PinCH Tutorial 0

Welcome! The PinCH team of the Lucerne University of Applied Sciences and Arts offers tutorials for the PinCH software to present to you the possibilities of the software and how to use it. In five tutorials, you will learn the basics of using PinCH for energy and cost optimization in industrial processes:

PinCH Tutorial 0	**Quick Overview**
PinCH Tutorial 1	Continuous Production Plant
PinCH Tutorial 2	Production Plant with Multiple Operating Cases
PinCH Tutorial 3	Discontinuous Production Plant
PinCH Tutorial 4	Integration of Thermal Energy Storage

The tutorials are sequential. If you are using PinCH for the first time, this Tutorial 0 is the ideal starting point for getting to know the software.

The tutorials and the associated "finished" PinCH files can be downloaded from the website www.pinch-analyse.ch. The tutorials can be solved with the trial version of PinCH (full version, but limited to eight process streams). To obtain the trial version, please send an E-Mail to pinch@hslu.ch.

The tutorials are available in German, English and French. The labels in process flow charts and the names of processes, streams, etc., as well as software-related terms, are always kept in English. The used currency is Euro.

The tutorials focus on using the PinCH software. It is assumed that you are familiar with the basic principles of the pinch analysis. We recommend the following books as an introduction or for a deeper insight into the pinch method:

- F. Brunner, P. Krummenacher: Einführung in die Prozessintegration mit der Pinch-Methode – Handbuch für die Analyse von kontinuierlichen Prozessen und Batch-Prozessen. Swiss Federal Office of Energy SFOE, 2017 (available from www.pinch-analyse.ch)
- R. Smith: Chemical Process Design and Integration. 2nd Edition, John Wiley & Sons, 2016; Pinch Analysis from Chapter 15 onwards (ISBN 9781119990130)
- I. C. Kemp: Pinch Analysis and Process Integration – A User Guide on Process Integration for the Efficient Use of Energy. 2nd Edition, Elsevier Butterworth-Heinemann, 2007 (ISBN 978-0-7506-8260-2)

Contents

I Introduction Tutorial 0 and Contacts

Learning Goal: Get to know the user interface of PinCH as well as the 10 Steps.

Duration: ½ Hour

In this Tutorial 0 the key aspects of the software user interface are illustrated followed by an explanation of the 10 Steps necessary for completing a pinch analysis successfully. At the end of this tutorial you will find a list of symbols and abbreviations, which applies to all tutorials.
If you have any questions, please do not hesitate to contact us. The PinCH team of the Lucerne University of Applied Sciences and Arts and the Centre de Compétence PinCH Francophone of the School of Management and Engineering Vaud are available at your convenience. Below you will find our contact details:

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II PinCH Workbench

Overview

Figure 1 shows the Workbench of the PinCH software.

