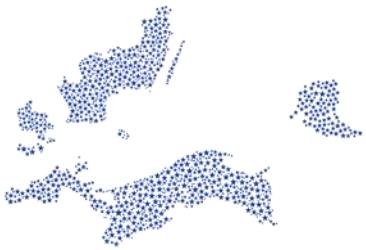
COASTAL BIOGAS

Cluster On Anaerobic digestion, environmental Services and nuTrients removAL

4th COASTAL Biogas Conference

December 9th, 2020

Online



Partners

Funded by

The contents of this report are the sole responsibility of the COASTAL Biogas consortium and can in no way be taken to reflect the views of the European Union, the Managing Authority or the Joint Secretariat of the Interreg South Baltic Programme 2014-2020.

Background and goal of the conference

The Interreg South Baltic project **COASTAL Biogas** revolves around co-digestion of cast seaweed collected on beaches and utilisation of the digestate as an organic fertiliser. In this way nitrogen and phosphorus are physically removed from the sea, the inconveniences with rotten seaweed are eliminated, biogas and organic fertilisers are produced, and the first step towards the circular bioeconomy is taken.

As part of the COASTAL Biogas project, five conferences are organised in order to spread the knowledge of the project as well as collaborate with other projects. The fourth conference was scheduled to take place in Rostock, Germany, but was held as an online event due to the COVID-19 situation. Nevertheless, the emphasis regarding the presentations was kept with German origin. The focus of the conference was on regulations and policies related to utilisation of marine biomasses.

The presentations are available at the conference webpage. Information about the previous and future conferences is available on the COASTAL Biogas website: https://www.coastal-biogas.eu/events/.

Eutrophication in the Baltic Sea and associated directives

Eutrophication affects 97% of the Baltic Sea and is one of the major environmental problems since it has both ecological and social consequences. The overload of nutrients, mainly from the agricultural sector, discharged into the Baltic Sea, results in excessive growth of micro algae, also known as algae blooming. When the blooming is over and the algae sink to the seafloor and decay, they consume the oxygen and create dead zones. Micro algae thrive due to the nutrient overload on the expense of other species, which is a strong threat to the biodiversity in the Baltic Sea.

There are several directives, which come in to play, affecting the state of the Baltic Sea, directly or indirectly. To reflect this, the presentations were touching on relevant regulations and policies and the panel debate highlighted challenges and regulatory aspects in collecting cast seaweed and use the nutrient content for fertilising purposes.

Projects related to the use of maritime biomasses

There are several ongoing projects targeting the utilisation of maritime biomasses. COASTAL Biogas has established collaboration with most of them and invites representatives on a regular basis to give presentations and be part of the conference series. During this conference, the projects CONTRA and SUSCULT were presented. The SUSCULT project focuses on seaweed cultivation strategies, whereas CONTRA is mainly addressing recycling and utilisation options of beach wrack. Both projects obviously have to be aware of the related regulatory framework in the Nordic and Baltic region. The presenters were able to provide an interesting overview of those, from slightly different perspectives.

In addition, a presentation on the Solrød Biogas plant was given, where cast seaweed is co-digested on an industrial scale.

The core of the **COASTAL Biogas** project is the removal of nutrients from the Baltic Sea and closing the nutrients cycle (see Figure 1) as means to mitigate eutrophication. By doing so, several other socio-economic benefits are obtained:

- elimination of the inconveniences with rotten seaweed on the beaches, e.g. bad smell and greenhouse gas emissions to the atmosphere from decaying seaweed
- improved water quality
- clean beaches for the benefit of recreation and tourism
- creation of local and resilient value chains
- production of biogas and organic fertiliser

