

# ORC Module – Our solution at a glance

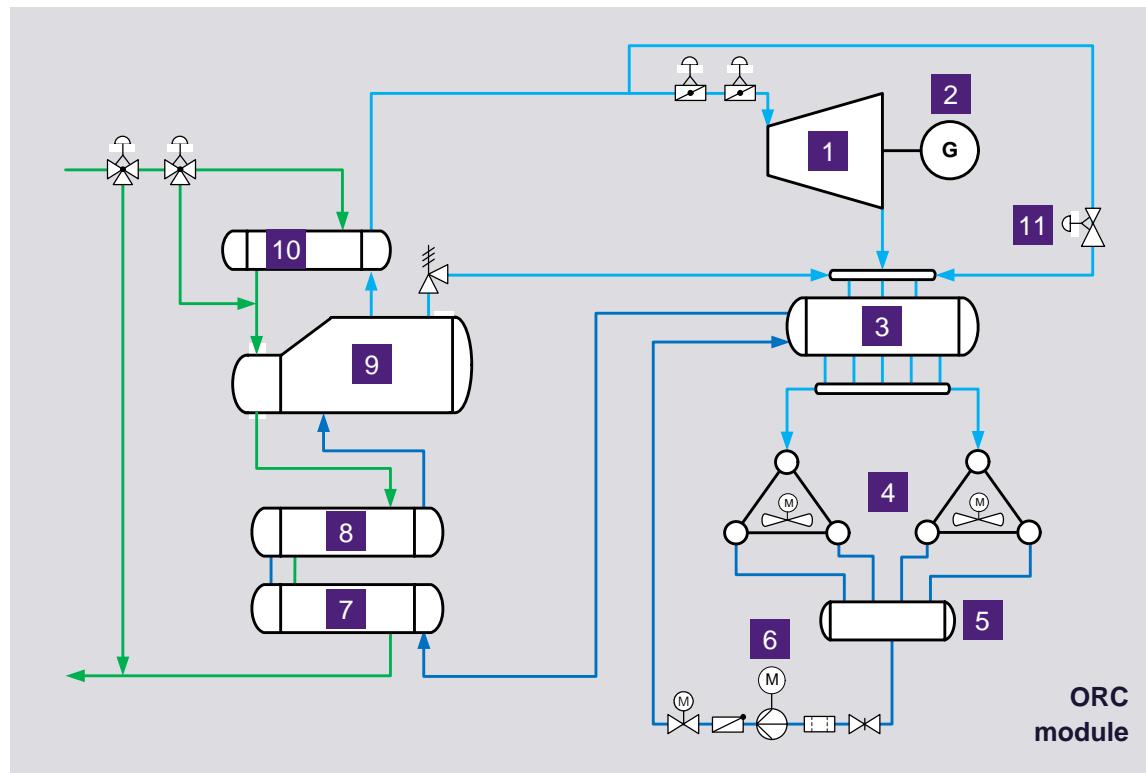
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# ORC technology

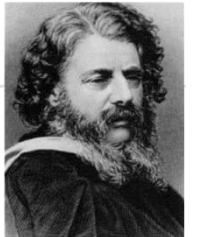
## What is an Organic Rankine Cycle?

### Organic Rankine Cycle



- 1 ORC turbine   2 Generator   3 Recuperator   4 Air cooled condenser   5 Storage tank   6 Feed pump   7 Pre-heater 1   8 Pre-heater 2   9 Evaporator   10 Super-heater
- 11 Bypass station   — ORC Vapor   — ORC Liquid   — Brine

### Organic Rankine Cycle



- The Organic Rankine Cycle (ORC) is named after the Scottish engineer and physics **William John Macquorn Rankine** (1820 – 1872)
- Instead of water-steam, the ORC system vaporizes an organic, high molecular mass fluid
- The fluid selection is done according to the available heat source temperature to adjust the liquid-vapor phase change, or boiling point exactly to the available heat source temperature
- The fluid allows ORC-cycle heat recovery from heat sources such as biomass combustion, gas turbines, industrial waste heat, geothermal heat, solar ponds etc.
- Even low-temperature, like geothermal heat can be converted into useful work, that can itself be converted into electricity were other technologies like a Steam Rankine Cycle (SRC) does not work anymore

