Technische Hochschule Ingolstadt
Institute of new Energy Systems

Development and Investigation of optimised Operation Strategies for District Heating Systems with variable Temperatures

5th International Conference on Smart Energy Systems 2019

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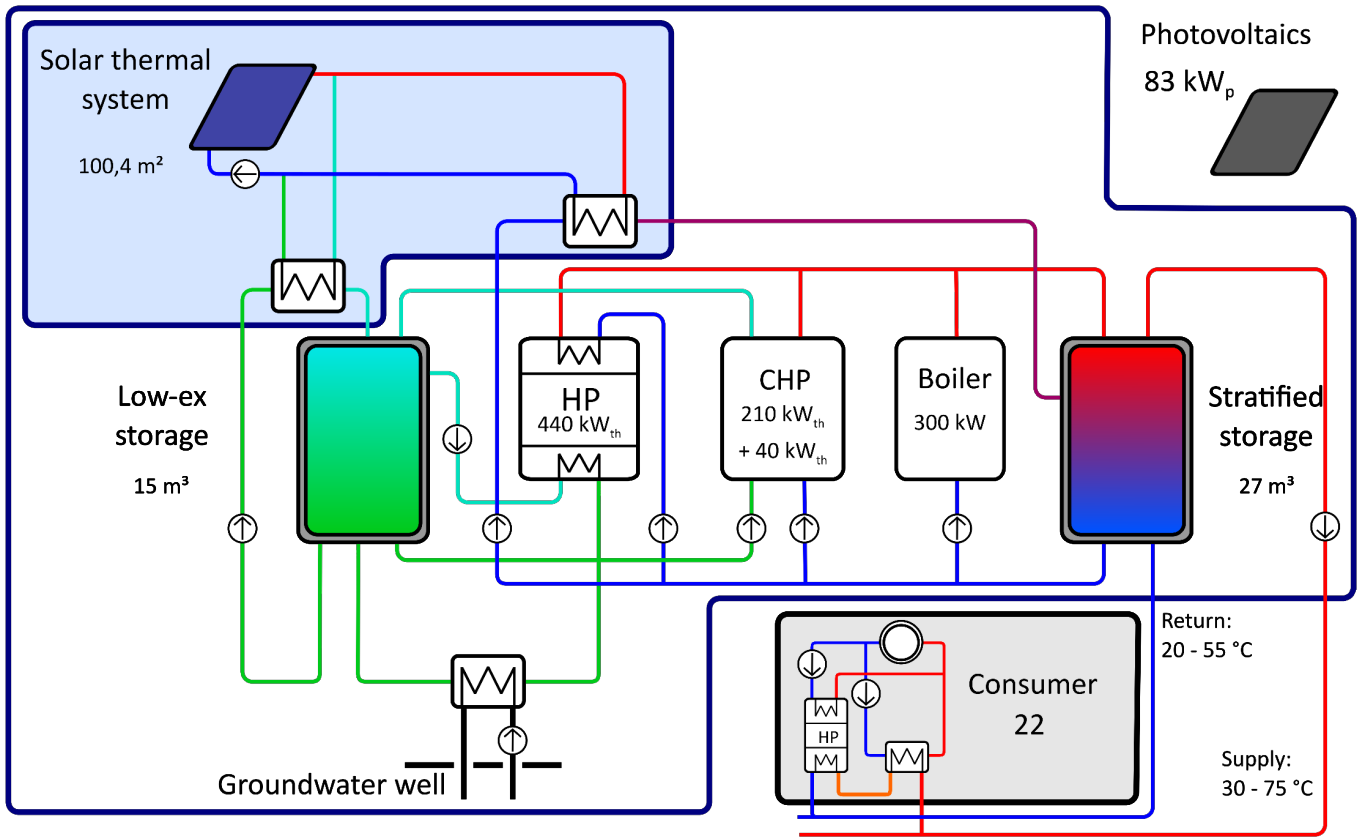
Agenda

