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Subtask C
Concepts, Case Studies and Guidelines

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SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Subtask C: Concepts, Case Studies and Guidelines

Objectives:

- Develop concepts and principles for high quality architectural integration of solar energy systems.
- Develop building concepts that utilize solar energy, achieving high quality architecture, sustainable solutions, attractive indoor climate and high energy performance.
- Develop knowledge and strategies to promote and implement high quality architecture using solar energy.

Subtask C: Concepts, Case Studies and Guidelines

Means:

- Collect buildings high quality architecture using solar energy and sort these into a set of typologies.
- Analyze such example buildings and document architectural quality, energy performance and indoor climate.
- Participate in the development of demonstration projects.
- Develop guidelines for communication process to increase use of solar energy
- Present results at international seminars.

Subtask C: Concepts, Case Studies and Guidelines

Results:

- Comprehensive collection of case studies of high quality architecture and energy efficient building designs including solar solutions for new build and renovation for various building types (housing, offices, schools, etc.)
- Communication Guidelines for architects to increase the use of cost effective solar energy solutions in building design

All Case Studies presented

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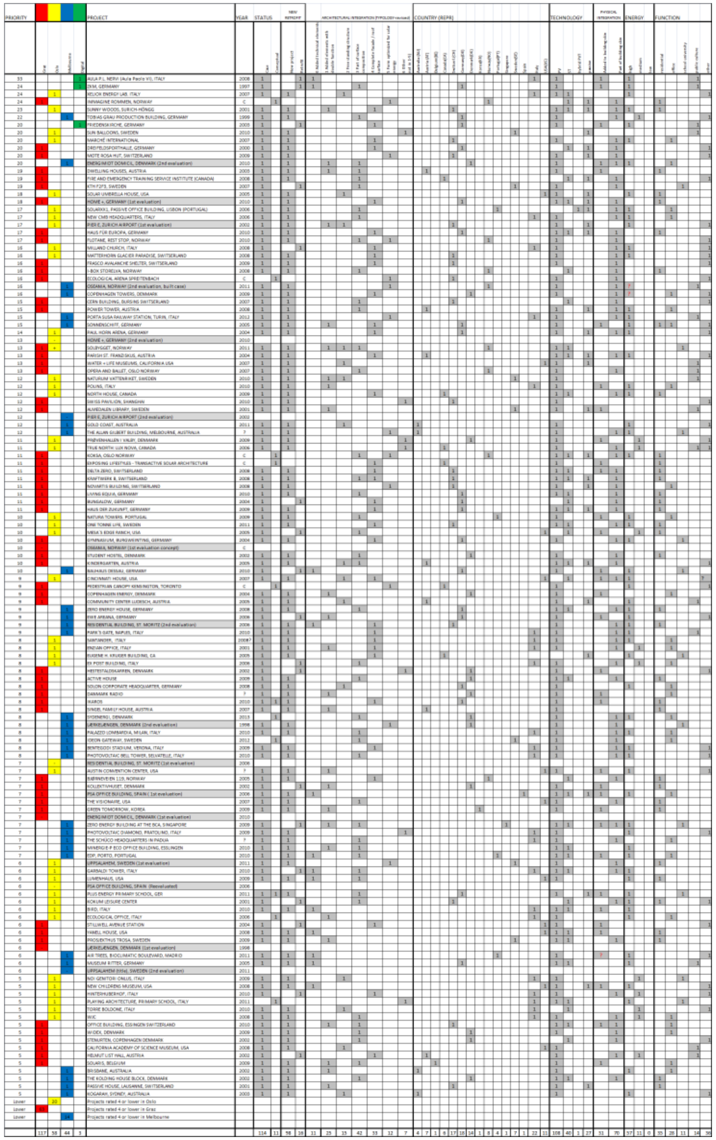

