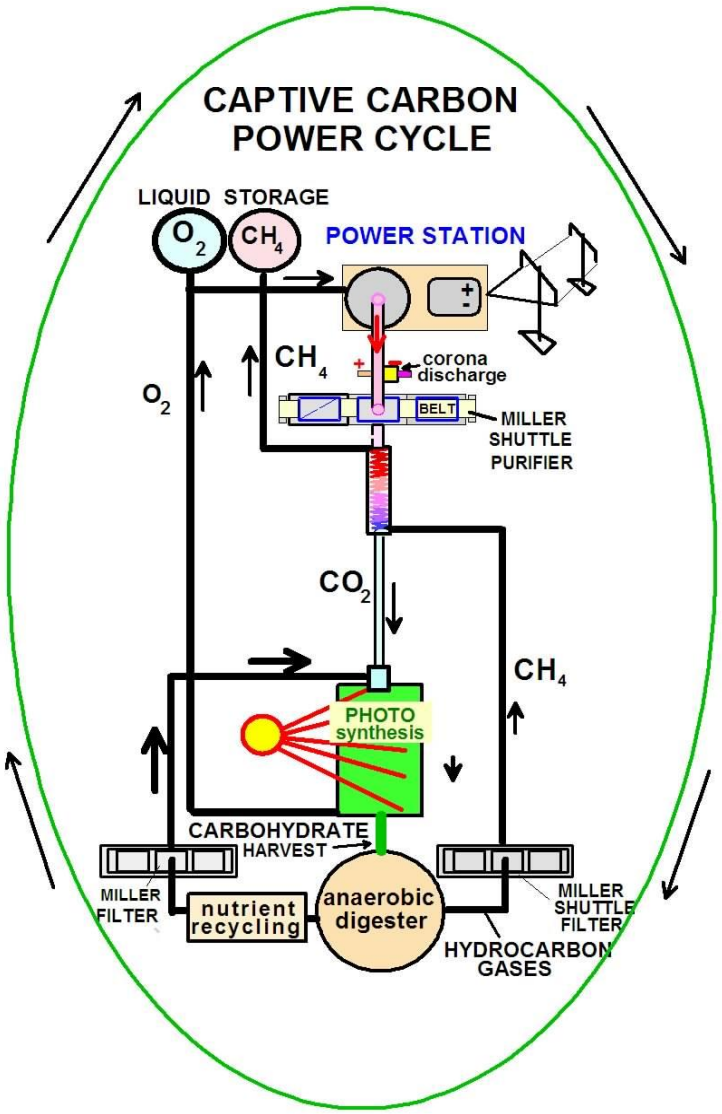
MILLER-CARBON
CYCLO-TEC-WORLD
RECYCLING

TECHNICAL SUMMARY

CARBON and WATER on our PLANET must be preserved!
To survive, mankind will continue to depend on the availability of the element carbon and access to clean water.
Today's international conflicts and environmental crises can be largely traced to the struggle for control over the world's raw resources and especially those of fossilised carbon and fresh water reserves.

1. CAPTIVE CARBON POWER CYCLE



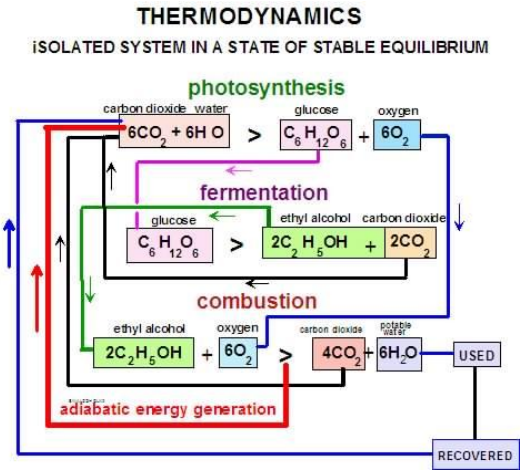
To end these struggles patented solutions are in the offing to isolate and continually *recycle* *set global quantities of carbon* and water whereby the world will be provided with power, carbonaceous products and potable water entirely devoid of emissions or depletion of global reserves .
This goal is not utopian. A development program engaging a multi-disciplinary team of scientists, engineers and technicians could achieve this goal within 3-5 years.
The figure entitled "CAPTIVE CABON POWER CYCLE" illustrates schematically how carbon in the form of methane as a product of photosynthesis and anaerobic digestion is recycled to fuel power stations whereby the ***carbon dioxide*** from both combustion in the power station and emissions from the digester are ***recycled*** to the photosynthesising unit to further maintain the cyclic process.
The challenges pertaining to the realisation of such cyclic power generation are:

- Developing photosynthesising bioreactors or contactors with the required capacity and degree of sterility of the operations.
- The availability of fluid purification systems to maintain a high degree of sterility of the circulating fluids of the system.

