Italcementi Group

A world class local business

Solar Power and new concrete applications: a pilot plant in Morocco

RENEWABLE ENERGIES for MANUFACTURING INDUSTRIES
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Italcementi Group at a glance

The world's fifth largest cement producer

A worldwide presence in 22 countries

An overall staff of 18,000 people

A consolidated production capacity of approximately 61 million tons

2014 annual sales exceeding 4.1 billion Euro

i.150

Italcementi

1864 · 2014

Over 150 years-old successful business strategy implemented by a family-driven company at its fifth generation

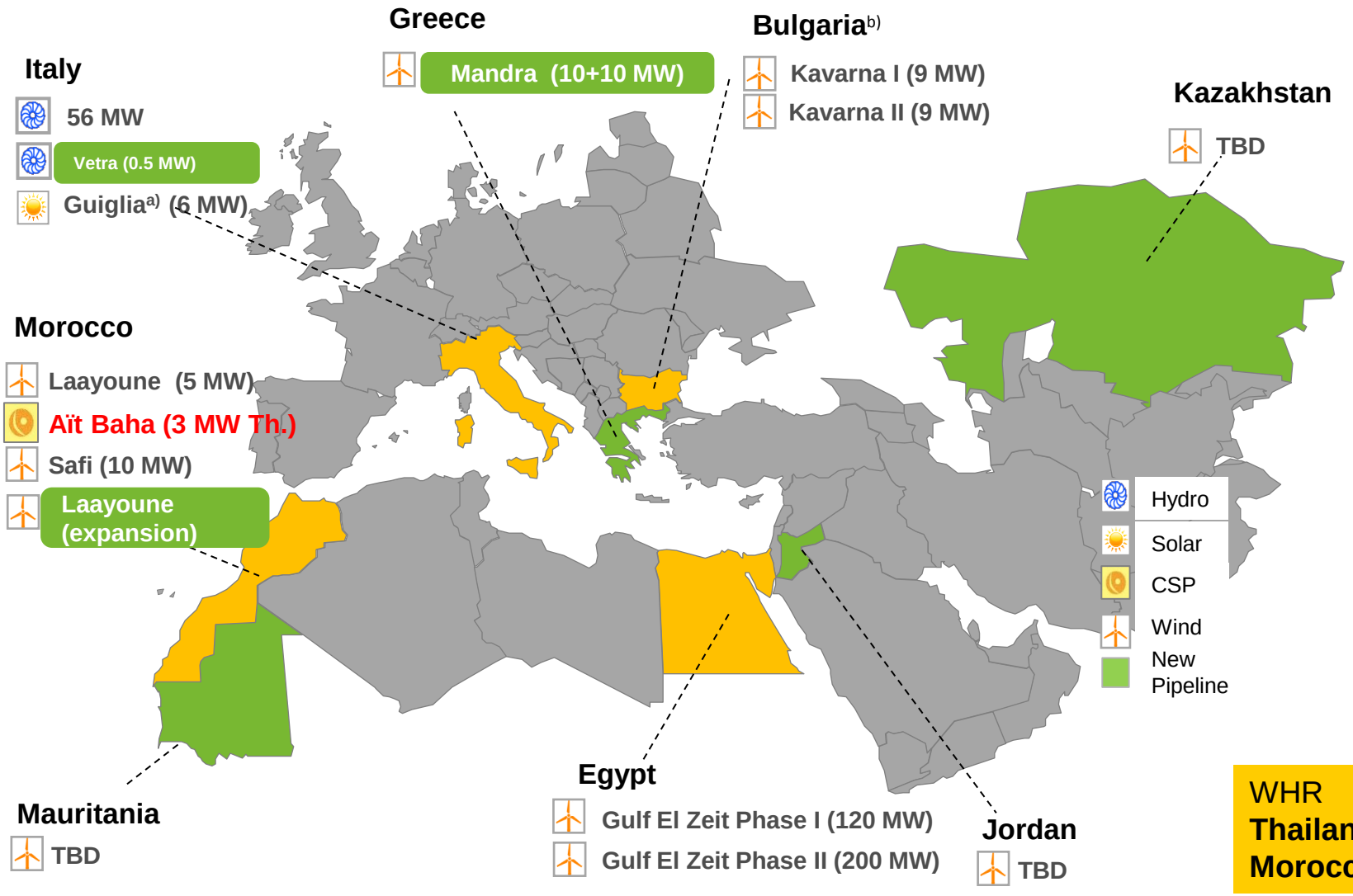
Strategic development based on sustainability: a global energy and climate policy to move toward a low-carbon economy

2020 ambitions for Energy and Climate

CO_2 intensity, related to direct or indirect emissions, is a representative indicator of global efficiency, as it combines most of the key levers to industrial excellence. Italcementi Group endorses a strategy leading to:

- cementitious products with less than 600 kg CO_2 per tonne;
- captive or offset production of renewable power up to 10% of the total electrical energy demand of production sites.