+ 222 projects presented

33 architects (T41) evaluated

Selected Case Studies

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PRIORITY	Graz	Oslo	Melbourne	Digital	PROJECT	YEAR	STATUS		NEW RETROFIT		ARCHITECTURAL INTEGRATION (TYPOLOGY-revised)							COUNTRY (REPR)															TECHNOLOGY				PHYSICAL INTEGRATION		ENERGY			FUNCTION				
							Case	Conceptual	New project	Retrofit	0 Added technical elements	1 Added elements with double function	2 Free standing structure	3 Part of surface composition	4 Complete facade / roof surface	5 Form optimized for solar energy	6 Other not in 1-5)	Australia (AU)	Austria (AT)	Belgium(BE)	Canada(CA)	Switserl.(CH)	Germany(DE)	Denmark(DK)	Korea(KR)	Norway(NO)	Portugal(PT)	Singapore (SI)	Sweden(SE)	Spain	Italy	USA(US)	PV	ST	hybrid PVT	passive	Added to building skin	Part of building skin	high	medium	low	residential	office	school university	public culture	other
33				1	AULA P.L. NERVI (Aula Paolo VI), ITALY	2008	1			1	1																				1		1				1		1						1	
24				1	ZKM, GERMANY	1997	1			1	1			1									1										1				1		1						1	
24		1			XELIOX ENERGY LAB. ITALY	2007	1		1				1																		1		1	1					1							1
24	1				IMMAGINE ROMMEN, NORWAY	C		1								1										1								1		1		1				1				
23		1			SUNNY WOODS, SURICH-HÖNGG	2001	1		1			1			1							1											1	1		1		1	1			1				
22			1		TOBIAS GRAU PRODUCTION BUILDING, GERMANY	1999	1		1					1									1										1					1		1						1
20				1	FRIEDENSKIRCHE, GERMANY	2003	1			1					1								1										1				1		1						1	
20		1			SUN BALLOONS, SWEDEN	2010	1		1								1												1							1									1	
20		1			MARCHÉ INTERNATIONAL	2007	1		1						1							1											1					1	1				1			
20	1				DREIFELDSPORTHALLE, GERMANY	2000	1		1						1								1											1		1		1								1
20	1				MOTE ROSA HUT, SWITZERLAND	2009	1		1							1						1											1			1		1								1
20			1		ENERGIMIDT DOMICIL, DENMARK (2nd evaluation)	2010	1		1			1		1										1									1				1	1	1				1			
19	1				DWELLING HOUSES, AUSTRIA	2003	1		1			1		1					1														1				1					1				
19	1				FIRE AND EMERGENCY TRAINING SERVICE INSTITUTE (CANADA)	2008	1		1					1							1													1		1		1								1
19	1				KTH F2F3, SWEDEN	2007	1			1				1															1				1					1						1		
18		1			SOLAR UMBRELLA HOUSE, USA	2005	1		1				1																			1	1			1			1			1				
18	1				HOME +, GERMANY (1st evaluation)	2010	1		1						1								1										1	1		1		1				1				
17		1			SOLARXX1, PASSIVE OFFICE BUILDING, LISBON (PORTUGAL)	2006	1		1					1													1						1	1		1		1	1				1			
17		1			NEW CMB HEADQUARTERS, ITALY	2006	1		1					1																	1		1					1	1				1			
17		1			PIER E, ZURICH AIRPORT (1st evaluation)	2002	1		1			1	1									1											1			1			1							1
17	1				HAUS FÜR EUROPA, GERMANY	2010	1		1						1								1										1	1		1		1				1				
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16		1			MATTERHORN GLACIER PARADISE, SWITSERLAND	2008	1		1						1							1											1					1	1							1
16	1				FRASCO AVALANCHE SHELTER, SWITSERLAND	2009	1		1						1							1											1					1								1
16	1				I-BOX STORELVA, NORWAY	2008	1		1					1												1								1				1				1				
16	1				ECOLOGICAL ARENA SPREITENBACH	C		1								1						1											1					1								1
16			1		OSEANIA, NORWAY (2nd evaluation, built case)	2011	1		1							1										1							1					1	?						1	
16			1		COPENHAGEN TOWERS, DENMARK	2009	1		1						1									1									1					1	?				1			1
15	1				CERN BUILDING, BURSINS SWITSERLAND	2007	1		1					1								1												1				1								1
15	1				POWER TOWER, AUSTRIA	2008	1		1					1					1														1			1		1	1				1			
15			1		PORTA SUSA RAILWAY STATION, TURIN, ITALY	2012	1		1							1															1		1					1	1						1	
15			1		SONNENSCHIFF, GERMANY	2005	1		1			1			1								1										1				1		1			1	1			1
14		1			PAUL HORN ARENA, GERMANY	2004	1		1						1								1										1			1		1	1							1
13		-			HOME +, GERMANY (2nd evaluation)	2010																																								
13	1				SOLBYGGET, NORWAY	2011	1		1			1	1	1												1							1	1										1		
13	1				PARISH ST. FRANZISKUS, AUSTRIA	2004	1		1						1				1														1	1		1		1	1							1
13	1				WATER + LIFE MUSEUMS, CALIFORNIA USA	2007	1		1				1																			1	1			1									1	
13	1				OPERA AND BALLET, OSLO NORWAY	2007	1		1					1												1							1					1							1	
12		1			NATURUM VATTENRIKET, SWEDEN	2010	1		1			1	1																1				1												1	
12		1			POLINS, ITALY	2010	1		1			1																			1		1				1		1				1			
12		1			NORTH HOUSE, CANADA	2009	1		1						1						1												1	1				1	1			1				
12	1				SWISS PAVILION, SHANGHAI	2010	1		1								1					1											1													1
12	1				ALMEDALEN LIBRARY, SWEDEN	2001	1		1			1																	1				1			1	1								1	
12			-		PIER E, ZURICH AIRPORT (2nd evaluation)	2002																																								
12			1		GOLD COAST, AUSTRALIA	2011	1		1				1					1															1						1							1
12			1		THE ALLAN GILBERT BUILDING, MELBOURNE, AUSTRALIA	?	1		1							1		1															1					1	1					1		
11		1			PRØVENHALLEN I VALBY, DENMARK	2009	1		1								1							1									1				1			1						1
11		1			TRUE NORTH: LUX NOVA, CANADA	2006	1		1								1				1												1					1		1					1	1
11	1				KOKSA, OSLO NORWAY	C		1						1		1										1							1	1		1		1	1			1				
11	1				EXPOSING LIFESTYLES - TRANSACTIVE SOLAR ARCHITECTURE	C		1							1						1												1				1					1				
11	1				DELTA ZERO, SWITSERLAND	2008	1		1						1							1											1	1			1	1				1				
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11	1				NOVARTIS BUILDING, SWITSERLAND	2008	1		1							1						1											1			1		1					1			
11	1				LIVING EQUIA, GERMANY	2010	1		1					1									1										1	1				1				1				
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11	1				HAUS DER ZUKUNFT, GERMANY	2009	1		1						1								1										1	1		1		1				1				
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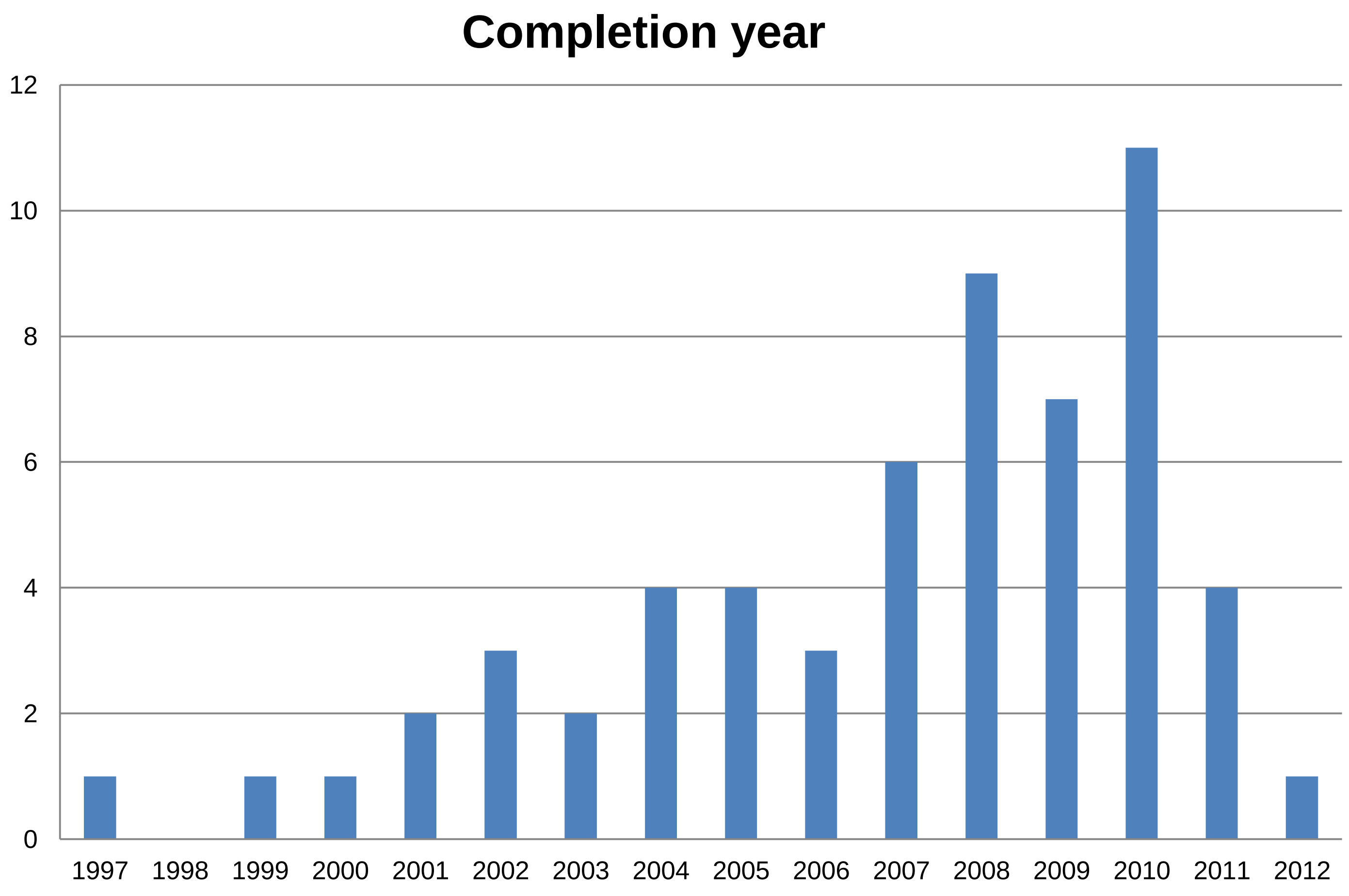
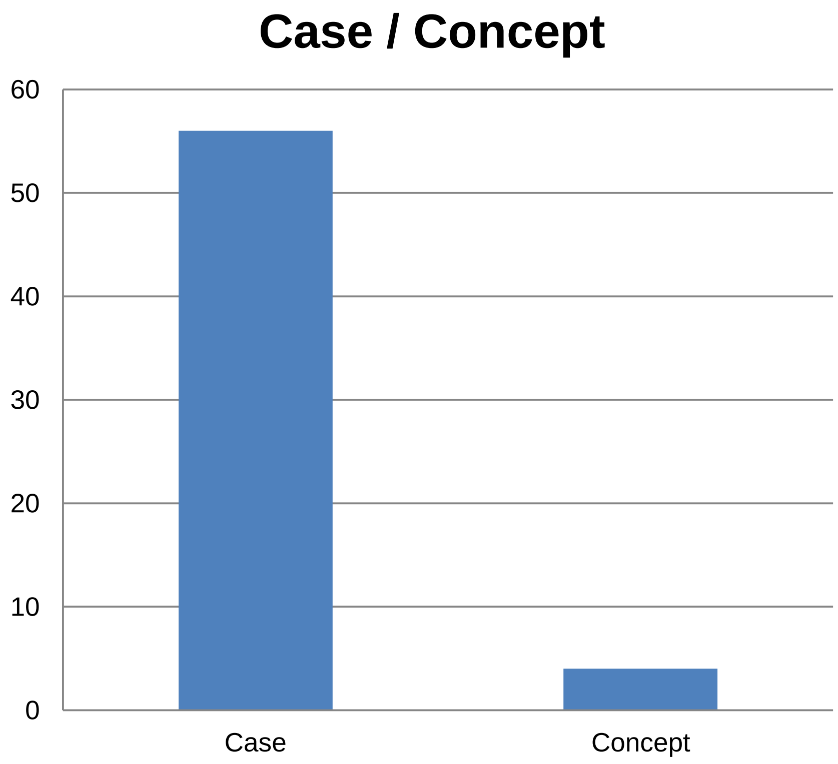
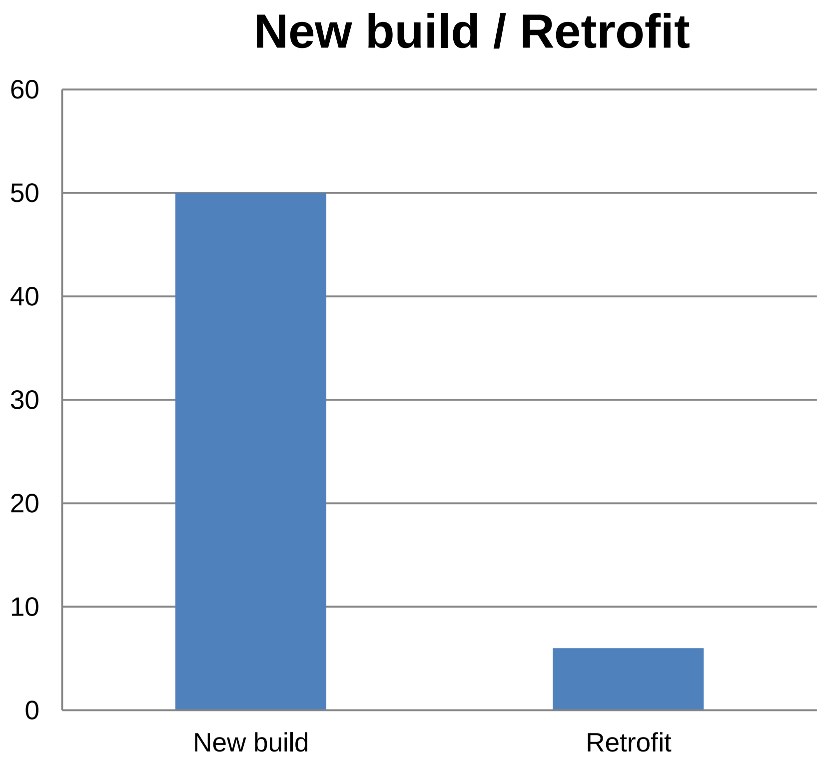
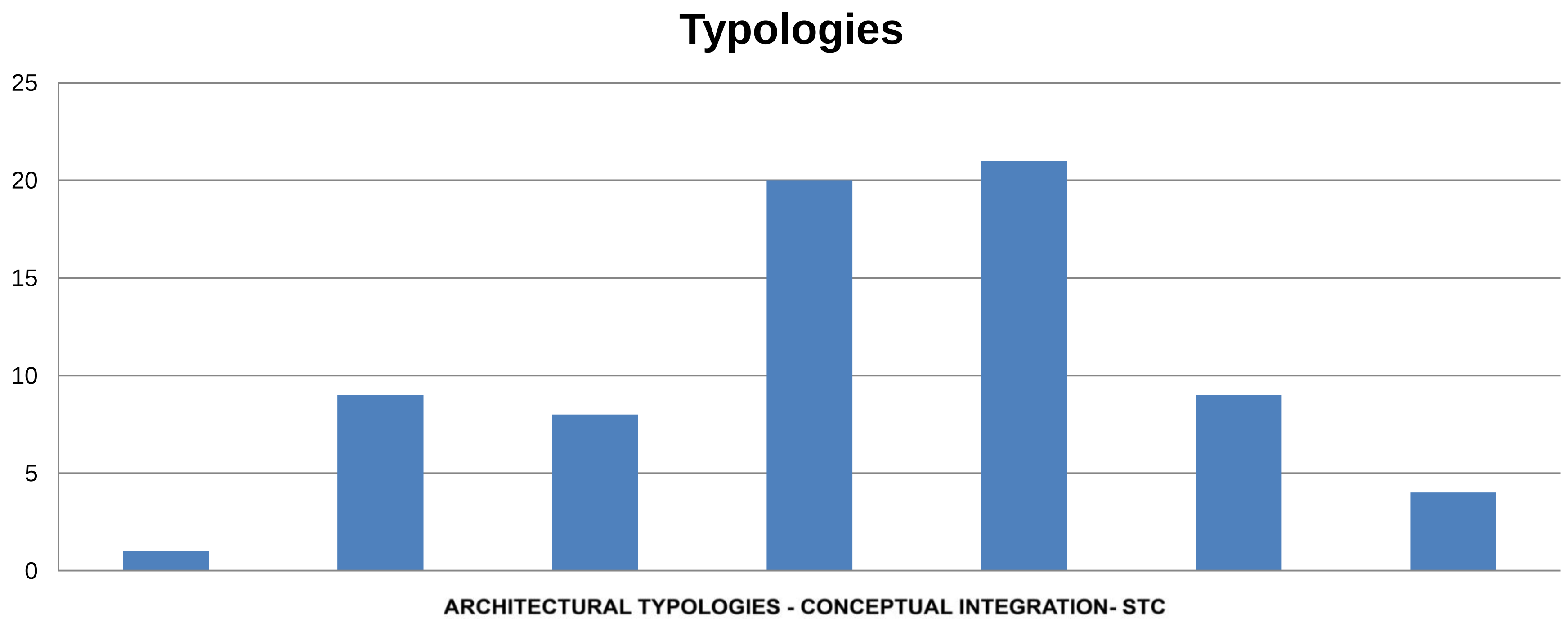
10		1			ONE TONNE LIFE, SWEDEN	2011	1		1						1							1											1	1				1	1			1				
10		1			MESA´S EDGE RANCH, USA	2005	1			1				1																		1		1			1			1		1				
10	1				GYMNASIUM, BURGWEINTING, GERMANY	2004	1		1						1								1										1					1	1					1		
10	-				OSEANIA, NORWAY (1st evaluation concept)	C																																								
10	1				STUDENT HOSTEL, DENMARK	2002	1		1					1										1									1					1				1				
10	1				KINDERGARTEN, AUSTRIA	2005	1		1				1	1					1														1	1		1		1								1
10			1		BAUHAUS DESSAU, GERMANY	2010	1			1	1												1										1				1		1					1		

