



Horizon2020 Information Days on Public-Private Partnerships

Brokerage event
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*AN INNOVATIVE WET STEAM SYSTEM TO TRANSFORM WASTE
HEAT INTO ELECTRICITY*

JAKUB KRUSZELNICKI

KRUSZELNICKI@TRANSFER.EDU.PL



ORGANIZATION

Cracow University of Technology
Institute of Thermal Power Engineering



Research area:

- Thermal Power Engineering
- Modern Power Systems
- Structural, heat and flow modelling of (MES, CFD)
- High pressure power boilers and units
- Life duration and creeping of pressure elements
- Experimental investigation of heat exchangers
- Flow and heat meters

Industry Cooperation:

The Institute made in cooperation with industrial partners a number of innovative solutions aimed at improving the safety, effectiveness and units efficiency.

Partners:

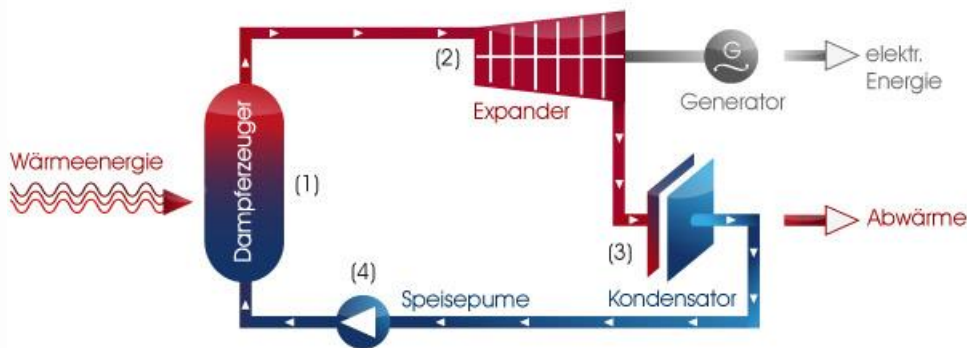
Heat&Power Plants,
Industrial Automatization and Control,
Power Boiler Manufacturers



PROJECT IDEA

Waste heat potential

- Germany:
 - 320 PJ¹⁾ (90 TWh)
- Europe:
 - 500 PJ (140 TWh)
- Base load capable
- Balancing energy
- Simple mechanical solutions



Overall decreasing heat demand and slightly higher electricity demand

1) Corresponds to around 12% of the industrial end energy or to around 2.5 GW of electrical power (3 to 5 large power plants)

Waste heat by sources: 40% cement, 30% iron alloys, 8% chemistry, 22% others

Literature sources: Institute for Energy and Environmental Research Heidelberg GmbH, Aqua Society Inc.

PROJECT IDEA

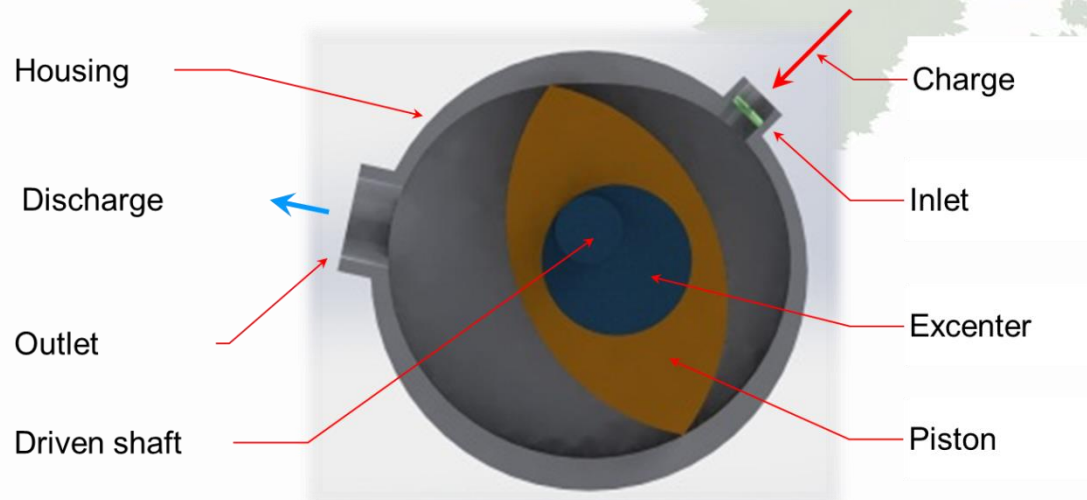
Why a volume displacement machine?

