MEDIGREEN ENERGY

ORC Turbines

Fuelling the future

About Us

MEDIGREEN ENERGY One offers its ORC based waste heat recovery turnkey solutions through its patented ORC turbines.Our scope covers the following:

- Design Engineering
- Project Management
- Technology Optimisation
- Turnkey Projects
- Operation & Maintenance
- Training
- Research & Development

Fuelling the future

Why Us

Our Vision

Be a leading driver for a commercially viable biofuel solutions globally

Our Mission

Our Mission to strive hard to achieve what has not been achieved hitherto and produce the world's best products & services in terms of quality, reliability and performance to serve the domain of biogas and translate our advanced technologies into value for our customers and stakeholders.

OUR EXPERIENCE – YOUR ADVANTAGE

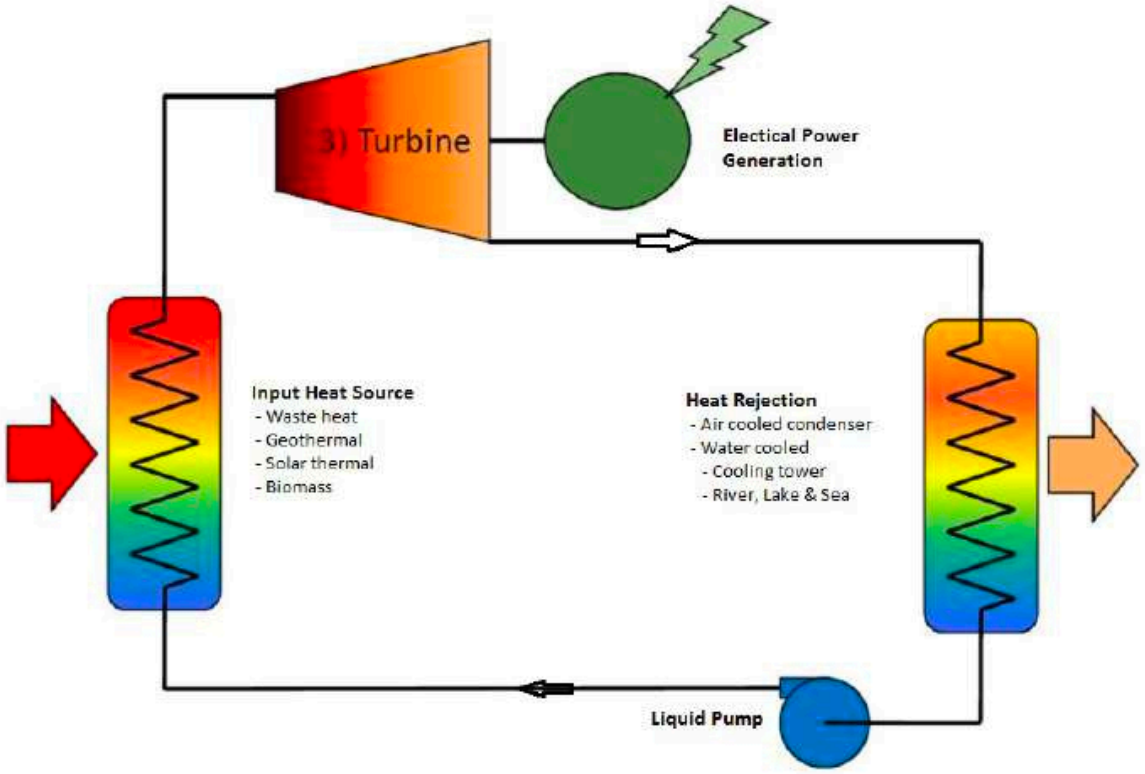
- Standard & individual solutions
- Innovative ideas & mature concepts
- Efficient processes & many years of experience
- Transparency & know-how in implementation
- Cost efficiency through a lean organization
- Social impact through local value creation

Our Facilities

Factory

Door No:2, First Floor M/s
Datta Guru Industries Gat no.53
Dehu Alandi Road Talawade Pune
Maharashtra

What is ORC Turbine?

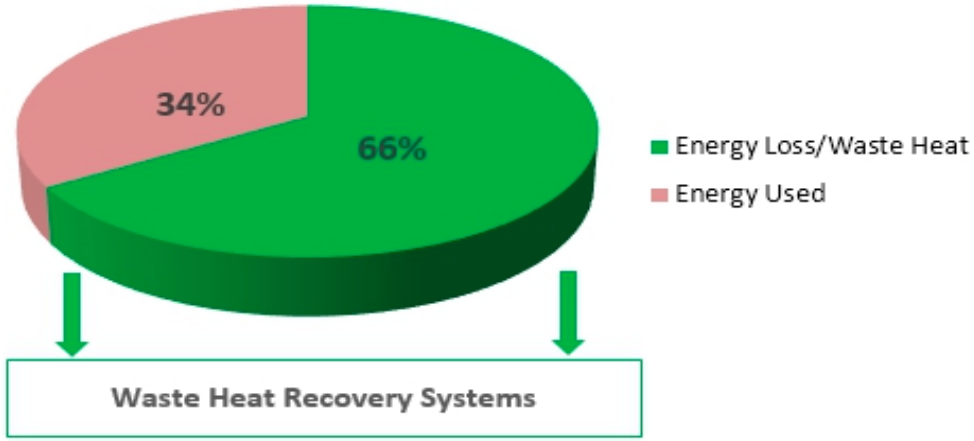


Simple Schematic of the Organic Rankine Cycle process

The Process

- A high molecular mass fluid is evaporated (boiled) to produce vapor (gas) at high pressure (1).
- The high pressure gas is expanded through the ORC turbine, converting it into kinetic energy (in the form of rotation).
- A high efficiency, high speed permanent magnet generator connected to the turbine wheel converts the rotational kinetic energy into electrical energy.
- Once the gas has expanded it flows into a condenser, where heat is rejected and it condenses back into liquid state
- The liquid is then pumped back to high pressure
- The liquid passes through the liquid heater and evaporator where it becomes a high pressure gas and starts the cycle over again (1)

