



**INDUSTRIAL  
EFFICIENCY | 2016 BERLIN**

Going beyond energy efficiency to deliver savings, competitiveness and a circular economy.

12-14 September 2016  
die Kalkscheune, Berlin

# **THEORETICAL ANALYSIS OF STEAM GENERATION METHODS ENERGY, CO<sub>2</sub> EMISSION, AND COST ANALYSIS**

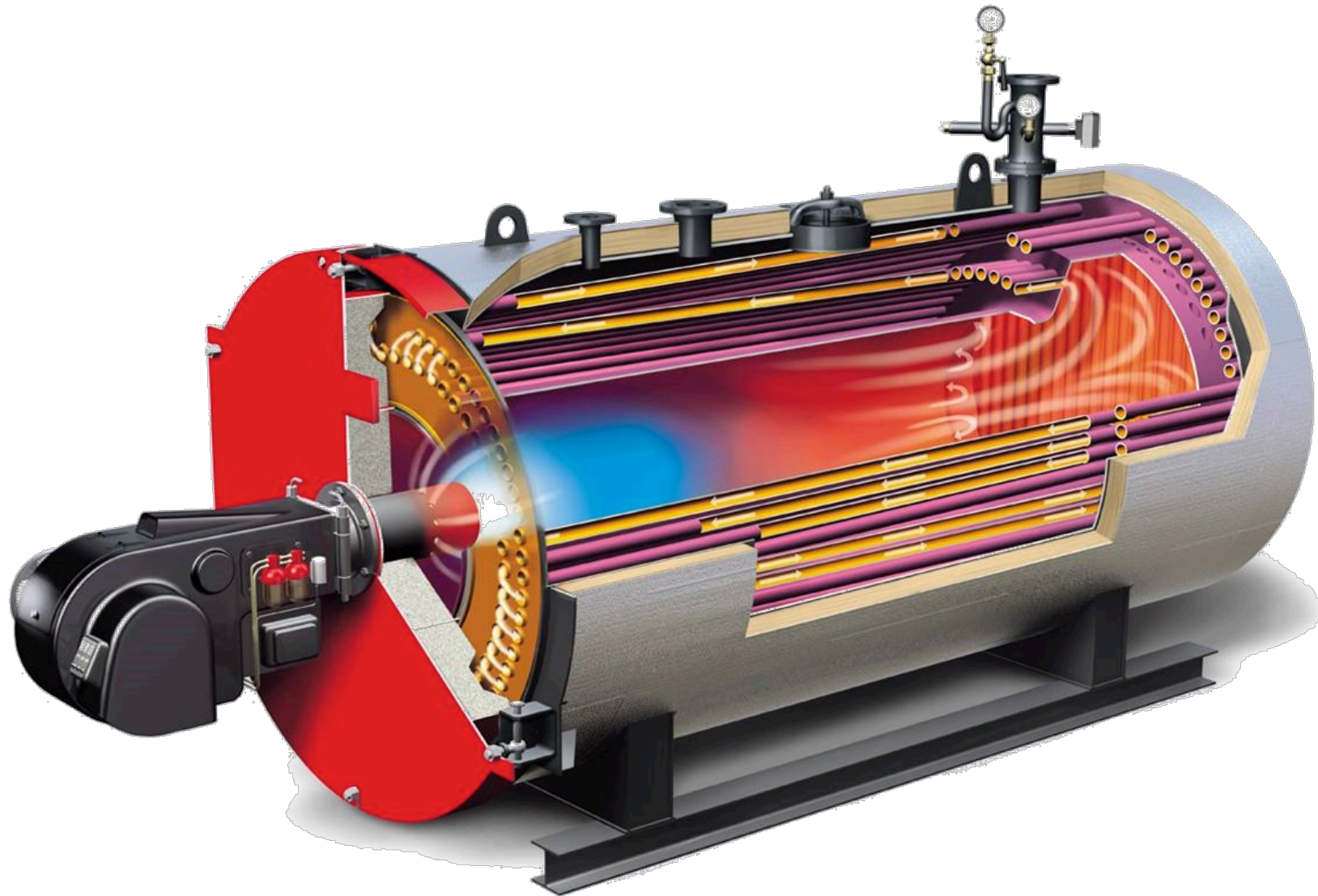
Dr. Frederic Bless

A photograph of a volcanic eruption. A massive, dark, and billowing plume of smoke and ash rises from a rocky, snow-dusted mountain peak. The plume is dense and textured, with various shades of grey and black. The sky is a clear, vibrant blue. The overall scene is dramatic and powerful.

