Solar Process Heat in Breweries

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Outline

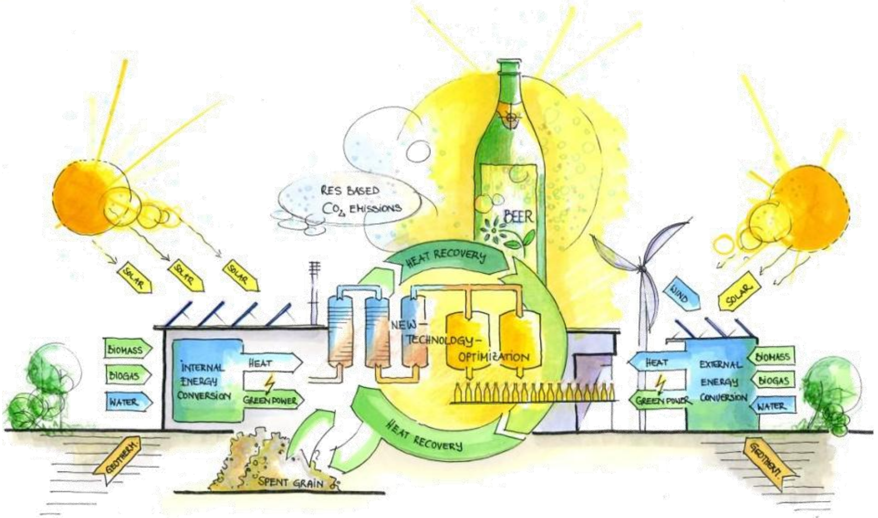
Introduction „Solar thermal heat for industrial processes“

- Motivation and potentials
- Assessment methodology for solar thermal integration
- Classification of integration concepts
- Process heat collectors

Concepts and experiences with installed systems

- Introduction to the project „**SolarBrew**“
- State of the project and introduction to the three demonstration sites
  - Brewery Goess, Austria (Mashing)
  - Brewery Valencia, Spain (Pasteurizing)
  - Malting Plant Vialonga, Portugal (Drying)

SolarBrew



Solar Brew: Solar Brewing the Future

EU FP7 (2012 – 2015)

Projekt Nr. 295660

PROJECT CONSORTIUM

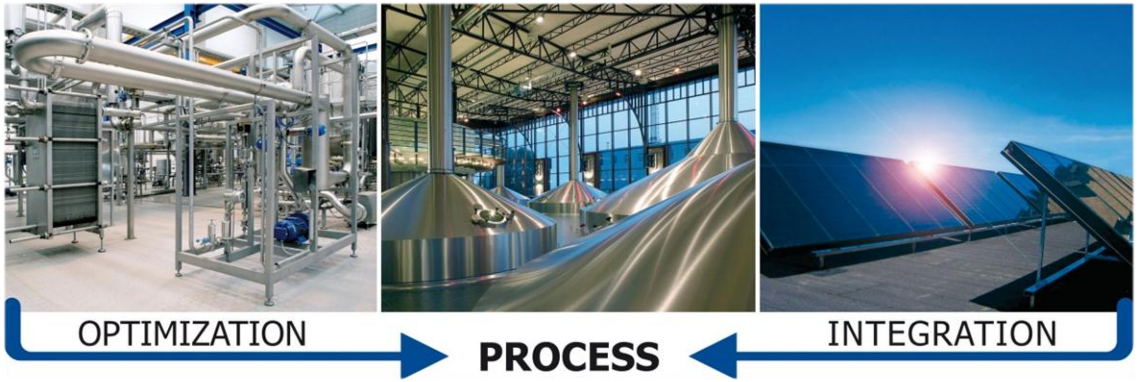
- AEE INTEC **(coordinator)**
- HEINEKEN Supply Chain B.V.
- GEA Brewery Systems GmbH
  - process engineering
- Sunmark A/S
  - solar engineering

SUSTAINABLE SOLAR SOLUTIONS

SolarBrew

Introduction to the project SolarBrew

- Demonstration of the technical and economical feasibility of large scale solar process heat applications ≥ 1 MWth,p in the brewing industry
  - Development of concepts for a solar heat integration on process level at temperatures ≤ 80°C
  - Design and construction of three demonstrators with a total capacity of 5.0 MWth,p
  - Development of a holistic "Green Brewery Sector Concept" combining energy efficiency and renewable heat integration