Cyclic carbon photosynthesising power generating system

The term ***"autonomic"*** in this article can be defined as ***"approaching selfsustainability".***

The set of cyclic reactions with flow lines illustrates a typical ***isolated*** autonomic chemically reactive system in a state of equilibrium.

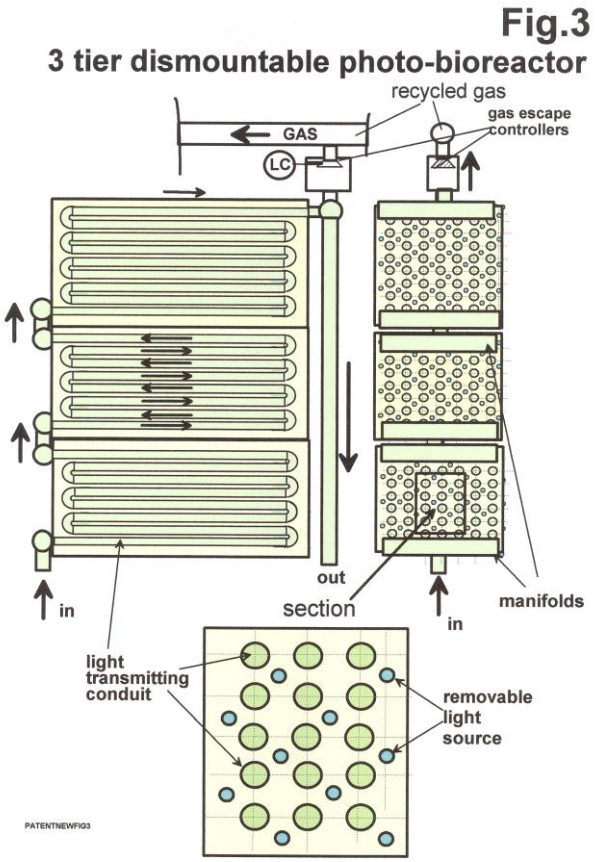


Application of 1st & 2nd laws of thermodynamics

By virtue of the 1st law the energy E of an isolated system is conserved. The energy consumed or degraded is not lost but according to the 2nd law is converted to heat at a higher level of entropy

Therefore the equation $E=mc^2$ also requires that the mass of the system is also conserved.

2. INNOVATIVE PHOTOSYNTHESE TUBULAR BIOREACTOR



Illustrated are batteries of groups of layered of stacked serpentine transparent conduits with lower inlet and upper outlet manifolds, the whole contained in transparent or internally reflective housings.

Provision is made for the insertion of removable light emitting elements preferably fibre optics with emitted wavelengths of 400-700 nm (nano-meter) between the individual fluid conducting conduits.

Water ideally seeded with micro-algae and charged with carbon dioxide is introduced under positive pressure into the lower manifold and travels in zig-sag fashion upwards exiting at the upper manifold whereby, initiated by gas escape controllers (LC), oxygen evolved during the photosynthesis is removed from the reactor.

Simultaneously the suspension of algae is delivered through the vertical outlet pipe to an external receiver.

3. UNLIMITED POTABLE WATER ON OUR PLANET!

State of the art desalination processes such as *multi-effect evaporation* and *reverse osmosis* demand high capital investment and energy consumption. Their installation and use are largely restricted to fossil fuel rich areas of the world and are accompanied either directly or indirectly by considerable energy consumption, emissions of green house gases and waste aqueous discharge from pre- and post-water treatment plants.

