

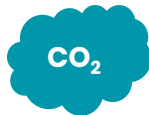
COASTAL POWER PLANT

KIEL'S INTELLIGENT ENERGY SOLUTION



DISTRICT HEATING CUSTOMERS

73,000



CO₂ SAVINGS FOR KIEL

70% reduction



FLEXIBLE GAS ENGINES

20 units



POWER TO HEAT

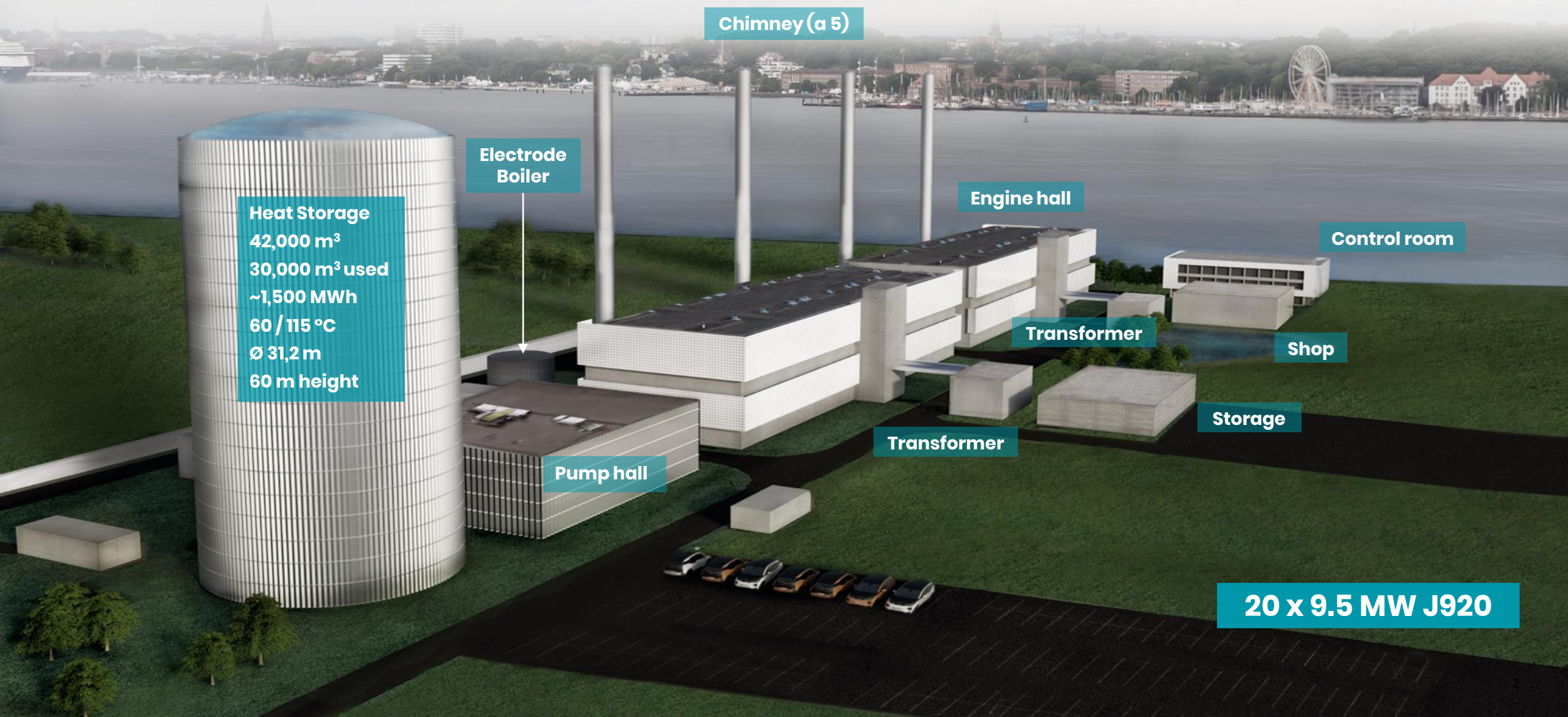
30 MW Electrode Boiler



HEAT STORAGE

30,000 m³

COASTAL POWER PLANT KIEL



Heat Storage
42,000 m³
30,000 m³ used
~1,500 MWh
60 / 115 °C
Ø 31,2 m
60 m height

Chimney (x 5)

Electrode Boiler

Engine hall

Control room

Transformer

Shop

Storage

Transformer

Pump hall

20 x 9.5 MW J920

COASTAL POWER PLANT KIEL (end 2019)

Heat Storage
42,000 m³
30,000 m³ used
~1,500 MWh
60 / 115 °C
Ø 31,2 m
60 m height

Chimney (a 5)