Waste Heat Sources

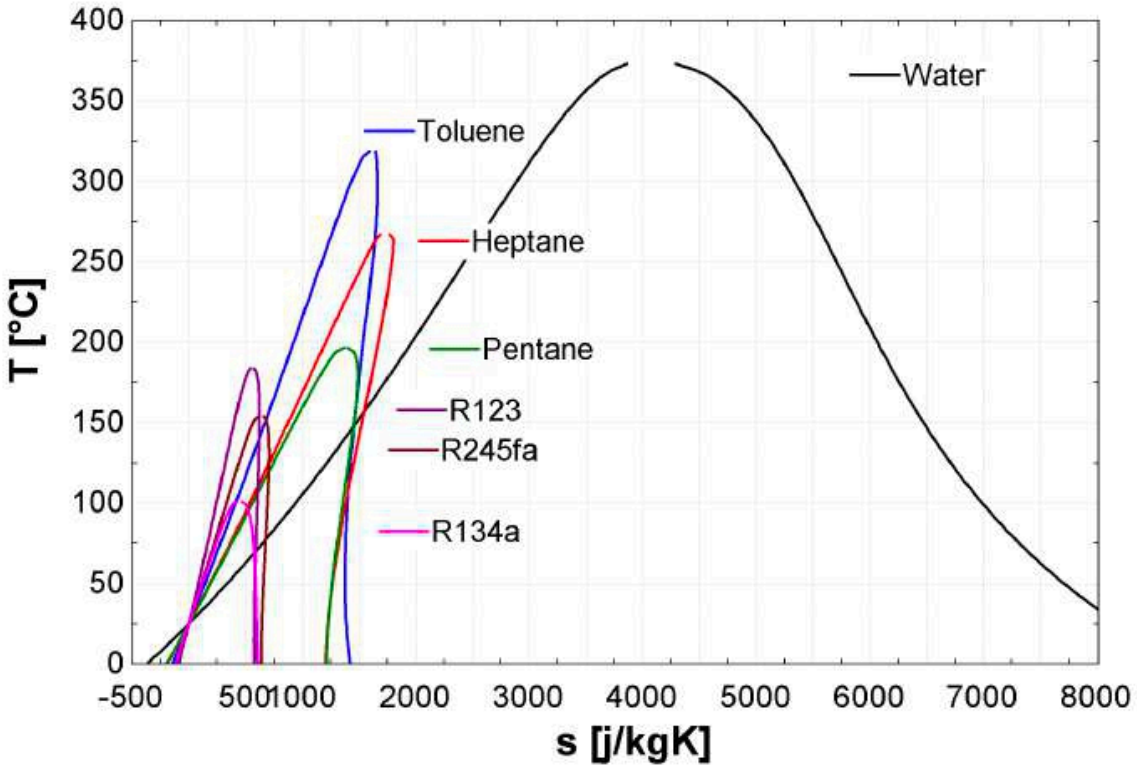


Uses of Waste Heat

Combustion Air PreHeating
Boiler Feed Water PreHeating
Power Generation
Steam Generation for Power Generation
Process Steam
Plant Comfort Heat
Water PreHeating
Transfer to Process Streams
ABsorption/ADsorption Chilling

Typical Waste Heat Temperatures*	°C	°F
Nickel Refining Furnace	1370 - 1650	2498 - 3002
Aluminum refining Furnace	650 - 760	1202 - 1400
Zinc Refining Furnace	760 - 1100	1400 - 2012
Copper Refining Furnace	760 - 815	1400 - 1499
Steel Heating Furnace	925 - 1050	1697 - 1922
Steam Boiler Exhausts	230 - 480	446 - 896
Open Hearth Furnace	650 - 700	1202 - 1292
Heat Treating Furnaces	425 - 650	797 - 1202
Glass Melting Furnace	1000 - 1550	1832 - 2822
Hydrogen Plants	650 - 1000	1202 - 1832
Solid Waste Incinerators	650 - 1000	1202 - 1832
Fume Incinerators	650 - 1450	1202 - 2642
Gas Turbine Exhaust	370 - 540	698 - 1004
Diesel Generator Exhaust	300 - 600	572 - 1112
Hot Processed Liquids	32 - 232	89.6 - 450
Welding Machines	32 - 88	89.6 - 190
Air Compressors	27 - 50	80.6 - 122
Pumps	27 - 88	80.6 - 190
*http://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf		

Organic Working Fluids



- ✓ Dry fluids => no threat of damage for the turbine
- ✓ High vapor density
- ✓ **Working fluid** at **low pressure**(<30 bar)
- ✓ Pressure in the condenser possibly higher than ambient pressure (**no infiltration**)

ORC Applications

Applications:

Heat Recovery

ORC units produce electricity by recovering heat from sources such as industrial processes, reciprocating engines, and gas turbines.

Biomass

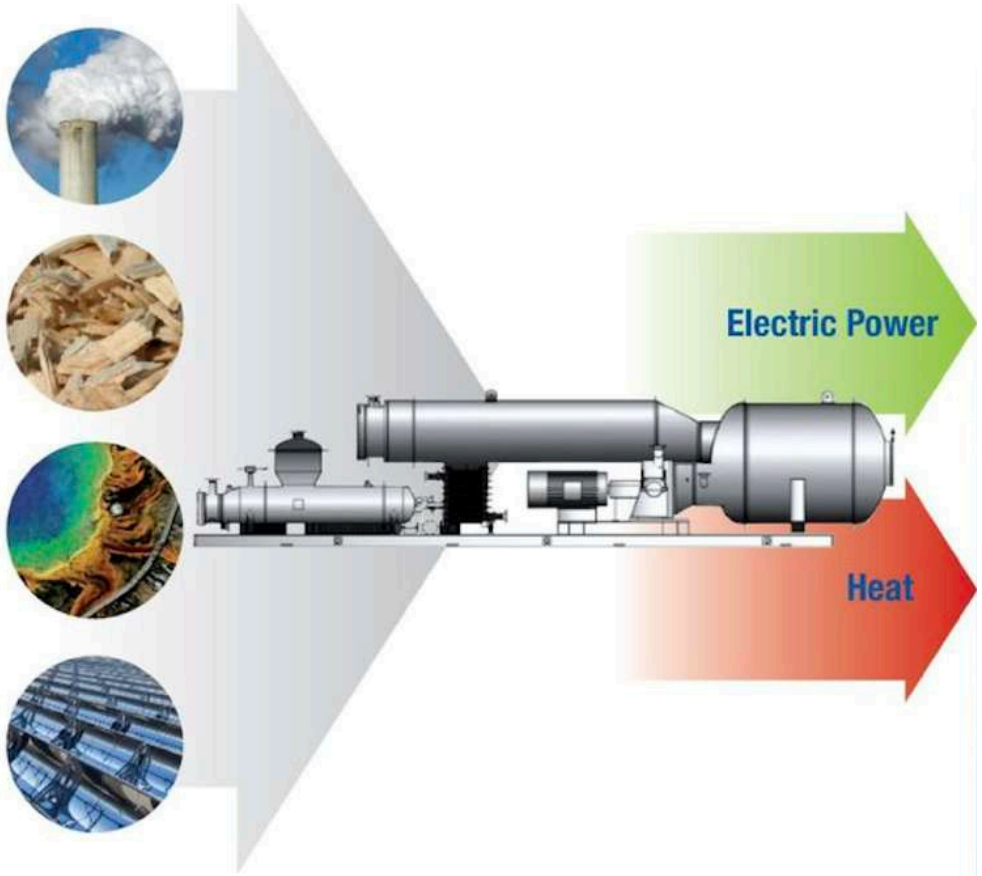
ORC units allow simple and efficient generation of electric power and heat from biomass.

Geothermal

ORC units can produce electricity from geothermal resources with medium-to-low-temperatures, generally ranging between 195° F - 355° F (90° C - 180° C).