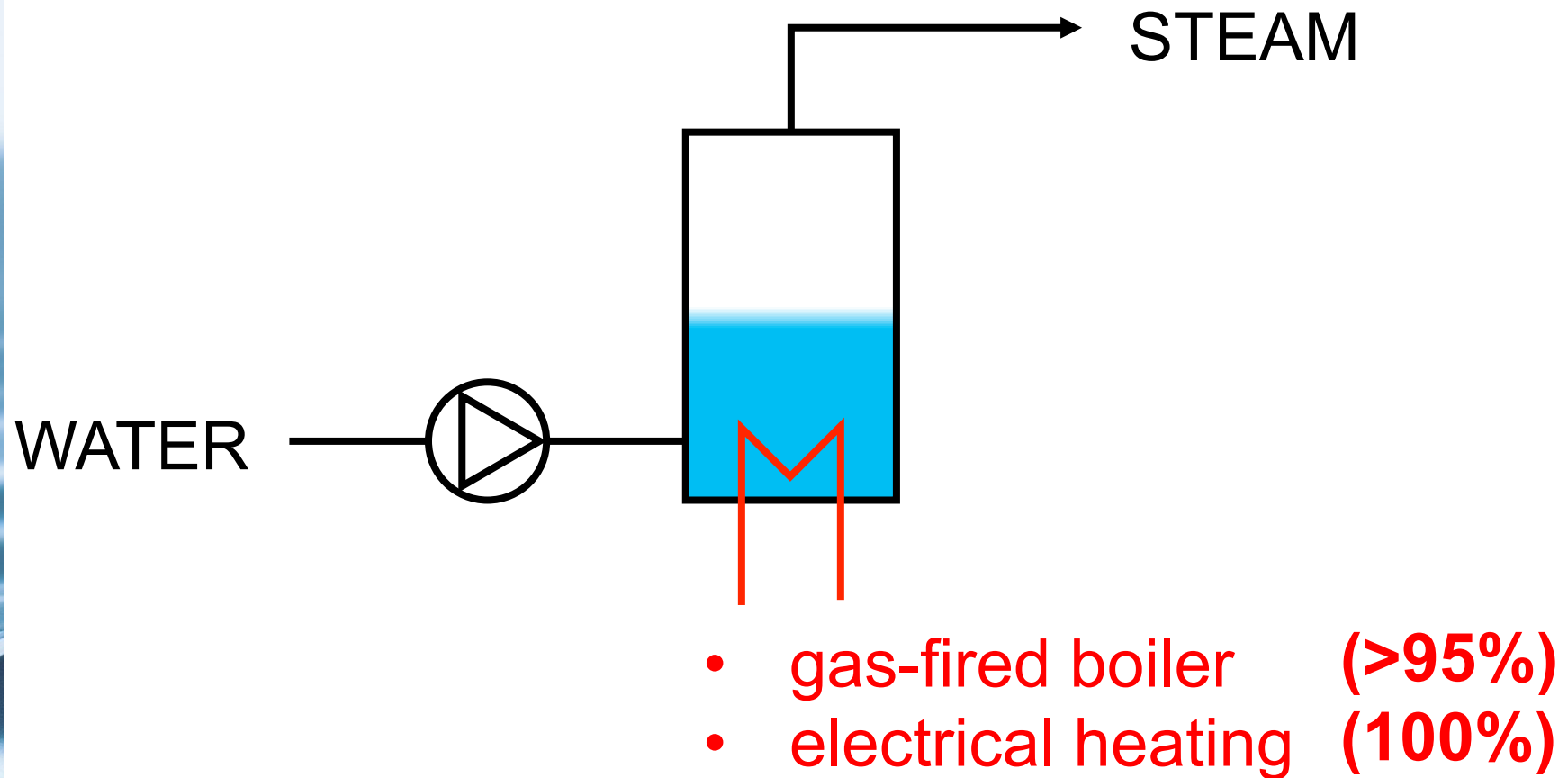
**STEAM**

A steam locomotive with "HOGWARTS EXPRESS" written on its side is stopped at a station platform. The station has a large, arched glass and steel roof. A person in a brown uniform stands on the platform next to the train. The scene is misty or steamy.

