THE FUTURE OF COGENERATION

Future-proof business models for cogeneration

Igor Petryk
Market Development Director
Wärtsilä Energy, Europe

Prepared for the future?

2007
E.On decides to build two CCGT blocks in Bavaria

2011
Inauguration

2015
Decision to close

Irsching Power Plant, Bavaria

Highest efficiency did not help. Why?

60.75% *(net)*

…the plant demonstrates that climate protection, low-cost power generation, and flexible operation using fossil fuels can be attained simultaneously.”

l Group
N_SE_en

hic prospects: Owners of the #Irsching 4 and 5 gas-fired power stations announce their closure

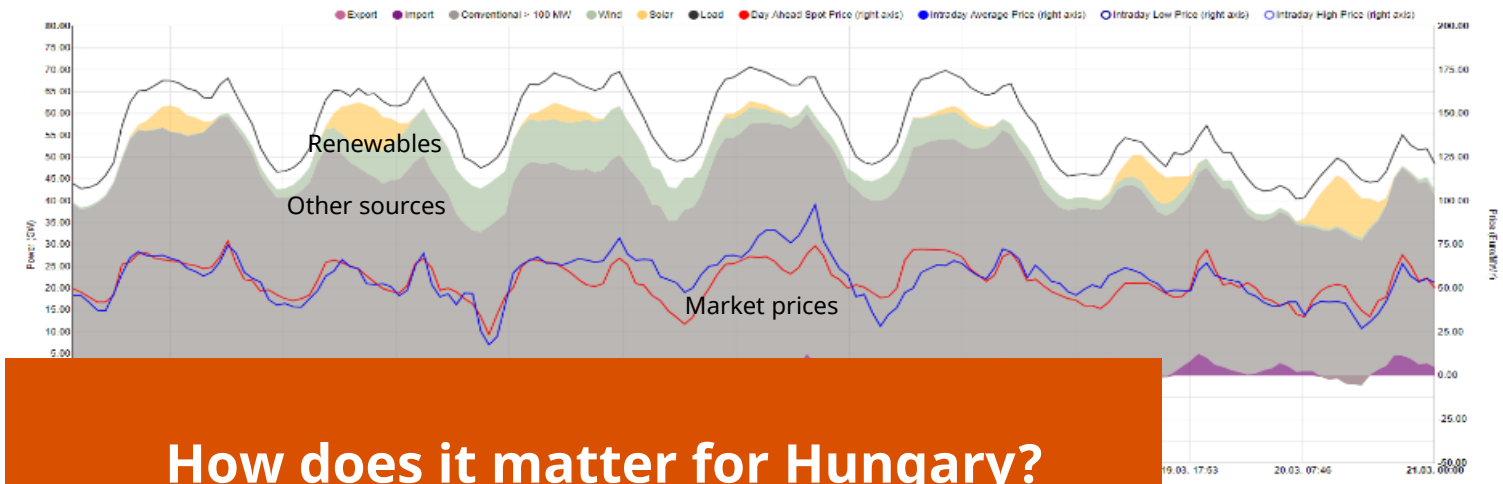
eon.com
Press releases: Our media room for latest news | E.ON

12:04 PM · Mar 30, 2015

This is what happened

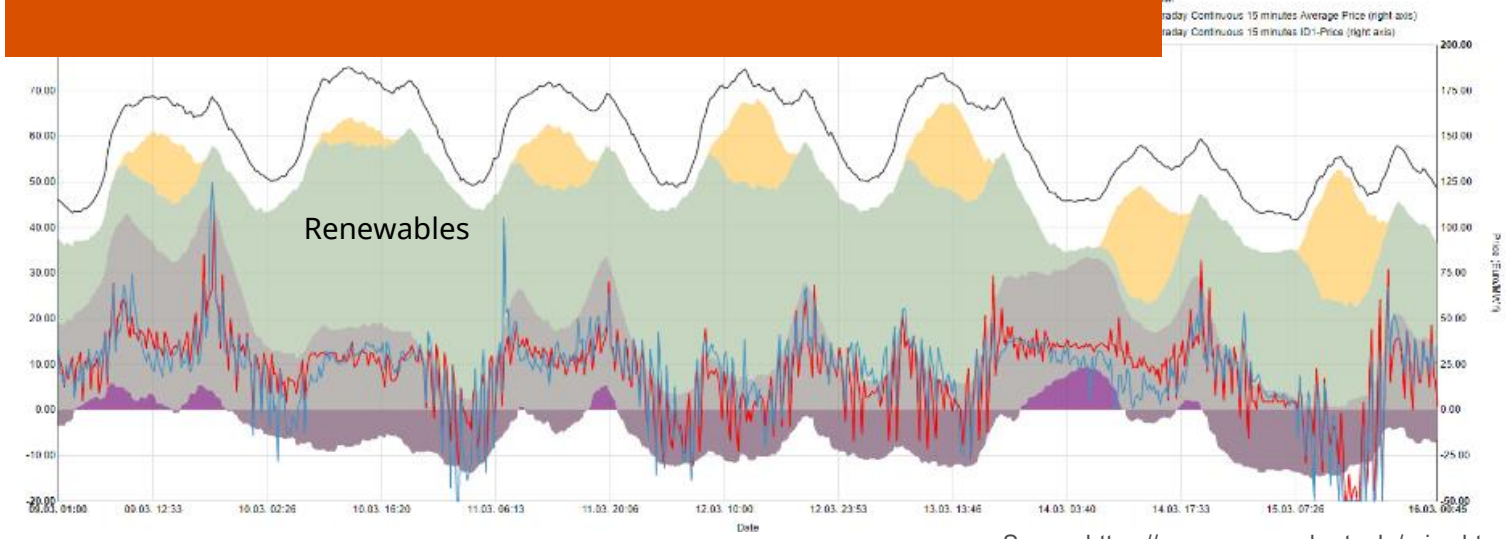
2011
Week 11

Germany: generation, import/export, prices



How does it matter for Hungary?

