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Building Integration of Solar Thermal Systems – TU1205 – BISTS

# Building Integration of Solar Thermal Systems (BISTS): Case Studies


Dr Mervyn Smyth

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A solar thermal system is considered to be building integrated, if for a building component this is a prerequisite for the integrity of the building's functionality.


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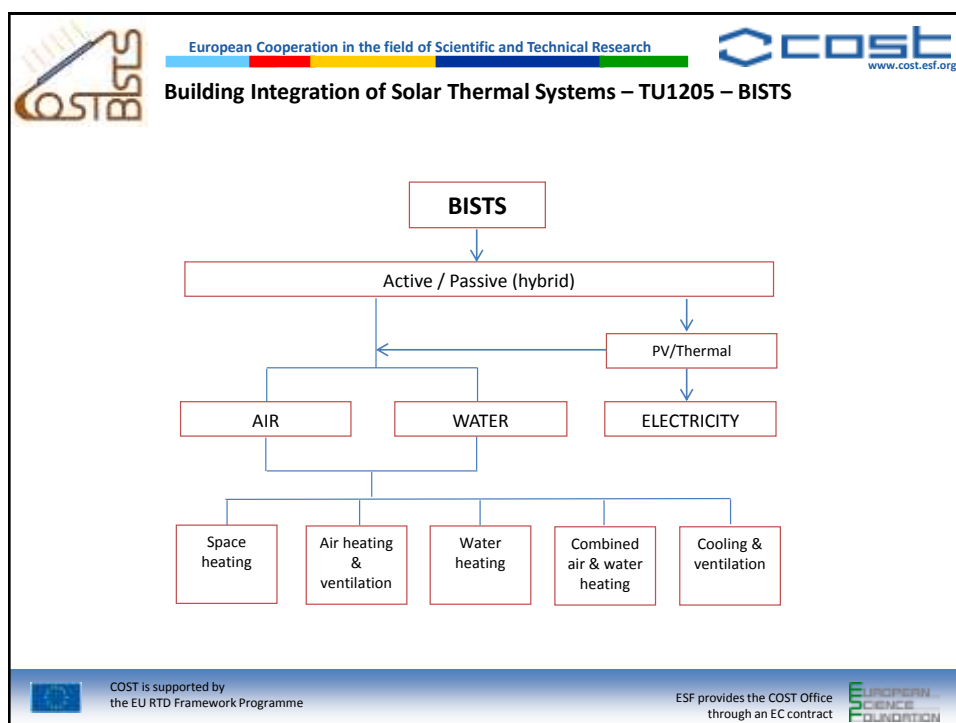
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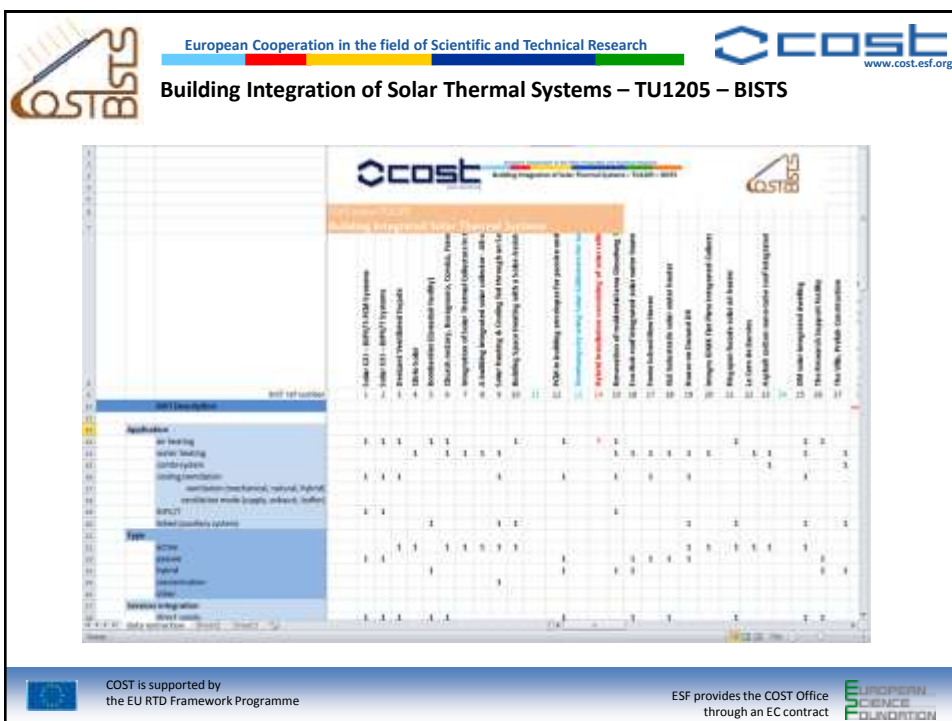
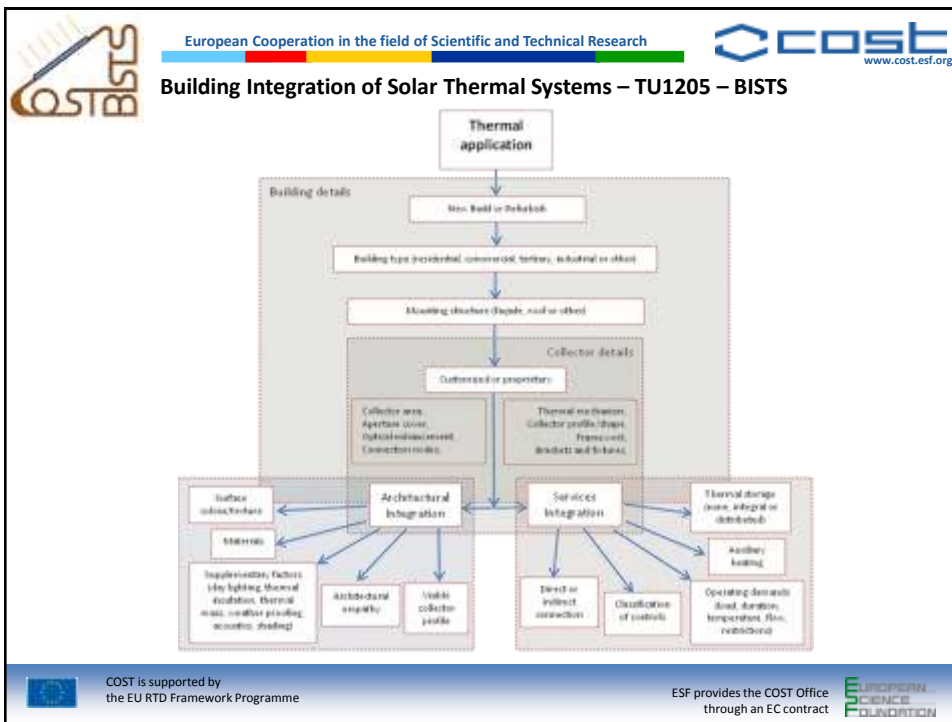
Over 90 case studies submitted to date  
 82 have been allocated reference numbers and reviewed  
 60 are of direct relevance  
 The remainder are model or support material

