SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

www.iea-shc.org

Laboratório Nacional de Energia e Geologia, I. P.

Solar Heating and Cooling Program of International Energy Agency

And Portuguese Participation

João Farinha Mendes

farinha.mendes@lneg.pt

FCT/UNL, 30 March 2012

GOVERNO DE PORTUGAL | MINISTÉRIO DA ECONOMIA E DO EMPREGO

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

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SHC Member Countries

Australia		Germany		South Africa	
Austria		Italy		Spain	
Belgium		Mexico		Sweden	
Canada		Netherlands		Switzerland	
Denmark		Norway		United States	
Finland		Portugal		European Union	
France		Singapore			

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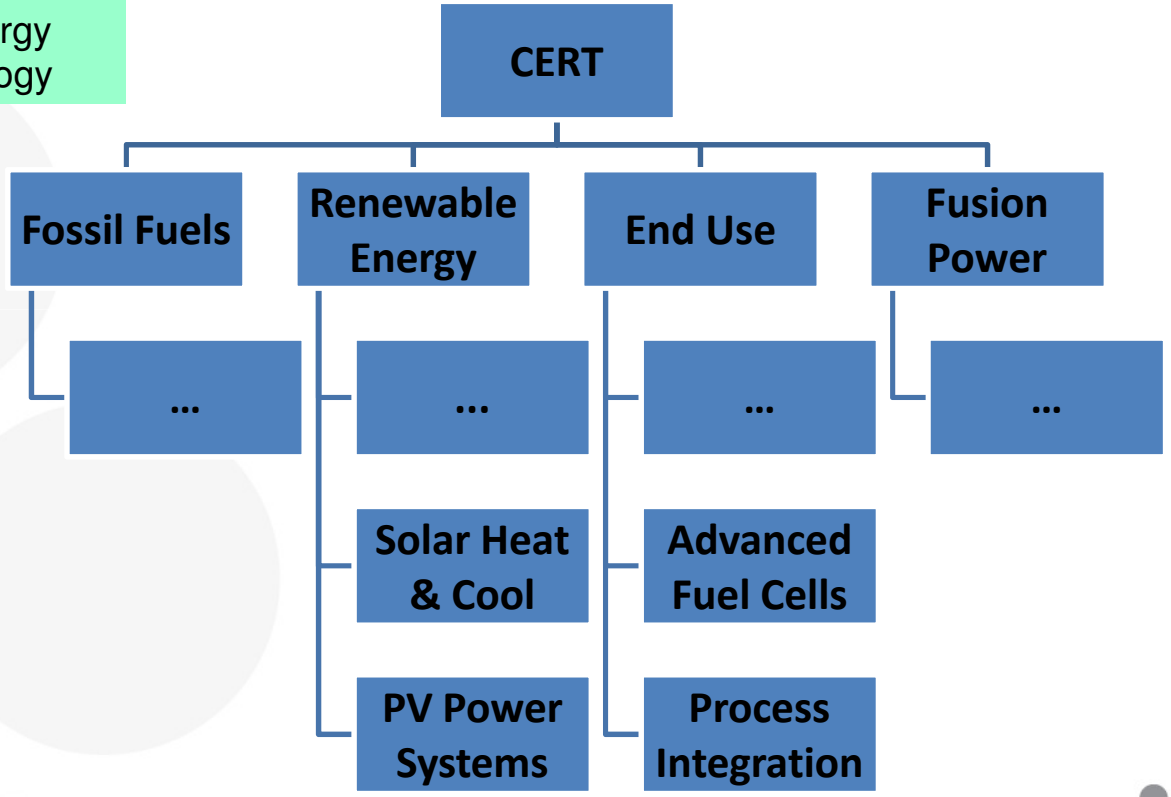
AIE – International Cooperation in Energy Tecnologies

IEA Committee on Energy Research and Technology

Working Parties

Implementing Agreements (Examples)



LNEG

Renewable Energy Working Party

- Bioenergy
- Geothermal Energy Research Technology
- Hydropower Technologies and Programmes
- Ocean Energy Systems
- Photovoltaic Power System (PVPS)
- Production and Utilization of Hydrogen
- Solar Heating and Cooling Systems (SHC)
- Solar Power and Chemical Energy Systems (SolarPACES)
- Wind Turbine Systems

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SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

- **SH&C Programme was initiated in the year 1976**

- **Vision - to contribute to a sustainable future using in large scale the "design" and solar technologies in building environment, agriculture and industry.**

Solar thermal energy systems will provide up to 50% of low temperature heating and cooling demand by 2030.

