Technische Hochschule Ingolstadt
Institute of new Energy Systems

General Optimization Guideline for District Heating Networks and its exemplary Application

7th International Conference on Smart Energy Systems 2021

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Agenda

- Background and Introduction
- Methodology
- Exemplary application of the guideline
- Outlook and Summary

In Germany, many small heating networks powered by biomass or -gas have been built in the last 30 years.

- Wood chip prices are rising
- Feed-in tariffs fall away

→ **How can we keep this district heating networks alive?**

- Many problems & Many optimization measures

→ **Catalog of optimization measures & Guideline**

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Two examples of district heating networks in rural areas using the guideline

Network 1

Heating plant

- 3 x biogas CHP
- 2 x central buffer storages à 8 m³
- 1,700 MWh/a, Thermal losses > 40 %

District heating network

- Constant feed temperature of 80 °C
- 2.5 km, Heat demand density: 0.7 MWh/m
- 39 consumers: Single- and multi-family homes, fire brigade, church
- Difference between feed and return temperature: 17 K

Consumer side

- Uncontrolled district heating substations
- Building standard: existing buildings

Network 2

Heating plant

- Base load: Mainly wood chip boiler, CHP (small)
- Peak load: Oil boiler
- 3,500 MWh/a, thermal losses > 40 %

District heating network

- Constant feed temperature of 80 °C
- 4.5 km, Heat demand density: 0.8 MWh/m
- 91 consumers: Single- and multi-family homes, public swimming pool (summer)
- Difference between feed and return temperature 5 K

Consumer side

- Uncontrolled district heating substations
- Building standard: existing buildings

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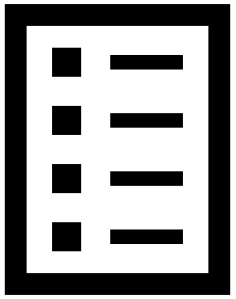
1 Catalogue



e.g. 30 measures

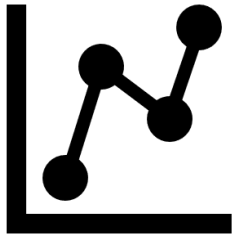
2 Specifica of individual network

e.g. heat demand density

type of generators

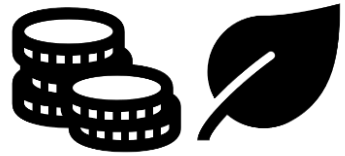
e.g. 15 measures

3 Small calculations / considerations



e.g. 5 measures

4 Examination in detail



Economic benefit

CO2 Savings

Collection of optimization measures

Select half of the measures by key indicators

- Small calculations
- Little effort

- Lab measurement
- Simulation
- Detailed work

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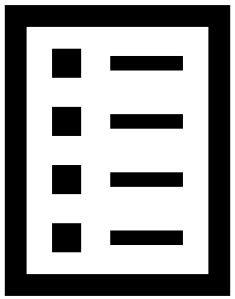
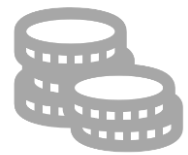


30 measures

15 measures

5 measures



e.g. heat demand density

type of generators

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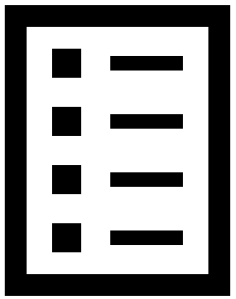

Catalogue of optimization measures for network 1 (selection)

Heating plant

- Add central buffer storage
- Change from constant to speed controlled boiler pumps

District heating network

- Decrease district heating network feed temperature
- Operate intermittend in summer

Consumer side

- …
- …

Methodology

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1 Catalogue

30 measures

2 Specifica of individual network

e.g. heat demand density

type of generators

15 measures

3 Small calculations / considerations

5 measures

4 Examination in detail

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G u i d e l i n e

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Catalogue of optimization measures for network 1 (selection)

Heating plant

- ~~Add central buffer storage~~
- ~~Change from constant to speed controlled boiler pumps~~

District heating network

Consumer side

- …
- …

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2

Catalogue of optimization measures (selection)

District heating network

✓ Decrease network feed temperature → pipe network calculation (thermo-hydraulic dimensioning) is available

yes → 3. Small calculation

no → 4. Detailed work

✗ Operate intermittend in summer

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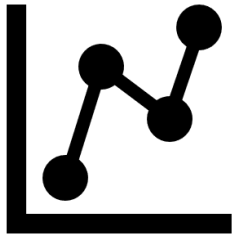
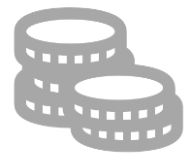


