

LEADING IN  
PRODUCTION  
EFFICIENCY

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# Clean power solutions with the Cyplan<sup>®</sup> ORC

Organic Rankine Cycle

The profitable way to generate electricity



# Converting thermal energy into an asset: clean power and useful heat

## SUSTAINABLE PRODUCTS AND PRACTICES: OUR GUIDING PRINCIPLE

We reconcile economic activity with ecology and fair working conditions. As a technology leader, we reduce the consumption of resources with our sustainable products and actively assume our social responsibility. We maintain fair and respectful dealing with employees, suppliers and business partners.



## Unlocking the electrical potential of thermal energy



FINANCIAL BENEFITS



CO<sub>2</sub> REDUCTION



POWER GENERATION



USEFUL HEAT

One of the most significant challenges we are facing today is the reduction of greenhouse gas emissions. Companies constantly seek to optimize production facilities' energy efficiency and operating costs.

With its cutting-edge solutions based on the **Cyplan**<sup>®</sup> ORC, Dürr meets these needs. Organic Rankine Cycle is a key technology for generating electricity from heat sources with medium and low temperature levels.

In combination with renewable heat sources or utilizing excess heat of different origin, **Cyplan**<sup>®</sup> ORC solutions generate CO<sub>2</sub>-free electricity. This allows companies to produce their own electricity, work more independently of external supply and reduce their carbon footprint.

### WHY ORC?

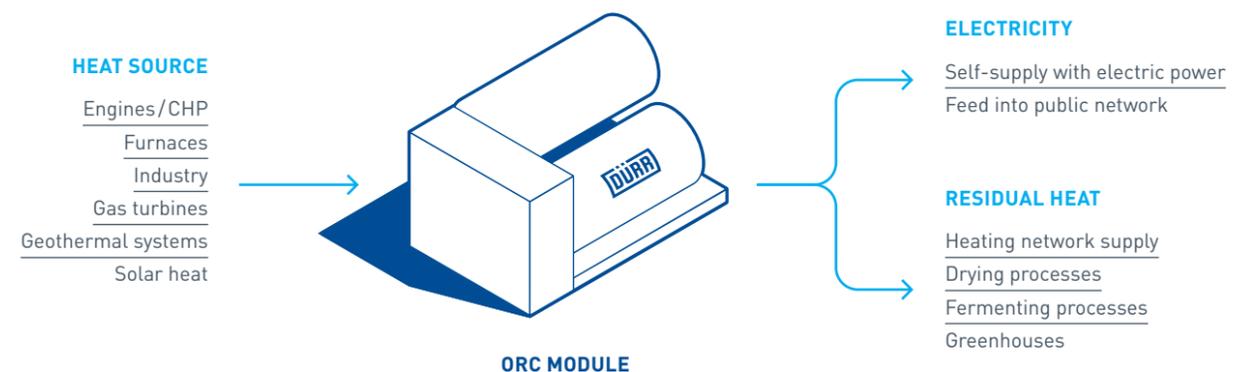
The Organic Rankine Cycle technology ...

- converts heat into electricity without CO<sub>2</sub> emissions
- utilizes small thermal inputs and heat at temperature levels that are unattainable for conventional energy transformation methods
- has potential for subsidies and fiscal benefits

### WHY CYPLAN<sup>®</sup> ORC?

**Cyplan**<sup>®</sup> ORC systems stand for ...

- financially attractive concepts
- the highest efficiency in its class
- superior flexibility for various heat sources
- combined heat and power (CHP) solutions
- over 10 years of experience
- more than 1.000.000 operating hours



