Position paper for the start of a

E S T T P

European Solar Thermal Technology Platform

SOLAR THERMAL

Position paper for the start of the European Solar Thermal Technology Platform

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ESTIF

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This Vision Paper was edited by the initiator group of the ESTTP with the support of the European Solar Thermal Industry Federation (ESTIF) and the European Renewable Energy Centres Agency (EUREC).

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EXECUTIVE SUMMARY

- At the beginning of 2005 solar thermal systems with approximately 10 GW_{th} capacity were in operation in Europe. Our vision is to increase this capacity to at least 200 GW_{th} by 2030. This goal is ambitious but well achievable with a mix of support measures and increased research and technical development (RTD)..

- In Europe, far more energy is used for heating and cooling in buildings than as electricity or transport.

- Buildings are on sale today that are powered exclusively by renewable energy (no fossil or nuclear energy). By increasing both the energy efficiency of the building stock and the use of solar thermal energy in the built environment, solar energy technology could provide most of the heating and cooling needs in buildings by 2030.

- The adoption of solar heating and cooling systems will accelerate because of decreasing system costs and the parallel increase of the costs of fossil fuels. The prices of solar thermal systems have already decreasedsignificantly and mass production and distribution will further drive down costs.

- In addition to the widespread use of solar thermal in the built environment, applications such as solar industrial process heat and solar thermal desalination will help substitute conventional energies, thus decreasing greenhouse gas emissions as well as our dependence on imported fuels. A large number of new jobs will be created mainly in small and medium-sized enterprises.

- The European Solar Thermal Technology Platform is being established to identify the areas in which strengthened RTD efforts will have the highest positive impact on the uptake of solar thermal energy. Amongst the key topics will be:

    - Improving the integration of solar thermal systems in buildings for heating and cooling in combination with improved building technologies.

    - Increasing the energy density of modern heat storages approximately 8-fold in order to be able to fully cover the heating and cooling demand of existing buildings and examining the potential for a dedicated European facility to undertake this.

    - Developing solar thermal cooling to a point where it can largely replace electric cooling machines and thus reduce electricity demand when it is at its peak in summer. This improves grid stability and reduces environmental pollution.

- The goal of the ESTTP is to develop a strategic research agenda for the solar thermal sector, which will help the industry, the research community as well as public funding bodies to focus on high-impact topics. This will reinforce the technological leadership of the European solar thermal sector, which is key to boosting worldwide exports of this sector's technology.

- Manufacturers, research institutes and policy makers are invited to support the establishment of the European Solar Thermal Technology Platform.

THE BACKGROUND

Solar thermal energy can be used in many ways, to replace conventional fuels such as coal, gas, oil and nuclear. Today it is used manly to heat domestic water and to some extent for space heating. As solar thermal is still an evolving technology many more applications of this clean energy source become available in the market. In a few decades only, solar thermal will supply significant portions of our heating and cooling demand.

Reducing the use of conventional energies is crucial in order to achieve three important goals:

- Stopping the disastrous implications of global warming
- Increasing our security of supply by reducing our dependence on fuel imports from politically unstable regions
- Reducing the negative economic effects of dramatically rising oil and gas prices

EUROPE FOSTERS RENEWABLE ENERGIES

To this end, the European Union has decided to strongly increase the use of renewable energies in general and of solar thermal in particular. Several documents have set the framework for the deployment of renewables:

- White Paper for a Community Strategy and Action Plan sets a target of 100 million m^2, which corresponds to 70 GW_{th} installed solar thermal capacity by 2010.
- Green Paper Towards a European Strategy for the Security of Energy Supply sets the target to double renewables from 6% in 1996 to 12% in 2010

EUROPE IS TECHNOLOGY LEADER IN SOLAR THERMAL

The European solar thermal industry is the clear technological leader in the world. A network of world class research institutes together with a strongly growing industry have developed highly efficient solar thermal technologies, which are exported to many countries around the globe.

