
Solar Air Conditioning and Refrigeration

Task 38 of the IEA Solar Heating & Cooling Programme



Task 38
Solar Air-Conditioning
and Refrigeration



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Workshop „Solar Air-Conditioning“ at the
ASHRAE Trade-Show

Orlando/Florida, January 27, 2010

Outline

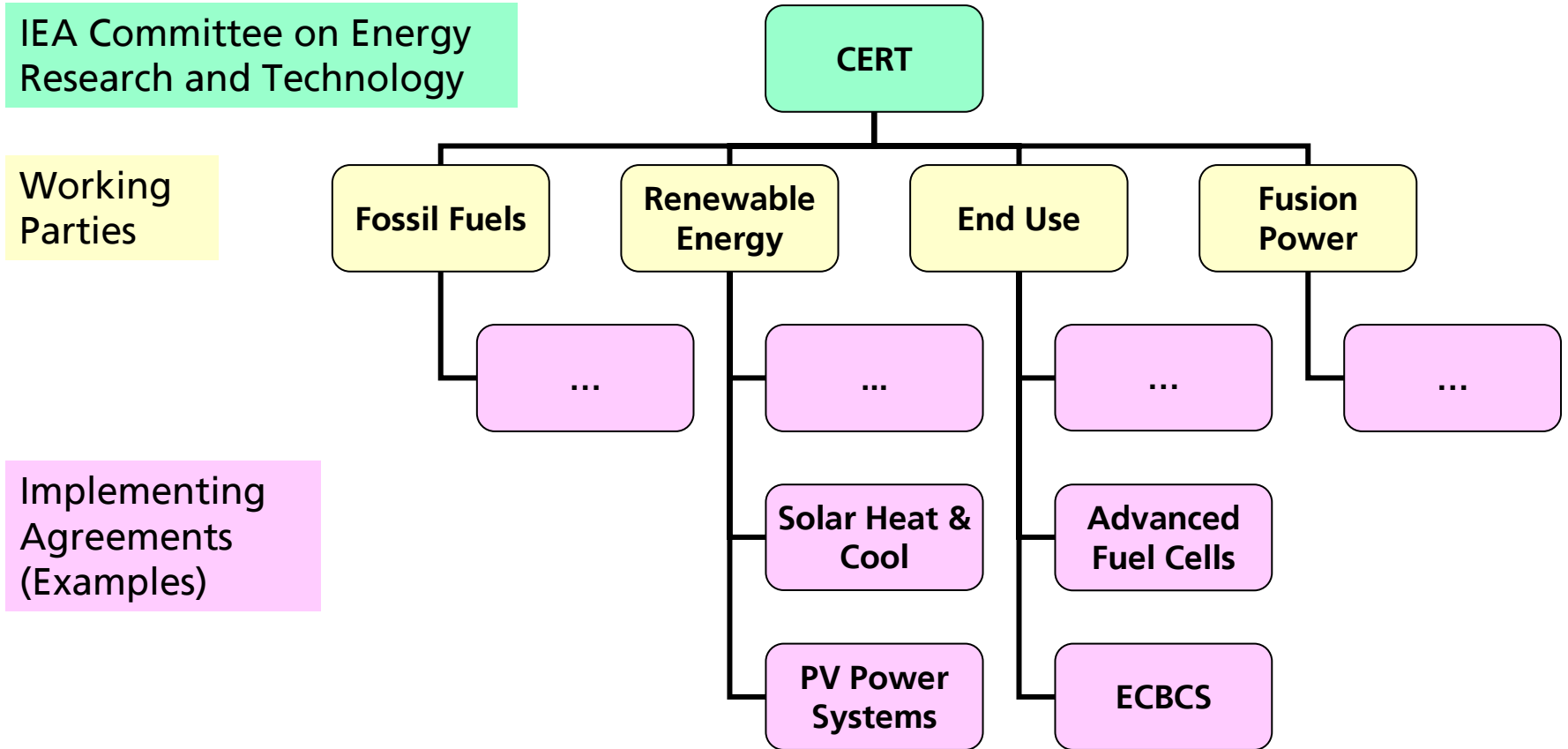
- The IEA Solar Heating & Cooling Programme
- TASK 38 „Solar Air-Conditioning and Refrigeration“
- Solar Air-Conditioning
 - Brief overview
 - Basic energy performance

The International Energy Agency



- The International Energy Agency (IEA) is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD)
- Established in 1974
- 26 member countries

