About TREC

The **T**rans-Mediterranean **R**enewable **E**nergy **C**ooperation (**TREC**) is an initiative of The Club of Rome, the Hamburg Climate Protection Foundation and the National Energy Research Center of Jordan (NERC) in the field of renewable forms of energy. Since it was founded in 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**), promoting cooperation between countries of the sun-belt and the technology belt. Now TREC is making this concept a reality in cooperation with people in politics, industry and the world of finance.

The core of TREC is an international network of scientists, politicians and other 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 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 developing concepts and promoting specific projects in this field.

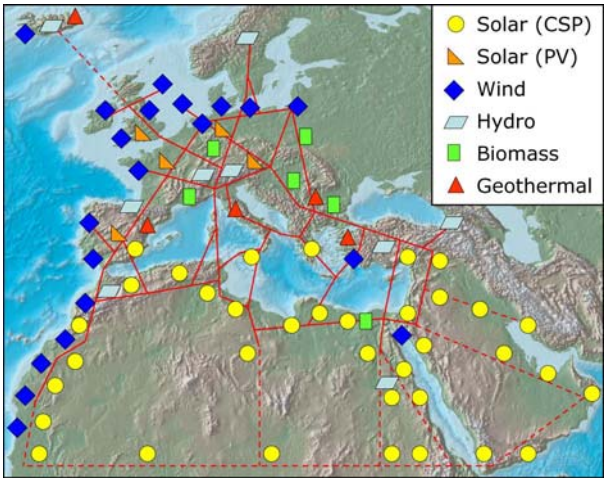
TREC
Clean Power from Deserts
Trans-Mediterranean
Renewable Energy Cooperation
An Initiative of The Club of Rome

THE CLUB OF ROME

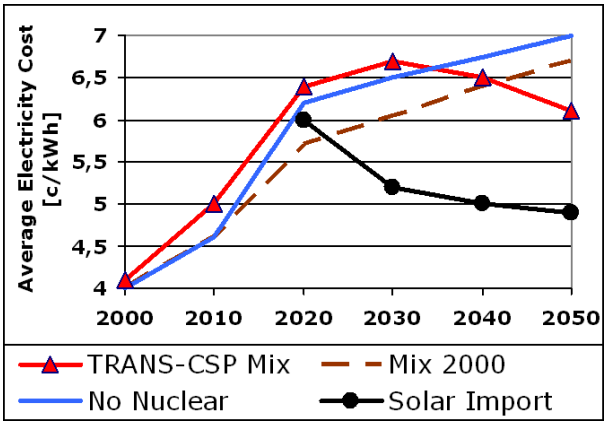
Two Studies by DLR

TREC was founded with the goal of providing clean energy for Europe and for sunbelt countries quickly and economically 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, drinking water and an improved infrastructure for people in the **M**iddle **E**ast and **N**orth **A**frica (**MENA**).

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 **electricity transmission grid** connecting the EU with MENA (a **EU-MENA-Connection**).
Those two studies were commissioned by the German Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU) and have been conducted by the **German Aerospace Center (DLR)**. The '**MED-CSP**' study was produced in 2005 and the '**TRANS-CSP**' study was completed in 2006. An '**AQUA-CSP**' study about the needs, the potential and the consequences of solar desalination in MENA is in progress.



Euro-Supergrid with a EU-MENA-Connection: Sketch of possible infrastructure for a sustainable supply of power to **EU-MENA**.



An example (Germany) of the **estimated cost of electricity in the future**, comparing the energy mix in the year 2000 with the TRANS-CSP Mix and showing the role of imported solar power.

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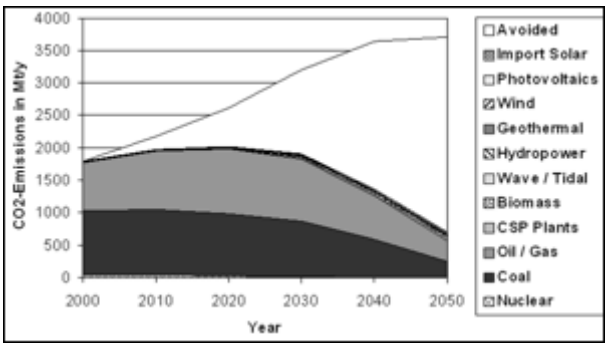
The DESERTEC Concept

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 and desalinated seawater to supply current demands in EU-MENA, and anticipated increases in those demands in the future. **Harnessing the winds** in Morocco and on land around the Red Sea would generate additional supplies of electricity. Solar and wind power can be distributed in MENA and transmitted via **H**igh **V**oltage **D**irect **C**urrent (**HVDC**) transmission lines to Europe with transmission losses that would be no more than 10-15%. The Club of Rome and TREC are both pursuing this **DESERTEC Concept: bringing technology and deserts into service for energy, water and climate security**. Countries like Algeria, Egypt, Jordan, Libya, Morocco and Tunisia have already shown an interest in this kind of cooperation.

