Potential of Solar Air-Conditioning Technology in Morocco

Eco-villes : quel modèle?

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Agenda

- Introduction
- Market Analysis
- Market Actors
- System Cost
- Potential of SAC in Morocco
- Politics: Incentives and Financial Schemes
- Successful Story
Objective of IEA SHC TASK 48:

- Make the solar thermally driven heating and cooling systems more:
  - efficient
  - reliable
  - cost competitive
Morocco Green Building Council

- Part of the World Green Building Council (WGBC)

- Currently offering online LEED classes for US as well as for international professionals

- Promoting Green Schools in US and abroad

- MGBC and its partners are working in facilitating communities and cities retrofitting with solar technology
Solar Air-Conditioning Types

- Solar AC
  - Electrically Driven
    - PV-Vapor Compression
    - PV-Peltier
  - Thermally Driven
    - Heat Transformation
    - Thermomechanical
      - Open Cycle
      - Closed Cycle
      - Ejector
      - Rankine Heat Engine
  - Absorption
  - Adsorption
Solar Cooling Applications

Application of SAC in a Building

- Solar Cooling
- Solar Heating
- Solar Domestic Hot Water (DHW)
- Solar Pool Heating

All in one System!

Source: Uli, Jakob, SOLARNEXT
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Market Analysis

- Percentage of use of different technologies for thermally driven chillers within 113 large scale systems.

Source: IEA SHC TASK 38, 2009
• Percentage of use of different technologies for solar thermal collectors within 112 large scale systems.
• Used heat back up in 34 installations.

Source: IEA SHC TASK 38, 2009
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Market Actors - Europe

- Sortech
- Invensor
- SonnenKlima
- Pink
- Climatewell
- EAW
- Ago AG
- Robur

8.75 kW
Market Actors – Out of Europe

- Broad (China)
- SWAC-10 (China)
- Maekawa (Japan)
- Yazaki (Japan)
- Dunham Bush (Russia)
- York (USA)
- Thermax (India)
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Some indicative cost for chillers
(For Europe incl. transport+start up, 2009)

- Absorption
  - 5-7 kW LiBr Chiller: 11,500 €*
  - 10 kW LiBr Chiller: 33,500 €*
  - 35 kW LiBr Chiller: 33,500 €
  - 105 kW LiBr Chiller: 35,200 €

(*Incl. delivery, installation, controls & start up)
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Morocco Energy Context

Electricity Consumption By Sector in 2008 (25,529 GWh)

Source: IEA
Morocco Energy Context (Cont.)

- Morocco imports close to 97% of its energy needs.
- The energy consumption has reached 15 MTOE last year.
- Our annual electricity consumption is rising by almost 7%, therefore, by the year 2020, our energy consumption would reach 30 MTOE.
Morocco Solar Resources

- Average Solar Potential: 5.5 kWh/m²/day
- More than 3000 hours of sunshine in some areas
The Logic of SAC
The Logic of SAC (Cont.)

- Look at the correlation between Hi. Temp. & Hi. demand. The higher the temperature the higher the demand.
Why SAC for Morocco?

• Saves energy (we import 97% of our energy...)

• Usage of an un-exhaustible source of energy (which we have plenty of it – 5.5 kWh/m^2/day)

• Does not use any toxic or harmful refrigerant (only water + lithium bromide)

• Reduces the strain on our electric grids, and therefore, avoid large capital investment for upgrades
Target Market

- Hotels
- Hospitals and nursing homes
- Large office buildings
- National education (Student Halls)
- Industry
- Private homes
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Politics: Incentives & Financial Schemes

- **Carrots**: stable, long-term incentive and secure low interest loan programs to help the deployment of SAC
- **Guidance**: public information campaigns, training of work force, and construction of demonstration projects
- **Sticks**: Rules and regulations. But no red tape

Source: OECD/IEA RETD Report, 2007
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Successful Story
The Steinway & Sons Project, New York

Primary System Equipment:

Abengoa-IST 38 PT-1 tracking trough receivers, roof mounted

Broad 83/99-ton multi-energy source (hot water and natural gas) 2E absorption chiller

Source: Henkel Solar Inc.
Successful Story (Cont.)
The Steinway & Sons Project, New York

- Total system cost: approximately $988,000 includes new AHUs
- NYSERDA grant: $300,000
- Federal 30% ITC: $270,000
- Federal 5-year MACRS with 50% first year bonus: $367,245
- Various NYS small tax incentives
- First year energy savings: $27,000
- First year sale of SRECs @ $25/MWh: $9,418
- First year maintenance: $4,000
- Appr. installed cost before incentive: $7,500/Ton (1,550 €/kW)
- Simple payback is under 3 years
Thank you!

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