## Not a quantitative analysis .... but rather indicative

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**BISTS Combinations**

				Installed on ....						
				Wall		Roof		Other		
				New	Refurbishment	New	Refurbishment	New	Refurbishment	
Output	Air	Air heating	Active	5 off	3 off	4 off	4 off	2 off	2 off	
			Passive	3 off	1 off	2 off	1 off			
		Combi systems	Active	1 off		6 off	2 off			
			Passive							
	Water	Water heating	Active	11 off	4 off	15 off	5 off	5 off	4 off	
			Passive	1 off	1 off	2 off		2 off	1 off	
		Cooling	Active	5 off	2 off	3 off	1 off			
			Passive	3 off	1 off	2 off	1 off	1 off		
		Electricity	PV/T	Active						
				Passive	2 off	1 off	1 off			

In addition, a further 15 systems have been described as being Hybrid in operation and 3 system utilised some form of solar concentration

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				Installed element					
				Facade		Roof		Other	
				New	Retrofit	New	Retrofit	New	Retrofit
OUTPUT	AIR	Air heating & ventilation	Active						
			Passive						
		Space heating	Active						
			Passive						
		Combined air and water heating	Active						
			Passive						
	WATER	Water heating	Active						
			Passive						
		Cooling & ventilation	Active						
			Passive						
ELECTRICITY	PV/T	Active							
		Passive							

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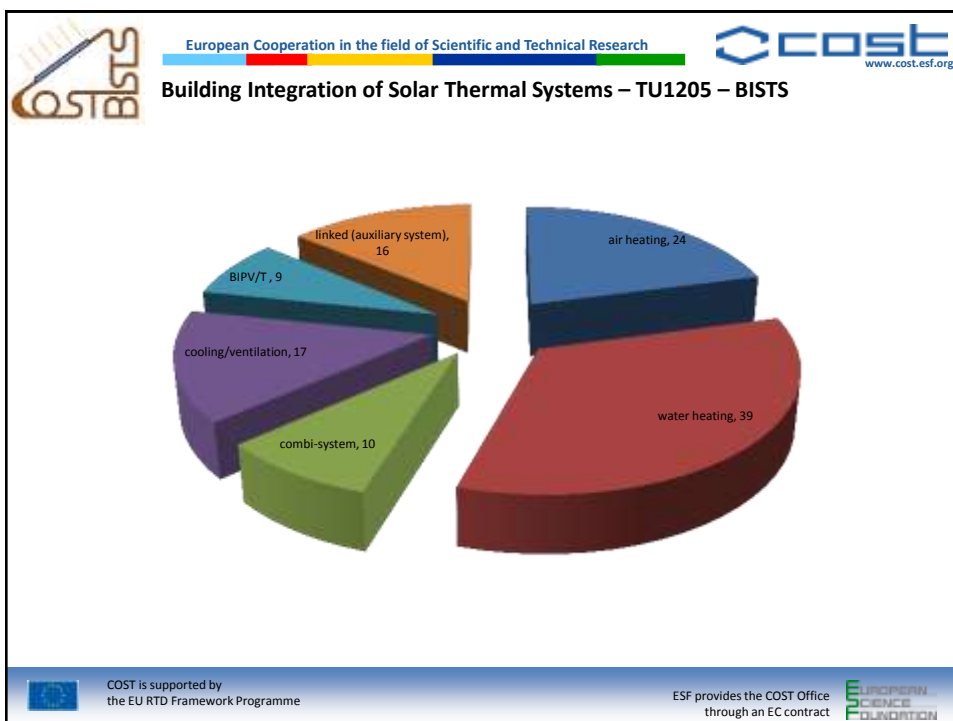
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# BIST Description

# Application

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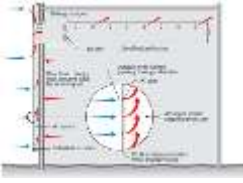
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**Air heating**


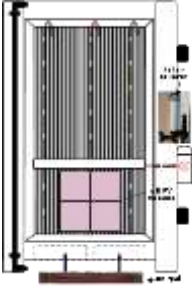
Transpired façade collector, Canada


Façade crown collector, UK



Window shutter, France

PVT roof collector, Canada



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**Water heating**

Shading device, France




Ridge tiles, Holland




Integrated roof tiles, China



Solar balustrade, USA



Unglazed façade collector, Switzerland



Flat plate collector, Ireland



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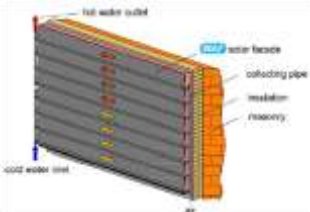
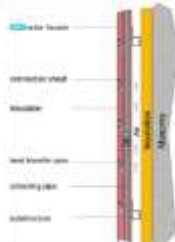

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**Combi-system**

Roof combined air/water collector

Wall combined air/water collector

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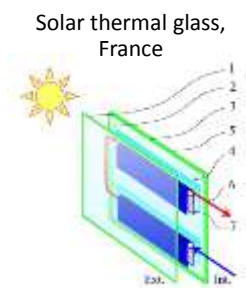

