Sustainable sanitation

for saving energy, efficient utilization of bioenergy and recycling of plant nutrients

Using local systems for bioconversion of **Renewable Organics to biogas and biofertilisers** will significantly reduce energy consumption and pollution in many ways.

Present sanitation – **centralised systems** for waste and wastewater management	***Future sanitation*** – decentralised/**local systems** for biogas production and cleaning of wastewater
Human excreta is diluted with water and transported to wastewater system containing chemicals from households, industries and roads and after several kilometres reaching wastewater treatment plants.	**Human excreta** is collected and blended with other Renewable Organics from households and industries and treated as close the source as possible in biogas plants using high-tech and latest knowledge on bioconversion.
Fossil energy is consumed for a) production of chemical (used in cesspools and wastewater treatment plants), artificial fertilisers and agrochemicals (pesticides, herbicides, etc.); b) sewage systems (long tubes, equipment, buildings); c) transport of waste water in sewage systems (pumps, blowing schemes).	**Bioenergy is recovered** as a) methane during bioconversion; b) biofertilisers that contain also most of the plant nutrients and beneficial microorganisms that are returned to cultivated soils, thus ecological production is promoted. Some extern energy is required for building local bioconversion plants for biogas production.
Emissions from sewage systems are polluting air, causing losses of plant nutrients as for example nitrogen and sulphur compounds that negatively affect environment, climate and human health.	**Emissions** are avoided because all processes are taking place in closed decentralised / local systems. Most of nitrogen, sulphur and other nutrients will be recycled in biofertilisers and used in ecological cultivation systems.
Water is polluted by human excreta and by man made chemicals. After cleaning in sewage plants still some pollutants reach floods and oceans.	**Water is protected** from human excreta pollution and less water will be used in households. Floods and oceans are protected from increased amount of nutrients and chemicals.
Costs for removal of nitrogen from wastewater to air depends on type of equipment and is between 5 and 30 euro per kilogram (in Sweden). Costs for artificially produced nitrogen in inorganic fertilisers is about 1 euro per kilogram.	**Nitrogen is bound** in biofertilisers and used in cultivation systems. Costs for removal and costs for production of artificial nitrogen will be avoided. Huge amount of fossil energy consumption and emissions as well as pollution of air, water and soil can be prevented.
Food contains residues of several unhealthy man-made chemicals and nutritional value in vegetables is lower.	**Food is free** from man-made agrochemicals and contains more nutrients, for example in vegetables.
Transport systems use **fossil energy** sources.	**Transport** systems use **renewable energy** sources.

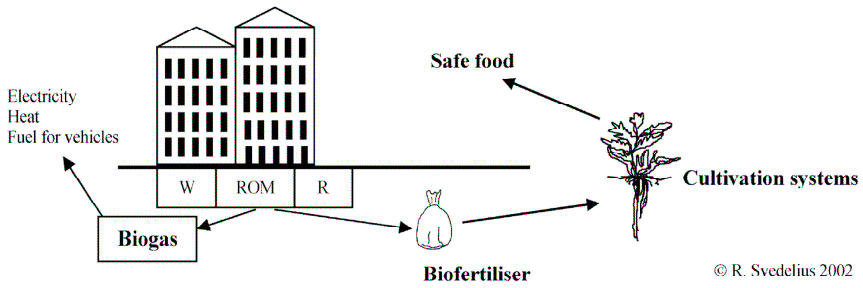

Figure 1: All local systems in each town has to be connected to central office where the newest knowledge on the bioconversion process, on the best logistics for transport of fresh organic materials, on use of biogas an biofertilisers, etc. etc.

Concept SOLIWA:

W – biological cleaning of water

ROM – biological transformation of renewable organic materials to biogas and biofertilisers

R – collection of waste for reuse, recovery, destruction or burying on landfills

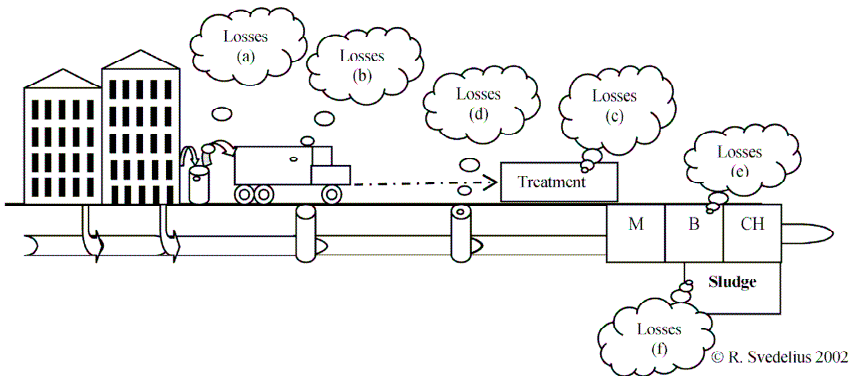

Figure 2: Present waste and wastewater management in open and centralised systems cause emissions that are "polluting losses" of bioenergy and plant nutrients.

