The Global Hydrogen Initiative

Introduction to the Global Hydrogen Initiative

To control climate change and financial crisis
- Hydrogen for transportation implementation
- Electric grid stabilisation
- Revenues and technical progress
- Immediate results

Index

- **The Signs of the times**

Those who ignore the signs of the times
will be punished by the economic evolution.

Desert Energy Project

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Actual situation

From 1993 until 2000 United States and the global economy experienced eight years of peace and prosperity.

The following years, from 2001 on, destabilised nations, emission of greenhouse gasses exploded, and worst of all, a financial crisis of unprecedented severity which is getting worse day by day reduced the investments for climate protection.

Real estate market, banks, car makers and related businesses from U.S.A. broke down igniting a global recession.

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Local activities will not be sufficient to counter the global recession and will not cope with the growing demand of renewable energy.
A new view of technology and a new view of aesthetics must be found.

The U.S.A., as biggest polluter, must abandon its standpoint that environmental politics is bad for the economy. It has to get in line with a majority of countries which are willing to cooperate with the resolutions of the Kyoto movement.

There are more than local activities necessary to secure energy supply and keep nature unharmed.
Only a global management of the problem can lead humanity to a safe handling of our planet.

The Global Energy Initiative is focused on activities which give immediate results and may be completed in few years.
The United Nations Climate Change Conference in Copenhagen December 2009 should gather the global community to start the initiative.

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Why change to Solar Energy/Hydrogen economy?

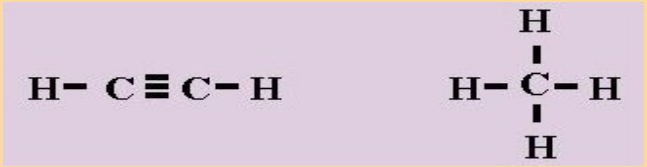
The Climate Killers
Fossil Energy from Petrol, Coal and Gas

Burning fossil fuel destroys valuable chemical resources the world needs and will rapidly deplete natural stores in a foreseeable time. The climate change due to increasing emission of CO2 by USA, China and India is accelerating the rapid depletion process.

CH3.....CH3 + 8O2 = CO2 + 4H2O +
+ C (soot particles) + Sulphur + SO2 + Ash + Energy

Oil and some Gases

High C:H Density.
High CO2 Emission



Some Gases

Low C:H density.
Reduced CO2 Emission,
but no zero emission.

All devices based on burning carbon compounds including bio alcohol and bio Diesel, should not be encouraged any more.

Solar energy/hydrogen: has zero emission and will boost business.

The Climate Killers

	Million Metric Tons of Carbon Equivalent	
Carbon dioxide from fossil fuel combustion	1,547.0	(82%)
Methan	175.8	(9%)
Nitrous oxide	97.5	(5%)
Others	31.7	(2%)
HFCs, PFCs, FS6	31.4	(2%)

- **SO2:** Acidifies the soil and sea. Nature is extremely sensitive to PH variations.

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EU Activities on Climate Change

Proposed by the EU Action Plan on Energy, March 2007, Renewed in December 2008.

No Workable Solution

Energy efficiency: Cutting energy consumption by 20% below levels of 1990, through improvement in the energy efficiency by 2020.

-Renewable energy: Increasing renewable energy from 7% to 20 %.

-Biofuels: Raising biofuels from 1% to 10 %

- Geological storage of CO2: Promoting carbon capture and geological storage (CCS)2 technology in new fossil-fuel power plants, if possible by 2020. Encourage the construction of 12 large scale demonstration plants in Europe by 2015 to store emission from power stations in underground cavities such as empty oil or gas fields or coal seams.

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The Premium Solution

The best way to handle financial crisis + Climate

- The Hydrogen Initiative: The Initiative may reduce emission by 90% below levels of 1990 by 2015 in engaged countries, and worldwide by 2025.

- The Initiative: The Initiative may provide 100% renewable Energy worldwide by 2025.

- Carbon dioxide emission: Biofuels are based on carbon dioxide emission. Hydrogen fuel is carbon free.

- The extreme costs of Carbon Capture and Store: The Initiative does not produce CO2. High research costs should be invested in the construction of solar power plants, which guarantee immediate results.

The EU Action Plan on energy, March 2007/December 2008

Increase biofuels up to 20%

Biofuels compete with food crops.

According to Inneke Herreman up to 58 per cent of total rapeseed oil made in the EU 25 countries is used for biofuel, and this corresponds to two per cent of total biofuel used in transport.

To achieve the 2010 directive, the rapeseed oil needed would surpass all EU provisions. This development would have a major impact on our industry.

(Inneke Herreman, of the International Margarine Association of the Countries of Europe, (IMACE). www.Foodanddrinkeurope.com 05.04.2006)

Importing bio Diesel and bioalcohol from Brazil will turn their agriculture in monoculture leaving small peasants without usable land.

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Biofuels result in monoculture and depletion of environment using increased fertilisers and pesticides.

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Old logistic problems of the bucolic ethanol mills of the past decade are solved. The agro-business took over, with enormous problems for the environment, like the pre-harvest burn of leaves of the sugar cane seen here.

Before harvesting the fields are sprayed with Herbicide 2,4 D, component of Agent Orange, which was used in the Vietnam War. Afterwards the fields are burnt, setting free huge clouds of dioxin that cause respiratory diseases of epidemic dimensions in the affected areas.

Desert Energy Project

Comparing area of fuel crops Brazil with area for solar energy for entire world

Brazil bio alcohol heavily supported by German government[1]

Sugar cane today	70 000 square kilometres equals a square area with sides of 265 km.
In 4 years	120 000 square kilometres equals a square area with sides of 346 km.
By 2025	210.000 square kilometres equals a square area with sides of 458 km. This is the size of UK

Germany, buying certificates from sugar cane from Brazil will heat up the climate, will impoverish the rural population and bring an ecological catastrophe to the country.

On the other side less area is needed to harvest solar energy from the desert [2]

To feed solar electricity for:

The whole World	110 000 square kilometres equals a square area with sides of 330 km.
The EU	22 500 square kilometres equals a square area with sides of 150 km.
Germany	7 800 square kilometres equals a square area with sides of 88 km
Kuwait	210 square kilometres equals a square area with sides of 14 km

[1] Spiegel Online: Brazil´s Rainforests: Is Cheap Meat Bigger Threat to Amazon than Biofuels? 05.05.2008.
http://www.spiegel.de/international/world/0,1518,druck552027,00.html
[2] Ecobalance of a Solar Electricity: Transmission from North Africa to Europe. Technical University of Braunschweig. Faculty for Physics and Geological Sciences. Diploma Thesis of Nadine May 17. August 2005.
http://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/projects/Ecobalance_of_a_Solar_Electricity_Transmission.pdf

The five biggest climate killers

USA has the highest CO2 emission and energy consume per capita.

Country 2007	% of world CO2 emission	% of World Energy consume	% of World Population Mio
USA	**21%**	**20%**	**4,6%**
China	**18%**	**15%**	**20,5%**
Russia	**5%**	**5%**	**2,2%**
India	**4%**	**5%**	**17,0%**
Germany	**3%**	**3%**	**1,3%**

USA has the highest CO2 emission and energy consume . China has lower emission and energy consume as USA, but a five fold population to live from.

The emission and how to avoid it

	CO2 emissic	Suggested remedy
Power plants	25%	PV, ISCC electricity for daytime integrated in a mix of fossil/wind energy
Industry	20%	Integration of solar energy to reduce costs
Cars / transport	13%	Hydrogen – cars
Buildings	10%	Solar energy, windmills and hydroelectic
Forestry	17%	Electricity and fuel from solar energy.
Farming	13%	Use of hydrogen as fuel for tractors and machines
Others	2%	Use of electricity and/or hydrogen as fuel

Air traffic must be reduced to a minimum because emission cannot be influenced decisively.

Payback of Energy Consumed during Production of PV modules [1]
The IEA says that the payback of the energy consumed during the production of the modules will be realized within three to four years, considering the high levels of solar irradiation from deserts.

Emission from production of PV modules can further be reduced to near zero by using the solar energy generated in the earth´s sun belt.

[1] IEA Photovoltaic Power Systems Program: Basics of PV: Environmental Considerations.
http://www.iea-pvps.org/pv/index.htm

Environment [1]
If photovoltaics are located where photosynthesising plants would normally grow, they simply substitute one potentially renewable resource (Biomass) for another.
Solar energy does not compete with plants in desert zones and does not harm environment so as it would do in vegetated regions.

[1] Wikipedia: Photovoltaics
http://en.wikipedia.org/wiki/Photovoltaic

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Hydrogen Source

Currently, hydrogen vehicles utilize hydrogen produced from hydrocarbons by steam reforming. The production of the hydrogen creates additional emissions due to input energy based on fossil fuel and liberates CO2 from the substrate.

Solar energy from photovoltaic farms from the desert turns the production of hydrogen so inexpensive that the introduction will be feasible and emission can be reduced near zero. Hydrogen from electrolysis of water is an energy storage which stabilises the electric grid. Overloads can be diverted to the production on hydrogen for transportation.