International energy technology co-operation



Solar Heating & Cooling Implementing Agreement



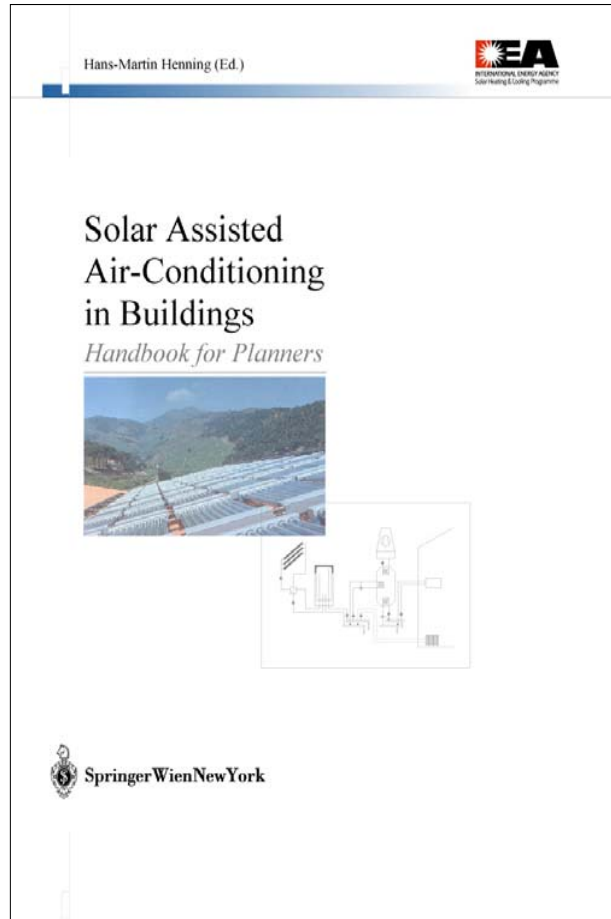
- Established in 1976
- Works on technologies that use the energy of the sun to heat, cool, light and power buildings
- 19 countries + European Commission
- Mission: "To facilitate an environmentally sustainable future through the greater use of solar design and technologies."
- International co-operation on a Task sharing basis

IEA SHC TASK 25 - Solar Assisted Air Conditioning of Buildings



- June 1999 – November 2004
- 11 countries
- 4 Subtasks
 - A: Survey of solar assisted cooling
 - B: Design tools and simulation programs
 - C: Technology, market aspects and environmental benefits
 - D: Solar assisted cooling demonstration projects
- 11 expert meetings; 3 trade fair participations
- Various national workshops in different countries

Main outputs of Task 25



- Handbook for planners
 - 2nd edition available
- Computer design tool for planners, architects & engineers
- Technical report about newly developed systems and components
- Guideline for system selection (decision tree)
- Technical report about the demonstration systems (11 systems)



Main requirements after finishing TASK 25

- standardized systems
- small capacity systems
- advanced operation & control
- transfer to professionals

➔ New Task 38 “Solar Air-Conditioning and Refrigeration”



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Main objective & Scope of Task 38

Implement measures to accelerate the market introduction of Solar Cooling systems in different sectors (residential, commercial, industrial)

Technical scope

- Standardised, pre-engineered systems for applications in the low capacity range (residential, small commercial)
- Develop concepts and create tools for a proper implementation in large scale applications (e.g., large office and residential buildings, hotels, industry, etc)
- Contribute to the realisation of new research activities for the development of advanced systems and concepts

Task structure

Subtask A

Pre-engineered systems for residential and small commercial applications

AEE INTEC (Austria): Dagmar Jähnig

Subtask B

Custom-made systems for large non-residential buildings and industrial applications