Italcementi operates in Italy in the energy sector since 1907; in 2001 Italgen was set up for electricity production and trading on the international market



WHR
Thailand: 20 MW
Morocco: 1,8 MW

a) Italgen holds a 30% stake in the company developing the photovoltaic power plant
b) Italgen holds a 49% stake in the company operating Kavarna plants

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Ait Baha cement plant (Morocco)

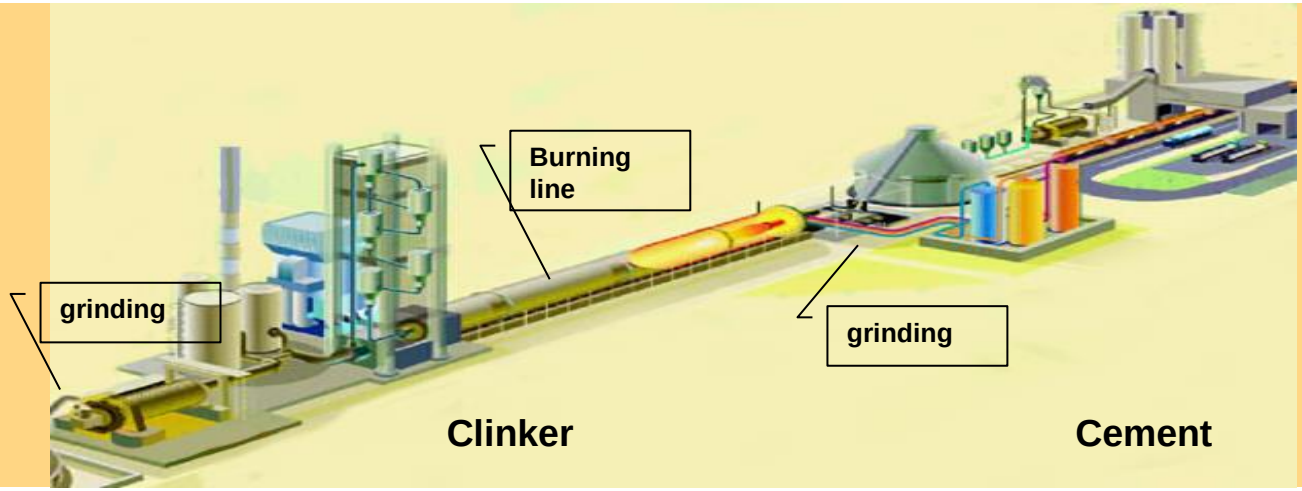
- Located in a remote area, in Agadir region
- Low availability of water
- High solar irradiance

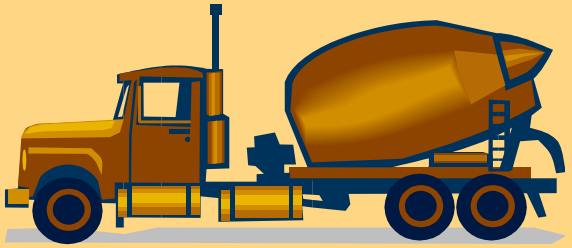
- Starting operations in 2010
- 5000 tons/day production

- ISO 14001 and ISO 50001 certified

- Use of alternative fuels
- On site renewable power:
  - WHR installed (prod.2013: 6 GWh) and
  - pilot CSP plant (additional 1 GWh)