Hydrogen Combustion Engine

The common internal combustion engine, usually fuelled with gasoline (petrol) or diesel liquids, can be converted to run on gaseous hydrogen. Vehicles, using hydrogen and gasoline are ideal for transition time during the implementation of the hydrogen infrastructuire. Researches on hydrogen storage built on metal hydrides and compression are progressind.

Electric car is not a global solution:

Electric cars equipped with batteries will be of minor importance. Batteries will limit the rage of these cars. The consumer needs a vehicle with unlimited range as he is used to. Hydrogen as clean fuel provides the same advantages of gasoline and can be introduced in standard compression combustion engines with small changes.

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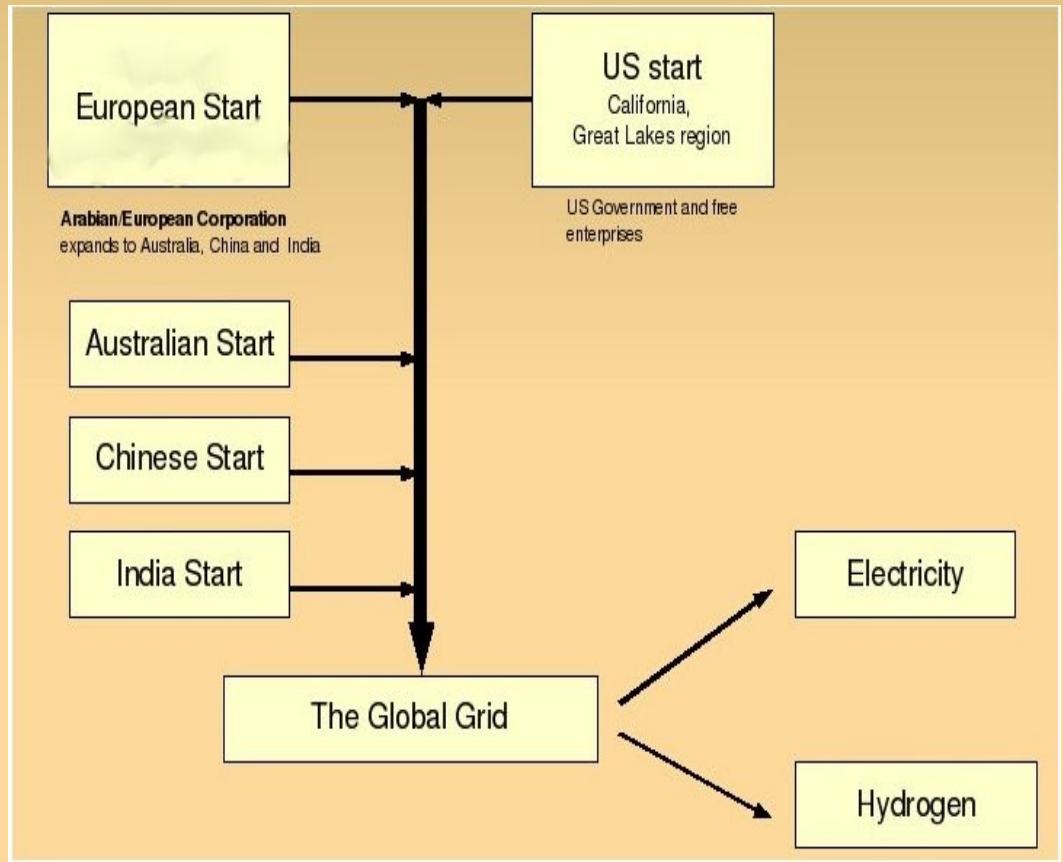
Hydrogen produced by electrolysis of water using solar energy brings global prosperity

Hydrogen Market

Hydrogen as fuel for transportation is a new market niche in Europe. The inexpensive solar electricity from sun belt and the desert can open this market niche for the European and Arabian countries to widen their energy portfolio fit for generations to come.

Hydrogen can reduce the burden of traffic emission in crowded regions. It is where tighter regulations will force the move to a partial replacement of traditional fuel with hydrogen.



Air traffic

The market of jet fuel will remain unaltered strong as there is no alternative for kerosene.

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The standard hydrogen engines

Two hydrogen internal combustion engines with twin intake of hydrogen/gasoline should be promoted as standard equipment of European cars:

46kW (63 PS) with 1 litre (1.060 ccm) displacement.

55,2 kW (75 PS) with 1,2 Litre (1.248 ccm) displacement.

Cars equipped with hydrogen engines between 46 kW and 55,2 kW should be free of all taxes. Production made in cooperation between all European car manufacturers will reduce price. There will be no distortion of the market with additional subventions of the European Commission when all car manufacturers can buy the standard engines at the same price.

All car models may retain individual bodywork maintaining a diversified market with two standard engines. All models may also be presented with engines of the conventional engines of the market, regardless to their specifications, but they will keep the present taxes and will not profit of the subventions.

Other long-term vision of sustainable energy systems using of a mix of different variety of energy forms postpone decisions which have to be made today.

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Summary

Solar energy from the deserts is the gift of nature which may supply energy for whole world. Together with wind turbines and hydro-electric power, integrated in a global grid, clean energy may be available around the globe.
Hydrogen obtained by electrolysing water is the fuel for transportation of the future.

The modular planing of the system allow small local starts to grow easily.. The production of hydrogen can be started on demand. Distribution of hydrogen may be made using recyclable portable tanks being distributed to the petrol stations. Later on hydrogen may be produced at the petrol station with their own equipment, using electricity from the grid.

China is in best position to start solar energy production using Very Large Scale Photovoltaic Power Generation Systems, as described by Kosuke Kurokawa. Detailed feasibility studies were made by the author related to the Gobi Desert.

The desert area West of the city Yinchuan and appropriate location between Yinchuan and Taiyuan is strongly recommended.

U.S.A. Is in a good position to produce solar electricity and hydrogen from its deserts of California and hydro-electric power from the Great Lakes region. Other local starts in Africa, such as the EU Desertec project, and isolated activities in the Middle East, are capable to supply US and Europe with solar electricity and hydrogen. Other important local sites are Australia, India and China, which may be united with a global grid according to Fuller.

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Who may Profit from the hydrogen economy?

Car makers: The companies which introduce the hydrogen technology will be leading the world market of cars.

Energy providers: It will be an improvement of their energy portfolio. Investments will be considerably less than drilling for oil.

Improving employment: The whole economy of countries engaged with Solar energy and hydrogen production will have a beneficial impact on job security and wealth from the revenues.

Governments: All governments may profit from a proposal of this global initiative in the decisions of the United Nations Climate Change Conference in Copenhagen in 30. November – 11. December 2009

Who must be on start?

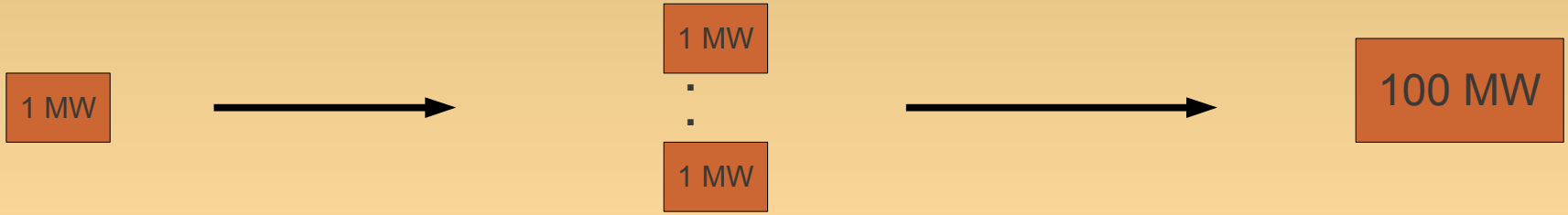
China increases its demand of energy. Solar energy from desert areas and wind turbines may cut the dependence on oil, coal and gas, and even produce an export revenue of electricity and hydrogen as fuel for cars.

Europe, due to its high energy prices, its high population density and its location near to the deserts of Africa is economically and regional structure is predestinated for an early start.

U.S.A., the biggest CO2 emitter, relies on cheap coal and low petrol prices. It will be very hard for this country to abandon its politics of war for oil, low energy prices and invest in its energy autonomy.

