The BSAP Fund

Speeding up the ecological restoration of the Baltic Sea

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Summer holidays by the sea at Elbiku (Ölbäck), Estonia.

FOREWORD

Financing for a cleaner Baltic Sea

We are united and connected by our common inland sea. Today, however, the Baltic Sea first brings to mind algal blooming and toxic substances. An area of the sea bottom equivalent in size to Lithuania is completely devoid of oxygen. To add insult to injury, the Baltic Sea has the dubious honour of being called "the world's most polluted sea".

For this reason, all the Baltic Rim States in HELCOM agreed six years ago to adopt the Baltic Sea Action Plan to save it. Known by its acronym BSAP, the programme specifies tangible objectives for reaching good ecological and environmental status of the Baltic Sea by 2021. The action plan was signed by Denmark, Estonia, Germany, Finland, Latvia, Lithuania, Poland, Russia, Sweden and the EU.

Unique in the history of the Baltic Marine Environment Protection Commission HELCOM, the action plan specifies concrete nutrient reduction requirements for all the states that are signatories to the document. Among other things, the BSAP aims at reducing phosphorus discharges by 15,176 tonnes and nitrogen discharges by 118,134 tonnes per year. To achieve these goals, every coastal nation is to prepare a national programme defining tangible measures.

It is difficult at times to raise funding for feasibility studies to help investors launch important projects beneficial to the Baltic Sea. In fact, this was one of the reasons why Finland and Sweden took the initiative to establish a joint BSAP Fund to address the bottlenecks in the preparation of key Baltic Sea projects.

All the capital in the fund has been allocated, with a total of 34 projects financed to date. The purpose of this brochure is to highlight the achievements of the fund and explain how the money has been spent. At the same time, we hope that the BSAP Fund will get a new lease of life with economic contributions from the countries around our common sea.

> "We hope that the BSAP Fund will get a new lease of life with economic contributions from the countries around our common sea.

Lena Ek
Minister for the Environment
Sweden

REGERINGSKANSLIET

Ville Niinistö
Minister of the Environment
Finland

PENTTI HOKKANEN / YHA KUVAPANKKI

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Rocky islet in the archipelago of Ingå (Inkoo), Finland.

FUND MANAGER'S OVERVIEW

Innovations for the Baltic Sea

Managed jointly by the Nordic Investment Bank and NEFCO, the HELCOM Baltic Sea Action Plan (BSAP) Fund was established to accelerate the preparation of projects, eliminate bottlenecks in their implementation and bring them forward. For example, the lack of business plans and feasibility studies often prevents or postpones project launches. The fund capital stands at EUR 11 million, of which EUR 2 million is provided by Finland for projects in Russia and the rest by Sweden. In addition to the EUR 11 million from the BSAP Fund, project owners and co-financiers have contributed with EUR 28 million to the projects.

Since its establishment in 2010, the Fund has approved a total of 36 projects. As two of them were aborted, 34 active projects remain. Seven projects were brought to completion in June 2013. Geographically, the projects were spread across the Baltic Sea Region from Russia, Poland, Estonia to Sweden and Finland as well as the Baltic Sea catchment area in Belarus.

The fund priorities are reductions of discharges of nutrients from agriculture, cleaner shipping as well as upgraded treatment of wastewater, manure and organic waste.

Most of the fund capital is allocated for the recycling of nutrients. A total of EUR 4.4 million in the portfolio has been assigned to 15 projects focusing on nutrient recycling and biogas production. In nine projects, co-funding has been provided for pilot-scale plants for testing or demonstrating processes such as the production of biogas and pyrolysis. A little less than one third of the Fund's projects, eleven in all, are related to wastes and wastewater treatment. Two projects concern the reception of wastewaters at ports.

Technical documents have been prepared for the upgrading of wastewater treatment facilities in Meriküla, Keila-Joa and Türisalu in Estonia, among others. New ideas and methods are called for in the efforts to protect the Baltic Sea to complement the existing toolkit. Current, attractive innovative projects include the conversion of a ro-ro vessel into a methanol-powered ship; the use of algae in the production of biogas; and the binding of nutrients in deep oxygen-depleted areas of the Baltic Sea by means of a floating wind power turbine.