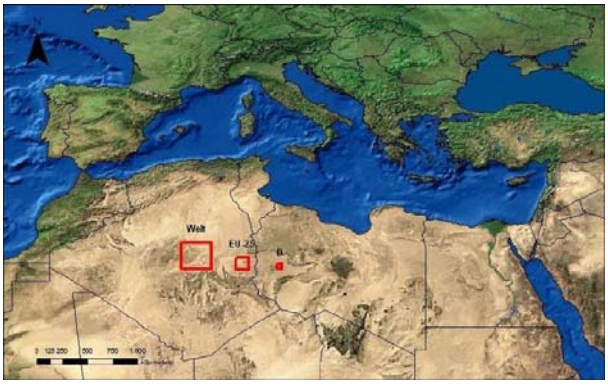


CO2-emissions from electricity generation expected for all EU-MENA countries (in millions of tons per year) assuming strong efficiency efforts.
Upper curve: With an electricity generation mix equivalent to that of the year 2000.
Second curve from top: For the scenario described in the TRANS-CSP study with emissions reduced by the use of renewable sources and the transmission of clean power from MENA to Europe.

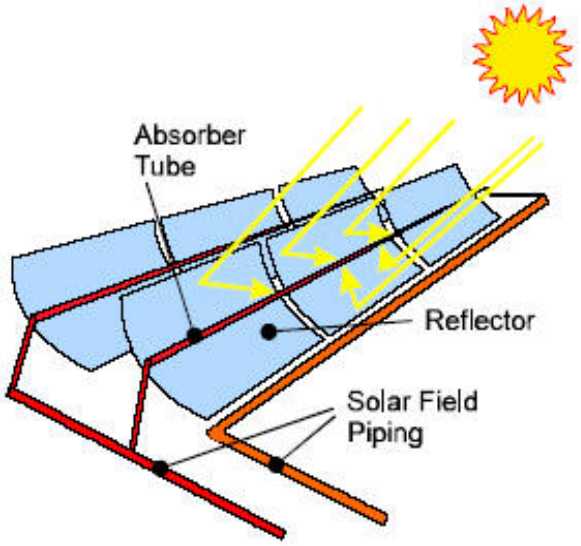
The Technology

The best solar power technology for providing secure power output is solar thermal power plants (also called **C**oncentrating **S**olar Thermal **P**ower, **CSP**). They use mirrors to concentrate sunlight and create heat which is used to raise steam to drive steam turbines and electricity generators. Excess heat from additional collectors can be stored in tanks of molten salt and used **to power 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 (without the need for expensive backup plants), the turbines can also be powered by oil, natural gas or biomass fuels. Waste heat from the power-generation process may be used (**in cogeneration**) to **desalinate seawater** and to generate **thermal cooling** – useful by-products that can be a great benefit to the local population.

Using **H**igh **V**oltage **D**irect **C**urrent (**HVDC**) transmission lines, loss of power during transmission can be limited to only about 3% per 1000 km. The **high solar radiation** in the deserts of MENA (twice that in Southern Europe), outweighs by far the **10-15% transmission losses** between MENA and Europe. This means that solar thermal power plants in the deserts of MENA are more economic than the same kinds of plants in Southern 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.



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)



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

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Security of Supply

Fuels such as uranium, natural gas and oil are considered to be politically risky since global reserves are shrinking inexorably and known reserves are found in only a few countries. This is leading to higher prices, to political dependencies and to limits on supplies. By contrast, solar power is plentiful, inexhaustible and available in many countries. And as volumes increase, costs will fall and the technologies will improve. Increasing solar power supplies to Europe will 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, and using **large numbers of solar thermal power plants** (typical capacity: 200MW) **and wind farms in many countries**. Likewise, the use of **many HVDC transmission lines** to Europe and a wide range of different owners of facilities (both public and private) will help to increase security of supply.

