

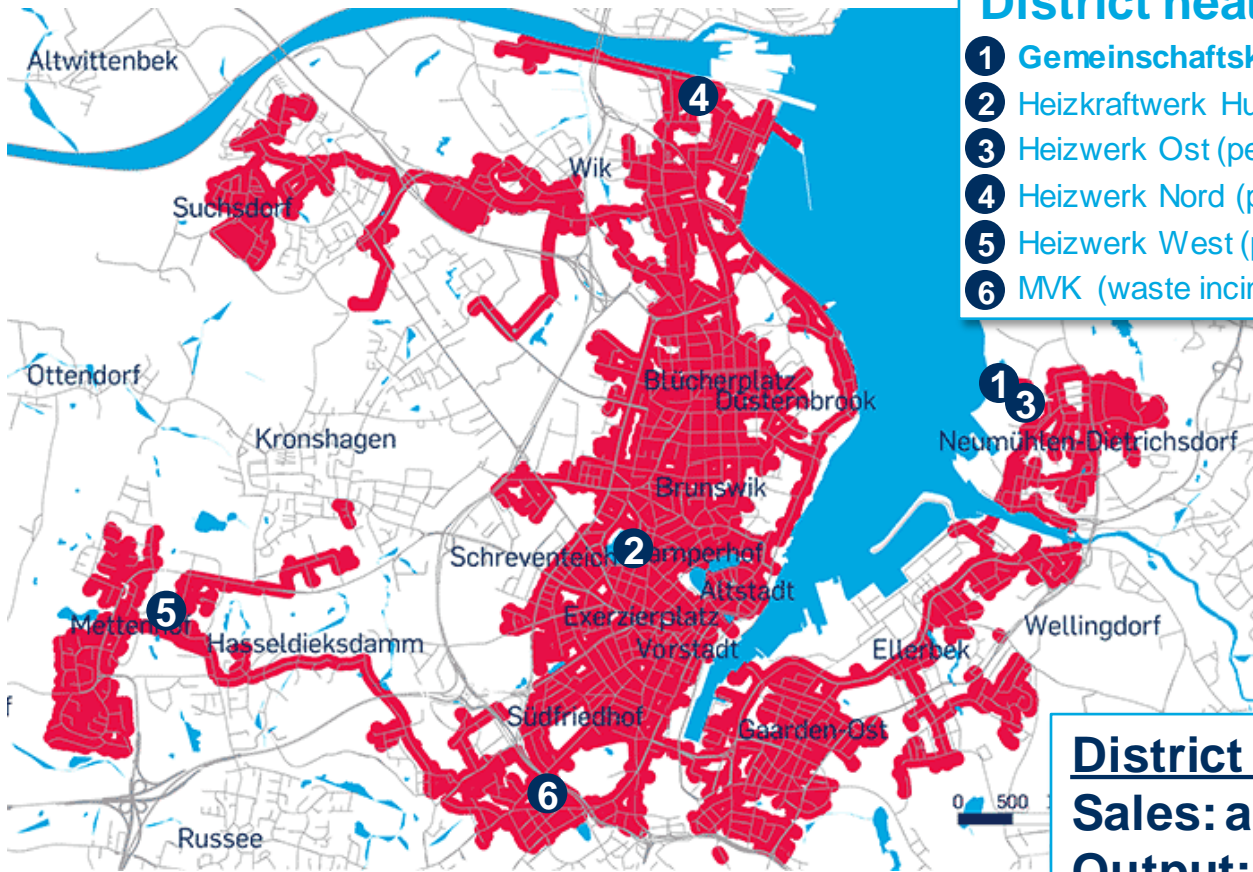
The Energy Transition Power Plant in Kiel – Küstenkraftwerk K.I.E.L.