EURAC (Italy): Wolfram Sparber

Subtask C

Modeling and fundamental analysis

INES (France): Etienne Wurtz

Subtask D

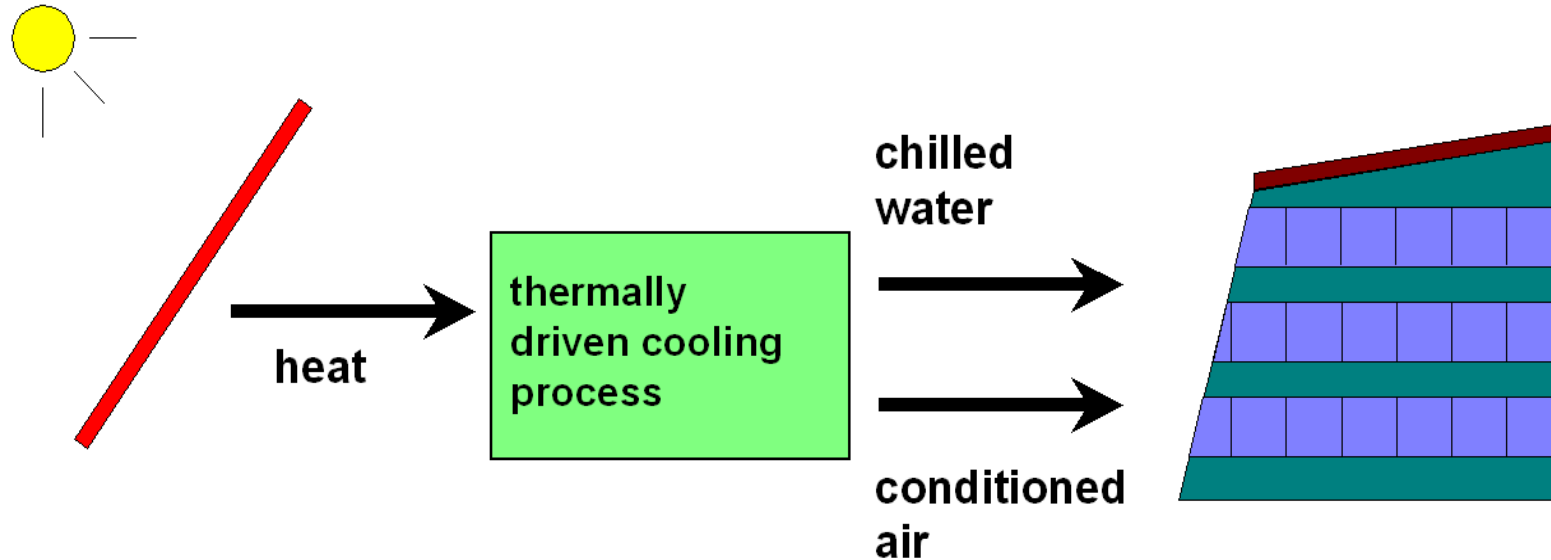
Market transfer activities

Politecnico di Milano (Italy): Mario Motta

Operating Agent

Fraunhofer ISE (Germany): Hans-Martin Henning

Thermally driven systems - basic principle



Basic systems categories

Closed cycles (chillers): chilled water

Open sorption cycles: direct treatment of fresh air (temperature, humidity)

Open cycles – desiccant air handling units

Solid sorption

Desiccant wheels

Coated heat exchangers

Silica gel or LiCl-matrix, future zeolite



Liquid sorption

Packed bed

Plate heat exchanger

LiCl-solution: Thermochemical storage possible



Closed cycles – water chillers or ice production



- Liquid sorption: Ammonia-water or Water-LiBr (single-effect or double-effect)
- Solid sorption: silica gel – water, future zeolite-water



- Ejector systems
- Other thermo-mechanical systems

Achievement of last decade: many small capacity systems



 SorTech AG



ClimateWell



EAW



InvenSor



SK SonnenKlima GmbH



Source: InvenSor

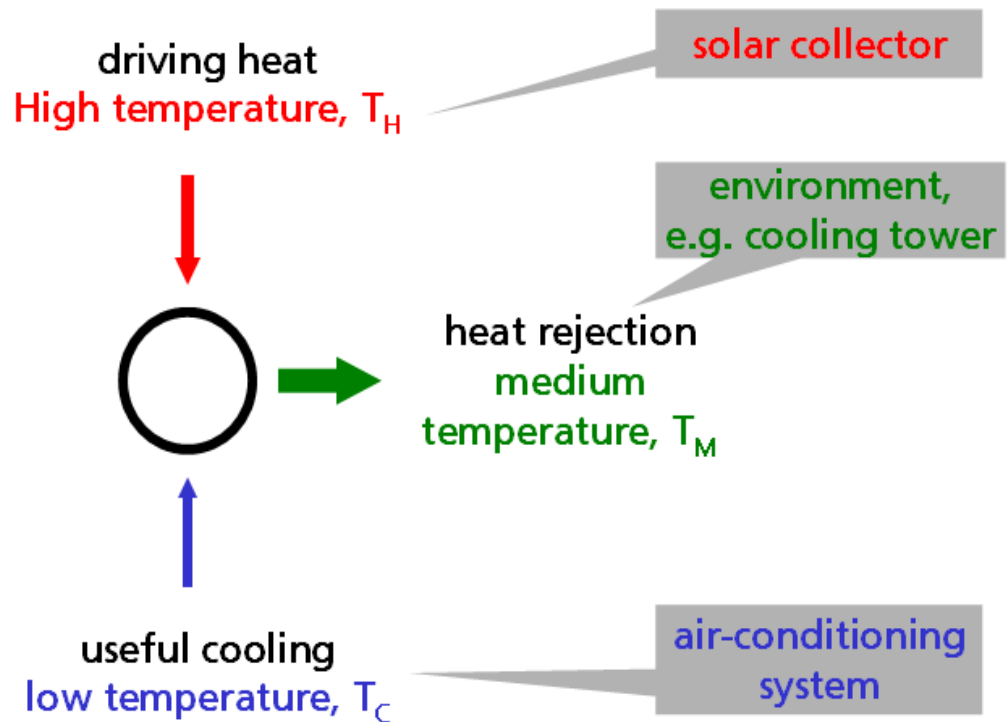
no claim on completeness

Classification of systems (closed cycles)

