

Innovation mit Fusionsenergie - statt Mittelalter-Technologie

Warum brauchen wir Fusion?

- **Der Brennstoffkrise entkommen**
- **Die falsche Energiepolitik der EU**
- **UN-Ziele 1 bis 3 erfordern nukleare Energie mit LENR**

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**Innovation mit Fusionsenergie -
statt Mittelalter-Technologie**

25. Okt. 26
Slide # <Nr.>

Dear Ladies and Gentlemen!

You are aware that energy is important for wealth. We look at the energy challenge from two perspectives:

1st: What are the primary goals of the UN?

2nd: What technologies for energy will arrive in the coming 10 years?

Escape from long-term global fuel Crisis

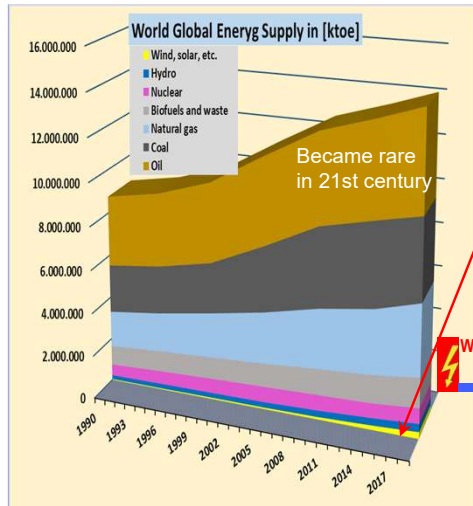
- Fossil fuels will run out - slowly.
What secures the global energy supply?
 - GER focus on wind & solar & H2 → drives costs
- Follow the top-objectives of the UN:
 - No Poverty; No Hunger; Health and Well-being
- Supports the EU Green Deal UN-objectives?
 - Costs for zero carbon by wind and solar and storage frequently violates UN-objectives by costs

First, we look at the future of fossil fuel and compare the cost of electricity and hydrogen

Second, note that the three top UN objectives don't include zero carbon!

Third, a short analysis indicates that the EU green deal violates the top three UN objectives.

EU: 1,000 billion for Clean Deal? EP voted for Climate Emergency on Nov. 28, 2019



Q: Website UN, IEA, eigene Recherchen und Hochrechnung bis 2020

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Clean Energy:

- UN: 2,500 billion invested up to 2020
- Covers only 13,5% of the growth in demand
- German electricity cost kills in poor countries
- Ruining the EU-power-grid, no global CO₂ saving
- Focus on fuel-free energy became a must!

Technology & Innovation!

The growing global energy demand is covered by burning fossil fuels. This image continued into 2025, with a small glitch due to the COVID-19 lockdown.

The red box indicates the global electric power and the blue box the contribution of the EU.

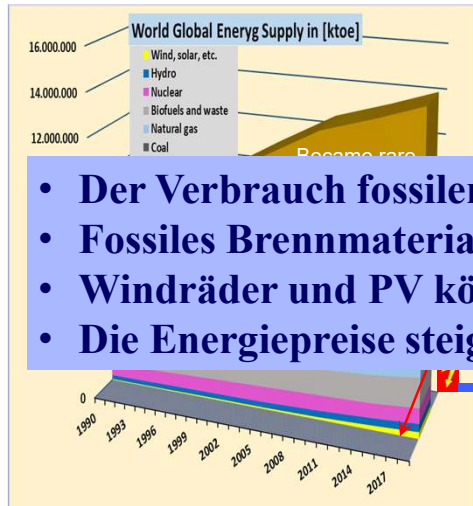
The energy consumption growth in one decade is about 7- times the contribution of the European electric power grid and predominantly covered by burning fuel.

Can expensive electric power in Germany and other “green policy states” stop the burning of fossil fuels globally?

The only solution is technology that most developed regions have to develop.

Some in the global elite believe reducing the global population is required. E.g., by vaccination stated by of them.

EU: 1,000 billion for Clean Deal? EP voted for Climate Emergency on Nov. 28, 2019



Clean Energy:

- UN: 2,500 billion invested up to 2020
- Covers only 13.5% of the

- **Der Verbrauch fossilen Materials wächst.**
- **Fossiles Brennmaterial ist endlich!**
- **Windräder und PV können das nie umkehren!**
- **Die Energiepreise steigen stärker als die Inflation!**

- Focus on fuel-free energy became a must!

Technology & Innovation!

Q: Website UN, IEA, eigene Recherchen und Hochrechnung bis 2020

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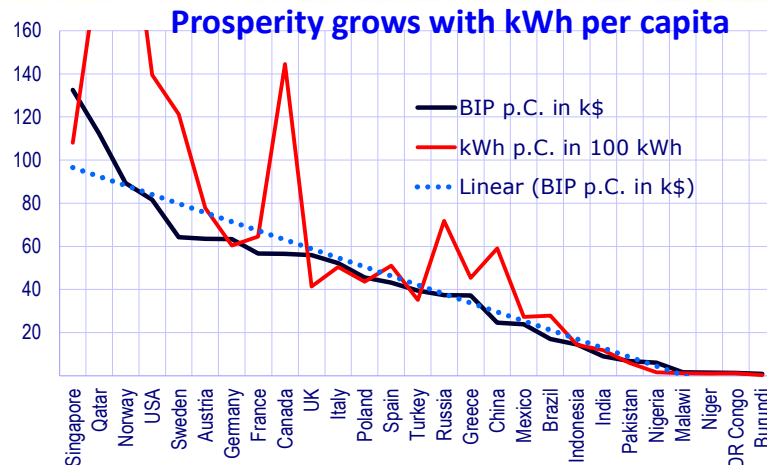
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Armutsbekämpfung: #1 UN-Ziel erfordert kostengünstige Energie



High electric energy usage in industry, e.g., for Aluminum and heating, if costs are very low.

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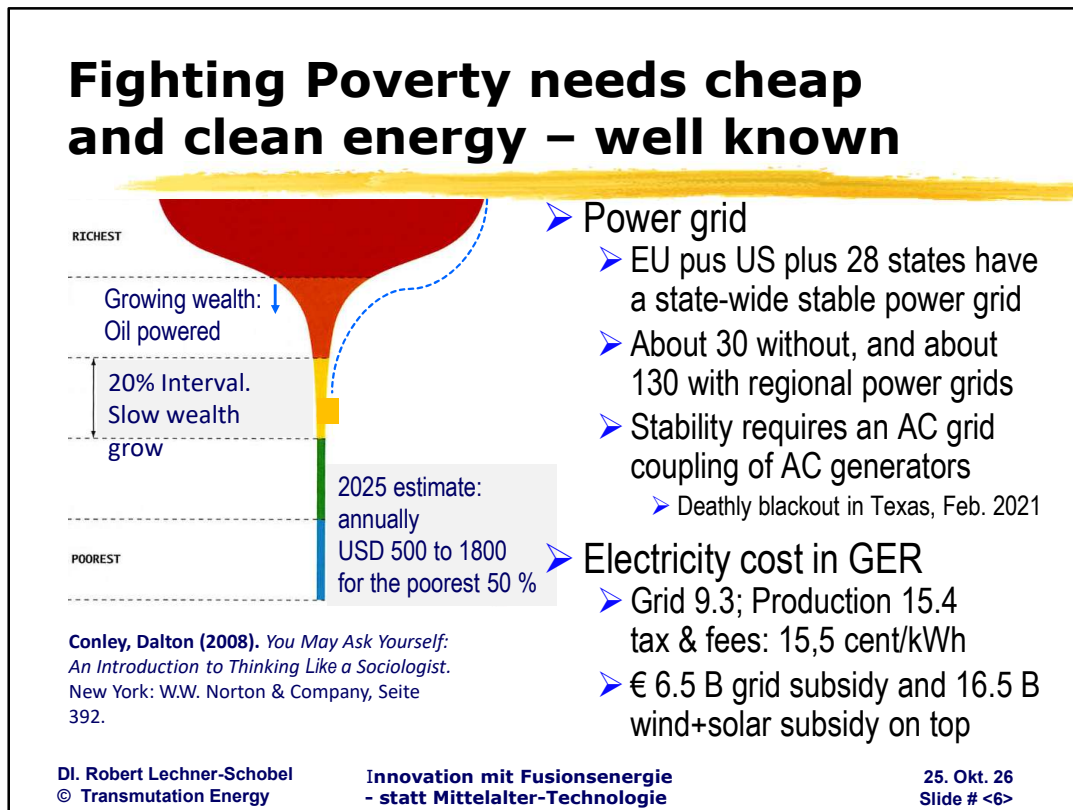
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Here is an alternative approach:

An affordable electric power supply is a prerequisite for every industry, including data centers for AI.