Disadvantages of other technologies

- Turbines are not suitable for wet steam
- Reciprocating machines are voluminous and mechanically complex

Advantages of the piston machine

- Compact
- Mechanical simple
- Suitable for wet steam

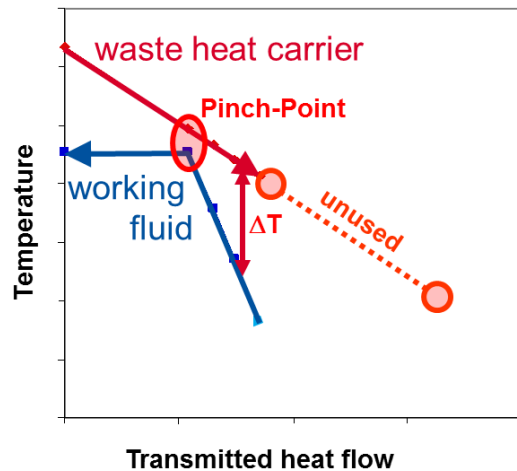


EXCELLENCE OF THE INNOVATION

Improvement of energy efficiency

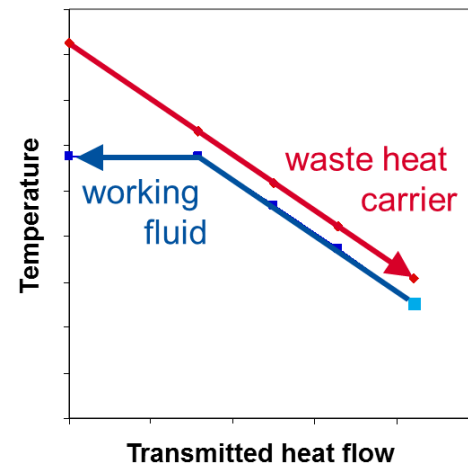
Disadvantages Standard-CRC/ORC

- Incomplete use of waste heat
- Low performance
- Pinch point problem



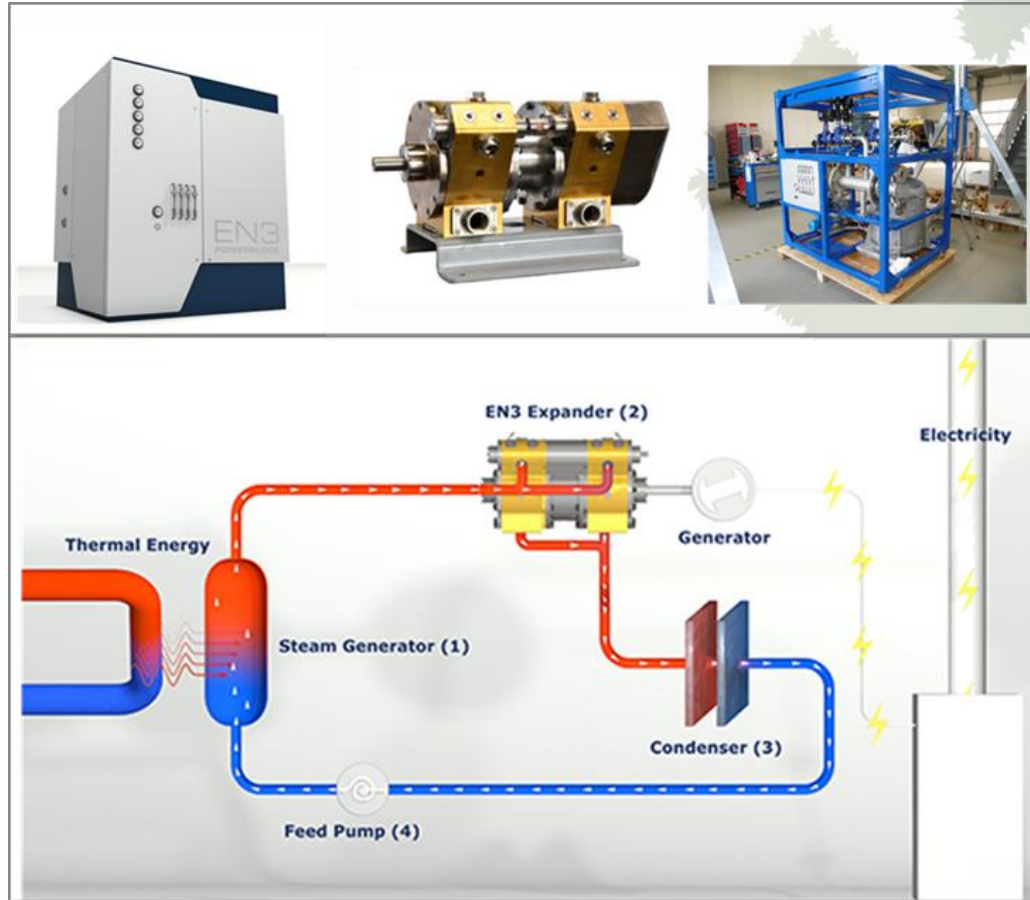
Advantages of wet steam expansion

1. Complete cooling of the heat source
2. Near maximal power output (delta process)
3. Almost free choice of working fluid



APPLICATION/PRODUCT IDEA

Decentralised 10 to 50 kW CRC System Module that taps into any waste heat source. These sources are usually hot (flue) gas streams.



IMPACT

- Novel expansion machine for Small Scale Waste Heat Recovery Systems (10 – 50 kW)
- Applicable to a broad range of waste heat sources, e.g. internal combustion (IC) engine tailpipes, industrial plant chimneys/stacks

Key Benefits

- Energy efficiency increase by 15 % and more.
- CO₂-free electricity @ no primary energy cost: waste heat is free of charge, no extra fuel costs!
- Short amortization period (about 2.5 years).

Key Markets:

IC-engines (transportation and stationary):

- Global production figures for 2013:

Segment	Production # in 2013
Commercial vehicles	5 200 000
Cars	78 300 000
Agricultural vehicles	19 100 000
Power generation (CHP)	11 500 000
Construction	1 800 000
Marine	1 200 000
Railway	50 000

- There are 13 800 Green CHPs (Biogas-Plants) in Europe alone.

