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Large-scale solar thermal and storage for district heating in Austria

Results of techno-economic evaluation and detailed simulation studies

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The urban district Heating extended project

- Share increase of renewable heat on existing district heating systems in Austria
- Integration of large solar thermal installation, absorption heat pumps, residual heat and large thermal heat storages

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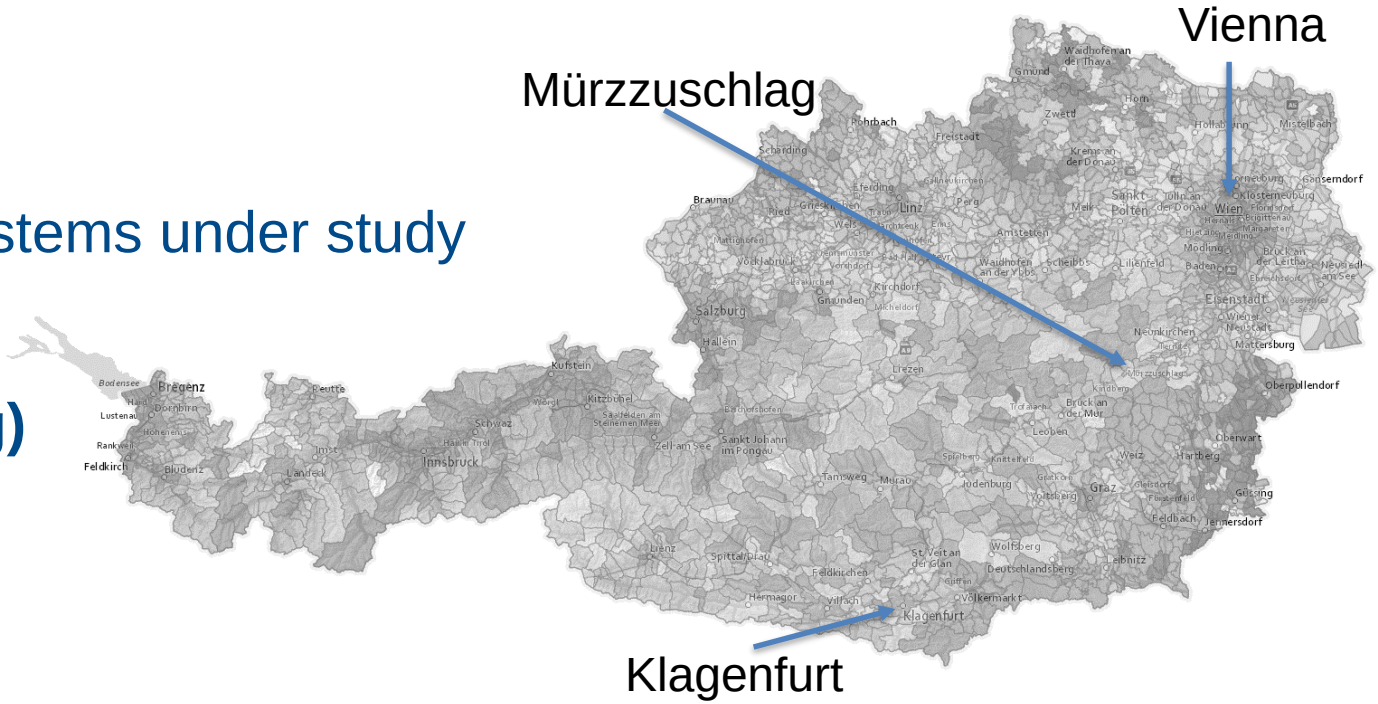
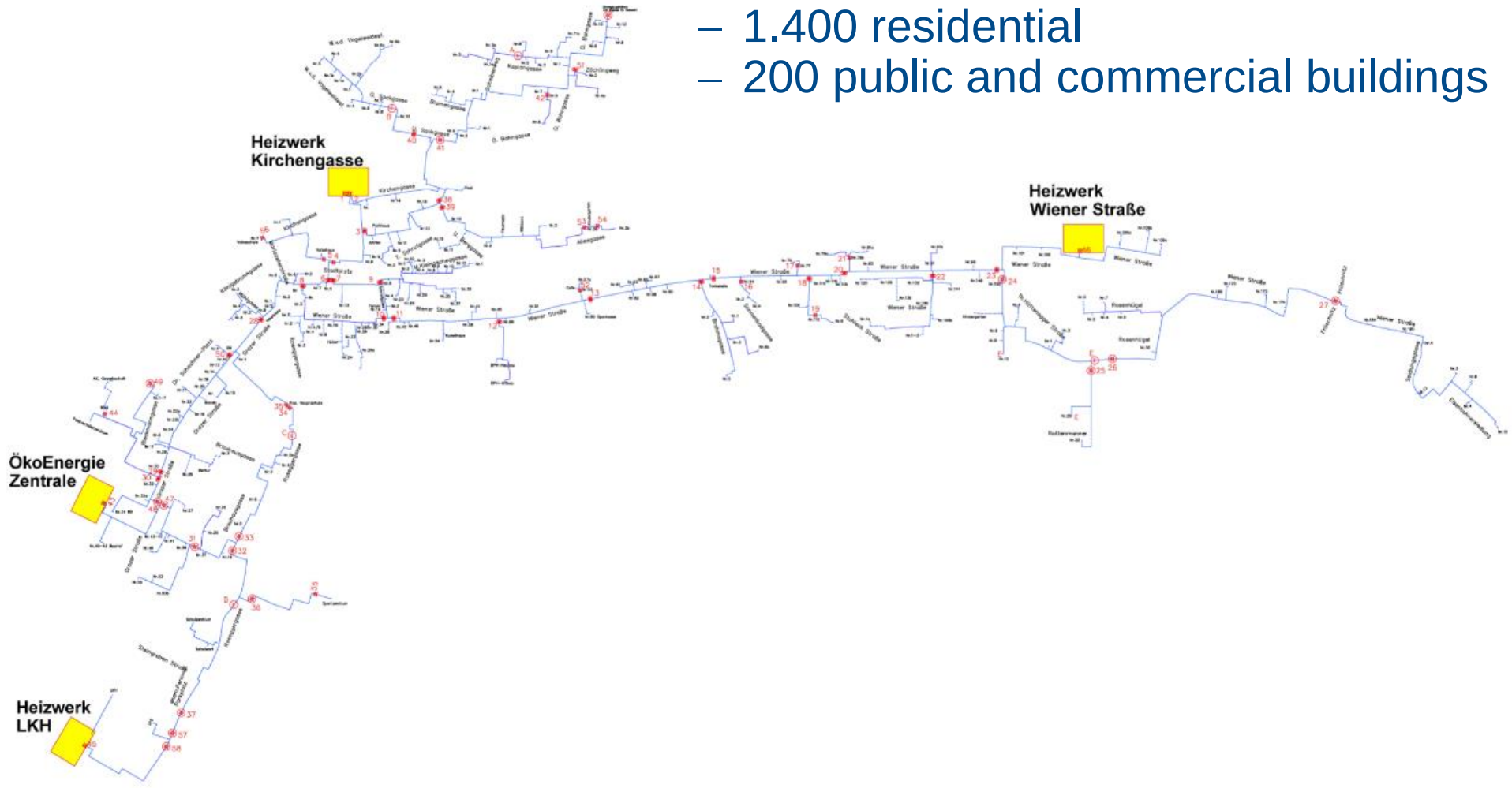
- Integration of large solar thermal installation, absorption heat pumps, residual heat and large thermal heat storages
- Three representative systems under study
  - Large (Wien)
  - Middle (Klagenfurt)
  - **Small (Mürzzuschlag)**