Cement is a product with high energy and CO_2 emissions intensity

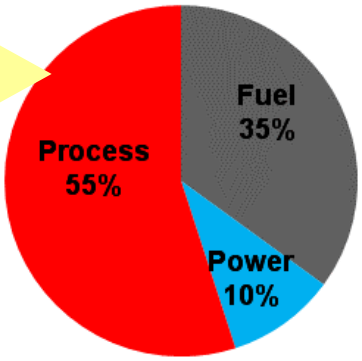




Concrete

1 ton clinker → ≈ 1.25 ton cement

CO_2≈ 650 kg /ton cement

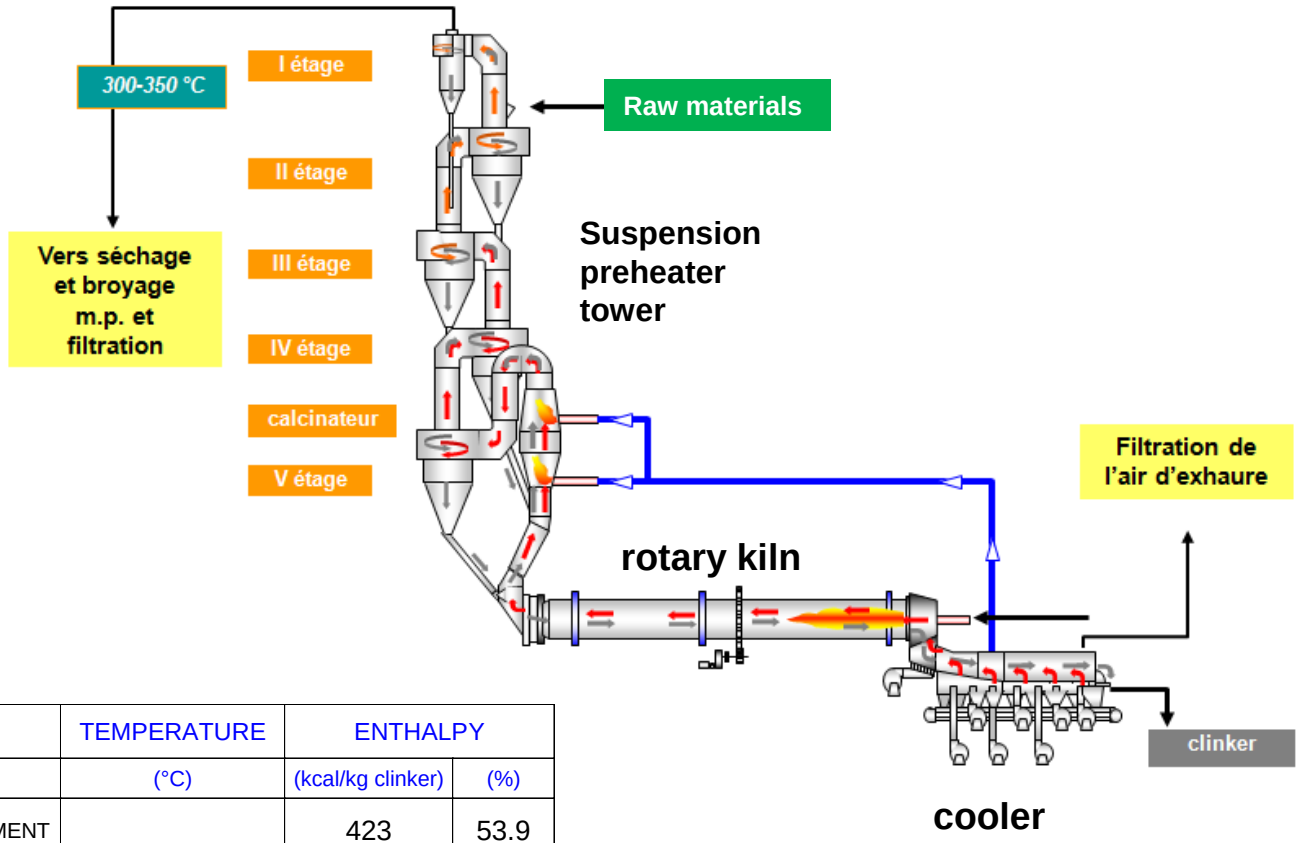


Thermal power ≈ 600 kcal/ton cement

Electricity ≈ 110 kWh/ton cement

Approximately 40% of variable production costs are energy related

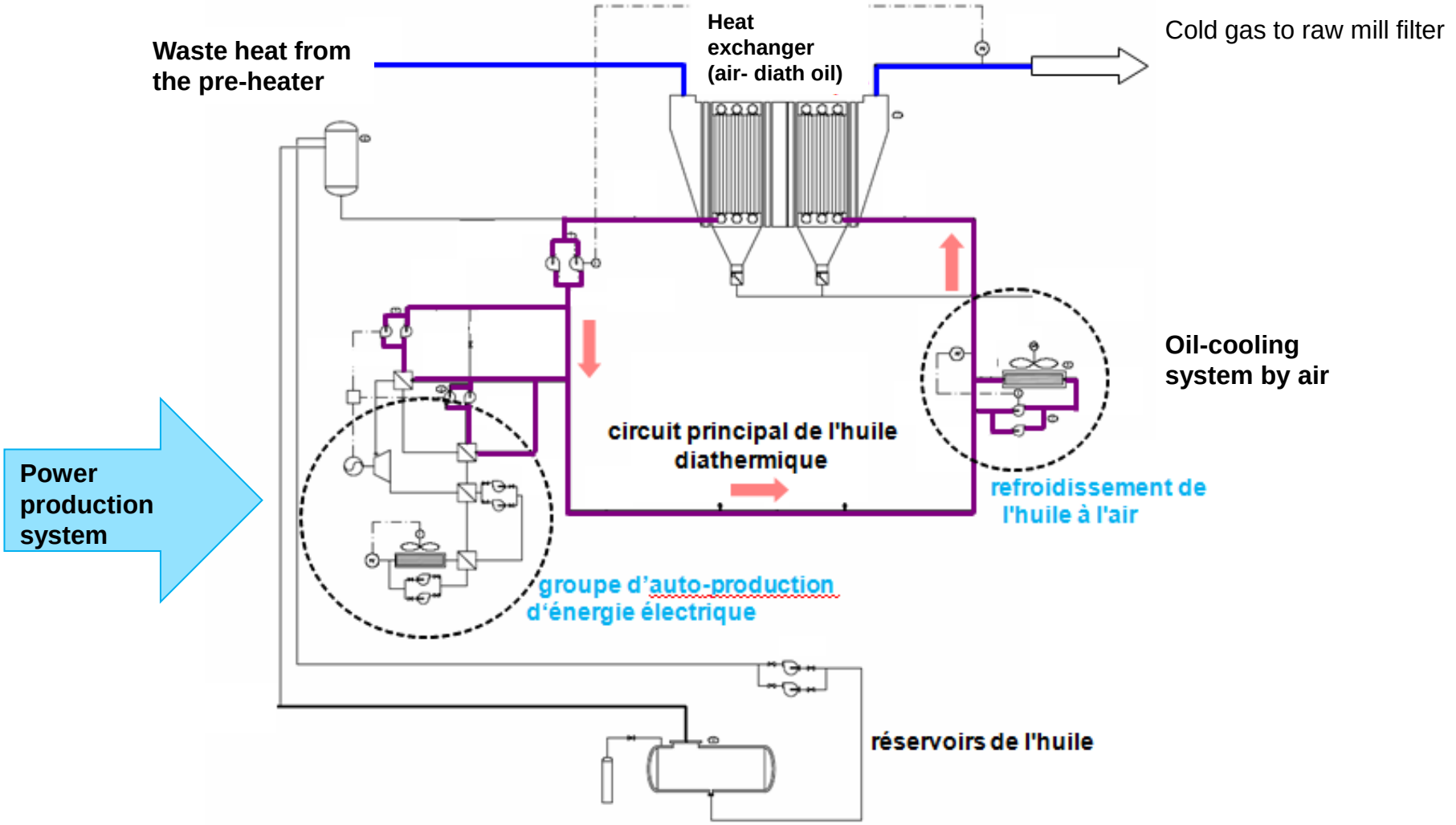
Recoverable waste heat is available from the burning process