Strengthening solar thermal in Europe not only reduces the use of conventional energies, but also increases competitiveness in one of the key technologies of the 21st century.

THE CURRENT SITUATION

The implementation of solar thermal technologies as a source for heating and cooling in Europe and the development of a strong European solar thermal sector are important steps towards achieving the European policy goals of increased security of energy supply, reduction of greenhouse gases and sustainable development.

A major part of the energy use in the EU is related to applications in heating and cooling which operate at temperatures below 250°C. In this temperature range solar thermal offers great opportunities replacing valuable fossil fuels by emission free solar solutions.

In the built environment alone, more than one third of the EU energy is used for heating. In both the built environment as well as the industrial sector, the EU consumption is around 40% of which approximately 80% is used for applications below 150°C.

These figures reflect the enormous potential for solar thermal as the main technology to replace traditional fuels used for heating and cooling. Based on the present state of the technology, the perspectives for further technological developments and the combination with price developments for traditional fuels as a result of scarcity and environmental cost, a realistic assumption can be made that in the next 25 years energy needed for heating and cooling in the EU can be reduced by a minimum of 50% through a mix of energy savings, energy efficiency and the use of solar thermal.

In economic terms this implies that widespread use of solar thermal technologies in combination with other energy reduction measures can take up to 15% or roughly € 100 billion out of the EU energy bill in a few decades time.

The worldwide and the European solar thermal markets have grown significantly over the recent years. The most dynamic markets for solar thermal systems with flat-plate and evacuated tube collectors worldwide are in China and in Europe. The average annual growth rate between 1999 and 2003 was 27% in China and 12% in Europe. At the beginning of 2005, the installed capacity of flat-plate and evacuated tube collectors in Europe was 10 GW_{th} (14 million square meters).

Although Europe is leading in technological terms and the growth rate has been remarkable, Europe cannot afford to be complacent. In terms of manufacturing, 75% of the solar thermal collectors produced worldwide in 2003 were produced in China. Europe comes in at second place, with just 10% of the worldwide production.

In order to improve European competitiveness and to open new markets, the European solar thermal sector needs to increase its research efforts and levels of market support. **Therefore a strong common European solar thermal technologies is needed.**

THE VISION FOR SOLAR HEATING AND COOLING

The vision for 2030 is to install into the built environment, solar thermal collectors with a capacity of 200 GW_{th}, to provide the energy required for hot water, space heating and cooling for the residential and tourism sector as well as heat and cold for industrial processes.

This would be **triple the goal set in the White Paper** for a Community Strategy and Action Plan, which set a target of 100 million m^2, which corresponded to 70 GW_{th} installed solar thermal capacity by 2010. With these ambitious, though realistic, growth figures, the heat generated by solar thermal systems would be about 114.000 GWh_{th} annually by 2030.

Developments in the building sector (new low energy and retrofit of existing buildings) show that it is possible to reduce the specific heating requirements of buildings significantly. If one takes a reduction in the heating requirements of 20 % by 2030 as a basis, then the share provided by solar energy could rise in Europe to around 6% of the final energy use for the overall hot water and space heating requirements.

THE ACTIVE SOLAR BUILDING

New buildings offer the chance of optimising building architecture by providing a large proportion of solar energy usage, minimum heat loss and an optimum integration of larger solar collector areas. By 2030, solar thermal systems will have developed into versatile building components, facilitating standardised and specific uses on a large scale. Almost all new buildings and a significant share of the renovated buildings will be fitted with solar thermal façades and roofs.

Integrated solar thermal façade collectors with vacuum insulation and solar roofs will minimise the heat losses of buildings and will provide at the same time the energy needed for heating, domestic hot water and for cooling of the buildings.

The elements will be offered in a wide range of standard sizes and offer the architect the possibility of adding full-surface solar façades to the building, as part of the renovation process, without significantly changing the proportions of the building. The ability to combine solar and opaque elements with any desired surface will extend the architectural design possibilities and offer the chance of providing a complete solar energy solution.