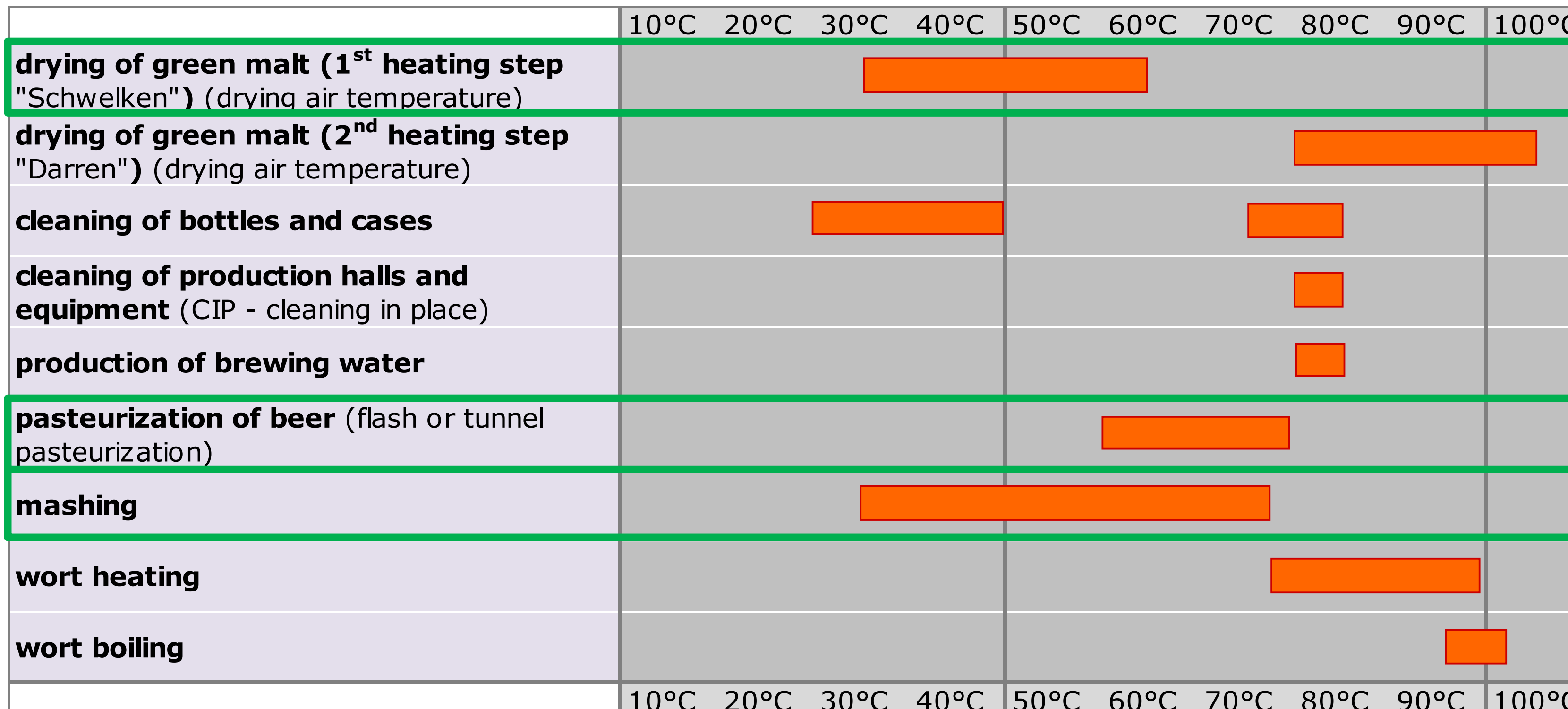


SolarBrew

Potential for solar heat in the brewing industry

- All thermally driven processes in breweries and malting plants require heat at a temperature on process level of between 25 and 105°C

SOLARFOODS



SAGRES CERVEJA

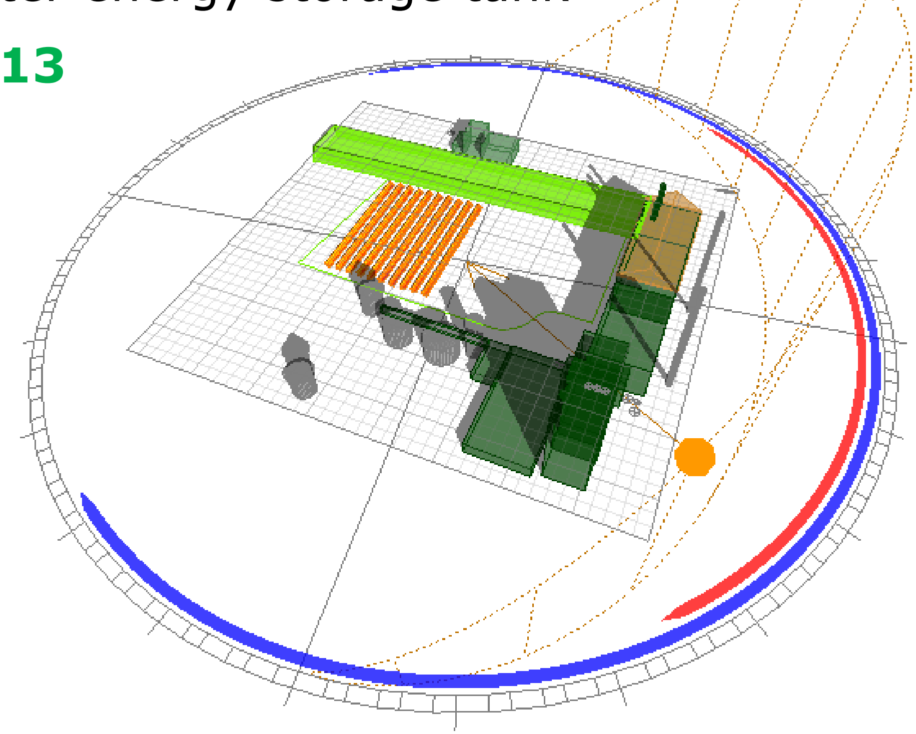
Cruzcampo

Gösser

State of the project

BREWERY GOESS

- <u>Solar assisted mashing process</u>
- 1.500m² ground mounted flat plate collector field
- 200m³ pressurized hot water energy storage tank
- **Commissioned: June 2013**



