



STS

SOLARNI TERMO SISTEMI
SOLAR THERMO SYSTEMS

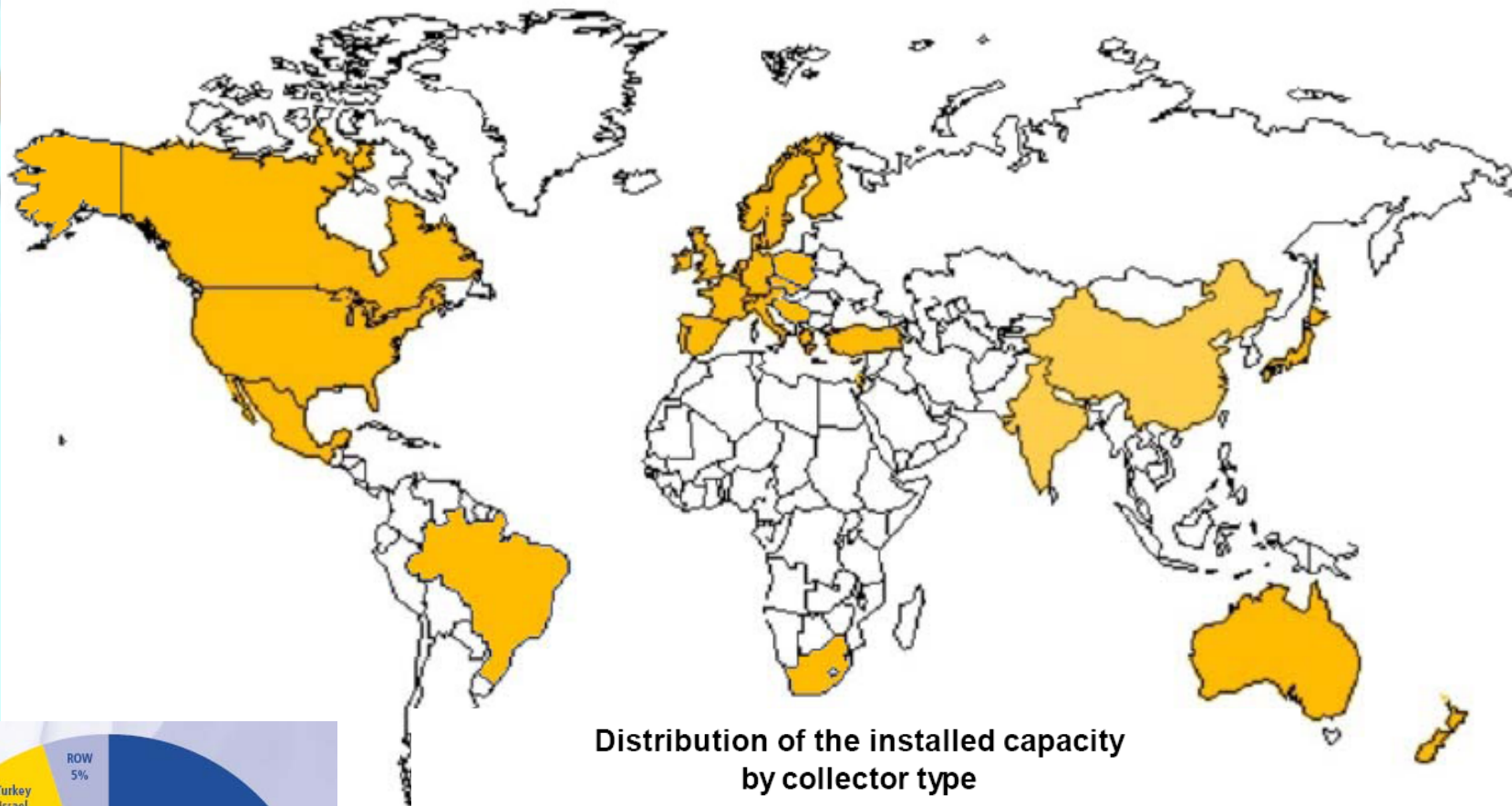
Junij 2009

POTENCIAL SOLARNE ENERGIJE

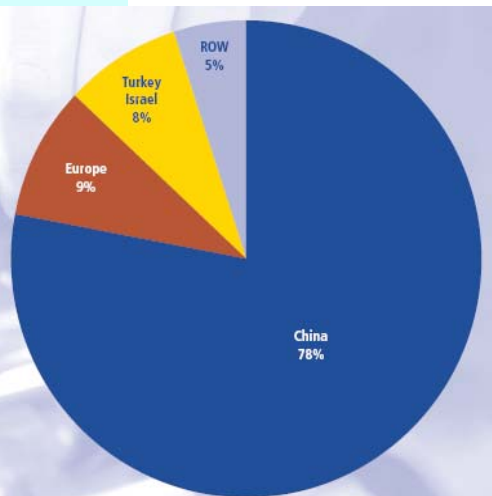
- Tehnični potencial za izrabo solarne energije je bil v
- državah EU pred njeno širitvijo v letu 2004 ocenjen
- na 1,4 milijarde m².

- Ta količina bi zadoščala za proizvodnjo 682 GWh
- (59 milijonov ton naftnega ekvivalenta) toplote na leto,
- kar bi ustrezalo:

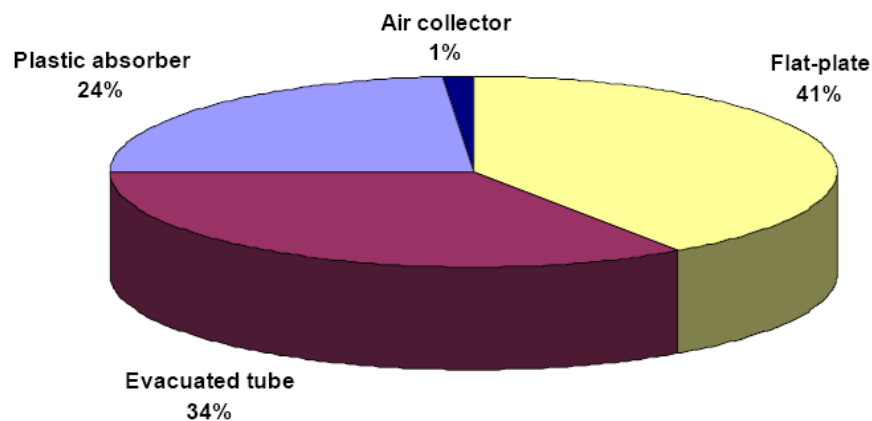
- 6% rabe končne energije v državah članicah EU-15,
- 30% nafte uvo`ene v EU z Bli`njega vzhoda.



Distribution of the installed capacity by collector type



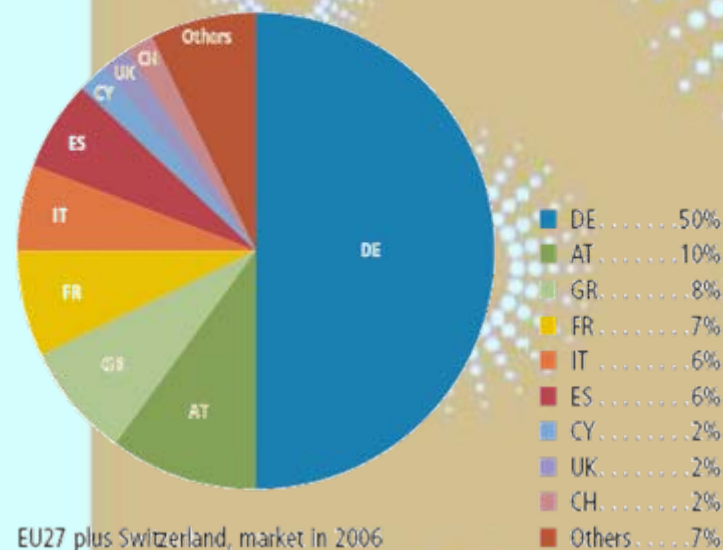
Distribution of Solar Thermal Market World Wide (newly installed capacity in 2004)



MARKET SIZE IN TERMS OF COLLECTOR AREA (m²)

	In Operation ²		Market (= Newly Installed)				Market Growth	Market Forecast
	2006	2004	2005	2006		2006/2005	2007	
	Total Glazed m ²	Total Glazed m ²	Total Glazed m ²	Total Glazed m ²	Flat Plate m ²	Vacuum Collectors m ²	Total Glazed %	Total Glazed m ²
AT (Austria)	2 611 627	182 594	233 470	292 669	289 745	2 924	25%	350 000
BE (Belgium)	104 118	14 700	20 234	35 636	31 267	4 369	76%	45 000
BG (Bulgaria)	25 100	1 800	2 000	2 200	-	-	10%	2 500
CH (Switzerland)	443 548	31 160	39 132	51 863	50 354	1 509	33%	65 000
CY (Cyprus)	560 200	30 000	50 000	60 000	-	-	20%	70 000
CZ (Czech Republic)	106 730	12 250	15 550	22 030	18 490	3 540	42%	30 000
DE (Germany)	8 054 000	750 000	950 000	1 500 000	1 350 000	150 000	58%	1 500 000
DK (Denmark)	362 280	20 000	21 250	25 300	25 000	300	19%	32 000
EE (Estonia)	1 120	250	250	300	-	-	20%	400
ES (Spain)	702 166	90 000	106 800	175 000	161 875	13 125	64%	325 000
FI (Finland)	16 493	1 630	2 383	3 400	-	-	43%	4 500
FR (France)	615 600	52 000	121 500	220 000	209 000	11 000	81%	275 000
GR (Greece)	3 287 200	215 000	220 500	240 000	235 200	4 800	9%	300 000
HU (Hungary)	6 250	1 500	1 000	1 000	-	-	0%	1 200
IE (Ireland)	15 790	2 000	3 500	5 000	-	-	43%	10 000
IT (Italy) ²	855 230	97 738	127 059	186 000	-	-	46%	285 000
LT (Lithuania)	2 750	500	500	600	-	-	20%	1 000
LU (Luxembourg)	15 900	1 700	1 900	2 500	-	-	32%	2 900
LV (Latvia)	3 850	500	1 000	1 200	-	-	20%	1 800
MT (Malta)	23 860	4 215	4 000	4 500	-	-	13%	5 500
NL (Netherlands)	318 441	26 300	20 248	14 685	-	-	-27%	18 000
PL (Poland)	167 520	28 900	27 700	41 400	35 100	6 300	49%	52 000
PT (Portugal)	180 950	10 000	16 000	20 000	-	-	25%	24 000
RO (Romania)	69 100	400	400	400	-	-	0%	500
SE (Sweden)	236 929	20 058	22 621	28 539	19 826	8 713	26%	34 000
SI (Slovenia)	109 300	1 800	4 800	6 900	6 300	600	44%	10 000
SK (Slovakia)	72 750	5 500	7 500	8 500	7 700	800	13%	12 000
UK (United Kingdom)	250 920	25 000	28 000	54 000	27 000	27 000	93%	70 000
EU27+CH	19 219 722	1 627 495	2 049 297	3 003 622	-	-	47%	3 527 300

