



EXERGY'S MAJOR INNOVATIONS AND THEIR PROVEN PERFORMANCES

—
INDUSTRY PITCH —
ORC SEMINAR

Luca Xodo – Head of
Business Development

SUMMARY

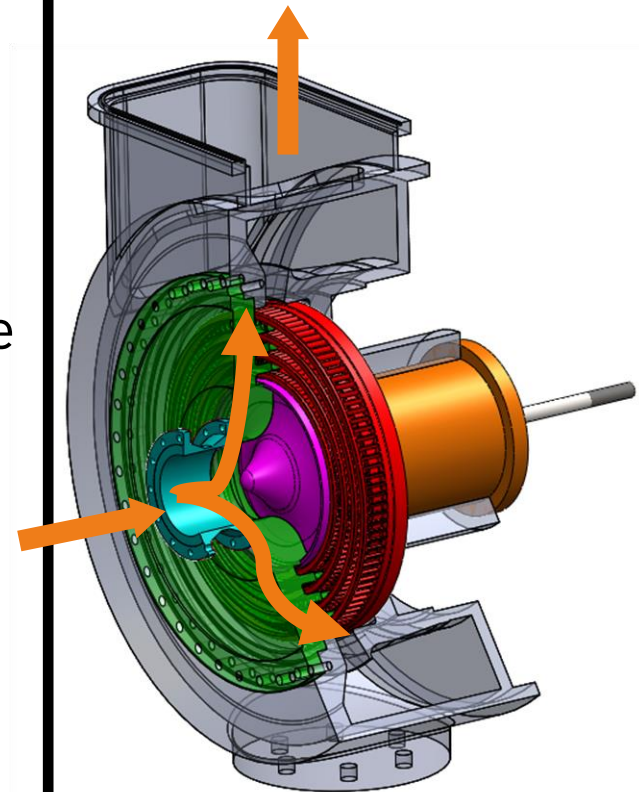
- Radial Outflow Turbine
- Tosunlar plant: 2 pressure level - single turbine
- Umurlu I plant: 12 MW plant
- NCG expander
- The NOSE CONE

EXERGY

- › Supplier of the full ORC cycle, utilising the **Radial Outflow Turbine**
- › **2 factories, Italy and Turkey**, manufacturing the Turbine
- › Offering **added value, resource assessments, financing possibilities, EPC services**

THE RADIAL OUTFLOW TURBINE

- 1** The fluid enters the turbine disk axially in its center
- 2** Deviates by 90° in the Nose Cone
- 3** Expands radially through a series of stages mounted on the single disk
- 4** At the discharge of the last rotor, the fluid flows through a radial diffuser
- 5** Is conveyed to the recuperator and/or condensation section of the system, through the discharge volute



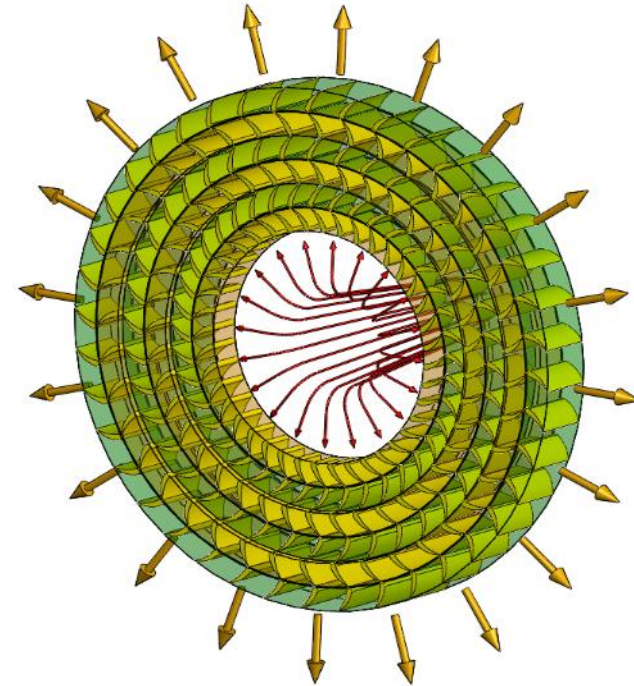
3D cross section of the radial outflow turbine

THE RADIAL OUTFLOW TURBINE

Why choose a centrifugal (outflow) turbine to expand a fluid?

Efficiency and simplicity!