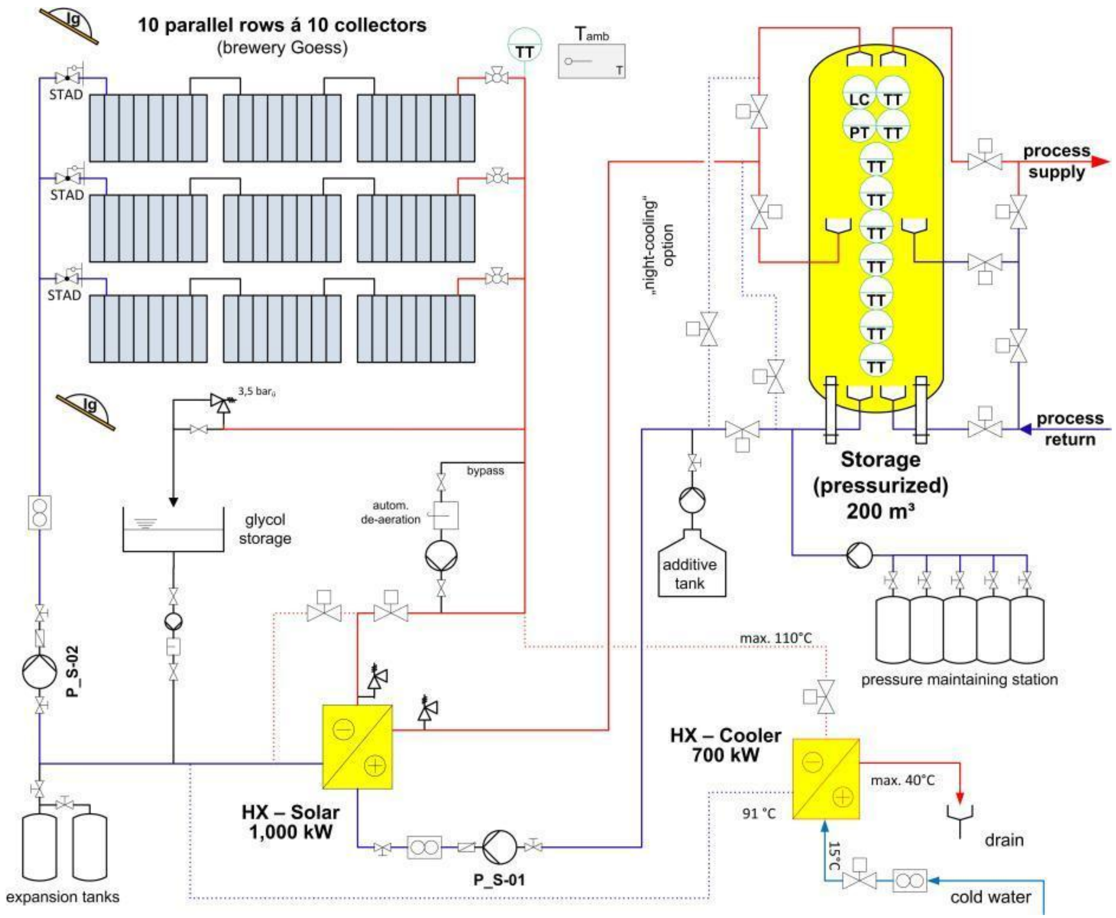
4.6 million pints of beer per year brewed with the power from the sun*

* assuming 60 MJ thermal energy consumption per hl of beer in the brewery Goess

State of the project

BREWERY GOESS

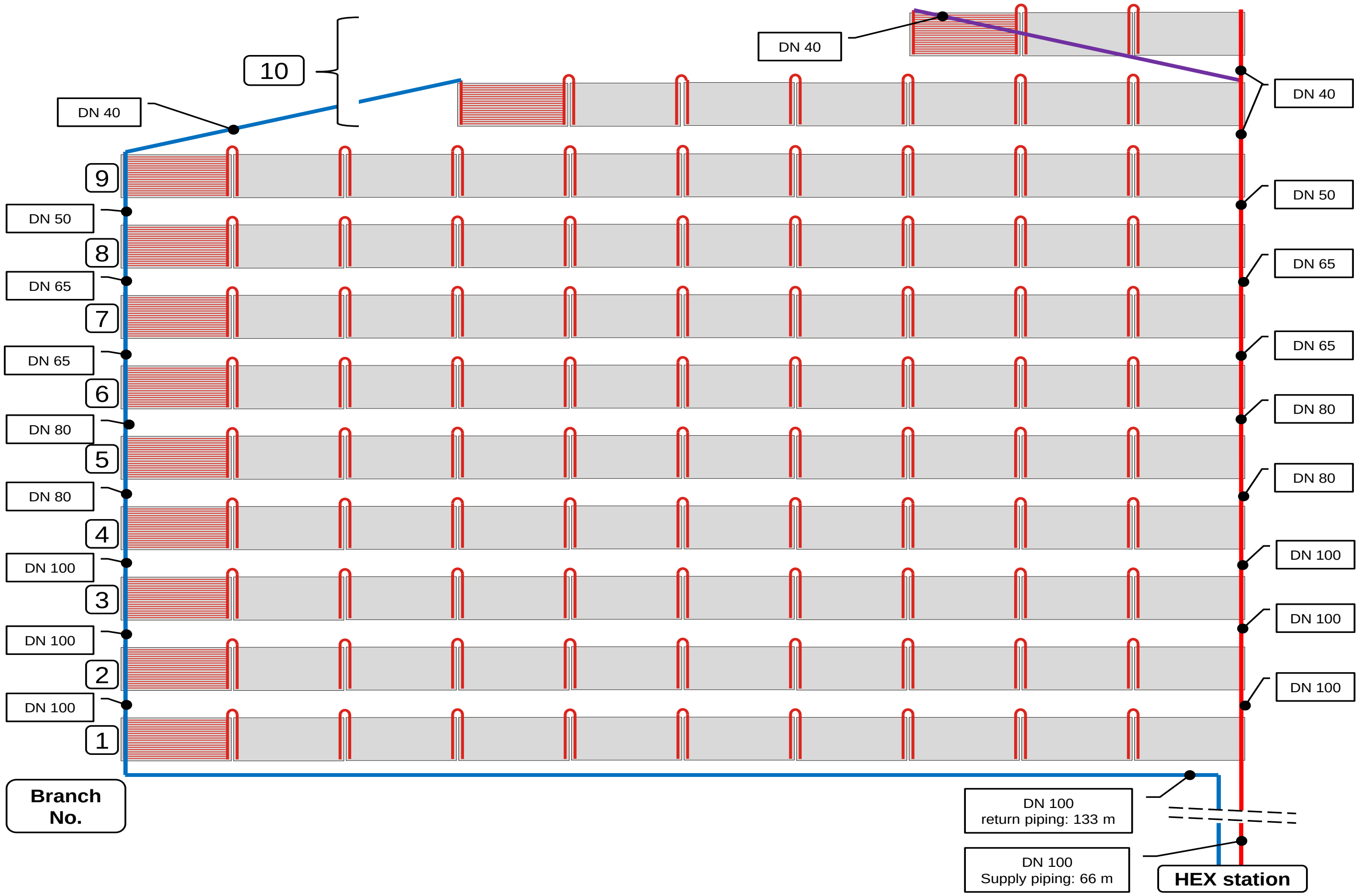
- Schematic diagram of the solar primary and secondary loop



