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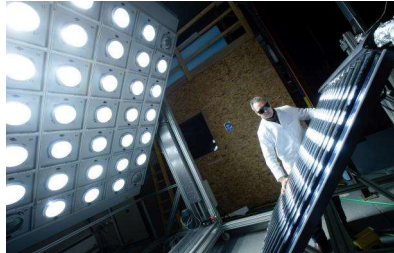
Building Integration of Solar Thermal Systems – TU1205 – BISTS





BISTS testing under a Solar Simulator


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Overview


- The CST Solar Simulator
- Uniformity, collimation and spectral output
- Light incident at non-normal angles
- Experimental set-ups




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- Solar energy system testing procedures which are conducted outdoors have large uncertainties due to the non-controllable insolation conditions.
- Indoor solar simulator facilities allow insolation conditions to be both limited and controllable.







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A solar simulator should provide:


- **Uniform illumination** over a given test area
- **Collimated light**
- **Spectral output** similar to that of the sunlight







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Solar Simulator Requirements (illumination)

The CST solar simulator was required to produce:


- continuous,
- highly uniform,
- collimated light,
- with a spectral output matching the AM 1.5 spectrum
- **allow testing at non-normal incidence angles of illumination**

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Solar Simulator Requirements (testing flexibility)


For testing building integrated technologies which are mounted vertically on a test rig (as on a building façade) the simulator needed a suitable mounting frame that would allow height adjustment from ground level to 6m and tilt adjustment from horizontal to vertical.

The simulator was also required to be mobile as to facilitate testing of the various technologies investigated within the CST laboratory.


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Unique Feature


- Solar simulators are unable to simulate sunlight incident at other than the normal angle on a large area test plane. The CST solar simulator was designed to achieve highly uniform illumination at non-normal incidence angles.
- This is particularly important for the experimental characterisation of solar concentrators and evacuated glazing

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The Lamp Array

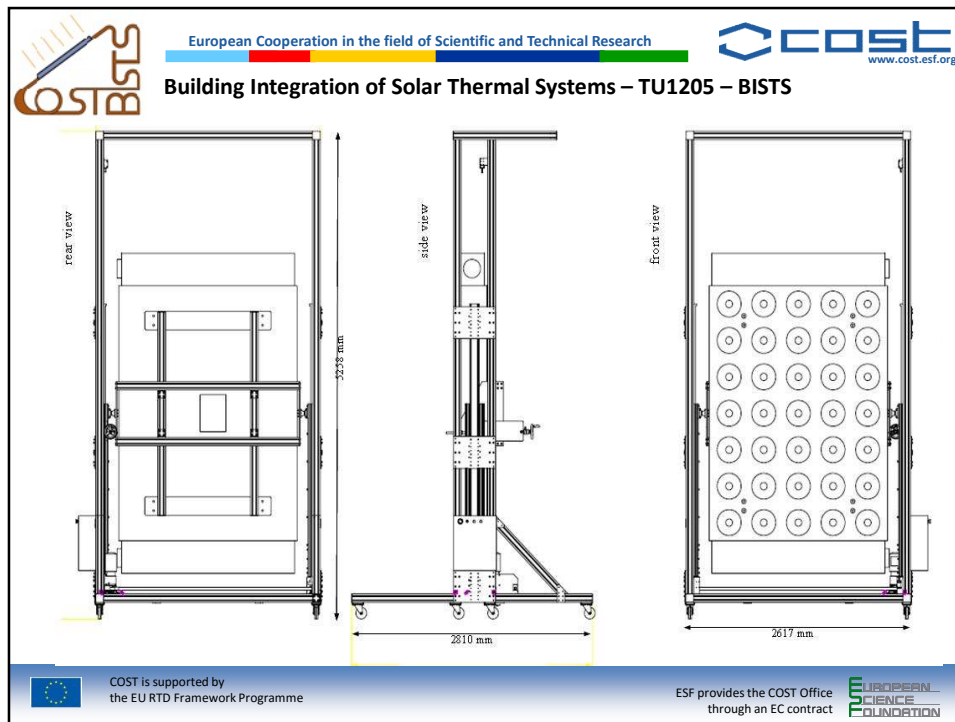
- It generates the simulator light.
- 35 lamps - arranged in 7 rows of 5 lamps each. Includes lamp reflectors.
- All components are housed in a 2750 mm x 2020 mm x 350 mm aluminum box.
- Two ducts at the ends of the aluminum housing contain fans which cool the lamps by forcing air through it at ambient temperature.
- The lamp arrangement was carefully selected by the manufacturer with the aim of producing the required highly uniform light output.