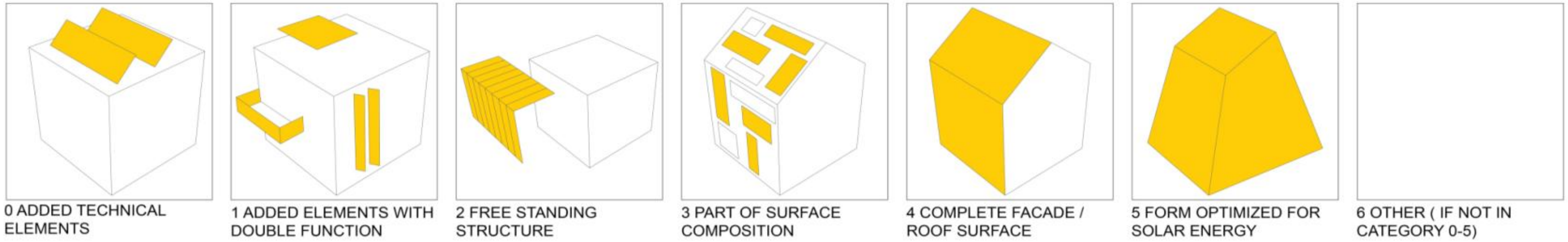
62 projects selected

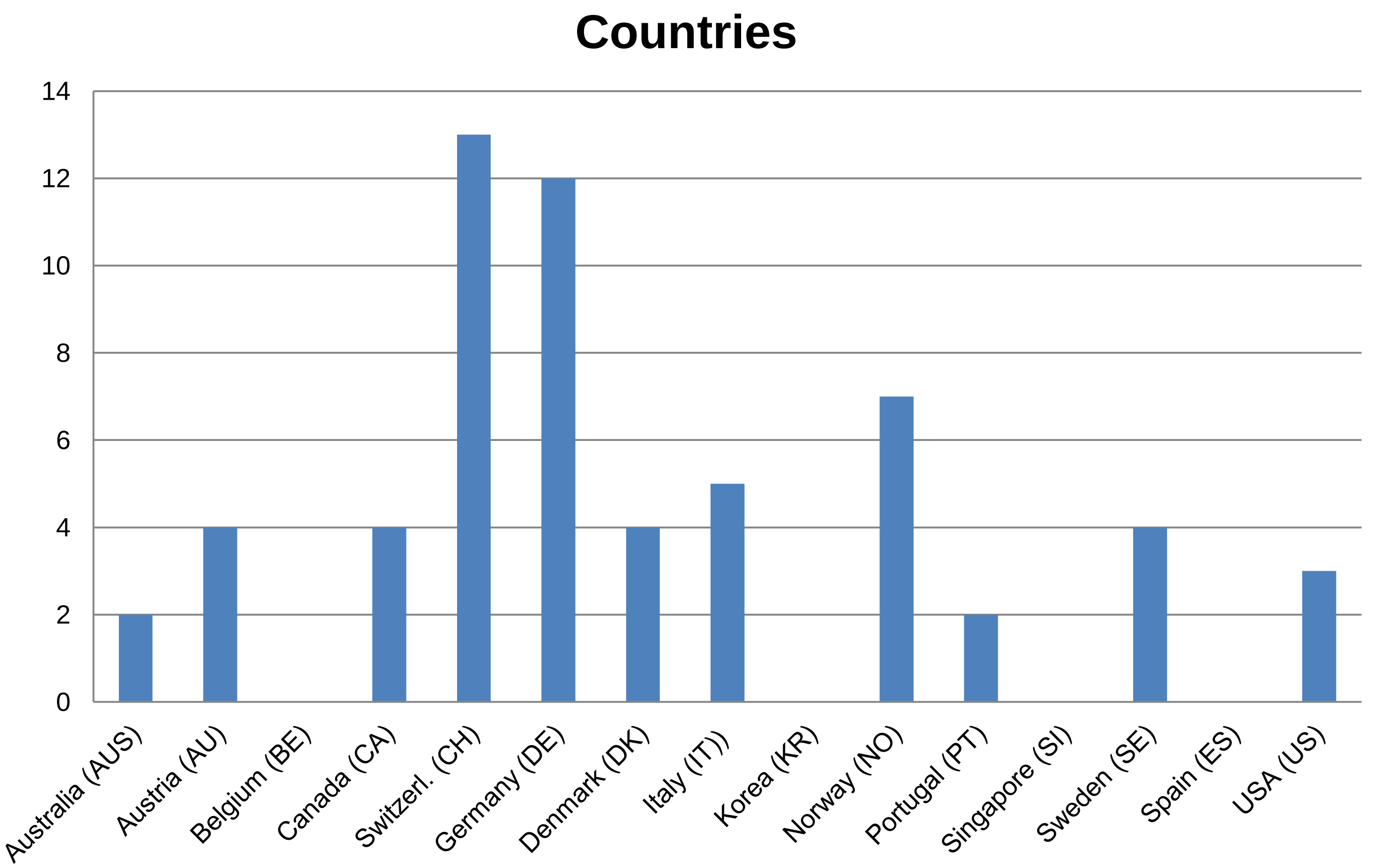

Completion year
12
10
8
6
4
2
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