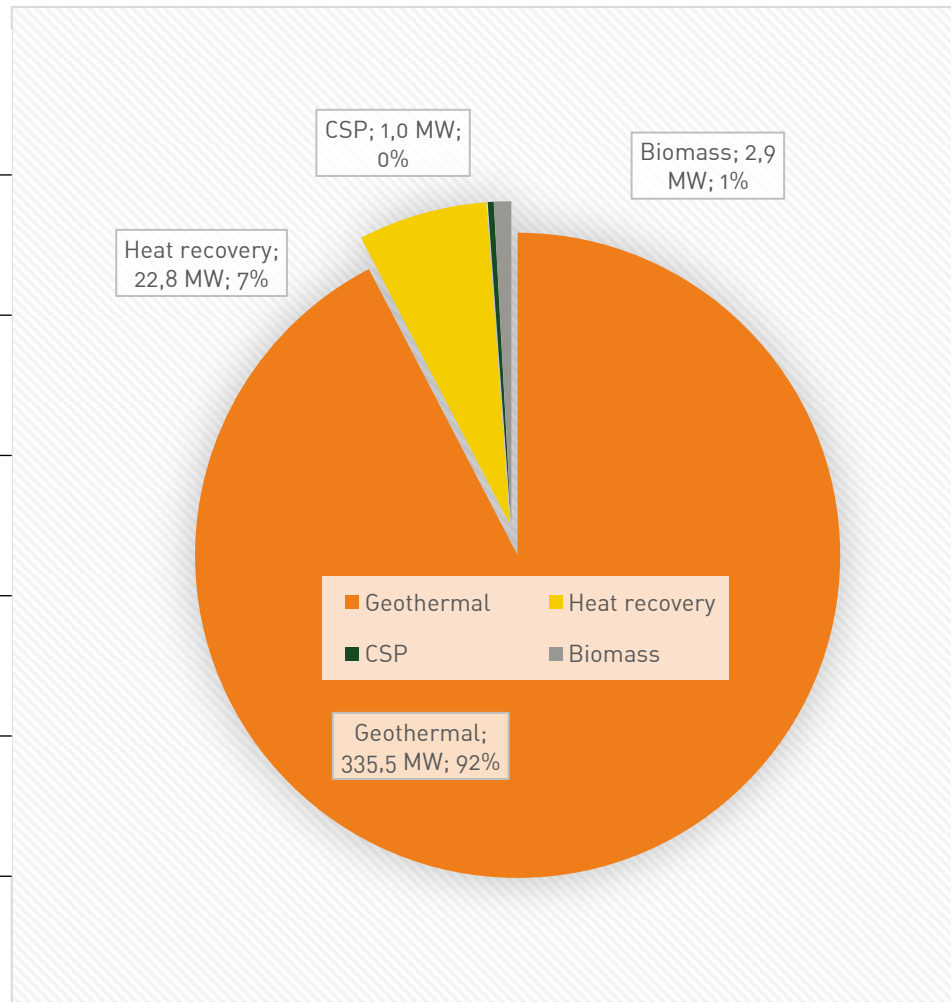
- › **Excellent match** between volumetric flow and the cross section across the radius.
- › **No 3D effects** thanks to pressure differential
- › **Simpler construction** technology:
 - straight blades
 - multiple stages and pressure on single disk
- › **Easy maintenance**
 - removable mechanical group



Only the Radial Outflow Turbine allows multiple pressure admissions on a single disk.

