MOMENT
modern water management

SEWAGE FROM SINGLE HOUSES

– A SUSTAINABLE SOLUTION

MOMENT
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RESULTS

THE MOMENT PROJECT

BACKGROUND

The MOMENT project has been implemented through cooperation between seven regions in four countries around the South Baltic Sea. All regions are members of the Euroregion Baltic (ERB) that was established in 1998 with the main objective to develop a long-term, politically governed cooperation between the member regions.

The project has aimed at reducing the discharge of nutrients and hazardous substances to the Sea by using modern water management methods. This has included the establishment of Water Users Partnerships (WUP), allowing a “bottom up” approach starting at a local level and working within river catchment areas independent of administrative boundaries.

A central part of the MOMENT project has been to carry out a number of concrete actions of best practice character, aiming at disseminating sustainable technology, decreasing outlet of nutrients and hazardous substances, and/or minimizing the negative effects of these substances, all actions aiming at enhancing the environmental status of the Baltic Sea. Thirteen innovative pilot area measures have been implemented. The project has been co-financed by the South Baltic Cross-border Cooperation Programme 2007-2013.

IMPLEMENTED CONCRETE ACTIONS

I. LAND USE:

Wetlands for nutrient reduction and fish reproduction, Kalmar, SE (Report 4.1.1)
Forestry and water, Kalmar, SE (Report 4.1.2)
Effective uptake of nutrients, Torsas, SE (Report 4.1.3)
Forestry and water quality management, Torsas, SE (Report 4.1.4)

II. SEWAGE FROM SINGLE FAMILY HOUSES:

Solutions for treatment of waste water from single houses, Kalmar, SE (Report 4.2.1)
Biogas production using sludge from small scale sewage plants, Ronneby, SE (Report 4.2.3)

III. TREATMENT OF STORMWATER:

Stormwater management plans for Gargzdai and Priekule towns, LT (Report 4.3.1)
Ecological adapted stormwater treatment, Kalmar, SE (Report 4.3.2)
Ecological adapted stormwater treatment, Kretinga, LT (Report 4.3.3)
Stormwater treatment in central urban areas, Kalmar, SE (Report 4.3.4.1)
Restoration of stormwater polluted recipients, Kalmar, SE (Report 4.3.4.2)

IV. INFORMATION AND COMMUNICATION:

GIS information system, Gdansk, PL (Report 4.4.1)
Information campaign on phosphorus free detergents, Klaipeda, LT (Report 4.4.2)

THEMATIC AREA
– SEWAGE FROM SINGLE HOUSES

Within the MOMENT project, one action and one study have been carried out within the thematic area Sewage from single family houses. The action is about a closed cycle technology for treatment of sewage from single houses, carried out in Kalmar Municipality, and the study about opportunities of biogas production using sludge from small scale sewage plants, carried through in Ronneby Municipality.

HIGHLIGHTS OF THE PROJECTS:

1. **A pilot facility has been constructed with a sustainable, closed cycle technology for treatment of sewage from individual households through reusing and refining the sewage as fertilizer for agriculture.**
2. **A feasibility study has been implemented indicating opportunities of taking care of sludge from single houses for biogas production.**

SOLUTION FOR TREATMENT OF WASTE WATER FROM SINGLE HOUSES

INTRODUCTION

Decreasing harmful substances that arise from single houses that either lack or are equipped with poorly functional sewage treatment, is by many aspects one of the biggest challenges around the Baltic Sea yet to be tackled. The efforts of implementing new treatment facilities for each single household and connecting them to municipal or other common waste water treatment is merely impossible, as the costs would simply be to high. New cost-efficient treatment techniques of waste water from single houses are therefore something that is highly sought for.

Sewage from single houses is not only a sanitary problem but also part of the eutrophication of inland and coastal waters. As soon as waste water outlets from villages and towns are treated in an acceptable way, untreated or insufficient treated sewage from contryside single houses stand for a substantial part of the total antroprogen outlets. This is relevant not least for phosphorous emanating from detergents and faeces. In addition, phosphorous is a limitid resource. There is a need of new, modern and sustainable methods for sewage from single houses – methods that fulfil sanitary and environmental requirements but also make it possible to recirculate phosphorous. Due to environmental, technical and economical reasons these modern methods often can be solved in a better way when adapting common solutions.

This action has been implemented in the Snarje stream catchment area by Kalmar Municipality. One objective has been to test a new technique that decreases emissions of nutrients to the Baltic Sea through construction of a pilot facility with a sustainable, closed cycle technology for treatment of sewage from individual households. The plan was to connect at least twelve households to a joint solution.