	TEMPERATURE	ENTHALPY	
	(°C)	(kcal/kg clinker)	(%)
THEORETICAL HEAT REQUIREMENT		423	53.9
HEAT DISCHARGED IN CLINKER	137	26.2	3.4
GAS AT PRS OUTLET	**315**	**144.7**	**18,4**
EXCESS AIR FROM THE COOLER	330	104.5	**13.3**
WALL HEAT LOSSES (kiln, PRS, cooler)		56.8	7.25
HOT AIR TO COAL MILL	603	16.0	2.05
DUST INTO PRS GAS	315	5.0	0.6
WATER EVAP. (COOLER, RAW MAT.)		8.8	1.1
TOTAL		**785**	**100**

About 32% of the total heat input is in form of recoverable heat (about 60% from the preheater and 40% from the cooler)

Waste heat at low enthalpy: Organic Rankine Cycle (ORC) application to the clinker process



1,8 MW Ait Baha ORC generator

Basing operating philosophy:

- Heat generated by diathermic oil is provided to a power production system based on ORC
- High turbine efficiency
- Use of organic working fluid instead of water allows for longer operational life
- Air-cooler to disperse heat in case ORC system is not available and for condensed water cooling

CO_2 savings: more than 4000 tons/year

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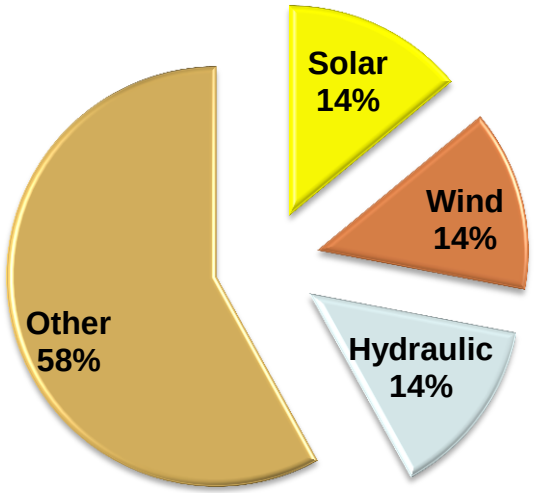
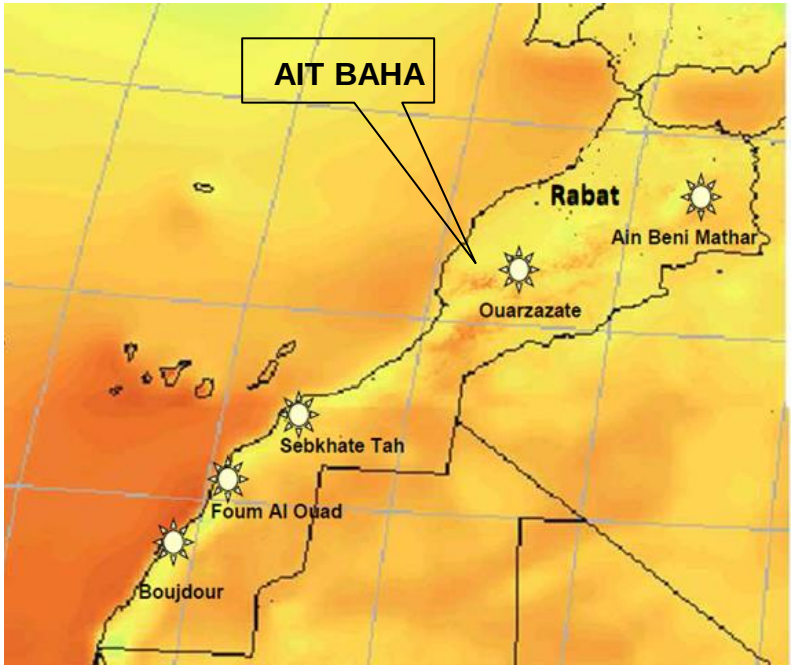
In 2020, according to the national energy plan, the solar will account for 14% of the total installed generation capacity in Morocco

