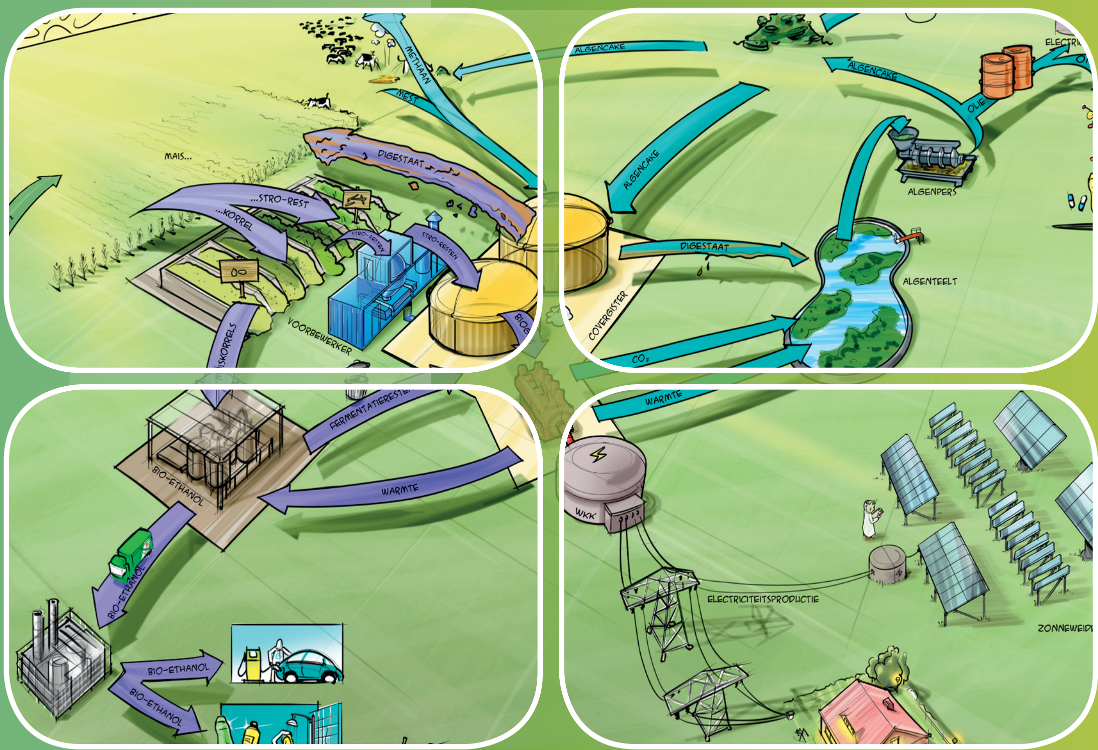
Application Centre for Renewable RESources

acrres

een WAGENINGEN UR initiatief

Co-fermentation
Optimal use of all residues
Bio-ethanol
The first bio-ethanol on a farm-scale
Algae
The energy source of the future
Solar fields
Test run of solar panels and exhibits



Brochure EnergieRijk

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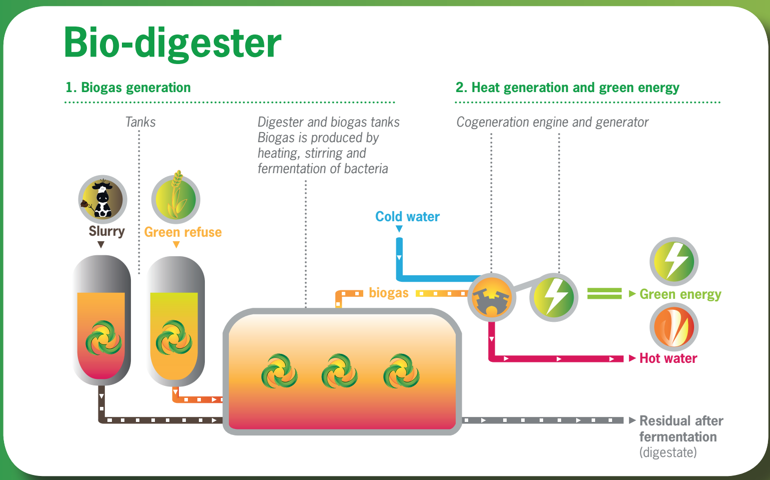
WAGENINGEN UR For quality of life