REFERENCES

	MW	#PLANTS
GEOTHERMAL	335,5	21
HEAT RECOVERY	22,8	14
BIOMASS	2,9	5
CSP	1	1
TOTAL	362.2	41



PROVEN PERFORMANCE





GEO THERMAL

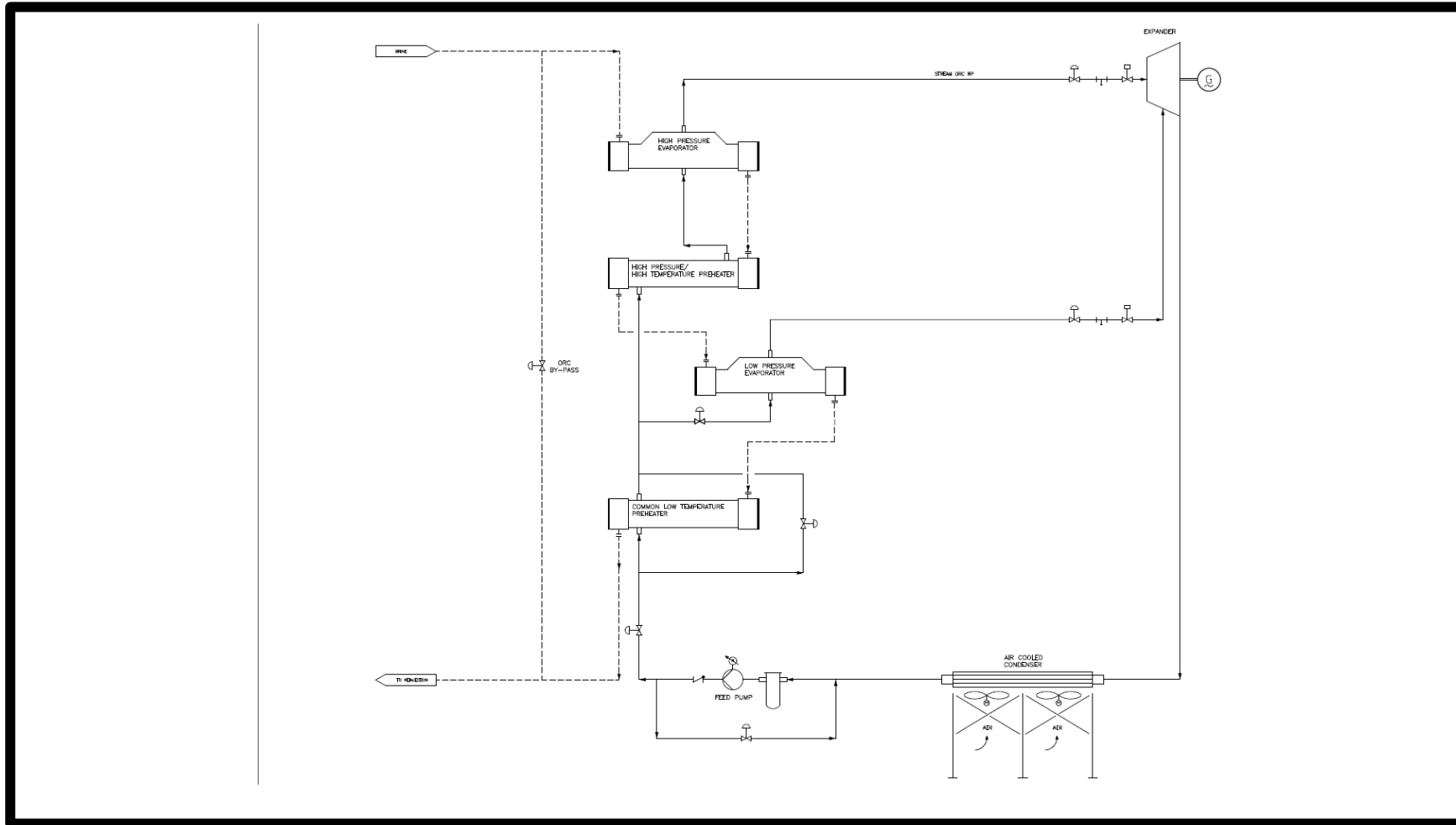
TOSUNLAR I PLANT



TOSUNLAR I PLANT

4MW 2 PRESSURE LEVELS - 1 TURBINE

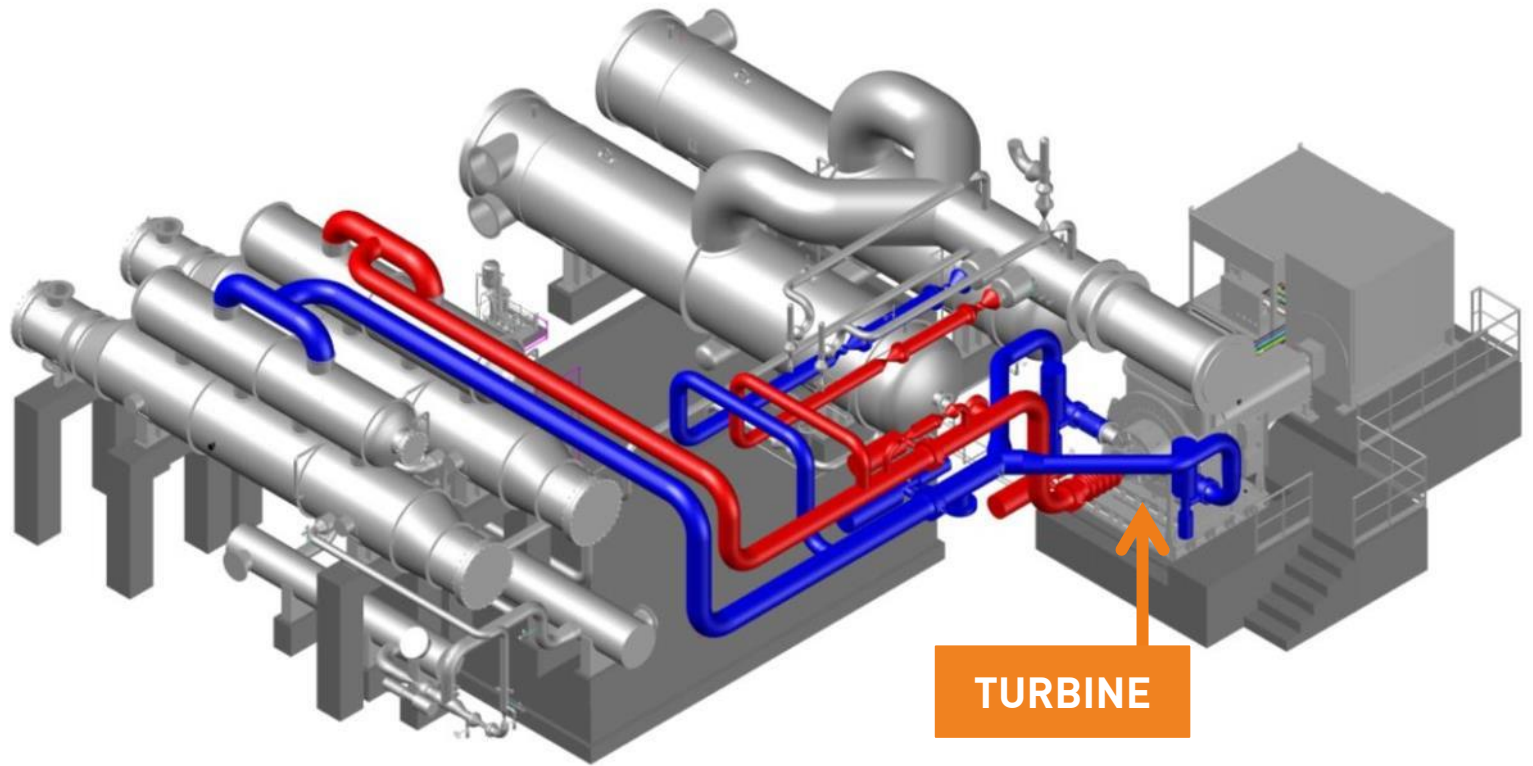
FLOW DIAGRAM



TOSUNLAR I PLANT

4MW 2 PRESSURE LEVELS - 1 TURBINE

