Process Simulation using UNISIM Design

(Training Course - Basic level)

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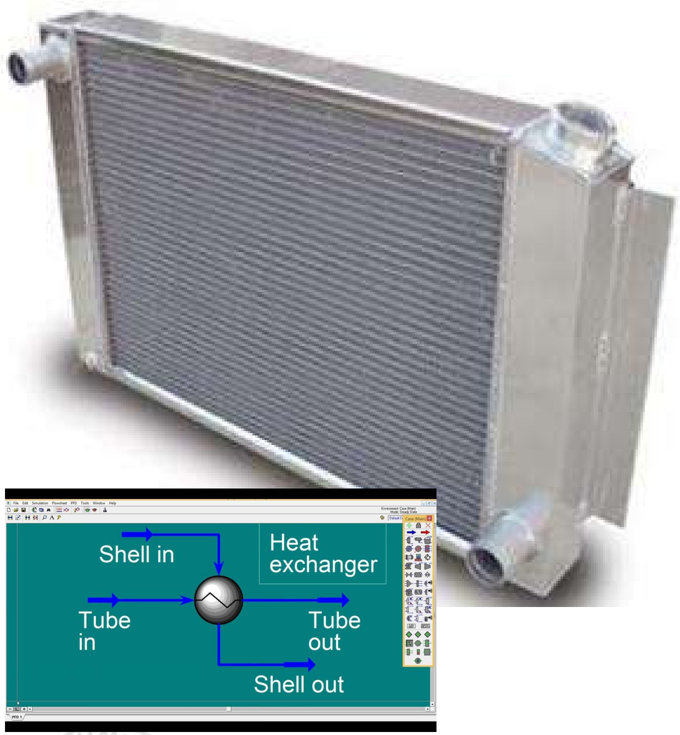
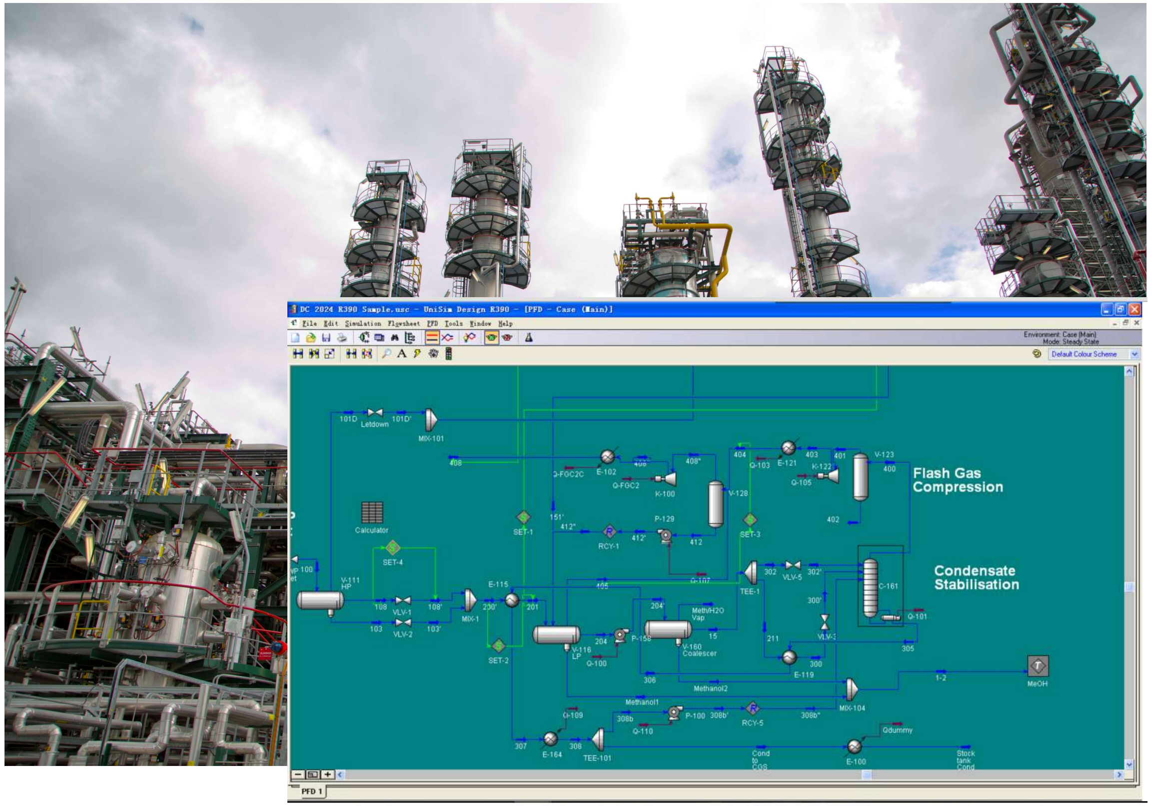
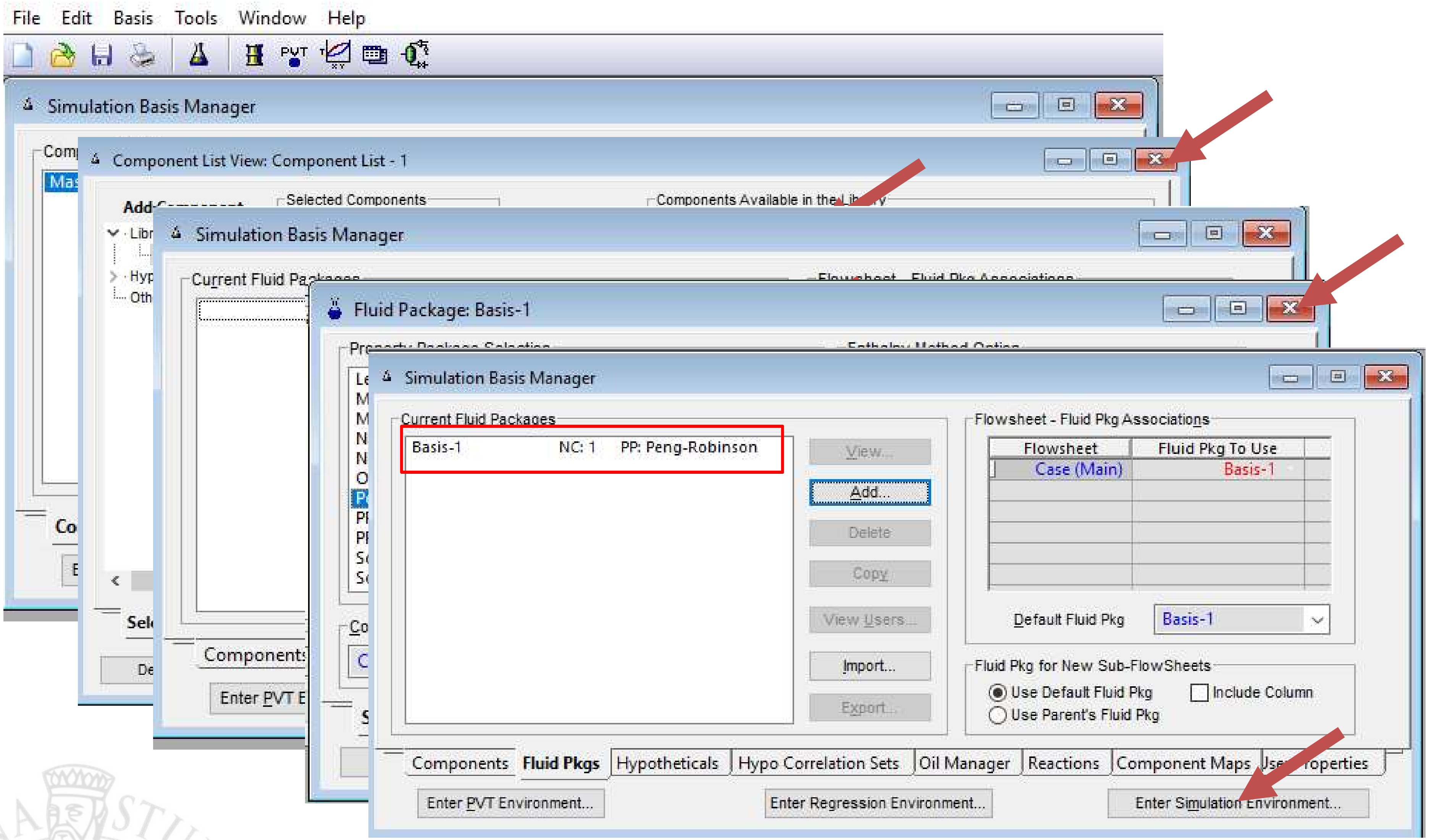
INTRODUCTION

