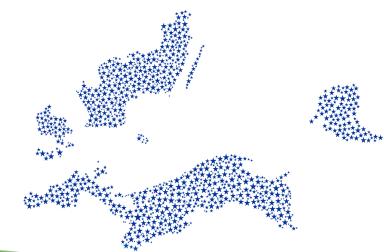




Cluster On Anaerobic digestion environmental Services and nuTrients remov~~AL~~

Potential and characterisation of seaweed

Vytautas Akstinas, LEI
Sebastian Foth, UROS
FINAL CONFERENCE,
9 December, 2021



Partners



Universität
Rostock

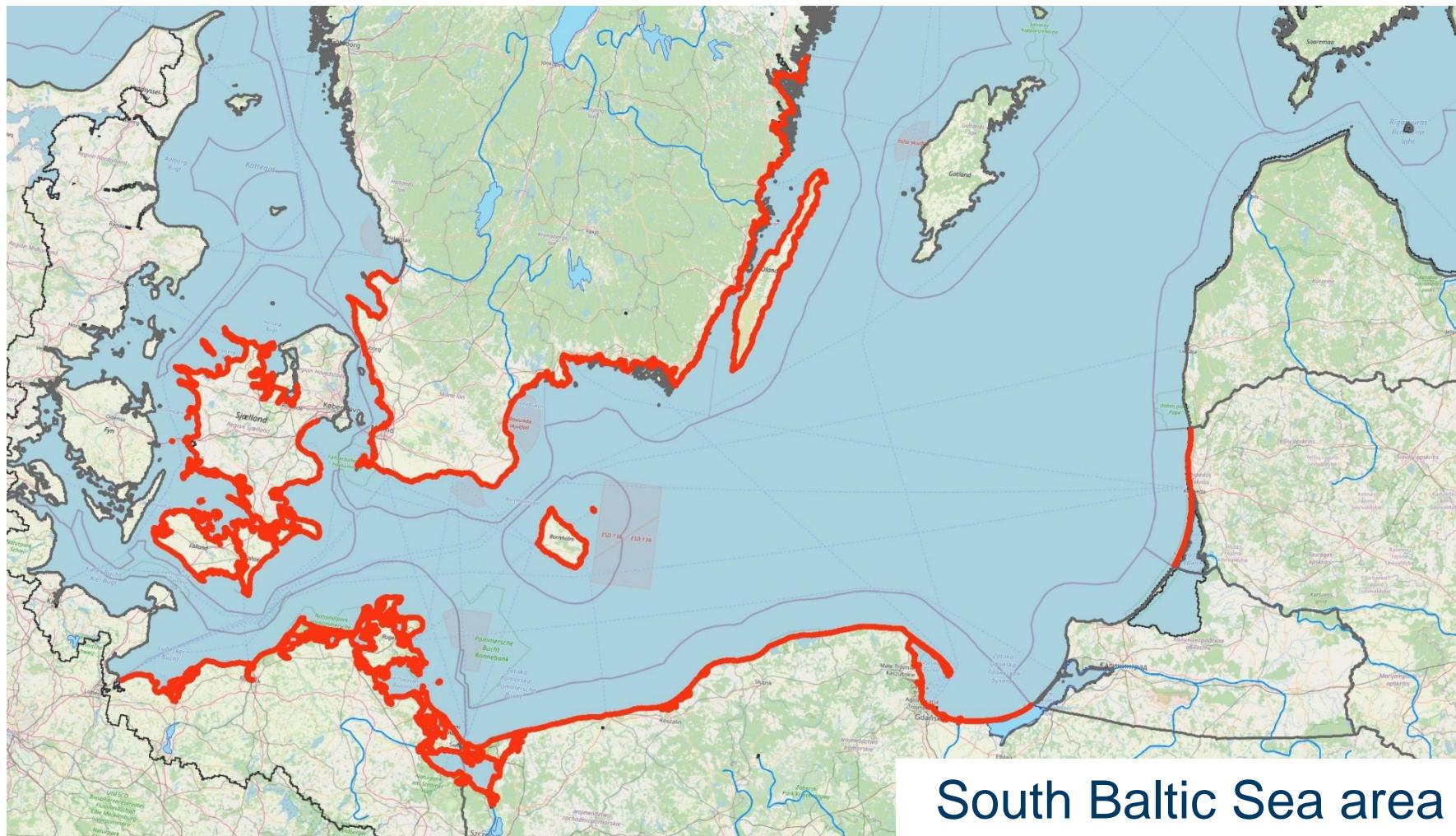


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Study area for the characterisation of seaweed potential