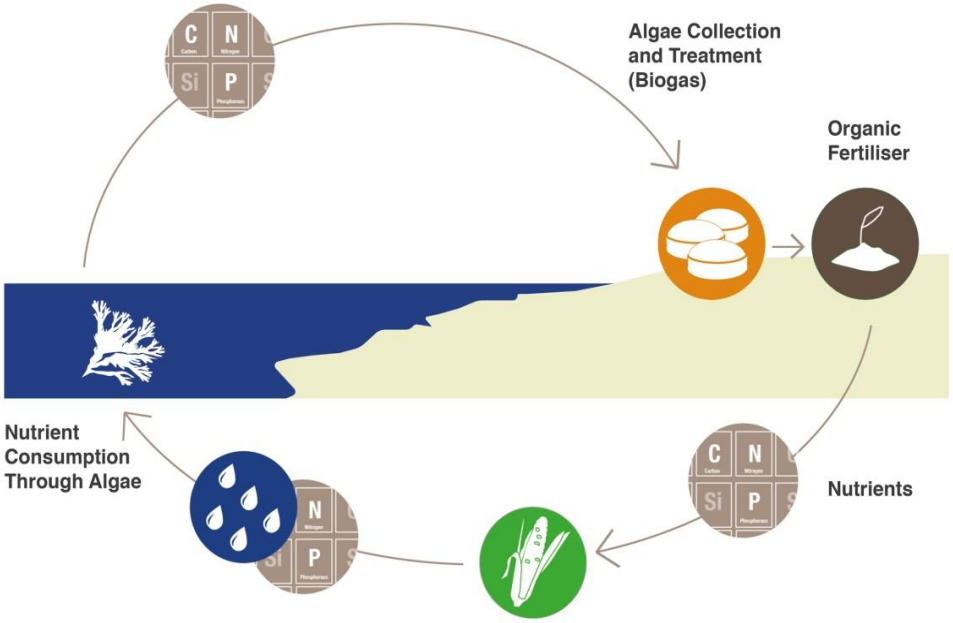


Figure 1: Overview of the COASTAL Biogas concept. Source: Presentation by Kristin Sternberg, FNR, available at https://www.coastal-biogas.eu/events/conference-germany/

The annual potential of cast seaweed in the South Baltic Sea area is estimated to approx. 1,800,000 tonnes[a]. The nutrients and heavy metal content of the seaweed varies and there can be large geographical differences as seen in a study, where samples were taken from 13 sites in Germany[b].

The COASTAL Biogas project outputs are: Improved processes of co-digestion of seaweed, Cross-border technology guidance and Decision support tool and training kit.

For more information about COASTAL Biogas: www.coastal-biogas.eu

a) Presentation by Vytautas Akstinas, Lithuanian Energy Institute
b) Presentation by Sebastian Foth, University of Rostock
Both presentations are available at https://www.coastal-biogas.eu/events/conference-germany

The Interreg Baltic Sea Region project **CONTRA** aims to find a balance between the utilisation of beach wrack , following the public demand for 'clean' beaches but also environmental protection and the economic considerations. The main output is a tool kit for beach wrack management.
Several case studies are conducted within CONTRA and these case studies include the use of beach wrack

- as soil improvers/fertilisers (composting)
- for biocoal production (see Virtual study tour at the end of this report for more info)
- as landfill cover (compost-layer containing bacteria that can convert methane into carbon dioxide)
- for coastal protection (beach wrack compost for dune greenery)
- for biogas production
- for wastewater treatment (beach wrack as co-composting material in wetland technology)

Source: Presentation by Jane Hofmann, The Coastal Union Germany, available at https://www.coastal-biogas.eu/events/conference-lithuania/

For more information about CONTRA: https://www.beachwrack-contra.eu/

The **SUSCULT** project – Sustainable cultivation of seaweed – is a sister project of GRASS, which was presented at the 2nd COASTAL Biogas conference. SUSCULT will complement the GRASS project in the following aspects

- expanding the legal analysis done in the Baltic Sea region to other Nordic countries, some of which have more experience in seaweed cultivation
- SUSCULT will do some actual growth experiments and data collection of growth potential of different seaweed in the different countries

Main EU regulations relevant for seaweed cultivation are:

- Maritime Spatial Planning Directive
- Marine Strategy Framework Directive
- Water Framework Directive
- Alien Species Regulation
- Habitats Directive
- Environmental Impact Assessment Directive
- Organic Food Regulation

Source: Presentation by Anu Lähteenmäki and Teresa Camarena Gómez, Finnish Environment Institute, available at https://www.coastal-biogas.eu/events/conference-lithuania/

For more information about SUSCULT: https://www.submariner-network.eu/sustainable-cultivation-of-seaweed-suscult-project-approved

Experiences from **Solrød Biogas** plant, where cast seaweed is co-digested on an industrial scale, were presented in relation to the main regulations.