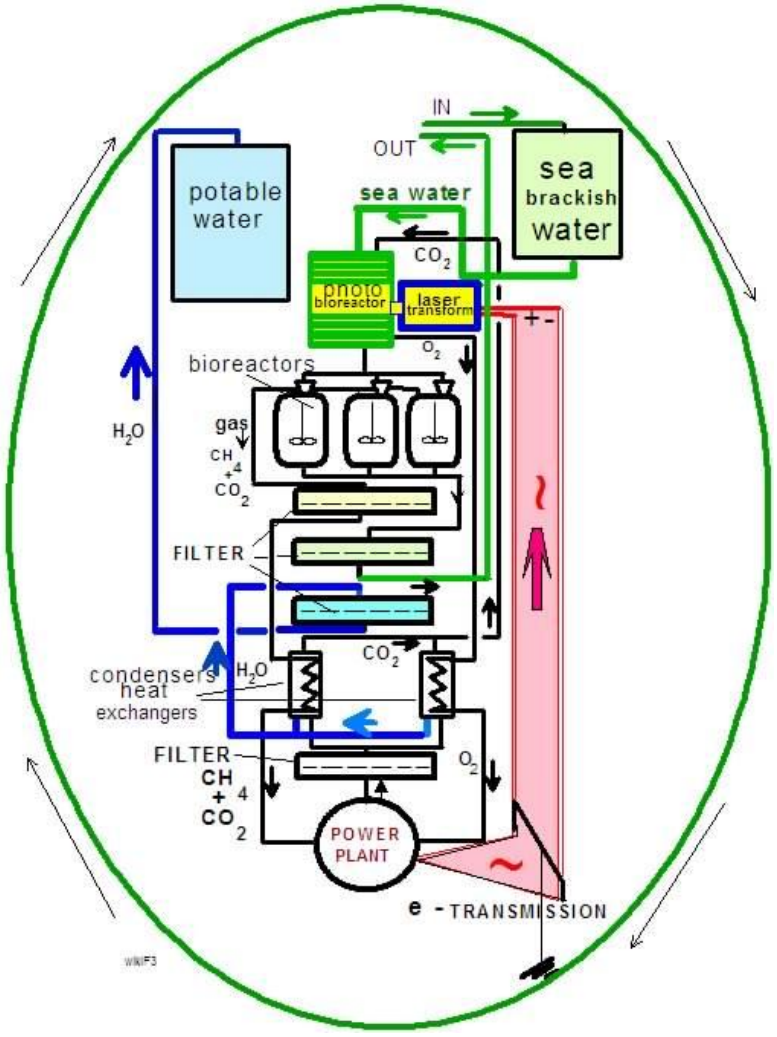
THE PRINCIPLE OF PHOTODESALINATION

The **photosynthesising "CAPTIVE CARBON POWER CYCLE**" provides the opportunity for not only recycling the carbon involved in the photosynthesising process but also recycling the generated **ENERGY** in the form of electric current converted to appropriate optimal electromagnetic wavelengths within the visible range for the photosynthesising step.

OPERATION

Sea or brackish water with carbon dioxide are passed through a photo-bioreactor whereby oxygen is emitted, purified and recycled as oxidizing agent for combustion in the power plant.
Biomass produced in the photo-bioreactor is fed to anaerobic bioreactors from which carbon gases such as methane are emitted, purified and recycled as fuel for combustion in the power plant.
The electric energy generated in the power plant is transmitted to the photosynthesising unit in which artificial lighting units are embedded to activate the photosynthesising process in the absence of solar radiation input.

The process *approaches* an autonomous state in round the clock operation.



The water vapor generated by the combustion process of the power plant is condensed in heat exchangers that preheat the emitted gases from photosynthesis, anaerobic digestion and fermentation fed as fuel to the power station.
Thus totally closed systems for the production of potable water are available for application anywhere on the surface of the globe with access to sea or brackish water for use in the vicinity or piped elsewhere.