Shares of the European solar thermal market

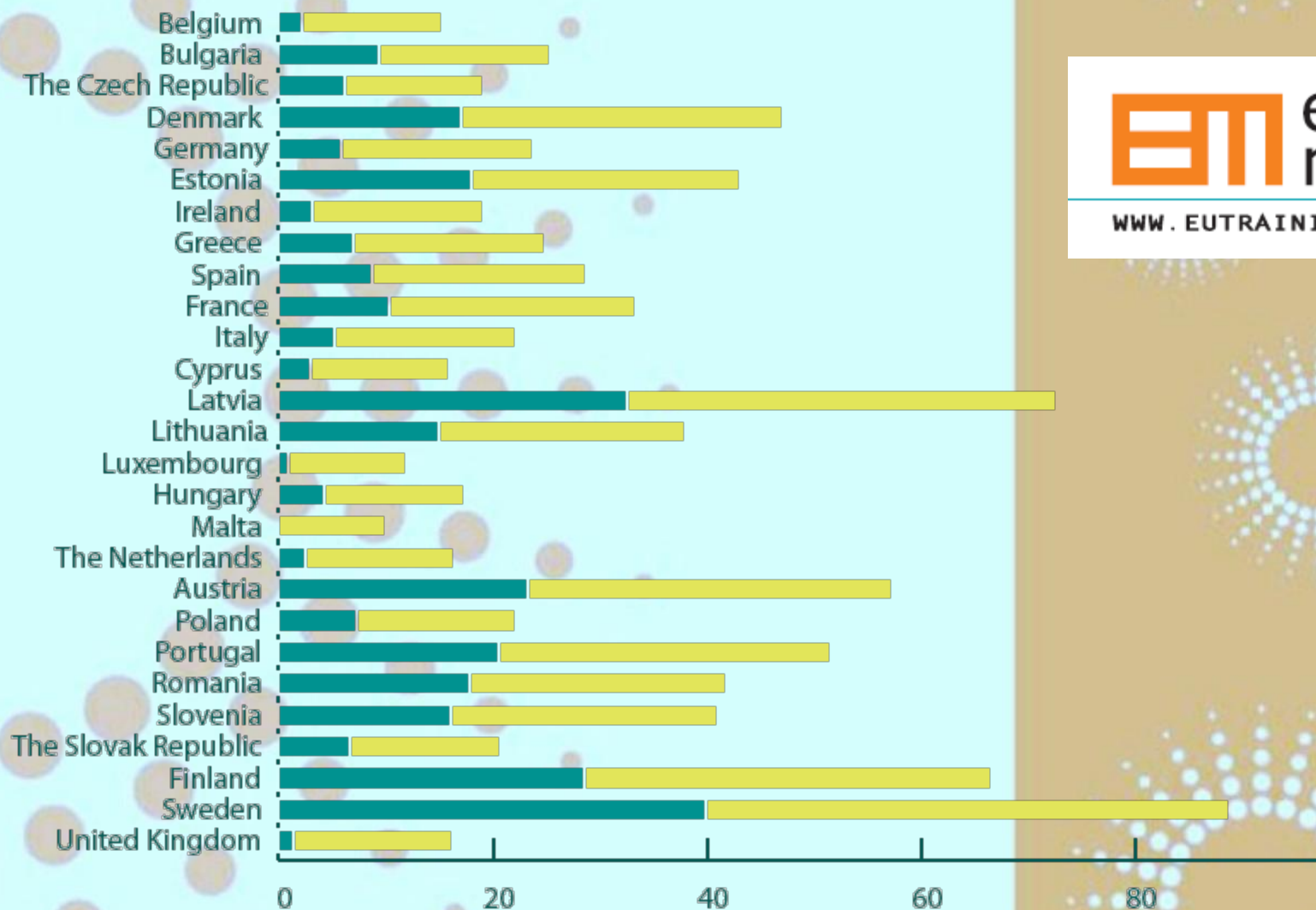


EU27 plus Switzerland, market in 2006

Figure 1

National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020

■ National Overall Target 2005
■ Target for 2020

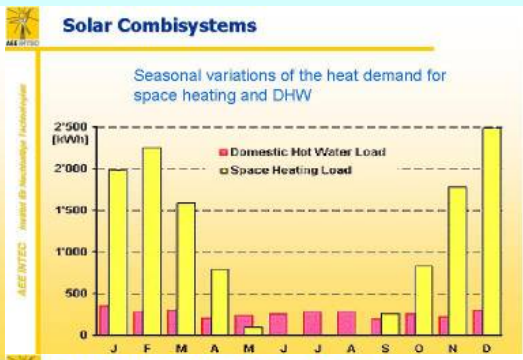


Trend razvoia

Solar Combisystems

Solar Combisystems

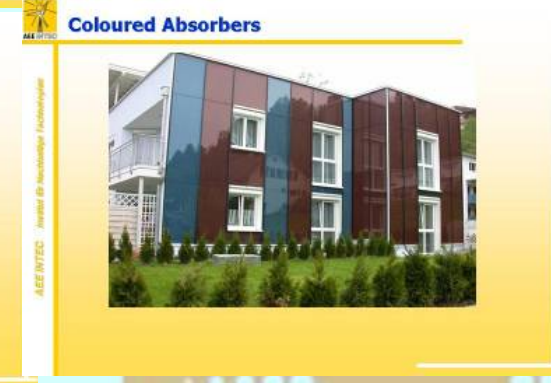
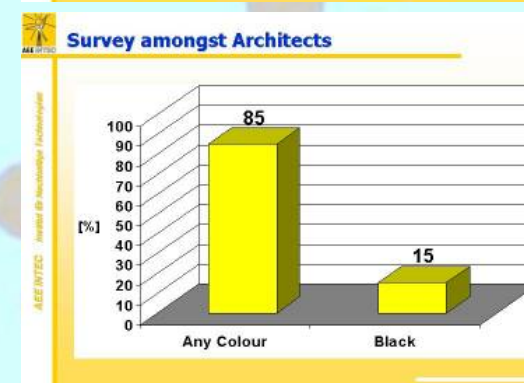
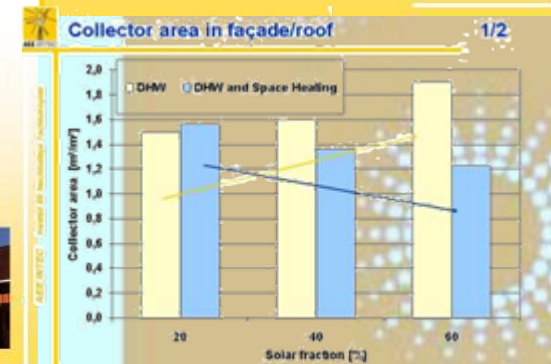
Solar Heating Systems for combined domestic hot water preparation and space heating



Solar Combisystems

System Concepts

- Using the thermal mass of the building as heat store
- Using Domestic Hot Water to store the heat
- Using the space heating store to store the heat



System with seasonal storage – Anneberg, S



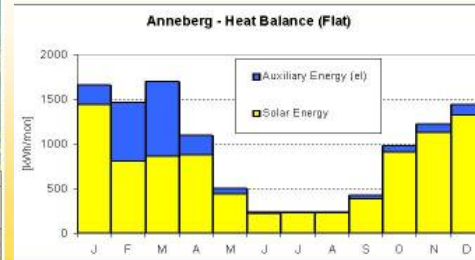
Project	Heat Storage	Project-Size			
		Collector area (m ²)	Storage Volume (m ³)	f _{sol} (%)	Nb. of Flats
Anneberg-Danderyd	seasonal	2.400 m ²	60.000 m ³	70%	50

System with medium-term storage – Gneis-Moos, A



Project	Heat Storage	Project-Size			
		Collector area (m ²)	Storage Volume (m ³)	f _{sol} (%)	Nb. of Flats
Gneis Moos	weekly	410 m ²	100 m ³	34%	61

System with seasonal storage – Anneberg, S



EU - Industry: Share of Heat and Electricity

Industry	[PJ]
Heat	
Electric	
Total	

Final Energy Use of the EU - Industry share of heat and electricity



Source: GREEN PAPER – TOWARDS A EUROPEAN STRATEGY FOR THE SECURITY OF ENERGY SUPPLY, Brussels, 2001

Most promising applications and processes

Applications

- Food industry
- Beverage industry
- Textile industry
- Chemical industry

Processes

- Drying processes
- Evaporation
- Pasteurising
- Sterilising
- Cleaning and washing
- General heating of processes

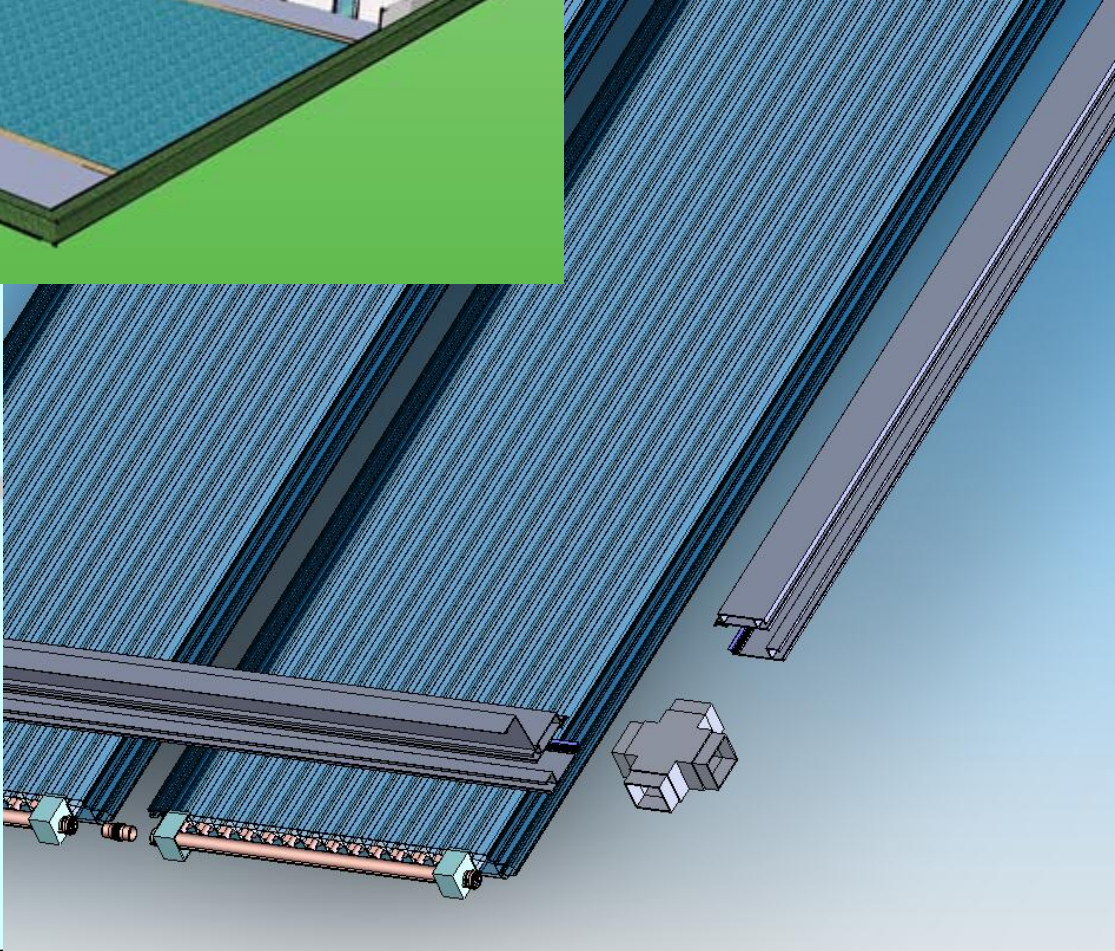
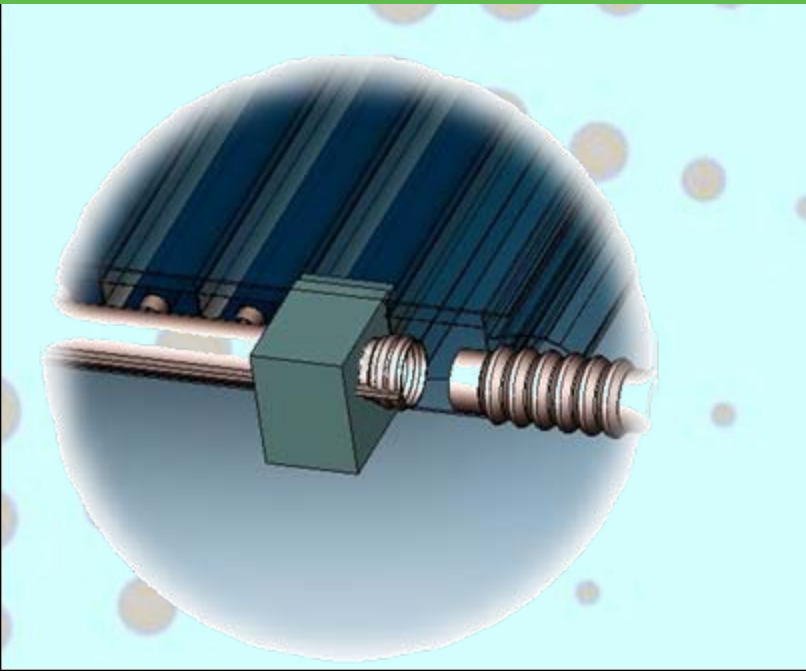
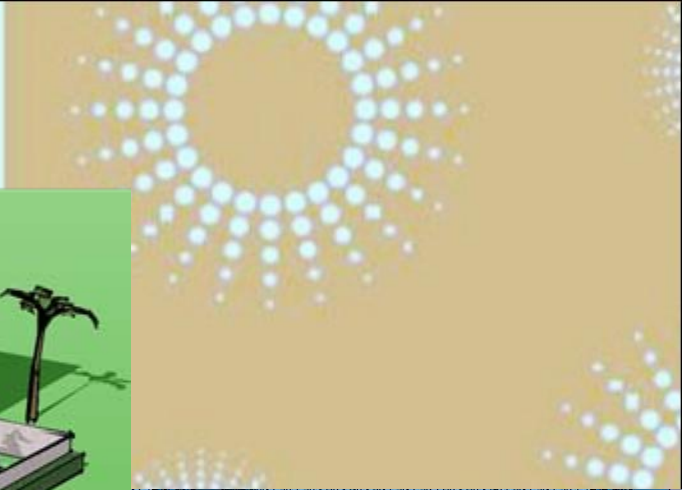
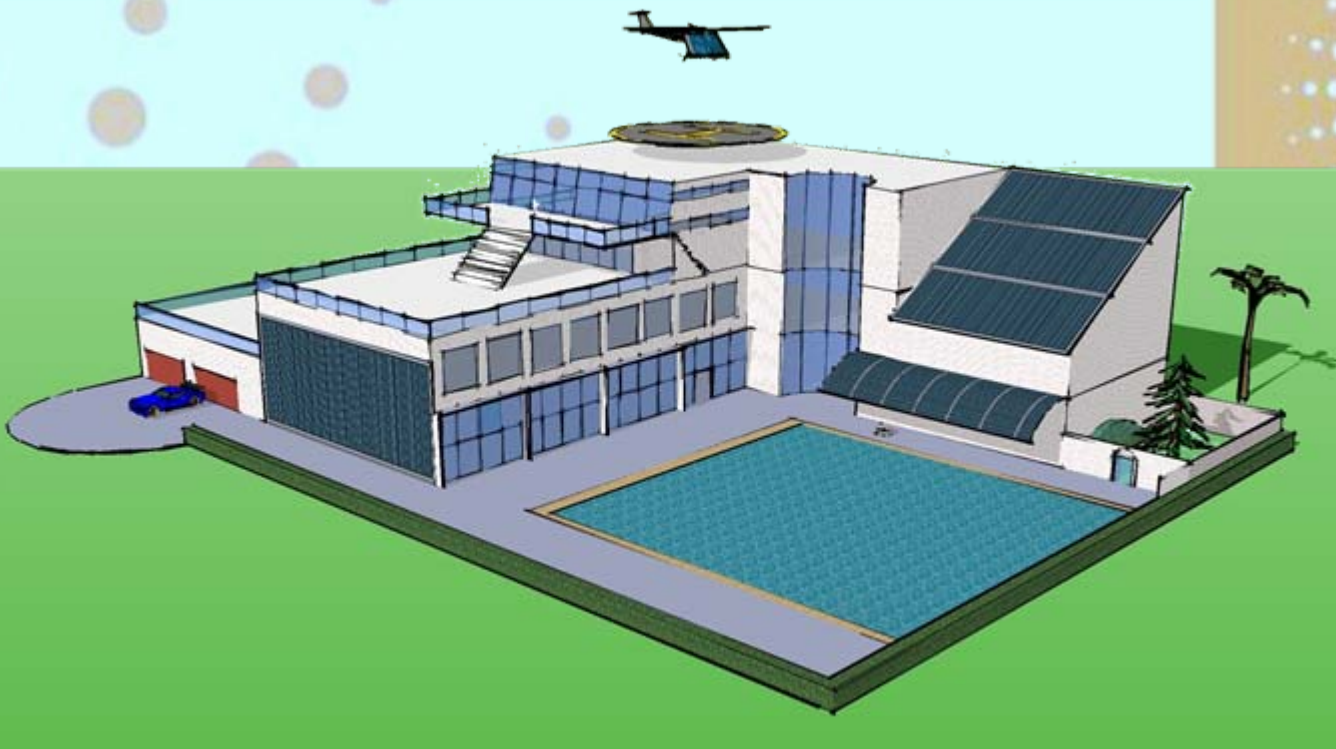