- You can simulate either simple cases or the most complicated plants

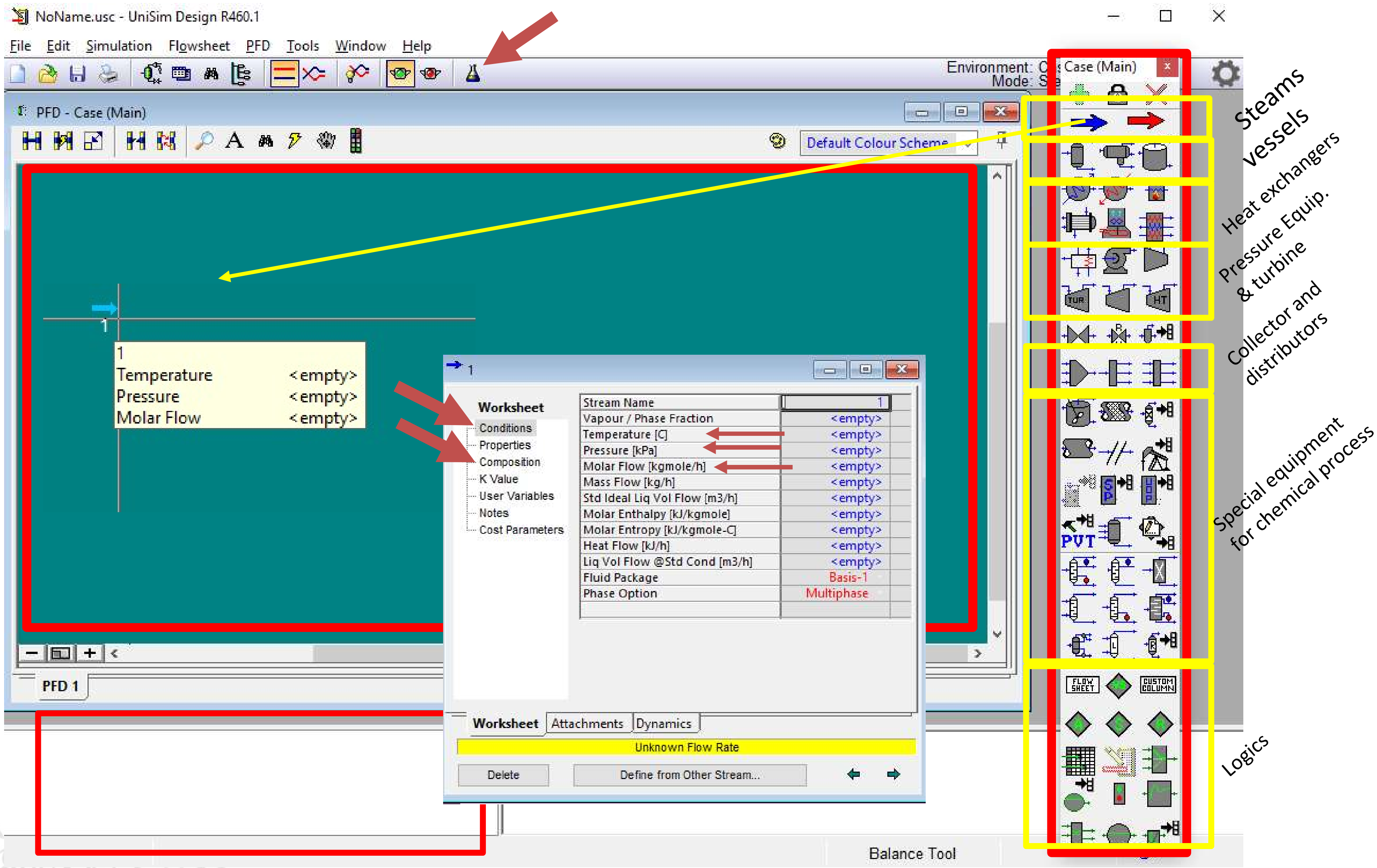




Starting the program

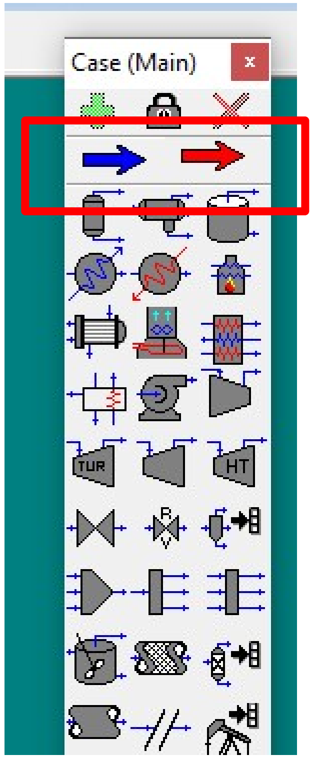


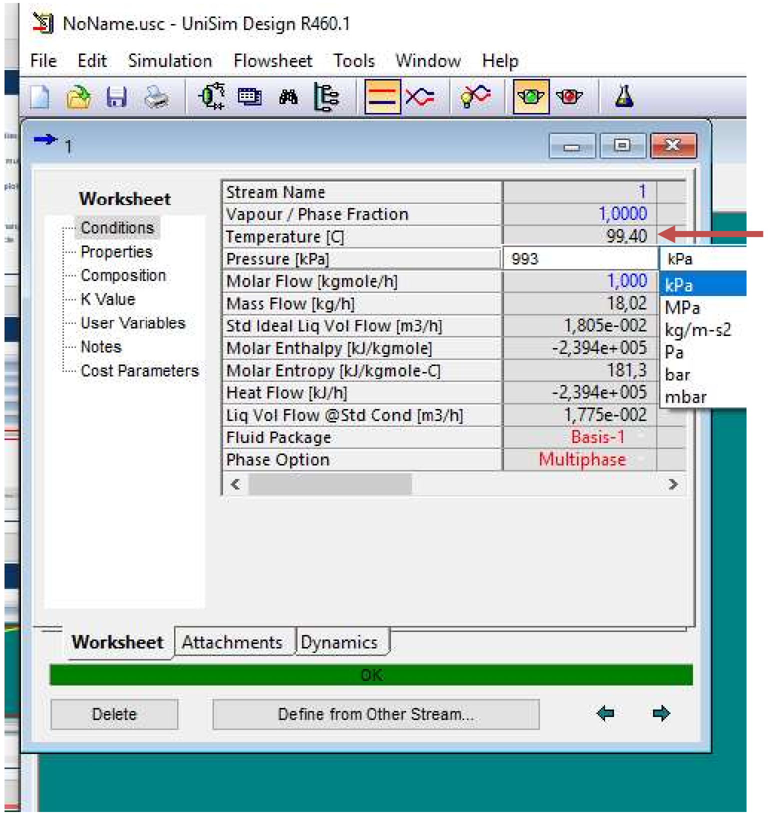