Systems will be adapted to the type of building and to geographic differences. Buildings in the north of Europe will tend toward the heating aspects, while buildings in the south of Europe will focus on cooling. Buildings in central Europe will most likely balance the two aspects into generic approaches.

BLOCK AND DISTRICT HEATING

The present situation where established gas networks hinder the development of block and district heating systems will change by 2030, as it is more interesting to use gas in cogeneration plants. The market for block and district heating plants will increase from today's 300 to 1000 TWh/a. About 5% of the heat, i.e. 50 TWh/a, is provided by solar thermal systems in combination with biomass boilers, which will create a market of more than 100 million m^2 of solar collectors in block and district heating applications within less than three decades.

INDUSTRIAL AND OTHER APPLICATIONS

Many of the industrial processes that require heating or cooling operate on a temperature level below 250°C. Solar thermal systems are widely used to serve this market segment. Emission regulations, emission trading schemes and fossil fuel price levels drive the implementation of solar thermal in this sector.

Available façades and roof areas are filled with solar thermal collectors, but adjacent ground mounting areas are developed as well for the same purpose. The need for cheap compact heat and cold storage systems is pushing researchers to break new frontiers in storage technology. New developments in solar thermal create new applications as a result of the availability of systems which operate on higher temperatures.

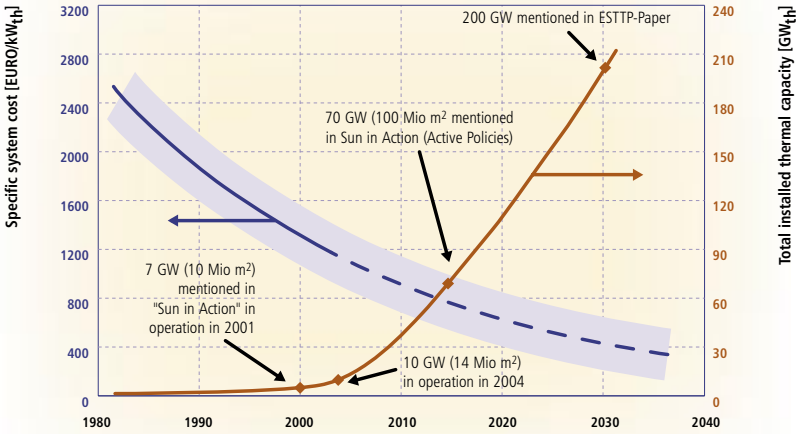
In the Mediterranean region the scarcity of fresh water is driving the applications of solar desalination.

COMPONENTS AND SYSTEMS

Depending on the application, a wide range of commercial solar collectors and systems will be available each with its own features. There will be a range of collectors for low temperature applications like domestic hot water preparation or space heating as well as middle temperature collectors, which provide heat up to 250°C for industrial- and cooling applications and sea water desalination. These collectors will be available as flat-plate collector or as concentrating collector.

The availability of new, compact time indifferent heat storage systems is essential for the breakthrough of solar thermal technology. In 2030 hot water stores will be available for half of today's price. Furthermore advanced storage concepts with a storage density 8 times higher than today's water storage will be on the market.

Development of specific costs and Installed capacity for small solar thermal systems with forced circulation in Central Europe



