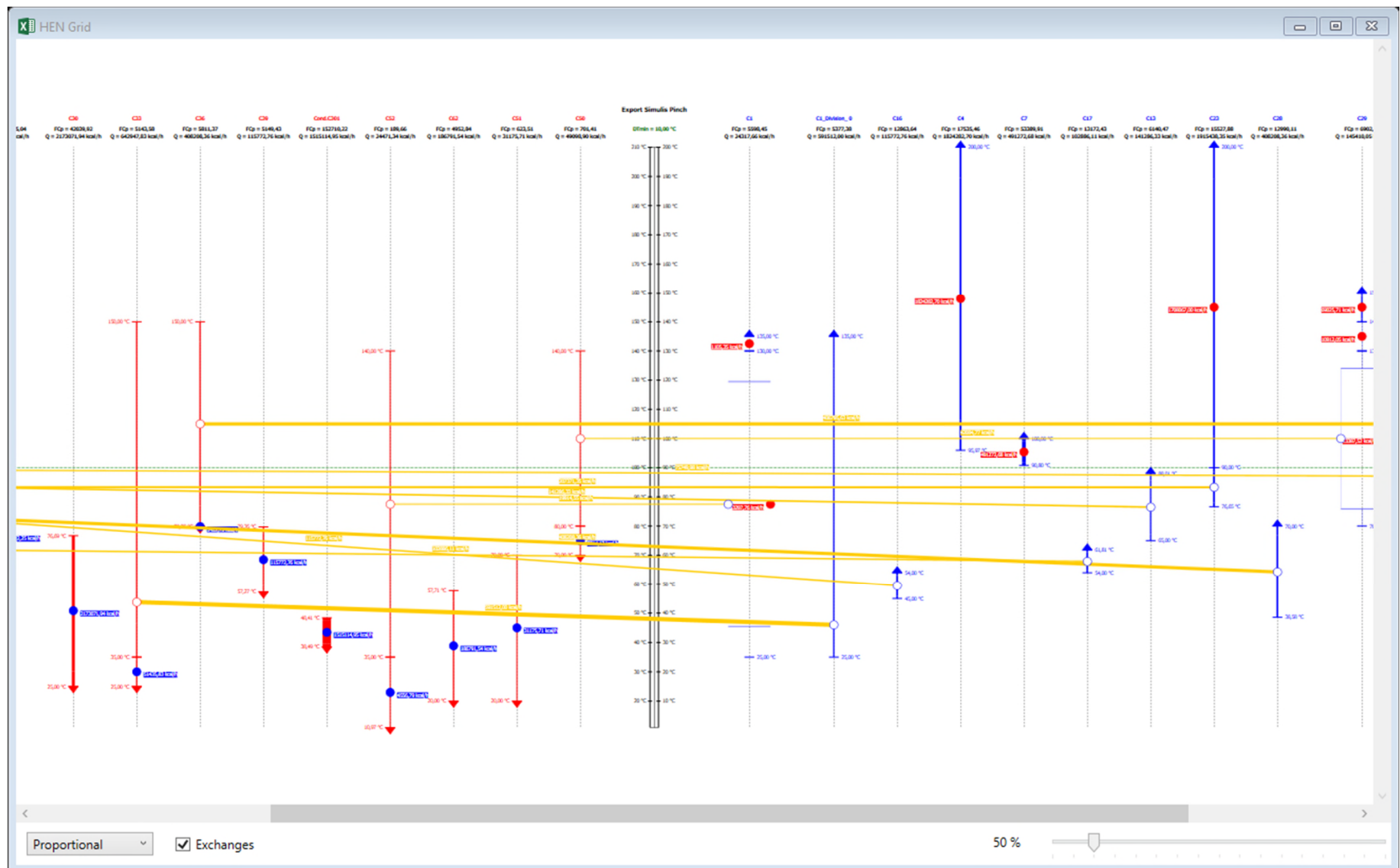
A message will indicate the end of the calculations (when a stop criterion is met)

For this example, the maximum number of heat exchangers defined by the user (10 heat exchangers by default) is reached