Ex. #1.1: property calculation



Ex. #1.1: Simple stream

Calculate Boiling temperature of water in Firenze?!





Inputs:

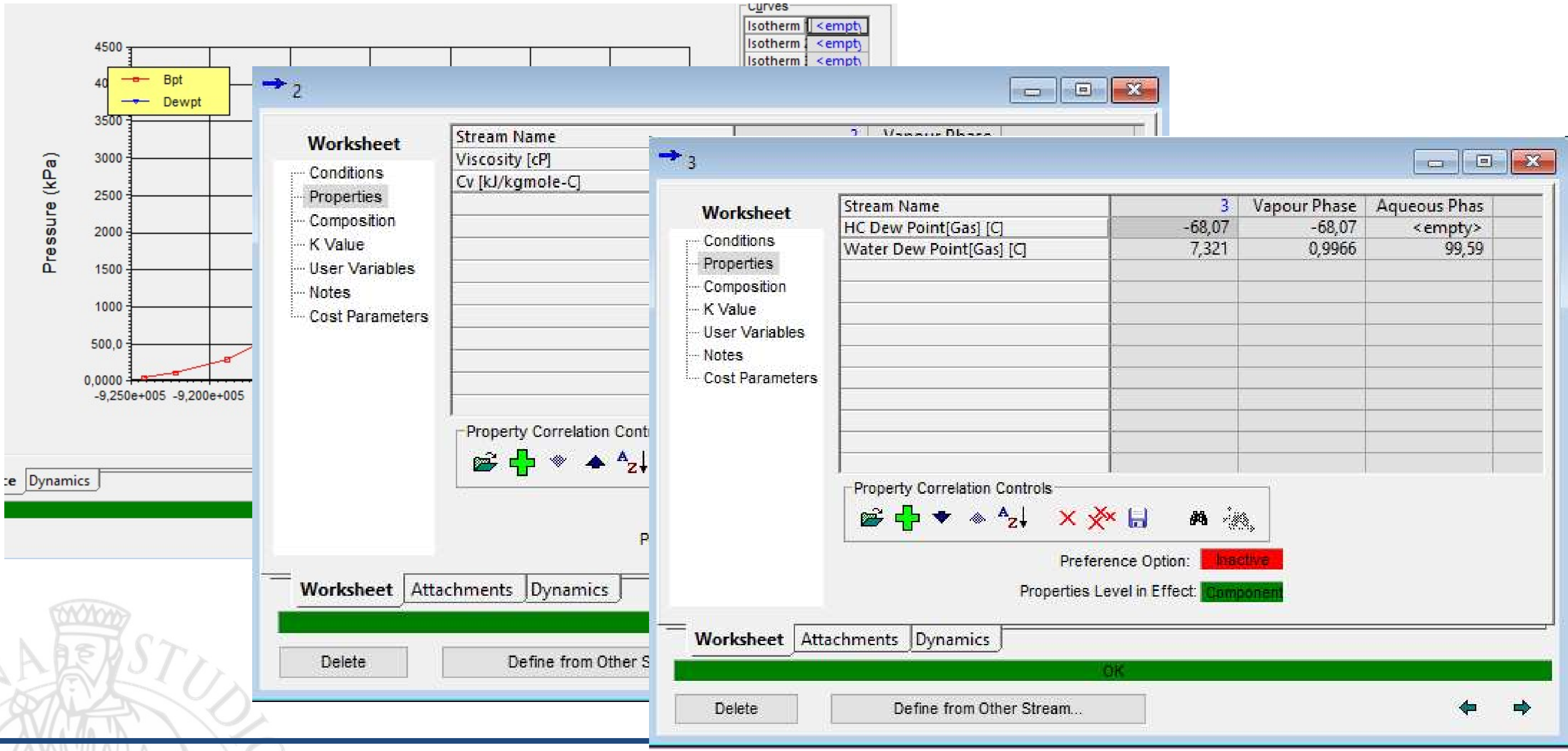
- **Water stream**
- **Pressure: 993mbar / Flow : 1 (not important) / ?**