The working steps on the road to implementation have been:

1. Finding a suitable location,
2. Finding an appropriate technology,
3. Getting the landowners interested to participate in implementation,
4. Procurement of consultancy services,
5. Procurement of contractors,
6. Implementation, and
7. Evaluation.

MAIN OBJECTIVE

The main objective has been to take actions to decrease emissions of nutrients to the Baltic Sea through **construction of a pilot facility with a sustainable, closed cycle technology for treatment of sewage from individual households**. The plan was to connect at least twelve households to a joint solution. The technology used was to add urea to the wastewater, thereby increasing the pH-level which decontaminates the water. The added urea also increases the total amounts of nitrogen in the sludge that remains after the purification process making it more interesting as a fertilizer. The purified lavatory water is distributed on nearby agricultural land.

THE FACILITY CHAIN

The facility chain is the following: The lavatory water from the joint tank for the households is retrieved with a tank truck from Hjalmo hamlet and then drained into a sanitation facility at the farm property. The installation is comprised of a drain with a funnel for adding the urea. A pump functions as a stirrer in the pit, as well as for pumping out the purified lavatory water to a former manure container at the farm. This container functions as storage before the purified lavatory water is distributed on agricultural land. The sanitation process takes approximately three weeks.

MAIN RESULTS

- **A pilot facility has been constructed with a sustainable, closed cycle technology for treatment of sewage from individual households through reusing and refining the sewage as fertilizer for agriculture.**
- **Fourteen households in the pilot area were supplied with the closed cycle system, in which their sewage is being transported and processed, cleaned and returned to agricultural land.**
- **The purified sewage corresponds to the need of fertilizers that covers 2-3 hectares of agricultural land.**

CONCRETE EFFECTS AND COSTS

The technology has been assessed to be cost-efficient, because the urea remains after the sanitation process and increases the nutrient contents of the lavatory water. Urea has a high content of nitrogen, 46 %. Since the sanitation process takes place in a closed system and the storage of the processed lavatory water is under cover, the loss of nitrogen is negligible. It means that most of the nitrogen that is put into the system ends up as fertilizers. Calculations show that the cost per hectare is approximately 170 EUR if urea treated lavatory water is used compared to over 190 EUR per hectare if standard fertilizer is used. The costs of transportation and infrastructure are not included, which requires the facility to be placed relatively close to where the purified sewage is to be spread.

CONCLUSIONS AND RECOMMENDATIONS

- **Reversal of wastewater to agricultural land reduces the loss of phosphorus and nitrogen to the Baltic Sea. Phosphorus is an essential nutrient and also a finite resource, and therefore the value of recovering is obvious. Local treatment of wastewater also reduces transportation that is costly. Screen tests will be carried out in order to evaluate the environmental effects of the new technology. Evaluations will also be done of the possibilities to apply the technology in other locations outside the pilot area. The technology and the knowledge are assumed to be of interest in water management activities nationally and internationally.**
- **Sanitation of lavatory water with urea is a relatively straightforward technology that also will work on other locations where lavatory water is collected in closed tanks. Examples of areas where closed tanks are common, and thereby interesting for the described technology, are summer cottage areas and water protection areas. An advantage with the technology is that it can be adapted to local conditions. In many cases, closed storage spaces are available in the form of e.g. manure pits.**
- **In Kalmar municipality there are about 200 closed tanks for collection of lavatory water. There are many farms in the municipality without animals in need of fertilizers for their crops. LRF – Sweden's national organisation of farmers – has commented positively on returning the black-water from individual households since the concentration of metals in such waste water is lower than in the sludge from municipal sewage treatment plants. The farmers must of course be paid for their services of collecting and treating the lavatory water.**

The completed facility with the manure container in the background.

- *The well is isolated in order to ensure that the sanitation process does not stagnate because of low temperatures.*
- *A pump functions as a stirrer, and pumps over the purified lavatory water through a pipe to the (former) manure container.*

INFORMATION

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FEASIBILITY STUDY ABOUT BIOGAS PRODUCTION USING SLUDGE FROM SMALL SCALE SEWAGE PLANTS

INTRODUCTION

Creating a cycle of nutrients means that nutrients in sewage fractions are returned to the soil where they are needed, without risk to human health and the environment. Part of this challenge lies in the fact that it is difficult to gain acceptance for spreading sludge deriving from treated sewage as fertilizer on farmland. The need to find other purposes how the sludge can become a resource is thereby evident.