Mürzzuschlag key values

Around 1.600 customers
- 1.400 residential
- 200 public and commercial buildings



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Heat produced at 4 different locations

- 27,6 GWh/a total heat produced
  - 19,1 GWh/a Biomass
  - 8,5 GWh/a Gas
- supply temperatures between 75 and 85 °C
- return temperatures (at heating plants) between 50 and 70 °C

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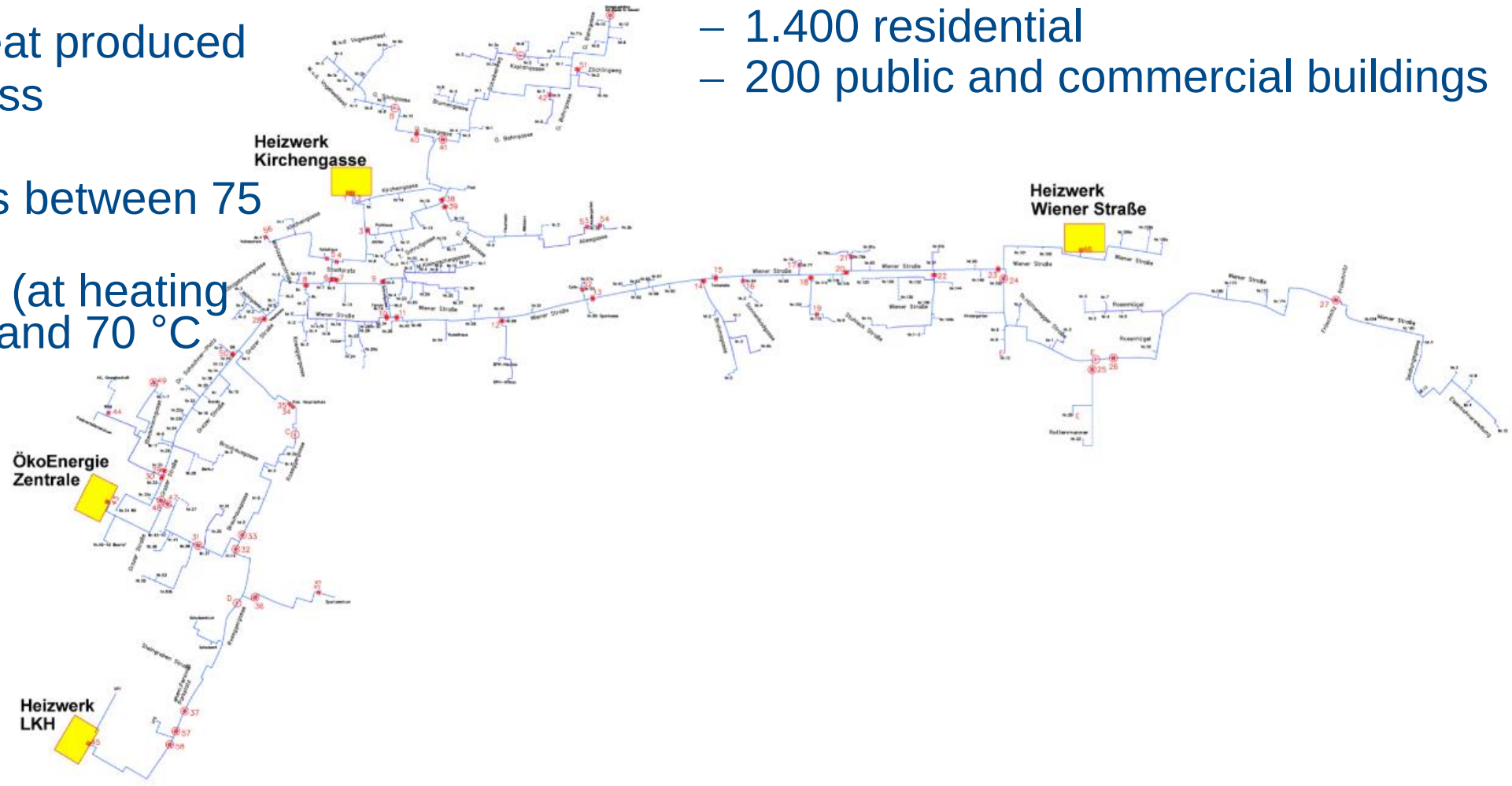