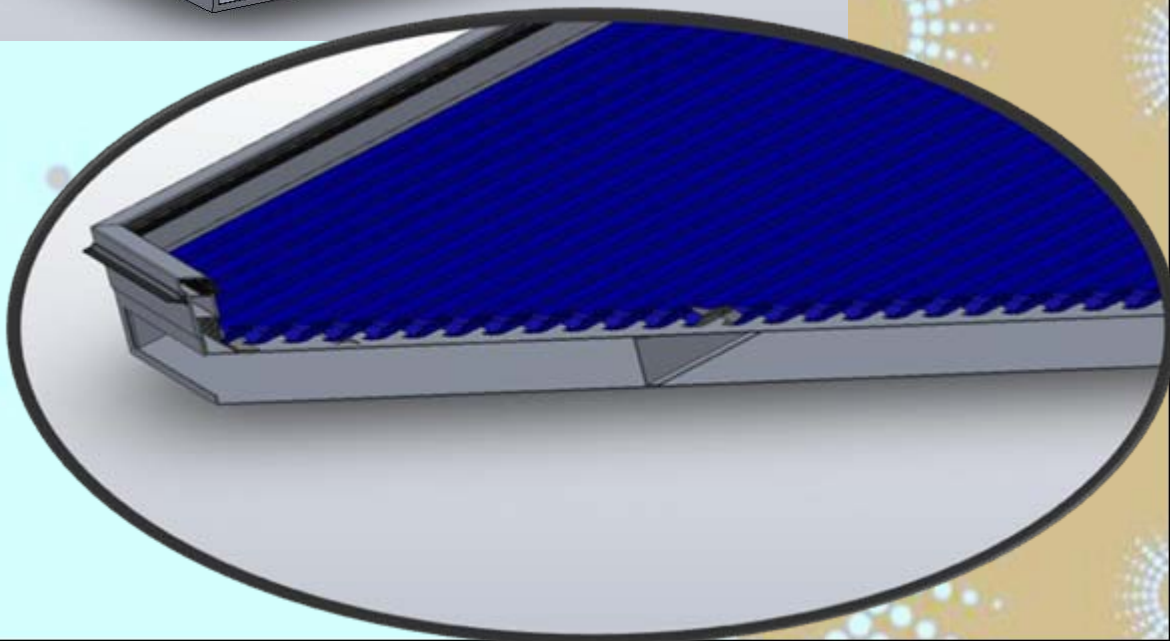
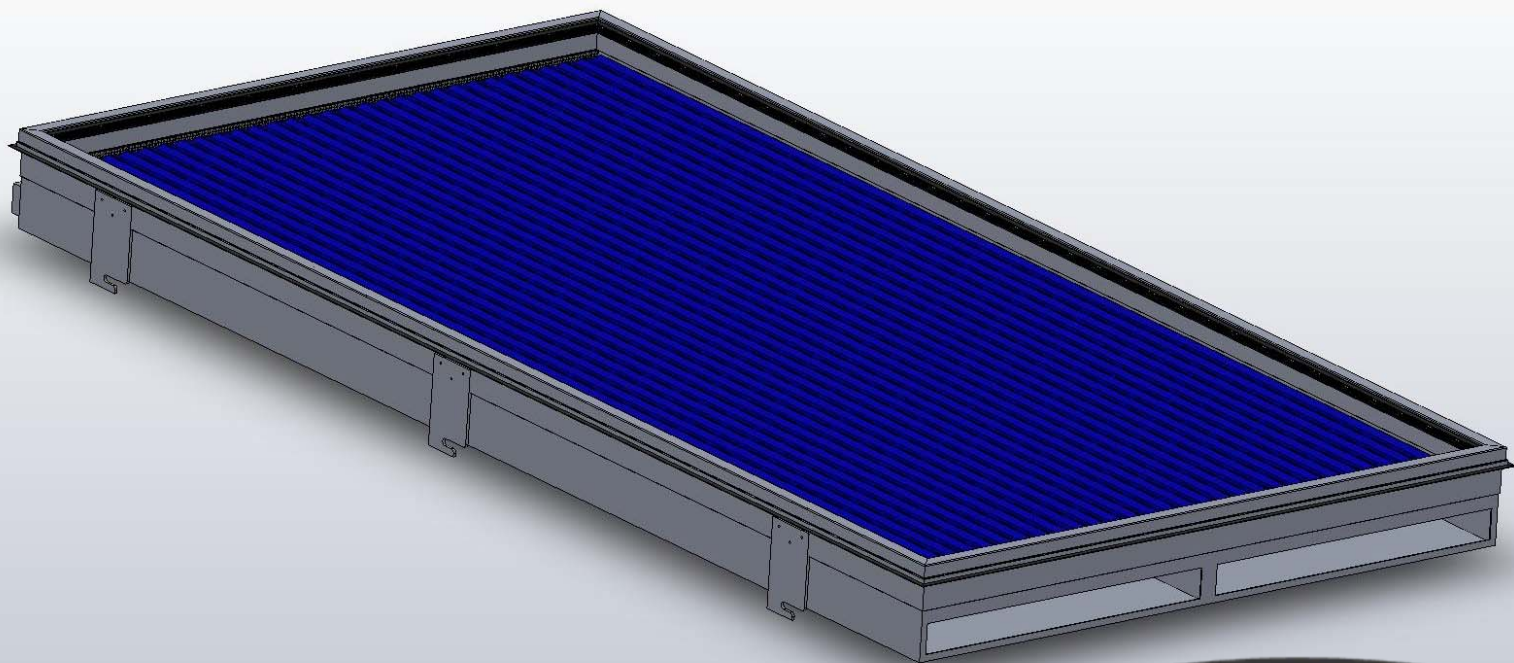
Tannery, Athens, Greece

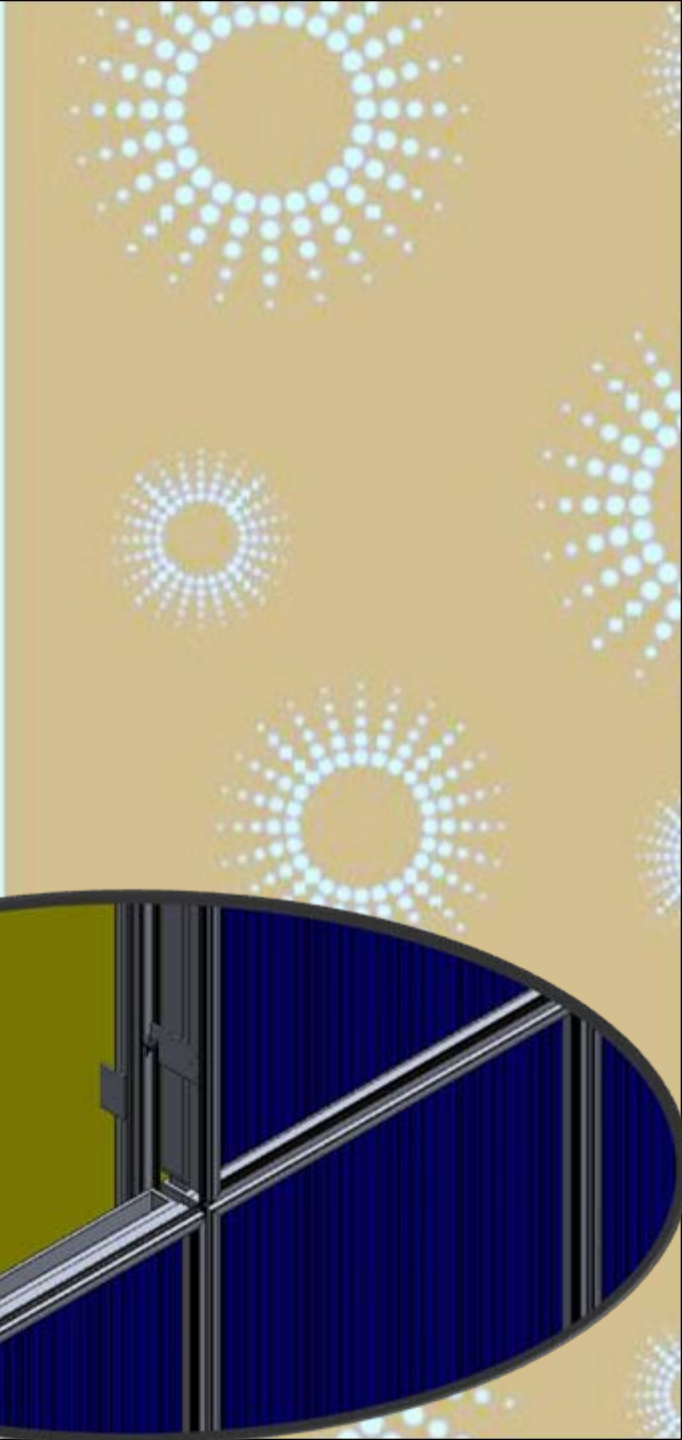
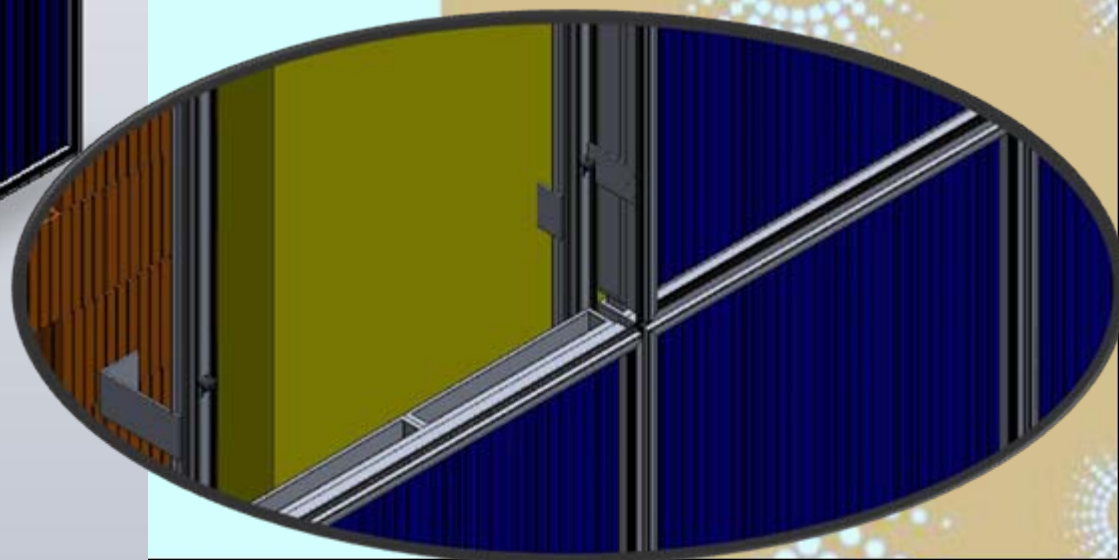
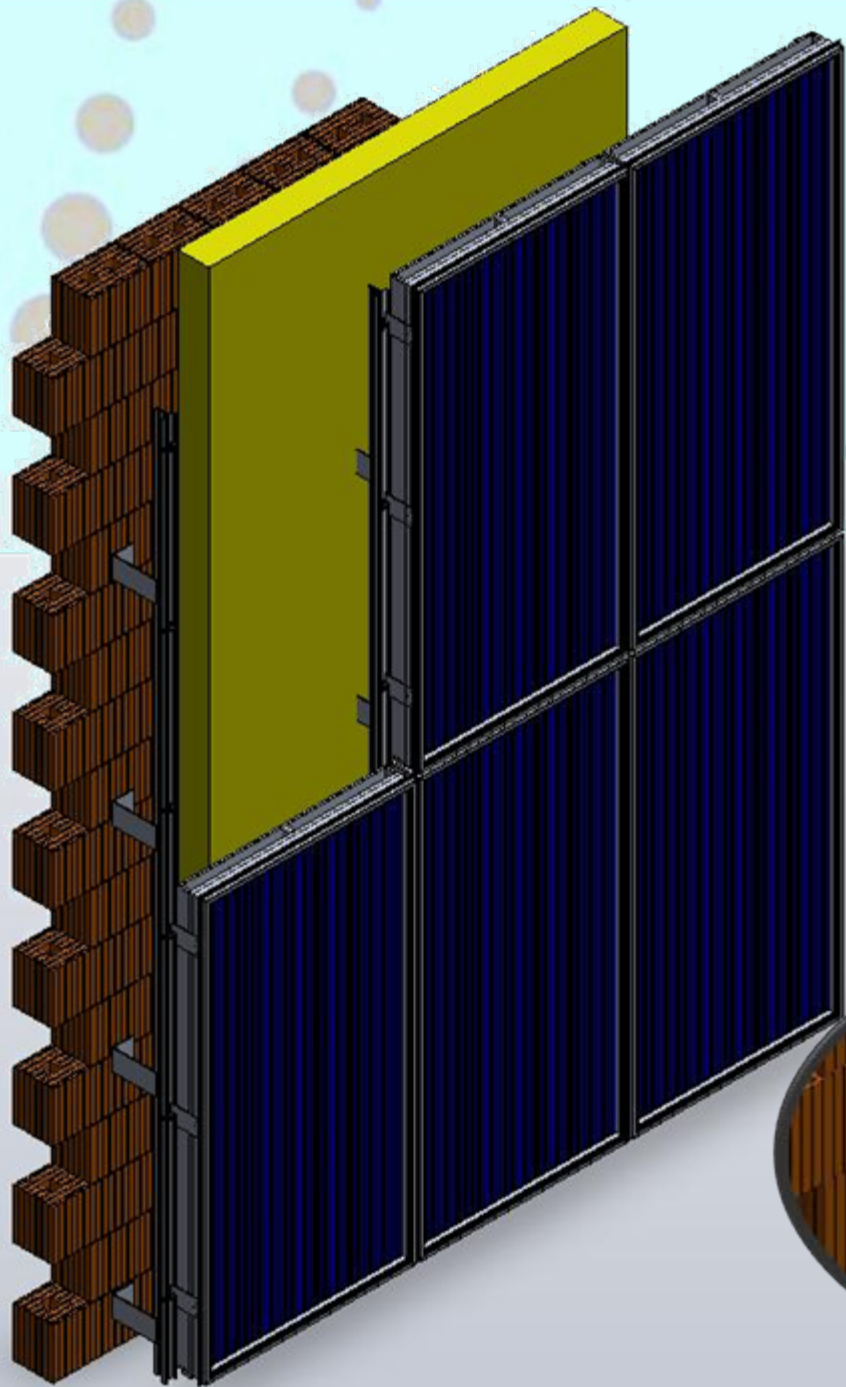
Use: Hot water for industrial processes (40 – 90 °C).



