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## Training for Renovated Energy Efficient Social housing

**Intelligent Energy Europe programme - Contract n° EIE/05/110/SI2.420021**

Intelligent Energy Europe

# Section 1 - Techniques
# 1.4 Solar Hot Water

**Jan-Olof Dalenbäck**

**CIT Energy Management AB**

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**Solar heatings systems are mainly used**

**in single family buildings in Greece,**

**Austria and Germany**

**The following is an introduction guide**

**how to apply solar heating systems**

**in existing multifamily buildings**

**all over Europe**

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Right:
Roof-intergrated solar collectors on multifamily building in Austria
Photo: SOLID / Austria Solar

Left:
Roof-mounted solar collectors on multifamily building in the Netherlands
Photo: Zensolar

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- **Design guidelines**
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# Introduction

- **Heat demand in existing res. buildings**
  - Heat transmission losses via building envelope
    – Maximum in Winter (~ ambient temperature)
  - Heat losses due to ventilation
    – Maximum in Winter (~ ambient temperature)
  - Heat demand for hot water – About constant (~ water use)
- **Solar heating in existing buildings**
  - Solar radiation - Maximum in Summer
  - Solar collectors best suited to heat hot water
    (unless it is feasible to store heat for longer periods)

# Prerequisites

- **Suitable location**
  - Available roof area for collectors ? Shading ?
  - Suitable place for a water storage tank, etc. ?
- **Existing heat supply system**
  - Heating plant in building or district heat supply ?
  - Existing central domestic hot water system ?
  - Installation of a central domestic hot water system ?
  - Existing statistics re. domestic hot water load ?
  - Water saving measures ?
  - Existing heat source and cost for heat ?

# Solar collectors

- **General**
  - Can be integrated in or mounted on a tilted roof

    - Marginal cost on tilted roof to be renovated
  - Solar roofs in SE, AT and DE
  - Can be standing on flat roofs
  - Facades – Think twice, reduced yield, shading, etc.
  - Not too far from heating plant / unit (pipe losses)
- **Orientation**
  - Due south, within SE to SW is acceptable (<10%)
  - Same as roof tilt, from low 15 º to high 45º is acceptable (<10%)

# System and load

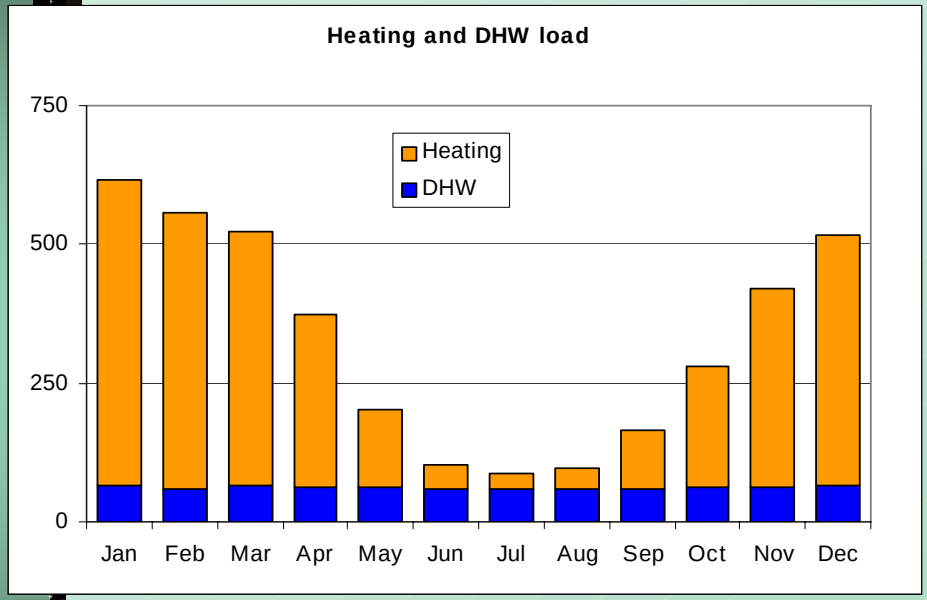
- **Existing heat supply system**
  - Heating plant in building
  - District heat supply

