3 GW nuclear fusion power station within 3-4 years realizable !

Climate change is the main problem for the mankind.
The UN claims a 80 % drop in CO_2 emissions until 2050.
Until 2035 the energy consumption in the world rises about 47%.
The energy problem can´t be resolved only with renewable energies.

Today are installed **worldwide 473 nuclear fission power stations.** A great number of nuclear power stations are worldwide under construction and planned.

Problems of nuclear fission power stations:

The energy change with nuclear fission is **risky** (Tshernobyl, Fukushima,…).
Reactor disasters can´t be with certainty excluded.

To produce enough neutrons the reactors are operated near the beginning of the **chain reaction**; under certain conditions an atomic explosion can occur;

Nuclear fuel rods can melt or even evaporate if they are not sufficient cooled.

Used fuel rods are highly radioactive with long half-life times. They must be disposed of.

The **uranium deposits are not endless**. Uranium : 0,0003 % of the earth´s crust; estimated range of availability: 20 to 200 years;

If the controlled nuclear fusion on the earth is realized than both the climate problem as well as the energy problem and with that the water problem are resolved for the mankind. Far reaching catastrophes are not possible.

Fusion reactions take place if two high-energy particles collide. The tunnel effect reduces the hindrance of the Coulomb force. Fusion begins at high pressure and long energy confinement time in the sun from approx. 10 MK, on earth from approx. 100 MK.
The most favourable fusion reaction is between deuterium (D) and tritium (T) because of the highest cross section and a high energy yield.

$$^{2}D + {}^{3}T \rightarrow {}^{4}He\ (3.5\ MeV) + n\ (14.1\ MeV);$$

Tritium does not exist in nature because it decays. Tritium is bred in the fusion reactor:

$$^{6}Li + n \rightarrow {}^{4}He\ (2.05\ MeV) + {}^{3}T\ (2.73\ MeV);$$
$$^{7}Li + n \rightarrow {}^{4}He + {}^{3}T + n - 2.47\ MeV;$$

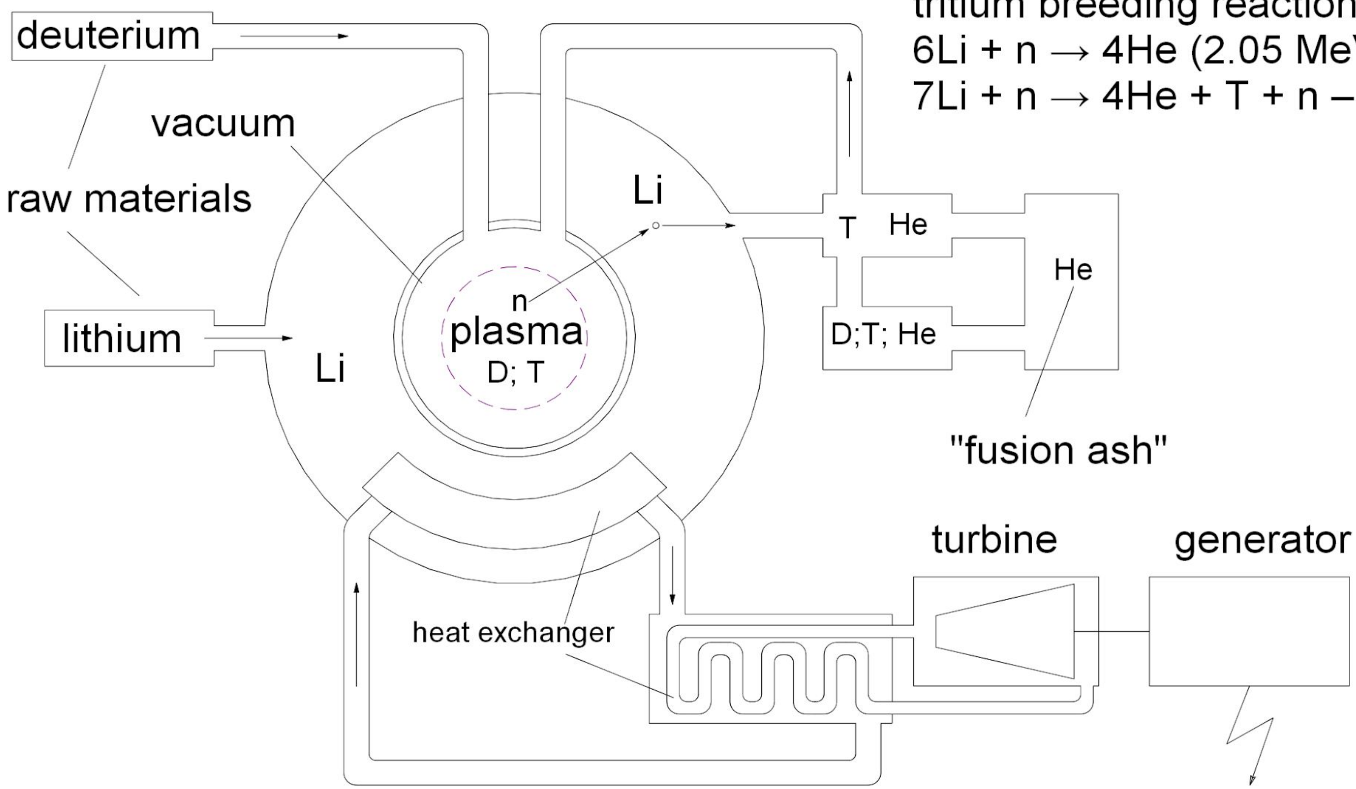
The commodities for Fusion power stations:
Deuterium (D): 0.015 % of all occurring hydrogen in the oceans of the earth;
Lithium (Li): 0.006 % of the earth´s crust; (^{6}Li 7,6%; ^{7}Li 92,4%);