- Technical Study

Modular Buildup



First Unit of 1 MW

5.556 modules Type 180
130 X 130 Metres area covered

Cost whole construction EUR

Modules	1,900,000
1 Electrolyser	835,000
Planning	240,000
Inverters	400,000
Building	100,000
Construction	950,000
Total	4,4**25,000**

More Units of 1 MW added focussed on final 100 MW

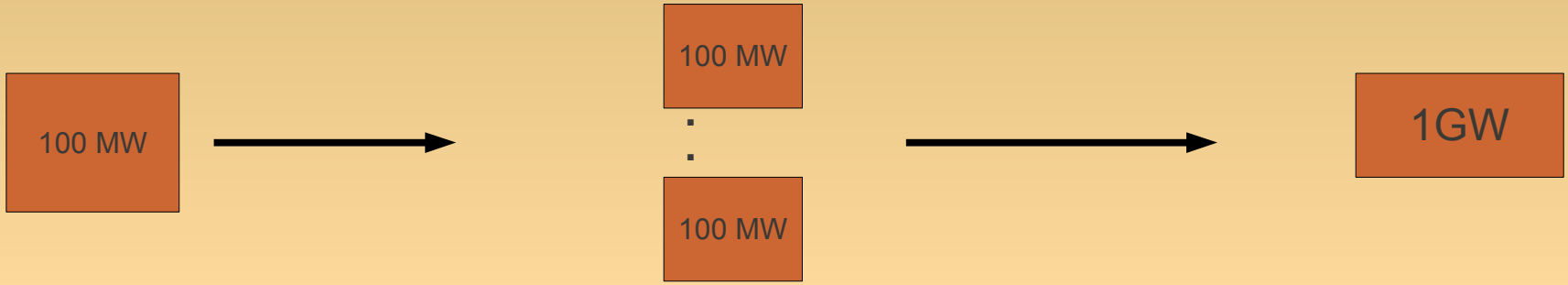
Final 100 MW

555.600 modules Type 180
1,3 X 1,3 Km area covered

Cost whole construction EUR

Modules	190,000,000
45 Electrolysers	30,060,000
Planning	480,000
Inverters	40,000,000
Building	2,500,000
Construction	80,000,000
Total	**343,040,000**

Modular Buildup



First Unit of 100 MW
Total 343,040,000 EUR

More Units of 100 MW added focussed on final 1 GW

Final 1 GW
555.600 modules Type 180
1,3 X 1,3 Km area covered

Cost whole construction EUR

Modules	1,900,000,000
450 Electrolysers	300,600,000
Transmission	550,000,000
Planning	480,000
Inverters	49,000,000
Building	25,000,000
Construction	550,000,000
Total	**3,375,080,000 EUR**

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Technical Study

100 MW Photovoltaic System

Phase 1 of the project consists of the construction of a 100 MW photovoltaic power plant.
800.000 PV modules with 125 W/h capacity will be linked in 4 units, each consisting of 200 subunits which consist of 4000 PV cells. The area needed is 2.4 km² (2.1 X 1.1 km). The Number of modules may vary according to the type being used.

Evolving to 1 GigaWatt System

Phase 2, 3 and 4: To complete 1 GigaWatt System nine 100 MW blocks will be added. Transmission cable to Europe from Phase 1 may be used for the initial HVDC line.

Integration of existent solar power plants and Wind turbines

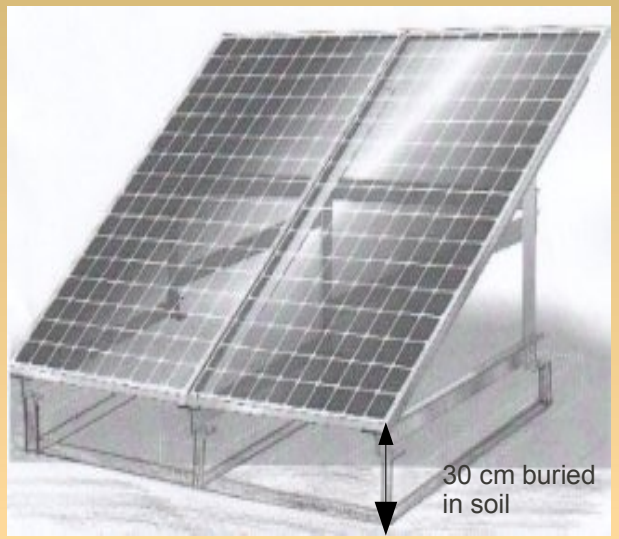
Energy from already existent solar power plants added by wind turbines like off-shore installation may be used for the initial production of hydrogen. The actual energy capacity produced by these plants are, however by far to low for the hydrogen project. Increasing the sites at the Gobi Desert are immediately needed. The Middle East must also be involved as hydrogen demand increases.

This will become a financial incentive to invest in construction, hydrogen infrastructure and car producing industry.

Mounting of PV Modules

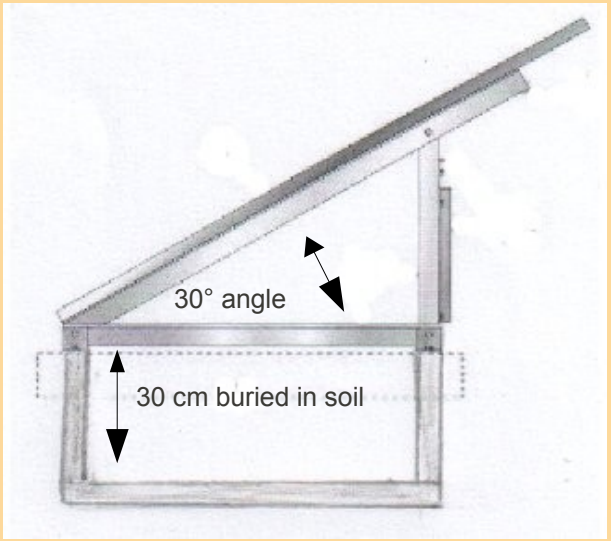
Modules must be mounted in an angle of 30°. Squared metal construction, buried 30 cm deep provide the support of the PV module mountings. This avoids extensive concrete devices as basis.

To improve efficiency structured modules are being developed improving light absorbance at large angles of incidence.



No tracking device is used to avoid failure of moving parts, additional fixation volume and high investment. Sun tracking provides an increase of efficiency of 30% but causes failure of the system and requires continuous maintenance of skilled personal. Tracking devices are thus recommended where available area is very limited.

In the deserts a maintenance and failure free device without moving parts is essential. Fixed mountings are thus strongly recommended.



Electrolyzer

One electrolyser type 485 NM³ may be installed for test production of hydrogen. A total of 450 electrolyzer complete the whole project. All units can be added as needed because of a modular concept which insures perfect customisation and orientation on market demands.

Initial tests may be performed in arid region. Water may be supplied by tank truck. Main production should, however take place in the proximity of a river.

Hydrogen: 100 MWatt/h produces 23.255 Nm³ of Hydrogen/hour equivalent to 9.658 litres gasoline/hour

Hydrogen Transport and filling stations

Hydrogen will be transported in multi-way tanks which can be delivered to gas stations in recycling modus. Bulk transport of these tanks in standard containers which may be mowed on road and on sea. Local production at petrol stations using electricity from the grid may complete the project.

Hydrogen car, how it works

Volkswagen

VW “space up!”

One charge of the lithium-ion batteries brings a range of 100 kilometres. With the hydrogen E-cell drive additional 300 kilometres are available to reach the next hydrogen refill station.
Hydrogen technology is independent of long battery recharging. Battery weighing 180 kg may be substantially reduced , using hydrogen power instead.

BMW

BMW relies on combustion engine which uses hydrogen and switches to petrol in case no hydrogen filling station is reached. The change from hydrogen to petrol happens automatically. BMW aims to reach a fuel efficiency of one kilogram of hydrogen for 100 kilometres.

Ford

Ford announced that it will equip its C-Max model which an hydrogen-combustion engine, as an intermediate step on the way to the fuel-cell. Ford technology uses three tanks with a total volume of 119 litres. Very high compression of the gas enables the car to drive 200 kilometres with one filling. In Berlin Ford hydrogen cars are using the fuel-cell technology.

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Technical Study

The Start of the System
A small demonstration hydrogen production unit may use the solar energy or use energy from wind turbines. Using peak loads for the hydrogen production may help to stabilise the grid.

To get better performance and have enough area to expand, the existing start of Desertec and the financial cooperation with Arabian countries must be focused on. Politicians are asked to get in contact with Arabian governments and investors. Arabian countries of the Arabian Peninsula have best position to add hydrogen and electricity to their energy export portfolio.

When the system evolves to 1 Giga Watt, and up, electrolysers should be located in proximity of a river.

Water consumption: 0,9 litre demin. water is needed for the production of 1 Nm^3 Hydrogen.

100 MW system: consumes approximately 21.000 litres water/hour.

1 GW plant: consumes around 2 000 Tons of water/d. Gasoline equivalent: 920 000 litres. Considering variations of weather conditions equivalence of 500 000 litres may be assumed as average days production of hydrogen.

HVDC overhead line

Export of electricity to the European Grid will be achieved using High Voltage Direct Current (HVDC) lines. There will be no DC to AC converter from at the end of the line because Europe handles electricity as DC on its grid. DC is therefore welcome.

The overhead transmission line of 2 500 km will interconnect the different blocs and transmit high direct current to the grid.