- Introduction
- Motivation
- Methodology
- Exemplary Implementation of Methodology
- Conclusion
- Outlook

Introduction

District heating system (DHS) with variable temperatures

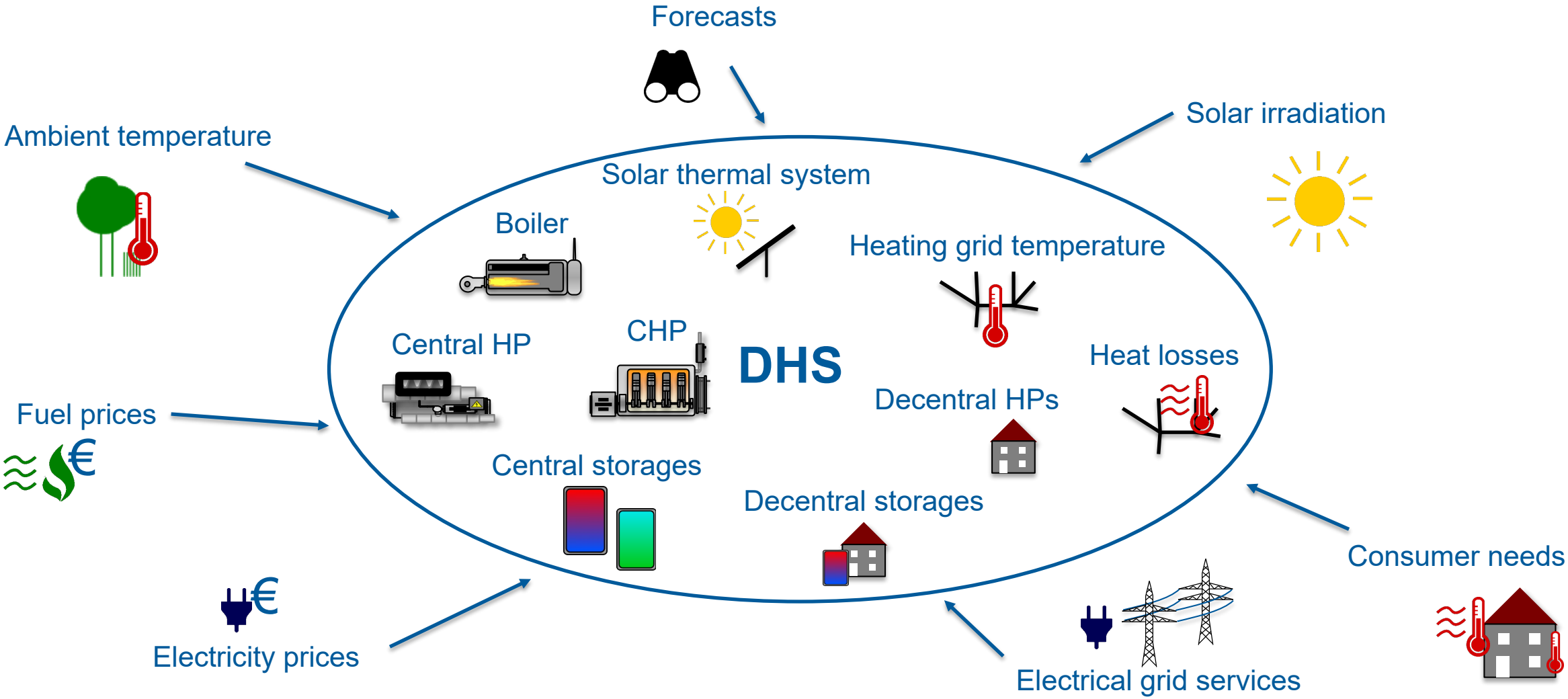


DolInstein System

- Annual **heat supply** 1100 MWh
- Variable grid **supply temperature**
  - Winter 75 ºC
  - Summer 30 ºC
- **Substations** with heat exchanger, heat pump and storage
- **Central heating station** with multiple producers
- **Linkage** between **heat** and **power** sectors