Output: Temperature

Ex. #1.2: property calculation

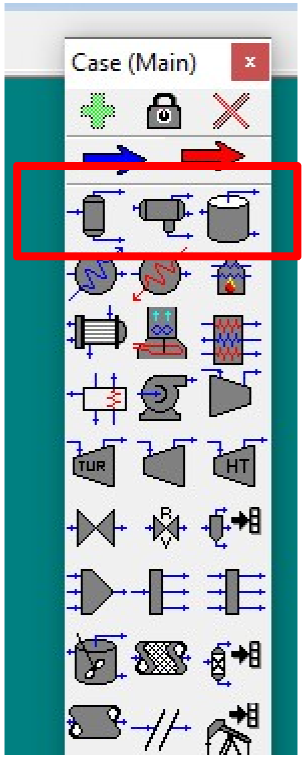
Calculate property of pure or mixture streams

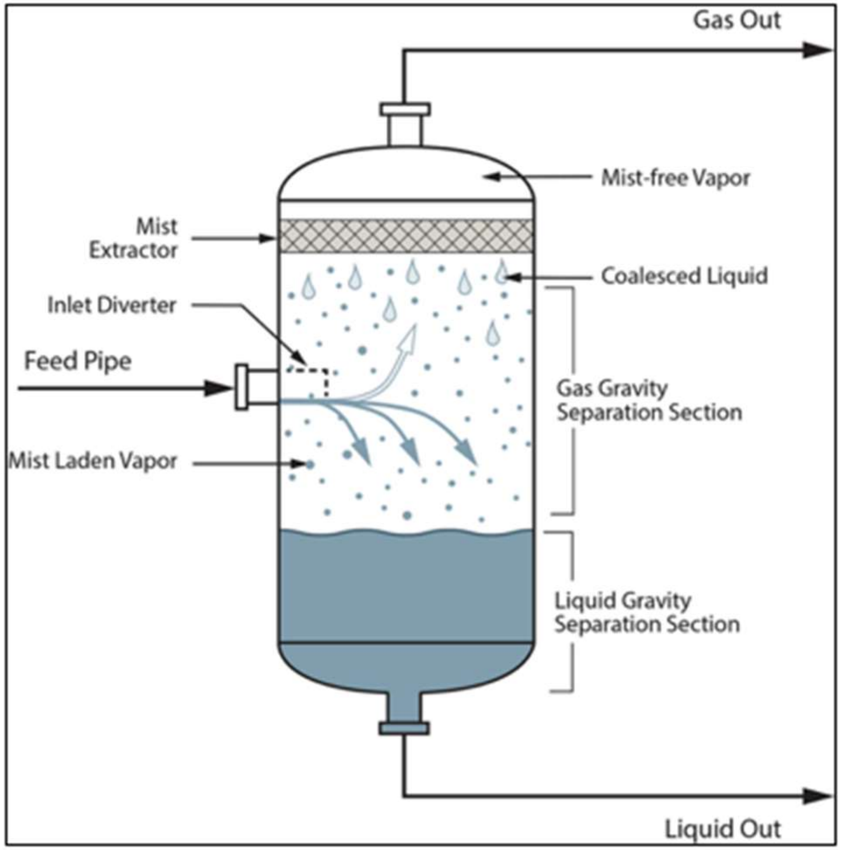
1. P-H diagram and T-S diagram of R134a?
2. Viscosity & C_v of air? (O2 21% N2 79%)
3. Water Dew point and hydrocarbon dew point of natural gas (C_1 96% C_4 3% water 1%)