From: Svedelius, R. and Watkin, S. J. 2002. Your Body, Renewable Organic Waste and the Environment - Sustainable Management of Solid and Liquid Waste - "SOLIWA". www.ramiran.net/DOC/E1.pdf

+46-707 33 11 20 rsvedelius@hotmail.com

Concept SOLIWA

for the integrated waste and wastewater "at source" management of **SO**lid and **LI**quid **WA**ste/residues in closed localised system.

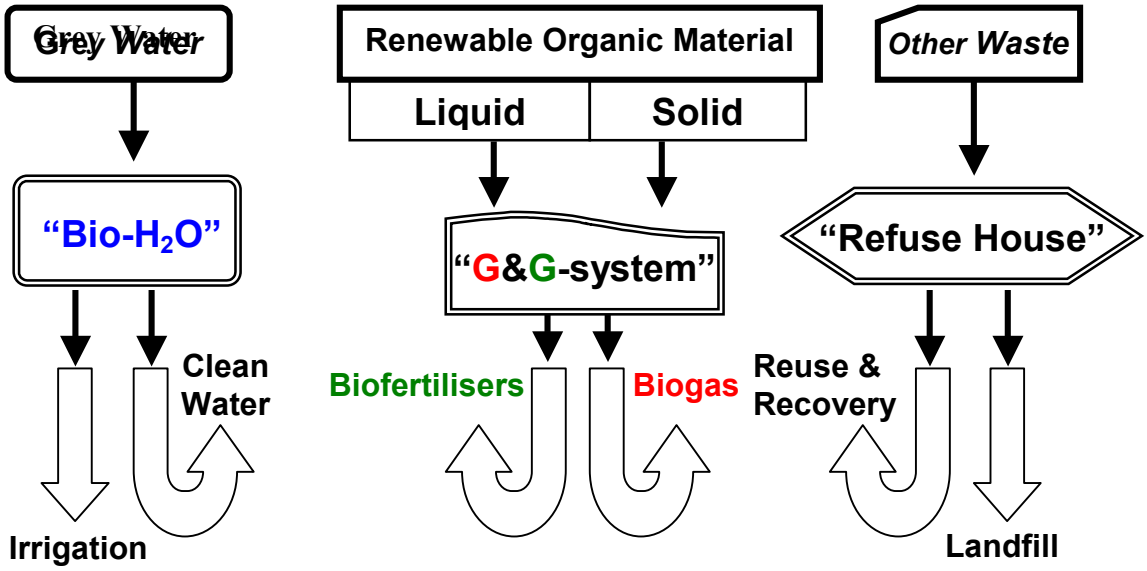

Figure 3: SOLIWA concept.

Description of SOLIWA

"Bio-H_2O"

Grey water is cleaned biologically. About 15 per cent less water will be polluted, as human excreta is collected in novel toilets. The cleaned grey water can be reused for irrigation or for other purposes.

"G&G-system"

An efficient batch system for bioconversion of ROM into biogas and biofertilisers. Raw materials for bioconversion are taken from renewable organic solid[1] and liquid[2] waste from households, from central markets, from the food and feed industry, slaughterhouses as well as from forestry, agri- and horticulture. Fuel crops mixed with other materials can also be used.

A mixture with a high content of dry matter is treated in a three-step process of bioconversion. Firstly, aerobic, then anaerobic and finally aerobic transformation is carried out in a new kind of closed bioreactors connected to a bio filters. The contents of the bio filters are reused in the process.

The biogas produced in the anaerobic step is converted into electricity and heat, used as fuel for vehicles, or both. Part of the electricity is used for equipment in the system.

Biofertilisers, adjusted for cultivation needs, contain energy rich organic structures, plant nutrients and beneficial microorganisms. Structures are important for soil organisms and as CO_2 sinks. The content and quality of biofertilisers can be modified with respect to needs of crops and the state of the soil.

"Refuse House"

Mixed waste of inorganic and non-renewable materials such as glass, plastic, metal and toxic waste are sorted, and then handled by specialists for reuse, recovery, destruction or burying on landfills.