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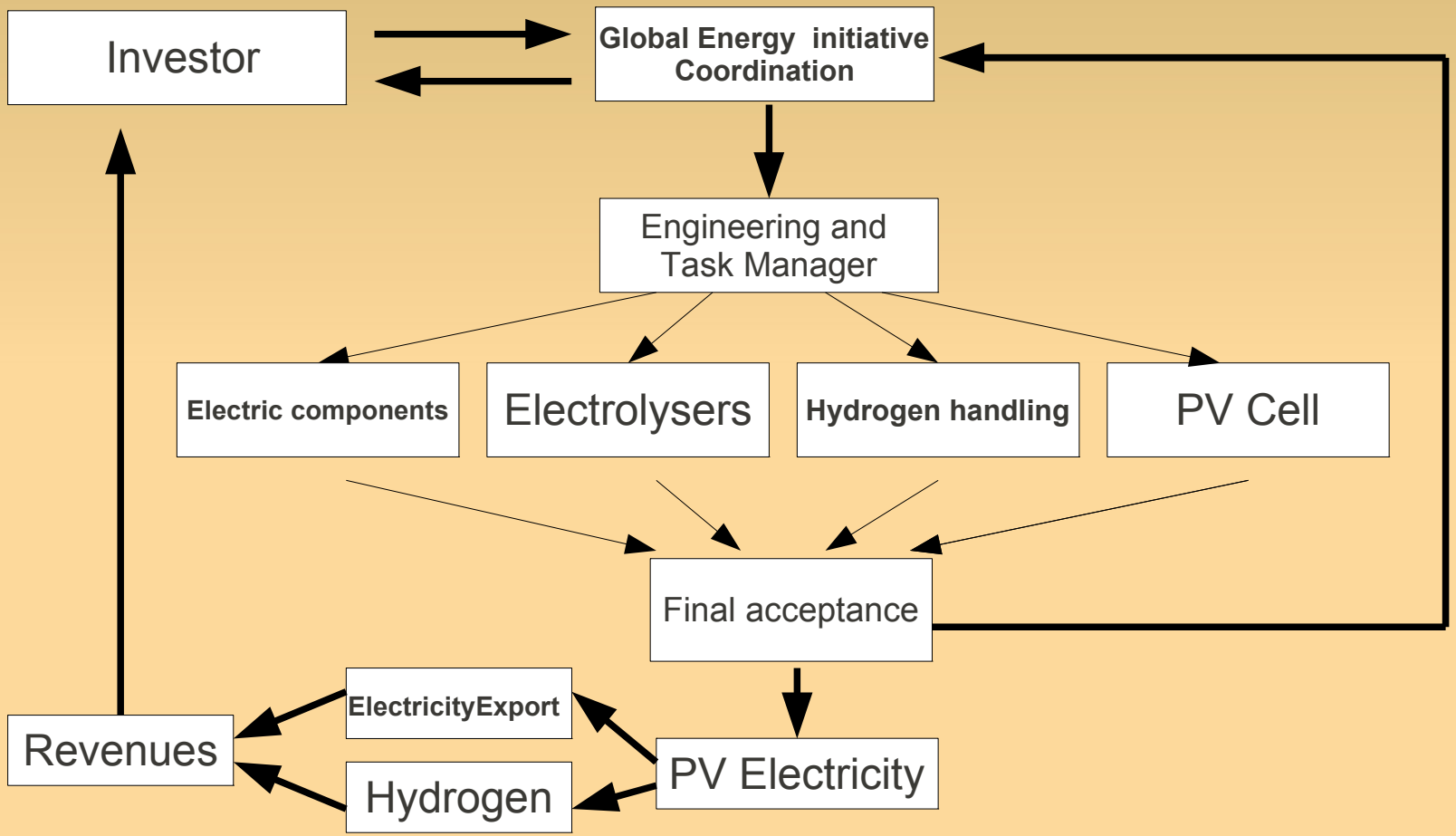
Technical Study

Task Flowchart



Conversion Factors

1Nm³H2= 4,30 KWh
1 kWh = 0,233Nm³H2
1kWh = 0.349 Gallon gasoline
1 Nm³ hydrogen = 0.34 litre gasoline
1 US Gallon = 3.785 litre
1 US Gallon Kerosene = 3.092 Kg
Density of Kerosene= 0.817
Density of gasoline vehicle = 0.737
Density H2 = 0.0899 Kg/Nm³
1 kWh = 0.092 litre gasoline
1 Litre H2 liquid = 0.27 litre gasoline
1 Kg H2 = 2.75 Kg gasoline
0,9 litre water = 1 Nm³ hydrogen
1 EUR = 1.23 US Dollar
10 hours sunshine/day 300 days/Year

Hydrogen Data: http://www.h2data.de/

All monetary conversions are subjected to changes

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- **FINANCING**

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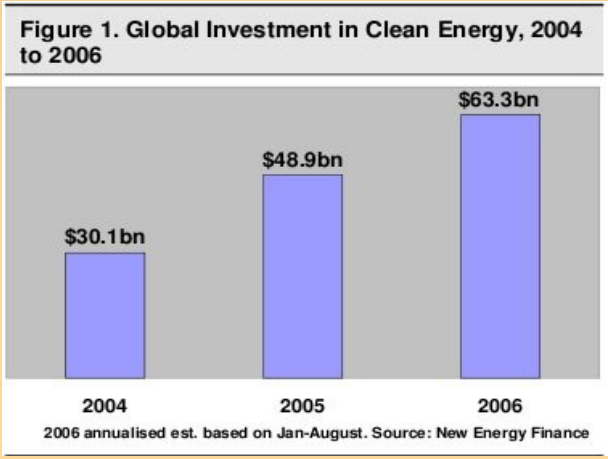
Financing

Prosperous clean energy investment means:

- **Investing in the right tool for the right business**
- **Investing at the right location**
- **Investing in a field not already dominated by established corporations**



Source: New Energy Finance: Global Clean Energy. Investment Overview. Trends and Issues in the Financing of Renewable. Energy and Low-Carbon Technology. Prepared for the Clinton Global Initiative. New York, 20-22 September 2006. http://www.clintonglobalinitiative.org/NETCOMMUNITY/Document.Doc?&id=42

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Choosing the right tool

Wind Turbines

Technically very complicated.Many troubles are known.

Three bladed, upwind, horizontal axis machines, typically larger than 1 MW capacity.

The rotational energy is transferred through a gearbox to a generator, where it is converted into electricity. There are about 19 separate components for the wind turbine.

When the wind blows over 60 mph the mechanism turns 90 degrees from prevailing winds to reduce stress on internal components and to prevent stalling due to over-speed conditions.

Cost / MW	**123,000 USD**
100 MWWind Capacity	**12,300,000 USD**

Difficult construction
Based on moving parts
No location change possible

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Choosing the right tool

Solar-Thermal Plants

According to New Energy Finance:

50 MW Solar-Thermal Plant costs 30 Million EUR [1]

8.9 GW Solar-Thermal Plants costs $ 35 Billions [1]

- Very long planing and construction time.
- Very sophisticated tracking system and heavy concrete foundations needed.
- Steam turbine as core of the system

[1] Giant Mirrors Tap Sun, Subsidies in Europe's Clean Power Bid. Blomberg. 24.09.2008.
http://www.bloomberg.com/apps/news?pid=20601109&sid=aESker8lE5B4&refer=exclusive

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Choosing the right tool

PV Cells

For dependable, maintenance-free very large photovoltaic array monochystalline silicon cells are recommended. This technology is mature and present best performance under desert conditions.

Price/Watt = 3.70 EUR (Price subjected to variations)
The price is decreasing rapidly and thin layer modules establishes new lows.

Alternatives

Other PV cell innovations

The innovations are not the best solution for desert environment. Some are
- si Microamorphous silicon thin film
CDETE Cadmium telluride
CIGS Copper indium gallium diselenide
Flexible
Thin-film solar cells are inefficient

Metallurgical grade silicon

CaliSolar developed less expensive solar cells using “dirty” metallurgical grade silicon. Upgraded Metallurgical Silicon (UMG Si) is substantially less expensive than the electronic grade silicon usually used to make solar cells. Not on market yet.

SolarConcentrators

Solar concentrators can lower the overall cost of solar power by making it possible to use much smaller cells.

SolFocus Concentrator PV Panels

Small mirrors focus sunlight to a small PV element in the focus of the mirror. Efficiency rises from 14% in silicon modules to 40,6% in Sol Focus panels. Suntracking is however necessary. This increases total costs enormously.

High temperature electrolysis of water [1]

According to Dr. Günter Schiller from the German DLR the electrolysis of water at the present is madeat 80 to 100°C. High temperature electrolysis at 800°C reduces the voltage from 2V down to 1.3 to 1.4Volts. This leads to an enormous reduction of energy needed by the system.

[1] Die Brennstoffzelle - DLR-Beteiligung beim internationalen Fachforum "f-cell" am 24. und 25. September in Stuttgart 21. September 2007
http://www.dlr.de/desktopdefault.aspx/tabid-837/1344_read-10523/

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Financing

- Four financing modalities

Four system dimensions are suggested.
Each one is calculate isolated, not modular.
One Giga Watt/h system modular build is shown under IV.