# Cyplan® ORC: How it works

②

**Evaporator**  
Heat transfer from heat source to working media

③

**Turbogenerator**  
Thermal power is partially converted into electric power

④

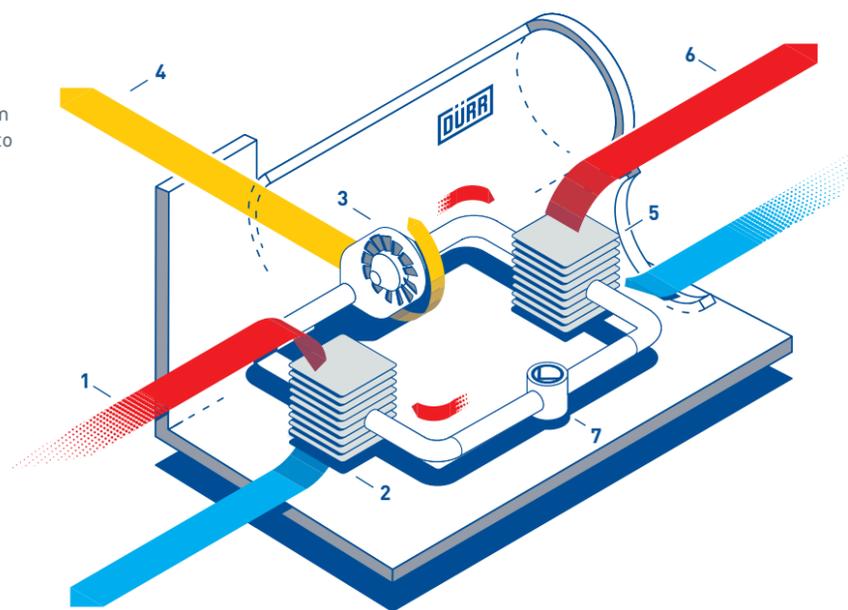
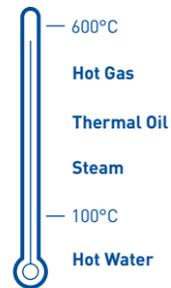
**Power generation**  
Electric power feed line to the grid

⑤

**Condenser**  
Condensation of working media vapor

①

**Heat supply**  
Heat transfer medium flows from the heat source into the ORC module



⑥

**Heat extraction**  
Condensation heat, that can be utilized for follow-up processes



⑦

**Pump**  
Recirculation of the working media

The Organic Rankine Cycle (ORC) is a thermodynamic process similar to the well-known water-steam cycle, which forms the basis of conventional electricity generation in power plants. The main difference is that the ORC uses an organic fluid with a low boiling point. Consequently, ORC systems can operate at lower temperature levels compared to the conventional water-steam cycle.

Following continuous research and development in the field of ORC technology, Dürr has been able to patent an improved design. Dürr's **Cyplan®** ORC systems offer significantly increased efficiency and higher flexibility.

## STAND-OUT FEATURES

- Hermetically sealed cycle of working media
- Highly efficient single-stage expansion turbine
- Combined heat & power capability on high-temperature applications with secondary heat use up to 95°C
- Adaptability to various heat transfer media that deliver the heat to the ORC
- Selection from a range of working media suitable for various applications

# Modules for all requirements

**Cyplan®** ORC modules are available as standardized prefabricated, pre-tested modules mounted on a steel frame with electrical output ranging from 50 kW to 500 kW. The six different module sizes available correspond to the power output of the turbogenerator.

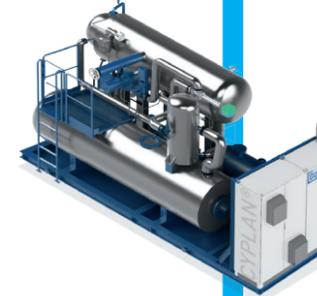
Dürr also develops customized ORC solutions that combine standardized elements with components that are specially designed for a specific purpose.

## PRODUCT FEATURES

- Compact skid-mounted units
- Easy transportation and integration
- Fully automated operation with remote control function
- Built according to industrial standards



Cyplan® ORC 50



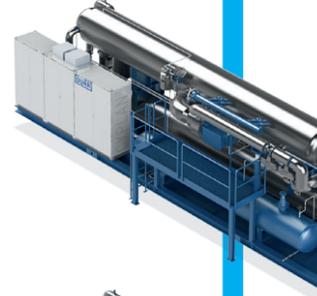
Cyplan® ORC 70



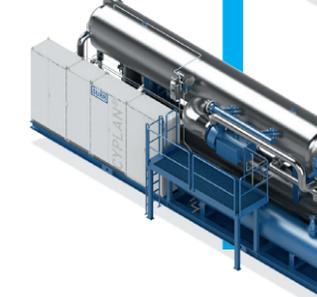
Cyplan® ORC 120



Cyplan® ORC 250



Cyplan® ORC 350



Cyplan® ORC 500

# The diverse Cyplan® ORC product portfolio enables a wide range of applications

# Dürr's Cyplan® ORC solutions for your business



## FURNACES

A **Cyplan®** ORC module added to a furnace can be combined with any kind of incineration: wood-based fuel, waste from wood processing, sewage sludge, small-scale municipal waste, etc. **Cyplan®** ORC can also be integrated with innovative thermal processes such as pyrolysis and biochar.

