QBIVIO

Crossroads Of Heat And Power

$$Q=mc\Delta t$$

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E&E ENERGY

About Us

- Our company specializes in the development of Micro Organic Rankine Cycle systems for waste heat recovery and renewable energy generation. With a wide range of power output options between 30-180 kW, we can offer a special solution for any application that requires heat recovery and energy production.
- Our systems are designed to be highly efficient and cost-effective, using advanced techniques to extract as much energy as possible from low-grade heat sources. We pride ourselves on our innovative approach and commitment to sustainability, and we're always looking for new ways to push the boundaries of what's possible with Micro ORC technology.

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Our Team

- Our Engineering Team is a group of experts specializing in the design, development and implementation of Micro Organic Rankine Cycle systems. We are constantly working to improve the efficiency and performance of these systems and develop new technologies and applications for their use.
- Our deep understanding of the physics and thermodynamics underlying ORC systems allows us to solve the most challenging problems in the field and provide innovative solutions that meet our customers' needs. Whether in the field of renewable energy, waste heat recovery or industrial power generation, our team has the knowledge and experience to deliver top quality results.

Meet The Team

Cihangir Gözalıcı
Mechanical Engineer

Prof. Dr. Reşat Selbaş
Mechanical Engineer Thermodynamics

Prof. Dr. İbrahim Üçgül
Mechanical Engineer

Eren Demir
Mechanical Engineer Thermodynamics

Ersoy Yüksel
Public Administration

Ceyhan Gözalıcı
Master Of Architecture

Gülsen Melis Gözalıcı
Industrial Engineer

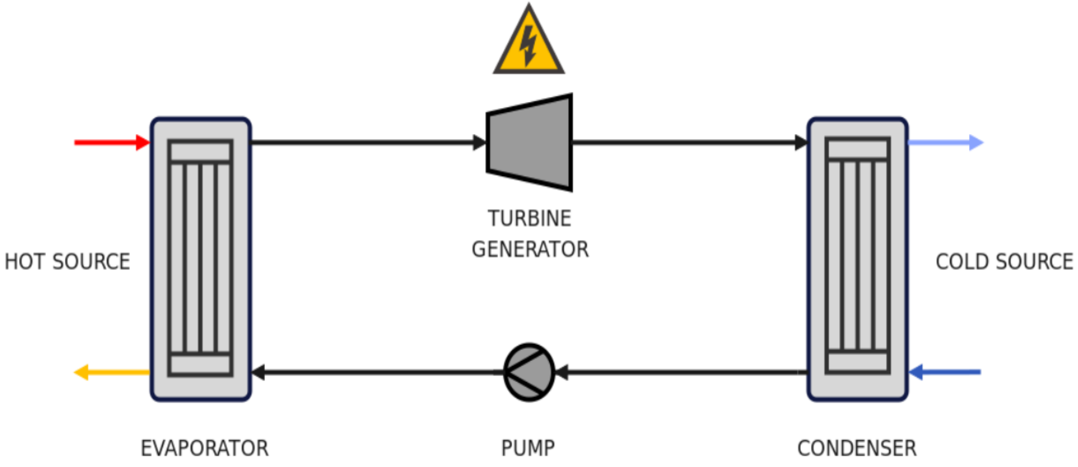
Process

Our research and development studies on Micro Organic Rankine Cycle have started by determining the need for a more efficient and sustainable energy transformation system for small-scale applications.

- A comprehensive literature screening of existing technologies and theories related to thermodynamics, heat transfer and fluid mechanics,
- Laboratory experiments to test ORC configurations and working conditions,
- Analysis of the results and optimizing the design of the loop process,
- Computer simulations using mathematical models and software tools to estimate performance under different working conditions,
- To confirm their predictions, to create a prototype to assess their effectiveness and reliability and test them in real world conditions,
- Prototype, continuous development according to the results of the tests and feedback from users,

production activity has been started without any problems through these stages.

How It Works



- In the Organic Rankine Cycle (ORC) system, organic fluids with hydrocarbon components are used instead of water as traditional fluid in order to obtain electrical energy from various waste heat sources. Since it is desired to work at low temperatures, R245fa is used as the most suitable operating fluid for these values.
- Micro ORC works in the form of evaporation of the fluid by transferring the heat energy obtained from various sources to Evaporetor, provoking the turbine of high temperature and pressure of high fluid vapor and obtaining electricity. The fluid in the turbine is converted into liquid in the fluid condenser and the pressure is increased with the help of a pump and sent back to Evaporator and the cycle is completed.
- Our system is designed to operate efficiently with a power output ranging from 30 kW to 180 kW and a temperature between 70 °C and 130 °C. It is also ideal for using waste heat from various sources such as industrial processes, geothermal heat power, oil & gas operations and marine.

