Module 5.2
Beyond substation: How to improve DHC networks performance

SHaKE – Sharing Heat and Knowledge on Energy Communities
Erasmus+ KA220-HED Cooperation Partnerships in Higher Education
Developing institution: Mines Paris – PSL
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SHaKE
Sharing Knowledge on Energy Communities

1. How to improve DHC networks performance

How to improve the use of renewable energies?

Biomass

- Need of available and close resources
- Responsible use (replanting)

Waste heat

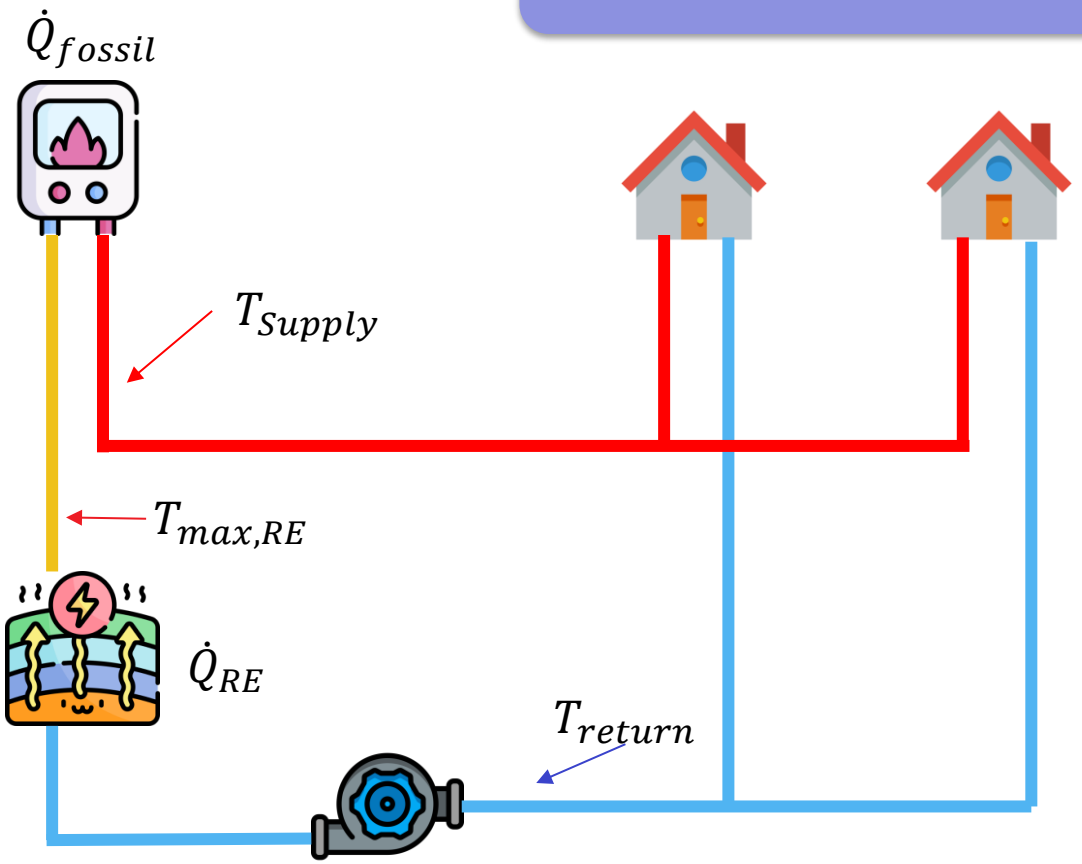
- Need of available and close resources
- Temperature limited

Geothermal energy

- Temperature limited
- Power limited

1. How to improve DHC networks performance

How to use limited temperature energy sources?



Reducing the return temperature

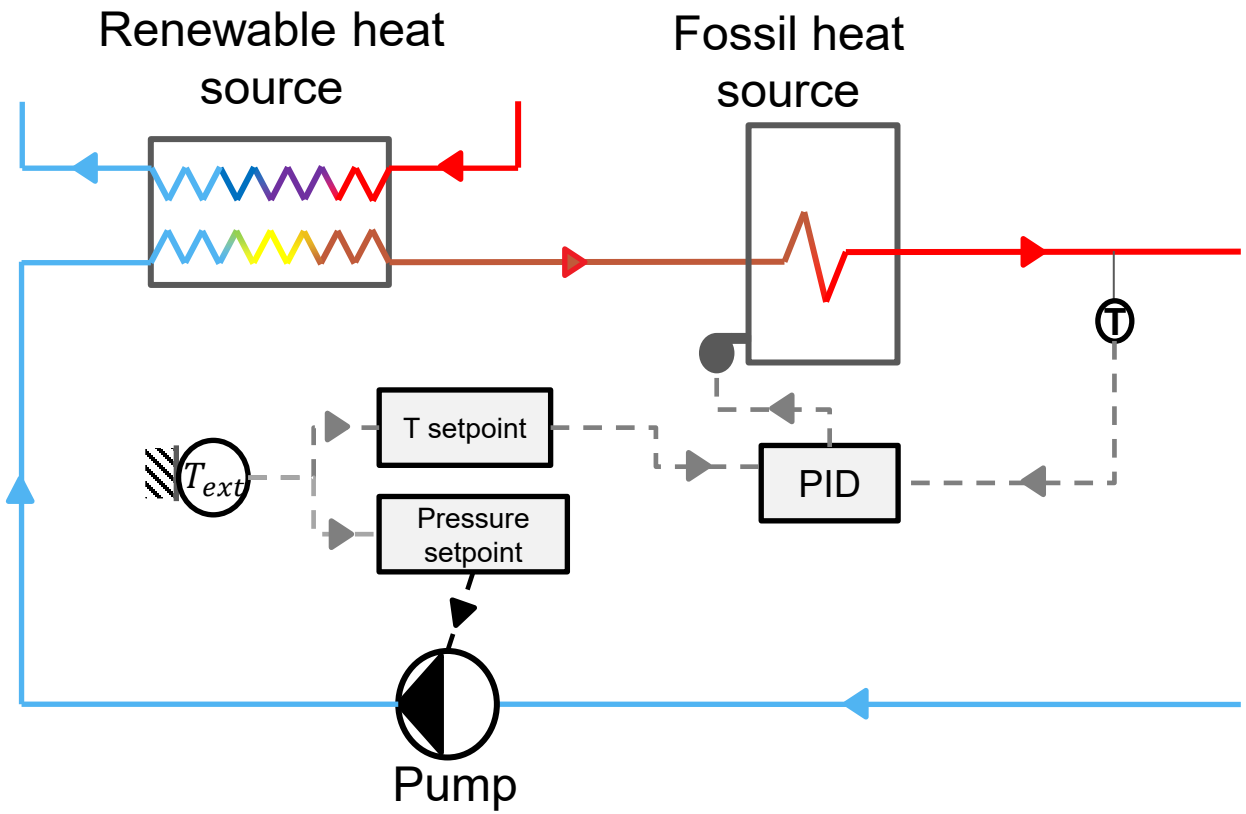
$$P = P_{fossil} + P_{RE}$$

$$P = \dot{m}\, Cp \left(T_{Supply} - T_{max,RE} + T_{max,RE} - T_{return}\right)$$

This also allows to:

- Reducing the thermal losses through the pipes
- Reducing the pump consumption
- Increasing the RE heat production from low temperature energy sources

1. How to improve DHC networks performance

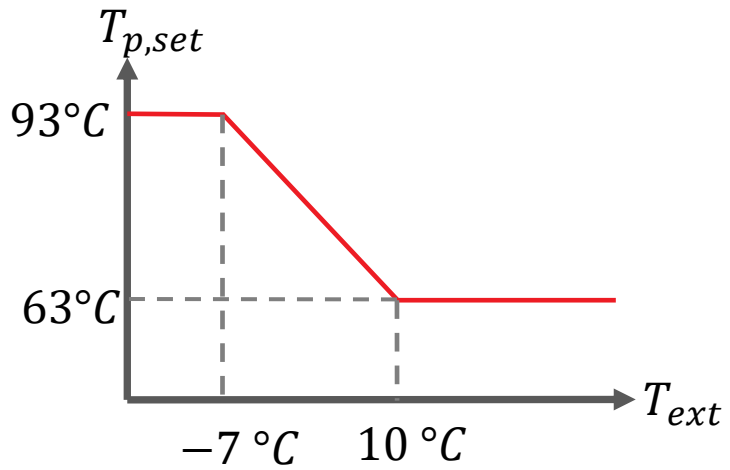


Classic DHN operation but:

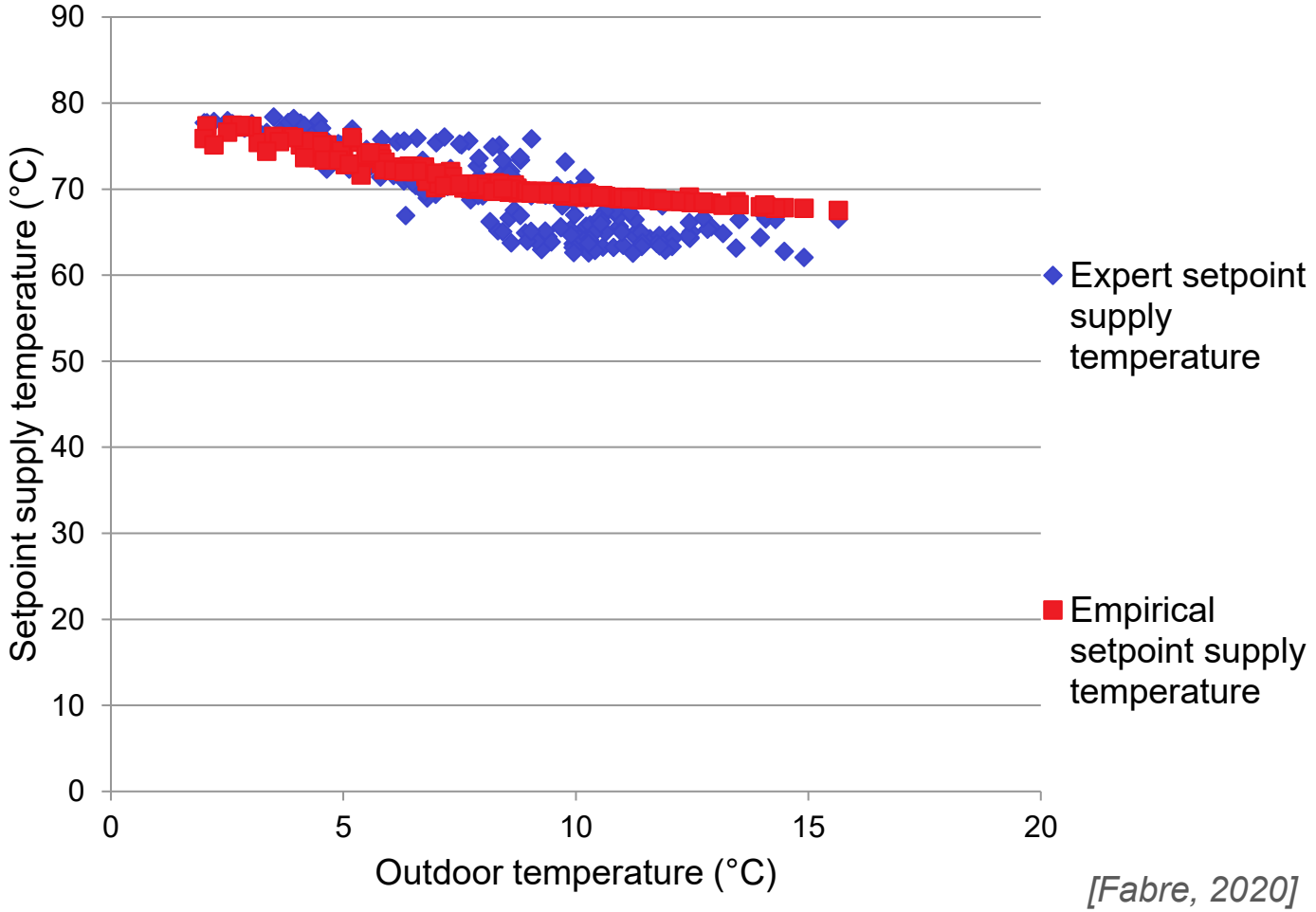
Potentially more sources in different locations
➡ Which source to use in priority?

Use of CHP (combined heat and power)
➡ When should CHP be used?

Simple primary supply temperature setpoint control



2. Impact of the return temperature reduction



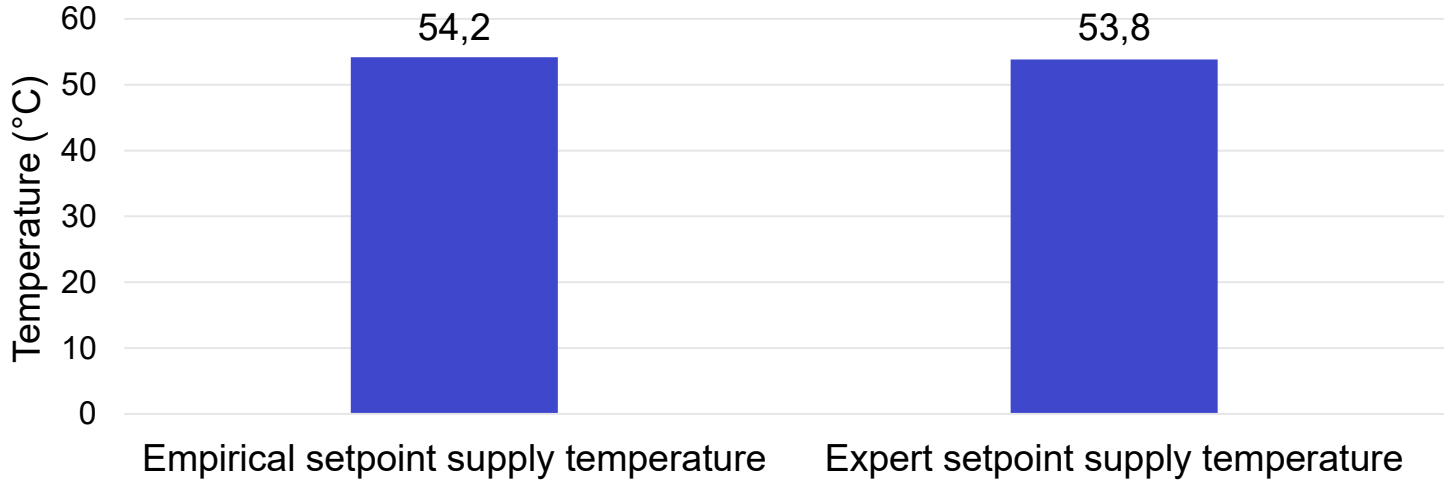
[Fabre, 2020]

The modification of the setpoint supply temperature has been used only on a part of the networks representing around 15% of the overall consumption

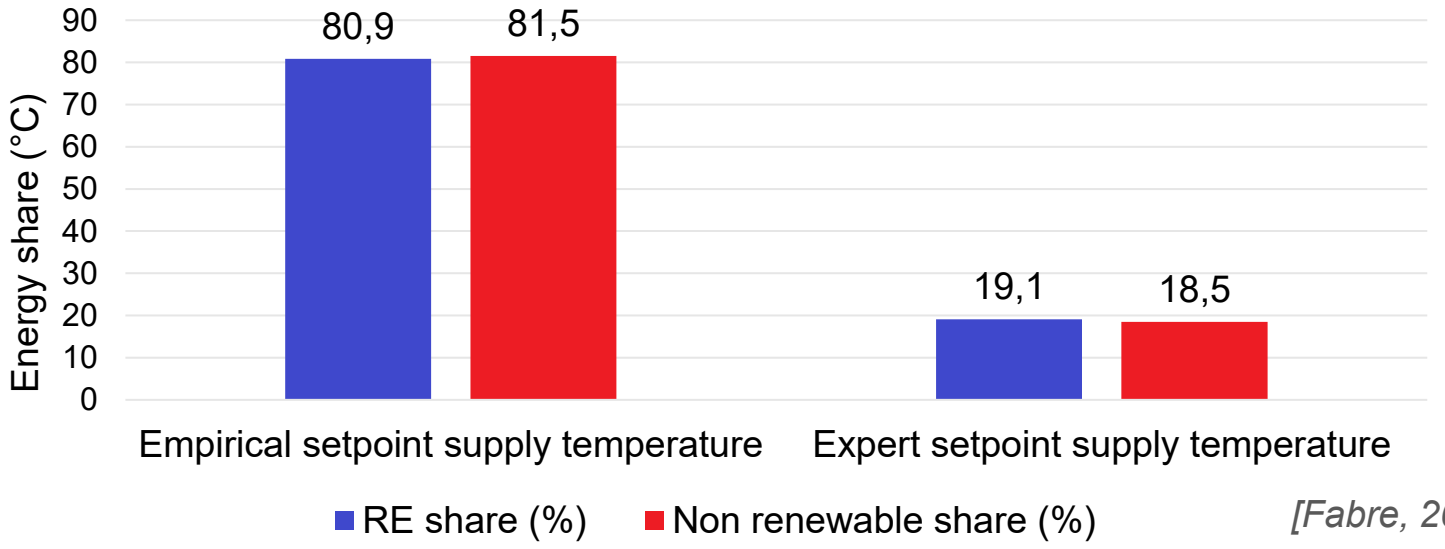
The two setpoint supply temperature are quite close

For an outdoor temperature up to 8°C, the expert setpoint temperature is lower by few degrees compared to the empirical one

2. Impact of the return temperature reduction



On the primary side, the global return temperature has decreased about 0.4°C



The share of RE in the network energy mix increased about 0.6%

On a heating period the used of the expert setpoint supply temperature can save 250MWh of gas or 49.5 tonnes of CO_2

[Fabre, 2020]

2. Impact of the return temperature reduction

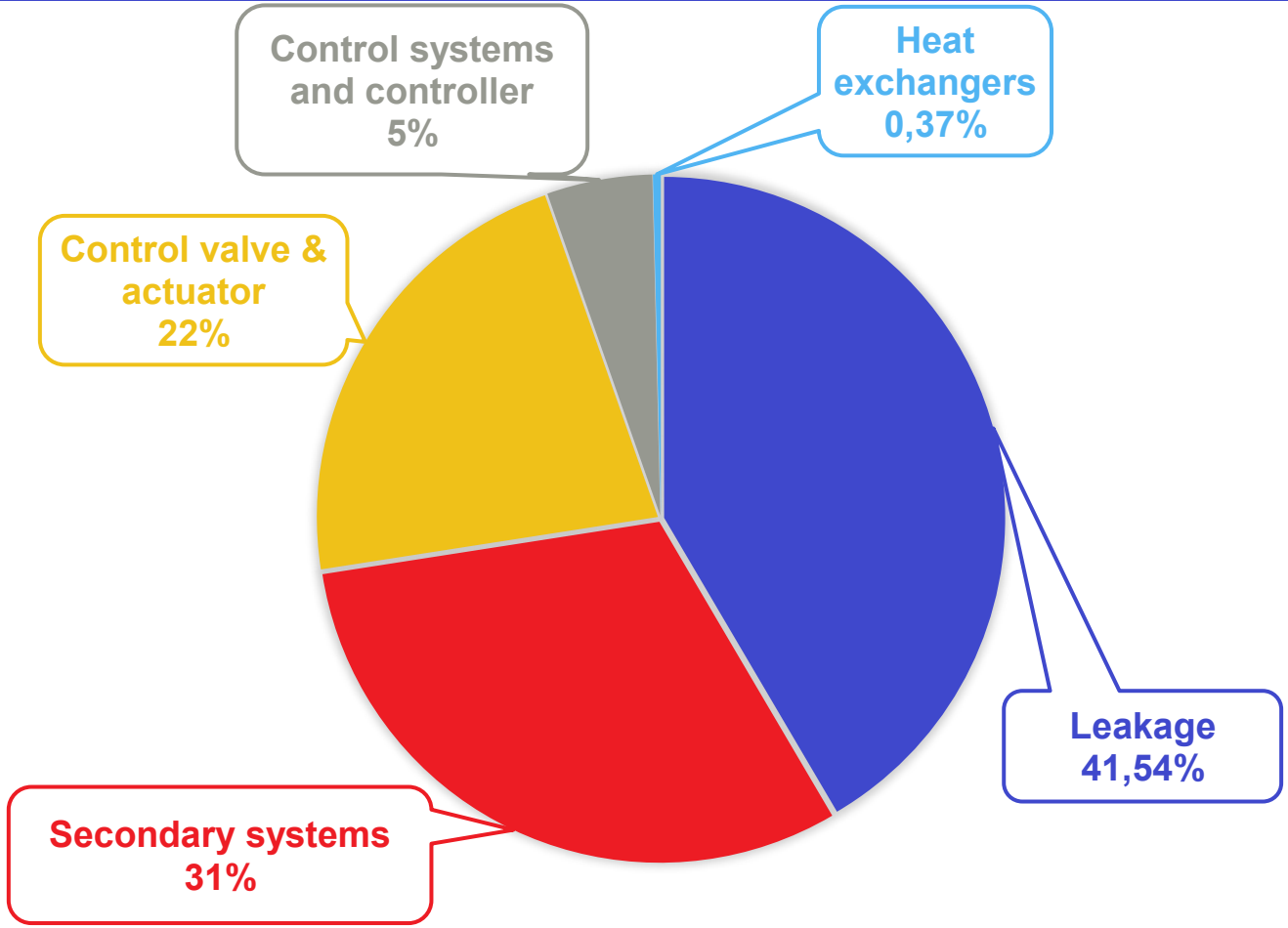
How can we meet European/national targets for the share of renewable energy in heating networks?