The BSAP Fund seeks to serve as a catalyst by offering funding for the development, preparation and implementation of projects. Naturally, all the projects must benefit the Baltic Sea in accordance with the BSAP's objectives and at the same time they must be economically feasible to make it possible to raise international funding for the schemes at a later stage.

Saving the Baltic Sea calls for innovative solutions. It remains to be seen whether the BSAP Fund will receive an infusion of capital from the Baltic Rim States to implement further innovative projects.

Anja Nystén
Fund Manager
BSAP Fund

ROBERTO NYBLIN

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> The BSAP Fund seeks to serve as a catalyst by offering funding for the development projects.

SIX YEARS OF BSAP

Baltic Sea on its way to recovery

The Ministerial Meeting on 3 October 2013 in Copenhagen is a major milestone in HELCOM's work to protect the marine environment of the Baltic Sea. It is time to evaluate the effectiveness of the national and regional actions against the targets of the Baltic Sea Action Plan (BSAP) adopted in 2007.

The BSAP reflects the ambition of the coastal nations to fight eutrophication, reduce inputs of hazardous substances, improve maritime safety and halt the loss of biodiversity.

Eutrophication, a major environmental problem caused by excessive inputs of nutrients, nitrogen and phosphorus, is high on the agenda. Recently, extensive work has been carried out to review and update the HELCOM nutrient reduction scheme. It now includes inputs through the air in addition to inputs from rivers. The targets of the scheme provide scientific guidance on how much pollution needs to be reduced to achieve a Baltic Sea without eutrophication.

Progress in reducing nutrient inputs to the Baltic Sea can be demonstrated. The overall nitrogen inputs have been reduced by nine per cent (80,937 tonnes) since the baseline period of the BSAP (1997–2003), and the phosphorus inputs by ten per cent (3,751 tonnes). However, when looking at the sub-basin and country levels, progress is not uniform - there are cases of significant improvements but also cases where inputs have not changed or have even increased.

Despite the clear overall positive trend, the Baltic Sea is still in poor environmental condition. How long will it take to see the positive effects in the marine environment once the reduction targets are met? It may take long before the objectives are fully reached. Nevertheless, significant and visible improvement is expected to take place rapidly, almost immediately after bringing the pollution down to the maximum levels. For instance, already one year after implementing the reductions, nitrogen fixation in the Gulf of Finland will be reduced by almost 20 per cent, and as a result there will be less summer blooms of blue-green algae and noticeably clearer waters.

Pollution does not only come from the HELCOM countries, there are other sources in other countries such as Belarus and Ukraine as well as at sea. It is important to address these sources through existing legislative and cooperation frameworks as well as by bi- and multilateral projects.

The BSAP Fund can help fulfil the ambitious targets of the HELCOM nutrient reduction scheme. It can bridge the still existing gap in translating the targets into area- or site-specific implementation, strengthening local contributions towards our common regional goals.

Monika Stankiewicz
Executive Secretary
HELCOM

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The BSAP reflects the ambition of the coastal nations to fight eutrophication, reduce inputs of hazardous substances, improve maritime safety and halt the loss of biodiversity.

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Icy waters in
the Gulf of Finland.

2010—2013

Projects

Since its establishment in 2010, the BSAP Fund has approved a total of 34 projects.

Project name: Business plans for poultry factories in the Leningrad region.
Country: Russia
BSAP support: 200,000

Project name: Putting best practices into work — consultancy services.
Country: All
BSAP support: 795,000

Project name: St. Petersburg nutrient removal in small wastewater treatment plants. Implementation support.
Country: Russia
BSAP support: 625,720

Project name: Pyrolysis of poultry manure for production of biofuel, fertilizers and energy.
Country: Russia
BSAP support: 92,520

Project name: Reduction of discharges from Swedish municipal wastewater treatment plants.
Country: Sweden
BSAP support: 739,368

Project name: Smyge algea biogas plant and biogas education and development centre.
Country: Sweden
BSAP support: 500,000

Project name: Novgorodsky biogas plant.
Country: Russia
BSAP support: 300,000

Project name: Recirculation of nutrients from small scale treatment plants (sanitation plant).
Country: Sweden
BSAP support: 411,765

