International Energy Agency
Solar Heating & Cooling Programme

25 YEARS OF SOLAR HEATING AND COOLING ACCOMPLISHMENTS

www.iea-shc.org

Overview

- Why use solar energy?
- Market potential and technology overview
- Current market
- Role of the SHC Programme
- Results of past work
- Current and planned work
- What is needed to accelerate the market
- What R&D is needed
- Future role for the SHC Programme

Why Use Solar Energy

- Energy demand is large and growing
  - **Buildings use 30-40% of total energy demand in OECD countries**
- Climate change concerns are growing
  - **Kyoto targets can be met using solar energy**
- Solar resource is large and inexhaustible
  - **Potential 100 times larger than current use. Appropriate for all climates**
- Substantial environmental benefits
  - **Sustainable building is solar building**
- Substantial economic benefits
  - **Integration of solar and energy conservation in homes can reduce energy consumption by 75-90%**

Market Potential

- Solar energy incident on Earth's surface is more than 10,000 times the world's current primary energy requirement
- 6 billion people use hot water and heating or cooling in their homes
- The global market in 2000 for solar collectors was 10 million square meters
- Market potential for solar water heaters in Europe alone is 300 million square meters
- Solar heating systems are cost effective compared to many conventional applications even without subsidies
- Solar technologies are appropriate for all building types
- Solar technologies help reach Kyoto targets

Available Technology

- Solar buildings
- Solar water heating
- Solar space heating
- Solar cooling
- Daylighting
- Solar drying
- Solar desalination

Current Market

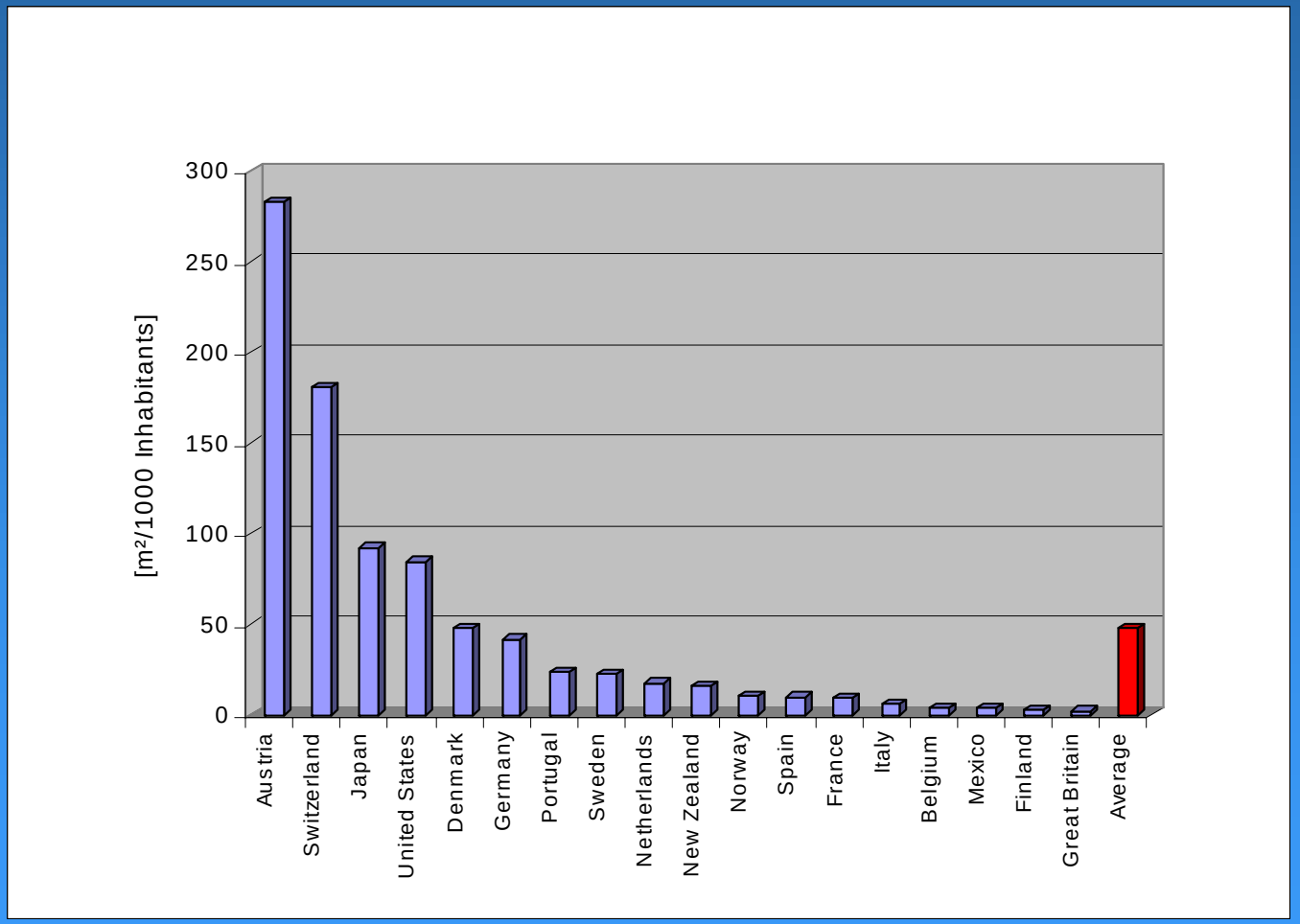
- Industry is small, production is local
- Governnemt policies and incentives can have a large impact on the market
- Products seen as power source not consumer product

