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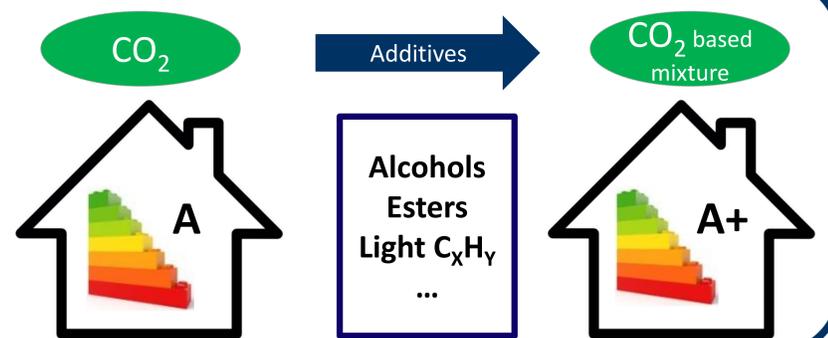
# Experimental bench design for heat pump using CO<sub>2</sub> based refrigerants mixtures

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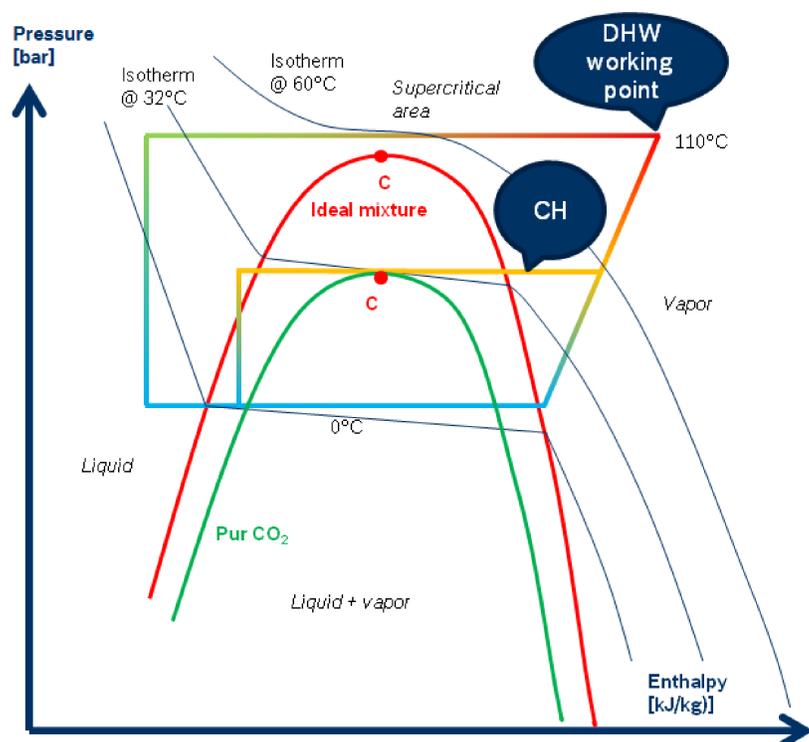
## Abstract

Current and future regulations related to refrigerants are pushing forward development of alternatives to HFC refrigerants, and natural refrigerants are potential candidates. **Aim** of my work is to **investigate CO<sub>2</sub> based refrigerant mixtures** in heat pumps, to produce domestic hot water (DHW) and hot water for central heating (CH) of houses, as efficiently as possible. I designed an **experimental heat pump** on which I measure **performance** and **composition** of the circulating fluid mixtures.



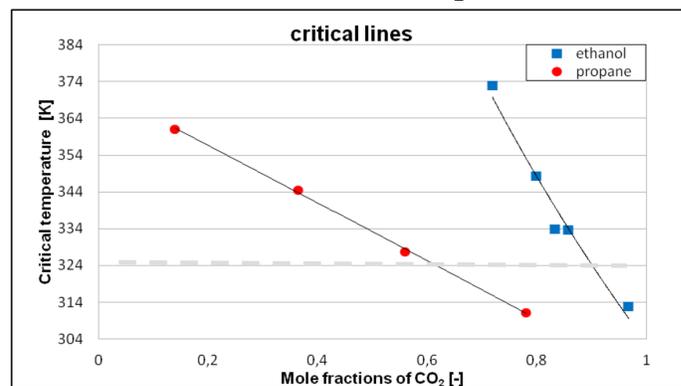
## General approach

Design of an experimental heat pump that is able to use pseudo-condensation for central heating (secondary fluid  $\Delta T$  about 5K) and transcritical cycle for domestic hot water production ( $\Delta T$  about 50K).