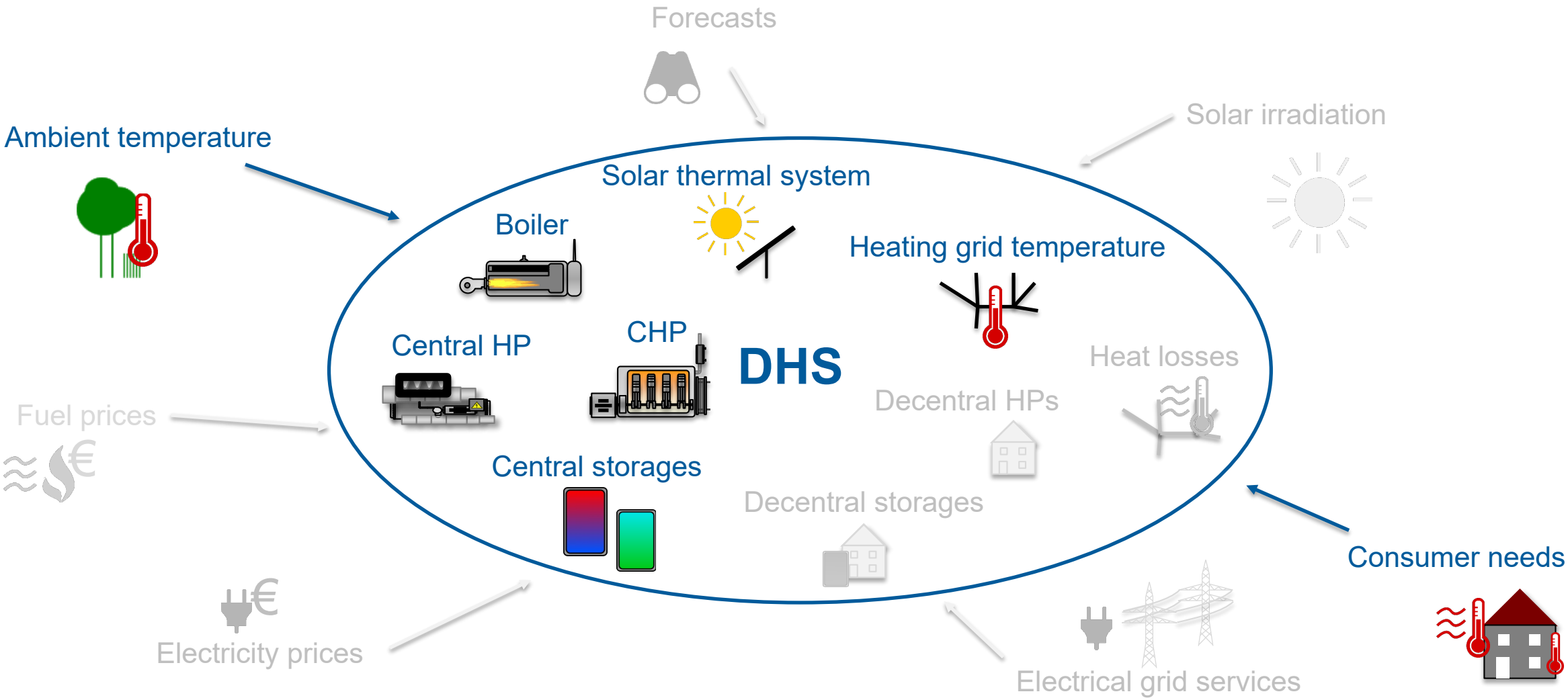
Motivation

How to utilise the benefits of a multivalent and complex DHS?