- Collector area: 308 m² (flat plate) , closed loop water circuit
- Fuel replaced: Natural gas







Selection of colors

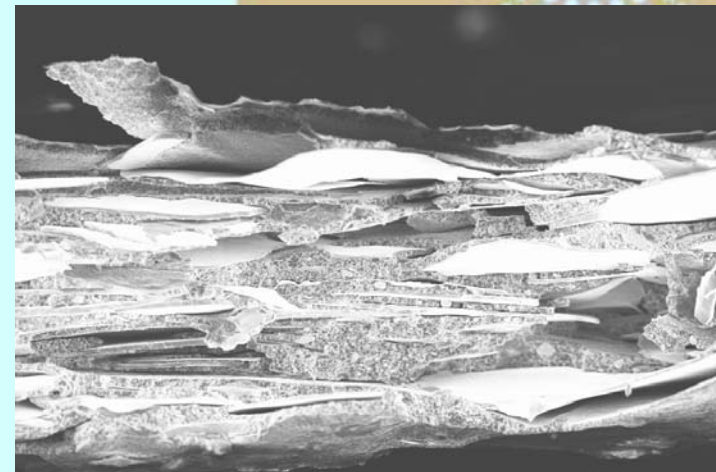
$e_T=0.45, a_s=0.87$

$e_T=0.30, a_s=0.90$



$e_T=0.34, a_s=0.80$

$e_T=0.34, a_s=0.82$

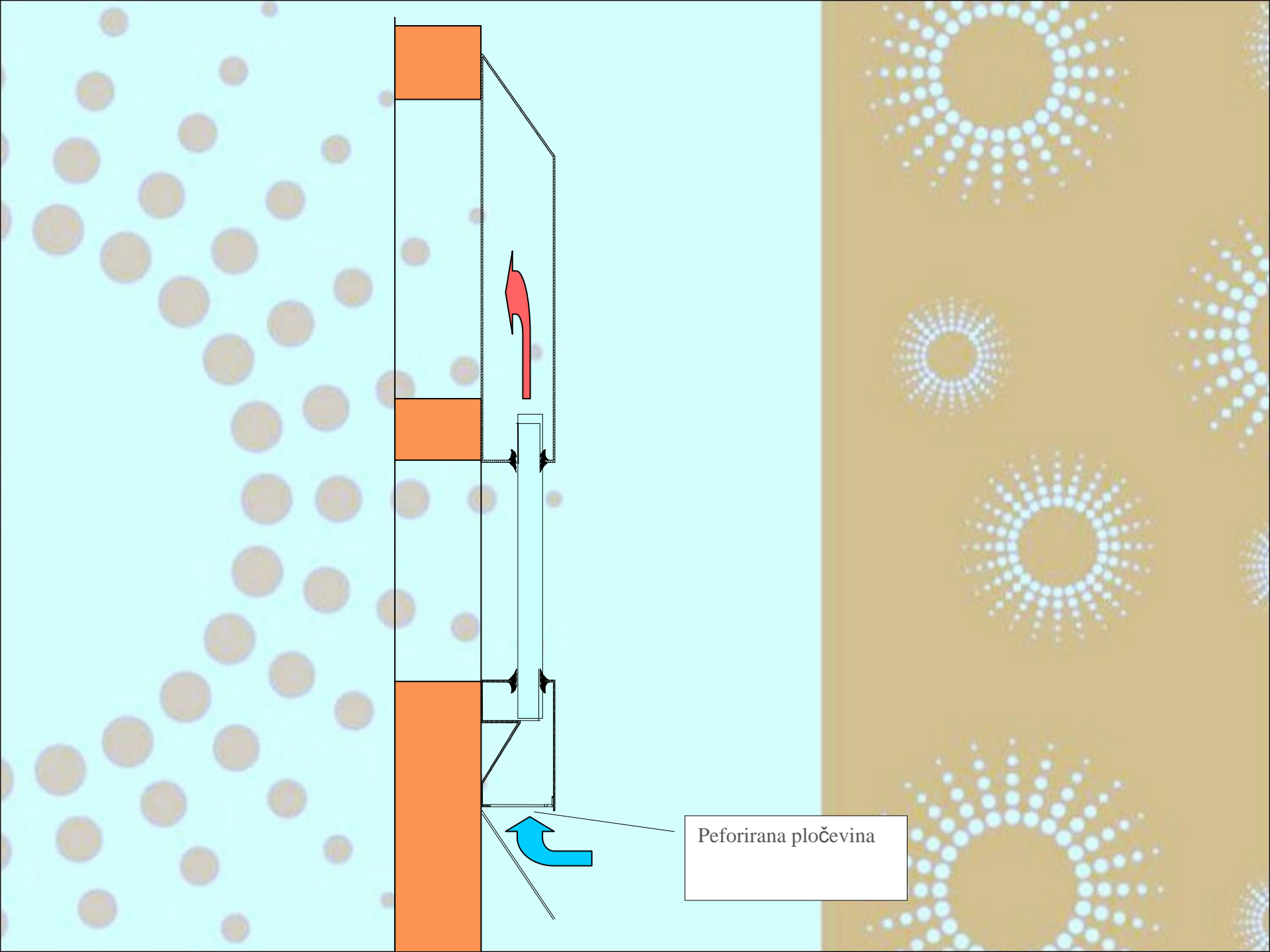


10 μm

EHT = 5.00 kV Signal A = InLens Mx Signal = 0.7924 Chamber = 3.09e-004 Pa
WD = 4 mm Aperture Size = 20.00 μm File Name = VZ6_007.tif

Date: 27 Aug 2007



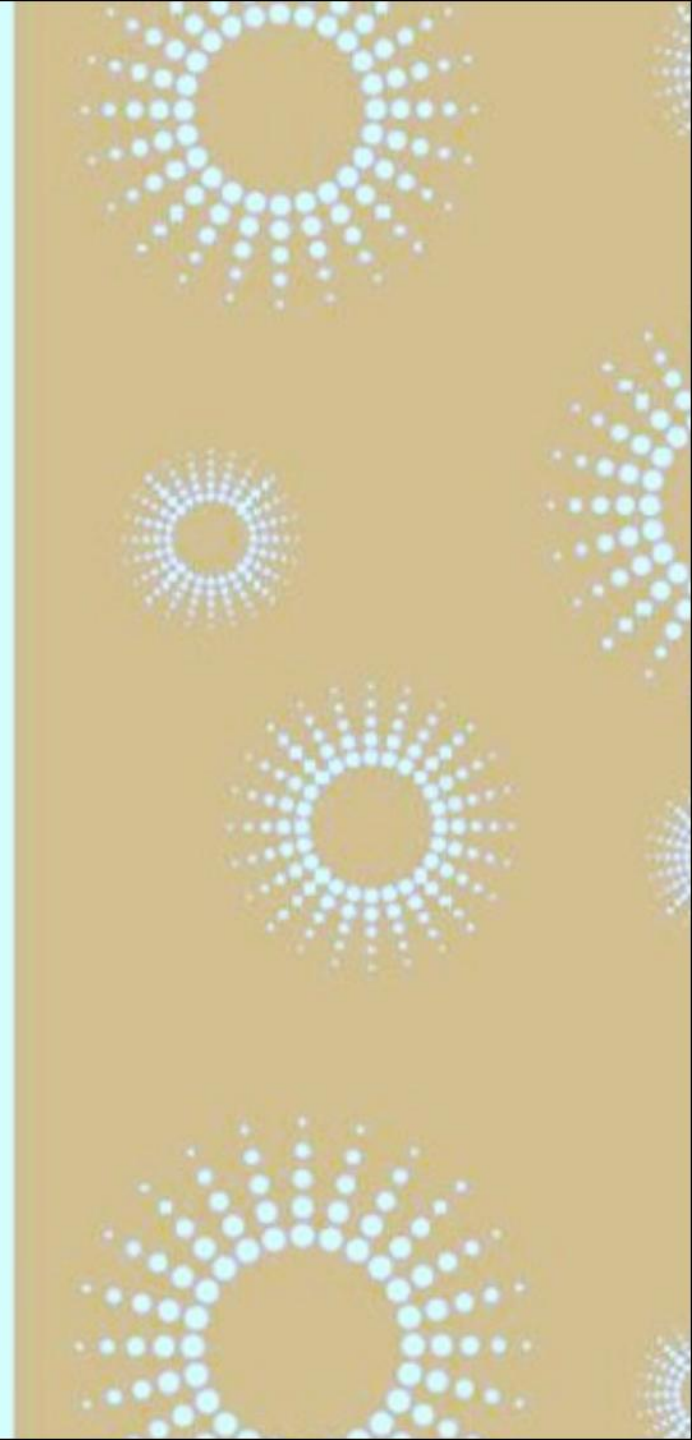
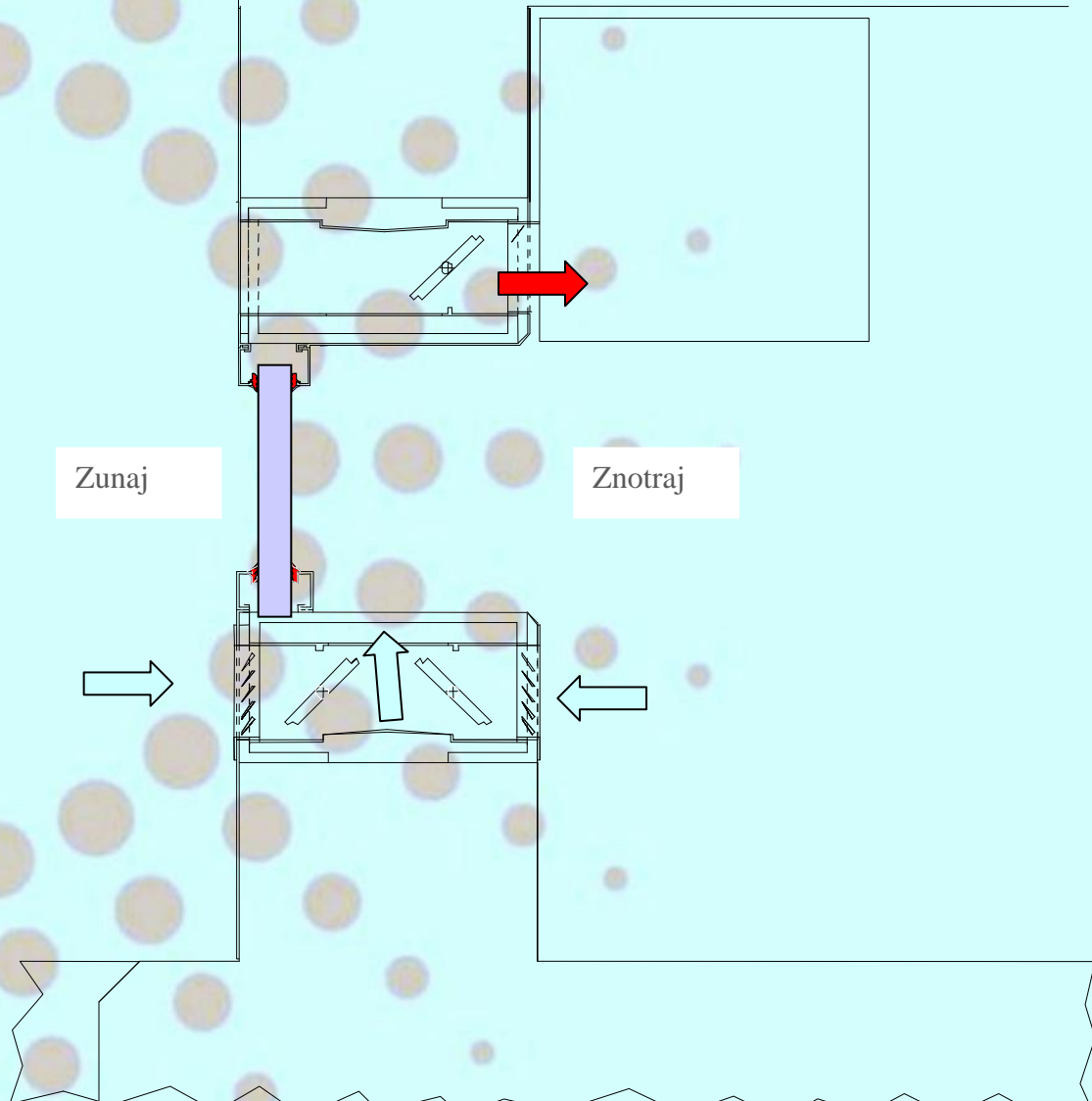