By 2050, between 10-25% of Europe's electricity may be clean power that is imported from sunny deserts. In the TRANS-CSP scenario, domestic renewables comprise about 65% of European supplies, while solar imports from MENA provide a further 17%. International trade in renewable energy will tend to increase the number of inexpensive sources of electricity anyway and should help to strengthen international cooperation. **New jobs** in the MENA region would be created during the construction of power plants, in the maintenance of those plants, and in the generation of **electricity and water** for local people. There is also the possibility of generating **hydrogen** (as a possible substitute for fossil fuels for transport) using inexpensive and inexhaustible supplies of solar energy. Furthermore there would be a reduced demand for **biomass** to generate electricity, so it could be used to a greater extent for transport.

Feasibility of the DESERTEC Concept

The technologies that are needed to realise the DESERTEC concept are already developed and some of them have been **in use for decades**. HVDC transmission lines up to 3 GW capacity have been deployed over long distances by ABB and Siemens for many years. In July 2007 Siemens accepted a bid to build a 5 GW HVDC System in China. At the World Energy Dialogue 2006 in Hanover speakers from both the companies just mentioned have confirmed that the implementation of a Euro-Supergrid and a **EU-MENA-Connection** is, technically, **entirely feasible**.

Solar thermal power plants have been in use commercially at Kramer Junction in California since 1985. New solar thermal power plants with a total capacity **of more than 2000 MW** are either planned, under construction, or already in operation. The Spanish government guarantees a feed-in tariff of **about 21 EuroCent/kWh for 26 years** and this has established favourable business conditions for CSP. Because of the higher solar radiation at good sites in the USA or MENA it is now possible to use lower rates in feed-in tariffs. The DLR has calculated that, if solar thermal power plants were to be constructed in large numbers in the coming decades, the estimated cost would **come down to about 4-5 EuroCent/kWh.**

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

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 km x km	CSP	15 x 15	30 x 30	40 x 40	50 x 50
	HVDC	3100 x 0.1	3600 x 0.4	3600 x 0.7	3600 x 1.0
Investment Billion €	CSP	42	143	245	350
	HVDC	5	20	31	45
Elec. Cost €/kWh	CSP	0.050	0.045	0.040	0.040
	HVDC	0.014	0.010	0.010	0.010

Capacity, Costs & Space:
Development of the EU-MENA-Connection (marked 'HVDC') and Concentrating Solar Thermal Power (CSP) in the TRANS-CSP scenario between 2020 and 2050.

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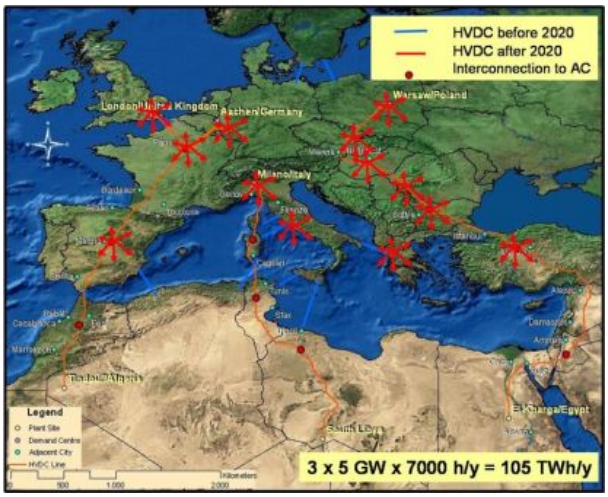
Measures to implement the DESERTEC Concept

Construction of new concentrating solar thermal power plants **has begun already** in Spain and in the USA (Andasol 1 & 2, Solar Tres, PS10, Nevada Solar One). Projects are in progress in Algeria, Egypt and Morocco and further plants are planned in Jordan and Libya. **Morocco has implemented a feed-in law** to support renewables (wind in particular). Discussions about the construction of a HVDC-Supergrid across Europe (a **Euro-Supergrid**) have started in the EU and plans for offshore wind farms are taking shape.

In order to establish, **by 2050**, **a capacity of 100 GW of exportable solar power in MENA**, over and above the domestic needs of sun-belt countries, only a **few governmental supporting measures** would be sufficient to make the construction of the power plants and the necessary transmission grid more attractive to investors, both private and public. To boost the construction of solar thermal power plants and wind turbines in MENA, **the EU should support a campaign to inform** MENA governments that, over the lifetime of those plants, they would be a cheaper source of power than electricity generated from oil or natural gas. This would reduce the domestic use of fossil fuels (which are continuing to increase in price) and, at the same time, it would enable the sun-belt countries to produce clean power from their own deserts for local use and for export.
While solar thermal power plants already work economically in MENA countries, further reductions in costs would be necessary to make CSP a profitable export option from MENA. Growth in the construction of those plants and EU support for the **Euro-Supergrid with a EU-MENA-Connection** will help to drive down costs in the period up to 2020. Towards that goal, it would be useful if the EU would provide advice and support for the possible introduction of **feed-in regulations in MENA** countries along the lines of the German and Spanish Renewable Energy Laws. International guarantees for the local feed-in contracts or power supply agreements would help to boost the construction of solar plants and wind turbines.