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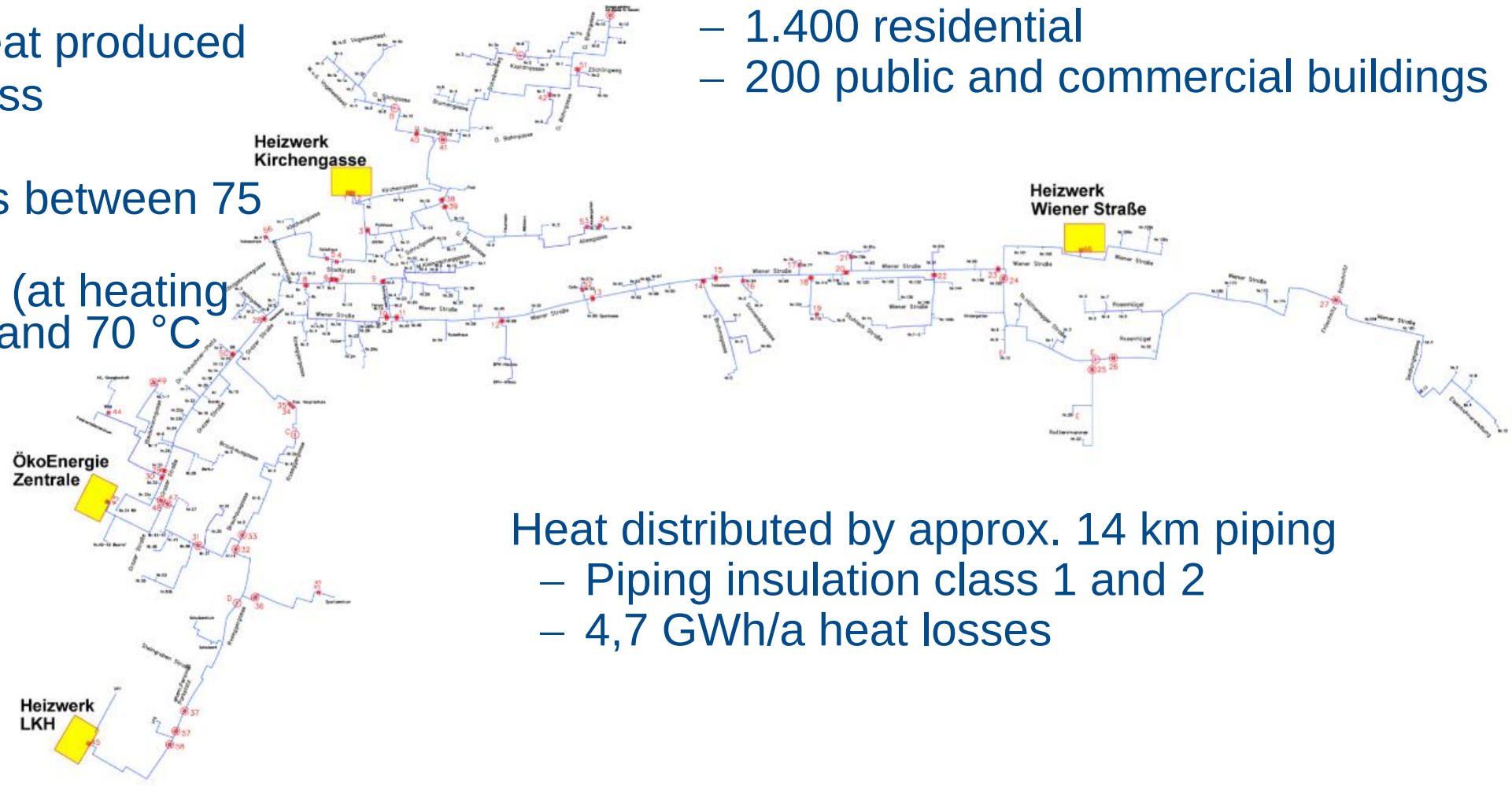

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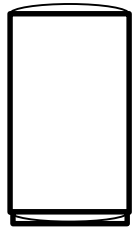
Heat distributed by approx. 14 km piping

- Piping insulation class 1 and 2
- 4,7 GWh/a heat losses

Reduction of gas consumption
Evaluated scenarios

- Integration of tank thermal energy storage (TTES). From 750 till 8.500 m^3



Reduction of gas consumption
Specific evaluated scenarios

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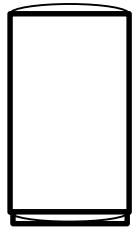
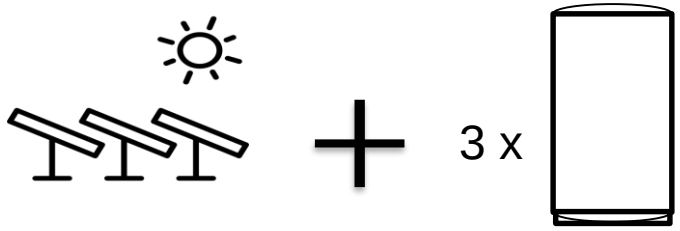


- Integration of small solar installation with TTES
  - 5.000 m^2 Solar inst. with 3 x 60 m^3 TTES



