

HiFlex – Lessons Learnt from Permitting Process of the HiFlex Project

SolarPACES 2021, 27th September – 1st October 2021

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HiFlex



Barilla
The Italian Food Company. Since 1877.



Knowledge for Tomorrow



DLR 06-1 Chart 2



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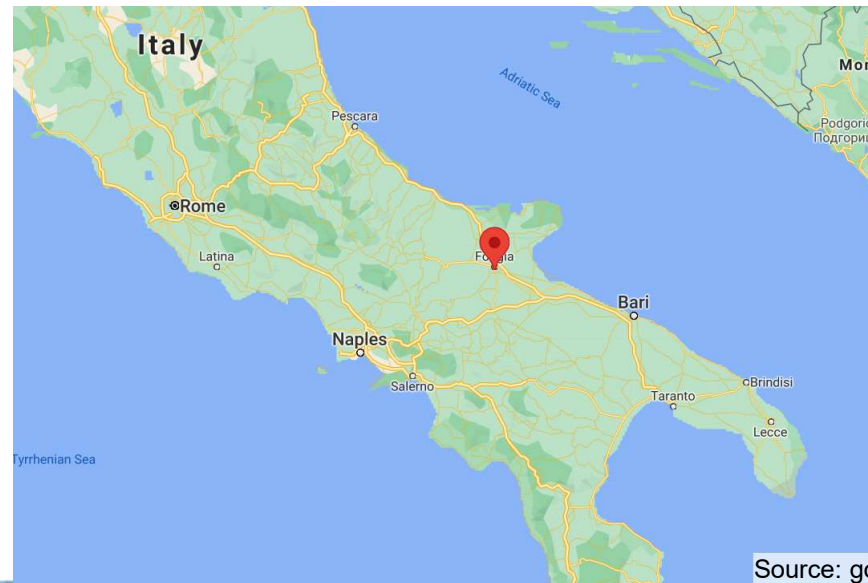
HiFlex – High Storage Density Solar Power Plant for Flexible Energy Systems

- Solid particles
- As heat transfer and storage medium
 - Increase process temperature
 - Two times higher storage densities
- Demonstrate pre-commercial CSP plant
- 24 hours steam production for process heat
- Supply to industrial application of Barilla in Italy



CARBOBEAD HSP

Source: Data sheet carboceramics

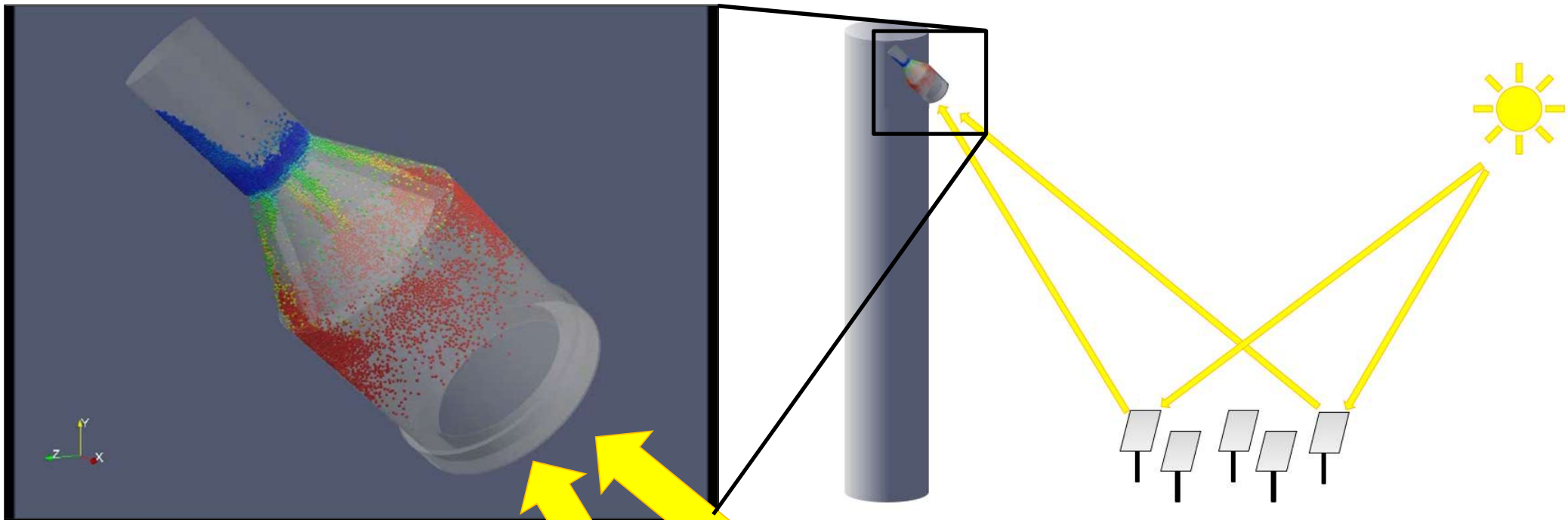


Source: google maps



Direct Absorption Particle Receiver

- Thermal power: $2.5 \text{ MW}_{\text{th}}$, peak
- Particle outlet temperature: up to 1000°C