COST TARGETS

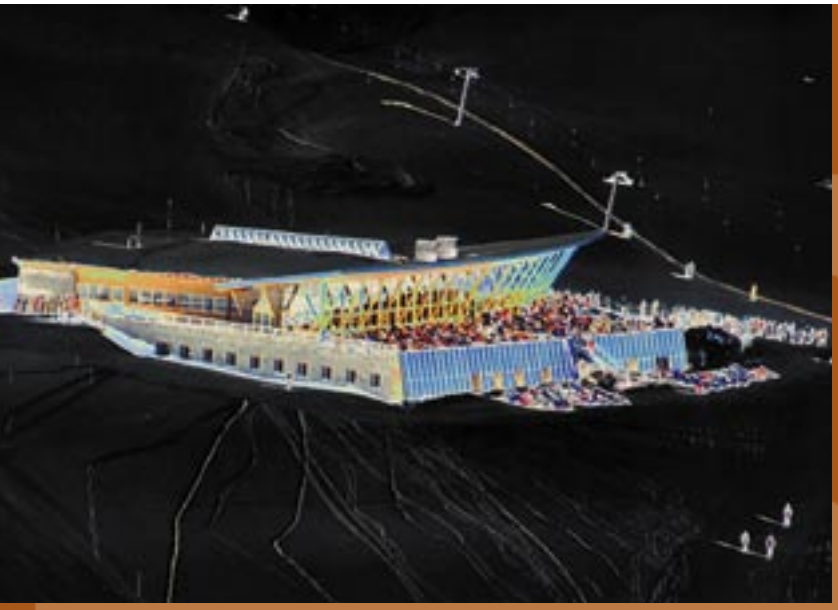
By 2030, the cost for thermal energy produced by solar thermal systems will be sufficiently low to compete within the heat market, all the more if fossil fuel prices continue to grow as expected.

In central Europe the cost target for a pumped solar domestic hot water system providing energy savings of 50 to 70% for a single family house is EUR 2000. For a solar combi-system that covers approximately one third of the heat required for domestic hot water preparation and space heating by means of solar energy costs of EUR 8000 to 9000 are expected in 2030.

In the year 2000 the price for solar heat was about 13 Eurocent/kWh in solar hot water systems and approx. 20 Eurocent/kWh in combisystems [1].
Solar thermal heat will be competitive with conventional heat from oil, gas or electricity all over Europe within 10 years due to the reduction in the system cost and even quicker if the oil price remains at the high level like in August 2005.

For 2030 the price for solar heat (based on system costs mentioned above) is expected to be 5 - 8 Eurocent/kWh in solar hot water systems and approx. 10 - 14 Eurocent/kWh in combisystems. For large-scale applications (>1MW$_{th}$) like district heating and industrial applications a price of 3 - 5 Eurocent/kWh is expected.

1 - *Cost basis Germany, 2000. Source: H. Drück, ITW, University Stuttgart, Germany*



SOCIO-ECONOMIC ASPECTS

By 2030, solar thermal will have developed into a large economic sector, both worldwide and in Europe. There will be a strong solar thermal industry with significant exports. The number of jobs created in the European Union will be between 200.000 and 250.000 based on a yearly European production of 20 GW$_{th}$. Many of these jobs will also be linked to the installation and building sector. These jobs will therefore be spread geographically and between SME's and large companies.

HOW TO REACH THE VISION

The research infrastructure in the field of Solar Heating and Cooling in Europe is highly fragmented. Up to now there is no existing official network of research centres. Co-operations are mainly within the framework of single, nationally or EC funded, projects.

In order to achieve the vision, activities need to be shaped into a coherent, long-term, market orientated strategy that includes targeted transitional actions. Given the potential of solar thermal, ongoing activities can be strengthened by adopting such a strategy thereby enabling accelerated cost reduction, build-up of new competitive solutions and a strong industrial base.

The key elements of such a strategy are:

- The need for a concerted effort, with continuity and full support of all stakeholders
- A comprehensive and structured approach
- Additional focus on critical technological issues
- Proportional accompanying measures.

To achieve the vision, the following specific issues should be addressed:

INCREASING RTD EFFORTS

Solar thermal systems have been regarded as a mature technology, with little potential for further R&D. This is not even true for solar water heating in small-scale systems, especially with regard to the wide range of other applications which require further applied and fundamental research. Compared to other renewable technologies significant research funds for solar thermal are presently not available, neither in the European framework programme nor in national programmes.

The level of effort needs to be significantly increased to be in balance with the present market growth and the potential of the technology. In order to account for the long-term and strategic nature of these research expenditures, dedicated research and development programmes should be designed on EU and Member State level.