State of the project

BREWERY GOESS

- Collector field hydraulics

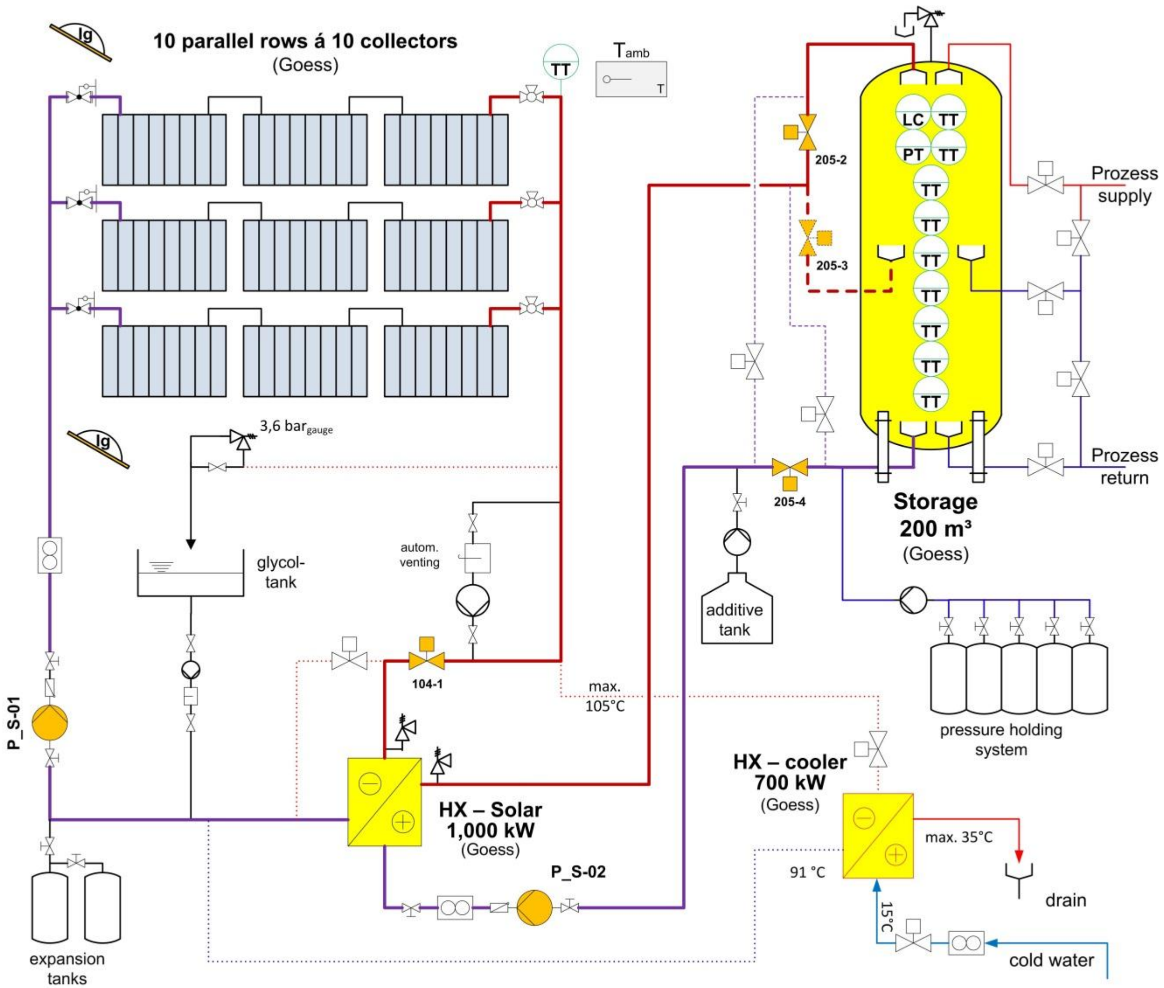


State of the project

BREWERY GOESS

- Stagnation prevention

- Stagnation prevention is done by means of 1) night cooling and 2) active water/water HX
- A pressure controlled safety valve opens if all other proceeding measures fail (due to malfunction, power outages, etc...).



