Reducing local energy system CO_2 emissions

by exploiting differences in district heating and electricity CO_2 intensity in a local energy market

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1. About the FED demonstrator and the local energy market
2. Preliminary analysis of the savings potential
3. Tentative evaluation results

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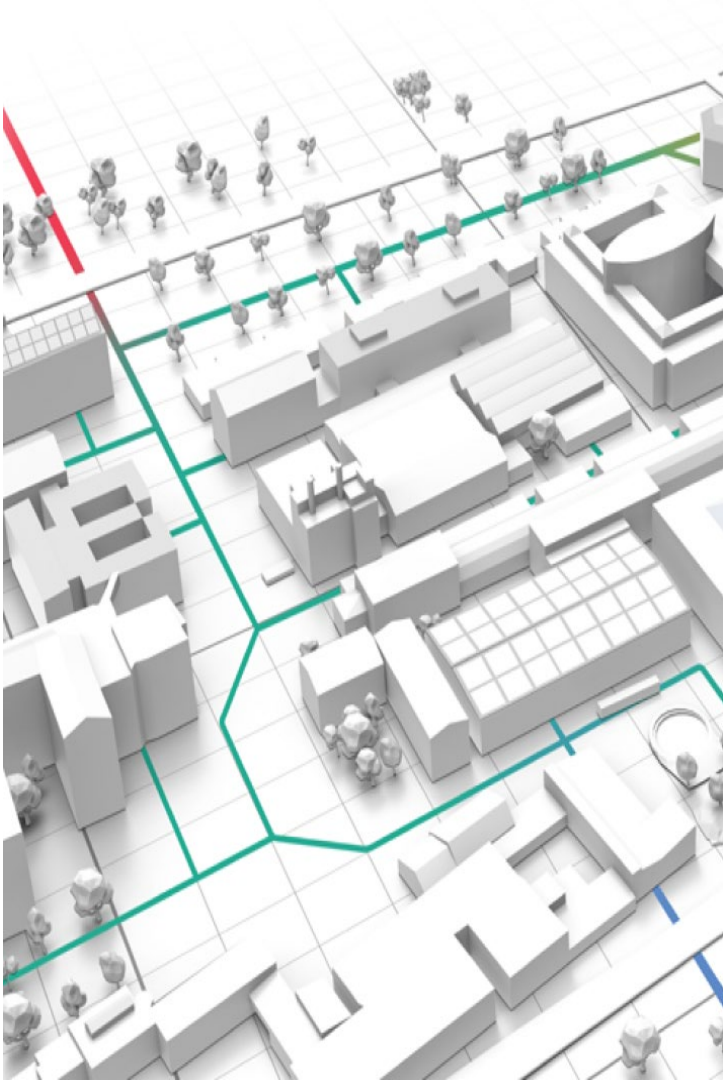
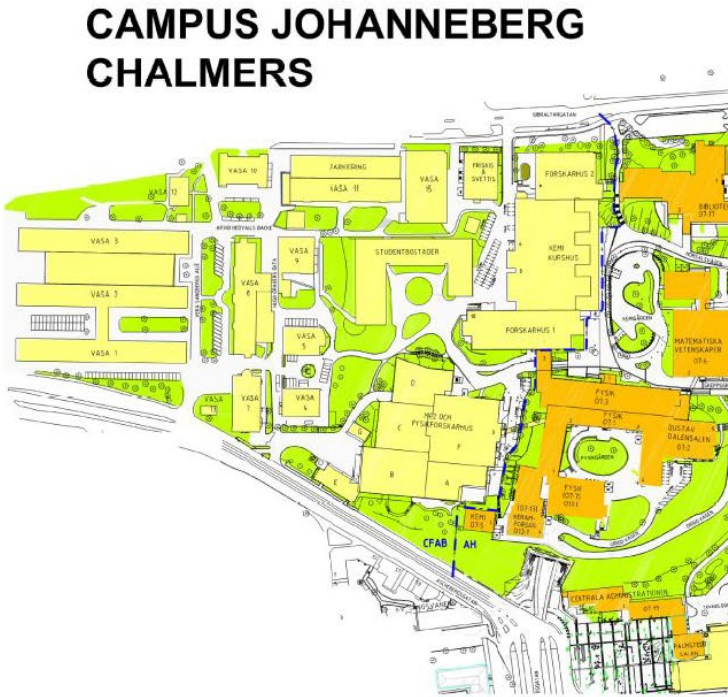
The FED Project

- A demonstrator funded by the UIA
- Demonstrating an integrated local energy market
- Focusing on reducing CO_2 and primary energy use on Chalmers University's campus in Gothenburg
- New investments, local energy market, evaluation