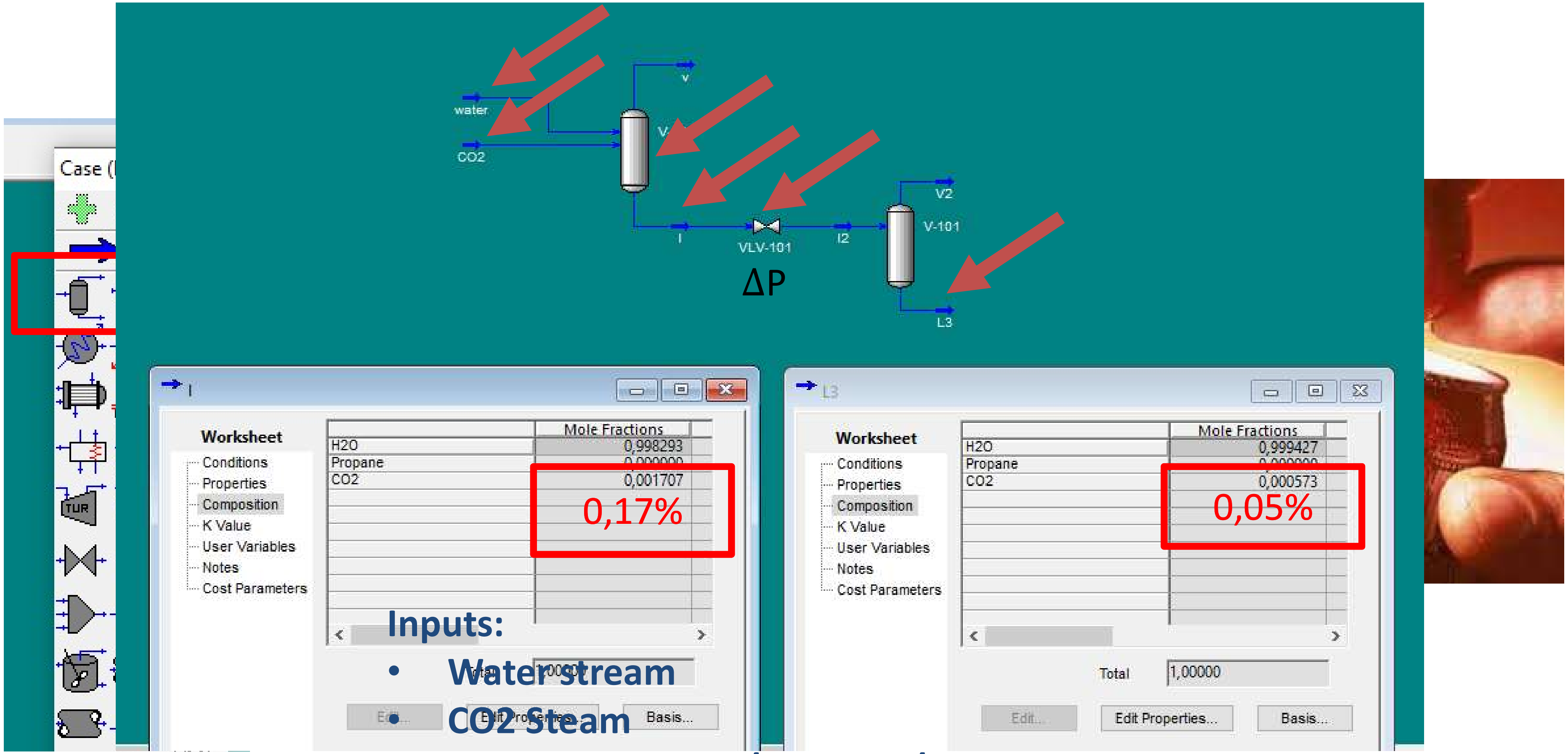
Ex. #1.3: Simple vessel

- (flash calculation, phase separator)





Ex. #1.2: Simple vessel



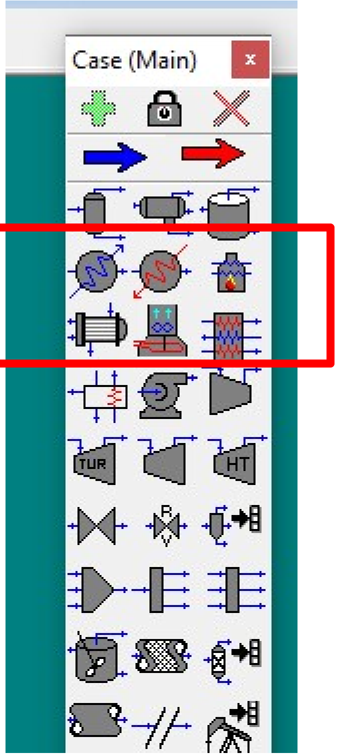
Inputs:

- **Water stream**
- **CO2 Steam**
- **Pressure: 300kPa / Flow : 1 / Temperatuer:20°C**

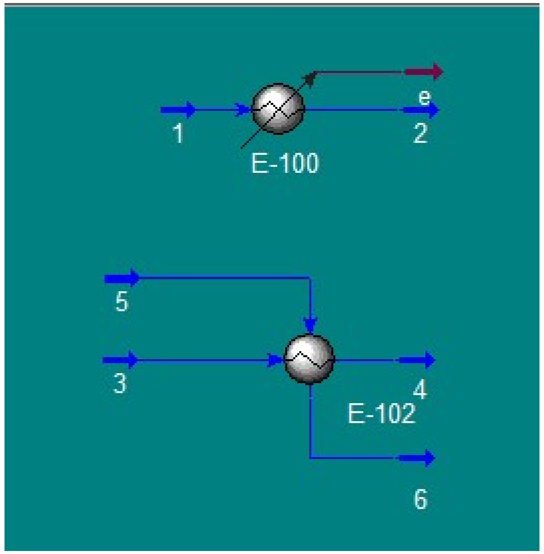
Output

- **solubility (CO2 composition in the liquid phase)**

Ex. #1.4: Heat Exchanger



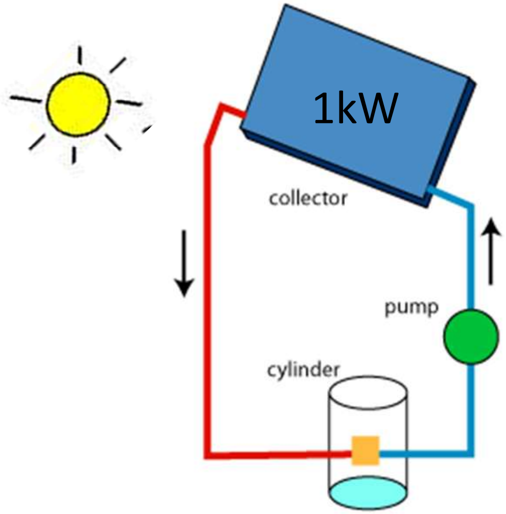
Cooler	• Stream input • Stream output • Energy
Heater	• Stream input • Stream output • Energy
exchanger	• Stream1 input • Stream1 output • Stream2 input • Stream2 output ~~Energy~~