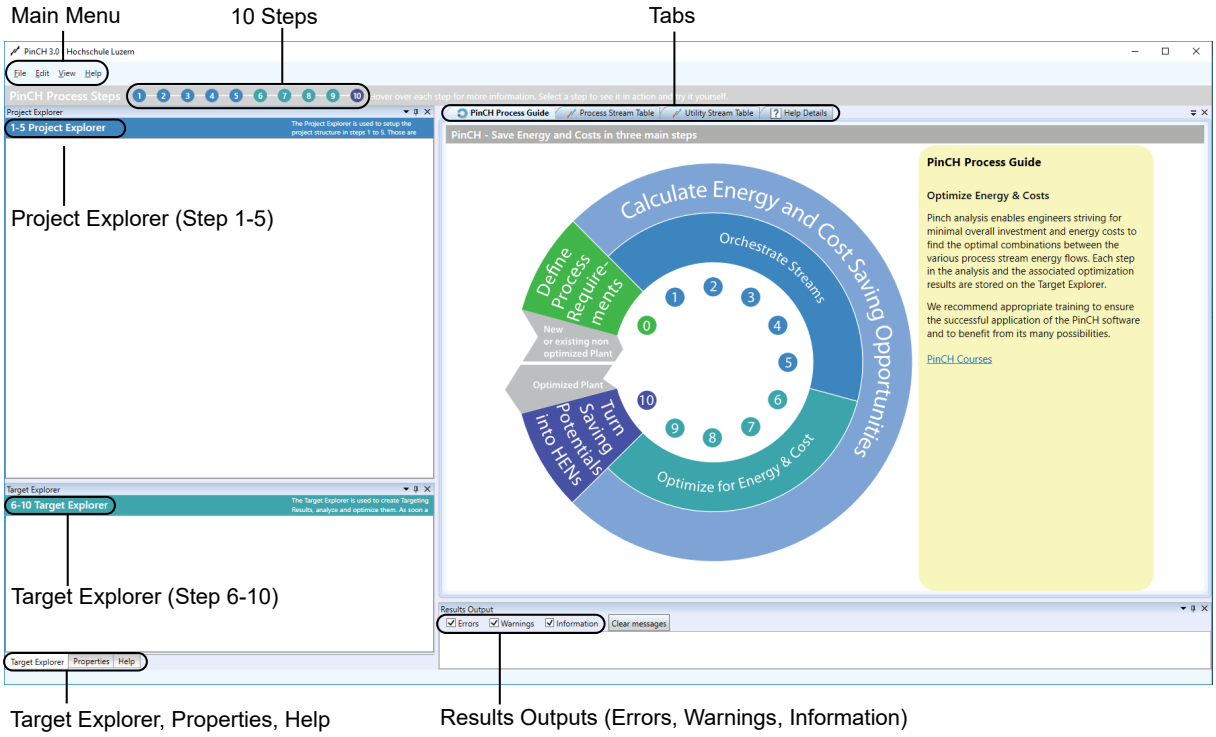

Figure 1: Workbench shown after starting the PinCH software. The Project and Target Explorer as well as the PinCH Process Guide and Results Output windows are displayed by default

In the Project Explorer is where configuration information related to the project for Steps 1-5 are grouped. The analysis and optimization done during Steps 6-10 are completed using the Target Explorer. In order to navigate and learn about the 10 Steps and the different user interface components, the PinCH Process Steps numbers shown directly below the menu items can be used. In order to complete the pinch analysis according to the 10 Steps, several tabs are available that can be used to view or enter detailed information that are later easily accessible from either the Project Explorer or Target Explorer.

Window Layout

If you would like to customize the layout of the windows and tabs (e.g. Project Explorer, Target Explorer, Results Output) in a different arrangement, the following can be done:

- ☞ Place the Cursor at the upper edge of the desired window or tab.
- ☞ With the left mouse key pressed, move the Window or tab to undock it from its current location and placing it in a floating position.

The displayed window docking control allows you to place the window or tab in a desired location (see Figure 2).