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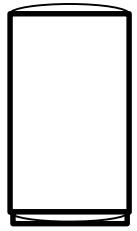

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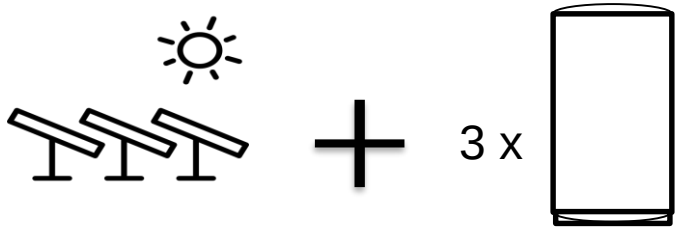
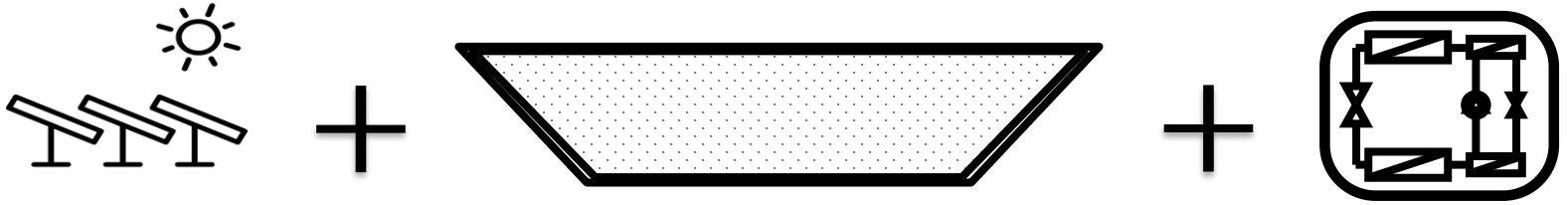


- Integration of larger solar installation with PTES (with / without AHP)
  - 10.000 m^2 solar inst. with 20.000 m^3 PTES (with 0,5 MW AHP)



Scenario challenges

- Limited transport capacity from solar installation location
  - DN 100 ≈ 15 kg/s ≈ 1.9 kW (dT = 30 K)
- No post heating possibility (no heating plant nearby)
- Interaction between biomass heating plants and solar installation
  - The biomass plant operated during the summer period (till mid July) requires to be operated at least at 25 % of its nominal capacity (500 kW)

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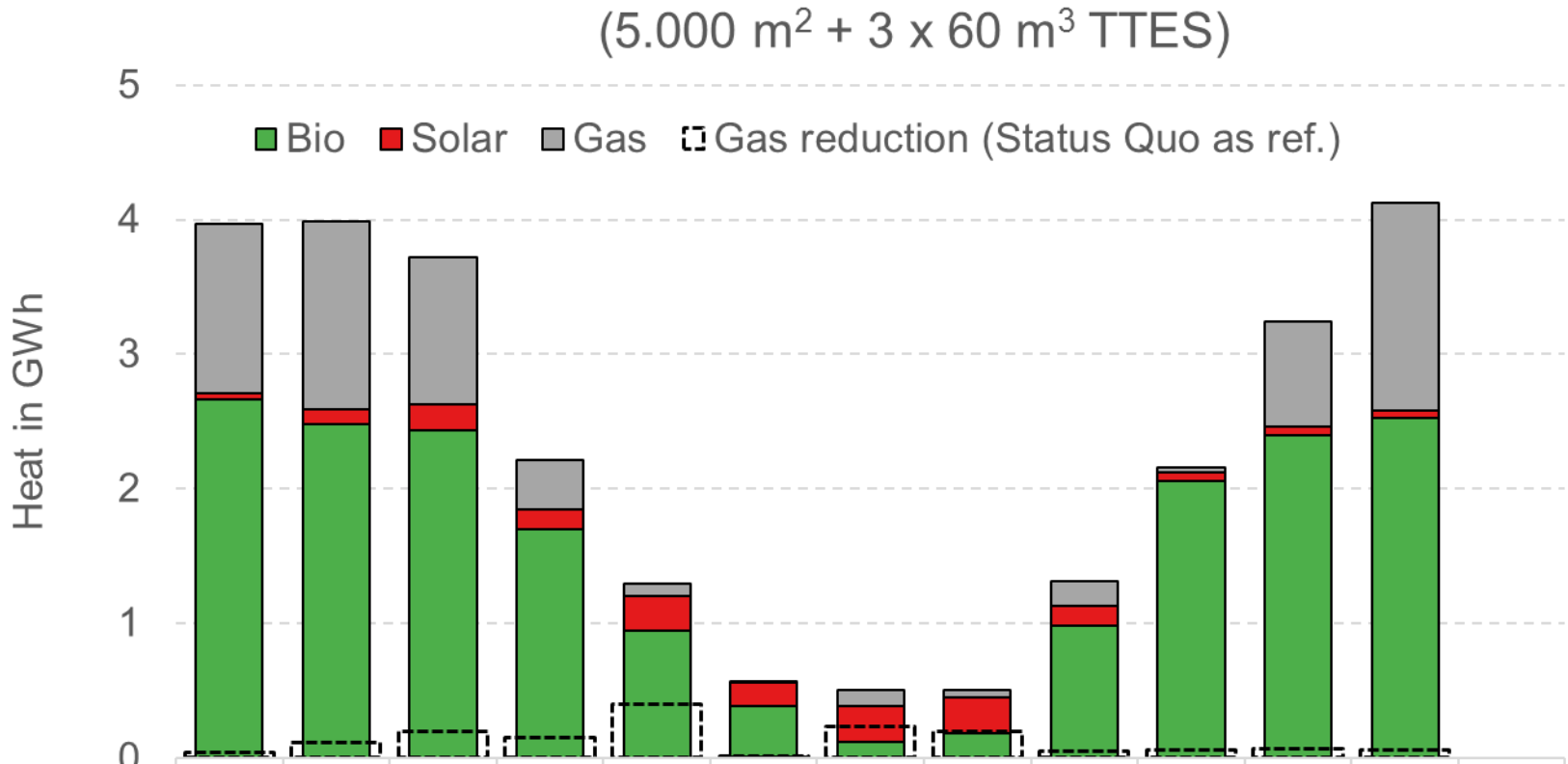
→ Accurate assessment of system performance by means of detail simulations in Dymola (Modelica)