The correlation between the GDP per capita and kWh per capita shows a clear message: To support the UN-Objectives, we need cheap electric energy – everywhere.



Since 2008, global wealth has been growing. The poorest billion people hardly benefited from that.

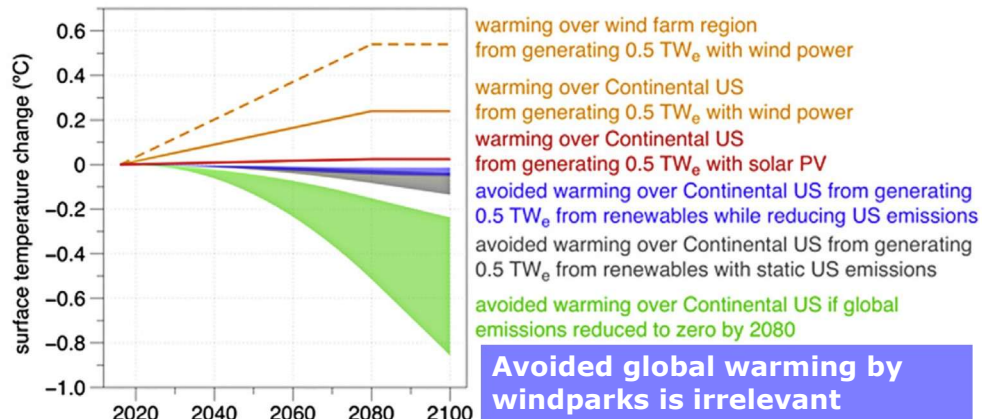
Look at the electricity costs in Germany: € 23 B of taxpayers' money to cover the cost for electric utilities adds 4,7 cent/kWh, resulting in 44,9 cent/kWh.

See the bureaucratic monster: 6,67 cent/kWh are collected from the user of electric energy to finance those subsidies for him.

Do you think this serves the UN objectives – if 25 % of the income goes for electricity in less developed countries?

Wind parks are questionable: Warming; dryness; health; birds; bats; insects

- (i) According to this model, 126 GW of wind power in Germany would cause a warming of $\sim 0.48^\circ\text{C}$. (ii) A forest absorbs more CO_2 than a wind farm saves. (iii) NASA measured $+0.72^\circ\text{C}$ in the largest wind farm in Texas (April 2012).



Q.: Climatic Impacts of Wind Power; Lee M. Miller, David W. Keith; 2628 Joule 2, 2618–2632, December 19, 2018

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Wind and solar farms have impacts that need to be analyzed to determine when and where their use is appropriate.

Besides significant warming by wind farms, there are other aspects to consider. They could impact human health.

We all love clean, fresh air and high-quality drinking water. Please choose the right way!

Nuclear Energy for a Clean Planet. The European Green Deal will fail.

- F. Rademacher: „we need a new type of steam engine“ ¹⁾
- W. Sassin: „Fusion energy will solve the challenges“ ²⁾
- GER, AUT & LUX requested in 2019 to forbid funding of nuclear projects, including fusion, by the EU Commission
- NASA: Earth became >10 % greener;
P. Moore³⁾ & John Clauser⁴⁾: “CO₂ is basic for life“.
- LaRouche's concept of "energy-flux density" for wealth
- TERRA FUSION states: Renewables are imperfect

1. Club of Rome Germany. From the Laudatio to honor Dennis L. Meadows, May 2019, Munich
2. After my speech „Fusionsenergie zum Greifen nahe“ in the Bavarian Economic Forum, July 2020, Ingolstadt. Researcher at IPCC & IIASA. Sciences Autor: „Evolutionary Environments - homo sapiens – an Endangered Species?“, Uni Innsbruck. CV on request.
3. Was for 16 years, Founding President of Greenpeace. Is pro science, against ideology. https://youtu.be/lX1z_6pvM-Q
4. Nobel Laureate 2022; presentation 2024 in Vienna, Austria

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Energy production is key to the survival of mankind.

Besides that, inherently safe nuclear energy is the “new steam engine”, as stated by Rademacher, Club of Rome, Germany.

My friend Wolfgang Sassin wrote „Evolutionary Environments - homo sapiens – an Endangered Species?“, jointly with a general from China and a general from Russia, after his research at the International Institute for Applied Systems Analysis (IIASA) in Austria.

Following my speech in July 2020 at the Bavarian Economic Forum, in which I announced the imminent market readiness of fusion energy, he declared: "The limitation described in my book will disappear."

Why? Nuclear and fusion power plants will come onto the market long before fossil resources are exhausted.

But will the global warming grill us before? No! “There is no existential threat to mankind” is a statement from Jim Skea, the head of the IPCC.

Immediately stopping fossil fuels would kill billions of people.

Continuing with fossil fuels for a few years until arrival of nuclear makes the planet greener. NASA observed >10 %. There will be more

food.

Nuclear Energy for a Clean Planet. The european Green Deal will fail.

- F. Rademacher: „we need a new type of steam engine“ ¹⁾
- W. Sassin: „Fusion energy will solve the challenges“ ²⁾
- **Storage costs for wind and solar energy limit their usability.**
- TERRA FUSION states: Renewables are imperfect

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Depending on the geographic region, seasonal storage of electrical energy is a challenge.

Germany's topography allows only 5% of the seasonal storage demand to be covered by pumped-storage power plants.

What about batteries as a seasonal energy storage solution? Germany needs all the known lead reserves for lead-acid batteries. For lithium, 1% of the world's population needs 16% of the known resources.

Regardless of the material used, it takes a decade to find and develop suitable mines. A mining investment that becomes unnecessary by the time it's completed.

Nuclear Science towards Fusion

- Nuclear Basics - A Journey Through Matter:
 - Atom, Proton, Neutron, Electron, Fission, Fusion
- Inherently safe Nuclear Power Plants
 - Six serious developments from 20 MW to 500 MW
 - Nuclear waste remains as challenge
- Fusion Power Developments
 - Global 64 Fusion-Developments for D + T or B + p
- Sufficient for the top-objectives of the UN?
 - Partly yes for the industry, but what next?

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In 2019, Reuters reported that the governments in Berlin and Vienna tried to convince the EU Commission to forbid investments in nuclear power, including fusion.

That changed now, incidentally, when I finished this presentation: The president of the EU Commission issued a clear statement in favor of nuclear.

In this section, you will get a basic understanding of physics and what changed to pave the way forward with nuclear.