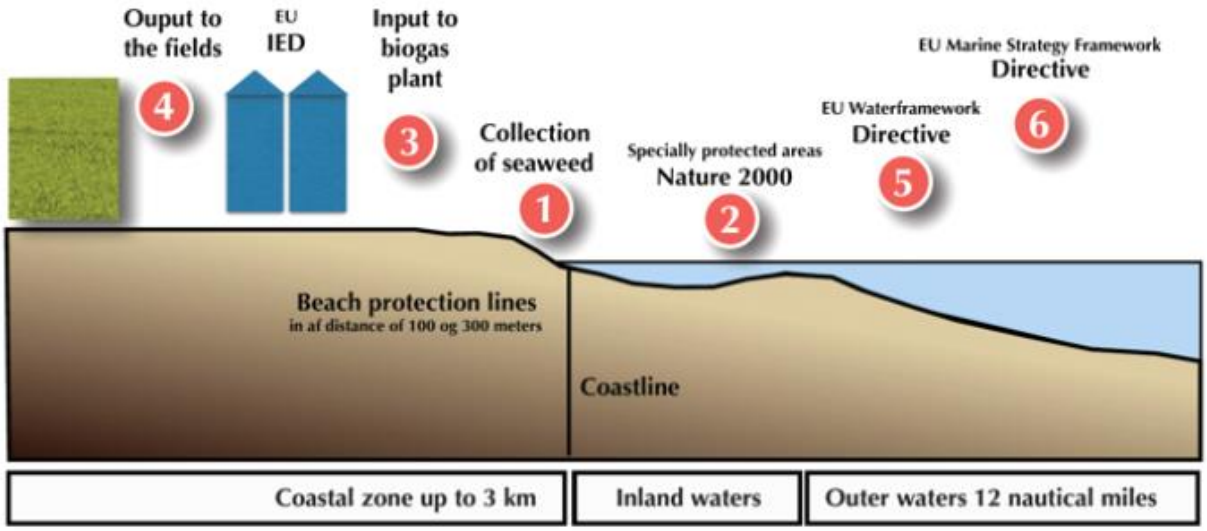


Figure 2: The main regulations (see numbers in the picture) related to the collection and use of cast seaweed as co-substrate in the Solrød Biogas plant. Source: Presentation by Tyge Kjær, Roskilde University, available at https://www.coastal-biogas.eu/events/conference-germany/

In 2019 more than 1,500 tonnes of cast seaweed were used as co-substrate in the Solrød Biogas plant. For each 1,000 tonnes of seaweed used in anaerobic digestion, 8 tonnes of nitrogen (N) and 197 kg of phosphorus (P) are removed from the sea, 4 tonnes of methane (CH_4) and 0.3 tonnes of nitrous oxide (N_2O) are avoided and more than 36,000 m^3 of biogas are produced. If the digestate is used to offset synthetic fertilisers on farmland, the COASTAL Biogas concept could lead to a greenhouse gas reduction of more than 350 tonnes of carbon dioxide (CO_2) equivalents.

For more information about the Solrød Biogas plant: http://solrodbiogas.dk/

Invited organisations related to environmental aspects of nutrient discharges and digestate utilisation

Representatives for the **European Biogas Association**, the **German Environment Agency** and **Institute for Agricultural and Urban Ecological Projects at the Humboldt University of Berlin (IASP)** were invited to give presentations.

Digestate can be either waste or by-product (waste framework directive) or it can cease to be waste if it is included in an EU fertilizing product (fertilizing product regulation). In EU-28, 10,120,000 tonnes of digestate (dry matter) were generated in 2019.

The Fertilizing Product Regulation will be fully implemented as of the 16th of July 2022. The regulation will help to achieve the EU Green Deal and the Farm to Fork Strategy targets for 2030:

- At least 25% of European agricultural land dedicated to organic farming
- Reduce by 50% nutrient losses

Source: Presentation by Marco Giacomazzi, policy officer at European Biogas Association, available at https://www.coastal-biogas.eu/events/conference-germany/

The presentation "Status of nutrients input to waters in Germany" revealed that Germany failed to comply with the Water Framework Directive and none of the coastal and transitional waterbodies reach a high or good ecological status in regard to the nutrient conditions. The failure was primarily caused by too high nutrient concentrations of lakes and coastal waters and hydromorphological modifications of rivers.
The phosphorus concentration has significantly decreased since the late 1980's and the nitrogen concentration has also decreased. This is mainly due to improvements at urban wastewater treatment plants.
There is rather no decreasing trend of nutrient input from agriculture over time as can be seen in Figure 3.
The threshold of 50 mg/l for nitrate in groundwater is exceeded at almost one out of five measuring points.