Step 3: Design of a heat exchanger network

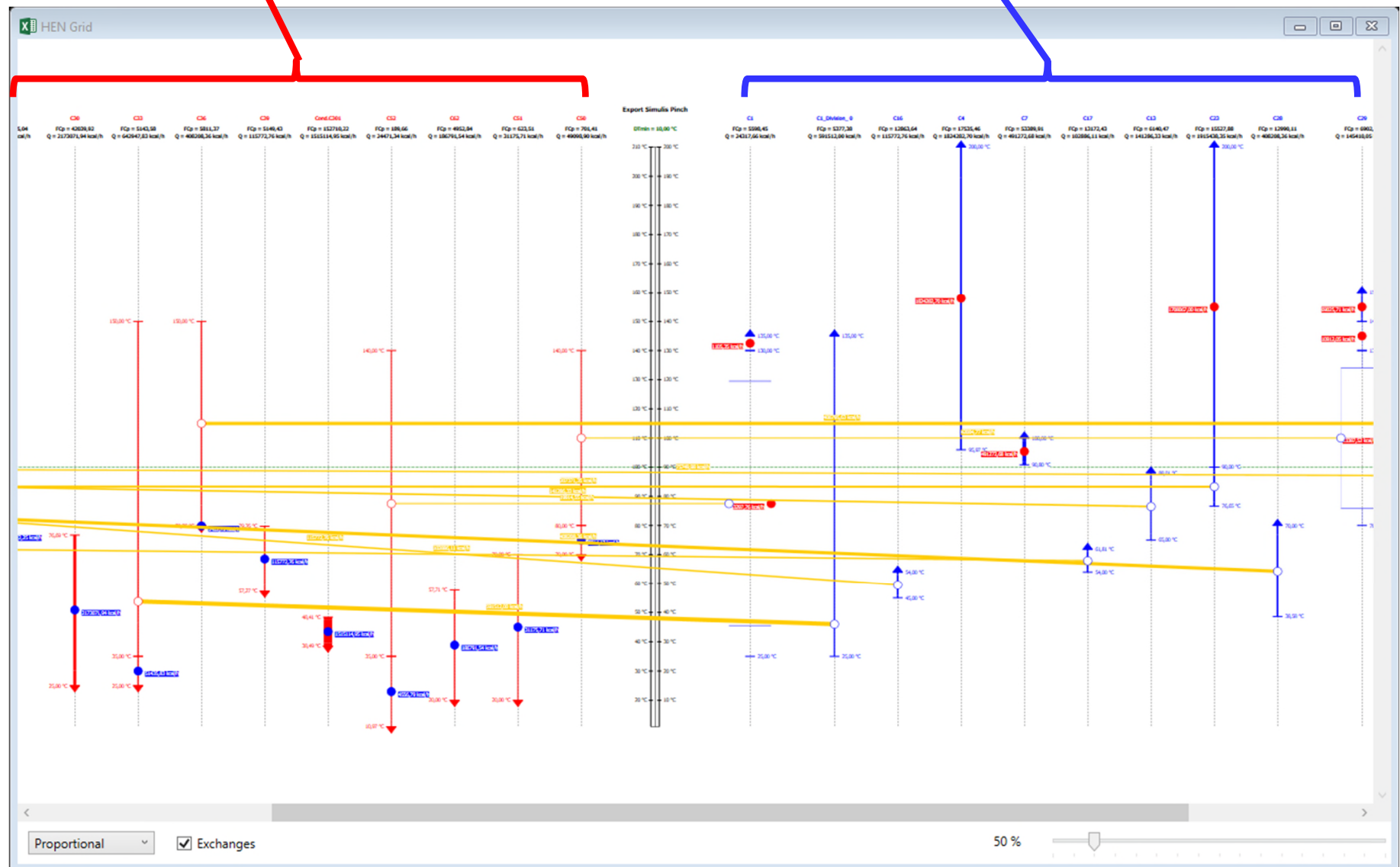
The heat exchanger network is then displayed:



Step 3: Design of a heat exchanger network

Names, $F \cdot Cp$ and Q of hot streams

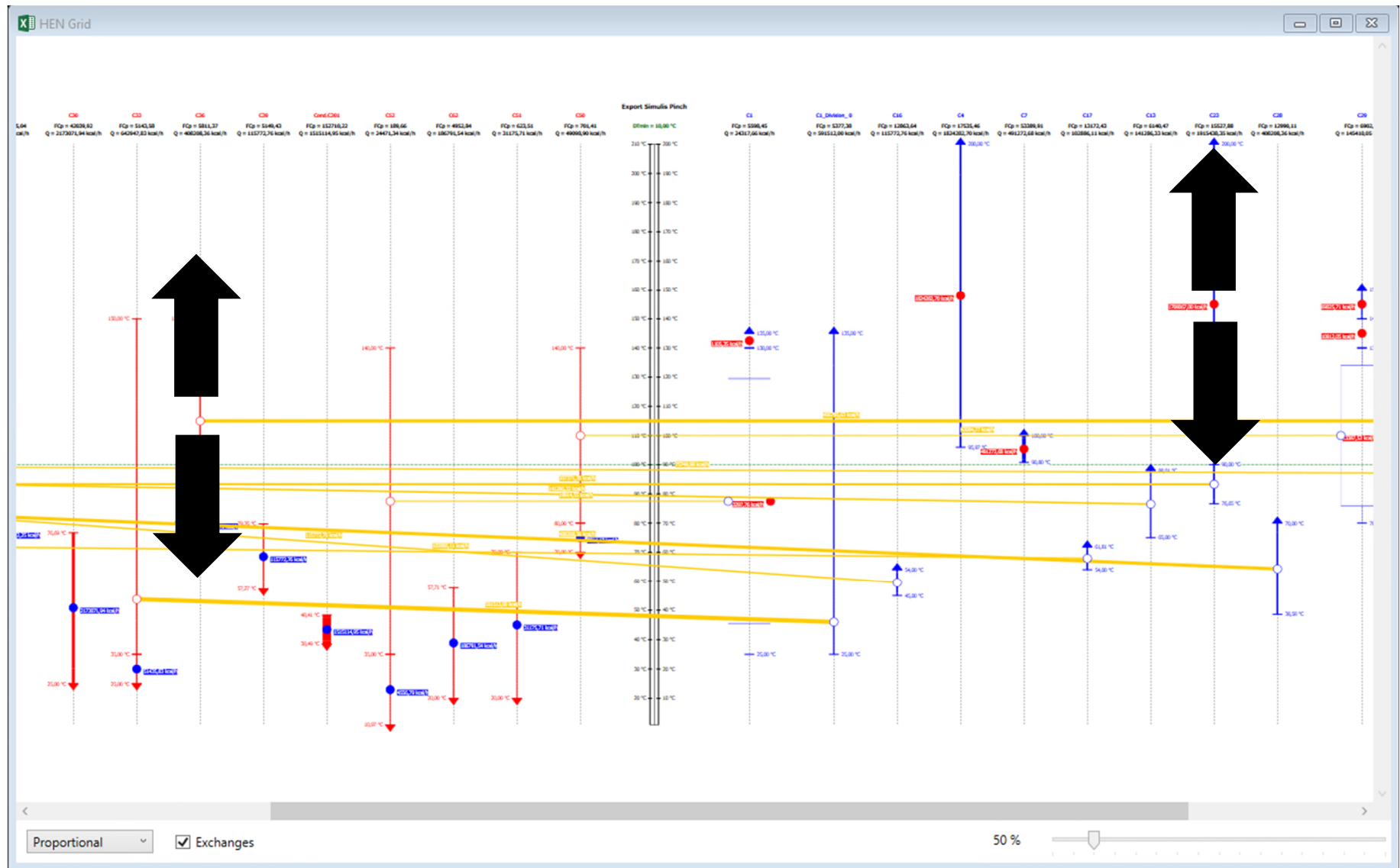
Names, $F \cdot Cp$ and Q of cold streams



Step 3: Design of a heat exchanger network

Each circle represents a cold utility exchanger (blue circle by default), a hot utility (red circle by default) or an integration heat exchanger (white circle by default)

It is possible to change the position of the heat exchangers and change the colors of different information

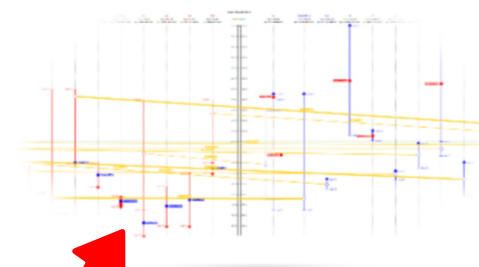


Step 3: Design of a heat exchanger network

Two additional sheets were generated:


1. **Energy integration results**
2. **Input data**

This button lets you display the heat exchanger network



SUMMARY FOR THE HEAT EXCHANGER NETWORK

Initial number of possible exchanges:	40
Multiplication factor for the initial number of streams:	1,0
Cumulative percentage of energy recovery:	98,83
Number of heat exchangers:	10
Total energy recovery (kcal/h):	2 111 581,8
Energy to recover (kcal/h):	9 837,3
Additional required amount of cold utility (kcal/h):	4 835 756,9
Additional required amount of hot utility (kcal/h):	4 725 562,0
Hot utility exchangers number:	10
Cold utility exchangers number:	13

 Display exchangers network

RESULTS FOR THE AUTOMATIC DESIGN OF THE HEAT EXCHANGER NETWORK

Exchanger Item	Cold Stream				Hot Stream				Cold Input T (°C)
	Name	Input T (°C)	Target T (°C)	Target Q (kcal/h)	Name	Input T (°C)	Target T (°C)	Target Q (kcal/h)	
1	C1	25,0	135,0	615 829,7	C33	150,0	25,0	642 947,8	25,0
2	C28	38,6	70,0	408 208,4	C43	100,0	82,1	1 556 510,7	38,6
3	C29	70,0	150,0	552 205,7	C36	150,0	79,8	408 208,4	70,0
4	C23	76,6	200,0	1 915 438,4	C43	100,0	86,8	1 148 302,4	76,6
5	C13	65,0	88,0	141 286,3	C43	100,0	86,8	940 931,0	65,0
6	C16	45,0	54,0	115 772,8	C10	100,0	80,0	141 286,3	45,0
7	C17	54,0	61,8	102 886,1	C11	80,0	65,0	102 886,1	54,0
8	Rebo.C301	83,9	136,2	650 000,0	C43	100,0	86,8	799 644,7	83,9
9	C29	70,0	140,0	76 384,3	C50	140,0	70,0	49 098,9	70,0
10	C1	25,0	135,0	24 317,7	C52	140,0	11,0	24 471,3	25,0