- **Mission - to continue being the most important international collaborative program in solar "design" solar and in heating and cooling solar technologies.**

- **The R, D&D collaborative work is done in a so called "*Task sharing*" basis, for the development of technologies using Sun energy for building heating, cooling, ilumination and electrifying purposes.**

LNEG

SHC OBJECTIVES

- Primary source of high quality **technical information and analysis** on solar heating and cooling technologies, designs and applications
- Contribute to a significant increase in the **performance** of solar heating and cooling technologies and designs.
- Enhance cooperation with industry and government on increasing the **market share** of solar heating and cooling technologies and designs
- Increase awareness and understanding on the **potential and value** of solar heating and cooling systems by providing information to decision makers and public.

SHC PRIORITY AREAS – 2009-2013

- Domestic hot water
- Solar combisystems for domestic hot water and space heating with an increasing solar fraction
- Passive and active solar buildings (including daylighting)
- Solar cooling
- Solar district heating
- Solar industrial applications
- Solar resource assessment
- Solar water treatment

IEA SHC TASKS

COMPLETED

– Building Energy Analysis Tools	(Task 22)	*1996-2003 (United States)*
– Optimization of Solar Energy Use in Large Buildings	(Task 23)	*1997-2002 (Norway)*
– Solar Procurement	(Task 24)	*1998-2003 (Norway)*
– **Solar Assisted Air Conditioning of Buildings**	**(Task 25)**	***1999-2004 (Germany)***
– Solar Combisystems	(Task 26)	*1998-2002 (Austria)*
– **Performance of Solar Façade Components**	**(Task 27)**	***2000-2005 (Germany***
– Sustainable Solar Housing	(Task 28)	*2000-2005 (Switzerland)*
– Solar Crop Drying	(Task 29)	*2000-2006 (Canada)*
– Daylighting Buildings in the 21st Century	(Task 31)	*2001-2005 (Australia)*
– Advanced Storage Concepts for Solar and Low Energy Buildings	(Task 32)	*2003-2007 (Switzerland)*
– **Solar Heat for Industrial Processes**	**(Task 33)**	***2003-2007 (Austria)***
– Testing &Validation of Building Energy Simulation Tools	(Task 34)	*2003-2007 (United States)*
– PV/Thermal Systems	(Task 35)	*2005-2007 (Denmark)*

- Portugal signed the SH&C Implementing Agreement in the year 1999.

IEA SHC TASKS

CURRENT & NEW

– Solar Resource Knowledge Management	(Task 36)	*2005-10 (United States)*
– Advanced Housing Renovation with Solar & Conservation	(Task 37)	*2006-09 (Norway)*
– **Solar Air Conditioning and Refrigeration**	**(Task 38)**	***2006-09 (Germany)***
– **Polymeric Materials for Solar Thermal Applications**	**(Task 39)**	***2006-10 (Germany)***
– **Net Zero Energy Solar Buildings**	**(Task 40)**	***2008- 13 (Canada)***
– **Solar Energy & Architecture**	**(Task 41)**	***2009 - 12 (Sweden)***
– Compact Solar Thermal Energy Storage	(Task 42)	*2009 - 12 (Netherlands)*
– **Rating & Certification Procedures**	**(Task 43)**	***2009 - 12 (Denmark+USA)***
– **Solar and Heat Pump Systems**	**(Task 44)**	***2010 -13 (Switzerland)***
– Large Solar Heating & Cooling Systems in combination with Heat Pumps and Seasonal Storage and other RE-Technologies	(Task 45)	*2011-13 (Denmark)*
– Solar Resource Knowledge Management	(Task 46)	*2010-15 (USA)*
– Advanced Renovation in Non Residential Buildings	(Task 47)	*2011-14 (Norway*
– Quality Assurance and Support Measures for Solar Cooling Systems	(Task 48)	*2011-15 (France)*
– **Solar Heat Integration in Industrial Processes**	**(Task 49)**	***2012-15 (Austria)***

UNDER DEVELOPMENT

- Advanced lighting solutions for retrofitting buildings
- Solar Energy and Urban Planning

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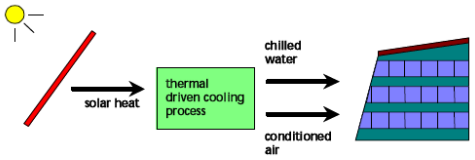
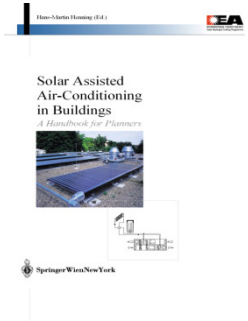