State of the project

BREWERY GOESS

- Construction of the 200m³ solar energy storage

State of the project

BREWERY GOESS

- Construction of the 1,500m² solar thermal collector field

State of the project

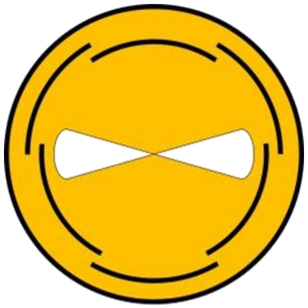
BREWERY GOESS

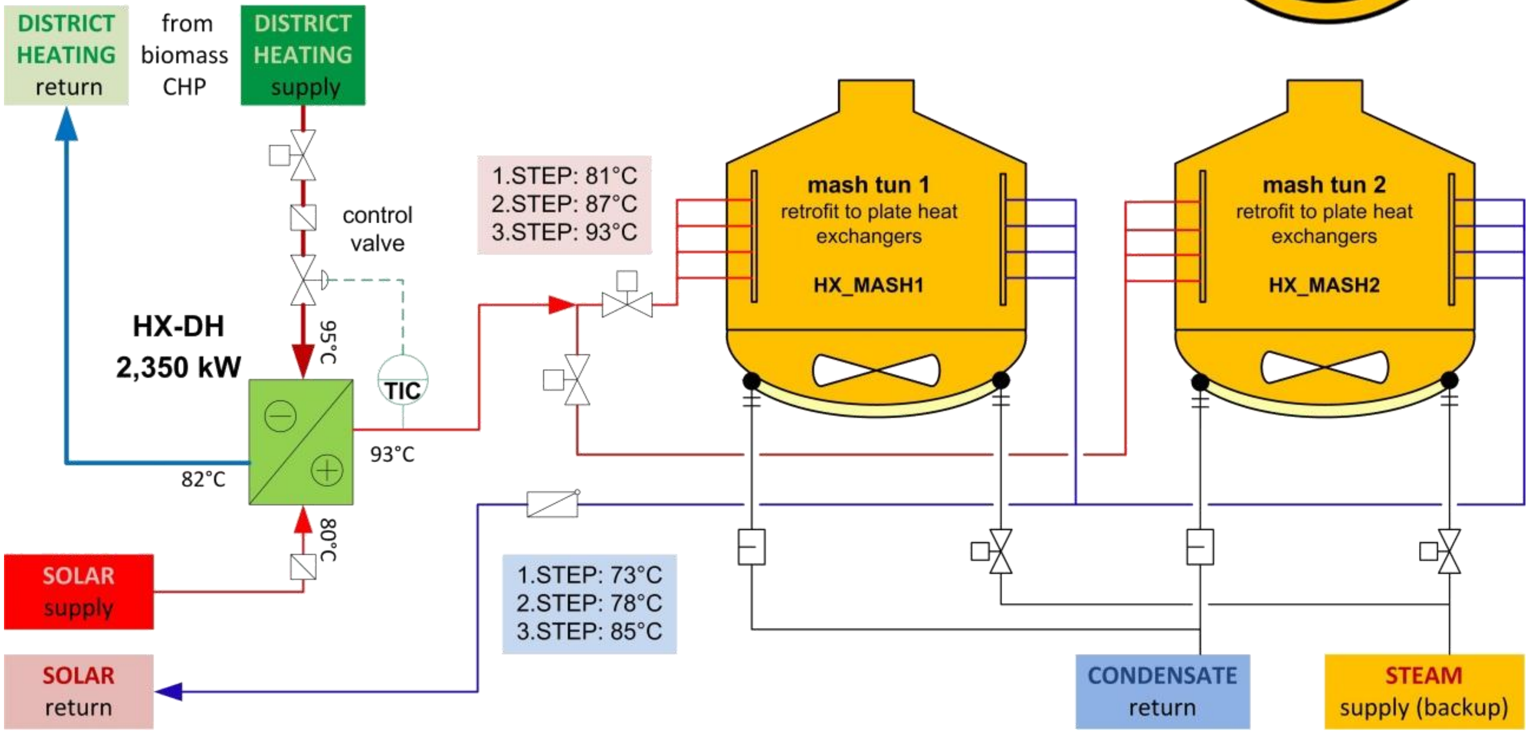
- Construction of the 1,500m² solar thermal collector field

State of the project

BREWERY GOESS

- Solar heat integration to mash tuns
- Retrofit of two existing mash tuns with heat exchanger templates





State of the project

BREWERY GOESS

- Construction of the heat exchanger templates






State of the project

BREWERY VALENCIA

- Solar assisted pasteurization of beer
- 1.620m² ground mounted flat plate collector field
- 350m³ atmospheric hot water energy storage tank
- **Construction end: Spring 2014**

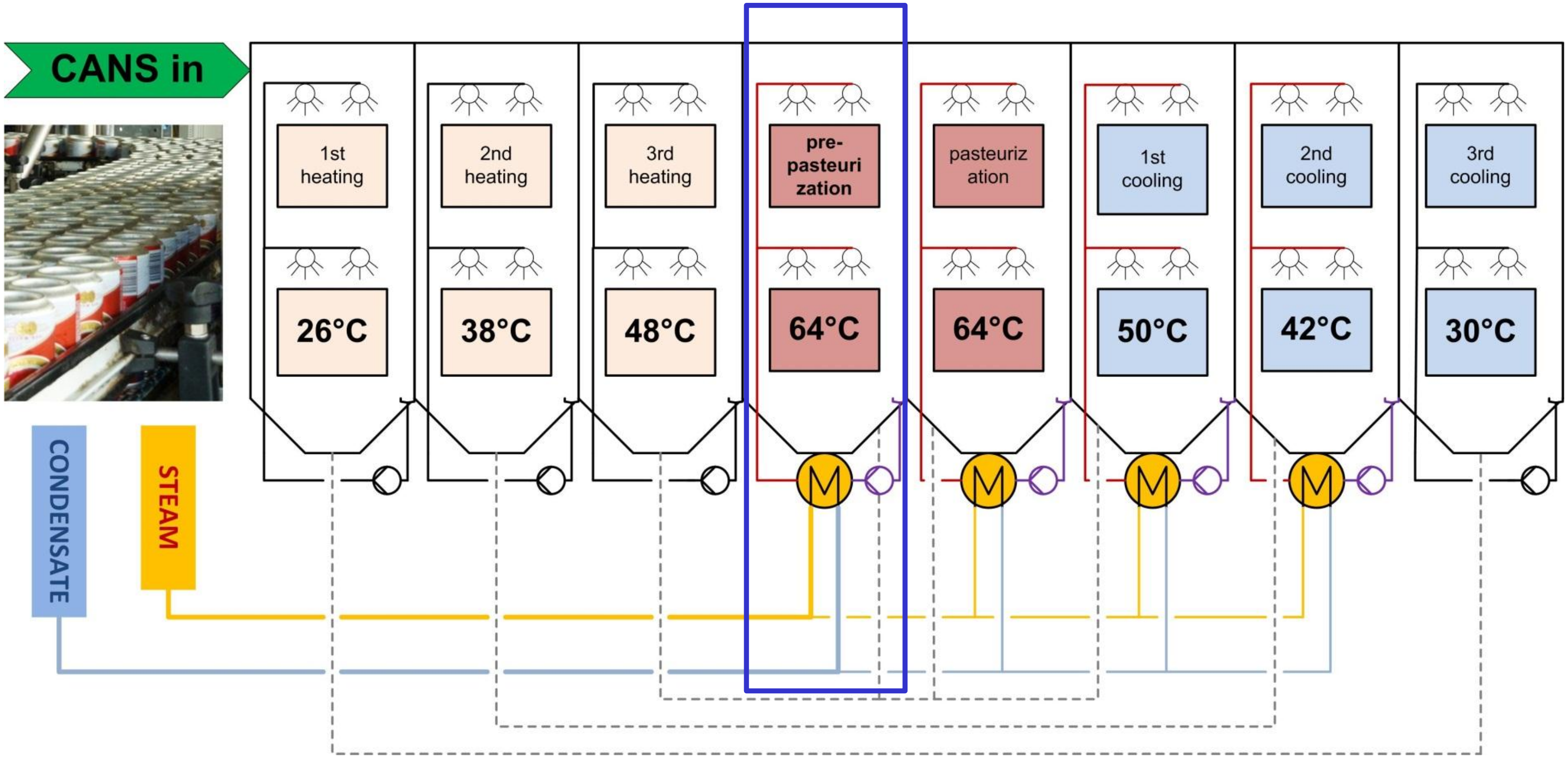
9.6 million pints of beer
per year brewed with the
power from the sun*