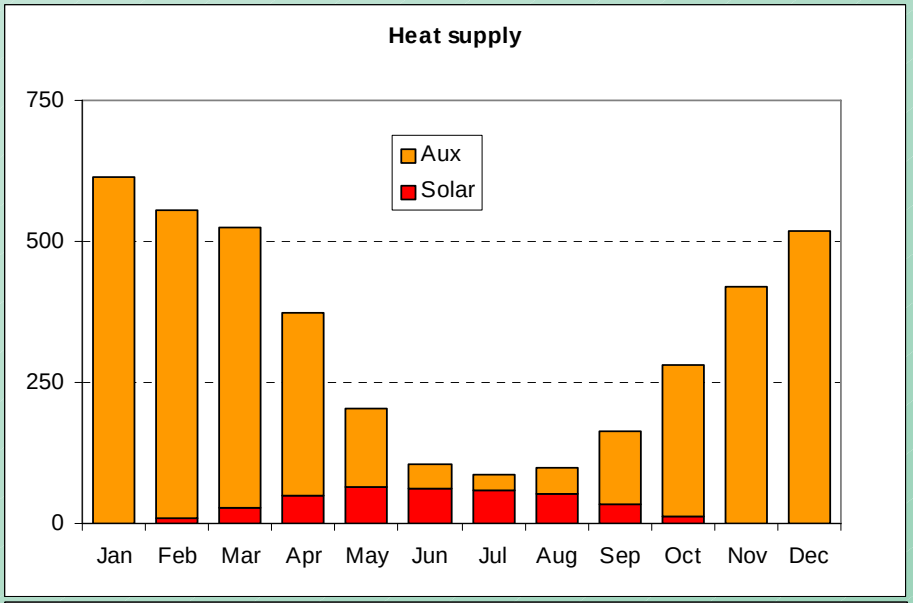
    (Common in North and East Europe)
  - Individual systems
- **Domestic hot water demand**
  - 30 - 50 cbm per year and apartment
  - 30 - 50 kWh per year and sqm of heated area
  - Monthly variations

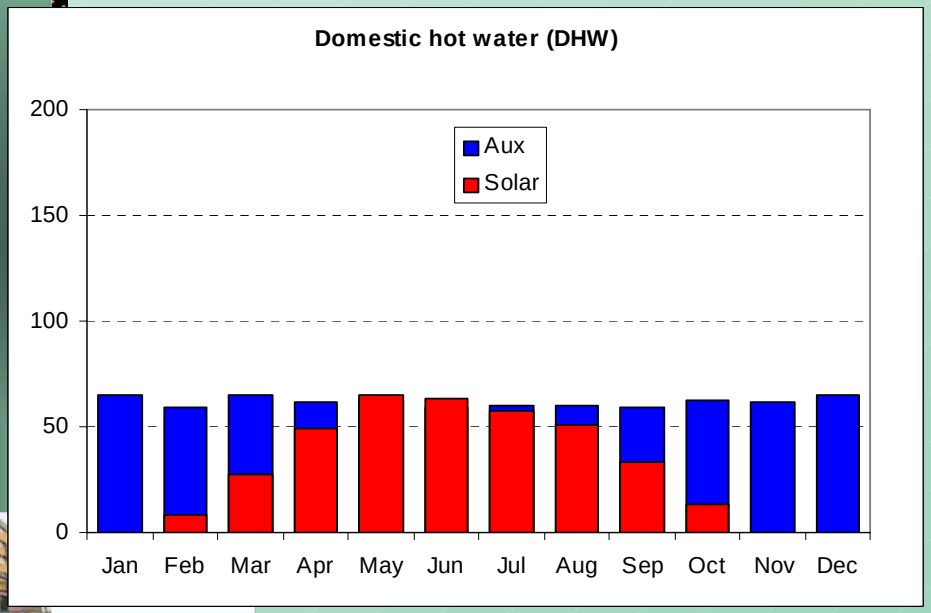
# Design guidelines

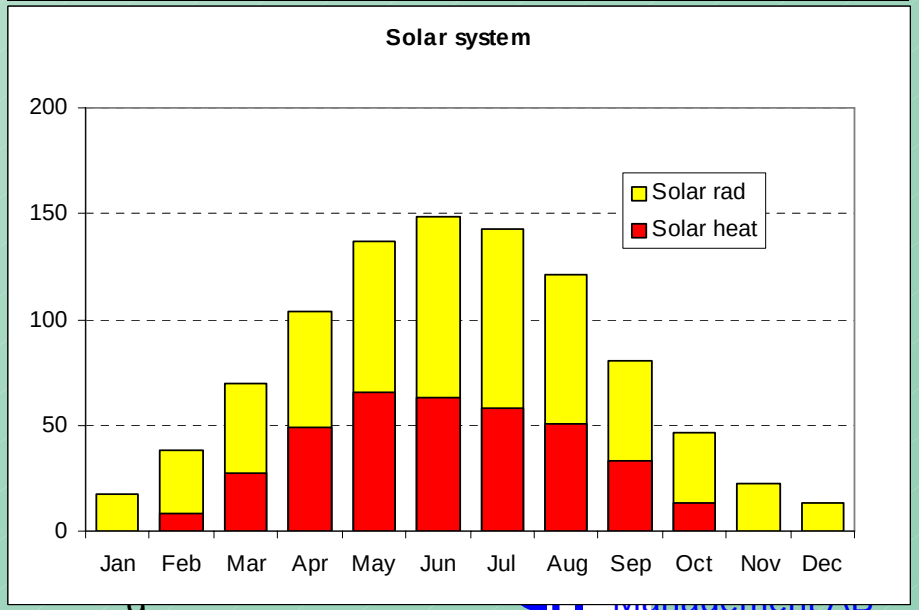
- **Pre-heating of domestic hot water**
  - Cover (close to) 100 % of the hot water in Summer months
  - Cover 30 - 70% of the annual DHW heat demand
    (Local climate conditions – Highest in South-Europe)
- **Solar collector area**
  - 2 - 4 sqm per apartment;
  - 0,5 - 1 sqm per person
- **Storage volume**
  - 50 - 100 litre per sqm of collector area
  - 150 - 200 litre per apartment