Ex. #1.4: Heat Exchanger

Solar water heater

- active

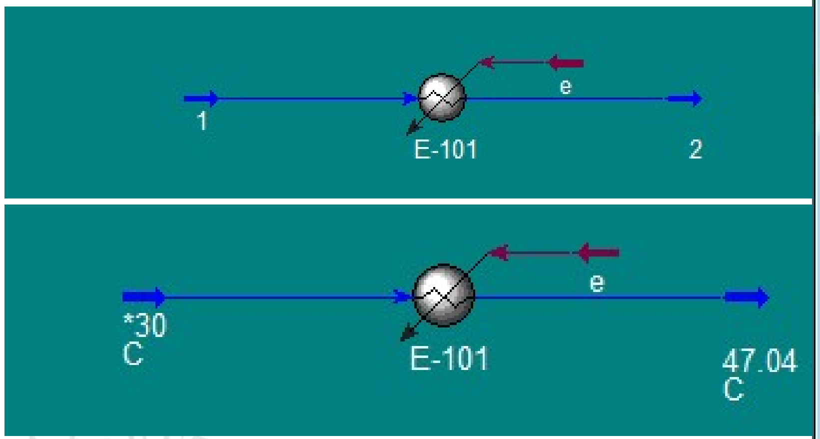


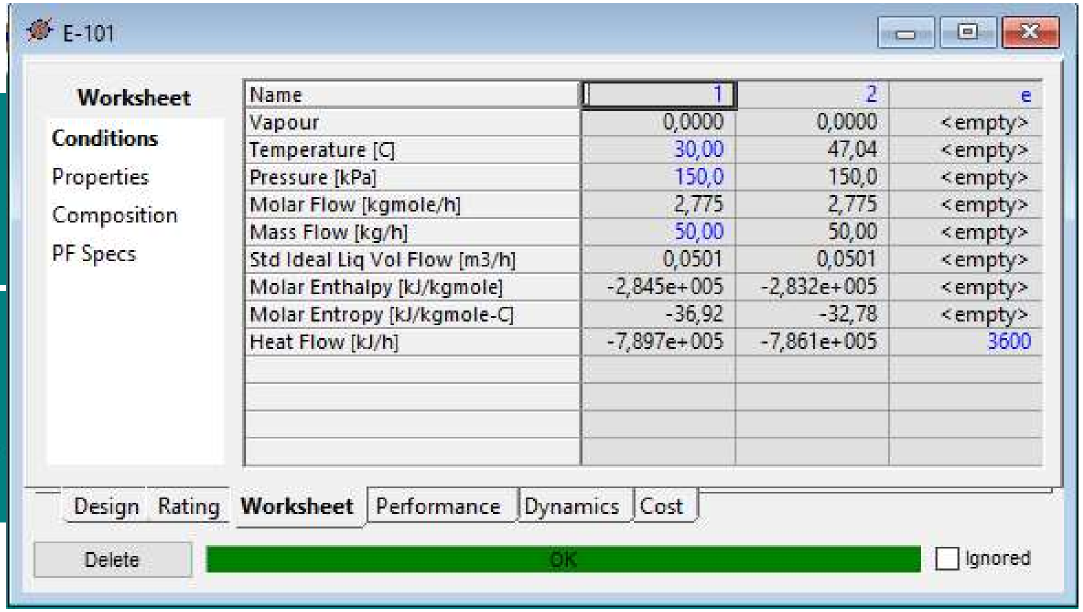
Inputs:

- **Water stream input**
- **Pressure: 150kPa / Flow : 50 kg/h / Temperatuer:30°C**
- **Energy stream : 1kW**

Output

- **Water Output temperature**





Name	1	2	e
Vapour	0,0000	0,0000	<empty>
Temperature [C]	30,00	47,04	<empty>
Pressure [kPa]	150,0	150,0	<empty>
Molar Flow [kgmole/h]	2,775	2,775	<empty>
Mass Flow [kg/h]	50,00	50,00	<empty>
Std Ideal Liq Vol Flow [m3/h]	0,0501	0,0501	<empty>
Molar Enthalpy [kJ/kgmole]	-2,845e+005	-2,832e+005	<empty>
Molar Entropy [kJ/kgmole-C]	-36,92	-32,78	<empty>
Heat Flow [kJ/h]	-7,897e+005	-7,861e+005	3600

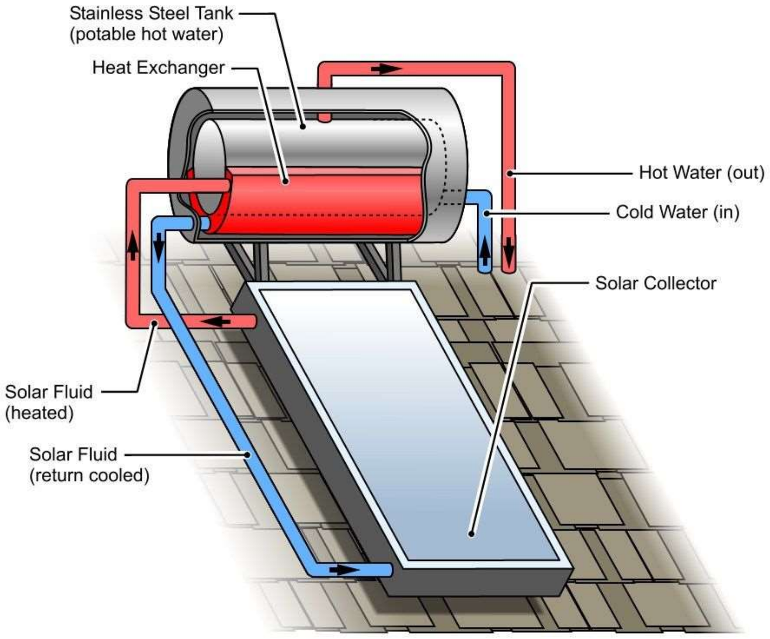
Ex. #1.4: Heat Exchanger

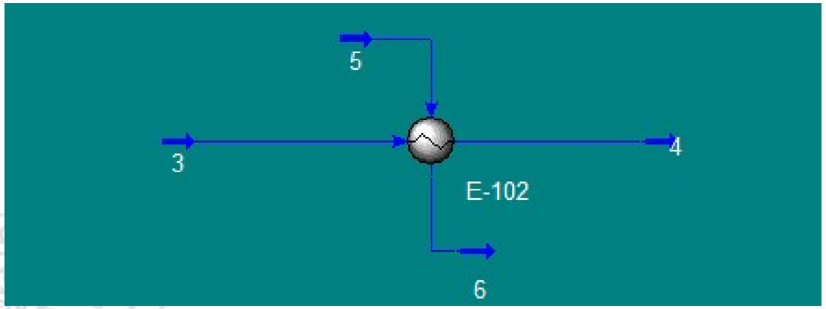
Solar water heater

- Passive by using Solar fluid : Ethylene glycol

Inputs:
- **Water stream input**
- **Pressure: 150kPa / Flow : 50 kg/h / Temperature:30°C**
- **Water stream input**
- **Pressure: 150kPa / Flow : “ / Temperature: ? °C**
- **Propylene Glycol**
- **Pressure: 150kPa / / Temperatuer:30°C**
- **Pressure: 150kPa / / Temperatuer:30°C**