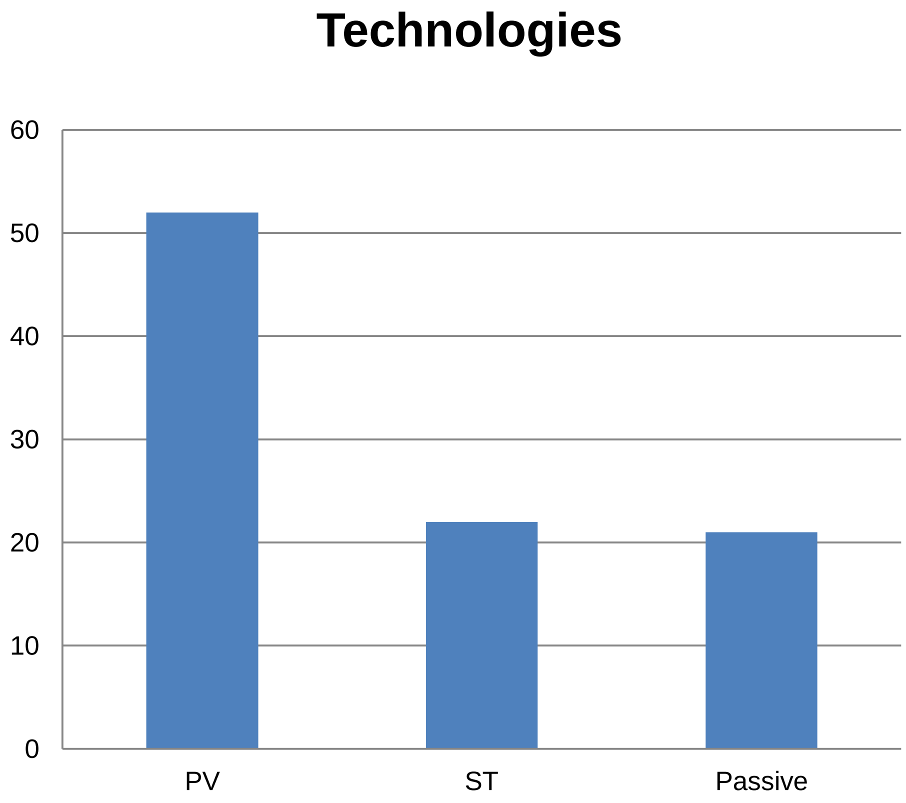

Case / Concept
60
50
40
30
20
10
0
Case
Concept

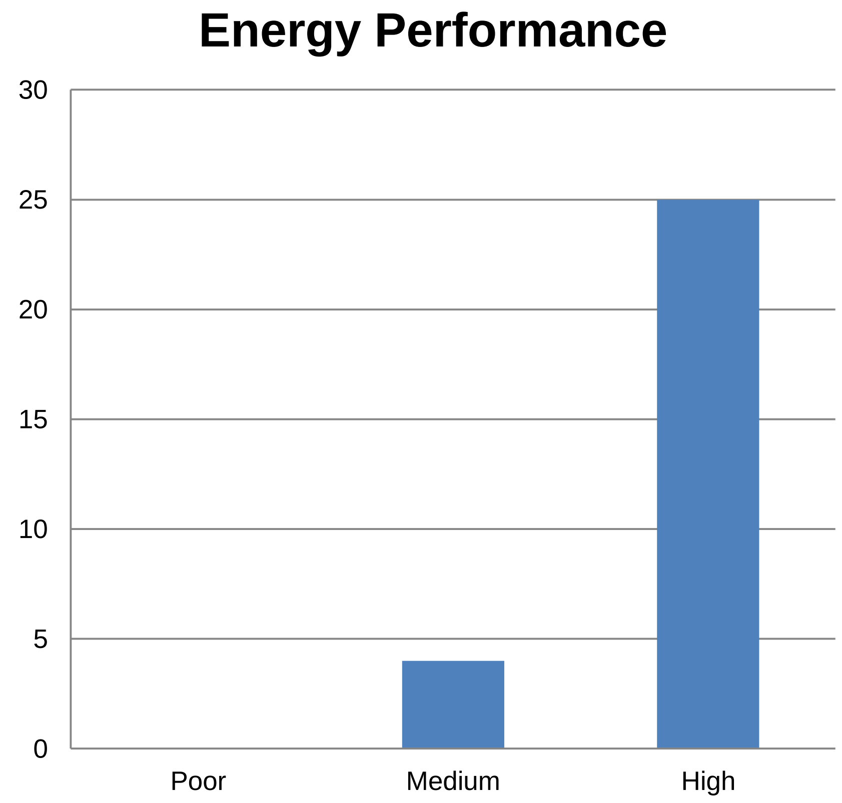

New build / Retrofit
60
50
40
30
20
10
0
New build
Retrofit

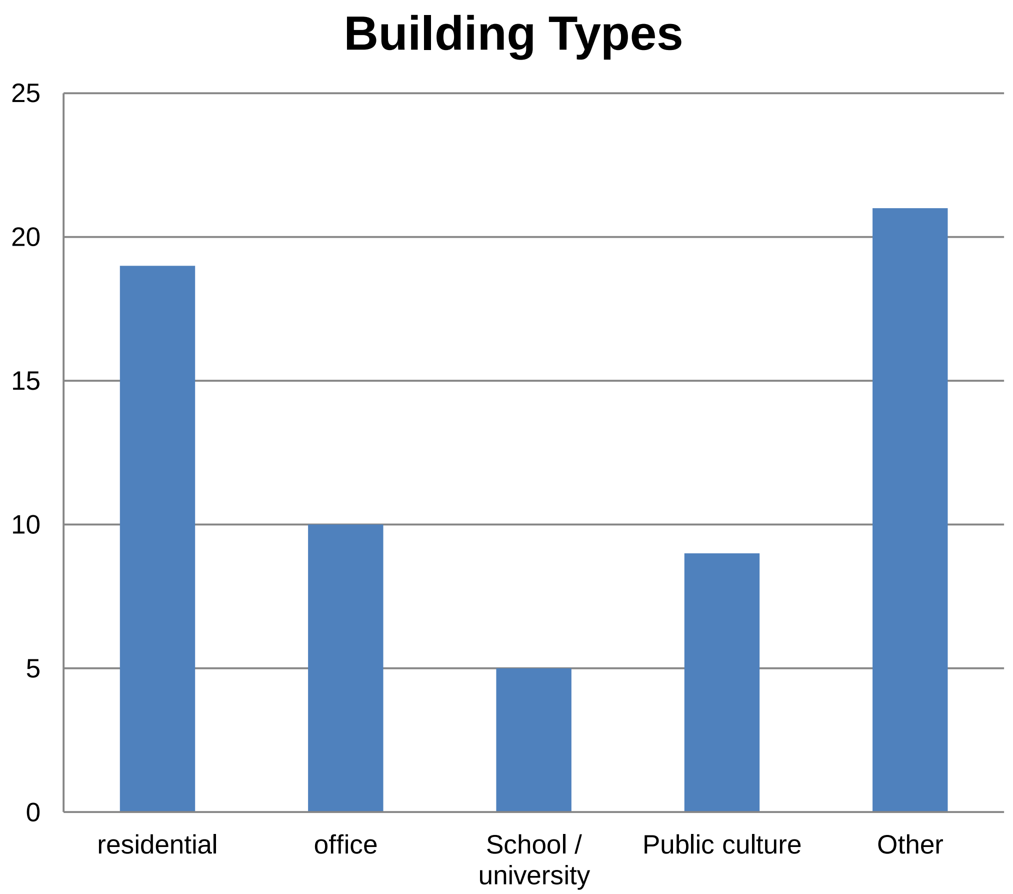

Typologies
25
20
15
10
5
0
ARCHITECTURAL TYPOLOGIES - CONCEPTUAL INTEGRATION- STC


0 ADDED TECHNICAL ELEMENTS
1 ADDED ELEMENTS WITH DOUBLE FUNCTION
2 FREE STANDING STRUCTURE
3 PART OF SURFACE COMPOSITION
4 COMPLETE FACADE / ROOF SURFACE
5 FORM OPTIMIZED FOR SOLAR ENERGY
6 OTHER (IF NOT IN CATEGORY 0-5)

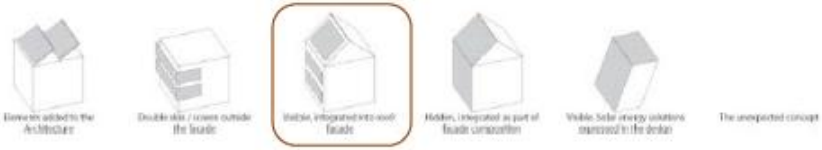

Countries
14
12
10
8
6
4
2
0
Australia (AUS)
Austria (AU)
Belgium (BE)
Canada (CA)
Switzerl. (CH)
Germany (DE)
Denmark (DK)
Italy (IT))
Korea (KR)
Norway (NO)
Portugal (PT)
Singapore (SI)
Sweden (SE)
Spain (ES)
USA (US)


Technologies
60
50
40
30
20
10
0
PV
ST
Passive


Energy Performance
30
25
20
15
10
5
0
Poor
Medium
High


Building Types
25
20
15
10
5
0
residential
office
School / university
Public culture
Other

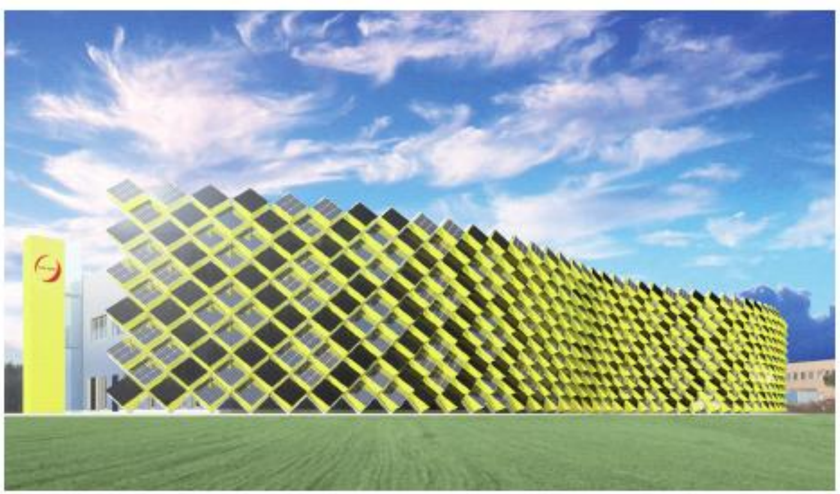
XELIOX, IT



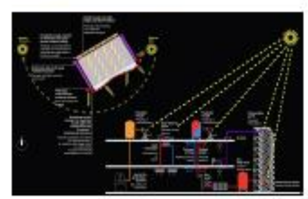
PROJECT	*XELIOX ENERGY LAB, ITALY*	***PV and ST***

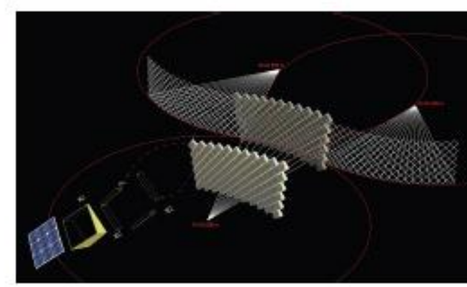
Xeliox Energy Lab is a manifesto-building for a company which produces solar parabolic troughs. The visual distinctive element is a large PV surface (35kWp) forming the diaphragm that screens a southern façade whose rhythm is defined by the repetition of a photovoltaic component sloping to find the sun. The energetic consumption of the building is very low (<6kWh/m3); also parabolic troughs and solar thermal have been used on the roof.

Poor	Average	Good
		x

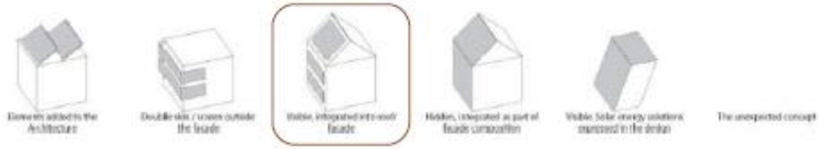


Xeliox Energy Lab, Medolago (BG), Marco Acerbis, Eliante, Solar Manufacturer
New Building (under construction), Factory, 2007





SUNNY WOODS, CH



PROJECT	*SUNNY WOODS, ZURICH-HÖNGG*	***Technology (PV/ST)***

SUNNY WOODS – A BUILDING LIVING UP TO ITS NAME

Sunny Woods was the first multi-family house to achieve an annual zero energy balance by reducing the energy demand to about 10% of a conventional building and including active and passive solar design strategies. The building won the Swiss and the European Solar Prize in 2002. 200 m2 roof integrated thin film PV cells cover about 80-100% of the electricity demand. 6 m2 vacuum collectors integrated into the balcony balustrades support the production of domestic hot water and space heating.

Poor	Average	Good
		x

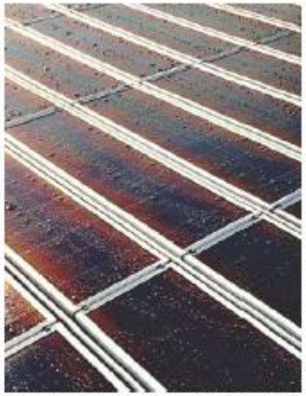
Diagram

South facing facade

Residential Building, Zurich-Höngg, Kämpfen für Architektur, Naef Energietechnik, Fabrisolar
New Build, Visible, integrated into roof/facade, 2001

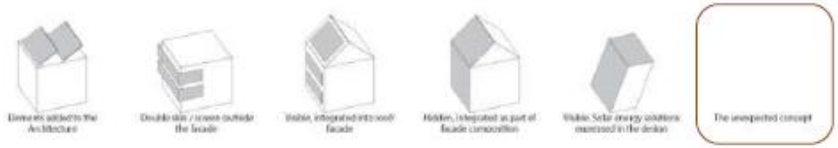
North facing fassade

PV cells integrated into the roof



Vacuum collectors acting as balcony ballustrades

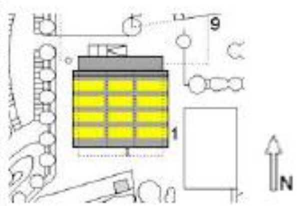
DREIFELD SPORTSHALLE, DE

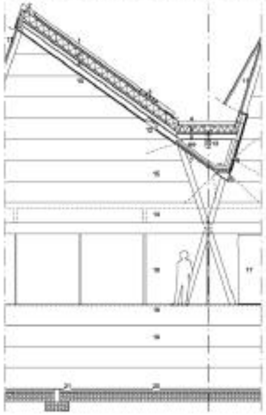


PROJECT	DREIFELDSPORTHALLE, GERMANY	SOLAR THERMAL ENERGY SYSTEM

The recent construction of a Gymnasium in Markt Großostheim comes with integrated solar thermal collectors. The roof of the hall is used as a thermal power station for a local heating network. This network is primarily supplying the gym itself, and an outdoor Pool.
The collectors are integrated into the south faced side of the sheds. With a declination of 35° they are optimally aligned for insulation.
The whole room is light-flooded and makes maximum use of daylight.

Poor	Average	Good
	X	

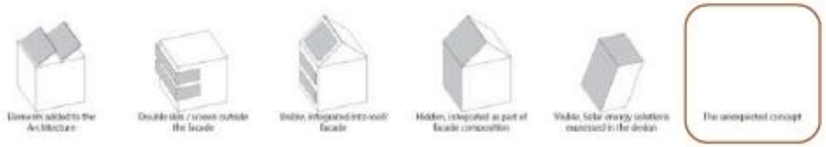




Dreifeldsporthalle, Großostheim, Dierks Blume Nasedy Architekten, Ing. Büro Rödel, New Building, Gymnasium, 2000

CaseStudy_A3NewGroßostheim

DWELLING HOUSES, AT



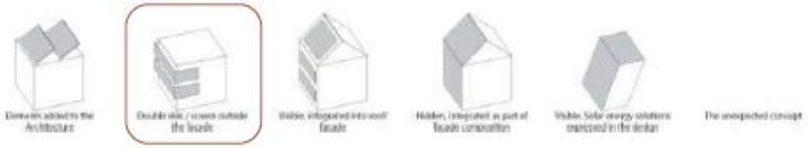
PROJECT	*Dwelling houses, Austria*	***Photovoltaik***

Hard in Vorarlberg faces a great demand for reasonably priced tenements - the goal of this project was consequently to optimize the building's structural shell and the floor plan in order to minimize rental and running costs. Prefabricated wood elements, a meticulously insulated roof to reduce the waste of energy and movable PVPs on the south side which serve also as sun protection are the most remarkable features of this house.

This building is an example for high quality in residential architecture aiming at low-income families. It is also a nice example for integration of solar energy. The skeleton structure with wooden wall panel and a prefabricated sanitary block are unusual for this kind of buildings. The effect of the interior quality is controllable with the moving solar shades.