# Sample – Swedish climate



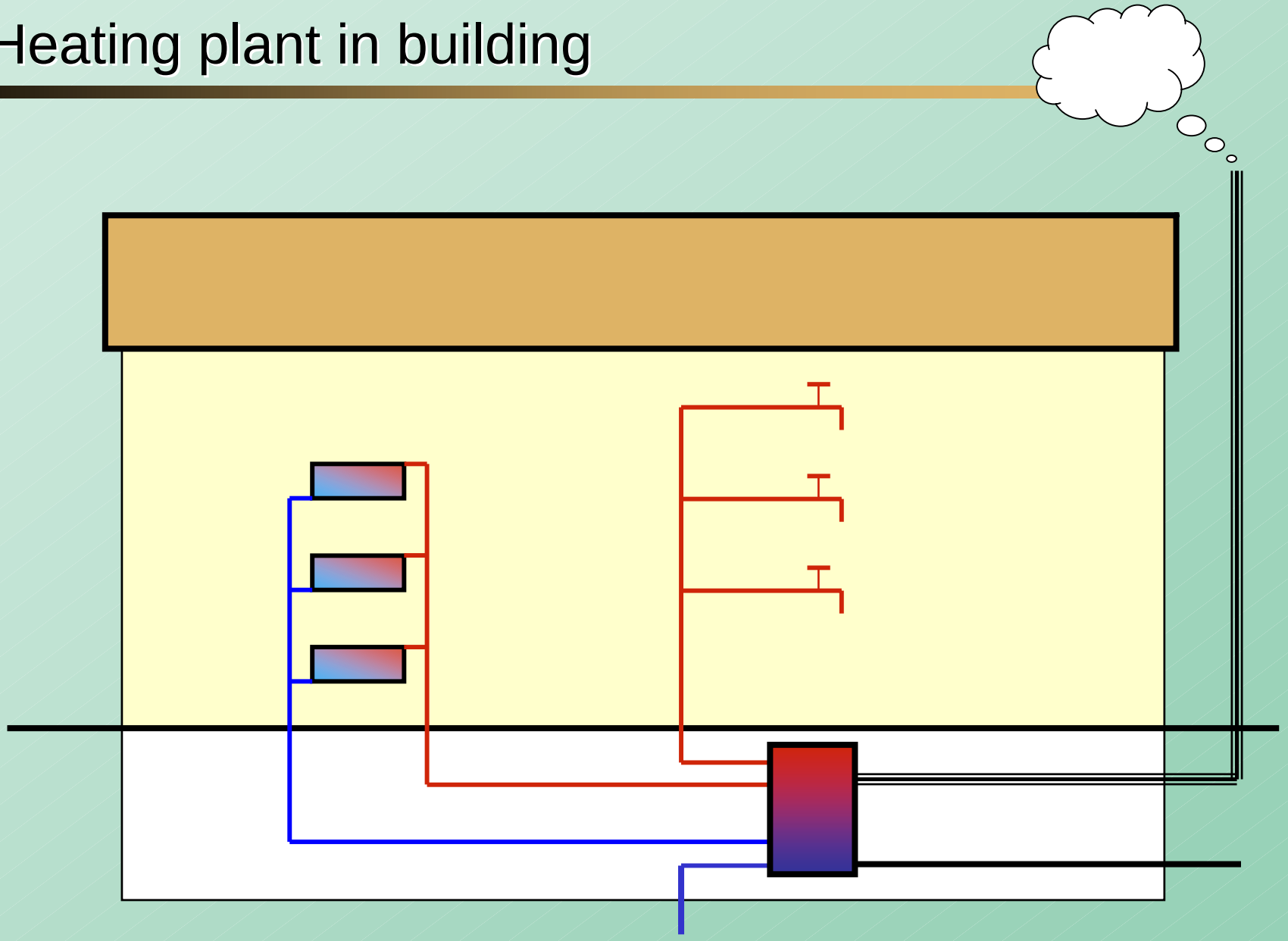



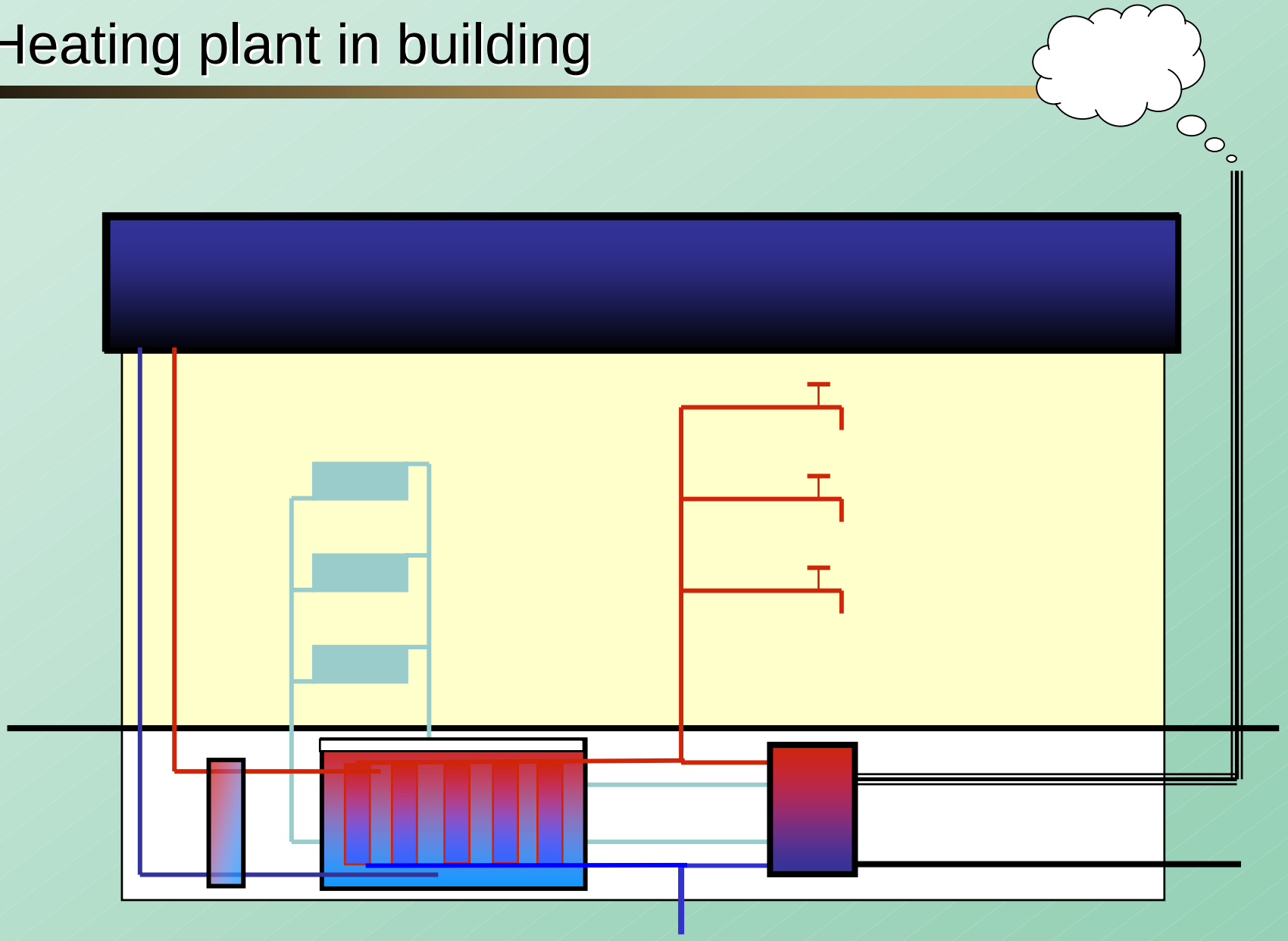
# System schematics

- **Heating plant in building**
  - Solar system for pre-heating hot water
  - (… a system also for space heating might be a design option)
- **District heat (DH) substation**
  - Solar system for pre-heating hot water (secondary circuit)
  - Solar collectors connected to DH (primary circuit) and controlled with constant outlet temperature (variable flow)