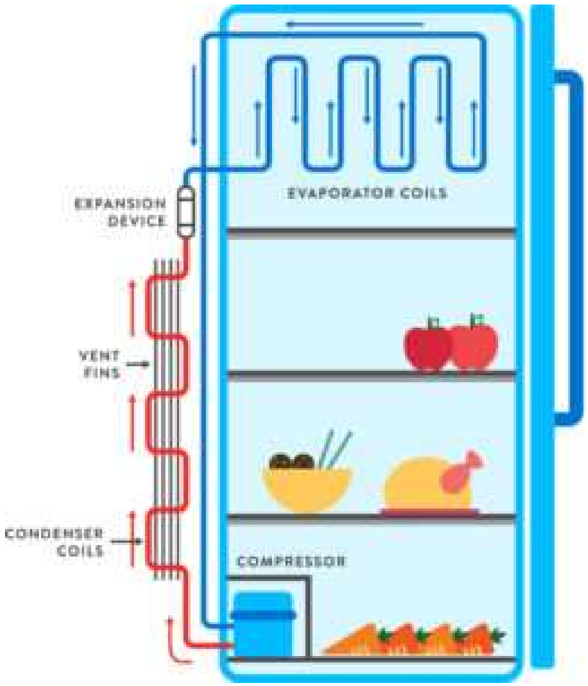
Output
- **Glycol flowrate**

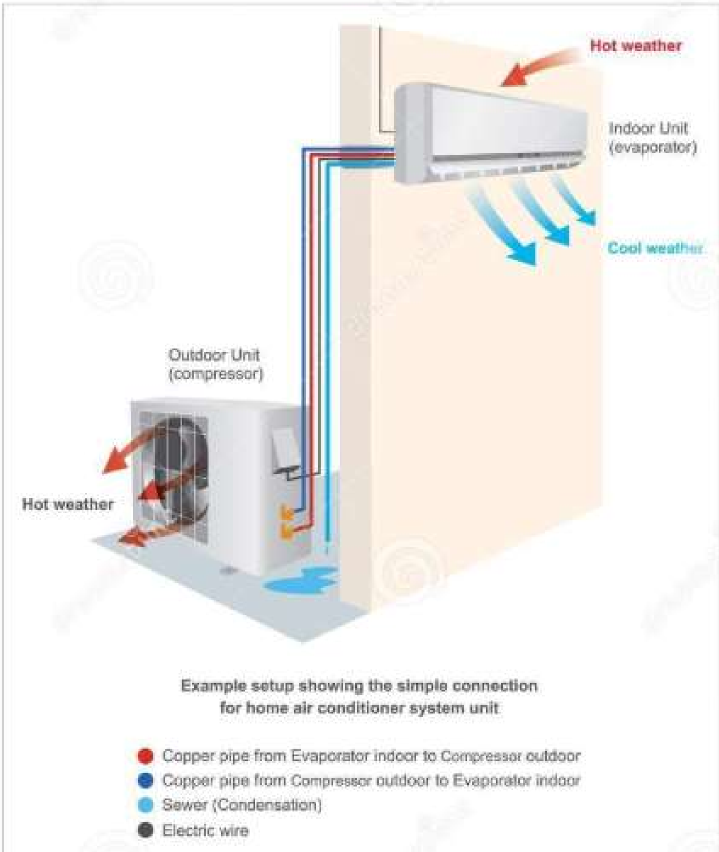


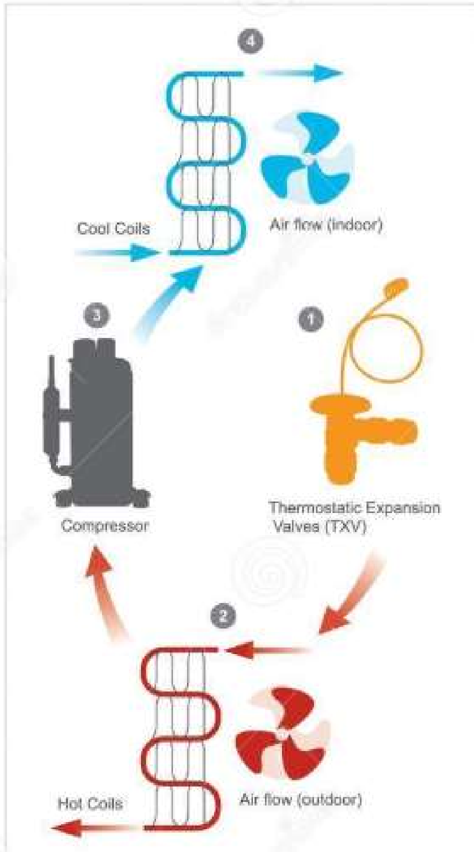


Break time

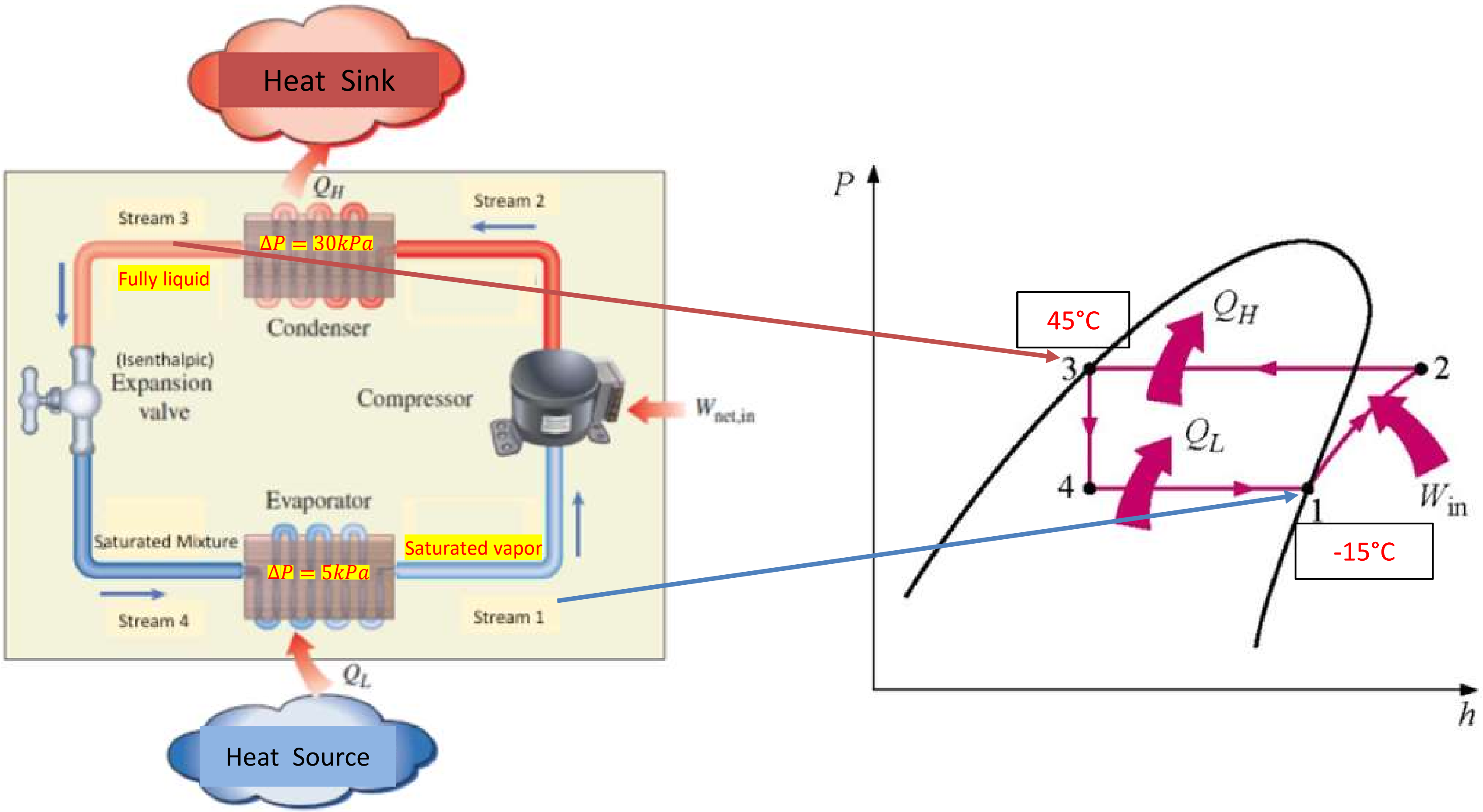
Ex. #1.5: Refrigeration Cycle



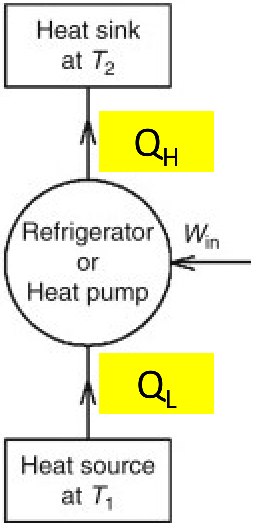




Ex. #1.5: Refrigeration Cycle



Ex. #1.5: Refrigeration Cycle



COP= Evaporator Duty/ Compressor Power

$COP=Q_L/W_c$

Example:

A Refrigeration cycle utilizes propane as the working fluid is used in the liquefaction of the NG. Propane is fed to an evaporator (Heater) the pressure drop=5 kPa, where it absorbed 1.50e+6 kJ/hr from the NG and leaves at the dew point (Vapor Fraction=1.0) at T= -15°C. The output of the evaporator is