- Energetic utilization of existing organic residues
- Suitable for all kinds of furnaces
- Secondary heat use downstream of ORC

## ENGINES / CHP UNITS

The **Cyplan®** ORC can be combined with all types of stationary gas and diesel engines such as biogas, sewage gas and landfill gas and has the potential to increase electrical output by up to 10%. Due to the direct evaporation technology the module is installed in the exhaust gas path between the engine and the stack.

- CHP capability
- Saves 3–5% of input fuel
- Electricity-producing heat exchanger with more than 95% heat usage



## GEOTHERMAL

Dürr **Cyplan®** ORC plants can be utilized as modularized power plants, wellhead generators, upgrades for existing flash plants with an additional binary cycle or seasonal operation plants.

- Modular and flexible design
- Operation optimized through cascade alignment
- Suitable for operation in adverse outdoor environments



## HEAT RECOVERY

Dürr can upcycle all kinds of heat above 90°C and transform it into electricity independent of the heat carrier (water, steam, thermal oil, hot gas).

- No intrusion into production process
- Reduces carbon footprint
- No operator needed



## SOLAR THERMAL ENERGY

**Cyplan®** ORC can be applied to different types of solar energy plants as a high-temperature solution in combination with a secondary heat source or as a low-temperature solution after the thermal storage.

- Excellent part-load behavior
- No water consumption
- Key element for hybrid power plants

## GAS TURBINES

**Cyplan®** ORC modules are an ideal add-on for small to medium-sized gas turbines running in open cycle. The potential output increase without additional fuel input is up to 25%.

- Fuel flexibility
- Direct evaporation
- Functions without water



# Your partner from idea to implementation



## 1 SETTING THE GROUNDWORK

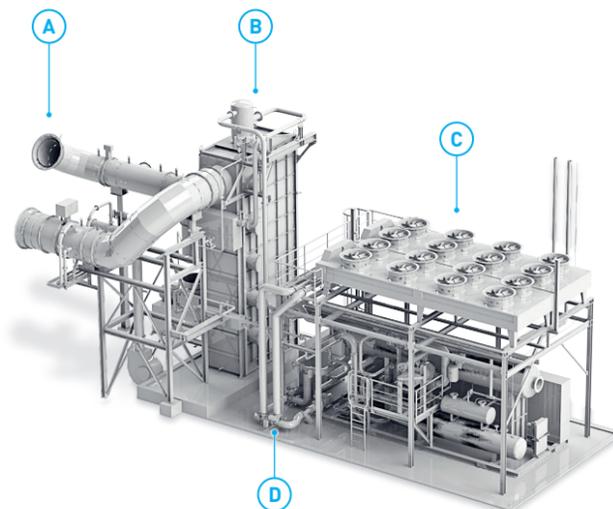
Drawing upon an extensive knowledge and industrial experience, the team of professionals at Dürr carefully examines the prerequisites for implementing **Cyplan**® ORC modules. Taking into account the source, quality and amount of the available thermal energy, peculiarities of the production process as well as existing or potential concepts of electricity and heat utilization, Dürr comes up with an initial economic and technical feasibility statement.

## 2 PLANNING SUCCESS

The overarching purpose of planning is to achieve the maximum electrical and economic output from available heat transformed within the **Cyplan**® ORC. It implies choosing the most suitable module within the standard portfolio based on the available heat source, heat transfer media and other conditions. For specific purposes it is possible to develop customized **Cyplan**® ORC solutions, in which a blend of standardized elements and components are engineered.