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Product Detail

Organic Rankine Cycle machine	
Generator type	Synchronous AC, 3 phase, 400V, 50-60 Hz
Generator Power Range	30kWe - 180kWe
Expander	Turbine
Heat Exchangers	Plate Heat Exchangers - Shell and Tube
Applied EG-Norms:	
✓ Machine directive	95/16/EC
✓ EMC Directive	2004/108 EC
✓ Low voltage directive	2006/95/EC
✓ Pressure Equipment Directive	97/23/EC
Electrical Enclosures	IP55
Control system	PLC, Web Based Remote Monitoring

Dimensions (L x W x H)	*2,500 mm x 2,000 mm x 2,000 mm*
Operating Mass (kg)	*± 5,000 kg*
Operating Conditions (ambient temperature)	*-20°C to +50°C*
Temperature Heat input	*80°C – 150°C*
Maximum heat input	*1,000 kWth*
Heat source	☐ Hot water ☐ Thermal oil ☐ Low Pressure steam
ORC working Fluid	☐ Honeywell r245fa*
Hydraulic connection heat source	2 Flanges DN150 PN16
Hydraulic connection cooling	2 Flanges DN150 PN16
Cooling system	☐ Cold water ☐ Cooling tower ☐ Air cooler
Housing	Suited for indoor installation
Noise level	<70 dB at 10 m
Emissions	☐ No Emission ☐ No fuel consumption

TYPICAL PERFORMANCES

HEAT SOURCE: Hot water 1,000 kWth - 43m³/h

COOLING: Cold water

	Gross power production	
Temperature heat source	Cold water out 20°C	Cold water out 30°C
80°C	*60 kWe*	*55 kWe*
90°C	*76 kWe*	*65 kWe*
100°C	*85 kWe*	*74 kWe*
110°C	*93 kWe*	*83 kWe*
120°C	*115 kWe*	*104 kWe*
130°C	*124 kWe*	*113 kWe*
140°C	*132 kWe*	*130 kWe*

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Industries

- Industrial Processes
- Geothermal Heat Power
- Oil & Gas
- Marine

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Indutrial Processes

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- Waste heat recovery is the process of using excess heat generated by industrial processes or equipment. This excess heat is typically released into the environment. This situation causes both the waste of usable energy and the increase in global warming.
- However, with the right technology, it is possible to capture this waste heat and use it to generate electricity, reducing the need for fossil fuels and reducing greenhouse gas emissions. One of the most suitable technologies for waste heat recovery is the Micro Organic Rankine Cycle (Micro ORC).
- One of the main advantages of using the ORC system for waste heat recovery is the zero-carbon impact. The ORC system does not produce any greenhouse gas emissions, making it a clean and sustainable source of energy.

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Geothermal Heat Power

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- Another approach to harnessing geothermal energy is the use of Enhanced Geothermal Systems (EGS). EGS covers artificially creating or increasing the permeability of underground rock structures to extract geothermal energy.
- EGS has the potential to exploit a much larger resource base than conventional geothermal systems, as it is not limited to areas with naturally occurring hot water or steam reservoirs.
- Micro ORC technology has several advantages for use with low enthalpy geothermal resources. For example, it can be used to power remote communities, to provide electricity for agricultural or industrial purposes.

Oil & Gas

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- Many oil wells have a natural geothermal slope, which means the temperature increases as the well gets deeper. This geothermal heat can be used and converted into electricity using the Micro ORC system. By using this technology, oil companies can reduce their dependence on fossil fuels and reduce their carbon footprint.
- Besides generating electricity, the Micro ORC system can also be used to power various on-board systems such as pumps and compressors. This is particularly useful in remote locations where access to conventional power sources may be limited.
- A particular example of successful application of the Micro ORC system in an oil well is the use of the system in an offshore drilling operation in the Gulf of Mexico. The well has a natural geothermal slope of about 20 degrees Celsius per kilometer at a temperature of about 150 degrees Celsius at a depth of 3 kilometers. The drilling operation, which uses the Micro ORC system to capture this geothermal heat and convert it into electricity, has reduced its dependence on fossil fuels by approximately 25%. This equates to approximately $1 million in fuel cost savings per year and a reduction in 5,000 metric tons of carbon dioxide emissions.

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Marine

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- Micro ORC is designed to withstand harsh conditions including high winds, salt water corrosion and rough seas. This system uses organic liquids such as propylene and butane to convert waste heat into usable electricity. It is particularly suitable for use in marine environments due to its compact size, low noise level and ability to operate at high temperatures.
- Many marine vessels, such as cargo ships and cruise ships, generate large amounts of waste heat as a byproduct of their operations. This heat is often released into the ocean, damaging the environment and causing global warming. The Micro ORC system uses these waste heat sources to convert them into useful energy, which reduces the ship's dependence on fossil fuels and lowers its carbon footprint.
- The Micro ORC system can also be used to power various on-board systems such as air conditioning and refrigeration. The system is useful for ships operating in hot climates where air conditioning is a critical component of comfort and safety. In this way, ships can significantly reduce their energy consumption and save on fuel costs. A successful and specific example is the use of the system on a large container ship.