Example of a potential Ph diagram designed for two working modes.

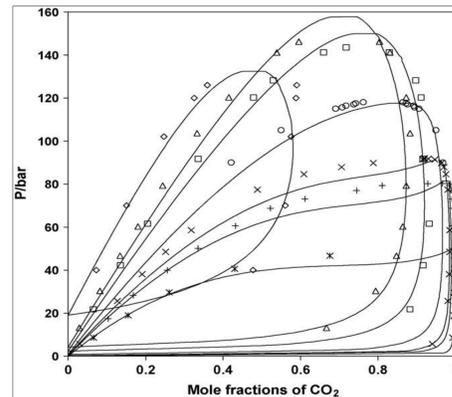
Addition of components to CO<sub>2</sub> moves equilibrium lines:



Critical lines for CO<sub>2</sub> + ethanol mixtures (data from Galicia-Luna and Ortega Rodriguez, 2000) and CO<sub>2</sub> + propane mixtures (data from Niesen and Rainwater, 1990)

To obtain a mixture with critical temperature of 328 K (55°C):

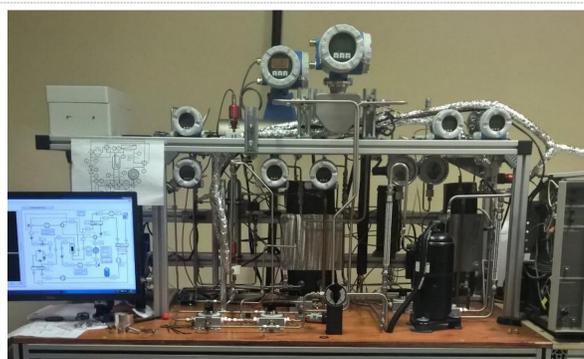
50% Propane  
or  
10% Ethanol



Vapor liquid equilibria for CO<sub>2</sub> + ethanol mixtures (Secuianu et Al., 2008)

Addition of less volatile components induce temperature glides in the evaporator. Such glides might result in having liquid left in the evaporator. That liquid needs to be treated separately and reinserted on the high pressure side, or vaporized using an internal heat exchanger.

## Experimental bench / measurements

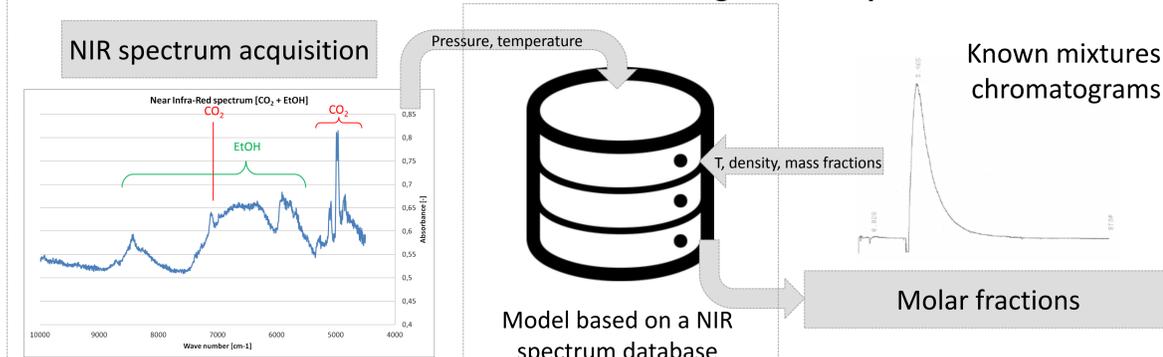


### Performances evaluations

Temperatures	2 Mass flow rates
6 Pressures	Electric power

➤ Coefficient of performance (COP) measured, to compare efficiency of the heat pump with different mixtures.

### Real-time measurement of circulating fluid composition



## Conclusion and perspectives

Assembly of the bench has been carried out, but the first tests have lead to modifications that are about to be implemented. Now, the spectrum database for composition monitoring needs to be done along with the first mixture tests. Evaluation of the mixtures will be carried out until May 2016.

## References

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