About TREC

The **T**rans-Mediterranean **R**enewable **E**nergy **C**ooperation (**TREC**) is an initiative, in the field of renewable forms of energy, of The Club of Rome, the Hamburg Climate Protection Foundation and the National Energy Research Center of Jordan (NERC). Since it was founded in September 2003, it has developed the **DESERTEC concept** for energy, water and climate security in **EU**rope, the **M**iddle **E**ast and **N**orth **A**frica (**EU-MENA**), building on the cooperation of sun-belt and technology belt. Now TREC is making this concept a reality in cooperation with people in politics, industry and the world of finance.

TREC
Clean Power from the Deserts
Trans-Mediterranean
Renewable Energy Cooperation
In conjunction with The Club of Rome

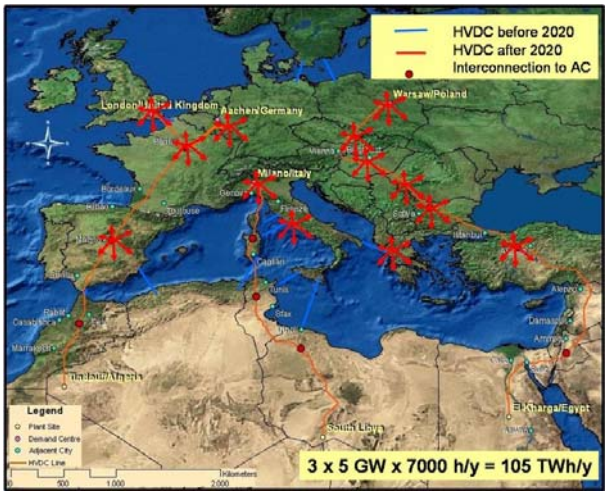
THE CLUB OF ROME

The core of TREC is an international network of scientists, politicians and experts in the field of renewable forms of energy and their development. The members of TREC (nearly 50 in number including *His Royal Highness Prince El Hassan bin Talal of Jordan*) are in regular contact with national governments and with private investors, aiming to communicate the benefits that may be obtained from the cooperative use of solar energy and wind energy, and promoting specific projects in this field.

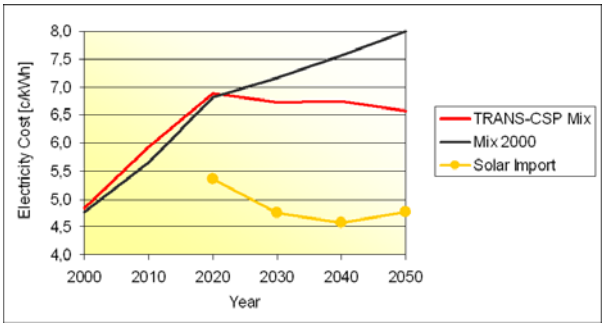
Two Reports by DLR

TREC was founded with the goal of providing clean energy for Europe and for sunbelt countries quickly and enconomically through a cooperation between the countries of EU-MENA. **Power from deserts, as a supplement** to European sources of renewable energy, can speed up the process of cutting European emissions of CO_2 and it can help to increase the security of European energy supplies. At the same time, it can provide jobs, earnings and other benefits for people in North Africa and the Middle East.

TREC has been involved in the conduct of **two studies** which have evaluated the potential of renewables in MENA, the expected needs for water and power in EU-MENA between now and 2050 and the potential for an intercontinental electricity transmission grid spanning the whole of EU-MENA. Those two studies were commissioned by the German Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU) and, starting in 2004, they have been conducted by the **German Aerospace Center (DLR)**. The **'MED-CSP'** report was produced in 2005 and the **'TRANS-CSP'** report was completed in 2006.