- The part of installed capacity of renewable energy will represent 42% of total electric installed capacity by 2020
- Solar will account for 14%



- Main sites for CSP (Concentration Solar Power) projects totalling 2000 MW have been identified in the Country by the Maroccan Agency for Solar ENnergy (MASEN).



Project rationale of AIT BAHA plant CSP project

- Main short term project targets:
  - set up and test of an **innovative renewable energy production technology**
  - demonstrate the effectiveness of an **alternative CSP** methodology studied for reducing investment and operational costs (low maintenance)
  - avoiding the recourse to flammable and dangerous hot material fluids
  - maximizing the **use of local materials**

- Long term targets :
  - diffusion of industrial scale CSP plants, mainly in the ITC MENA region cement plants
  - reach Renewable Energy ITC targets
  - reduction of the dependency from external power supply and optimization of the overall process efficiency

- Strategic target :
  - enhancement of **high performance** and **rapid hardening cementitious materials** for new and innovative applications

Ait Baha CSP pilot plant main technical data

- Technology : linear troughs
- Number of modules : 3
- Overall dimensions : 215 x 11m
- Total active surface : 6000 m2
- Total plant area : 4,5 ha
- Thermal peak power : 3.800 kW
- Storage capacity : 12 hours
- **Yearly production : 1.000 MWh/year**

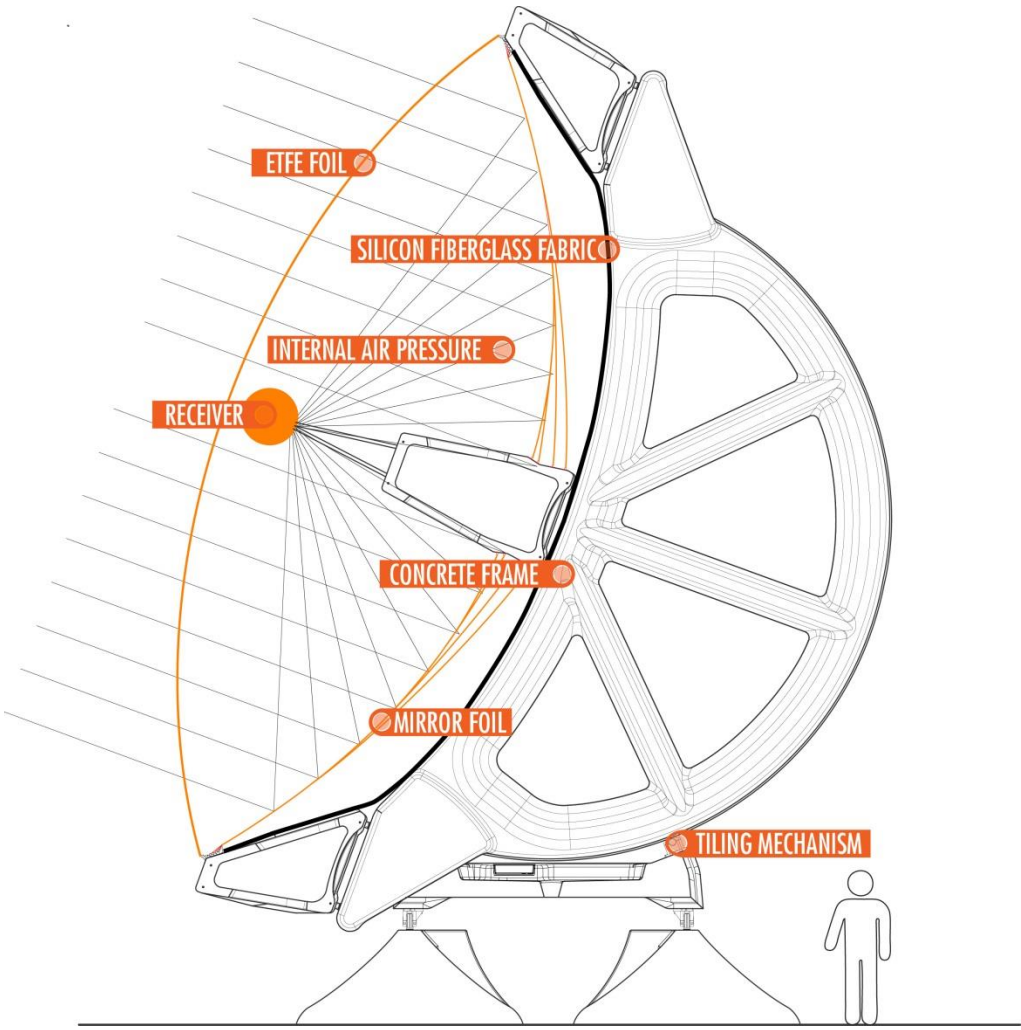
  *** Additional generation of existing ORC generator**

