EXEMPLARY OF SPECIAL FEATURES
PH and Phase Change Materials
CONTENT OF THIS PRESENTATION:

11.04.00  PCM´s - Phase Change Materials
11.04.01  Senior residence, Domat/Ems (CH)
11.04.02  Apartment building “Im Bächli”, Teufen (CH)
11.04.03  Apartment house Eulachhof, Winterthur (CH)
11.04.04  Office building Marché, Kemptthal (CH)
Phase Change Materials

Sensible and latent heat

Temperature gradient of water with continuous heating

Beginning in the solid state (Ice), those increases Temperature up to the phase change, until thus the so-called "melting temperature" is reached.
Then the supplied energy is needed for the phase change. Only if all ice is transferred into the liquid condition, the temperature continues to rise. The same pattern repeats itself with the further energy input. The liquid is warmed up, until those characteristic temperature of the boiling point is reached.
The sequential supply of Energy converts the liquid without temperature change in gas.
Phase Change Materials

A Phase Change Material (PCM) is a substance with a high latent heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa; thus, PCM’s are classified as latent heat storage (LHS) units.

Source: [http://en.wikipedia.org/wiki/Phase_change_material](http://en.wikipedia.org/wiki/Phase_change_material)
Phase Change Materials

Sensible and latent heat

Phase Change Materials (PCMs) store energy by changing phase from solid to liquid (i.e. melting) and releasing heat by changing phase from liquid to solid (i.e. freezing).

Phase change materials provide a large heat capacity over a limited temperature range.

They act a little like an isothermal reservoir of heat.

### Some useable PCM – Materials and their melting point:

- **Organic PCM’s: (Flammable)**
  - Paraffin
    - Hexadekane: 18 °C
    - Nonadekane: 32 °C
    - LWSM-Paraffin: 30 °C
  - and Fatty acids
    - Capric acid: 31 °C
    - Palmitic acid methyl ester: 30-39 °C
    - Palmitic methyl ester: 29-35 °C

- **Inorganic PCM’s: (Non-flammable)**
  - Salt hydrates
    - CaCl$_2$·6H$_2$O: 27 °C
    - CaBr$_2$·6H$_2$O: 34 °C
    - Na$_2$SO$_4$·10H$_2$O: 32 °C

Source: [http://en.wikipedia.org/wiki/Phase_change_material](http://en.wikipedia.org/wiki/Phase_change_material)
Phase Change Materials

The change of the phase in the translucent "GlassXcrystal" element with a salt hydrate

- cooling down

- crystal state
- change phase
- liquid state

- heating up
11.04.01

Senior Residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz
Via Calundis 8
CH 7013 Domat/Ems, Switzerland
www.schwarz-architektur.at
Senior residence, Domat/Ems (CH)

Architectural concept

20 small apartments

- Compact form
- Orientation to the sun

South view

- Optimised thermal shell
- Ventilation system
- Special translucent glazing with a phase change material

North view

Fotos: Architect Dietrich Schwarz, Zürich CH  www.glassx.ch

Source: Architect Dietrich Schwarz, www.glassx.ch
Senior residence, Domat/Ems (CH)  
Architectural concept

The snow increases the solar gains by reflection of the solar radiation.
Senior residence, Domat/Ems (CH)
Architectural concept

- Staircase supports social contacts
- Lighting of kitchen via staircase
- Differently mirrored floor plans
- Spatial references within the flat
- Solar cladding with interior windows

Source: Plan and fotos: Architect Dietrich Schwarz, Zürich CH www.glassx.ch
Special translucent glazing

Loggias can be closed in winter time

Architectural concept

Source: Plan and fotos: Architect Dietrich Schwarz, Zürich CH  www.glassx.ch
Universal design for kitchen and bathroom.
South glazing with PCM (Phase Change Material)

GLASSX®crystal
www.glassx.ch
SPECIAL FEATURES, PH and PCM’s

- TRANSPARENT HEAT INSULATION with Insulation glass with multiple low-E coating and inert gas filling
- OVERHEATING PREVENTION with Prism glass
- HEAT-STORAGE with Latent storage with PCM