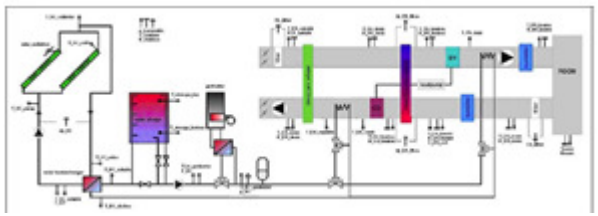
Task 38. Solar Air conditioning and Refrigeration

To contribute to the implementation of measures that acelerate market introdution of solar heating and cooling systems in the residential, comercial and industrial sectors. To achieve it, will be necessary :

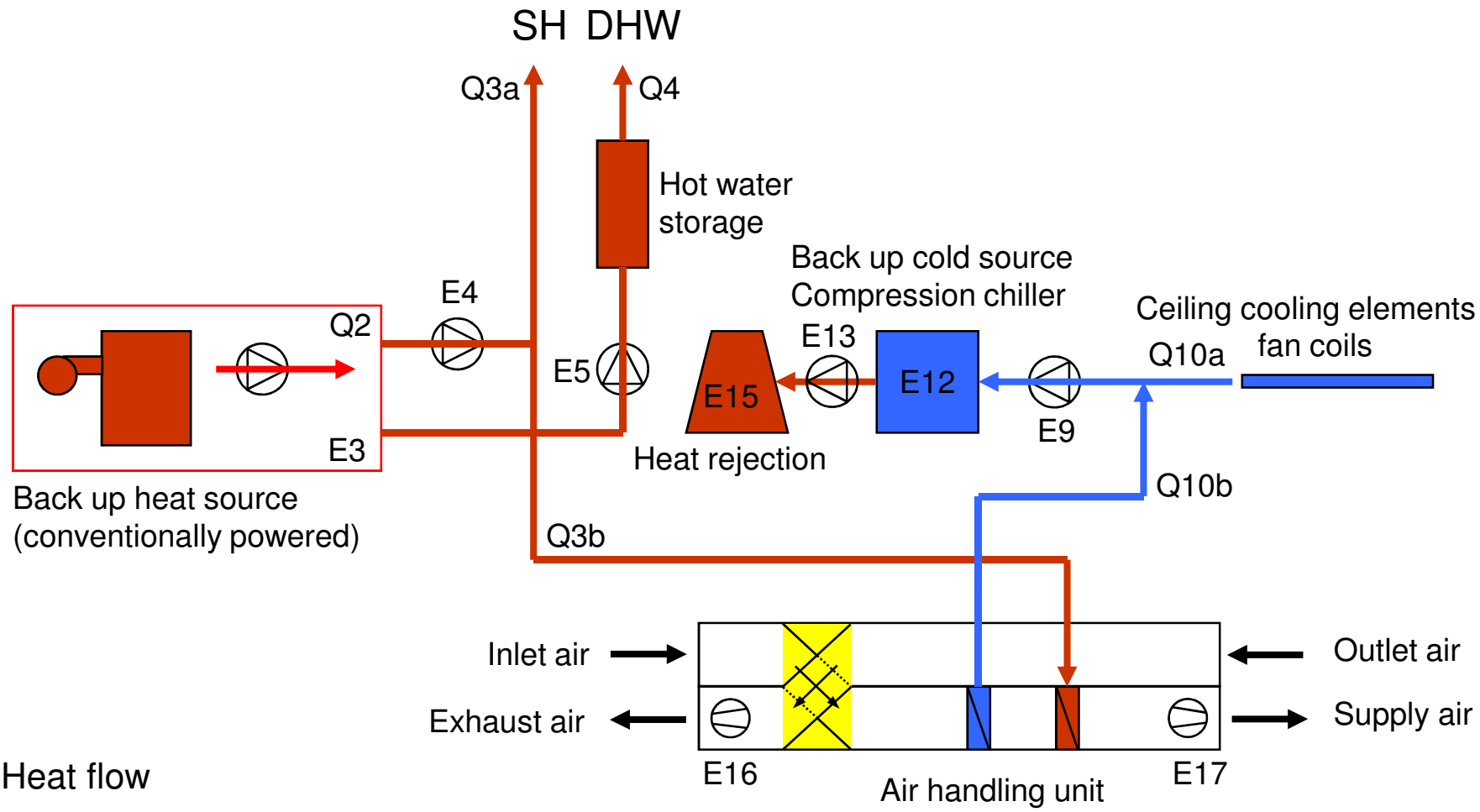
1) To develop activity in “standardized” systems, pré-fabricated in factory of the low level power range (residential and small comercial applications);
2) To develop new conceptions and to create tools for a correct implementation in large scale applications (pavihões industriais, etc);
3) To contribute for new R&D activities and to the development of advanced design of systems.