Peforirana pločevina


PRINCIP DELOVANJA


Zunaj


Znotraj



 Rotacijski izmenjevalec vlage


 Rotacijski toplotni izmenjevalec


 Ploščni rekuperator


 Regulacijska žaluzija

 Regulacijska žaluzija

 Ventilator


 Mešalna komora

 Toplotni izmenjevalec zrak voda

 Pršni vlažilec

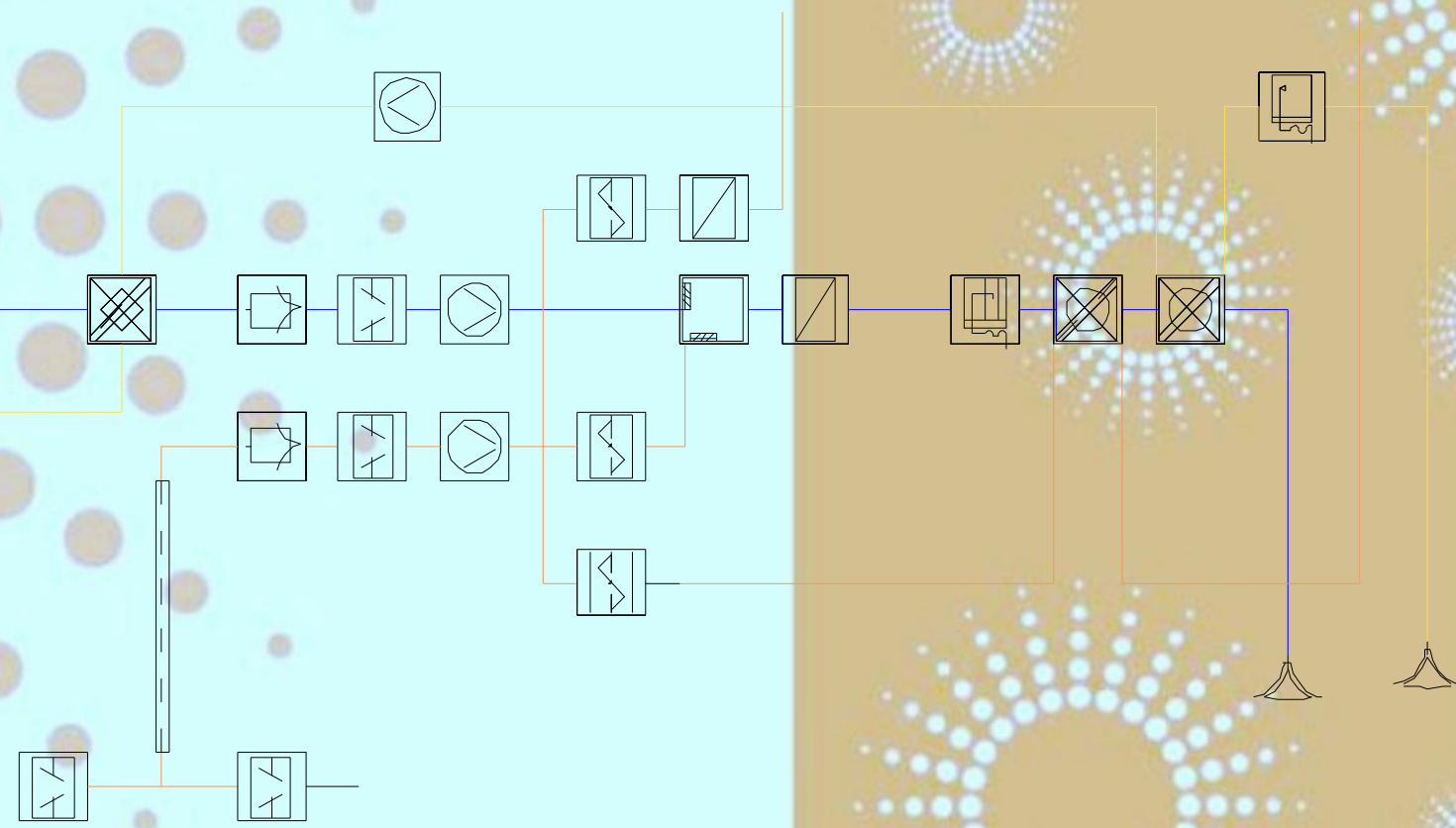
 Kontaktni vlažilec

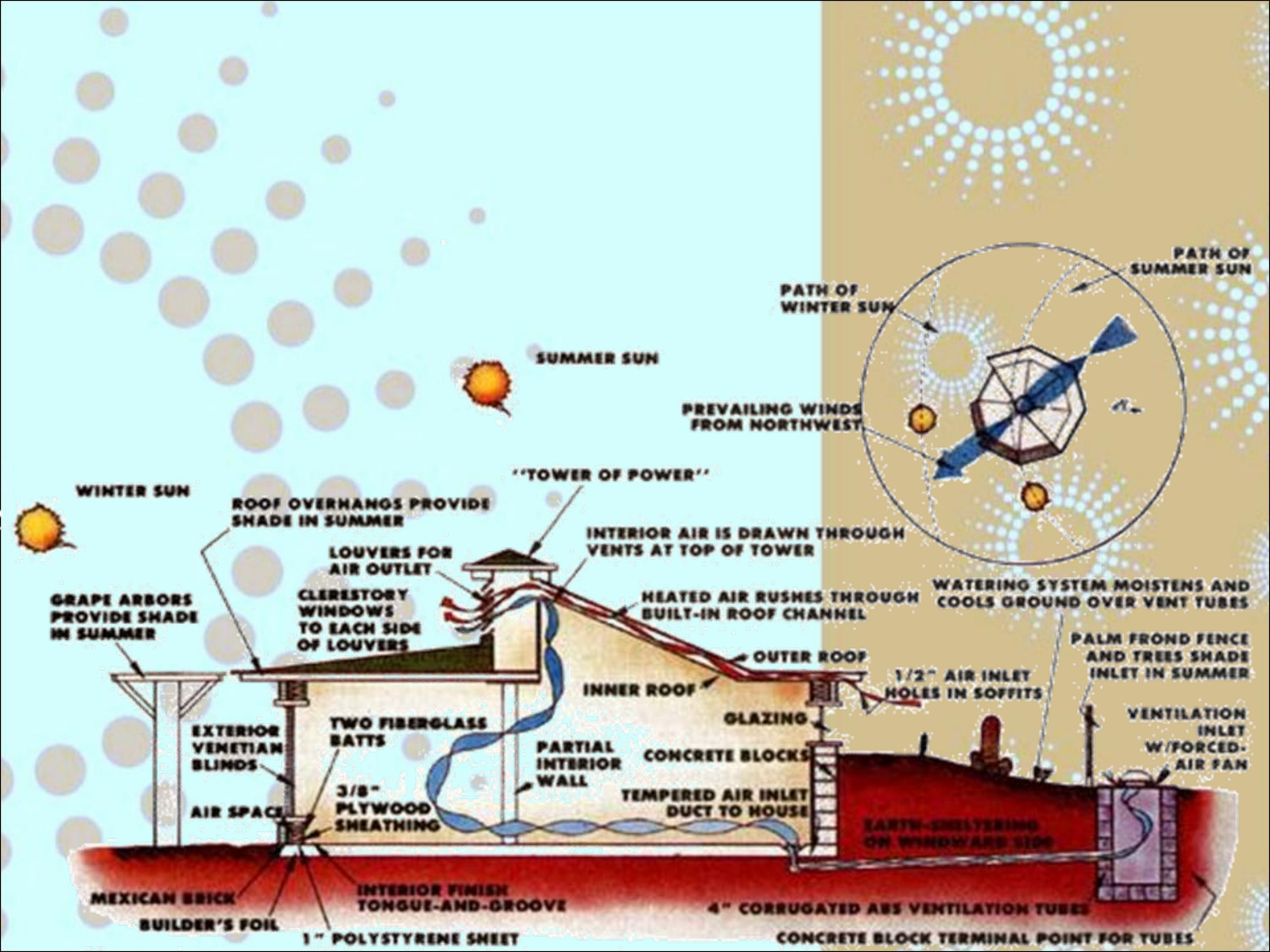
 Filter

 Sončni kolektor za ogrevanje zraka

 Difuzor

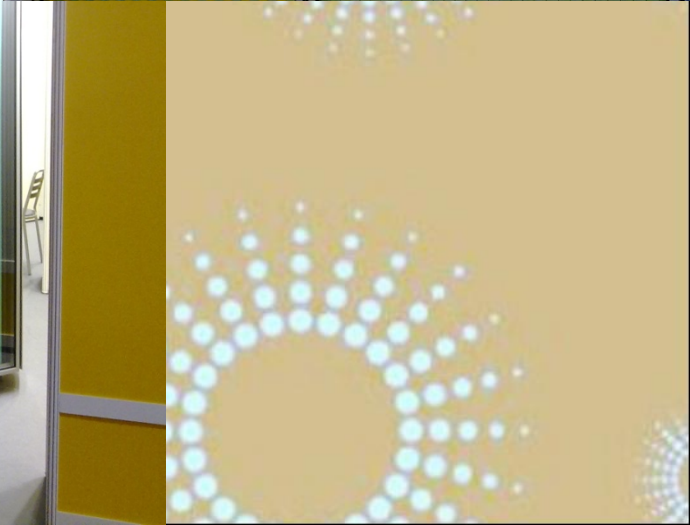
Centralni prezračevalni sistem z integriranim sistemom solarno podprtega hlajenja



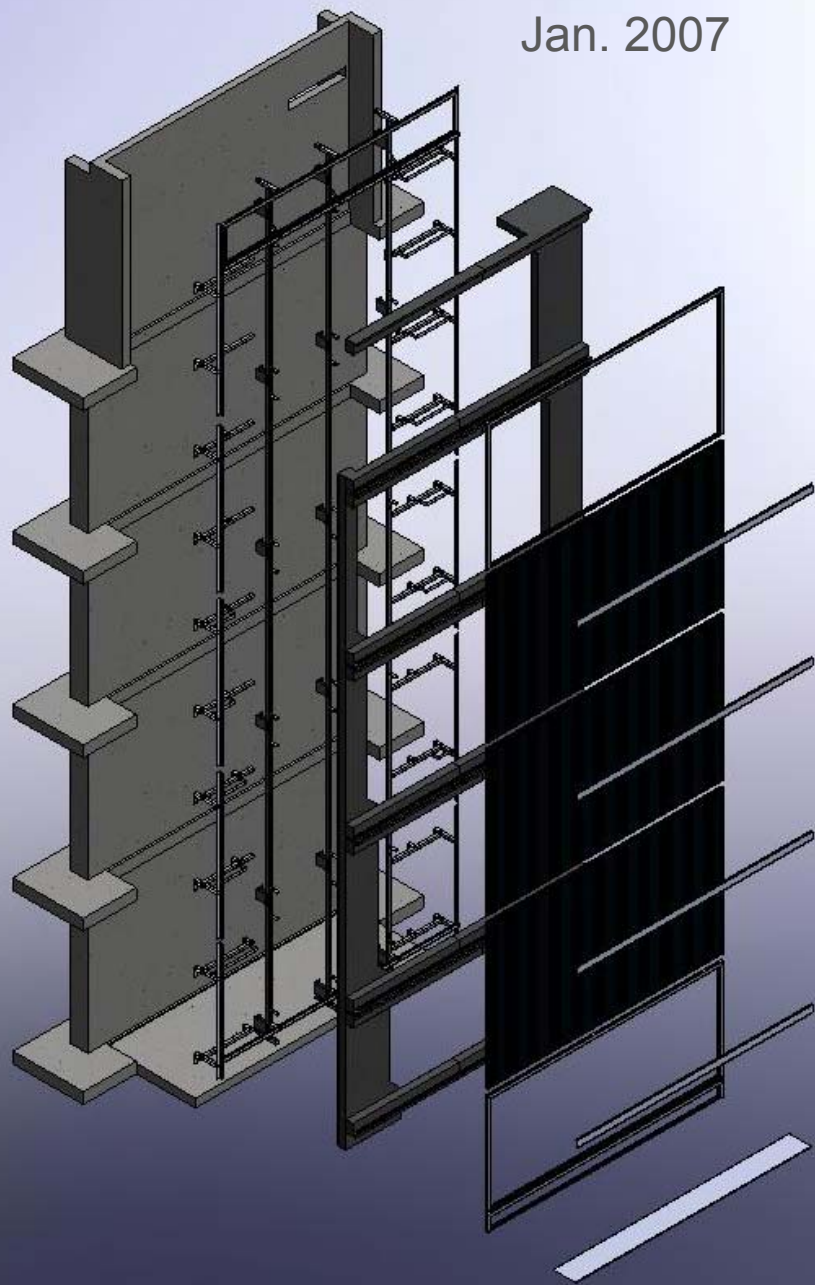


INTERSOLAR 2009





Jan. 2007



Project information

Project name	Tehnološki park II
Project location	Celje tehnopolis
Prepared by	STS
Project type	Heating
Technology	Solar air heater
Analysis type	Method 2
Heating value reference	Lower heating value (LHV)

Climate data location

Project location

Latitude	°N	46,1	46,1
Longitude	°E	15,3	15,3
Cooling design temperature	°C	23,7	
Earth temperature amplitude	°C	20,1	

	Unit	Base case	Proposed case
Heating	MWh	73	0
Resource assessment		-	-
Solar tracking mode		Fixed	-
Slope	°	90,0	-
Azimuth	°	0,0	-
		Daily solar radiation - horizontal	Daily solar radiation - tilted
	Month	kWh/m²/d	kWh/m²/d
	January	1,39	2,59
	February	2,33	3,38
	March	3,36	3,29
	April	4,16	2,82
	May	5,02	2,68
	June	5,21	2,53
	July	5,37	2,69
	August	4,83	2,95
	September	3,53	2,93
	October	2,15	2,49
	November	1,44	2,42
	December	1,14	2,29
	Annual	3,33	2,75
Annual solar radiation - horizontal	MWh/m²	1,22	
Annual solar radiation - tilted	MWh/m²	1,00	

Solar air heater		
Type	Other	
Manufacturer	STS	
Model		
Solar collector area	m ²	88
Solar collector shading - season of use	%	0%
Solar collector efficiency	%	75,0%
Incremental fan power	W/m ²	
Electricity rate	€/kWh	

Heating system

Base case

Fuel type		Natural gas - m ³
Seasonal efficiency		70%
Fuel consumption - annual	m ³	11.022,8
Fuel rate	€/m ³	0,400
Fuel cost	€	4.409

Percent of month used

Month	
January	100%
February	100%
March	100%
April	50%
May	25%
June	0%
July	0%
August	0%
September	25%
October	50%
November	100%
December	100%

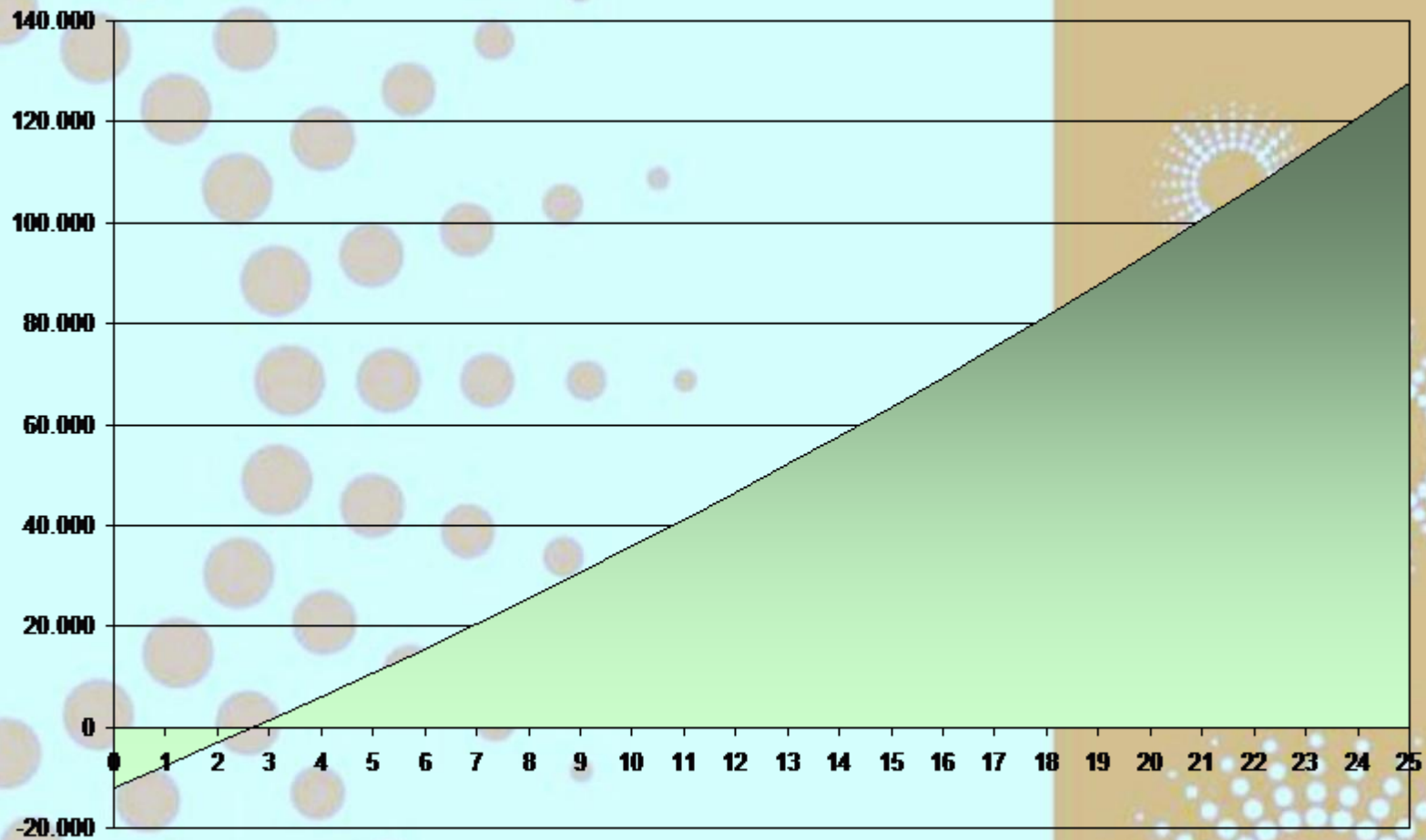
Base case system GHG summary (Baseline)