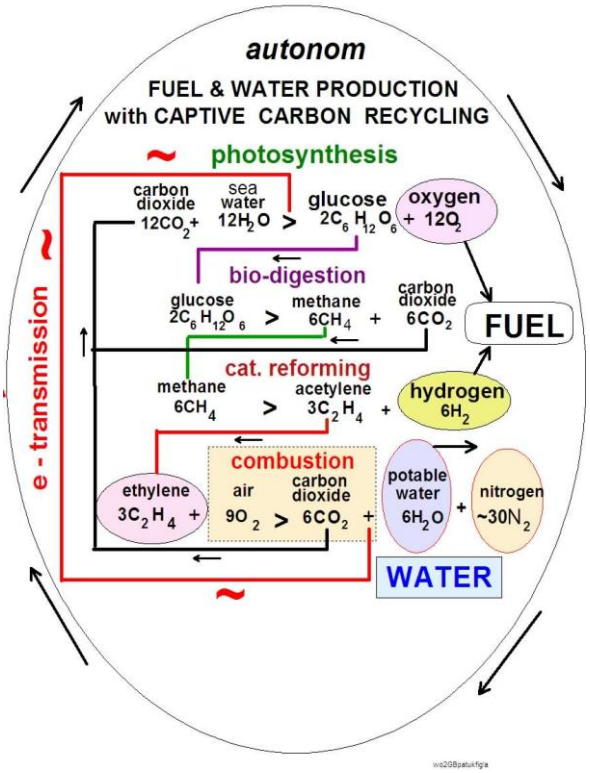
Economics of photodemineralisation

Preliminary calculations indicate that the production cost of potable water from saline water by photosynthesis undercuts the nearest competitive process of Reverse Osmosis by approximately 50% with the added advantage that there are no emissions of green house gases and there are no emissions of environmental damaging liquid effluents.

State of the art vs Innovation of the invention:

Photodesalination: Capital Amortization / Operating Cost: ca. £0.35/m^3
Reverse Osmosis: Capital Amort./ Energy / Operating Cost ca. £0.65/m^3

4. CYCLIC CAPTIVE CARBON PHOTOSYNTHESISING SYSTEM with *HYDROGEN, OXYGEN & WATER as BYPRODUCTS*



The illustrated cyclic captive carbon reaction represents a chain of four separate reactions, whereby, in the course of the reaction ***by-products*** consisting of ***oxygen, hydrogen, nitrogen and potable water*** are produced.
This captive carbon reaction cycle is closed by recycling the carbon dioxide produced in the photosynthesis and bio-digestion steps and the generated electric current in the combustion step for the purpose of irradiation in the photosynthesising stage.

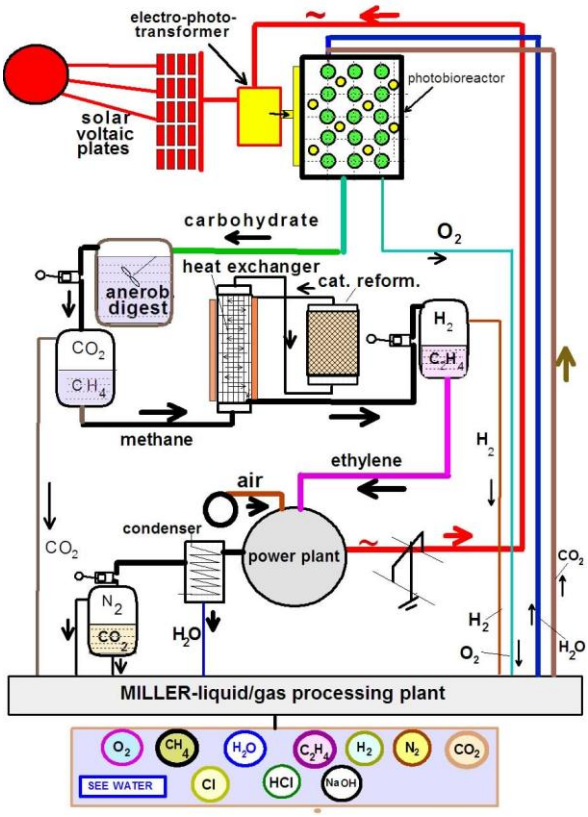
Effectively 12 moles of carbon dioxide produce as by-products 12 moles of oxygen, 6 moles of hydrogen, 6 moles of water and approx. 30 moles of nitrogen.

Of special interest is *the potential application of* *fuel cells* for the electrification of transport by the combustion of hydrogen and oxygen or air with water as the condensed product of combustion stored and used as a source of trade.