Status of Solar Collectors in 2000

45,876,254 m^2 OF COLLECTORS INSTALLED IN SHC COUNTRIES

Austria	2 282 710	Netherlands	282 226
Belgium	42 975	New Zealand	64 000
Denmark	258 732	Norway	48 600
Finland	13 200	Portugal	239 500
France	542 600	Spain	399 922
Germany	3 446 000	Sweden	199 900
Italy	344 000	Switzerland	1 303 000
Japan	11 752 489	United Kingdom	150 000
Mexico	378 400	United States	24 128 000

Total Installed Collector Area per Thousand Inhabitants in SHC Countries



SHC Programme

- 21 Member countries
- 25 years old
- 20 Tasks completed
- 9 Tasks running with 220 experts.
- Over 150 reports published

SHC Mission

To facilitate an environmentally sustainable future through the greater use of solar design and technologies

SHC Member Countries


Australia


Austria

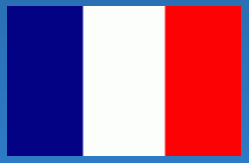

Belgium


Canada


Denmark

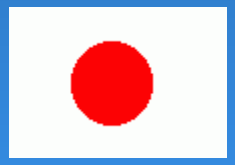

European Union


Finland


France


Germany


Italy


Japan


Mexico


Netherlands


New Zealand


Norway


Portugal


Spain


Sweden


Switzerland


United Kingdom


United States

Programme Results

SOLAR RADIATION

- Developed measurement and estimation techniques
- Developed irradiance measurements for solar collector testing
- Developed representative climatic design years
- Developed spectral radiation data for design and analysis purposes for PV and advanced glazing applications

Programme Results

SOLAR BUILDINGS

- 14 new homes showed how solar and EE technologies can reduce average total energy consumption by 75%
- 17 new buildings demonstrated successful integration of PV in buildings
- Demonstrated successful and economical integration of solar technologies in renovated buildings
- International exhibition and demonstration center for PV building elements

Programme Results

BUILDING ENERGY ANALYSIS

- Developed BESTEST – validation methodology to test whole-building energy simulation tools
- Developed algorithms for:
  - Atria
  - Transparent insulation materials
  - Optical switching glazings

Programme Results

ADVANCED GLAZING MATERIALS

- Identified and defined parameters to characterize energy performance of windows
- Developed state-of-the-art design guidance on frame and edge seals for advanced glazings
- Construction of world's first framed vacuum window
- Facilitated development of Australian Window Energy Rating Scheme
- Quantified savings gained from using advanced glazings
- Focused R&D on:
  - High performance glazings
  - Optical switching glazings
  - Transparent insulating materials
  - Light transport materials application assessment

Programme Results

SOLAR AIR SYSTEMS

- In-depth examination of 6 types of solar air systems for homes
- 7 manufacturers tested prototype solar air collectors
- Improved performance of Solarwall – performance increased by 40% and installation costs reduced by by 25%
- Developed TRANSAIR - computer tool to analyze key design variables

Programme Results

DAYLIGHTING

- Monitored daylight performance of 15 buildings
- Tested 15 daylight responsive control systems
- Established international procedures and protocols for monitoring daylight performance
- Established international procedures for evaluating daylighting design and system performances
- Developed ADELINE – lighting design and analysis computer tool
- Developed LESO-DIAL – lighting design computer tool