(Gas engine combined heat and power (CHP) plant)

Dr. Jörg Teupen
Technology and Personnel Executive

District heating supply in Kiel

Supply coverage area and generating plants



District heating generation:

- 1 Gemeinschaftskraftwerk Kiel (GKK)
- 2 Heizkraftwerk Humboldtstraße (thermal power plant)
- 3 Heizwerk Ost (peak load heating plant)
- 4 Heizwerk Nord (peak load heating plant)
- 5 Heizwerk West (peak load heating plant)
- 6 MVK (waste incineration, external procurement)

District heating:

Sales: approx. 1.2 TWh

Output: approx. 500 MW

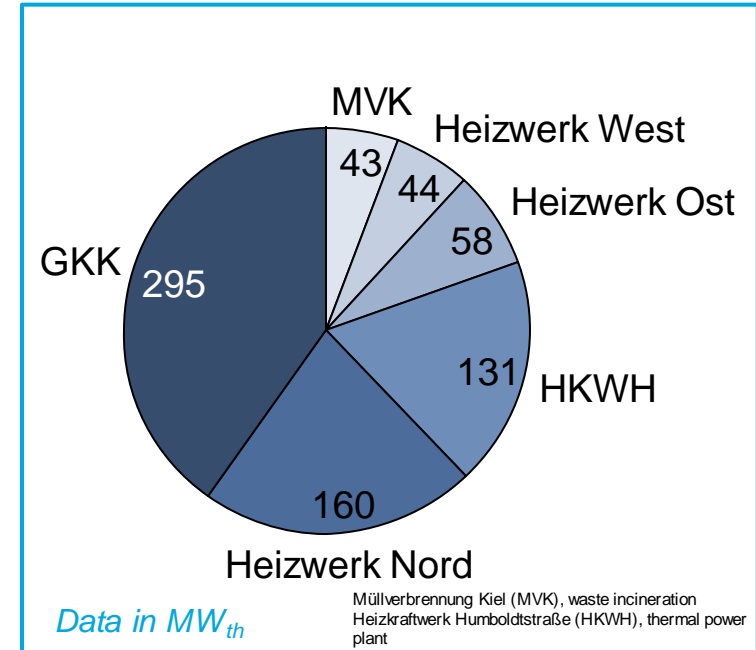
Approx. 70,000 households

District heating generation in Kiel

The coal-fired power plant is currently the core element for the district heating base load

The coal-fired power plant (GKK) has reached the end of its technical service life

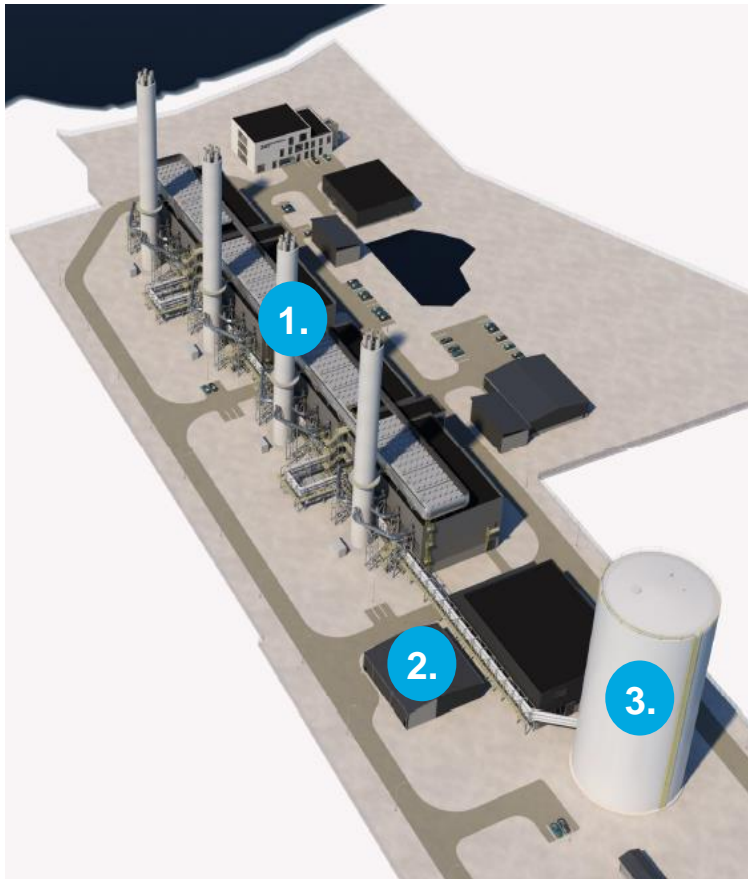
- With 295 MW thermal output, the GKK is the core element for the district heating base load
- With 40 percent of the total installed power, it is the most important district heating feed-in point



