

clean energy ahead[®]
TURBODEN

WASTE TO ENERGY

TURN YOUR WASTE INTO USEFUL POWER.

They believe in us



HEIDELBERGCEMENT

AGC



Turn waste into useful power

Turboden Organic Rankine Cycle (ORC) technology can be profitably and efficiently used to produce electric and thermal power from waste and to enhance the efficiency of existing waste to energy plants.

Turboden ORC turbogenerators in this application are able to produce up to 40 MW of electric power per single generator.

MUNICIPAL SOLID WASTE

- ▼ Food waste
- ▼ Refuse-derived fuel (RDF)
- ▼ Solid recovered fuel (SRF)
- ▼ Plastic



ANIMAL WASTE

- ▼ Chicken manure
- ▼ Other animal manure
- ▼ Dairy operation waste
- ▼ Animal by-products



SEWAGE SLUDGE

- ▼ Municipal wastewater
- ▼ Industrial wastewater



INDUSTRIAL AND HAZARDOUS WASTE

- ▼ Hospital & Medical
- ▼ Chemical
- ▼ Pulp & Paper
- ▼ Tires
- ▼ Industrial by-products



ELECTRIC POWER and THERMAL POWER

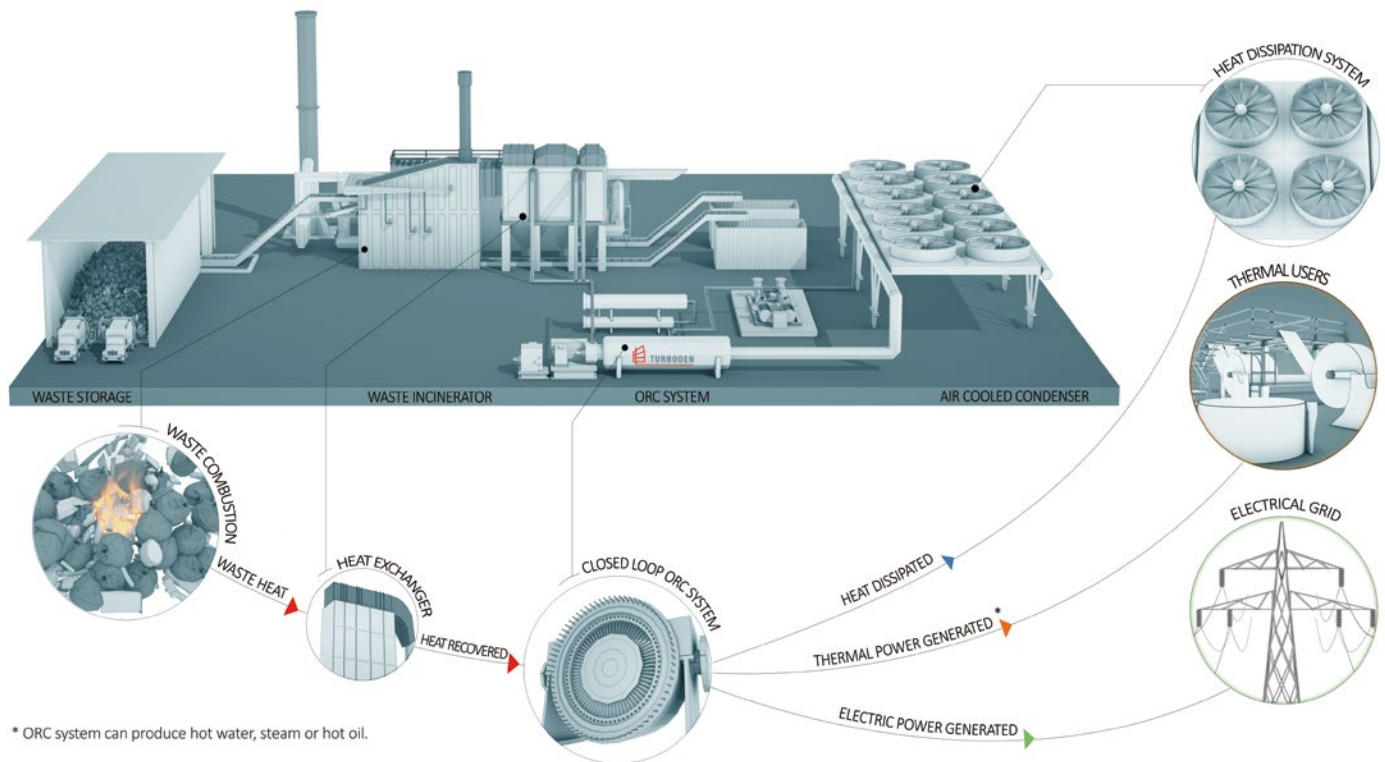


Make your business more sustainable

Designed according to specific client requirements, the ORC-based Waste to Energy plant is able to produce electric power only with an electrical efficiency up to 30% or Combined Heat & Power (CHP). Depending on specific characteristics of the waste, various waste combustion technologies and heat recovery exchangers may be employed.