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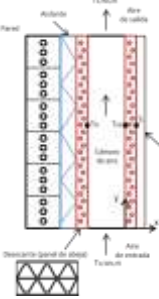
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**Cooling/ventilation/shading**



Solar thermal glass, France



Solar awning, USA



Radiant cooling, Japan

Desiccant Ventilated Façade

Solar facade blinds, USA

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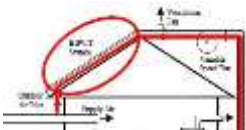


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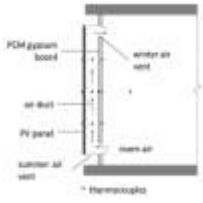
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**Building Integrated PV/Thermal**



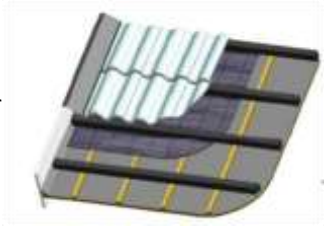
PV roof air heating, Canada

PV air heating, Portugal



PV water heating, Sweden



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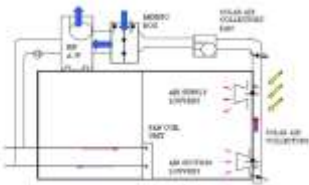
**BIST** **cost** [www.cost.esf.org](http://www.cost.esf.org)

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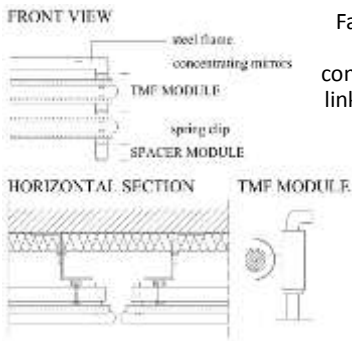
**Linked systems**



District heating, Sweden



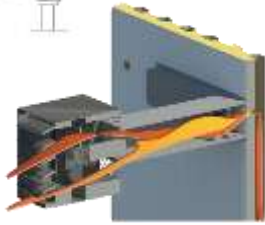
Air heat pump on the roof, Greece



Front View: steel plate, concentrating mirrors, TME MODULE, spring clip, SPACER MODULE

HORIZONTAL SECTION: TME MODULE

Facade integrated solar thermal concentrated system linked to absorption chiller, Italy




Kingspan facade linked to auxiliary air heater, UK

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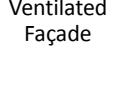
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**Other**



