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Compare three methods in which bioenergy ie. the solar energy stored in the renewable organic materials (ROM) are used and what effects it causes long-term sustainability - ecological, economic and social.

Sustainable METHANE FERMENTATION

Methane fermentation is the biochemical conversion of renewable organic material in the absence of free oxygen (O_2). During the methane fermentation various microorganisms are active and the bioconversion gives

1) **BIOGAS** consisting of 50-75% methane (CH4) and 25-50% carbon dioxide (CO2) with small amounts of other gases. Biogas can be upgraded to the equivalent in quality to the fossil fuel natural gas with 97-98% methane biogas but, unlike natural gas that causes carbon neutral when burned, no increase of atmospheric carbon dioxide.

2) **BIOFERTILIZER** that are produced in systems based on the newest knowledge and contains

• most elements from raw materials which include plant nutrients

• bioenergy is partially retained in the energy-rich organic structures that take longer to transform and that enrich the soil with organic carbon (carbon sequestration - carbon sink!);

• microorganisms - living and dead.

Biofertilizer affect positive, long-term cultivation soil fertility and growth of new biomass that is, high yields, today and tomorrow. Biofertilizers are important energy source for soil organisms that help plants to absorb nutrients.

For efficient production of biogas and biofertilizers microorganisms need

* The right water content - about 70% instead of current 90 - 97%. Methane is not produced from the water, only the cost of the process increases.

* Mixture of several types of renewable organic material such as

-- wet, mostly nitrogen-rich materials (food waste, animal and human excrement, waste products from food, dead animals, etc.)

-- dry, finely ground structure bearing materials - which are often rich in organic carbon (sawdust, pellets, straw, leaves, bark, forest residue, paper, willow, etc.)

Unsustainable THERMAL GASIFICATION

Thermal gasification requires input of energy to (1) drying of raw material, (2) increase in temperature, and (3) increase in pressure during gasification. The product is synthetic gas called Syngas or Bio-Syngas (see below * outsourced energy).

Questions regarding Bio2G as E.ON launches the biogas plant:

What happens to all the chemical elements present in the raw material (eg, in forest residues = stumps and cave)?

What remains after the thermal gasification? ASH or TAR?

What is in ashes?

What does the tar?

How can nitrogen, phosphorus, potassium and sulfur recycled to farmland?

* Outsourced energy by Ulf-Peter Grano, Kokkola 2010

http://www.scribd.com/doc/49586560/12/Fermentering-av-Bio-Syngas

Gasification is a thermochemical conversion of biomass by heat and limited oxygen supply to temperatures as biomass is converted into gas form. The gasification is usually divided into a low and a high gasification process, in between a medium temperature zone.

- Gasification of low temperatures, 800-1000 ° C
- Gasification of medium temperature, 100-1200 ° C
- The high-temperature gasification, 1200-1400 ° C

In English literature, it is often called the gas produced for the Syngas from gasification below 1000 ° C, while gas from the reactors with temperatures over 1 200 ° C is called Bio-Syngas. The gas produced at these temperatures is almost entirely consisting of H_2 (hydrogen) and CO (carbon monoxide), in addition to CO_2 (carbon dioxide) and H_2O (water).

..... But there is tar in syngas which is the biggest problem for most companies struggled to purify the gas. To clean the product gas from the tar has been complicated and difficult. "Tar free" reactors are under development.

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Unsustainable COMBUSTION

The burning of renewable organic matter is ongoing chemical oxidation and bioenergy is converted into light and heat. Two important plant nutrients nitrogen and sulfur leaves in the form of nitrogen oxides and sulfur dioxide. At the same time are formed many other substances in air pollution that negatively affect health.

RELEASE OF CLAIMS AGENTS combustion of different fuels

http://www.sgc.se/dokument/sgc090.pdf With unregulated compounds means emissions of substances that are not subject to taxation. The subjects covered are

- Dust particles
- Metals
- Carbon monoxide (CO)
- Nitrous oxide (N2O)
- Ammonia (NH3)
- Hydrogen chloride (HCl)
- Carbon-sulfur compounds (COS, CS 2)
- Dioxins, furans (PCDD, PCDF)
- Organic compounds (PAHs, BaP)

Waste incineration is the worst. For every tone of incinerated waste remains 200-250 kg environmentally hazardous ash.

THE BLACK EMPIRE http://www.greenpeace.se/files/1800-1899/file_1811.pdf

It is a common notion that the garbage that is burned disappears. But physically, no matter disappear, only transformed into new forms. The garbage we send to the incineration plants will inevitably look like new trash - sometimes more toxic than the ones we put in from the beginning.

During the combustion the chemical substances in the waste are broken up and react with each other. Some substances pass through the fire unchanged while others break down into harmless forms. But the opposite is also common; some relatively harmless substances are converted into extremely hazardous substances.

In recent years, energy companies have managed to reduce the amount of emissions of contaminants into the air by filtering the flue gas. This in turn leads to much of the toxic agents instead end up in ashes. There is considerable uncertainty about which and how many materials stored there, but in recent years, research has suggested that the ash can be much more dangerous than what we know today.

Swedish authorities estimate in the current situation that the air emissions of dioxins from waste incineration in Sweden revolve around 1-3 grams per year. This is a rather uncertain estimate because the methods used to measure emissions have several shortcomings. The levels of dioxins in the ash from the Swedish waste incineration is estimated, however, lie at significantly higher levels, estimated to 160 g per year. Of the total releases of dioxins from waste incineration is estimated 70-80% down-the-waste products, ie. ash. This will boost current emissions on to future generations.

Waste incineration is an unsustainable system

We citizens are cheated. There are those who profit from waste incineration, are lobbying hard and allows us to pay for the following:

1) *Collection, transportation and management of waste* resulting in polluting emissions. How much does it cost in your community? Is it 1 300 – 2 700 SEK per ton of household waste?

2) *Incineration* - construction, operating costs, handling of hazardous slag and ash that is in the dumps, and some substances polluting leachate that goes to sewage treatment plants.

Waste incineration costs were in 2001 about 600 SEK / ton.

3) *Heat and electricity produced.* Citizens paid for both waste treatment and then for electricity and heat - waste companies earned a lot!

- The heat from one ton of waste – in 2001 consumers paid in Malmö 1 342 kr.
- Costs to produce 1 kWh of electricity through incineration of waste in 2003 was -0.36 SEK (ie, minus 0.36 SEK per kWh, the cheapest way to produce electricity!).

4) *Medical expenses* due to health problems caused by pollution in air, water, soil and food crops that are adversely affected by emissions from combustion.