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Cast seaweed potential in Sweden

Country	Scale	Available annual data (t/a)	Seaweed amount (t/km/a)	Coastline with/without protected areas (km)	Theoretical potential of seaweed (with protected areas) (t/a)	Theoretical potential of seaweed (without protected areas) (t/a)
Sweden	Trelleborg coast (Stavsten-Skateholm) (17 km) ^[1]	10,500 ^[1]	617			
	Scania 35.6 km ^[2]	21,902 (2014) ^[2]	615		83,100 ^[2]	63,600 ^[2]
	Country ^[4]		615	1,590/960 ^[3]	978,000^[4]	590,000^[4]



[1] Tatarchenko O. Assessment of macroalgae harvesting from the Baltic sea from an energy balance perspective.

Master of Science Thesis. Stockholm, 2011: <https://www.diva-portal.org/smash/get/diva2:579473/FULLTEXT01.pdf>

[2] BUCEFALOS Project: https://utveckling.skane.se/siteassets/publikationer_dokument/biogaspotential-fran-akvatiska-substrat-i-skane_de1.pdf

[3] GIS data

[4] Cluster On Anaerobic digestion, environmental Services and nuTrrients removal (COSATAL Biogas). Project.

<https://www.coastal-biogas.eu/publications/>

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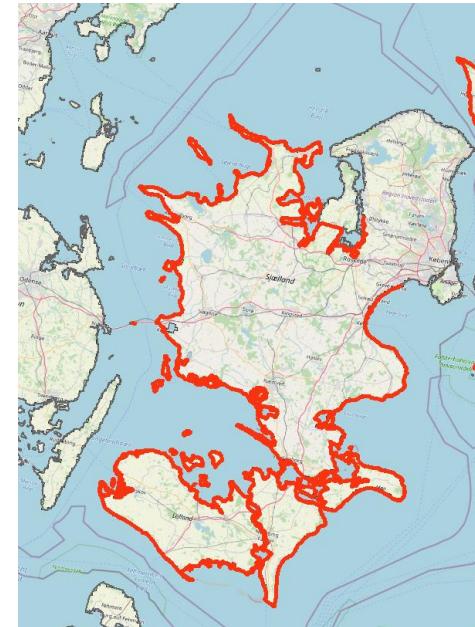
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Cast seaweed potential in Denmark

Country	Scale	Available annual data (t/a)	Seaweed amount (t/km/a)	Coastline with/without protected areas (km)	Theoretical potential of seaweed (with protected areas) (t/a)	Theoretical potential of seaweed (without protected areas) (t/a)
Denmark	Solrød municipality (3.7 km) ^[5]	1,500 ^[5] Up to 4,000 (2009) ^[5]	405 1081			
	Køge Bay (38.6 km) ^[5]	7,000 ^[10]	181			
	Country ^[6]		4-500 ^[6]		1,200,000^[6]	420,000^[6]
	Country ^[4]		405	1,962/1,611 ^[6]	795,000^[4]	652,000^[4]



^[4] Cluster On Anaerobic digestion, environmental Services and nuTrients removal. Project. <https://www.coastal-biogas.eu/publications/>

^[5] Anaerobic Co-digestion of Cast Seaweed and Organic. Project. <https://energiforskning.dk/sites/energiteknologi.dk/files/slutrapporter/12097slutrapport-12097.pdf>

^[6] Project partner data (Roskilde University)

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Cast seaweed potential in Germany

Country	Scale	Available annual data (t/a)	Seaweed amount (t/km/a)	Coastline with/without protected areas (km)	Theoretical potential of seaweed (with protected areas) (t/a)	Theoretical potential of seaweed (without protected areas) (t/a)
Germany	Managed beaches (350 km) ^[7]	17,500 ^[7]	50 ^[7]			
	Country ^[4]		50 ^[7]	377/306 ^[7]	19,000^[4]	15,300^[4]



^[4] Cluster On Anaerobic digestion, environmental Services and nuTrints removal. Project. <https://www.coastal-biogas.eu/publications/>