2020
Week 11



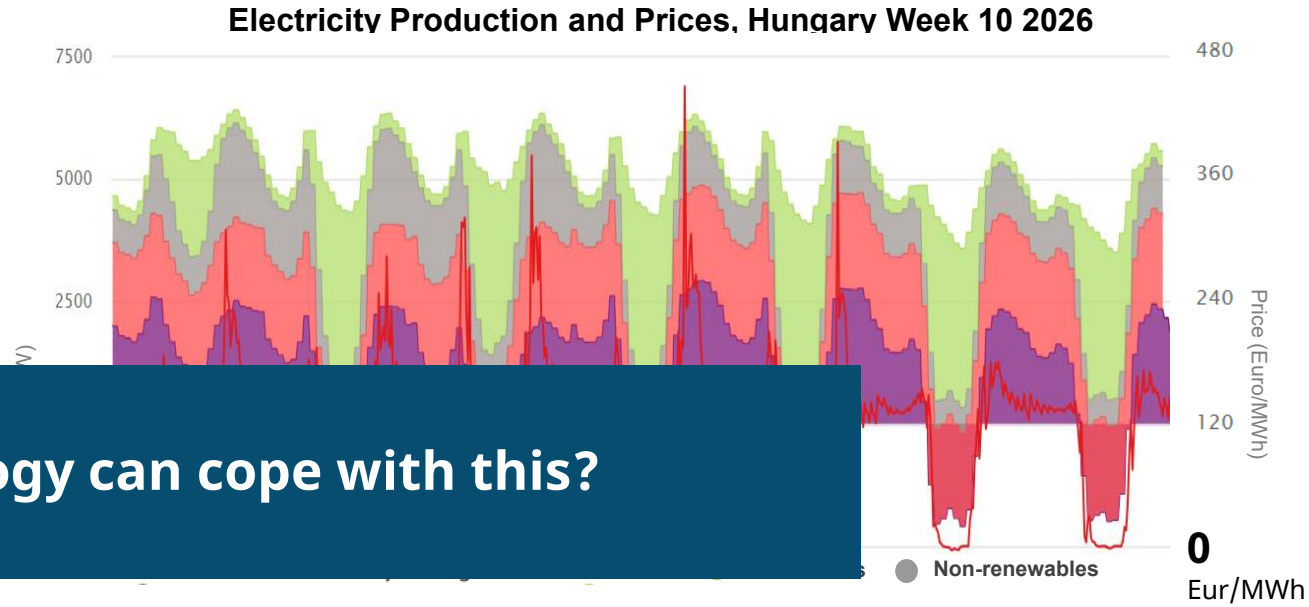
Source:https://www.energy-charts.de/price.htm

Hungary: a challenge for CHP plants

When the share of renewables grows

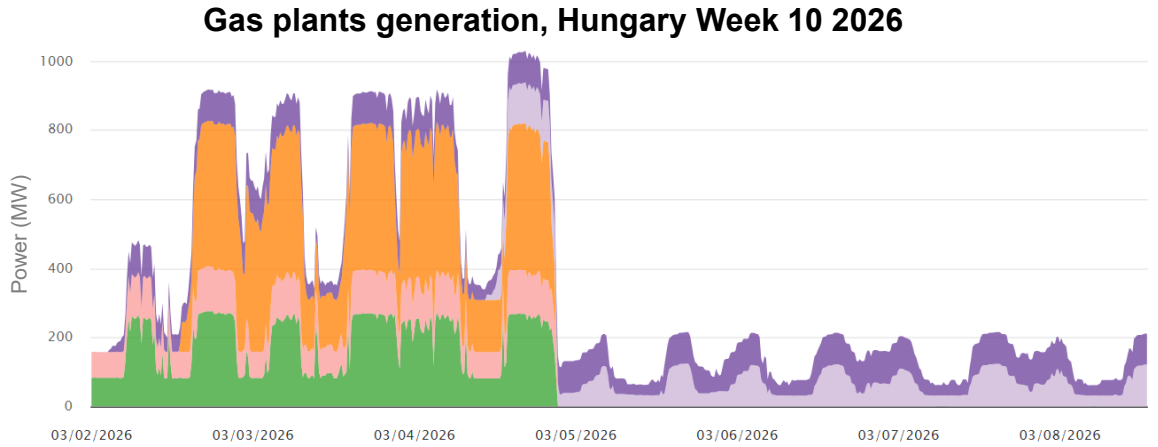
- Prices fluctuate with renewables' output

So, what gas technology can cope with this?



- Gas CHP plants are forced to cycling
- They need to start 1..3 times every day or they are out of operation