Participant countries:
Germany, Austria, Canada, Denmark, Spain, Italy, Mexico, **Portugal**, S witzerland.





Definition of a conventional reference system



Q… Heat flow

… Pump

E… Electricity consumption of pump, fan, motor, …

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INTERNATIONAL ENERGY AGENCY

International Energy Agency
Energy Conservation in Buildings and Community Systems Programme

SHC TASK 40 - ECBCS ANNEX 52

Towards Net Zero Energy Solar Buildings

http://www.iea-shc.org/task40/

Duration: October 1, 2008 - September 30, 2013

Team

LNEG

Helder Gonçalves

Helder.Goncalves@lneg.pt

Laura Aelenei

Laura.Aelenei@ineti.pt

FCT

Daniel Aelenei

aelenei@fct.unl.pt

Task 40 structure

Sub-task A: Definições

Sub-task B: Ferramentas de design

Sub-task C: Desenvolvimento de estratégias e métodos - NZEB — **LNEG**

Sub-task D: Disseminação

Objectivos

- Estudo dos edifícios de balanço energético nulo ou quase nulo e de consumo energético reduzido;
- Desenvolver uma estratégia comum, um quadro internacional harmonizado incluindo definições, ferramentas, soluções inovadoras e orientações para indústria.

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Task 41 – Solar Energy and Arquitecture

http://www.iea-shc.org/task41/

The main goals of the Task are to help achieving high quality architecture for buildings integrating solar energy systems, as well as improving the qualifications of the architects, their communications and interactions with engineers, manufactures and clients. Increased user acceptance of solar designs and technologies will accelerate the market penetration. The overall benefit will be an increased use of solar energy in buildings, thus reducing the non-renewable energy demand and greenhouse gas emissions.

To achieve these goals, work is needed in three main topics:

- Architectural quality criteria; guidelines for architects by technology and application for new products development.
- Tool development for early stage evaluations and balancing of various solar technologies integration.
- Integration concepts and examples, and derived guidelines for architects.

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Task 43 – Solar Rating and Certification Procedure

http://www.iea-shc.org/task43/

Período de Execução: 1 de Julho de 2009 a 30 de Junho de 2012
Representantes LNEG: Maria João Carvalho / Ana Neves Sol
Reuniões realizadas: 15&16.10.2009 – Joanesburgo, África do Sul (*)
9&10.02.2010 – Estugarda, Alemaha
(*) LNEG não esteve presente

Objectivos:

- **Investigação e Desenvolvimento no domínio dos ensaios de colectores e sistemas solares térmicos, incluindo ensaios de comportamento térmico e qualificação, avaliação do impacto ambiental, ensaio de envelhecimento de curta duração, modelação numérica e analítica;**

Solar Heating & Cooling Programme

Task 43 – Solar Rating and Certification Procedure

Principais vantagens da participação do LNEG/INETI:

• **Conhecimento e troca de informação entre laboratórios congéneres e outros participantes, de novas metodologias de ensaio desenvolvidas e de revisões normativas que daí advêem, permitindo oferecer aos seus clientes uma capacidade de resposta actualizada; Melhoria contínua do sistema de gestão do LES, no âmbito da sua Acreditação, visando a satisfação do cliente.**

Principais dificuldades da participação do LNEG/INETI:

• **Difilcudade de obtenção de financiamento para projectos de investigação aplicada nacionais e para aquisição de equipamento moderno.**

SOLAR HEATING & COOLING PROGRAMME
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IEA
OECD

HP
SOLAR

IEA SHC & IEA HPP: TASK44 – Annex 3x

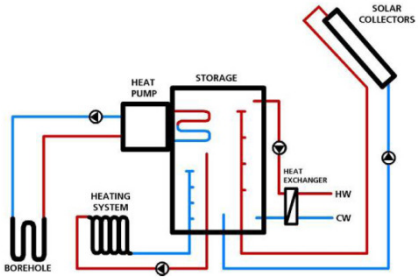
SOLAR AND HEAT PUMP SYSTEMS

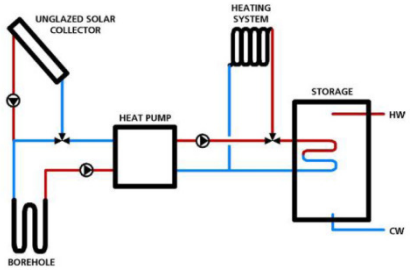
http://www.iea-shc.org/task44/

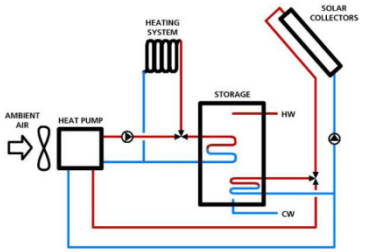
Objectives:

- **To study interaction between heat pumps and solar thermal collectors for domestic heating and cooling.**

- **To minimize energy consumption, the initial investment and operating cos mdotid o consumo energético (electricidade), o investimento inicial e os custos de manutenção.**







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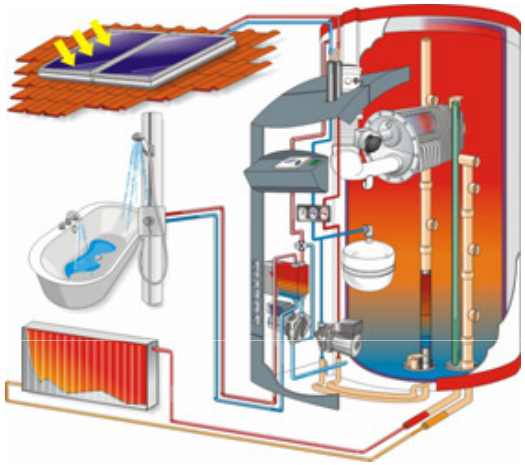
Task 44 - **Solar Process Heat for Production and Advanced Applications**
http://www.iea-shc.org/task44/

- Further develop and improve solar process heat collectors and components
- analyze and provide new knowledge on high temperature behavior of process heat collectors and solar loops
- develop a testing procedure and to provide a basis for the comparison of collectors under certain conditions
- provide engineering tools for optimized heat integration and optimized planning of solar thermal integration by advanced pinch analysis and storage management
- identify new applications for solar thermal energy in several production processes through the combination of process intensification technologies
- develop planning tools, calculation tools for solar yields in large scale plants
- gain proven solutions for stagnations behavior
- install and monitor large-scale demonstration systems
- develop guidelines for solar process heat
- to lower the barriers for market deployment

R&D PRIORITIES – Solar Combisystems

- Development of systems and compact products (including storage)
- Formation of installers and designers (engº and arqº).
- Information and dissemination of successful cases of systems with high durability and fiability.



R&D PRIORITIES – Active Solar Cooling

Market niches with high potential

- "Solar combi-plus systems" (DHW+heat+cool) for residential and small comertial buildings.
- Aplications with another added value, in adition to energy savings, as it is the case of green revolution, with new behavior, ecoturism, etc.

R&D PRIORITIES– Natural Lighting

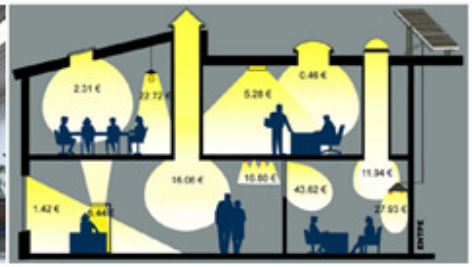
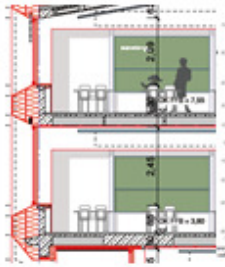
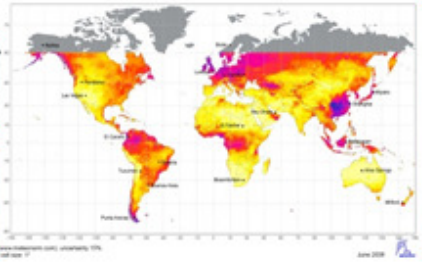
- Development of design tools and adaptative control
- To assure new materials and components
- Formation in the building sector

NECESSARY POLICIES

Legislation on Solar Systems for DHW and AC

- Solar Building regulamentation
- Directives on Heat Production
- R&D suport in the heat production sector.
- Pilot projects with detailed monitorization.
- Stable Research Programs at least for 10 years
- Good pratice manual for low temperature applications

- **Information**
  - Formation on installation ad rules for arquitecture
  - Benefits quantification.