* assuming 70 MJ thermal energy consumption per hl of beer in the brewery Valencia

State of the project

BREWERY VALENCIA

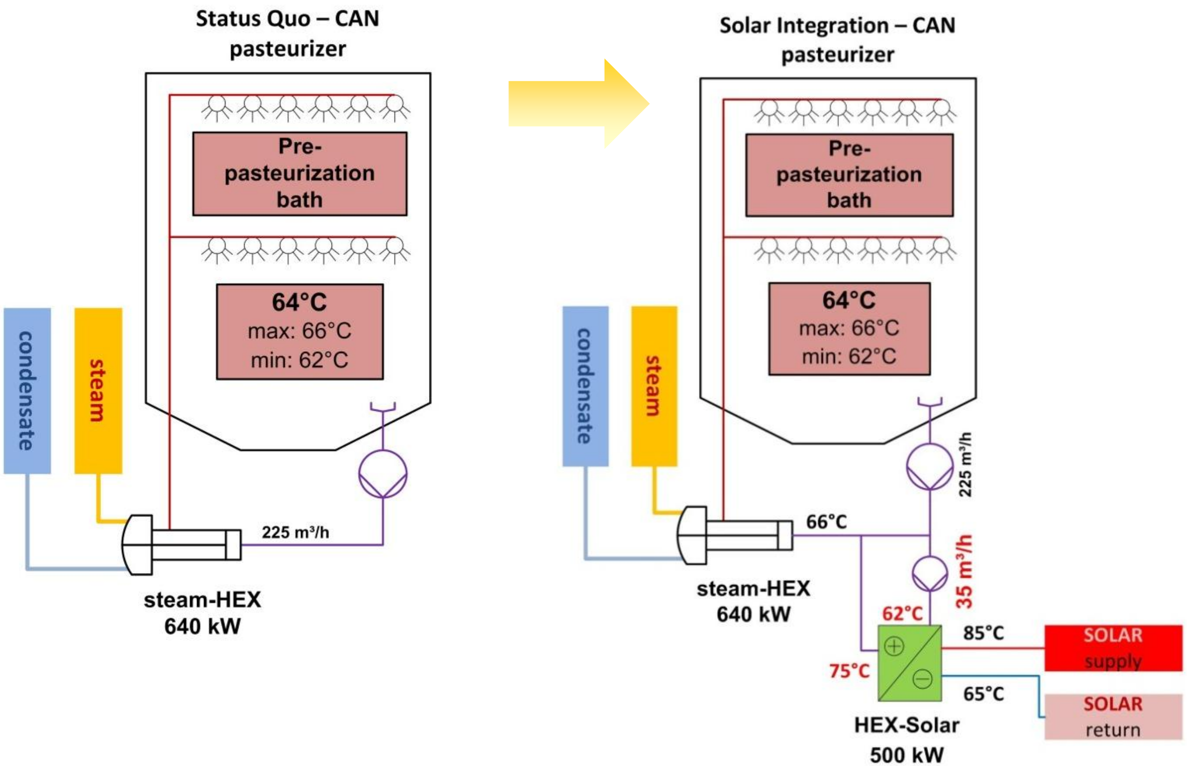
- Solar heat integration to a tunnel pasteurizer



State of the project

BREWERY VALENCIA

- Retrofit of a steam based supply system with a serial connected hot water plate heat exchanger



tunnel pasteurizer

existing steam bundle HX

State of the project

MALTING PLANT VIALONGA

- Solar assisted drying of green malt
- 4.725m² ground mounted flat plate collector field
- 400m³ atmospheric hot water energy storage tank
- **Construction end: Spring 2014**




