

Decentralised Energy Self-Sufficient Supply and Disposal Systems

1. Situation – Goal – Realisation

2. Components for new sustainable concepts

- Energy supply
- [• Water supply]
- Sewage purification
- Waste treatment (especially organic)

3. Examples for new sustainable concepts

- Water reuse after anaerobic sewage treatment
- Energy self-sufficient supply and disposal concept



1. Situation – Goal – Realisation

Situation: Sources of fossil energy and water are increasingly diminishing
Partial or complete lack of resources - decentralised systems

Goal: Concepts for complete replacement of fossil energy
and
minimisation of water

Realisation: Fossil energy replaced by

- Solar energy such as photovoltaic and wind,
- implementing water for energy such as hydro power and
- biogas from anaerobic fermentation



In fact:

- ☞ Small villages, rural settlements, hotels and chalets are often located outside of the conventional energy supply and disposal systems.
- ☞ These locations are often situated in ecologically very sensitive areas.
- ☞ Necessity to use water and energy in a very rational manner

DEMAND FOR:

**Sustainable concepts for supply and waste disposal
!! reliable and self-sufficient operation !!**

The supply and disposal concepts have to be adapted
to the various different conditions of locality.



2. Components for new sustainable concepts

**For decentralised self-sufficient supply and disposal systems
the following components will be presented:**

- the separate components for energy
(and water supply),
- sewage purification and
- treatment of organic waste.



2. Components for new sustainable concepts

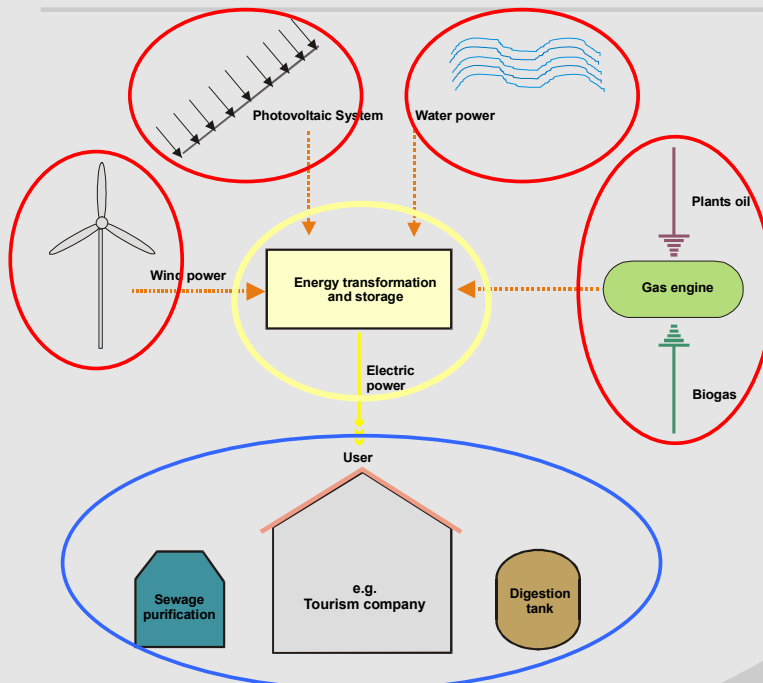
Energy supply

- ☞ Where no central energy supply is available, diesel generators are often used.
- ☞ Diesel causes detrimental effects on the environment
- ☞ The use of renewable energy sources are unavoidable in future

Implementation of following self-sufficient components:

with respect to the geographical and topographical location

- Photovoltaic systems, solar collector panels
- Wind power systems
- Water turbines
- Co-generated power-stations
(coupling of electricity and heat, fuelled by biogas or plant oil) and
- Oil, natural or propane gas storage as a security measure



2. Components for new sustainable concepts

Sewage purification

For isolated hotels, farms, small settlements, chalets etc.
small and decentralised sewage treatment plants can be realised.

Installations should be implemented to meet the demands:

- minimisation of noxious substances,
- reduction of energy consumption,
- reuse of the purified sewage and
- easy operation and maintenance.

The technology which will be inserted depends on

- the boundary conditions,
- the purification requirement and
- the purpose of reusability.



2. Components for new sustainable concepts

Aerobic sewage purification e.g. by rotating disc filters

This technique is distinguished by

- ✓ low energy consumption,
- ✓ inexpensive,
- ✓ space saving,
- ✓ easy control and maintenance and
- ✓ it can be used at any localities.

Carbon and Ammonia are minimised by aerobic treatment.

The phosphorus is still available.