Dwelling houses Spinnereistraße, Hard, Architect: Hermann Kaufmann, Energy Consultant: stromaufwärts Photovoltaik, New Building, residential, 2003

Fire & Emergency Training Inst., CAN

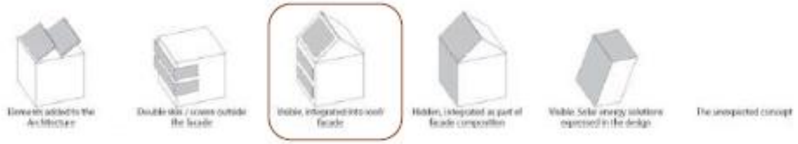


PROJECT	*Fire and Emergency Training Services Institute*	*Technology (ST)*

As part of the ongoing expansion of Pearson International Airport, the new Fire and Emergency Services Training Institute (FESTI) came with a mandate to pursue high sustainability practices. Taking full advantage of the site, the double-angled, south-west facing, 240m² solar wall heats the air that is then used to condition the interior spaces. By combining the use of the solar wall with the thermal mass of hollow core concrete slabs, heat captured from the sun's energy can be stored and released on demand, while eliminating much of the bulky mechanical equipment traditionally needed to condition interior spaces. As one of the primary expressive elements of the building, solar wall compliments and works with the architecture rather than competing against it.
On the angled south-west facade black, perforated corrugated metal makes up the solar wall. Additional non-perforated metal panels are used behind the solar wall on the tower to harmoniously bring together the various elements of the project. The bold colour and large surface of the solar wall highlights this facade as being significant to the project without compromising the architectural language of the project. The successful integration of the solar thermal energy system, and the layering of materials adds to the visual aesthetic and modern appearance of the facility.

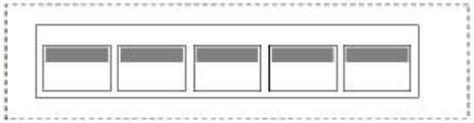
Fire and Emergency Training Services Institute , Kleinfeldt Mychajlowycz Architects Inc, Ontario canada, New Build, Institution, 2008

KTH F2F3, SE



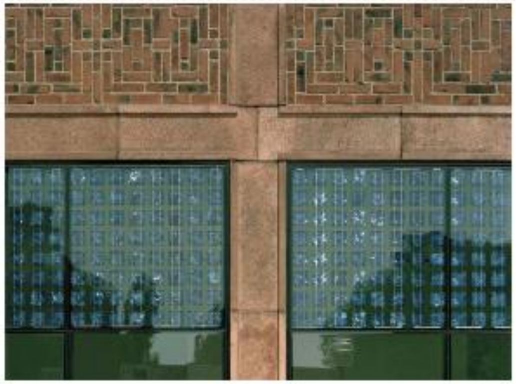
PROJECT	KTH F2F3, Sweden	PV-cells

The portrayal has developed from the problem to cope with sun shading for the new glazed facade to the entrance hall facing directly to the south and against the open space by the yard. From the yard, the pattern of the solar cells in interact in a delicate way with the existing brick pattern. The facility combines an aesthetically attractive manner with the use of solar cell shading.



The Royal institute of Technology, Stockholm, Stadion architects, PO Andersson AB, Renovation, School university, 2007

Solar cells integrated in window



SOLAR UMBRELLA HOUSE, USA

PROJECT	SOLAR UMBRELLA HOUSE, USA	Technology (PV)

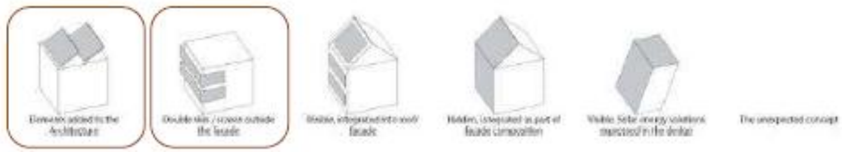
PV WALL / ROOF STRUCTURE AS SOLAR CANOPY.

The solar shelter, called solar umbrella, consists of a 4-kilowatt solar panel array. It wraps the house from the south side and continues up and over the roof. The solar array acts as a screen which protects the house from direct heat gain, while taking in the sun's rays in order to provide 100% of the building's electrical energy requirements. Since the Solar Umbrella House's system is grid intertied, all surplus energy is returned to the community. Its strength lies in the use of PV technology to create an element of architecture.

Poor	Average	Good
		x

Solar Umbrella House, Venice, California, Pugh and Scarpa Architects
New Build, Visible and Integrated into Roof, 2005

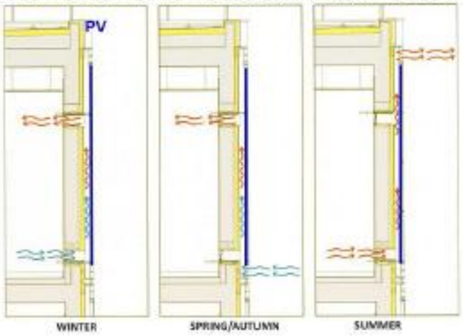
SOLAR XXI, passive office building, PT



PROJECT	*SolarXXI (passive office building), PT*	***PV + ST + daylight + ground cooling***

In this building, vertical bands of photovoltaic panels are integrated into the south facade, with an alternative rhythm with the glazing, resulting in an elevation based on the concept of modularity and repetition. The PV panels acquire a compositional quality determinant to the final outcome. The project seeks to reconcile the different systems - photovoltaic, solar collectors, ground passive cooling - by a balance of formal and spatial integration. The systems are assumed from the initial phase as compositional elements that potentially generate the final form and not as disruptions added during the process, and thus act as an example of project methodology applicable in similar cases.

Poor	Average	Good
		X

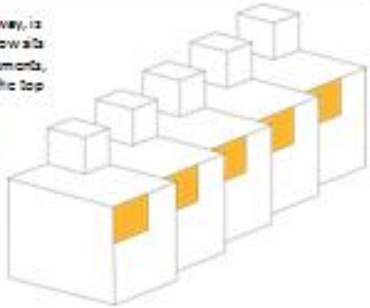


Solar XXI, Passive solar office building, Lisbon, Pedro Cabrito + Isabel Diniz, Helder Gonçalves (LNEG), New Building, Office,2006

I-BOX, STORELVA, NO

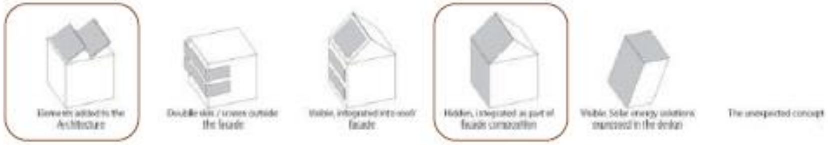
1. PROJECT TITLE	I-BOX STORELVA, NORWAY	Effect: ca 1 700 kWh/year

This seven-unit passive row house in Tromsø, in the very north of Norway, is focused on low energy usage and the environment. The three storey row sits on a site sloping down to a river. The main structure is solid timber elements, with external mineral wool insulation and heartwood pine boarding. The top portion of the south façade is covered with solar collectors.
The collectors replace cladding, making them flush with the cladding below. The top of the collectors extend above the roof terrace, acting as a balustrade. The light cladding and large windows make the collectors stand out as a clear statement of the environmental intentions of the building.
In addition to the solar collectors, heat collectors are placed in the ground for pre-heating/cooling of the air intake. A buffer tank for the heat collection systems, combined with a backup air-to-water heat pump, stores and delivers energy to the underfloor heating system.



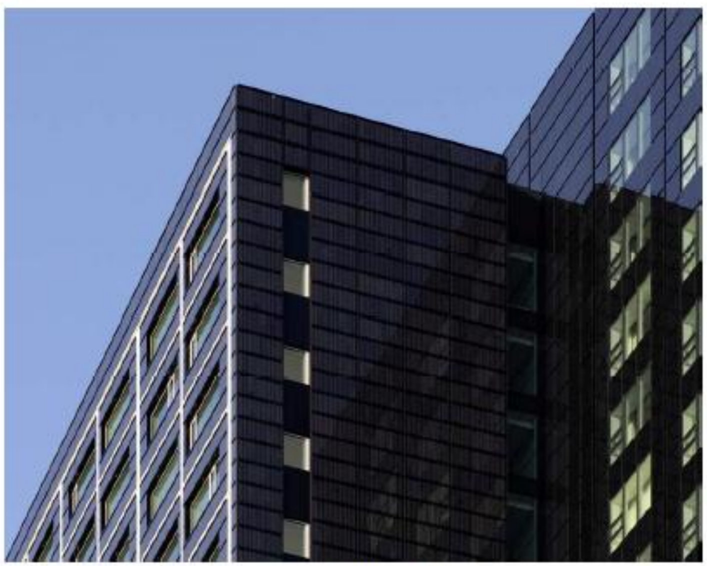
Passivhouse, Tromsø, Steinsvik Arkitektkontor AS

COPENHAGEN TOWERS, DK

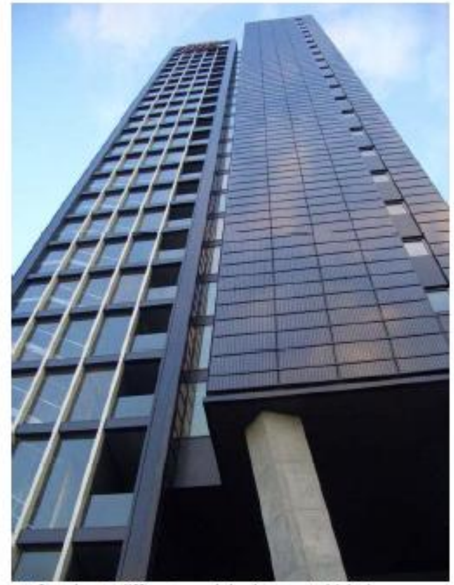


PROJECT	*Copenhagen Towers, Denmark*	***Technology (PV)***

Copenhagen Towers' are two buildings with hotel and offices. The façade of the hotel is consisting 1,700 m^2 customized photovoltaic modules in 38 different sizes which match the rest of the facade as an integrated part of the design.
The building integrated solution that replaces the entire facade cladding.
The size of the plant is 200 kWp on the facade of the South Towers east, west and south-facing façade. At the roof of South Wing is placed a 70 kWp plant at 500 m^2.