South glazing with PCM (Phase Change Material)
a Salt hydrate - melts at 26°C

Source: Architect Dietrich Schwarz, Zürich CH  www.glassx.ch
1: Four safety glasses, each 6 mm thick
2: Prisms panel of 6 mm in double-glazing cavity (20 mm) with inert gas filled
3: double-glazing cavity (12 mm), filled with inert gas
4: double-glazing cavity (22 mm) with PCM-Panel and a storage capacity of 1185 kWh/m²

U-value = 0.47 W/m²K

High summer sun > 40°
Total reflection of the direct irradiation

Flat winter sun < 35°
Passage of the direct irradiation without loss

11.04.09
Senior residence, Domat/Ems (CH)  Architecture: Dietrich Schwarz

Energy concept - PCM

Source: Architect Dietrich Schwarz, Zürich CH  www.glassx.ch
GLASSX® crystal integrates 4 system components in a functional unit:
– transparent heat insulation,
– protection from overheating,
– energy conversion and
– thermal storage.

A 3-ply insulating glass construction provides excellent heat insulation with an U-value of less than 0.5 W/m²K.

A prismatic glass implemented in the space between the panes reflects sun rays with an angle of incidence of more than 40° (in summer, when the sun is high in the sky). On the other hand, the winter sun passes through the sun protection at full intensity.

The central element of GLASSX® crystal is a heat storage module that receives and stores the solar energy and, after a time, releases it again as pleasant radiant heat. PCM (Phase Change Material) in the form of a salt hydrate is used as the storage material. The heat is stored by melting the PCM; the stored heat is released again when the PCM cools. The salt hydrate is hermetically sealed in polycarbonate containers that are painted grey to improve the absorption efficiency.

On the interior side, the element is sealed by 6 mm tempered safety glass that can be printed with any ceramic silk-screen print.
Senior residence, Domat/Ems (CH)  
Architecture: Dietrich Schwarz

Energy concept - PCM

Measuring results of GLASSX® crystal elements

Important is the inside temperature behind the glass
Senior residence, Domat/Ems (CH)

Energy concept - PCM

Diagram of summer and winter temperatures

Temperatures inside behind the glass

Source: GlassX - Energieeffizienz und erneuerbare Energien in der Architektur

INTERNATIONAL PASSIVE HOUSE SUMMER SCHOOL FOR STUDENTS
Senior residence, Domat/Ems (CH)  
Architecture: Dietrich Schwarz

Energy concept - PCM

Comparison of the effective heating need $Q_{h,\text{eff}}$

Variations – GlassX and different thermal qualities (u-value)
of the opaque building shell

This comparison shows that the PCM element enables the builder to reduce the thickness of the necessary heat insulation of the building.

Source: GlassX - Energieeffizienz und erneuerbare Energien in der Architektur

INTERNATIONAL PASSIVE HOUSE SUMMER SCHOOL FOR STUDENTS
Senior residence, Domat/Ems (CH)

Energy concept

Domestic hot water with heat pump and solar heat collector.

Central ventilation system with heat recovery

Source: Fotos: Schweizer BauJournal – SBJ 2/05
11.04.02

Apartment building “Im Bächli”, Teufen, Aargau (CH), 2006

Architecture: Dietrich Schwarz
Via Calundis 8
CH 7013 Domat/Ems, Switzerland
www.schwarz-architektur.at
Apartment house „Im Bächli“, Teufen (CH)  
Architectural concept  
A row house with 4 units in a small Swiss village.

PV and solar collector modules are integrated surface-concisely into the roof.