Eneco

Provincie Flevoland

Hier wordt geïnvesteerd in uw toekomst vanuit het Europese Fonds voor Regionale Ontwikkeling

CO-FERMENTATION OPTIMAL USE OF RESIDUALS



Energy Production from fermentation of animal slurry is of great interest to agricultural companies. During fermentation biogas is produced from the organic material in slurry.

This works as follows: a mixture of various micro-organisms within the slurry react, resulting in a mixture of methane and CO2. This is called biogas. The biogas is then burned in an engine (including cogeneration) generating electricity. After the gas has been removed from the slurry the residual is called digestate. This digestate is used for fertilising the soil and can help to reduce the use of fertilisers.

Considerably more energy can be produced when corn, straw or other plant material is added to the slurry. This process is called co-fermentation. Up to fifty percent may consist of another material if the digestate is used for fertilisation.

Fermenting slurry is good for the environment because it helps to reduce the greenhouse gasses in two ways. The energy is produced sustainably from residues in slurry and there is less greenhouse gas emission than would otherwise be released during storage of the slurry.

Much of the energy produced is released as heat. A small portion can be used to heat the digester and the animal sheds. In practice the remainder is usually lost. The EnergieRijk project aims to use the residual heat to make the fermentation process more cost-effective and energy efficient.

AIM

In this project, the waste heat from the digester is used to produce bio-ethanol and algae. The residual heat is then applied to other sustainable processes. In addition, residuals from these two processes return back into the digester. The process becomes more cost-effective by using the residual heat. Furthermore there is a good local cycle through the local application and processing of nutrients. The illustration shows how it works in practice.

RESULTS

Knowledge of the use of a co-digester in combination with other processes to use waste heat. Recommendations for an economically and environmentally beneficial form of fermentation.

IMPACT

The additional knowledge gained into the use of waste heat together with the combination of bio-ethanol and algae can be built into existing plant digesters. A positive result can also lead to greater use of co-digesters and more research into other technical links for the further optimisation of the process

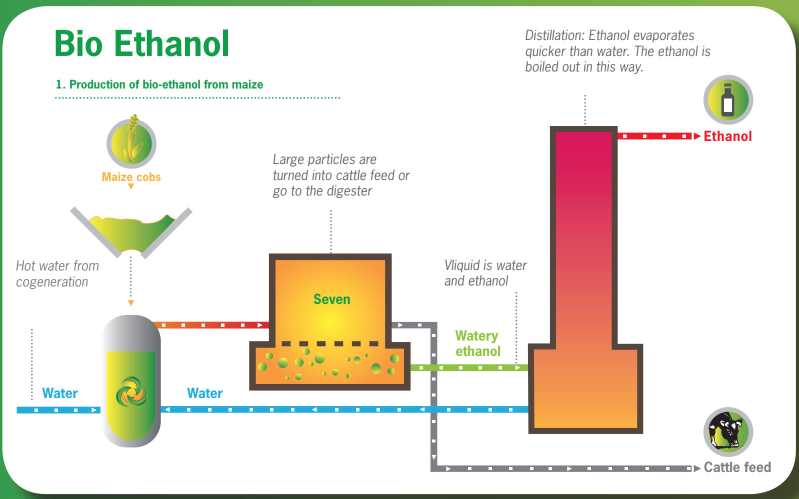
FACTS

The methane in biogas is also found in natural gas. However, the problem is that biogas contains more CO2, making it harder to burn. Therefore biogas is not suitable for use in households, but must first be upgraded

In the Netherlands there are currently about 180 co-digesters. With a more favourable subsidy scheme in Germany, 5,000 units have been built.