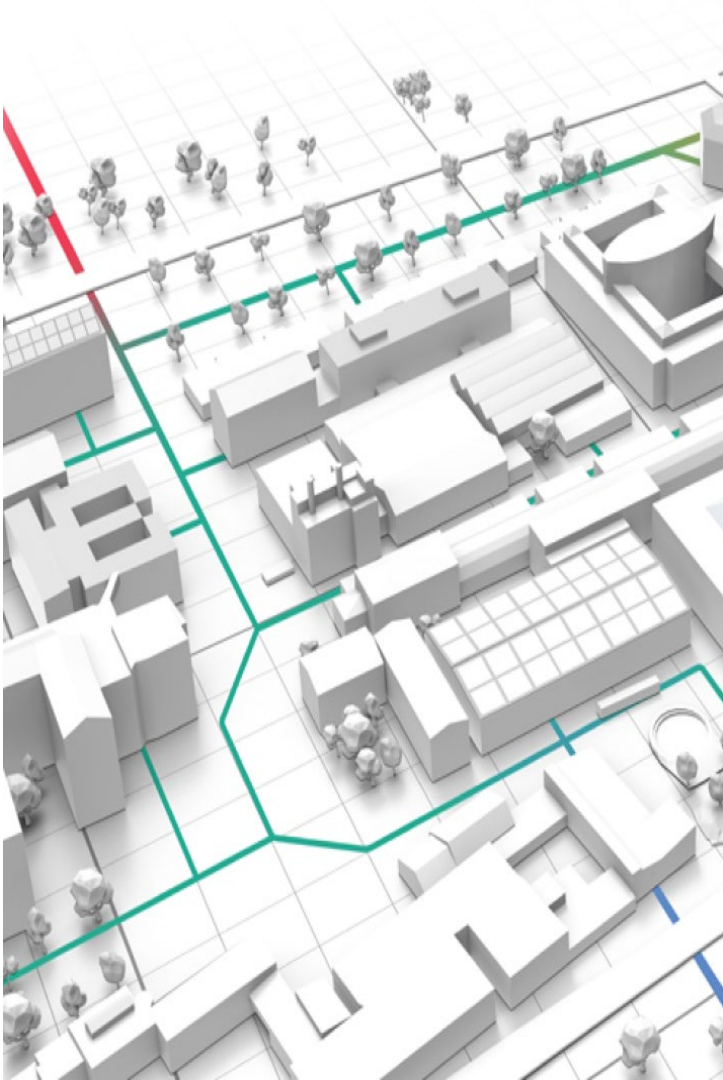
The Chalmers campus area

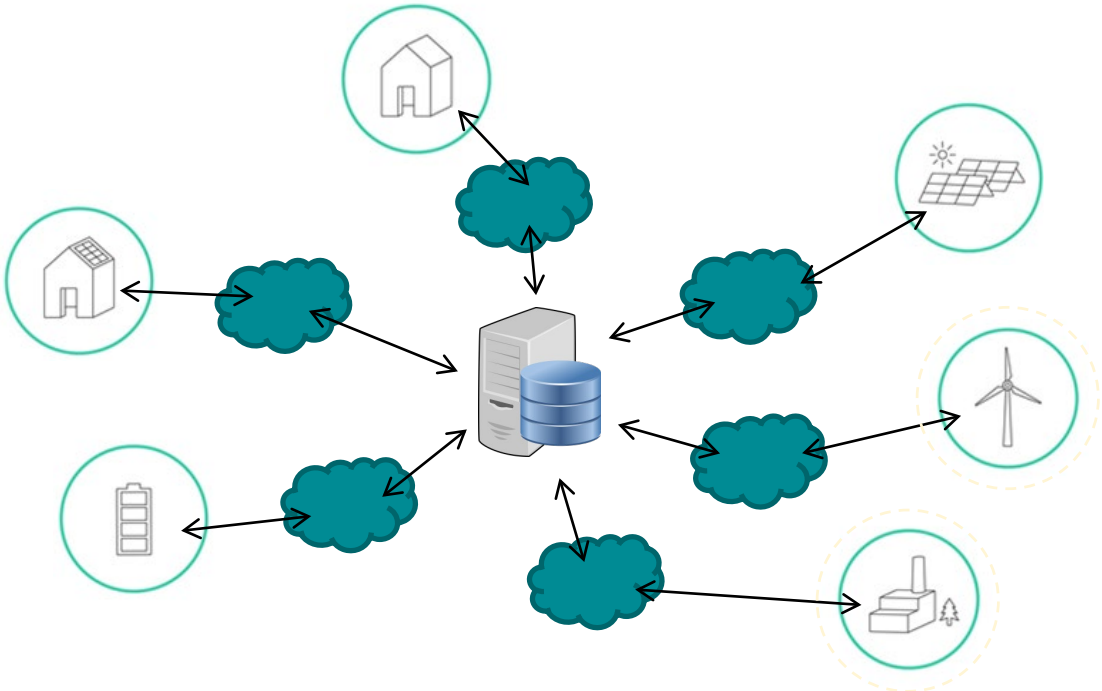
- Chalmers Campus has a district heating and a district cooling grid
- Several production units before the start of the project (biomass boiler,CHP, solar PV, heat pumps, cooling machines, absorption cooling)
- Power grid where Swedish Energy Markets Inspectorate concessions (permits) do not apply (private area)
- New investments in storage of electricity and cooling, more solar PV, connection of cooling production to the municipal cooling grid and active building control