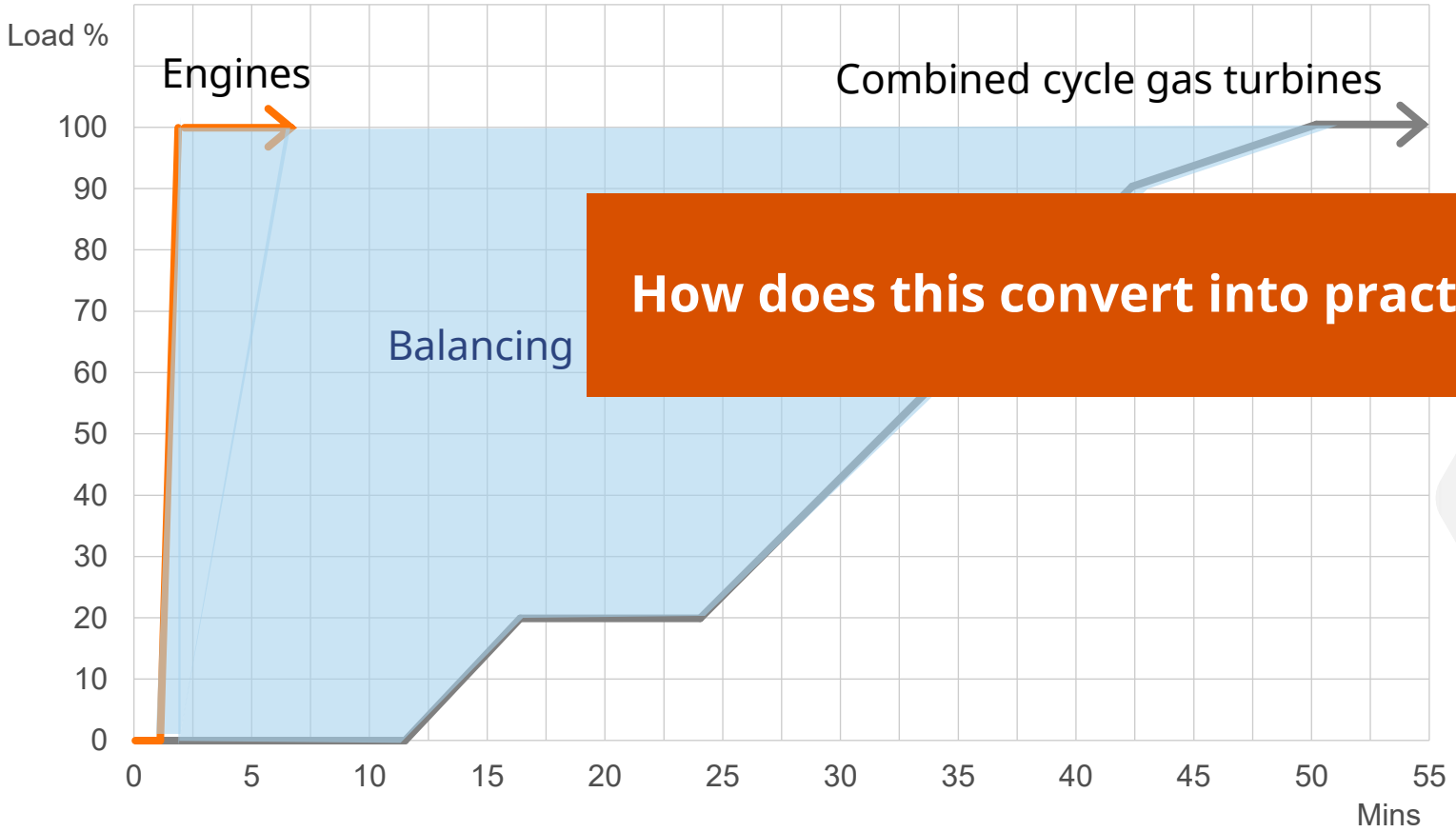
BASE LOAD is no longer a viable mode



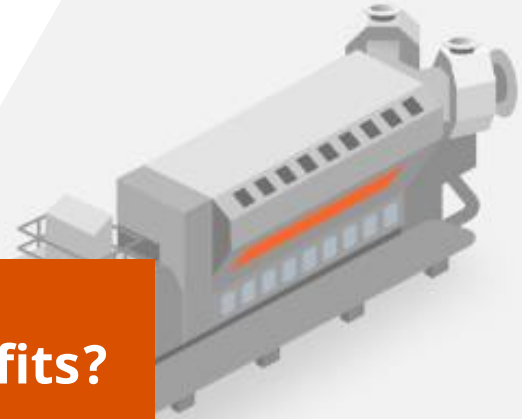
Source: Fraunhofer ISE https://energy-charts.info

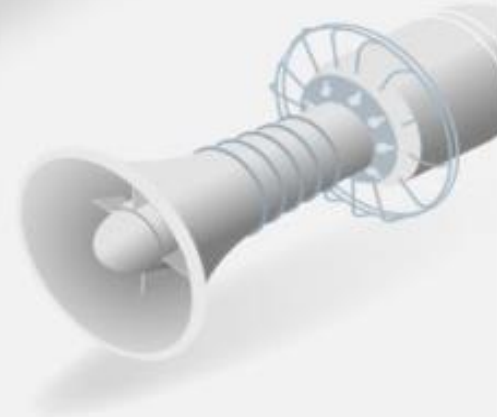
Flexibility of different technologies

Start-up time



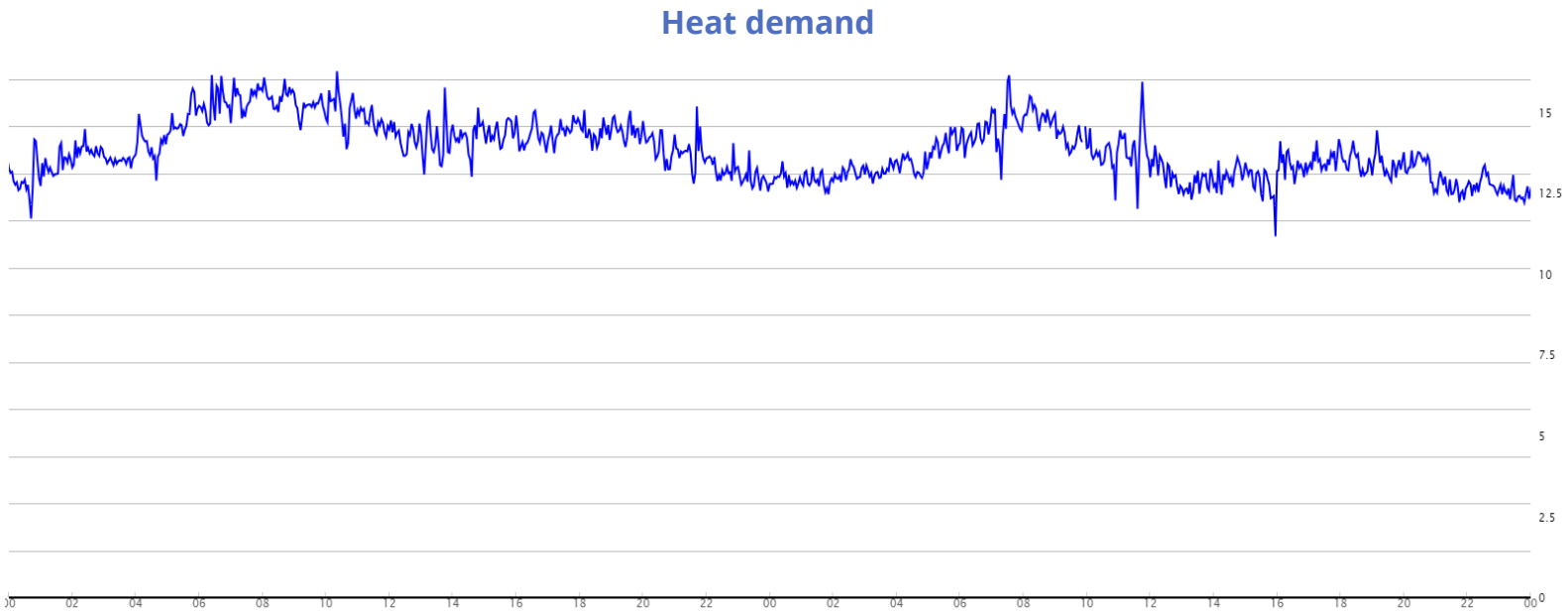
How does this convert into practical benefits?





