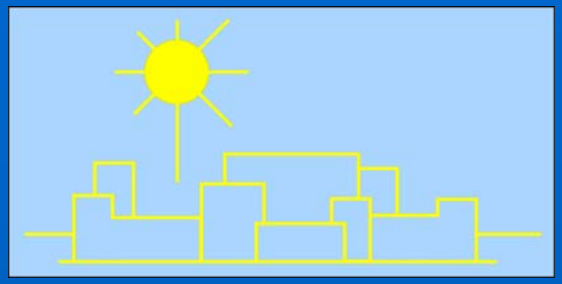

**Worker's Housing Organization (OEK)**
**SOLAR VILLAGE**

# Retrofitting, Renovation and Optimization of the Solar Village Energy Systems Efficiency

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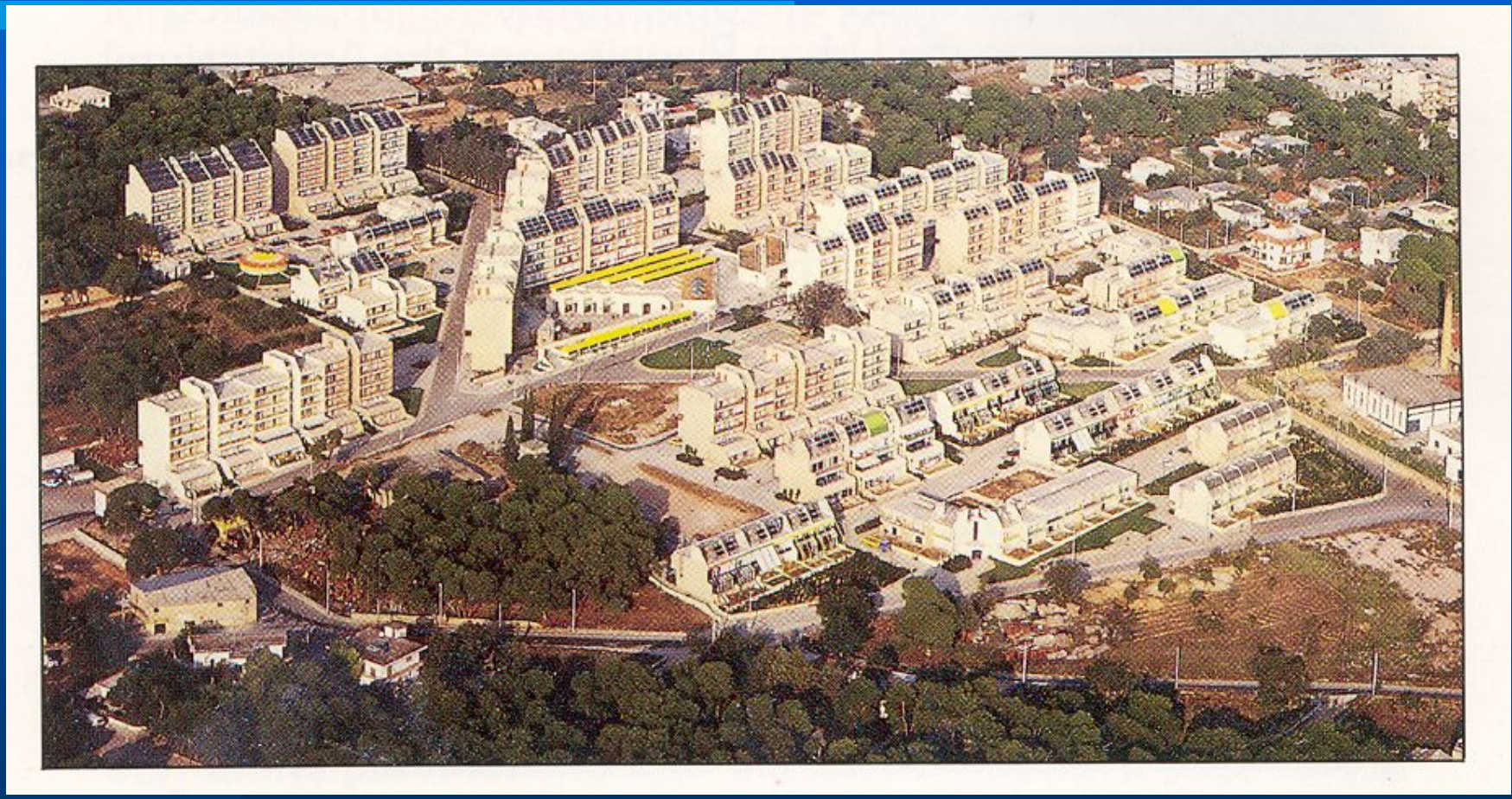
**Dipl. Mechanical & Electrical Eng.**