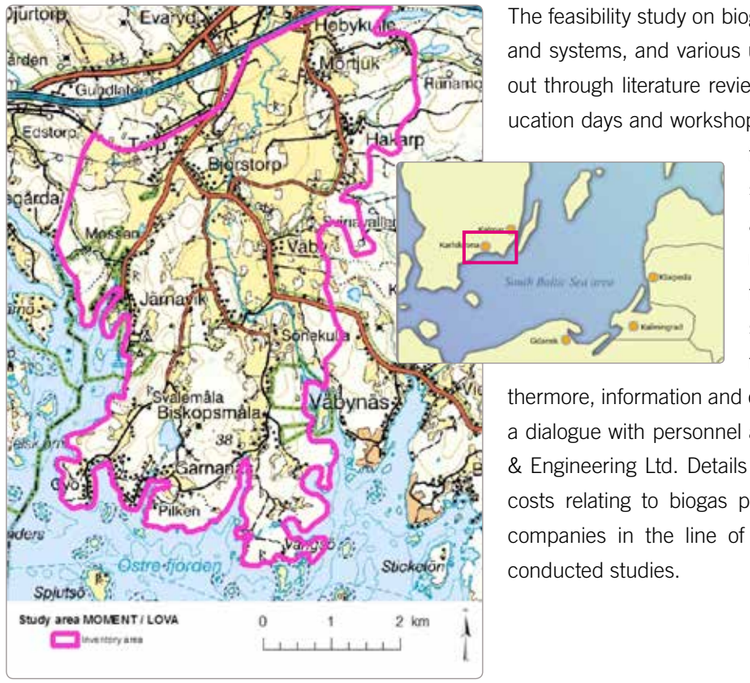
The other action within the thematic area Sewage from single family houses is a feasibility study about biogas production using sludge from small scale sewage plants.

MAIN OBJECTIVE

The project objectives have been to examine the status of existing private small scale sewage plants and carry out a feasibility study on the potential biogas production volumes through using sludge from these sewage plants. The examined area is a coastal section about 23 km long and with a total area of 25 km^2 in the southwest part of Ronneby Municipality, see figure. The study has been conducted as a combined sewer inventory and literature study on biogas production techniques. To achieve recycling of nutrients, they need to be returned to agriculture. Above all, it is the limited resource of phosphorus that needs to be recycled.

METHOD

The feasibility study on biogas production techniques and systems, and various use of biogas, was carried out through literature reviews and attendance at education days and workshops. Study visits were made to some biogas production sites in southern Sweden and to Lund University's research station on biogas techniques. A complete survey and sewage inventory was carried out. Furthermore, information and data was gathered through a dialogue with personnel at Ronneby Environmental & Engineering Ltd. Details of potential revenues and costs relating to biogas plants were gathered from companies in the line of business, and previously conducted studies.



The project study area is located in the southwest part of Ronneby municipality.
(Background Map © Lantmäteriet Gävle 2011, under contract M2005/3986 for resulting output)

RESULTS

The study report is summarising different steps of the processes in a biogas reactor, the nutrient contents in sewage sludge and its qualifications as a substrate, the contents of the biogas produced, and different techniques for digestion processes.

About 480 residential addresses have been screened in the sewer inventory. 44 % of the houses have an adequate sewage treatment whereas 53 % have not. The remaining 3 % have a sewage plant of dubious function.

The infrastructure of present collection methods is described. Environmental benefits of different techniques as well as handling of digestate is discussed, and it is concluded that to gain acceptance for spreading of digestate as fertilizer on farmland, at least REVAQ certification and a clear declaration of contents is required. It is also required that the digestate has reasonable nutrition content in relation to transport costs that are relatively high.

SOME FACTS

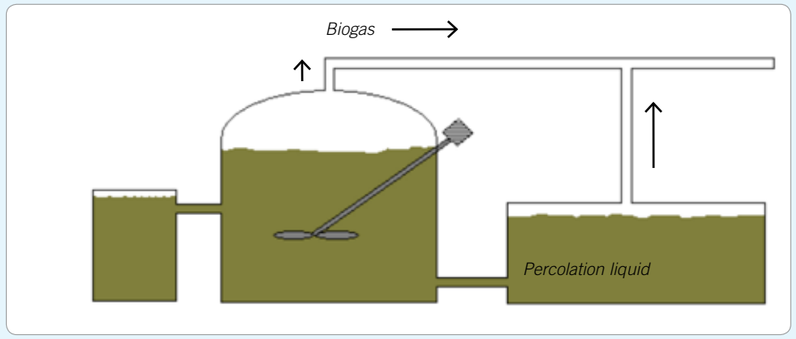
- **The Swedish EPA estimates the number of single houses with own waste water treatment to about 1 million. About 50 % are estimated to have insufficient tretament and about 125 000 of these only have a septic tank without any further treatment. The contribution of phosphourous from single house waste water today is estimated to a tenth of the total Swedish outlet to the Baltic Sea.**
- **For the Baltic Sea it is estimated that 13 % of the added phosphorus and 2 % of the added nitrogen comes from private wastewater.**