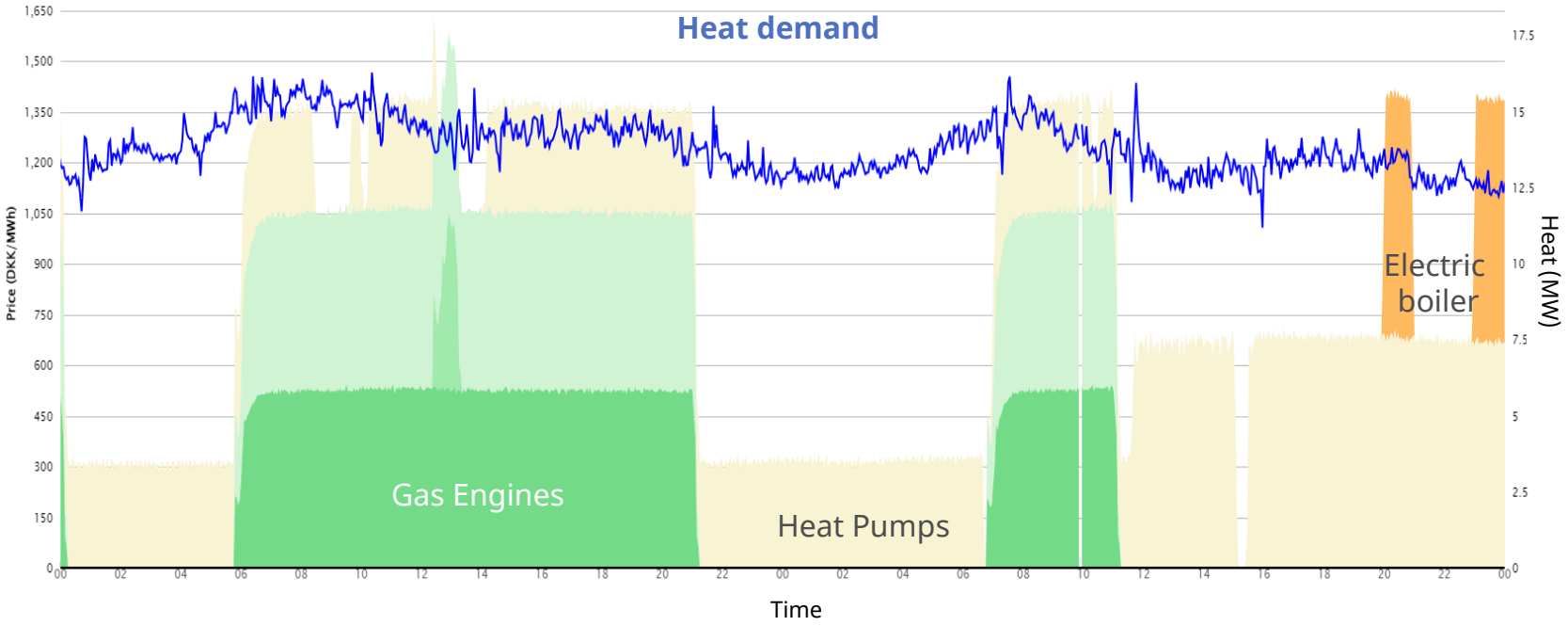
Case:
District heating in Denmark

Skagen district heating, two days in February



http://www.energyweb.dk/skagen/?english&history

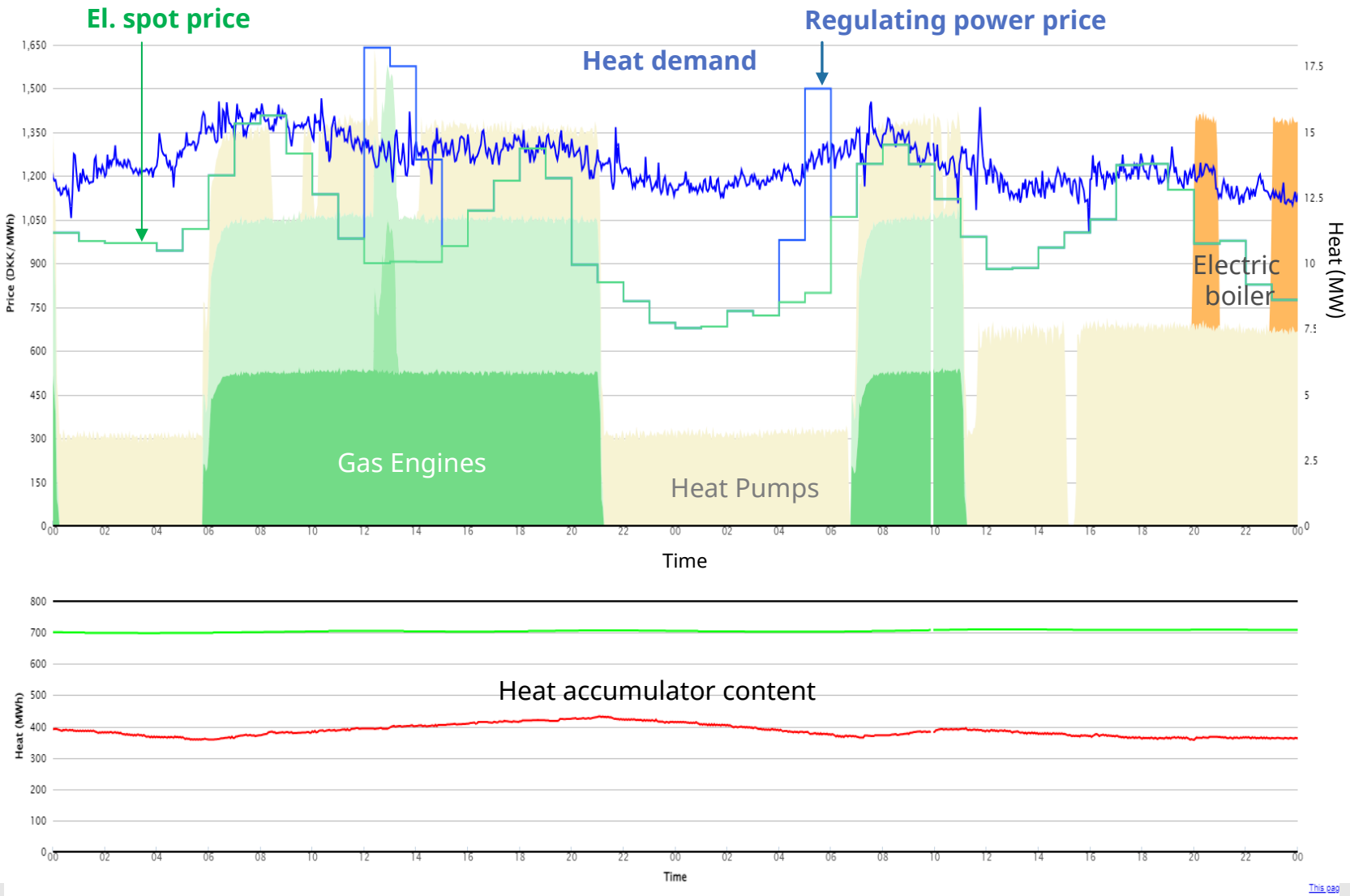
Skagen district heating, two days in February