Solar Thermal Power

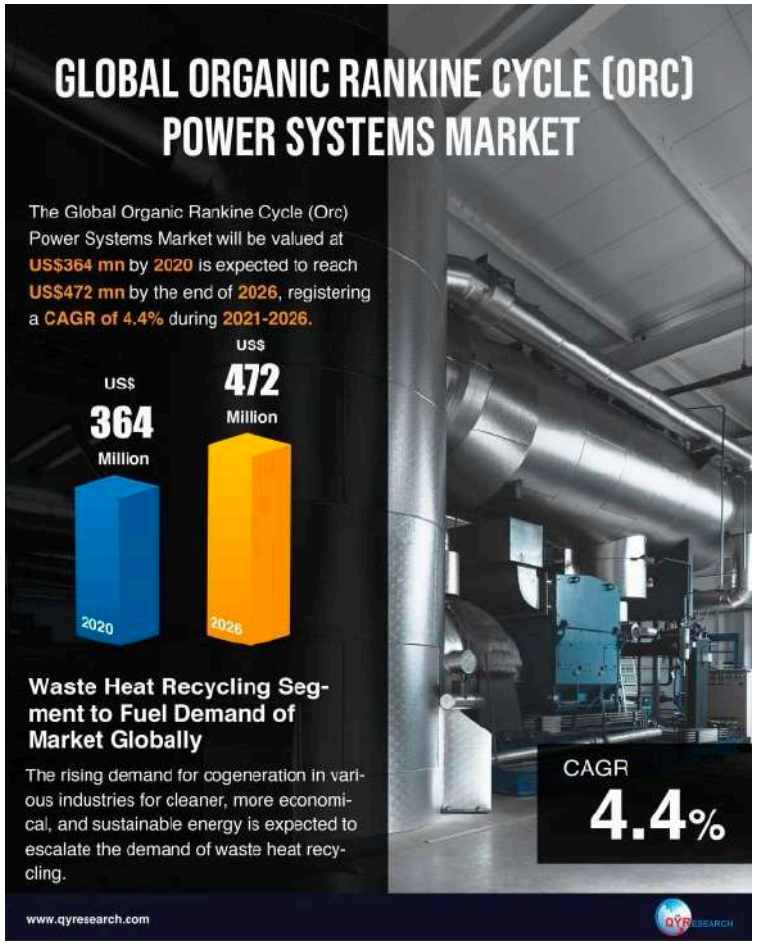
Concentrating solar power systems with Turboden ORC units allow conversion of heat harnessed by solar collectors into electricity through an efficient thermodynamic cycle.



Market Evolution

- ✓ Growing market
- ✓ 3 important markets:
  - ➢ Waste heat recovery (WHR): 20%
  - ➢ Biomass combined heat & power (CHP): 48%
  - ➢ Geothermal energy: 31%

- ✓ Still few solar applications
- ✓ Technological maturity >50 kWe
- ✓ **Powers <50 kWe: mainly in R&D**

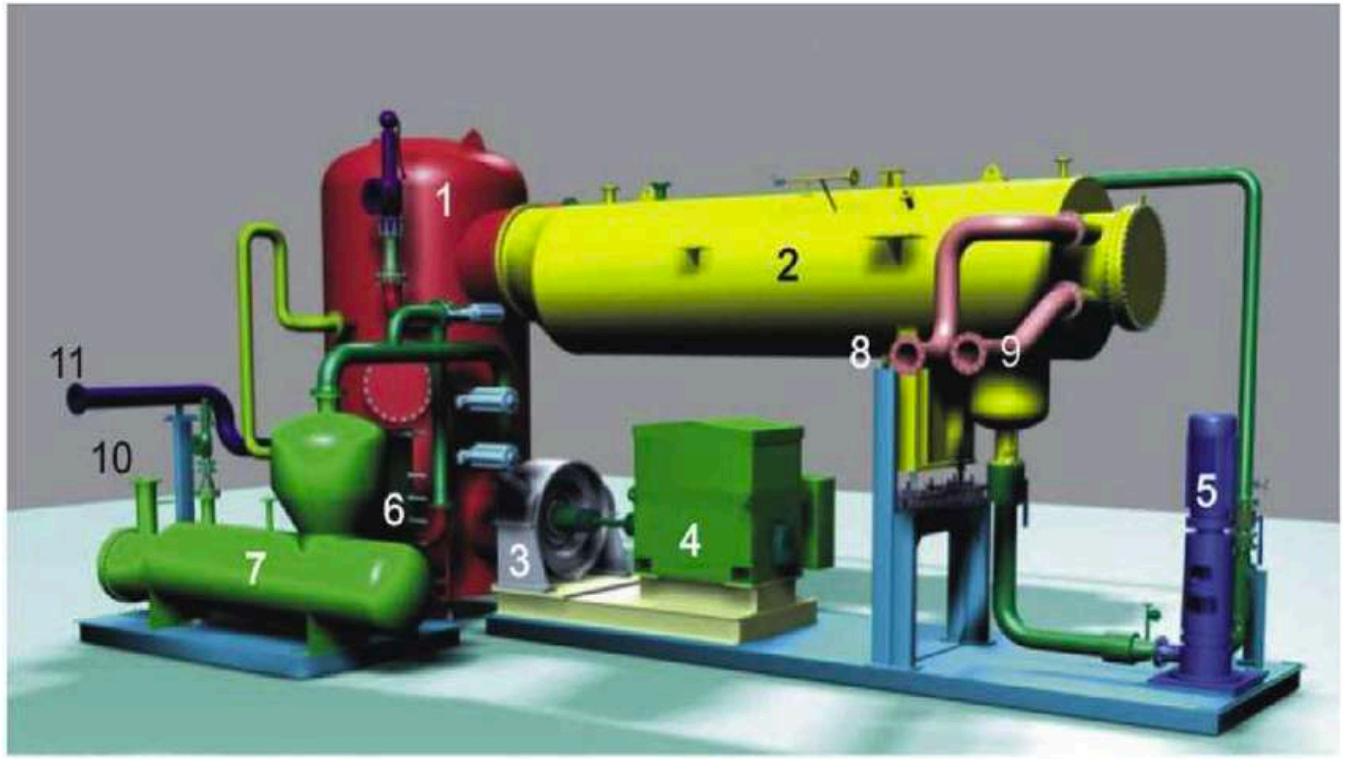


ORC Potential Assessment

- Requirements:
  - Minimum temperature
  - Minimum thermal power
  - Minimum running hours
  - No condensation
  - Possibility to interfere in the process

- H-REII project: establish which industries fit better ORC opportunities for heat recovery to power:
  - Cement
  - Glass
  - Steel
  - Oil&gas

ORC Components



1 Regenerator
2 Condenser
3 Turbine
4 Electric generator
5 Circulation pump
6 Pre-heater
7 Evaporator
8 Hot water inlet
9 Hot water outlet
10 Thermal oil inlet
11 Thermal oil outlet