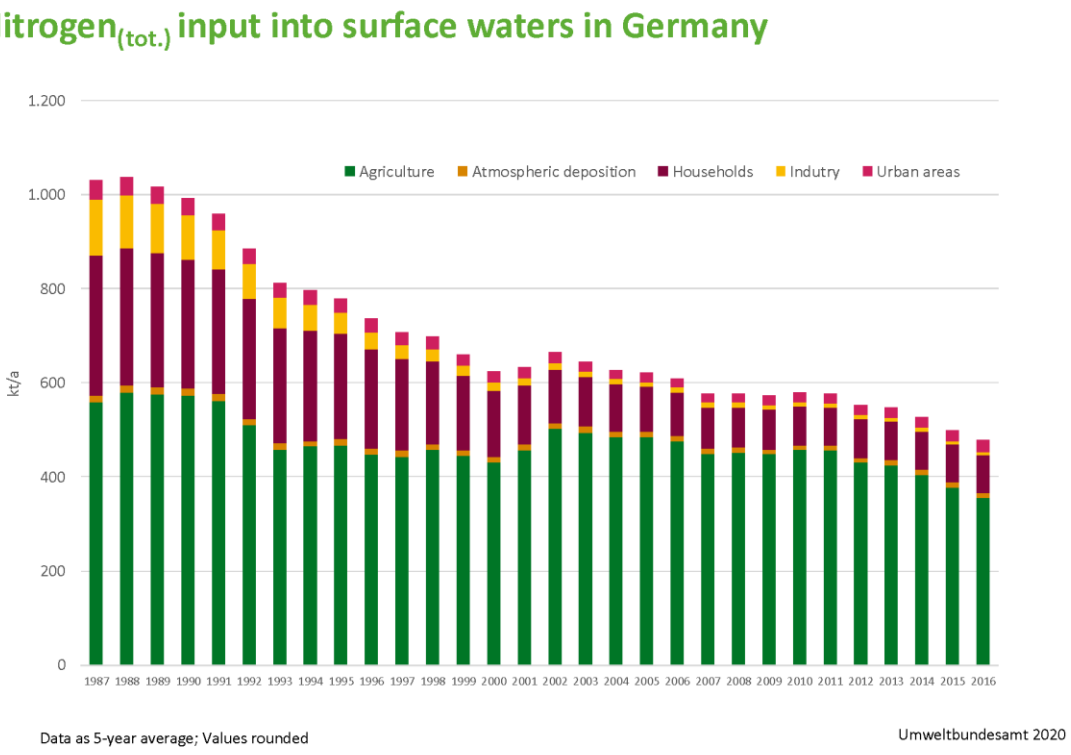


Figure 3: The nitrogen input to surface waters in Germany has decreased over time. The main contributor to the nutrient input is the agricultural sector (green bars). Source: Presentation by Jeanette Völker, German Environment Agency, available at https://www.coastal-biogas.eu/events/conference-germany/

IASP has made long term field experiments with digestate. The same amount of C and N (balanced with mineral N) were applied on different plots using different types of digestate, farmyard manure, cattle slurry, and mineral fertilizer. The organic carbon in the soil improved after five years of fertilization with digestates. The yield for two of the applied digestates, digested pig slurry and digested crops, showed similar yields of maize and green rye compared with plots, where mineral fertilizer was used. An interesting observation was that earthworms seemed to avoid plots fertilized with digestate in the beginning but, after some time, higher abundance of earthworms was found in the soil fertilized with digestate.

The conclusion of the field tests was that biogas digestates have effects on soil chemistry, biology and physics. If applied correctly, they can increase soil fertility and improve crop yields.

Source: Presentation by Andreas Muskolus, Institute for Agricultural and Urban Ecological Projects at the Humboldt University of Berlin (IASP), available at https://www.coastal-biogas.eu/events/conference-germany/

The panel discussion with **Jane Hofmann**, **Marco Giacomazzi**, **Tyge Kjær** and **Andreas Muskolus** was focussing on the main challenges for the collection of seaweed and utilisation of digestate as an organic fertiliser.