Working principle of Centrifugal Particle Receiver (CentRec)


Centrifugal Particle Receiver on top of the tower

For further information on the plant design

DLR.de • Folie 1 > HIFLEX - Detail Engineering of a High Storage Density Solar Power Plant for Flexible Energy Systems > M. Ebert > SolarPACES 2021, 27 September

HiFlex

**HIFLEX – Detail Engineering of a
High Storage Density Solar Power Plant for Flexible Energy Systems**
SolarPACES 2021, 27th September – 1st October 2021
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DLR

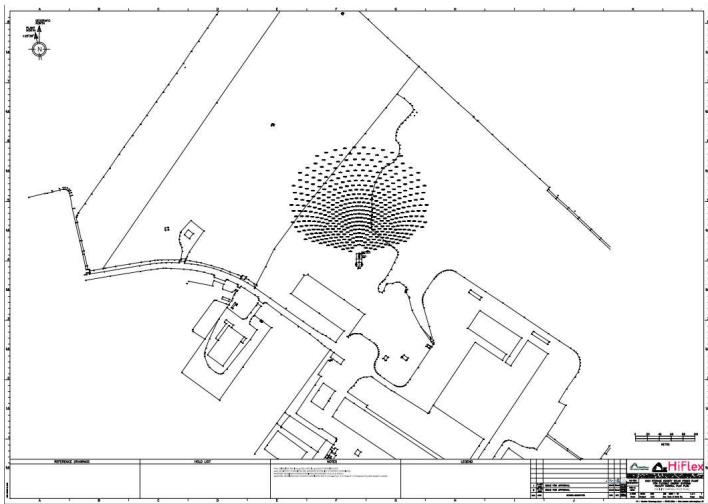
Knowledge for Tomorrow



Introduction Permitting Process

Provides several unique permitting challenges:

- Particle based CSP system as a first of its kind
 - Nearby the town of Foggia, < 10 km away from airport
 - Integrated into an existing industrial reality already owning authorizations
- ➔ **Condition for future process heat applications**



Authorizations



Screening of Environmental Impact Assessment & Integrated Environmental Authorization amendment

Region and Province of Foggia



Obstacles / interference with air traffic evaluation

ENAC/ENAV



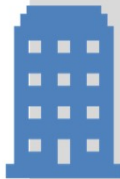
Fire Prevention Practices

VVFF (Fire Department)



Permit to Build

Municipality of Foggia



Structural Calculation

Foggia Province



Authorizations



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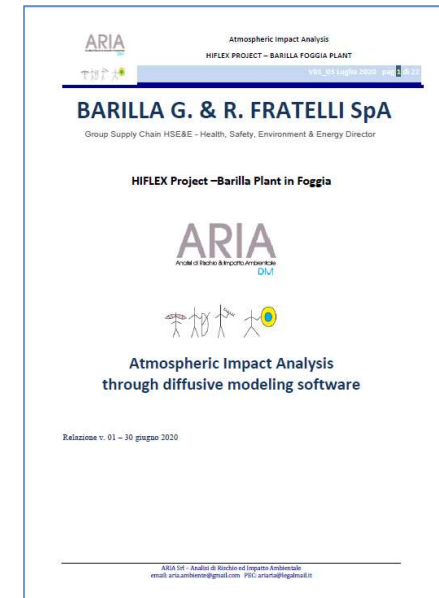
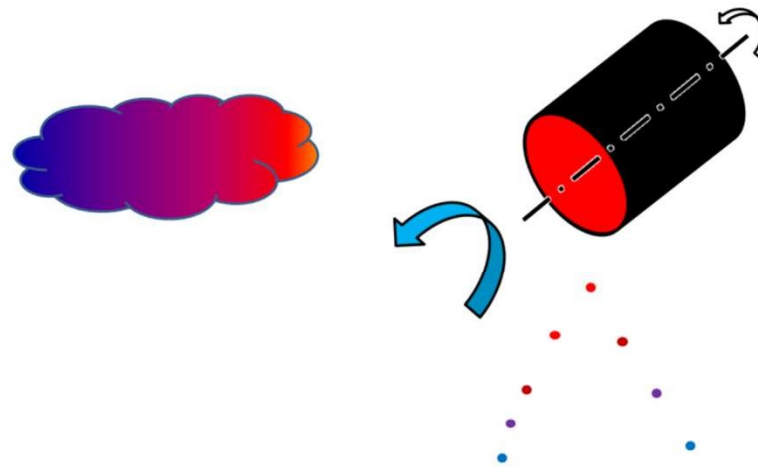