Advanced lighting solutions for retrofitting buildings

Subtask A

Benchmarks & Requirements, System Characteristics

Subtask B

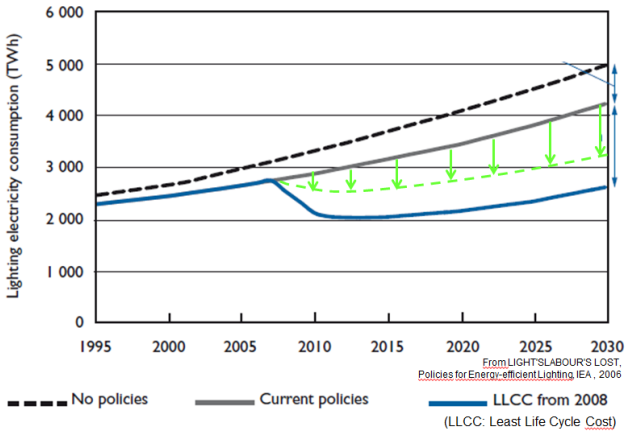
Daylighting and System Technology

Subtask C

Methods and Tools

Subtask D

Case Studies



Advances in Complex Fenestrations Systems (CFS)

- Glazing Systems
- Light Guidance (Hybrid Systems)
- Rooflights


Mayhoub, Carter, LR, 2009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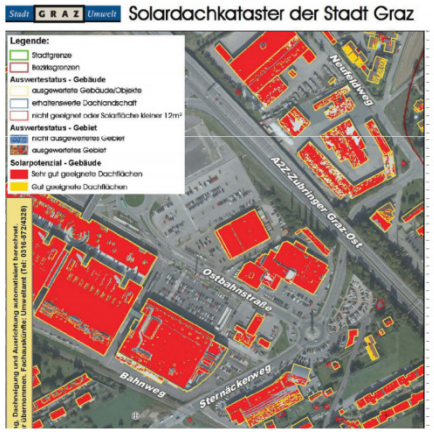
Solar Energy and Urban Planning

We would like to ensure that solar energy planning will be a clear and well developed strategy in future planning of urban areas and whole cities !

Subtask A: Computer Tools: GIS

Solar potential
Roof areas

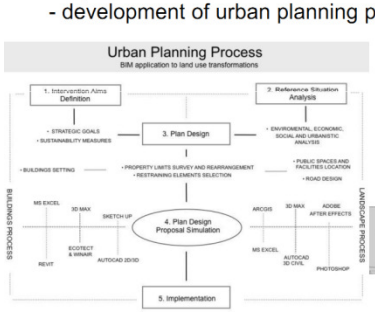
City of Graz

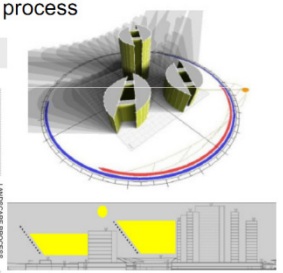


http://geodaten1.graz.at/WebOffice/synserver?project=solar&client=flex

Subtask A and B: Computer Tools and Methods…

"City Information Modelling"*
- development of urban planning process



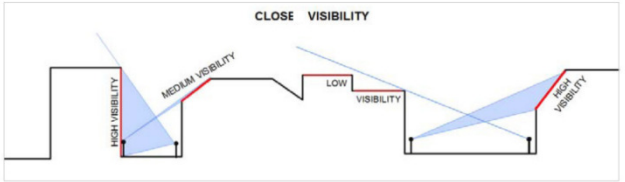


*) Amado, M.P. & Poggi, F. (2011) Oeiras masterplan; A methodology to approach urban design to sustainable development. In proceedings CISBAT 2011