^[7] Landtag Mecklenburg-Vorpommern, Wahlperiode 7, Drucksache 7/191, 13.02.2017: Kleine Anfrage des Abgeordneten Dr. Wolfgang Weiß, Fraktion DIE LINKE, Entsorgung oder Verwertung von Seegras und anderem Treibgut. <http://www.dokumentation.landtag-mv.de/Parldok/dokument/38809/entsorgung-oder-verwertung-von-seegras-und-anderem-strandgut.pdf>

Partners



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Cast seaweed potential in Poland

Country	Scale	Available annual data (t/a)	Seaweed amount (t/km/a)	Coastline with/without protected areas (km)	Theoretical potential of seaweed (with protected areas) (t/a)	Theoretical potential of seaweed (without protected areas) (t/a)
Poland	Sopot (4.5 km) [8]	400 (2011) [8]	88			
	Gulf of Gdansk (~150 km) [8]	800-1000 [9]				
	Country [10]		22 [10]	770/440 [10]	17,000 [10]	9,500 [10]



[8] Bucholc K., Szymczak-Żyla M., Lubecki L., Zamojska A., Hapter P., Tjernströmc E., Kowalewska G. Nutrient content in macrophyta collected from southern Baltic Sea beaches in relation to utrophication and biogas production. Science of the Total Environment 473–474 (2014) 298–307. <https://doi.org/10.1016/j.scitotenv.2013.12.044>

[9] WAB (Wetlands, Algae and Biogas – a southern Baltic Sea Eutrophication Counteract Project, 2010 – 2012). Technological solutions for the collection and removal of algae from the beach, sea and coastal strip in Trelleborg Municipality. <http://wabproject.pl>

[10] Project partner data (Gdansk University of Technology)

Partners

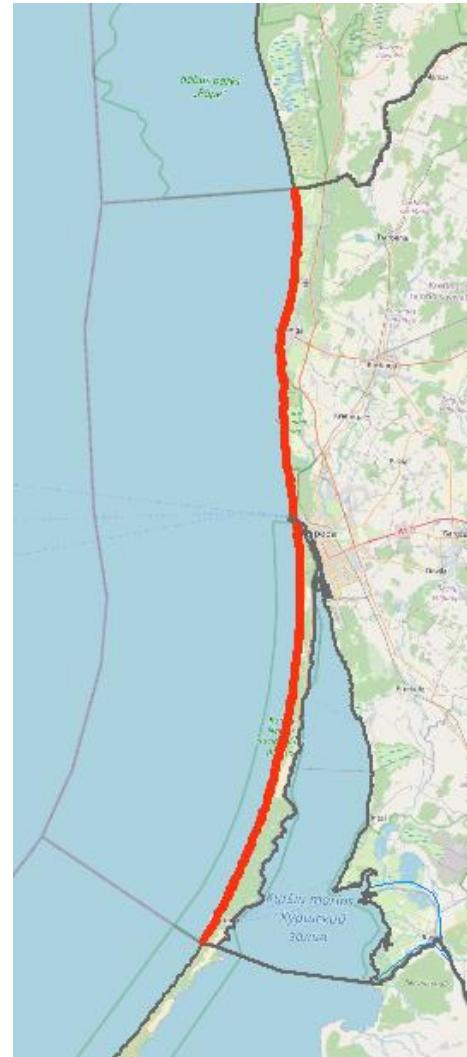


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Cast seaweed potential in Lithuania



Country	Scale	Available annual data (t/a)	Seaweed amount (t/km/a)	Coastline with/without protected areas (km)	Theoretical potential of seaweed (with protected areas) (t/a)	Theoretical potential of seaweed (without protected areas) (t/a)
Lithuania	Palanga municipality (25 km) [11]	50 (2018) [11]	2 [11] Up to 400 (2010) [12]			
	Country [4]		2	95/27 [3]	190 [4]	54 [4]

[3] GIS data

[4] Cluster On Anaerobic digestion, environmental Services and nuTrients removal. Project. <https://www.coastal-biogas.eu/publications/>

[11] Data from Palanga City municipality

[12] Unseen abundance of algae in Palanga beach: <https://www.delfi.lt/grynas/gamta/palangos-papludimye-neregeta-gausybe-dumbliu.d?id=36065449>

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Total cast seaweed potential in South Baltic Sea region