Main sources of heat: CHP gas engines, Heat Pumps, Electric Boiler

Why is heat dispatched in pulses?

Skagen district heating, two days in February

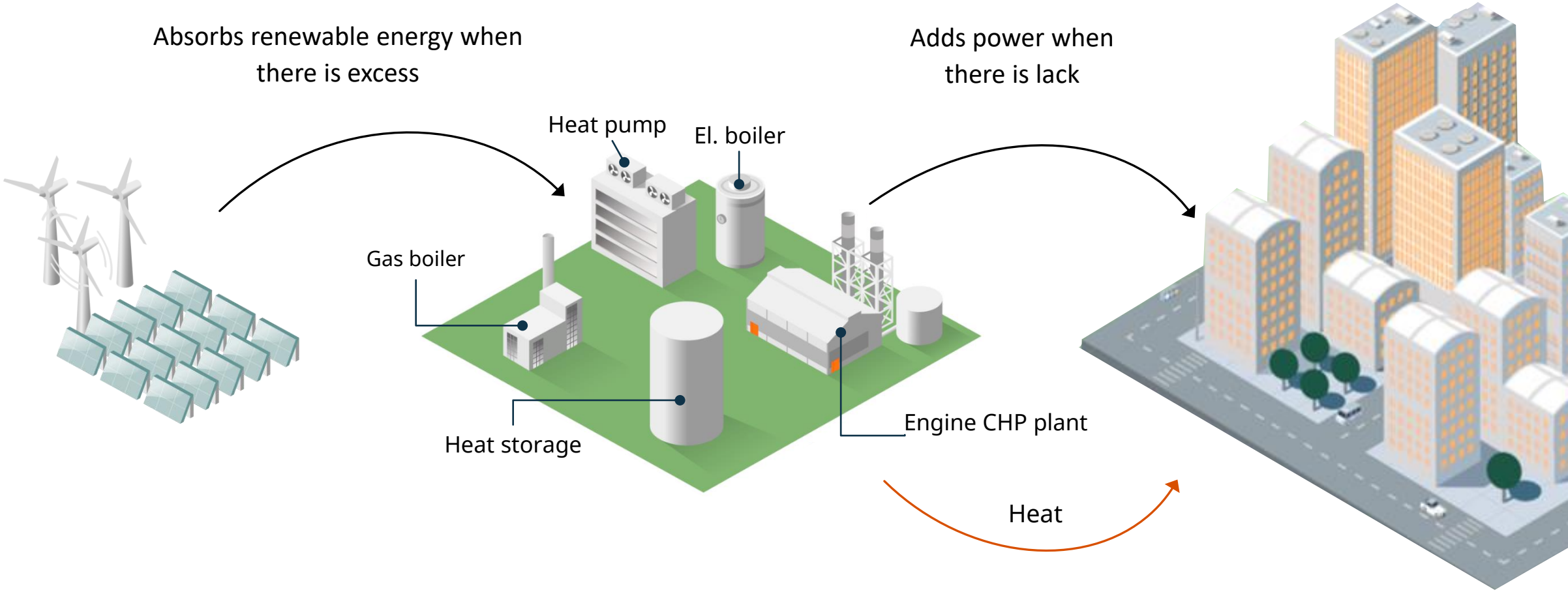


maximizing profit

- Buying cheap electricity to produce heat
- Generating electricity when price is high

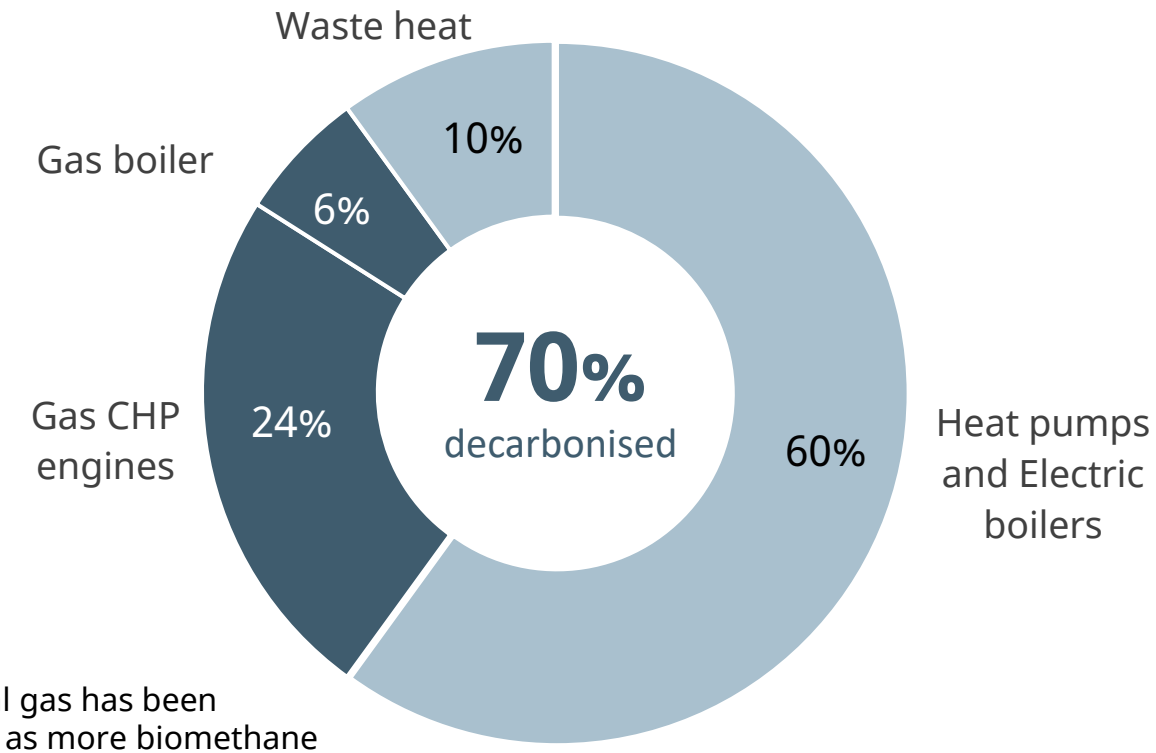
Two-way sector coupling:

Flexible district heating system generates heat while balancing the power system



Meanwhile, Skagen gradually decarbonises district heat

Heat generation mix GWh, 2022



The share of natural gas has been steadily decreasing as more biomethane is injected into the pipeline

http://www.energyweb.dk/skagen/?english&history

Wärtsilä is an expert in modelling
of energy future for cities and countries

= PLEXOS study conducted by Wärtsilä

190+

Country and system studies made by Wärtsilä with PLEXOS software

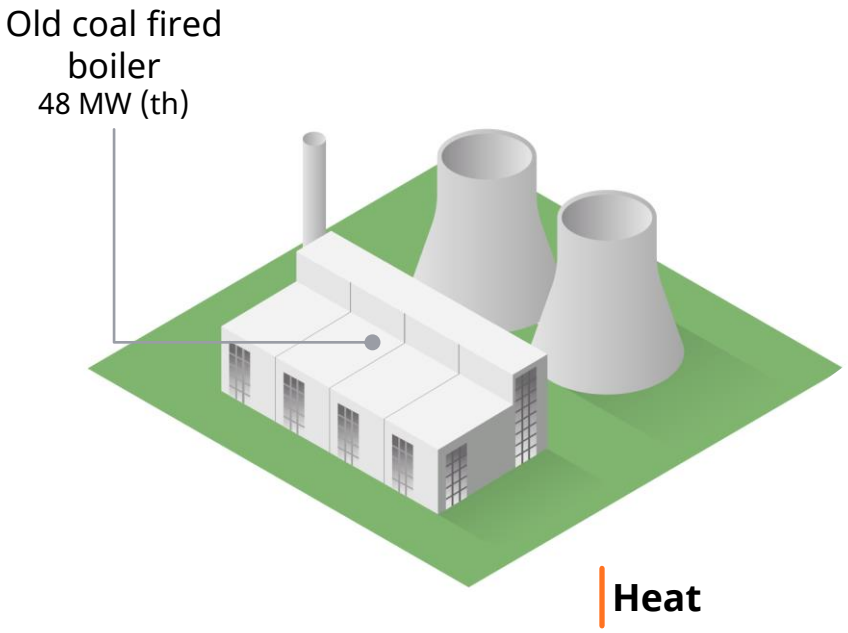
PLEXOS by Energy Exemplar

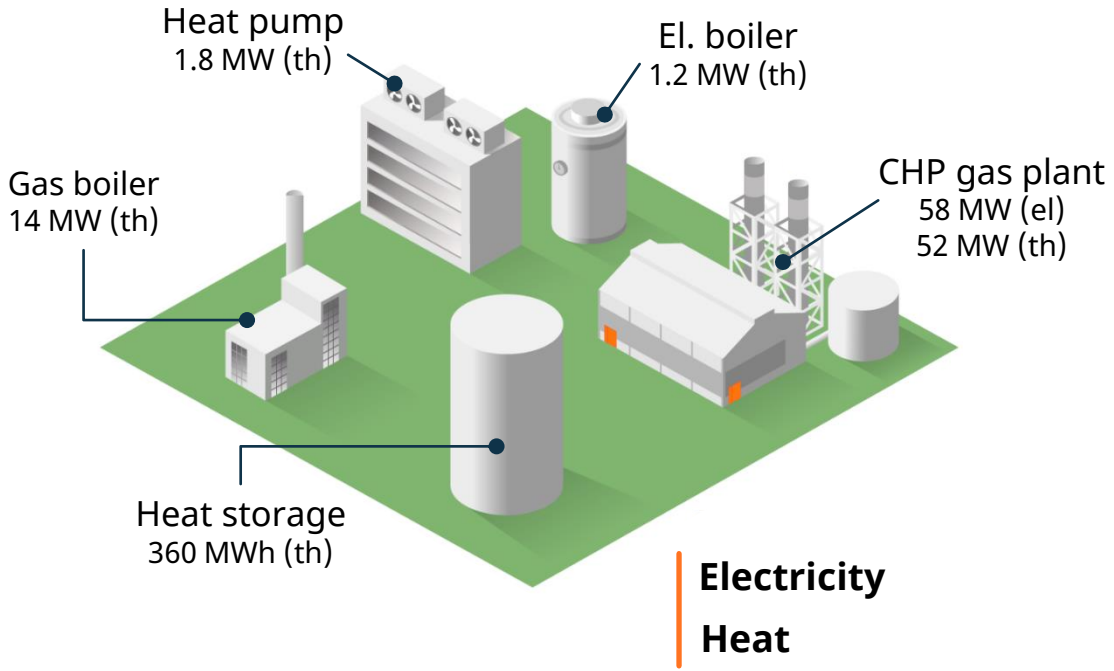
Modelling case: Grudziądz, Poland

Portfolio optimisation outcome

