

# Impact of Legionella regulation on a 4<sup>th</sup> generation district heating substation energy use and cost: the case of a Swiss single-family household

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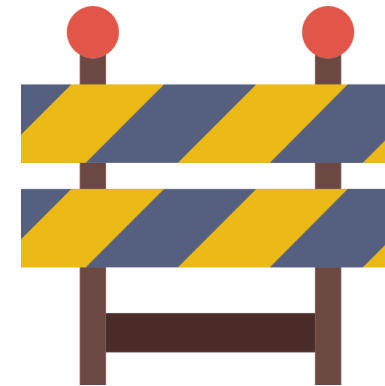
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# Introduction

Decrease of District Heating (DH) temperature → 4<sup>th</sup> Generation DH (4GDH)

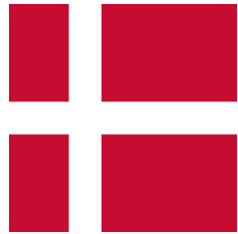


Domestic Hot Water (DHW) temperature for preventing Legionella



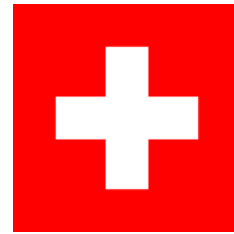
# Introduction

DHW regulation varies in Europe especially for small buildings



**≥ 55 °C at the tank outlet**

≥ 50 °C in the system,  
except at peak flows



**≥ 60 °C at the tank outlet**

≥ 50 °C at the tapping  
point



**No minimum temperature**

“3-liter rule”:  
≤ 400 L tank & ≤ 3 L pipe

# Objective & case study

Impact of **different Legionella regulations** on the **energy consumption** and **economic cost** of **user substation** connected to a **4GDH**

A 150-m<sup>2</sup> single-family house of 4 persons located in Switzerland

Swiss standard SIA 385/2:2015 for DHW sizing

170 L tank + assumption for “3-liter rule”

4GDH network at 50 °C

# Objective & case study

SH demand: 20100 kWh/y and 16 kW

DHW demand: 2713 kWh/y and 3 kW (Swiss norm)

A 150-m<sup>2</sup> single-family house of 4 persons located in Switzerland

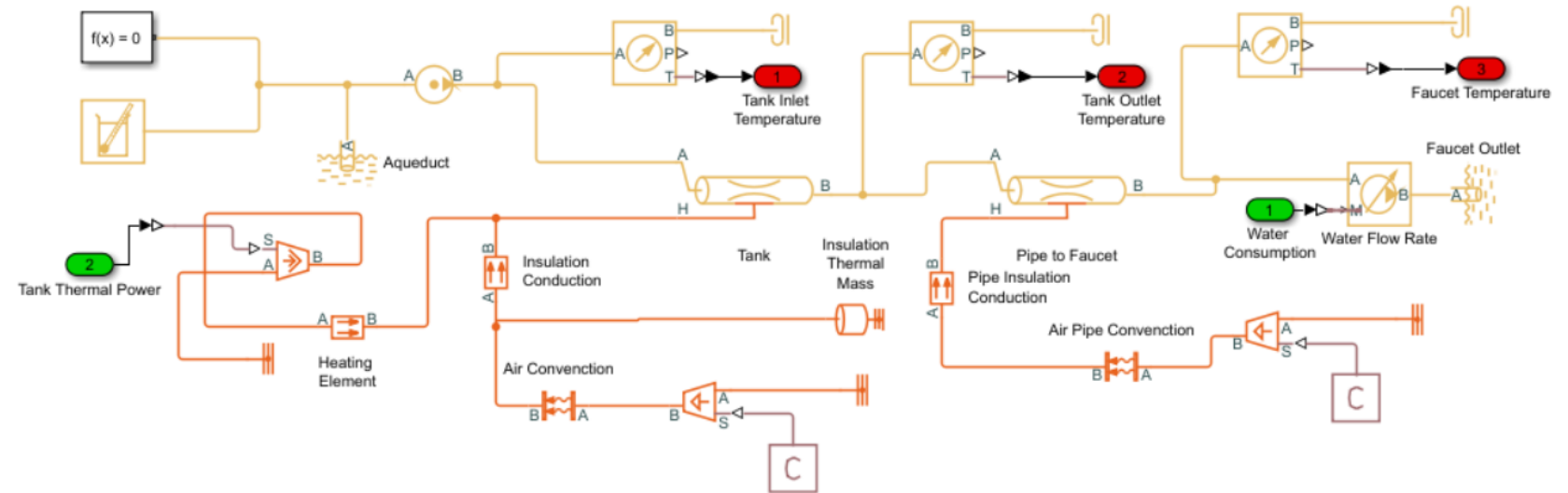
Swiss standard SIA 385/2:2015 for DHW sizing