then compressed adiabatically with efficiency of 75%, and then it's condensed to reject heat. Inside the Condenser there is a pressure drop of 30 kPa, and leaves as saturated liquid at 45°C. Finally, the propane passes through a valve to return the pressure of the Evaporator.

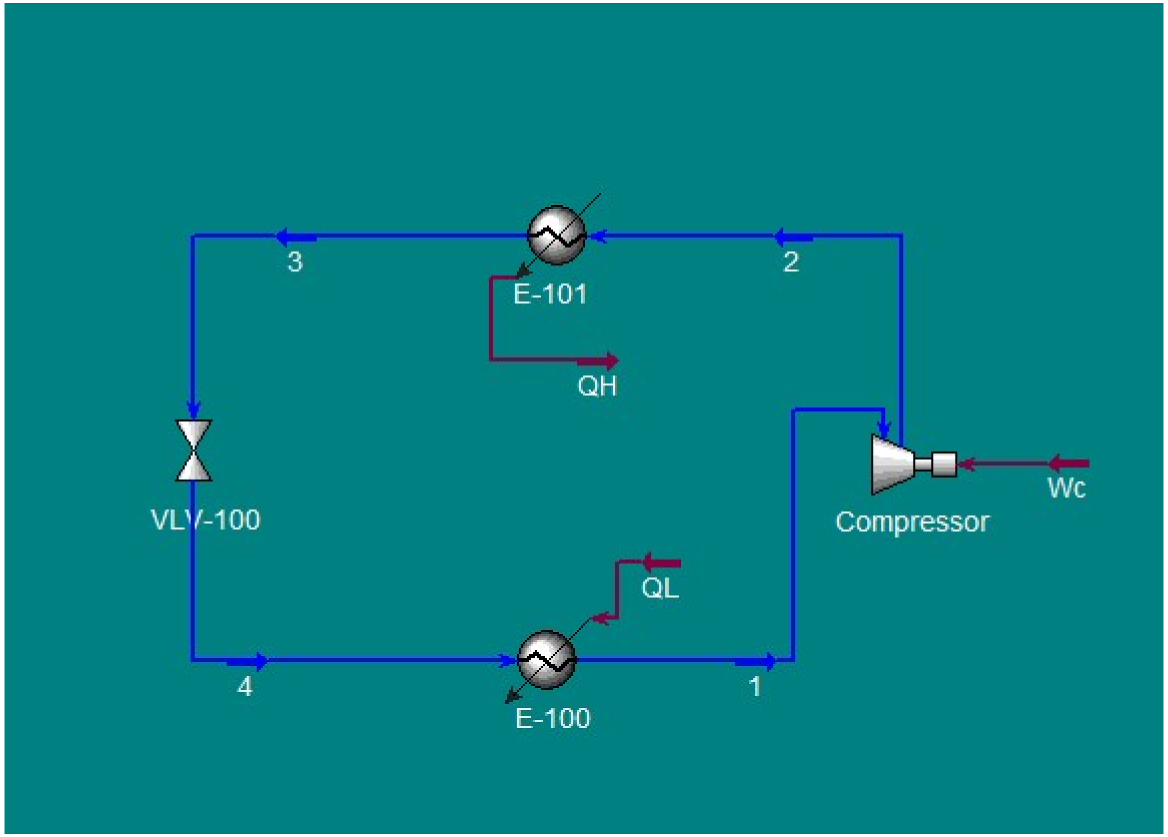
Fluid Pkg: Peng Robinson

Calculate:

Pressure of the evaporator fed in kPa.	
Flow rate of propane in kmol/hr.	
Valve pressure drop in kPa.	
Temperature of the valve outlet in °C.	
Compressor duty in hp.	
Condenser duty in kJ/hr.	

Ex. #1.4: Refrigeration Cycle

- Final Solution is:



Ex. #1.4: Refrigeration Cycle

- Calculate Coefficient of performance (COP)
- Adjust the configuration to have COP of 2.