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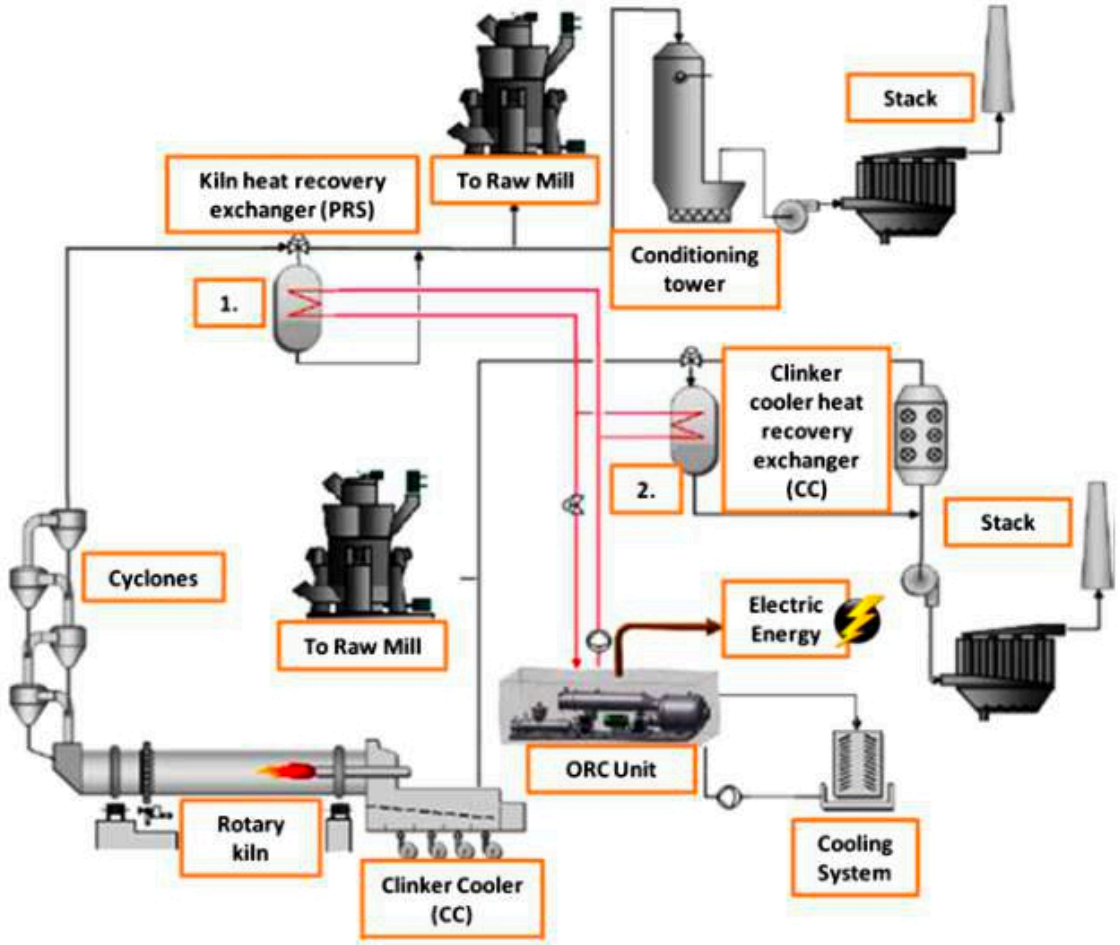
ORC in Cement Industry