Create new 4th and 5th generation DHC networks

Improve the performance of existing network

Renovating the heat generation plant of 1st and 2nd generation DHC network

2. An overview of faults in DH network



[Mansson & al, 2019]

Only 26 % of the substation works correctly

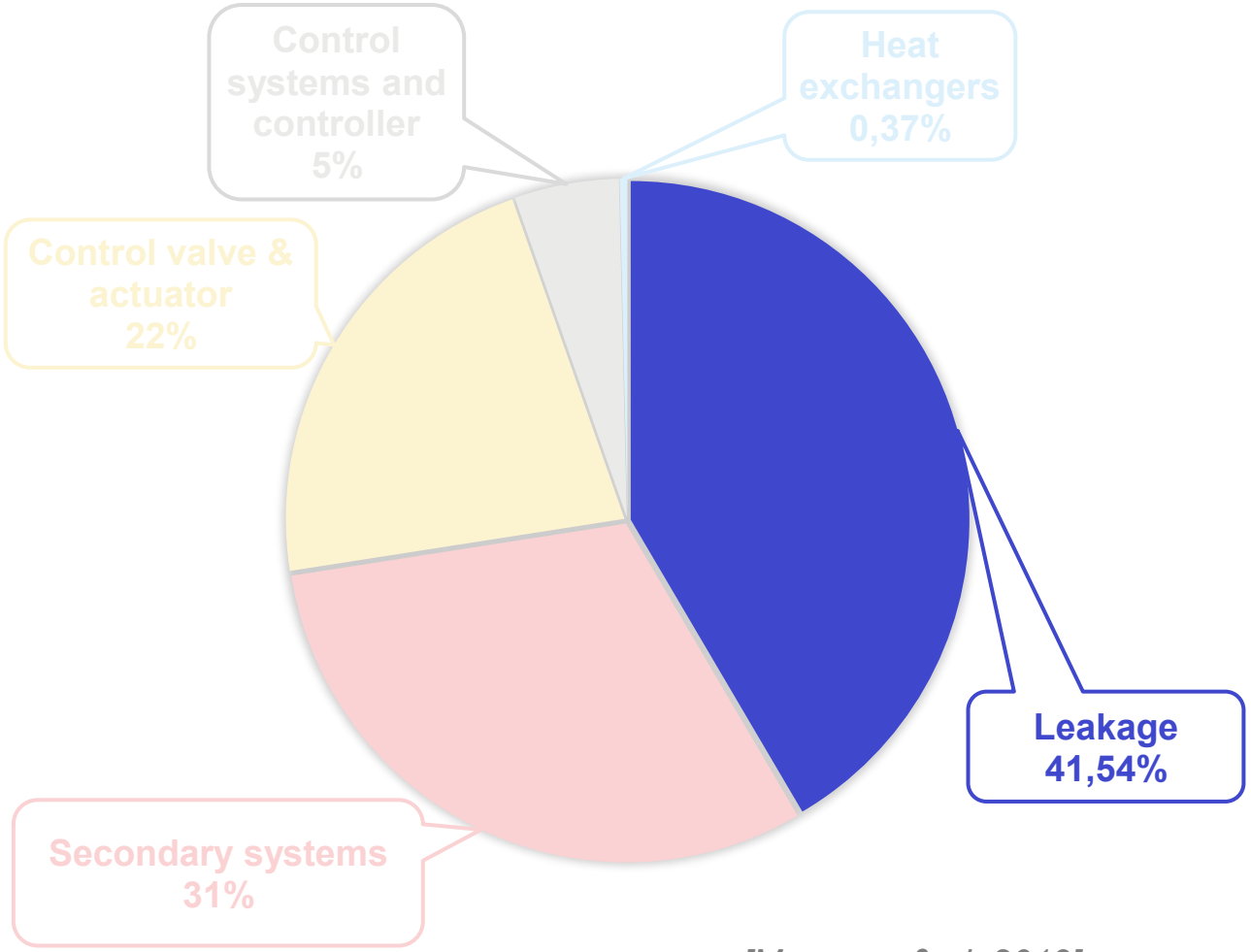
[Gadd et Werner, 2015]

The most impacting malfunctions are:

- Faulty control valves
- Unsuitable secondary network systems
- Unsuitable DHW supply system

[Zinko et Al, 2005]

2.1 Leakage



[Mansson & al, 2019]

There are two types of losses:

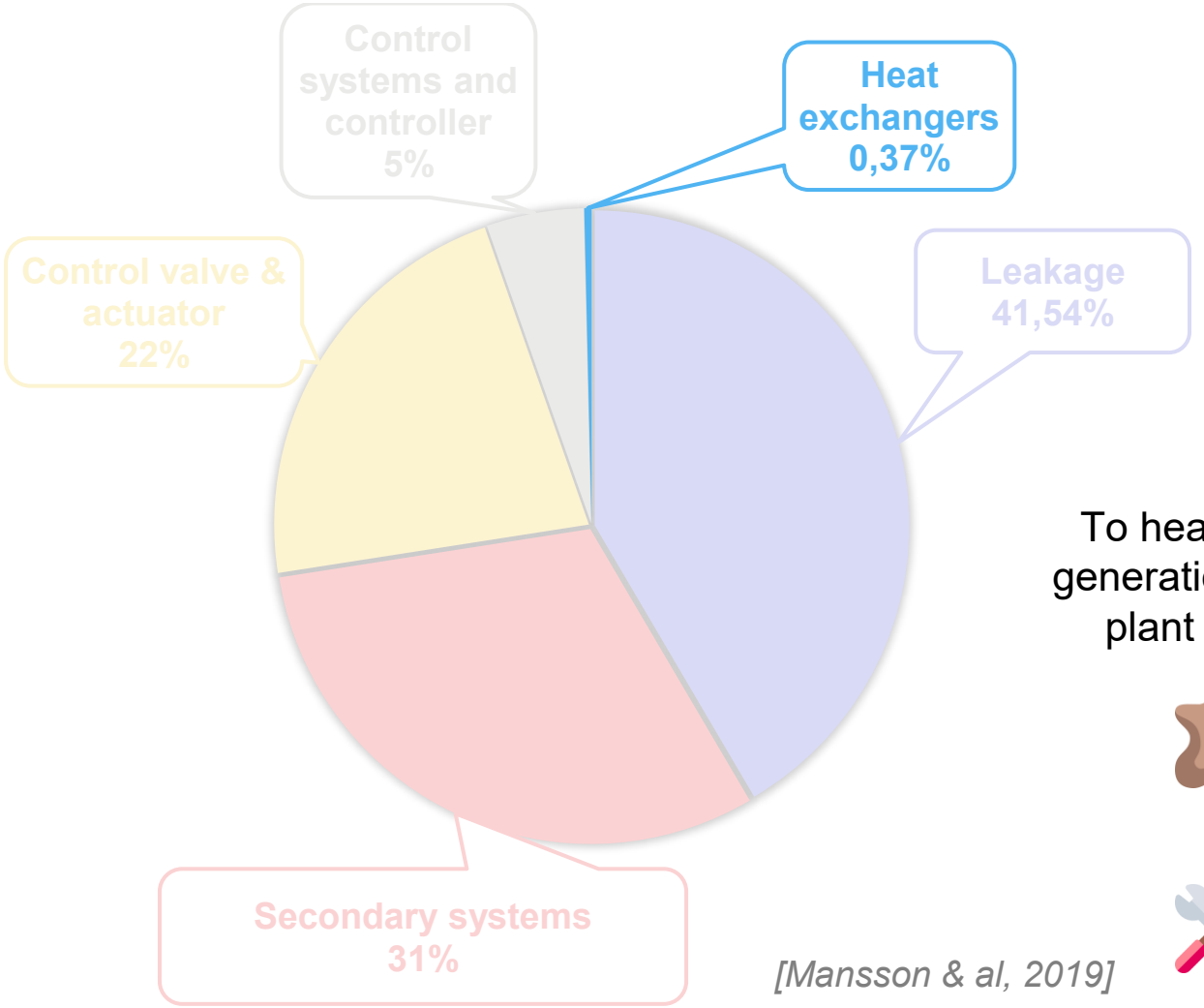
A deterioration of thermal insulation

➡ Temperature drop leading to overconsumption

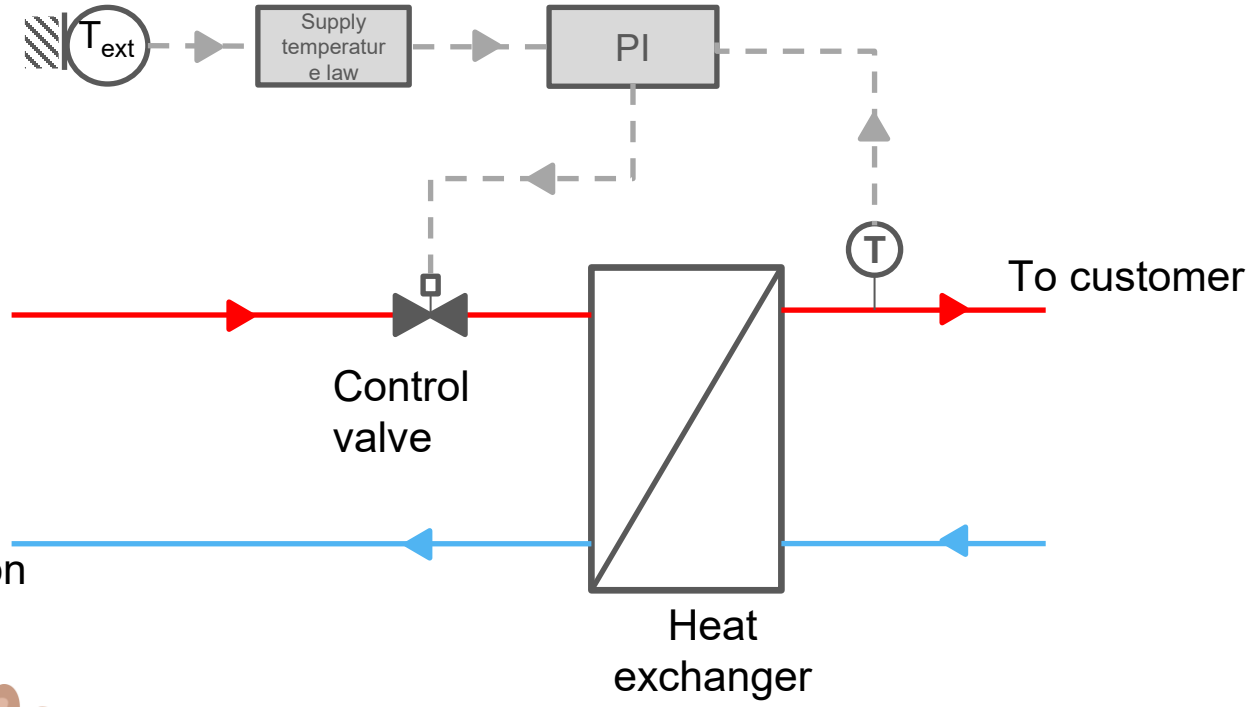
A water leakage

➡ Water flow rate drop leading to the need of refill the network and overconsumption

2.2 Heat exchanger



[Mansson & al, 2019]

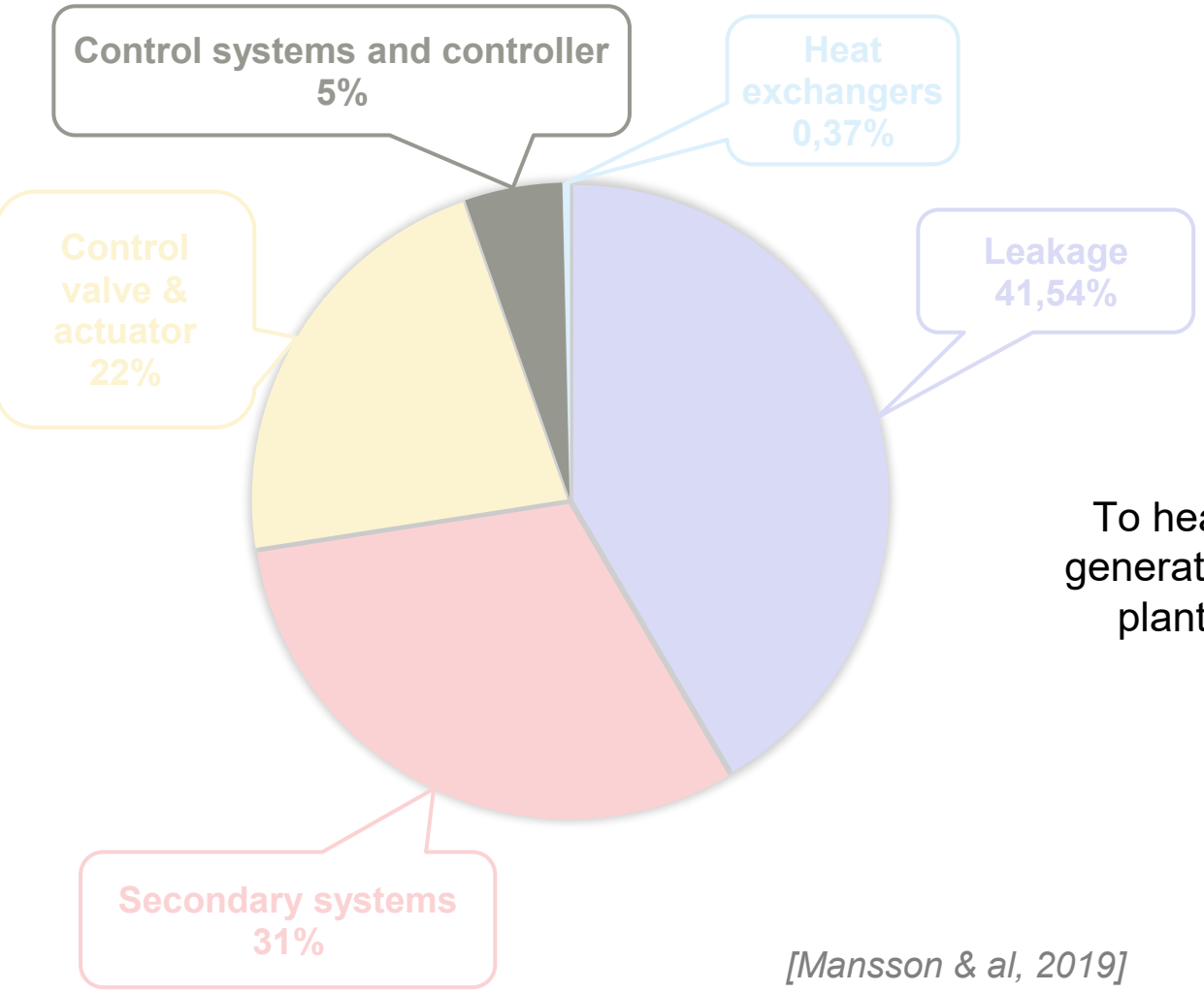


Fouling

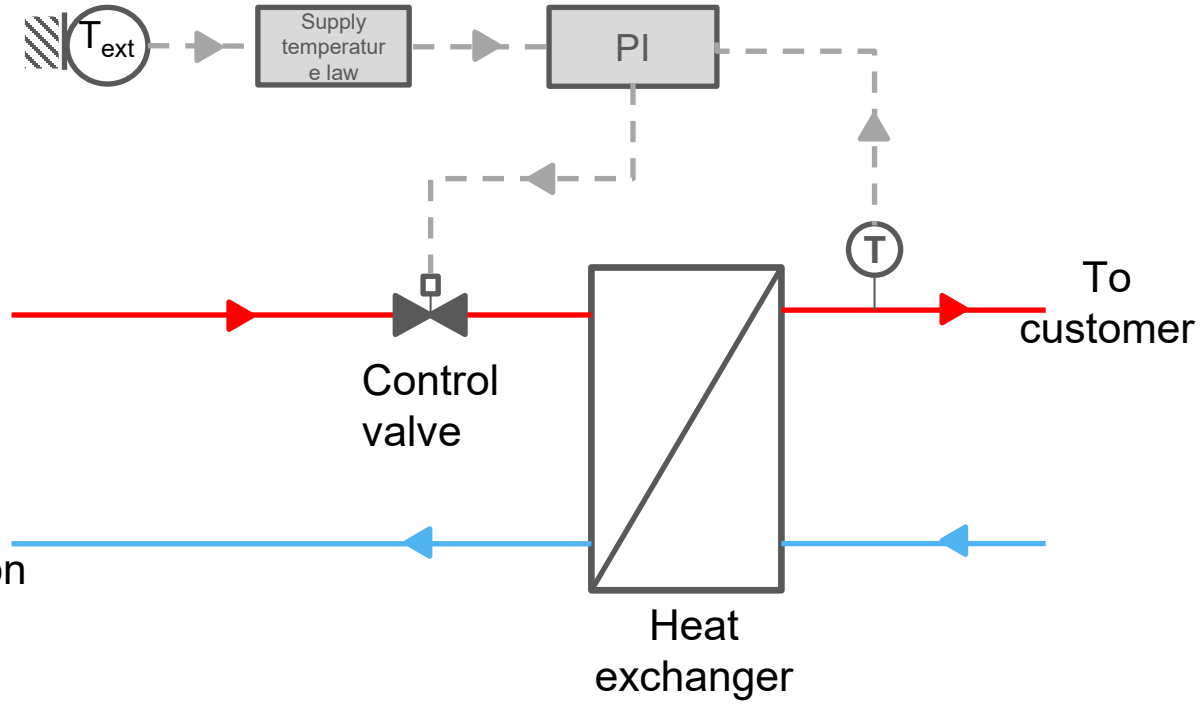
Unsuitable mounting

A deterioration of the HEX efficacity leading to increasing return temperature

2.3 Control systems and controller



[Mansson & al, 2019]