It is very important that **talks begin soon on the** development of the proposed **Euro-Supergrid with a EU-MENA-Connection.** This would facilitate the optimal integration of all renewable sources of energy from Europe with renewables from MENA. In itself, the initiation of the EU-MENA-Connection for the transmission of clean power from deserts to Europe would create a boom of investments in renewable sources of energy in MENA countries and would give Europe access to cheap, clean and inexhaustible electricity. The construction of **HVDC grids** for the first **10 GW**, as described in the TRANS-CSP scenario, would cost about **5 billion Euros**. If the EU-MENA-Connection is to start transmission by 2020, talks within the EU and with the governments of MENA (perhaps in the Barcelona Process) must begin as soon as possible.



EU-MENA-Connection: existing and planned HVDC transmission lines before 2020 (blue) and three traces researched by DLR (orange)

As compared to power from "domestic" new fossil and nuclear plants (curve "Mix 2000" on page 1), **solar power from North Africa will be cheaper** in Southern European countries like Spain and Italy with beginning of transmission in 2020. With progressing cost reduction and EU-MENA grid expansion this will become so in most other European countries latest in 2030. The power cost reducing EU-MENA-Connection as studied in the TRANS-CSP scenario will require an investment of 45 billion Euros until 2050, and **yield annual savings of up to 10 billion Euros**. Lean cost clean power from deserts will become the least cost option and setting up the EU-MENA-Connection appears as a "must" for European economies.

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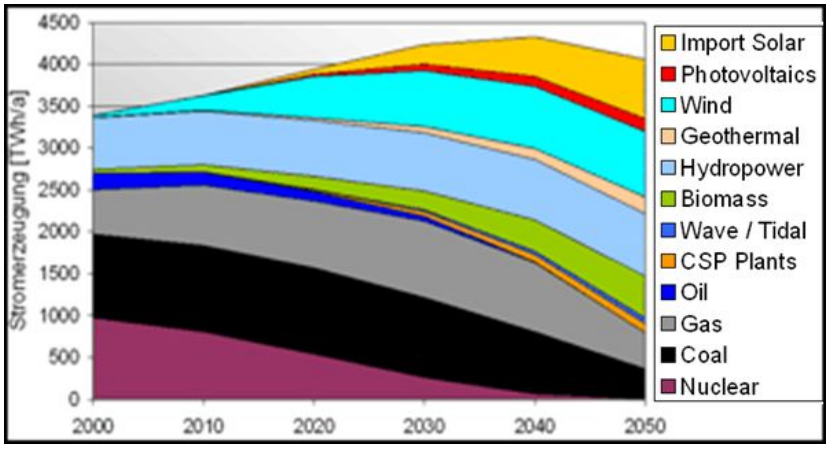
In addition to these direct supporting measures, TREC proposes **two projects** to help bring down the cost of CSP and to alleviate pressing social and political problems at the same time. Both projects are technically possible, but require financial and political support:

1. **Gaza Solar Power & Water Project:** To **build CSP plants for the combined generation of electricity** (1 GW in total) **and desalination of sea water**. These plants, part of a potential international recovery programme for Gaza, could be **located in the Egyptian Sinai coastal region**. With the provision of appropriate water and power lines into the Gaza strip, these facilities could provide supplies for 2-3 Million people. This project could mark **a turning point in the currently disastrous social and economic development** 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:** To build desalination and power plants near the Red Sea for the Yemenite Capital Sana'a which is facing the exhaustion of its ground water reserves in about 15 years. These plants, powered by solar energy, would generate **fresh water for Sana'a** and, at the same time, would produce the power needed to pump the fresh water through a pipeline to the city of Sana'a 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 about 30 billion Euros. This is very much more expensive than the **5 billion Euros** needed for the alternative plan: to let people to stay in Sana'a and build solar power plants and a pipeline to supply them with water.

By the middle of the 21st century, the MENA countries could have upgraded their deserts to inexhaustible sources of clean energy and sell clean power to European countries, thus contributing to bring down European 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 and supply security mix** in the EU

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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 the worlds of 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 dominate the global agenda today 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 for 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 for 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.

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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 depends financially 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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