Source: Architect Dietrich Schwarz, Zürich CH  www.glassx.ch
SPECIAL FEATURES, PH and PCM’s

Apartment house „Im Bächli“, Teufen (CH)

Architectural concept

- Orientation to the sun
  - Solar windows
  - PCM’s
- Compact form
- High quality building shell
- Ventilation system with heat recovery

Apartment house „Im Bächli“, Teufen (CH)

**Architectural concept**

**Southern façade**

**Northern façade**

Apartment house “Im Bächli”, Teufen (CH)

Building concept

**Construction:**
- timber element construction with cellulose insulation
  - U-value: 0.11 W/m²K
- exterior wall covering: larch planking pre-greyed
- interior walls and ceilings: 3-layer slabs
- floor: cement slate or parquet

Source: Foto: dsc - St.Galler Tagblatt

Architecture: Dietrich Schwarz

Source: http://www.glassx.ch
Energy concept

Building services:
(Amstein & Walthert AG, Zurich)
- compact unit with controlled ventilation with heat recovery
- 6 m² solar collector
- 63 m² photo voltaic unit

Special aspect:
- heat storage element: GLASSX® crystal

- Energy reference plane (gross): 776 m²
- Heating demand: 12,2 kWh/(m²a)
- energy index heat: 22,5 kWh/(m²a)
- Pressure test result: 0,35 – 0,50 h⁻¹
Apartment house „Im Bächli“, Teufen (CH)

Energy concept – PCM elements
11.04.03

Apartment house Eulachhof, Else-Züblin-Strasse, Winterthur (CH), 2006

Architecture: GLASSX AG
Technoparkstraße 1
CH 8005 Zürich, Switzerland
www.glassx.ch
Apartment houses Eulachhof, Winterthur (CH)
Architectural concept
132 apartments with a zero-heating energy concept at the place of an old factory.
Apartment houses Eulachhof, Winterthur (CH)

Architectural concept

- Compact volume
- Optimal orientation of the building
- Optimized solar gains
- Use of PCM-panels
- PV – panels on the roof
- Low running costs
- A wheelchair-friendly area
- The distance of the two main buildings was calculated to enable the sunlight to come into the ground-floor apartment of the second building even in winter.
- 20% of the solar radiation is used by the PV roof (active-solar energy use) and 80% on the south facade (passive-solar energy use).
Apartment houses Eulachhof, Winterthur (CH)
Architectural concept

Sun protection (summer time)
- the balconies are the shading for southern glass
- the PCM-panels have the prism reflection

Source: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf
Foto: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf
Internal aspects
• optimized day-light
• open and transparent flats
• high comfort temperatures

Free cross ventilation
• comfort ventilation system
• very low indoor pollution
• good noise protection
Apartment houses Eulachhof, Winterthur (CH)

Architectural concept

Floor plan - 5th floor with terraces on the north side
Apartment houses Eulachhof, Winterthur (CH)
Architectural concept

Floor plan – 1st to 4th floors

Source: www.eulachhof.ch/grundriss.php
Apartment houses Eulachhof, Winterthur (CH)
Architectural concept

Floor plan - Ground floor / special types

Source: www.eulachhof.ch/grundriss.php
Apartment houses Eulachhof, Winterthur (CH)
Architectural concept

Floor plan – Ground and 1st floor / maisonette

Source: www.eulachhof.ch/grundriss.php
Apartment houses Eulachhof, Winterthur (CH)

Building concept

Concrete structure

Optimized building shell with prefabricated wooden lightweight elements with very high thermal quality:

- Roofs < 0.10 W/m²K
- Facades < 0.15 W/m²K
- Windows < 0.80 W/m²K
- Minimized thermal bridges
- Air-tight building shell
Material aspects

• high percentage of reused materials, use of recycling-concrete granulate
  – for construction concrete 50%
  – for lean concrete 100%

• materials with low environmental stress, wood and wood fibre for the external walls

• simple de-construction (demolition)
Apartment houses Eulachhof, Winterthur (CH)

Building concept

Prefabrication and transport of the lightweight façade elements

Source: www.erne-gruppe.ch   ERNE fenster + fassaden und HUSNER AG Holzbau
Apartment houses Eulachhof, Winterthur (CH)  
Architecture: GlassX AG

Building concept

Construction detail – wooden façade element with window and sun shutter

- air-tight and
- thermal bridge free construction.
Apartment houses Eulachhof, Winterthur (CH)

Building concept

Detail for the basement/wall connection

Detail for the wall/roof connection

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz
Apartment houses Eulachhof, Winterthur (CH)