POWER ONLY: generation of electric power only with no condensing heat valorization.

CHP: generation of heat and electric power.



Example of a small-medium decentralized Waste to Energy plant integrated with a Turboden ORC system.

Why choose Turboden for decentralized Waste to Energy?

GENERATE PROFIT FROM WASTE, VALORIZING HEAT AND POWER

REDUCE VOLUME OF WASTE AND ITS COST OF DISPOSAL

ENHANCE WASTE LOGISTICS, WITH LOWER ROAD TRANSPORT

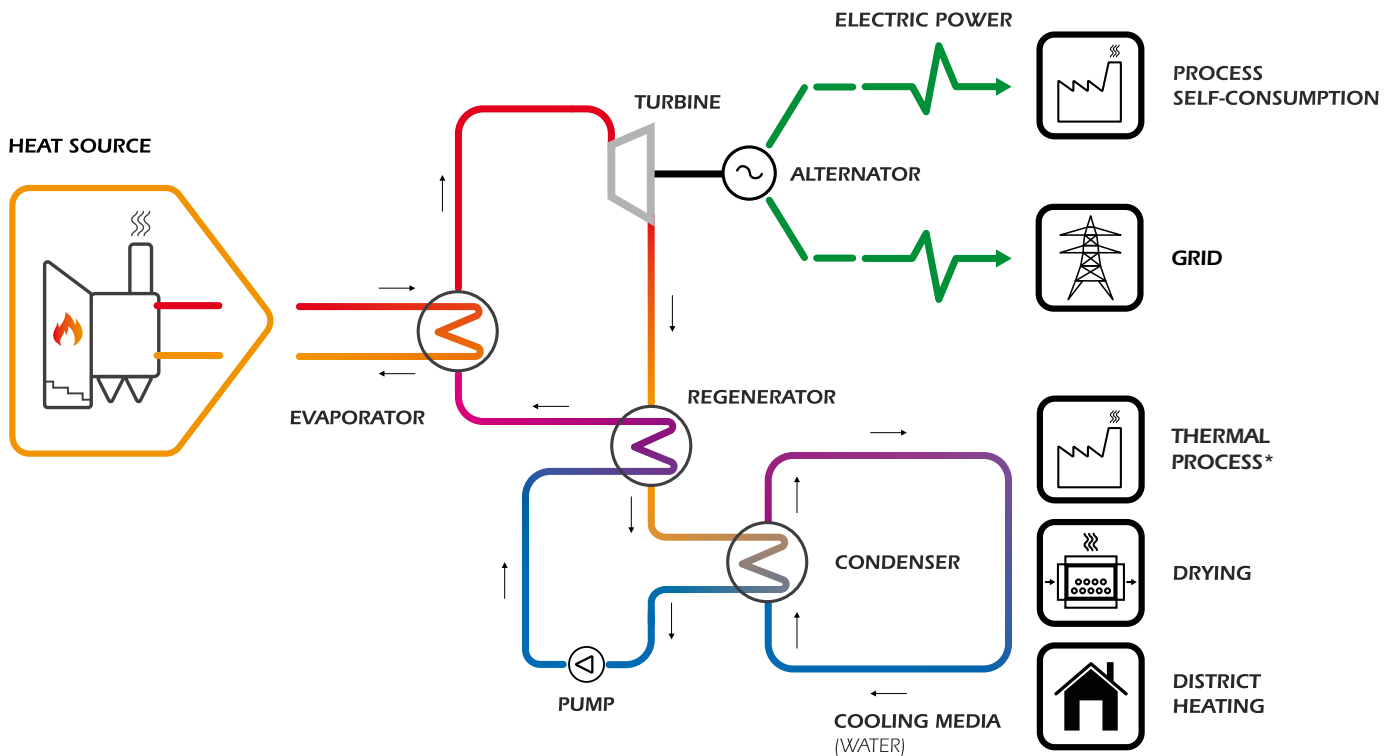
REDUCE CO₂ EMISSIONS, IMPROVING COMPANY SUSTAINABILITY

GET ACCESS TO A SIMPLIFIED AUTHORIZATION PROCESS

- ▼ ease of integration and high reliability (98% availability)
- ▼ electrical efficiency up to 30%
- ▼ low footprint and environmental impact
- ▼ automatic operation with no operator attendance required
- ▼ no water consumption, low maintenance required



Working Principle



* ORC system can produce hot water, steam or hot oil.