System	Capacity	Planing expertises	PV Modules 1.90 EUR/W cost	Construction and supplements	Building	Inverters	Electrolysers Units	Electrolysers	DC Cable HVDC EU grid	Cost Sum EUR
I	1 MW	240,000	1,900,000	950,000	100,000	400,000	1	835,000		4,425,000
II	10 MW	240,000	19,000,000	9,500,000	250,000	4,000,000	4	3,340,000		36,330,000
III	100 MW	480,000	190,000,000	80,000,000	2,500,000	40,000,000	45	30,060,000		343,040,000
IV	1 GW	480,000	1,900,000,000	550,000,000	25,000,000	49,000,000	450	300,600,000	550,000,000	3,375,080,000
V	next 1GW	480,000	1,900,000,000	950,000,000	40,000,000		900	751,500,000		3,641,980,000

Yield forecast

System	Capacity	Investment EUR	50% H2 Gasoline Eqiv. Litres/10 hrs day 300 days/year	50% local Electricity use 10 hrs/day 300 days/year	Years to pay Investment Gasl 1,06EUR/l KW 0,10 EUR	Total revenues In 25 years	Carry an interest /year %
I	1 MW	4,425,000	138,000	1,500,000	14,9	2,982,000	3,37
II	10 MW	36,330,000	1,380,000	15,000,000	12,3	37,740,000	5,19
III	100MW	343,040,000	13,800,000	150,000,000	11,6	397,660,000	5,80
IV	1 GW	3,375,080,000	138,000,000	1,500,000,000	11,4	4,031,920,000	5,97
V	1 GW	3,641,980,000	100% H2 276,000,000		12,4	3,672,020,000	5,04

Suggested system I to III:
From 1 to 100MW 50% for H2 and 50% for local use.
No HVDC cable

System IV 1 GW 50% for H2 and export + HVDC cable to EU Grid
System V 1 GW 50% for H2 and export + HVDC cable to EU Grid

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Financing

- Emerging market for hydrogen

Norway and Germany are strongly engaged to build an infrastructure for Hydrogen cars.

German National Development Plan for the “Hydrogen and Fuel Cell Technology Innovation Programme”
http://www.now-gmbh.de/uploads/media/Developmentplan_02.pdf

Renewable Energy made in Germany
http://www.german-renewable-energy.com/Renewables/Navigation/Englisch/solar-power,did=109916.html

Federal Ministry of Economics and Technology, Germany

Contact: RD Böhler
Tel +49 30 1815 73 66
Fax: +49 30 18615
Email wolfdieter.boehler@bmwi.bund.de

European Union and German Industry: Project Zero Regio
Established the hydrogen infrastructure, the Hydrogen Ionic Compressor 900 bar and filling stations by Hoechst, Germany

http://www.zeroregio.com/front_content.php?idcat=185

The Global Hydrogen Initiative
Financing

The Kuwait Energy initiative producing solar electricity and hydrogen

The Start of the System
A good location for a first 100 MW PV array is between Jahrah and Al Salmy.

Water consumption: 0,9 litre demin. water is needed for the production of 1 Nm³ Hydrogen.

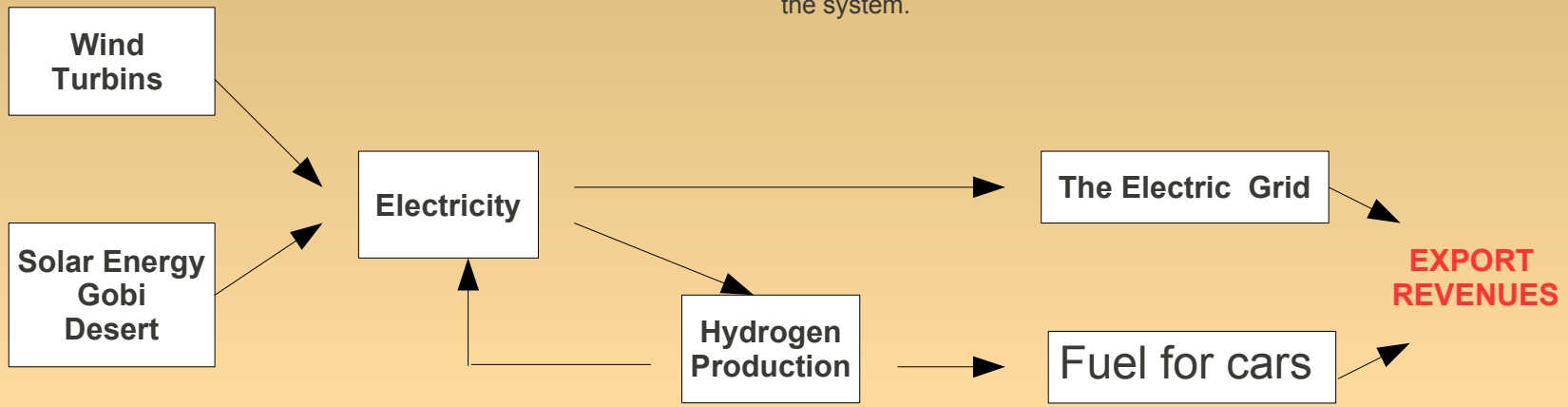
100 MW system: consumes approximately 21.000 litres water/hour.

1 GW plant: consumes appr. 2 000 Tons of water/d.
Gasoline equivalent: 920 000 litres.
Considering variations of weather conditions equivalence of 500 000 litres may be assumed as average days production of hydrogen.

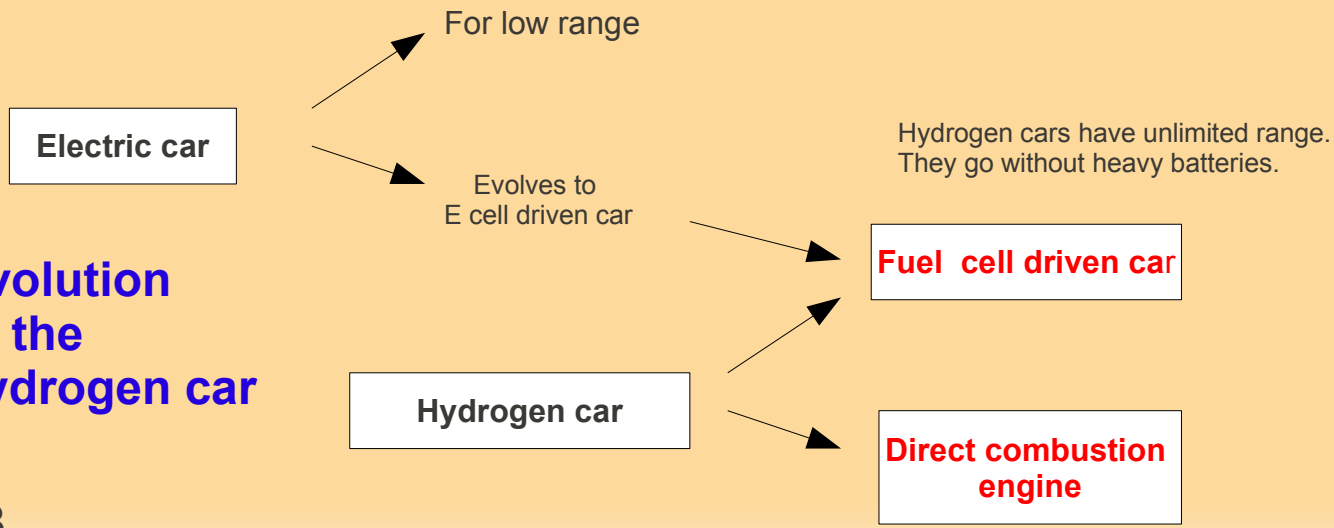
The Global Hydrogen Initiative
Financing

The hydrogen economy

Electricity and hydrogen export to the growing Asian market create the basis for the development of the system.



Evolution of the hydrogen car



The Global Hydrogen Initiative
Financing

Suggested Inverstment Start
1 MW Plant with an Investment of 5.5 Million EUR

The start
- We suggest to start with the System of 1 MW which includes one electrolyser.
The system can be quickly expanded on a modular basis to 100 MW (Investment of 461 Million EUR).

Investment security
-The Photovoltaic start presents the highest level of investment security, because all parts may be easily resold should the holding be dissolved. This is a valuable argument for a no-risk start with PV arrays.

Location
- The Mediterranean, African and Middle East locations provide solar energy for the European and African demand of hydrogen and electricity.
- US initial location in California and the Great Lake region is strongly recommended.
- The Thar Desert in India and the Gobi desert in China may provide Asia with green eneregy.
- Australia may become an exporter of hydrogen.
- The Middle East will be leading in investments in the hydrogen ecoinomy.

Potential customers of hydrogen: Shell, Aral Germany, Agip (Italy), Höchst, (Germany) Statoil (Norway).
Potential customers of solar electricity: Vattenfal, EWE, RWE and other suppliers of clean electricity.
Interested Governments: German Government and the European Commission are strongly promoting clean energy and clean transportation fuel.

The Global Hydrogen Initiative
how to put it into action

- **Looking forward**

As the system increases, the investment costs will substantially reduce due to better conditions in material buying.

After consolidation of the initial phase, solar thermal power plants may be integrated in the system. The initial start should, however be made with PV arrays because it is trouble-free, generates immediate outcomes and requires no maintenance.