INLET OF 2 PRESSURE LEVEL STREAMS



LOW PRESSURE

HIGH PRESSURE

TOSUNLAR I PLANT

4MW 2 PRESSURE LEVELS - 1 TURBINE

**RESOURCE
TEMPERATURE** 105 °C

**REINJECTION
TEMPERATURE** 65 °C

GUARANTEED MWeI 3,478

CORRECTED MWeI ↑ 3,850

**PLANT OVER-
PERFORMANCE** + 10,7%

**TURBINE
EFFICIENCY** 91,69%
93,65%

Third Party Test by



**POLITECNICO
MILANO 1863**



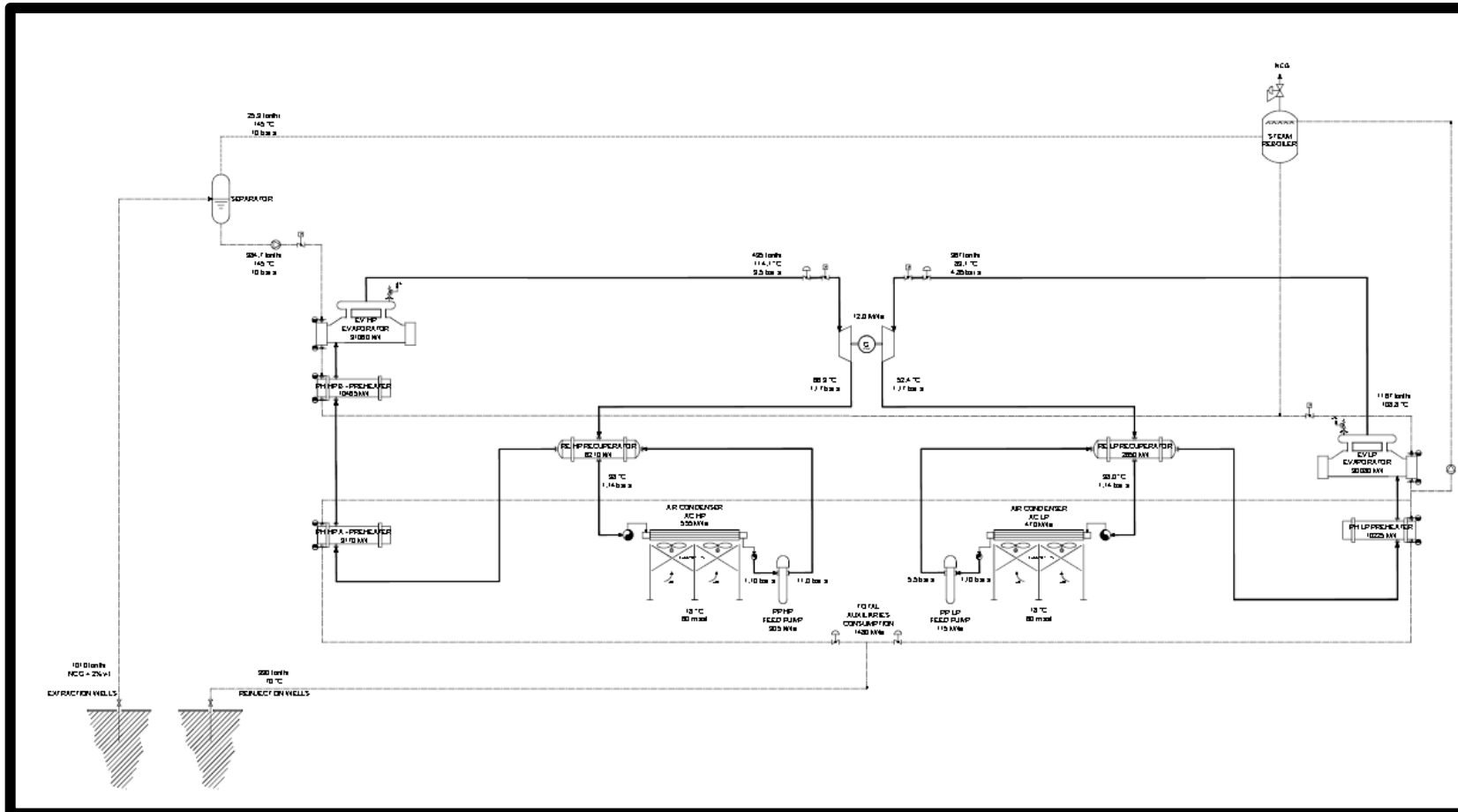
UMURLU I PLANT



UMURLU I PLANT

2 PRESSURE LEVELS - 2 TURBINES 12MW

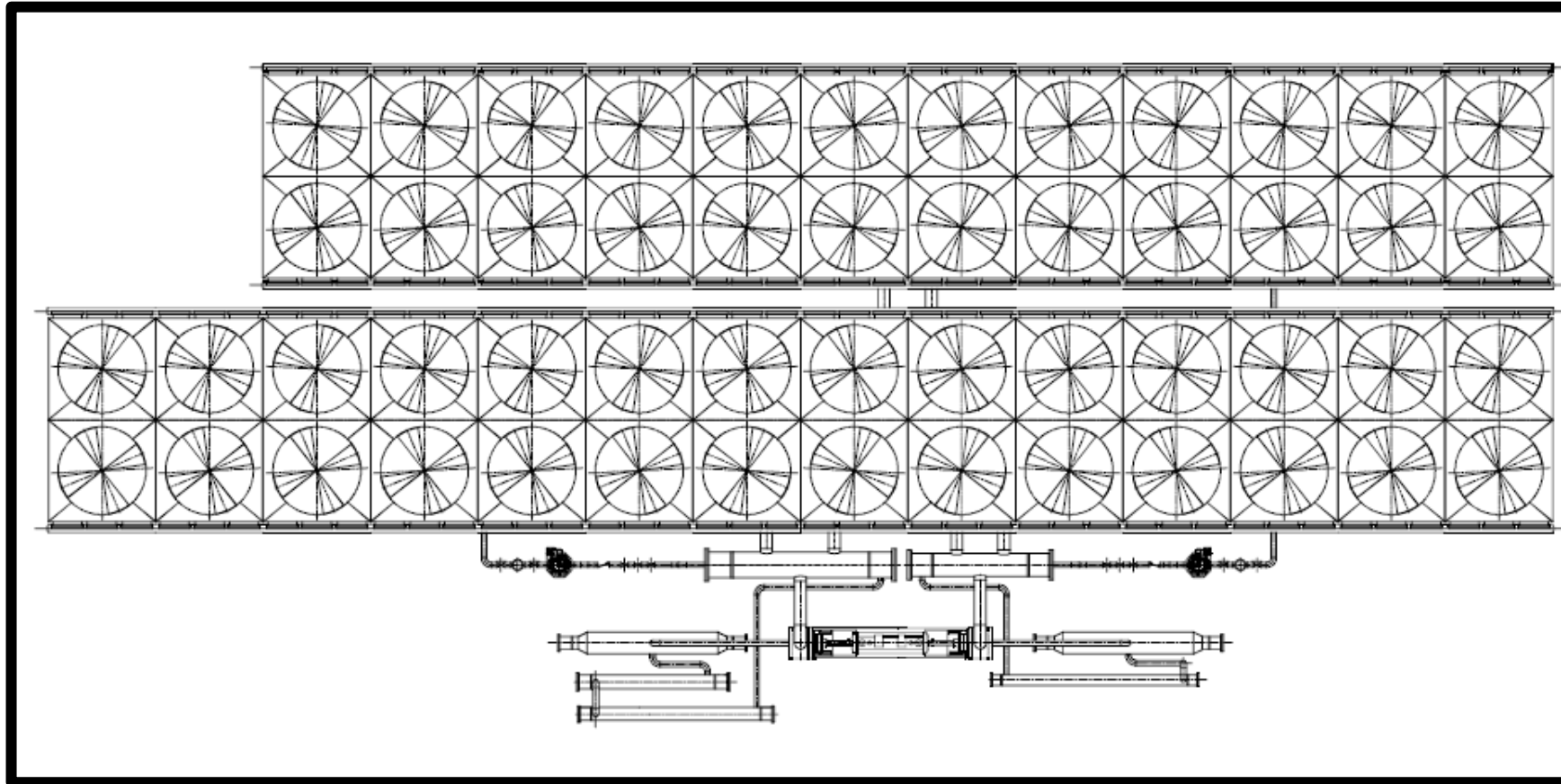
FLOW DIAGRAM



UMURLU I PLANT

2 PRESSURE LEVELS - 2 TURBINES 12MW

LAYOUT



UMURLU I PLANT

2 PRESSURE LEVELS - 2 TURBINES 12MW

RESOURCE
TEMPERATURE

145°C

REINJECTION
TEMPERATURE

70°C

GUARANTEED MWe_l

12

CORRECTED MWe_l

↑13,670

OVERPRODUCTION

↑ 13,9%

Third Party Test by



THE NCG EXPANDER

EXENERGY



THE NCG EXPANDER

MORE EXTRA POWER WITH THE NCG EXPANDER

- > **Designed to recover additional MW of power** from non-condensable gases of the geothermal fluid
- > **In house** design
- > Single shippable **standard module**