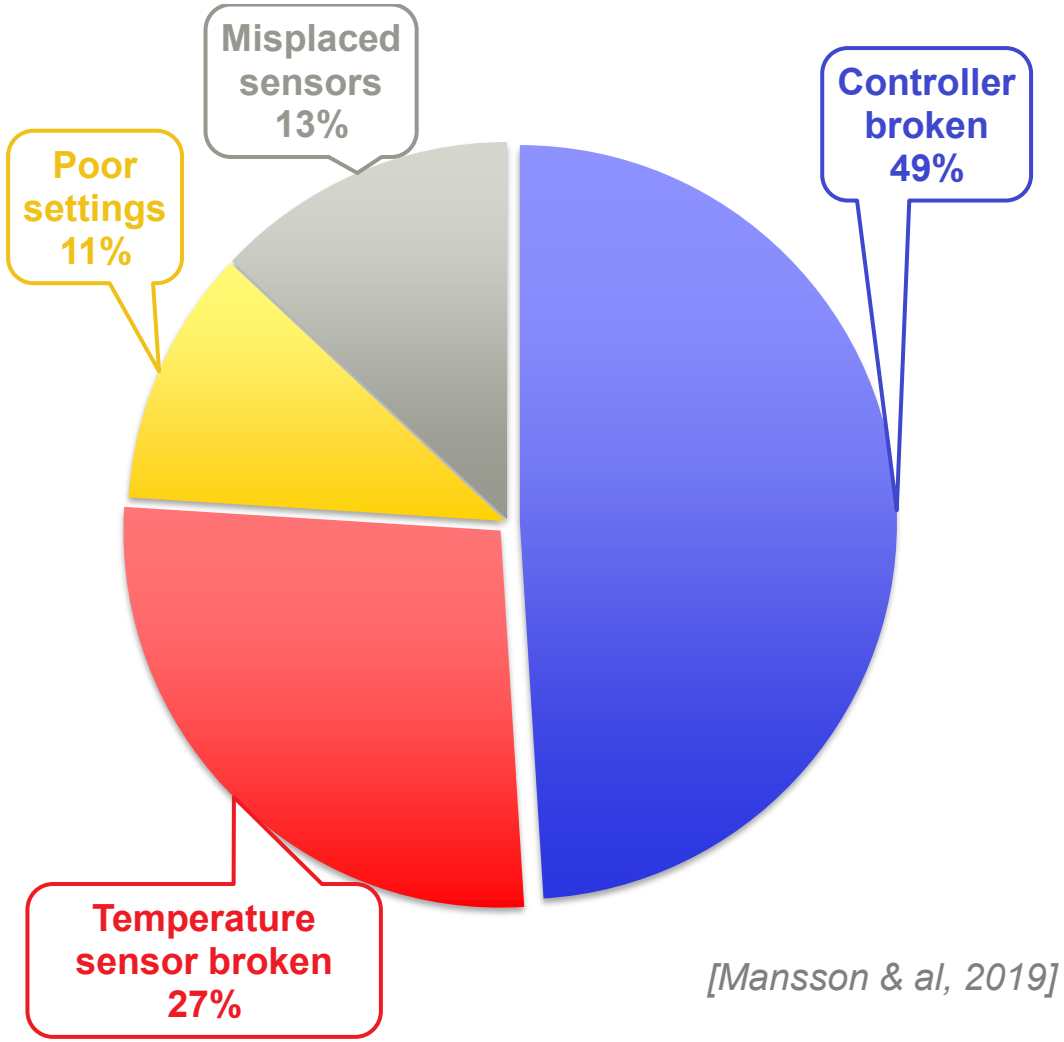


Failure

Unsuitable mounting

An unsuitable control possibly leading to an augmentation of return temperature or poor heating supply

2.3 Control systems and controller



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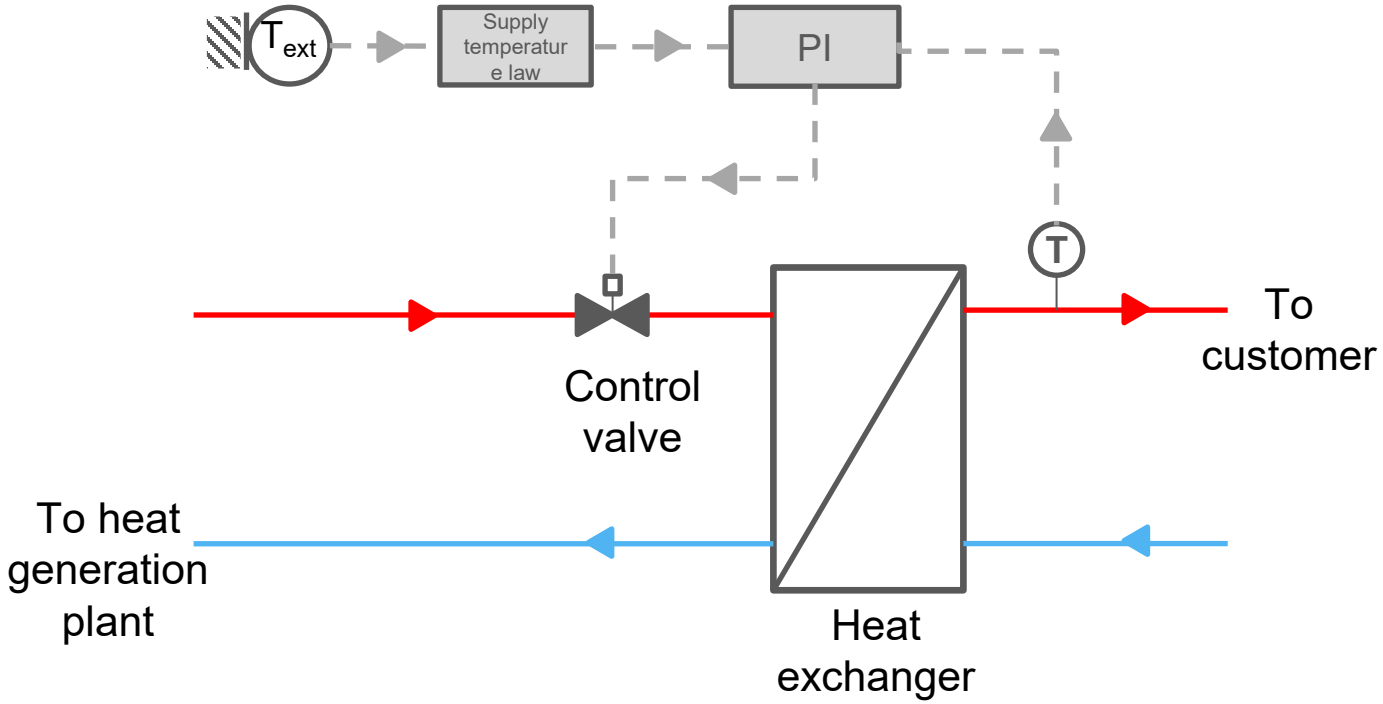
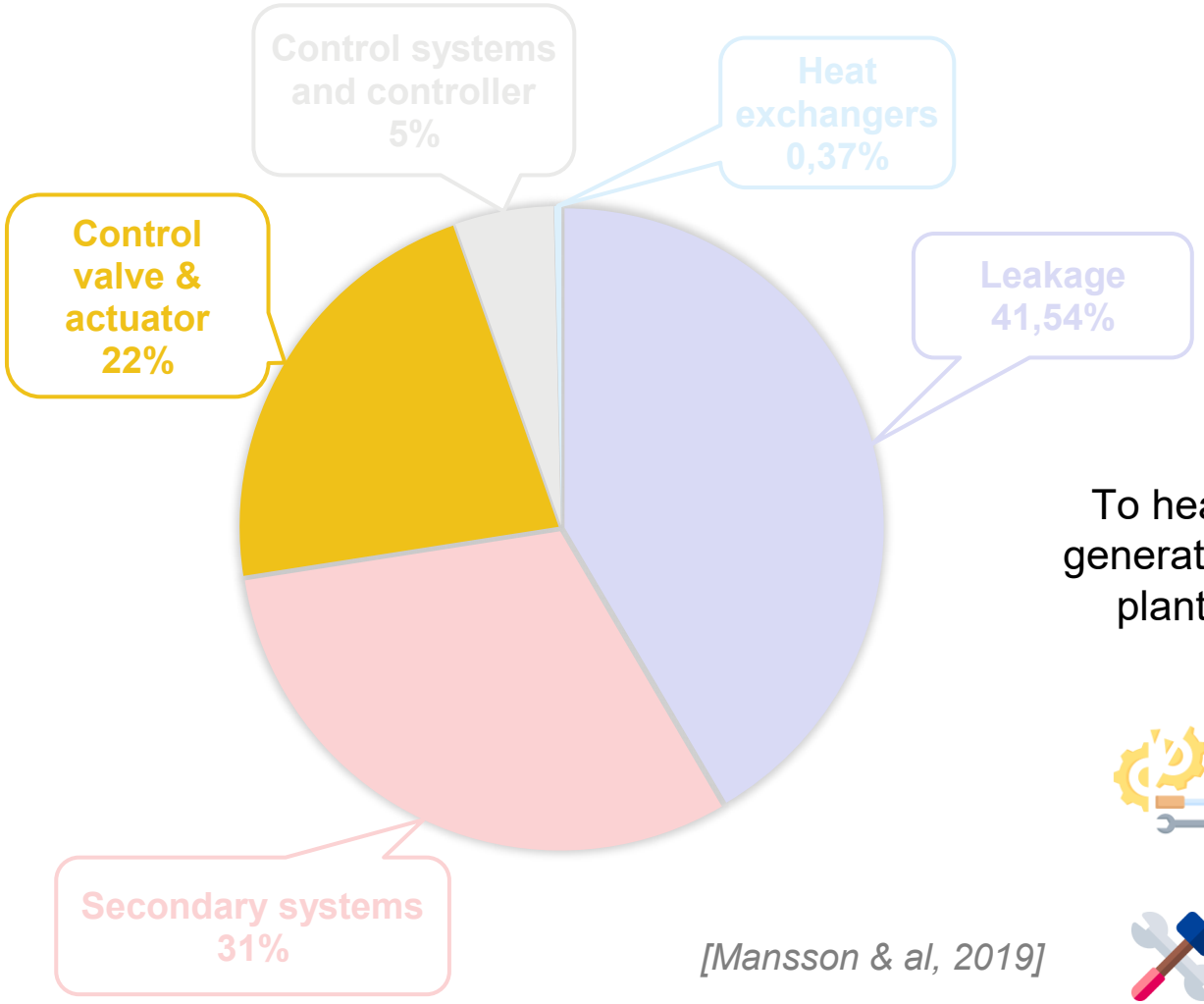


Failure ➡

Unsuitable mounting ➡

An unsuitable control possibly leading to an augmentation of return temperature or poor heating supply