The ORC turbogenerator makes use of a closed thermodynamic cycle to convert heat into electricity. The thermal power recovered from waste combustion vaporizes a suitable organic working fluid, which then expands through the turbine and produces clean and reliable electric power through the alternator. Thanks to the regenerator, internal heat recovery takes place improving the cycle efficiency. Downstream from the regenerator, the organic vapor is condensed and pumped back to start the cycle again. The heat from condensation can either be used by the heat users or dissipated.

The heat from waste combustion is transferred to the ORC working fluid by means of an intermediate circuit or directly via the combustion gases in direct exchange systems. The media used in the intermediate circuits are thermal oil, saturated steam or superheated water.



From words to deeds



ALBANY COUNTY SEWER DISTRICT - USA

- ▼ SIZE: 1 MWe
- ▼ STATUS: in operation since 2013
- ▼ APPLICATION: power generation from sludge incineration in a wastewater treatment plant
- ▼ WASTE: sewage sludge



GÜRES - TURKEY

- ▼ SIZE: 2.3 MWe
- ▼ STATUS: in operation since 2018
- ▼ APPLICATION: CHP in an egg production facility
- ▼ WASTE: chicken litter



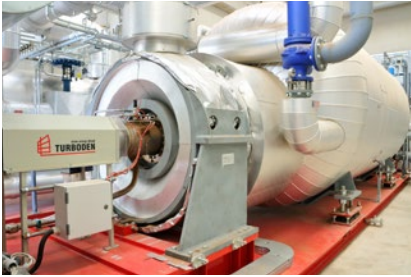
SUEZ INTERNATIONAL - ROMANIA

- ▼ SIZE: 2 X 0.6 MWe
- ▼ STATUS: under construction
- ▼ APPLICATION: power generation from sludge incineration in a wastewater treatment plant
- ▼ WASTE: sewage sludge



MIROM ROESELARE - BELGIUM

- ▼ SIZE: 3 MWe
- ▼ STATUS: in operation since 2008
- ▼ APPLICATION: power generation from a waste incineration plant
- ▼ WASTE: municipal solid waste



AGRIVIS - ITALY

- ▼ SIZE: 0.5 MWe
- ▼ STATUS: in operation since 2005
- ▼ APPLICATION: power generation from a waste incineration plant
- ▼ WASTE: industrial and hospital waste



THE CORPORATION OF THE CITY OF LONDON - CANADA

- ▼ SIZE: 0.6 MWe
- ▼ STATUS: under construction
- ▼ APPLICATION: power generation from a fluidized bed incineration plant
- ▼ WASTE: sewage sludge



ITC - TURKEY

- ▼ SIZE: 2 X 5.3 MWe
- ▼ STATUS: in operation since 2014 - 2015
- ▼ APPLICATION: power generation from a waste gasification plant
- ▼ WASTE: industrial waste



PROMONT - POLAND

- ▼ SIZE: 1 MWe
- ▼ STATUS: in operation since 2018
- ▼ APPLICATION: power generation from a waste incineration plant
- ▼ WASTE: plastic and hospital waste



ABOUT US



Turboden, a group company of Mitsubishi Heavy Industries, is an Italian firm and a global leader in the design, manufacture and maintenance of Organic Rankine Cycle (ORC) systems, highly suitable for distributed power generation. ORC systems can generate electric and thermal power exploiting multiple sources, such as renewables (biomass, geothermal energy, solar energy), traditional fuels and waste heat from industrial processes, waste incinerators, engines or gas turbines.



Mitsubishi Heavy Industries, Ltd. (MHI), headquartered in Tokyo, is one of the world's leading industrial firms with 80,000 group employees and annual consolidated revenues of around 38 billion U.S. dollars (year 2016). For more than 130 years, the company has channeled big thinking into innovative and integrated solutions that move the world forward. MHI owns a unique business portfolio covering land, sea, sky and even space. MHI delivers innovative and integrated solutions across a wide range of industries from commercial aviation and transportation to power plants and gas turbines, and from machinery and infrastructure to integrated defense and space systems.

Why Turboden?

PART OF MITSUBISHI HEAVY INDUSTRIES GROUP

Turboden benefits from the Mitsubishi Heavy Industries global network in a number of ways, including: financial stability, sharing of business practices (including customer warranties) and technology development.