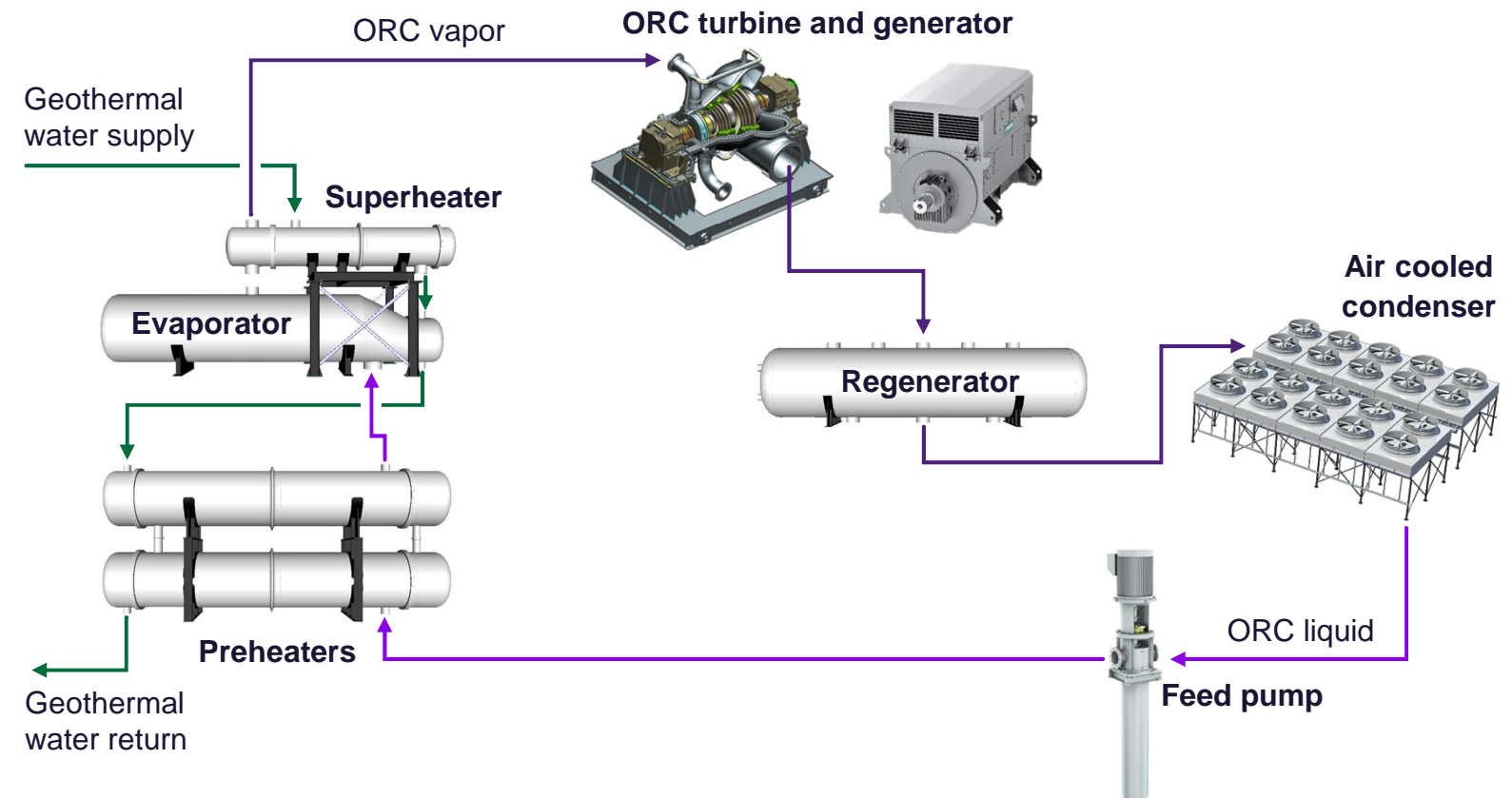
# ORC technology

How does the power plant work?