Fuelling land, sea and air transport with hydrogen and oxygen/air would solve much of the existing global political, economical and environmental problems arising from the present global dependency on fossil

FLOW SHEET OF SYSTEM

The flow-lineation of the process shows how the inevitable increase in entropy of the system **due to internal energy degradation is compensated for in this case by external solar voltaic panels contributing to electro-photo-transformers producing a source of narrow-banded electro-magnetic wave-beams for the photosynthesising reaction within the photobioreactor, whereby the bulk of the photon energy is provided by the output of a power plant utilising the entire photosynthesised carbon from the photobioreactor in the form of unsaturated hydrocarbon as fuel.**
The methane from the anaerobic digestion step is ***catalytically reformed*** to produce unsaturated hydrocarbons (e.g. ethylene / acetylene) and **hydrogen gas** that after purification in the liquid/gas processing plant is **stored with the oxygen produced in the photobioreactor as fuel.**



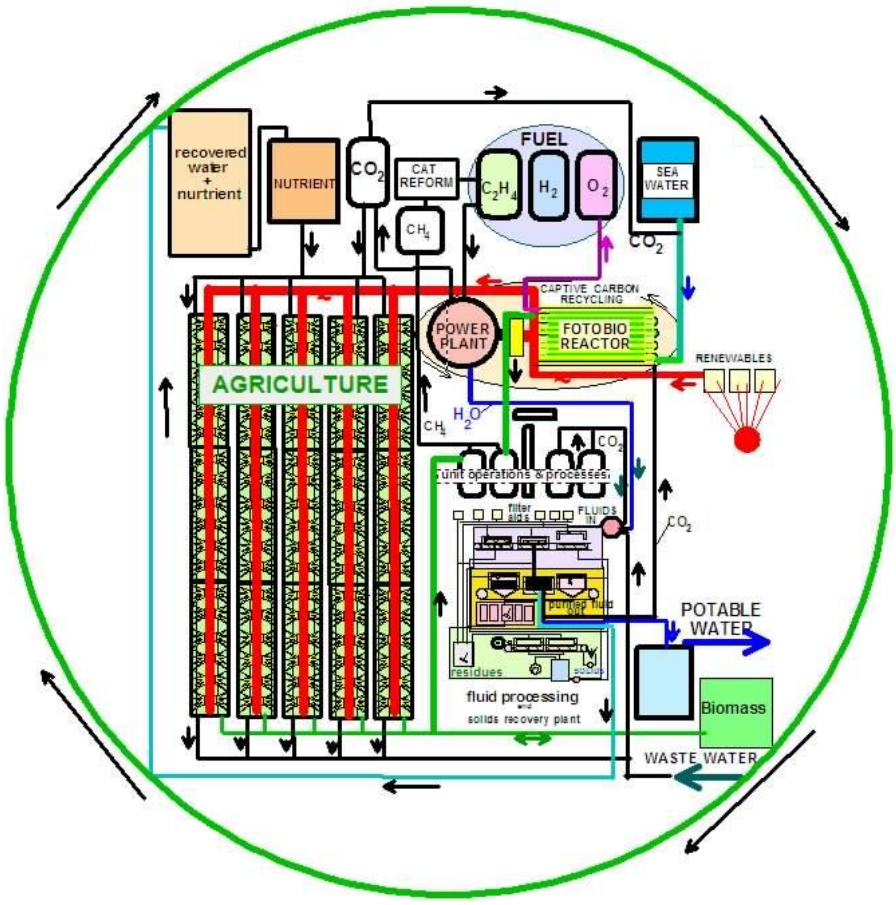
Economics of photosynthesized HYDROGEN / OXYGEN

The production of hydrogen und oxygen as by-products according to the system and process illustrated indicates that the predicted ***crisis immune*** selling price of the fuel **HYDROGEN & OXYGEN** would be **in the vicinity** of **$1 -10 / metric ton** whereby the combustion reaction is represented by **$2H_2+O_2 > 2H_2O$** and contrasts markedly with a present selling price of contemporary fossil-carbon fuel of the order of **$700,--/metric ton**
Alone the *crisis immune* cost incentive of HYDROGEN / OXYGEN fuel according to this disclosure would have an enormous positive impact on the global economy as well as the global environment.