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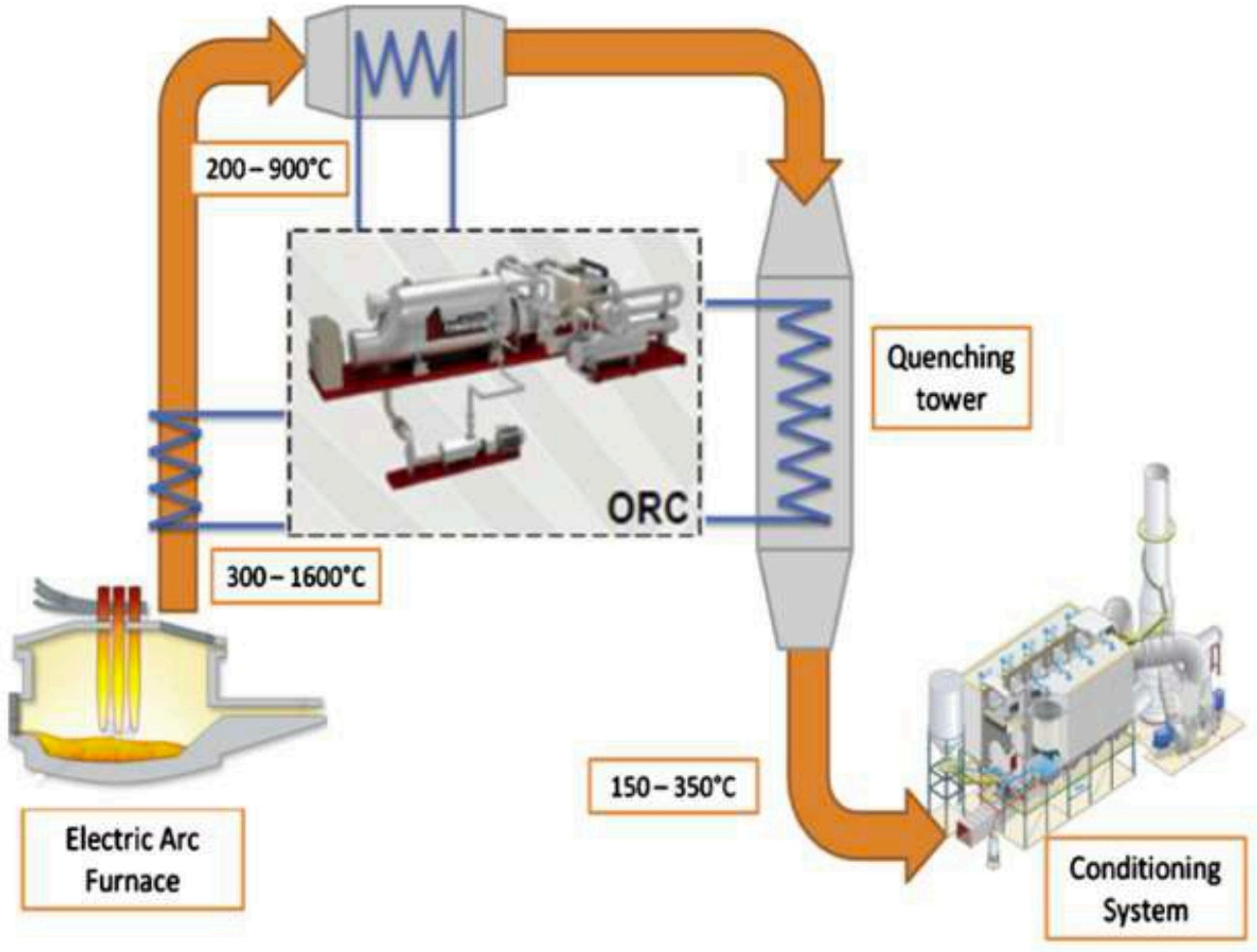
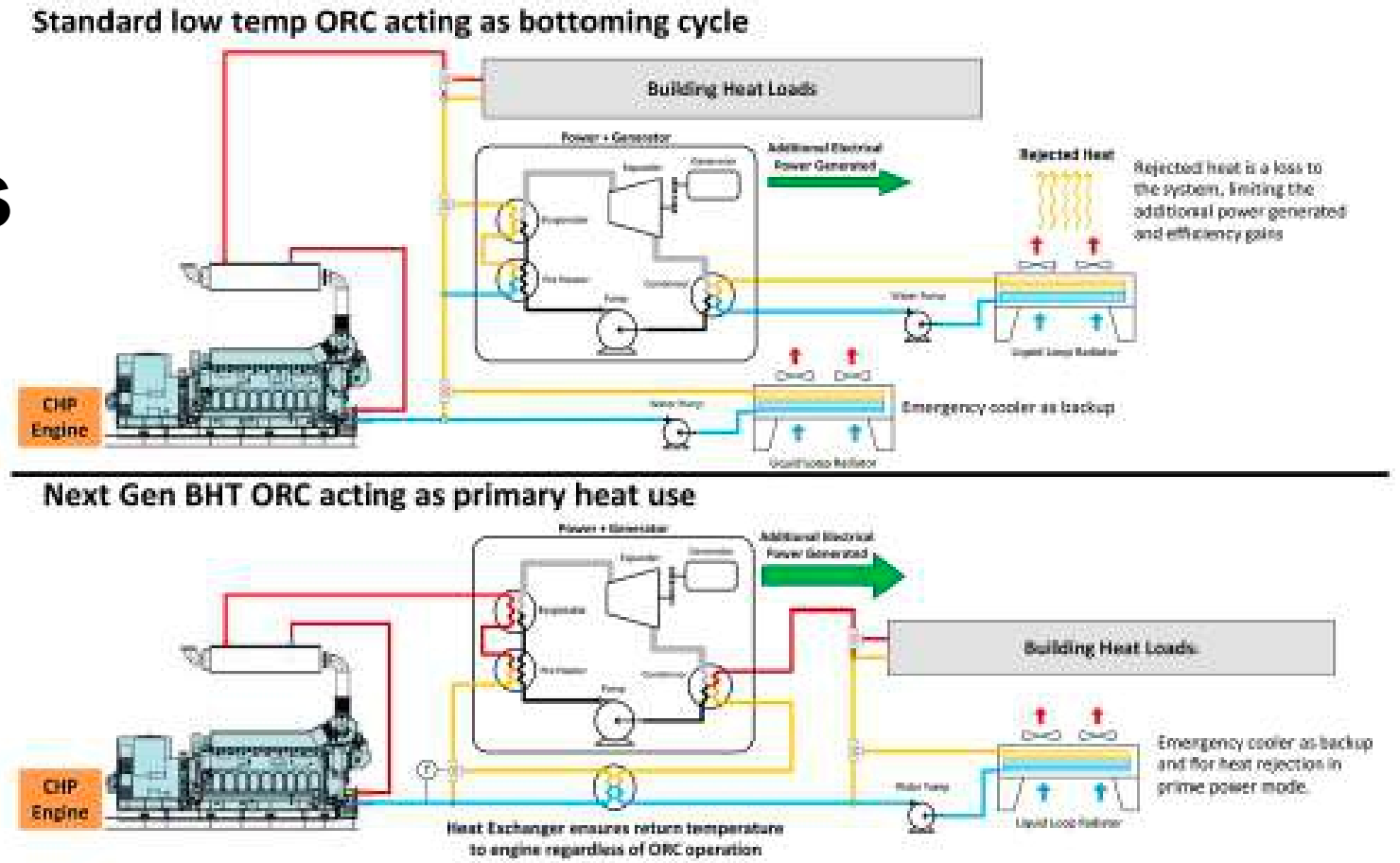
ORC in Steel industry



ORC for Diesel Exit Gases



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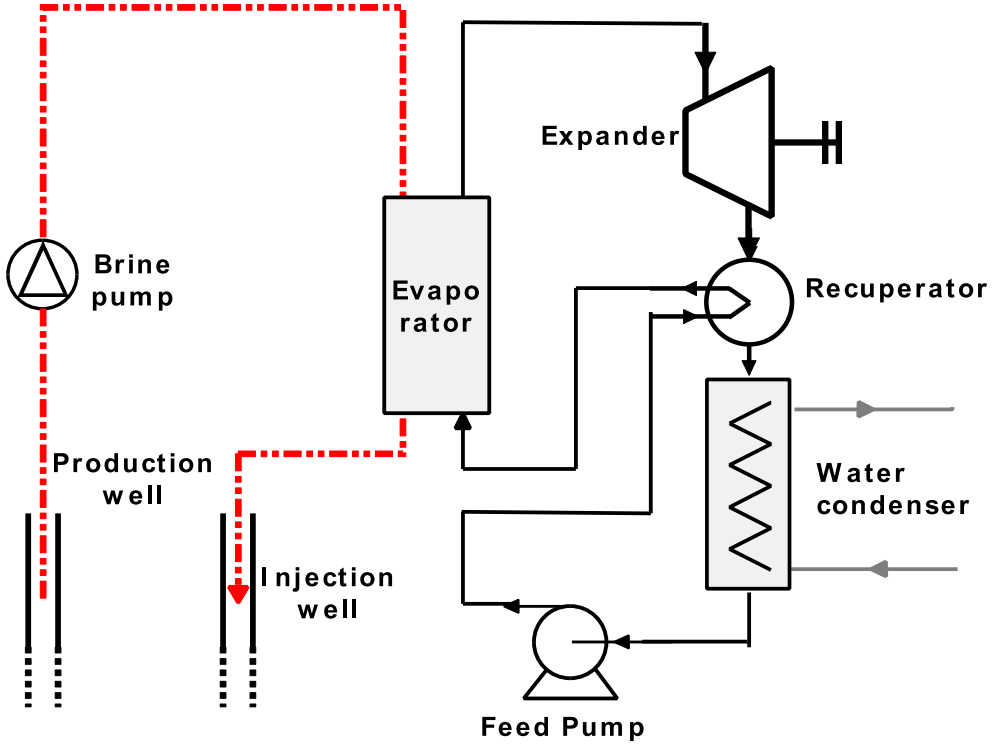
ORC Geothermal