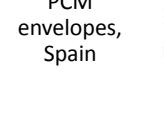
Desiccant  
Ventilated  
Façade



NCT asphalt  
collector, UK

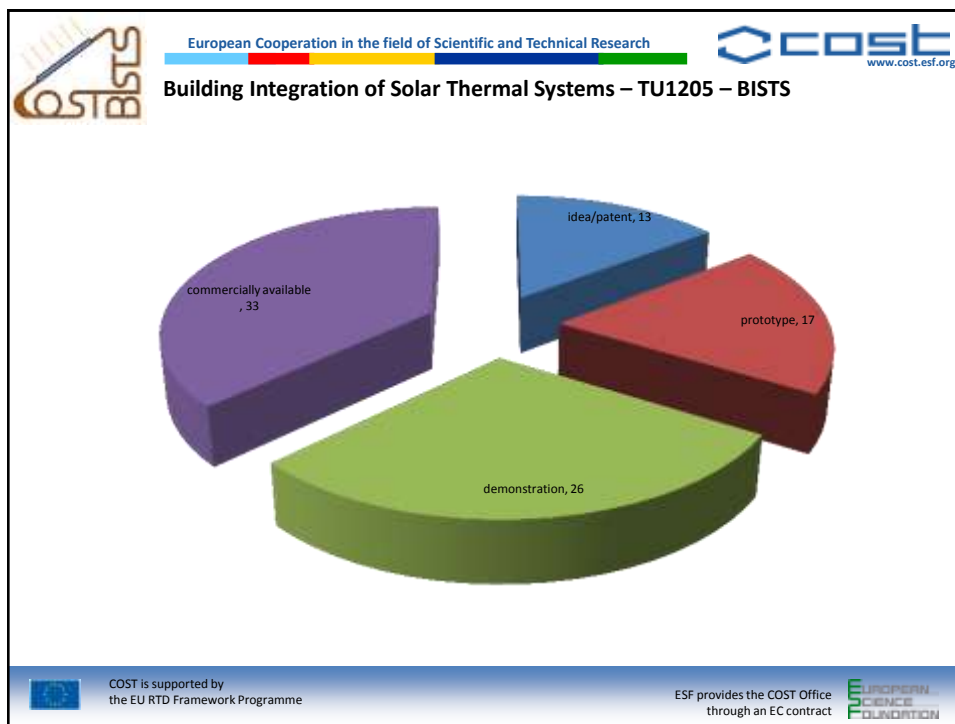


Integrated photo-bioreactor, Germany



PCM  
envelopes,  
Spain

A large, faint watermark of the COST logo is visible in the background of the slide. The logo consists of the word "COST" in a stylized, bold, sans-serif font, with a small graphic element to its left.



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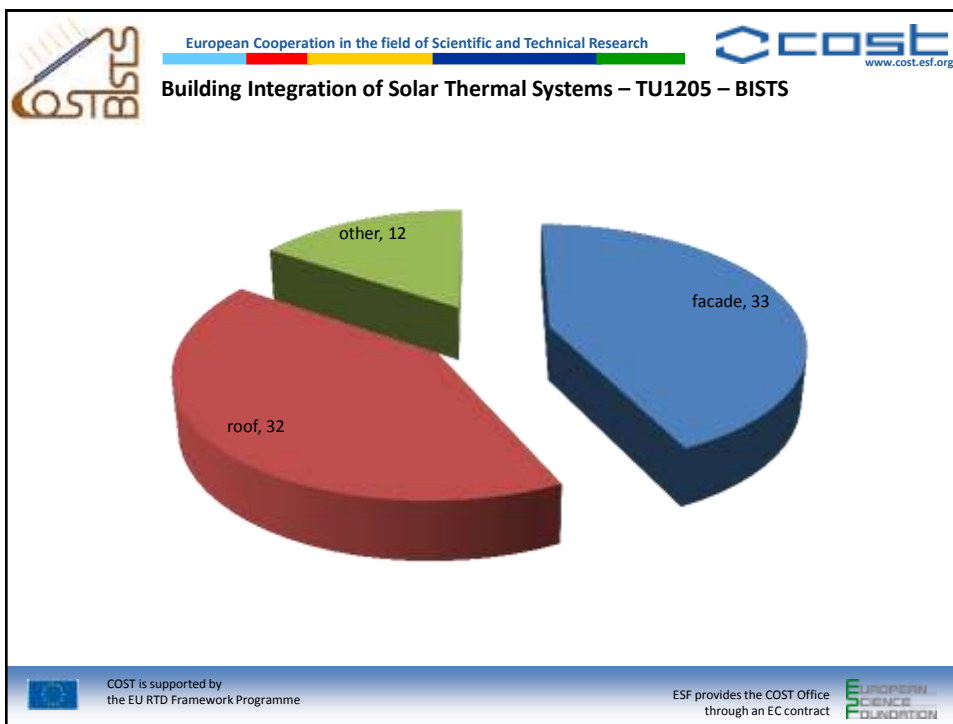
# BIST Description