## Benefits to use ORC technology

- No use of water
- Simple and compact design
- Outdoor arrangement possible
- Recuperated and non-recuperated cycle possible
- Hermetically closed cycle

## Process flow scheme



# Siemens Energy ORC module

## The clean and efficient renewable baseload power plant

### Attractive CAPEX and low LCoE

Combining the simplicity of the ORC-design and the ORC turbine based on SE proven steam turbine technology result in a cost-effective binary power plant.



### Environmentally sound solution

No water usage, low emissions and limited noise pollution support a better climate.



### Future-proof design

State of the art technology, providing remote and unmanned operations, ready for a new era.



**A reliable solution** for environmentally sound, affordable electricity generation



# Features of ORC-technology

## Efficient

- Highly efficient ORC-Turbine based on proven Siemens Energy steam turbine portfolio
- Good part load efficiency

## Reliable

No blade erosion due to superheated turbine exhaust vapor (dry ORC fluid used)

## Flexible

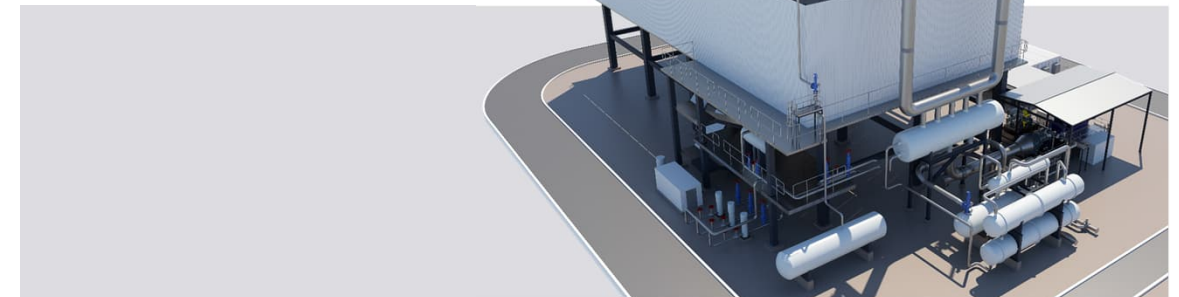
Wide operation range possible (10 – 100%)

## Low investment costs

- Simple and compact plant design
- Lower temperatures and pressures compared to conventional steam applications

## Low operation costs

- No make-up water treatment necessary
- Unattended operation possible
- Low demand on repair and maintenance