2.4 Control valves and actuators



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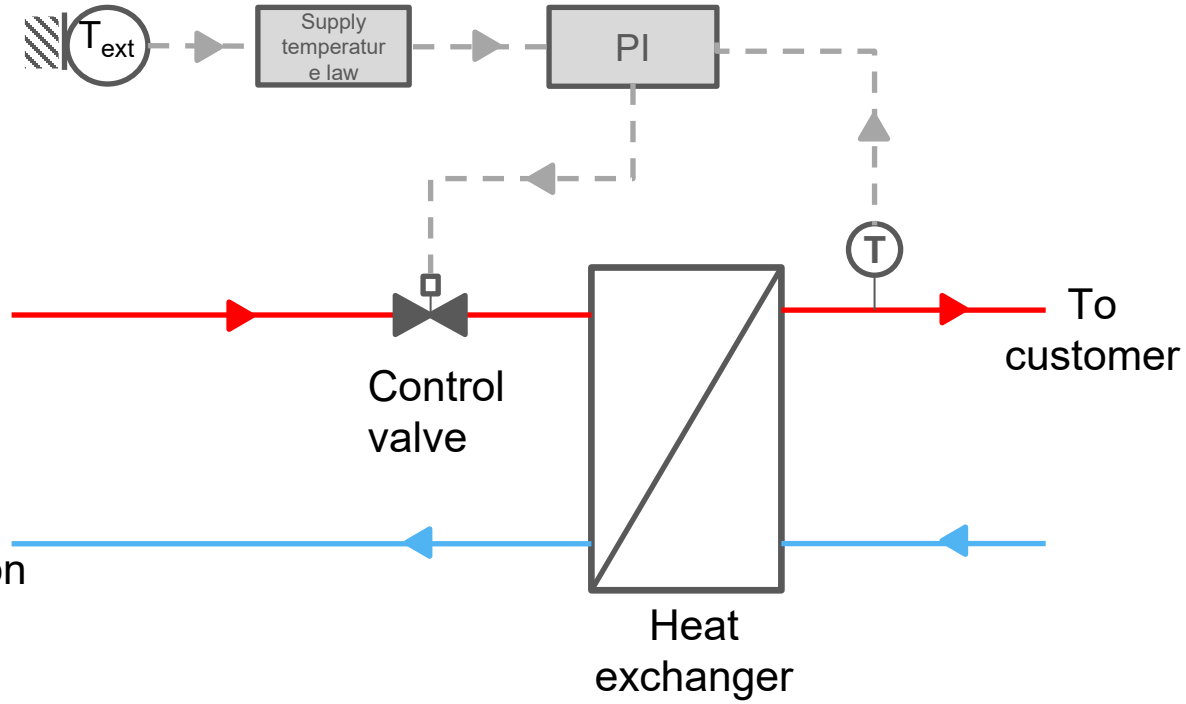
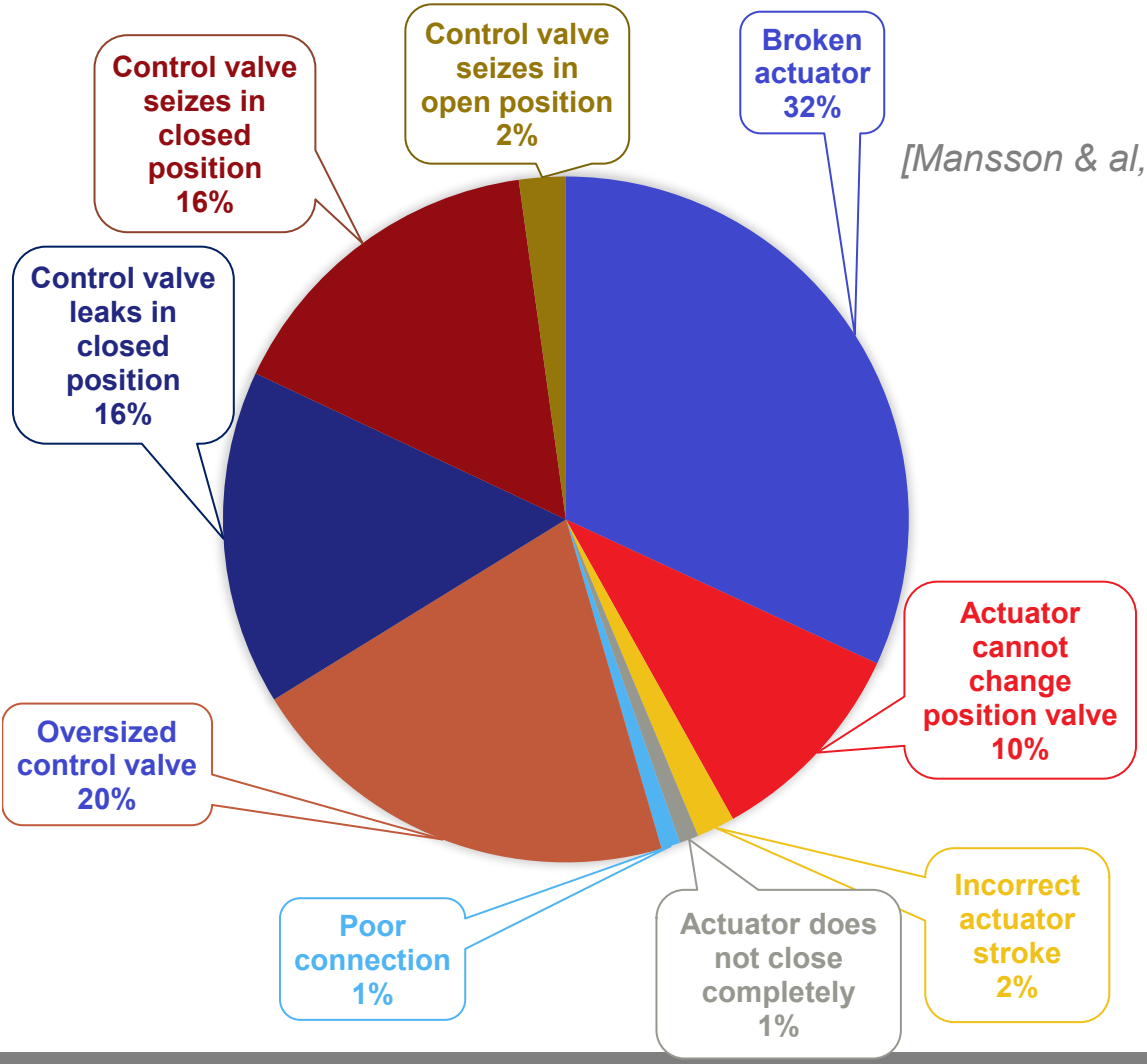


Blocked opening ➡

Unsuitable mounting ➡

An unsuitable control possibly leading to an augmentation of return temperature or poor heating supply

2.4 Control valves and actuators



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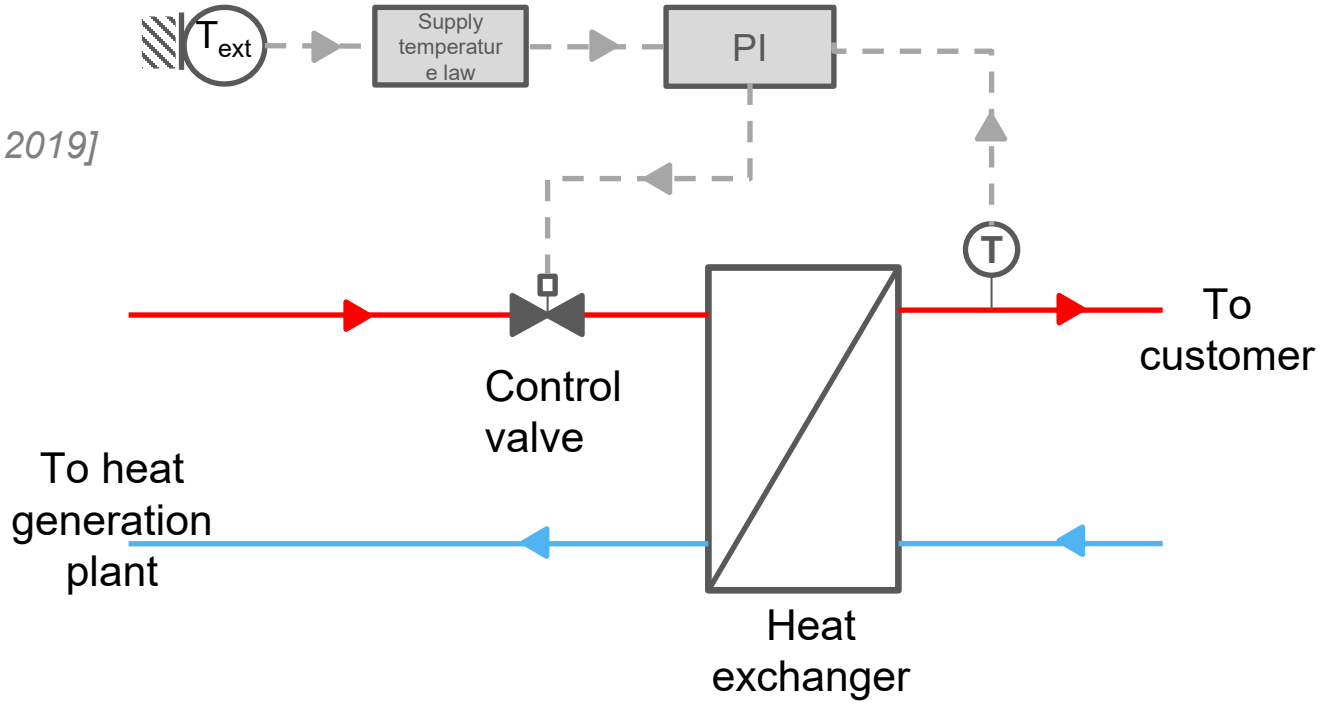