Boron (B): 0.0016 % of the earth´s crust; $^{10}B + n \rightarrow {}^{7}Li + {}^{4}He + \gamma$;

Principle of a nuclear fusion power station

The most favourable fusion reaction is between deuterium and tritium: highest cross section, high energy yield: $2D + 3T \rightarrow 4He\ (3{,}5\ MeV) + n\ (14{,}1\ MeV)$

tritium breeding reactions:
$6Li + n \rightarrow 4He\ (2.05\ MeV) + T\ (2.73\ MeV)$
$7Li + n \rightarrow 4He + T + n - 2.47\ MeV$



With nuclear fusion a far reaching catastrophe can´t occur even if one would deliberately strive to cause devastation.

There are not nuclear fuel rods which could melt or evaporate.

It doesn´t exist a chain reaction which can cause an atomic explosion.

There are not any processes which must be maintained even when the reactor is shut down, as e.g. the cooling of the fuel rods in nuclear fission power plants.

We have not the problem of the disposal of high radioactive used fuel rods.

The disposal of created radioactive materials (tritium, inner wall of reactor) can be mastered. Half-life periods are comparatively short.

A single fly can disturb the fusion conditions and end the power creation. In the worst case of an airplane crash the radioactive material of the inner reactor wall remains at the site and can be disposed of with robots. The possible set free small tritium cloud is fast diluted and causes no harm.

Tritium: ^{3}T; β-emitter; half life: 12,46 a;
maximum energy: 18,8 keV; range in air: < 3 cm;

Lawson criterion

The product of temperature, particle density and energy confinement time must exceed a certain value: $\alpha > 5 \cdot 10^{21}$ keV m^{-3} s;

Fusion reactors are distinguished after the type of plasma confinement.