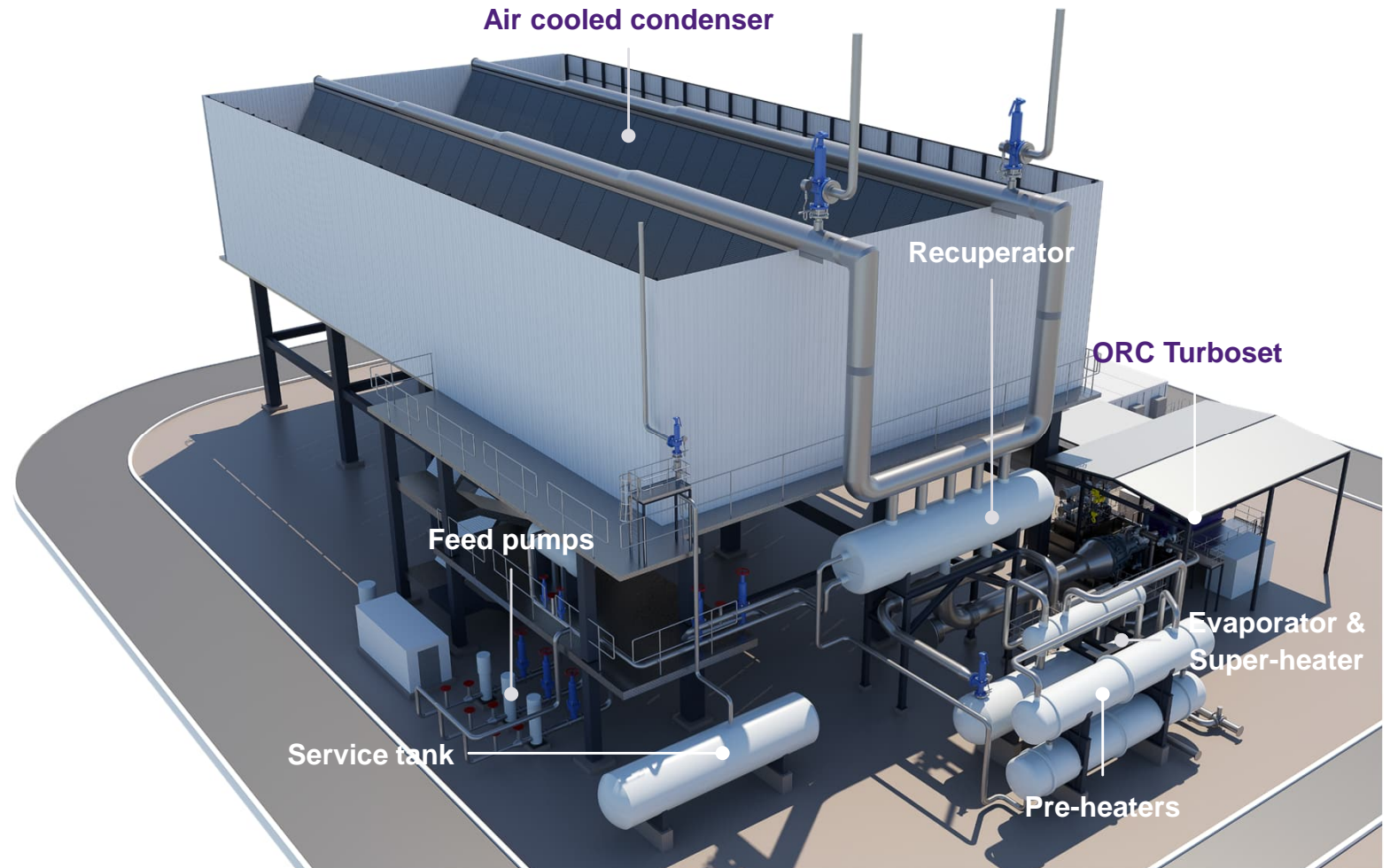


# ORC Module (up to 20 MWe)

## 3D view

### Main features of the arrangement concept

- **Binary cycle ORC system** (geothermal water as heat carrier)
- **Outdoor arrangement** of the main equipment
- Electrical and control system **containerized**
- Weather roof for turboset (rain & sun protection)
- **Air cooled condenser** (optimized auxiliary power consumption)
- **Air cooled** closed cooling water system via fin-fan coolers (optional)
- **Water free solution** for plant operation