ADVANTAGES

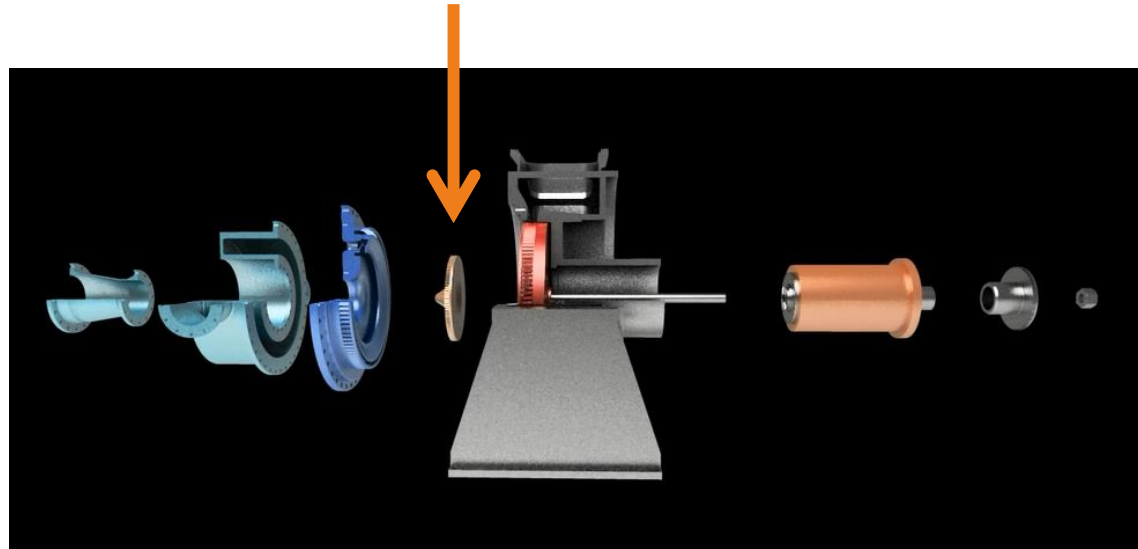
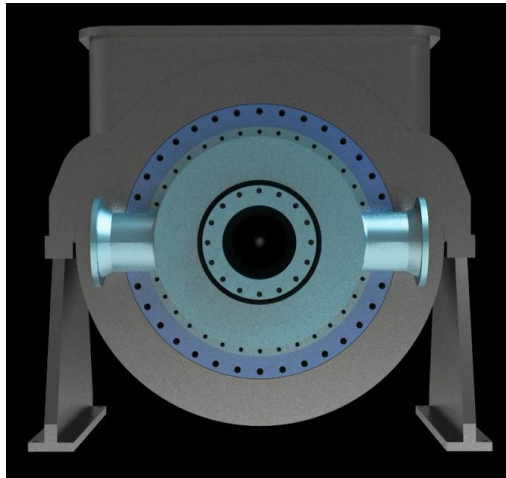
Improved **performances** and **profitability** of the plant



NOSE CONE



NOSE CONE



- › Resource conditions can **change over time, or fail to meet expectations**
- › A quick and inexpensive change to the first stage of the turbine, allows Exergy to **better optimize the turbine for the new conditions, recovering some of the lost power**

NOSE CONE

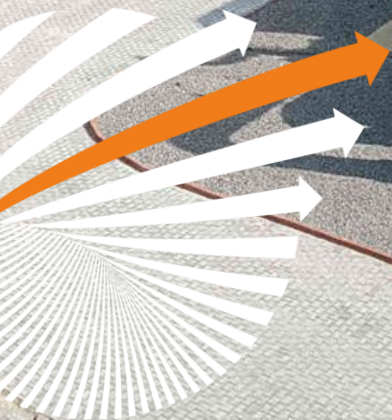
Assumptions:

- > Heat exchangers and ACC (NO CHANGE)
- > Brine flow rate (824 t / h)

Nose Change	Brine Temperature [°C]	Net Power [kWe]	Net power increase [%]	Absolute difference [kWe]
Design	145	6240		
Same turbine	130	4188		0
Nose Changed	130	4489	7.2%	301
Optimized turbine	130	4620	10.3%	432

GREENECO ENERJI, SARAYKÖY 1, TURKEY

YEAR: 2015
APPLICATION: GEO
POWER: 12 MW






KARADENIZ
HOLDING,
UMURLU 1,
TURKEY

YEAR: 2015
APPLICATION: GEO
POWER: 12 MW





EDA
RENOVAVEIS,
PICO ALTO,
TERCEIRA
(AZORES, PT)