- Similar to WHR technologies
- From 200 kW up to 100 MW
  75 to 300°C

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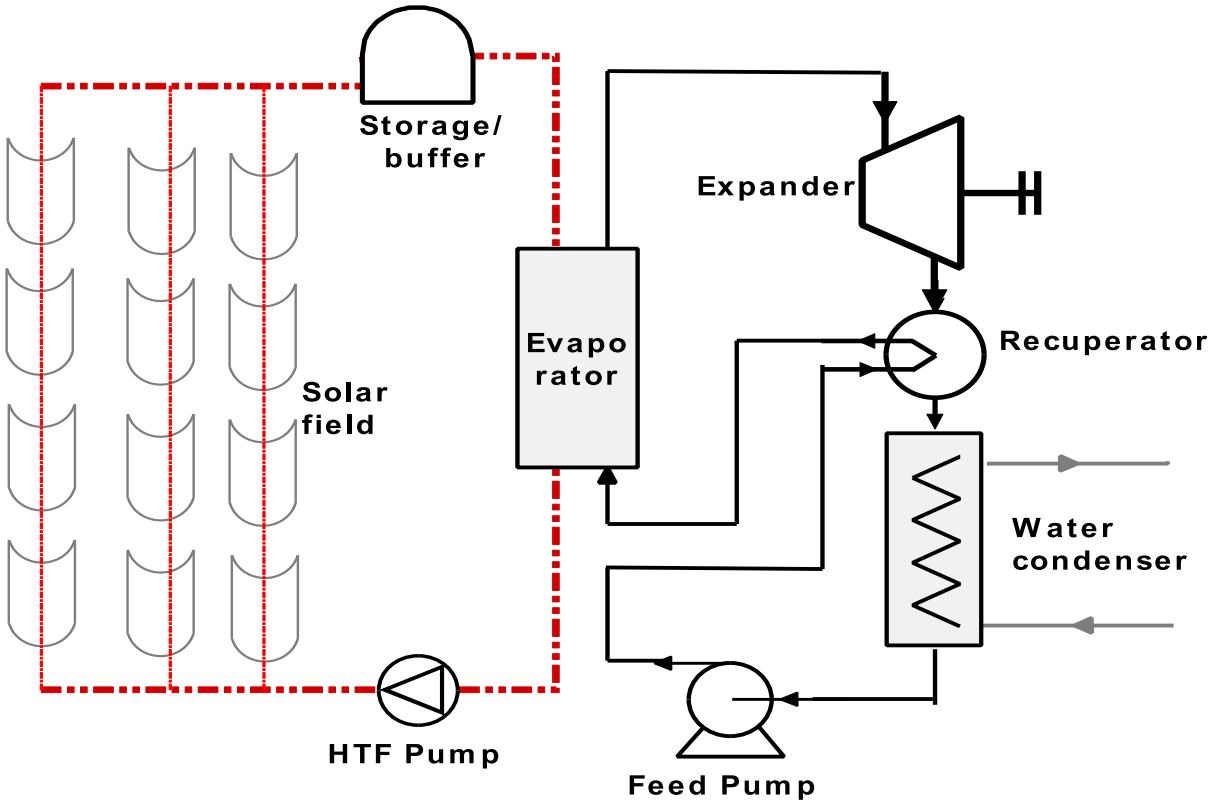
ORC - Solar

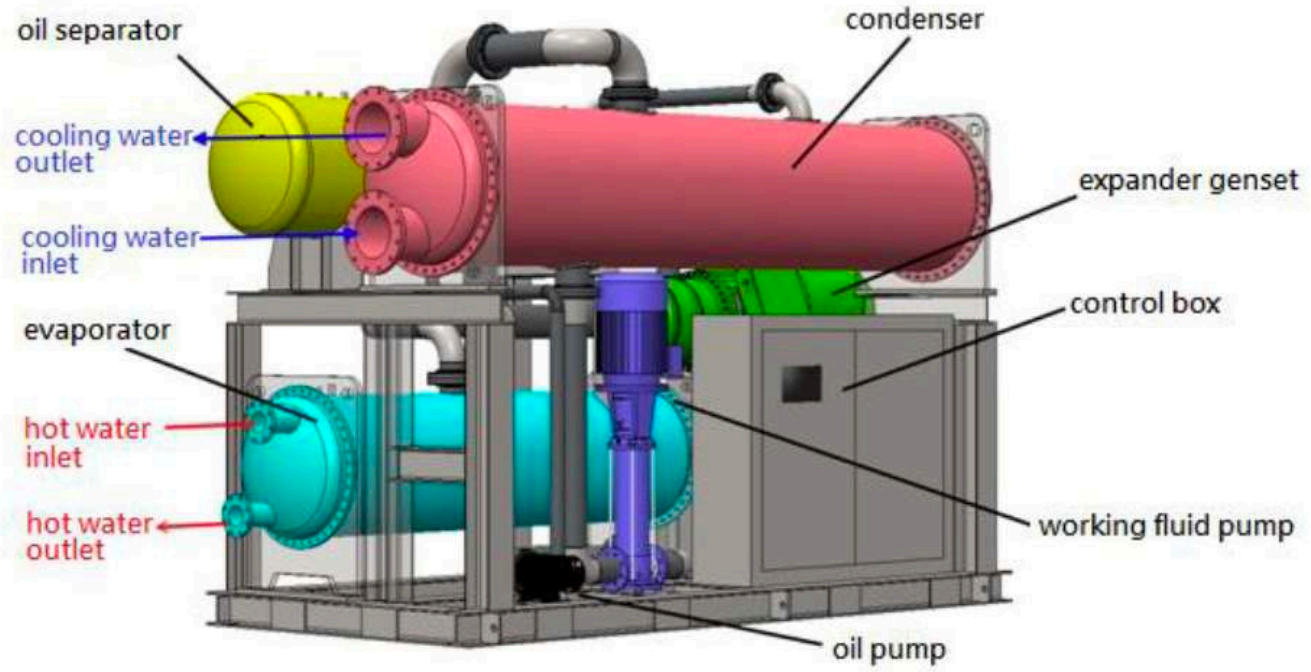

Storage/
buffer
Expander
Evapo
rator
Recuperator
Solar
field
Water
condenser
HTF Pump
Feed Pump

Features

- Proven concept on larger volumetric ORC units
- Very few moving parts and low stress on components
- No friction, no wear – there's no metal to metal contact
- Oil Free
- No fluid leaking
- Low maintenance
- Extremely compact units

