Morocco coast Nov 2009

Climate change countermeasures:

Grand scale forest preservation and forestation, solar energy and offshore wind power.

By Gunnar Ettestøl, Msc, Vegårshei, Norway January 2010

The most important Norway can do is to spend some of its national oil wealth to:

- **Continue Norway's engagement in rainforest preservation.**
- **Participate in programs for seawater desalination with solar energy.**
- **Participate in programs for forestation in dry tropical and subtropical regions.**
- **Participate in programs for development of grand scale solar power plants.**
- **Fund industries in Norway and Europe to develop large floating wind turbine rigs for competitive production of electricity or hydrogen gas.**

The World and Norway must reduce the exploitation of fossil energy sources.

The Earth used more than 500 million years to build its layers of fossil energy. Now, the humans of the Earth may consume most of the remaining fossil energy resources in 500 years, with catastrophic climate changes as a result. And the climate changes can have serious impacts on the world's economy and large groups of people within a few decades.

Everything seems to show that we are forced to use our entire collective knowledge to carry out actions against the climate changes. And the initiatives ought to be carried out where they have the most positive local effects, at the same time as the effects against global warming are beyond dispute, such as preservation of the rainforests.

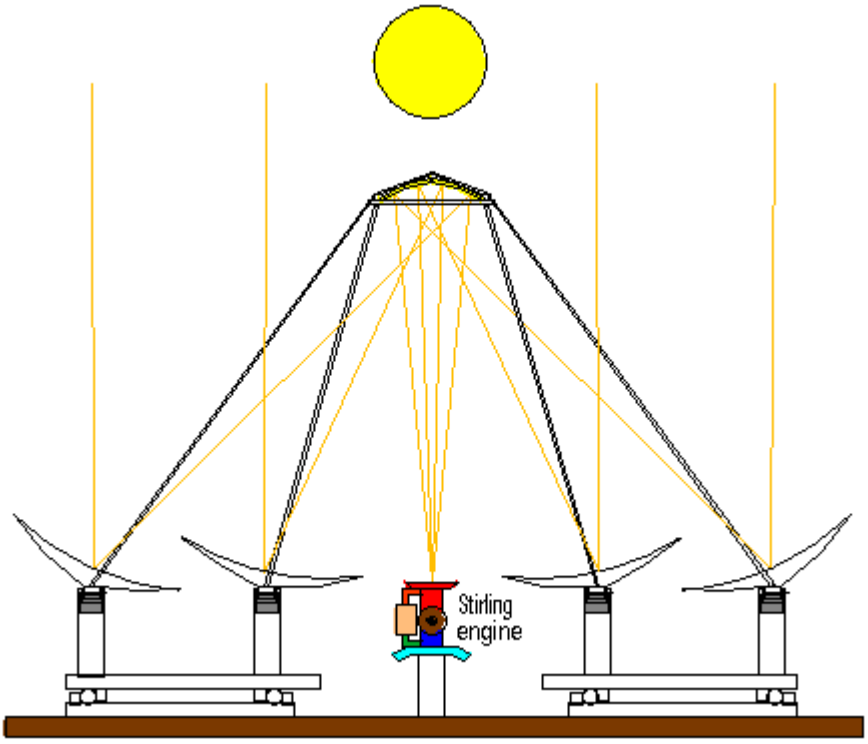
The most effective countermeasures against climate changes for the next 30 years will be: Comprehensive programmes for CO_2-binding with forestation in tropical and subtropical dry land and deserts.

Sunny and arid regions of the world have become dry and inhospitable and suffer from deforestation. We are letting this happen although the world has both competence and capital to stop this by contributing to the conservation of the rainforests and develop new forestation programmes in sparsely populated and non-populated dry regions.
But comprehensive plans for forestation even in non-populated desert land can be met along with limitations and objections as a consequence of political and social conditions.
Norway and other northern countries can expand their forestland with an increase in the binding of CO_2 without conflicts. But the forest growth is lower in the north and thus the CO_2-binding is appreciably inferior here than compared to the tropics. And conifer forests in the boreal zone have a low albedo. Broadleaf forests with light green foliage can contribute to an increase in albedo in all seasons, and in particular in a snow-covered landscape during winter. Selection of broadleaf trees for bright energy forests, with good growth in boreal regions, should have high priority for agricultural authorities and forest researchers in northern countries.
The world's nations possess large competence in forestation, bio energy, desalination, hydropower and solar energy production. We can capitalize this knowledge to make the world better.

We can make big new green ranges in non-populated subtropical desert land with a massive aiming at transformation of salt water into fresh water with the help solar energy. And with the use solar energy we can divert abundant water from rivers for irrigation of arid land or deserts.

Example of a solar power plant for running generators, pumps or compressors.

The main reflectors are made of high-gloss aluminium plates.



Solar powered vacuum boilers and compressors can be used for desalination.
The salt water is transported in pipes to the desalination unit, which is heated with solar energy.
Generators, pumps and compressors are directly powered by Stirling engines and solar energy.

Concentrated salt water is returned to deeper seawaters in pipes.
The fresh water can be distributed in pipes or aqueducts with pumps powered by wind or solar energy. The fresh water cannot be used as potable water unless it is first mineralised.

An installation, which can produce water enough for a plantation of 10 square kilometres on dry land or desert, may cost about 10.7 million USD, or about 1070 USD per decare (1000 square meters) including pipelines to local water taps.

For 55 billion USD per year we could give the world a new forest area of 50000 square kilometres. By improving technologies, this area can be increased.