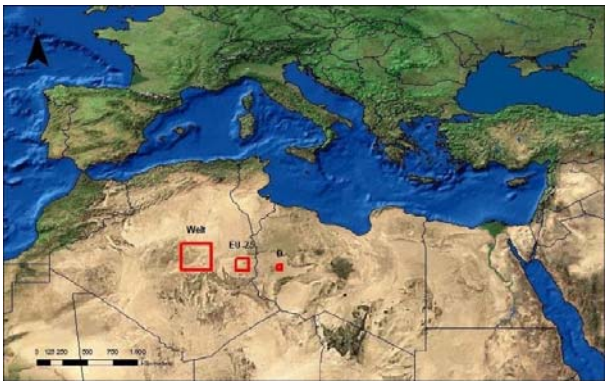
HVDC-Traces analysed in the DLR-study TRANS-CSP for Trans-Mediterranean power transmission.



Estimated **future electricity costs** in Spain by using the actual energy mix (black) or the TRANS-CSP Mix (red) with shares of imported clean power.

The DESERTEC Concept

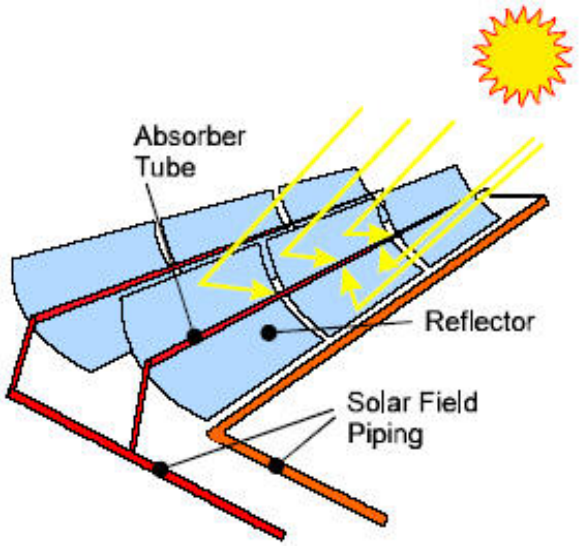
Satellite-based studies by the German Aerospace Center (DLR) have shown that, using **less than 0.3% of the entire desert areas** of the MENA region, Solar Thermal Power Plants can generate enough electricity to supply current demands in EU-MENA, and anticipated increases in those demands in the future. In addition, it has potential to alleviate shortages of fresh water in the MENA regions. The trade winds of southern Morocco may be harnessed to generate additional supplies of electricity. Clean electricity can be transmitted via **H**igh **V**oltage **D**irect **C**urrent (**HVDC**) transmission lines throughout EU-MENA with overall transmission losses that would be no more than 10-15%. The Club of Rome and TREC are both supporting this **DESERTEC concept of putting technology and deserts into service for energy, water and climate security**. Countries like Egypt, Algeria, Jordan, Morocco and the United Emirates have already shown a strong interest in this kind of cooperation.



For illustration: Areas of the size as indicated by the red squares would be sufficient for Solar Thermal Power Plants to generate as much electricity as is currently consumed by the World, by Europe (EU-25) and by Germany respectively. (Data provided by the German Aerospace Center (**DLR**), 2005)

The Technology

The best solar power technology for providing secure capacity is solar thermal power plants (also called **C**oncentrating **S**olar Thermal **P**ower, **CSP**). They use mirrors to concentrate sunlight to raise steam and generate electricity. Excess heat from additional collectors can be stored in tanks of molten salt and then be used **to power the steam turbines during the night**, or when there is a peak in demand. In order to ensure uninterrupted service during overcast periods or bad weather, the turbines can also be powered by oil, natural gas or biomass fuels. An interesting by-product that can be a great benefit to the local population is that waste heat from the power-generation process can be used to **desalinate seawater** and to **generate thermal cooling**.



Sketch of a **parabolic trough collector**.
(A simplified alternative to a parabolic trough concentrator is the linear **Fresnel** mirror reflector.)

With the technology of **H**igh **V**oltage **D**irect **C**urrent (**HVDC**) power, transmission losses can be limited to only about 3% per 1000 km. The better solar radiation in North Africa outweighs by far the **transmission losses across the Mediterranean of 10-15% to Europe.** Although hydrogen has in the past been proposed as an energy vector, this form of transmission is very much less efficient than HVDC transmission lines.