3.6 million tons malt per year dried with the power from the sun*

basis for **40 million pints of beer****

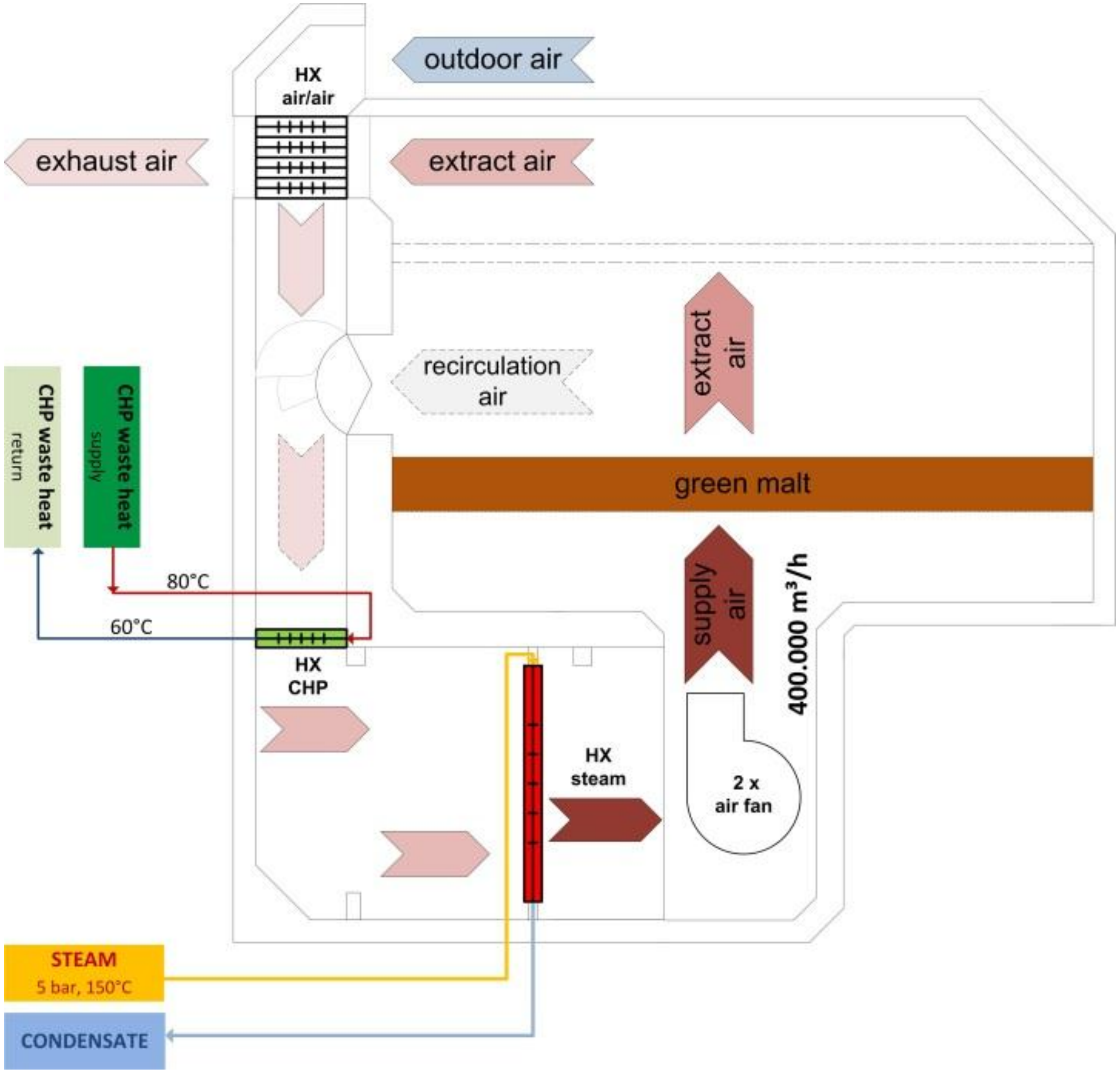
* assuming 3.1 MJ thermal energy consumption per ton of malt in Vialonga

** assuming 18 kg malt per hl of beer

State of the project

MALTING PLANT VIALONGA

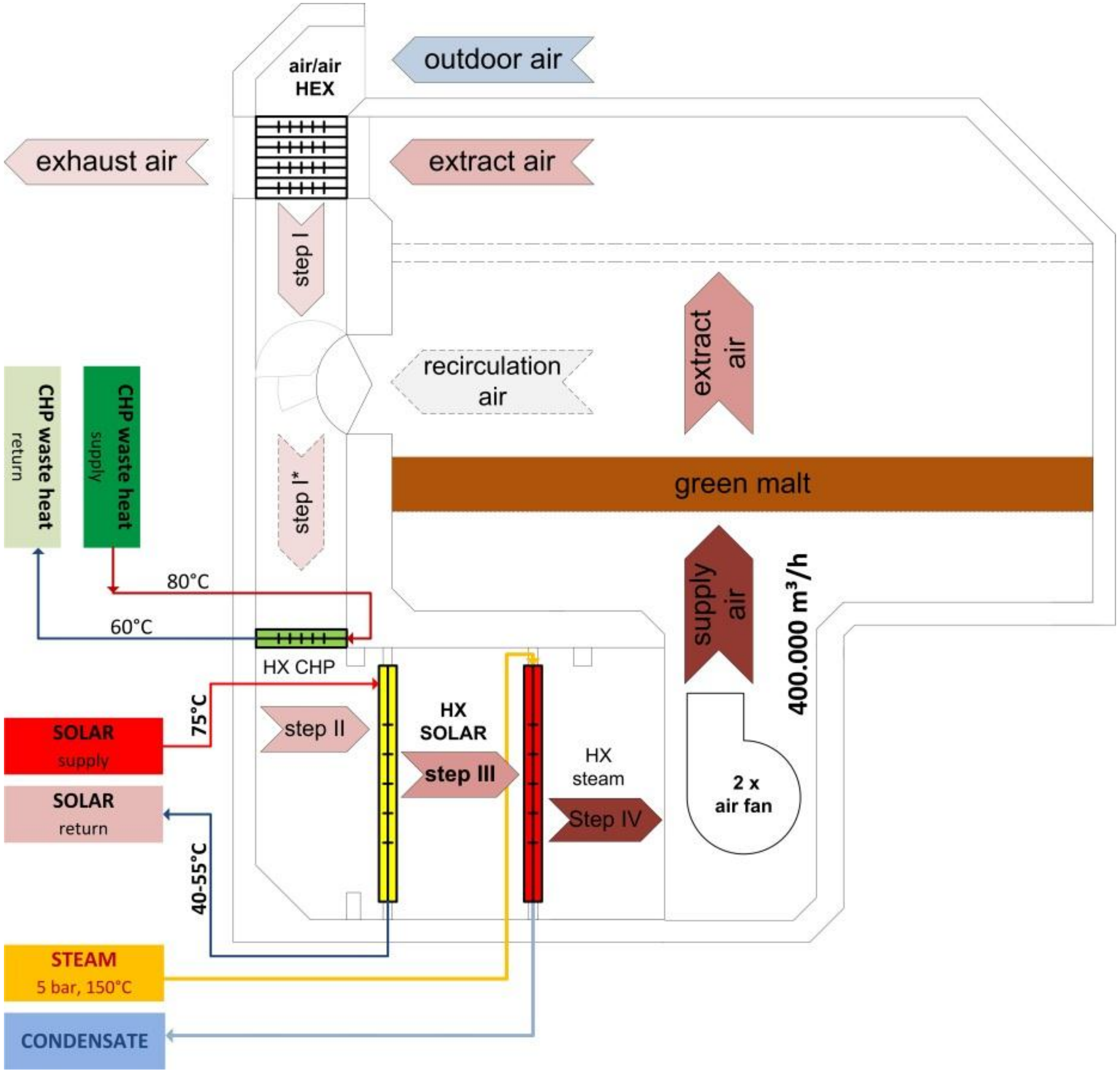
- Solar heat integration to drying kiln



State of the project

MALTING PLANT VIALONGA

- Solar heat integration to drying kiln
- Installation of a new water/air heat exchanger for the exergetically optimized cascade supply of heat
- Heating-up drying air from 35–55°C