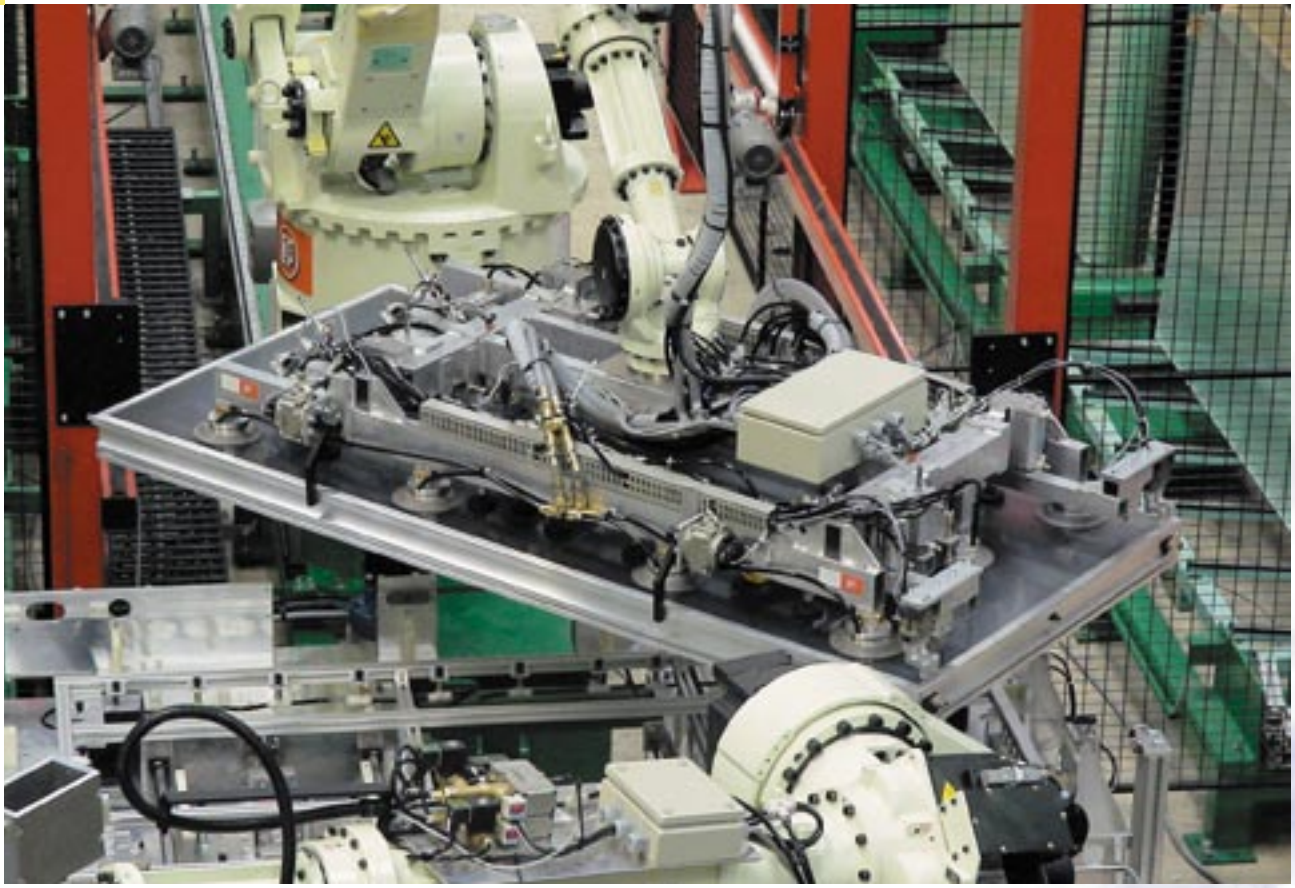
CONTINUITY AND LONG-TERM ACTION

Given the timescales needed to realise the full potential of solar thermal, continuity of action is essential. Technology development and falling costs have been a reality, and with support, this trend can be expected to continue, thereby enabling progressive developments of new competitive markets.

