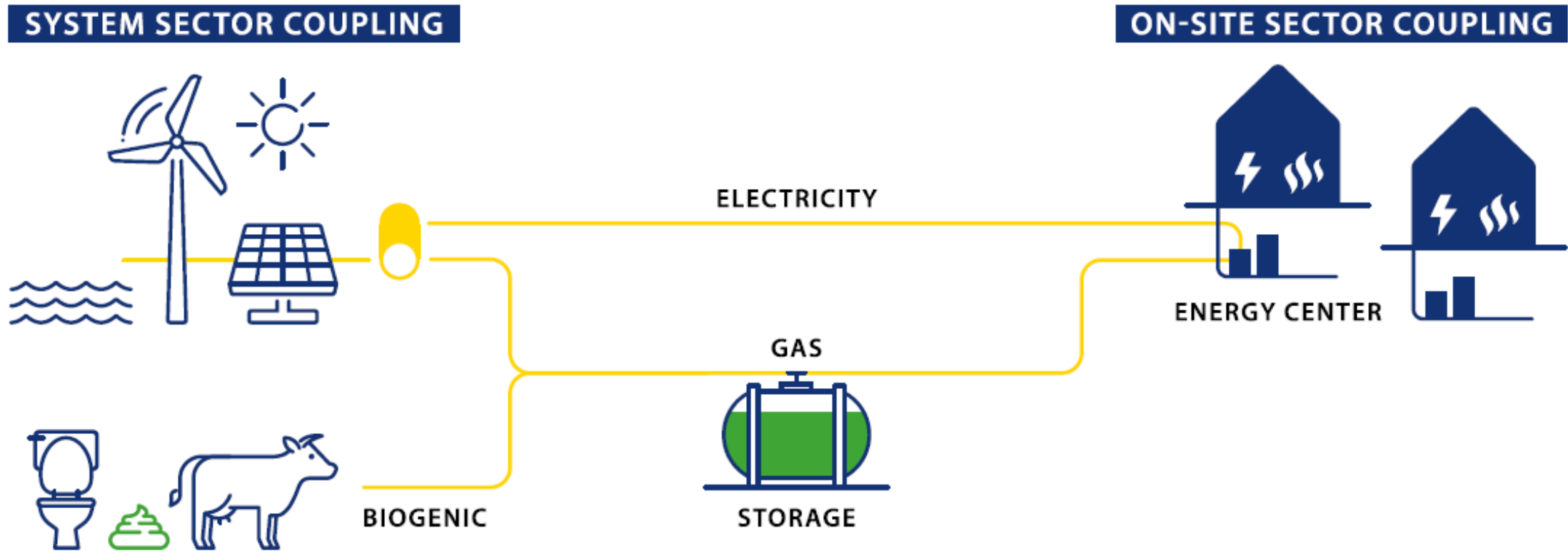


COGENERATION AND HEAT PUMPS: WIN-WIN FOR HADBJERG SCHOOL IN DENMARK

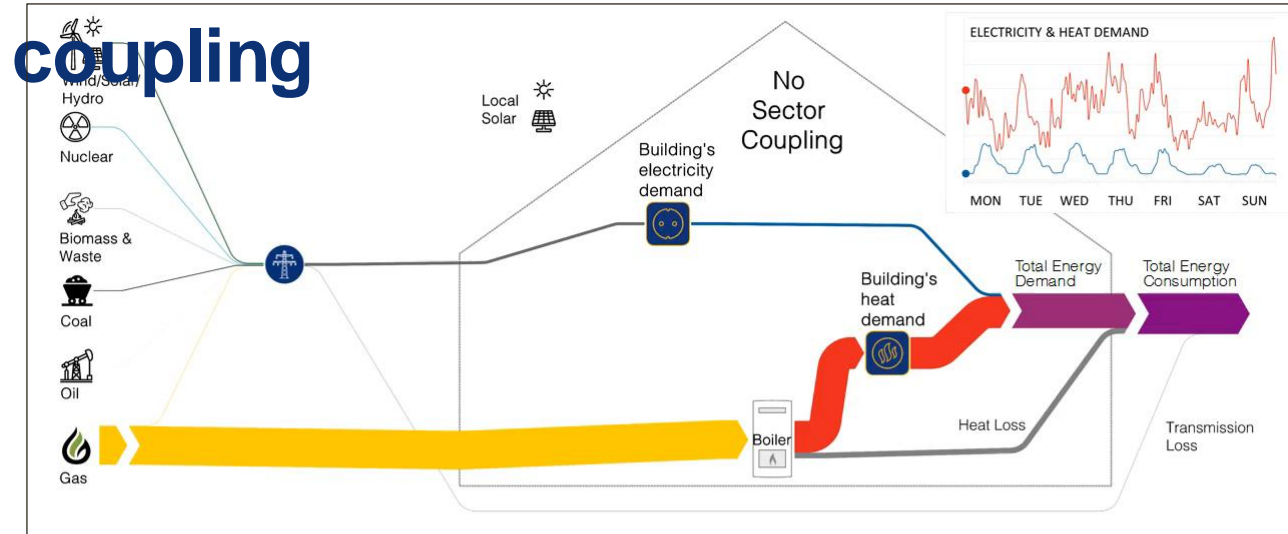


About EC POWER



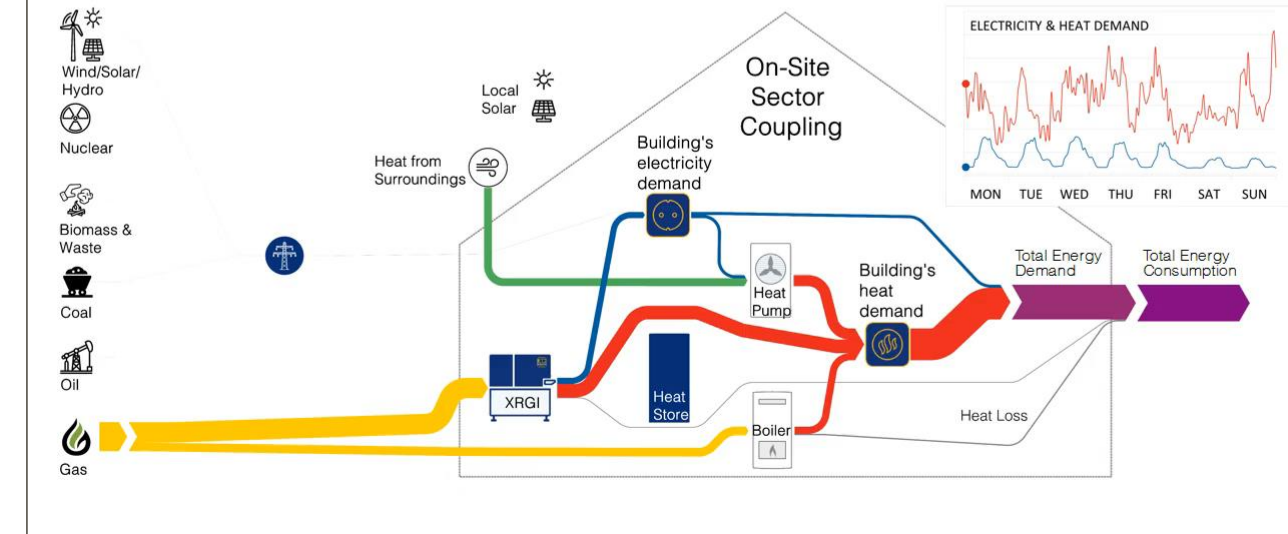
- Founded in 1996
- Head Office & Production in Aarhus, Denmark
- Academy in Berlin, Germany
- Clean-Tech Products
- Knowledge-intensive Solutions and Services
- Sales in Europe and Americas
- +10,000 systems in operation
- Market leader in the 10-20 kW_e segment
- > 27 patents
- Profitable & Visionary
- Extensive partnerships

Benchmark: Individual sectors vs. on-site sector



Today: Majority of buildings has no on-site sector coupling

- The video shows hourly energy flows in a school in Denmark – Week 40 2018
- The building is connected to the electricity grid and a gas grid is fueling a boiler. Moreover, it has a local solar panel.
- Please note how the electricity and heat demands independently fluctuate throughout the week.
- Wind and solar sources prevail in the Danish electricity grid, however controllable sources contribute in serving demand. Data according to www.energidataservice.dk.
- Please note losses contributing to total energy consumption



Today: A minority has a flexible & efficient energy supply

- Same building, same week, same demands. The video shows hourly energy flows with an Energy Center Solution (On-Site Sector Coupling).
- The building is still connected to a gas grid and the electricity grid (difficult to see as grid supply is significantly relieved). Besides a local solar panel and a boiler, it has a micro-CHP, a heat pump and a heat store.
- Please note how the fluctuating electricity and heat demands are served by different sources in a flexible and highly efficient manner.
- Please note the reduction in total energy consumption.