# Heating plant in building



# Heating plant in building



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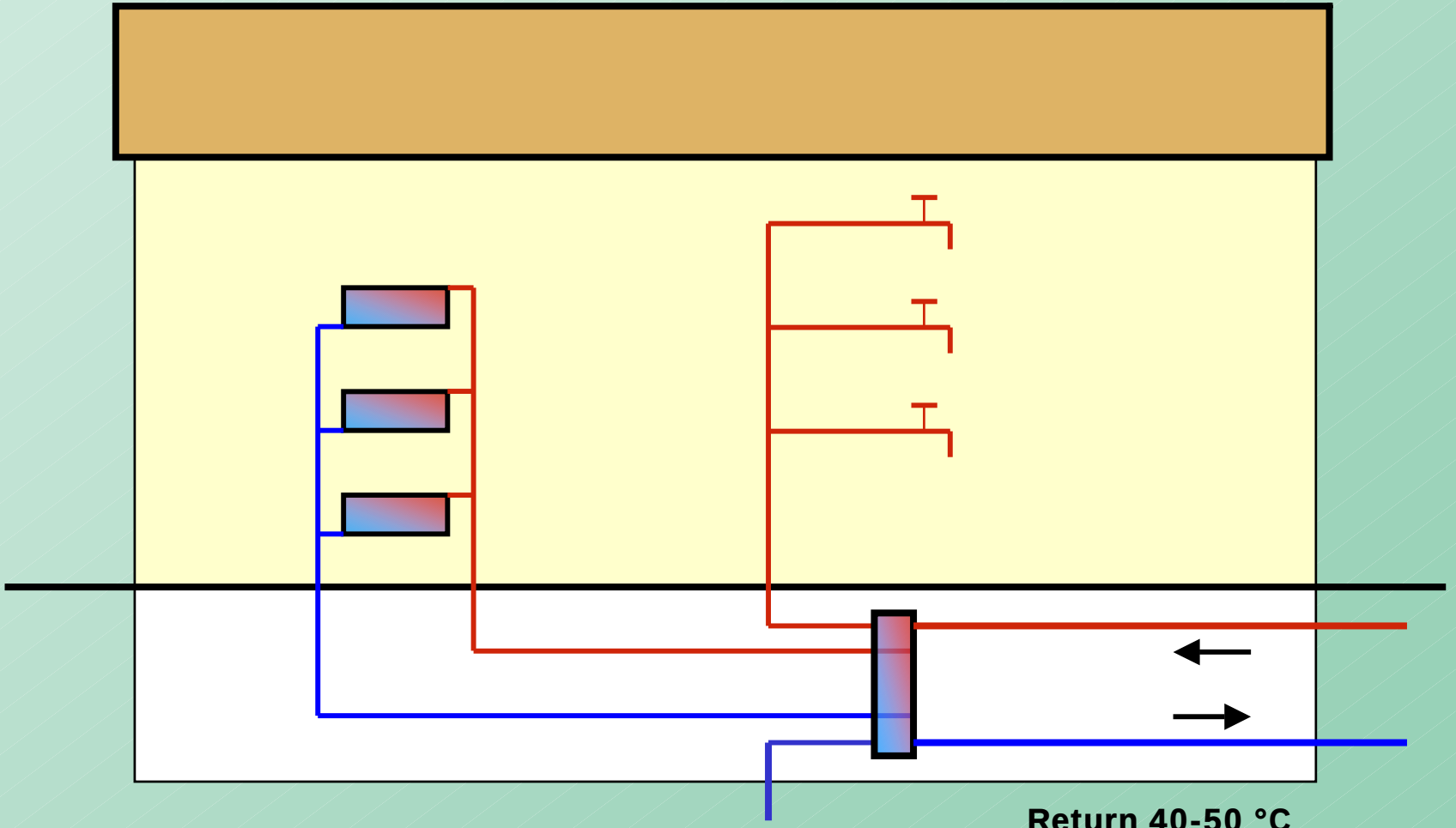
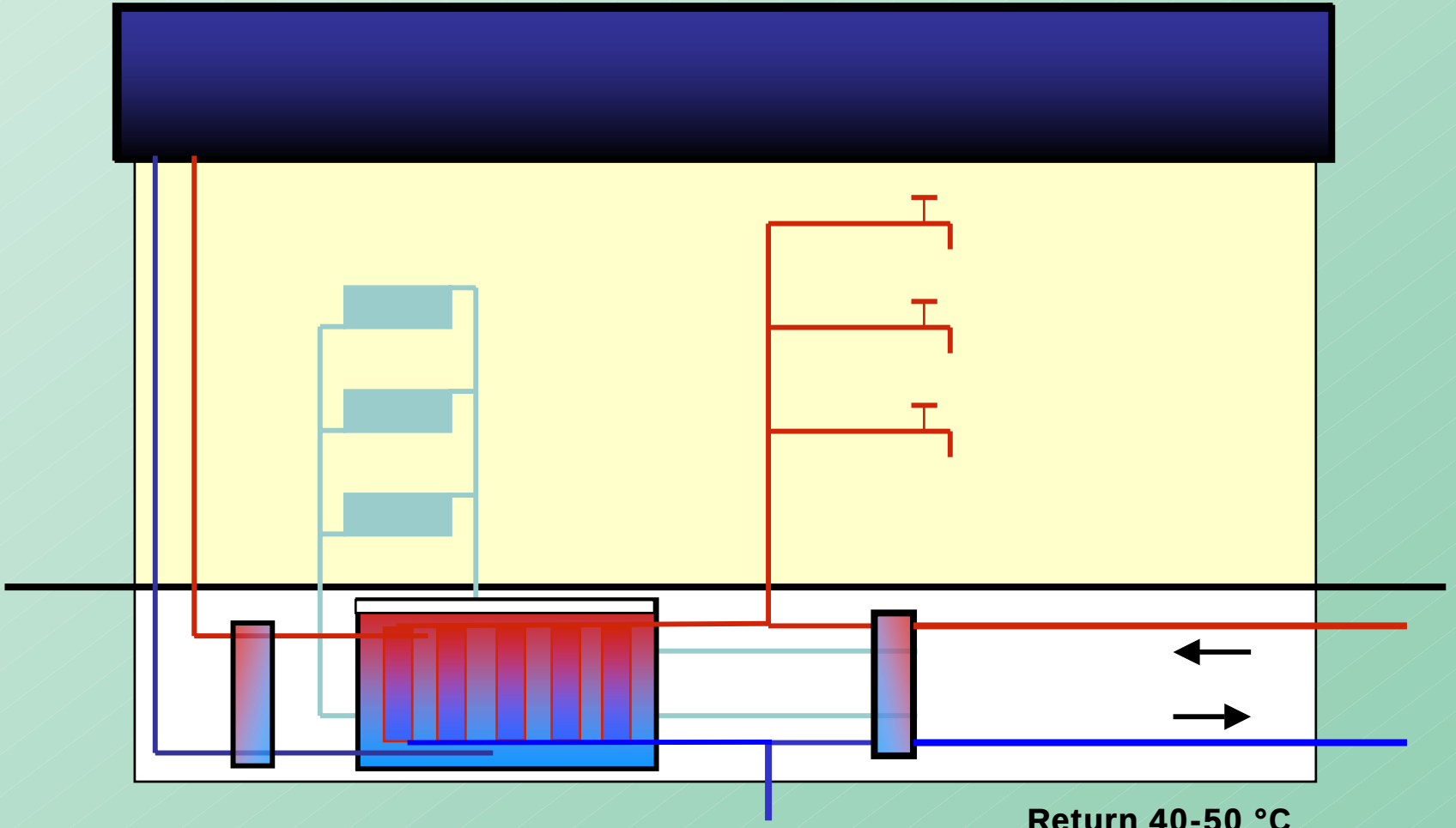
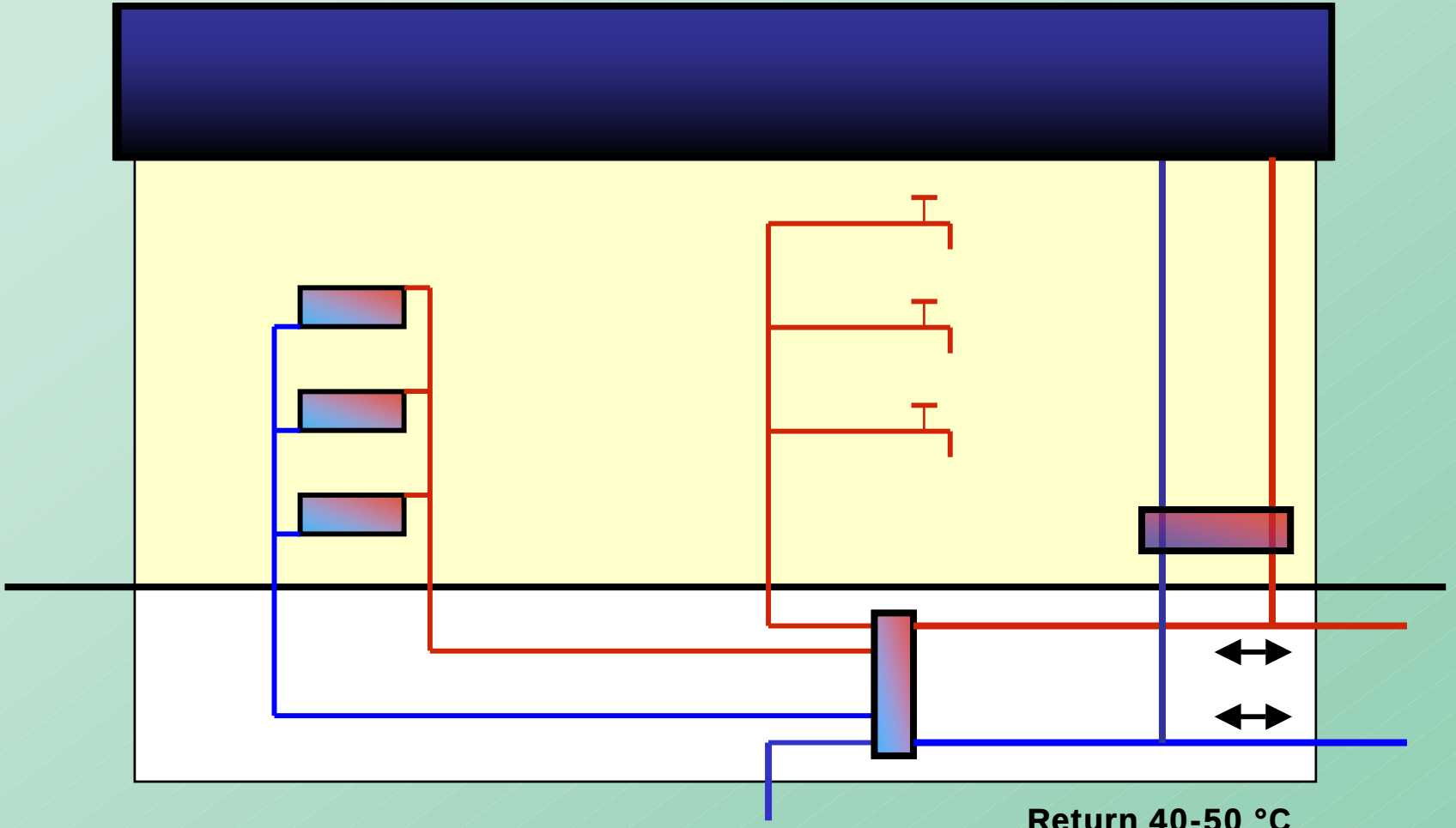
# DH substation