# MULTIPLE APPLICATIONS



# STEAM BOILER



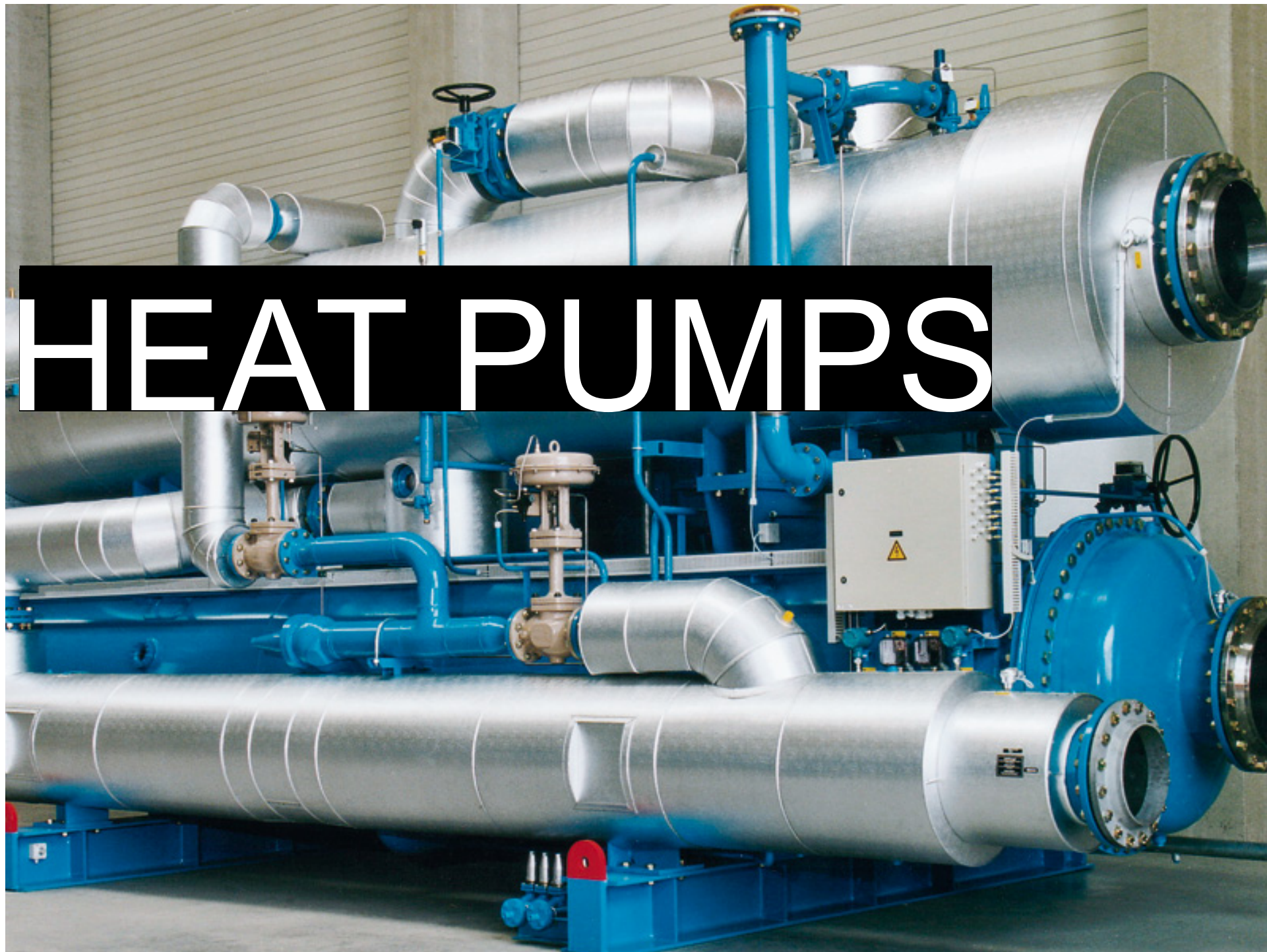
# STEAM BOILER

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THE END