Engine hall

Control room

Electrode Boiler

Shop

Storage

Transformer

Pump hall



Kiel ... largest J920 FleXtra gas engine CHP plant

Municipality of Kiel, Germany



5 min
from
0 to 100%
load

OLD: HARD COAL PLANT

323 MW net electric output
295 MW heat output
>50 % total efficiency

Inflexible operation

Designed annual start
Age: ~50 years

NEW: 20 x JENBACHER* J920 GAS ENGINES

190.4 MW plant net electric output
191.8 MW thermal output
91 % total efficiency

Highly flexible operation

5 min. start up time
4 MW minimum stable load

*Indicates a trademark



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Kiel, Cogen Europe webinar May 2020

Kiel ... Coal to gas switch (COD end of Nov, 2019)



picture from end 2019



MUNICIPALITY KIEL CHP PLANT, GER

20 x Jenbacher* J920 FleXtra gas engines

190.4 MW	plant net electric output
45 %	plant net electric efficiency
191.8 MW	thermal output
91 %	total efficiency

4 x 5 unit blocks

One of the largest gas engine based CHP plant worldwide

COAL REPLACEMENT

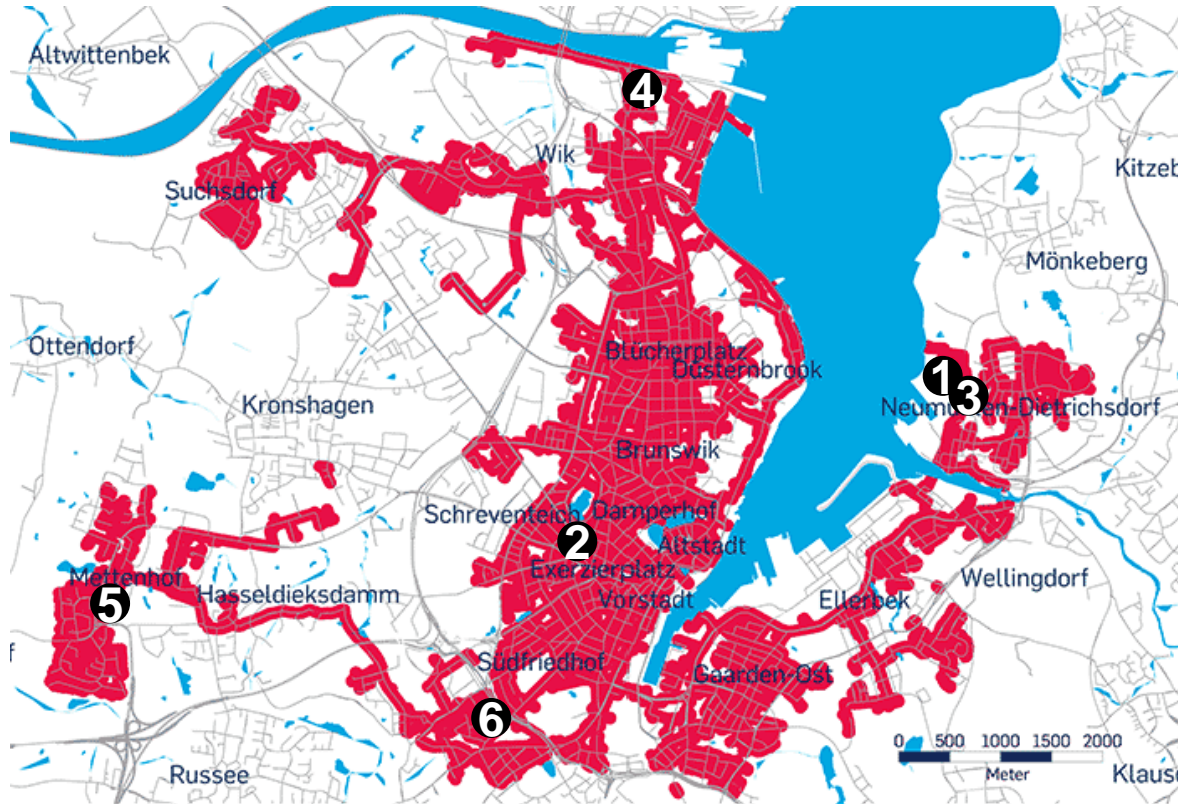
Benefits from new CHP incentives to replace coal and reduce CO₂ by approx. 70%

290 mio. EUR total investment by SW Kiel (not gas engine plant EPC cost)

with ~225 g/kWh of CO₂ emissions (using heat bonus method), the Kiel CHP plant is eligible for EIB financing



Kiel heating network



HEAT GENERATION:

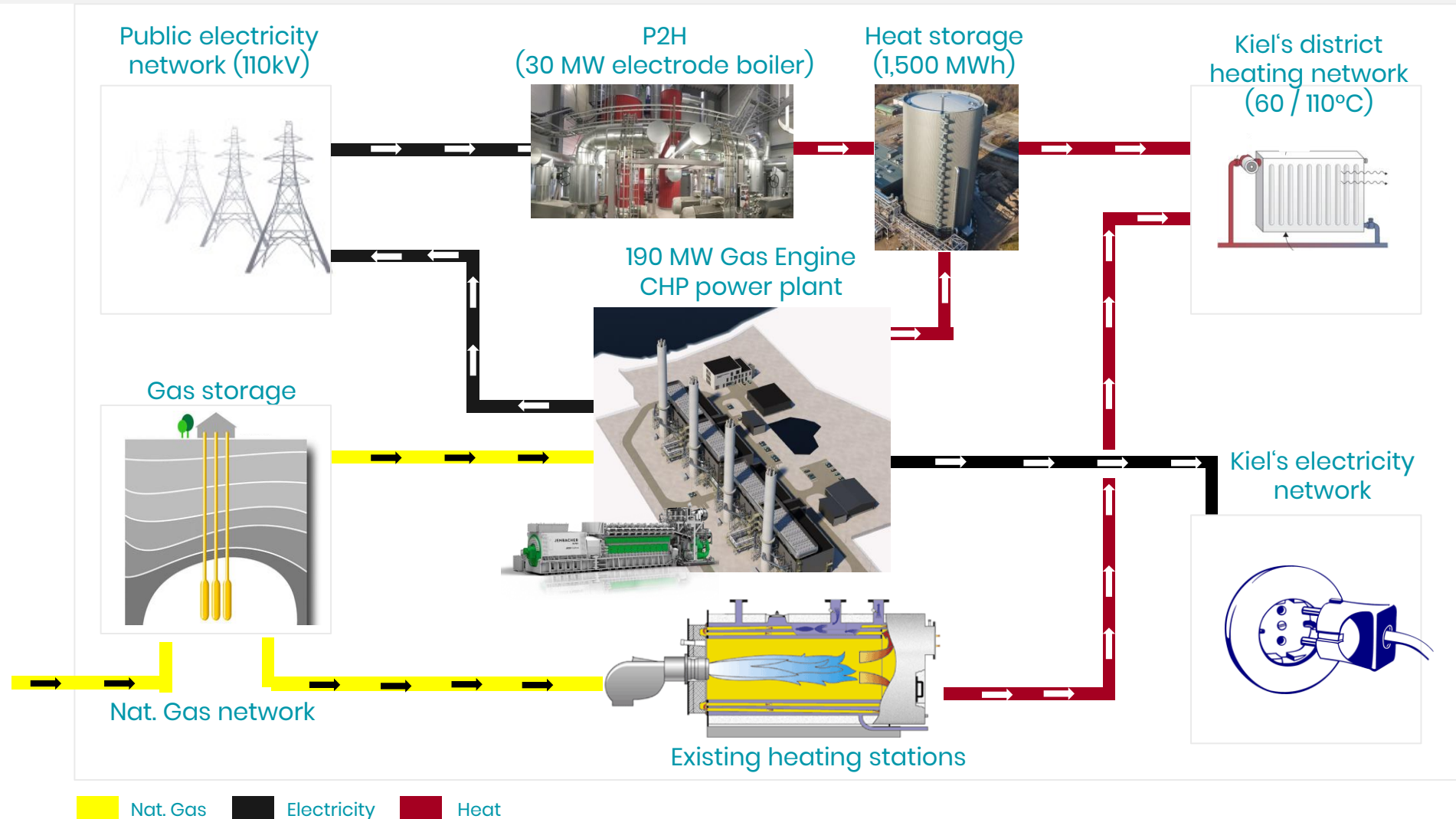
- / 1 Existing Coal Plant Kiel (295 MWth) → 192 MWth
- / 2 CHP plant Humboldtstraße 102 MWth + 4 GT CHP 48 MWth
- / 3 Heating station East (peak load) 59 MWth
- / 4 Heating station Nord (peak load) 160 MWth
- / 5 Heating station West (peak load) 44 MWth
- / 6 Sourcing from external 28 MWth

~720 MWth currently

DISTRICT HEATING:

- Total Sales: ~1 TWh
- Peak load: ~500 MW
- Offtaker: ~73.000 households

Sectoral Integration (Gas, Electricity, Heat)