The micro-organisms used in co-fermentation and manure fermentation are the same type used for the production of alcohol in beer and wine. The difference is that in slurry fermentation, there are micro-organisms that also break down the alcohol.

BIO-ETHANOL THE FIRST BIO-ETHANOL ON A FARM SCALE



Due to the rising prices of fossil fuels and the European guidelines for lowering CO2 emissions, the demand for bio-fuel production has increased significantly. Bio-ethanol is a fuel that can be added to petrol and then be used without problems in petrol cars.

Crops such as maize, wheat and sugar beet are suitable for the production of bio-ethanol because of their high starch or sugar concentrations. The following happens: in a tank the crop is digested by yeast, converting it into bio-ethanol and water. Before it can be used as a fuel, the bio-ethanol and water have to be separated. The bio-ethanol can now be used as a fuel.

Ethanol is also an important raw material for the chemical and pharmaceutical industries. It is used directly in cosmetic products and for antiseptic use, but also after chemical conversion for a variety of applications ranging from plastics to raw materials for paint ingredients.

At present, ethanol is mainly produced from crude oil, a process that requires a lot of energy. EnergieRijk is carrying out this research to find a cheaper and more environmentally friendly method of production of bio-ethanol. Now fuel is needed for the heat required making the production of bio-ethanol more expensive and less environmentally friendly. However, this can be avoided by using the residual heat from a co-digester. A second advantage is that the residue after bio-ethanol production can, in turn, be fermented producing more energy or be used as cattle feed. The illustration shows how this cycle works.

AIM

The concept developed by the company Zeafuels utilises the waste heat from the digester to produce bio-ethanol. This link has three major advantages:

1.Higher returns

The bio-ethanol production utilises residual heat and the waste from this production is used to power the digester. This increases the efficiency and energy production per hectare of land significantly

2.Less transport.

As the bio-ethanol is produced locally fewer transport movements are required. In addition, the residues are used locally. Since only the bio-ethanol has to be transported the transportation costs are lower and there is less CO2 emission.

3. Closure of the local cycles.

The residue from the production of the bio-ethanol can be used for cattle feed or to fertilise farmland. The nutrients and minerals it contains are reused. This closes the local circuit.

Where possible, it will be seen as to what extent agricultural waste products such as beetroot and potato leaves, grass and rejected batches of consumption potatoes and wheat could be used to produce bio-ethanol.

RESULT

The optimal method for the production process can be determined using the knowledge obtained during the research..

IMPACT

By making bio-ethanol production financially attractive, these processes can be more widely used in existing and future digesters. The cost of bio-ethanol can be reduced by further optimisation and thus become more competitive with fossil fuels. Wider use of bio-ethanol also has a very positive impact on the environment.

FACTS

In 1925 Henry Ford told a reporter from the New York Times that ethanol would be the fuel of the future. “The fuel of the future will come from fruit, such as sumac, apples, weeds sawdust……… almost everything”. However, with the advent of cheap petrol from oil, bio- ethanol was ousted. Ethanol is the same as the alcohol that we know in beer and wine. The difference is that bio-ethanol as a fuel is not suitable for consumption because of the presence of other substances. In Brazil and Sweden, bio-ethanol is already widely used. In Brazil, cars run on blends of 30- 100% bio-ethanol. In Sweden all petrol contains 5% bio-ethanol and there are more than 1000 petrol stations where petrol containing 85% bio-ethanol can be used for refuelling. All petrol cars can run on fuel containing up to 10% bio-ethanol and many cars can already drive on E85. A new technology has made it possible to produce bio-ethanol from woody material. The advantage of this is that it does not compete with the food market because it is produced from materials such as pruning waste and plant debris. There are currently pilot factories in Sweden and Canada. The construction of commercial factories is planned from 2011.