Simulation results: monthly heat generation by source

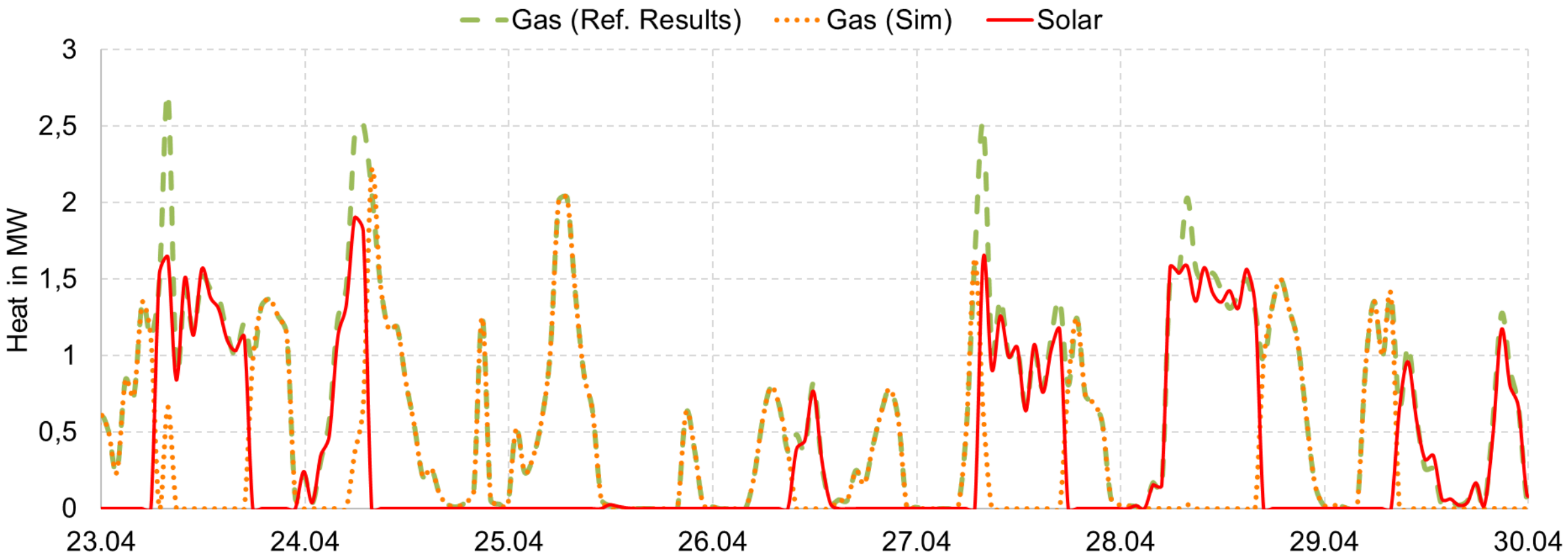
- 1,6 GWh/a gas reduction
  - Mainly in May, July & Aug
- 1,8 GWh/a solar heat
  - 360 kWh/m²
  - Relatively low because of priority of biomass heating plant
- 0,2 GWh/a less biomass production



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Gas	1,3	1,4	1,1	0,4	0,1	0,0	0,1	0,1	0,2	0,0	0,8	1,5	6,9
Solar	0,0	0,1	0,2	0,1	0,3	0,2	0,3	0,3	0,1	0,1	0,1	0,1	1,8
Bio	2,7	2,5	2,4	1,7	0,9	0,4	0,1	0,2	1,0	2,1	2,4	2,5	18,9
Gas reduction (Status Quo as ref.)	0,0	0,1	0,2	0,2	0,4	0,0	0,2	0,2	0,1	0,1	0,1	0,1	1,6