ADDRESSING THE BARRIERS

Besides the evident issue of cost, several other barriers exist which hinder the large scale deployment of solar thermal systems. These include technical issues, manufacturing issues, the structure of the energy sector, standardisation, financing, education and training of installers and not least market awareness and public acceptance.

The different barriers need to be systematically clarified and addressed, with the involvement of all stakeholders.



MANUFACTURING ISSUES

When it comes to the competitiveness of the solar thermal industry, it is not sufficient to have excellent R&D results.

The technological solutions developed need to be compatible with industrial processing. Application-oriented research should be addressed at an earlier stage in full cooperation with industry. Moreover, manufacturing-related issues need to be better addressed in technology development programmes.

Fully automatised production is needed to achieve the goals regarding the cost targets and the capacity to be installed in 2030.

CRITICAL MASS

European solar thermal activities, both in research and industry, are characterised by a large range of projects, research groups and companies, some of which are small. While this situation has grown naturally and favours healthy competition as well as a broad set of different technology options, it can hamper the formation of critical mass to penetrate the market successfully. By clustering different activities more effectively, overlap can be reduced in favour of complementary strengths.

JOINING FORCES AND COMPETENCIES

The solar thermal sector can benefit from stronger exchange and cooperation with other sectors of research (e.g. materials, chemistry, and nanotechnology in the fields of collector and storage development), industry (e.g. building industry, equipment manufacturers) and the energy sector (e.g. other renewable energy technologies, district heating and heat storage). A proactive dialogue can result in new synergies where different competencies allow promising new partnerships. By combining the use of solar thermal systems with other energy technologies more intensively e.g. in the building sector or in hybrid systems like PVT (combined photovoltaic-thermal collector), solar thermal can benefit and resolve some of its inherent weaknesses.

BUILDING SUSTAINABLE MARKETS

The global market for solar thermal applications has been growing considerably over the past years. However, the market can be vulnerable due to policy changes which create insecurities for investment. Even if market support schemes are transitional measures, it is important to develop "sustainable" support schemes which favour private investment in the domestic and export markets.

APPROACH

This document outlines a strategic action plan necessary to achieve the vision. The proposals presented here cover three main areas of intervention:

- Research and technology
- Industrial step
- Policy

To advance rapidly and to connect these three areas more strongly than they are today, a European Solar Thermal Technology Platform was established.

SOLAR THERMAL TECHNOLOGY PLATFORM

The establishment of a Solar Thermal Technology Platform is considered by the European Solar Thermal Industry and Research Centres to be a crucial strategic measure to support the achievement of the Solar Thermal Vision for 2030. Its role will be to define, support and accompany the implementation of a coherent and comprehensive strategic plan. The Technology Platform will:

- mobilise all actors sharing a long-term European vision for Solar Thermal Technologies
- define the European Strategic Research Agenda for Solar Thermal Technologies for the next decade(s) and give recommendations for their implementation
- ensure Europe maintains and improves its industrial position

More specifically, the Solar Thermal Technology Platform will:

- implement a strategic plan to provide advice and expertise to the decision makers to allow them to make informed decisions regarding the long term potential of Solar Thermal Technologies
- propose actions to all policy makers to help to ensure that clear, coherent priorities are established and that support is fully integrated, thereby facilitating implementation
- foster joint initiatives involving stakeholders in the formulation of research programmes
- ensure strong links and co-ordination between industry, research and market

The **European Solar Thermal Technology Platform (ESTTP)** is initiated in order to

- accelerate the technology development the field of solar thermal energy
- secure the leadership of Europe's solar companies
- maintain the scientific and technical leadership of Europe's R&D institutes
- increase the use of solar thermal energy and reduce Europe's dependency from fossil fuels and electricity for heating and cooling purposes.