It weighs approximately 500 kg (including cables) and is connected to the control unit via heavy duty cabling

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Technical - Electrical Data	
Wattage	575 W
Voltage	95 V
Current	6.7 A

Technical - Geometries	
Light centre length (LCL)	70 mm
Electrode gap cold	7.0 mm
Bulb diameter	30.00 mm
Length	145 mm
Diameter	30 mm

Technical - other	
Cooling	Convection
Lifespan	1000 h
Colour temperature	6000 K

Metal halide (Osram HMP 575W)


Spectral output

Graph showing Relative Intensity (S_f) versus Wavelength (nm). The curve shows a broad spectrum with peaks around 400 nm, 500 nm, and 600 nm.


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The completed solar simulator in operation at the CST laboratory at the University of Ulster




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Infra-Red (IR) filter

Purpose of the filter is to reduce excess IR radiation produced by the metal halide lamps at wavelengths above 740 nm.


The filter is important for testing PV technologies where IR radiation can increase temperature and reduce electrical conversion efficiency



Two 4 mm thick low-iron glass panes are mounted on a purpose built frame which creates a 50 mm gap between them. Fans integrated within the frame provide forced air circulation to keep glass cool and reduce IR re-radiation




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The solar simulator with the IR filter in operation


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Achieving uniformity on the test target

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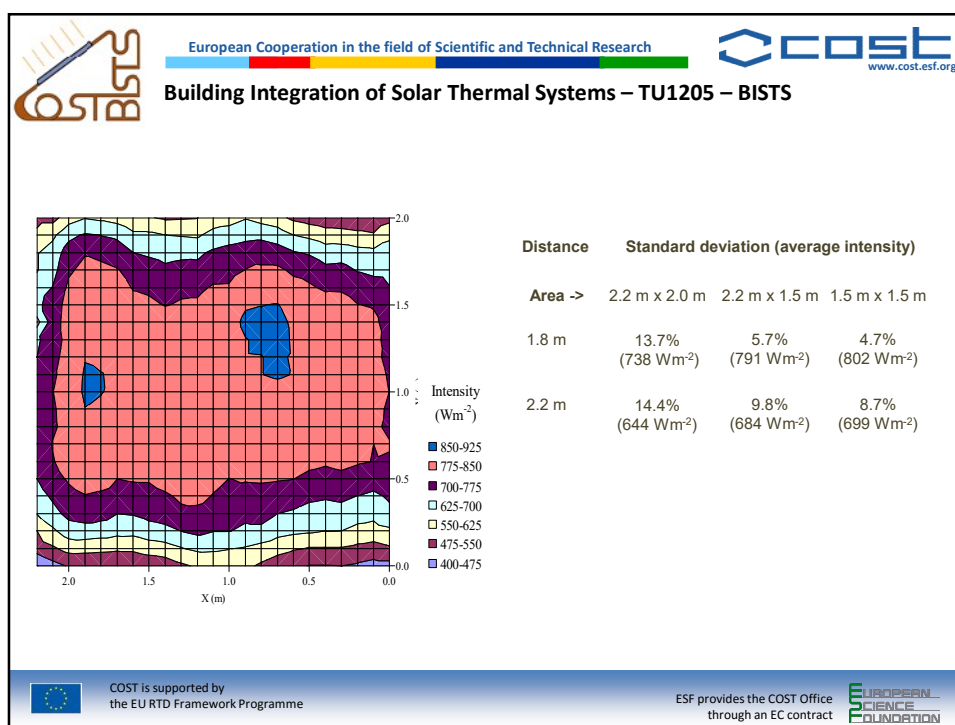
Normal Incidence