The fresh water is clean as rainwater, and the irrigation gives no deposits of bad mineral salts. Establishing big new forest fields will humidify the local climate and also feed the ground water supplies. This will imply that adjacent fields can get natural new vegetation.
Local clouds may build up and give rainfalls, and the clouds are causing the albedo to rise and the net sun radiation decreases. This gives new opportunities for farming, and production of energy forests in large scale along with work and prosperity for people who will live there.

After 30 years with forestation in tropical and subtropical regions, the CO_2-uptake is declining and the forests need rejuvenation. But then the world has great new reserves of bio-energy to replace fossil energy. And we have got new large fertile fields and time to convert other renewable energy sources.

Electricity supply with solar powered pumped-storage plant.

Mass production of solar collectors with direct drive of thermo-mechanical engines also opens for electricity production in large scale, especially where pumped-storage plants can be built. This means that the ground above solar collector plant must be suitable for building a reservoir for a conventional hydroelectric power station.
It is favourable to combine the pumped-storage plant with desalination or purification plant, or irrigation installations for river water. This kind of power plant is very suitable for construction in tropical or subtropical regions.

With a received power of nearly 1 kW per square meter, 1 square kilometre of solar collector area will give a power output of 250.000 kW when about 25 percent of the solar energy can be used. Or recalculated to 0.6 TWh per square kilometre per year.

Large electrical solar cell arrays can be built to a cost of about 3.6 USD per watt, equivalent to an energy price of 16 US cents per kWh at a depreciation time of 20 years. A solar cell power plant with daytime output of 250.000kW will cost more than 880 million USD, without pumped-storage facilities and distribution systems.

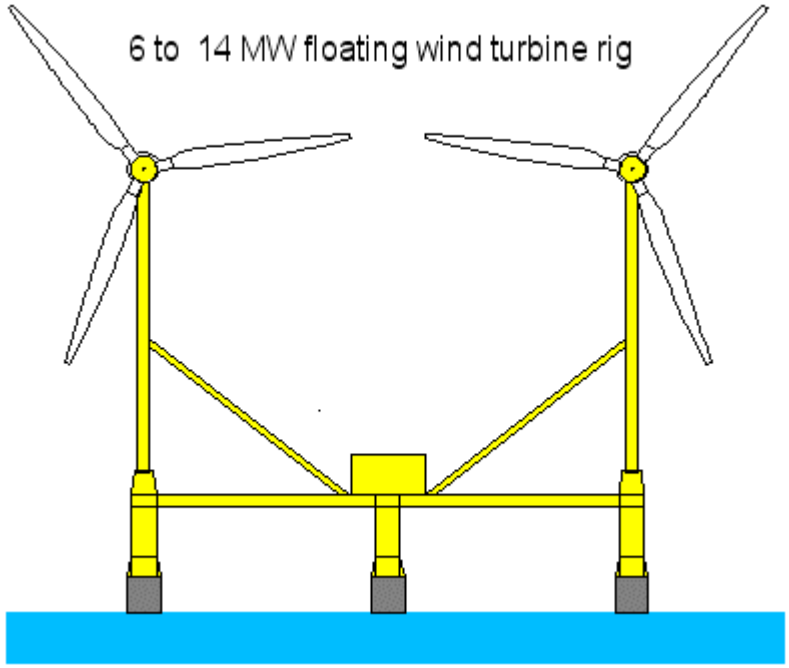
When the solar collector systems for direct drive of engines comes into mass production, the above solar energy driven pumped-storage plant can be built at a cost of about 420 million USD, without distribution systems.
The cost represents an energy price at about 8 US cents per kWh + costs of grid connections, when the depreciation time for the installation is set to 20 years.

Thermal solar power plants like this are suitable for use in countries like Morocco, where the front side picture is taken.

Offshore production of electricity on large floating rigs.

Main point for the construction of the rigs:

- 2 units of contra rotating wind turbines of 3 to 7 MW each at winds speed of 11 m/sec.
- Hydraulic pumps directly connected to wind turbines.
- Reduced top weight makes reduced material use in towers possible.
- Hydraulic motors driving conventional generators on deck.
- 5 legs design with underwater construction in reinforced concrete.
- Large rigs can be built to withstand wave heights of 32 to 45 m.



The production capacities of the rigs depend on the wind conditions offshore. Favourable placed in the North Sea the calculated full operation time is 4000 hours per year. In the Norwegian Sea equivalent time is 5000 hours per year.
One rig placed in the North Sea can give a kilowatt-hour cost price of 10.5 US cents per kWh. Costs for bringing the power on shore to European Union (EU) countries: minimum 5 US cents per kWh. Equivalent kilowatt-hour price of 9 US cents per kWh from rigs in the Norwegian Sea, but with increased costs for bringing the electricity on shore to the EU market.

Annual production from a 10 MW (10000 kW) rig i North Sea can be 40 GWh (40 mill kWh). To produce energy corresponding to the Norwegian hydropower system, 3000 rigs of 10 MW each are needed. The rigs can be placed offshore along the west coast of Europe and replace 30 large coal fired thermal power plants. Investment costs for 3000 rigs with anchoring system and power lines will be about 150 billion USD, depending on the distance to the EU market.

The electricity from the wind power rigs in the Norwegian Sea and the North Sea can also be used to produce hydrogen gas in sub sea installations. The hydrogen gas can be transported in pipelines to EU and can be used for heating, industrial purposes and transportation.

Concluding remarks:
But forestation and electricity production with solar energy in other countries must not take away our focus on reducing our own consumption of energy from fossil sources.