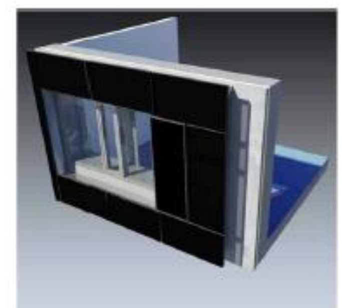
Copenhagen Towers, Ørestads Boulevard 106-116, København.
Architects: Dissing+Weitling (hotel) og Foster+Partners (offices), Gaia Solar, New Build, hotel and office, 2009



PV façade: 38 different modules integrated (size)

Hotel and Office buildings

At South Wings roof : 70 kWp



MELBOURNE, AUS

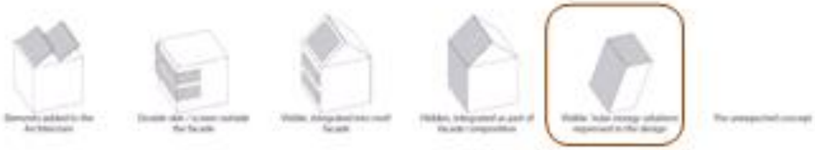
PROJECT	*Melbourne, AUSTRALIA*	*PV*

Poor	Average	Good
		X

Architect - Metier 3 (architects)
PV system designers - Arup and Sustainable Technologies International
Structural facade engineers - Meinhart
Solar manufacturer - BP Solar and Flabeg International

A very progressive façade installation was completed using a standard fixing system at the Allan Gilbert Building, University of Melbourne where 45.48kWp BP Solar poly-crystalline cells were laminated by Flabeg International into heat-strengthened glass panels. This is connected to six 5kW and four 6kW inverters to convert the DC panel power into usable balanced three phase AC grid power. The PV panels sit within a 2mm liquid interlayer, sandwiched between 6mm thick clear inner and low-iron outer glass. Building on project expertise developed both in Australia and overseas by design partners ARUP, BP Solar, and Solar Technologies, the facility demonstrates the application of building-integrated photovoltaic power generation within an urban habitat.

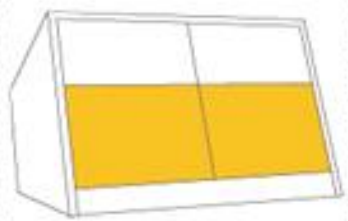
FLOTANE, REST STOP, NO



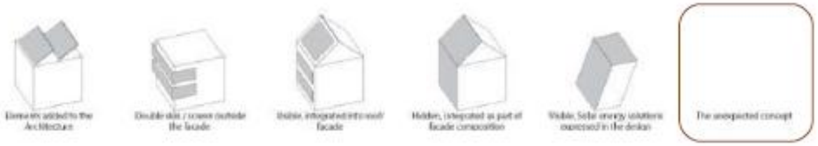
PROJECT	FLOTANE REST STOP, NORWAY		Crystalline PV

A small concrete cube housing toilet facilities by the tourist route Aurlandsfjellet, in the west of Norway. Situated in a vast mountain landscape close to lakes and great views, it's a popular starting point for hiking and fishing trips. The southern façade is glazed, with PV cells integrated in the lower part of the glass. The PVs provide privacy for the toilets as well as power supply for the vacuum-toilets and water pump.

Poor	Average	Good
		x



FRIEDENSKIRCHE, DE



PROJECT	*FRIEDENSKIRCHE, GERMANY*	***PHOTOVOLTAIC SYSTEMS***

Since July 2003 this high-technology photovoltaic system on the roof of the Friedenskirche (peace church) in Tuebingen, Southern Germany, generates a nominal output of 12,96 kW which adds up to 10 900 kWh per year.
The system consists of 216 modern thin film modules (CIS technology) and covers a surface of nearly 160 square metres.

Poor	Average	Good
		x

ZENTRUM FÜR KUNST & MEDIENTECHNIOLOGIE, DE

PROJECT	ZKM, GERMANY	PHOTOVOLTAIC SYSTEMS

The Zentrum für Kunst und Medientechnologie (ZKM) in Karlsruhe, Germany was built from 1993 to 1997 and consists a museum, a gallery and the institute of the college of art.
The photovoltaic system of the ZKM generates 86 600 kWh and feeds into the city's light-rail system.
Fourty solar modules with monocrystalline technology are separated into roof, façade integrated and sloped elevation components.

Poor	Average	Good
		x

SHC SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

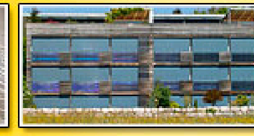
AULA PAOLO VI, IT

PROJECT	*AULA P.L. NERVI (Aula Paolo VI), ITALY*	***PV/Polycrystalline***

The Paul VI Hall is a large auditorium built in 1971, for the papal audience. It is located in Rome, near St. Peter's Basilica in the Vatican. In 2008 it started operating the PV system. The 2,400 modules are facing south and have been installed replacing the existing concrete roof panels, now degraded, reproducing the size of the original design of Pier Luigi Nervi. The system can cover at least one quarter of the energy needs of the auditorium and surrounding buildings, producing 315,000 KW per year. The PV modules perform the dual function of "passive" protection of the building from direct radiation and "active" solar energy conversion into electricity, giving to the aesthetic value an environmental surplus. The view from the St. Peter's dome was minimally affected.

Collection of Case Studies
Summer 2012

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY



TASK 41

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Solar Energy and Architecture

OVERVIEW

It is clear that solar energy use can be an important part of the building design and the building's energy balance to a much higher extent than it is today. This Task should help achieving high quality architecture for buildings integrating solar energy systems, as well as improving the qualifications of the architects, their communications and interactions with engineers, manufactures and clients. The vision - and the opportunity - is to make architectural design a driving force for the use of solar energy.

The title of this Task indicates that focus is on both high architectural quality and high energy performance. Thus, it would be counterproductive to show the use of solar applications in buildings where the energy performance is poor or even worse than without solar applications.

This title also indicates a new way of approaching the use of active solar energy in buildings that sees architects composing their architecture with solar components conceived as building elements.

The illustrations above are from left to right:
Lærkelængen school by Box25arkitekter, Denmark;
Sunny Woods by Beat Kämpfen Architects, Switzerland;

Task Information

Duration
May 1, 2009 - April 30, 2012

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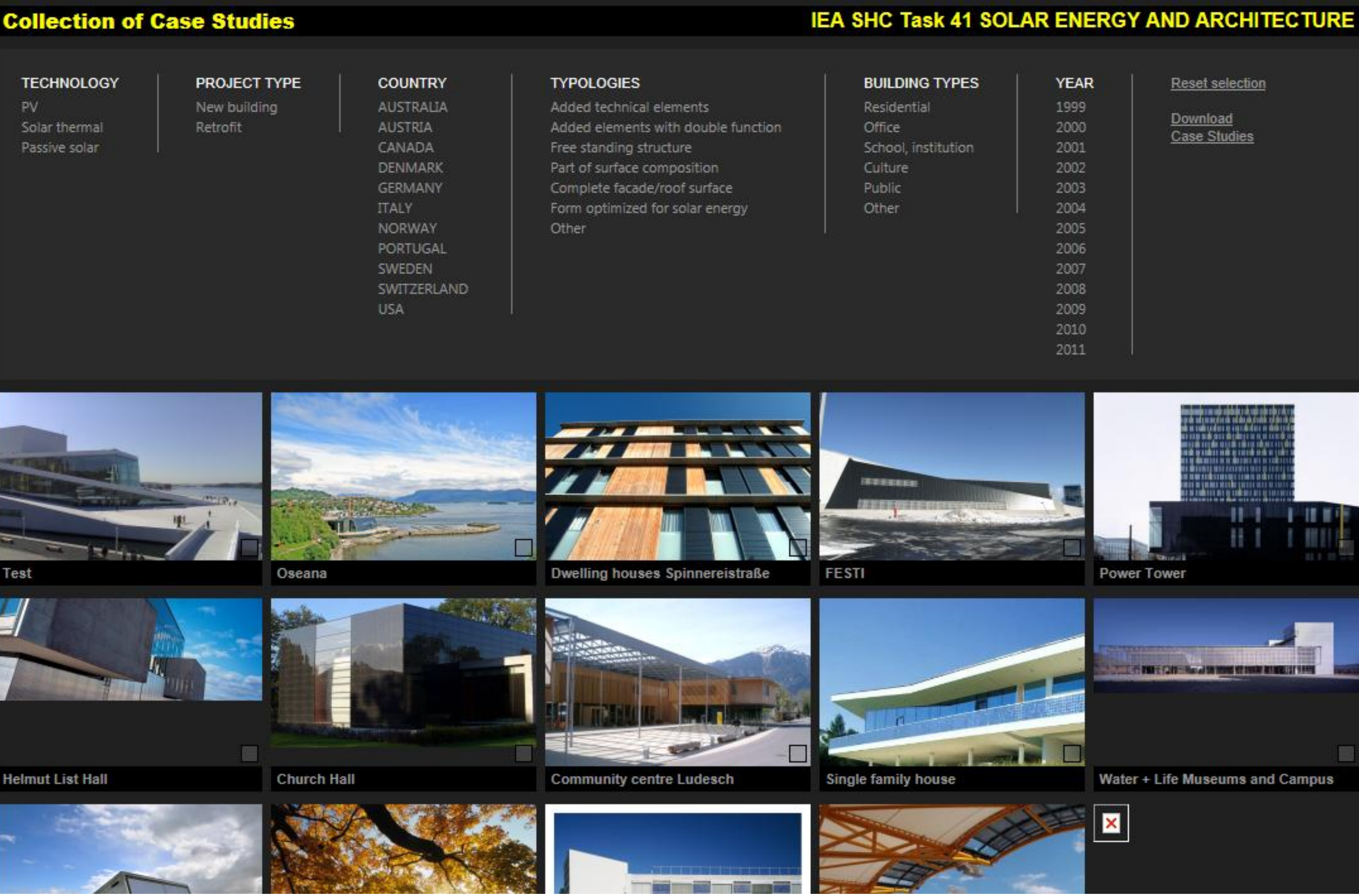
Task News

Task 2010 Highlights now Online.

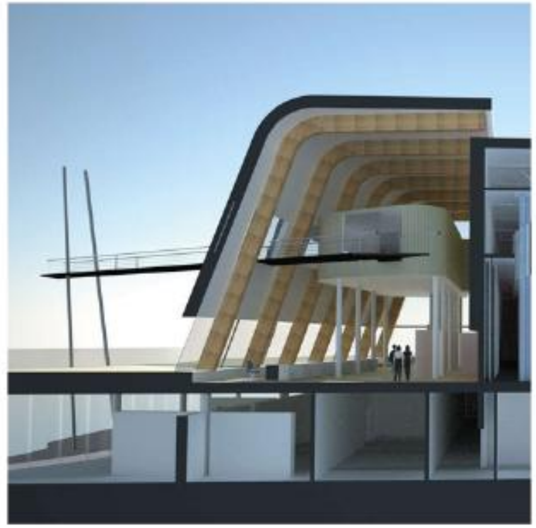
www.iea-shc.org/task41



www.iea-shc.org/task41

Oseana | NORWAY

PHOTOVOLTAIC | SOLAR THERMAL



THE OVERALL GLOBAL COMPOSITION

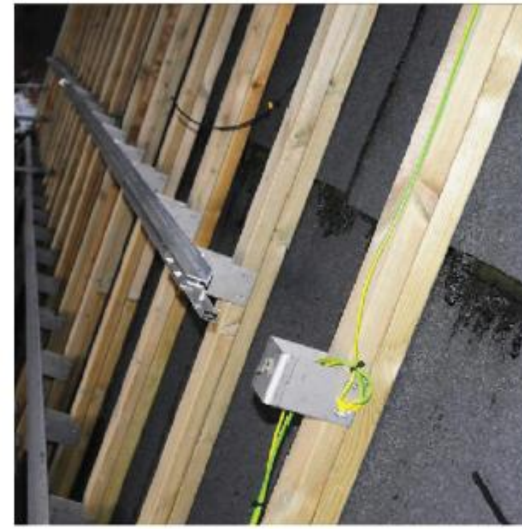
The building is composed for three main volumes. Their differences bring tension to the overall composition. The first is a one storey high base whose shape plays with the organic forms of the rocky coastline. This space appears to have a seascape-centered design since the huge windows and proximity to the water frame quite spectacular views. Landing on the base, a much heavier and solid looking element, contains the biggest room of the building, the big auditorium. The latter presents a much regular shape then the former and its approach towards the water is also different since it steps back against the hill. Finally, a third shape makes the transition between the already mentioned ones. This is a curved surface coated with the photo voltaic elements.