The light is perpendicular on the test plane

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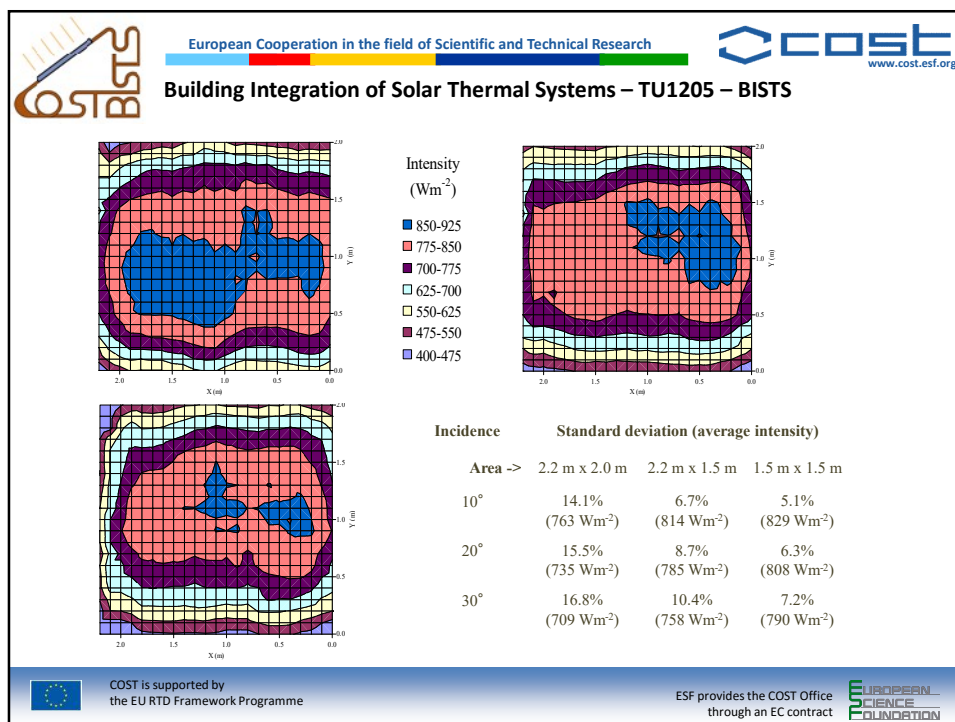
Non-normal Incidence