## Collector building element

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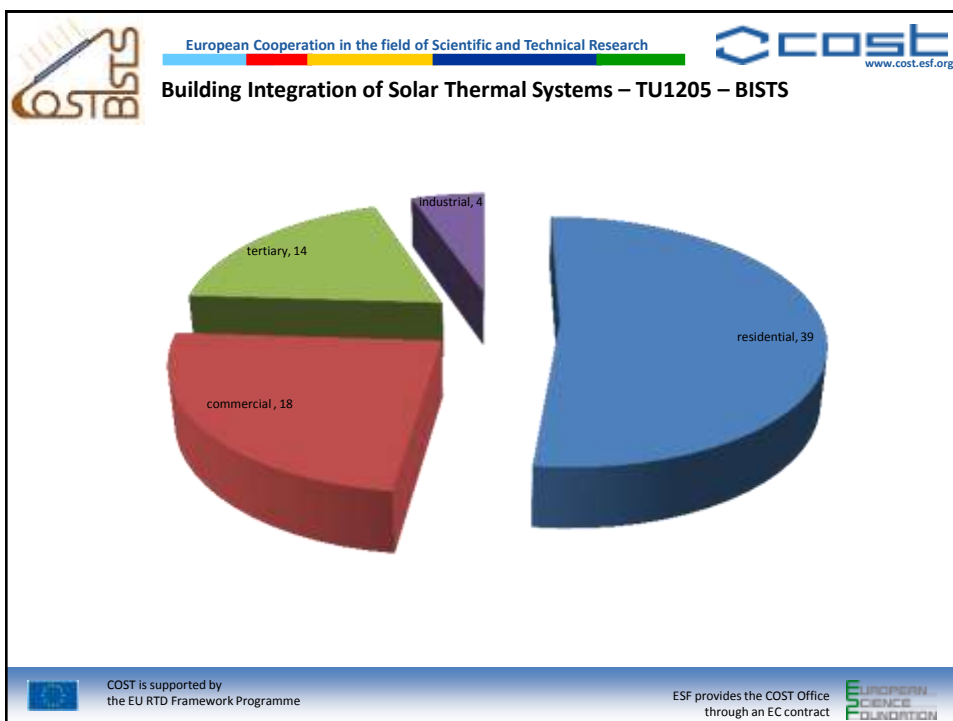
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# Architectural integration

## Building type


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# Architectural integration


## Building physics




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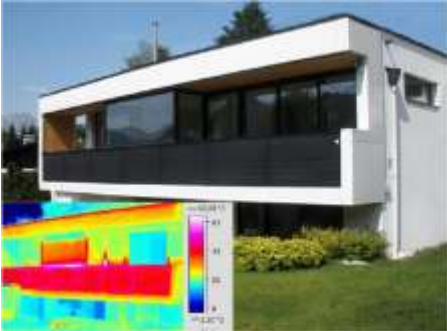




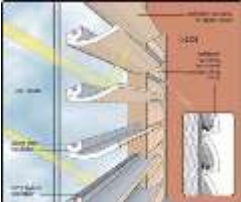
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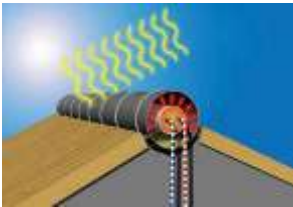
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Structure: Combined air/water balcony



Shading: PVT window blinds, Sweden




Integral storage: ICS ridge collector, Holland



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**Insulation**

Significant back panel insulation, Portugal

PVT back panel insulation, Brazil

Transpired air collector with and without back insulation

Solar-comb insulation, Austria

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# Architectural integration

## Building Architectural Integration

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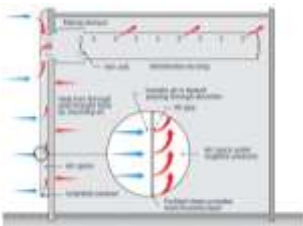
**Architectural empathy?**




Obvious, but the north side is covered with the same stainless steel elements but not thermally active






Blended, mounted in the apex ridge of pitched roof





Invisible transpired wall collector






Out of sight


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# Wider considerations


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## Areas of obvious technological development and deployment

### Minimal work published in


- Economics....some on capital costs and running costs, nothing on payback and maintenance
- Some on embodied energy, nothing on sustainable materials, environmental impact, fire safety
- Some on project motivation, nothing on social impact or legislation