The Global Hydrogen Initiative

how to put it into action

First Phase

Daytime operation

During Sunshine hours there will be energy available to feed the European grid and to produce hydrogen in different European locations to provide fuel for cars.
Conventional power plants must be equipped with hydrogen production and storage facilities. The power plants produce hydrogen and no electricity during the day.

Night operation

At night solar thermal power plants use the stored heat and the conventional power plants use the hydrogen from the day as fuel to feed the grid.

Special operation

In emergencies the power plants can use natural gas. A 10% storage of hydrogen will be available for adverse weather condition or sand storms for long periods which cannot be bridged by thermal storage.

Hydrogen the solution to store energy for stable energy supplies

Storing solar energy during daytime as hydrogen at the power stations, right there where it is needed at night.

Wind Energy storage

Storing wind energy as hydrogen is the best way to cope to much energy from strong wind or to compensate for dead calm. Utsira a model for renewable energy and hydrogen economy.
Surplus power from the windmills goes to production of hydrogen, which is stored and used as fuel for a generator.
The full story:

http://www.guardian.co.uk/science/2005/jun/16/environment.society1
https://www.hfpeurope.org/uploads/699/808/UTSIRA.pdf

The Global Energy Solution Roadmap

Contracting Phase

The initial Partners	Duration	Completion
Invitation and Contract Phase	**6 Month**	**July 2011**
Invitation and Contract Phase Oil and Gas Companies Power Plant Carriers PV Module and Equipment Producers Investment Business		

The Global Energy Solution Roadmap

Phase1

Phase 1	Duration 6 Month	Completion December 2011
100 Mwatt/h photovoltaic plant and Concentrating Solar Thermal Power Plants		

The Global Energy Solution Roadmap

Phase 2

Phase 2	Duration 10 years	Completion December 2021
Global Electricity and Hydrogen Demand Provided by Photovoltaic and Concentrating Solar Thermal Power Plants Wind Energy		

The Global Energy Solution Roadmap

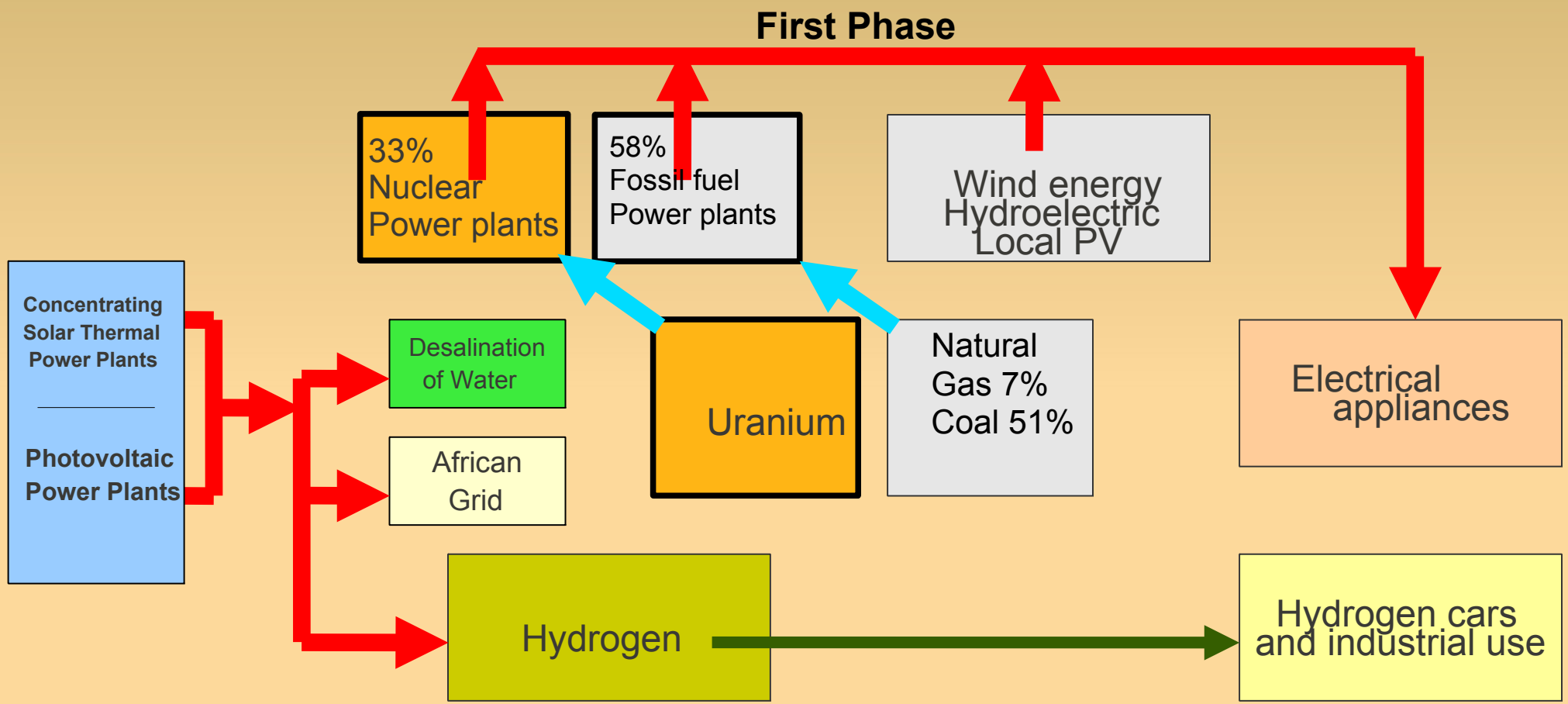
Phase 3

Global interconnection of the grid

Phase 3	Duration unlimited	Begin 2021
Interconnection of the different sites using HVDC cable Production of world demand of ground based energy consuming devices.		

The Global Hydrogen Initiative

how to put it into action

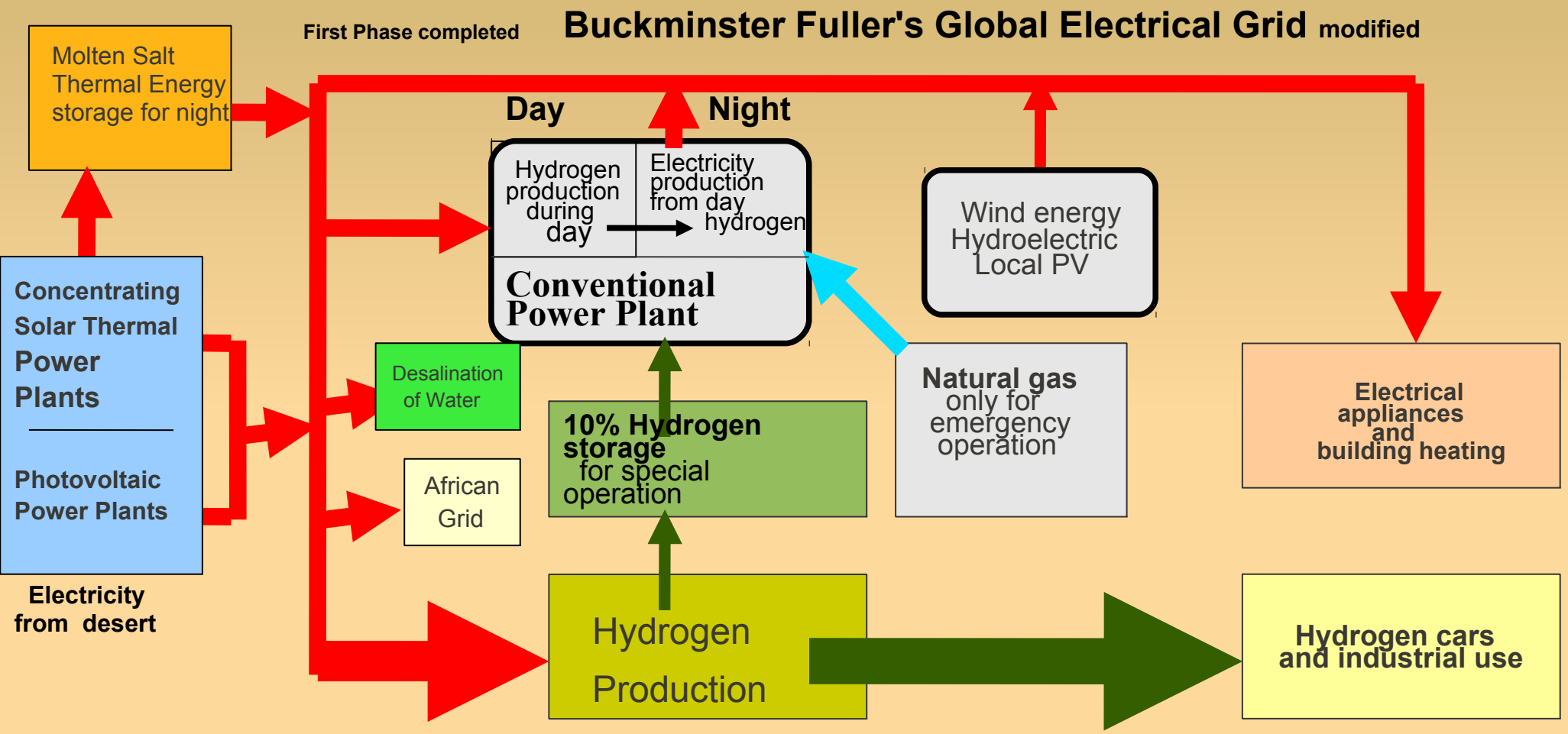


The Initiative may begin in the Australian deserts with the installation of photovoltaic arrays and the production of hydrogen as fuel for cars and a superconducting grid to Europe.