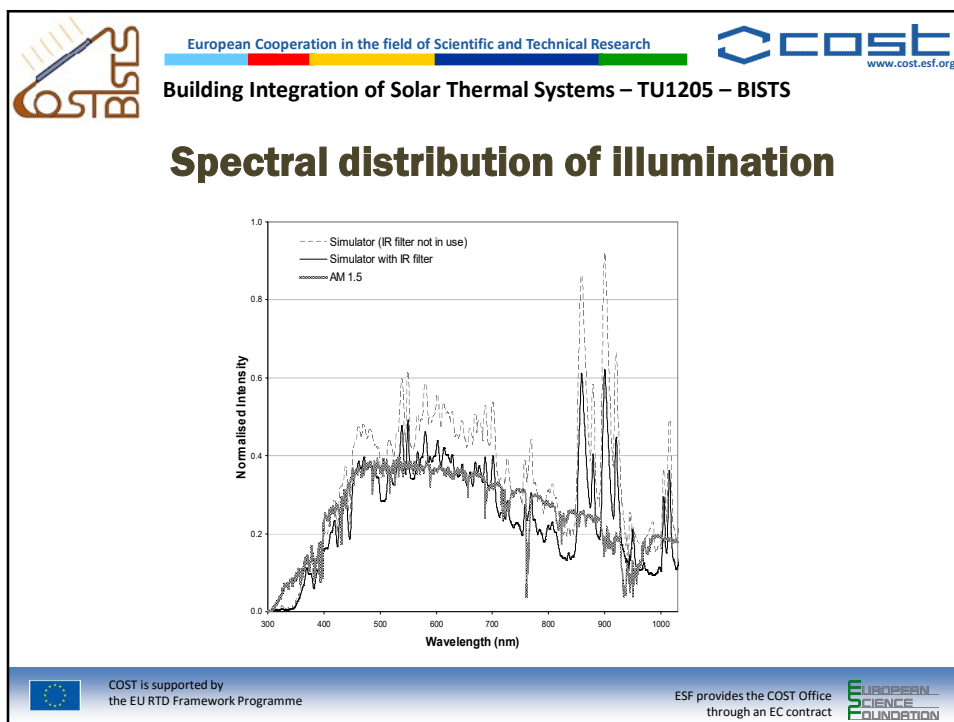
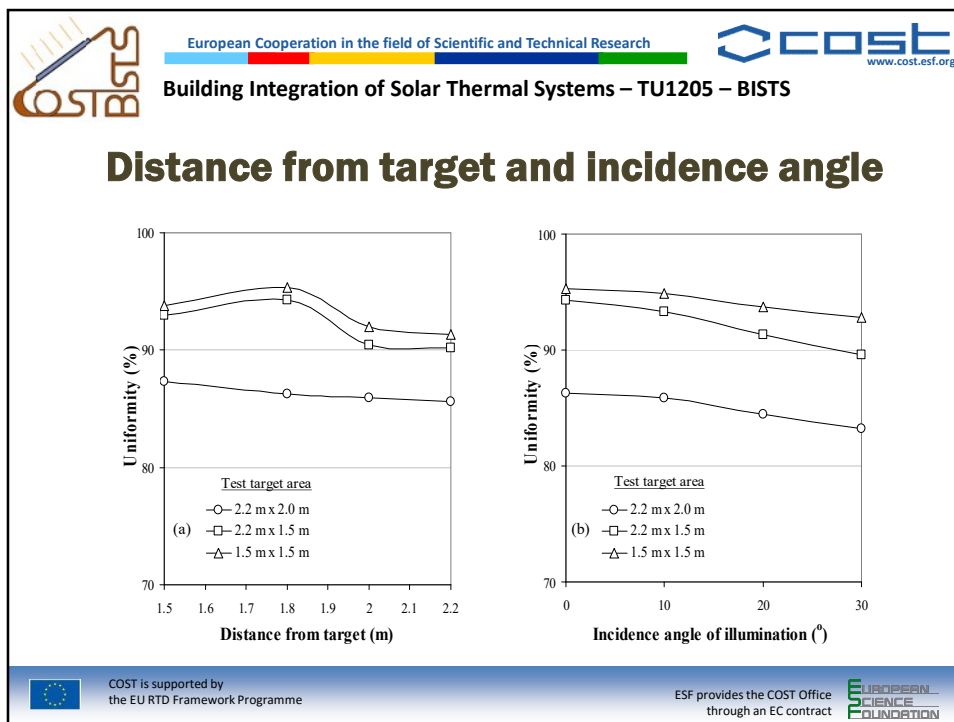
The light is incident at an angle on the test plane


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Testing under the Solar Simulator


(Components and full systems)




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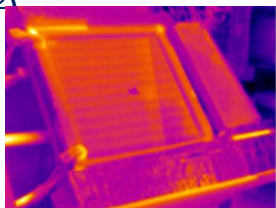
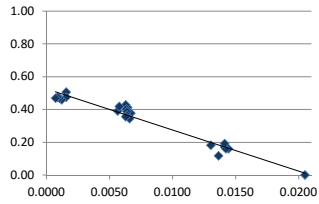
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Thermal efficiency for a novel BISTS (CoPVTG²)







Temperature Difference (°C)	Thermal Efficiency
0.0000	0.48
0.0050	0.42
0.0100	0.35
0.0150	0.25
0.0200	0.15



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Proprietary solar collector testing