EXCHANGERS STILL REMAINING AFTER THE HEAT EXCHANGER NETWORK SYNTHESIS

Exchanger Item	Cold Stream				Hot Stream				Cold Input T (°C)
	Name	Input T (°C)	Target T (°C)	Target Q (kcal/h)	Name	Input T (°C)	Target T (°C)	Target Q (kcal/h)	
1	C29	70,0	130,0	23 387,5	C10	100,0	96,4	25 513,6	70,0
2	C29	70,0	130,0	23 387,5	C10	100,0	96,4	25 513,6	70,0

Energy Integration results

Input data

Grand composite curve

Composite curves (TQ)

Streams

Pinch results

PSPS_EXX_Procédé_Esterification ...

Step 3: Design of a heat exchanger network

The first part of the "Energy integration Results sheet" summarizes the global information on energy integration and on the heat exchanger network

SUMMARY FOR THE HEAT EXCHANGER NETWORK

Initial number of possible exchanges:	40
Multiplication factor for the initial number of streams:	1,0
Cumulative percentage of energy recovery:	98,83
Number of heat exchangers:	10
Total energy recovery (kcal/h):	2 111 581,8
Energy to recover (kcal/h):	9 837,3
Additional required amount of cold utility (kcal/h):	4 835 756,9
Additional required amount of hot utility (kcal/h):	4 725 562,0
Hot utility exchangers number:	10
Cold utility exchangers number:	13

In the present case, with 10 integration heat exchangers, the heat exchanger network proposed by Simulis Pinch Energy recovers 98.83% of MER (**M**aximum of **E**nergy **R**ecovery)

Step 3: Design of a heat exchanger network

The 10 heat exchangers are described in a table showing their characteristics:

RESULTS FOR THE AUTOMATIC DESIGN OF THE HEAT EXCHANGER NETWORK

Exchanger Item	INPUT DATA							
	Cold Stream				Hot Stream			
	Name	Input T (°C)	Target T (°C)	Target Q (kcal/h)	Name	Input T (°C)	Target T (°C)	Target Q (kcal/h)
1	C1	25,0	135,0	615 829,7	C33	150,0	25,0	642 947,8
2	C28	38,6	70,0	408 208,4	C43	100,0	82,1	1 556 510,7
3	C29	70,0	150,0	552 205,7	C36	150,0	79,8	408 208,4
4	C23	76,6	200,0	1 915 438,4	C43	100,0	86,8	1 148 302,4
5	C13	65,0	88,0	141 286,3	C43	100,0	86,8	940 931,0
6	C16	45,0	54,0	115 772,8	C10	100,0	80,0	141 286,3
7	C17	54,0	61,8	102 886,1	C11	80,0	65,0	102 886,1
8	Rebo.C301	83,9	136,2	650 000,0	C43	100,0	86,8	799 644,7
9	C29	70,0	140,0	76 384,3	C50	140,0	70,0	49 098,9
10	C1	25,0	135,0	24 317,7	C52	140,0	11,0	24 471,3

EXCHANGER CHARACTERISTICS						INFORMATION ON ENERGY INTEGRATION						
Cold Stream		Hot Stream		Heat duty exchanged (kcal/h)	UA Factor (kcal/h/°C)	LMTD (°C)	% of energy recovery /	Degree of coupling	Index	Efficiency	Splitting ratio	Heat duty* efficiency
Input T (°C)	Output T (°C)	Input T (°C)	Output T (°C)									
25,0	135,0	150,0	35,0	591 512,0	47 967,5	12,3	27,7	2	222	0,99	0,96	587 304,8
38,6	70,0	86,8	82,1	408 208,4	14 553,5	28,0	26,7	1	111	1,00	1,00	408 208,4
70,0	140,0	150,0	80,0	406 795,6	40 679,6	10,0	36,3	3	322	1,00	0,84	406 795,6
76,6	90,0	100,0	86,8	207 371,3	20 601,6	10,1	29,0	2	212	1,00	0,18	207 371,3
65,0	88,0	100,0	86,8	141 286,3	8 614,9	16,4	27,8	1	112	1,00	0,15	141 286,3
45,0	54,0	96,4	80,0	115 772,8	3 001,1	38,6	31,6	1	111	1,00	1,00	115 772,8
54,0	61,8	80,0	65,0	102 886,1	7 197,6	14,3	41,1	1	111	1,00	1,00	102 886,1
83,9	90,0	100,0	98,7	75 750,0	6 176,6	12,3	51,3	2	213	1,00	1,00	75 750,0
70,0	130,0	140,0	80,0	42 084,8	4 208,5	10,0	58,6	3	322	1,00	0,64	42 084,8
25,0	130,0	140,0	35,0	19 914,6	1 991,5	10,0	66,9	3	322	1,00	0,86	19 914,6

Step 3: Design of a heat exchanger network

The first result shows that $\approx 100\%$ of energy (MER) have been recovered using 10 heat exchangers.