Project name: Investment preparation in the ports of Tallinn, Muuga and Paldiski.
Country: Estonia
BSAP support: 34,446

Project name: Shore-side sewage water receival and treatment for Ro-Ro ferries: Investment preparation in the port of Trelleborg.
Country: Sweden
BSAP support: 300,000

Project name: Meriküla wastewater treatment renovation.
Country: Estonia
BSAP support: 92,000

Project name: Türisalu wastewater treatment renovation.
Country: Estonia
BSAP support: 90,000

Project name: Information hub regarding structural liming and lime filter ditches.
Country: Sweden
BSAP support: 250,000

Project name: Pig manure based demonstration biogas plant.
Country: Poland
BSAP support: 100,000

Project name: Alcohol (spirit) and ether as marine fuel (SPIRETH).
Country: Sweden
BSAP support: 650,000

Project name: Full-scale site solution of phosphorus retrieval from biowaste.
Country: Sweden
BSAP support: 175,000

Project name: Jordberga farming system project (biogas).
Country: Sweden
BSAP support: 460,000

Project name: Agrowaste — pilot demonstration. Installation of microscale biogas plant in Boleslawowo.
Country: Poland
BSAP support: 45,000

Project name: Waste management from poultry farms in the area of Golienów (biogas).
Country: Poland
BSAP support: 500,000

Project name: Assessment of regional nutrient pollution load and identification of priority investment projects to reduce nutrient pollution from Belarus to the Baltic Sea.
Country: Belarus
BSAP support: 243,870

Project name: Biogas production and nutrient recycling from municipal food waste and manure – Demonstrating a systems approach to organic waste management for Polish municipalities.
Country: Poland
BSAP support: 340,000

Project name: Box-Win business plan. A full-scale model "demonstrator" for a floating wind turbine unit which combines oxygenation of the deep water and simultaneously generating energy.
Country: Sweden
BSAP support: 180,000

Project name: Preventing direct leakage from old manure storage facilities of the Udarnik poultry farm.
Country: Russia
BSAP support: 115,000

Project name: Improvement of water and wastewater services in Kingisepp, the Leningrad region.
Country: Russia
BSAP support: 129,930

Project name: Elimination of pollution of the Baltic Sea by run-offs of poultry manure and pig slurry through the financially sustainable production and export of biomethane and organic fertilizers.
Country: Russia
BSAP support: 325,000

Project name: Rehabilitation of the municipal water and wastewater services in Sosnovyi Bor — phase 3.
Country: Russia
BSAP support: 90,000

Project name: A new modern wastewater treatment plant in Kalmar to reduce discharges of nutrients to the Baltic Sea.
Country: Sweden
BSAP support: 170,000

Project name: PURSUC Biochar system.
Country: Russia
BSAP support: 67,500

Project name: Myślibórz biogas plant.
Country: Poland
BSAP support: 200,000

Project name: Agrowaste, Lublin province (biogas).
Country: Poland
BSAP support: 230,000

Project name: The establishment of a pig manure based biogas demonstration plant in Poland to produce renewable energy, improve manure nutrient management and reduce nutrient leaching.
Country: Poland
BSAP support: 300,000

Project name: Renovation of Muuga wastewater treatment plant.
Country: Estonia
BSAP support: 170,000

Project name: Renovation of the wastewater treatment plant in Võsu.
Country: Estonia
BSAP support: 93,000

Project name: Closing nutrient cycles of material flows from agriculture, industry and communities by combining biogas and pyrolysis processes.
Country: Finland
BSAP support: 460,000

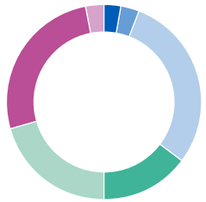
Footnote: All BSAP support figures are in EUR

2010—2013

Projects

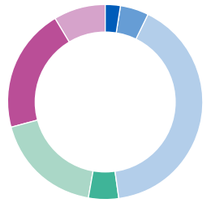
Sectoral and geographical distribution of all BSAP projects

Number of projects per country (No.)