Global Industrial Waste Heat Potential:

- Translates to \$ 53.12 Billion.

EXISTING PROJECT CONSORTIUM



- Laboratory for Energy and Process Engineering



- Developer of innovative CRC power plant systems (12 patents)



- Cracow University of Technology



- Bosal



- ORLEN



- Sapienza University of Rome

Topics

1. Transient evaporation and heat transfer processes¹⁾
2. Performance and system engineering²⁾
3. Measuring and controlling steam quality and two phase flow
4. Compact and low cost heat exchanger design and production
5. Hosting Lighthouses for demonstration
6. Wet steam injector optimization

1) Minimize the losses, injection - flash evaporation

2) Heat exchangers, pumps, measuring and control engineering

LOOKING FOR PARTNERS

- We are offering opportunities for partners with a long-term strategic interest in the described product idea.
- Ideally the new partner would buy this Waste Heat Recovery System once the product development will be finished in the future because this product offers the economic benefits described here.
- In this project, the new partner would represent the end-user and host the system demonstration as a real life lighthouse demonstration.
- Partner entities could be
 - ✓ Energy Supply Companies
 - ✓ Biogas-/Biomass Plant Operators
 - ✓ Industrial Plant Operators
 - ✓ Engine OEMs (both transportation and stationary) including off-highway, marine, railway

CONTACT DETAILS



Prof. Dr. Andreas Gubner
andreas.gubner@hm.edu



Kruszelnicki Jakub
tel.: +48 12 628 28 45 +48 12 628 28 45
email: kruszelnicki@transfer.edu.pl