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
• Government 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Collectors Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2,282,710 m²</td>
</tr>
<tr>
<td>Belgium</td>
<td>42,975 m²</td>
</tr>
<tr>
<td>Denmark</td>
<td>258,732 m²</td>
</tr>
<tr>
<td>Finland</td>
<td>13,200 m²</td>
</tr>
<tr>
<td>France</td>
<td>542,600 m²</td>
</tr>
<tr>
<td>Germany</td>
<td>3,446,000 m²</td>
</tr>
<tr>
<td>Italy</td>
<td>344,000 m²</td>
</tr>
<tr>
<td>Japan</td>
<td>11,752,489 m²</td>
</tr>
<tr>
<td>Mexico</td>
<td>378,400 m²</td>
</tr>
<tr>
<td>Netherlands</td>
<td>282,226 m²</td>
</tr>
<tr>
<td>New Zealand</td>
<td>64,000 m²</td>
</tr>
<tr>
<td>Norway</td>
<td>48,600 m²</td>
</tr>
<tr>
<td>Portugal</td>
<td>239,500 m²</td>
</tr>
<tr>
<td>Spain</td>
<td>399,922 m²</td>
</tr>
<tr>
<td>Sweden</td>
<td>199,900 m²</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1,303,000 m²</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>150,000 m²</td>
</tr>
<tr>
<td>United States</td>
<td>24,128,000 m²</td>
</tr>
</tbody>
</table>

45,876,254 m² of collectors installed in SHC countries.
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
To facilitate an environmentally sustainable future through the greater use of solar design and technologies
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
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
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
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
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 for at 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