Source: *Science* 1 Nov. 2002. Vol 298. no 5595.pp.981-987
Doi: 10.1126/science.1072357

The Global Hydrogen Initiative

how to put it into action



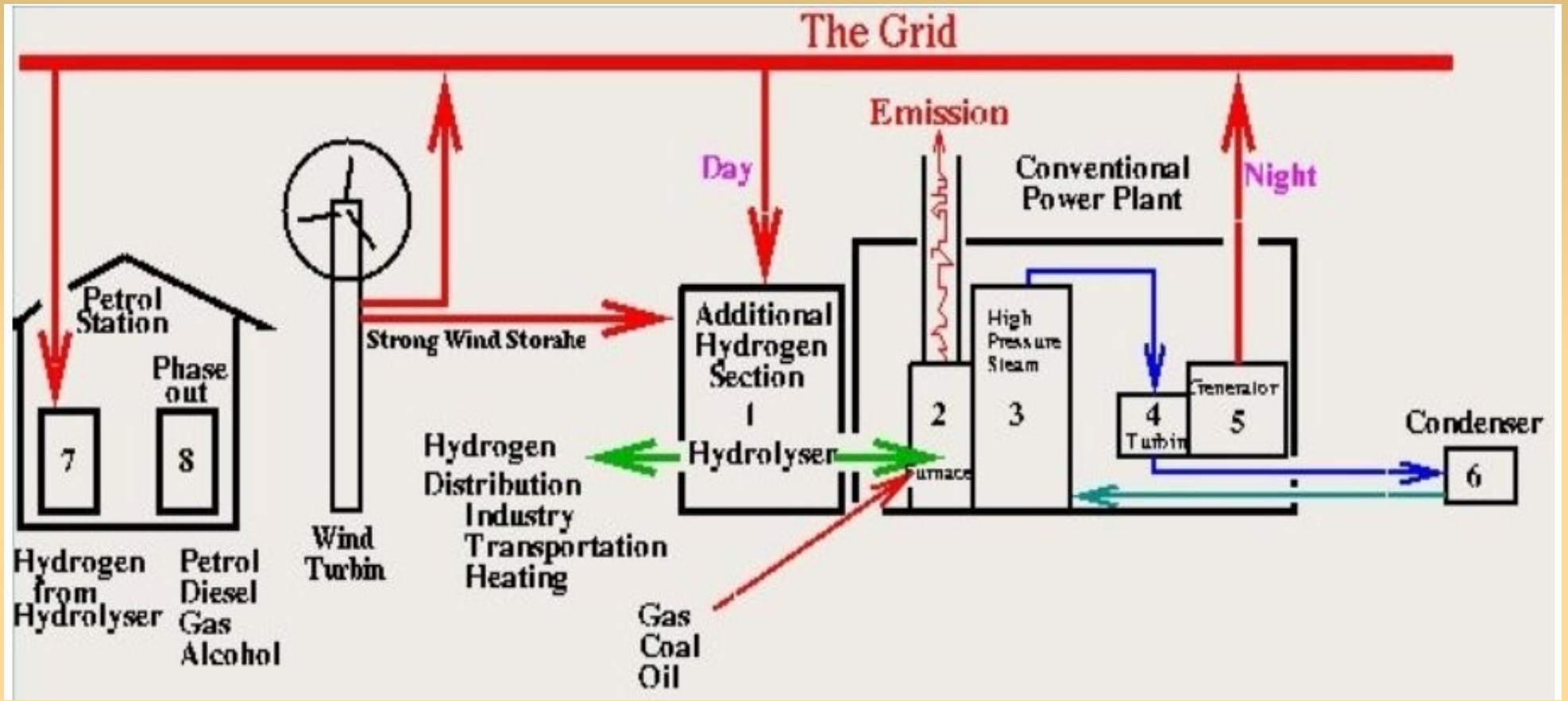
First Phase completed: Electricity from solar energy feeds the European electric grid. During Daytime the power plants store energy by thermal storage and hydrolyses of water. The daytime storage of heat and/or hydrogen can be used to feed the grid during the night.

Source: *Science* 1 Nov. 2002. Vol 298. no 5595.pp.981-987
Doi: 10.1126/science.1072357

The Global Hydrogen Initiative

how to put it into action

Storage of wind energy as hydrogen, and use as fuel for transportation



1. Hydrogen Hydrolysis
2. Furnace of Power Plant
3. High Pressure Steam
4. Turbin
5. Generator
6. Condenser
7. Hydrogen Electrolyser at Local Petrol Station
8. Phase-out of Carbon Based Fuel

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how to put it into action

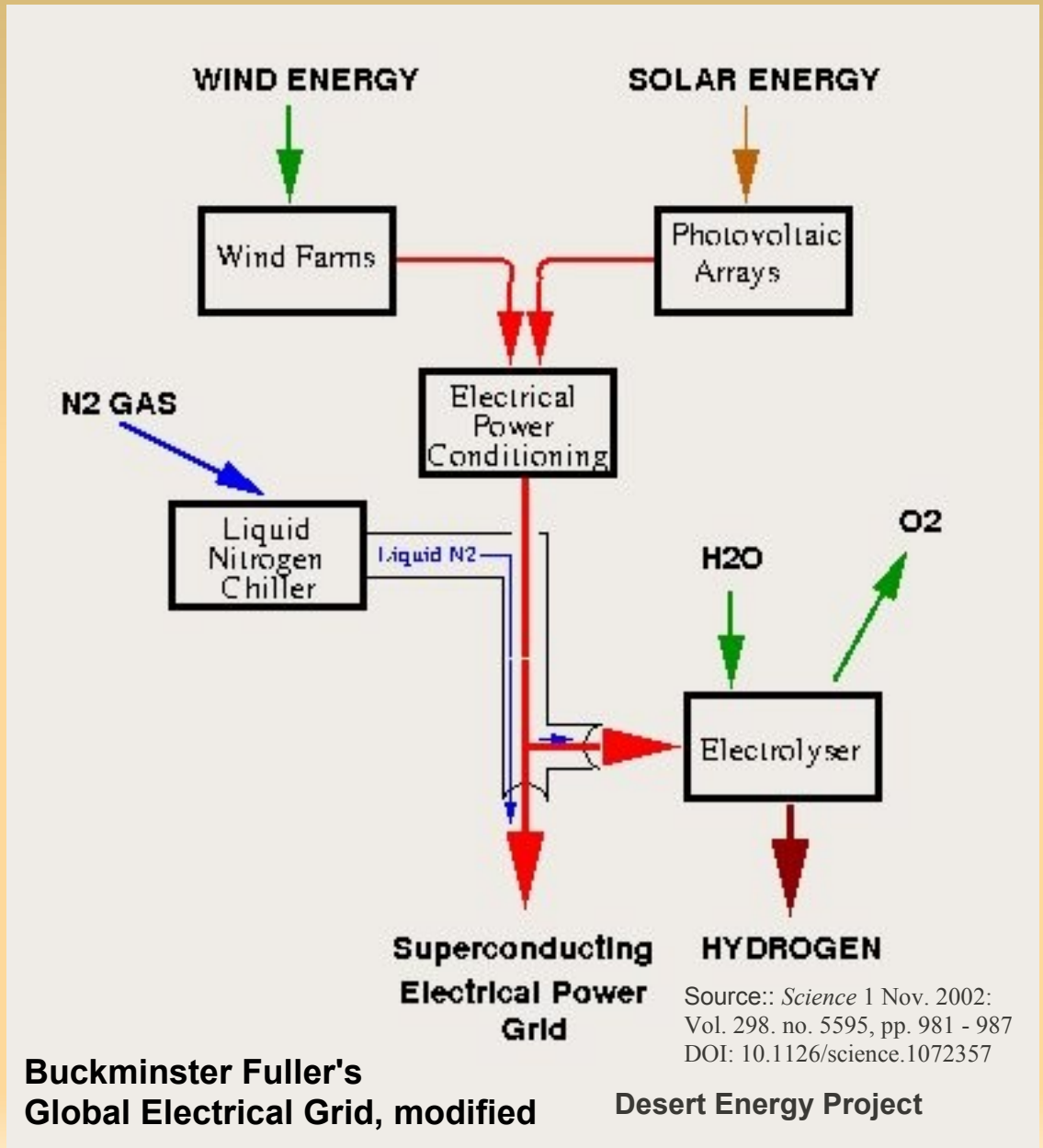
Electricity From The Grid And Hydrogen For Transportation

The Grid:

Wind and Solar Energy is conditioned and fed into the global superconducting electrical Grid for electrical appliances.