A Journey Through Matter:

- Demokrit ~400 BC: states the Atom
- Dalton (1808): Modern atomic theory
- Avogadro (1811): Gases are molecules
- J. J. Thomson (1897) isolates the electron;
- Rutherford (1911) gold-foil experiment
Tiny dense nucleus, lots of empty space
- Bohr's (1913) discrete orbits of electrons;
- Proton (p) identified (1917)
- Neutron (n) discovered (1932)
- Quarks & Gluons (1960s–70s) form p and n
- Low Energy Nuclear Reaction: Fleischmann & Pons (1989); "Cold Fusion" false name

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Rutherford: Atoms proven divisible;

Bohr's (1913) Quantized Model of Electrons in discrete orbits; explains atomic spectra.

1932 — mass puzzle solved with the discovery of neutrons;

How Quarks & Gluons (1960s–70s) form p and n was detected:
Gluons bind the quarks strongly together.

Gell-Mann & Zweig propose quarks - Quantum Chromodynamics:

Periodic Table 2016 (IUPAC): 1869 Mendelejew; 1913 Moseley; 1940 Seaborg

Das Periodensystem der Elemente

Ordering number: 1 H 1.00794
Mass (u): 1.00794
Symbol: H
Occurrence: naturally (o), naturally radioactive (x), synthetic (s)
State: solid (X), liquid (l), gaseous (g)

Series: Alkali metal, Alkaline earth metal, Transition metal, Lanthanoid, Actinoid, Metal, Metalloid, Non-metal, Halogen, Noble gas

Inner transition metals (Lanthanoids and Actinoids)

Chemical Binding Energy:

- > 0.01 eV Van der Waals
- 0.10 eV biology
- ca. 1–10 kJ/mol

Lithium battery:

- ~3.7 eV per LiCoO_2 -Moleküle

Carbon triple ($\text{C}\equiv\text{C}$):

- ~8.7 eV (ca. 830 kJ/mol)

Battery shrinking done.

Chemistry cannot cover future energy demand!

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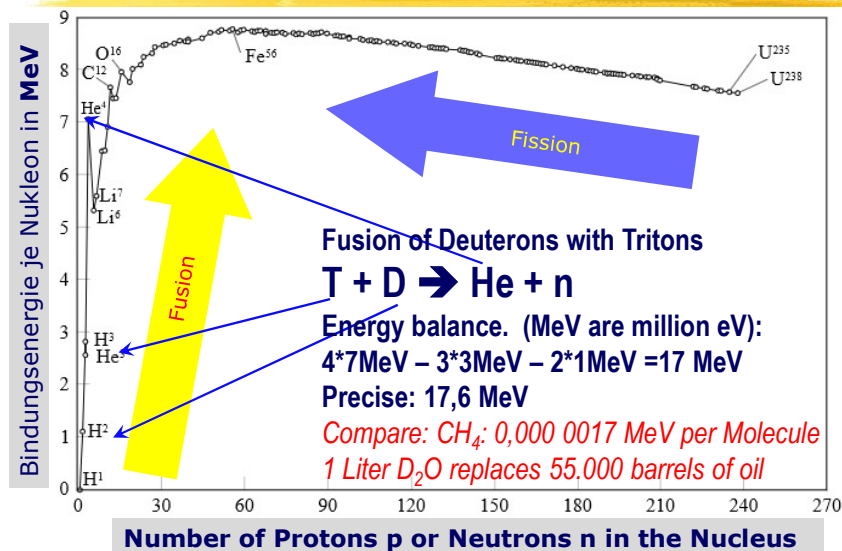
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The chemical binding energy is defined in eV. One eV is the energy required to move a single electron one Volt against the electric field.

The Limit for a Lithium battery is 3.7 eV. There is no shrinking beyond the density of those molecules.

The binding energy of gluons in a proton or neutron is millions of times higher than the chemical binding energy.

Binding Energy in the nucleus exceeds the chemical million times.



Q: <https://commons.wikimedia.org/w/index.php?curid=6939117>

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The binding forces between nucleons vary depending on their number in the atomic nuclei. In hydrogen, which consists of one proton and one electron, this force is zero.

These nuclear binding forces are an energy field that corresponds to a mass, according to Einstein's formula $E = m \cdot c^2$.

When nucleons combine to form iron, the released binding energy comes from fusion. When large atoms break apart, we see fission. Although this energy is small per nucleon, there are 235 in ^{235}U .

The energy is measured in eV. One eV is the energy to move an electron against an electric field of one volt. This corresponds to 1.60×10^{-19} watt-seconds.

The chemical bond energy in methane is vanishingly small per molecule, compared with the binding energy created by gluons.

This is what makes fusion energy so attractive! Fuel costs are around 0.015 cents per kWh when tritium is produced from lithium.

For a typical two-person household with an annual consumption of 4,000 kWh, the fuel cost would amount to € 0.60.

Kernkraftwerke

- Bisherige GAU in Kernkraftwerken
 - Keine Redundanz (Kabel Tree Miles Island)
 - Totalitärer Eingriff in ein Experiment (Tschernobyl)
 - Notgenerator dem Tsunami ausgesetzt (Fukushima)
- Kein GAU wäre in Dt. KKW möglich
 - EDF rüstete Notgenerator nach!
- Neue Kernkraftwerke
 - Inhärent sicher und Einsatz von Thorium
 - Typgeprüft, d.h., Zulassung geht schneller
 - Weniger radioaktiver Abfall
 - Höhere Betriebstemperaturen => Wirkungsgrad

Inherently safe Small Modular Reactors (SMR) – CAPEX high

- The split of large nuclei release energy
- SMR will be approved as type, not per project.
- Used nuclear fuel must be disposed like today.
- Fission Reactors are forbidden in GER and ...
- Ordering possible; power to the grid > 5 years

SMR-Type	Power (MW _e)	Steam Temp.	CAPEX (est.)	1st deployment
GE Hitachi BWRX-300	300	~286°C (Steam)	16 Mio. USD/MW	2029-2030
StarCore Nuclear HTGR	20-120 (modular)	~750°C (Helium)	5,8 Mio. USD/MW	open
X-energy Xe-100	80	~565°C (Helium)	Unknown	Mid-2030s
Kairos Power KP-FHR	100-140	~500°C (Flouridsalt)	Unknown	in 2030s
Holtec SMR-160	160	~270°C (Steam)	6,0 Mio. USD/MW	open
Rolls-Royce SMR	470	~270°C (Steam)	8,5 Mio. USD/MW	Mid-2030s
NuScale Power Module	77 (per Modul)	~250°(Steam)	3,6 Mio. USD/MW	from 2030s

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None of the three major nuclear accidents could have happened in Germany.

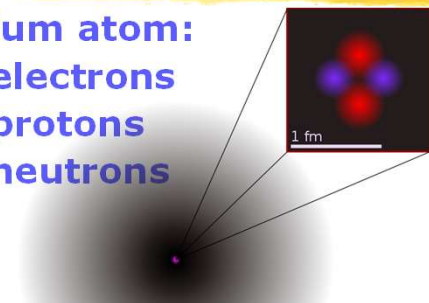
The new reactor types are designed to be inherently safe, even without the safety precautions built into German reactors.

There is no reason to delay their introduction.

Binding energy (gluons) hold the nuclei in the core together

Helium atom:

- 2 electrons
- 2 protons
- 2 neutrons



Nucleus is like a pinhead in a 100m electron cloud

$100\,000\text{ fm} (= 1\text{ Å}) = 0,1\text{ nm}$

on a scale of $10^{15}:1$

Helium_atom_QM.svg: User:Yzmoderivative work: Cepheiden (talk) - <https://commons.wikimedia.org/w/index.php?curid=6949216>

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Fusion:

- The joining of nuclei into larger nuclei releases energy.
- Nuclei repel; are positively charged
- High temperatures (~ 150 million $^{\circ}\text{K}$) overcome repulsion.
- **Smart solutions outside mainstream.**

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Atomic nuclei fuse when they get close to each other.