- Evacuated tube
 - HP
 - DF
 - Concentrated
- Flat plate





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One-off collector testing

- NCT asphalt BISTS collector
- Unglazed polymer collector







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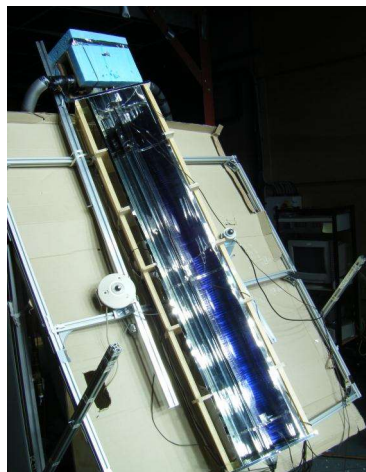



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Concentrating PV




Evacuated tube collectors





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Integrated Collector Storage systems

- Façade collector
- Small scale AD
- Reflector augmentation





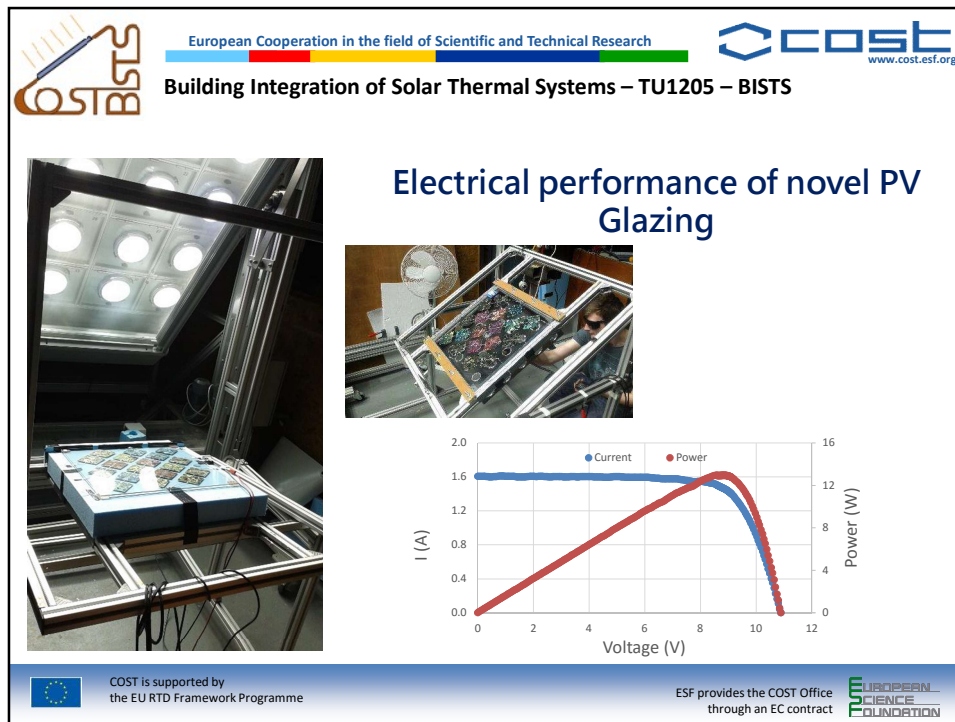




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Building elements

- Insulating panels
- Evacuated glazing
- Evacuated PV/thermal glazing




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Commercial products

- Unilever Ice-cream cabinets
- PV dog collars
- Solar/air heat recovery AHU
- SolaSiphon
- SolaPlug