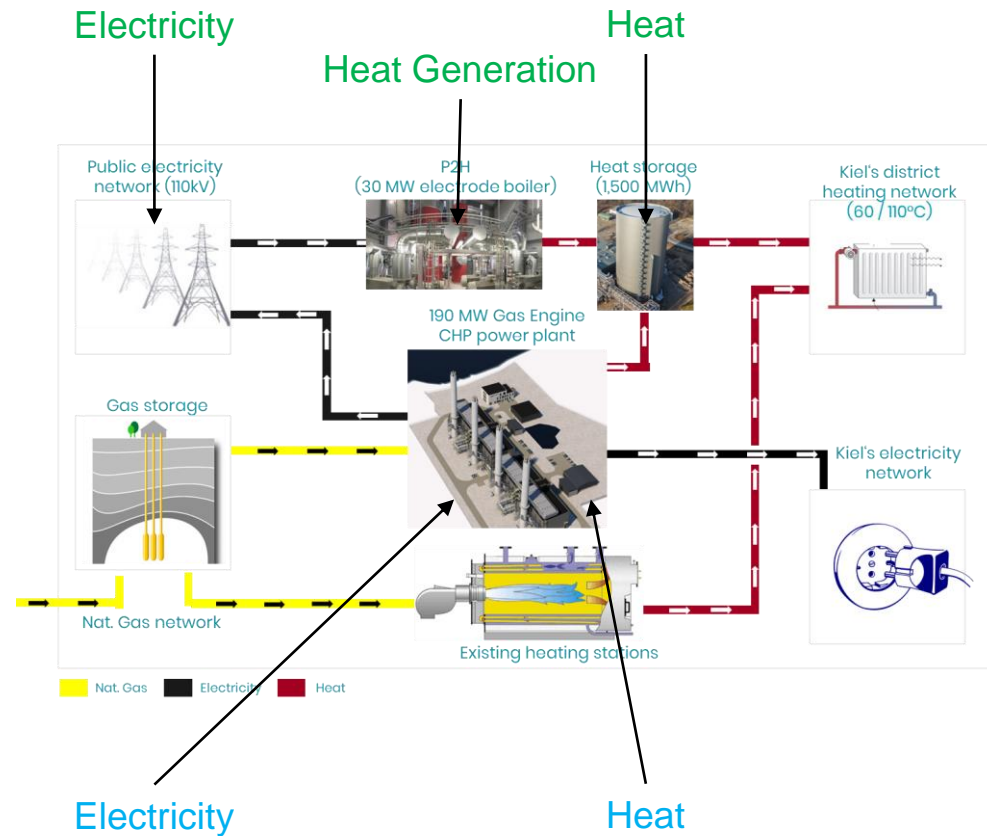
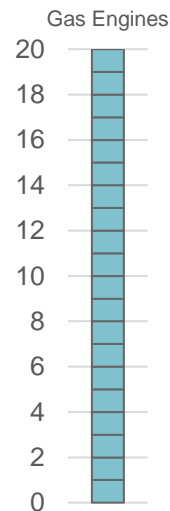
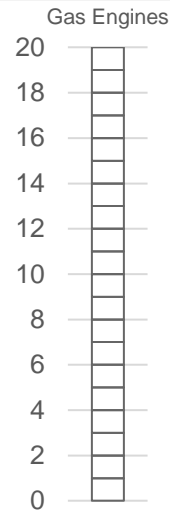