ORGANISATIONAL STRUCTURE OF THE ESTTP

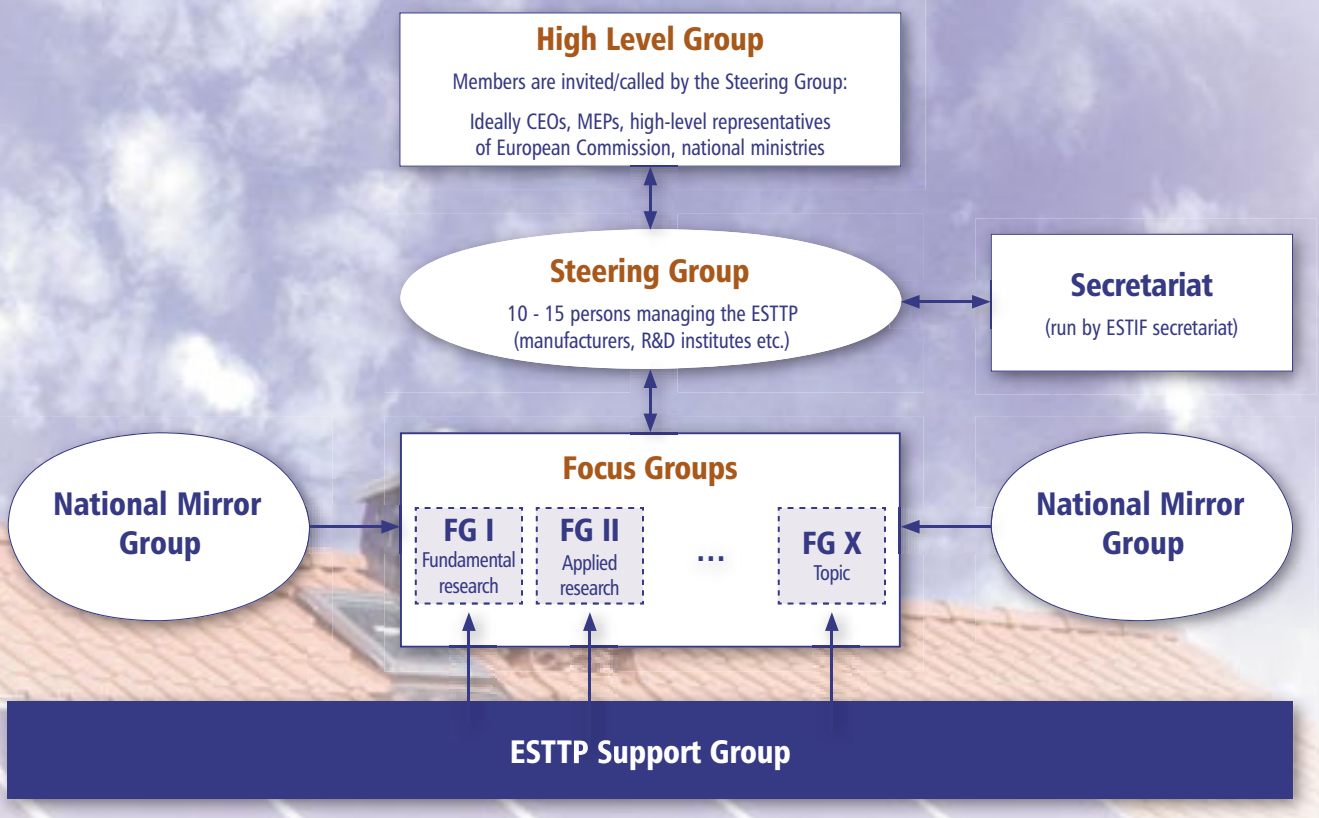


Photo courtesy: Architekt Klaus Mathoy, ARCON, Hammerer Transports, SCHOTT-Rohrglas, S.O.L.I.D., Sunmaster Energiesysteme, Wagner & Co — Design: ACG Brussels

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