Building concept

Details for the window/wall connection

horizontal

vertical

PCM - GlassX

Stütze

fresh air

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz
Apartment houses Eulachhof, Winterthur (CH)

Building concept

Horizontal cladding (Douglas fir) – rough/unplaned wood

Pre-greying with “Pento-Fluid Silver wood”

Source: www.eme.net/aktuelles/FF-Newsletter_Januar09_wattdOr.pdf

www.pentol.ch/default.asp?code=12010806
Energy concept

The energy concept is based on established and usual techniques like:

- ventilation system with heat recovery
- heat pumps
- district heating
- floor heating
- Photovoltaic

Combined is the result a Residential building with Swiss zero-energy-standard of MINERGIE-P-ECO® and

- No dependence on fossil energy sources
- CO2 – emissions minimised
Energy concept

- use of high efficient technologies for all appliances, engines, lighting, building services
- efficient ventilation system with DC-vents
- heat pumps with high efficiency factor
- household appliances with classification A to A+++ 
- maximal use of waste heat by heat recovery from waste water and reusable materials

=> Full recovery of energy need with renewable energies (incl. exergy-need)
Apartment houses Eulachhof, Winterthur (CH)

Energy concept

With the thermal reuse of the refuse in the incineration plant, the apartment house is fully self-supported with energy.
Apartment houses Eulachhof, Winterthur (CH)

Energy concept – Ventilation, heating and heat recovery

- **Outside air**: -10°C
- **Supply air**: 20°C (air volume flow is constant)
- **Exhaust air**: 22°C, 4°C
- **Waste water**: heat recovery
- **Waste water - heat pump**: SEER 3.8
- **Exhaust air - heat pump**: SEER 5.4
- **Water / glycol cycle**: District heating from incineration plant
- **Hot water DHW**: 22°C
- **Exhaust air 22°C**: Airbox: 2 x 80 m³/h supply air / apartment (variable from 50% - 100%)

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz
Apartment houses Eulachhof, Winterthur (CH)

Energy concept - Ventilation

The special “Airboxes” used in this project have no direct heat exchange. The heat recovery is taken from the exhaust air by a central heat pump. The “Airbox” includes:

- Filter
- 4 Mini-vents
- Air heater
- Silencer
- Air distribution

It is integrated into the concrete ceiling.

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz
Floor plan with position of the „Airbox“, the supply air and the floor heating in the edge areas and bathroom.

Exhaust air
Apartment houses Eulachhof, Winterthur (CH)

Energy concept - Wastewater heat

Heat exchanger with 2 heat pumps
Condenser performance: 80 kW (2 x 40 kW) Annual coefficient of performance COP: 4,2 (at 60°C storage temperature)
Shaft size: 15 m³

The heat exchanger is installed in a separate shaft where the filtered wastewater from the entire buildings is temporarily collected, cooled and disposed again to the channel system. A filter holds back the collected grunge and sand and disposes it again to the wastewater system. The shaft is always filled up to a certain level with wastewater to insure the necessary heat transfer. For cleaning purposes the filter is automatic rinsed once a day. Fully cleaning of the shaft takes place every 1 to 2 years.
By the use of all waste water heat combined with a heat pump an all-season domestic hot warm water (DHW) supply is guaranteed. It can be completely done without an additional heating system (solar collector). The electricity comes from the PV-panels.

Source: FEKA Energiesysteme AG - www.feka.ch/pdf/FEKA_Energie_aus_Abwasser.pdf
These multilayer solar crystals (GLASSXcrystal) have the effect of heating during wintertime and cooling in summer.
Apartment houses Eulachhof, Winterthur (CH)  
Energy concept – PV panels  

The electricity for the building is provided by photovoltaic cells. Therefore the Eulachhof residents do not need to pay extra for any external energy source. Only the personal electricity use (TV, computer, etc.) is externally supplied.
Apartment houses Eulachhof, Winterthur (CH)

Energy concept - Balance

Effective heating need

- Roof: 5.6 kWh/m²
- Exterior walls: 2.2 kWh/m²
- Floor: 1.0 kWh/m²
- Windows: 2.4 kWh/m²
- Thermal bridges: 5.5 kWh/m²
- Ventilation losses (Standard): 3.5 kWh/m²
- Additional ventilation losses (Airboxes): 2.3 kWh/m²