# Motivation

- Large use of RES in Greece.
- Why Renovation of Solar Village?
- Problems: Difficulties in giving property documents.

# Solar Village (SV), Pefki Attica



# Contents

# Solar Village Project

- SV, an OEK settlement in Pefki, a suburb of Athens.
- Agreement on Scientific & Technical Cooperation: Greece - Germany.
- Program phases:

  (a) Design & Construction: August 1984 – June 1988.

  (b) Measuring & Evaluation: July 1988 – December 1991.
- Aiming: Rational use of Energy with increased application of Solar Thermal Technology.
- Experimental, Researchable & Demonstrative character of Project.

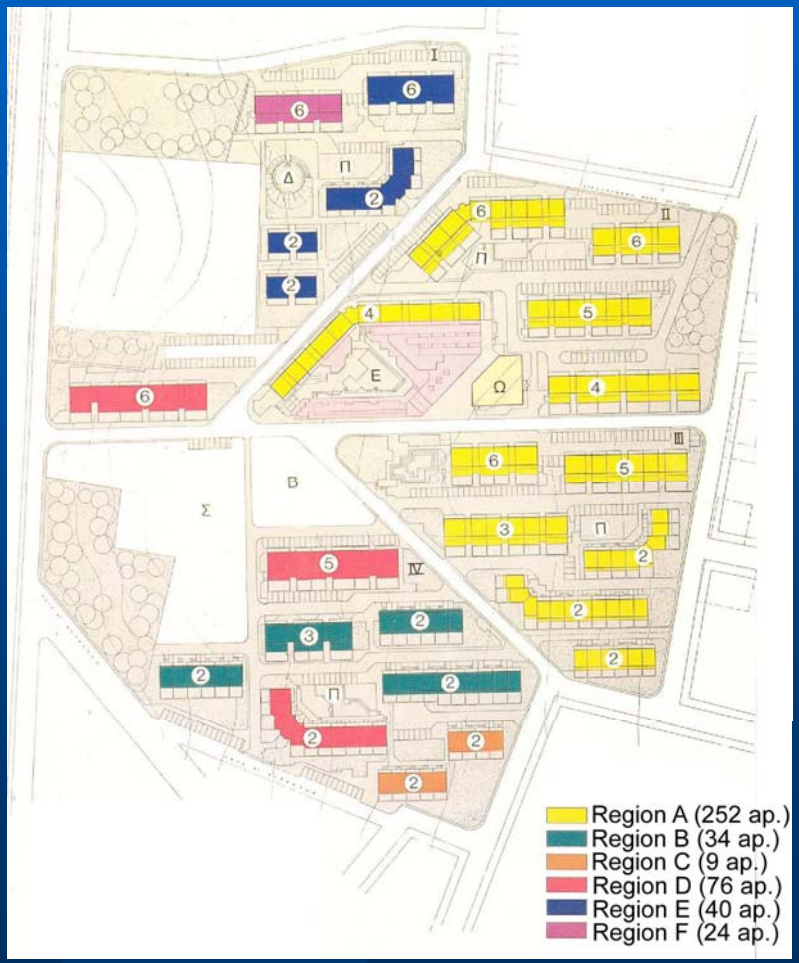
# A Sociological Approach

- Assistance of the SV inhabitation.
- Degree of acceptance of the applied systems.
- Rational use of energy by the SV inhabitants.
- Quality of social life & environment in the community.