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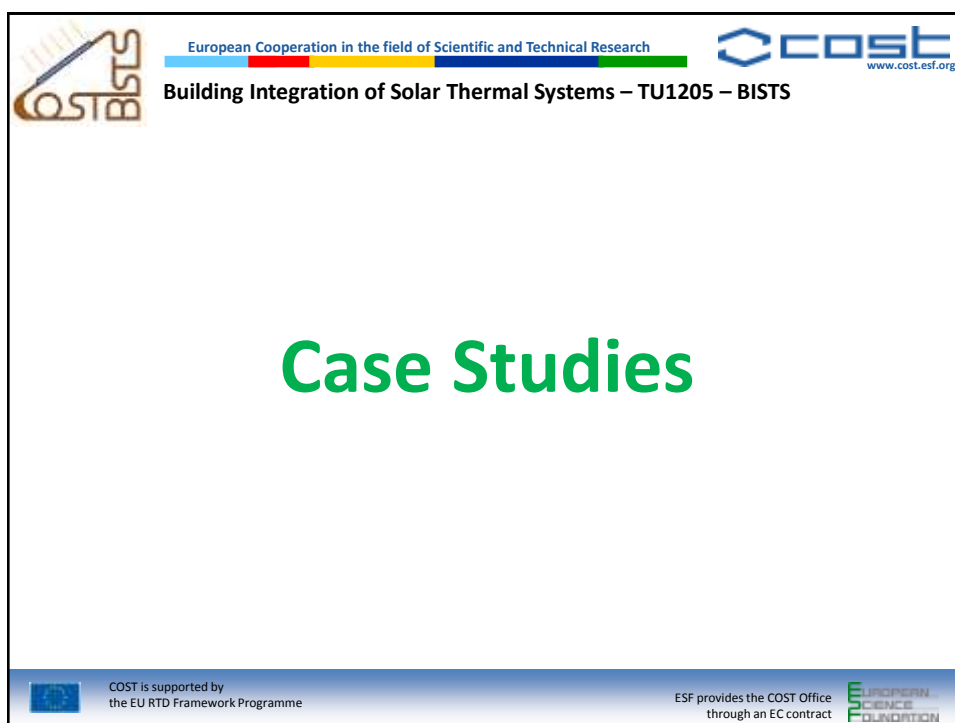
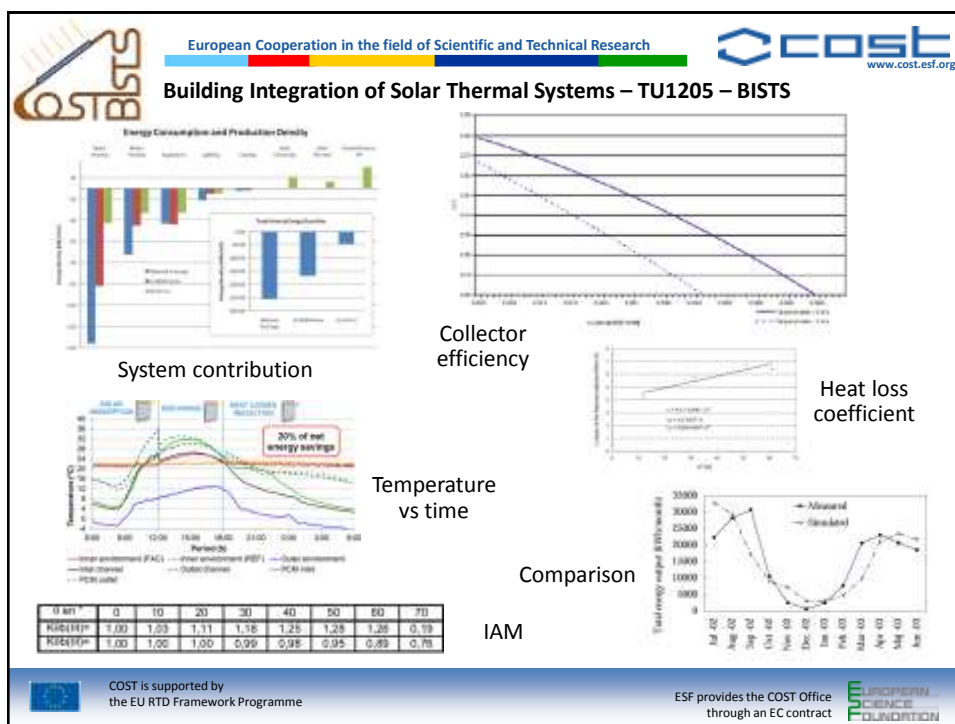
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# Performance