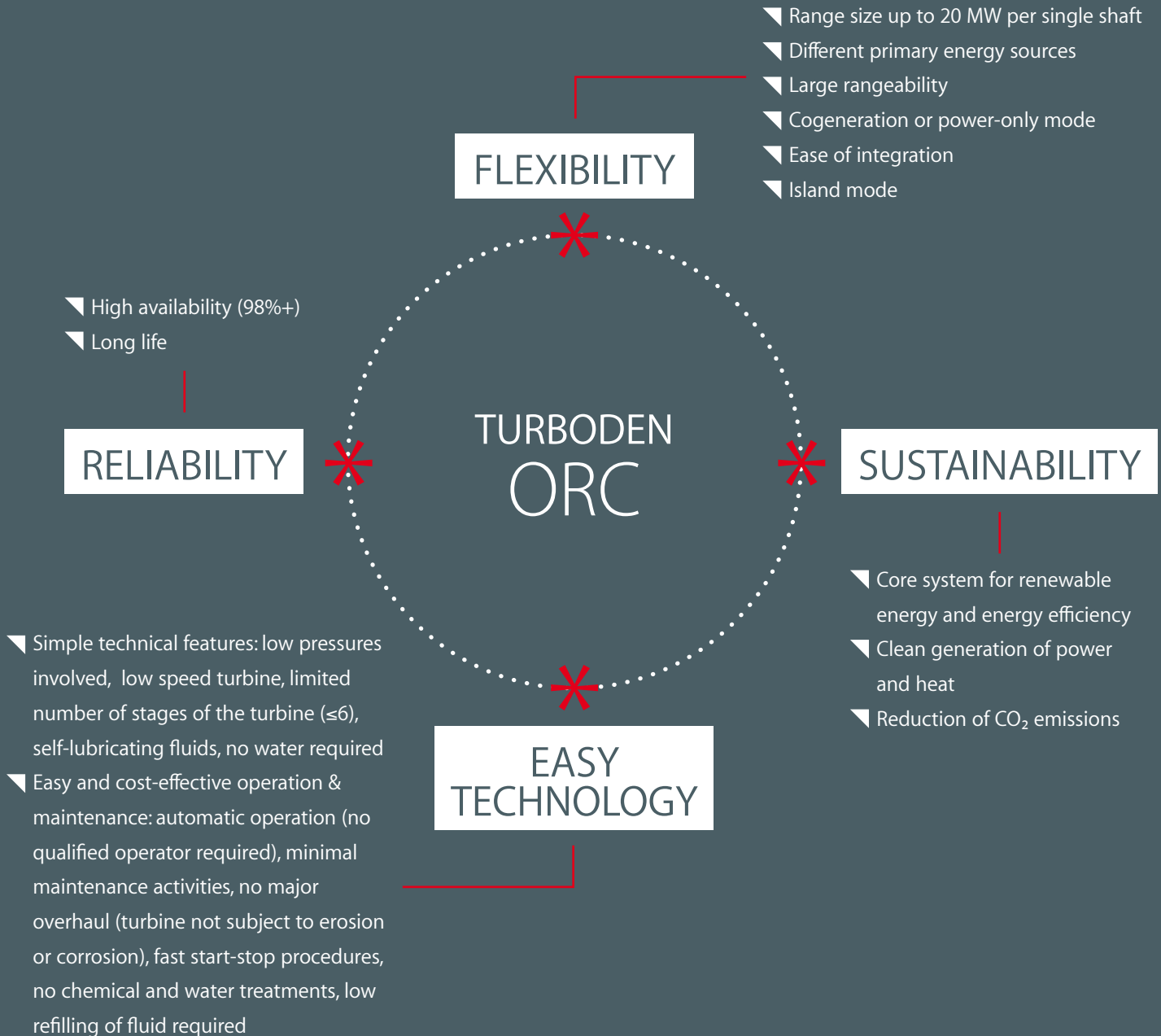
CAPABILITIES & EXPERIENCE

With over 35 years of experience, a global presence, 600+ MWe installations, and 370+ plants in 42 countries, Turboden is a market leader in the proprietary design and manufacturing of ORC optimized turbines.

CUSTOMER ORIENTATION

Optimized solutions for each customer and a qualified service department exclusively dedicated to customer assistance.

Feel our strengths



Always by your side

24/7

SUPPORT*

<2h

REACTION TIME

97%

PLANTS WITH AFTER-SALES
CONTRACTS

*up to

GLOBAL COVERAGE

- ▼ 2 service subsidiaries and 5 international service partner companies

CUSTOMIZED SERVICES

- ▼ single contact for requests for support
- ▼ staff dedicated to on-site and remote technical support
- ▼ assistance of an international network of companies able to provide technical support
- ▼ wide range of services provided
- ▼ prompt assistance and customized after-sales services
- ▼ remote technical support using innovative tools
- ▼ dedicated spare parts warehouse



CUSTOMER REQUEST
OR TURBODEN
PLANNED CHECKS



TREND ANALYSIS
WITH LOCAL
OPERATOR SUPPORT



FOCUSED TEAMWORK
AND TECHNICAL
DECISIONS



REACTION PLAN:
REMOTE OR ON-SITE



SATISFIED
CUSTOMER

Meet our global and proven experience



WtE

PLANTS: 16
TOTAL CAPACITY: 32 MWe

PLANTS: 377
COUNTRIES: 42
TOTAL CAPACITY: 607.4 MWe
CUMULATIVE OPERATION TIME: 15 million hours
AVERAGE AVAILABILITY: 98+%

Update March 2019