Coverage heating need

- District heating from incineration plant: 6.6 kWh/m²
- Exhaust air - heat pump: 26.2 kWh/m²
- Seasonal Energy Efficiency Ratio (SEER): 5.4

Power need for heating (unweighted): ~ 5 kWh/m²

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz
11.04.04

Office building - Marché International, Kemptthal (CH), 2007

Architecture: Beat Kaempfen (kaempfen for architecture)
Badenerstrasse 571
CH 8048 Zurich, Switzerland
www.kaempfen.com
Office building Marché, Kemptthal (CH)

Architectural concept

The international company Mövenpick / Marché assigned the Swiss architect Beat Kämpfen to plan the new head office with the guidelines:
- „No luxury“
- A pleasant working environment for the employees
- 12-month time from planning start to completion
- High quality of the building
  - sustainability
  - healthy working environment
- Best economy

Result:

First Swiss Zero-Energy-Office building

Source: Fotos: Schweizer Solarpreis 2007
Office building Marché, Kemptthal (CH)
Architectural concept

Southern view, photo voltaic panels on the roof
- Passive – solar building concept
- Completely glazed south facade with „GlassX“
- Tight and high thermal quality building shell

Swiss Solar Award 2007

Source: www.kaempfen.com
Office building Marché, Kemptthal (CH)

Architectural concept

Southern view with solar windows and 50% translucent PCM-panels

Day and night

Source: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf
Office building Marché, Kemptthal (CH)  
Architectural concept

Inside view with solar windows and translucent PCM-panels

Source: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf
Office building Marché, Kemptthal (CH)

Architectural concept

Floor plan

- Focus to ecological, environmentally compatible construction
- 3 – level office building with timber construction
- Cost-effective solutions
- “Minergie-P Eco” certification

Source: www.kaempfen.com

INTERNATIONAL PASSIVE HOUSE SUMMER SCHOOL FOR STUDENTS
Office building Marché, Kemptthal (CH)

Architectural concept

Section

Roof unheated

Small windows to north

Big glazing areas to south
50% GlassX for thermal storage

Storage mass

Porch and balcony gives shadow in the summer

Fresh air

Photovoltaic system

Soil register
Office building Marché, Kempfthal (CH)

Architectural concept

Characteristics:

- Standard / certificate: Zero-energy / Minergie-P-eco
- Energy value: 7.8 kWh/m²a
- Floor area GF: 1,454 m²
- Volume (SIA 416): 5,757 m³
- Costs / m³ BKP 2: 565 CHF/m³ or 2,235.- CHF/m²
  (1,475.- €/m²)
Office building Marché, Kemptthal (CH)

Building concept

**Timber construction on strip foundation (ventilated)**
- built completely with prefabricated wooden panel elements (4.00 x 12.00 m)
- high precision of the construction
- very fast planning/construction time (12 month)

**For more thermal mass**
- concrete floor with natural stone coating on timber construction
Office building Marché, Kemptthal (CH)

Building concept

Building elements:

Floor slope: U-value = 0.095 [W/m²K]

Roof: U-value = 0.084 [W/m²K]

Exterior wall: U-value = 0.104 [W/m²K]

Window: Ug=0.5 [W/m²K], g=54 %

GlassX: Ug=0.46 [W/m²K]

Source: Fact Sheet, Support Office Marché International, Mai 2007
The load carrying structure is a 3.5 cm wooden board on the inside.

The ducts for the ventilation system are built with and integrated in the wooden construction.