Is this solution the most suitable? Is there a more interesting configuration?

From the energy recovery point of view, $\approx 100\%$ of the heat have been recovered, it seems hard to go further!

From the design point of view, there may be site constraints:

- Two streams can not exchange because they are too viscous (heat exchangers design problem)
- Two streams can not exchange because they are too far from each other
- The user prefers a local integration
- The user does not want stream division
- The user wants to reduce the capital cost of heat exchangers
- ...

It will be cheaper to promote heat exchangers with a logarithmic mean temperature difference (LMTD) between the hot and cold streams as high as possible in order to minimize the exchange surface area and thus reduce capital costs of heat exchangers.

At this stage, it is possible to choose another specification for heat exchangers, or modify criteria to find the best suitable solution.

Step 3: Design of a heat exchanger network

The **Graphic options** of Simulis Pinch Energy :

Heat exchangers network analysis

Exchange characterization

Minimum heat duty (kcal/h)

Minimum percentage of energy recovery / MER (%)

Maximum coupling degree

☒ Allow stream division

Utility to preserve
☒ Hot utility
☐ Cold utility

☒ Heat exchangers network design

Selection method: ☒ Automatic ☐ Semi-Automatic ☐ Manual

Criteria for automatic exchangers selection

First criterion

Second criterion

Third criterion

Procedure stop criteria

☒ Multiplication factor of the number of initial streams

☒ Minimum threshold of energy recovery / initial MER (%)

☒ Maximum number of heat exchangers

Graphic options ...

Optional constraints ... Help Default parameters < Return Calculate Cancel

Heat exchanger network design: Graph settings

☒ Display exchangers network

Display type

Flux display option

Grid options...

☒ Additional graphical results

☐ Draw bar diagrams of heat exchangers

☒ Draw connections between the streams

☒ Show stream names

☒ Display the exchanger item numbers

☐ Add background picture

No picture selected

Dimensions selection

Help Validate Cancel

Step 3: Design of a heat exchanger network

The **Graphic options** of Simulis Pinch Energy :

Heat exchanger network design: Graph settings

☒ Display exchangers network

Display type: Standard

Flux display option: Proportional

Grid options...

☒ Additional graphical results

☐ Draw bar diagrams of heat exchangers

☒ Draw connections between the streams

☒ Show stream names

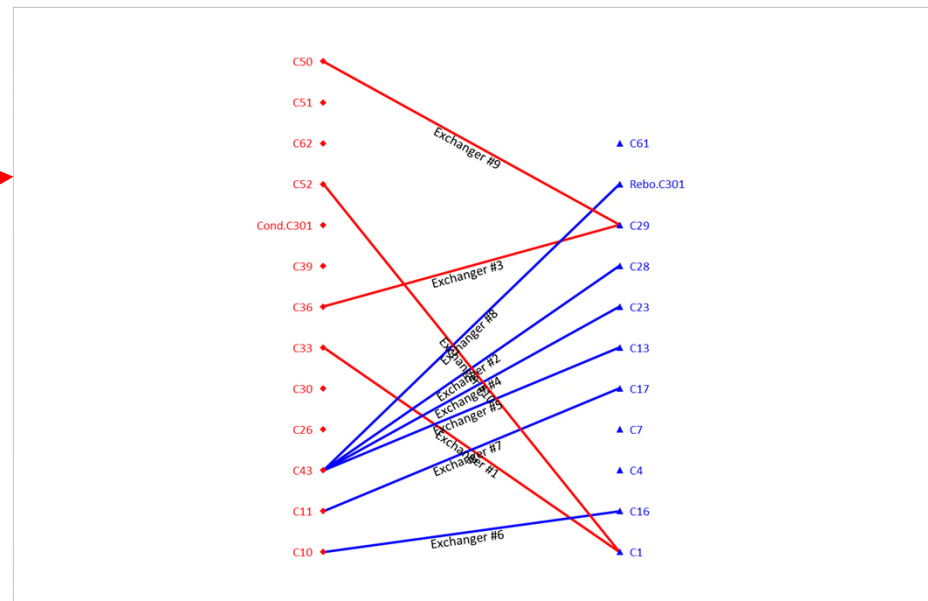
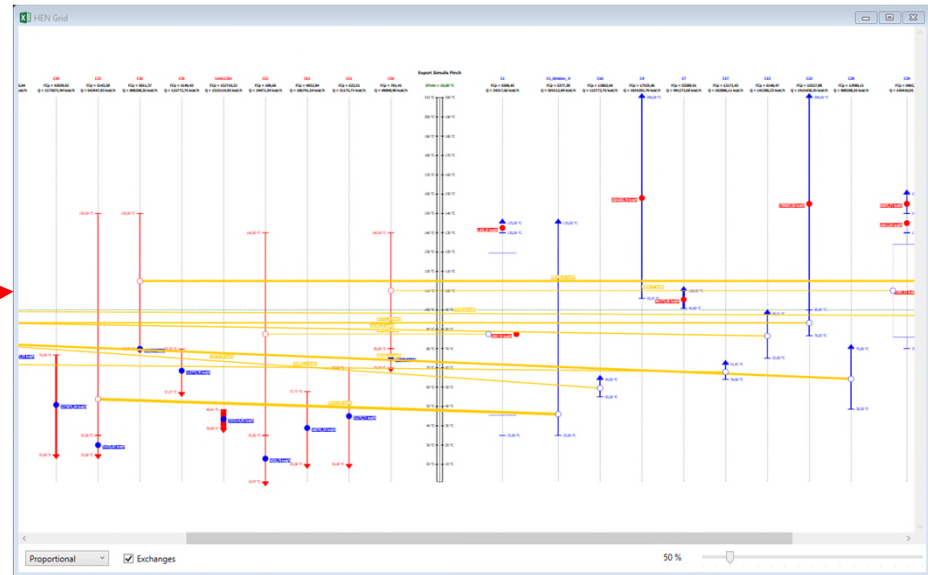
☒ Display the exchanger item numbers