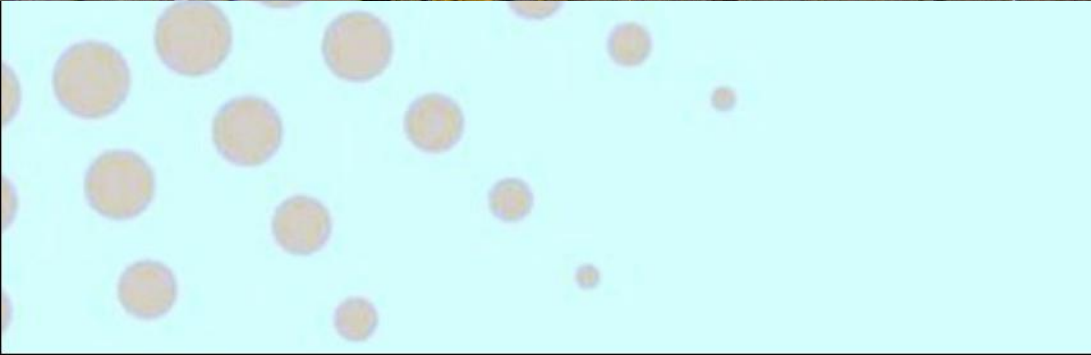
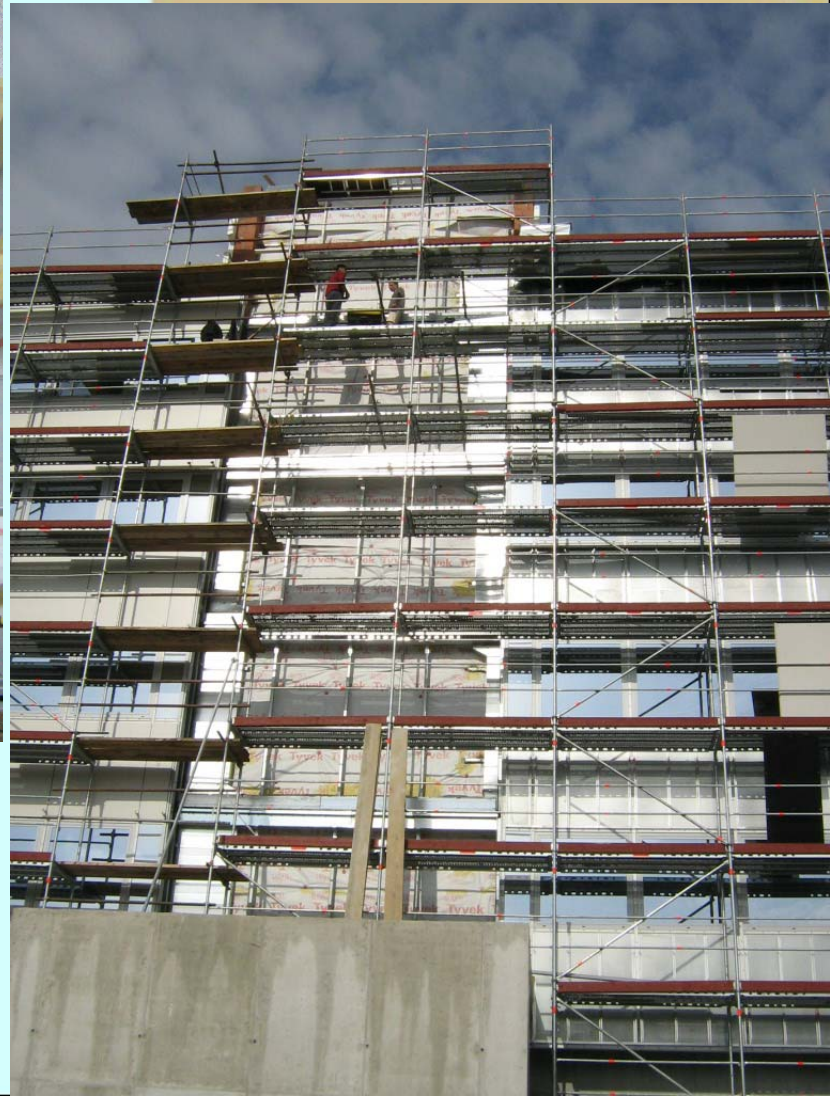
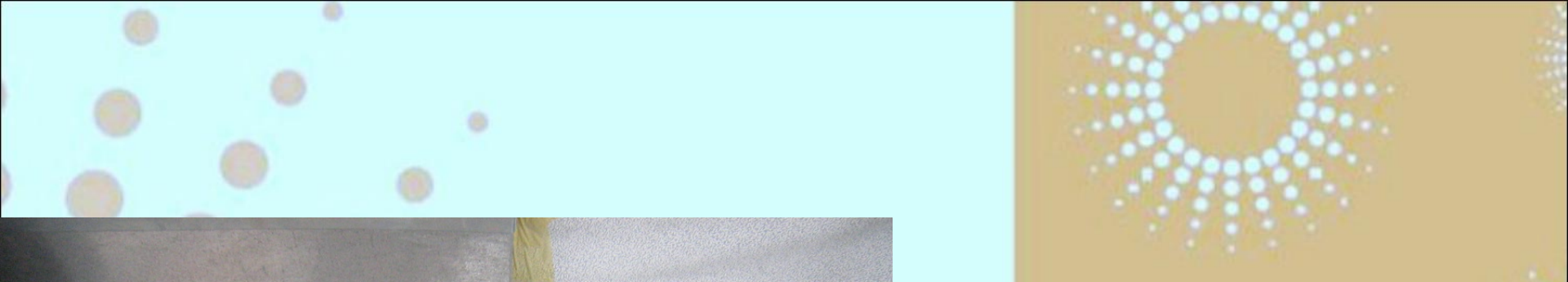
	Fuel mix	Fuel consumption	GHG emission factor	GHG emission
Fuel type	%	MWh	tCO2/MWh	tCO2
Natural gas	100,0%	104	0,197	21
Total	100,0%	104	0,197	21

GHG emission reduction summary

	Base case GHG emission	Proposed case GHG emission	Gross annual GHG emission reduction	Net annual GHG emission reduction
	t CO2	t CO2	t CO2	t CO2
Heating project	21	0	21	21
Net annual GHG emission reduction		20,5	8.335	Litres of gasoline not consumed

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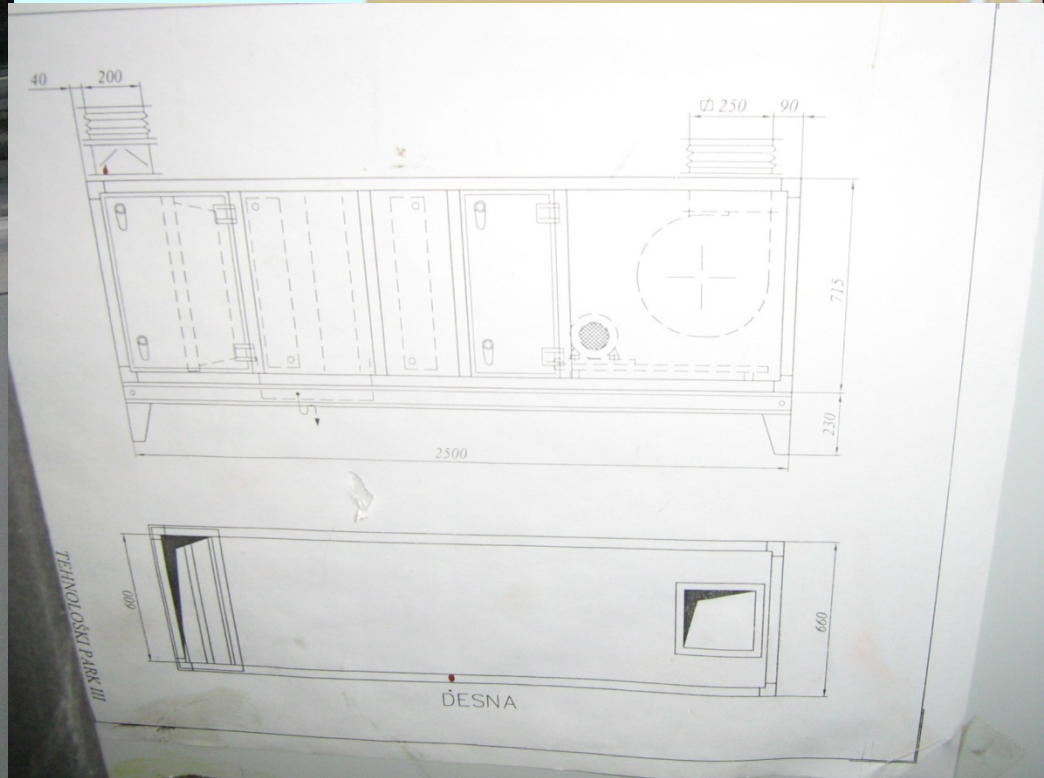
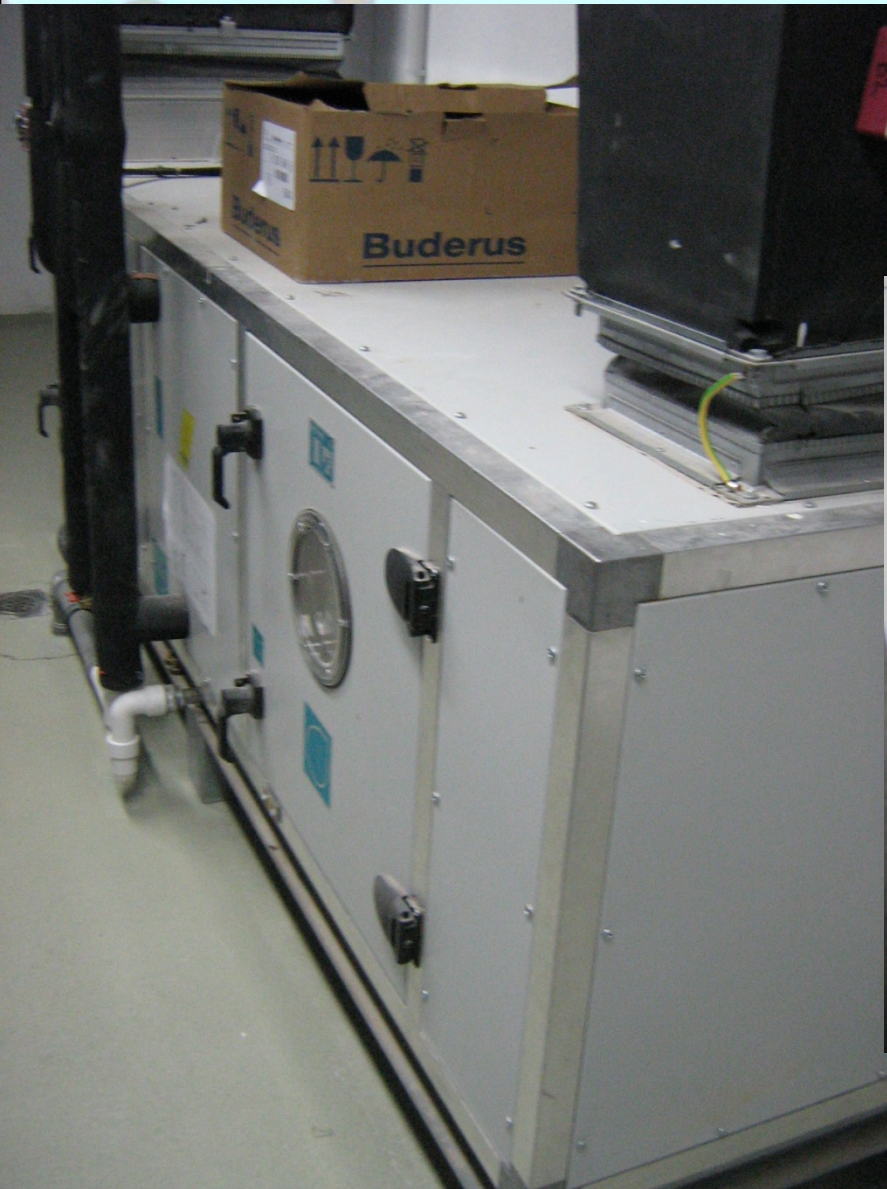