The purified water can then be re-used for cleaning purposes, flushing systems etc.

As energy source photovoltaic panels or wind wheels can be used.





Rotating discs
(System S&P, Kirchberg/Germany)



2. Components for new sustainable concepts

Anaerobic sewage purification e.g. by UASB-reactors

(UASB – Upflow Anaerobic Sludge Bed)

The carbon in the sewage will be converted to biogas with ~ 65 % methane.

This technique is distinguished by

- ✓ low specific energy consumption,
- ✓ space saving,
- ✓ easy control and maintenance

Carbon is minimised by anaerobic treatment.

Ammonia and Phosphorus are still available e.g. for fertilisation.

After disinfection the purified sewage can be re-used e.g. for irrigation.

As energy source photovoltaic panels or wind wheels can be used





UASB
experimental plant
ISET e.V.
Hanau/Germany



2. Components for new sustainable concepts

Organic waste treatment

Organic waste can be used for the supply of energy and heat.

Until now biological waste has been composted in the best of cases

☞ **With this method, carbon is converted but no profit is made out of it.**

For economically use of the carbon

the following substances can be anaerobically fermented together:

- ✓ the biological waste
- ✓ faeces and urine
- ✓ sewage from the kitchen including fat
- ✓ excess sludge from sewage treatment and
- ✓ screenings from sewage treatment (only organic matter).

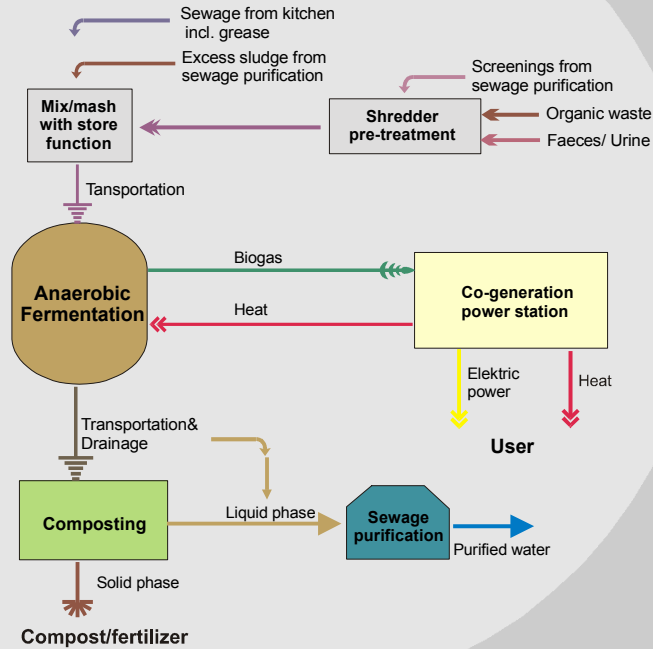
The biogas from digestion is made of 60 to 70 % of methane gas.

Utilisation in generators to produce electricity and heat.

The rotted sludge can then be composted and used as fertiliser.



**Anaerobic fermentation
of all
organic waste**



3. Examples for new sustainable concepts

Water reuse by anaerobic sewage treatment

Water is a resource running shorter.

The reuse of sewage e.g. for irrigation of surroundings, agriculture etc. has to be included in existing and planned sewage concepts.

The sewage contains several ingredients - depending on its origin -, which can be used for irrigation as fertilisers in part.

EXAMPLE ⇒ **anaerobic sewage purification by UASB- reactors and final disinfection.**

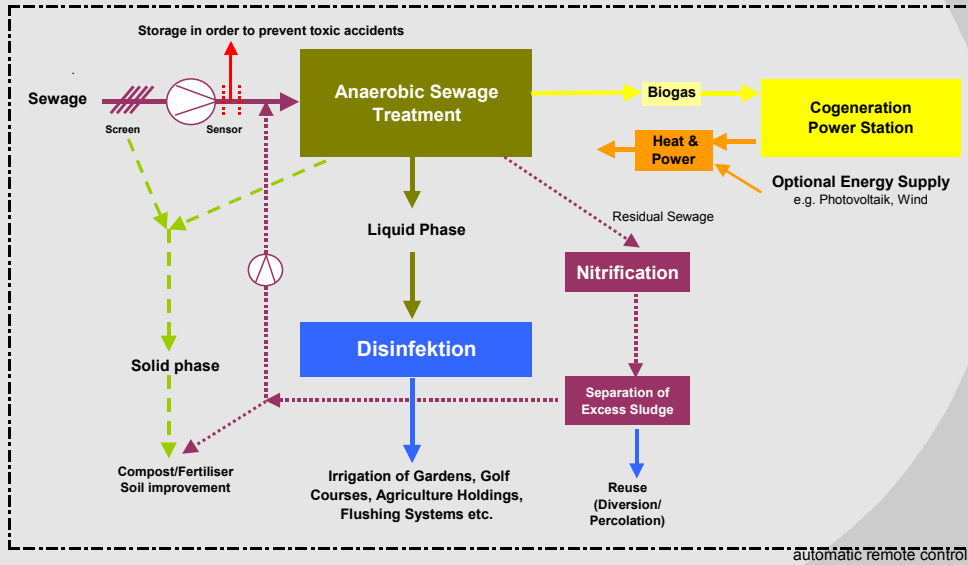
The autonomous operation will be ensured by regenerative energy sources e.g. photovoltaics and/or wind power.