There are two challenges:

1st, they are positively charged and therefore repel each other.

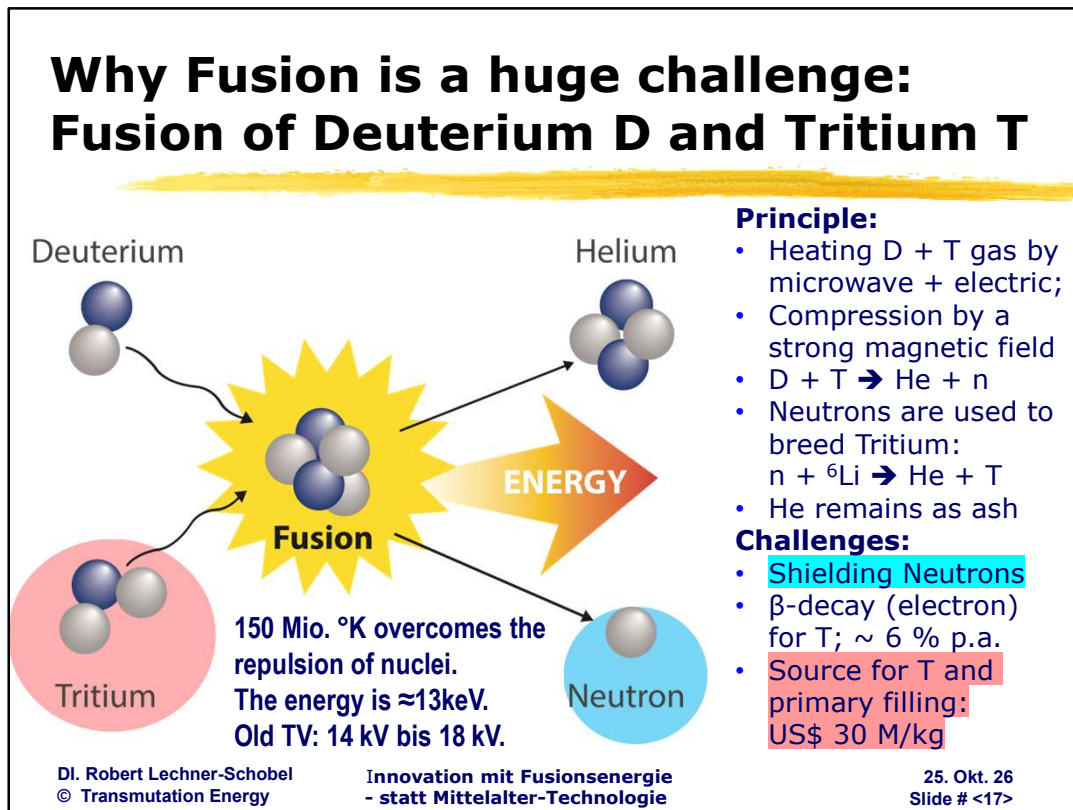
2nd, they have a large distance.

The ratio of the diameter of the sun to the distance of the Earth is about 107. For Helium, that ratio is beyond 50,000!

Furthermore, the pressure in the fusion chamber at room temperature is only a few millionths of the atmospheric pressure.

To overcome those hurdles, the atomic nuclei need a high temperature of about 150 million $^{\circ}\text{C}$. This corresponds to 13 keV. An energy you had in your old TV set.

Further, you need a density as high as possible: i.e., stronger magnets.



The principle of fusion energy seems simple: deuterons ($p + n$) and tritons ($p + n + n$) fuse. This releases millions of times more energy than a chemical reaction.

Tritium is produced as a byproduct in nuclear power plants. It costs US\$ 35,000 per gram. Approximately 20 kg is consumed annually for 100 MWe.

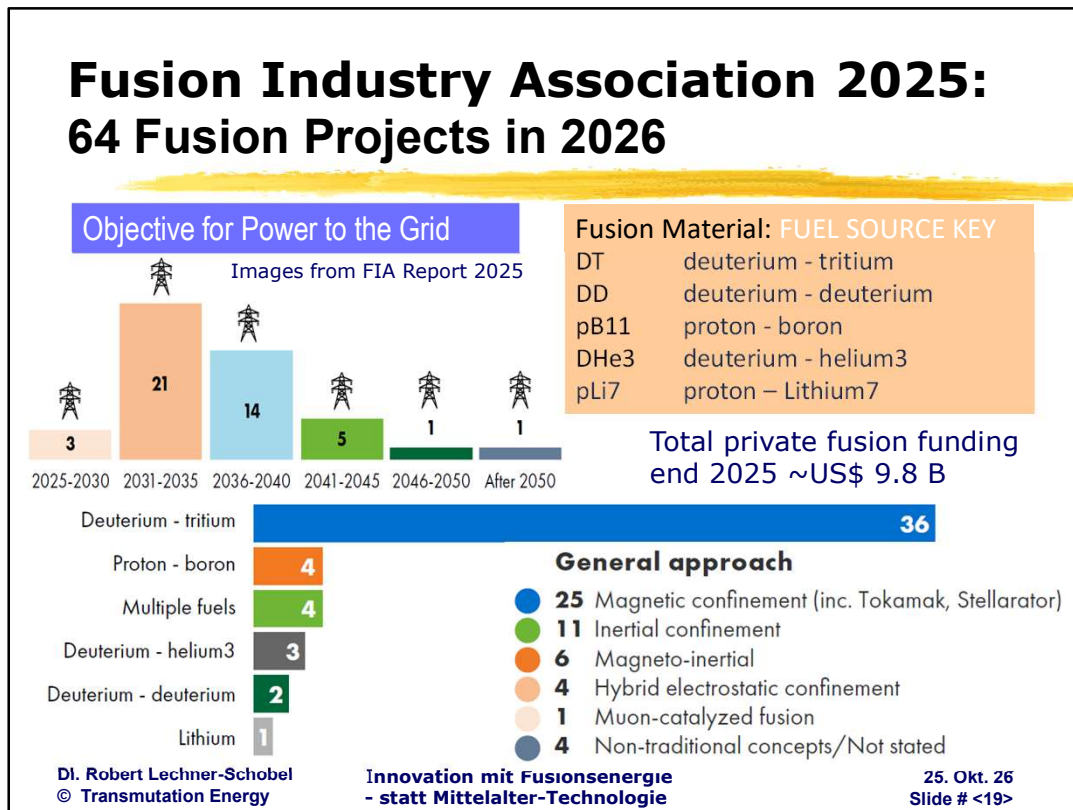
Through beta decay, in which an electron is released, annually 6 % of tritium became ${}^3\text{He}$.

When a fast neutron from the fusion of deuterons D and tritons T collides with the nucleus of a lithium-six atom (${}^6\text{Li}$), helium and tritium are produced.

If the blanket is located within the vessel shell, as by GeneralFusion, more tritium is produced than consumed. This could be sold, e.g., for the initial filling of Fusion Power Plants or to compensate for the loss of tritium in other fusion core designs.