☐ Add background picture

No picture selected

Dimensions selection

Help Validate Cancel



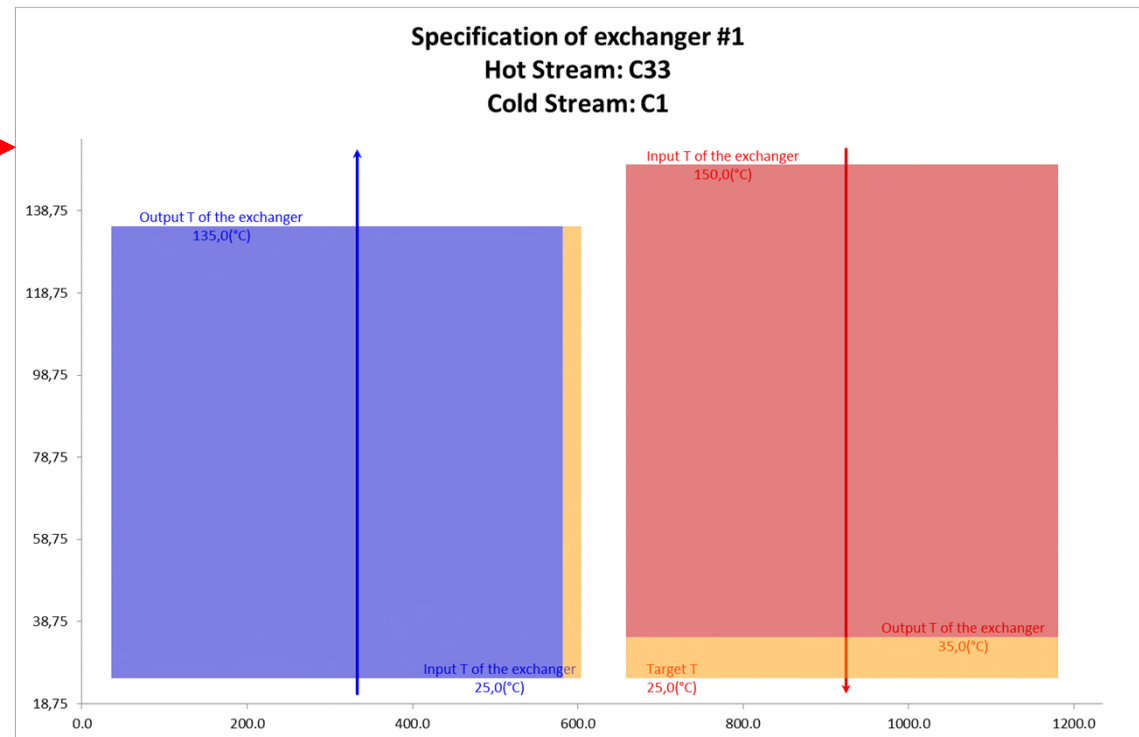
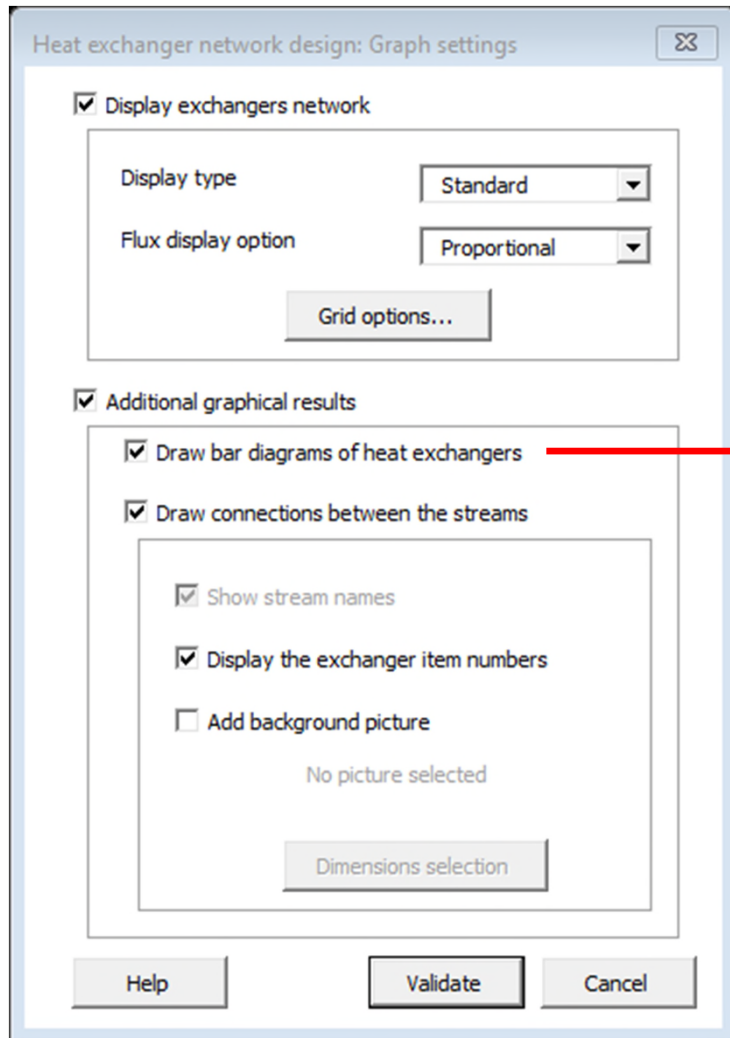
Colors used for network exchangers can be modified by clicking on the button **Grid options**