# Characteristics of SV

- Site Total Area…….. 90,440 $m^2$.
- Building Area……. 47,798 $m^2$.
- Utilities & Landscaping Area……... 35,740 $m^2$.
- Community Area…… 6,902 $m^2$.
- Number of Apartments (60-100 $m^2$)…… 435.
- Apartments Effective Area…… 33,130 $m^2$.
- Apartments Buildings (multi storied)……25.
- Energy Center……1 Building.
- Community Center……. 3 Buildings.
- Year of the inhabitation beginning……...1989.

# Description of the SV Energy Regions




**6 Energy Regions:**

- **Region A** (11 b., 252 ap.): District-Heating Underground Network.
- **Region B** (4 b., 34 ap.): Passive Houses.
- **Region C** (2 b., 9 ap.): Autonomous Air Solar Collectors (SH & DHW).
- **Region D** (3 b., 76 ap.): Heat Pumps Air-to-Water (SH & DHW).
- **Region E** (4 b., 40 ap.)
- **Region F** (1 b., 24 ap.): Interseasonal Storage Tank (SH & DHW).

# Description of the SV Energy Regions

# Description of the SV Energy Regions

Glasshouse and Trombe Wall

# Description of the SV Energy Regions

Heat Pipe Collectors

Interseasonal Storage of UFA

# Description of the SV Energy Regions

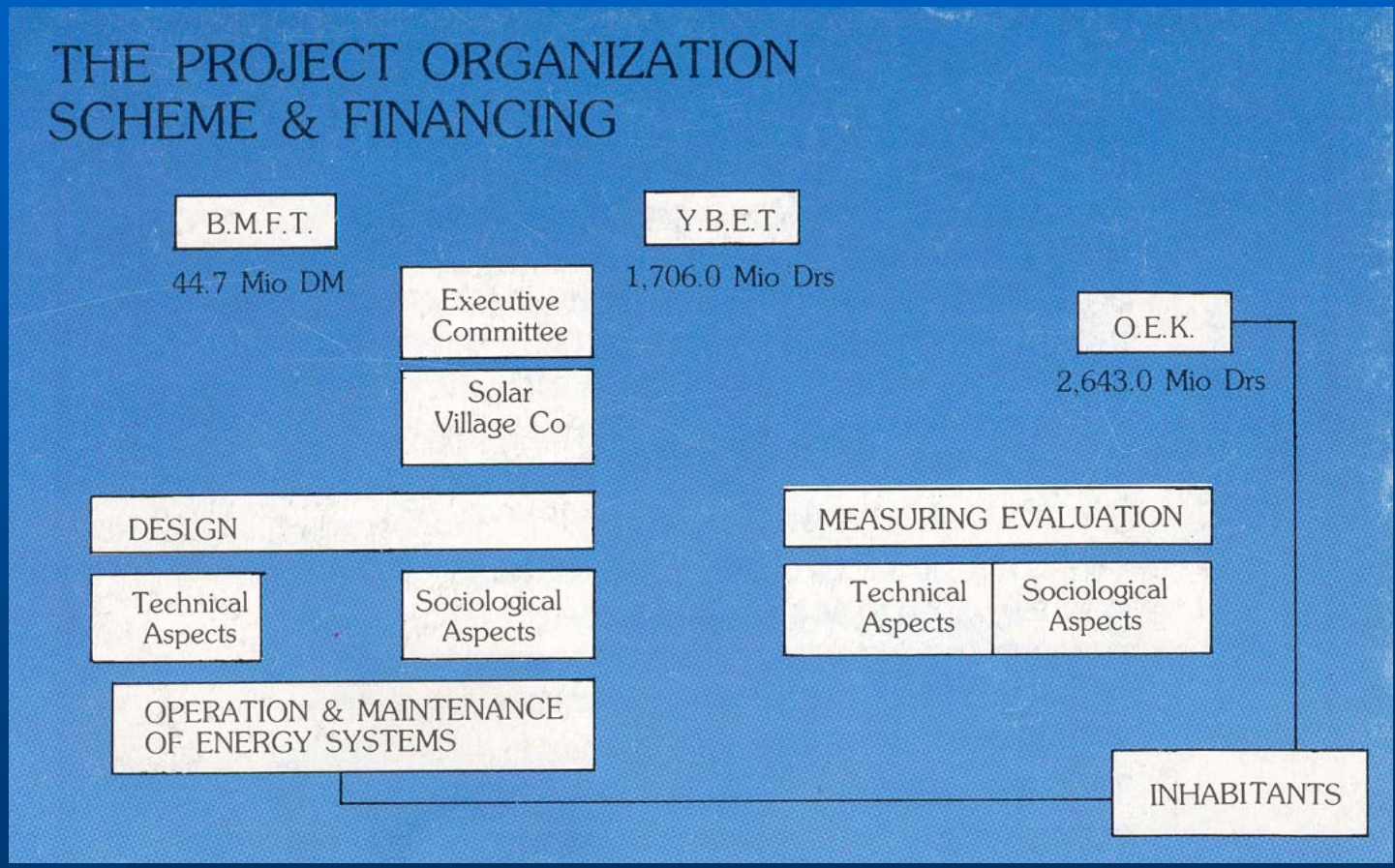
OEK
SOLAR VILLAGE/PEFKI, ATTICA

**TECHNICAL DATA OF ENERGY SYSTEMS AND BUILDINGS**

| No | REGION | NAME OF BUILDING | NUMBER OF FLATS | FLAT EFF. AREA ($m^2$) | NUMBER OF INHABITANTS | SOLAR COLLECTORS (CENTRAL SYSTEMS) TYPE | INCLIN ATION ($^0$) | AREA ($m^2$) | CONSTRUCTOR | USERS NEED | ENERGY TRANSFER FOR SH | WATER TE-MPERATURE FEED/ RETURN ($^0$C) | HEAT DEMAND FOR SH (kW) | BOILER POWER (kW) | CONSUM-PTION OF DHW PER DAY (Theor.) ($m^3$/day) | ENERGY DEMAND PER DAY (kWh/day) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | UAA | 41 | 2.750 | 152 | VACUUM | 50 | 98 | CORNING | DHW | Radiators | 67/47 | 113,50 | | 7,60 | 266 | District Heating |
| 2 | | UAB | 24 | 1.700 | 91 | VACUUM | 50 | 54 | CORNING | DHW | Radiators | 67/48 | 74,40 | | 4,55 | 159 | District Heating |
| 3 | | UAC | 40 | 2.960 | 154 | FLAT PLATE | 50 | 128 | BP - CALPAK | DHW | Radiators | 67/49 | 124,80 | | 7,70 | 269 | District Heating |