Herausforderungen bei der Fusion von Deuterium + Tritium

- Coulomb'sche Abstoßung → 150 Mio °C
- Fusionsrate steigt mit B^4 → Magnetfeld
 - ITER <13 T; Proxima <20 T; 5,6-fache Energiedichte
- Fusionsreaktion D+T → 17,6 MeV
 - ^4He (3,5 MeV) + n (14,1 MeV); n → Blanket
 - $^6\text{Li} + n \rightarrow ^4\text{He} + ^3\text{H} + 4,78 \text{ MeV}$
- Mantel des Vakuumgefäßes erhitzt durch ^4He , geschädigt durch Neutronen
- Blanket innerhalb des Mantels schützt
 - $>\sim 200.000$ weniger n als ITER
 - Betriebstemperatur 800 °C → H_2 ohne Elektrolyse



Important: Fusion technology will eliminate fuel costs. The modernization of the electricity grid using fusion energy could be completed long before the planned ending of the EU Green Deal.

The Fusion Industry Association (FIA) publishes annually an overview of privately funded fusion solutions. These images are from their 2025-report. Today, 64 fusion developments are in the focus of FIA.

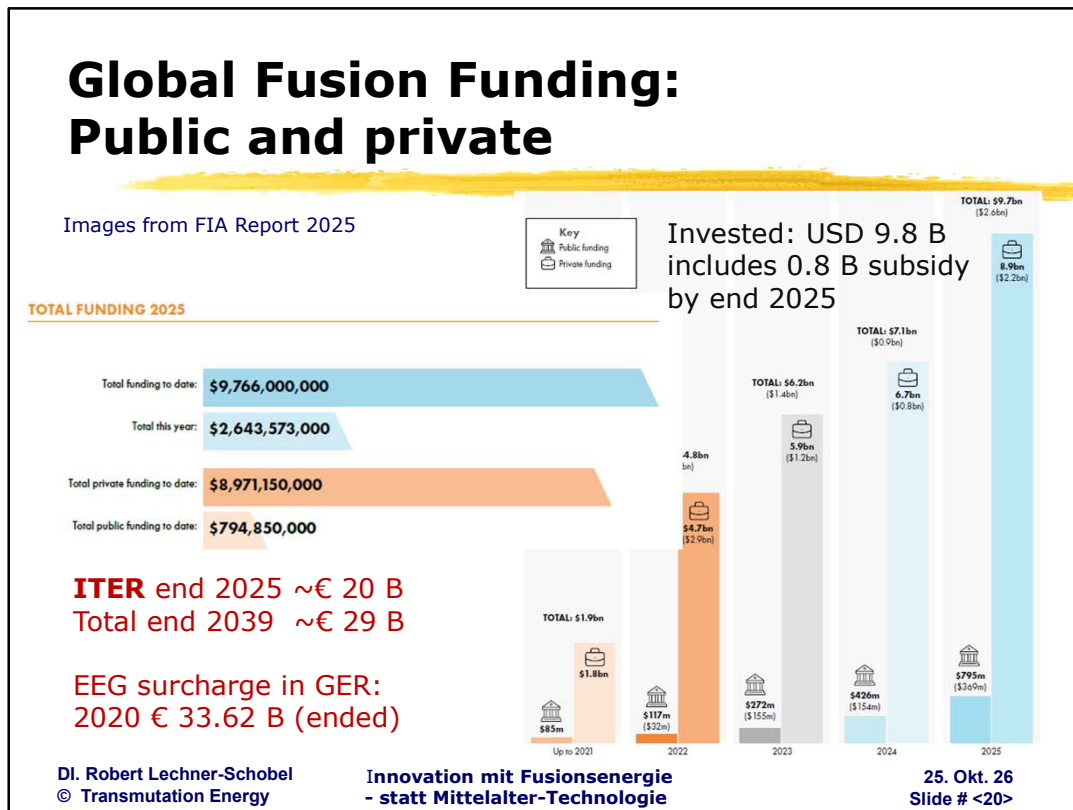
Upgrading a coal-fired power plant is possible by replacing the coal heater with a Fusion heater. The cooling system can stay in use. This reduces the conversion costs for the grid by one magnitude compared to the actual plan with a grid for wind farms and PV parks.

The FIA initiated the approval process for FPP in the US and recently approached the EP. The approval for FPP is much simpler than for Nuclear Power Plants. There is no radioactive waste and no radioactive feedstock. False reports in newspapers created “nuclear” fears.

Note that 21 fusion companies start delivering commercial electricity to the grid between 2031 and 2035. Prototypes at least one year earlier.

FPPs cover a wide range of applications. Some are used for desalination, others for hydrogen production and others for space propulsion.

Their power range is from 10 kW_{el} and, in combination with multiple fusion cores, up to GW_{el}.



ITER stands for International Thermonuclear Experimental Reactor.

This was intended as the international flagship for fusion power research and is constructed in Cadarache, France.

ITER was designed with superconductors that need fluid helium for cooling. These became obsolete with high-temperature superconductors (HTS), which only require liquid nitrogen.

None of the 64 privately funded fusion developments is waiting for experiments at ITER. Some use the simulation tools and expert knowledge at ITER.

ITER had burned by the end of 2025 two times the money all the privately funded fusion development companies spent together.

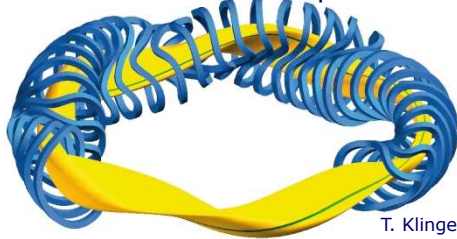
This raises the question: Why continue the construction of ITER?

Look at the subsidies paid by the EEG law for green technology in Germany: If used properly for innovation, where would we stand now?

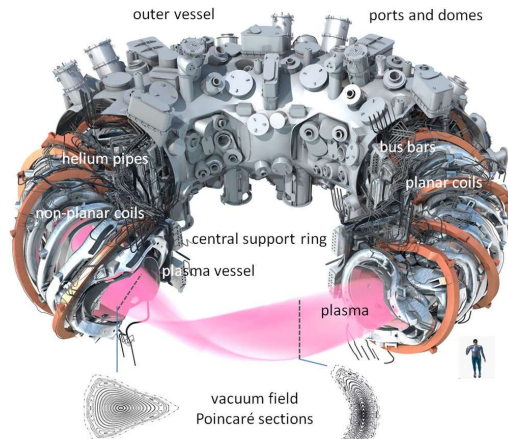
Stellarator: A Fusion technology e.g., for Proxima Fusion

From research to the Product:

- No poloidal coil → complex magnetic field
- Self-burning plasma in 30 m³
- Further development with best superconductors → smaller higher density → D + T fusion
- Neutrons shielding in outside blanket where T is produced



Wendelstein W7X in Greifswald



T. Klinger et. al., commons.wikimedia.org/w/index.php?curid=69391204

IPP - commons.wikimedia.org/w/index.php?curid=24388371

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Proxima Fusion starts with the Stellarator, developed from the Institute for Plasma Physik in Greifswald, Germany.

This is not the only development based on a stellarator. They secured € 2 B funding.

The ingenious idea was to form a magnetic field that does not need a central coil for heating the plasma as in a TOKAMAK.

Principle MTF: GeneralFusion

Plasma Injection into rotating liquid metal shell

Pistons compress the liquid shell.

A plasma beam creates a magnetic field.

Less volume → magnetic field goes up



The world's largest plasma injector is ready

Source with video:

<https://generalfusion.com/fusion-technology/>



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GeneralFusion is the first Fusion Company listed at the NYSE and fully financed.

The blue arrow indicates the point where the plasma injector injects the plasma into the fusion cylinder.

Liquid metal, consisting of lead and lithium, flows along the inside of the rotating cylinder.

Compression pistons are located on the outside. They compress, once in a second, the plasma shot.

That plasma shot has, like lightning in a thunderstorm, a magnetic field. If the volume was compressed, the magnetic field would increase up to 100 Tesla. Sufficient to trigger the fusion.