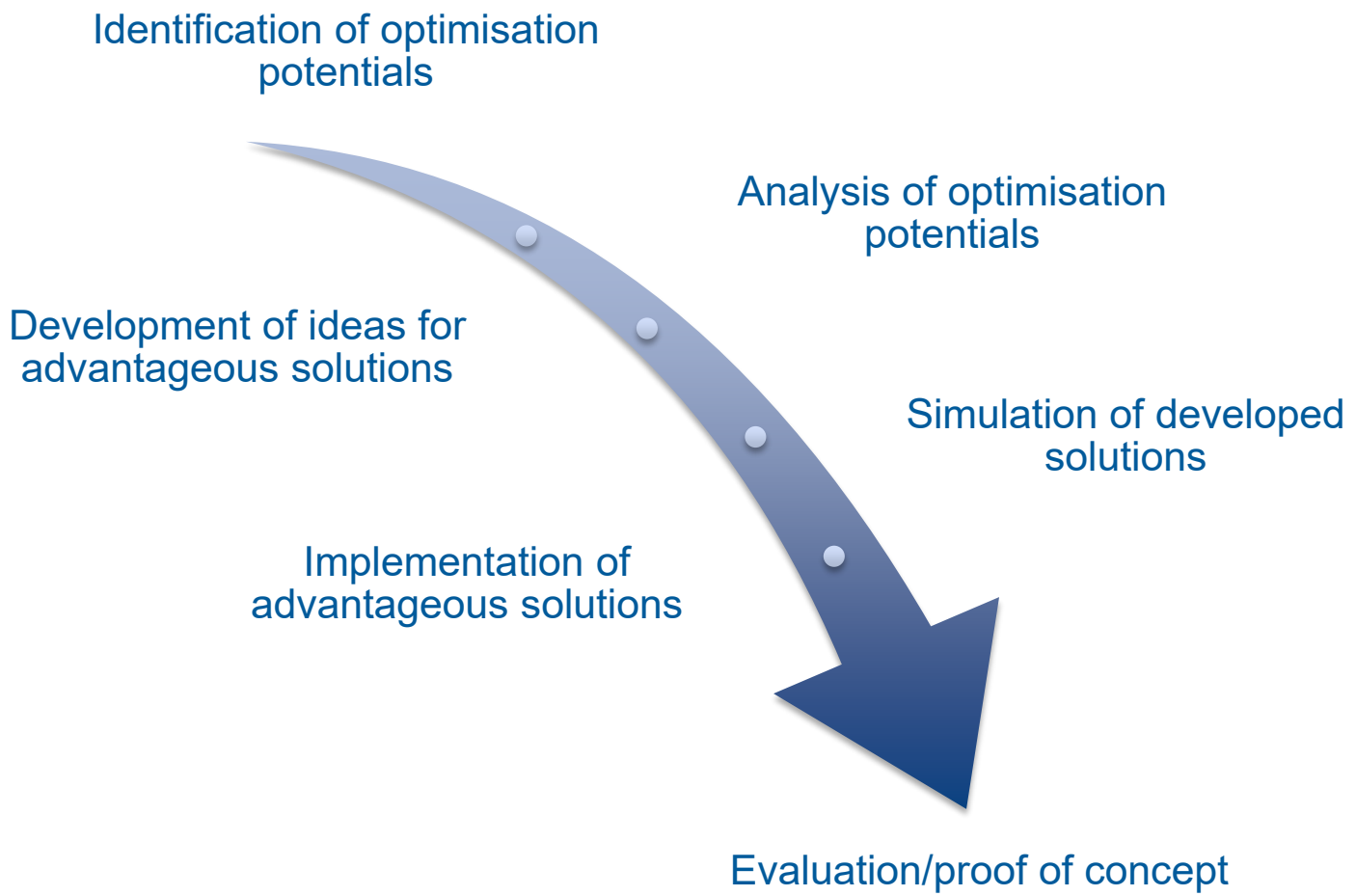
Motivation

Status of actual semi-automated control



Methodology

Overview



Methodology

1) Identification of optimisation potentials

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Legend

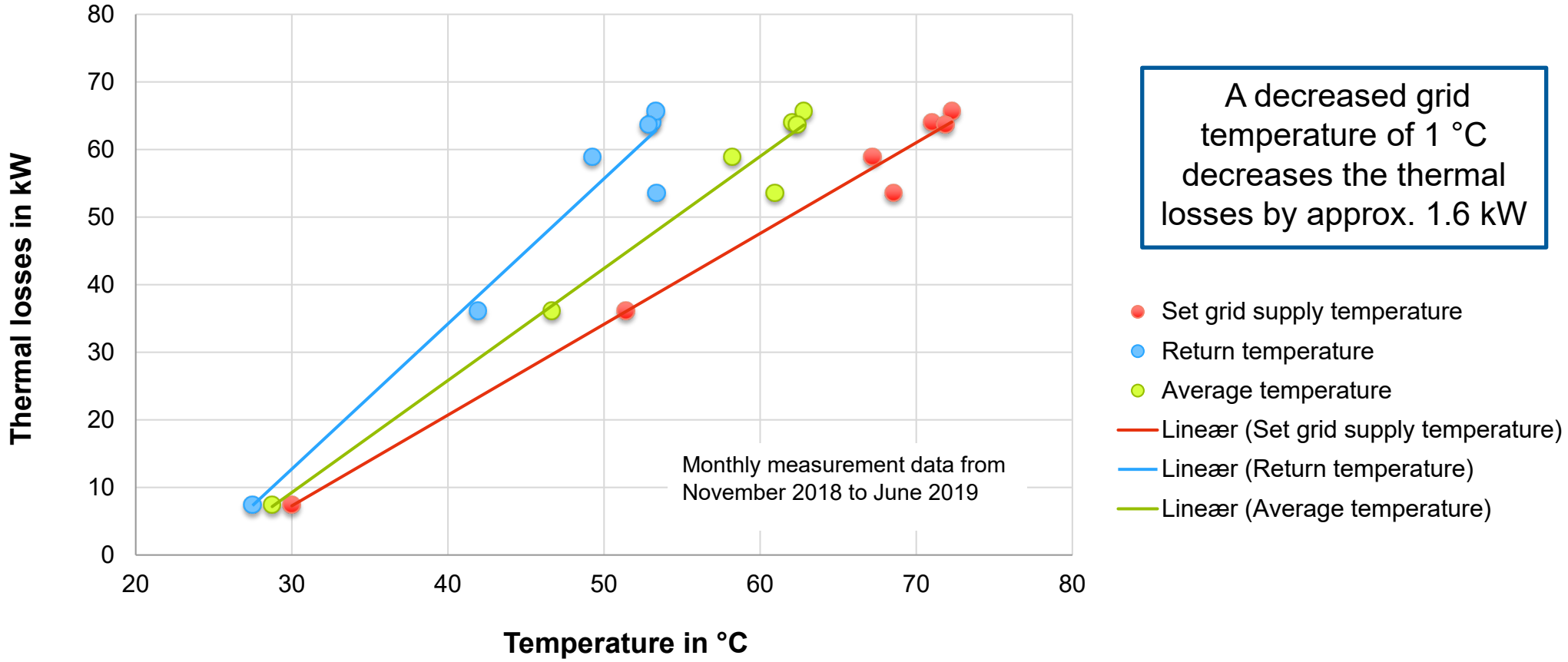
++	Directly achievable potential
+	General potential
o	No general potential
-	always comparative

Modules of system	Targets				
	Ecology (CO_2 emissions)	**Economy**	**Primary non-renewable energy** (PEF)	**Electric grid services**	**(Electrical) Self-sufficiency**
Flexible tariffs	+	+	+	+	-
Grid temperature	++	++	++	o	o
Solar thermal system	+	+	+	o	o
HP (central)	+	++	+	+	+
CHP	+	++	+	+	+
Boiler	o	o	-	-	o
Th. storage (central)	++	++	++	++	++
HP (decentralised)	++	++	++	+	+
Th. storages (decentralised)	++	++	++	+	+
DH substation (control)	+	+	+	o	o
Heating system	+	+	+	o	o

1) Identification of Optimisation Potentials

Reduction of thermal losses of the distribution grid

During operation the temperature is the main impact factor for the thermal losses of the distribution grid.