| 4 | | UAD | 26 | 1.770 | 97 | VACUUM | 50 | 63 | CORNING | DHW | Radiators | 67/50 | 79,00 | | 4,85 | 170 | District Heating |
| 5 | | UAE | 24 | 1.920 | 96 | FLAT PLATE | 50 | 72 | CALPAK CICERO | DHW | Radiators | 67/51 | 83,60 | | 4,80 | 168 | District Heating |
| 6 | A | UAF | 24 | 1.700 | 91 | FLAT PLATE | 50 | 72 | CALPAK CICERO | DHW | Radiators | 67/52 | 74,40 | | 4,55 | 159 | District Heating |
| 7 | | UAG | 30 | 2.030 | 112 | FLAT PLATE | 50 | 81 | CALPAK CICERO | DHW | Radiators | 67/53 | 89,70 | | 5,60 | 196 | District Heating |
| 8 | | UAH | 18 | 1.230 | 68 | FLAT PLATE | 50 | 51 | CALPAK CICERO | DHW | Radiators | 67/54 | 56,90 | | 3,40 | 119 | District Heating |
| 9 | | UAJ | 8 | 800 | 40 | FLAT PLATE | 50 | 30 | CALPAK CICERO | DHW | Fan Coil Un. | 55 | 36,30 | | 2,00 | 70 | District Heating |
| 10 | | UAK | 11 | 1.100 | 55 | FLAT PLATE | 50 | 40 | CALPAK CICERO | DHW | Fan Coil Un. | 55 | 49,70 | | 2,75 | 96 | District Heating |
| 11 | | UAL | 6 | 600 | 30 | FLAT PLATE | 50 | 23 | CALPAK CICERO | DHW | Fan Coil Un. | 55 | 27,00 | | 1,50 | 52 | District Heating |
| 12 | G | Total: | 252 | 18.560 | 986 | | | 712 | | SH | | | 809,30 | 1.335,00 | | | |
| 13 | | UBA | 6 | 600 | 30 | FLAT PLATE | 50 | 24 | CALPAK CICERO | DHW | Passive | | | | | | Autonomous thermosyphon |
| 14 | B | UBB | 12 | 840 | 45 | FLAT PLATE | 50 | 33 | CALPAK CICERO | DHW | Passive | | | | 2,25 | 79 | Central System |
| 15 | | UBC | 6 | 600 | 30 | FLAT PLATE | 50 | 24 | CALPAK CICERO | DHW | Passive | | | | | | Auton. Thermosyphon, 4 m² |
| 16 | | UBD | 10 | 1.000 | 50 | FLAT PLATE | 50 | 40 | CALPAK CICERO | DHW | Passive | | | | | | Auton. Thermosyphon, 4 m² |
| 17 | C | UCA | 4 | 400 | 20 | AIR COLLECT | 50 | 44 | | DHW+SH | Air ducts | 35/26 | | | | | Auton. air collector, 11 m² |
| 18 | | UCB | 5 | 500 | 25 | AIR COLLECT | 50 | 55 | | DHW+SH | Air ducts | 35/26 | | | | | Auton. air collector, 11 m² |
| 19 | D | UDA | 36 | 2.660 | 139 | HP | | | | DHW+SH | Radiators | 60/46 | 114,50 | 120,00 | 6,95 | 243 | Heat Pumps electr. Driven (Out of order) |