Investment is feasible with **20%** lower heat tariff

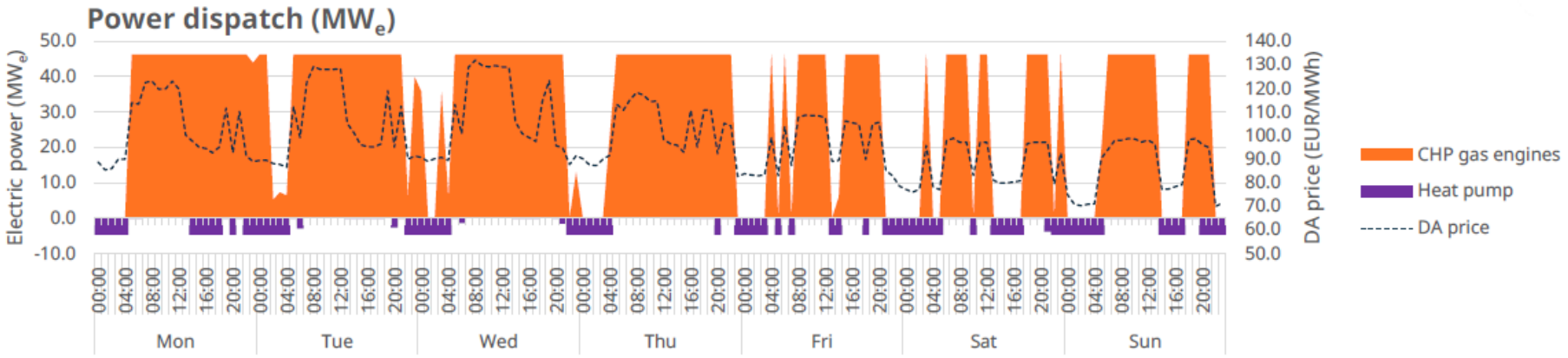
42% lower CO2 emission





*Assumptions (one of 12 reviewed scenarios): Prices: coal 26 EUR/MWh; gas 54 EUR/MWh; average annual electricity 103 EUR/MWh; carbon cost 100 EUR/t of CO2; CHP-bonus 41.9 EUR/MWh

One-week example of co-optimised dispatch simulation



↑ Engines produce electricity when market price is high

Scenario assumptions: gas price 54 EUR/MWh$_{fuel}$, elec. av. 97.5 EUR/MWh$_e$

Not all engine technologies are equally feasible

Medium-speed vs. High-speed engines

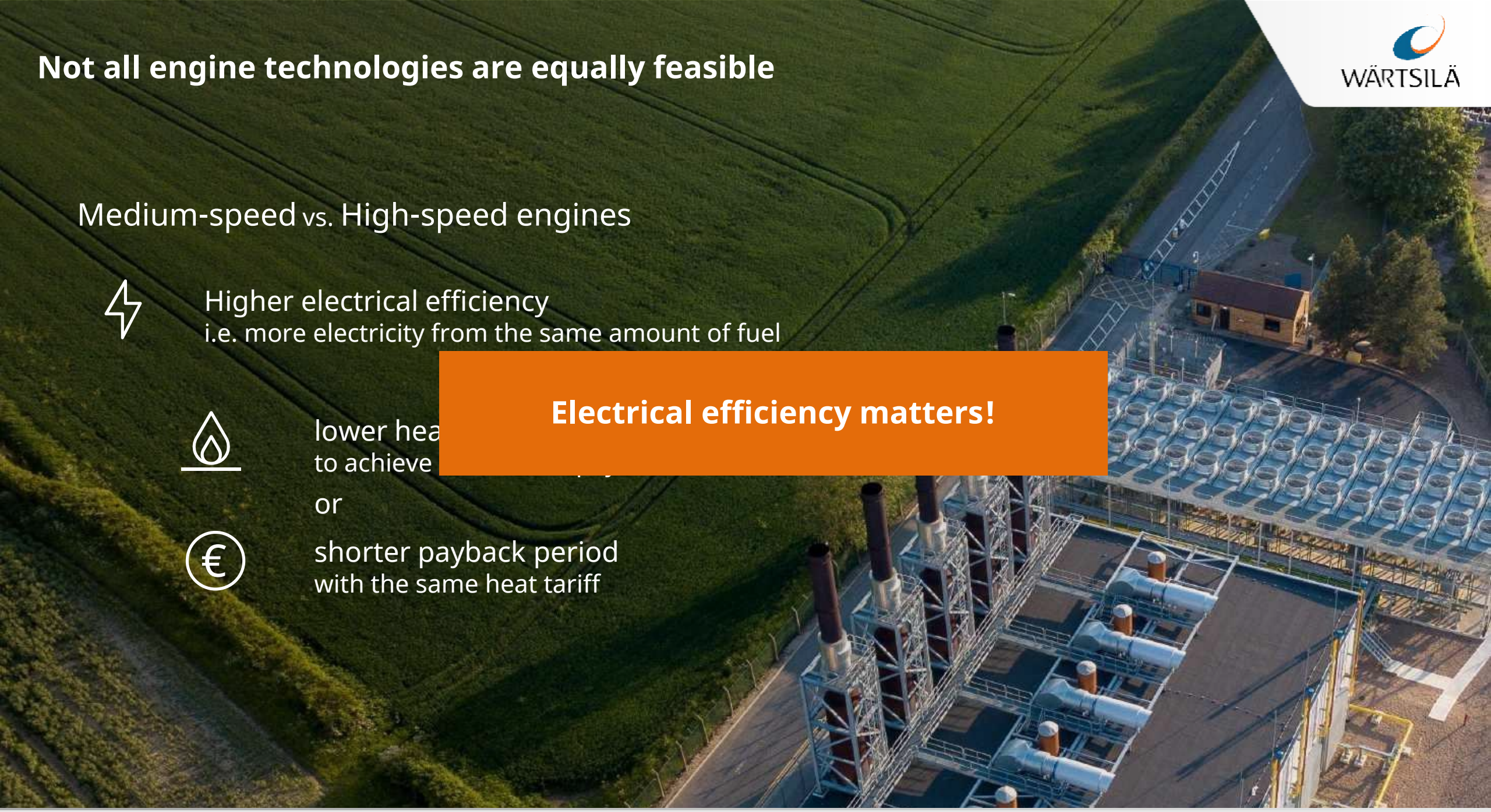
Higher electrical efficiency
i.e. more electricity from the same amount of fuel