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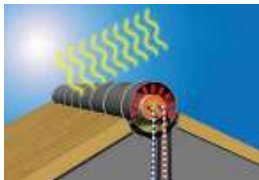
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### The Eco-Nok

Roof ridge ICS solar water heating module.  
Residential, new build and passive or active  
Each module is 1.5m long 270mm in diameter  
The effective collection area per module is 0.36 m<sup>2</sup>  
Annual energy collection (3 modules) in Holland is 2.1GJ  
Up to 50% annual savings on hot water energy consumption  
The unit cost is Euro 420 with a family sized system costing up to Euro 3000 fully installed





## CASE STUDY 1




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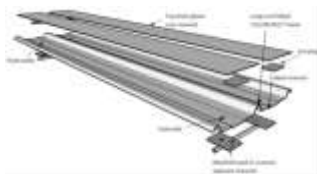


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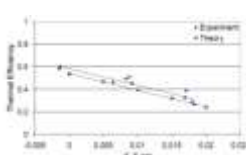




### Building Integrated Solar Heating and Radiant Cooling Collector

Developed to be directly integrated into a troughed sheet metal roof  
Unglazed solar water heater during the day  
Unglazed radiant cooling panel at night  
Separate heat and coolth storage




## CASE STUDY 2a







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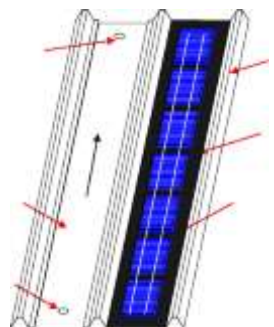




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**CASE STUDY 2b**

**The BIPVT roof collector**

Simple fabrication process with holes drilled into the trough and connection nipples to connect to a manifold

Water or air heating

Laminated PV cells on top of the absorber sheet

Low-iron-glass aperture cover

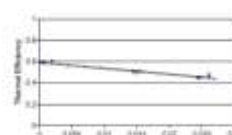
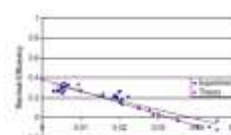





Fig. 5. Experimental and theoretical thermal efficiency of a glazed BIPVT collector.


Fig. 6. Experimental and theoretical thermal efficiency of an unglazed BIPVT collector.



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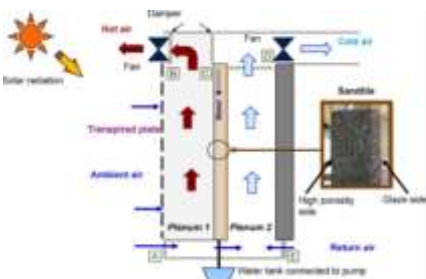


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**The building integrated (solar thermal) cooling facade**




**CASE STUDY 3**

**Fan-assisted system that consists of two vertical plenums.**

The first plenum was made of black aluminium (absorber) transpired plate and a sandtile wall (evaporative pad)


The second plenum is formed by the sandtile wall (with water-resistant layer) and the building wall

Energy consumption to generate 1 kW of cooling that cooled the air to 293K is only 52 W




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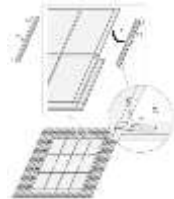
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## Case Studies – observations...so far

- **Wide range of interesting concepts/systems** (although some repetition of the same system on different buildings)
- **Limited information**
- **BIST description** (generally good, less regarding the building detailing)
- **Sizing procedure** (minimal)
- **Building physics** (secondary consideration)
- **Physical connection** (some detailing, but minimal)
- **Costs - economic, environmental, social** (limited)
- **Performance** (wide variation)
- **Aesthetics** (missing)
- **Distribution** (exclusively developed world)




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# Thank you

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