OTHER  
WAYS  
USING  
WASTE HEAT

# HEAT PUMPS



TOO HOT

Heat pumps:  $<80^{\circ}\text{C}$

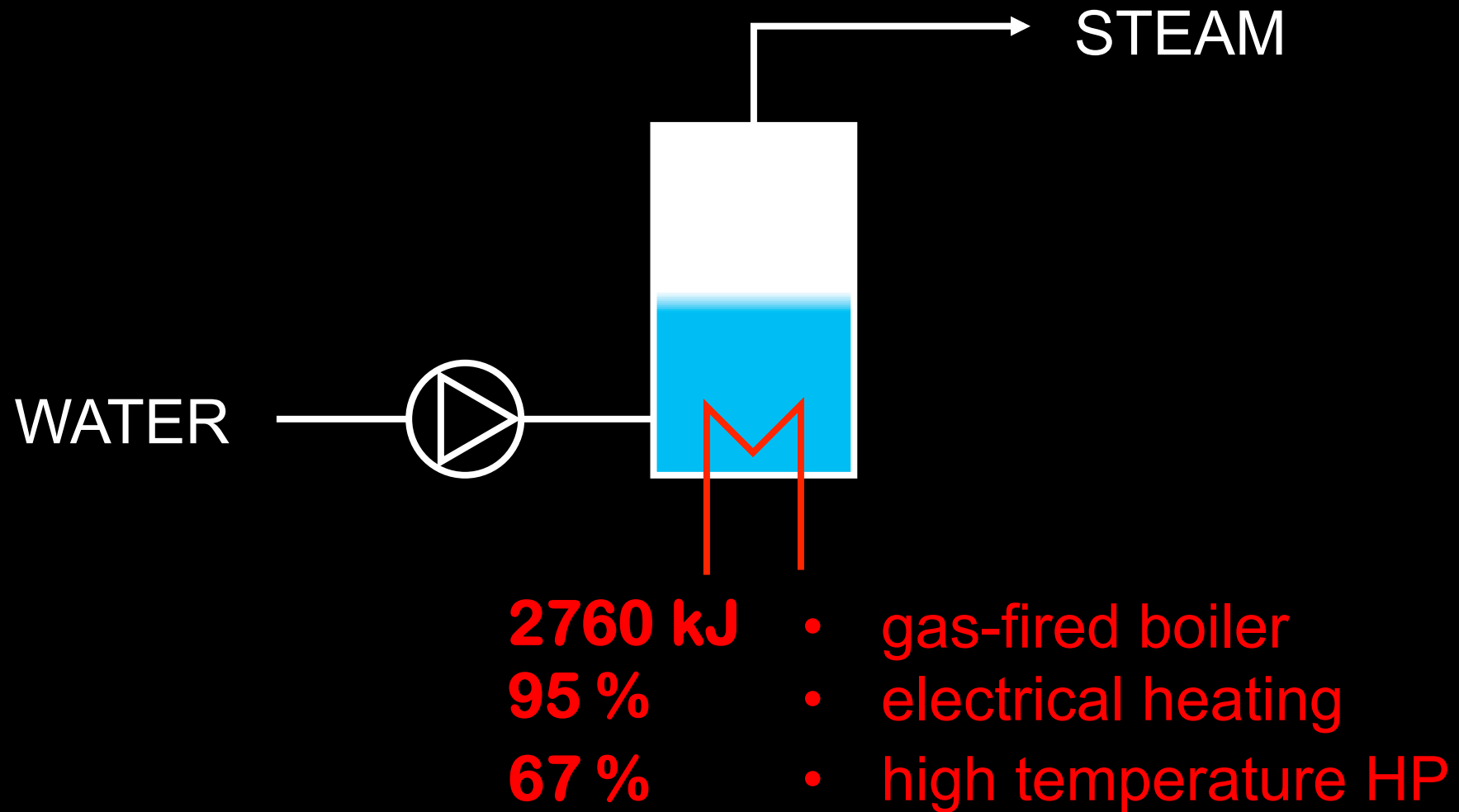
Example:

- Initial state: 25°C, 1 bar
- Final state: 133°C, 3 bar

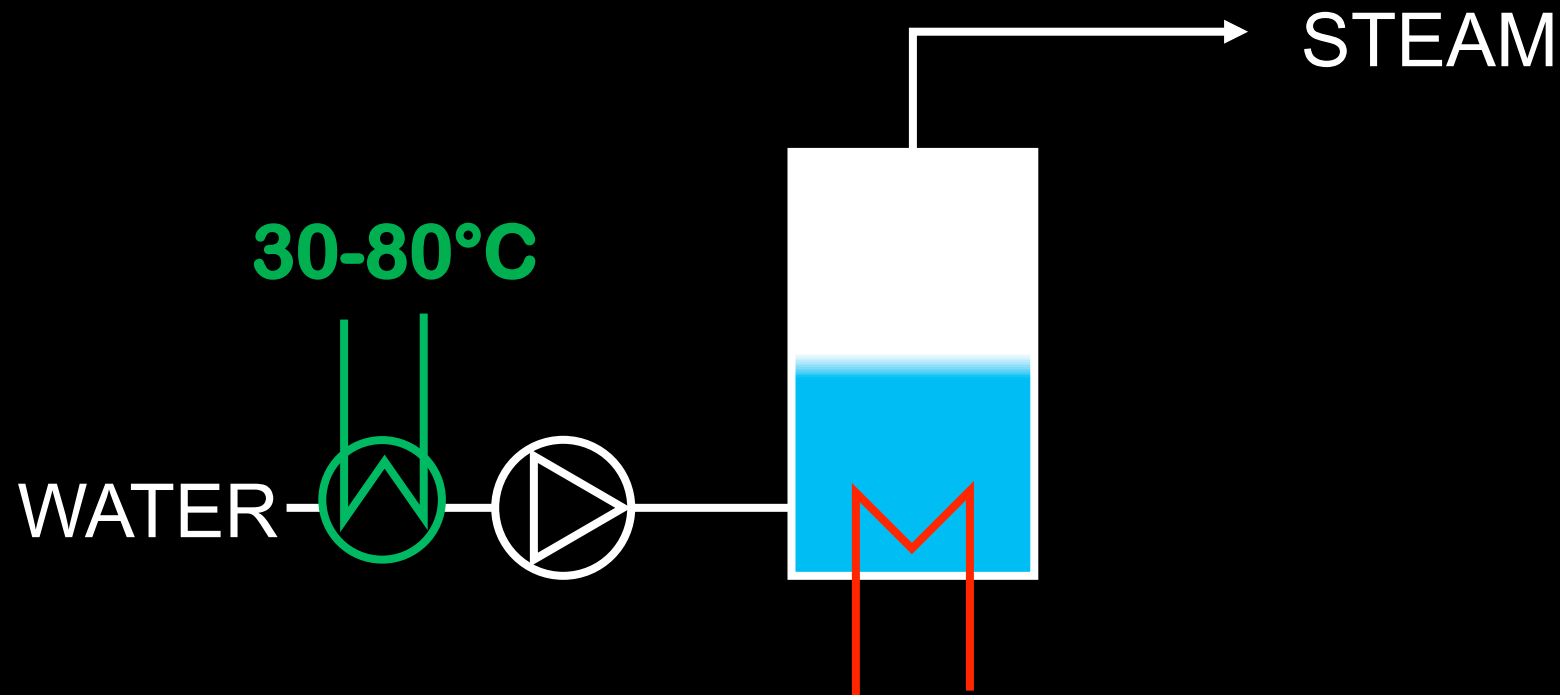
=> 2620 kJ per kg of steam

Example:

- Waste heat  
=> 30-80 °C



# STEAM BOILER



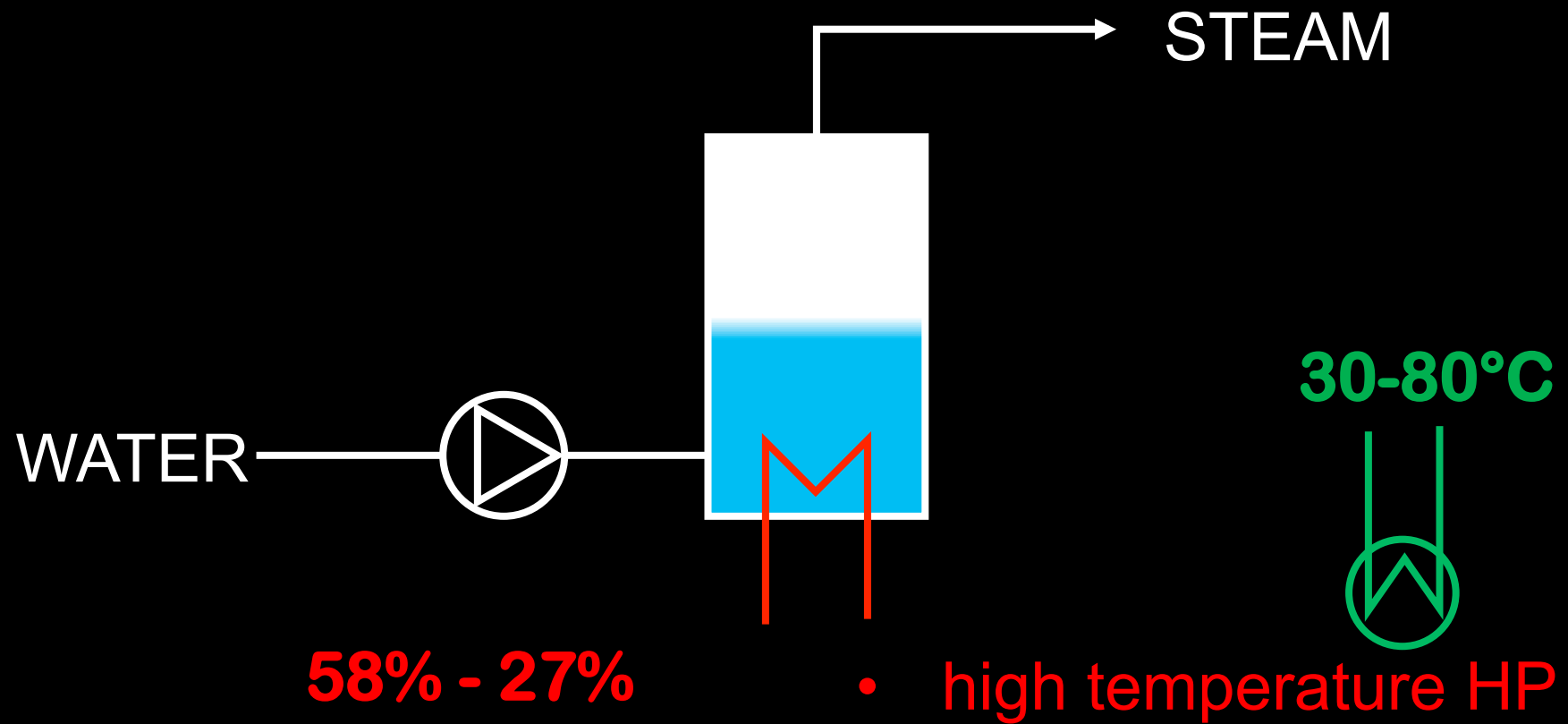
**100% - 92%**

**95% - 87%**

**67% - 62%**

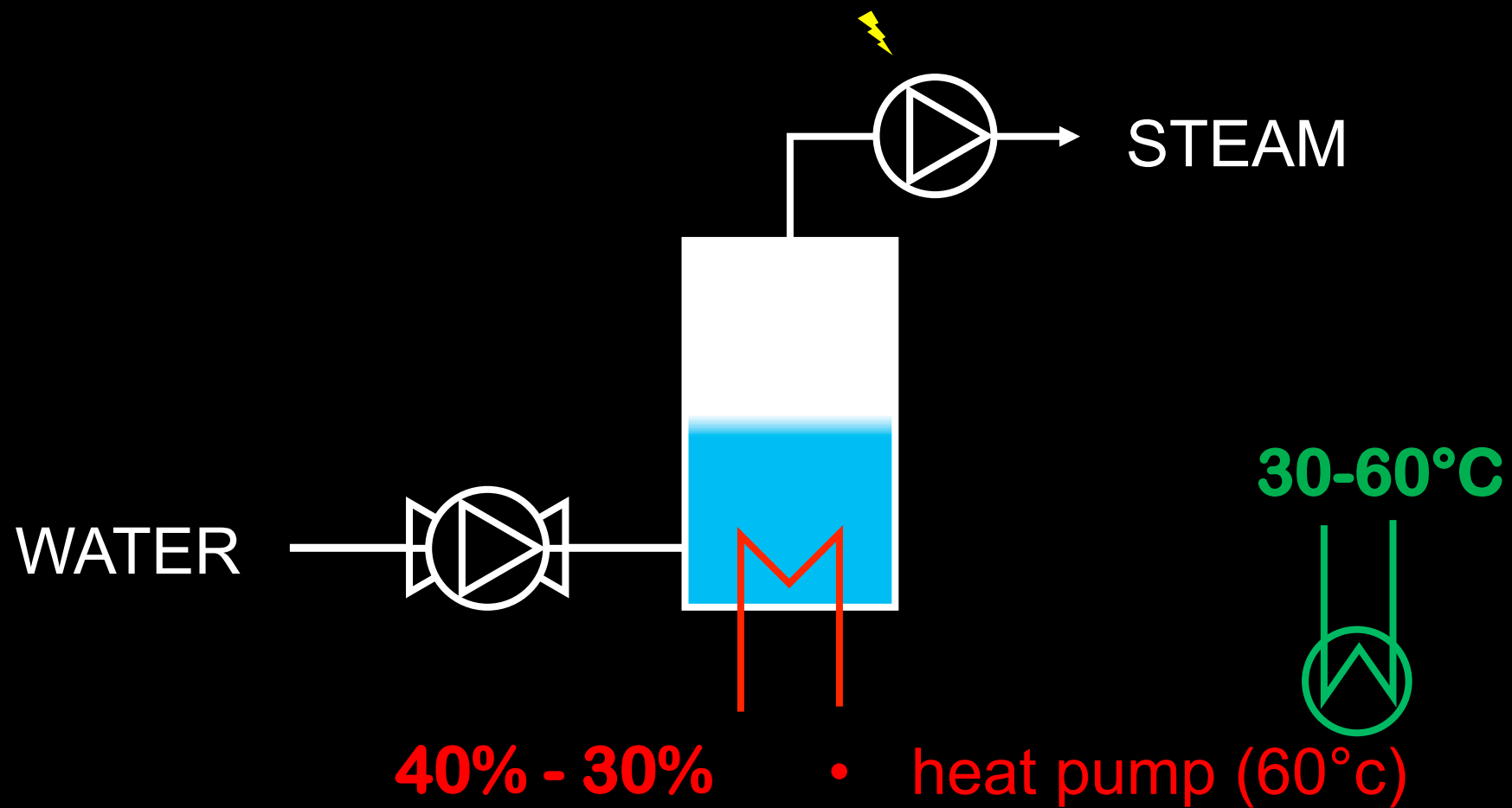
- gas-fired boiler
- electrical heating
- high temperature HP