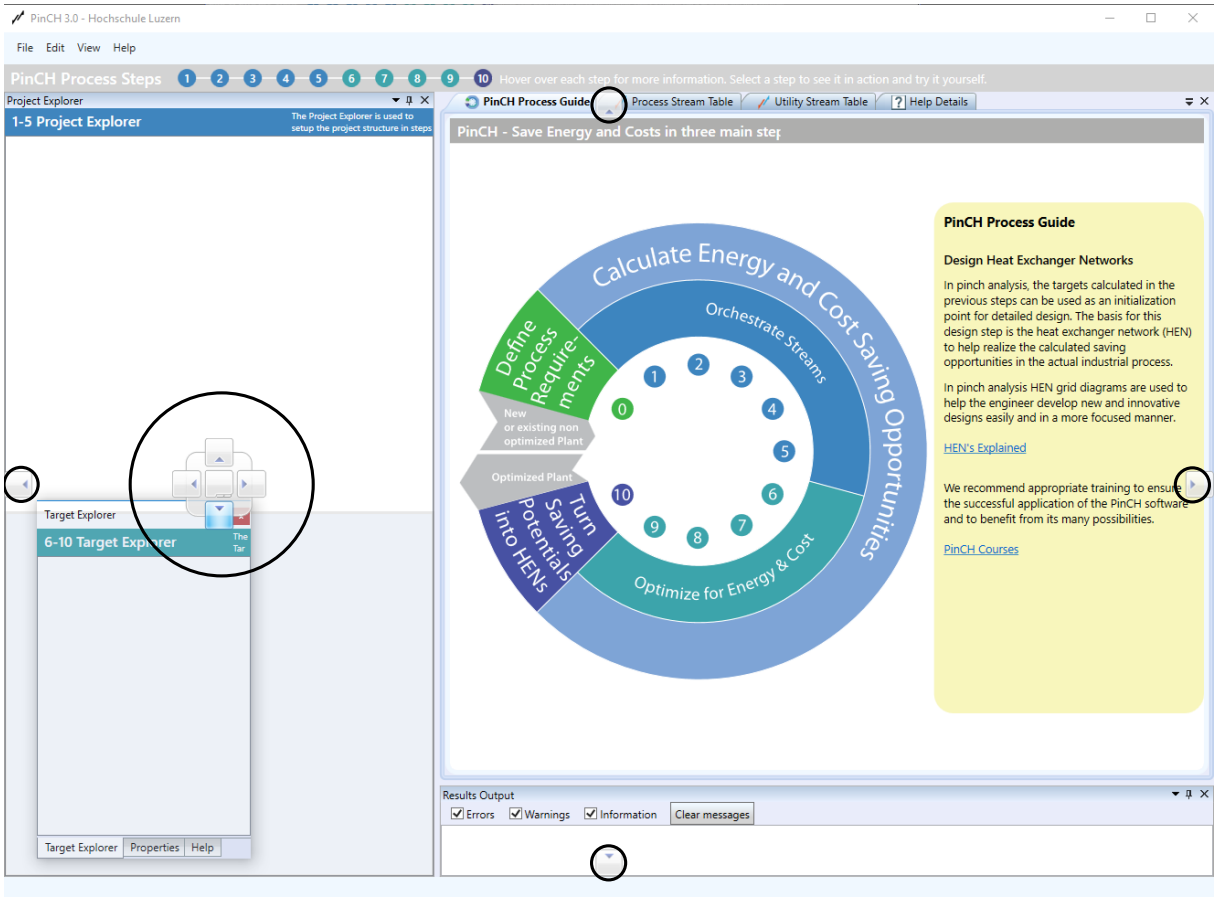

Figure 2: Repositioning the Target Explorer from a floating position to a desired location using the window docking control (highlighted in red rectangles).

In order to change the size of the Window, the following can be done:

- ☞ Place the mouse cursor over the edge of the window (double arrow cursor is shown)
- ☞ Press the mouse key and drag the edge to the desired size.

Settings

The configuration of the project settings can be done using the main menu:

☞ File ☞ Settings

In the setting there are five tabs:

- On the User Interface tab different widgets can be shown or hidden.
- On the Units tab different engineering unit sets can be selected to be shown in the results.
- On the Currencies tab different currencies can be selected to be shown in the results (Swiss Franc CHF, Euro € or US Dollar $). If you wish to use a different currency as the Swiss Franc, then the currency conversion rate relative to the Swiss Franc must be given.
- On the General settings tab, a collection of defaults used for calculations (e.g. ambient temperature used in calculating carnot factor).
- On the Licensing tab commands for the activation and management of the software license are available.

It is recommended to change all the settings before beginning the pinch analysis.

III The 10 Steps in PinCH

The application of pinch analysis in industry can be diverse and multifaceted. The complexity of the analysis depends on various factors, e.g. number of considered processes, size of each process (i.e. number of process streams), number of operating cases, continuous/discontinuous operation and much more. To guide the engineer step by step through the energy and cost optimization, we introduced the 10 Steps in PinCH. Not always are all steps needed, but they should serve as a convenient "guide" during a pinch analysis.