- Start up : October 2014
- Total investment : 3 M€
- Partnership with airlight energy

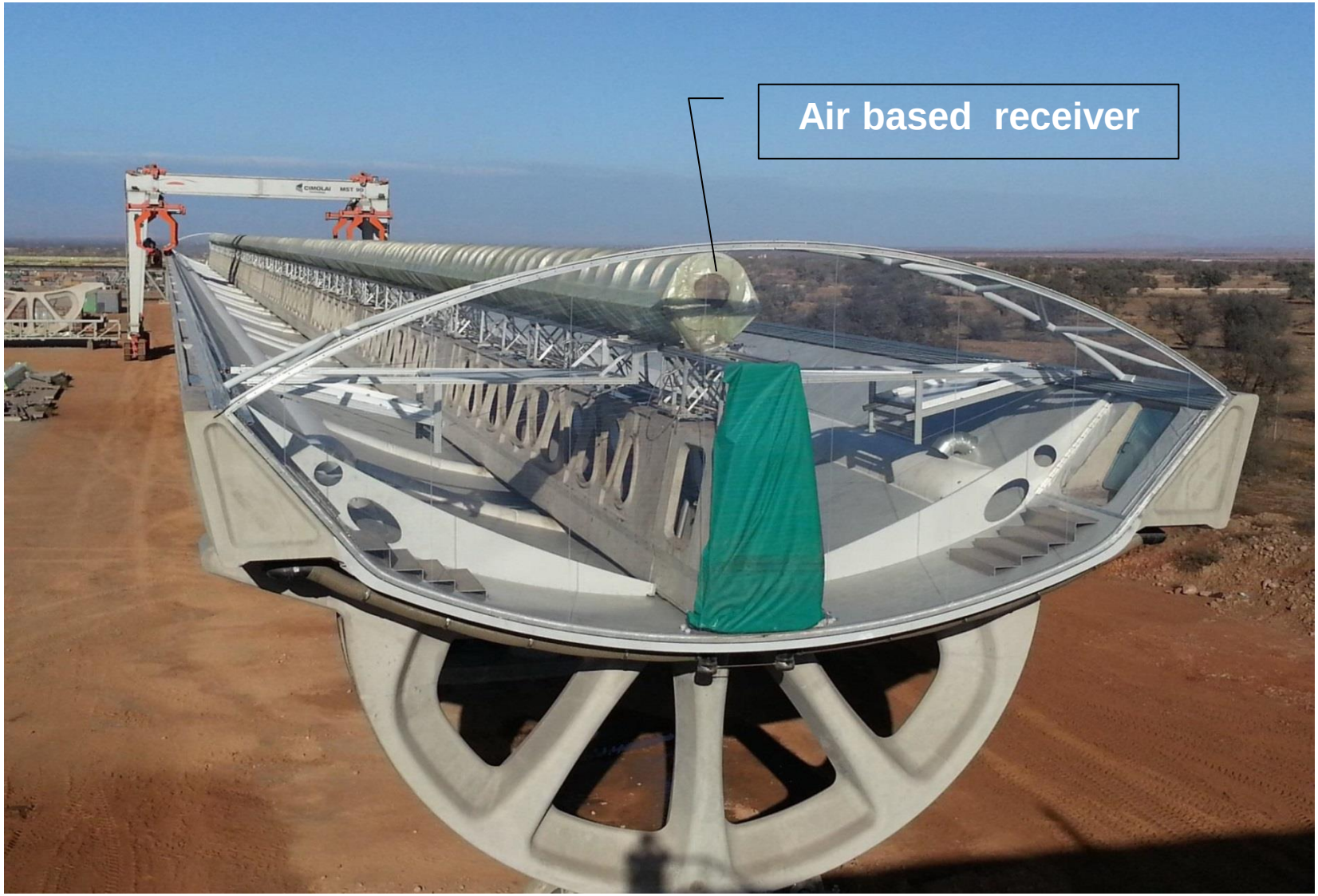
http://www.airlightenergy.com/csp/

The Ait Baha parabolic trough

- The module frame rotates during the day following the direction of the sun
- The mirror is made of a plastic membrane coupled to an aluminium foil for high reflectance
- A transparent membrane (ETFE) is installed above the mirror for protecting the mirror surface
- A controlled air pressure maintained between the mirror and the protective cover
- The pneumatic system allows to achieve the focusing characteristics of a parabolic trough with high optical efficiency
- The membrane is kept in shape by differential pressures with a linear parabolic configuration