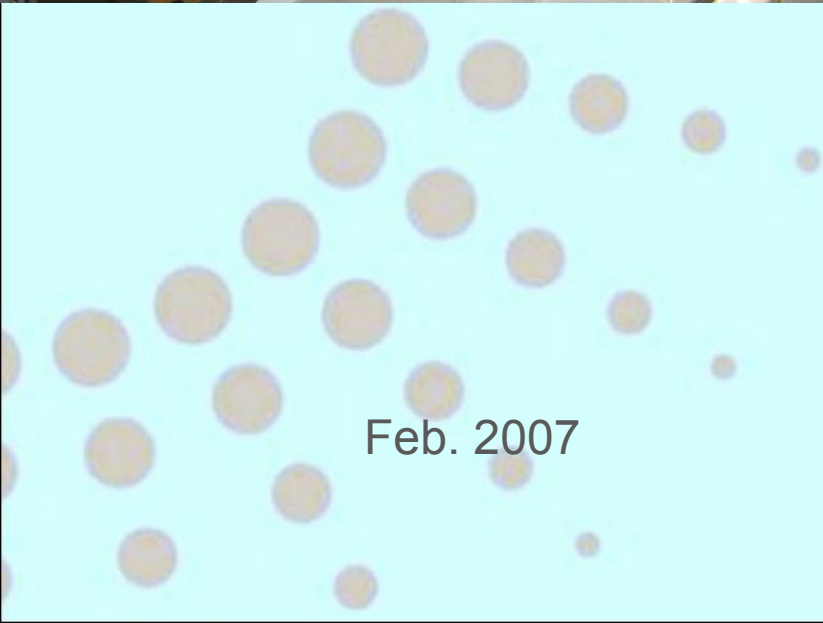
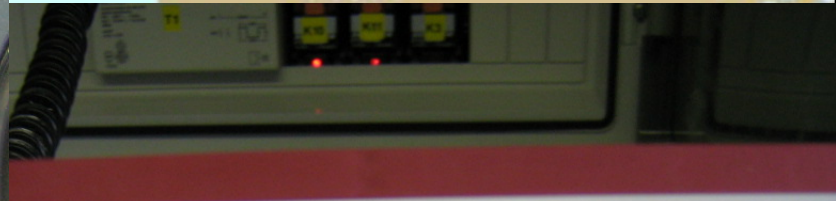
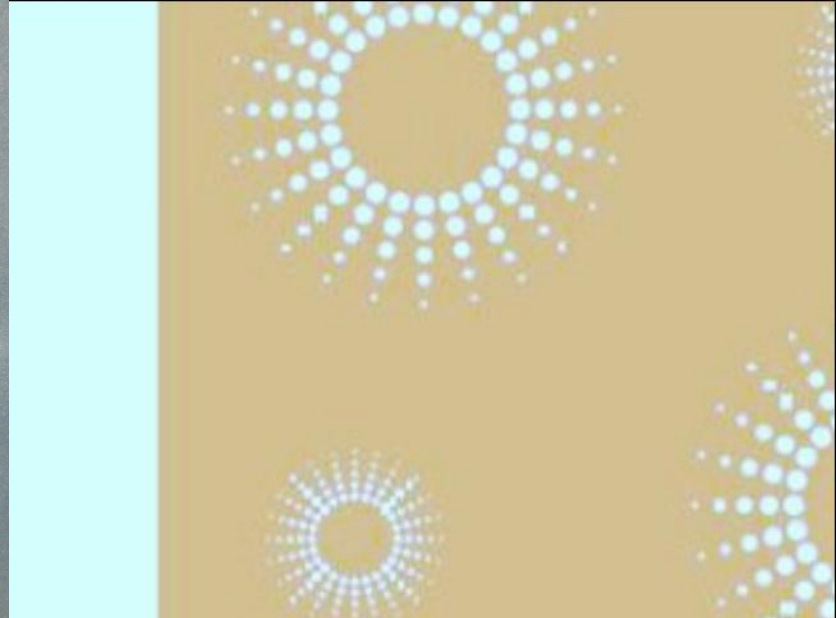




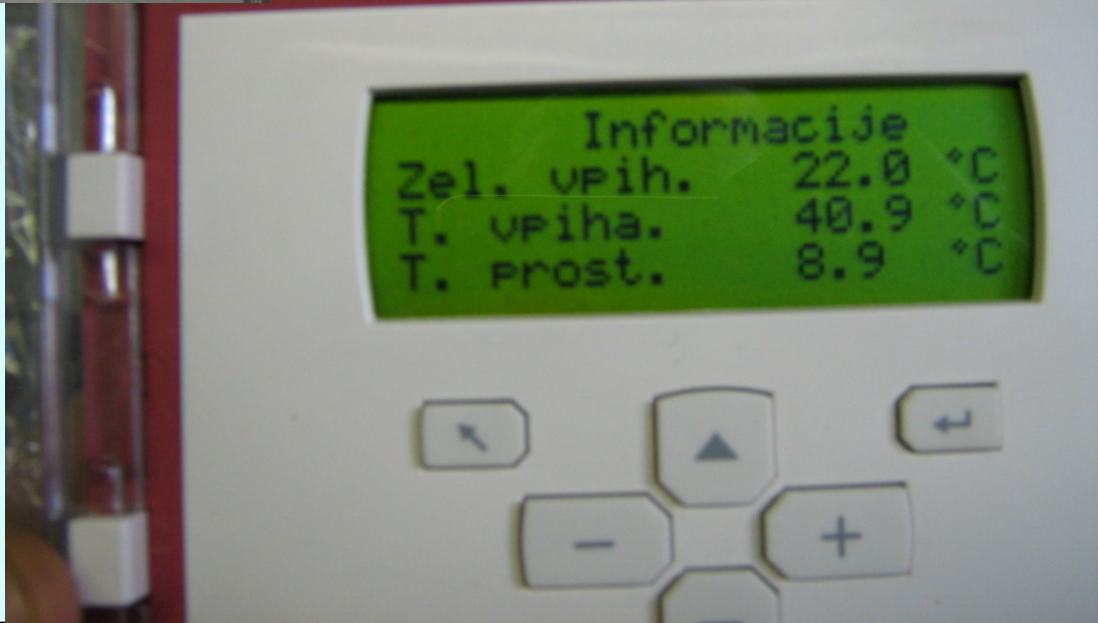








Feb. 2007



Site Conditions		Estimate
Project name		Recreation Centre
Project location		NWT, Canada
Nearest location for weather data		Fort Smith A, NT/NWT
Annual solar radiation (tilted surface)	MWh/m ²	1.10
Annual average temperature	°C	-3.0
Annual average wind speed	m/s	3.3



System Characteristics		Estimate
Heating application type	-	Ventilation air
Base Case Heating System		
Heating fuel type	-	Diesel (#2 oil)
Heating system seasonal efficiency	%	70%
Building		
Building type	-	Commercial
Maximum delivered air temperature	°C	17.0
RSI-value of building wall	m ² - °C/W	3.0
Airflow Requirements		
Design airflow rate	m ³ /h	9,000
Operating days per week	d/w	7.0
Operating hours per day	h/d	14.0
Solar Collector		
Design objective	-	High temperature rise
Collector colour	-	Dark Grey
Solar absorptivity	-	0.85
Suggested solar collector area	m ²	125
Solar collector area	m ²	150
Percent shading during season of use	%	0%
SAH fan flow rate	m ³ /h/m ²	60
Average air temperature rise	°C	8.9
Incremental fan power	W/m ²	0.0



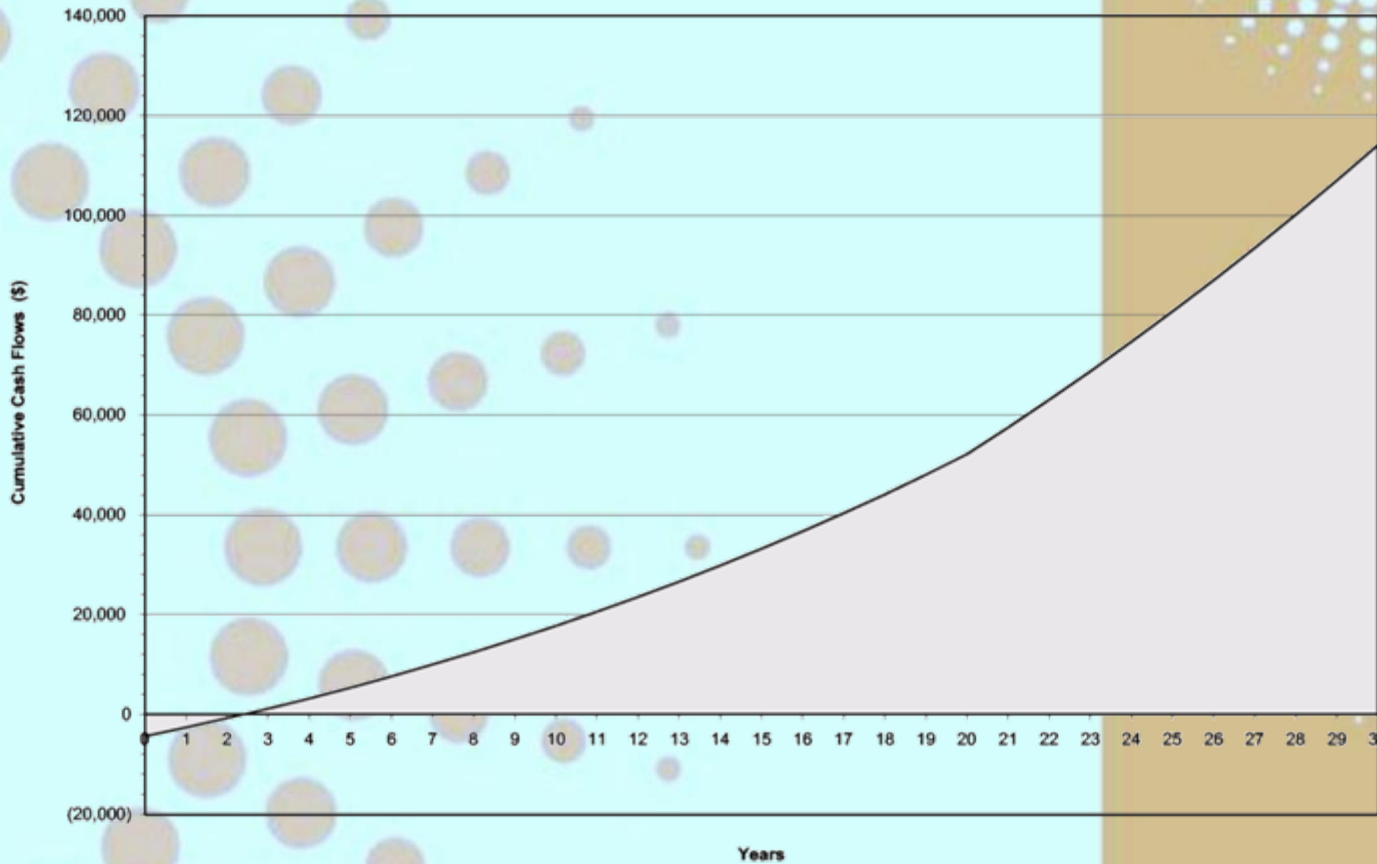
Annual Energy Production (9.0 months analysed)		Estimate
Incremental fan energy	MWh	0.0
Specific yield	kWh/m ²	430
Collector efficiency	%	52%
Solar availability while operating	%	68%
Renewable energy collected	MWh	59.1
Building heat loss recaptured	MWh	5.5
Renewable energy delivered	MWh	64.6
	GJ	232.4

SAH Project Cumulative Cash Flows Recreation Centre, NWT, Canada

Year-to-positive cash flow 2.4 yr

IRR and ROI 45.5%

Net Present Value \$ 25,407



GHG Emission Reduction Summary

	Base case GHG emission factor (t _{CO2} /MWh)	Proposed case GHG emission factor (t _{CO2} /MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t _{CO2})
Heating system	0.384	0.000	64.6	24.82
			Net GHG emission reduction	t _{CO2} /yr 24.82

Site Conditions**Estimate**

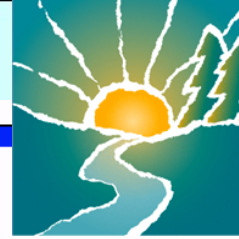
Project name		Apartment Building
Project location		Ontario, Canada
Nearest location for weather data		Windsor A, ON
Annual solar radiation (tilted surface)	MWh/m ²	1.15
Annual average temperature	°C	9.2
Annual average wind speed	m/s	4.6

**System Characteristics****Estimate**

Heating application type	-	Ventilation air
Base Case Heating System		
Heating fuel type	-	Natural gas
Heating system seasonal efficiency	%	67%
Building		
Building type	-	Residential
Maximum delivered air temperature	°C	30.0
RSI-value of building wall	m ² - °C/W	1.5
Airflow Requirements		
Design airflow rate	m ³ /h	23,000
Operating days per week	d/w	7.0
Operating hours per day	h/d	24.0
Solar Collector		
Design objective	-	High temperature rise
Collector colour	-	Dark Brown
Solar absorptivity	-	0.90
Suggested solar collector area	m ²	319
Solar collector area	m ²	335
Percent shading during season of use	%	0%
SAH fan flow rate	m ³ /h/m ²	69
Average air temperature rise	°C	8.2
Incremental fan power	W/m ²	0.0

**Annual Energy Production (9.0 months analysed)****Estimate**

Incremental fan energy	MWh	0.0
Specific yield	kWh/m ²	627
Collector efficiency	%	64%
Solar availability while operating	%	77%
Renewable energy collected	MWh	190.4
Building heat loss recaptured	MWh	19.5
Renewable energy delivered	MWh	209.9
	GJ	755.6