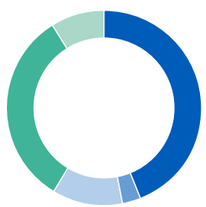
Belarus	1
Finland	1
Sweden	10
Estonia	5
Poland	7
Russia	9
All	1

Grant value per country (MEUR)



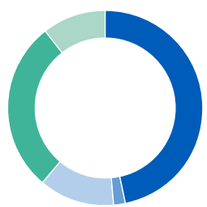
Belarus	0.24
Finland	0.46
Sweden	3.84
Estonia	0.48
Poland	1.72
Russia	1.95
All	0.80

Project categories March 2013 (No.)



Recycling of nutrients, biogas	15
Restoration and binding of nutrients	1
Agricultural load reduction	4
Water and waste-water load reduction	11
Shipping and port load reduction	3

Project categories March 2013 (MEUR)



Recycling of nutrients, biogas	4.44
Restoration and binding of nutrients	0.18
Agricultural load reduction	1.18
Water and waste-water load reduction	2.69
Shipping and port load reduction	0.98

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Boathouses in Högsåra, Finland.

CASE STUDY 1

Alternative fuels to reduce airborne emissions from shipping

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The Port of Reposaari (Räfsö), Finland.

Project: Alcohol and ethers as marine fuel

Project owner: SSPA AB, Sweden

Duration: 2012–2014

Year of BSAP funding: 2012

Approximate total budget: EUR 3.7 million

BSAP Funding: EUR 650,000

Contact person: joanne.ellis@sspa.se

Airborne emissions from shipping contribute to pollution and environmental problems. The HELCOM Baltic Sea Action Plan has identified emissions from shipping as one of the inputs of nitrogen to the Baltic Sea area which contributes to the eutrophication problem. Alternative fuels will be part of solving this problem.

The Baltic Sea is part of a designated Sulphur Emission Control Area where the maximum allowable sulphur content in marine fuels will be reduced to 0.1% in 2015. Nitrogen oxide (NO_x) emissions will also need to be reduced in emission control areas starting from 2016.

Switching from heavy fuel oils to cleaner alternatives is, from an environmental perspective, a sound solution for reducing emissions. Methanol and di-methyl ether (DME) are very interesting alternative fuels that should enable ships to comply with the upcoming SECA regulations without any further exhaust gas after-treatment. They can also be produced from several types of feed stock such as fossil fuels, biomass and by synthesis of H_2 and CO_2 in a so called Carbon Capture and Recycling (CCR) process, thus they have the potential to be a "green" fuel in the future.

The use of a methanol-based fuel will be demonstrated in a marine engine on board an existing Swedish ropax vessel. An auxiliary engine and generator set will be modified to operate on a fuel which is a blend of methanol and DME. This fuel will be produced from methanol in a process plant on board the vessel, using a technology called "On Board Alcohol To Ether" (OBATE). The project also includes modifying a marine engine for operation on methanol and testing it in an engine laboratory.

An assessment of operational performance, safety, and environmental performance with respect to emissions reduction will be carried out within the project. The on board testing is expected to provide unique field-based information on emissions levels, engine performance, and operational costs. The cost effectiveness and cost benefit of the systems will be assessed and compared to other methods of meeting emission control guidelines.

The project group consists of SSPA Sweden (project coordinator), Scandinaos (technical coordinator), Stena Rederi, Haldor-Topsøe, Wärtsilä, Lloyd's Register EMEA, and Methanex. The results of the pilot demonstrator project are expected to be useful for ship operators within the Baltic Sea area for making decisions regarding the fulfilment of upcoming emissions regulations.

> "The on board testing is expected to provide unique field-based information on emissions levels, engine performance, and operational costs.

CASE STUDY 2

Receiving ship-generated sewage in a busy Baltic Sea cruise port

Project: Designing of sewage water system for Port of Tallinn Old City Harbour

Project owner: TS Energia, Estonia

Duration: January–July 2012

Year of BSAP funding: 2011

Approximate total budget: EUR 54,000

BSAP funding: EUR 34,446

Contact person:
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TS Energia OÜ
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During the cruise season Tallinn's Old City Harbour hosts over 300 cruise ships and 11 passenger ships.