Country	Seaweed amount (t/km/a)	Coastline with/ without protected areas (km)	Theoretical potential of seaweed (with protected areas) (t/a)	Theoretical potential of seaweed (without protected areas) (t/a)
Sweden	615 [1], [2]	1,590/960 [3]	978,000 [4]	590,000 [4]
Denmark	4-500 [6]		1,200,000 [6]	420,000 [6]
	405 [5]	1,962/1,611	795,000 [4]	652,000 [4]
Germany	50 [7]	377/306	19,000 [4]	15,300 [4]
Poland	22 [14]	770/440	17,000 [10]	9,500 [10]
Lithuania	2 [11]	95/27 [3]	190 [4]	54 [4]
Total		4,794/3,344	1,809,190 [4]	1,266,854 [4]

[1] Tatarchenko O. Assessment of macroalgae harvesting from the Baltic sea from an energy balance perspective.

Master of Science Thesis. Stockholm, 2011: <https://www.diva-portal.org/smash/get/diva2:579473/FULLTEXT01.pdf>

[2] BUCEFALOS Project: https://utveckling.skane.se/siteassets/publikationer_dokument/biogaspotential-fran-akvatiska-substrat-i-skane_del1.pdf

[3] GIS data

[4] Cluster On Anaerobic digestion, environmental Services and nuTrients removal. Project: <https://www.coastal-biogas.eu/publications/>

[5] Anaerobic Co-digestion of Cast Seaweed and Organic. Project. <https://energiforskning.dk/sites/energiteknologi.dk/files/slutrapporter/12097slutrapport-12097.pdf>

[6] Project partner data (Roskilde University)

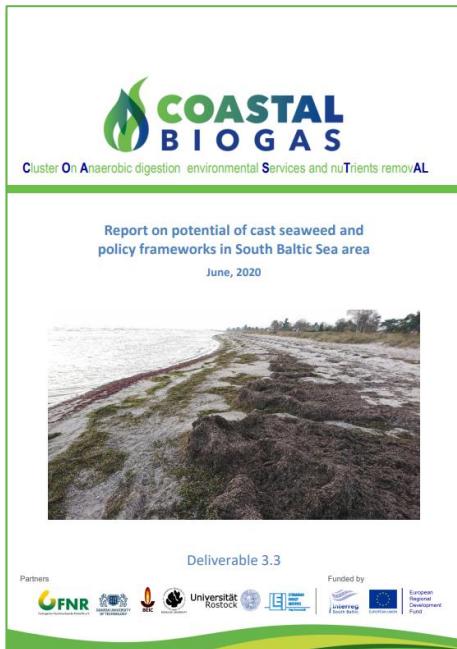
[7] Landtag Mecklenburg-Vorpommern, Wahlperiode 7, Drucksache 7/191, 13.02.2017: Kleine Anfrage des Abgeordneten Dr. Wolfgang Weiß, Fraktion DIE LINKE, Entsorgung oder Verwertung von Seegras und anderem Treibgut. <http://www.dokumentation.landtag-mv.de/Parldok/dokument/38809/entsorgung-oder-verwertung-von-seegras-und-anderem-strandgut.pdf>

[10] Project partner data (Gdansk University of Technology)

[11] Data from Palanga City municipality

For more information

<https://www.coastal-biogas.eu/publications/>



Deliverable 3.3. Report on potential of cast seaweed and policy frameworks.

The report gives a quantitative potential of cast seaweed in the territory covered by the Interreg South Baltic Programme. The report covers policy frameworks related use of seaweed as a potential feedstock for green energy production and regulations on biogas plant establishment in DE, DK, LT, PL and SE.



Beach Wrack



Partners



Fachagentur Nachwachsende Rohstoffe e.V.



GOÅNSK UNIVERSITY
OF TECHNOLOGY
BEIC



Roskilde University



Universität
Rostock



LITHUANIAN ENERGY
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Beach Wrack

Composition of beach wrack

seaweed

- macroalgae
 - brown algae
Pilayella littoralis
 - red algae
Furcellaria lumbricalis
 - green algae
Enteromorpha sp.

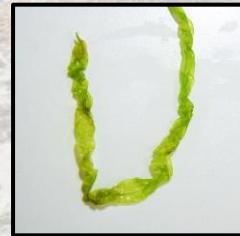
▪ macrophytes

eelgrass *Zostera marina*
sago pondweed *Potamogeton pectinatus*

organisms or residues

dead wood

inurities/waste



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Beach Wrack



Reasons for differentiation

- exposition
- acute weather events
- seasons
- nutrient inputs

How do the seaweed end up on the beach?