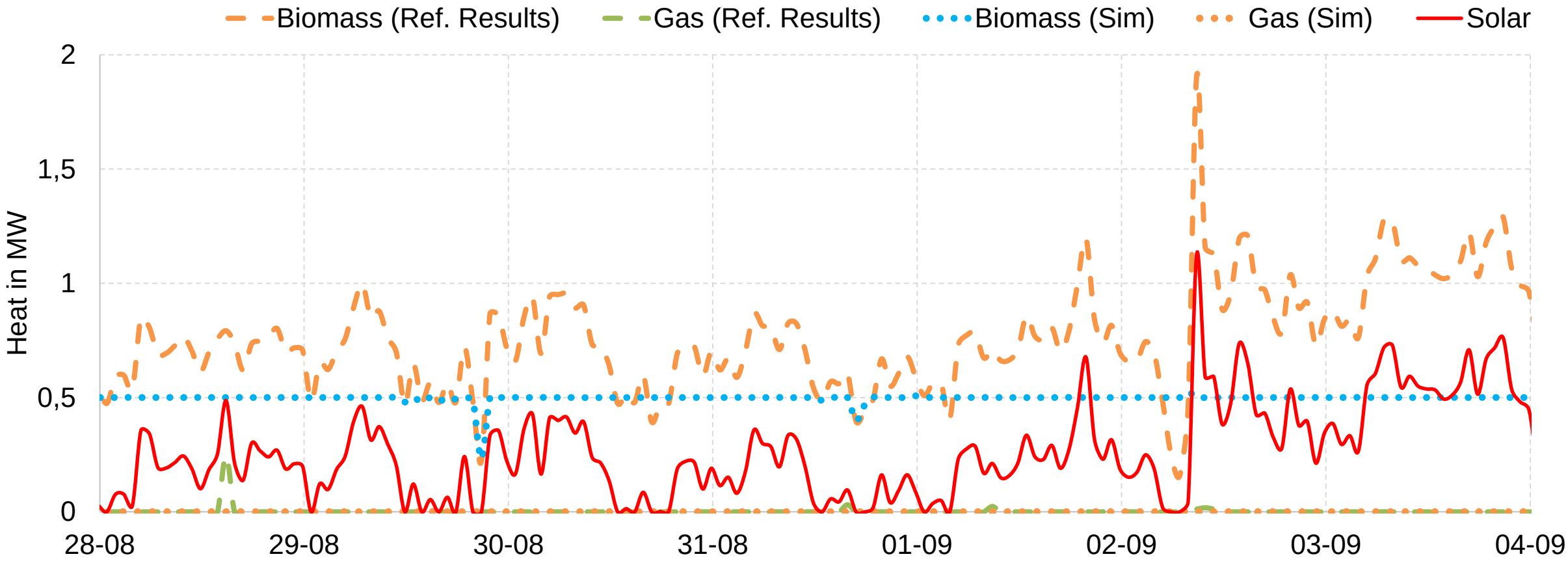
Solar heat usage

- Solar heat (red line) to contribute to cover heat demand peaks previously covered by gas (green dashed line). Gas consumption reduced (orange dotted line)



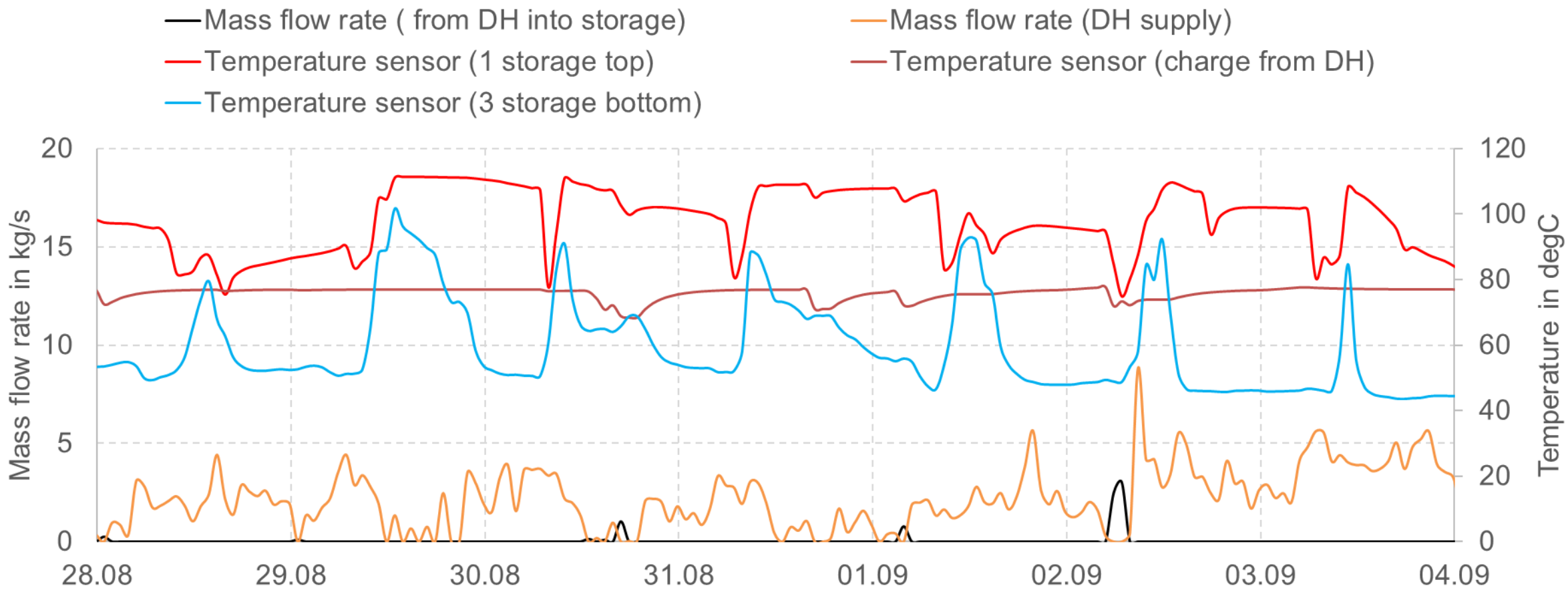
Biomass heating plant operation

- Smoother operation of biomass power plant
- TTES to help biomass heating plant to operate above minimal heating power improved (see blue doted line above orange dashed line)