Subtask B: Existing urban areas

Architectural Criteria*

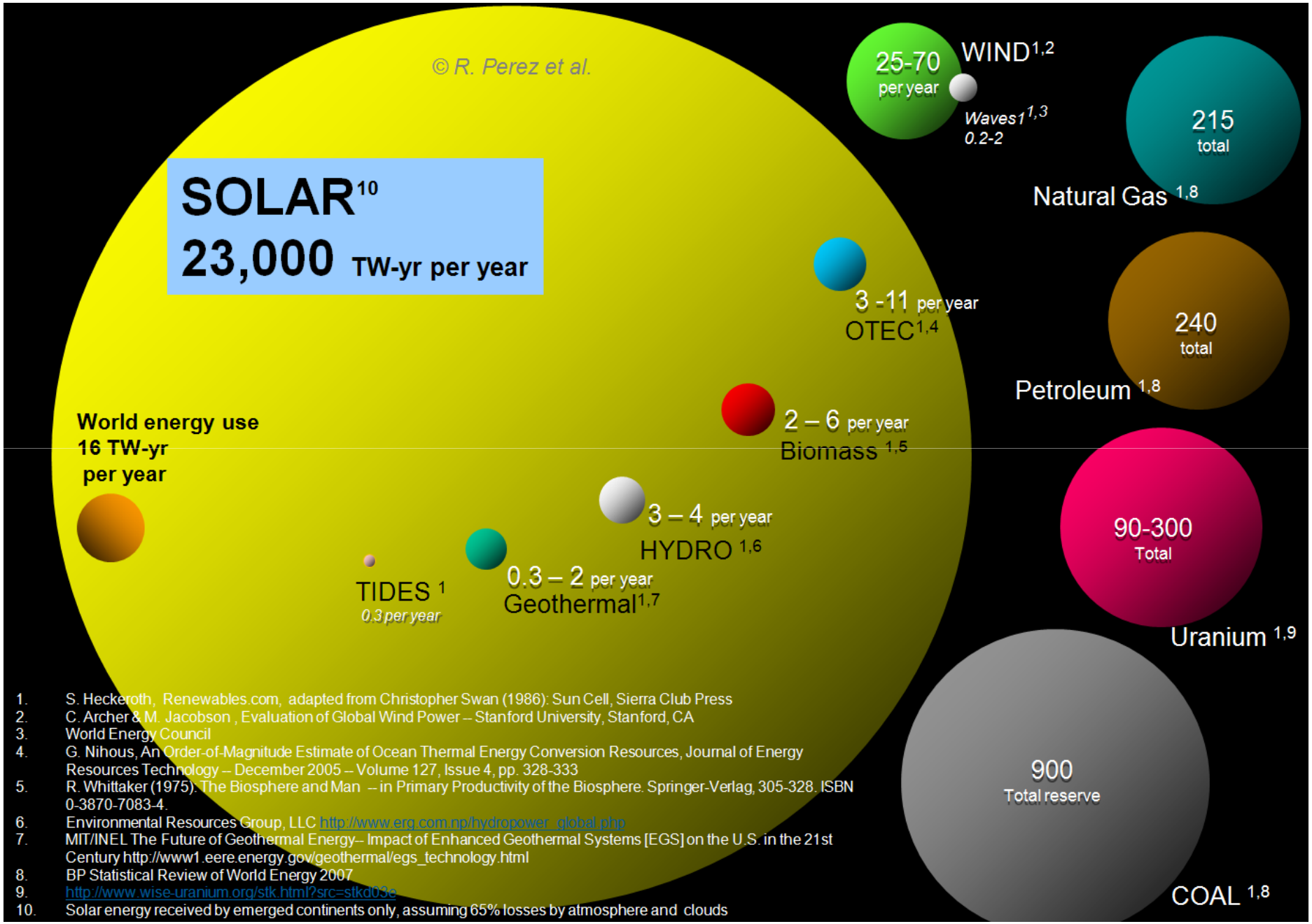
- ❑ zone sensibility (historical city centre – industrial area)
- ❑ zone visibility (close – remote)
- ❑ political context (environmental goals, energy needs…)



*) Munari Probst, M.C & Roecker, C. (2011). Urban acceptability of building integrated solar systems: LESO-QSV approach. EPFL-LESO PB, Switzerland. *ISES SOLAR WORLD CONGRESS 2011*

SubTask C – Urban Case studies and Case Stories

Sub Task D - Education



1. S. Heckeroth, Renewables.com, adapted from Christopher Swan (1986): Sun Cell, Sierra Club Press
2. C. Archer & M. Jacobson , Evaluation of Global Wind Power -- Stanford University, Stanford, CA
3. World Energy Council
4. G. Nihous, An Order-of-Magnitude Estimate of Ocean Thermal Energy Conversion Resources, Journal of Energy Resources Technology -- December 2005 -- Volume 127, Issue 4, pp. 328-333
5. R. Whittaker (1975). The Biosphere and Man -- in Primary Productivity of the Biosphere. Springer-Verlag, 305-328. ISBN 0-3870-7083-4.
6. Environmental Resources Group, LLC http://www.erg.com.np/hydropower_global.php
7. MIT/INEL The Future of Geothermal Energy-- Impact of Enhanced Geothermal Systems [EGS] on the U.S. in the 21st Century http://www1.eere.energy.gov/geothermal/egs_technology.html
8. BP Statistical Review of World Energy 2007
9. http://www.wise-uranium.org/stk.html?src=stkd03e
10. Solar energy received by emerged continents only, assuming 65% losses by atmosphere and clouds

REDIENE

Red Iberoamericana de Energía

FORUM CYTED-IBEROEKA 2010

"Energía: Fuentes y Aplicaciones"

22 y 23 de noviembre de 2010 / **Cancún – México**

La Red Iberoamericana de Energía y sus beneficios

Daniel López Aldama*

*Centro de Gestión de la Información y Desarrollo de la Energía **(CUBAENERGIA)** e-mail: aldama@cubaenergia.cu

CYTED

CIENCIA Y TECNOLOGÍA PARA EL DESARROLLO

¿Qué es REDIENE?