Along with supplying outstanding equipment for green electricity generation, Dürr provides its clients with a comprehensive support throughout all project stages. Dürr offers cooperation from carrying out turnkey projects or providing supervision only for specific project stages to organizing training courses for the customer's employees. The professional project management teams at Dürr guarantee transparency and seamless communication. At the same time Dürr commissions plants within the budget, scope and deadline agreed with the client.

### SPECIALLY DESIGNED CYPLAN® ORC 500 HT CHP FOR UTILIZATION OF EXHAUST GAS HEAT



- A Full duct-work integration including ID fan
- B External evaporator with reduced pressure drop
- C Stand-by cooling device
- D Heat exchanger to district heating network

## 3 STARTING IMPLEMENTATION

When it comes to order execution, planning is once again the key to success. To ensure smooth realization, Dürr keeps track of the process environment, which implies performing 3D layouts, P&IDs, calculation of thermal stress, pressure losses, static and dynamic analysis of piping systems.

## 4 ROLLING OUT

When manufacturing **Cyplan**® ORC modules and auxiliary equipment, Dürr combines in-house production and contributions from external partners. Strict quality management, continuous improvement of production processes and high standards for suppliers ensure the quality of the ready-made modules.



The Dürr-patented turbogenerator is the core component of the **Cyplan**® ORCs, fabricated and assembled at Dürr production sites.

### HERMETICALLY SEALED TURBOGENERATOR



- No separate lubrication circuit
- Compact design
- High efficiency
- Low maintenance
- Integrated cooling system
- Mounted on one turbine shaft

# Dürr provides customized solutions on demand to perfectly suit customer needs

## 5 HITTING THE GROUND

Delivering the skid-mounted and pre-tested **Cyplan**® ORC module to the site allows fast and cost-effective installation. Dürr professionals execute proper and prompt commissioning. Post-commissioning training on the client site empowers customer employees for further successful module operation.

# Invest in a sustainable future

... by investing in a sustainable solution that pays off and brings financial income.

## POWER GENERATION

With self-generated electricity you will benefit from a range of attractive financial opportunities:

- Decrease your electricity bills and dependency on the public grid
- Make use of attractive Feed-in-Tariffs for green electricity
- Obtain subsidies or local tax advantages for sustainable technology implementation

## USEFUL HEAT

Cyplan® ORC also provides advantages connected with utilization of the useful heat:

- Apply it in the follow up processes
- Sell it to the district heating network

## CO<sub>2</sub> REDUCTION

Benefit from the significant reduction of your company's carbon footprint.

### TYPICAL BENEFITS USING TWO CYPLAN ORC STANDARD MODULES AS EXAMPLES

CYPLAN® ORC 120	↗ Production	↘ Savings
	 <b>13,000</b> MWh Energy <sup>1</sup>	 <b>-11,000</b> tons Carbon Dioxide <sup>3</sup>
	equiv.  <b>350</b> Households <sup>2</sup>	equiv.  <b>55,000,000</b> km <sup>4</sup>
CYPLAN® ORC 500	↗ Production	↘ Savings
	 <b>54,000</b> MWh Energy <sup>1</sup>	 <b>-45,000</b> tons Carbon Dioxide <sup>3</sup>
	equiv.  <b>1,500</b> Households <sup>2</sup>	equiv.  <b>225,000,000</b> km <sup>4</sup>

<sup>1</sup> - Period of Observation: 15 years, 8000 hrs per year | <sup>2</sup> - Around 2,500 kWh consumption per household per year | <sup>3</sup> - Based on 830 g/kWh of CO<sub>2</sub> emissions from coal fired power plants | <sup>4</sup> - Based on 200g/km of CO<sub>2</sub> emissions

# Your partner for successful production



Dürr's customer service team provides expert support wherever you are in the world. Dürr is always on-site to help reduce production costs, increase plant availability and provide rapid technical support.

We offer a comprehensive service package that can be adjusted according to your specific requirements. Our services include prompt repair, preventive maintenance, consulting and upgrading of your individual plant.

## OUR SERVICE AT YOUR DEMAND



- [Ramp-up and launch management](#)
- [Modifications and upgrades](#)
- [Engineering with experience](#)
- [Spare parts service](#)
- [Expert engineering](#)
- [Inspection and maintenance](#)
- [Service locations all over the world](#)

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