A decreased grid temperature of 1 °C decreases the thermal losses by approx. 1.6 kW

2) Analysis of Optimisation Potentials

Reduction of thermal losses of the distribution grid – supply temperature

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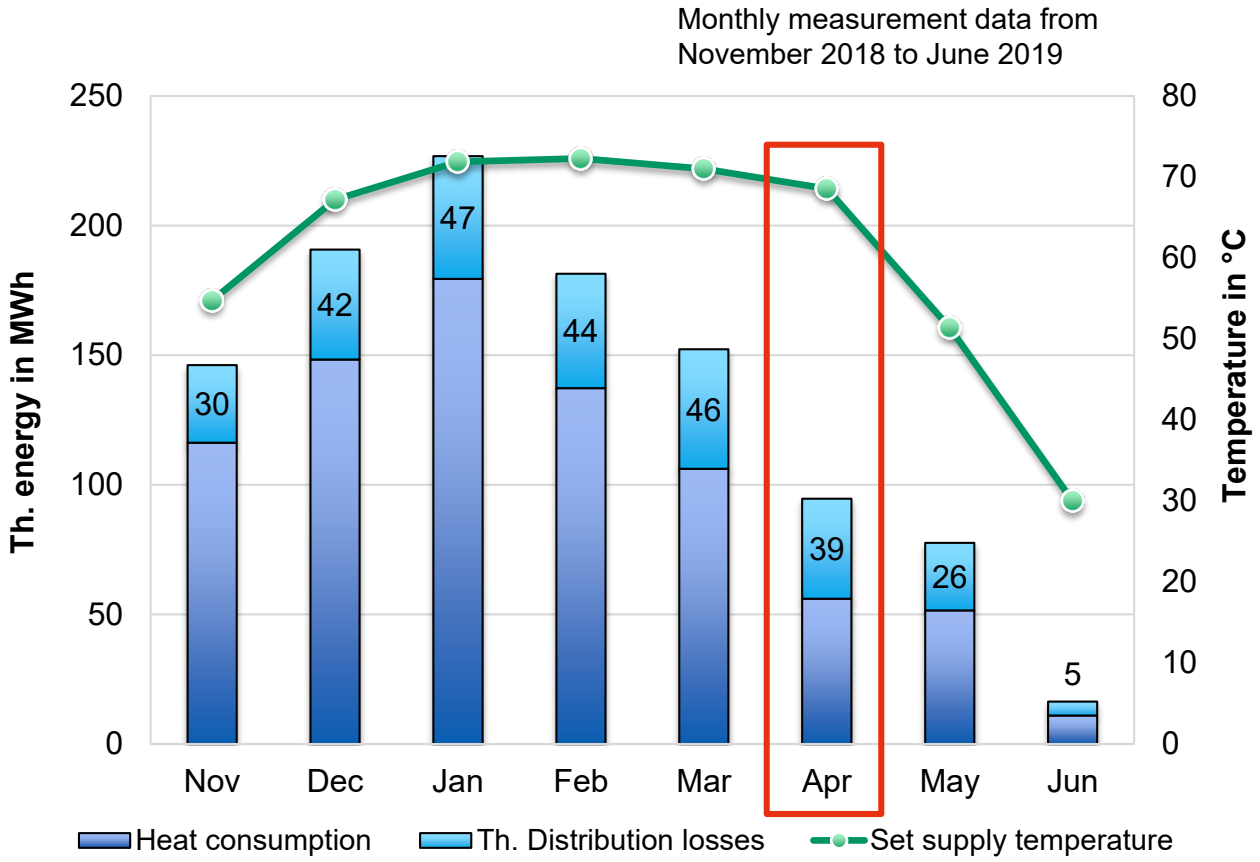
Impact factors on and constraints for the target supply temperature

- Ambient temperature
- Heat demand
- Construction and energy equipment of building stock
- Heat transfer unit