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Unsuitable mounting ➡

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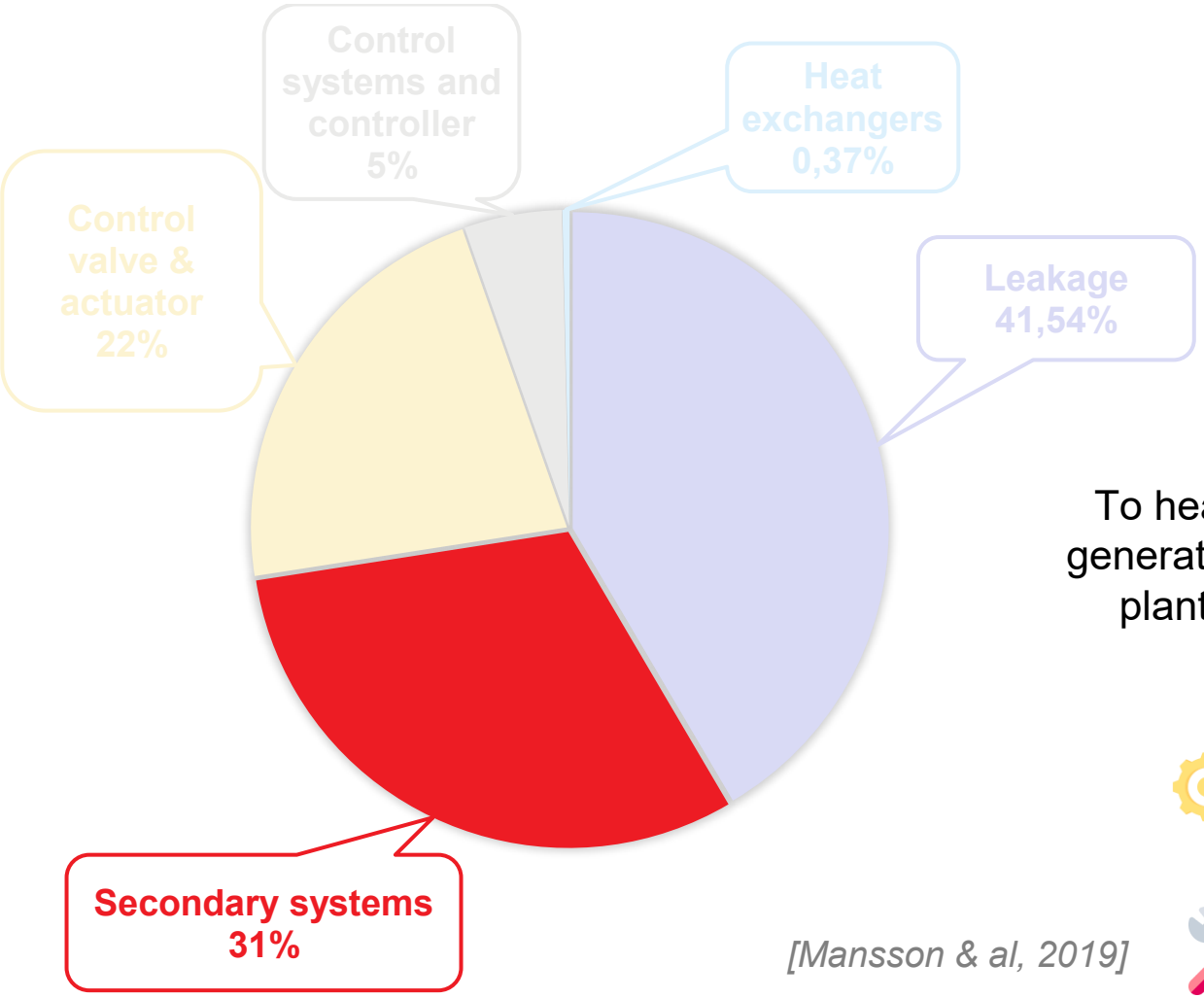
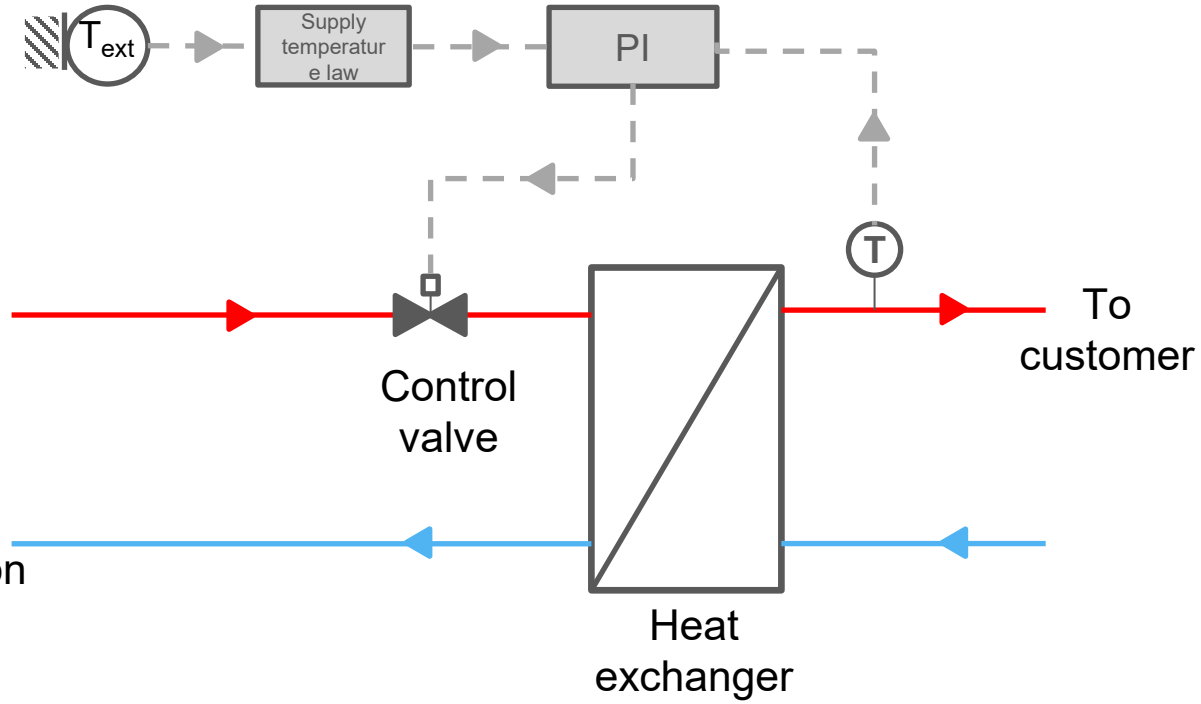
2.5 Beyond the substation



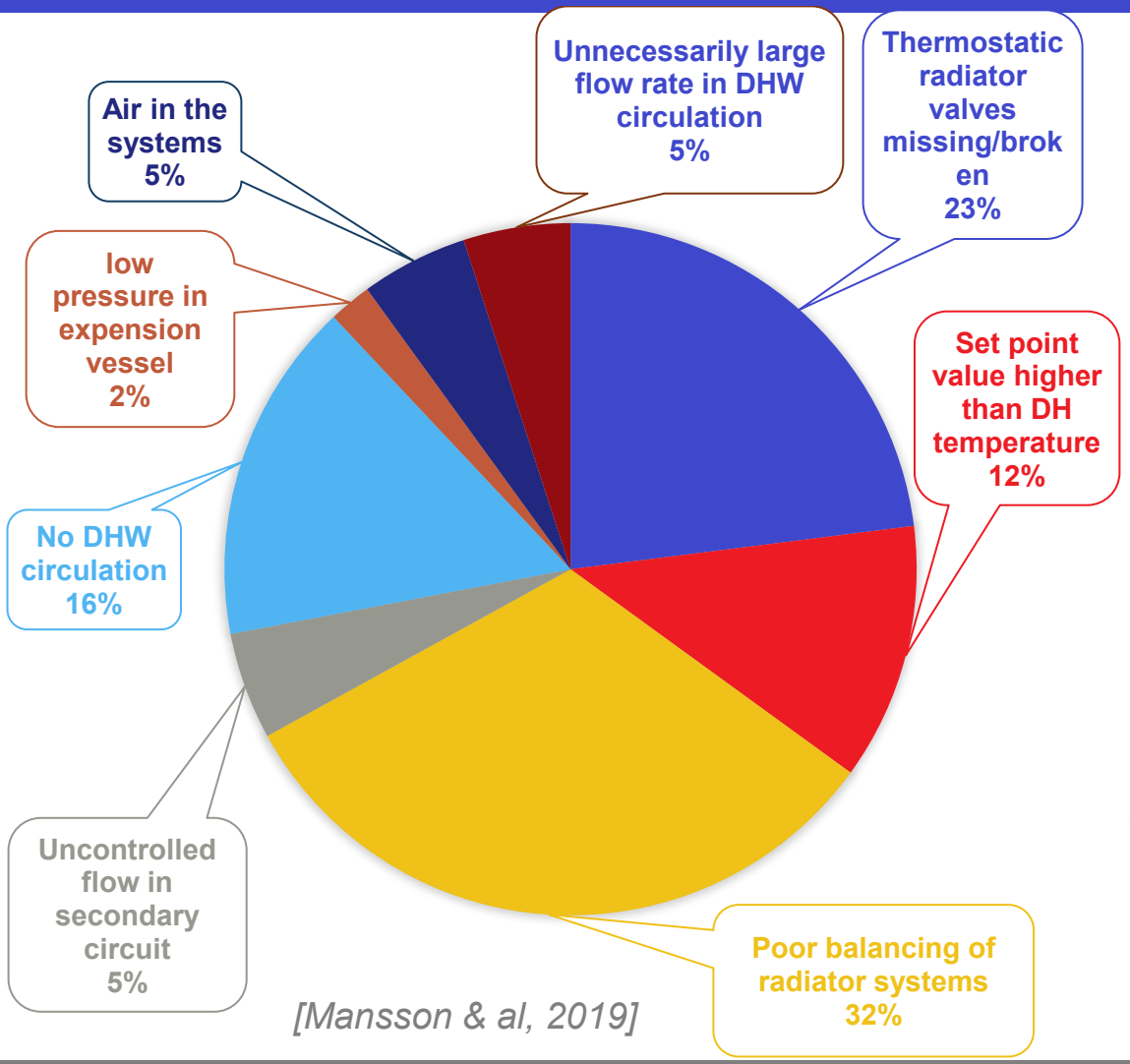
[Mansson & al, 2019]



Unsuitable equipment → An unsuitable control possibly leading to an augmentation of return temperature or poor heating supply