Office building Marché, Kemptthal (CH)

Building concept

Prefabricated wooden elements with cross laminated panels. The stairs are made of concrete.
Office building Marché, Kemptthal (CH)

Building concept

No connection between wooden structure and concrete stairs – for structure-borne and impact sound protection.
Fixing the PCM-panels

50% of south side glazing - GlassX for thermal storage

Source: Foto: Beat Kämpfen, Zürich
Office building Marché, Kemptthal (CH)

Energy concept

- Compact volume
- South oriented
- Thermal optimized building envelope
- Ventilation with heat recovery
- Fresh air trough (sub-) soil heat exchanger
- Ground source heat pump
- Thermal storage with PCM´s
- PV-power for domestic technique
- Overall energy consumption 10 times lower than an ordinary building

Small windows towards north
Office building Marché, Kemptthal (CH)

Energy concept

Ventilation system: Demand controlled (3-steps)

Photovoltaics 451Wp

Outside air
Ventilation unit
Exhaust air

Supply air
Used air

Air humidification with planted wall

Air space
Air space ground heat exchanger


Architecture: Beat Kaempfen
Energy concept

Energy characteristics (SIA 380/1)

- Treated floor area (TFA): 1.516 m²
- Building shell value (A/TFA): 1.29
- Annual heating need: 28 MJ/m²a (Minergie-P Standard air change 0.33 m³/m²h)
- Annual heating need: 19 MJ/m²a (Minergie-P Standard air change 0.16 m³/m²h)
- Air tightness of the building shell: 0.57 h⁻¹

Certificate: Minergie - P - ECO
**Energy concept - Energy balance**

<table>
<thead>
<tr>
<th>Energy need building</th>
<th>Heating</th>
<th>12'000 kWh/a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ventilation</td>
<td>4'000 kWh/a</td>
</tr>
<tr>
<td></td>
<td>Warm water</td>
<td>2'000 kWh/a</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>18'000 kWh/a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy need</th>
<th>Lights</th>
<th>8'000 kWh/a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Office equipment</td>
<td>12'000 kWh/a</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>2'000 kWh/a</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>22'000 kWh/a</td>
</tr>
</tbody>
</table>

**Energy need total**

40'000 kWh/a

Photovoltaic system: installed power 44'600 kWp / annual production 40'000 kWh/a

**Energy production total**

40'000 kWh/a

**Energy need**

0 kWh/a

*Source: Fact Sheet, Support Office Marché International, Mai 2007*
- Life Cycle Analysis with Eco-indicator
- Calculation for grey energy and material flow:
  - production of construction materials,
  - construction of the building,
  - the running energy over 45 years,
  - demolition of the building with removal

=> A third of the energy of a conventional building
Office building Marché, Kemptthal (CH)

Energy concept - Eco balance

Technical equipment:
- Subsoil heat exchanger - length 25 m
- Ventilation system with heat recovery: Cesovent Minair 3000 PH
  - Air volume 750m³/h, max. 2'500m³/h
  - Heat recovery value 91% bei 2700m³/h (ABL 22°/AUL-10°)
- Post heating of supply air only from -3° outside temperature
- Ventilation system with heat recovery (relaxation rooms): Renovent 300
  - Air volume 60m³/h, max. 250m³/h
  - Heat recovery value > 90%
- Heating: Heat pump CTA Optiheat 18e
  - with 2x180m subsoil probe
- Photovoltaic system 485 m²
  - First solar thin film cells
  - 44'600 Wp installed power
- Rain water basin / Biotope ca. 100m³

Source: www.kaempfen.com
Office building Marché, Kemptthal (CH)

Energy concept - Ventilation

The domestic engineering equipment is located on top of the stairs.

The horizontal ventilation ducts are distributed in the roof and covered with heat insulation.

The vertical ducts are integrated in the wooden structure.

All floors have a 12 m² plant wall. 30 litres of water evaporate daily from each plant wall for a comfortable indoor air humidity.
Office building Marché, Kemptthal (CH)
Energy concept - Ventilation

Heat recovery with heat exchanger
Energy concept – Heating /Cooling

On top of the wooden box beam elements is a concrete floor screed with a floor heating system. It is supported by the ground source heat pump. In the summer time it is used for cooling (with 18°C).
Office building Marché, Kemptthal (CH)

Energy concept - PV

485 m² Photovoltaic system:
installed power 44'600 kWp
annual production 40'000 kWh/a

- Pitched roof directly south
- Slope 12°
- Roof skin = shiny anthracite coloured thin film solar panels
- Enough electricity for technical installations and running the office