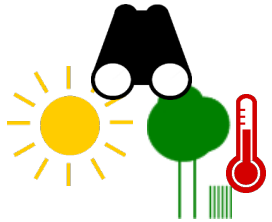
1) Adapt to temperature level of heat demand

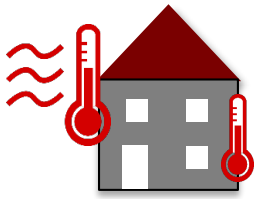
- Primary energy needed for central heat generation
- Coefficient of performance of decentralised HPs

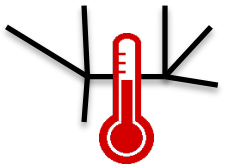


3) Development of Ideas for advantageous solutions

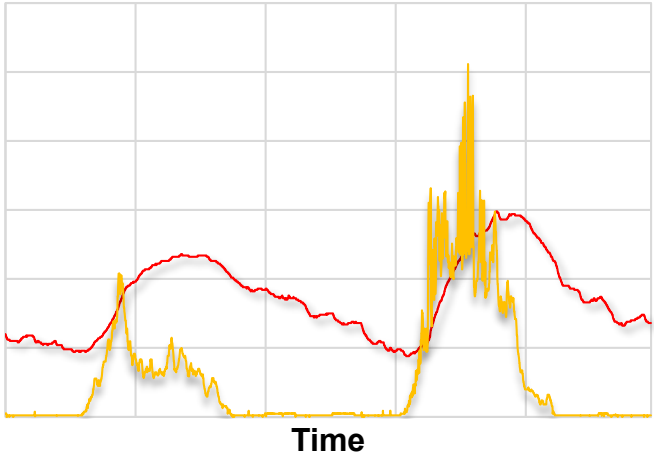
Automatised control of grid supply temperature

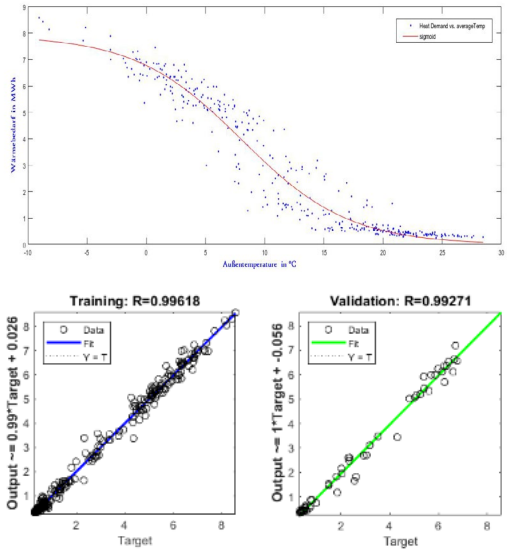


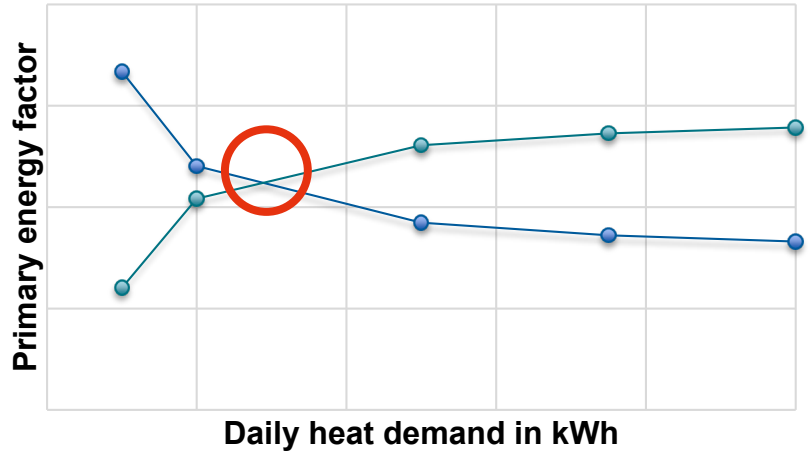




Weather forecast → **Prediction of heat demand** → **Determination of set supply temperature**