5 measures

4 Examination in detail



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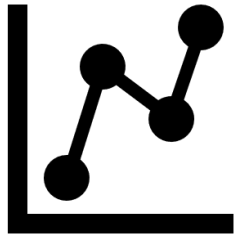
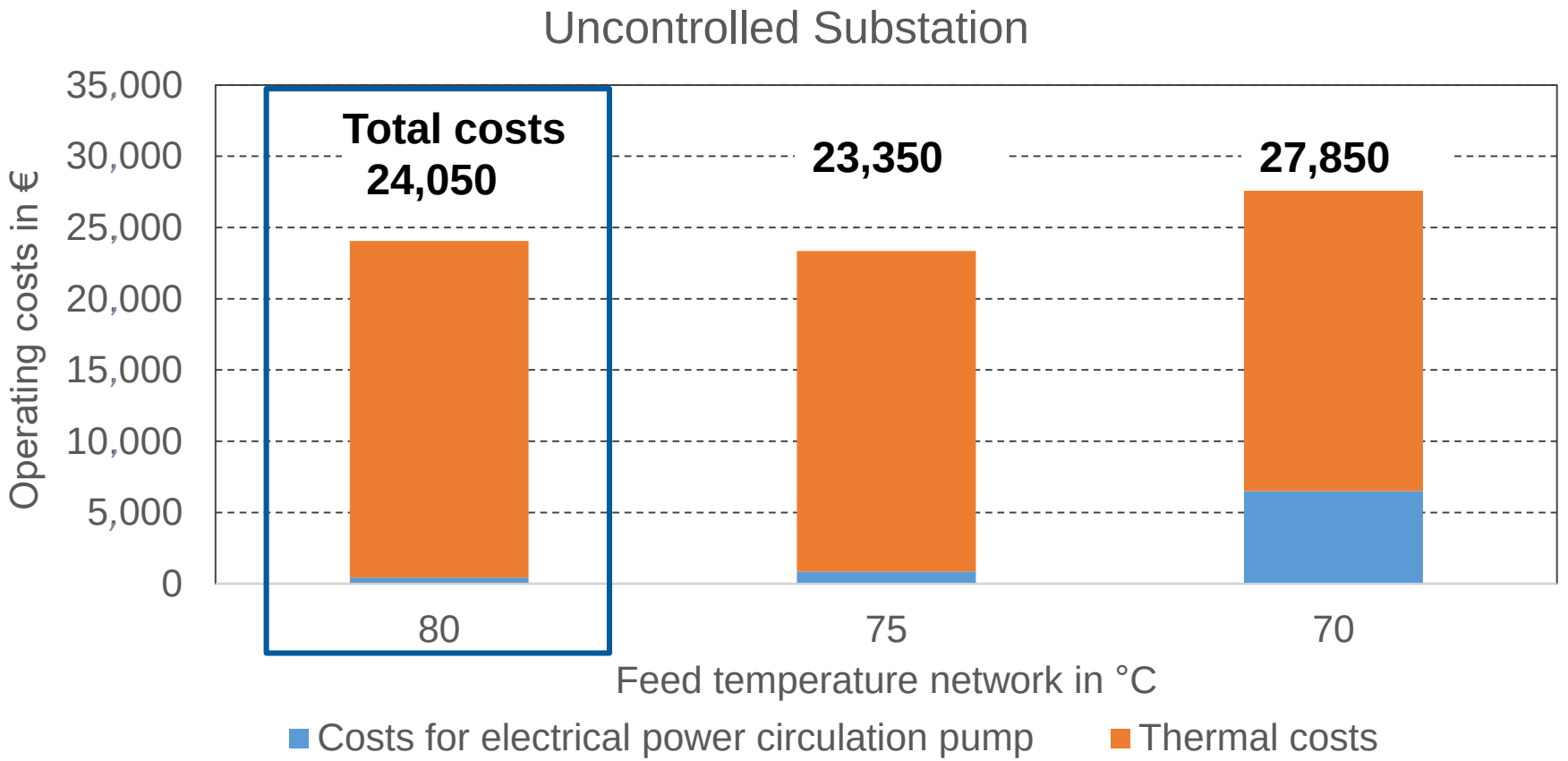
G u i d e l i n e