1	**Enter Stream Data**	Enter process streams
2	**Configure Equipment**	Assign the process streams to equipment
3	**Define Processes**	Group streams to processes
4	**Apply Scheduling to Processes**	Configure your process time dependence
5	**Set Economic Data**	Assign equipment based cost parameters
6	**Prepare Targeting Calculations**	Prepare different analysis scenarios
7	**Analyze Energy Targets**	Preanalyze the energy targets of the total site
8	**Calculate Energy & Cost Targets**	Calculate your total energy demand and costs
9	**Integrate Energy Conversion Units**	Properly integrate Energy Conversion Units
10	**Design Heat Exchanger Network**	Create different Heat Exchanger Networks

Table 1: The 10 Steps in PinCH

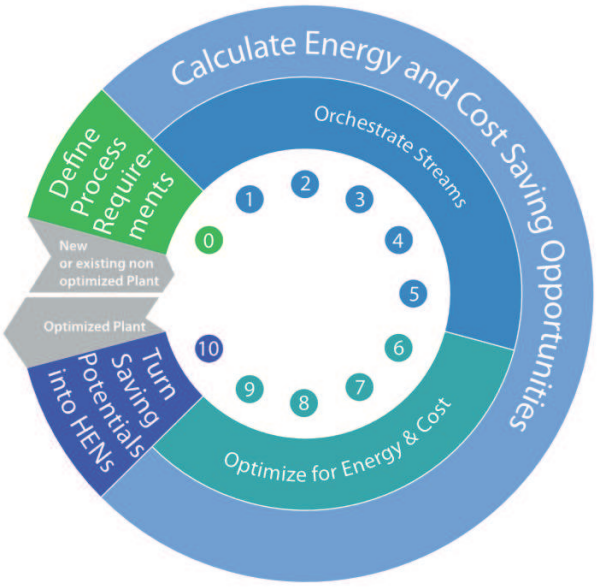

Figure 3: PinCH Process Guide

The goal orientated process as shown in Table 1 enables the systematic and efficient completion of a pinch analysis. We recommend that you practice the 10 Steps together with the help of the tutorials. Our PinCH Process Guide available in the software (see. Figure 3) provides a dynamic overview of the 10 Steps. By clicking on the circles within the figure, information related to the individual steps is displayed with links to further information found in the on-line help.

Additional information: The definition of the process requirements in Step 0 (Define Process Requirements) is the foundation for a pinch analysis. Step 0 is done outside of the PinCH software.

A graphical overview of the 10 Steps and related key actions is shown in Fig. 4.