Current Work

- Task 22: Energy Analysis Tools
- Task 23: Solar Energy Use in Large Buildings
- Task 24: Solar Procurement
- Task 25: Solar Cooling
- Task 26: Solar Combisystems
- Task 27: Solar Facade Components
- Task 28/BCS Annex 38: Sustainable Solar Housing
- Task 29: Solar Crop Drying
- Task 31: Daylighting Buildings in the 21st Century

Current Work

TASK 22: ENERGY ANALYSIS TOOLS

ESSENTIAL FOR SOLAR DESIGN

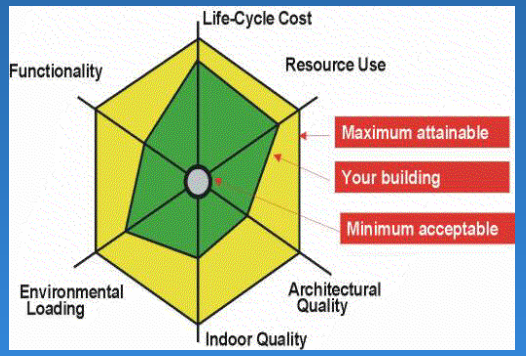
- Comprehensive building energy analysis tool evaluation methodology
- IEA BESTEST and HVAC BESTEST suite of comparative test cases
- ASHRAE, CEN and national organizations using Task research to develop standard method of testing energy codes and standards
- Library of engineering algorithms for object oriented simulation environments
- Empirical data sets

Current Work

TASK 23: SOLAR IN LARGE BUILDINGS

ESSENTIAL FOR INTEGRATION OF SOLAR INTO DESIGN PROCESS

- Case studies of 5 buildings which integrate low energy and solar technologies to reduce total energy use
- Electronic, multi-dimensional integrated design process guidelines – the “Navigator“
- Multi criteria discussion and decision making tool – “MCDM-23”
- Demonstration buildings

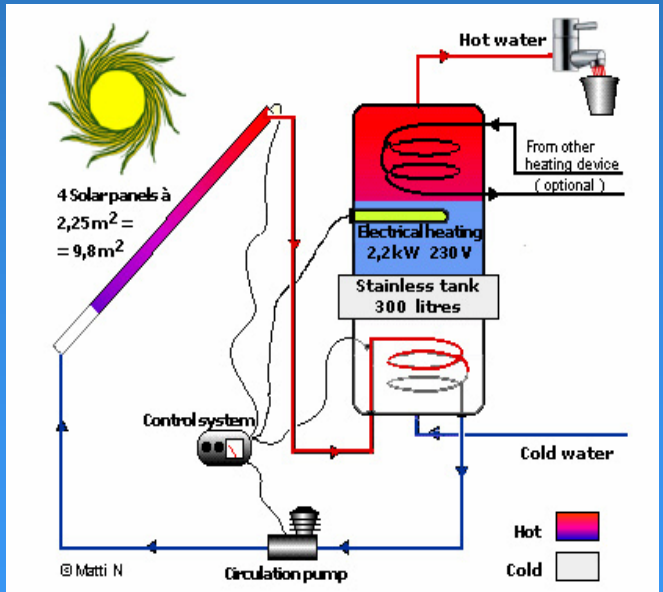


Current Work

TASK 24: SOLAR PROCUREMENT

A MEANS TO ACCELERATE SOLAR WATER HEATER MARKET

- In Denmark, a 20% price reduction was achieved for solar water heaters
- In the Netherlands, 59 housing associations formed a buyer group
- In Sweden, 8 small system prototypes were tested



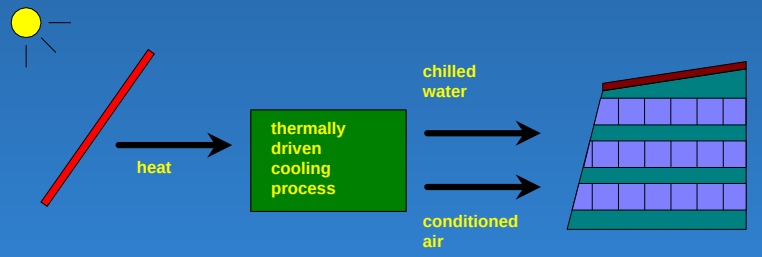
An outline over Uponor's solar heated tap water system, 2001 "Uposun HW 300"

Current Work

TASK 25: SOLAR COOLING

A NEW AND PROMISING MARKET

- Survey of 28 installations and overview of national R&D activities in participating countries
- Handbook for planners
- Computer design tool for solar assisted air conditioning systems
- Monitoring & evaluation of 10 projects