02
Mapping out sewage pipes in the Port of Tallinn.

In 2007, the states in the Baltic Sea region decided to adopt the HELCOM Baltic Sea Action Plan, which defined the actions needed to protect the natural environment of the Baltic Sea. One of the issues targeted was minimising pollution from ships' sewage, which need enhanced port reception facilities in order to reach that goal.

The International Maritime Organisation has declared the Baltic Sea a special area for environmental reasons and decided that from 2016 all new passenger and cruise ships are not allowed to release their sewage into the sea (MARPOL Convention Annex IV). From 2018, the same ban will apply to the rest of the passenger and cruise ships travelling in the Baltic Sea.

The European Cruise Council has also declared that it will promote the ending of the polluting of the Baltic Sea by ship sewage in that case that the ports build adequate sewage water reception facilities.

During the cruise season the Old City Harbour hosts over 300 cruise ships and 11 passenger ships (from Helsinki, Stockholm, St Petersburg) daily. The calculated amount of sewage water needed to be collected from these ships amounts to 150,000–200,000 m³ yearly.

For these reasons, TS Energia OÜ, the energy company of the Port of Tallinn, is procuring this project to design the port sewage water reception facilities in the Old City Harbour in the Port of Tallinn.

Designing port reception facilities

TS Energia OÜ is the utility services and energy company owned by the Port of Tallinn, operating in five ports: Muuga Harbour, Old City Harbour, Paldiski South Harbour, Paljassaare Harbour and Saaremaa Harbour.

TS Energia provides its clients with electrical current, water, sewage and heating. Additionally, the services offered are engineering, building, inspection, maintenance and consultation for the these utilities and systems.

Consultants have developed a plan and design for installing port reception facilities in cooperation with a project team from TS Energia OÜ and additionally experts from Tallinna Vesi (the water company of the City of Tallinn).

> One of the issues targeted was minimising pollution from ships' sewage.

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CASE STUDY 3

Using algae for recycling phosphorus and nitrogen in the Baltic Sea

Project: Smyge Algae Biogas Plant and Biogas Education and Development Centre, Sweden

Project owner: Municipality of Trelleborg, Sweden

Duration: 2012

Year of BSAP funding: 2011

Approximate total budget: EUR 1.5 million

BSAP funding: EUR 500,000

Contact person:
Claus Pedersen
Trelleborg's Municipality
claus.pedersen@trelleborg.se

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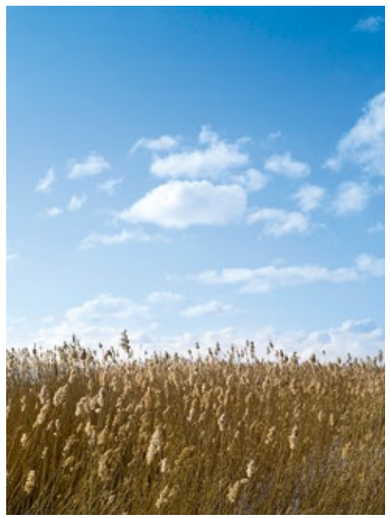

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The municipality of Trelleborg, a small city situated on the southern tip of Sweden, has decided to become a true pioneer in reducing all its releases of nutrients to the Baltic Sea in its coastal zone.

The aim is to reach a nutrient sea balance and stop the eutrophication of its part of the Baltic Sea's vulnerable brackish waters. This is a great challenge for a community with one of the largest agricultural area proportions in Sweden and the largest roll on–roll off (Ro-Ro) port in the Baltic region.

"If Trelleborg can succeed with this, then most other coastal zone municipalities around the Baltic Sea should also be able to create their own functioning nutrient balance," says Claus Pedersen, Head of Department of Environmental and Urban Management of the Municipality of Trelleborg.

Practical and functional solutions

All nutrient flows from farmlands are fetched up in rivers and wetlands, where sweet water algae are grown and collected at a full-scale biogas plant, in which the green energy is used for heating and electricity production. Phosphorus reaching the sea is swept up in algae from the sea and also used for the production of biogas. The heavy metals in the residues are removed, and they go back to the farmlands again as fertilizers.

