Solar Buildings:
Main Players of Sustainable Campus

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Hurricane Katrina (USA - 2005)
Water Floods & Heatwaves (Europe - 2007)

Greece – June 2007

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- Introduction
- Climate Changes: Outlook and Challenges
- Solar Buildings: Contribution and Role
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**Scenario for Switzerland (2050)**

- 2 to 3°C Temperature Increase
- 10 to 20% Diminution of Rain Falls
- Higher Frequency of Extreme Events
- Acute Risk of Floods and Torrential Flows
- Increase of Droughts and Heatwaves Occurrence (Summertime)
- Decrease of Snow Falls Occurrence (Wintertime)

OcCC/ProClim, 2007.
-11% (2030) to -15% (2050) Mitigation of Building Heating Loads
+100% (2030) to +150% (2050) Increase of Building Cooling Loads
- Transfer from Heat toward Electricity Demand
 (+3200 GWh/a for Non-Residential Buildings)

OcCC/ProClim, 2007.
Building Cooling Loads – Heatwave 2003

Scorching Summer 2003 (Zürich)
Highly Glazed Facade (80%), Solar Blinds (SHGC: 0.10)
Moderate Free Gains (15 W/m²)
Natural Ventilation (Night Cooling)

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OcCC/ProClim, 2007.
**2000 Watts Society - Factor 4**

The chart illustrates the average power consumption in watts per capita for various categories:

- **Work & Habitat**: 1500 W/ca
- **Feeding & Wealth**: 1140 W/ca
- **Infrastructures**: 570 W/ca
- **Electricity**: 480 W/ca
- **Mobility (Road)**: 230 W/ca
- **Mobility (Airplane)**: 140 W/ca
- **Mobility (Railway)**: 100 W/ca

The chart compares the consumption for today's family (4 persons, 4960 W/ca) and the 2000 Watts Society family (1960 W/ca).

**Introduction**

**Outlook & Challenges**

**Contribution & Role**

**Future Perspectives**

**Conclusion**
LESO Solar Building - Key Instrument

- 30 m² PV Panels (3 kW-peak)
- Anidolic Daylighting System ($DF_{AVG} = 3\%$)
- Double Insulated Selective Glazing ($U = 1.1 \text{ W/m}^2\text{K}$)
- Larch Breast-wall ($U = 0.85 \text{ W/m}^2\text{K}$)

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LESO Solar Building - 2000W Target

PV Power Plant 15.5 MJ/m².a
PC & Appliances 129 MJ/m².a
Lighting 42 MJ/m².a
Heating 76 MJ/m².a
Walls 96 MJ/m².a
Windows 96 MJ/m².a
AirR 83 MJ/m².a

EPFL Campus – Design & Planning 1975-2008

1st Stage (1975 - 1985)
- 8 cm Thermal Insulation
- Triple Insulated Glazing
- Low Air Infiltration Rate
- Natural Ventilation

2nd Stage (1985 - 1999)
- 10 cm Thermal Insulation
- Double Insulated Glazing
- Passive Solar Design
- Cooling Load Extraction
- Natural Ventilation

3rd Stage (1999 - 2008)
- 10 cm Thermal Insulation
- Double Selective Glazing
- Cooling Load Extraction
- Natural Ventilation

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EPFL Campus – Buildings Energy Performance

Heat & Electricity Demand (2007)

Buildings Heat Demand
25'333'162 kWh
35.5%

Buildings Water Cooling Demand
1'077'316 kWh
1.5%

Buildings Electricity Demand
44'884'636 kWh
63%

Energy Sources - Heat Demand (2007)

Water Pumping Electricity Demand
4%

Heat Pump Electricity Demand
20%

Back-up Heat (Fuel)
4%

Environment (Heat Pump)
72%

Mitigation of 250’000 Tons CO₂ over 25 years
(22’000 Tons CO₂ per annum in 2007)

Zero Energy Building – Forum Chriesbach

Main Features

Architects : Bob Gysin + Partners (Zürich)
Contractor : Implenia SA (Dietikon)

Volume (SIA 416) : 32'986 m³
Building Area (SIA 416) : 5’012 m²
Heated Floor Area (HFA) : 11’170 m²

External Shading (lamellaes)
Daylighting Technology (atrium)
Free Cooling (canadian well)
Active & Adaptive Facades

PV Solar Panels (459 m²)
Thermal Solar Collectors (50 m²)
Rain Water Recovery (4 m³)
Biological Toilets (Nomix)
Forum Chriesbach – Building Views

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Forum Chriesbach – Building Performance

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Primary Energy Demand [MJ/m².a]

- Embodied Energy
- Electricity
- Cooling
- Heating

2000 Watts Target
EPFL Solar Energy Lab - R&D Focus

Integration of REN Technology

Urban Scale

Nano Scale

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Coloured Solar Collectors – Basic Principles

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Absorber Plate    Interference Filter    Diffusing Treatment

Solar Radiation

Diffusing Glass Reflection  8 %
Coloured Glass Reflection  6 – 10 %
Coloured Solar Collectors – Glass Treatment

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Coloured Solar Collectors – Glass Samples

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Coloured Solar Collectors – Case Study

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Conclusion

- Solar Buildings are Main Players in the Mitigation of Climate Changes (IPCC RET Special Report)
- Substantial Scientific and Technological Progress was achieved in the last Decades (Zero & EnergyPlus Buildings)
- Focus on Refurbishment, Electricity Demand and Embodied Energy is required (Growing Concerns)
- Future Research Efforts must address the Integration of Solar Technologies in the Built Environment (Dissemination)
Any Questions?

Thank you for your Attention