Key system parameter:
temperature lift

Difference between
temperature of useful
cooling and heat
rejection

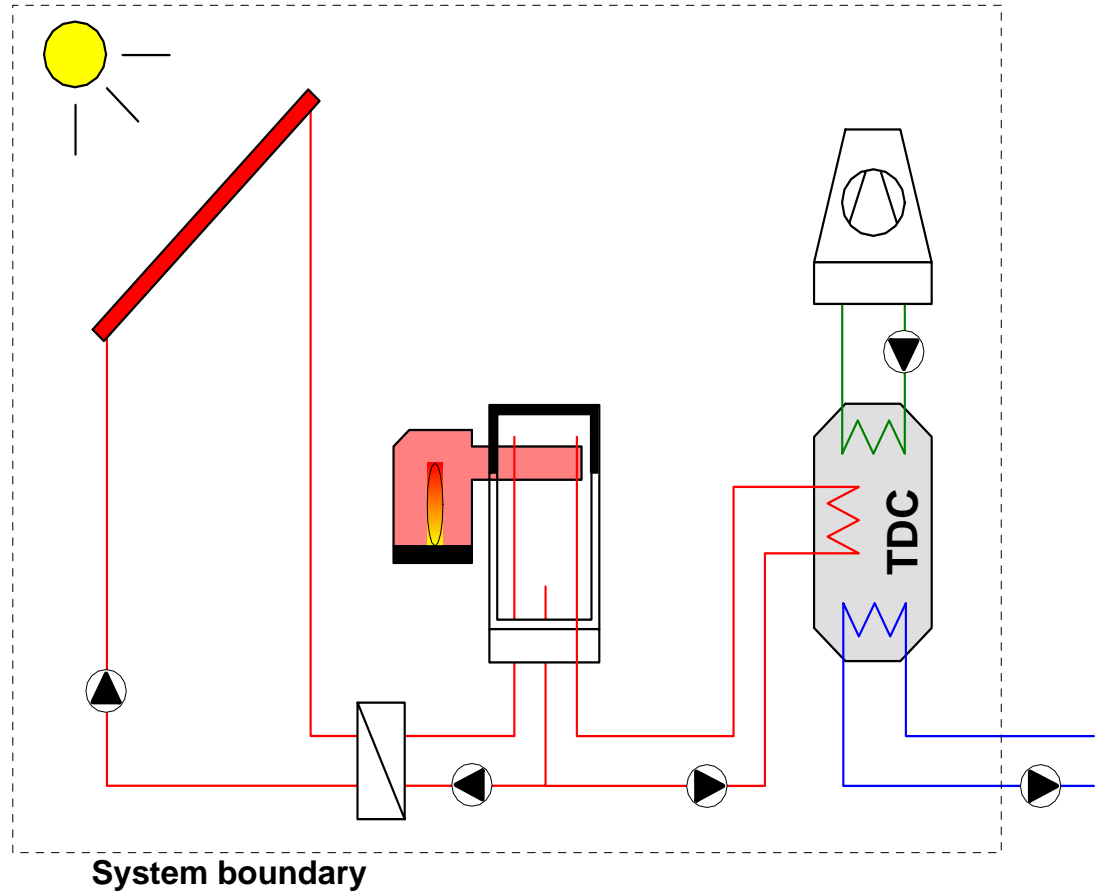
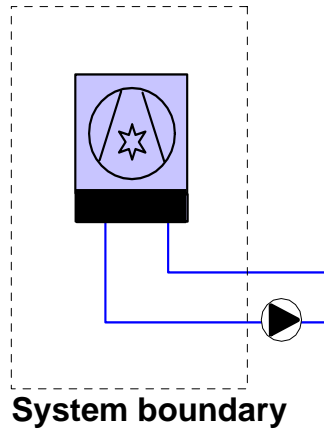
$$\Delta T = T_M - T_C$$