Parabolic trough collector field for the CSP power plants in Kramer Junction, California

Feasibility

The technologies that are needed to realise this concept are already developed and some of them have been **in use for decades**. HVDC transmission lines up to 1.5 GW capacity have been utilized for many years by ABB and Siemens. If more power is to be transmitted, more than one line can be used. At the World Energy Dialogue 2006 in Hanover, Germany, both companies have confirmed that the implementation of a Trans-Mediterranean energy cooperative is, technically, not a problem at all.
Solar Thermal Power Plants such as, for example Parabolic Trough Power Plants, have been in use commercially at Kramer Junction in California since 1985. Further solar power plants are actually planned or in construction e.g. in Nevada and Spain, with German, Spanish and US companies playing a major role. Solar Thermal Power Plants can generate electricity in the deserts of MENA at all times of the day and night, throughout the year. The DLR has calculated that, if Solar Thermal Power Plants were to be constructed in large numbers in the coming years, the estimated cost (including transmission cost) **will come down to about 5 EuroCent/kWh**.

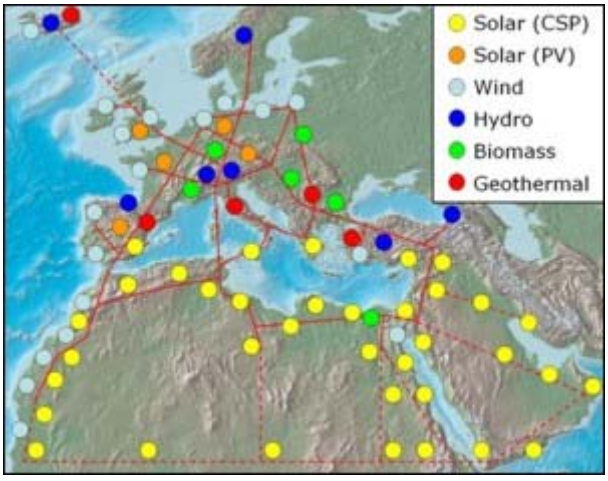
In order to establish, by 2050, a transmission grid and **a capacity of 100 GW of exportable solar power**, over and above the domestic needs of Sunbelt countries, the required governmental financial support would be **less than 10 billion Euros**. Given that level of support for feed-in regulations, the construction of the solar power plants and the necessary transmission grid would very soon be attractive to investors, both private and public. The total investment that would be needed would be about 400 billion Euros over 30 years. An exact investment forecast for the TRANS-CSP scenario has been researched by the DLR.

Year		2020	2030	2040	2050
Transfer Capacity GW		2 x 5	8 x 5	14 x 5	20 x 5
Electricity Transfer TWh/y		60	230	470	700
Capacity Factor		0.60	0.67	0.75	0.80
Turnover Billion €/y		3.8	12.5	24	35
Land Area	CSP	15 x 15	30 x 30	40 x 40	50 x 50
km x km	HVDC	3100 x 0.1	3600 x 0.4	3600 x 0.7	3600 x 1.0
Investment	CSP	42	143	245	350
Billion €	HVDC	5	20	31	45
Elec. Cost	CSP	0.050	0.045	0.040	0.040
€/kWh	HVDC	0.014	0.010	0.010	0.010

Capacity, Costs & Space:
Possible parameters of the total EU-MENA **H**igh **V**oltage **D**irect **C**urrent (**HVDC**) interconnection and **C**oncentrating **S**olar Thermal **P**ower (**CSP**) plants from 2020 – 2050 according to the TRANS-CSP scenario.