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Novel PV blind

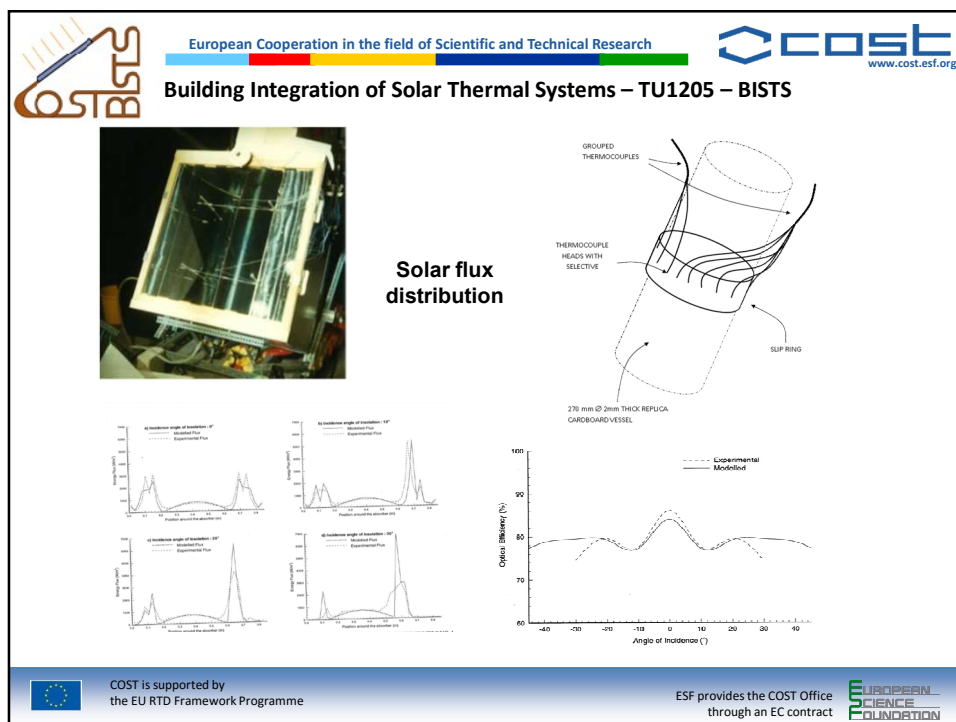
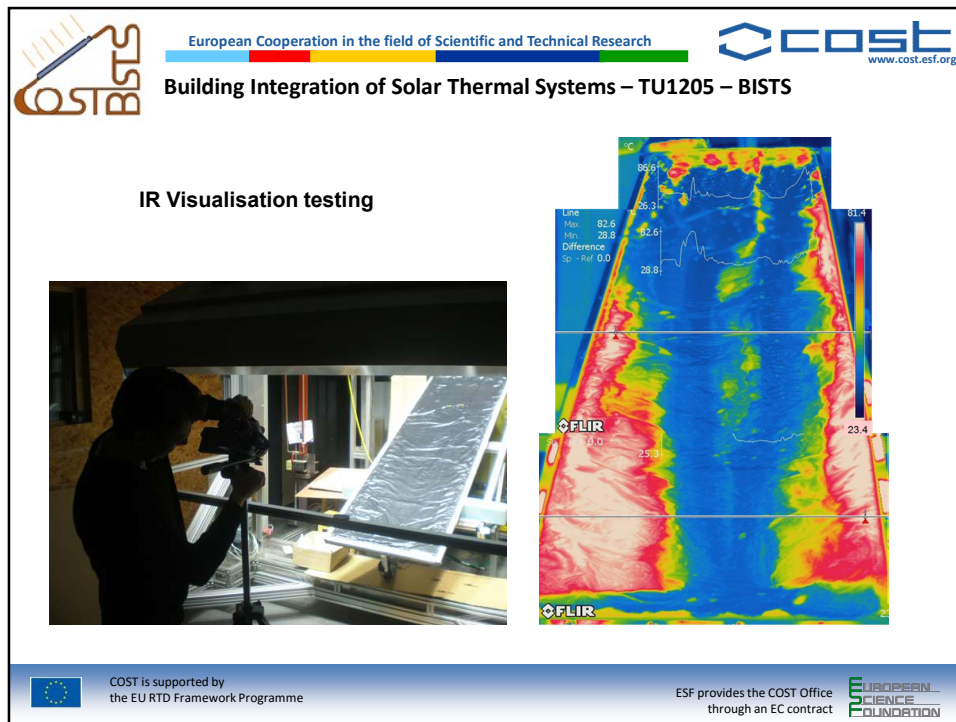




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