Sectoral Integration enables high renewable generation

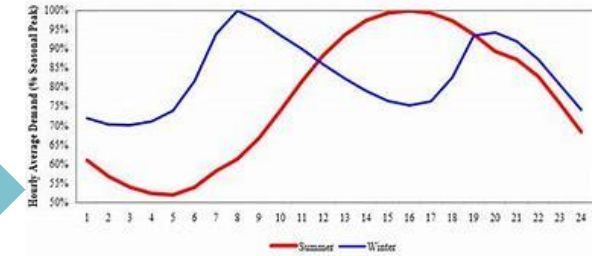
High Wind



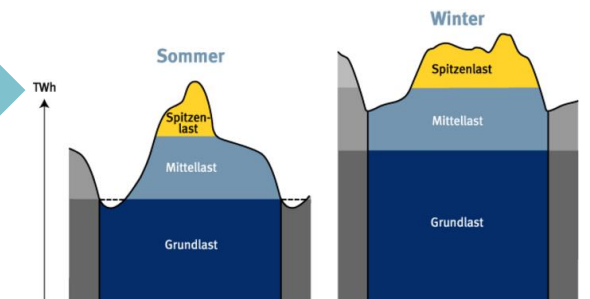
Low Wind



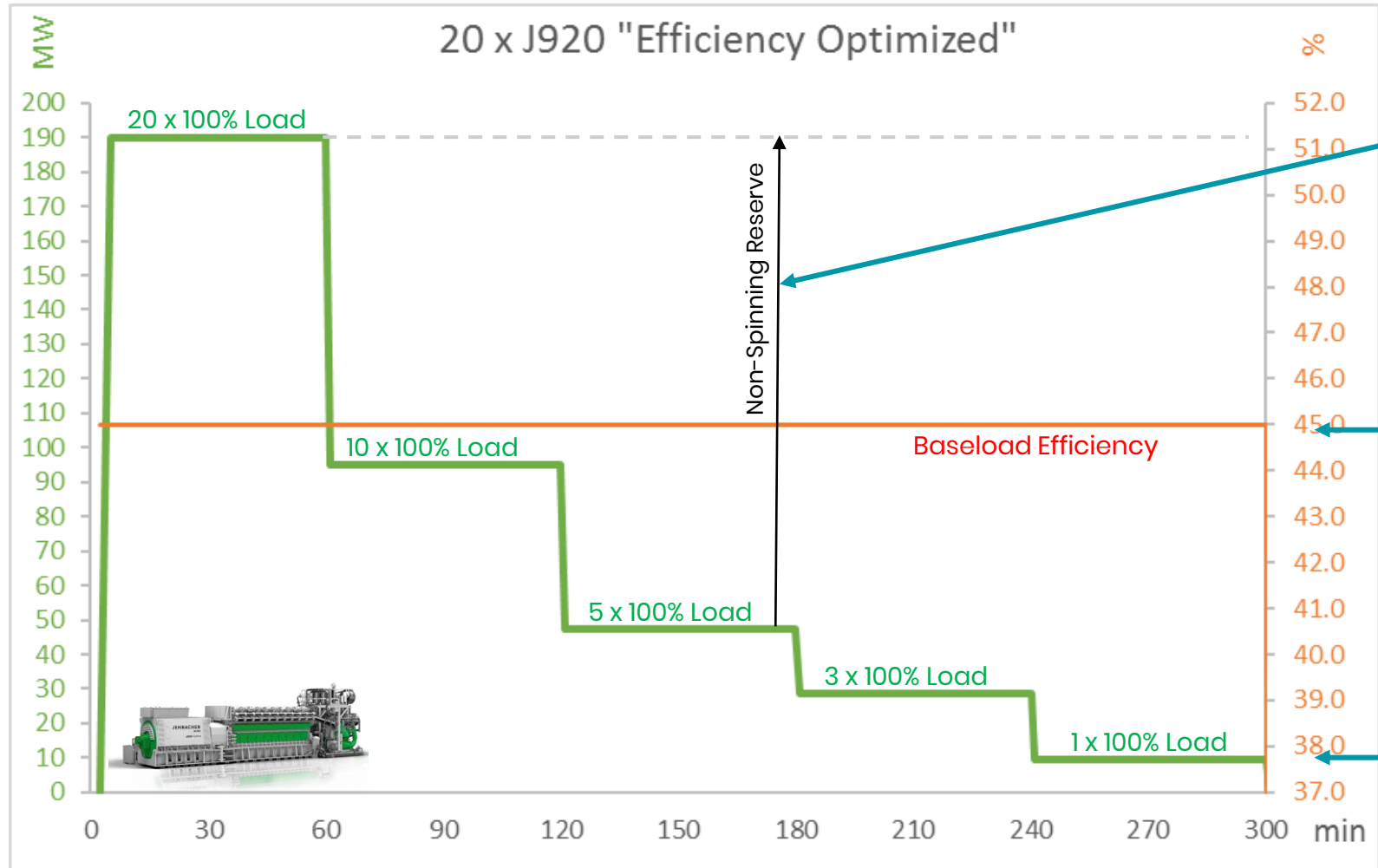
Heat demand curve



Electricity demand curve



Kiel's Intelligente Energie Lösung



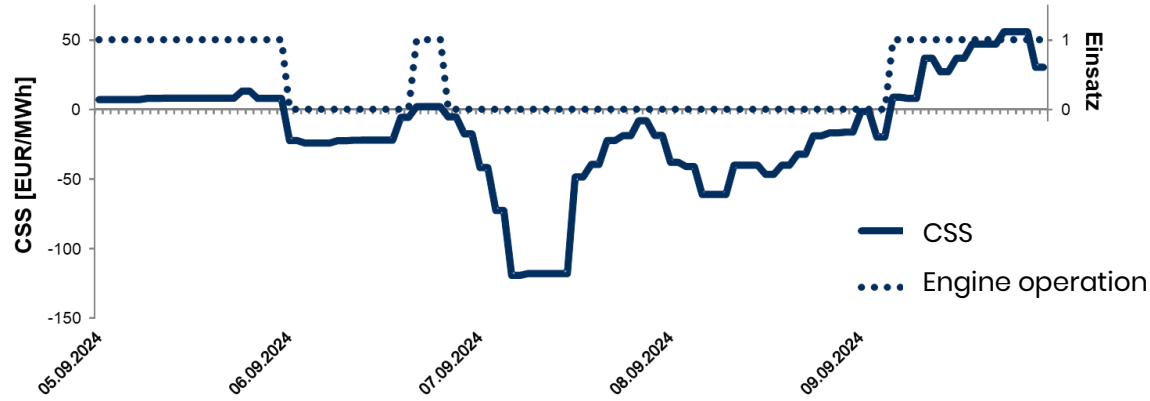
Available in <5 min.

