



**WASTE HEAT CASE STUDY**  
**CRH GROUP CEMENT PLANT**

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# WASTE HEAT RECOVERY IN THE INDUSTRY

## Organic ← **O R C** → Cycle

**ORGANIC FLUID**  
(e.g. hydrocarbons, silicon oil, refrigerants)

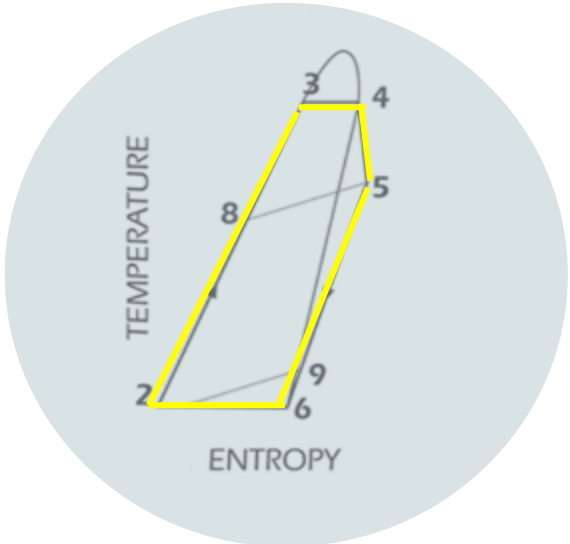
instead of

**WATER / STEAM**

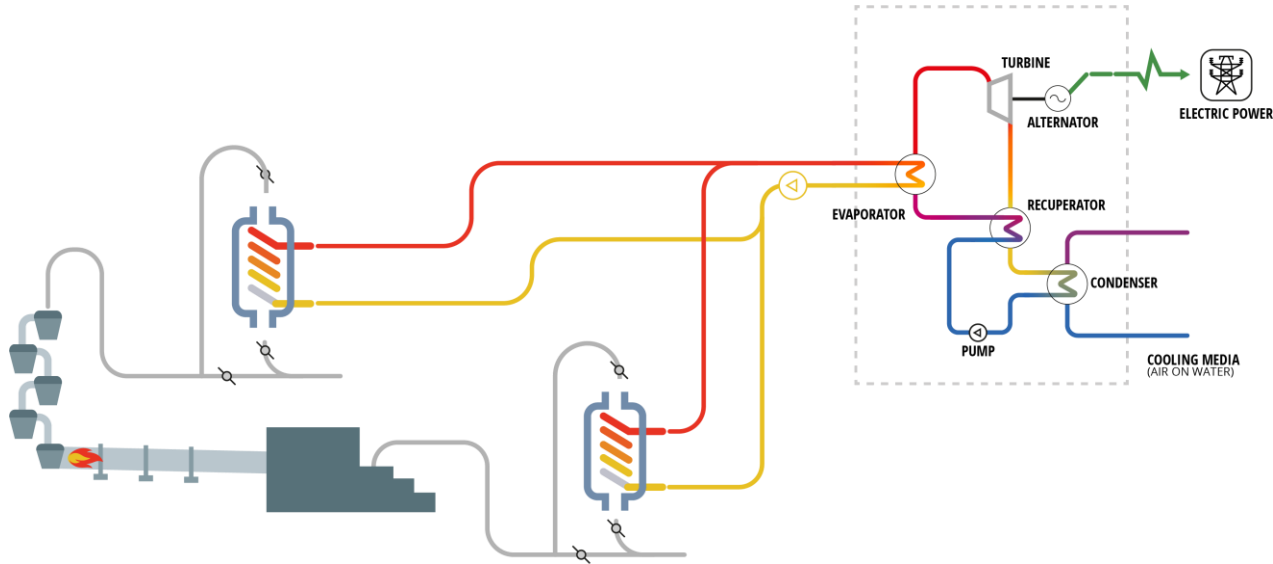
### Rankine



**William John Macquorn Rankine**  
(5 July 1820 - 24 December 1872)



# WHY WORK WITH ORC?



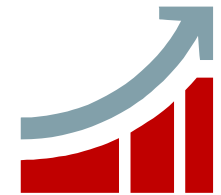
GOOD EFFICIENCY  
IN CONVERTING MEDIUM-LOW  
TEMPERATURE HEAT SOURCE



GOOD EFFICIENCY  
AT PARTIAL LOADS



POSSIBLE CONFIGURATION  
WITH NO WATER CONSUMPTION



HIGH AVAILABILITY,  
NO MAJOR OVERHAUL  
COMPLETELY AUTOMATIC



# WASTE HEAT RECOVERY APPLICATION

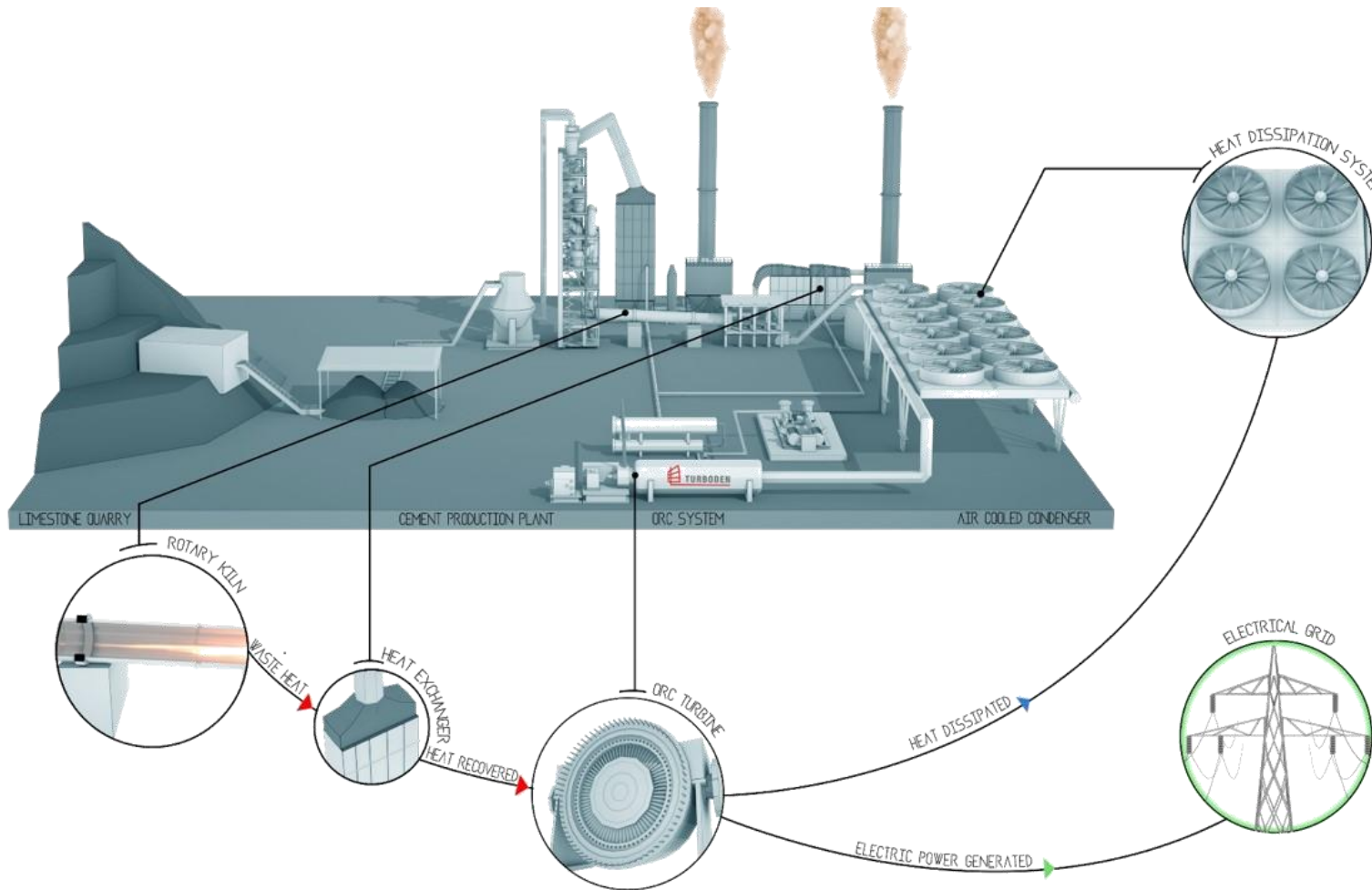
Turboden Organic Rankine Cycle (ORC) units can produce electricity by recovering residual low-grade heat from industrial processes. The generated power ranges from 600 kW<sub>e</sub> up to 20 MW<sub>e</sub> electric per single shaft.

## WHY CHOOSE ORC FOR ENERGY EFFICIENCY?

- Generate profit by valorising a waste heat source
- Reduce specific production cost by decreasing energy demand (10–30%)
- Improve company sustainability
- Contribute to decarbonisation and net zero objective



# WASTE HEAT RECOVERY IN CEMENT INDUSTRY



In cement production process, Turboden ORC systems can produce electric power by recovering waste heat from two hot gas streams:

- kiln pre-heater (PH) gas
- clinker cooler (CC) gas

Turboden ORC systems are easy to integrate, with no impact on industrial process or prime equipment (engine, gas turbine) operation.