On the port side, the solutions are equally simple. Phosphorus and nitrogen flows from the ferries' kitchens and toilettes are kept on board and pumped over in port, and used for biogas production in the municipality's sewage water treatment plant. These residues are also being certified and used as fertilizers for farmlands.

Trelleborg strives to assist and encourage other Baltic Sea municipalities to copy these solutions, and is therefore presently setting up a Biogas Education Centre, where visitors can learn about and share achievements and solutions. This centre will be available for information and training purposes, and together with the ferry sewage installations and the full-scale biogas plant, become ready during 2012.

The BSAP fund has found the solutions to be of such interest for replication in other coastal zone municipalities and ports that it has decided to support the pilot biogas plant and the Education Center financially.

> "If Trelleborg can succeed with this, then most other coastal zone municipalities around the Baltic Sea should also be able to create their own functioning nutrient balance.

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Trelleborg has the largest ro-ro harbour in the Baltic region.

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All nutrient flows from farmlands are fetched up for cultivation of sweet water algae and production of biogas.

CASE STUDY 4

Processing chicken manure in Russia into marketable products

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New technology may make possible the use of manure as raw-material for the production of bio-oil, nutrient rich charcoal and biogas.

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CATA PORTIN

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Deposit of poultry manure in the Leningrad region, Russia.

02
There are approximately 20 million chicken in the vicinity of St. Petersburg, Russia.

Project: Pyrolysis for the production of bio-oil, fertiliser and energy from chicken manure

Project owner:
Scandinavian Enviro Systems (SES), Sweden

Duration:
September 2010–April 2011

Year of BSAP funding: 2010

Approximate total budget:
EUR 120,000

BSAP funding: EUR 92,000

Contact person:
Ola Ekman, CEO
Scandinavian Enviro Systems
ola@envirosystems.se

In the Leningrad Oblast, Russia, chicken manure from chicken production units form a considerable waste problem by adding to the nutrient load into the Baltic Sea.

Most of the more than 1 million tonnes of manure annually produced within the region is not managed properly, meaning that nutrients are leaking, or may leak, into the Baltic Sea. New technology may, however, make possible the use of manure as raw-material for the production of bio-oil, nutrient rich charcoal and biogas. All of these have a market value and may be further processed for use elsewhere.

“Carbonising by Forced Convection” is a patented Swedish technology for recirculation of organic material. The technology has so far been used for processing of used car tyres.

“Principally the process may be illustrated by a reversed baking process, where the bread is placed in the oven and after a while out comes the flour, yeast, salt, and water. The output from a car tyre recycling process is carbon black, oil, gas and steel. In the case of chicken manure, the same products, except steel, are recovered from the process,” says Karl-Johan Lehtinen, Environmental Analyst at NEFCO.

The bio-char formed contains phosphorus and nitrogen, making it a valuable non-smelling and lightweight fertiliser which can be further processed into high value products. The oil can be used as such for energy production similarly as fuel oil or heavy crude oil, or further processed into products for the pharmaceutical industry. The gas can be used partly in the process. Furthermore, excess gas can be used for other possible processes, such as heating or further distillation of oil components.

The company Scandinavian Enviro Systems (SES), founded in 2001 with the business idea of building and operating pyrolysis plants in cooperation with partners, has established a full-scale recirculation plant for used car tyres in the former pulp mill Åsensbruk in Sweden. According to SES, processing chicken manure does not differ much from the processing of used car tyres. However, the process needs refinement in order to reveal specific key process conditions needed for optimal product composition. The Baltic Sea Action Plan (BSAP) Fund has allocated EUR 92,000 for the optimisation of process conditions for the handling of chicken manure. The aim is to implement the technology at a chicken farm in the Leningrad Oblast.

Until now, there has been no technology to handle chicken manure in both an environmentally and economically sustainable fashion as direct incineration of the manure has been found not to be economically viable. The Russian government has expressed a goal to considerably increase chicken and egg production within the next few years in the Leningrad Oblast. Thus, if no measures are undertaken, uncontrolled discharges of nutrients will increase further. However, in the Russian National Implementation Plan of the BSAP, eutrophication from agricultural activities within the Leningrad Oblast is identified as a key area for remedial actions.