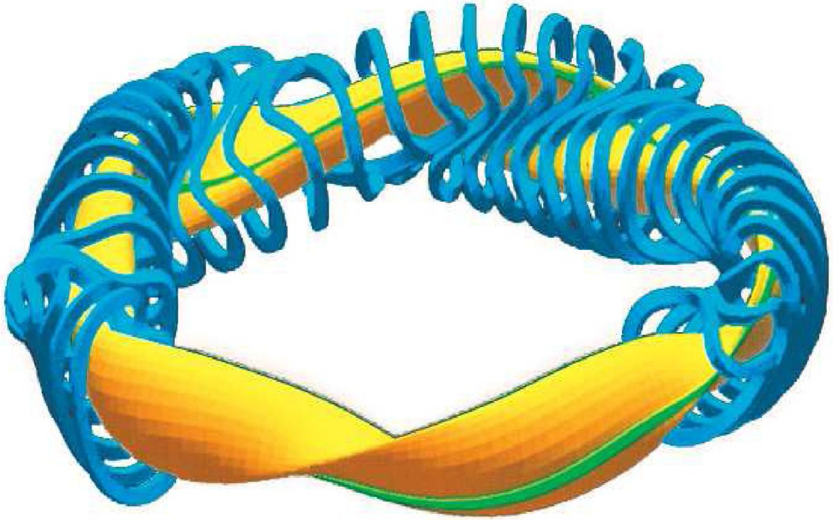
Inertial confinement: laser fusion

A small target is very fast heated to high temperature and kept together from inertia.

NIF target chamber

Laser fusion

National Ignition Facility (NIF) in Livermore
Completion 2009
Extremely strong lasers are focused on a ^{2}D-^{3}T-target.
192 high energy lasers
Total laser power: 500 TW
Long time between the „shots“



Part of the plasma vessel

Magnetic confinement:

Magnetic fields confine the plasma.

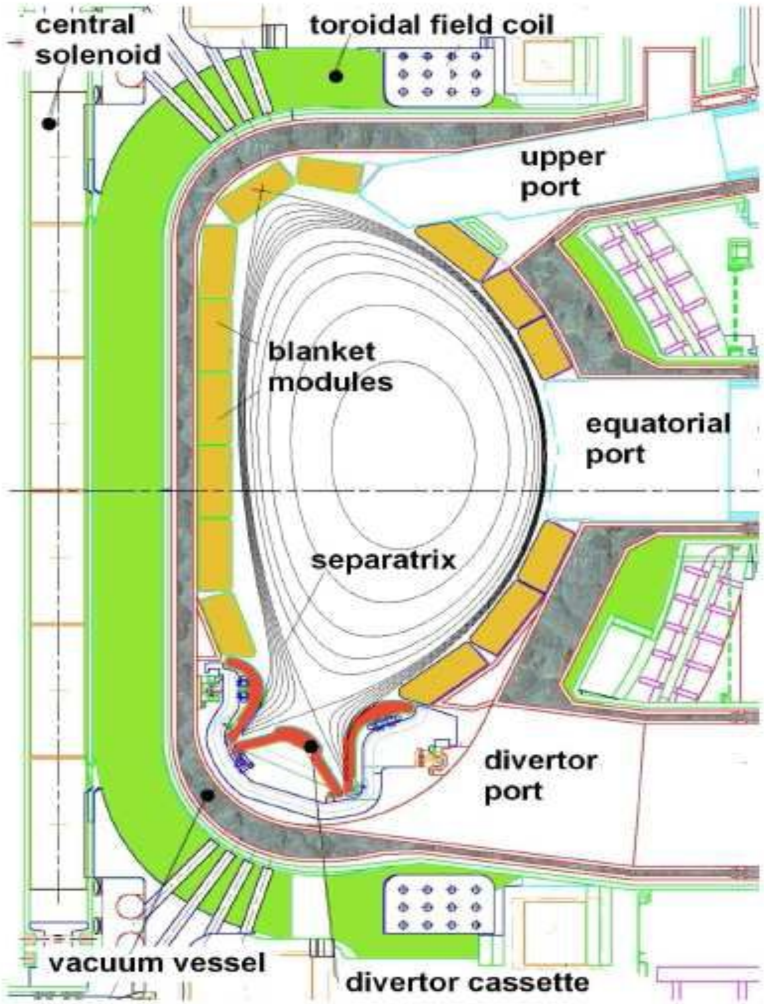
Stellerator:

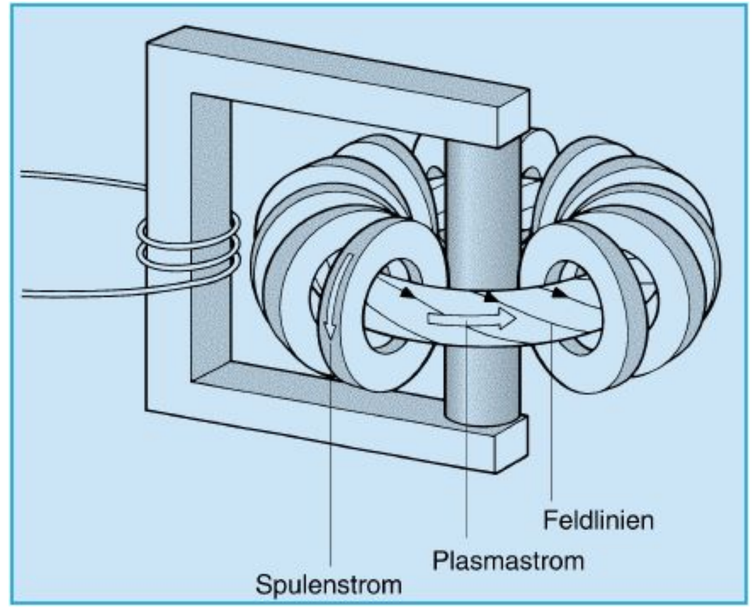
to put into operation 2011 in Greifswald (Germany);
cost: ca. 300 mio Euro
radius: 5,5 m
continuous operation until 30 min
microwave heating of plasma: 15 MW