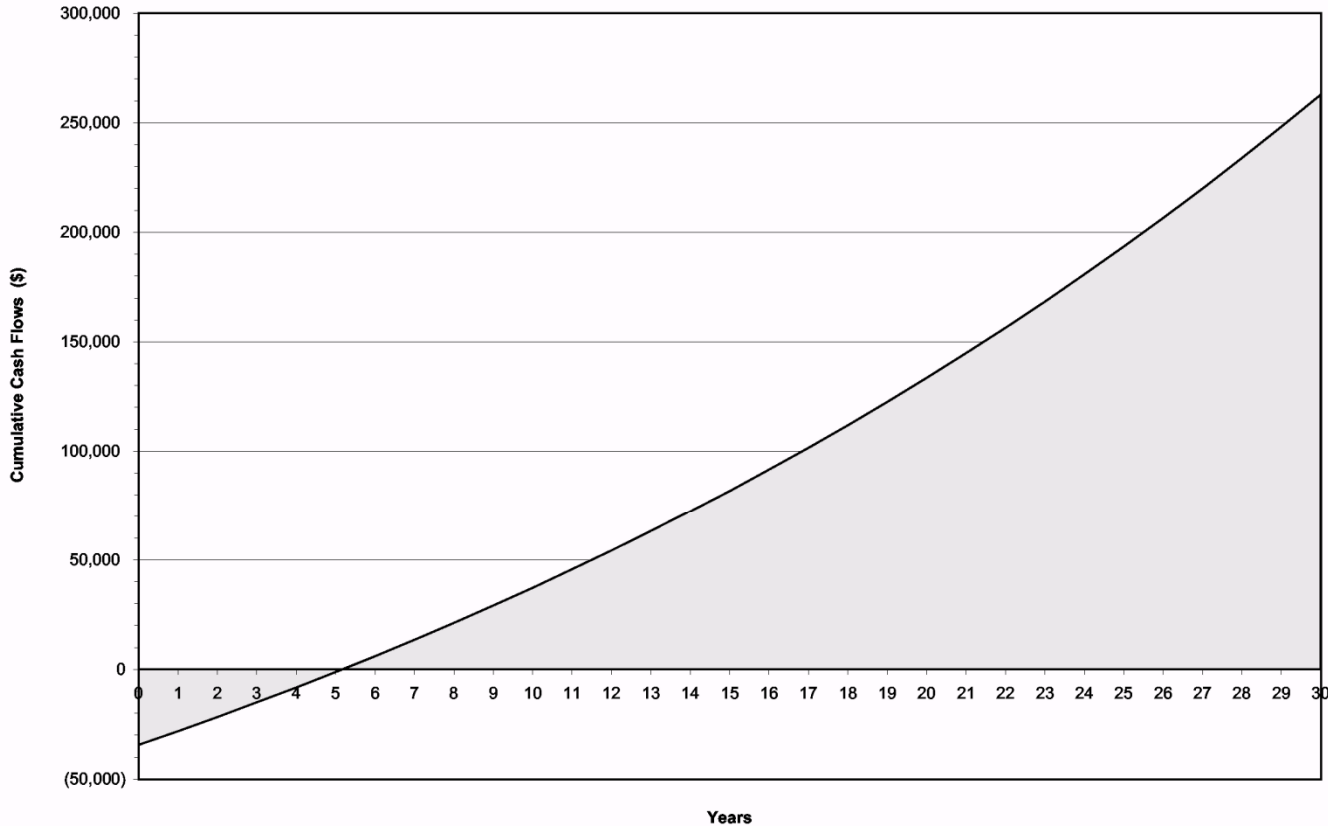
Cumulative Cash Flows Graph

SAH Project Cumulative Cash Flows
Apartment Building, Ontario, Canada

Year-to-positive cash flow 5.2 yr

IRR and ROI 21.1%

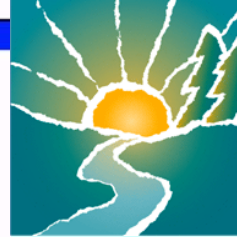
Net Present Value \$ 72,090



GHG Emission Reduction Summary

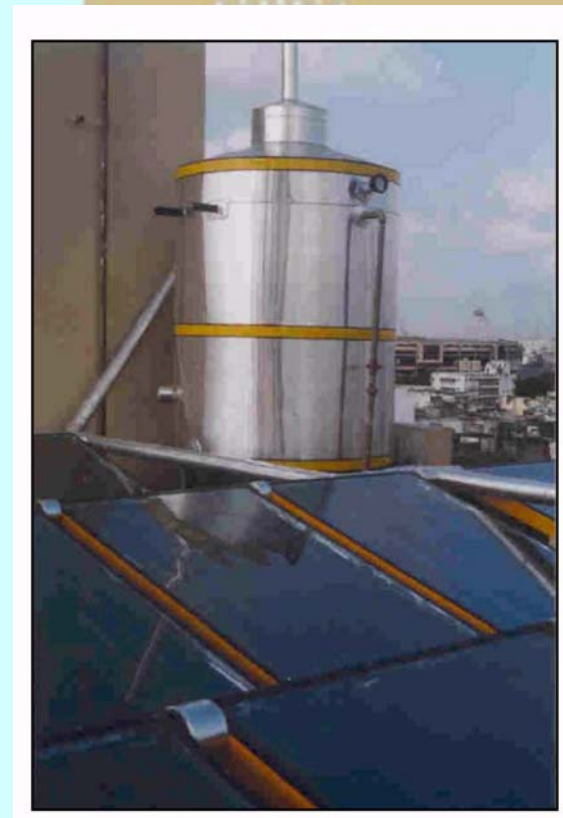
	Base case GHG emission factor (t _{CO2} /MWh)	Proposed case GHG emission factor (t _{CO2} /MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t _{CO2})
Heating system	0.303	0.000	209.9	63.69
			Net GHG emission reduction	t _{CO2} /yr 63.69

Site Conditions		Estimate
Project name		Hotel
Project location		Tamil Nadu, India
Nearest location for weather data		Madras/Minambakkam
Annual solar radiation (tilted surface)	MWh/m ²	1.99
Annual average temperature	°C	28.8
Annual average wind speed	m/s	2.4
Desired load temperature	°C	70
Hot water use	L/d	3,000
Number of months analysed	month	12.0
Energy demand for months analysed	MWh	52.67



System Characteristics		Estimate
Application type		Service hot water (with storage)
Base Case Water Heating System		
Heating fuel type	-	Electricity
Heating system seasonal efficiency	%	100%
Solar Collector		
Collector type	-	Glazed
Solar water heating collector manufacturer		Tata BP Solar India
Solar water heating collector model		TBPT 24M1
Area per collector	m ²	2.31
Fr (tau alpha) coefficient	-	0.69
Fr UL coefficient	(W/m ²)/°C	4.20
Suggested number of collectors		15
Number of collectors		14
Total collector area	m ²	32.3
Storage		
Ratio of storage capacity to coll. area	L/m ²	93.0
Storage capacity	L	3,004
Balance of System		
Heat exchanger/antifreeze protection	yes/no	No
Suggested pipe diameter	mm	19
Pipe diameter	mm	38
Pumping power per collector area	W/m ²	0
Piping and solar tank losses	%	1%
Losses due to snow and/or dirt	%	2%
Horz. dist. from mech. room to collector	m	5
# of floors from mech. room to collector	-	8

Annual Energy Production (12.00 months analysed)		Estimate
Pumping energy (electricity)	MWh	0.00
Specific yield	kWh/m ²	790
System efficiency	%	40%
Solar fraction for months analysed	%	48%
Renewable energy delivered	MWh	25.50
	GJ	91.8





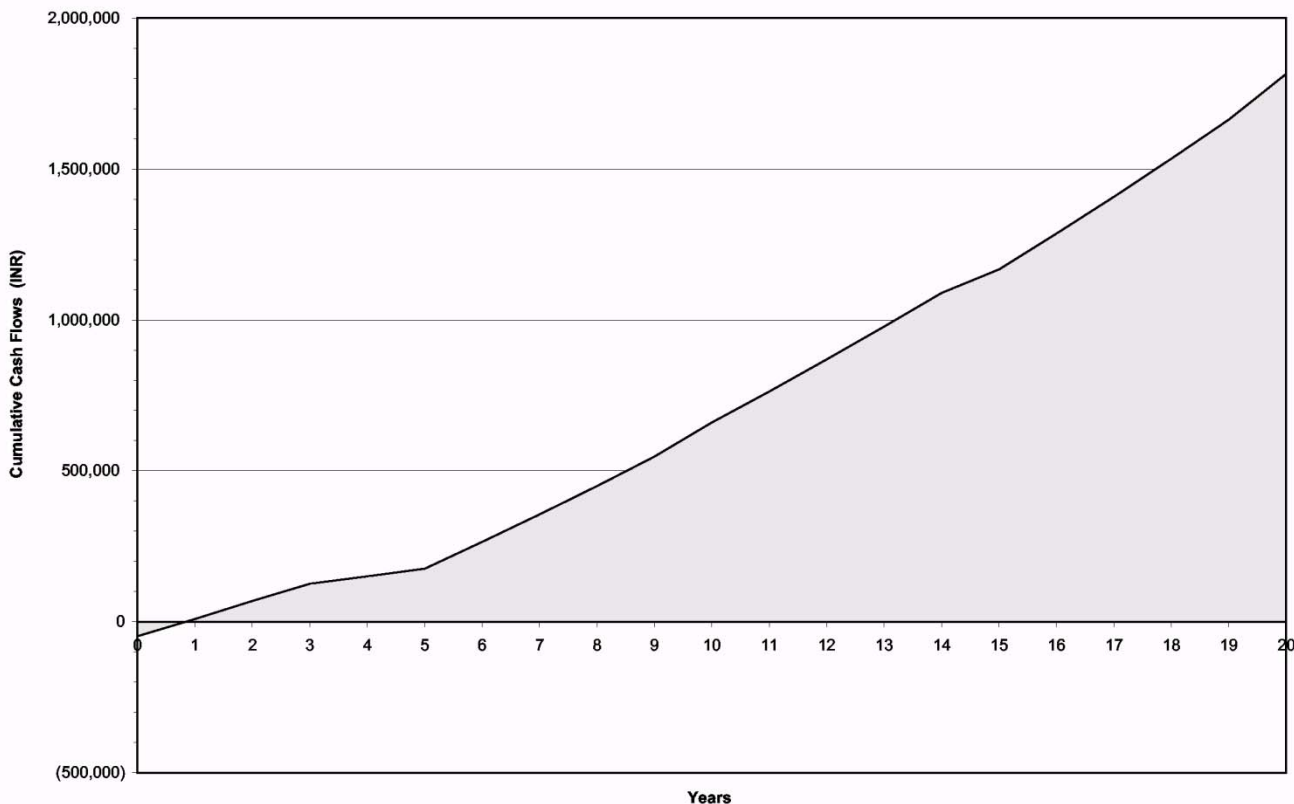
Cumulative Cash Flows Graph

**SWH Project Cumulative Cash Flows
Hotel, Tamil Nadu, India**

Year-to-positive cash flow 0.8 yr

IRR and ROI 118.9%

Net Present Value INR 520,722



GHG Emission Reduction Summary

	Base case GHG emission factor (t _{CO2} /MWh)	Proposed case GHG emission factor (t _{CO2} /MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t _{CO2})
Heating system	0.534	0.000	25.50	13.62
Net GHG emission reduction t _{CO2} /yr				13.62

Site Conditions		Estimate
Project name	All-Season Swimming Pool	
Project location	Okotoks, Alberta	
Nearest location for weather data	Calgary Int'l. A, AB	
Annual solar radiation (tilted surface)	MWh/m ²	1.79
Annual average temperature	°C	3.9
Annual average wind speed	m/s	4.4
Desired load temperature	°C	29
Number of months analysed	month	12.0
Energy demand for months analysed	MWh	677.93



System Characteristics		Estimate
Application type	Swimming pool (indoor)	
Base Case Water Heating System		
Heating fuel type	-	Natural gas
Heating system seasonal efficiency	%	60%
Solar Collector		
Collector type	-	Glazed
Solar water heating collector manufacturer	Thermo Dynamics	
Solar water heating collector model	G32	
Area per collector	m ²	3.00
Fr (tau alpha) coefficient	-	0.74
Fr UL coefficient	(W/m ²)/°C	5.25
Suggested number of collectors	94	
Number of collectors	100	
Total collector area	m ²	300.0
Balance of System		
Heat exchanger/antifreeze protection	yes/no	Yes
Heat exchanger effectiveness	%	80%
Suggested pipe diameter	mm	31
Pipe diameter	mm	35
Pumping power per collector area	W/m ²	8
Piping and solar tank losses	%	3%
Losses due to snow and/or dirt	%	3%
Horz. dist. from mech. room to collector	m	15
# of floors from mech. room to collector	-	1



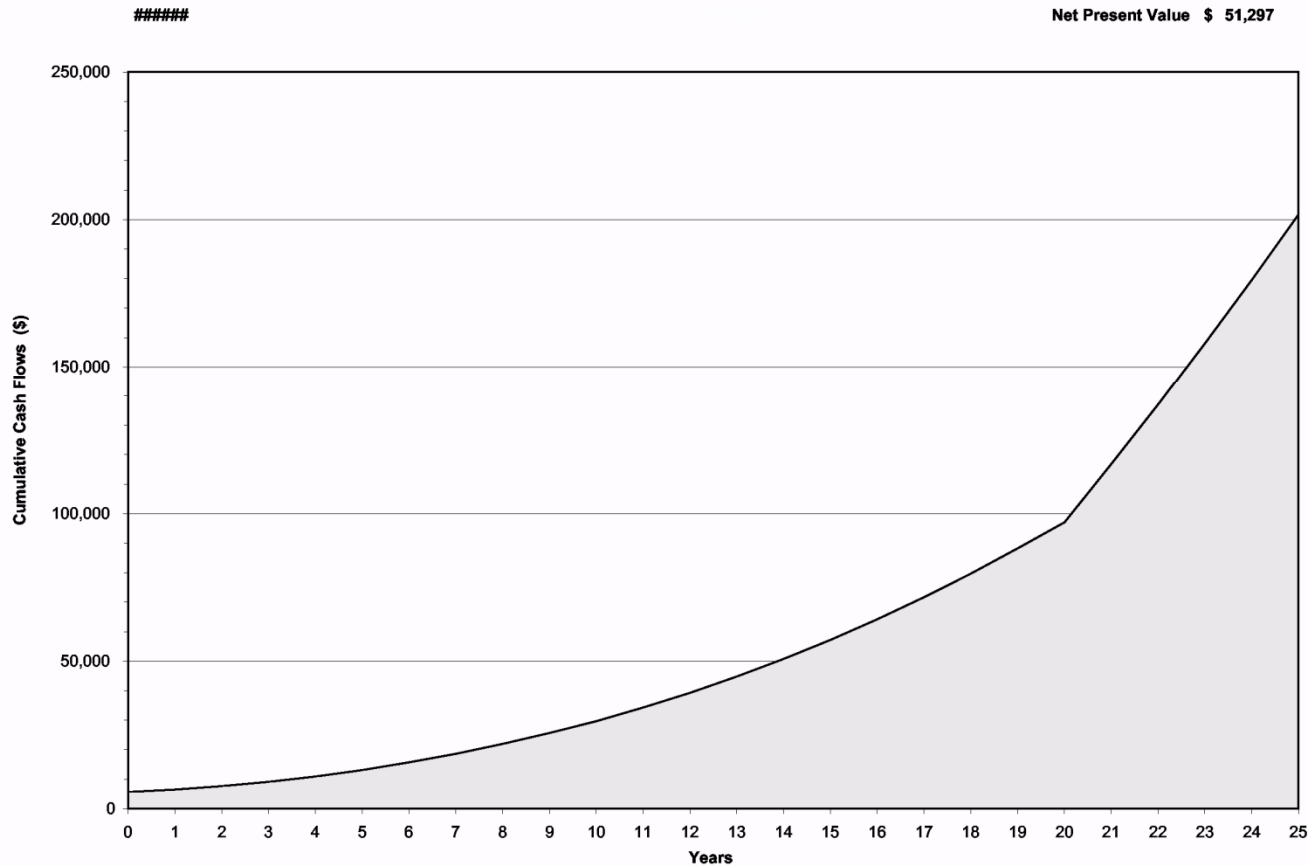
Annual Energy Production (12.00 months analysed)		Estimate
Pumping energy (electricity)	MWh	5.61
Specific yield	kWh/m ²	787
System efficiency	%	44%
Solar fraction for months analysed	%	35%
Renewable energy delivered	MWh	236.24
	GJ	850.45



Cumulative Cash Flows Graph

**SWH Project Cumulative Cash Flows
All-Season Swimming Pool, Okotoks, Alberta**

Net Present Value \$ 51,297



GHG Emission Reduction Summary

	Base case GHG emission factor (t _{CO2} /MWh)	Proposed case GHG emission factor (t _{CO2} /MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t _{CO2})
Heating system	0.339	0.024	236.24	74.49
Net GHG emission reduction t _{CO2} /yr				74.49



STS

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