Reduction by +50 % of freshwater for irrigation and toilet flushing systems if the modified anaerobic sewage purification is applied.

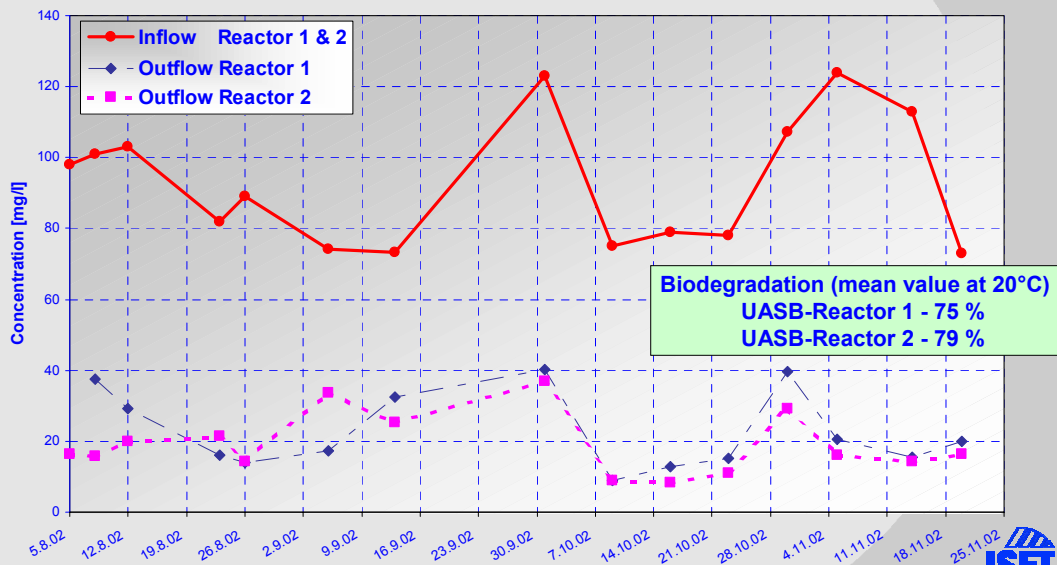
Such a concept also requires a minimum of energy.



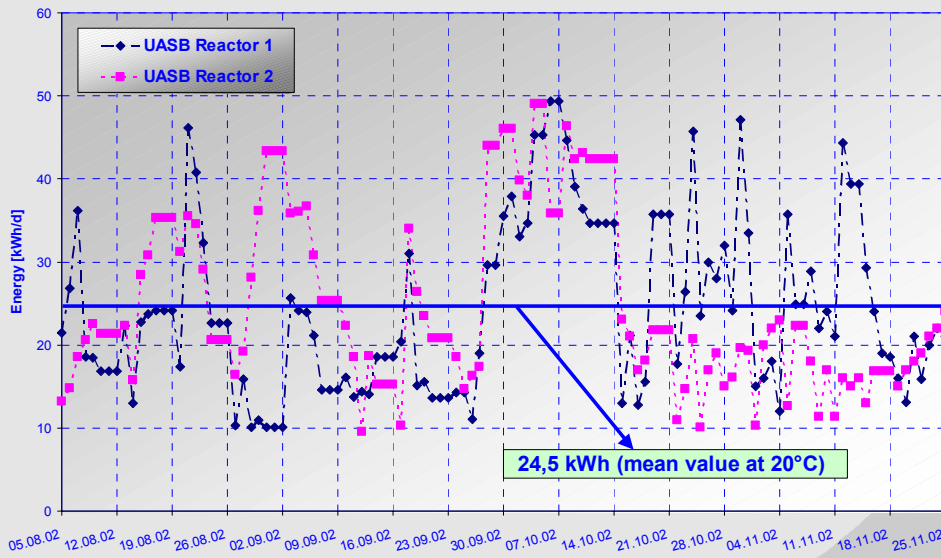
Concept for Sewage Reuse



UASB Experimental plant - TOC Data (5.8.02 - 20.11.02)