- 1) Strong storm tears the seaweed up and leads it towards the coast.
- 2) Currents and waves bring the decomposed seaweed into the shore as a mixed, mushy mass.

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Focus of Investigation

What all have we investigated?

Algae biomass

- quantitative data on distribution of beach-cast seaweeds
- analyses of different beach wrack substrates
- benefit of Value creation from cast seaweed
- effects of removals on the coastal ecosystem and population

Beach Cleaning

- cost and efficiency of the methods
- influence on ecosystem

Storage

- The measurements of basic physicochemical properties such as dry matter, organic matter, sand content, etc.
- influence on properties
- methods and Best-Practice

Cutting

- The collected algae biomass was ground using laboratory

5 mm

Analyses

The measurement of basic physicochemical properties such as dry matter, dry organic matter, sand content, etc.

Mixing

- The feedstock was prepared by mixing 25% (by mass) of algae biomass with 75% of cattle manure

Diluting

The mixture of biomass was diluted to keep approximately 8% TS

Results

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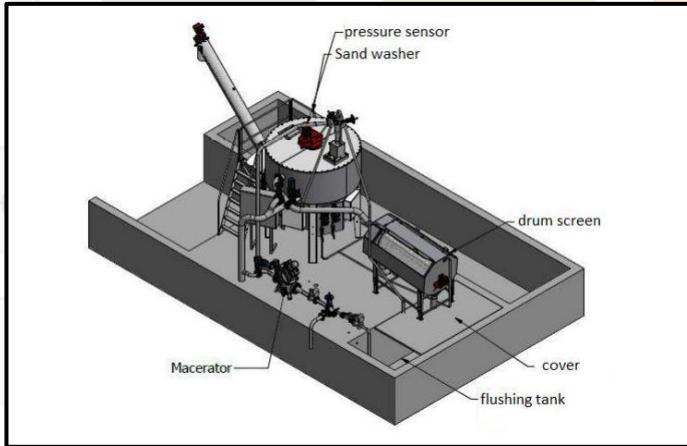
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Focus of Investigation

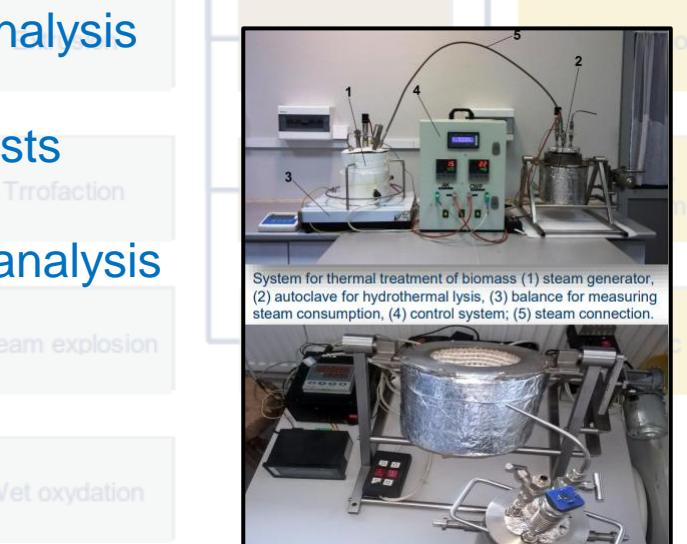
Pre-Treatment

- Mechanical
- Chemical
- Thermal
Chipping



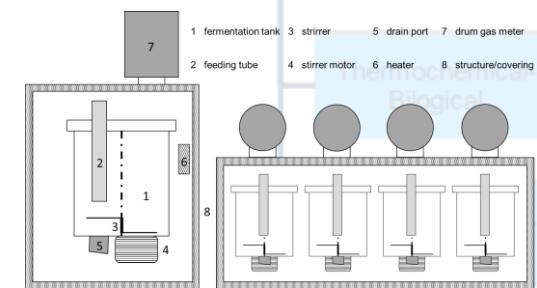
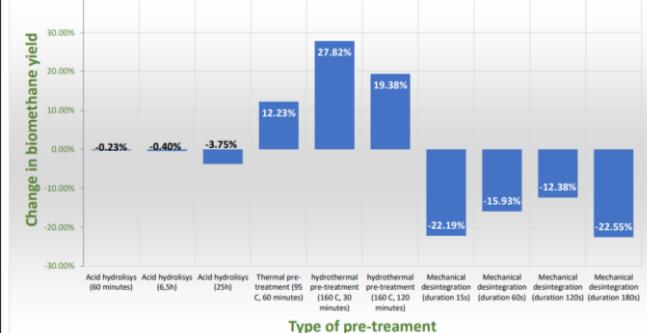
Utilization