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Advantages

- Reducing dependence on fossil fuels and reducing greenhouse gas emissions.
- Provides a decrease in energy costs by generating electricity..
- Facilitating access to electricity.
- Simple integration and low area requirements.
- Zero carbon effect.
- Reduction of oil companies' dependence on fossil fuels and carbon footprints.
- Significant cost savings and environmental benefits in open marine drilling operations, improvement of overall efficiency and performance.
- For example, a cargo ship produces about 2 MW waste heat from its engine and other built -in systems. The ship using the Micro ORC system to capture this waste heat and convert it into electricity can reduce its dependence on fossil fuels by approximately 15 %, thus saving a fuel cost of approximately $ 500,000 per year and a decrease in 3,000 metric tons of carbon dioxide emissions.

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Assumption Table

Estimated Production Table of a Facility Operating on a 24/7 Basis

Estimated Production

General Information		
Annual Working Hours	6.500	Hour
Administrative Expenses	0,00432	USD/kWh
Credit		
Investment Loan Rate	100%	
Loan Repayment Period	5	Year
Electricity Generation Information		
Total Installed Power	175	kW
Internal Consumption	15	kW
Total Annual Production	1.040.000	kW

Netting Price	0,14700 $/kWh
IRR	74%
NPV	$374.470
Production costs	0,09101 kW/$

* 0.147 $/kWh Settlement Price has been determined according to the Average Price of EPİAŞ 1.January.2022 -31.December.2022
* Annual working hours are 8,760 hours, but the efficiency has been calculated as 6,500, assuming 74%

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Project Investment Cost Table

ESTIMATED PROJECT INVESTMENT

	$USD
Project Development	10.000
Micro ORC	380.000
Commissioning	5.000
Insurance	5.000
Invisible Expenses	10.000
TOTAL $USD	410.000

$/kW 2.343

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Financial Program Table

Financial Program

TOTAL INVESTMENT	410.000 USD
INVESTMENT FINANCE	410.000 USD
Payback Period	5 Year
Depreciation	5 Year
Investment Annual Interest Rate	12,00%

Commercial Loan Payment Table	Y 1	Y 2	Y 3	Y 4	Y 5	Y 6	Y 7	Y 8	Y 9	Y 10
Principal Money	410.000	328.000	246.000	164.000	82.000	-	-	-	-	-
Interest	49.200	39.360	29.520	19.680	9.840	-	-	-	-	-
Principal Payment	82.000	82.000	82.000	82.000	82.000	-	-	-	-	-
Total Refund	131.200	121.360	111.520	101.680	91.840	-	-	-	-	-

Total Interest Payment	147.600	USD
Total Principal Payment	410.000	USD
Total Refund	557.600	USD

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Cash Flow Table

Table 4 – Cash Flow

		Investment 1	Operation 1	Operation 2	Operation 3	Operation 4	Operasyon 5	Operation 6	Operation 7	Operation 8	Operation 9	Operation 10	Operation 11+
EXPENSES													
Investment		410.000	0	0	0	0	0	0	0	0	0	0	0
Operations		0	38.893	38.893	38.893	38.893	38.893	38.893	38.893	38.893	38.893	38.893	38.893
Finance		0	131.200	121.360	111.520	101.680	91.840	0	0	0	0	0	0
INCOME													
Netting		0	152.880	152.880	152.880	152.880	152.880	152.880	152.880	152.880	152.880	152.880	152.880
Credit		410.000	0	0	0	0	0	0	0	0	0	0	0
Cash flow		0	-17.213	-7.373	2.467	12.307	22.147	113.986	113.985	113.984	113.983	113.982	113.981
IRR	73,79%	5,00%											
NPV	$374.470												
Cash Flow		-410.000	113.987	113.987	113.987	113.987	113.987	113.987	113.987	113.987	113.987	113.987	113.987
Cumulative		-410.000	-296.013	-182.026	-68.038	45.949	159.936	273.923	387.910	501.898	615.885	729.872	843.859

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Annual Working Hours	6.500	Hour
Administrative Expenses	0,00432	USD/kWh
Credit		
Investment Loan Rate	100%	
Loan Repayment Period	5	Year
Electricity Generation Information		
Total Installed Power	175	kW
Internal Consumption	15	kW
Total Annual Production	1.040.000	kW

Netting Price
0,19000 $/kWh
IRR
123%

NPV
$674.770
Production costs
0,09101 kW/$

* Determined by the Netting Price of $0.190/kWh

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