5/6. Autonomic hydrogen/oxygen fuel and potable water from agro-photobiomass

The contemporary trend of resorting to "biofuels" in the form of vegetable oils, fats and alcohol from the edible parts of food crops apart from the high price for such products cause market short-falls in crop foods available to hunger stricken parts of the world.
The cost of harvesting and the continuing need for extra fertilisation and irrigation over extensive land areas is hindering the realisation of such proposed solutions to the fossil fuel crises.
In addition the green house gas emissions of these fuels are almost identical to those of fossil fuels whereby the claim of "carbon-neutral" benefits is spurious

The scheme illustrated below shows an autonomous enclosed photosynthesising site suitable for satisfying **energy, non-carbon fuel and potable water** requirements of whole communities, whereby present environmental issues are solved.
Such covered sealed autonomous agricultural and production facilities can produce, in addition a wide variety of agricultural food products,

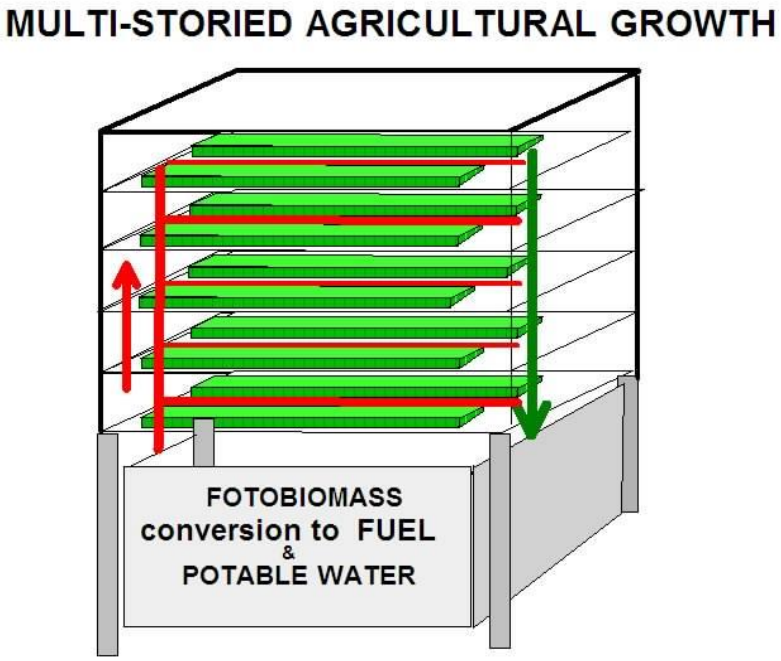


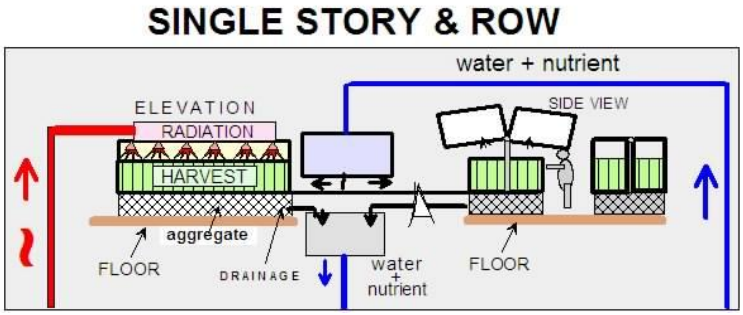
These photosynthesising sites can be ideally established for supporting clusters of existing small to medium-sized communities in existing industrialized or developing countries
For example hundreds of such sites spread over a typical industrialised landscape would achieve the decentralization of civilian and industrial demand for energy and potable water while completely eliminating greenhouse gas emissions, effluent pollution and the need for fossil fuels. Each site could be capable of comprehensively supporting an optimal surrounding population of ca.100,000.

OPERATION

Genetically modified (GM) fast growing plants produce biomass. The totality of the carbohydrate biomass is subjected to biological digestion and/or direct combustion.
The aqueous irrigation with rest-nutrients are purified in the fluid processing plant and ***recycled*** to the sealed crop containers that are irradiated with pulsed laser or gas-discharge electromagnetic beams with a chosen optimal narrow band of wave lengths generated by power stations largely fuelled in effect by the retrieved hydrocarbons generated in bioreactors**. Hydrogen, oxygen and potable water are produced as byproducts of the cyclic carbon photosynthesising process**.
Harvesting and planting are carried out on a ***permanent basis*** round the clock and years, whereby the circulating carbon dioxide is held at an optimal concentration at all times.