DETAILED COMPOSITION OF SURFACE AND MATERIALS

Solution somehow inspired in the surrounding natural elements, rock and water. The finishing of the auditorium exterior walls is made with dark rock slabs similar to the one we can find both in the hills and coastline of western Norway. Opposing to the strength and heaviness of the rock fairly big glass sheets reflect the surrounding landscape blending the building with its constraint. The photo voltaic panels also recall the water for all their reflexes and several shades of black. It is interesting to observe how the photo voltaic panels characteristics are placed in the middle of the other two used material solutions. Even though they show a few reflections they are not totally flat as glass presenting some texture created by the jointing.

ADDED VALUES AND FUNCTION

Having the best shape and position for the caption of solar light, the curved surface also holds the main lobby for the whole building, connecting, not only in terms of composition, the auditorium with the "sea level" gallery. This lobby is characterized not only from the shape that can also be felt from the inside, but also for its wood structure and the full height dimensions. A free standing mezzanine emphasizes the amplitude of this space. The curved surface coated with the photo voltaic panels is also supporting a viewpoint prefabricated bridge over the ocean.



VISIBLE MATERIALS

As for the out shell of this construction, mainly three materials are used, and always in large surfaces. There is a clear contrast created between natural materials like the dark rock used in the auditorium and artificially created ones such as glass panels, hold by discrete black framings. The third main material are the photo voltaic elements that constitute the curved surface of the main lobby. Some small notes of other materials can also be read such as the pre fabricated concrete of the view point or the metal cladding covering the thickness of the curved slab. Somehow there is a very refined sense of detailing. On the inside of the curved slab, again a contrasting material: natural, and rather traditional wooden structure, is used in to hold together the modern photovoltaic system.

COLOURS AND REFLECTIVITY

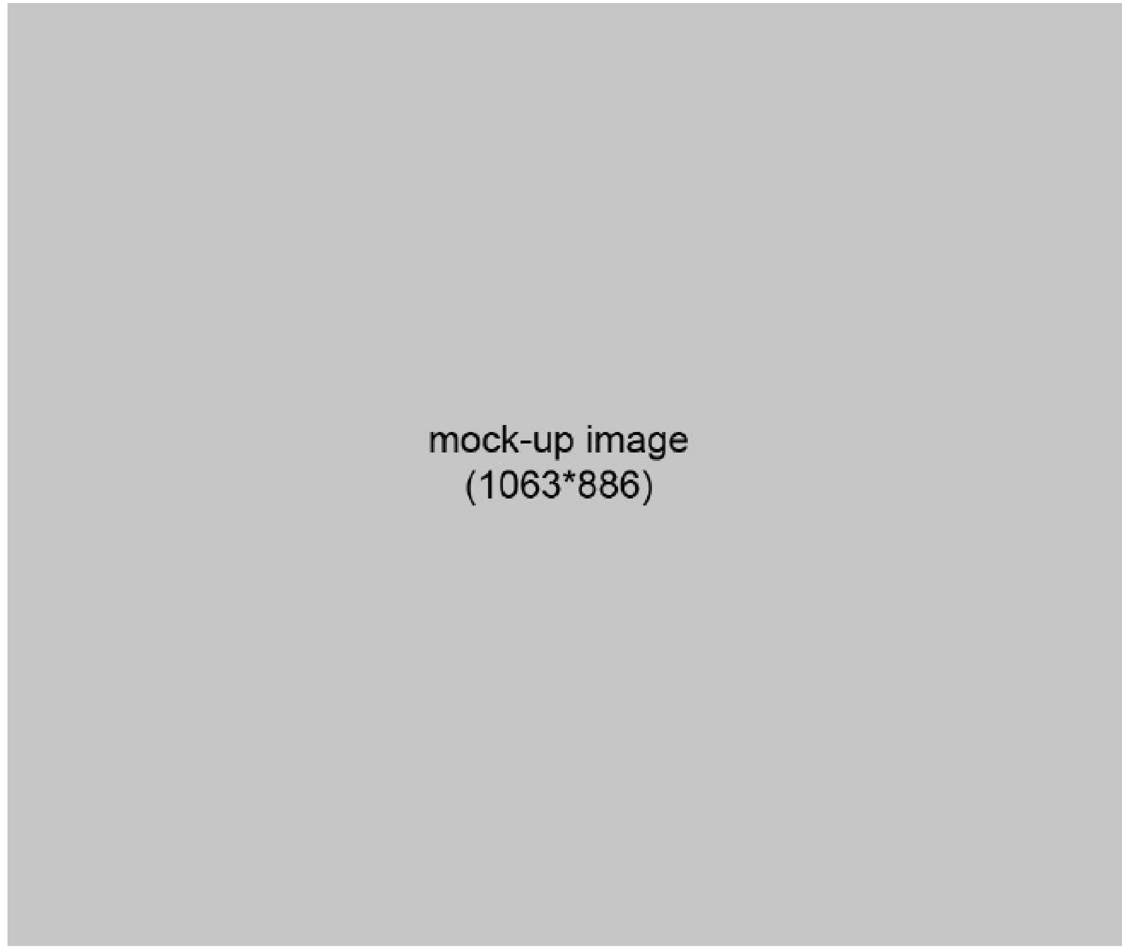
The black solar cells coating the curved surface of the lobby establish a consistency amongst the dark color of the rocks on the coast line and the water surface. There's a obvious connection between the way both the water and the photo voltaic panels react to sun light, creating several shades and reflections. The same reactions can be observed in the glass surfaces used in this building.

FIXING SYSTEM/JOINTING

Several wooden pieces, equally distanced from each other, are attached vertically to the curved surface right over the asphaltic membrane. This allows the screwing of metallic mounting brackets in the opposite direction of the wood pieces which creates a grid fully covering the 463 m2 surface. The 363 voltaic panels are then attached along to the metal profiles through railings placed on their back that allow an easy adjustment (right to left) during installation. Each panel has a black aluminum frame. Also framing the entire curved surface, a grey steel element is used.

ENERGY CONCEPT | active solar

TextField #6



BUILDING SIZE

0 m²

ENERGY DEMAND, BUILDING

(space heating, domestic hot water, ventilation, lighting)

kWh/m²/year *case study*

kWh/m²/year *according to national building code*

Calculated

This project reveals that when working with solar panels as full facades coating, a lot of thought has to be put into dimensioning all the elements that usually constitute a façade. This process concerns both the size of the used panels, specially their size after installation with all the needed framings and gaps, but also the dimensions of all windows, gutters, vents, and others used in the coated façade. In this specific case some more work could have been done concerning the matching of the dimensions of both the window and the landing of the bridge. In both cases we can observe metallic elements that were used to fill up the differences of both used metrics. Basing the design in the dimensions of the photo voltaic system would have been a good design option.

Also important to mention is the need of enlarged ventilation elements when such a big amount of solar panels is used at once. This must also be considered from an architectural point of view from the design stage in order to reach a bigger harmony and integration with the overall composition.

FACTS | additional information

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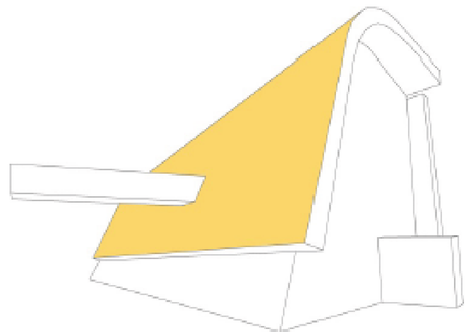
LINK TO GOOGLE MAP
http://mapof.it/mobergsbakken,20,5200,os,norge



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ARCHITECT
Grieg Arkitekter AS

ENERGY CONSULTANT
Asplan Viak – KanEnergi AS

SOLAR MANUFACTURER
GETEK AS

COMPUTER TOOLS USED FOR SOLAR DESIGN

PHOTOGRAPHERS
Johan Elm – Erco / Grieg Arkitekter

PHOTOVOLTAIC

TYPE AND LOCATION
Fiona 175 from SolPower AS

STANDARD OR CUSTOM MADE
Standard

ORIENTATION
South

SLOPE (HORIZONTAL)
70 °

TOTAL SYSTEM SIZE
463 m^2

INSTALLED NOMINAL POWER PV
63,5 kWp

YIELD
42000 $kWh/year_{elec}$
7 kWh/m^2year_{elec}
Calculated

EFFICIENCY

UTILIZATION OF GENERATED ENERGY (PV)
Building usage and connection to public electrical grid

SOLAR FRACTION
~8 $\%_{PV}$

SOLAR THERMAL

TYPE AND LOCATION

STANDARD OR CUSTOM MADE

ORIENTATION

SLOPE (HORIZONTAL)
°

TOTAL SYSTEM SIZE
m^2

YIELD
$kWh/year_{elec}$
kWh/m^2year_{elec}
Calculated

EFFICIENCY

UTILIZATION OF GENERATED ENERGY (PV)

SOLAR FRACTION
$\%_{PV}$

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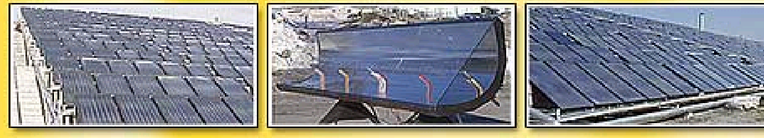
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY



TASK 37

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Task 37 - Advanced Housing Renovation with Solar and Conservation

OVERVIEW

Buildings are responsible for up to 35 percent of the total energy consumption in many of the IEA participating countries. Housing accounts for the greatest part of the energy use in this sector. Renovating existing housing offers an enormous energy saving potential. The Task objective is to develop a solid knowledge base on how to renovate housings to a very high energy standard and to develop strategies which support market penetrations of such renovations. Task 37 will include both technical R&D and market implementation as equal priority areas.

The Task will begin by analyzing the building stock in order to identify building segments with the greatest multiplication and energy saving potential. Examples of building segments are year of construction, type of buildings, type of envelope and components. Within these segments important topics for discussions are: - ownership and decision structures, inhabitants and their characteristics and actual groups of retrofit market players.

In parallel, exemplary renovation projects

Task Information

Duration
1 July 2006 to 30 June 2010

Operating Agent
Mr. Fritjof Salvesen
KanEnergi AS
Operating Agent on behalf of Royal Norwegian Ministry of Industry and Energy

Task News

Market Development for Advanced Housing Renovation
April 2010

Advanced and Sustainable Housing Renovation Handbook
June 2010

Presentations from Task 37 Seminar

www.iea-shc.org/task37

Terraced houses, Albertslund, DK

Bjørnens Kvarter 15C og 15D

PROJECT SUMMARY

Renovation and re-insulation of roof, facade and floor. Bay windows. New bathroom, kitchen and interior surfaces. Designed according to Danish low energy class 2 (63,3 kWh/m² pr year for a 120 m² house).