# CRH GROUP – DANUCEM, SLOVAKIA



## **CUSTOMER:**

CRH Group – DANUCEM (former Hblcim Group)

## **COUNTRY:**

Slovakia

## **CLINKER PRODUCTION CAPACITY:**

≈ 3,600 ton/day

## **STATUS:**

in operation since February 2014

## **ORC SIZE:**

5 MW

## **HEAT SOURCE:**

pre-heater exhaust gas + clinker cooler air

## **HEAT CARRIER:**

thermal oil

## **COOLING SYSTEM:**

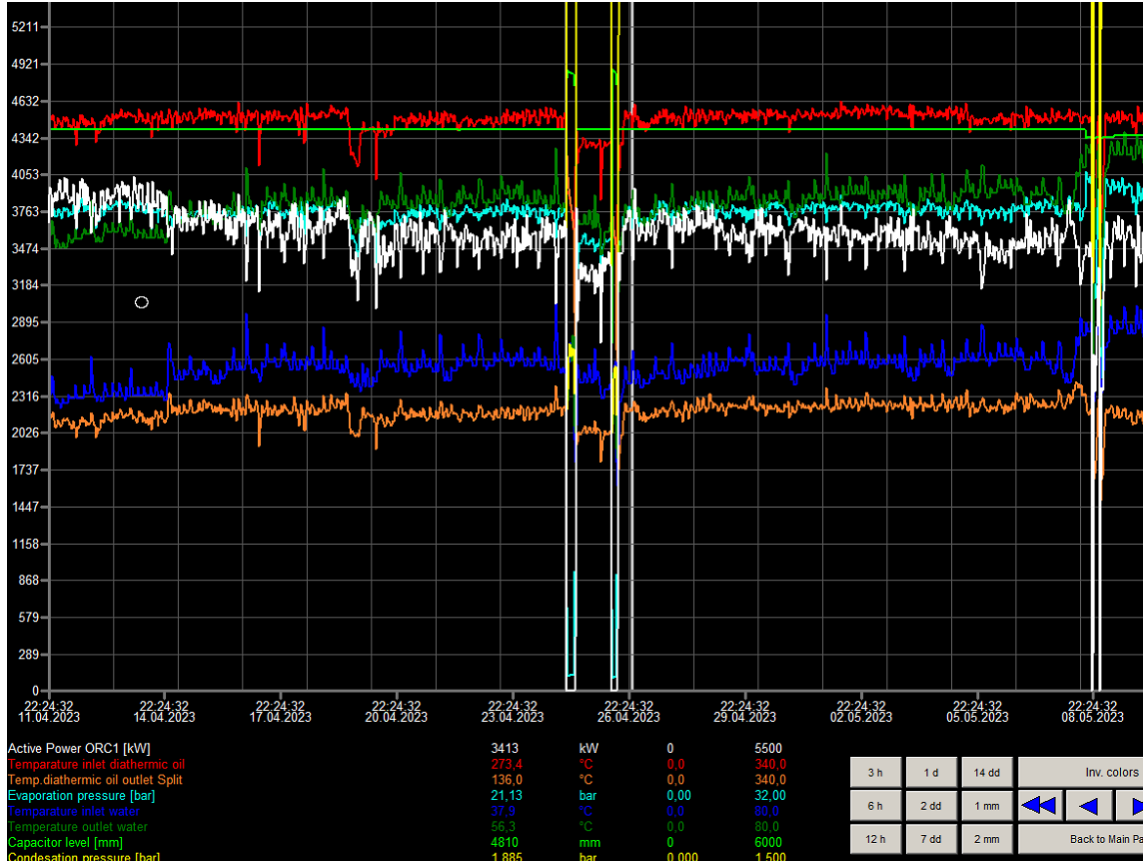
water cooled condenser + cooling towers

# CHR-DANUCEM CEMENT



[Turboden - Heat Recovery system with ORC technology for CRH cement plant - YouTube](#)