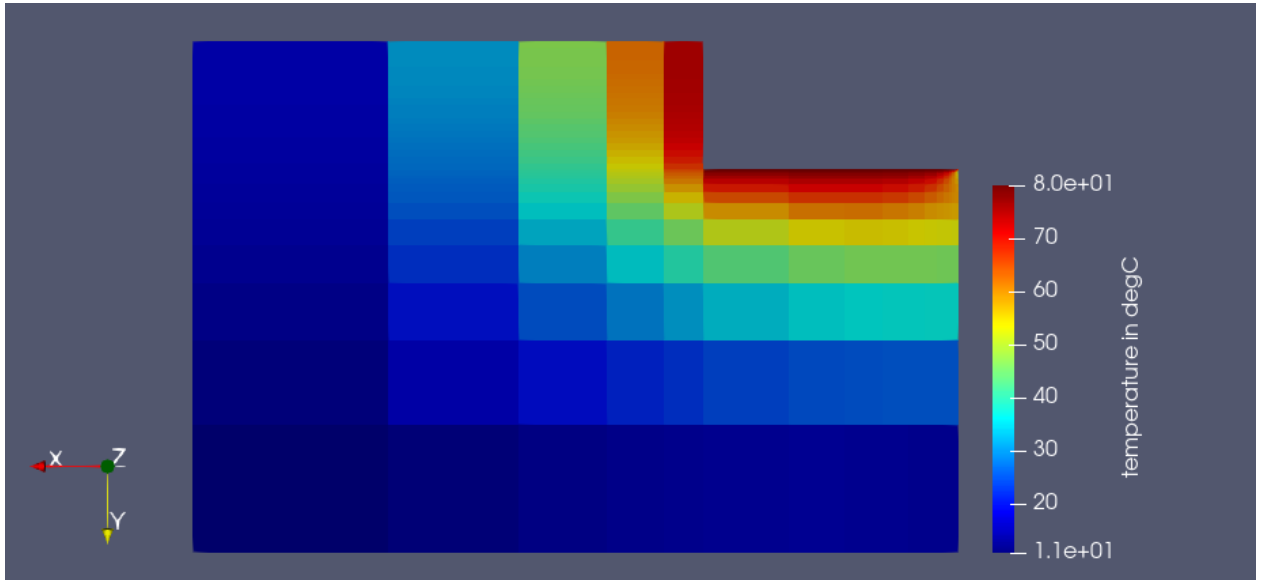
Temperatures and mass flow rate at the storages

- Mass flow rate from DH can be only charge at the top of the 1/hot storage
  → Charge storage tank from DH with lower temperature at the top

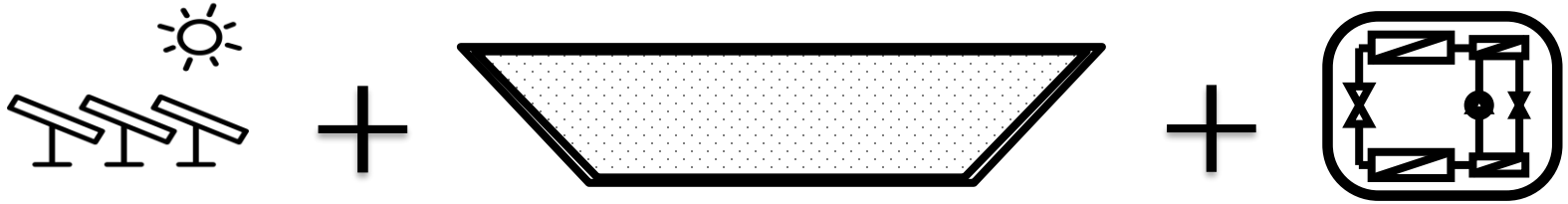


Next steps

- Finish implementation of soil model in Modelica



- Carry out detail simulations for extended scenario
  - 10.000 m² solar inst. with 20.000 m³ PTES and 0,5 MW AHP



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IDEA TO ACTION

This project has been funded in scope of the Austrian „Stadt der Zukunft, 3. Ausschreibung“ Research program, project no. 854666.