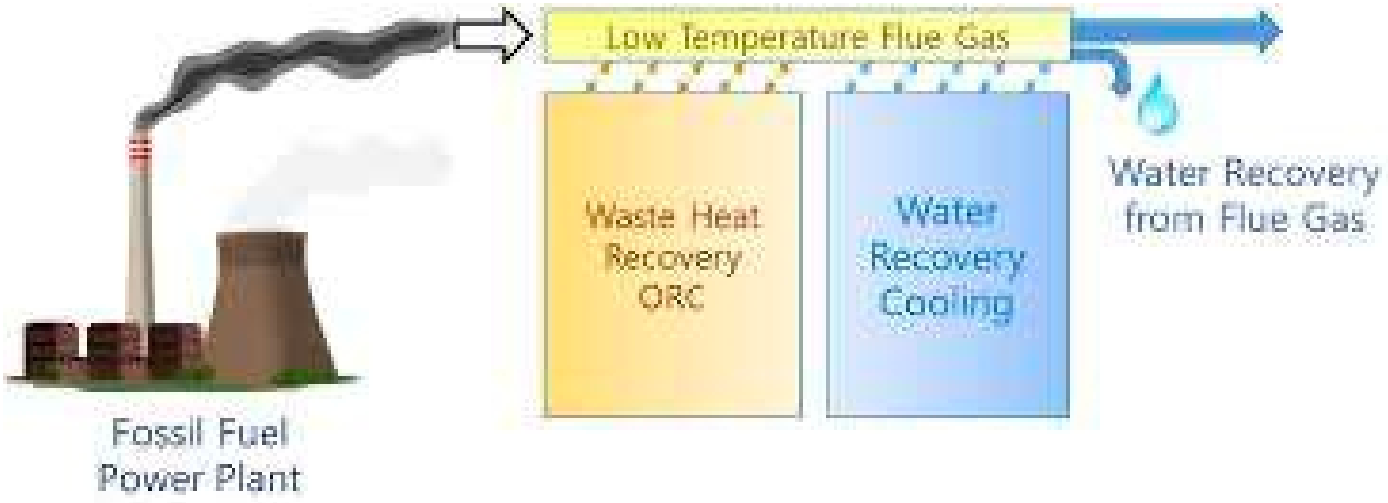
MAKE THE MOST OUT OF YOUR WASTE HEAT

Customised ORC



Heat Source	Hot Water	Hot Oil	Steam	Flue Gas
Temperature	≧80°C	≧80°C	≧70°C	≧120°C

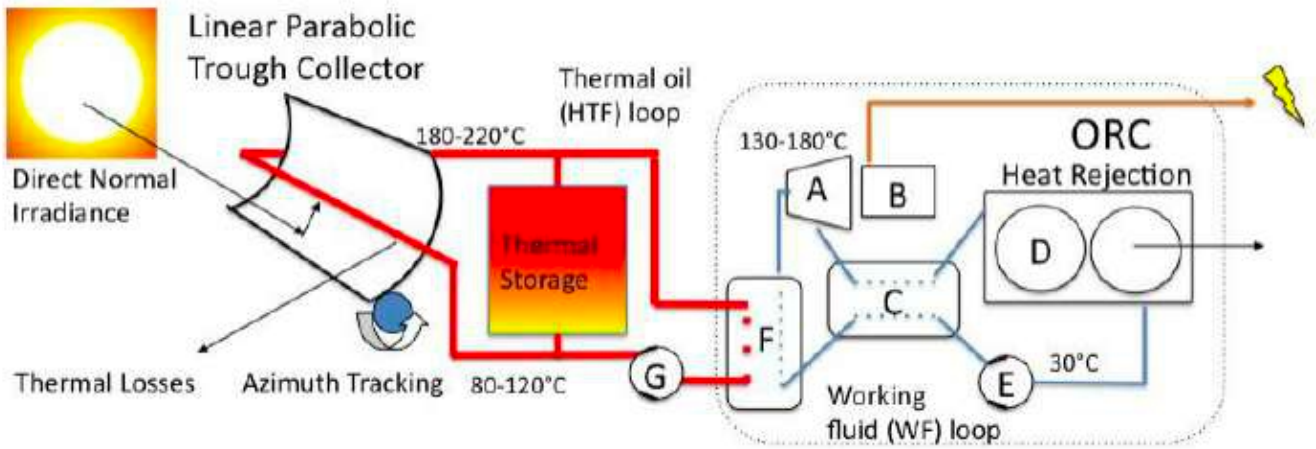
ORC Models



MEDIGREEN ORC Specifications Using Flue Gas

Flue Gas Temp. = 380°C/140°C, Cooling Water Temp. = 25°C/31°C , Working Fluid – Toluene						
Net Power Output (kW)	20	50	100	150	200	250
Thermal input from Flue Gas Kj/Sec	160	358	666	950	1250	1450
Cooling Water Flow (Lit/Sec)	5	10.25	18.5	29	35	45

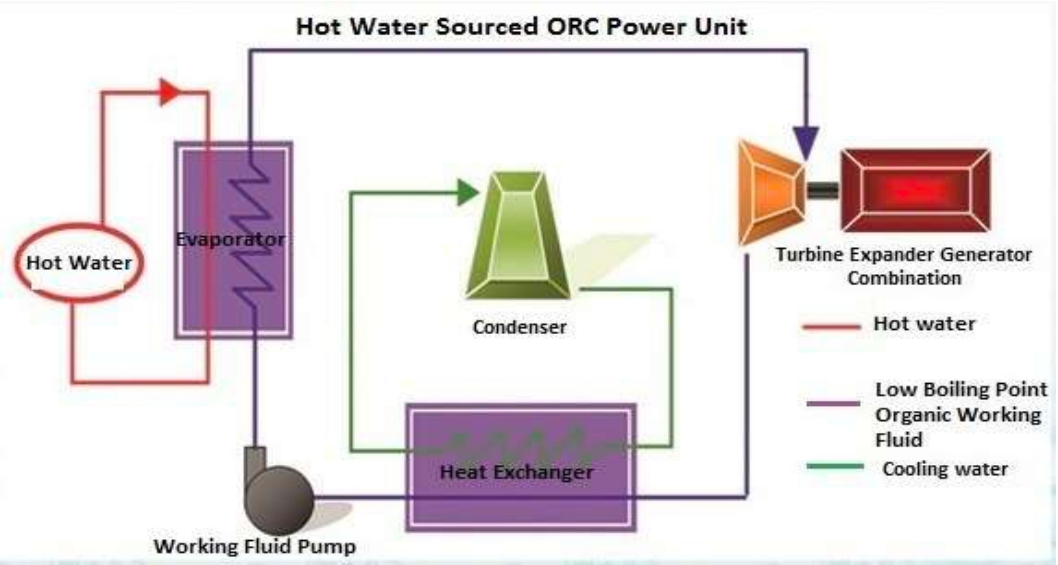
ORC Models



MEDIGREEN ORC Specifications on Hot Oil

Steam Temp. = 280°C/140°C, Cooling Water Temp. = 25°C/31°C , Working Fluid – Toluene						
Net Power Output (kW)	20	50	100	150	200	250
Thermal input from Hot Oil Kj/ Sec	145	300	568	800	1050	1230
Cooling Water Flow (Lit/Sec)	5	10.25	18.5	29	35	45