CASE: “Hadbjerg Skole” - a School in Favrskov,



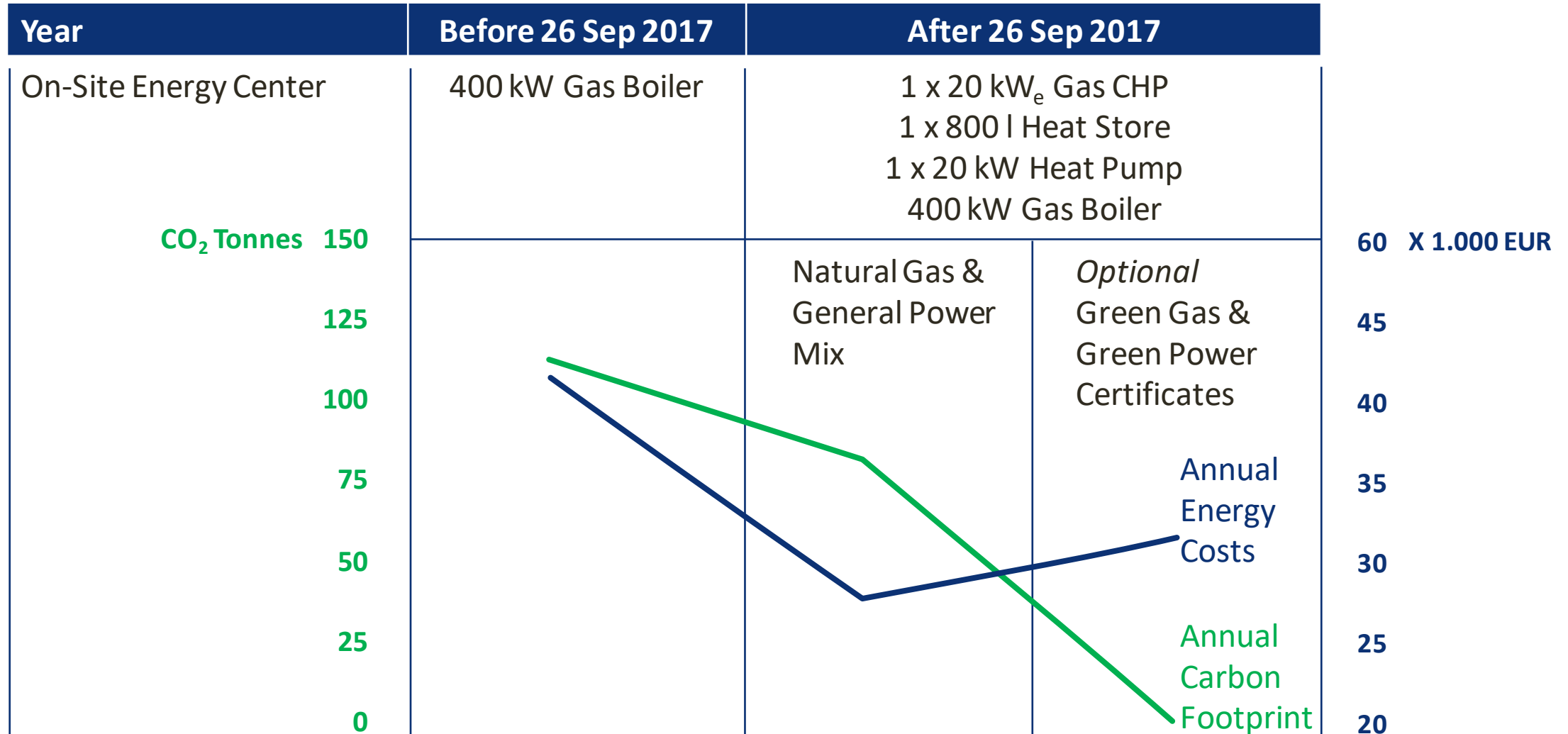
Denmark



- **Municipal School built 1928/1961/2012**
 - 440 students
- **On-Site Energy Center built 2017**
 - CHP, electric load tracker
 - Heat store, consumption balancing
 - Heat pump, heat booster
 - Boiler, back up heat
- **On-Site Energy Center annual performance**
 - 63% power supply, rest from grid
 - 100% heat supply (10% from boiler)
 - 120% total energy efficiency