lower hea
to achieve

or

shorter payback period
with the same heat tariff

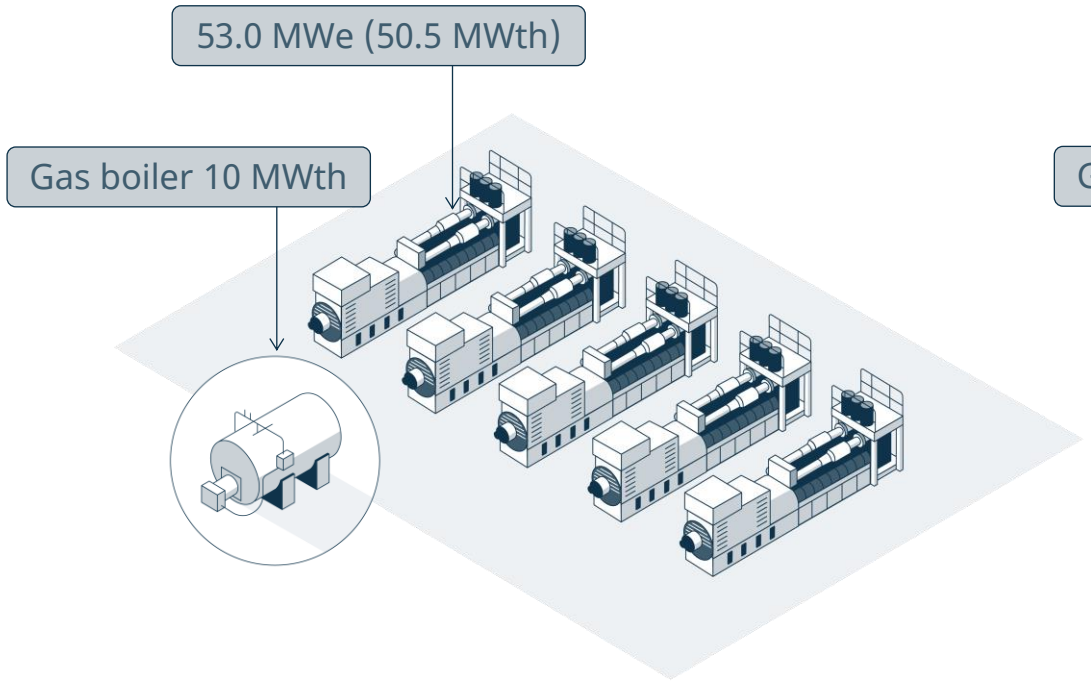
Electrical efficiency matters!



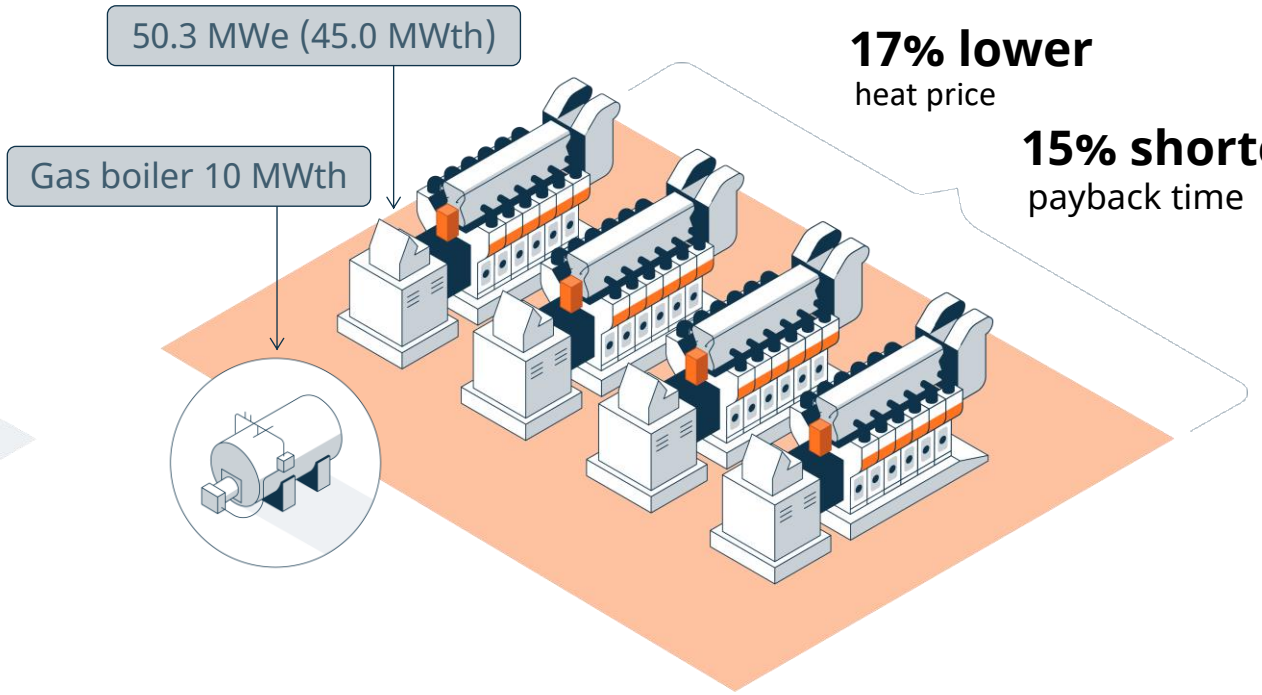
Impact of electrical efficiency

Real life case comparison for a district heating system with 50 MW_{th} peak demand

1. Engine CHP plant
42% electrical efficiency



2. Engine CHP plant
48% electrical efficiency



We conducted numerous district heating Plexos studies

PLEXOS

Enefit

NAFTOGAZ GROUP

opec

PGE Energia Ciepła

Grupa GPEC

OPEC GRUDZIĄDZ

Ciepłownia Siemianowice

The outcome was consistent throughout all cases

Viable combination: **renewable energy and flexible gas**

- clean heat
- CHP engines produce balancing power and heat
- Heat storage balances heat supply

What about Germany then?

Business models of CHP Plants in Germany

Dresden: ~4000 h/year Flexible baseload

Mainz: ~1000 h/y
Selling Ancillary services

Bremen: ~2000 h/year
Optimized for multiple starts

WÄRTSILÄ ENGINES

WÄRTSILÄ

WÄRTSILÄ MEDIUM SPEED ENGINES 10 MW...23 MW


WÄRTSILÄ