Temperature lift	Low 10-20 K	Medium 20-30 K	Medium 20-30 K	High 30-40 K	Very high > 40 K
Supply temperature, room system	15-20°C e.g. chilled ceiling, floor cooling	15-20°C e.g. chilled ceiling, floor cooling	6-12°C e.g. fan coil, AHU with dehumidification	6-12°C e.g. fan coil, AHU with dehumidification	< 0°C e.g. ice production, ice storage
Reject temperature, reject system	25-30°C wet cooling tower; ground	35-45°C dry cooling tower	25-30°C wet cooling tower; ground	35-45°C dry cooling tower	35-40°C dry cooling tower
Driving temperature, single effect	70-85 °C	85-110°C	85-110°C	100-130°C	180-250°C
Collector type	Flat plate	(Flat plate) Evacuat. tube	(Flat plate) Evacuat. tube	(Evacuated tube) Single-axis track.	Single-axis tracking
Driving temperature, double effect		130-160°C	130-160°C		
Collector type		Single-axis tracking	Single-axis tracking		

Temperature lift	Low 10-20 K	Medium 20-30 K	Medium 20-30 K	High 30-40 K	Very high > 40 K
Supply temperature, room system	59-68°F e.g. chilled ceiling, floor cooling	59-68°F e.g. chilled ceiling, floor cooling	41-50°F e.g. fan coil, AHU with dehumidification	41-50°F e.g. fan coil, AHU with dehumidification	< 32°F e.g. ice production, ice storage
Reject temperature, reject system	77-86°F wet cooling tower; ground	95-113°F dry cooling tower	25-30°C wet cooling tower; ground	95-113°F dry cooling tower	95-113°F dry cooling tower
Driving temperature, single effect	158-185°F	185-230°F	185-230°F	212-266°F	356-482°F
Collector type	Flat plate	(Flat plate) Evacuat. tube	(Flat plate) Evacuat. tube	(Evacuated tube) Single-axis track.	Single-axis tracking
Driving temperature, double effect		266-320°F	266-320°F		
Collector type		Single-axis tracking	Single-axis tracking		