UASB Experimental plant - Energy in kWh (5.8.02 - 25.11.02) Projection of the energy production for 100 inhabitants



3. Examples for new sustainable concepts

Energy Self-Sufficient Supply and Disposal Concept

A possible comprehensive concept which conserves water and produces energy is the

⇒ **anaerobic fermentation of all organic waste:**

faeces, urine, biological waste,
sewage water from the kitchen and
excess sludge from sewage purification.

In combination with the

☞ treatment of residual sewage (greywater) from
bath basins, showers, bath tubs and washing machines and
the liquid phase of the anaerobic fermentation.

The purified sewage can be re-used for
irrigation, sprinkling and/or cleaning purposes.



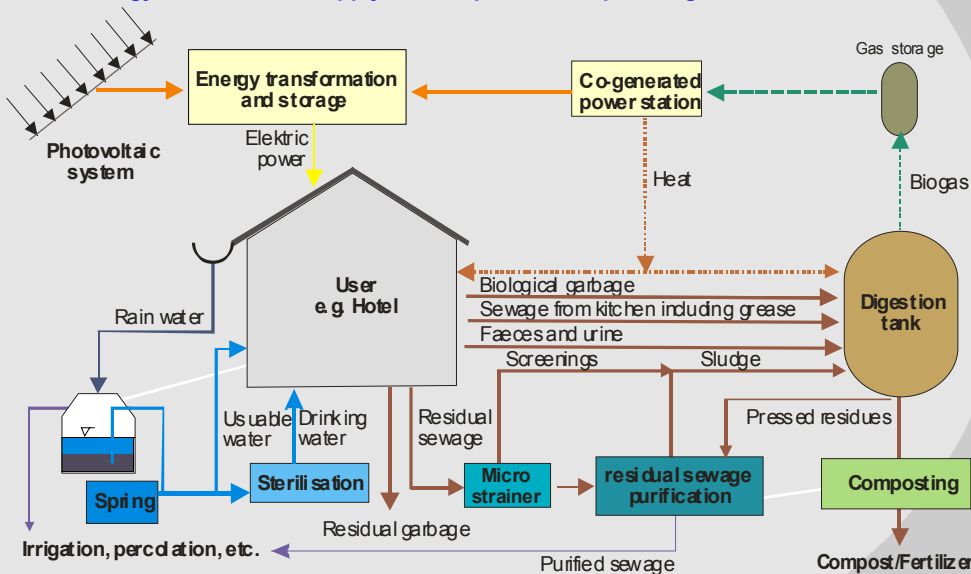
⇒ anaerobic fermentation of all organic waste:

Heat and energy from burning biogas
can be used for the operation of digestion and the greywater purification.

- ☞ The surplus can be channeled to the user.
- ☞ Solar energy can be generated the remaining need for heating.
- ☞ Securing energy supply by additional solar system
(Purification / disinfection of water for drinking and other uses)



Energy self-sufficient supply- and disposal-concept for e.g. a hotel



Energy supply for a stand-alone system (50 PE)

Source of Energy	Energy utilisation	Offer [kWh/y]
Biogas Solar cells	Power supply (Disinfection, Sewage treatment, Illumination, Kitchen appliance etc.)	40.000
Biogas Solar heating	Fermentation Hot water, Heating	90.000
Wood	Heizung/Heating	30.000
Biogas, Propane keep in stock	Cooking, Illumination	20.000
Total		180.000

⇒ With the use of biogas and solar cells and collector panels
up to 9.000 liters of heating oil can be conserved



Such sustainable concepts have the following advantages:

- ✓ emission free production of electricity by the use of photovoltaic, wind and/or hydropower
- ✓ emission free generation of heat through solar cells (water- or air collectors)
- ✓ acquiring digester biogas (fuel)
- ✓ thorough use of fuel through co-generated power-stations (coupling of electricity/heat)
- ✓ conservation of water by using the dry latrine or vacuum technology
- ✓ residual sewage purification only
- ✓ reduction of waste by using fermentation of the biological portion
- ✓ saving of diesel oil
- ✓ no soot- and smell-emissions
- ✓ installations which are simple and easy to operate





Bioenergy Center ISET (Experimental hall)

THE END