Bundesministerium Verkehr, Innovation und Technologie

FFG

STADT der Zukunft

STW Stadtwerke Klagenfurt

Stadtwerke MÜRZZUSCHLAG GMBH

WIEN ENERGIE

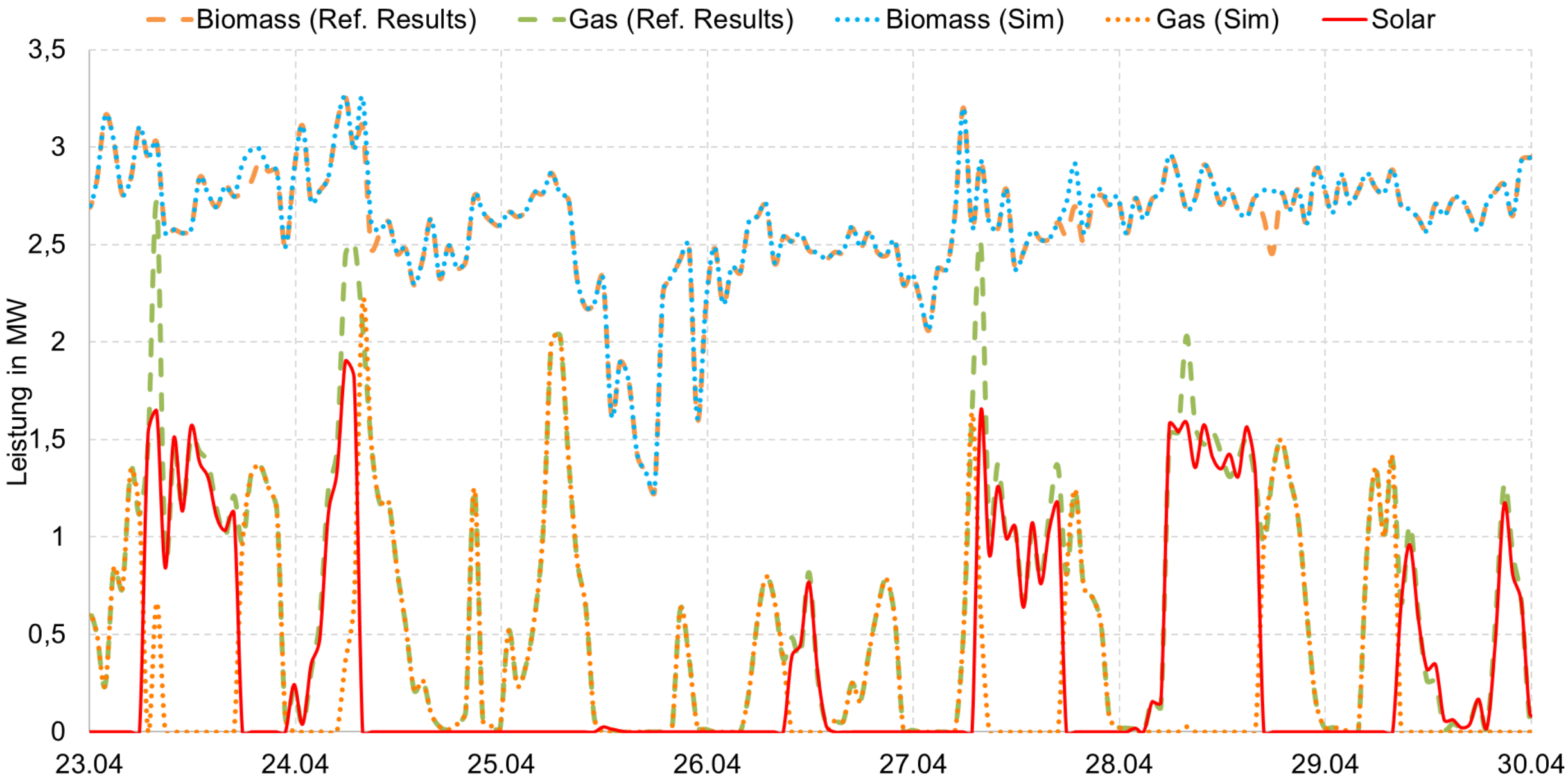
AEE INTEC

PlanEnergi

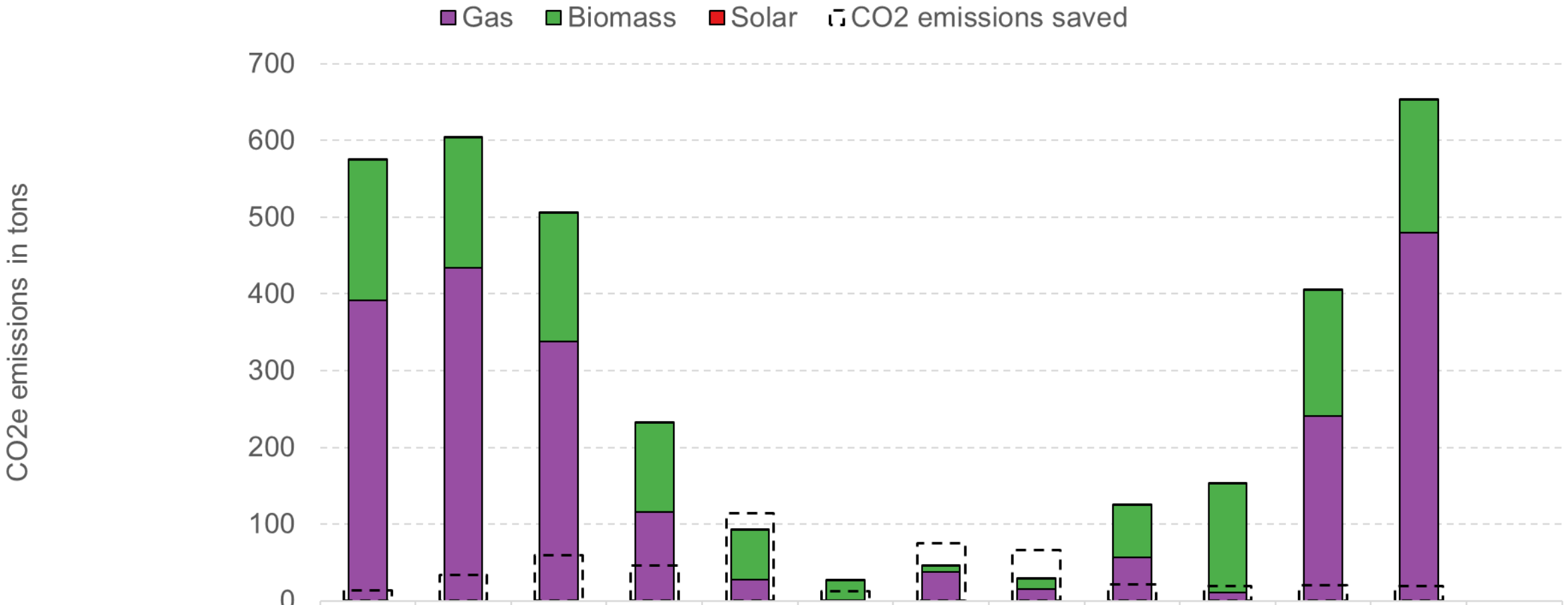
TU Graz Graz University of Technology

SOLID solarinstallation+design

Results April week including biomass



Emissions of CO2e



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Solar	0,3	0,7	1,1	0,7	0,9	0,6	1,0	1,0	0,7	0,4	0,4	0,3	8,0
Biomass	182,9	170,3	167,4	116,7	64,9	26,2	8,3	12,6	67,4	141,4	164,3	173,5	1.296,0
Gas	391,3	433,6	338,4	115,5	27,9	0,4	37,1	15,8	57,1	10,8	241,0	479,7	2.148,6
CO2 emissions saved	13,4	33,7	59,4	46,0	114,5	12,3	75,5	65,5	21,8	19,0	20,1	19,2	500,4

Results prefeasibility studies (incl. CO2 tax)