Environmental permit

Amendment on the existing Integrated Environmental Authorization (AIA) of Barilla's Foggia factory


Barilla has analyzed:

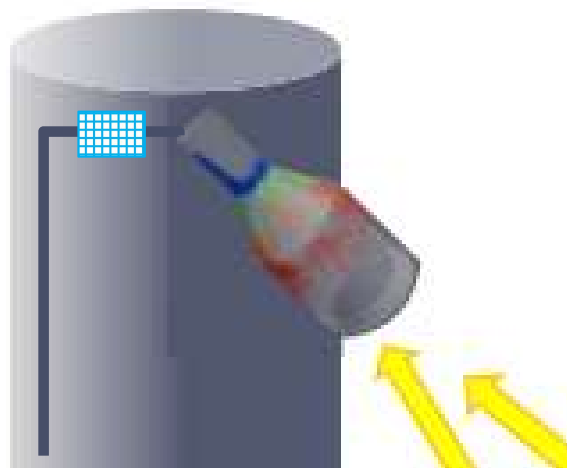
- Potential emissions from the receiver (dust and particles)





Environmental permit – preliminary results

- Particles remain in the direct proximity of the tower
- Negligible magnitude of PM10* emissions reaching the ground
 - Monitoring measure:
Measurement of dust before starting the construction and during operation
 - Mitigation measure:
Dust extraction system 



Aerosolmonitor 8533 DUSTTRAK DRX

*PM = particulate matter





Fire Prevention Practices Methodology

- Hot particles from leakage from the HIFLEX receiver, driven by wind
 - fire risk and the protection of human life

- 2 main scenarios analyzed
 - spillage of a single particle
 - spillage of a set of particles





Fire Prevention Practices Methodology and results

Performance thresholds are identified

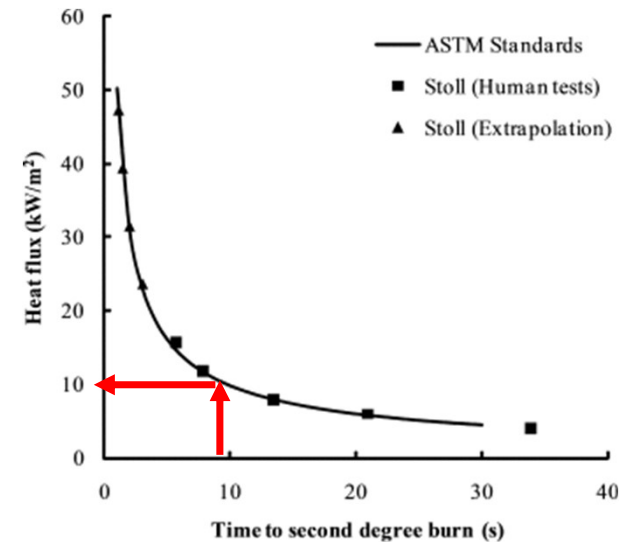
Effect	Heat Flux (kW/m ²)
Solar radiation (sunny day)	1
Wood volatiles ignite with flame exposure*	12.5

Fire risk:

- Exchanged heat output < 12.5 kW/m²
- Thermal power 2-5 orders of magnitude below threshold

Protection of human life

- Heat exposure time according to "Stoll criterion"
- Assess time at which particle in contact with human body create second-degree burn
- No risk of burn



Stoll criterion

Li-Na Zhai, Jun Li, Prediction methods of skin burn for performance evaluation of thermal protective clothing Burns, <https://doi.org/10.1016/j.burns.2015.02.019>.

Source:

* I. Lawson and L. Simms, "The ignition of wood by radiation"

** The Society of Fire Protection Engineers, *Engineering Guide: Predicting 1st & 2nd Degree Skin Burns from Thermal Radiation



Obstacles/ Interference with airport


Authorization from:


ENAC (National civil aviation body) and
ENAV (National Flight Assistance Body)

- Fundamental input for environmental and building permit
- Permit has been identified as the most difficult one

- Tower height
 - Limited to 40 m
 - Design of plant adjusted

- Glint and glare assessment

 Airport close to plant

 Plant location



Glare of heliostat field

Picture Source: DLR, Plataforma Solar de Almería (CIEMAT)