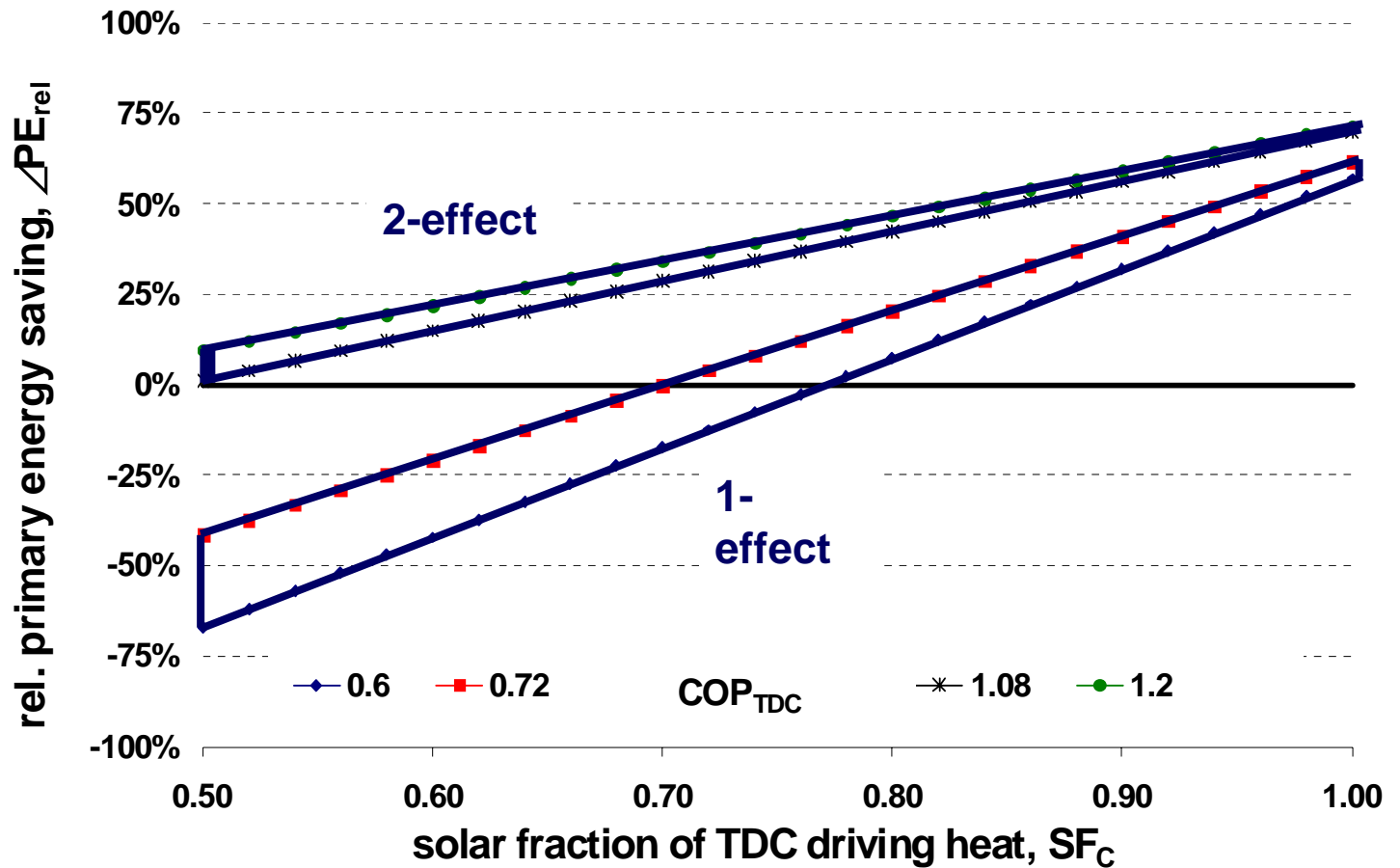
Energy balance



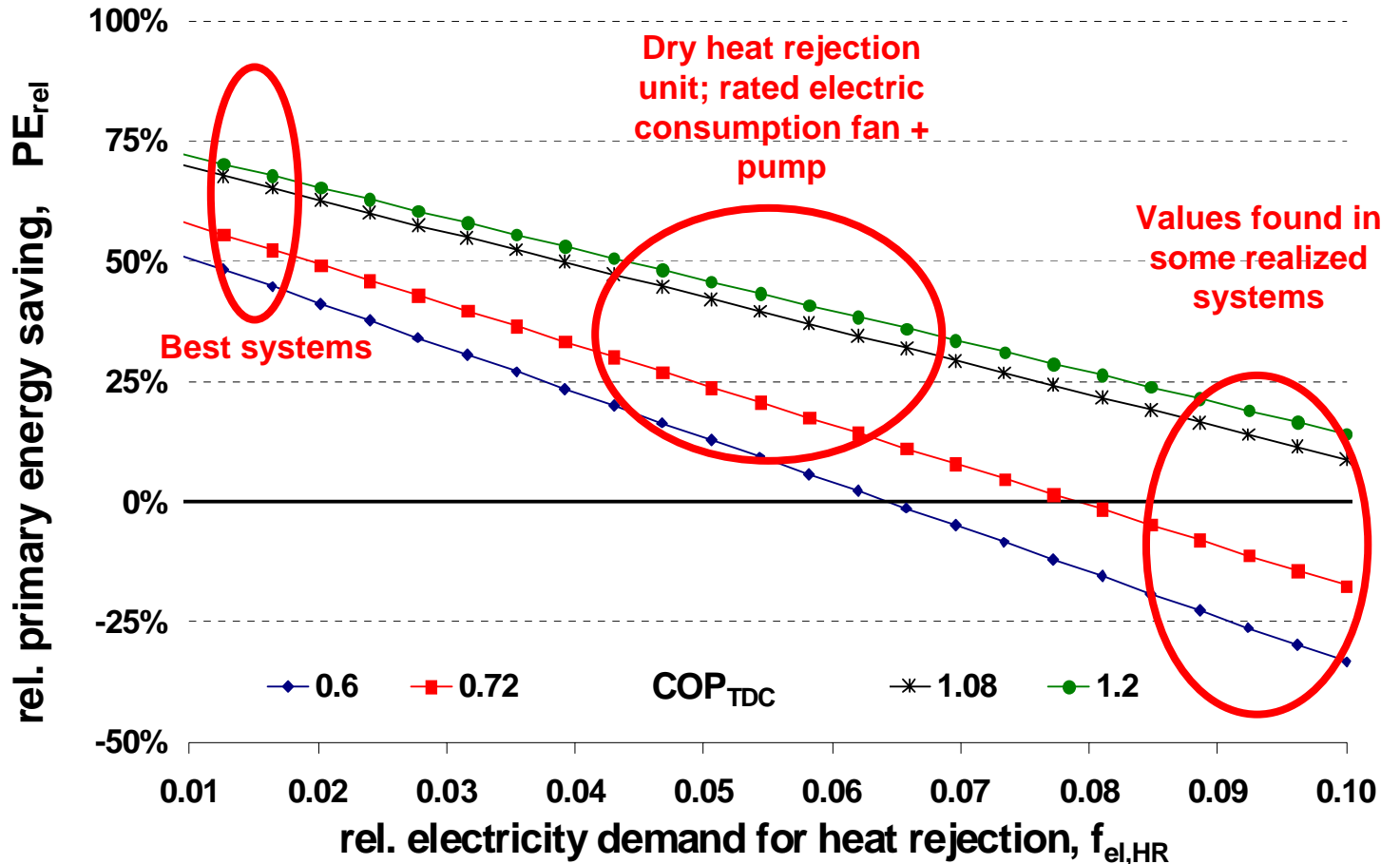
reference

solar

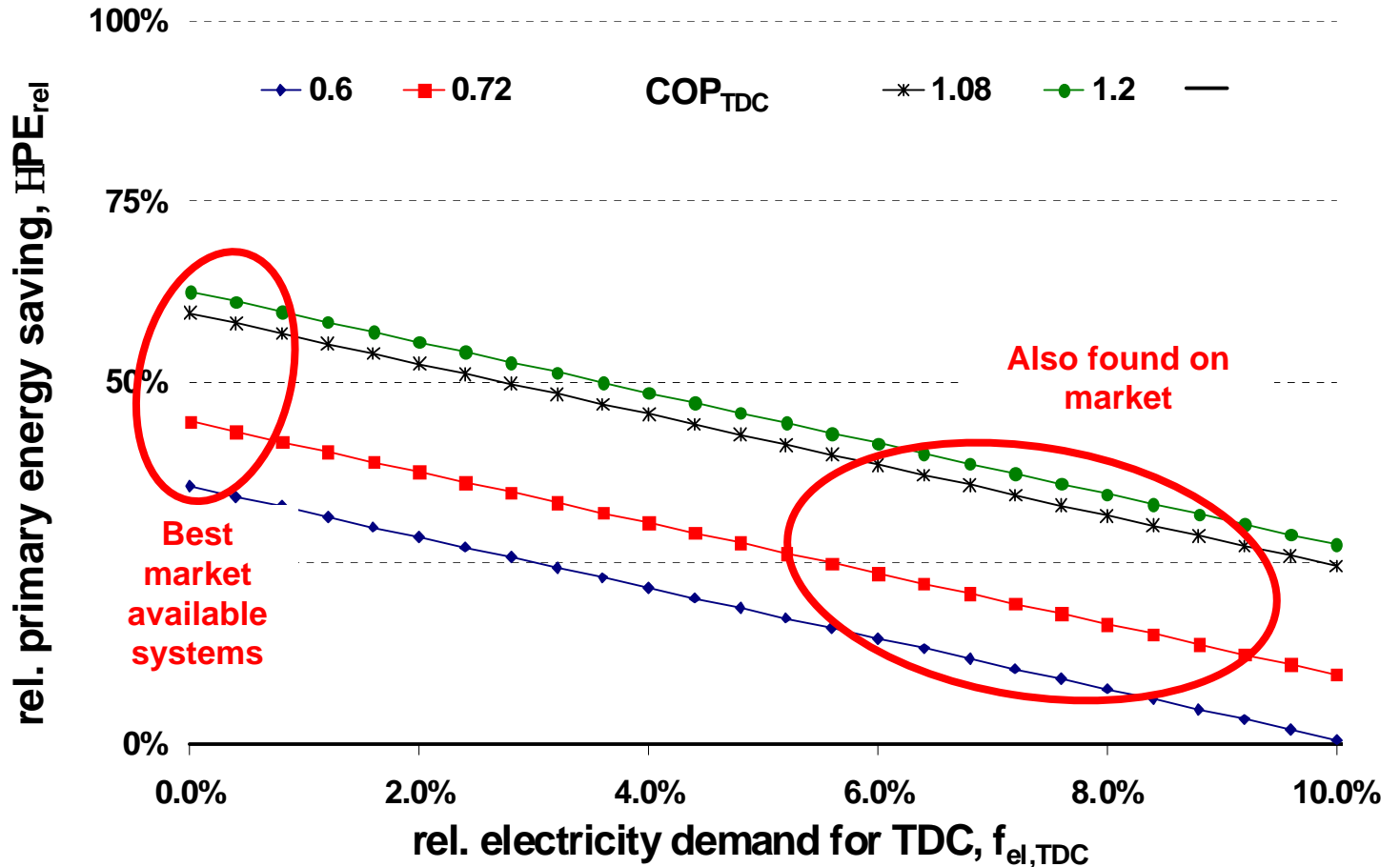
Solar fraction



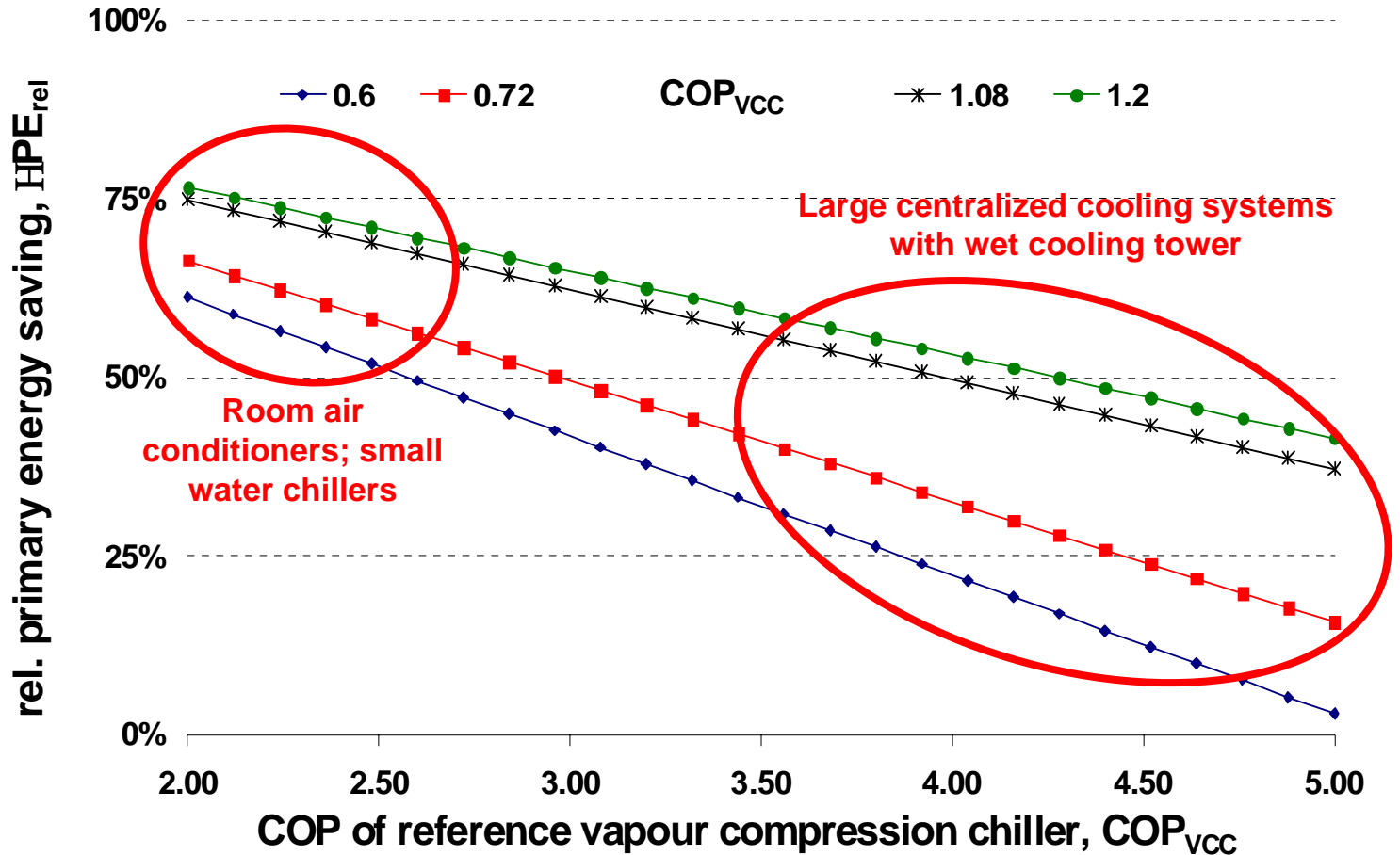
Electricity consumption heat rejection



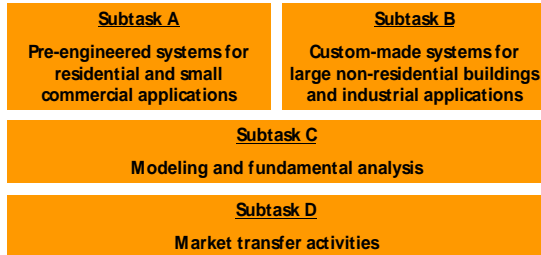
Electricity consumption TDC



COP of conventional vapour compression chiller



Task 38 Solar Air-Conditioning and Refrigeration



- Ongoing Task of the IEA Solar Heating & Cooling Programme
- Participants (research, companies) from 12 countries
- Extensive monitoring and evaluation of pre-fabricated and custom-made systems
- New, completely revised edition of handbook for planners and other professionals
- Thermodynamic analysis (exergy)

www.iea-shc.org

... thank you very much for your attention