ENERGIERIJK
METHAAN
MEST
MAIS...
DIGESTAAT
...STRO-REST
...KORREL
CO_2
STRO-RESTEN
STRO-RESTEN
VOORBEWERKER
MAISKORRELS
BIOGAS
FERMENTATIERESTEN
BIO-ETHANOL
WARMTE
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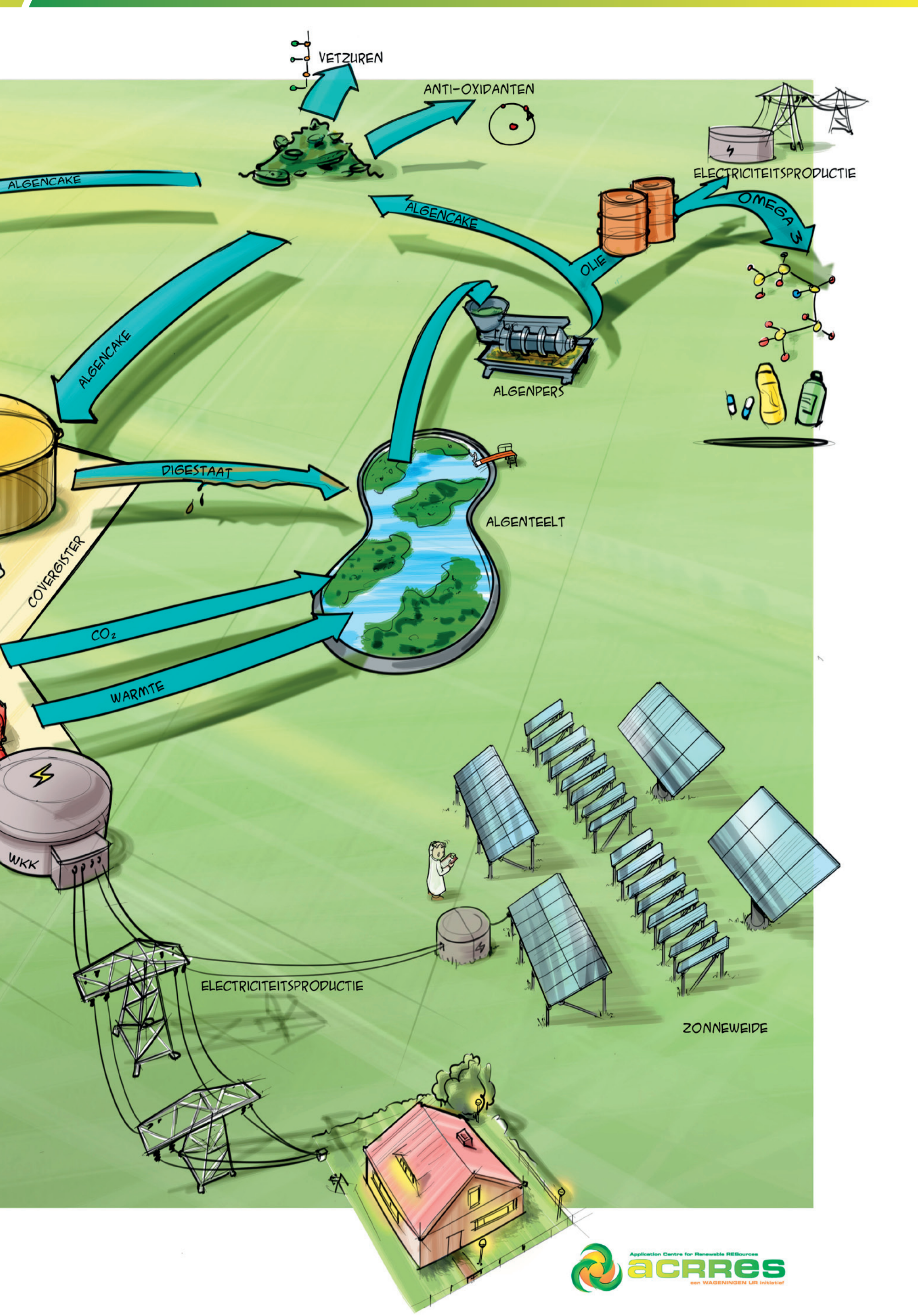
VETZUREN
ANTI-OXIDANTEN
ALGENCAKE
ELECTRICITEITSPRODUCTIE
OMEGA 3
ALGENCAKE
OLIE
ALGENCAKE
ALGENPERS
DIGESTAAT
ALGENTEELT
COVERGISTER
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ELECTRICITEITSPRODUCTIE
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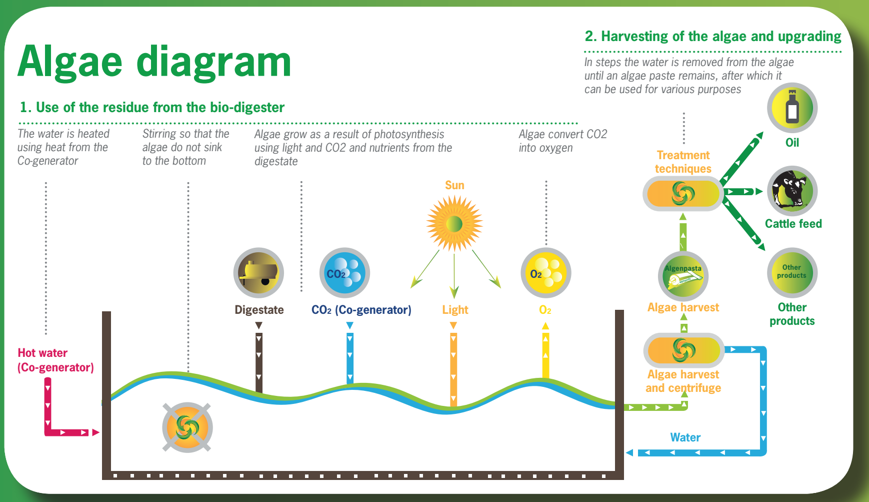
ALGAE THE ENERGY SOURCE OF THE FUTURE.