“From a broader perspective, the successful implementation of a plant for pyrolysis of chicken manure would serve as a demonstration for other chicken producers of how to convert an environmental liability into a profitable way of producing renewable products,” says Mr Lehtinen.

CASE STUDY 5

Deepwater oxygenation in the Baltic Sea

The potential of phosphorus removal in the Bornholm Basin by the oxygenation of the deepwater is at least 5,000 tonnes per year.

Project:
Box-Win Business Plan

Project owner:
University of Gothenburg

Duration:
2012–2013

Approximate total budget:
EUR 400,000

BSAP funding:
EUR 180,000

Contact person:
Prof. Anders Stigebrandt
anst@gvc.gu.se

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It is estimated that deepwater oxygenation can bind phosphorus at an average price of EUR 9,000 per tonne.

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Floating wind turbine equipped with a pump.

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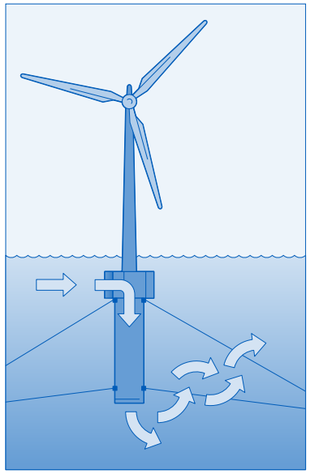

Floating wind turbines equipped with pumps may be used for deepwater oxygenation in the Baltic Sea and the production of sustainable electric energy. Oxygenation of the deepwater will bring life to dead bottoms and stop the outflow of phosphorus from them.

This innovation, in turn, will decrease eutrophication leading to improved water quality, for example by reduced blooming of cyano bacteria in summer in the open Baltic Sea as well as in most coastal areas. The Unit Abatement Cost (UAC) of phosphorus removal by deepwater oxygenation in the Bornholm Basin is estimated at EUR 9,000 per tonne with a potential of at least 5,000 tonnes per year.

The phosphorus (P) concentration in the water column of the Baltic proper has increased since the 1980s despite the fact that the external phosphorus supply has been halved. The explanation of this apparently paradoxical situation is that the growing internal sources (approx. 100,000 tonnes P/year) now dwarf the external sources (approx. 35,000 tonnes P/year) as explained in a recent scientific report by the BOX project. With reference to internal sources, the report shows that anoxic bottoms have a high leakage of the phosphorus that has accumulated under previous oxic conditions over many decades. Obviously, the on-going eutrophication of the Baltic Sea can only be halted by stopping internal phosphorus sources by the permanent oxidation (natural or manmade) of the anoxic bottom sediments. Whether time-limited (restoration) or long-term oxygenation is needed essentially depends on the magnitude of the external supply.

The purpose of BOX-WIN is to build a Demonstrator of a full-scale wind-driven pump unit of a type that can be used in a future system of many pumps for the oxygenation of the deepwater of the Baltic Sea. Gothenburg University and Falkung Miljö-Energi AB have jointly performed the first phase of the feasibility study, which has resulted in a number of reports covering both the environmental and legal aspects of pumping oxygen saturated water into the deepwater of the Bornholm Basin as well as the Demonstrator's technical specifications. Its design – engineering, construction, transportation and installation – is based on components well proven in the offshore oil and gas, and wind industries as well as in traditional shipbuilding. The reports can be downloaded from www.box-win.se. A study into the crucial ecological effects of oxygenation in the Bornholm Basin remains to be published.

According to the BOX report, the potential of phosphorus removal in the Bornholm Basin by the oxygenation of the deepwater is at least 5,000 tonnes per year. The estimated annual cost for oxygenation, by pumping 1,000 m^3 per second of oxygen saturated so-called winter water from 30 m depth into the deepwater at 90 m depth, is estimated by Box-Win to be about SEK 382 million (about EUR 45 million), giving a Unit Abatement Cost (UAC) of about EUR 9,000 /tonne phosphorus immobilized. This order of magnitudes is less than the UAC of most other methods that have much smaller phosphorus removal potentials.