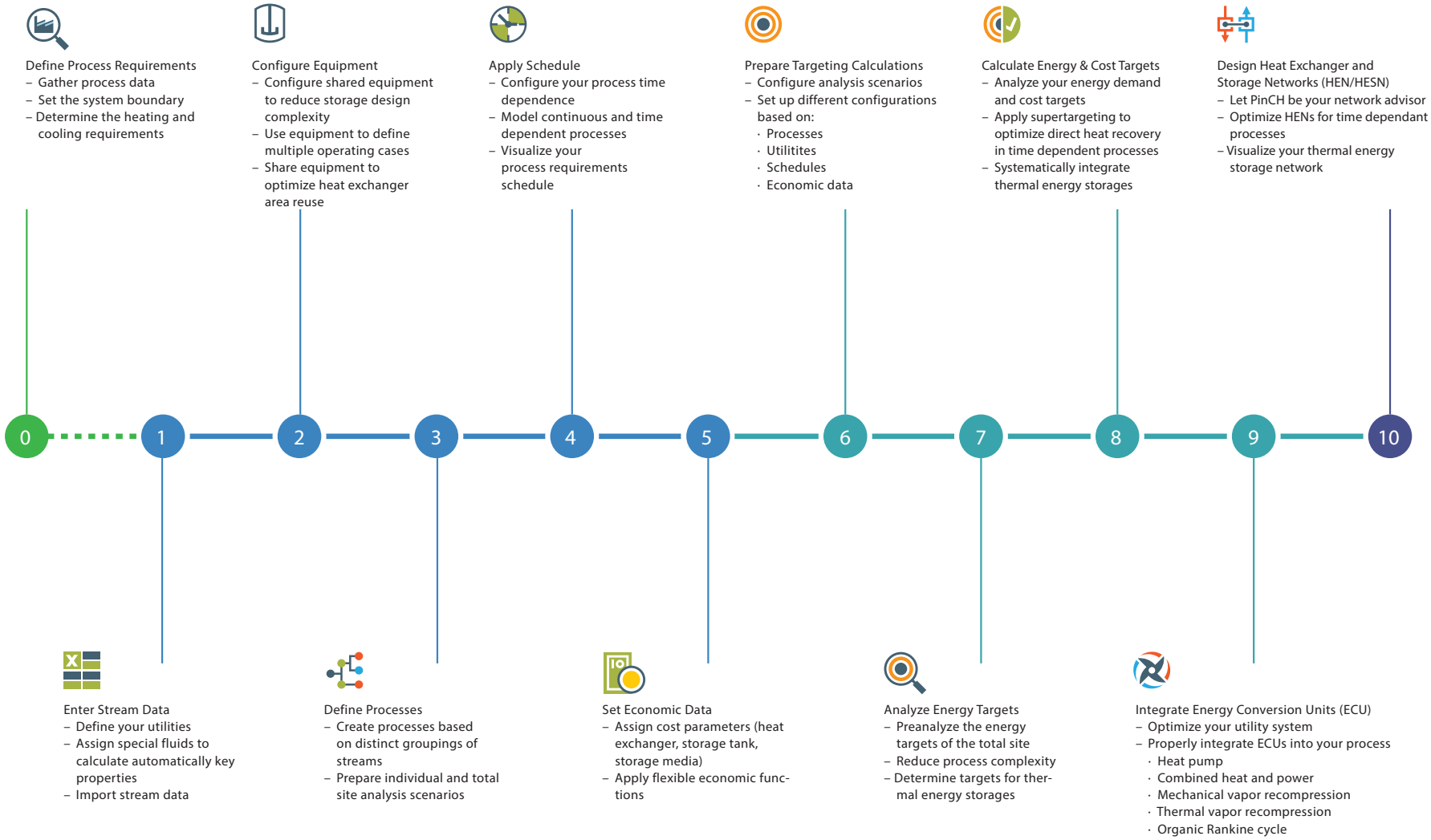

Figure 4: Overview of the 10 Steps

IV List of Symbols and Abbrevations

Latin Letters

A	Area	m^2
a	annuity factor	-
C	costs	€
c	specific costs	€/kg, €/kWh
CP	heat capacity flow rate	W/K
c_p	specific heat capacity at constant pressure	J/kg K
$\dot{H}$	enthalpy flow	W
Δh_V	specific enthalpy of evaporation	J/kg
k	overall heat transfer coefficient	W/m^2 K
m	mass	kg
m	degression factor	-
$\dot{m}$	mass flow	kg/s
N	number of streams	-
n	investment period	a
P	power	W
p	absolute pressure	Pa
Q	heat energy	J
$\dot{Q}$	heat flow	W
T	absolute temperature	K
T_{Pinch}	pinch temperature	°C
T^*	shifted temperature	°C
ΔT	temperature difference	K
ΔT_m	logarithmic mean temperature difference	K
ΔT_{min}	minimum temperature difference	K
$\Delta T_{min,opt}$	optimal minimum temperature difference	K
t	time	s
V	Volume	m^3
Z	interest rate	-

Greek Letters

α	heat transfer coefficient	W/m^2 K
τ	annual operating duration	h/a

List of Abbrevations

SFOE	Swiss Federal Office of Energy	ISSP	intermediate source and sink profile
C	cold stream	MER	minimum energy requirement, maximum energy recovery
CCs	composite curves		
CHPP	combined heat and power plant	MER HEN	minimum energy requirement HEN, maximum energy recovery HEN
CU	cold utility		
ECU	energy conversion unit	opt	optimal
el	electric	ORC	organic rankine cycle
GCC	grand composite curve	PA	pinch analysis
H	hot stream	PI	process integration
hs	heating steam	SM	storage medium
HEN	heat exchanger network	SS	stratified storage
HESN	heat exchanger and storage network	TAM	time average model
HEX	heat exchanger	tot	total
HS	heat storage	TSM	time slice model
HU	hot utility		
IL	intermediate loop		
Inv	investment		