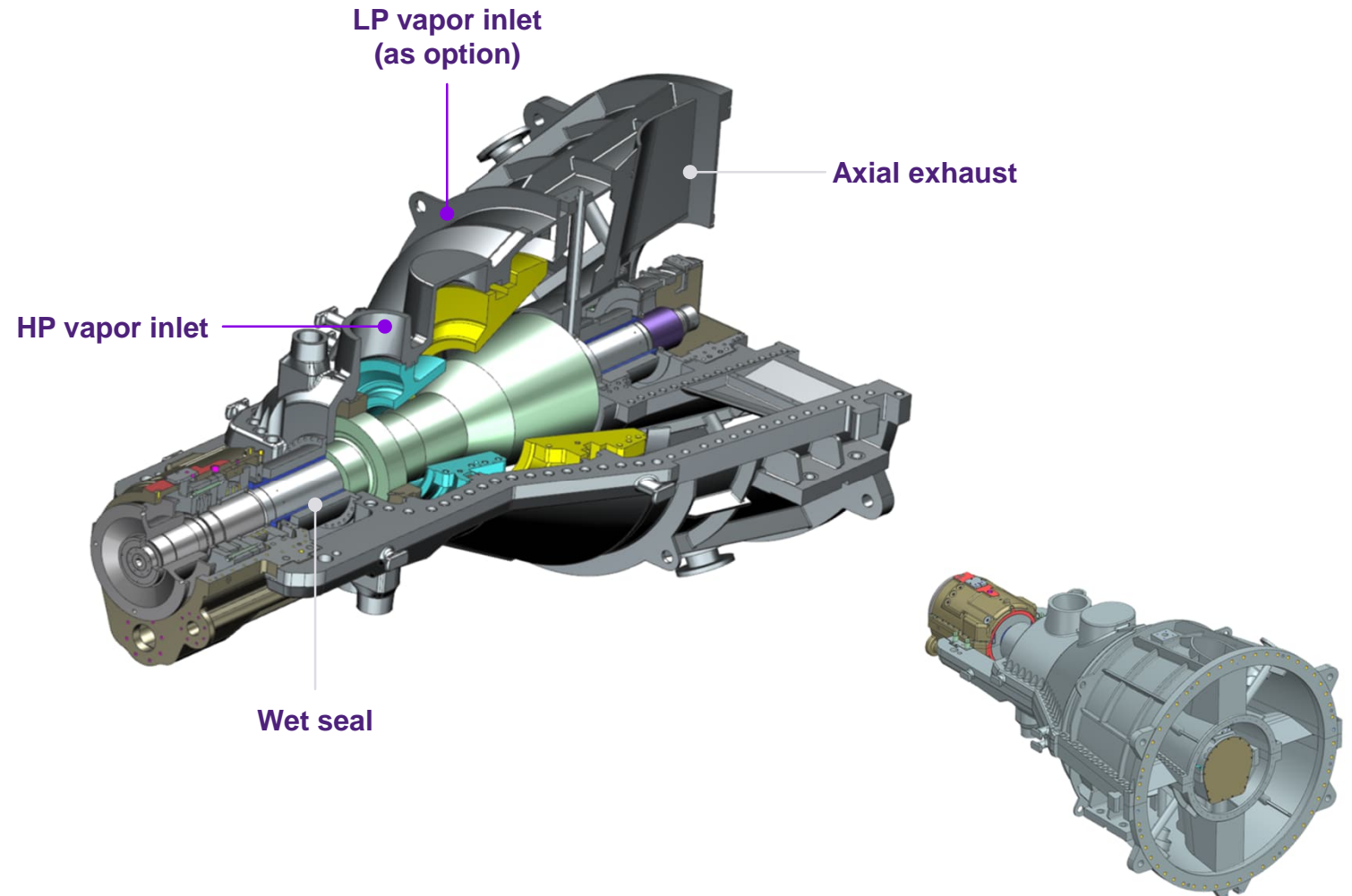


# SST-600 ORC Turbine Up to 20 MWe

same DNA as our Steam Turbines

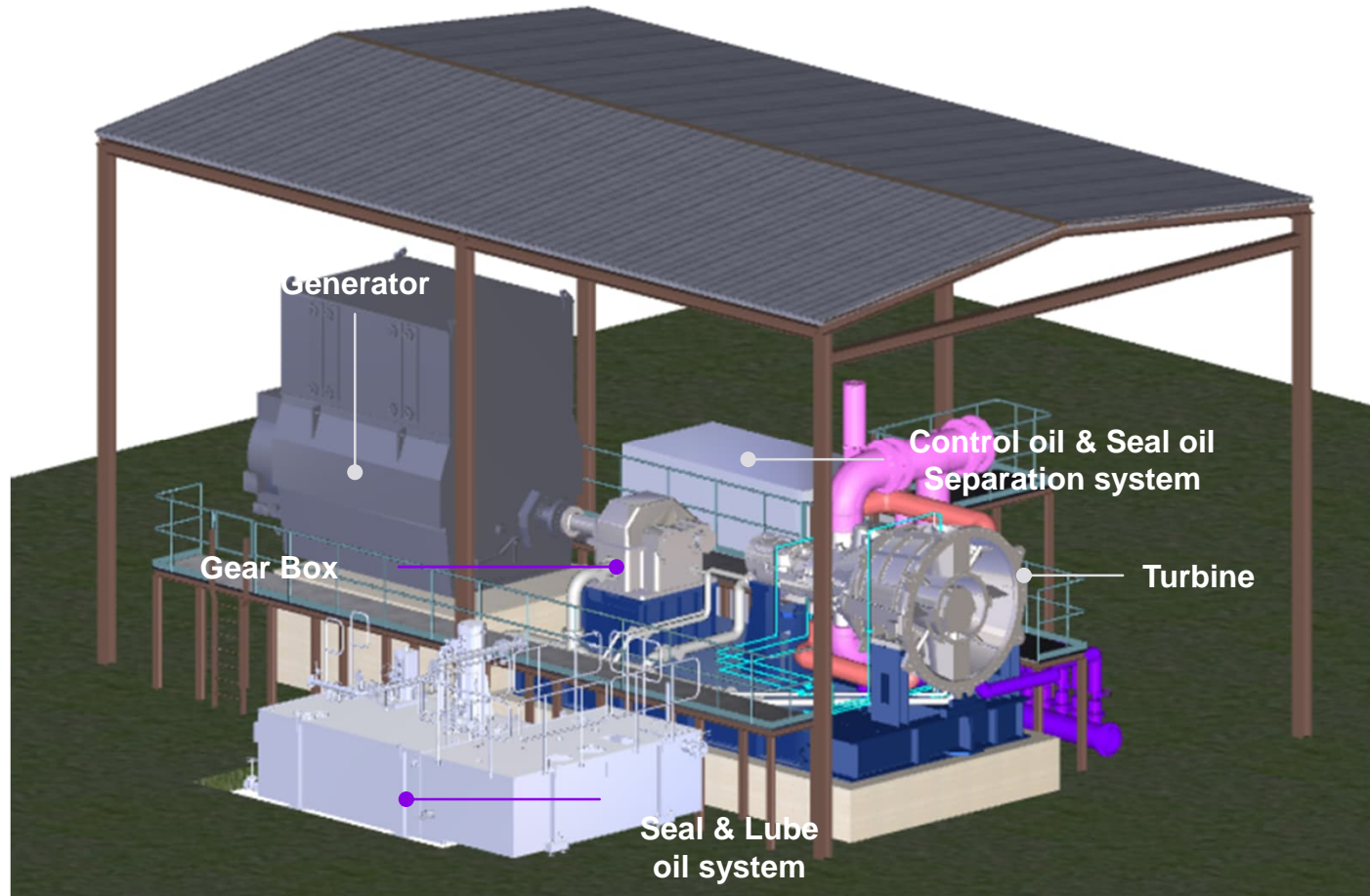
## High Synergy between SE Steam Turbine Technology and ORC

- Reaction Blading Technology
- >90% turboset efficiency (@ Generator terminal)
- In-between bearing concept
- Axial exhaust for low level installation & easier maintenance
- Single Casing Design
- One HP and one LP blading group
- LP admission possible for dual pressure concept
- Robust double acting Mechanical Seal design at both shaft ends
- Long Service Intervals due to less complex design



# SST-600 ORC Turbine Generator Set Up to 20 MWe

## Technical Data & Layout Arrangement



### Technical Data

- Inlet Parameters
  - **Pressure:** up to 40 bara
  - **Temperature:** up to 300°C
- **Exhaust Pressure:** based on cycle design
- **Speed:** 3000 RPM with gear box
- **Power Range:** 10 – 20 MWe gross
- **Inlet Connections:** Up to 1 x DN450 ESV
- **Exhaust Connection:** DN2160 Axial Exhaust
- **LP admission:** possible