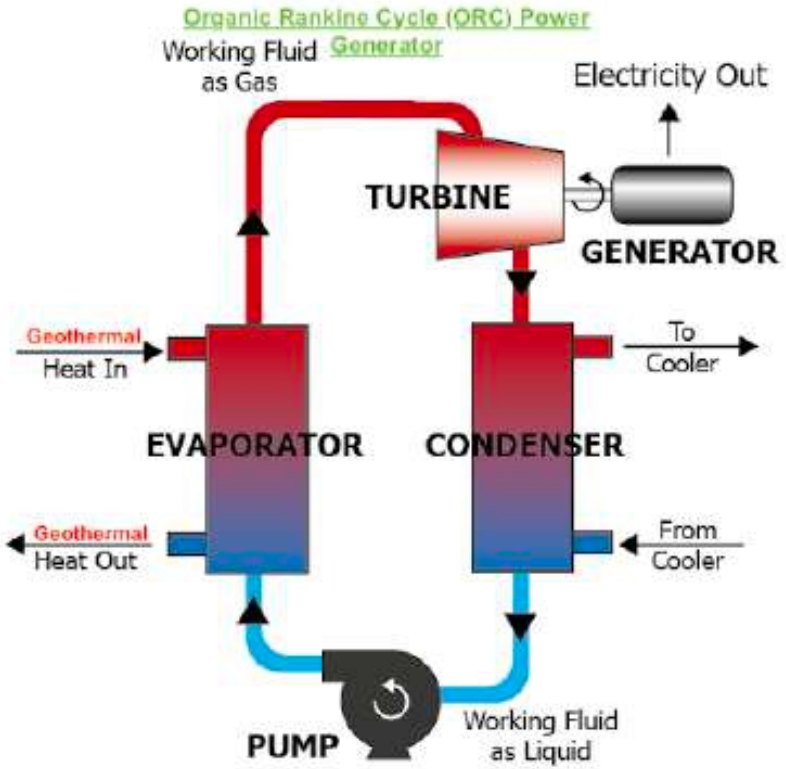
ORC Models



MEDIGREEN ORC Specifications on Using High Temperature Hot Water

Hot Water Temp. = 130°C/70°C, Cooling Water Temp. = 25°C/31°C, **Working Fluid – n Pentane**						
Net Power Output (kW)	20	50	100	150	200	250
Thermal input from Hot Water Kj/Sec	310	625	1100	1500	2000	2500
Cooling Water Flow (Lit/Sec)	10	21	40	60	75	90

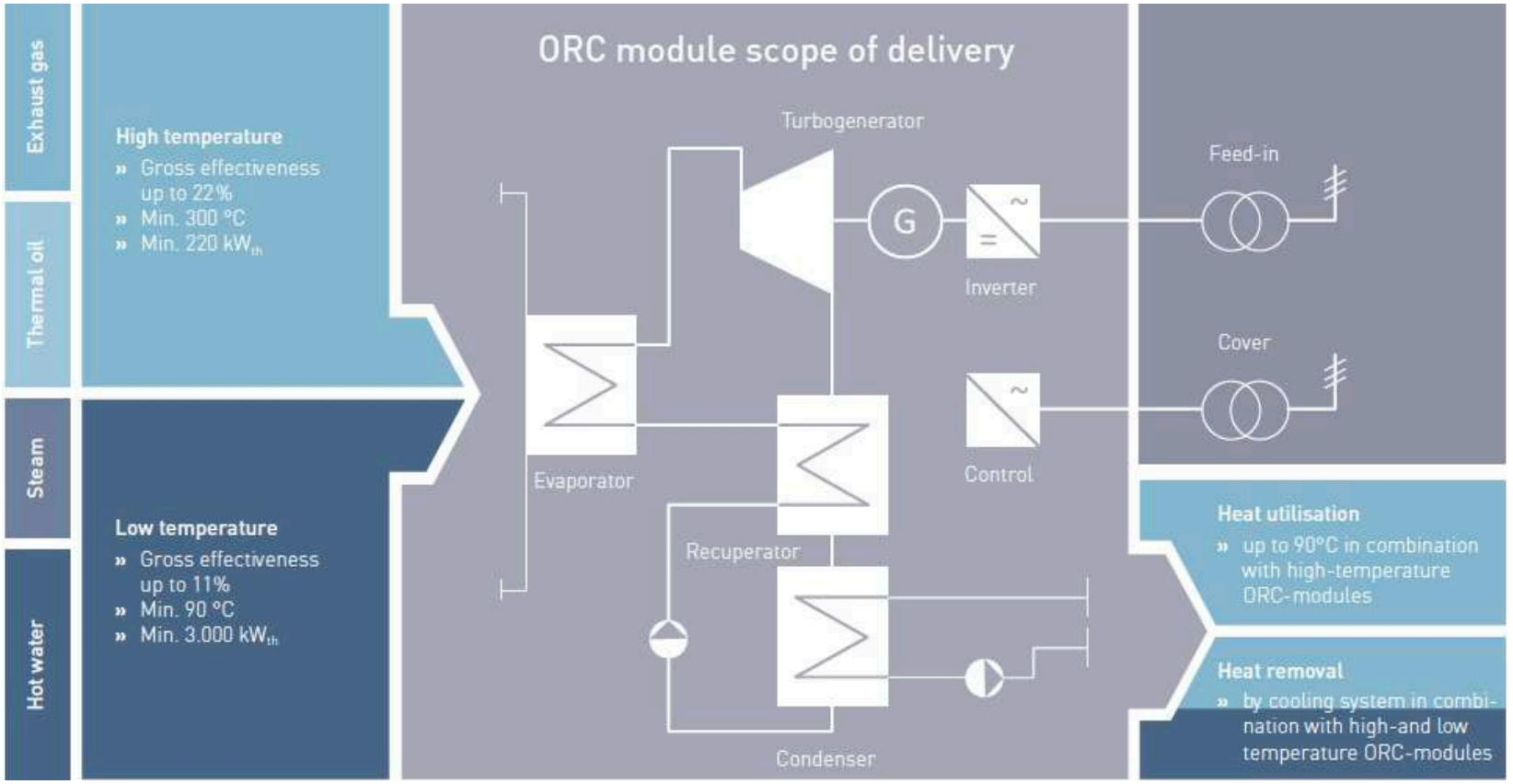
ORC Models



MEDIGREEN ORC Specifications on Using Low Temperature Hot Water

Hot Water Temp. = 95°C/58°C, Cooling Water Temp. = 25°C/31°C,Working Fluid – R 245 fa						
Net Power Output (kW)(***)	20	50	100	150	200	250
Thermal input from Low Temp Hot Water Kj/Sec	450	1000	1818	2727	3333	4166
Cooling Water Flow (Lit/Sec)	18	36	70	100	130	160

ORC Scope of Delivery



Our Installations

10 KW ORC
Sri Ram Industries
Delhi

20 KW ORC
BITS Pilani

70 KW NGL Tech
Malaysia

10 KW ORC
Eddie Solar , Chennai

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Patents

Patent No:	286409
Application No:	1699/CHF/2009
Date of Filling:	17/07/2009
SL No:	044101844

GOVERNMENT OF INDIA
PATENT CERTIFICATE

An Improved Turbine and Method Thereof

MEDIGREEN
ENERGY

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Maharashtra

www.medigreenenergy.com

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