CONCRETE EFFECTS AND COSTS

A construction proposal is presented based on a biogas plant with wet digestion and a digestion chamber with the size of 700 m^3. The substrate used is 10 000 m^3 sewage sludge from septic tanks in the entire municipality and 56 tons of chopped straw. Estimated production is 178 000 Nm^3 biogas per year, or 20 Nm^3 biogas per hour. The compared alternatives are cogeneration (CHP) and upgrading to vehicle gas. The calculations show a deficit of about 25 000 SEK for cogeneration (CHP) and a surplus of about 125 000 SEK for vehicle gas production. It must be underlined here that transport costs for bringing the sludge from the small sewage plants to the biogas plant are not included.

Assuming that the amount of methane produced in uncontrolled conditions would be roughly the same as in controlled digestion for biogas production, the annual figures for Ronneby Municipality would be approximate reductions of 128 tons (178 000 Nm^3) of methane and 440 tons of carbon dioxide. On a per capita basis for the entire municipal population this would correspond to 4.6 kg of methane and 15.7 kg of carbon dioxide.

As the digestate from the processing of sludge from small scale sewage plants is less contaminated by metals than sludge from municipal waste water plants, there would be improved opportunities for recirculation of nutrients (particularly phosphorus) and humic substances to cultivated soil. For Ronneby Municipality the amount of phosphorus in the digestate might be in the order of 6.4 tons per year (using data provided in the report). This would correspond to about 0.23 kg per capita when considering the entire population.



Concept of a wet digestion facility with propeller agitation and continuous operation.

CONCLUSIONS AND RECOMMENDATIONS

- In general, production of biogas from sewage sludge is a good way to produce energy. It is environmentally friendly, renewable and resource efficient. If the biogas is processed to vehicle fuel, we can also reduce our dependence on fossil fuels that significantly contribute to global climate change.
- Production of biogas from sewage sludge is a good way to produce energy. It is environmentally friendly, renewable and resource efficient. Sewage sludge from households is less burdened with heavy metals than conventional sewage sludge. A separate collection and treatment of this sludge provides better conditions for the return of nutrients to soils and recycling systems. This is particularly important for phosphorus that is a finite resource.
- The cost effectiveness of the proposed actions is estimated to be high.
- The feasibility study recommends an investment in biogas production with subsequent upgrading to vehicle gas. The gas should then be used primarily for municipal waste collection vehicles. If the recommendations in the report are followed and the biogas will be used as vehicle gas, there would be a double positive effect on factors connected to climate change: (1) decreased outlets of methane from the degradation of organic matter in the sludge, (2) decreased outlets of carbon dioxide when the biogas produced is used as substitute for fossil fuels.
- The most appropriate option in the study area would be to collect the sludge to a larger facility. The amount of sludge within the study area is however too small to make it economically viable to build a biogas plant only for the study area. To reach financial pay-off, a biogas plant should be built for the sludge from all small scale sewage plants in the municipality.
- To gain acceptance for spreading of digestate as fertilizer on farmland, at least REVAQ certification and a clear declaration of contents is required. It is also required that the digestate has reasonable nutrition content in relation to transport costs that are relatively high.
- Collecting sludge from single houses requires a high amount of transports which, at least until today, are based on fossil fuels. Also the process itself uses energy. To be able to estimate the net energy and climate contribution in each case, an energy- and climate Life Cycle Analysis is needed. On the other hand, the pilot area transports already exist, since the sludge already today is transported to the municipal waste water treatment plant.

INFORMATION

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THE MOMENT PROJECT

In cooperation between seven regions in four countries around the South Baltic Sea area the project MOMENT aims at reducing the outflow of nutrients and hazardous substances by modern water management. This includes the establishment of Water User Partnerships allowing a "bottom up" approach starting at a local level and working within river basins letting the water set its own independent borders. The project is co-financed by the *South Baltic Cross-border Cooperation Programme 2007-2013* and runs from September 2009 until June 2013.

Find information and all reports on www.momentproject.eu

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South Baltic PROGRAMME

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