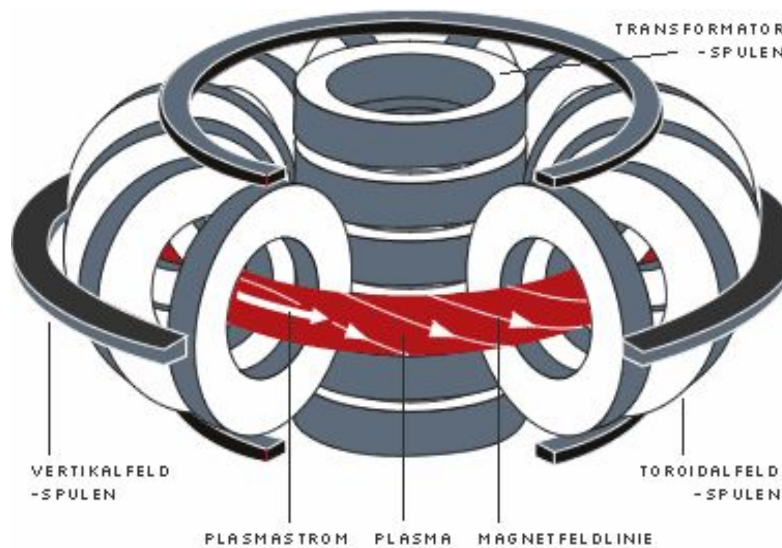
ITER: Tokamak

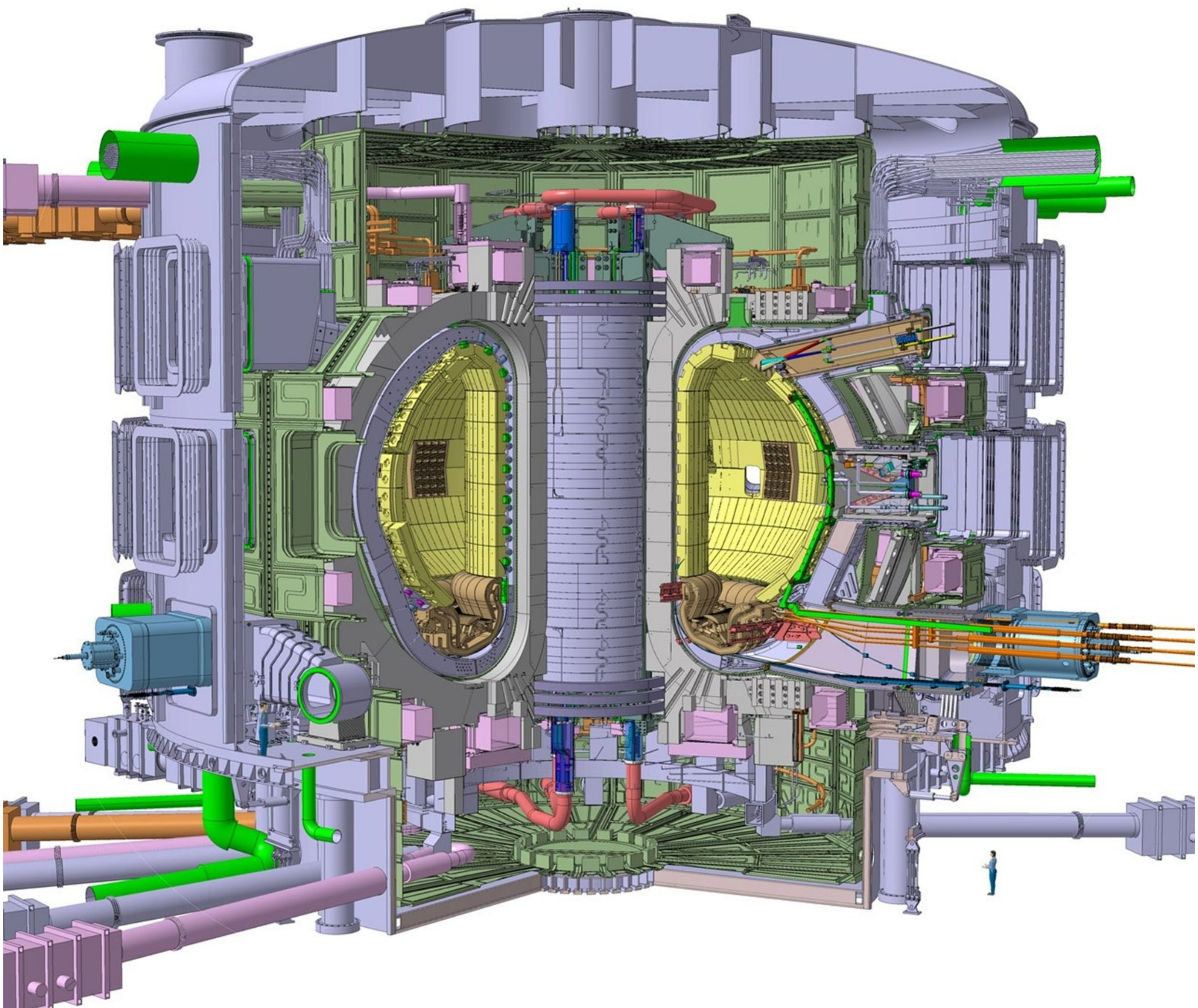
site: Cadarache (Frankreich)
to put into operation 2015
cost: ca. 6 billion Euro
plasma radius: 6,2 m
magnetic field: 5,3 T
plasma current: 15 MA
burning duration: until 8 min
external heating power: 73 MW
fusion power: 500 MW
2006 start of construction
2017 first stabilized plasma
20 years of operation

ITER Querschnitt









Despite all advances with the existing processes it is not possible to construct fusion power stations in the next decades.

I therefore offer a process which enables the construction of a 3 GW (electr.) fusion power station within 3-4 years.

The advantages:

The continuous operation requires less energy to reach and maintain the fusion conditions.

An other building geometry simplifies the construction.

On the inner wall of the reactor rests a low weight.

The with time embrittled inner wall of the reactor is easily accessible for robots and can be replaced.

We have an uninterrupted inner reactor wall and thus no losses of neutrons.

The created ^{4}He particles (fusion ash) are reliable sucked off.

The installation of a sufficient thick lithium blanket is possible. Even the ^{7}Li blanket is surrounded by a ^{6}Li blanket. In this way no neutrons get lost and tritium is bred.

Sufficient space for the heat exchange with the circulation of the turbine is available.

Building parts, which proved itself in modern engineering, are exclusively utilized.

We have a considerable short development time.

The necessary safety precautions are compared to those of nuclear fission power stations vary low. This is one point, that the investment costs are comparatively low.

To almost zero the financial risk can be reduced.

A fast alteration of power in the region from 10 MW to 3 GW is possible. Thus peak hour power stations are not necessary;

The conversion of existing nuclear power stations and coal-fired power stations is possible. Therefore the mankind doesn´t live with any risk and the CO_2 emissions are reduced to zero. Existing turbines, generators, cooling towers, grids, systems for feeding into the grid,… could be further used.

With the abundant electricity from fusion power stations ammonia (NH_3) can be produced. With ammonia the whole traffic can be freed from CO_2 emissions.