YEAR: 2017
APPLICATION: GEO
POWER: 4 MW



AKÇA ENERJİ
DENİZLİ,
TURKEY



YEAR: 2014
APPLICATION: GEO
POWER: 4 MW

ENEL GREEN POWER BAGNORE, ITALY

APPLICATION: GEO
YEAR: 2012
POWER: 1MW
Click for video





WASTE HEAT RECOVERY

FROM INDUSTRIAL PROCESSES
AND POWER STATIONS



GLASS MILL
APPLICATION:
SISECAM
TARGOVISHTE

WASTE HEAT RECOVERY

HEAT RECOVERY SYSTEM FOR TARGOVISHTE GLASS MILL



WASTE HEAT RECOVERY

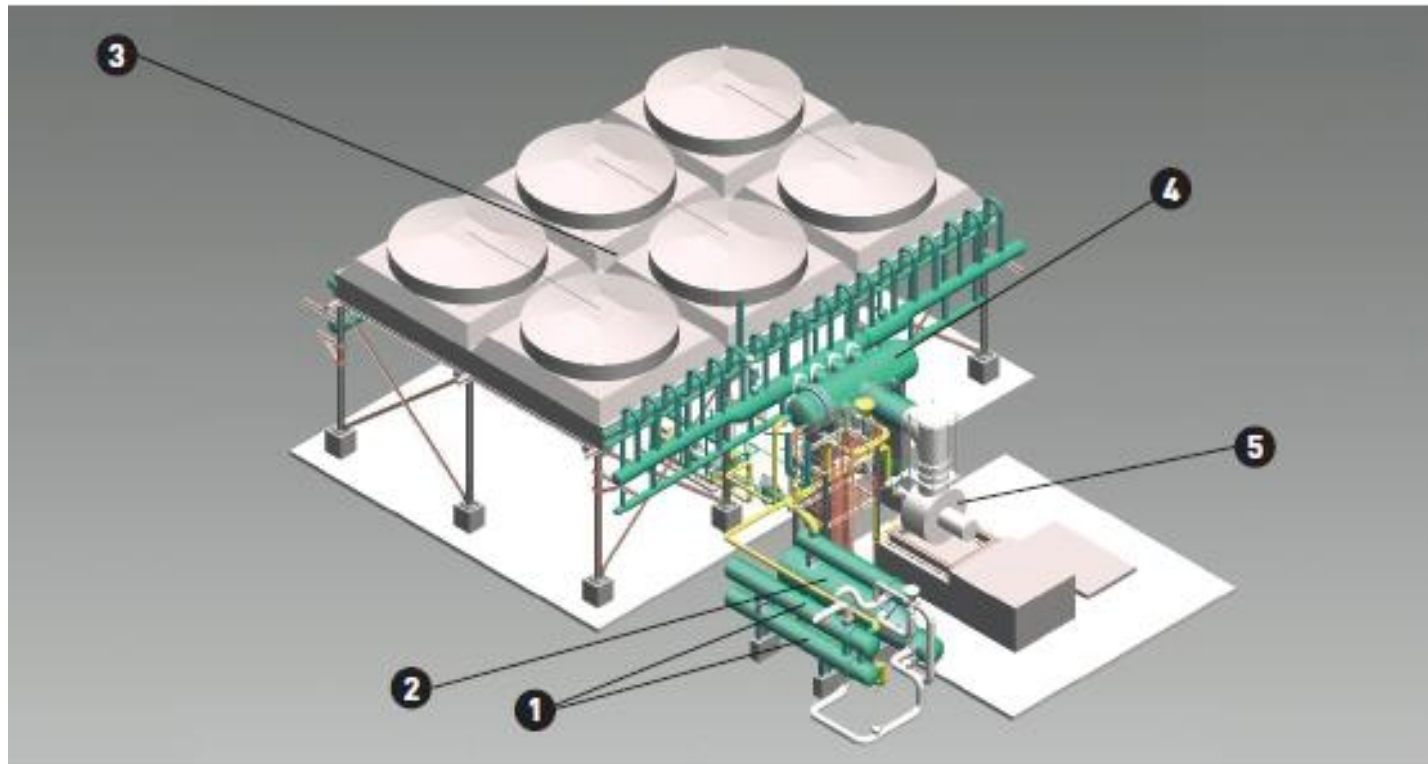
HEAT RECOVERY SYSTEM FOR TARGOVISHTE GLASS MILL

PERFORMANCE OF THE UNIT

GROSS EL POWER	5 MW
NET EL POWER	4.7 MW
EFFICIENCY	22.6%
TOTAL THERMAL INPUT	21,3 MW
EXHAUST VOL. FLOW	270,000 Nm ³ /H
INLET TEMPERATURE	420°C
OUTLET TEMPERATURE	200°C
CAPEX(total)	10.500.000,00 €
OPEX	100.000,00 €/year
OPERATING HOURS	8000h

WASTE HEAT RECOVERY

3D EXAMPLE OF AN ORC HEAT RECOVERY SYSTEM



1 Preheater 2 Evaporator 3 ACC 4 Recuperator 5 Radial outflow Turbine (ROT)

Come to meet us at our booth and turbine exhibition



operating
hq

HEAD OFFICE

Via degli Agresti, 6

40123 Bologna (BO) ITALY

OPERATING HEADQUARTERS

Via Santa Rita, 14

21057 Olgiate Olona (VA) ITALY

Tel +39 0331 18 17 711

Fax +39 0331 18 17 731

EXERGY-ORC.COM

INFO@EXERGY.IT