170 L tank + assumption for “3-liter rule”

4GDH network at 50 °C

# Energy model

Annual simulation  
(8760 h with  
60 s timestep)  
in **Simscape**



DHW profile generated with **DHWCalc 2.02**

# Economic model

Major indicator → **annualized cost**

**Incentive** for DH substation **favouring heat pumps**

Heat exchanger cost	$2408 \times Q_{\text{installed}}^{0.4101} \text{ CHF/unit}$
Heat pump cost	4600 CHF/unit
Incentive for a DH substation with heat exchanger	5000 CHF + 50 CHF/kW <sub>th</sub>
Incentive for a DH substation with heat pump	11000 CHF + 50 CHF/kW <sub>th</sub>
Electricity price	0.20 CHF/kWh <sub>el</sub>

# Scenarios

1. **Swiss regulation (60 °C)**
2. **Danish regulation (55 °C)**
3. **3-liter rule (45 °C)**

The solution for DHW preparation depends on the temperature requirement

**> 45 °C**

Heat exchanger +  
micro booster DHW heat pump

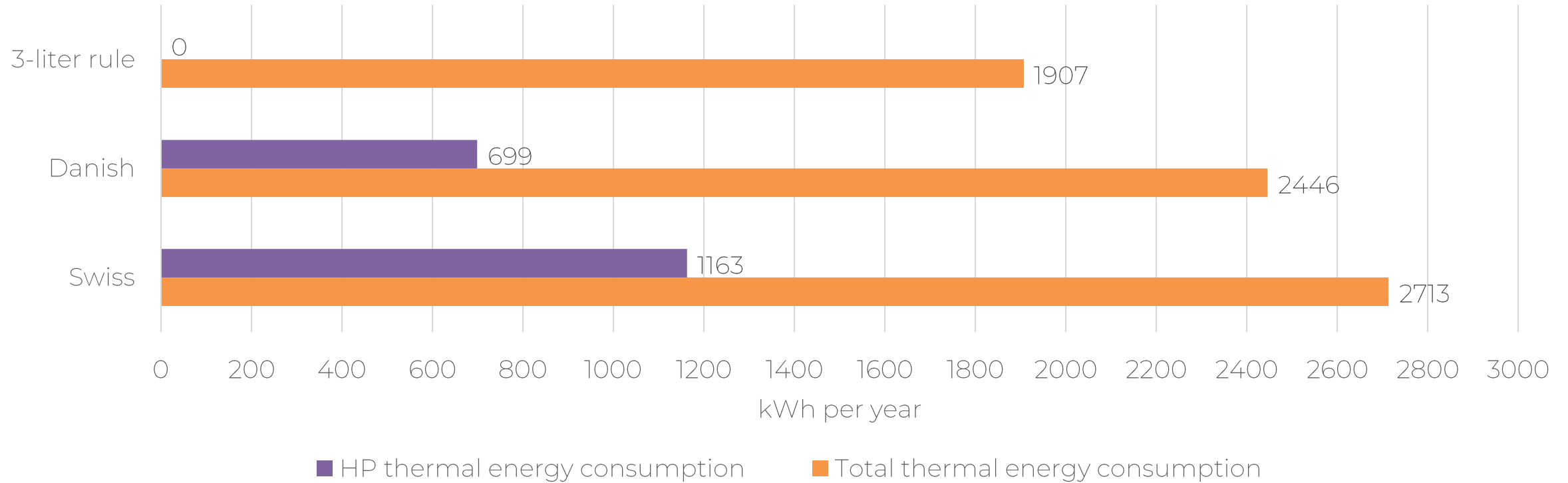
**≤ 45 °C**

Heat exchanger

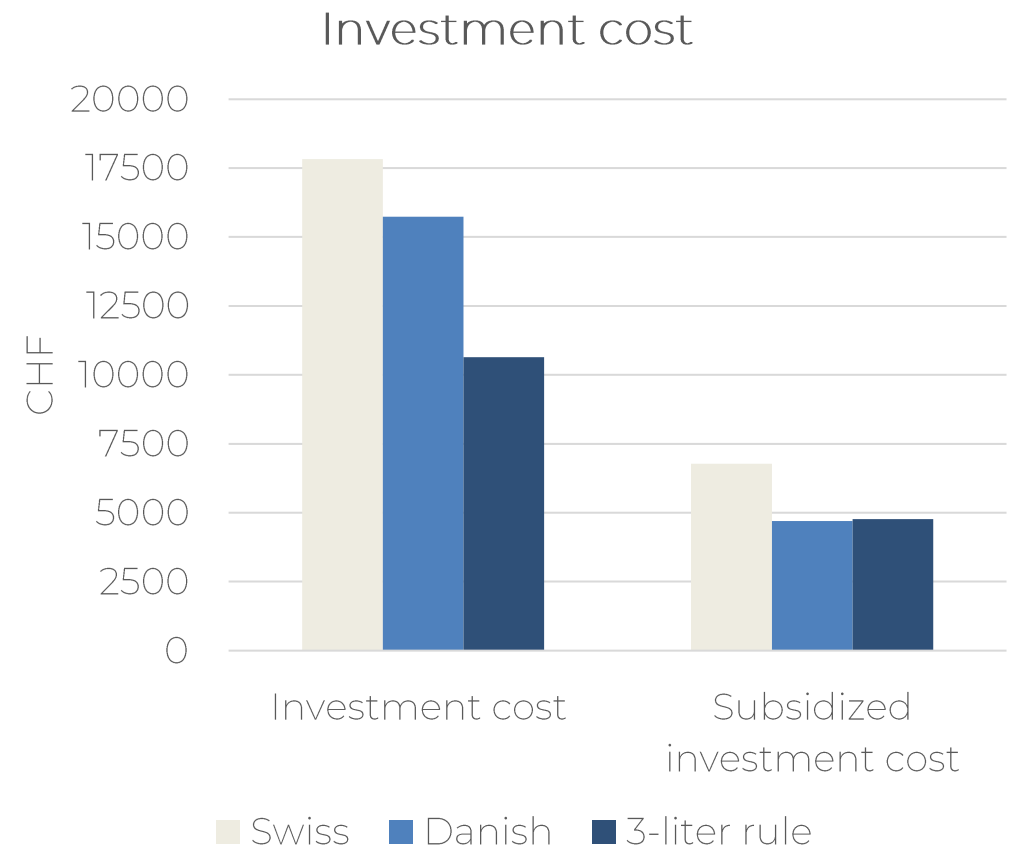
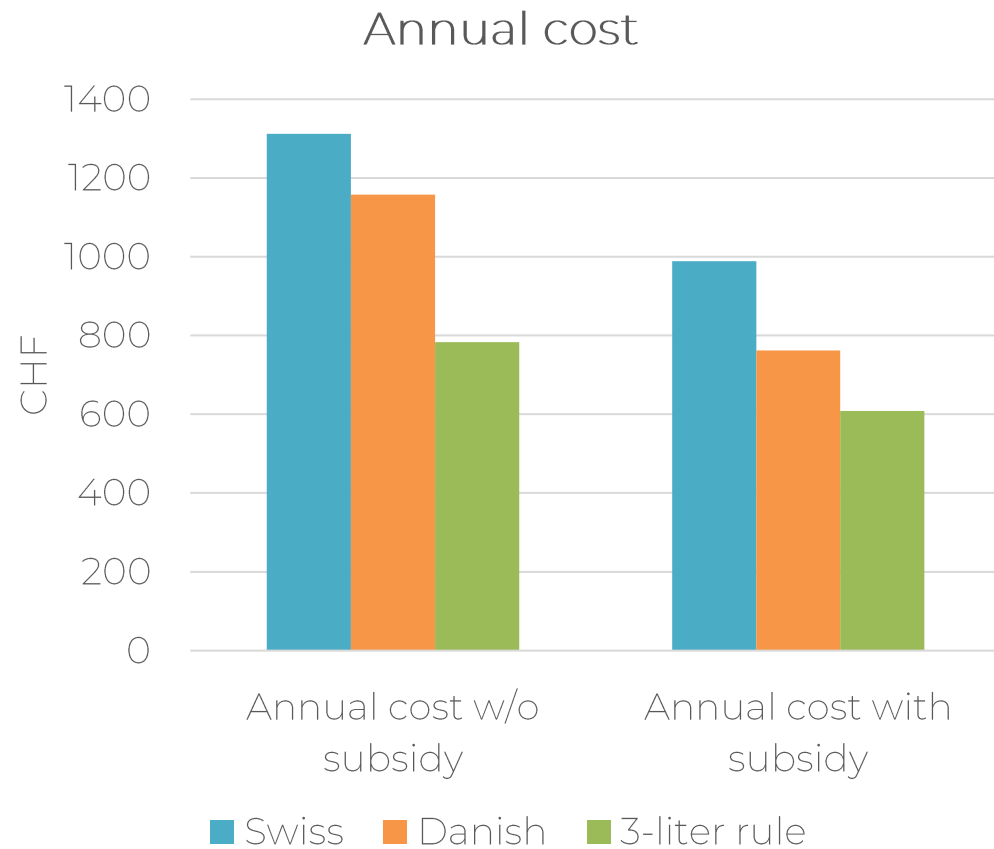


# Results: energy

Thermal energy consumption



# Results: cost



# Conclusion

- Reduction of 5 °C in DHW temperature effective for:
  - decrease thermal energy consumption
  - the investment cost of the system, given the current incentive policy for DH
- “3-liter rule” → lowest investment and annual cost without subsidies

# Thank you for your attention!

If you have any question, feel free to contact me at  
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