SPECIAL FEATURES

Solar panels for domestic hot water and mechanical ventilation with heat recovery

ARCHITECT

NOVA5 architects, DK

ENERGY CONSULTANT

Niras Consulting Engineers, DK

OWNER

BoVest Building Association, DK

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation

From the entrance 15C - After Before

House 15D After – seen from the garden

BACKGROUND

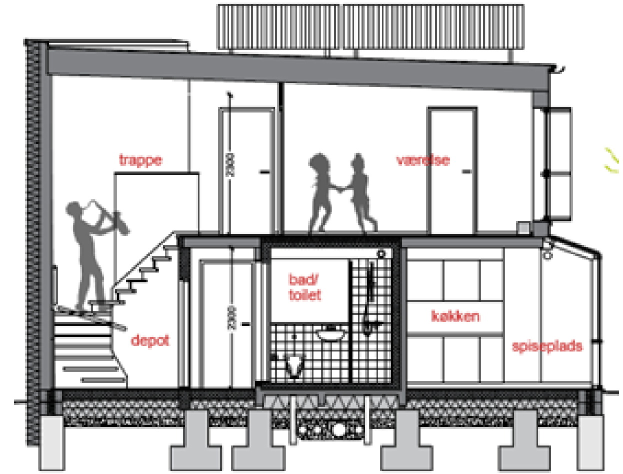
The houses in the living area of Albertslund South were built in 1963-65 and consists among others of 550 terraced houses. Today the houses suffer from variuos constructural problems being very hard to solve. Therefore, the owner, BoVest housing association, decided to implement a comprehensive renovation.

Due to a fire in two of the houses (Bjørnens Kvarter 15C og 15D) it was decided to make these exhibition house showing how the renovated and rebuilt houses would look like.

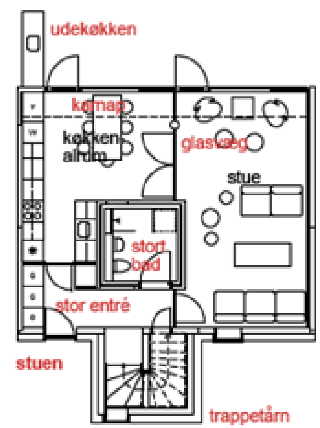
It is an aim that the houses are renovated so they comply with the standards for low energy class 2 (63,3 kWh/m² pr. year for a house of 120m²). To meet this goal solar panels and mechanical ventilation with heat recovery has been installed.

SUMMARY OF THE RENOVATION

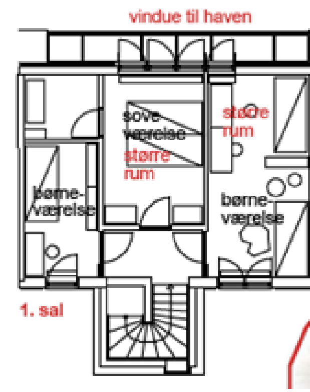
- New roof construction (prefabricated roof elements)
- Reinsulation of lightweight facades
- New windows and doors with triple energy glazing
- New kitchens and new bath rooms
- Ventilation with heat recovery
- Solar panels for hot water and also connected to the floor heating in order to use the waste heat.
- Mounting of prefabricated bay windows



Section



Ground floor



First floor

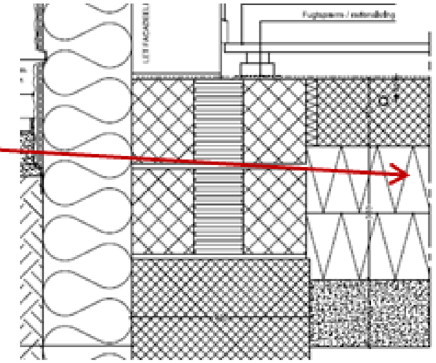
Large glazing areas results in good utilisation of daylight

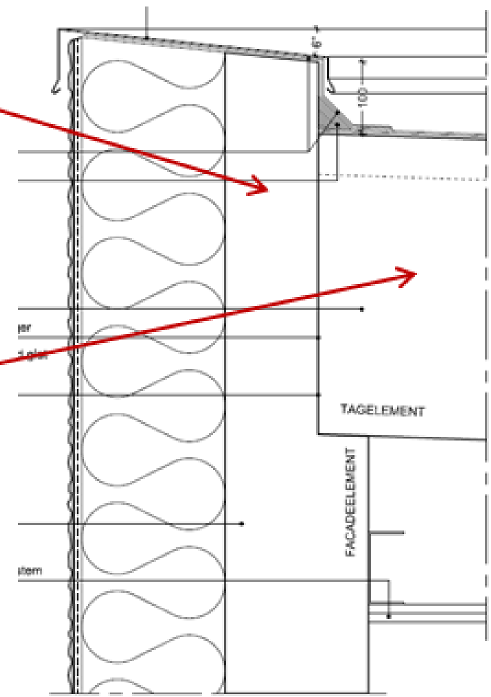
CONSTRUCTION

Floor construction	*U-value: 0.15 W/(m²·K)*
(interior to exterior)	
White oiled parquet (on joists)	22 mm
Joists	50 mm
Vapour barrier	
In-situ casted ground deck floor heating	150 mm
Rigid insulation	300 mm
Capillary break layer	150 mm
Total	672 mm

Wall element	*U-value: 0.18 W/(m²·K)*
(interior to exterior)	
2 layer of plaster	24 mm
Vapour barrier	
Lightweight element:	200 mm
Insulation	200 mm
Flat plaster layer	mm
Total	424 mm

Roof Element	*U-value: 0.12W/(m²·K)*
(top down) Lightweight prefab. element:	
Asphalt roofing,	
Ventilation space min.	45 mm
Insulated ridge construction	400 mm
Vapour barrier.	
Suspended celing	200 mm
2 layers of plaster on steel section	24mm
Total	669 mm





Summary of U-values W/(m²·K)

	Before	After
Attic floor	0,19	0,12
Walls (lightweight)	0,36 - 0,45	0,18
Basement ceiling	0,60	0,15
Windows*	2,8	1,42

** the u-values varies from 1.02 to 1,85; the most commonly used windows have U-values of 1,41 – 1,42 w/m²K.

BUILDING SERVICES

The houses are situated in an area with disctrict heating. The district heating supply of Albertslund Municipality has a future goal of supplying the living area with low temperature district heating. The houses will be prepared with radiators for low temperature heating. In house 15C solar panels will be used for heating of the hot water. In house15D a circulation water heater will be tried out.

RENEWABLE ENERGY USE

The future houses are all expected to use solar energy through integration of solar panels.

ENERGY PERFORMANCE

Space + water heating (primary energy)*
Before: 213,7 kWh/m²
After: 61,3 kWh/m² (house C)
64,1 kWh/m² (house D)
Reduction: 71% (C) and 70% (D)
*Standard: Danish Building Regulation 2008

The area used in the calculation is the total heated area (netto m²).

*Danish factors used when converting energy to primary energy:
Electricity: 2,5
Heating: 1

INFORMATION SOURCES

Building Assciation BoVest - www.bo-vest.dk
Nova5 architects – www.nova5.dk
Niras Consulting Engineers - www.niras.dk

Brochure authors

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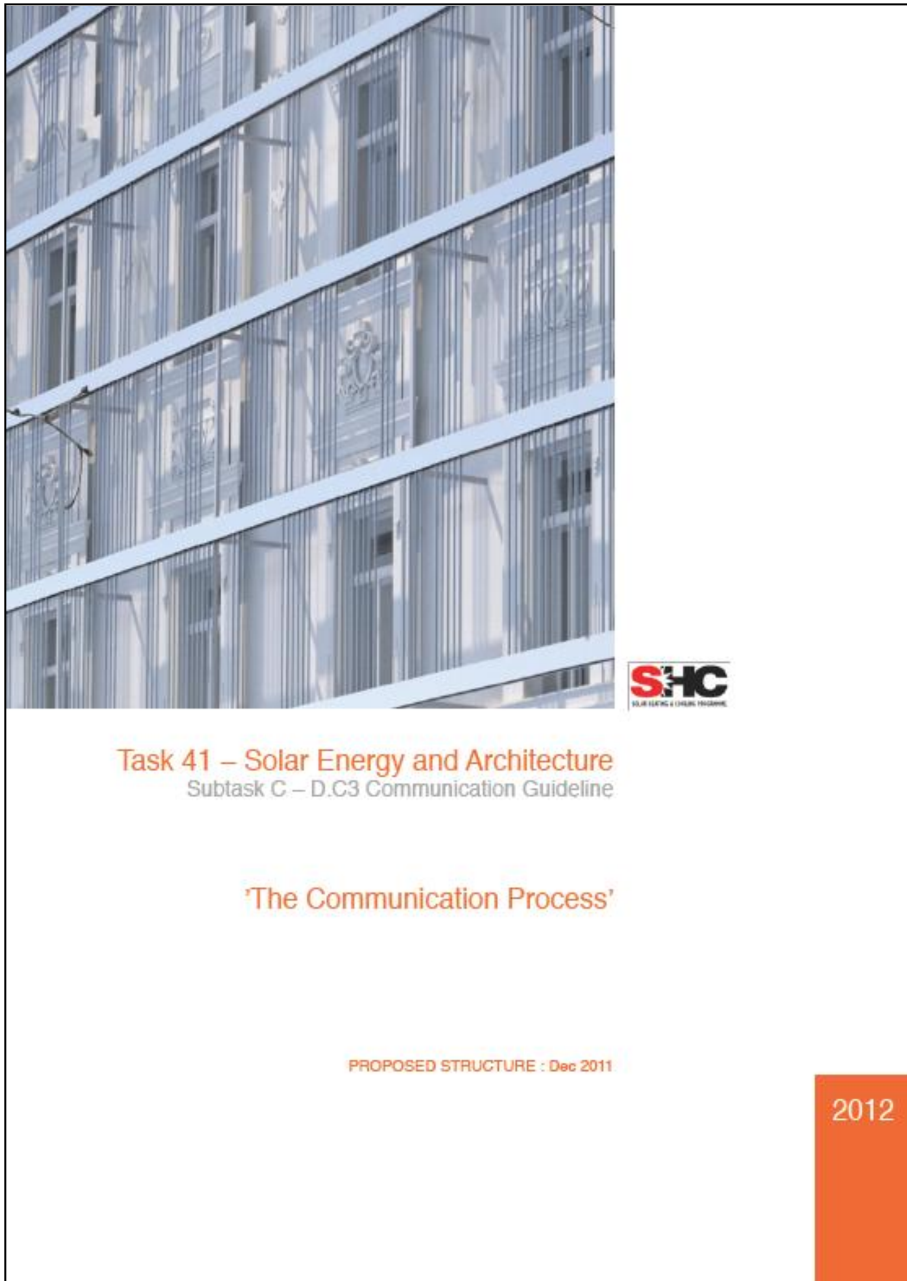

Communication Guidelines

Part 1:

Convincing clients to request and commission solar buildings

Part 2:

Communication strategies at the design / construction team level

Part 3:

Tools and References

Will be available at:

www.iea-shc.org/task41

When done the right way, ***solar and high quality architecture walk hand in hand and does pay!***