Hydrogen:

Part of the electricity is used for the production of hydrogen for Transportation, heating and other applications where the grid does not applies.



Source:: *Science* 1 Nov. 2002: Vol. 298. no. 5595, pp. 981 - 987 DOI: 10.1126/science.1072357

Buckminster Fuller's Global Electrical Grid, modified

Desert Energy Project

The Global Hydrogen Initiative

how to put it into action

First Phase of Project:
Distribution of hydrogen with portable gas tanks.

Second Phase of Project:
Portable gas tanks and pipeline to feed some regions which are away from the grid.

Third Phase of Project:
Portable gas tanks and pipeline coverage to a full supply of distant places.

Suggested Initial Distribution of Hydrogen

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how to put it into action

Hydrogen as clean fuel

Currently, hydrogen vehicles utilize hydrogen produced from hydrocarbons by steam reforming. The production of the hydrogen creates additional emissions due to input energy based on fossil fuel.

Solar energy from photovoltaic farms from the desert turns the production of hydrogen so inexpensive that the introduction will be feasible and emission can be reduced near zero.

Fuel	g CO2 /km Emission
Petrol	160
Diesel	139
Natural Gas	125
H2 from Gas reforming	250
H2 from Wind/solar energy	25

Hydrogen engines

The common internal combustion engine, usually fuelled with gasoline (petrol) or diesel liquids, can be converted to run on gaseous hydrogen. However, the more energy efficient use of hydrogen involves the use of fuel cells and electric motors. Researches on hydrogen storage built on metal hydrides and compression.

Hydrogen marketing

European efforts for climate protection

Hydrogen as fuel for transportation is a new market niche in the European market. The inexpensive solar electricity from the desert can open this market niche for the Arabian countries to widen their energy portfolio fit for generations to come.

Hydrogen can reduce the burden of traffic emission in crowded regions. It is where tighter regulations will force the move to a partial replacement of traditional fuel with hydrogen.

Air traffic

The market of jet fuel will remain unaltered strong as there is no alternative for kerosene.

The Global Hydrogen Initiative

how to put it into action

The Buckmister Fuller's Global Electrical Grid modified

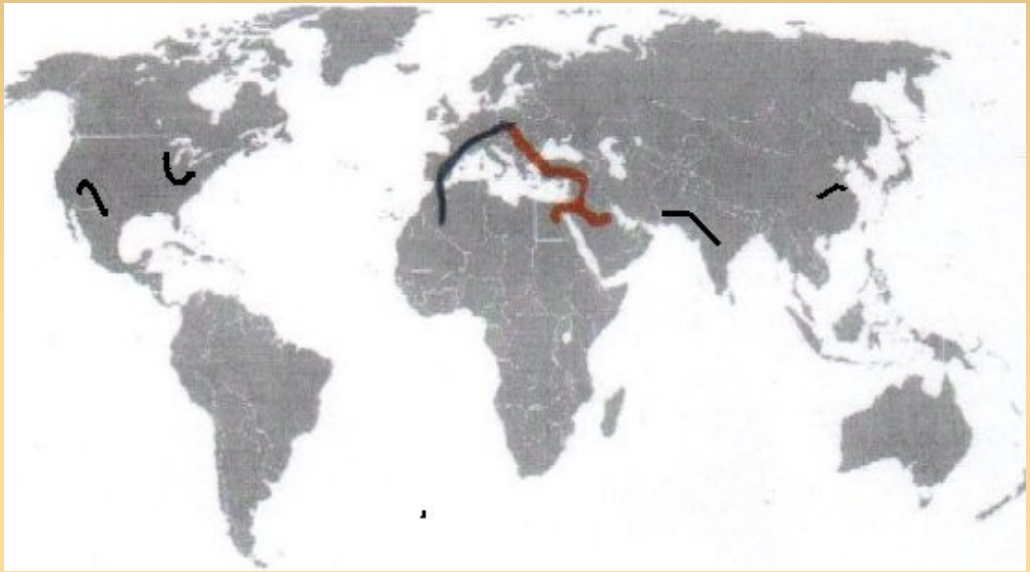
Phase 1

The Gobi desert area West of the city Yinchuan and appropriate location between Yinchuan and Taiyuan may provide energy for East Asia.

The Thar Desert supplying India.

California and the region of Detroit and Chicago as US Start.

Western Sahara and/or Arabian Peninsula may supply Europe.



First Phase: The Project may begin in USA, India, Africa, Arabian Peninsula, China and Australia with the installation of photovoltaic arrays and a n electrical grid from Algeria to Europe, with immediate production of hydrogen.

Source: Science. 1. Nov. 2002. Vol.298. No. 5595
pp.981-987. Doi: 10.1126/science.1072357

The Global Hydrogen Initiative

how to put it into action

The Buckmister Fuller's Global Electrical Grid modified

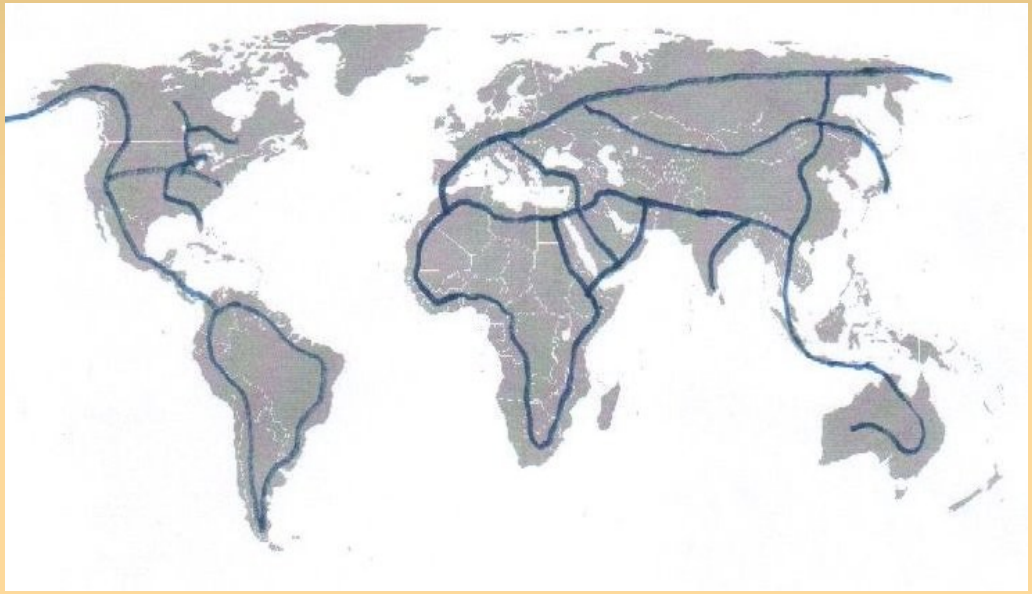
Phase 3

The African Desert for Europe, Africa and Middle East

The Thar Desert for India.

The Gobi Desert for China, Japan and Siberia.

The US Deserts,Mexican deserts for The American Continent.



Third Phase: Completion of the global electrical grid and installation of solar power plants in different deserts. Production of hydrogen all around the world. Supervision under UN.

Source: Science. 1. Nov. 2002. Vol.298. No. 5595
pp.981-987. Doi: 10.1126/science.1072357

The Global Hydrogen Initiative

how to put it into action

Responsibilities All small activities such as biofuel are eyewash

Governments

The governments have the responsibility to correct the poor economy leading to environmental disaster by:
Sustaining and helping the installation of a hydrogen economy to solve the problem of who comes first: "The egg or the hen".
The creation of an initial (small) PV/parabolic trough power plant, together with hydrogen production with extreme low price is the egg from which the hen can arise. The start is therefore the responsibility of the Governments.

1- Zero CO2 Emission for 2013: There must be a stiff prohibition of CO2 emission at any levels for new cars following 2013.

2- Hydrogen price: Hydrogen must be subsidized for 30 cents at the gas station in Europe to competing with 1,40 Euro/litre petrol.

3- Zero taxes: Complete exemption of any sales taxes on hydrogen cars, hydrogen fuel and electricity from solar energy used for heating home and industry.

4 – **Biofuel:** Stop of subsidies of biofuel (Bio diesel, Bio alcohol). Biofuel is an environmental disaster which supports the CO2 based car production. Even the Green Party of Germany relies on this dreadful error.

5 – **Nuclear power plants:** Stop nuclear power station madness in France, such as widening their nuclear plants, selling new nuclear plants to Libya and China and increasing nuclear waste all over the world.

The Global Hydrogen Initiative

how to put it into action

Suggestion of a Strategy for the
United Nations Framework Convention on Climate Change
- 4 to 9 October 2010 in Tianjin, China
- 29 November-10 December 2010Cancun - COP 16 & CMP 6

1 – The economy of solar energy

The foregoing 5 items should become a part of the strategy by parties committed to sustainable energy in Copenhagen 2010.

2 - Follow-up agreement to the Kyoto Protocol

The solar energy, such as presented here, should be proposed as binding commitment as a Follow-up agreement to the Kyoto Protocol.

More details: **www.desertenergyproject.net**

END