### Main features of the arrangement concept

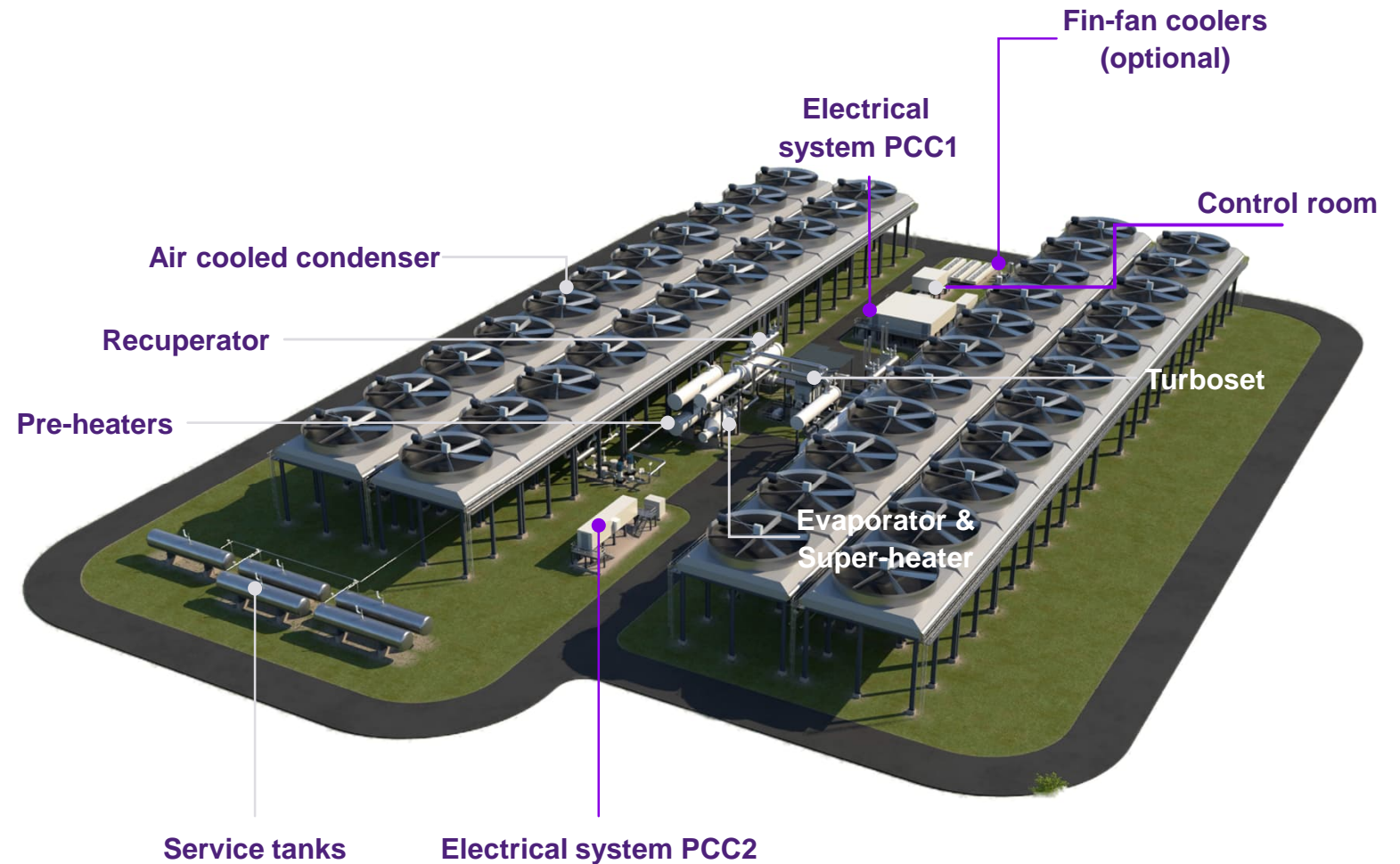
- **Outdoor arrangement** of the main equipment
- Electrical and control system **containerized**
- Weather roof for turboset (rain & sun protection)
- **Low level plant arrangement** – lower civil costs

# ORC Module (up to 60 MWe)

## 3D view

### Main features of the arrangement concept

- **Binary cycle ORC system**  
(geothermal water as heat carrier)
- **Outdoor arrangement** of main equipment
- Electrical and control system **containerized**
- **Weather roof for turboset**  
(rain & sun protection)
- **Air cooled condenser**  
(optimized auxiliary power consumption)
- **Air cooled** closed cooling water system via fin-fan coolers (optional)
- **Water free solution** for plant operation



# ORC Module (up to 60 MWe) 3D views