1) Identification of optimisation potentials

Identified potentials which will be addressed in future research

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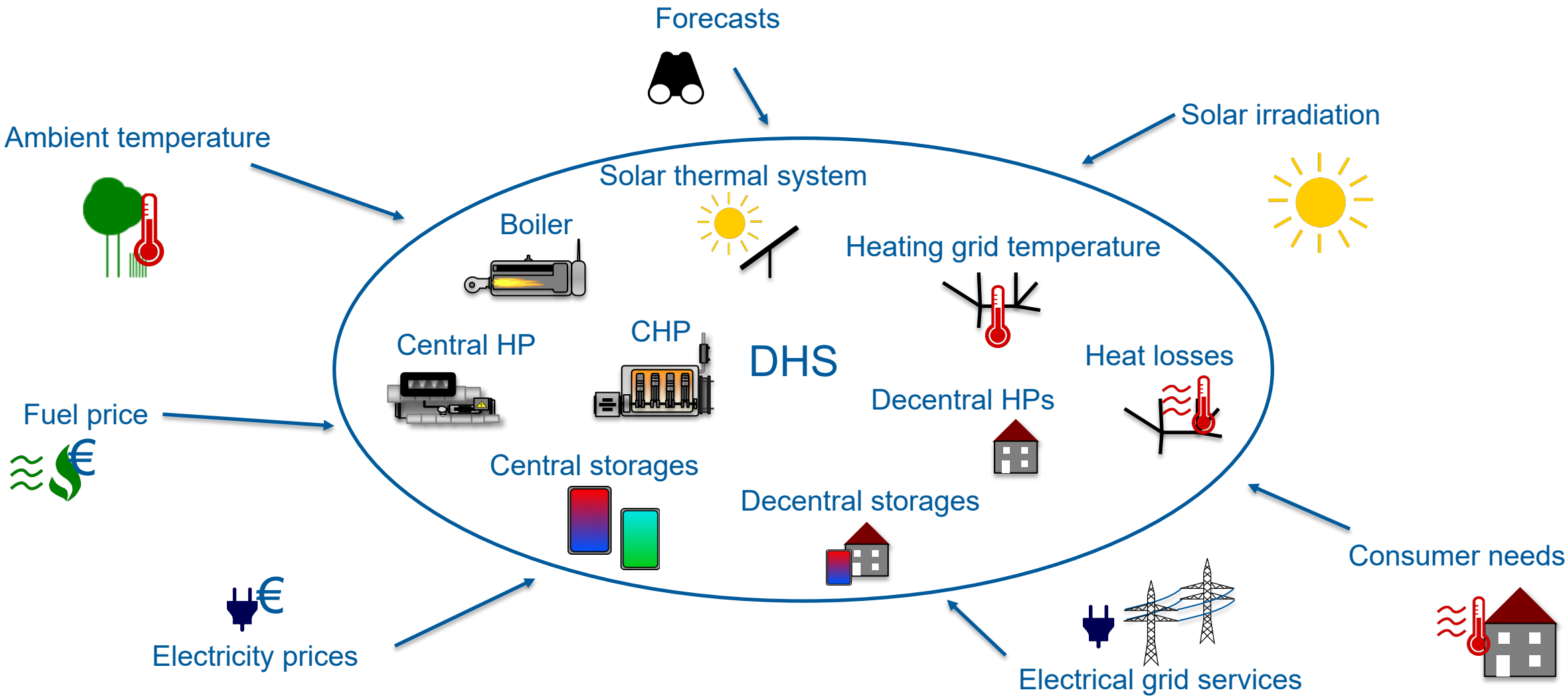
Conclusion and Outlook

Conclusion

- A new kind of installed DHS was presented.
- A method for development of improved control solutions was shown.
- The method was exemplary implemented.
- The presented control can be integrated to further automate and optimise the control of the DHS.
- The benefits need to be verified by simulation and by the implementation within the real system.

Conclusion and Outlook

Outlook



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