45% constant efficiency
91% constant fuel utilization

Minimum part load:
5% from nominal output

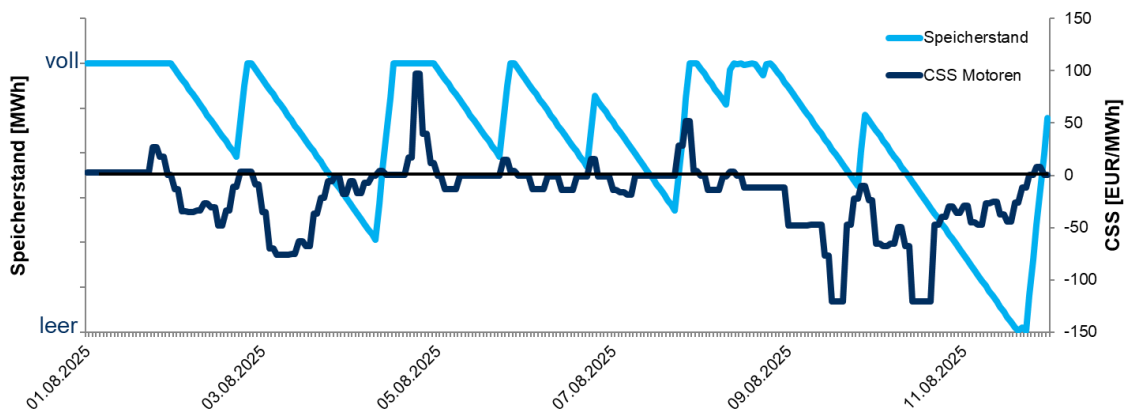
Kiel operation ... flexibility means options

A dispatchable resource to balance RES such as wind in northern Germany



ELECTRICITY MARKET BASED OPERATION:

- Engines are running when CSS is positive

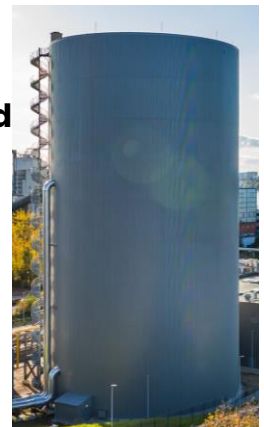


DECOUPLING OF ELECTRICITY PRODUCTION AND HEAT DEMAND:

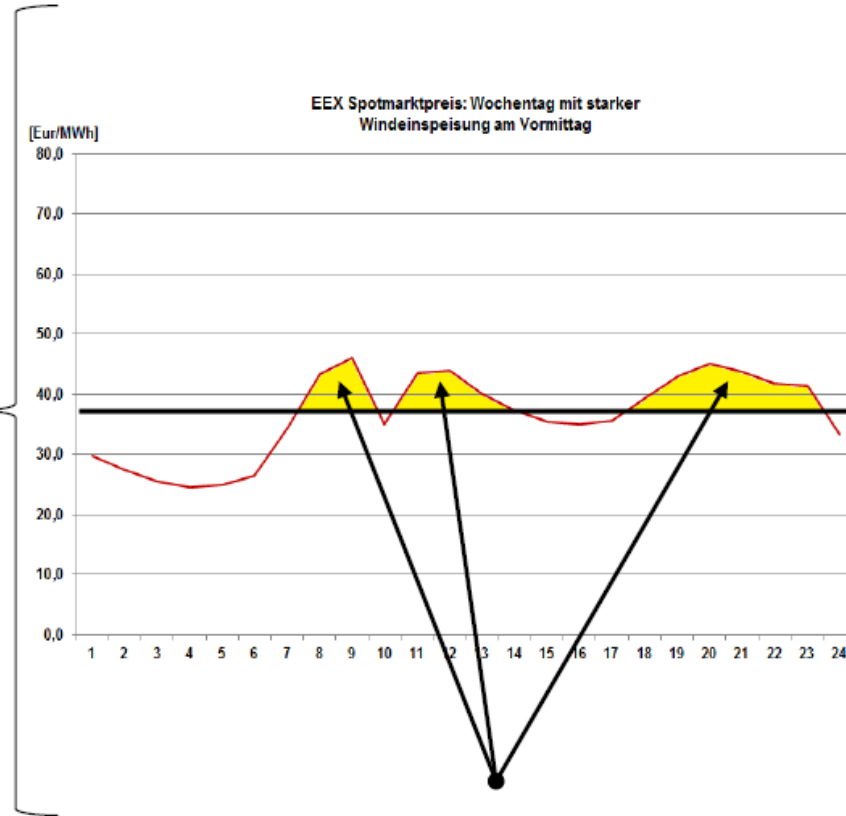
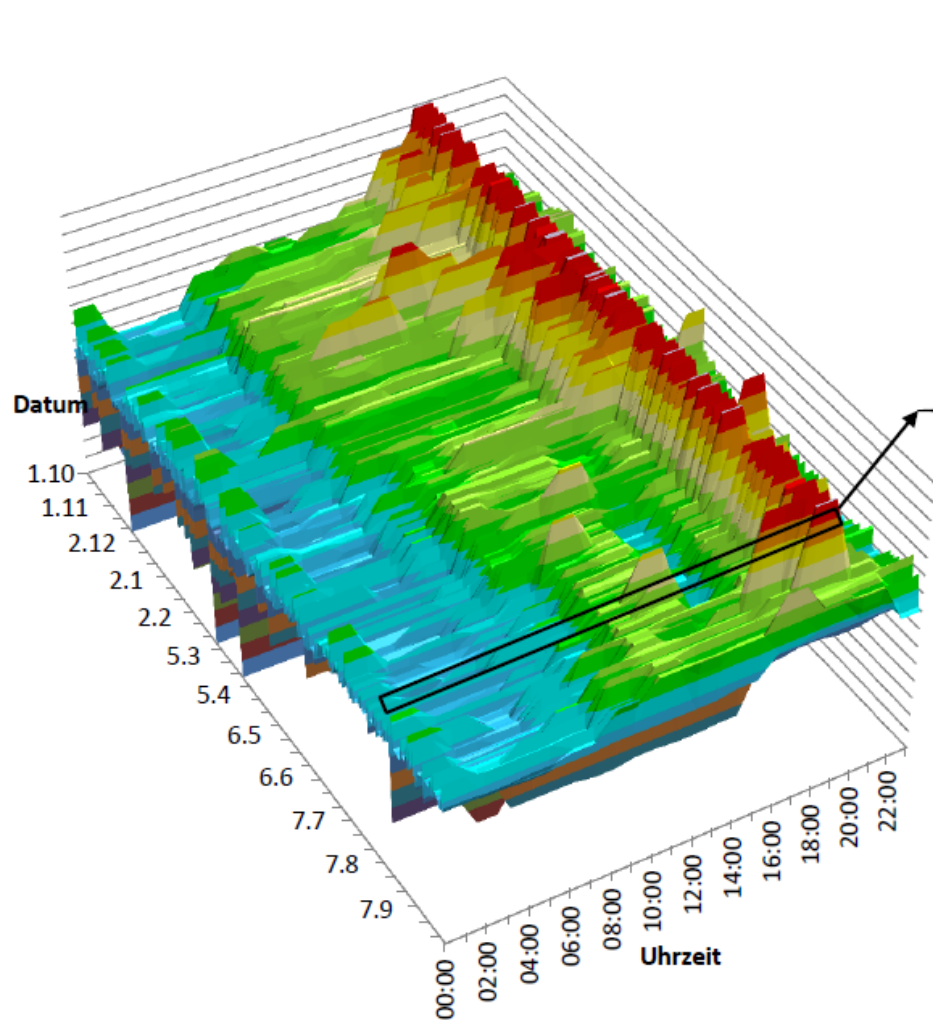
- Heat is going to storage if no demand
- Heat can be provided from storage in case of demand

1,500 MWh HEAT STORAGE:

192 MWth x 7.8 hrs = 1,500 MWh of heat



Simulation of Kiel's gas engine CHP power plant



← 37 EUR/MWh

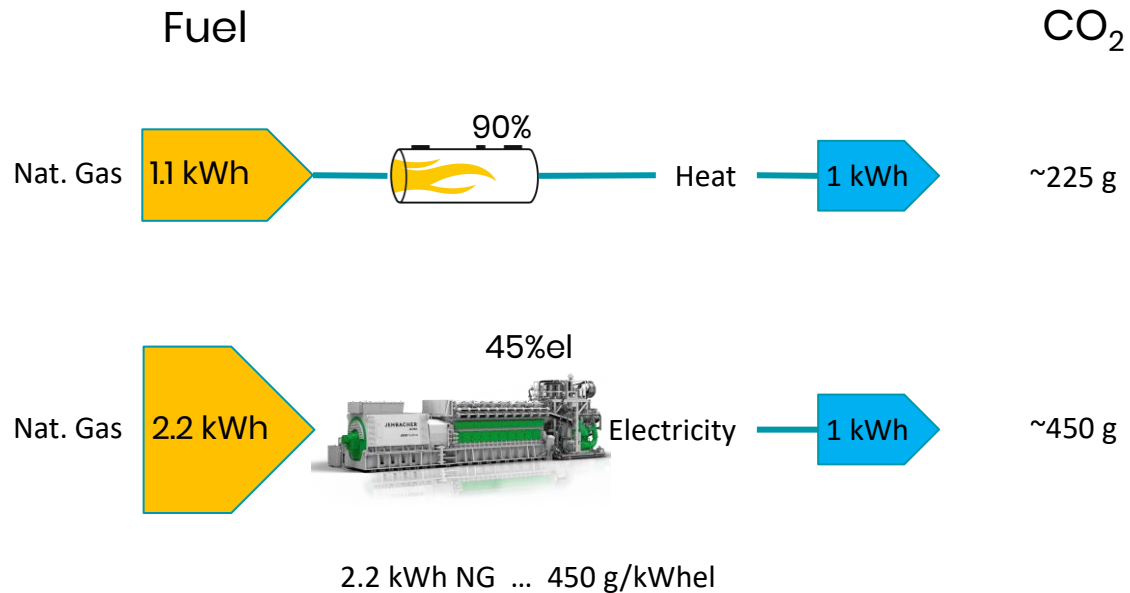
Electricity is sold on the GER electricity market (day ahead and intraday)

J920 FLEXTRA CHP GAS ENGINE PLANT

1 day simulation
 ... up to 3 or 4 starts / day
 ... up to 800 starts / yr

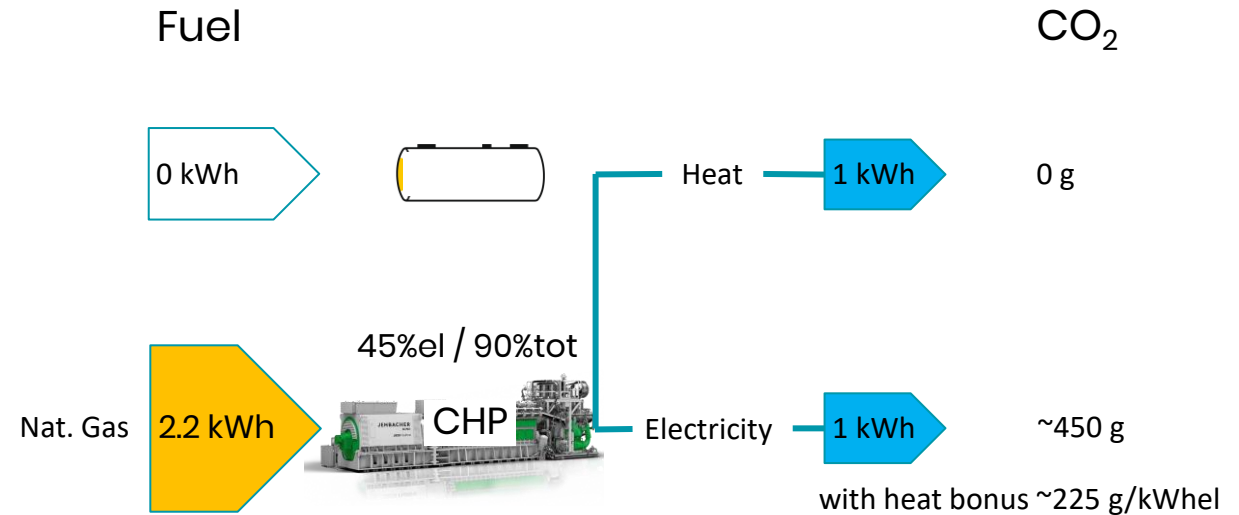
CHP benefits

Heat and Power



to produce 1 kWh of electricity 2.2 kWh of NG are required and 450 g of CO₂ are emitted.
 Additional 1.1 kWh of NG are required for heat and producing 225 g CO₂.
 Total CO₂ emissions: **675 g**

CHP



to produce 1 kWh of electricity and 1 kWh of heat 2.2 kWh of NG are required. Heat bonus method used to replace a boiler.
 No additional NG required for heat
 Total CO₂ emissions: **450 g**

Primary energy savings with CHP ~33%
 CO₂ emissions reduction with CHP ~33%



Thank you