Security of Supply

Imports of fuels such as uranium, natural gas and oil, are considered to be politically risky, since the global reserves are shrinking inexorably. This is leading to higher prices, to political dependencies and to limits on supplies. By contrast, solar power is plentiful and inexhaustible, and its extended use will lower costs and improve the technologies. Increased demand by Europe would lead to more business opportunities for the MENA countries. This in turn may help to increase political stability and improve relations between Europe and MENA.
Too large a dependence on one country and on only a few power plants can be avoided by diversifying the range of sources of renewable energy, as illustrated by the figures showing **large numbers of solar power plants and wind farms in many countries** — and by of the use of several different HVDC transmission lines to Europe. Possible worries about security of supply will also be reduced if there are many different owners of the facilities, both public and private.



Sketch of possible infrastructure for a sustainable supply of power to **EU-MENA**.

By 2050, between 10-40 % of Europe's electricity may be clean power that is imported from the deserts. International trade in renewable energy will tend to increase the number of available sources and should help to strengthen international stability. The creation of **new jobs** in the MENA region should enhance its internal stability. Employment would be created in construction phase, in the maintenance of power plants, and in the generation of **electricity and water** for local people.
There is also the possibility of generating **hydrogen** through inexpensive and inexhaustible supplies of energy as a possible substitute for fossil fuels for transport. Furthermore there would be a lower need of **biomass** to generate electricity, so it could be used to a greater extent at for transport.

A way to implement the DESERTEC concept

As a means of implementing the DESERTEC concept, TREC proposes an initiative that would be as ambitious as the Apollo SPACE program that took people to the moon. In addition to feed-in regulations and other measures in support of clean power generation from the deserts, this **Apollo** '**DESERTEC**' **program** could be boosted by **three projects** that are technically possible, but require financial and political support:

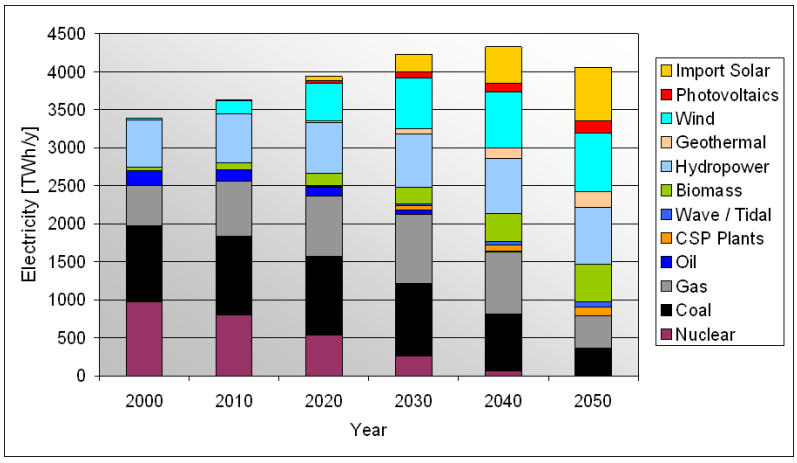
1. **Gaza Solar Power & Water Project:** To **build CSP plants** for the generation of electricity and desalination of sea-water using solar energy. These plants, part of a potential international recovery programme for Gaza, could be **located** at suitable places **in the Egyptian Sinai coastal region**, with appropriate water and power lines into the Gaza strip, providing supplies for 2-3 Million people. This project could become a turning point in the currently disastrous social problems of Gaza, in the regional conflicts for water and in the stalled peace process between Israel and Palestine. The total investment required would be about **5 billion Euros**.

2. **Sana'a Solar Water Project:** For the Yemenite Capital Sana'a, which is confronted with the possible exhaustion of its ground water reserves in about 15 years, to build desalination and power plants near the Red Sea, powered by solar energy, that will generate **fresh water for Sana'a** and, at the same time, will produce the power that will be needed to pump the fresh water through pipe lines to the city at an altitude of 2200 meters. This Sana'a project could **avoid a looming humanitarian disaster and social unrest in Yemen**, and would save a cultural heritage of world-wide significance. Moving 2 million people from Sana'a to new settlements would cost more than 27 billion Euros. This is very much more expensive than the **5 billion Euros** needed for the alternative plan: to let people to stay where they are living already and build solar power plants and a pipeline to supply them with water and electricity.