Footnote: UAC = Unit Abatement Cost of a tonne of phosphorus usually compared with a relevant and comparable Nordic shadow price.

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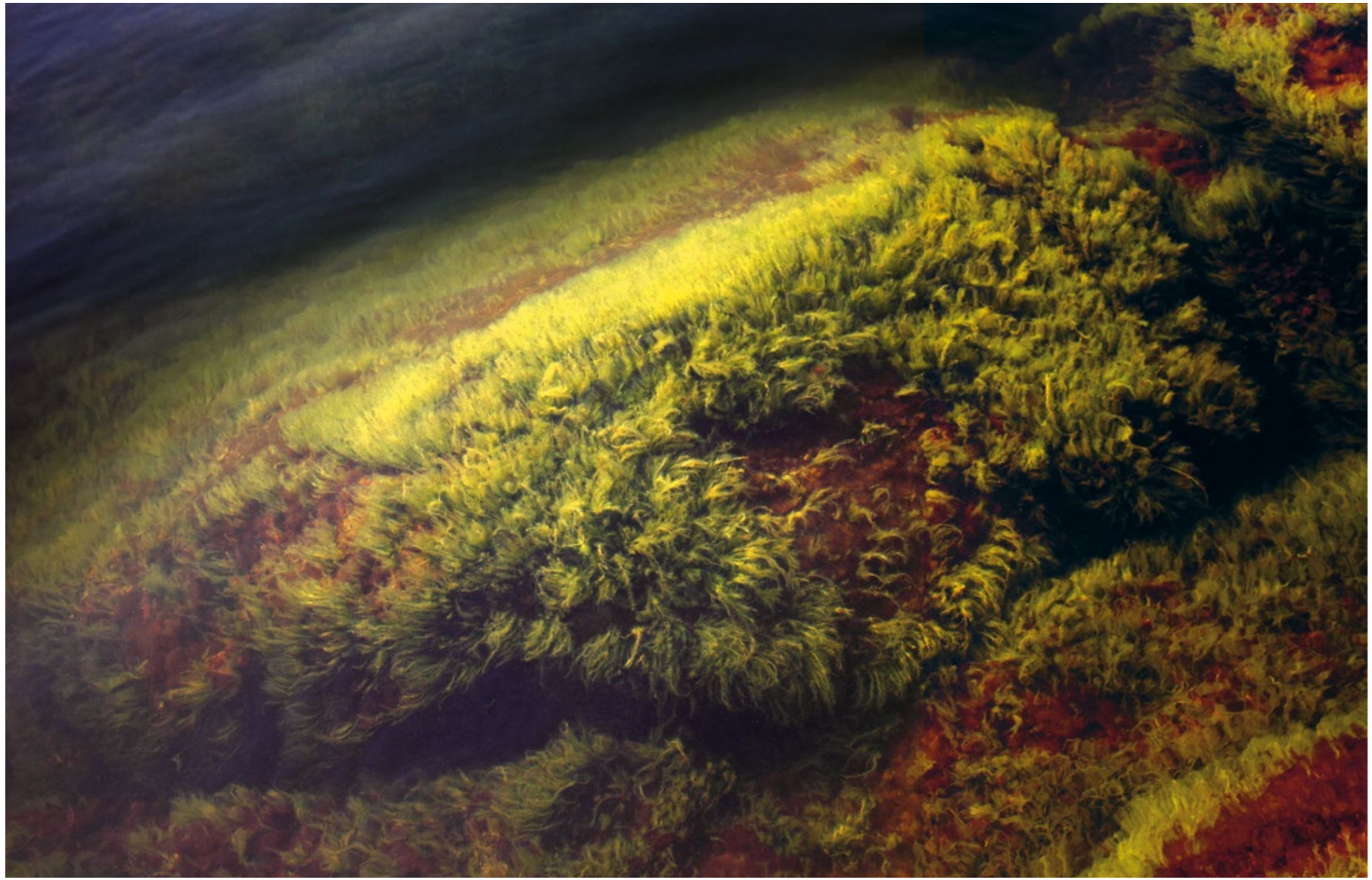

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The eutrophication of the Baltic Sea feeds excessive growth of filamentous algae.

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