# DH substation (Secondary)



# DH substation (Primary)

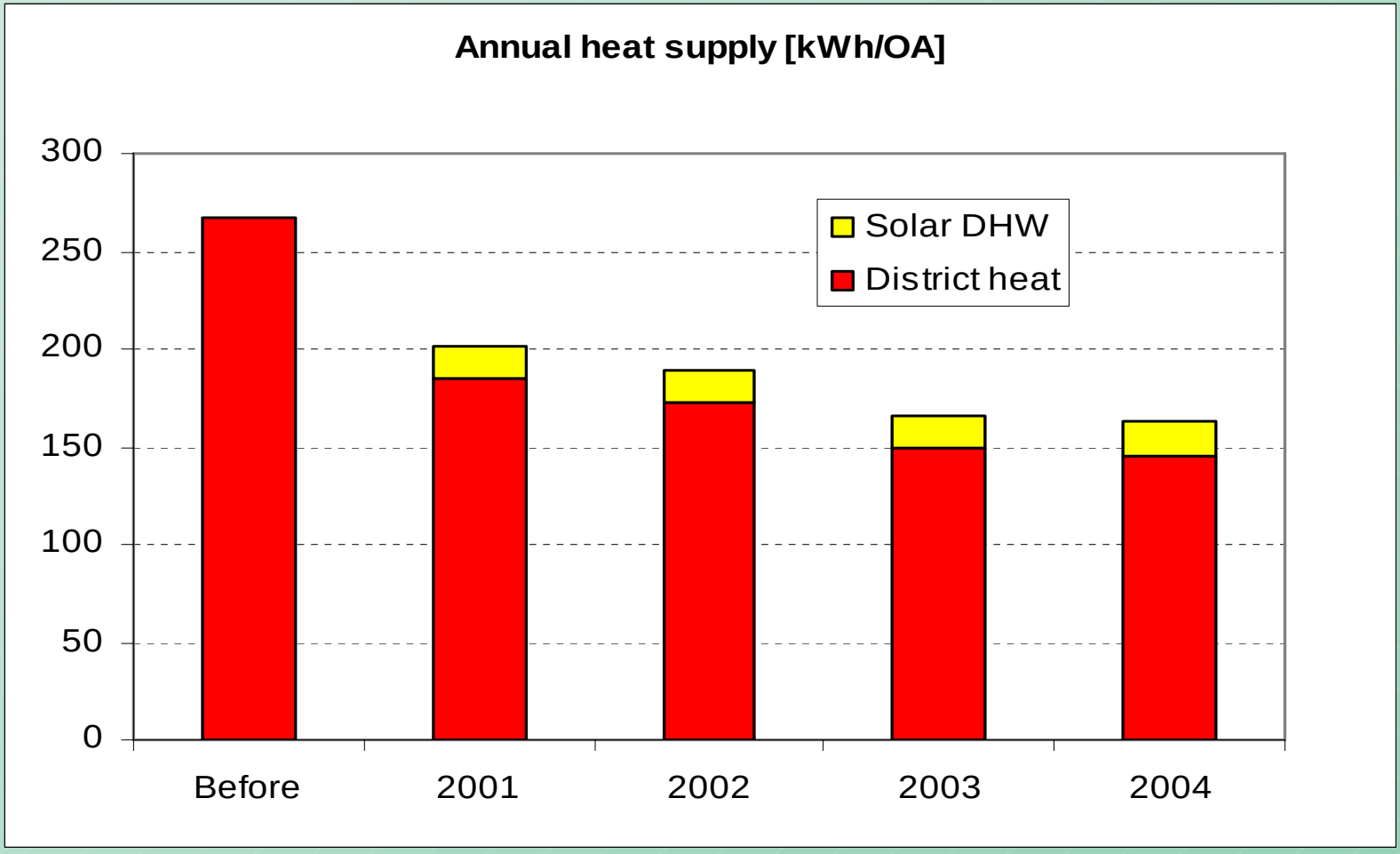


# Case study - Illustration

# Case study - Description

- **Multifamily buildings from the 70's with flat roofs to be renovated**
- **10 buildings – 3 oriented to south - 255 apartm.**
- **District heating supply for 3 x 85 apartm.**
- **Solar systems with 3 x 235 sqm roof-integrated collectors (i.e. ~ 3 sqm per apartm.)**
- **Provides > 10 % of the total heat demand (30 – 40 % of the heat demand for hot water)**

# Case study - Result

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# Case study - Cost

- **Solar collector roofs ~ 250 Euro/sqm**
- **System and storage ~ 250 Euro/sqm**
- **Total investment ~ 500 Euro/sqm**
- **Net annual solar contribution ~ 400 kWh/sqm**
- **Solar heat cost ~ 0,10 Euro/kWh**
- **VAT excluded**

# Facts - I

- **Solar radiation**
  - 0 – 1 000 W per sqm
  - 1 800 – 1 000 kWh per year and sqm
    (South to North Europe)
- **Solar collector**
  - Absorbs solar radiation and transfers heat to a circulating media
    (usually a mixture of water and glycole for freeze protection)