The further extension of the above concept is the provision of MULTI-STORIED BIOMASS or CROP GROWTH UNITS.
These units are suitable not only for BIOMASS GROWTH but also for <u>LARGE SCALE AGRICULTURAL FOOD PRODUCTION.</u>
Contemporary global agriculture is fundamentally still based on practices originating in ancient civilisations and is still subject to the drawbacks of repeated drought, floods, pest damage, water shortages and wasted fertiliser. The systems of agriculture illustrated here are far removed from the days of the pharaohs and more akin to the days of the internet and space travel.
The systems are essentially closed, cyclic, autonomous and independent of *all weather conditions, latitudes and longitudes*

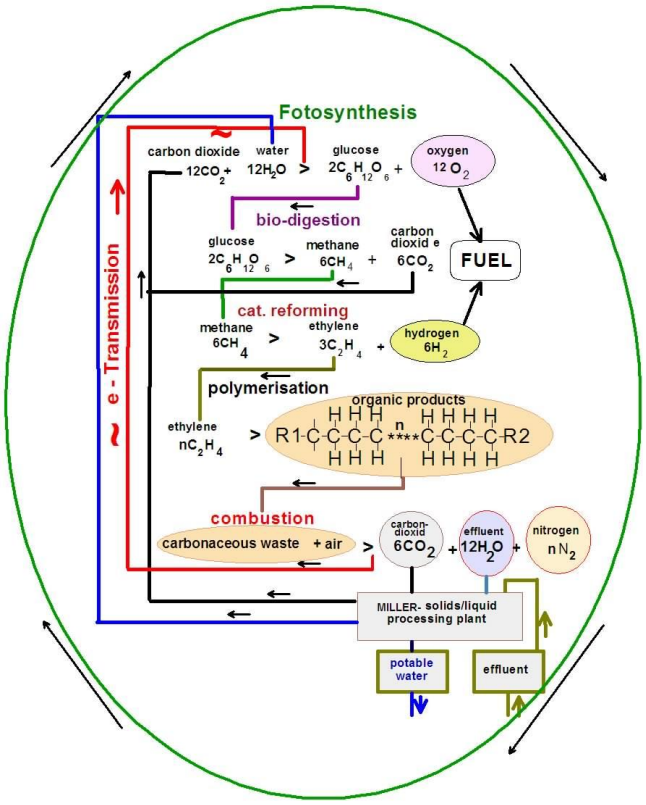




The element carbon of course is at the core of any terrestrial agriculture and also takes centre stage in the agricultural plan illustrated.
In these systems no earth is ploughed and no fertilisers are wasted. In fact the growth units are supported on strips of impervious slab-material that support *<u>internally irrigated</u>* layers of aggregate material suited for root growth.
These agricultural systems approach the autonomic agricultural ideal based on the concept according to the principle of TOTAL RECYCLING.

Autonomous farming with total capture and recycling **is an answer to the contemporary and looming burgeoning population and global food problem**.

7. CYCLIC PHOTOCHEMICALS, HYDROGEN, OXYGEN and WATER



Waste carbonaceous plastics are already threatening the global ecological system !
The **cyclic chain reaction** Illustrated on the left are the bones of **a *cyclic photochemical* site.**

These sites carry out *closed cyclic chain reactions* with the following steps:

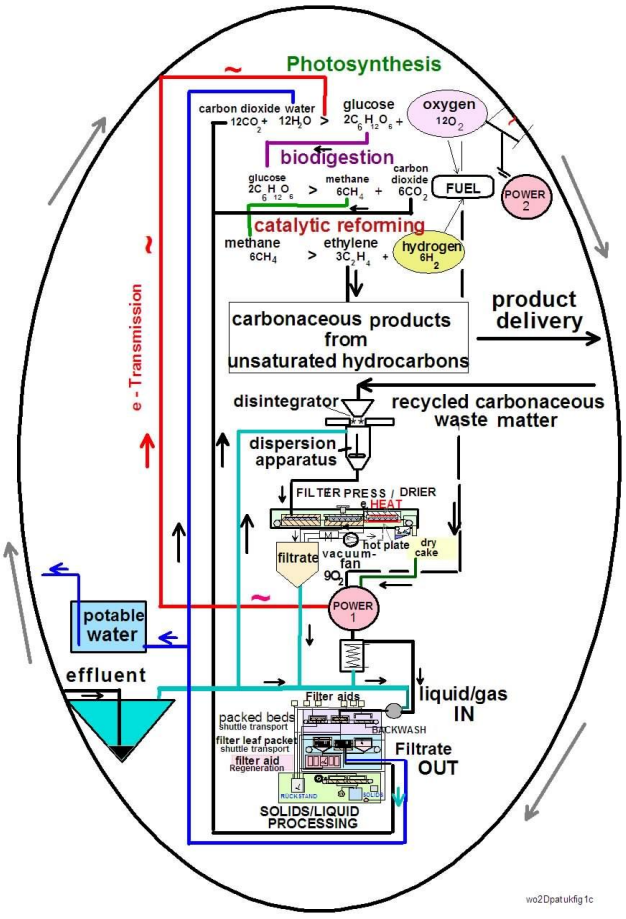
- ***photosynthesis,***
- ***bio-digestion,***
- ***catalytic reforming,***
- ***polymerisation***
- ***combustion***