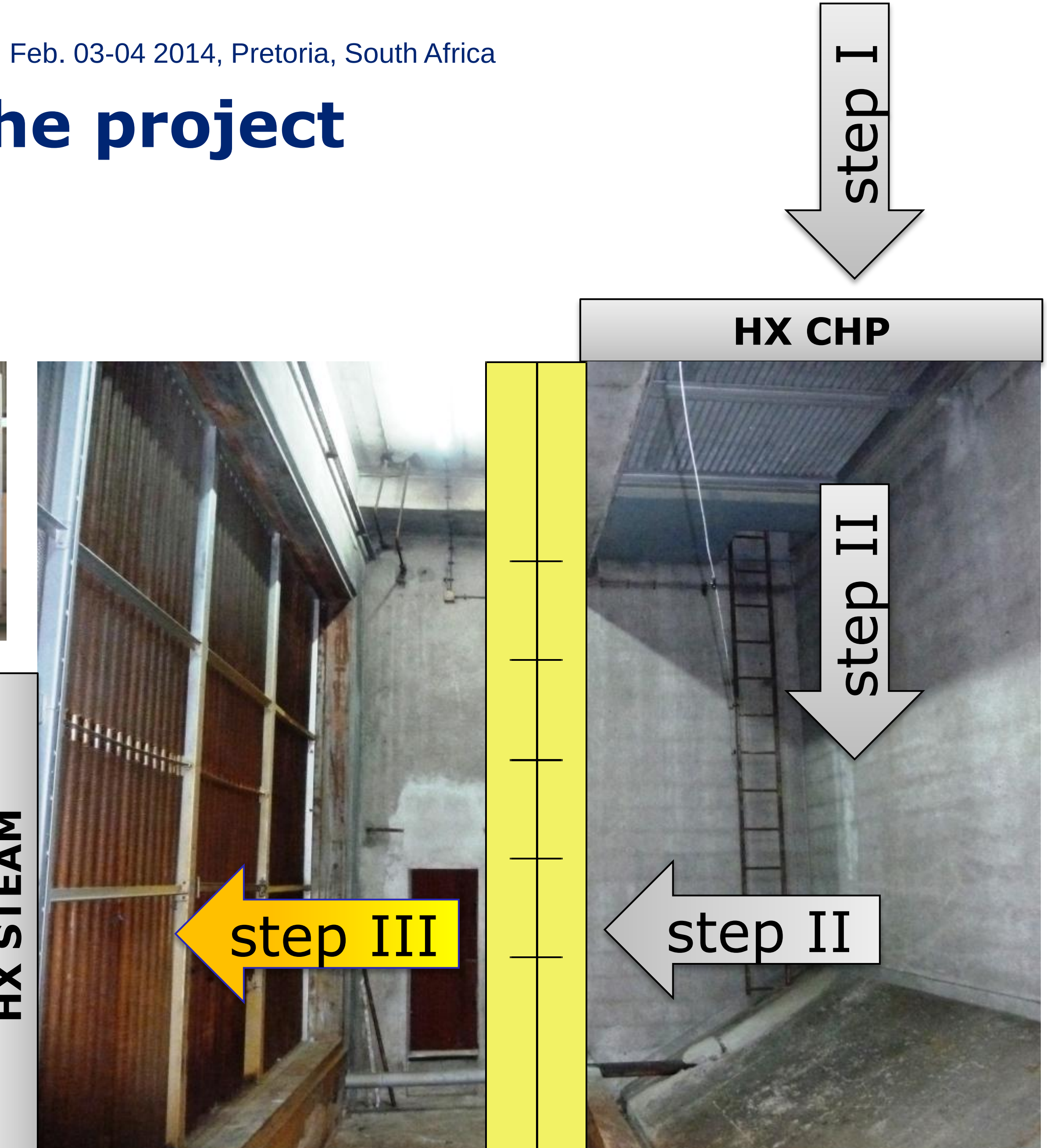
State of the project

MALTING PLANT
VIALONGA


(GEA Brewery Systems)

step IV

400.000 m³/h



Summary "SolarBrew"

Overview over the three demonstrators

SITE & LOCATION	Collector field size[1] [m²]	Thermal peak capacity [$MW_{p,th}$]	Solar energy storage volume [m³]	Process supplied process temperature [°C]	Expected solar yield[2] [kWh/(m²·a)]	Solar fraction[2,3] [%]	Irradiation onto horizontal plane [kWh/(m²·a)]
Brewery Goess, AT	1,375	1.0	200 (pressurized tank)	mashing **58-78°C**	**280**	**~ 30%**	**1.070**
Brewery Valencia, ES	1,485	1.0	350 (atmospheric tank)	pasteurization of beer **63-65°C**	**630**	**~ 45%**	**1.610**
Malting plant Vialonga, PT	4,331	3.0	400 (atmospheric tank)	drying of green malt **35-55°C**	**720**	**~ 20%**	**1.690**
Total	**7,191**	**5.0**					

[1] Reference: aperture area

[2] Simulation results based on representative (measured) load profiles

[3] Solar fraction with regard to the respective process supplied with solar thermal heat

Conclusions

There is huge (technical) potential for solar process heat applications in Europe

To obtain (exergetically) best results measures to increase energy efficiency have to be investigated prior to the integration of renewable energy supply technologies

Detail engineering and construction of solar process heat applications demand both process engineering and solar engineering expertise – **a holistic methodological approach is needed**

This course aims to follow such an approach

Thank you for your attention!

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