Algae in water have the property that in the presence of nutrients, light and heat they can convert CO2 to oxygen. In addition, they multiply rapidly and the algae formed can be used for many purposes. For example, algae can be used for fish and cattle feed or possibly for even more advanced applications such as medicinal compounds, vitamins, minerals and natural pigment. The cultivation of algae has a very high yield per hectare, providing a factor of 3 to 20 times more dry material than normal agricultural crops.

The reason for the study is the use of the residues from a co-digester. An environmental en economic value can be given to the waste by using algae for the production of animal feeds and possibly other more advanced applications.

AIM

In a concept developed by ACRRES, a co-digester is linked to an algae pond. This link has three important advantages.

1. **The waste products from the co-digester will be used usefully.** When burning the biogas that is produced, CO2 is released. In the production of algae, CO2 is used as food for the algae.

2. **Optimal utilisation of heat.** The heat produced by the digesters during generation of the electricity can be usefully used by the algae. The use of waste heat for the algae leads to high energy utilisation.

3. **Closure of local circuits.** As well as the CO2 that is used as food for the algae, the digestate from the co-digester can also be used to feed the algae. The local use of these residues and raw materials provides a good closure of the local circuits.

RESULT

The project aims to develop knowledge about the cultivation, harvesting and marketing of algae, leading to good economic prospects.