Module ready for the installation of the top membrane



Precasted concrete structure on site manufactured

- The tilting structure is made of concrete beams in order to improve the stiffness and resistance of the frame where the membranes are fixed
- Each support of the assembly is provided with and independent electrical motor
- Gears are made of concrete

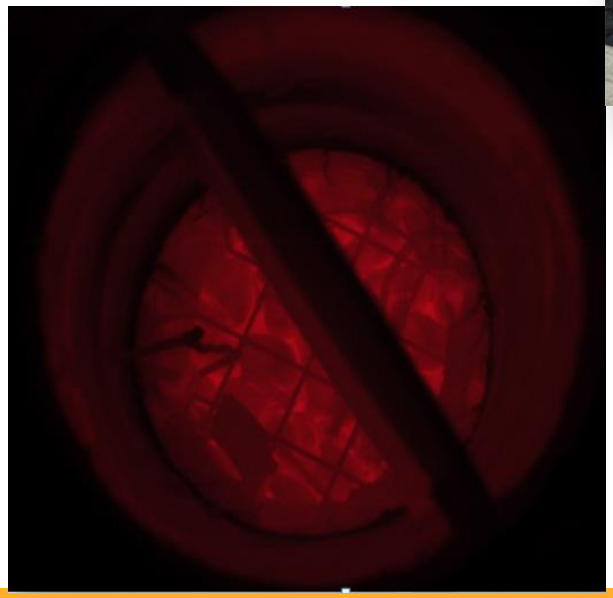
215 m lenght/ collector
1700 t/module

Long life

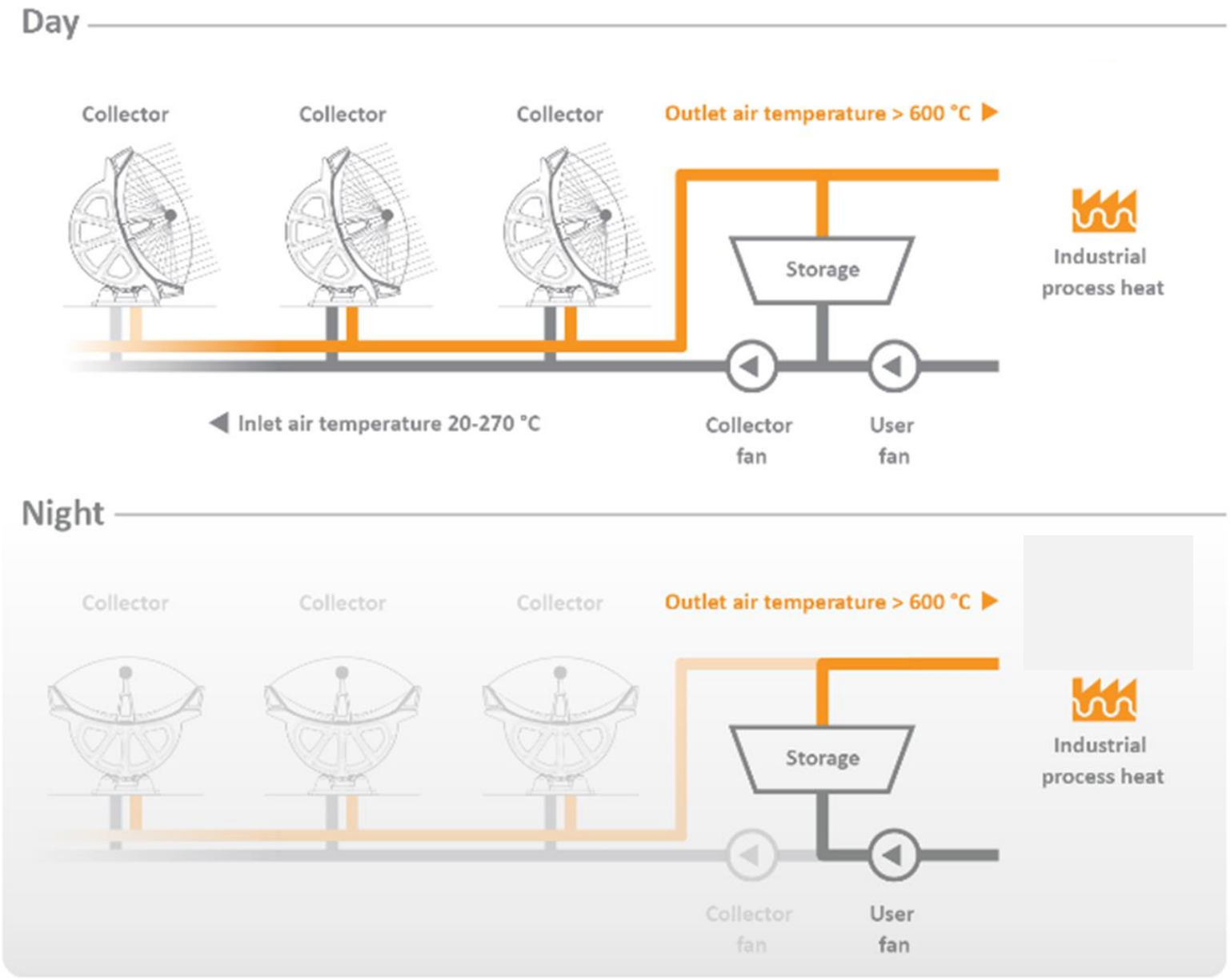
Packed bed thermal heat storage

- Air as a heat transit fludi
- The storage is an underground reservoir filled up with heat resistant gravel
- During the heating phase the gravel may reach up to 650°C.
- Hot air flows from the top to the bottom during the heating phase and vice-versa during the night
- A special **heat resistant concrete** is used for the construction of walls and roof of the reservoir