Location of HIFLEX plant and airport

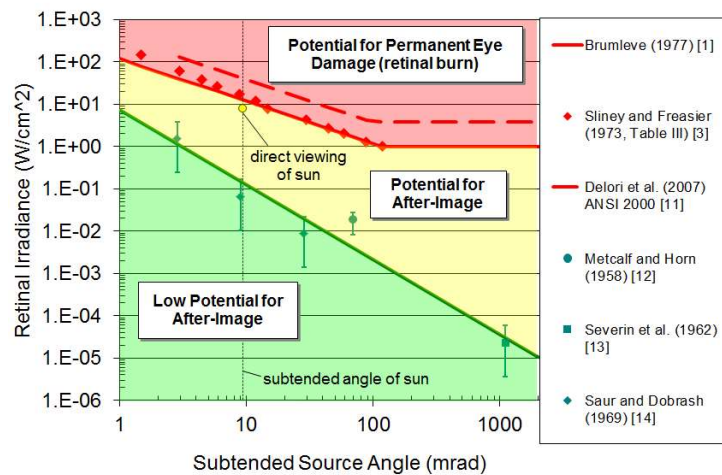
Picture Source: google maps



Obstacles/Interference with airport Glint and glare assessment - Methodology

Based on requirements of Federal Aviation Administration (FAA) regulation

1. No potential for glint or glare in Airport Traffic Control Tower
2. No potential for glare or “low potential for after-image” along final approach path for landing



Potential ocular impact

Source: Jr, Diver & Ghanbari, Cheryl & Ho, Clifford. (2011).

Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation. Journal of Solar Energy Engineering. 133. 10.1115/ES2010-90053.

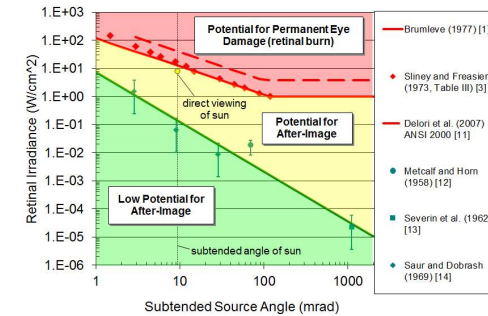
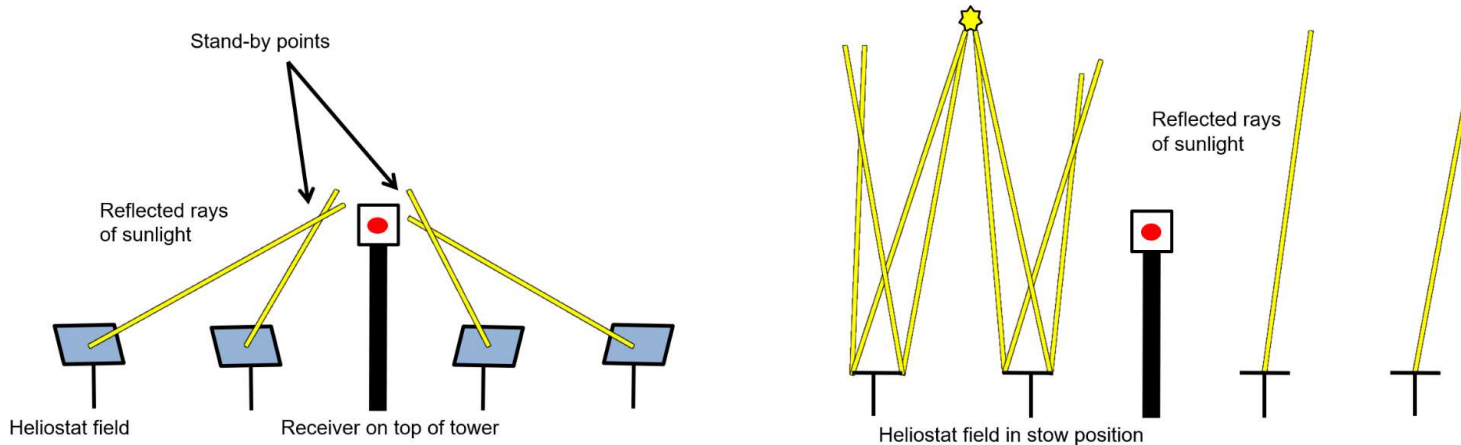




Obstacles/interference with airport Glint and glare assessment - Results

Distance in line of focus from any single heliostat to be exposed to

- No eye damage for airmen ✓
- Low risk of after-image is up to 1350 m: ✗
- Mitigation measures:
 - Several stand-by points to reduce flux density in focal points ✓
 - Stow positions not 100% horizontal to reduce reflection intensity for aircraft passing above ✓



Summary and Outlook

- Innovative plant, no previous project to take as example
- Assessments carried out to obtain required information
- Mitigation measured defined for implementation in plant
- Authorization process started with beginning of project
- Progress achieved, processes defined, basis for future plant
- Permit from National Civil & Flight Body critical path in the authorization process → first step successful ✓
- Near to submit the environmental permit and permit to build ✓
- Foreseen to receive a feedback within 2021
- Start construction in 2022, Start solar operation in 2023



DLR/06/17 Chart 17



Thank you for your attention!

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