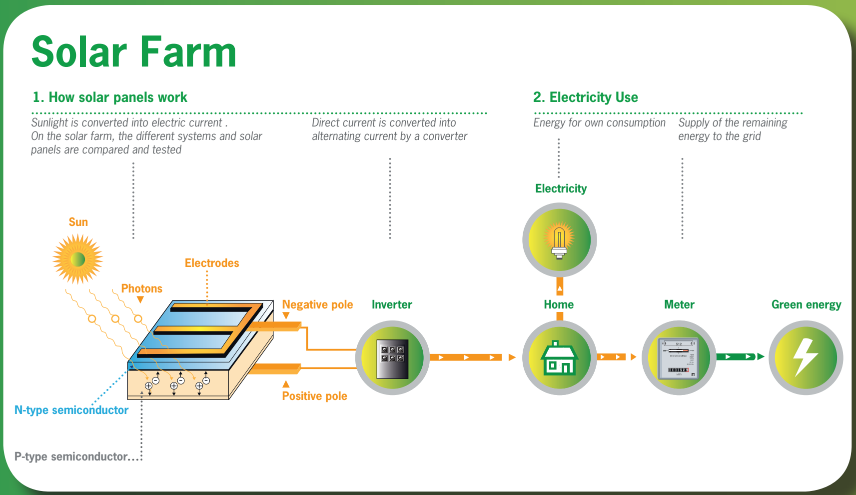
IMPACT

A positive result for the production, harvesting and marketing of algae can lead to high quality algae being produced near co-digesters and manure digesters. Furthermore, the knowledge acquired may be used by industrial companies to reduce CO2 emissions.

FACTS

Algae convert an estimated 435 billion tons of CO2 per year and they produce as much oxygen as all the green plants on earth put together. There are approximately 100,000 different species of algae that vary greatly in appearance, growth and characteristics. At this moment the characteristics of only four hundred species are reasonably well known. Algae are almost everywhere and can remain alive even under the most extreme conditions. They are present in hot springs with temperatures between 75 - 85˚C and in fresh and salt water. When looking at blue algae, the water is usually green. Only when the algae dies does the water become blue, hence the name. Besides blue and green, algae can also occur in a red-brown colour. Sometimes, it seems as though there is a paint or oil film floating on the water. This is caused by a small amount of oil present in the algae.

SOLAR FARMS FIELD TESTS OF SOLAR INSTALLATIONS



The sun is a sustainable source of renewable energy. It is infinite and clean. Therefore ACRRES has realised a solar farm. Several (generations) of PV panels are tested and demonstrated in the field. By opening this to the public, ACRRES hopes to stimulate the use of solar energy.

PV stands for Photovoltaics, or a photovoltaic cell. When sunlight falls on the cell, electrons are knocked loose and because of the composition of the solar cell, these electrons can move in one direction only. The movement of all these electrons together is the electrical current. The electricity generated can be stored in batteries, be used immediately or go to the electricity grid. With immediate consumption and/or supply to the power grid, a converter (inverter) is required to convert the 12 or 24 volts direct current into 230 volts alternating current.

AIM

The aim of this project is to test and demonstrate the various types of solar panels in different configurations under practical conditions. They are tested on the following points.

1. **Operation of solar panels**
   The information on the operation of the different systems, technical characteristics and the general expectations are collected on the solar farm. This data is set out clearly so the information can be shared with those interested in solar panels.
2. **Revenue**
   The difference in yield between the various setups. This data is recorded and evaluated by means of a log and monitoring system.
3. **Financial aspects**
   Giving insight into the costs and benefits of the different systems. For example, does a mobile system provide sufficient additional power to make the system viable.

The three configurations are:

- permanent setup
- variable, manually adjustable setup
- mobile setup (so-called sun following or tracker system)

RESULT

The project provides insight into the differences between the solar panels and the effect of the configurations upon them.

IMPACT

With the acquired knowledge and understanding, interested parties can gain a better insight into the financial returns. This information can contribute to an objective decision on whether or not to invest in solar panels.

FACTS

The sun provides more than fifty times more energy than The Netherlands consumes in gas, electricity and fuel. The government's objective is that in 2020, 14% of the energy will be generated from sustainable sources. In 2009, 3.8% of the energy came from sustainable sources. In The Netherlands, the maximum annual yield can be obtained with a due south facing panel set at an angle of 36˚. Any deviation from this decreases the amount of solar energy by about 15%. One hour of sunlight provides 1kWh/ m² of electricity. A solar panel is about 1m², giving 85-110 kWh of electricity per year (in the Netherlands).

Solar Panels	Type
Polycristalline	Solarpark SPP 225
Amorf Silicium	Scott Solar ASI 97
Copper-Indium-deSelenide	Sulfurcell SCG62-HV-F
Polycristalline	Kyocera

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Within EnergieRijk, we work with:

Algae Food & Fuels
Sustec
Van der Valk
Zeafuels
Zelziuz

LEK Habo
MV Solar
TOD Nijkamp

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