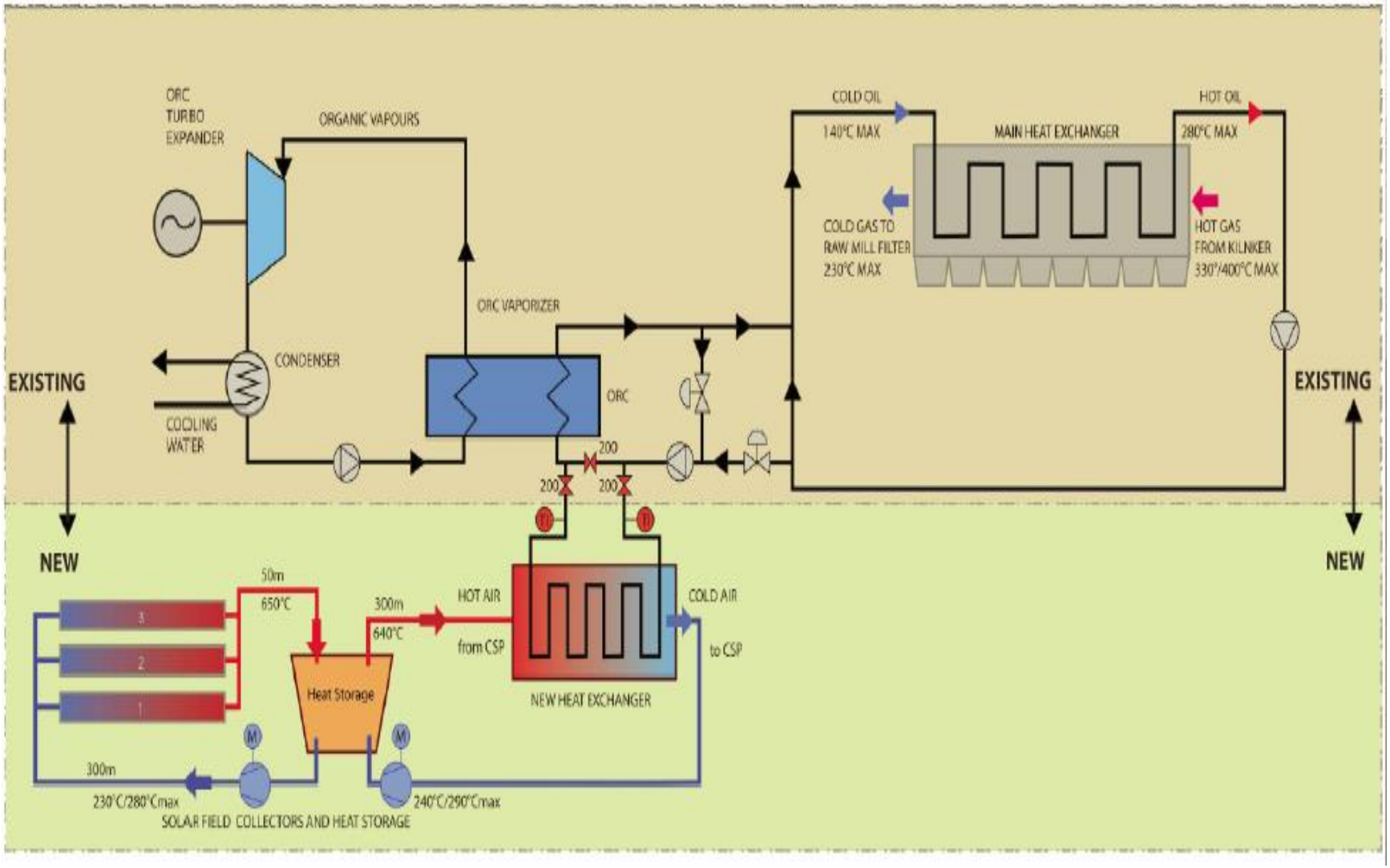
Storage before filling with stone gravel



The CSP operating scheme



The integration of the CSP with the WHR



.. Take away on our pilot project

Italcementi Group
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- Renewable energy ambitions for a high energy intensive industry as cement are a challenge

- Sustainability means take opportunities from local sources and face environmental constraints

- Partnership is the enabling factor: high profile technology company (solar technology/energy storage) and innovative materials producer

THANK YOU FOR YOUR ATTENTION

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