If that happens, fast neutrons heat the plasma and the liquid metal. Approximately 80% of the compression energy goes directly back into the pistons.

The liquid metal circulates through a heat exchanger which delivers the steam or heats up the helium for the turbines.

The solution is theoretically unambiguous and has been confirmed in

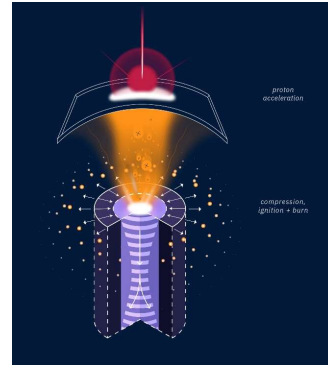
self-destructive tests and many studies at different universities.

Inertial LASER Fusion for $p + {}^{11}\text{B}$

Energy released at $p + {}^{11}\text{B}$ fusion:

- 8.5 times the initialization energy is released. System losses are not covered.
- Solution: A point on the target struck by the laser beam fuses and ignites fusion for the rest of the target.
- The fusion product is $3 \cdot {}^4\text{He}$
- No neutrons and negligible gamma radiation.
- Up to 10 LASER pulses per second
- The frequency controls the power to the desired level.
- Extremely short LASER-pulse 10^{-15} sec, within light moves $3 \mu\text{m}$

Marvel Fusion, Munich and **HB11**, Sydney, in cooperation with GSI Helmholzzentrum, Darmstadt, GER



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The fusion of boron-11 with protons has one advantage and one disadvantage: it produces three helium nuclei plus energy, but almost nothing else, meaning no neutrons and rare gamma rays.

The disadvantage is that initiating such a fusion needs about ten-times the energy input as for the D+T fusion. An ultrashort LASER-pulse delivers that energy.

The original concept of synchronizing multiple lasers was abandoned. Instead, ultrashort LASER-pulses trigger the fusion in one part of the target, inducing the fusion in the rest of the target.

These laser pulses last only one femtosecond. The light travels only $3 \mu\text{m}$ in this time interval.

LLPFusion and Avalanche ENERGY



LLPFusion uses Focus Fusion.

Simultaneous discharge of several high-voltage capacitors in a Containment with Bor and Hydrogen. Fusion initiated by electron density & magnetic field at the focus point. Hoes KG, Munich, leading with patented synchronization.

Avalanche Fusion

develops generators for electricity in the range from 1 kW to 100 kW. They use for their ORBTRON a special process with clouds of plasma and ions.

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There are two promising developments in low-power fusion.

They are not based on the principles of LENR, but they have a similar power range.

These developments support the top priorities of the UN with low cost and ease of transportability.

Fulfilling the UN objectives with Fusion: An overview

Technology	Neutrons & Tritons	Remarks
Stellarator	Blanket outside ; D + T; TBR 1.05	for E- Grid; 250 MW;
Magnetic Target Fusion (MTF)	Blanket inside ; shields container against neutrons; TBR 1.50	for E-Grid 2*125 MW and for H ₂ : (HyS from DoE). Better as electrolysis
Inertial Fusion	p+ ¹¹ B; direct conversion	for E-Grid; 250 MW
Focus Fusion	p+ ¹¹ B; direct conversion	For E-Lok, Trucks, Villages; 1 to 5 MW

- **Stellarator has no central heating coils, as in TOKAMAK**
- **MTF needs no superconductor and saves cooling power**
- **Inertial Fusion depends on superfast LASER**
- **Focus Fusion needs to ns synchronized arc-discharges**

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Most Fusion Companies fuse deuterons and Tritons.

Tritons must be created inside the fusion core. How well this work is shown in the TBR, the Tritium Brew Rate.

If the blanket is inside, the containers is protected from neutrons. Compared to ITER, 100,000 times better at GeneralFusion.

Therefore, it is easy to use 800 °C, as required for the Hydrogen-Sulfur-Process defined by the DoE for hydrogen production as most efficient.

Any solution has specific challenges with a known solution.

Kosten für Energiewende:

- Produktionskosten je kWh, netztauglich
 - VERBUND AG, AT: 2,2 Cent je kWh (Wasserkraft)
 - Fusionskraftwerke (GF, Maavel): ~ 5 Cent je kWh
 - Zielwerte für LPPFusion, Höß KG: ~ 1 Cent je kWh
- Deutschland je kWh mit Zukauf
 - Produktion: 15,4 Cent je kWh
 - Stromnetz: 9,3 Cent je kWh
 - Steuern und Gebühren: 15,5 Cent je kWh
 - Subvention für Netz und Strom: 29,5 Milliarden
 - Kosten für Netzengpassmanagement: ~3 Milliarden
 - Subvention & Kosten: 6,9 Cent je kWh @ 460 TWh)

Kosten für Energiewende:

- Produktionskosten je kWh, netztauglich
- VERBUND AG, AT: 2,2 Cent je kWh (Wasserkraft)

Stromkosten sind ein Hemmnis für:

- ❖ Energieintensive Industrie
- ❖ Server Centers für KI
- ❖ Wärmepumpenheizung
- ❖ E-Mobility

Mit 47,1 Cent je kWh wurde DE unattraktiv.

Was ist der Ausweg?

- Kosten für Netzenpassmanagement: ~3 Milliarden
- Subvention & Kosten: 6,9 Cent je kWh @ 460 TWh)

The Challenge: Nuclear reactions at room temperature?

- Fusion of Deuterons if electron replaced by Muon
 - Theory by A. Sacharow, 1948
 - Experiment by Alvarz, 1956 in Berkely
- Atomic nuclei repel each other through the Coulomb barrier
- Matter waves from the atomic nuclei can overlap if electrons weaken the Coulomb barrier sufficiently. Then they fuse.
- This results in Low Energy Nuclear Reactions (LENR)
- Many effects show LENR
 - Mainstream focusses on Metal Hydrides (Solid State Fusion = SSF)
 - Many effects / observation need further research
 - No contradiction to the standard-model in physics
- What LENR-effects are commercially usable?

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Nuclear reactions are possible at room temperature. That was for a long time misunderstood as hot fusion reactions at room temperature. Those are impossible.

In 1926, the Viennese chemist Fritz Paneth discovered in an experiment performed in Berlin, that helium was produced when a palladium wire enriched with deuterium exploded due to an electric shock. Andrej Sacharow calculated in 1948 that Deuterons fuse if muons, i.e., heavy electrons, replace the electrons.

This was experimentally confirmed by Alvarex in a laboratory in Berkeley in 1956. In 1989, Pons and Fleischmann (born in Carlsbad) discovered an energy surplus that arises during the production of helium from deuterium in palladium. The misleading term "cold fusion" was born.

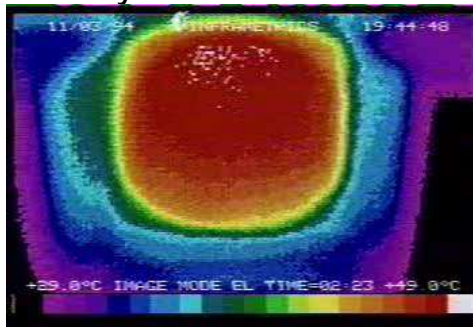
Many experiments confirmed that nuclear reactions happen at room temperature. But how to use those effects was unclear.

In 2012, the world's very first prototype of a heating system was demonstrated by the Austrian inventor, Dr. h.c. Hans-Peter

Bierbaumer, who was based on LENR.