The local energy market

- Energy demand and supply matching function.
- Integrating different energy carriers (heating, cooling, electricity).
- Defines prices and transactions.
- Energy market and system service market
- Hourly market settlement
- All producers and consumers represented by software agents, bidding to the market





Preliminary analysis of potential savings

Research question

- What is the impact on local CO_2 emissions and primary energy use by just resdispatching the existing system through optimization to minimize cost or CO_2 (taking into account the production in the outside grid)?

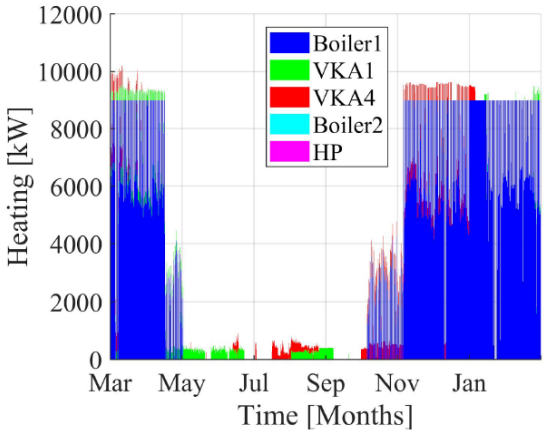
Methodology/Analysis

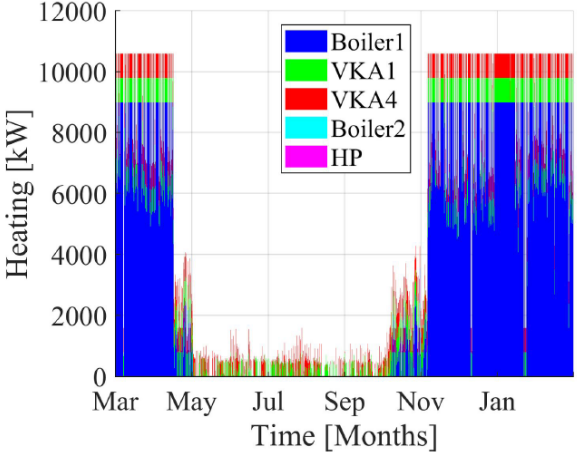
- Optimization based investment analysis with a holistic integrated view of the local energy system

- Optimisation based redispatching of local generation units to establish the potential reductions possible in terms of costs and emissions

Redispatching

- Cost optimization reduces CO_2 emissions
- Largely an effect of increasing exports during high demand periods
- Dispatching heat pumps to hedge differences in electricity and heating prices





Redispatching

- By redispatching the existing units a total reduction in CO_2 emissions is possible
  - 22 % total reduction in emissions through cost optimization
  - 3 % reduced operating costs
  - 30 % emissions reductions possible, at 41 % increase in operation cost

Tentative evaluation results

Tentative results from live evaluation (PR3)

- 12 % decrease in primary energy
- 23 % decrease in imported CO_2 emissions
- 107 280 transactions made in the market place

Thank you!

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To learn more about FED, visit:
www.johannebergsciencepark.com/en/projects/fed-fossil-free-energy-districts

Investments made

Investment options	Capacity
Boiler 2	6000 kW
Turbine	800 kW
Cooling to MC2	YES
TES	285m3
BITES	14.9 MWh [5 Buildings]
Building Advanced Control (BAC)	[5 Buildings]
PV	800 kW
BES	320 kWh

Results if minimizing CO_2

Change in	CO_2 factor from waste heat is 98 g/kWh; with TES	CO_2 factor from waste heat is 0 g/kWh; with TES	CO_2 factor from waste heat is 98 g/kW; without TES	CO_2 factor from waste heat is 0 g/kWh; without TES
Total PE	22.8%	22.7%	22.5%	22.5%
Total CO_2	-91.3%	-61.2%	-89.2%	-59.6%
Peak CO_2	-48.1%	33.4%	-34.5%	-47.5%
Operation cost	-3.6%	3.3%	-3.3%	3.4%
Total investment cost	69.6 MSEK	69.6 MSEK	63.3 MSEK	63.3 MSEK