# CRH GROUP – DANUCEM SLOVAKIA – OPERATING DATA



Total operating hours: **57617 hours**

Electric power produced from the installation: **220 GWhel**

CO2 tons avoided: **31.240\***

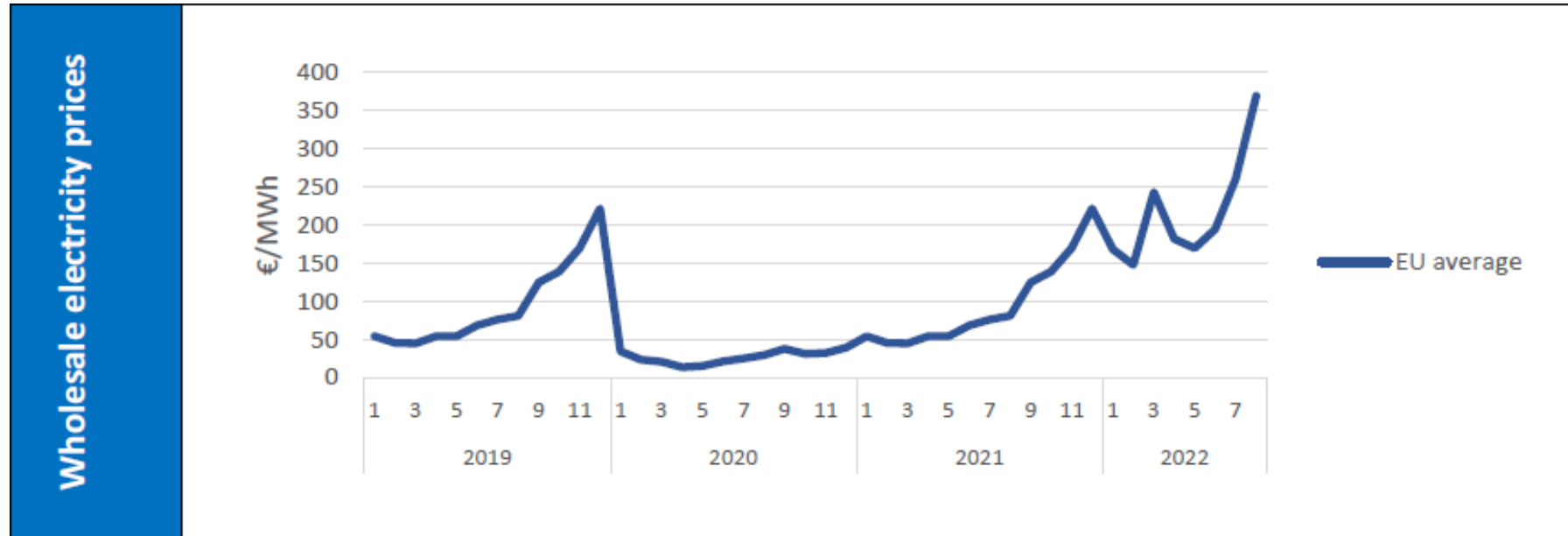
% of cement plant electric consumption covered: **about 20%**

\*142 g CO2eq/kWh in Slovakia



# ELECTRICITY PRICES 2019-2022

In the past year electricity price has been skyrocketing through all Europe.



Source: REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS (18/10/2022)

In this scenario, taking into account also the attitude towards the transition to cleaner energy production, waste heat recovery from industrial processes becomes a key factor to the reduction of energy-related costs and to the enhancement of the plant energy efficiency, in almost every sector.



**THANK YOU FOR THE ATTENTION**

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Q&A SLIDES



# TURBODEN REFERENCES IN HEAT RECOVERY



WHR APPLICATION	OPERATING PLANTS	PLANTS UNDER CONSTRUCTION	TOTAL ELECTRIC POWER INSTALLED (KW)	ORC SIZE (KW)
CEMENT	9	1	41,000	1,500-11,000
STEEL&METAL	8	0	21,5000	600-10,000
GLASS	5	6	14,700	600-5,000
OIL&GAS (from GAS COMPRESSOR STATION and FLARE GAS)	3	1	32,000	1,000-28,000
OIL&GAS (from INTERNAL COMBUSTION ENGINES)	13	0	18,6	500-2,300
GAS EXPANDER	1	3	2,600	300-1,300