# STEAM BOILER

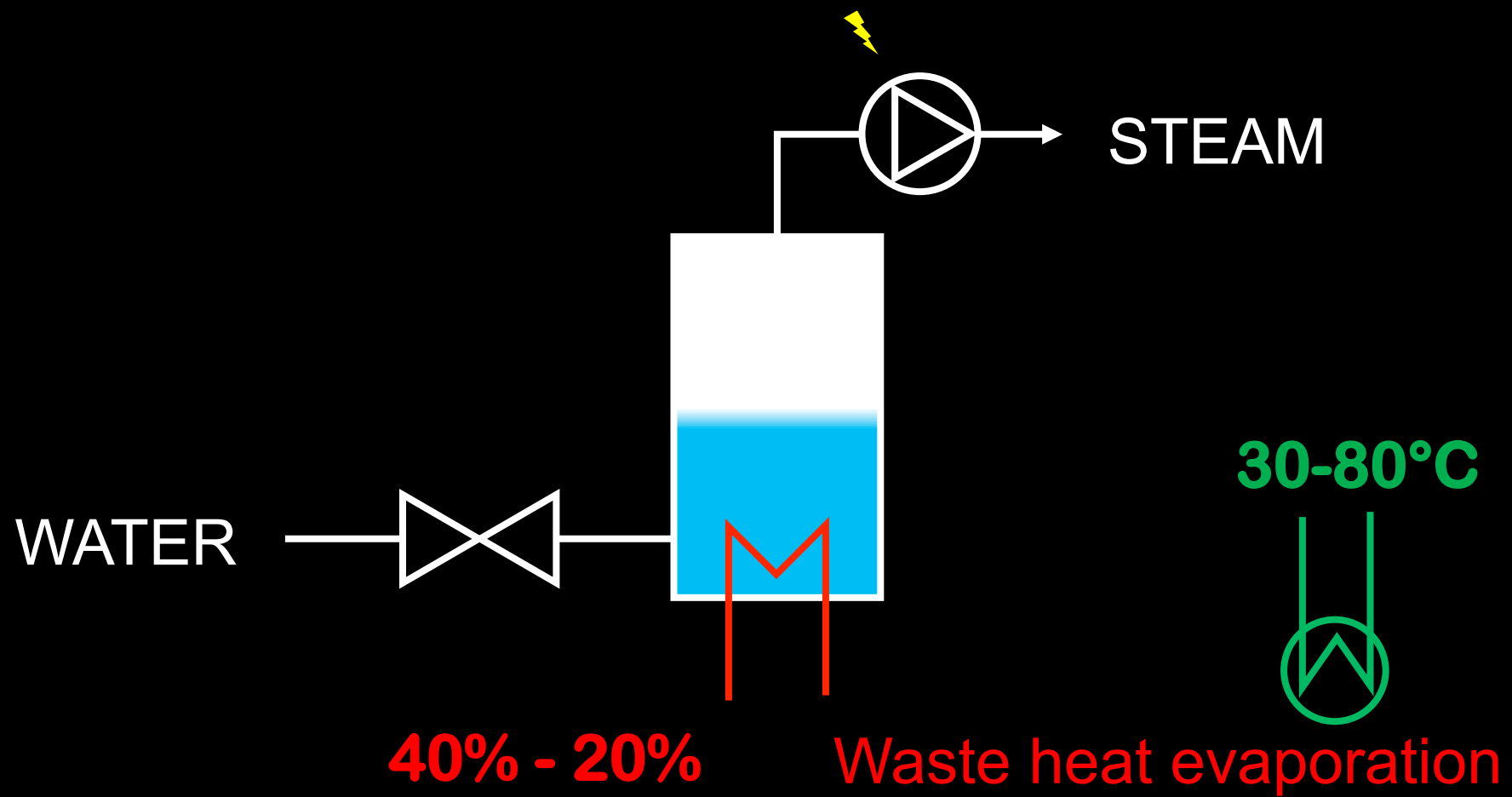


# STEAM BOILER

CURRENT HEAT



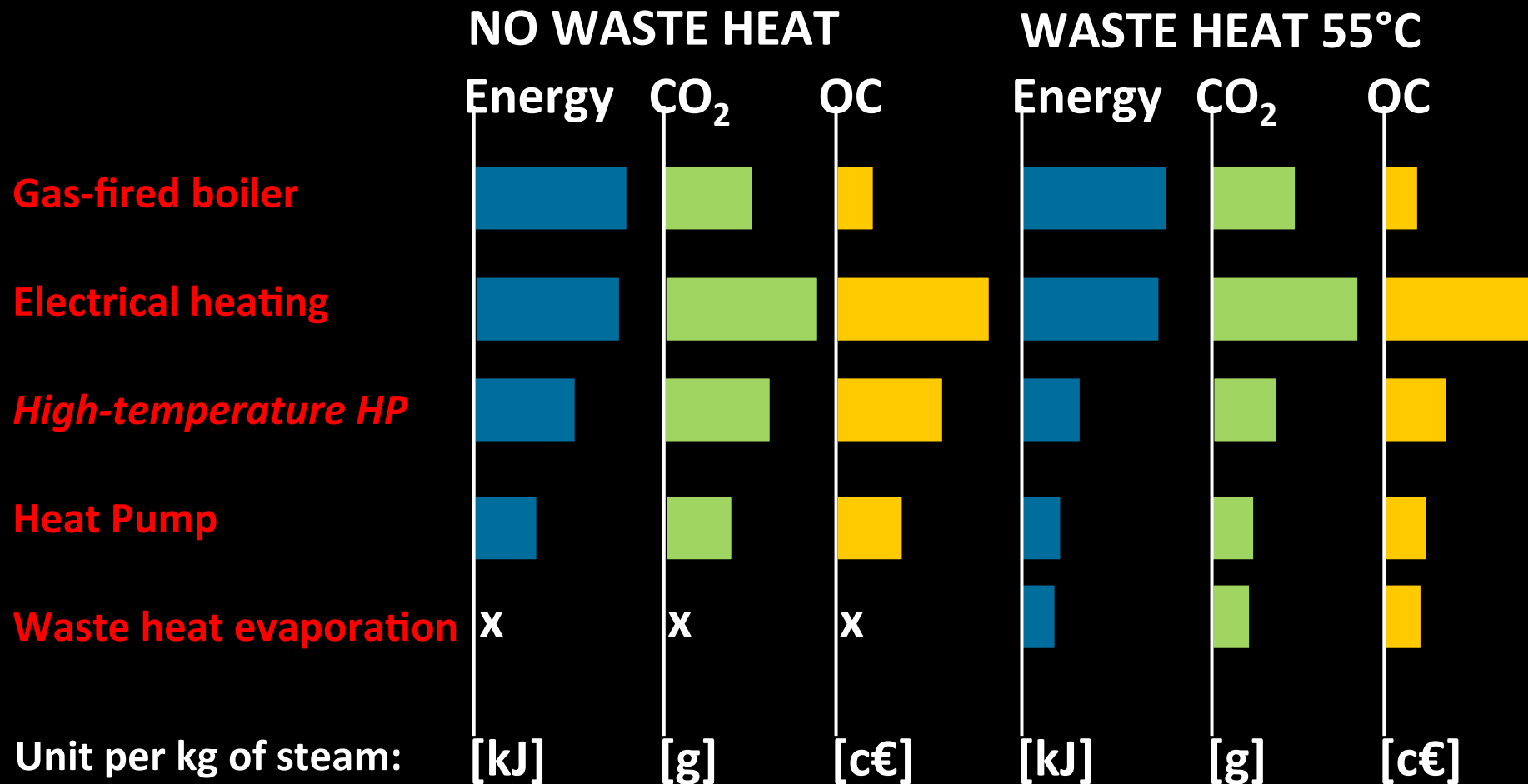
# CURRENT HEAT



NO HEAT PUMP

CONCLUSIONS

# RESULTS



**\*Using values for Germany**



**ENERG**

STEAM 3bar, 133°C



FREDERIC BLESS

14.09.2016



**A**

**STEAM**

**800**

kJ/kg of steam

**Thank you  
very much**

THANK

YOU