Unsuitable supply temperature law →

2.5 Beyond the substation



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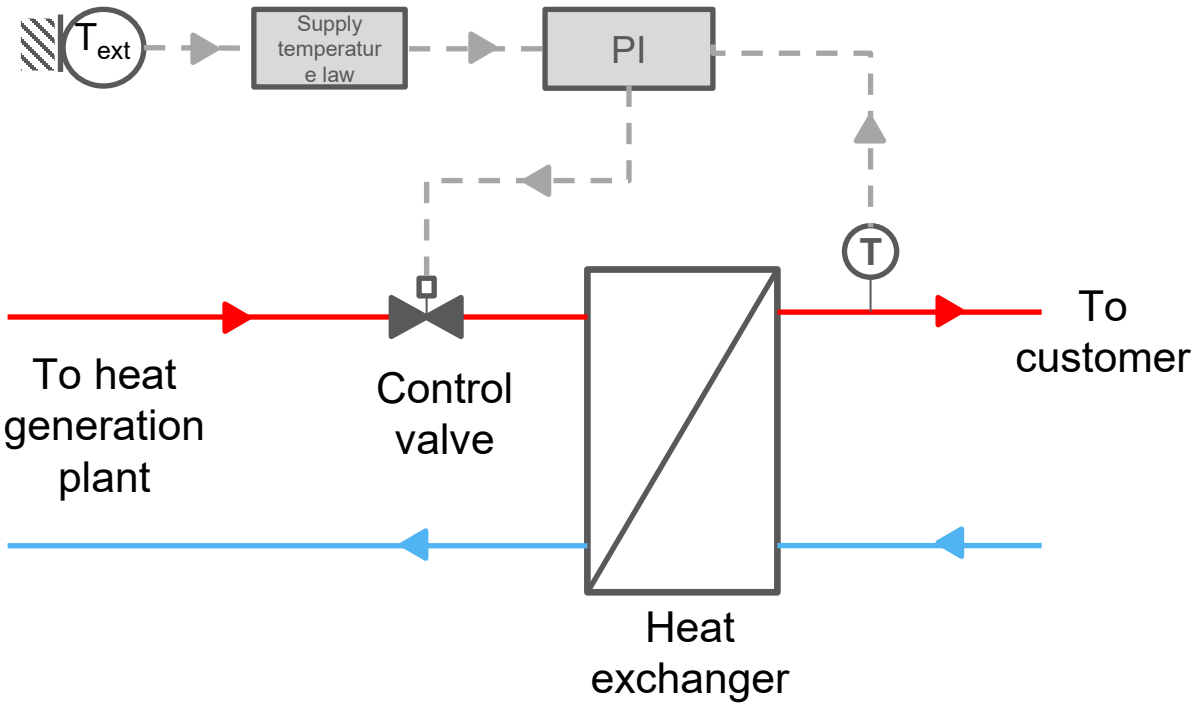
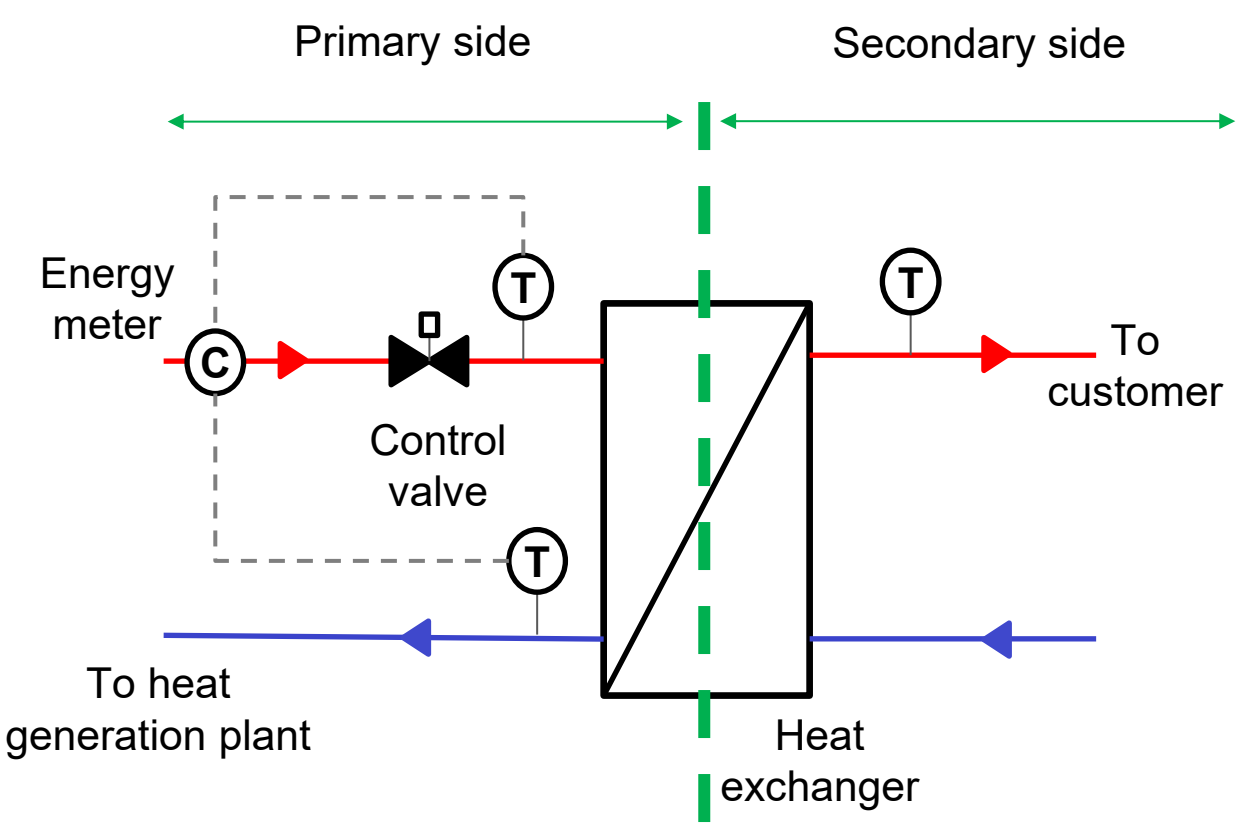


Unsuitable equipment

Unsuitable supply temperature law

An unsuitable control possibly leading to an augmentation of return temperature or poor heating supply

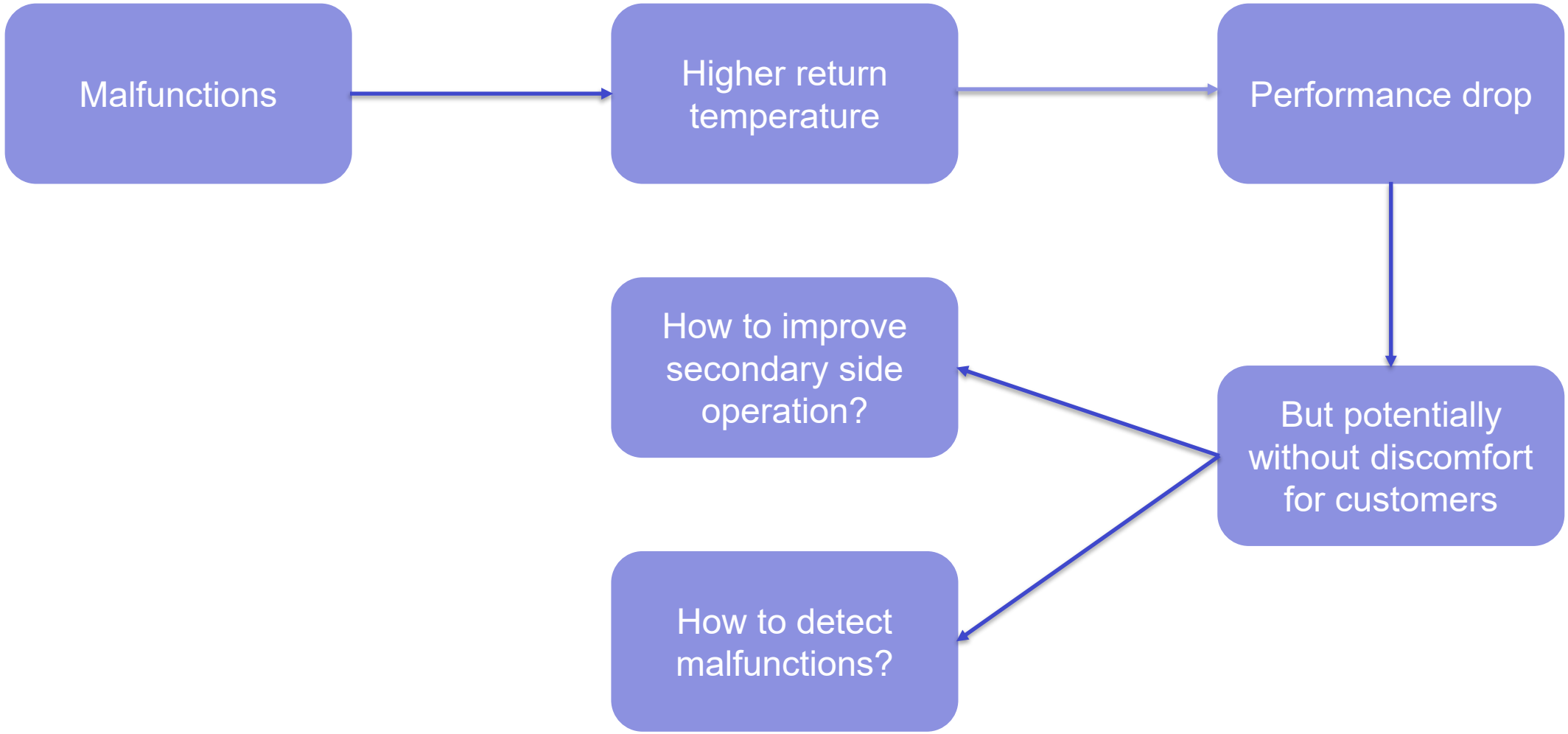
3. How to improve DHC networks performance



Usually, the DHC network operator only owns the primary side (including the heat exchanger and the secondary supply temperature sensor)

For billing purpose only exchanged power through the heat exchanger is legally mandatory. Usually, this data is measured through an energy meter (Two temperature sensors and one flow rate sensor)

3. How to improve DHC networks performance



References

- **S. Månsson, P. O. Johansson Kallioniemi, M. Thern, T. Van Oevelen and K. Sernhed**, "Faults in district heating customer installations and ways to approach them: Experiences from Swedish utilities," Energy, vol. 180, pp. 163-174, 2019 https://doi.org/10.1016/J.ENERGY.2019.04.220
- **A. Fabre,** "Développement d'indicateur de performance et de détection de défauts sur les réseaux de chaleur dans une démarche d'optimisation de leur pilotage", PhD Thesis, Mines Paris PSL, 2020 https://doi.org/10.70675/656cda46z6318z424bz8417za6c460641433

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Thank you!

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