3. **South-North grid:** To begin construction of a large scale South-North grid for the transmission of clean power from deserts to Europe **until 2020**, as infrastructure for energy and climate security. A high-capacity grid for the transmission of inexpensive and clean power to Europe would create a boom of investments in MENA countries in Solar Thermal Power Plants and wind farms. The construction of **HVDC grids** for the first **10 GW** would cost about **5 billion Euros**.

The implementation of just one of the first two projects would help bring the technology of solar steam generators to the point where it would **undercut the costs of most fossil fuels**. Such low cost solar steam generators would facilitate the development of desert areas **all over the world** as solar power houses and, in the vicinity of coasts, as inexhaustible sources of fresh water. Together with a South-North grid the Gaza and the Sana'a projects could become key projects in a 'Copernican' revolution towards global balance and sustainability. As suggested in the recent Stern report, this kind of investment would be safer and much cheaper than letting climate change proceed unchecked, and then paying for the resulting damage.

By the middle of the 21st century, the deserts of North Africa and the Middle East could provide most of the power needed in the MENA region, and become inexhaustible sources of clean energy for European countries, thus helping to bring down emissions of Greenhouse gases to a sustainable level. In the scenario described in reports from the DLR, it will be possible to **cut emissions of CO_2 from electricity generation by 70% and phase out nuclear power at the same time – with decreasing electricity costs in the long-term.**



TRANS-CSP **climate security mix** in the EU

Appendix

Comparing a renewable energy strategy for Europe with a nuclear – fossil energy path

Electricity Mix dominated by Renewable Energy with Fossil Fuel Backup	**Electricity Mix dominated by Nuclear Power and Fossil Fuels**
Power on demand by a well balanced mix of renewable and fossil energy sources	Power on demand by using stored forms of energy like uranium, coal, oil and gas
Supply based on many, mostly unlimited resources	Supply based on few, mostly limited resources
Domestic sources dominate the electricity mix	Energy imports dominate the electricity mix *
Low vulnerability of decentralised generation	High vulnerability of large central generation units
Low hazardous waste, recyclable materials	Disposal of nuclear waste and CO2 unsolved
Low risk of contamination or major accidents	Risks of plutonium proliferation and nuclear accidents
Requires public investment over limited time span	Requires long-term continuous subsidisation
Low environmental impact	Climate change, pollution and nuclear radiation
Intrinsic trend to lower cost and less price volatility	Intrinsic trend to higher cost and price volatility
Requires a change of structures and thinking	Fits in with present structures and thinking
Based on proven and demonstrated technologies	Requires major technological breakthroughs: o Safe fission and breeder technology o Commercial fusion reactor o Carbon capture and sequestration (CCS)
=> Low risk strategy	**=> High risk strategy**

(TRANS-CSP Study; Page 118; Table 4-4)

* In spite of a convention that nuclear power is a domestic source of energy, Europe will depend entirely on imported sources of uranium after 2025 (today, 30 % of the European Uranium consumption is supplied by domestic sources, mainly in Eastern Europe).

Contact

For further information on the TREC's work or upcoming activities, please visit the TREC website: http://www.TREC-EUMENA.net or contact the TREC-Coordinator:

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The Club of Rome:

Finding solutions for the world problems

The birth of the Club of Rome: A quiet villa and a big bang

In April 1968, a small group of leaders from diplomacy, industry and civil society met at a quiet villa in Rome. Invited by Italian industrialist Aurelio Peccei and Scottish scientist Alexander King, they came together to identify and address the world's most critical problems. This group agreed to launch for the first time an initiative on what they called "World Problematique", long before many problems which today dominate the global agenda were even recognised as issues for wider discussion. Named after the place where the first meeting was held, the Club of Rome was born.

The outcome of this meeting was a process that led to the first *Report to the Club of Rome:* "The Limits to Growth" in 1972. With its future-orientated views and provoking scenarios the report sold more than 12 million copies in some 30 languages and established the serious reputation of the Club, particularly among leaders and decision makers in all spheres of society.