---

[1] Solid organic wastes can be dry or wet. Examples of dry organic materials are: paper, paper packages, straw, wood and wooden residues, bark, dry leaves. Examples of wet organic materials are: food residues, grass clippings, weed plants and crop residues. In today's Western Europe, household waste is being generated at a rate of over 1kg per person per day. *In Sweden 76 per cent are of organic origin (REFORSK, 1998)!*

[2] Liquid organic waste is both from human and animal excreta. A human excreta in developed countries averages 1.2 kg per person per day. *In Sweden, a human excreta is diluted with 200 to 550 litres of wastewater per day!*

+46-707 33 11 20 rsvedelius@hotmail.com

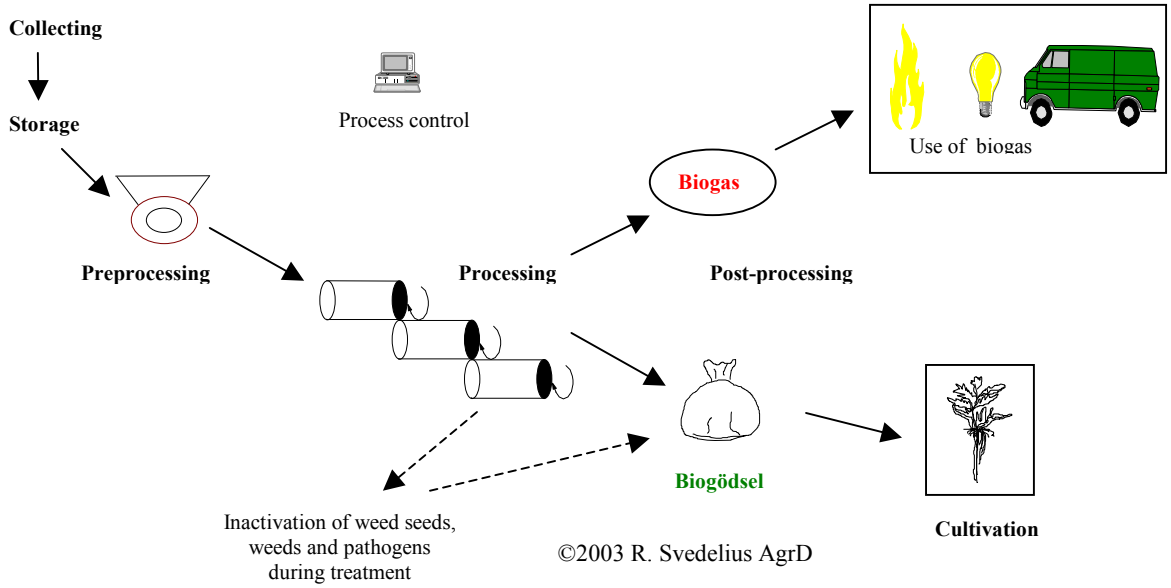

Figure 4: Flow in management of renewable organic matter.

Economic benefits of the SOLIWA concept are:

* Lower total costs for waste and wastewater treatment;
* Lower costs for collection and transportation of waste and wastewater;
* Profit from biogas;
* Profit from biofertilisers.

By expanding the agricultural possibilities of biofertilisers, produced from ROM in solid and liquid urban waste in localised bioconversion plants, savings would come from:

* Reduced collection and transportation costs;
* Increased yields of cultivated crops;
* Reduced use of fossil-based fertiliser, pesticides, and herbicides;
* Water savings;
* Energy savings.

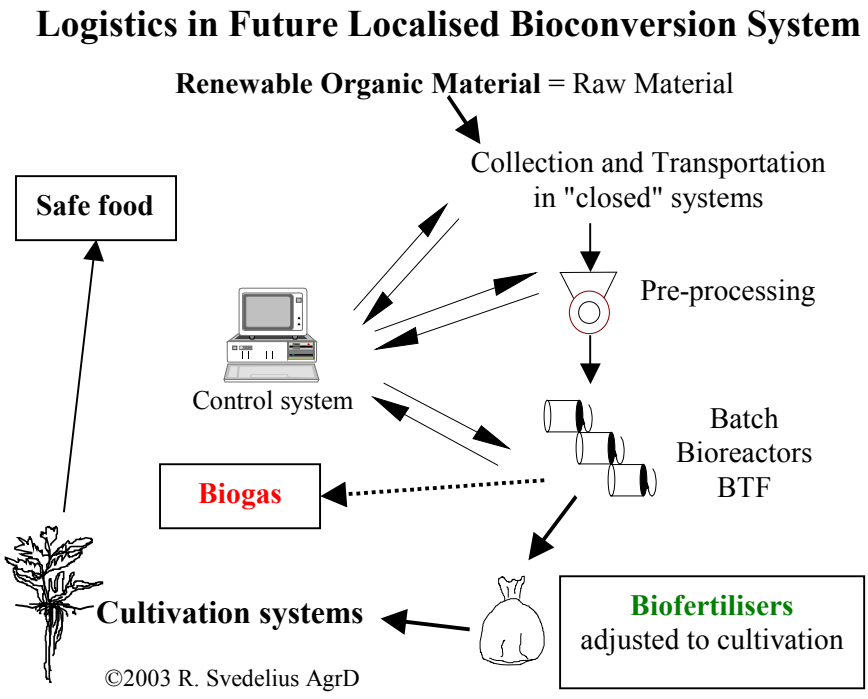

Figure 5: Logistics during management of renewable organic material.