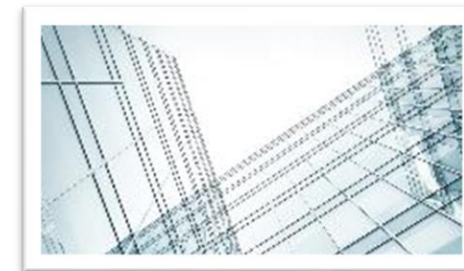
**CEMENT**



**STEEL**



**GLASS**



**O&G**



# TURBODEN REFERENCES INCEMENT



PLANT	START UP	COUNTRY	KILN CAPACITY (TON/DAY)	HEAT SOURCE	HEAT CARRIER	ORC GROSS ELECTRIC POWER (kW)
CIMENTS DU MAROC (HeidelbergCement, former Italcementi)	2010	Morocco	5,000	PH	thermal oil	2,000
HOLCIM ROMANIA (LafargeHolcim Group)	2012	Romania	4,000	PH + CC	thermal oil + superheated water	4,000
CRH SLOVAKIA (former Holcim Group)	2014	Slovakia	3,600	PH + CC	thermal oil	5,000
CARPATCEMENT (HeidelbergCement Group)	2015	Romania	3,500	PH + CC	thermal oil	3,800
JURA-CEMENT-FABRIKEN (CRH Group)	2016	Switzerland	3,000	PH	superheated water	2,300
CEMENTI ROSSI	2018	Italy	3,500	PH + CC	none – direct exchange	1,500
ÇİMKO (Sanko Group) EPC: CTP Team & CTN	2019	Turkey	9,500	CC	thermal oil	7,000
HOLCIM SUISSE ECLÉPENS (LafargeHolcim Group)	2020	Switzerland	2,300	PH + CC	superheated water	1,300
SÖNMEZ ÇİMENTO EPC: CTP Team & CTN	2020	Turkey	6,000	PH + CC	thermal oil	8,100
SECIL EPC: CTP Team & CTN	Under construction	Portugal	3,800	PH + CC	thermal oil	7,000
Undisclosed	Under construction			PH + CC	thermal oil	8,000
Undisclosed	Under construction			PH + CC	thermal oil	6,000

# TURBODEN REFERENCES IN STEEL & METAL



PLANT	START UP	MAIN PROCESS EQUIPMENT			HEAT CARRIER	ORC gross electric power (kW)
		type	charge	capacity		
<b>NATSTEEL</b> Singapore	2013	steel rolling mill billet reheating furnace	billet	125 ton/h	none – direct exchange	700
<b>ELBE STAHLWERKE FERALPI</b> Germany	2013	steel electric arc furnace	scrap	100 ton	saturated steam	2,700
<b>ORI MARTIN</b> Italy	2016	steel electric arc furnace	scrap - consteel	85 ton	saturated steam	2,200
<b>FONDERIA DI TORBOLE</b> Italy	2016	iron cupola furnace	scrap, pigs	30 ton/h	thermal oil	700
<b>ARVEDI</b> Italy	2018	steel electric arc furnace	scrap	250 ton	saturated steam	10,000
<b>SAFRAN</b> EPC: INVEST ENERGY Malaysia	2019	chemical vapor infiltration furnace	n.a.	n.a.	thermal oil	1,900
<b>POSCO ICT</b> South Korea	2019	Fe-Mn submerged arc furnace	raw materials	150 ton/d	thermal oil	1,200
<b>SACAL</b> Italy	2019	aluminum rotative furnaces	scrap	n.a.	thermal oil	2,100



# REFERENCES FROM INTERNAL COMBUSTION ENGINES



PLANT	COUNTRY	START UP	ORC SIZE (MWe)	ENGINES
PISTICCI I	Italy	2010	1.8	3 x 8 MWe Wärtsilä diesel engines
TERMOINDUSTRIALE	Italy	2008	0.5	1 x 8 MWe MAN diesel engine
PISTICCI II	Italy	2012	4	2 x 17 MWe Wärtsilä diesel engines
CEREAL DOCKS	Italy	2012	0.5 (direct exchange)	1 x 7 MWe Wärtsilä diesel engine
E&S ENERGY	Italy	2010	0.6	2 x 1 MWe Jenbacher gas engines + 3 x 0.8 MWe Jenbacher gas engines + 1 x 0.6 MWe Jenbacher gas engine – landfill gas
ULM	Germany	2012	0.7	2 x 2 MW Jenbacher gas engines (+ additional heat from process)
KEMPEN	Germany	2012	0.6	Gas engines
MONDO POWER	Italy	2012	1	1 x 17 MWe Wärtsilä diesel engine
HSY	Finland	2011	1.3	4 x 4 MWe MWM gas engines – landfill gas
FATER	Italy	2013	0.7 (direct exchange)	1 x 8 MWe Wärtsilä diesel engine
ORTADOGU I	Turkey	2020	2.3	12 x 1.4 MWe Jenbacher engines – landfill gas
ORTADOGU II	Turkey	under construction	2 x 2.3	20 x 1.4 MWe Jenbacher engines + 4 x 1.2 MWe MWM engines – landfill gas
BIOGASTECH	Belgium	2019	0.7	4 x 3.3 MWe Jenbacher gas engines