- **Marco Giacomazzi** – Highlighted the main barriers/challenges to harmonize the regulations for digestate utilisation in Europe. One is that compliance with the fertilising products regulation adopted by the European parliament in 2019 is optional and national regulations will still be in place. This means that compliance with the harmonised rules is only required if the product is made available on the European market. If used nationally, it is sufficient to comply with the national regulations. The COVID-19 pandemic is another challenge since it affects the implementation of the fertilising products regulation.
- **Jane Hofmann** – Pointed out some health and safety aspects related to the collection of cast seaweed. Sharp objects can be hidden in the beach wrack but what people are mainly concerned about are the gases that are released when the beach wrack decomposes. The characteristic smell of rotten eggs comes from hydrogen sulphide, which can cause health problems if inhaled. Sewage contamination with elevated levels of faecal indicator organisms in the beach wrack and faeces from high concentration of seabirds might pose a risk when dealing with beach wrack.
- **Andreas Muskolus** – Emphasized that the main challenge of increasing digestate utilisation in Germany is more related to technical issues. There are 9,000 biogas plants on farms and there is quite a lot of digestate on the market. In the end it is a question of what the farmer needs. If one could convert the digestate into a more homogenous fertiliser (similar to the mineral one) having a suitable nutrient composition, it would be easy to put that on the market. According to Andreas Muskolus, efficiently removing water during the digestion process remains one of the biggest barriers in that regard.

- **Tyge Kjær** –The main challenge at Solrød in terms of regulations relevant to the use of digestate from co-digestion of cast seaweed as a fertilizer is that most of the regulations are dependent on a linear economy. Reuse of seaweed is a question of a circular bioeconomy. Most of the regulations are not in favour of that. In Denmark, there is an input regulation and an output regulation (input to, and output of, the anaerobic digester) which make it very complicated. Perhaps the European fertilising product regulation will change the picture. Many regulations are not in line with the circular bioeconomy thinking. The waste directive sets up certain rules for waste. Municipalities are not supposed to handle waste if one can recycle it.

Virtual study tour

The participants were taken on a virtual study tour to see the production of biochar from beach wrack, one of the activities within the CONTRA project. Beach wrack is treated with steam at elevated temperature and pressure in an electrically heated 15-litre lab scale reactor. The reaction time is approx. 3 hours at a pressure of 23 bar and a temperature of 220 °C. The product is biochar, rich in carbon, primarily used as fuel to replace fossil coal but soil amendment is another option for utilisation.
The main problem is the high content of sand in beach wrack. It doesn't affect the reaction as such, but it lowers the calorific value of the biochar since it passes the reaction unaffected and stays in the biochar.

Figure 4. Biochar production in lab scale. Source: Presentation by Timo Garrels, KS-VTCTech GmbH, available at https://www.coastal-biogas.eu/events/conference-germany/

Main takeaways

It is evident that there is a strong interest to use marine biomass as a resource and obtain different socio-economic benefits. However, the regulations and directives are not always adopted to such initiatives since they were introduced to solve other types of problems. Even if the regulations and directives do not pose a barrier for utilising marine biomass as a resource, stakeholders normally optimise their own businesses from an economic perspective rather than from an environmental perspective. There are a lot of socio-economic benefits related to the anaerobic digestion of cast seaweed and the utilisation of the digestate as an organic fertiliser, as part of the circular economy. However, if the biogas operator is not economically compensated for the reduced eutrophication, the elimination of greenhouse gas emissions from decaying seaweed, the improved water and soil quality, and compliance with different directives etc., the operator might look for other substrates that generate a higher methane yield. Therefore, it is important to take a holistic approach and convince stakeholders of the socio-economic benefits to avoid disadvantages for the environment.

ACKNOWLEDGMENTS

We would like to thank our speakers and contributors to the programme:
Kristin Sternberg, *Fachagentur Nachwachsende Rohstoffe e.V. (FNR)*
Vytautas Akstinas, *Lithuanian Energy Institute*
Sebastian Foth, *University of Rostock*
Jane Hofmann, *Coastal Union Germany*
Tyge Kjær, *Roskilde University*
Anu Lähteenmäki-Uutela and **Teresa Camarena Gómez**, *Finnish Environment Institute*
Marco Giacomazzi, *European Biogas Association*
Jeanette Völker, *German Energy Agency*
Andreas Muskolus, *ISAP Berlin*
Timo Garrels, *KS-VTCTech GmbH*
Angela Clinkscales, *University of Rostock (moderator)*
Jörgen Held, *Baltic Energy Innovation Centre (moderator)*
as well as our participants for the contributions to the discussion!