Current Work

TASK 26: SOLAR COMBISYSTEMS

CAN EXPAND USE OF SOLAR IN HEAT-DOMINATED CLIMATES

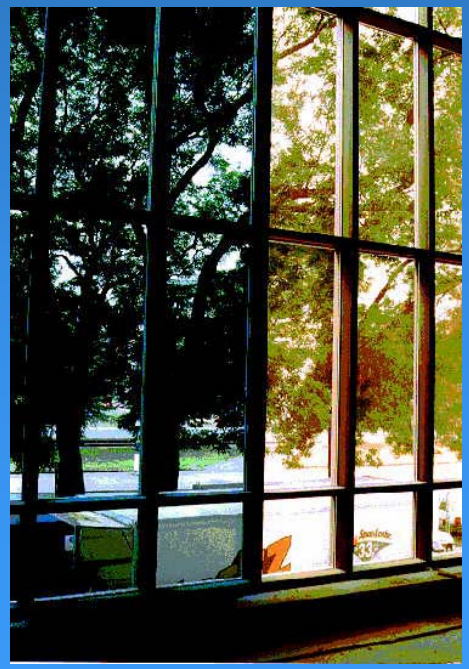
- Single-family home system optimization
  - Solar fractions up to 50% for hot water and demand
- Multi-family home system optimization
  - Solar fractions up to 40% for overall heat demand
- Test procedures development
- 7 Industry Workshops
- Installation of 140 systems ALTENER project
- Liaison with CEN TC312

Current Work

TASK 27: SOLAR FAÇADE COMPONENTS

ESSENTIAL FOR DESIGN OF SOLAR BUILDINGS

- Methodology development for accelerated service life test procedures
- Methodology report on nominal service life prediction and anticipation of premature termination
- Report on performance test procedures for solar facade components



Current Work

TASK 28: SUSTAINABLE SOLAR HOUSING

A MEANS TO ACCELERATE MARKET FOR SOLAR HOUSES

- Review of national markets for sustainable housing:
  - **Construction must be as maintenance free as possible**
  - **Aesthetics are important**
  - **Energy cost savings are a selling point**
- Reference buildings selected based on national codes
- Data sets compiled for 53 buildings

Current Work

TASK 29: SOLAR CROP DRYING

A MEANS TO ACCELERATE SOLAR DRYING MARKET

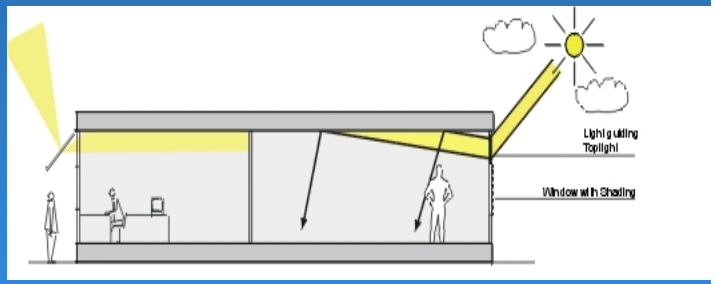
- Feasibility studies of 12 sites in 10 countries
- Projects in operation:
  - **Tobacco drying in Zimbabwe**
  - **Coffee drying in Panama**
  - **Core pith drying in India**
- Projects under construction:
  - **Jujube drying in China**
  - **Biomass drying in China**
  - **Cardamom drying in India**
- Negotiations underway
  least 2 more projects