  - 500 – 700 W per sqm design heat output
  - 300 – 700 kWh per year and sqm thermal yield

# Facts - II

- **Flat plate solar collector**
  - Transparent cover (typical glass)
  - Selective absorber, insulated box, etc.
  - Varying module size from 1 – 20 sqm
    (large modules favourable in large systems)
- **Evacuated tube collector**
  - Designed as a glass tube - vacuum as thermal insulation
  - Designed with absorber as in a flat plate collector
  - Designed with a heat pipe and a heat exchanger
  - Designed with and without reflector
  - Varying module size, mounting procedure, etc.

# Facts – III

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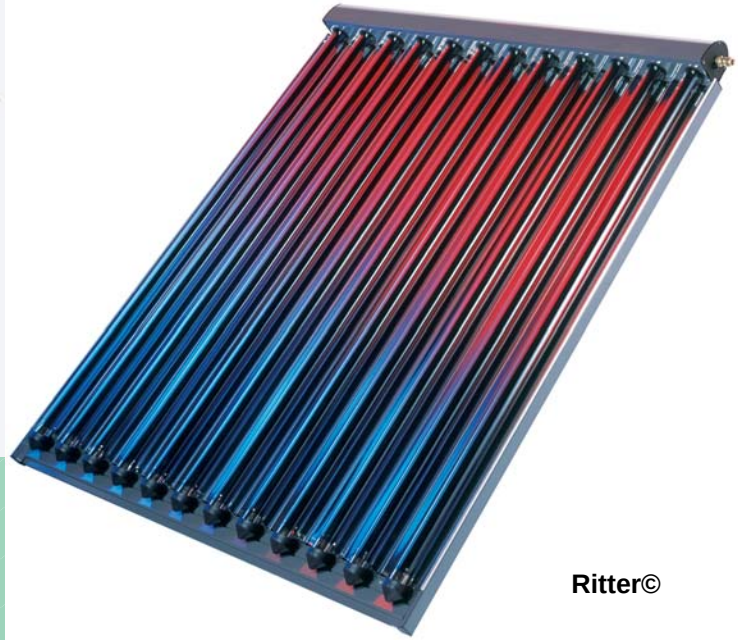

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# Addresses

- **www.estif.org**
  - European Solar Thermal Industri Federation – ESTIF
  - European industry and industry associations
  - Promotes Solar Keymark – European test certificate
- **www.solarge.org**
  - EC project with examples and guidelines related to solar heating systems in multifamily buildings, etc
- **www.valentin.de**
  - Simulation software