Low Energy Nuclear Reaction LENR Early research

- F. Paneth in 1926: ^4He after a wire explosion
- Pons & Fleischmann 1989; „Cold Fusion“ and excess energy
- Many confirmations
- EU research program **CleanCME** in 2020
- Theory according to the Standard Model
- Hot Spot at cathode SPAWAN, Cal.
- No usable power; May 2009



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Low Energy Nuclear Reaction (LENR) has a long history. LENR is not radioactive and produces no radioactive waste.

When chemists Pons and Fleischmann discovered in 1989 the energy surplus in electrolysis cells using palladium, the university administration dubbed it "cold fusion." This caused an outcry among physicists, since there was no gamma radiation and no neutrons.

Their experiment was difficult to replicate. We know why now. LENR uses various reactions, but definitely not hot fusion at room temperature.

Deriving practical applications from the observed effects remains a challenge. That changed with H.P. Bierbaumer in 2012.

Since summer 2020, the EU has funded relevant research through its CleanCME program, that is coordinated by the University of Szczecin.

LENR Product Companies: Mature products expected soon

Key benefits: Low costs; no radioactivity; no radioactive waste
Mass production in many factories
Business opportunity for Application Optimized Products

Company	Product / Status	Power	Type of power	COP
HYLENR (Indien)	LENR Hybrid Heat Reactor (available since 2024)	150 W	thermal	1,5
Clean Planet (Japan)	QHe IKAROS Industrial Boiler (prototype, pilot plant planned)	24 kW , 600 kW (25-Moduls)	thermal (steam/heat)	private
ENG8 Intern. (Europa)	EnergiCell (Gen 2 in development, first installation planned for 2026)	5 W – 50 kW	thermal + electric + steam	~3–5
Leonardo Corp. / E-Cat (USA)	E-Cat NGU Power Cell & Generator (mass production delayd)	10 W, 100 W, 1–10 kW	electric (DC)	private
Prometheus (Italien)	UM Microreactor (prototype, ongoing lab testing)	private	thermal + pressure + hydrogen	1,5 (in Tests)
Aureon Energy (Kanada)	SAFIRE-based Plasma Reactor (early development, patent)	nicht öffentlich spezifiziert	isotope transmutation & heat	private
Transmutation Energy	Home Heating System in 2012 from Hydrogen Research	20 kW _{th}	hot water	20 to 50

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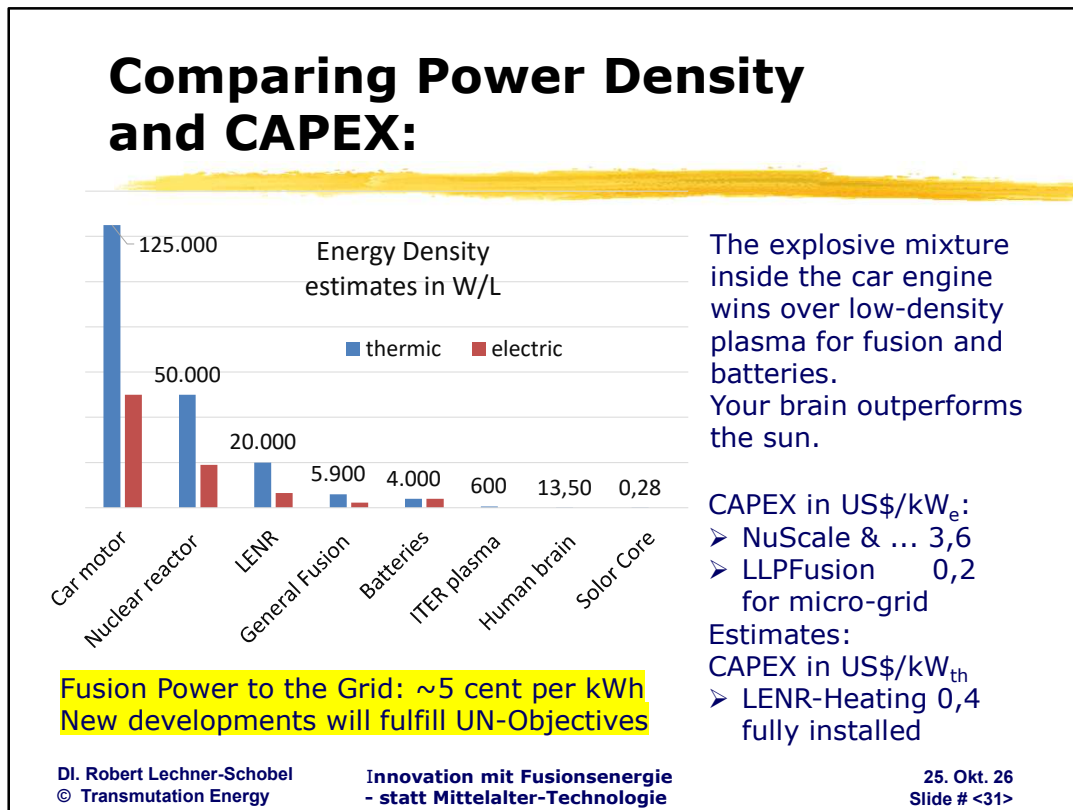
Several companies in the LENR sector have launched their first products.

The crucial parameter is the ratio of energy output to energy input at the system level, the so-called coefficient of performance (COP).

A typical heat pump has a COP between 3 and 5. Only ENG8 achieves such a value with LENR.

Transmutation Energy aims to reduce electricity costs by an order of magnitude compared to a conventional heat pump. An earlier development from Austria serves as a reference.

HYLENR's products are of interest for satellites. They enable significant weight savings while delivering the same amount of energy.



We look now at Watts per liter of the volume where this energy was created.

"We bring the sun to Earth"—who doesn't know this advertising slogan?

Think about it! Your brain has a significantly higher power density than the sun. Use it!

Look at ITER: Would you want to drive a car with that low power density?

In terms of power density, a nuclear power plant would be right next to a car engine. But who wants nuclear energy and nuclear waste in their car?

What is LENR? Let's see the next slide.

➤ **Support UN-Objectives 1 to 3 with LENR and low-cost Fusion**

➤ Promising Fusion Technologies Examples

- Proxima Fusion with Stellaris
- General Fusion with MTF
- MARVEL Fusion with LASER Fusion

➤ LENR Companies

- Overview
- LENR Heating System
- LLPFusion for lowest costs

➤ Assessment

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Let's look at the technologies of the future. Not just pipe dreams, but real product development. All based on existing science.

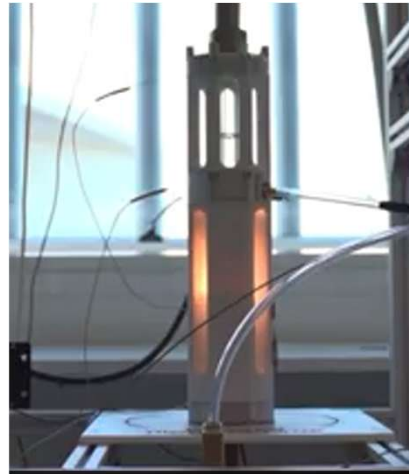
A short overview on Fusion Technologies

RLS2

LENR-Test Cells with burning plasma

From ENG8, Portugal

From HYLENR, India



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Prototype 20 kW heating system: 2012 in Austria with COP ~33



Inventor: Dr.h.c. Hans-Peter Bierbaumer (+2012)

Manufacturing costs: Control + heater ~€ 0,15 per W

Operated for 2 months; measured COP 20 to 50

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In 2012, the Austrian inventor Dr. h.c. Hans-Peter Bierbaumer presented the world's first heating system using LENR (Low Energy Nuclear Reactions). His prototype still possesses, up to now, unparalleled properties.

The open challenge was to extend the service interval from two months to more than twelve months. Tragically, he passed away much too young in August 2012.