Step 3: Design of a heat exchanger network

The **Graphic options** of Simulis Pinch Energy :

A diagram display for each heat exchanger is possible by checking the next box.

Simulis Pinch Energy generates at the calculation end a MS-Excel sheet for each heat exchanger with the diagram depending on temperature.



Step 3: Design of a heat exchanger network

Simulis Pinch Energy proposes **Manual** or **Semi-Automatic** selection modes:

1. Select the data and find the next window
2. Check the **Heat exchanger network design**
3. Selection method: **Manual**

Heat exchangers network analysis

Exchange characterization

Minimum heat duty (kcal/h)

Minimum percentage of energy recovery / MER (%)

Maximum coupling degree

☒ Allow stream division

Utility to preserve

☒ Hot utility

☐ Cold utility

☒ Heat exchangers network design

Selection method: ☐ Automatic ☐ Semi-Automatic ☒ Manual

Criteria for automatic exchangers selection

First criterion

Second criterion

Third criterion

Procedure stop criteria

☒ Multiplication factor of the number of initial streams

☒ Minimum threshold of energy recovery / initial MER (%)

☒ Maximum number of heat exchangers

Graphic options ...

Optional constraints ... Help Default parameters < Return Calculate Cancel

Step 3: Design of a heat exchanger network

Exchanger Item	INPUT DATA								EXCHANGER CHARACTERISTICS						
	Cold Stream				Hot Stream				Cold Stream		Hot Stream		Heat duty exchanged (Mcal/h)	UA Factor (Mcal/h/°C)	LMTD (°C)
Name	Input T (°C)	Target T (°C)	Target Q (Mcal/h)	Name	Input T (°C)	Target T (°C)	Target Q (Mcal/h)	Input T (°C)	Output T (°C)	Input T (°C)	Output T (°C)				
1	C1	25,0	135,0	615 829,7	C43	100,0	82,1	1 556 510,7	25,0	90,0	100,0	82,1	363 899,3	13 464,1	27,0
2	C1	25,0	135,0	615 829,7	C43	100,0	82,1	1 556 510,7	25,0	90,0	100,0	95,8	363 899,3	11 713,6	31,1
3	C1	25,0	135,0	615 829,7	C30	76,7	25,0	2 173 071,9	25,0	66,7	76,7	35,0	233 403,2	23 340,3	10,0
4	C1	25,0	135,0	615 829,7	C30	76,7	25,0	2 173 071,9	25,0	66,7	76,7	71,1	233 403,2	9 875,5	23,6
5	C1	25,0	135,0	615 829,7	C33	150,0	25,0	642 947,8	25,0	135,0	150,0	35,0	591 512,0	47 967,5	12,3
6	C1	25,0	135,0	615 829,7	C33	150,0	25,0	642 947,8	25,0	130,7	150,0	35,0	591 512,0	41 768,2	14,2
7	C1	25,0	135,0	615 829,7	C36	150,0	79,8	408 208,4	62,1	135,0	150,0	79,8	408 208,4	25 044,6	16,3