An ecological and economic follow-on solution is required to secure Kiel's district heating supply.

Küstenkraftwerk K.I.E.L.

92 % efficiency, 70-80 % less CO₂, €290 million investment volume, 190 MW power (electrical/thermal); **an energy system for the energy transition**



1. Twenty gas engines



2. E-boiler



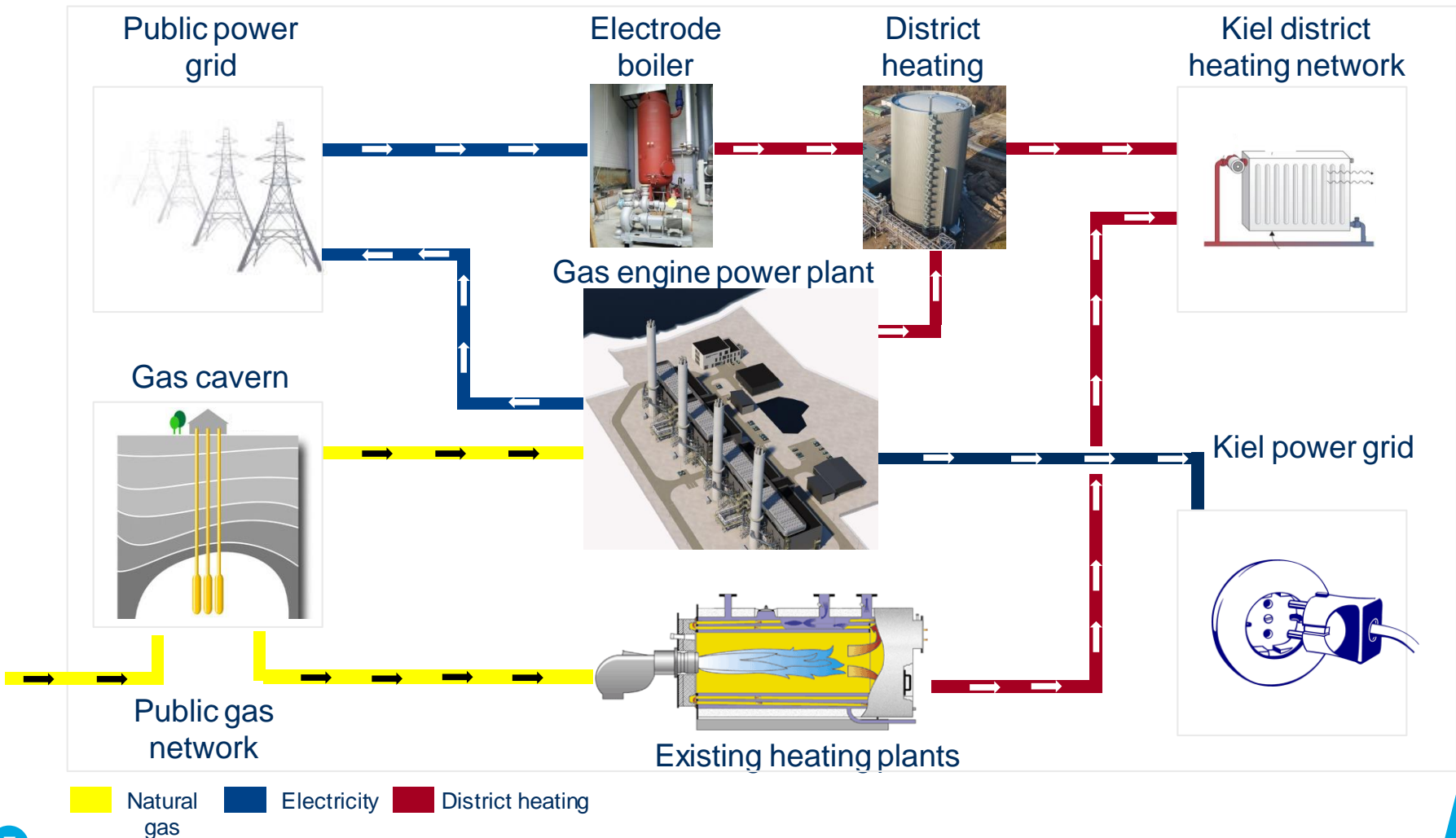
3. Thermal storage unit



Operating principle of Küstenkraftwerk STADTWERKE KIEL

CHP-plant is part of an energy system with high flexibility (cross-sector applications)

Schematic system structure

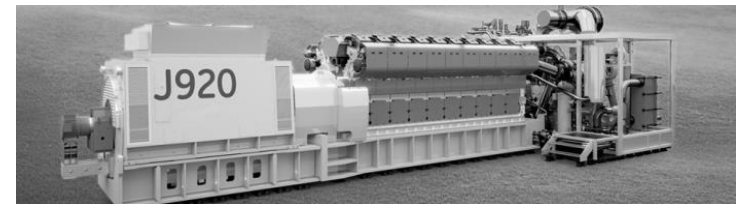


Technology-based decision

Why 20 gas engines and not four gas turbines?