+46-707 33 11 20 rsvedelius@hotmail.com

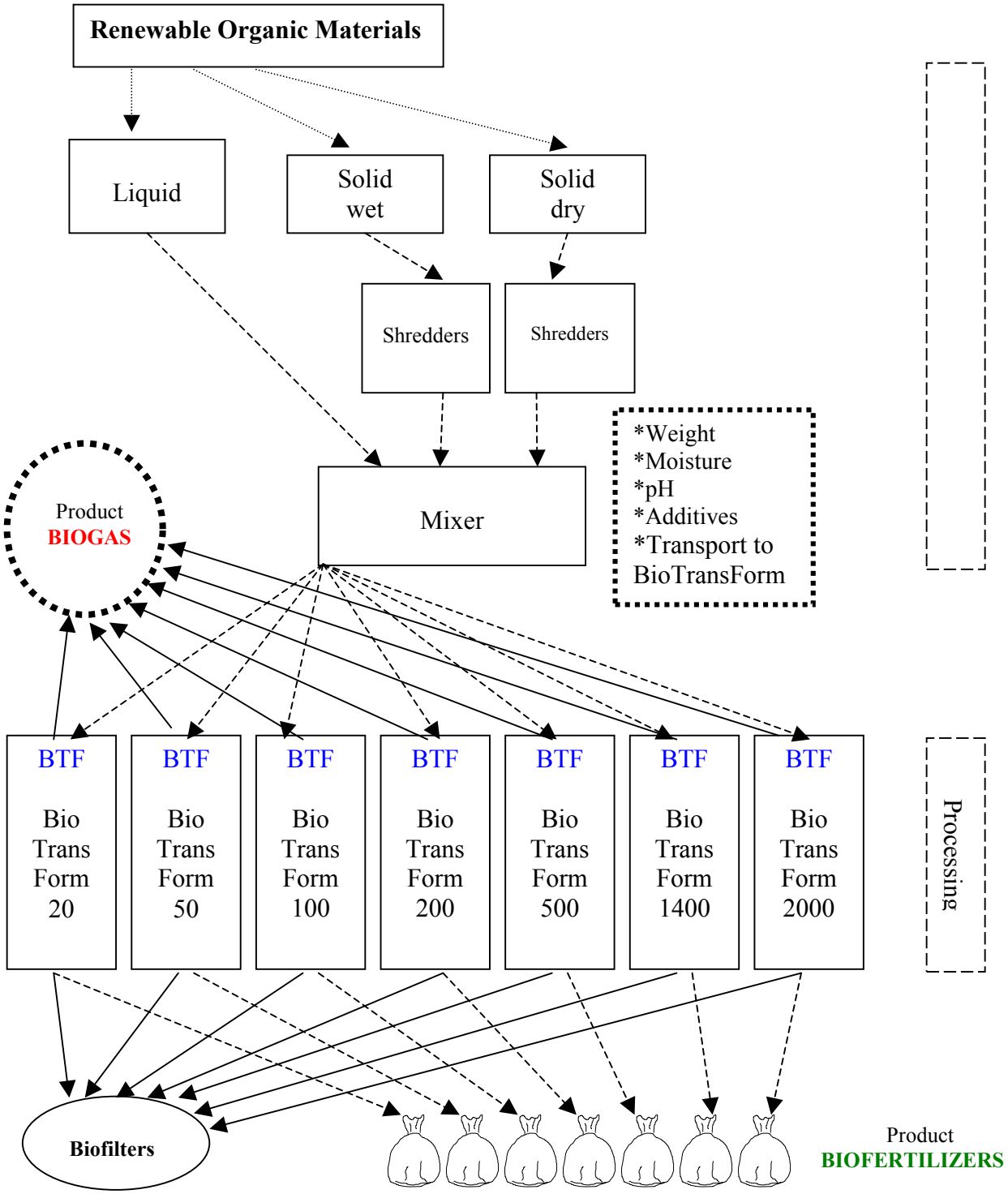

Figure 6: Sketch of a plant for production of biogas and biofertilizers.

+46-707 33 11 20 rsvedelius@hotmail.com