



# Technology

## ORC

### Technology Leadership

Ormat offers unique renewable power solutions based on the ORMAT® ENERGY CONVERTER (OEC), a power generation unit which converts low, medium and high temperature heat into electrical energy. With 73 patents worldwide, the OEC is a state-of-the-art implementation of Organic Rankine Cycle [1] technology that we have refined and perfected through more than 30 years of use under the most challenging conditions. Ormat's flexible, modular solutions for Geothermal Power [2], Recovered Energy, [3] and Remote Power [4] generation are all based on the OEC, which is specifically designed for customized power plant options.

Our proprietary technology enables geothermal developers to efficiently and economically use the full range of naturally occurring geothermal resources found throughout the world – from low temperature geothermal water to high-pressure steam. Globally, the OEC is converting energy sources, whether geothermal, gas or heat, into valuable electricity, while setting industry standards for simplicity, reliability and low operating costs.

### Ormat Advantages:

Designed for outdoor use as well as indoor installation and remote, unattended operation, the OEC combines technological innovation with over 50 million operating turbine hours in the field.

- **Flexibility**

Specially designed and tailored plants match resource conditions and optimize the efficiency and cost effectiveness of electrical generation.

- **Assures Long Turbine Lifespan**

Unlike its steam turbine counterpart and as a thermodynamic consequence of the hydrocarbons' 'drying fluid' saturation curve, the OEC turbine remains dry under all expected working conditions. This eliminates the possibility of erosion damage to the turbine's buckets and nozzles. Thus, the OEC can accommodate part load operation and large transients more effectively than steam systems.

- **Operation at Low Temperatures and Anti Freeze Control**

The freezing point of the motive fluid is extremely low. This feature eliminates the requirement to implement controls and procedures to prevent freeze-up within the condenser, heat exchangers and piping.

- **Remote, Unattended Operation**

ORC-type power systems have compiled an exemplary reliability record wherever Ormat has applied them. These systems do not require 24/7 manning by a licensed steam plant operator. These two features result in the ability to operate OEC plants in a remote, unattended mode by the same compression station operators.

- **High Turbine Efficiency at Low Speeds**

Due to the motive fluid's low sonic velocity, the OEC yields high turbine efficiency at 1500 or 1800 RPM (50 or 60 Hz) without a gearbox, increasing plant output while reducing costs.

- **Condensing Near Atmospheric Pressure**

The thermodynamic properties of the motive fluid provide much higher condensing pressures than comparable steam systems. By operating at condensing pressures near atmospheric, the turbine requires shorter blades and the ingress of air into the system is significantly minimized. The latter feature mitigates the need for vacuum maintenance.

- **High Availability**

Ormat binary cycle plants have demonstrated the highest average plant availability in today's market.

- **Air and Water Cooling**

The OEC can operate with either air or water cooling, depending on the availability and cost of suitable water resources. Air cooling systems feature low operating costs and an exceptionally low environmental profile. They operate in a closed loop, do not require chemical additives and involve no waste disposal. In addition, air cooled plants do not produce a visible plume and blend into the landscape.

- **Moisture-free Turbine Expansion**

The OEC turbine remains dry, eliminating the possibility of erosion damage to the turbine's buckets and nozzles. Therefore, the OEC can accommodate part load operation and large transients effectively.

- **Synchronous and Asynchronous Generators**

The OEC can be configured to produce either synchronous or asynchronous electricity according to local requirements.

- **High Performance with Minimal Environmental Impact**

Ormat's modular power plants are designed to be environmentally friendly. Air-cooled condenser technology enables us to re-inject almost 100% of all extracted geothermal fluids, thereby avoiding the use of geothermal steam condensate or external water resources for cooling and preventing the need for chemical additives. The 100% re-injection also sustains reservoir life and productivity. Due to the low profile of the air-cooled condensers and the lack of any plumes from water cooling towers, both environmental and visual impacts are minimized.

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