Anyway, products like this will be developed and conquer the world.

Assessment: Do Fusion Power Plants (FPP) make sense now?

- **Supports UN-Objectives**
- **The winner is open, but**
 - **SMR** will bridge the gap
- **Deployment of FPP** starts in 5 years; at the grid < 2035.
- **Back to market condition**
 - Subsidies only for pilot projects (guarantee)
- **For all markets:**
 - Focus Fusion and LENR
- **No overpopulation!**
- **We see a climate change**
 - No climate panic; discourse!
 - CO₂ contributes 20% (NASA)
- **Literature examples**
 - S. Koonin „Unsettled“
 - P. Moore „ice ages began at 500 ppm CO₂“
 - J. Skea „No existential threat for humans“
 - V. Zharkova “sun ignored”
 - CLINTEL “ICCP errors”
 - John Clauser “endless errors”

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This analysis shows that we can escape from the fossil fuel trap at much lower costs as with hydrogen created by sunlight or wind.

Wolfgang Sassin was right, predicting that growth limits would disappear with fusion.

It remains open who wins the fusion energy race. The biggest risk is a crisis in the financial markets. Therefore, I gave two examples where funding is secured.

The commercial rollout of FPP will start in 2031. Will Wind- Solar- Storage- System be fully depreciated before they are obsolete?

Subsidies for the Green Deal can be eliminated. Cancelling the biodiesel-tax-benefit sent 50 % of the capacity into bankruptcy.

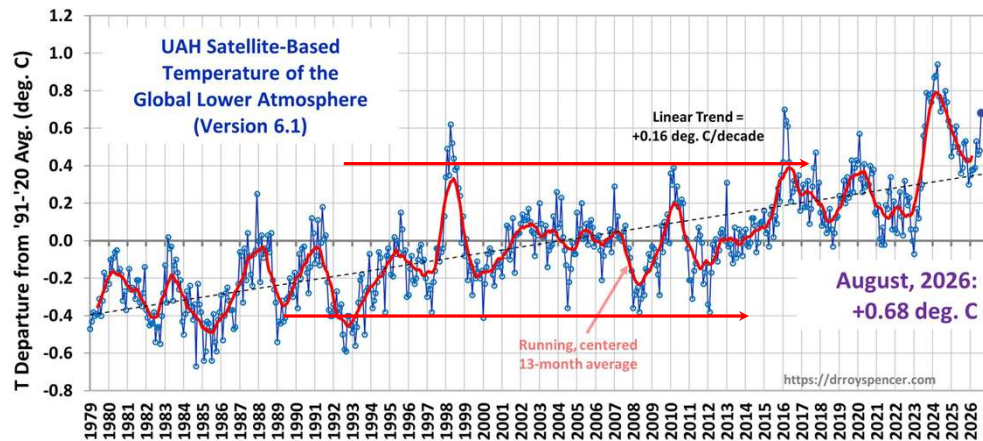
More CO₂ increases food growth. We see more CO₂ before the transfer to fusion energy is complete. Forget overpopulation-fears.

Forget the created climate fears. An open scientific discourse is required. Prof. Steven Koonin worked on that subject for Biden.

Many aspects of warming are not considered in the IPCC climate model #AR6. First time mentioned in a recent document by the US government. This is a separate speech, e.g., by Dr. Fleischmann.

Haben wir Zeit für diese Innovation?

IPCC: 1,4 °C Anstieg entspricht 0,28 °C je Dekade
 UAH Satellite Data zeigt 0,16 °C ja Dekade

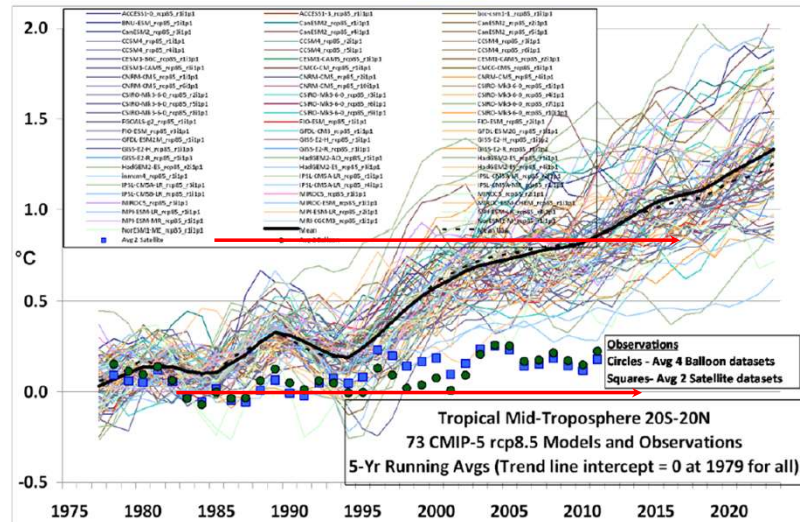


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IPCC-Model über 50 Jahre: 1,4 °C Anstieg entspricht 0,28 °C je Dekade



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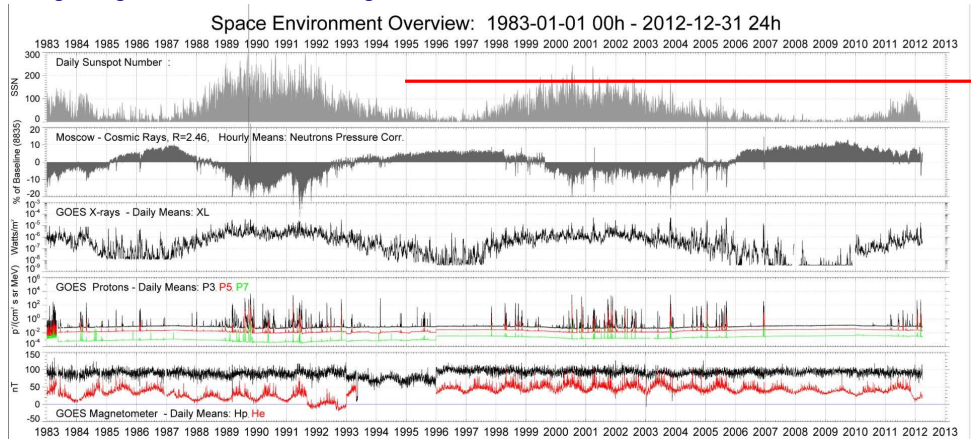
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Weltraum-Bedingungen: Partikel- und Röntgenstrahlung

Kurzfristig: Klimaeinfluss durch Wolkenbildung => nicht im IPCC

Langfristig: zu kurze Beobachtung



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SUMMARY: Innovation brings a bright future

- Nuclear energy, especially LENR, supports the UN goals in poor regions
- Fusion power plants have zero fuel costs! Wind and solar became a cost-only factor
- Dependency on fossil fuels disappears in one generation
- LENR enables innovation with new devices and thus supports economic growth in developed countries

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Think of the many products you use in your life that are energized by power. Will they be the same when energy is almost free and in your hands?

Compare the coming development with the smartphone. That created a large market for Apps and new services.

The forecast is that applications that are currently too expensive will become possible in your home market and in less developed countries.

LENR will become an innovation factor where the know-how to make valuable products exists.

The future is bright! Where depends on you.

Your final e-car with lifetime energy?

See also LENR Cars



<https://inhabitat.com/laser-power-systems-is-developing-cars-fueled-by-nuclear-power/>
https://www.youtube.com/watch?v=Fy_REO0jFwY

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My dream is a car that never needs to be plugged in or pumped.
 That dream will become a reality with LENR. And you'll be a part of it.
 Thanks for your attention.