Engines are more flexible and faster with high availability

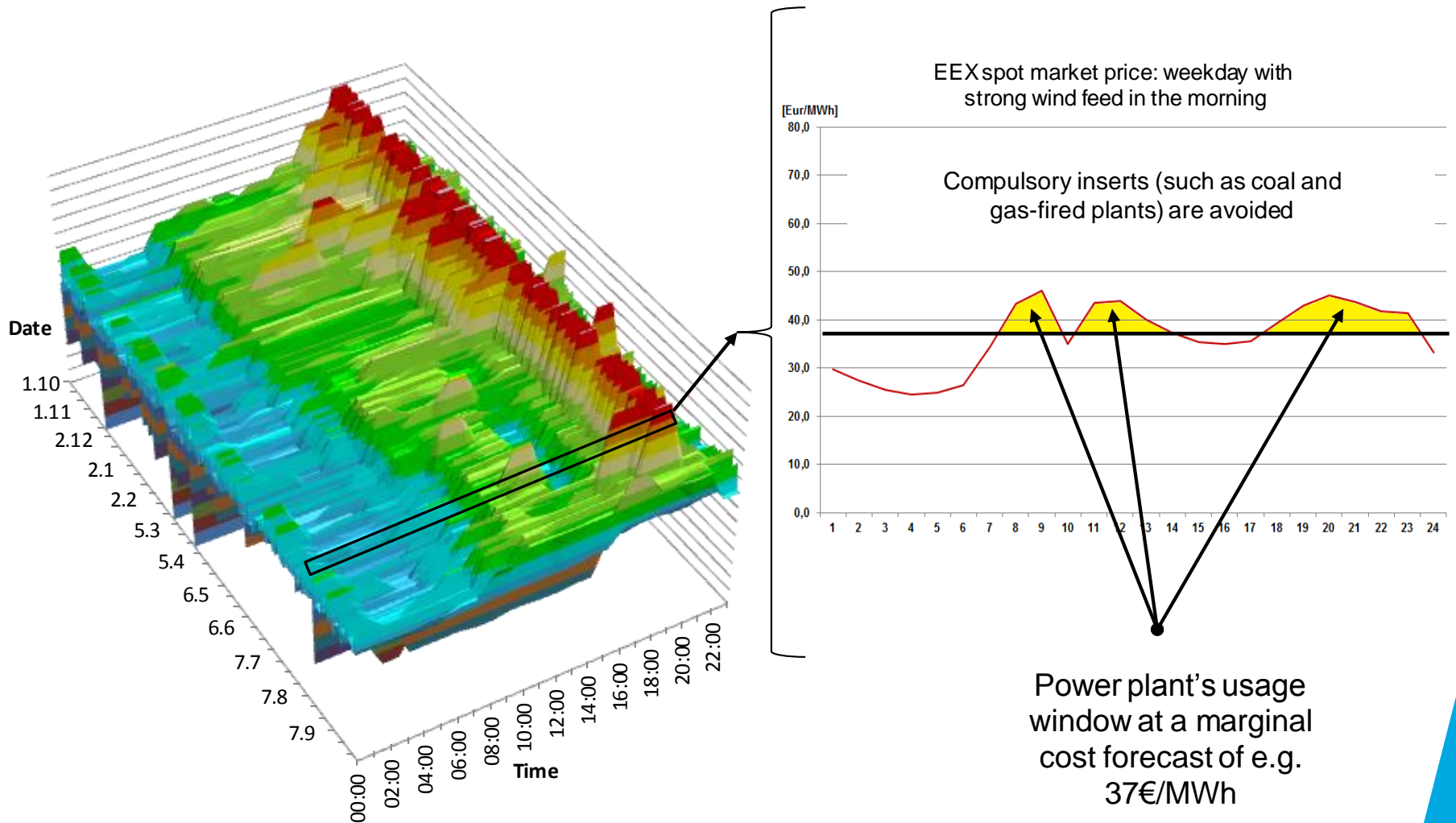
- The 20 gas engines can be operated independently of each other
- Rapid start-up capability (<5 minutes)
- High availability of over 95 percent (19 engines all year round)
- Capable of frequent start-ups (around 800 start-ups per year or several start-ups a day)
- Option of modular extension



Because of the modular design, the individual engine blocks can be very flexibly geared towards the current energy demand.

The energy transition needs speedboats, not tankers!

Opportunities for use in the forecast electricity market



Financing

The new construction involves a total investment of around €290 million

- The total corporate finance has been restructured (rescheduling of existing loans and new loans taken out)
- The largest amount for financing has been contributed by the European Investment Bank (EIB) at €105 million

Other participating banks:

- Investitionsbank Schleswig-Holstein (IB.SH)
- Berliner Sparkasse
- Helaba
- SEB
- ING
- Commerzbank

Economic viability of gas engine power plants

Several factors are significant for the economic viability:

- The project relies on profit contributions from the sale of district heating
- The project needs secured cogeneration funding; particularly in the first few years after commissioning
- Our future price forecasts on the electricity market assume price peaks, when the wind doesn't blow and the sun doesn't shine (average low CSS* but sufficient number of hours a year with high CSS)
- Flexibility on the electricity market will become significantly more important in the future
- The use of the power plant is electricity driven and not heat driven

A variable and highly flexible concept was the basis of the project planning; gas engines are superior to the gas turbines in this case.

* Clean-Spark-Spread: profit margin

Conclusion

Generation can be economically viable, even in a difficult energy environment

The keywords for economic viability are:

- Appropriate funding of cogeneration units
- Stable heating sales volume
- Production in all markets (futures market, day-ahead market, intraday market, SRL market)
- Backup technology heating plants (no “must run” of the CHP plants)
- Thermal storage unit (so that no generated heat is “thrown away”)
- Rapid, controllable and modular plant