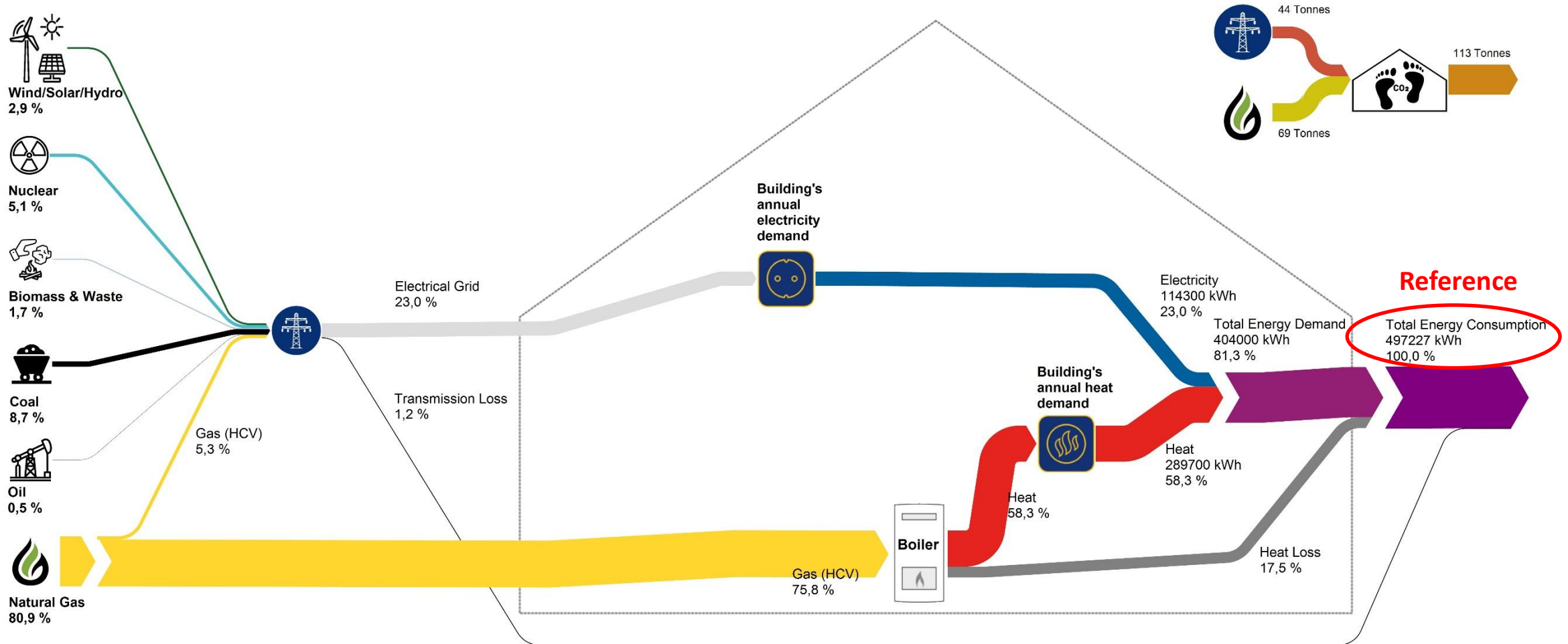


CASE: “Hadbjerg Skole” - Carbon & Cost



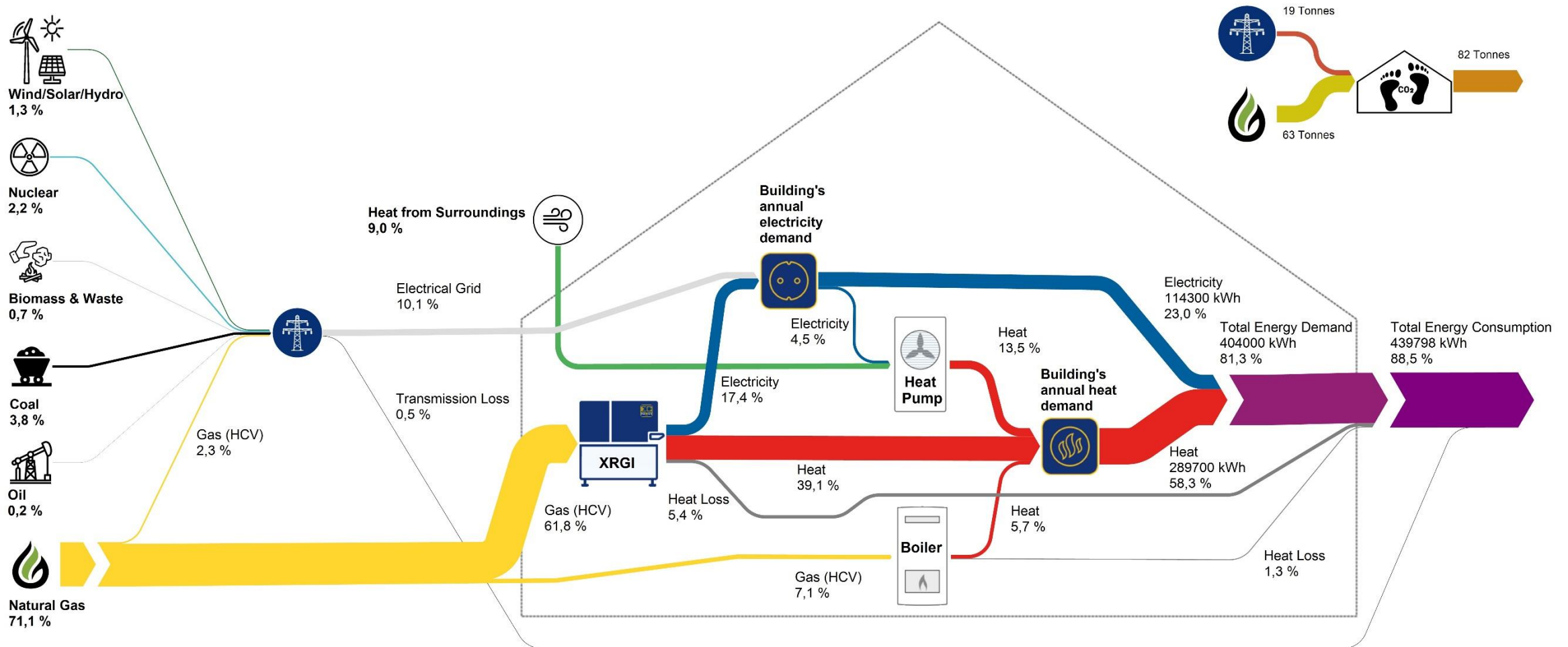
CASE: "Hadbjerg Skole" - Before Renovation

Annual Energy Flow & Carbon Footprint without On-Site Sector Coupling / XRGI® Energy Center



CASE: "Hadbjerg Skole" - After Renovation

Annual Energy Flow & Carbon Footprint with On-Site Sector Coupling / XRGI® Energy Center



CASE: Housing Cooperative “Gartnerengen” - Fjellerup



- **16 apartments built in 1999**
 - 7 x 75 m² - 2 room apartments
 - 7 x 90 m² - 3 room apartments
 - 2 x 115 m² - 4 room apartments
- **On-Site Energy Center built 1999/ refurb. 2018**
 - CHP, electric load tracker
 - Heat store, consumption balancing
 - Heat pump, heat booster
 - Boiler, back up heat
- **On-Site Energy Center annual performance**
 - 84% power supply, rest from grid
 - 100% heat supply (6% from boiler)
 - 132% total energy efficiency (annual)

Takeaways – Cogeneration and Heat Pumps

	Individual Sectors	On-Site Sector Coupling
System Efficiency	36%-96%	Up to 160%
Wind and solar grid integration	Up to 50%	Unlimited
Flexibility	Low	High
Security of Supply	Single	Dual