whereby provision is made in the ***polymerisation step*** for the production of a comprehensive range of carbon based products that combined with comprehensive closed cyclic systems provide a solution to the burgeoning global waste disposal problem
The world is entering an era when carbonaceous plastic material will largely replace the present day use of metals.
With the contemporary trend of ever-increasing prices not only for fossilised fuel but also for practically all rapidly diminishing reserves of raw materials in the earth's crust the introduction of systems of **total recycling** is now imperative.

OPERATION

A) Polysaccharides are produced by means of **photosynthesis** in tubular photobioreactors with oxygen as byproduct
B) The polysaccharides are converted to hydrocarbons and carbon dioxide by **biodigestion** in conventional bioreactors
C) The hydrocarbons are subjected to ***catalytic reforming*** producing unsaturated hydrocarbons with hydrogen as a byproduct
D) The hydrocarbons are converted to **carbonaceous products** that are delivered to external users

The used **carbonaceous products** are recycled as **waste** and are **disintegrated, dispersed, filtered, pressed, dried and fired** in a **power plant** whereby the electric current generated is transformed to light bundles for **photosynthesis** and the accompanying water vapour from combustion is condensed and subjected to *searching purification* in the miller Liquid-Solids-Processing-System to produce **potable wate**r for external consumption and recycled for repeated purification and use as carrier in the photosynthesising operation and further external consumption.



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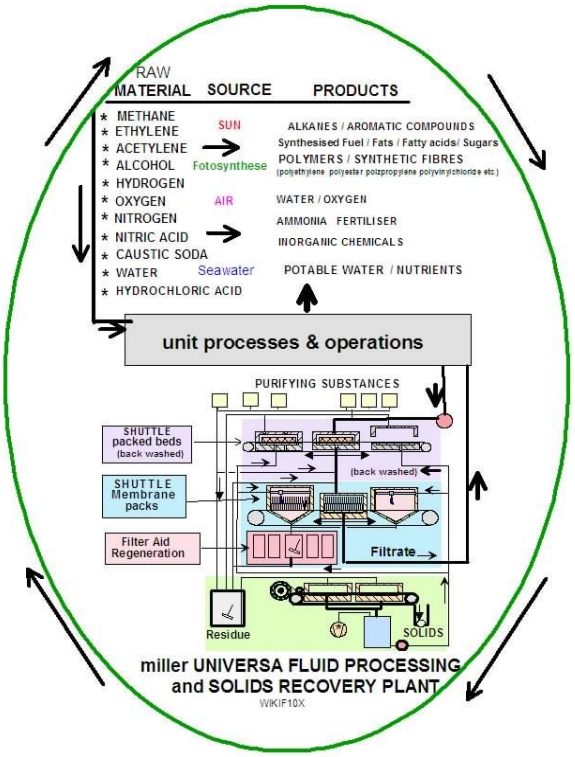
8.. RECYCING ***PHOTOCHEMICAL*** PLANT



SUN, SEA and AIR
are all that is needed!

Today's **mega** environmental polluting petrochemical Industries could be replaced by a large number of small to medium sized production units whereby the carbon in the products is no longer emitted into the environment or buried in the earth's crust but

permanently recycled.

9. GENUINE CARBON RECYCLING FOR THE WORLD'S EXISTING FOSSIL FUELLED POWER STATIONS

Carbon dioxide becomes a valuable commodity for trading on the global market! Photosynthesising sites installed adjacent to or distanced from the existing power stations in sun-bathed areas of the world will solve the transitional phase to a new era of ***recycling*** **industrial practice**.