The *World Problematique*

"World Problematique" is a concept created by the Club of Rome to describe humanity's most critical problems. This includes politics, economy and technology as well as culture and ethical values. The complexity of the *World Problematique* lies in the way these problems mutually depend on each other. They are aggravated by the length of time the impact of acting and reacting in this complex system becomes evident.

The approach of the Club of Rome to the solution of the world problems is to identify critical problems before they actually emerge as issues in the general public. It develops an analysis from an integrated, global, interdisciplinary and long-term perspective which addresses alternative solutions and scenarios. The results of this work are communicated to high-level decision-makers and to the general public worldwide.

Following the example of *Limits to Growth,* many other reports have continued to inspire whole generations of economists, politicians and scientists. In the more than 30 years since the *Big Bang* created by the publication of *Limits to Growth* the Club of Rome has continued its unique and insightful way of identifying important aspects of the *world problematique* and evolving practical, credible solutions for them.

Continuing a success story – the Club of Rome today

Today, more then ever, the Club of Rome (CoR) plays a distinctive role in the global marketplace of ideas. In its reports and conferences, the Club deals with current issues of global concern at the highest intellectual level.
The main aim of the Club of Rome is to act as a catalyst of change. It is independent of any political, ideological or business interest. As an organization devoted to future problems, the Club of Rome has a well-deserved reputation as an agenda setter for tomorrow's issues in the fields of economics, government and science. With its unique network of outstanding members, the Club communicates across cultures and across generations throughout the world.

Issues for the Club of Rome

The scope of the Club's work is the world. Over the decades, the Club of Rome has given much inspiration to the world's leaders, especially in the fields of:

- Sustainable Development, Globalised Markets, Overcoming Poverty, Ethics of Solidarity
- Governance and Political Stability
- Information Society and Digital Divide
- Learning and Work
- Cultural Diversity and Tolerance

However, discussing these issues is meaningless to the Club of Rome unless there are credible and convincing proposals for solutions. This is an attitude that has distinguished the Club of Rome from many other initiatives that have more recently attempted to address the world's critical problems.

Reports and Annual Conferences

The primary product of the Club of Rome is its reports. After its critiquing and processing, the Club provides a platform that helps create the "Reports to the Club of Rome" and their key messages. The Club's aim is to carry these messages to world leaders and decision makers. These reports are widely discussed in the scientific community, through the media and by the broader public.

Every year, the Club of Rome holds its annual conference where members interact, discuss and implement new ideas. The Club of Rome regularly invites personalities from all over the world to take part in these discussions.

The Club of Rome is an animator of high-level debates, bringing in well-informed participants when needed. Projects in collaboration with other organizations such as the UNESCO underline the Club's global commitment.

The Club of Rome Members

The Club's members share a common concern for the future of humanity. Among its members are former Heads of State, decision makers and opinion leaders from politics and business, international high civil servants, and leading heads from the world of science. These members bring in top-quality, highly diverse thinking. The Club continues to appoint members with outstanding intellectual and moral qualities only. Their number is limited to 100.

Approx. 30 "National Associations for the Club of Rome" have been established all over the world. They disseminate the Club's ideas from their country's or region's perspective and stimulate debate on ideas and projects.

The Club of Rome is also aware of the need to reach out to the younger generation. tt30 (think tank 30) was established in 2000. It comprises 30 young people around the age of 30 in a network comprising men and women with different backgrounds and from a range of world regions.

The Club of Rome Foundation

As a non-profit organization, the Club of Rome financially depends on donations. Therefore, the Foundation of the Club of Rome in Luxemburg has been set up to secure its financial independence through the foundation's endowment capital. The foundation gives donors opportunity to contribute to the Club of Rome and to have access to its exclusive network.

Contact

For further information on the Club's work or upcoming activities as well as historical data, please visit the Club of Rome website: http://www.clubofrome.org/ or contact the Secretariat-General:

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