3 **Small calculations / considerations**



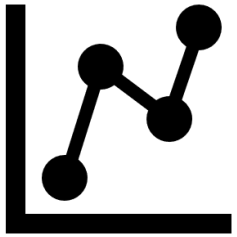


*heat production costs 50 Euro MWh , electricity price 23 Cent/kWh

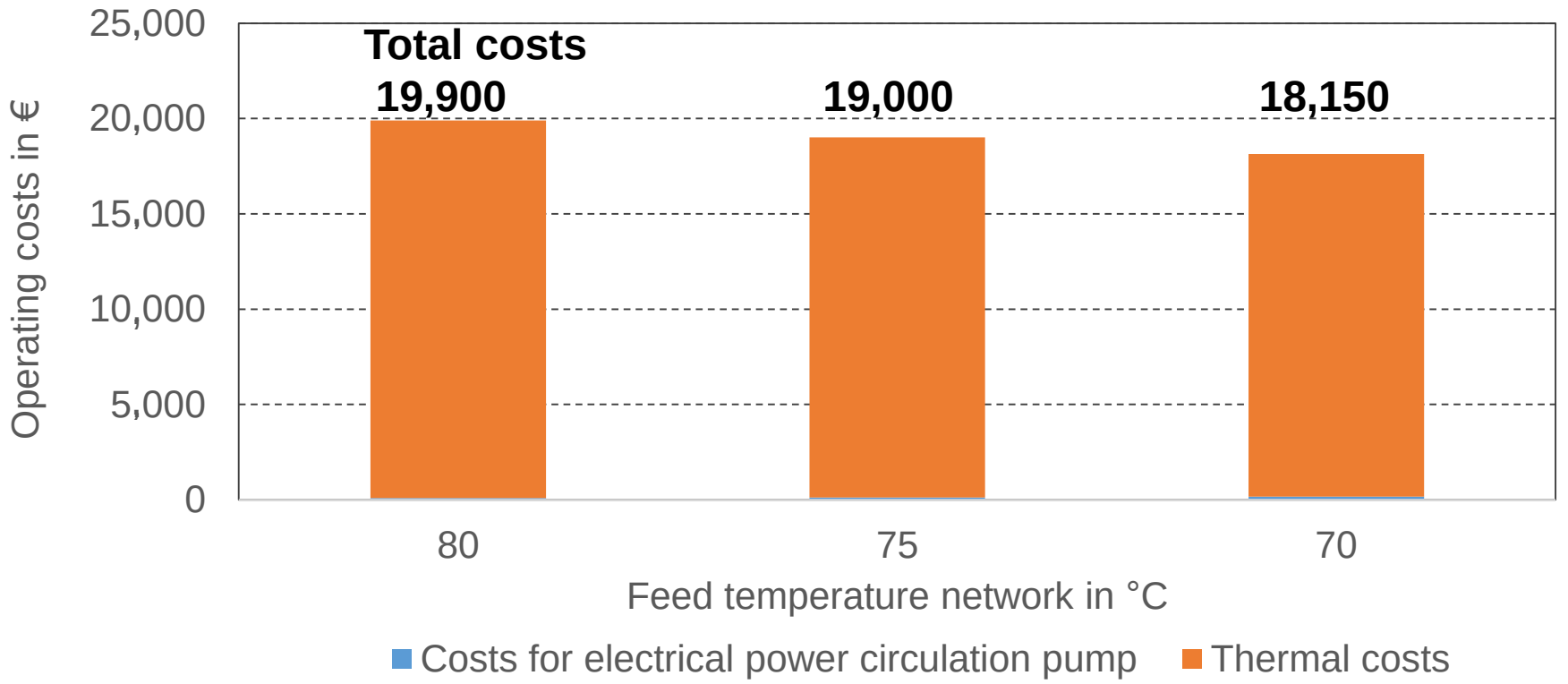
- Benefit: Lowering the supply temperature from (current state) 80 to (case study) 75 degrees can save 3% of the operating costs
- Effort: An adapted circulating pump has to be installed

→ **Not economical**

3 **Small calculations / considerations**



Electronically controlled substation (e.g. reduced volume flow)

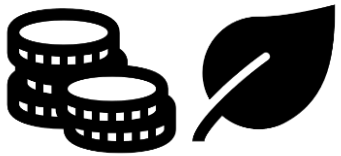


*heat production costs 50 Euro MWh , electricity price 23 Cent/kWh

- Lowering the supply temperature from (current state) 80 to (case study) 70 degrees can save 9% of the operating costs
- An adapted circulating pump has to be installed

→ **Static payback period: 3 years**

4 Examination in detail



Economic benefit

CO2 Savings

- Lab measurement
- Simulation
- ➢ Detailed work

- **Laboratory measurement**
  - Retroffiting substations
- **Simulation**
  - Various operation strategies
  - Upgrading the heating plant

Summary

- District heating network with **high feed temperatures** and **high heat looses**
  - Only residential consumers
  - Previously operated with **constant** feed temperature (here: 80 ºC)
- **Result**

  ➢ Decreasing feed temperature can be economical when substations are controlled electronically

The catalog is scheduled to be published on our website in the middle of 2022, as well as the guideline, which will be explained using two existing networks.

Thank you for listening!

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