La Red Iberoamericana de Energía, REDIENE, es una vía para crear y estrechar vínculos entre distintas instituciones del sector energético para dar soluciones a problemas y necesidades existentes, que permitan potenciar el desarrollo energético sostenible en Iberoamérica.
Es una acción del área temática Energía, del Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo, CYTED.

Misión

Potenciar la gestión del conocimiento en energía, a través del intercambio de información, conocimientos, experiencias y soluciones que contribuyan al desarrollo energético sostenible y científico-tecnológico de la región iberoamericana.

Visión

REDIENE servirá de apoyo a la toma de decisiones en el sector energético de Iberoamérica.

Objetivo General

Potenciar la gestión del conocimiento en energía, a través del intercambio de información científica y tecnológica, conocimientos, experiencias y soluciones que contribuyan al desarrollo energético sostenible, y científico tecnológico de la región Iberoamericana; fomentando la cooperación de instituciones, centros de investigación, universidades, empresas, especialistas y profesionales relacionados con los recursos, las fuentes y tecnologías energéticas en toda la cadena energética desde la exploración y extracción hasta los servicios

Objetivos Específicos

- Integrar instituciones, empresas, especialistas y profesionales vinculados al sector energético de Iberoamérica.
- Intercambio, divulgación y publicación de información científica y tecnológica de energía como soporte a la toma de decisiones en Iberoamérica.
- Educar y entrenar a recursos humanos (Jornadas Iberoamericanas, Talleres Especializados y Cursos /Seminarios en diferentes países integrantes de REDIENE) del sector energético.

Beneficios que ofrece

- Brinda a empresarios y otros actores la posibilidad de promover sus productos, servicios, catálogos.
- Brinda a investigadores y otros profesionales la posibilidad de publicar resultados, dar a conocer sus experiencias.

Reuniones

- Encuentro Preparatorio y de Conciliación. Marco FIBECYT. Isla Margarita 2 - 3 de Diciembre 2008. Venezuela.
- Primera Reunión de Coordinación. Universidad Tecnológica de Panamá. Panamá 14 -15 Abril 2010. Panamá.
- Reunión del Comité de Área con los Coordinadores de Acciones vigentes. Marco Foro CYTED-IBEROEKA. Playa del Carmen 22-23 de noviembre 2010. México
- Segunda Reunión de Coordinación. Cartagena de Indias, abril 2011. Guatemala (por confirmar)

Países y entidades que integran REDIENE hasta el momento

ARGENTINA / Universidad Nacional De Salta (UNSA)
BRASIL / Universidad de São Paulo (FZEA/USP)
CHILE / Centro Interdisciplinario de Energía, Pontificia Universidad Católica de Valparaíso (PUCV)
CUBA / Centro de Gestión de la Información y Desarrollo de la Energía (CUBAENERGÍA)
ECUADOR / Pontificia Universidad Catolica del Ecuador (PUCE)
EL SALVADOR / Universidad Centroamericana "j. S. Cañas" (UCA)
ESPAÑA / Universidad de Valladolid (UVA)
GUATEMALA / Ministerio de Energía y Minas (MEM)
HONDURAS / Universidad Nacional Autónoma de Honduras (UNAH)
Investigación, Desarrollo y Demostración en Energía y Ambiente S de RL (IDEA)
PANAMA / Universidad Tecnologica de Panama (U.T.P.)
PARAGUAY / Instituto Nacional de Tecnología, Normalización y Metrología (INTN)
PERÚ / Universidad Nacional de Ingeniería (UNI)
PORTUGAL / Instituto Nacional de Engenharia Tecnologia e Inovação, IP (INETI),
/ Escola de Ciências e Tecnologia / Universidade de Évora (ECTUE).
REPÚBLICA DOMINICANA / Universidad Autónoma de Santo Domingo (UASD).
VENEZUELA / Universidad Bolivariana De Venezuela (UBV).

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