| 20 | | UDB | 30 | 2.130 | 114 | HP | | | | DHW+SH | Radiators | 60/46 | 93,50 | 120,00 | 5,70 | 199 | |
| 21 | | UDC | 10 | 1.000 | 50 | HP | | | | DHW+SH | Fan Coil Un. | 45/37 | 45,10 | 45,36 | 2,50 | 87 | |
| 22 | E | UEA | 24 | 1.700 | 91 | FLAT PLATE | 38 | 94 | CORNING | DHW+SH | Floor Heating | 32/28 | 74,30 | 85,00 | 4,55 | 159 | Initialy vacuum collectors |
| 23 | | UEB | 8 | 800 | 40 | FLAT PLATE | 50 | 52 | BP - CALPAK | DHW+SH | Fan Coil Un. | 32/28 | 36,30 | 35,00 | 2,00 | 70 | |
| 24+ 25 | | UEC/D | 8 | 640 | 32 | FLAT PLATE | 38 | 40 | 25% SIEMENS, 25% STIEBEL ELTRON, 50%SET | DHW+SH | Floor Heating | 32/28 | 29,80 | 34,00 | 1,6 | 56 | |
| 26 | F | UFA | 24 | 1.700 | 91 | VACUUM | 50 | 168 | PHILIPS | DHW+SH | Floor Heating | 32/28 | 74,30 | 119,15 | 4,55 | 159 | Interseasonal Storage Tank |
| TOTAL | | | 435 | 33.130 | 1.743 | | | 1.286 | | | | | 1.277,10 | 1.893,51 | 79,40 | 2.776,00 | |

ABBREVIATIONS : **DHW:** Domestic Hot Water **SH:** Space Heating **IST:** Interseasonal Storage Tank **HP:** Heat Pump

# SV Project Financing



# Property Documents

- Difficulties in giving the final properties documents to the beneficiaries of OEK.
- Demand of the inhabitants: cheaper energy & more simplified energy systems.
- The Renovation works of the energy systems of the SV is unique solution.

# Intended Renovation Works

- Replacement of solar collectors.
- Substitution of the heat pumps of Region D by central solar systems.
- Substitution of oil by natural gas.
- Installation of a new IST for Regions B & C.
- New global automation control system (BMS).
- Extended maintenance/ repair of all Energy systems.
- Improvement works of the buildings waterproof installation.

# Conclusions

- **Simplification of all energy system installations.**
- **Improvement of energy system efficiency.**
- **Significant decrease of the conventional fuel consumption.**
- **Minimization of gas pollution.**
- **Minimization of operation & maintenance cost.**
- **OEK vests property documents to the SV inhabitants.**
- **Quality ameliorating of SV inhabitants life.**