8	C1	25,0	135,0	615 829,7	C36	150,0						79,8	408 208,4	13 295,0	30,7
9	C1	25,0	135,0	615 829,7	C36	150,0						79,8	408 208,4	7 642,9	53,4
10	C4	96,0	200,0	1 824 282,7	C33	150,0						106,0	226 492,2	22 649,2	10,0
11	C4	96,0	200,0	1 824 282,7	C33	150,0						106,0	226 492,2	10 290,8	22,0
12	C4	96,0	200,0	1 824 282,7	C36	150,0						106,0	255 897,4	25 589,7	10,0
13	C4	96,0	200,0	1 824 282,7	C36	150,0						106,0	255 897,4	11 927,2	21,5
14	C7	90,8	100,0	491 272,7	C33	150,0						100,8	253 072,5	10 182,6	24,9
15	C7	90,8	100,0	491 272,7	C33	150,0	25,0	642 947,8	90,8	95,5	150,0	100,8	253 072,5	9 647,3	26,2
16	C7	90,8	100,0	491 272,7	C36	150,0	79,8	408 208,4	90,8	100,0	150,0	100,8	285 928,5	11 504,6	24,9
17	C7	90,8	100,0	491 272,7	C36	150,0	79,8	408 208,4	90,8	96,2	150,0	100,8	285 928,5	10 978,7	26,0
18	C23	76,6	200,0	1 915 438,4	C33	150,0	25,0	642 947,8	76,6	140,0	150,0	86,6	325 870,5	32 587,1	10,0
19	C23	76,6	200,0	1 915 438,4	C33	150,0	25,0	642 947,8	76,6	97,6	150,0	86,6	325 870,5	12 734,7	25,6
20	C23	76,6	200,0	1 915 438,4	C36	150,0	79,8	408 208,4	76,6	140,0	150,0	86,6	368 177,8	36 817,8	10,0
21	C23	76,6	200,0	1 915 438,4	C36	150,0	79,8	408 208,4	76,6	100,4	150,0	86,6	368 177,8	14 880,6	24,7
22	C28	38,6	70,0	408 208,4	C43	100,0	82,1	1 556 510,7	38,6	70,0	86,8	82,1	408 208,4	14 553,5	28,0
23	C28	38,6	70,0	408 208,4	C43	100,0	82,1	1 556 510,7	38,6	70,0	100,0	82,1	408 208,4	11 235,1	36,3

Selection of the exchanger

Select the item number of the desired exchanger

Automatic selection

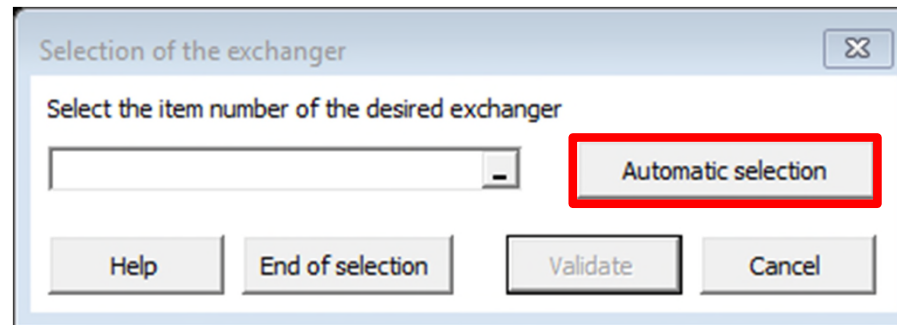
Help End of selection Validate Cancel

1. Select the heat exchanger in the column **Exchanger item**
2. Click on **Validate**

Step 3: Design of a heat exchanger network

In **Manual** selection mode, Simulis Pinch Energy offers the user a list of heat exchangers. The user selects the heat exchangers until one of the stop criteria is reached.

In **Semi-Automatic** selection mode, the user starts to select the heat exchangers like for **Manual** method. With this method, the user can at all time request Simulis Pinch to select automatically heat exchangers (**Automatic** method) by clicking on the **Automatic selection** button.





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