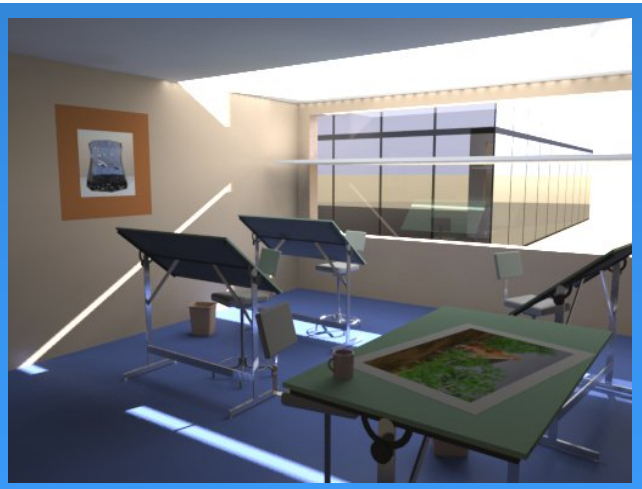
Current Work

TASK 31: DAYLIGHTING BUILDINGS IN THE 21ST CENTURY

ESSENTIAL FOR ADOPTION OF INTEGRATED DAYLIGHTING SOLUTIONS

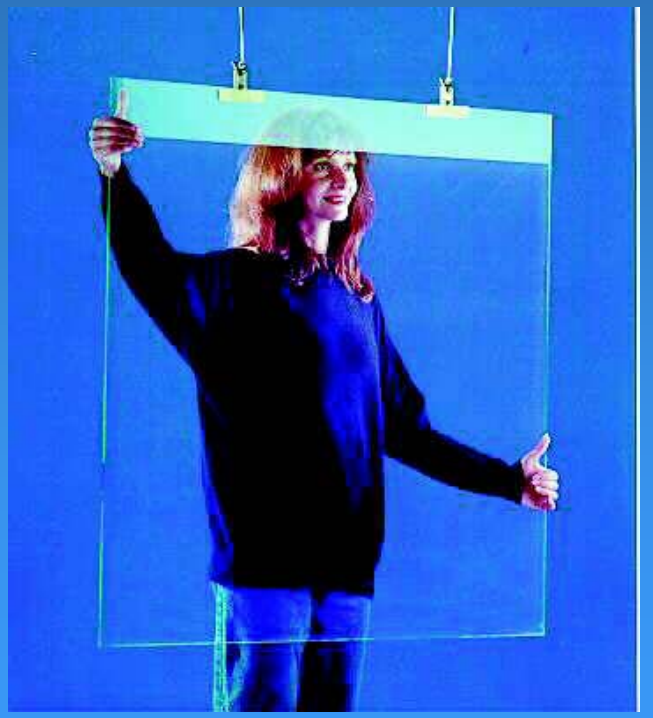
- Computer tools with plug-in specifications for sky models and fenestration systems
- Methods to assess visual and indoor comfort in daylit spaces
- Design solutions roadmap for designers
- Optimization of smart daylighting control systems and procedures
- Credible performance data for building owners and manufacturers





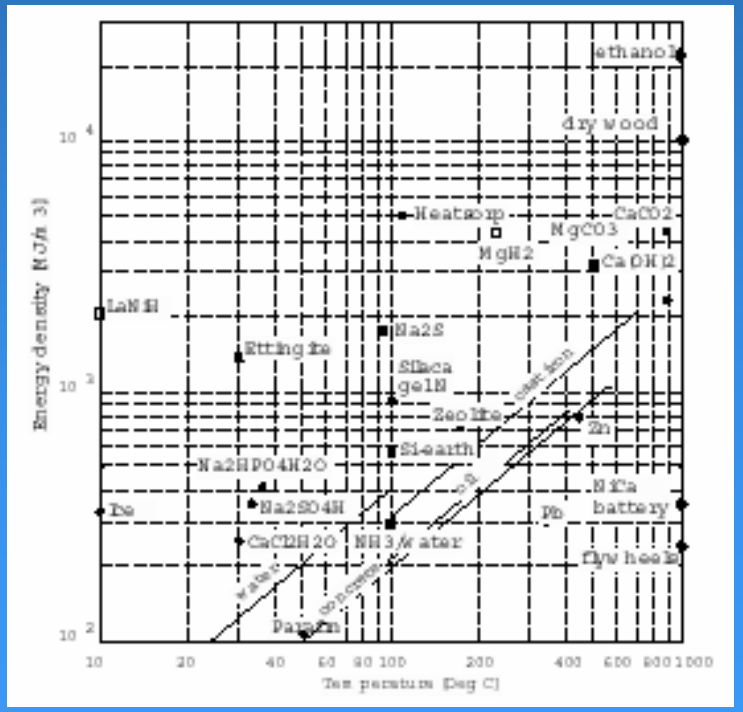
What is Needed to Accelerate the Market

- Positive governmental policies
- Industry needs to grow with the product
- Separate approach for each technology and market
- Market as a consumer product not as power source



What R&D is Needed

- Storage technology
- Price reduction
- Sustainability
- System integration
- Integrated building design
- Designing for the



Future SHC Work

- Solar City
- PV-Thermal Systems
- Solar Heat for Industrial Processes
- Advanced Storage Concepts for Solar Thermal Domestic Applications
- Market Analysis of Solar Heating and Cooling Markets

Future Role of SHC Programme

- Collaborative R&D
  - **Continue work in SHC priority areas**
- Market acceleration
  - **Expand activities in this area**
  - **Identify strategic business opportunities for solar building technologies**
  - **Continue to provide a means for international collaboration**

SHC Website

www.iea-shc.org