- Substrate analysis
- Digestion tests
Deflaker, Disperser
- Digaestate analysis



Type of algae	Total solids, [%]	Total volatile solids, [%]	Sand content, [%]
Enteromorpha compressa	8.9	83.8	11.65
Enteromorpha plumosa	7.2	79.7	4.96
Potamogeton pectinatus	13.1	61.4	4.00
Zostera marina	12.6	79.6	20.88
Pheophyta (mainly <i>Pyliella litoralis</i>)	17.2	63.9	7.80

Change in biomethane yield compared to untreated seaweed



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Utilization

What's all in the beach wrack?

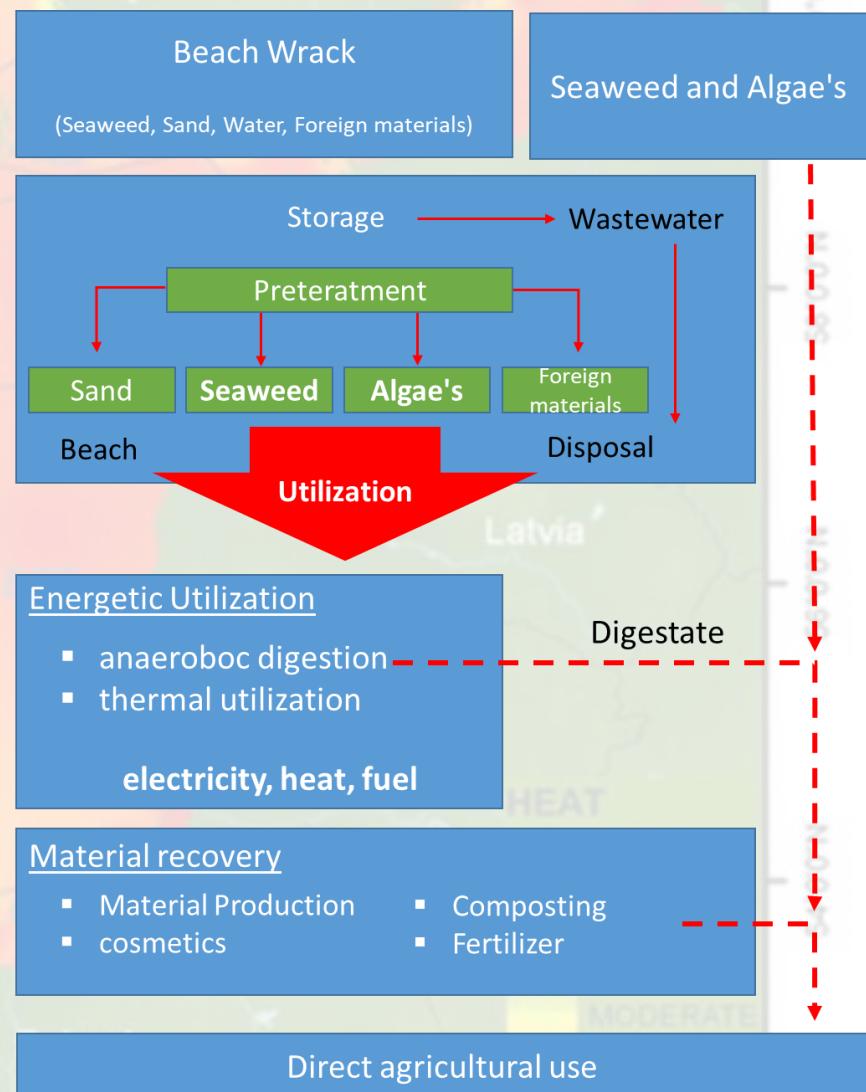
- Carbohydrates
- Proteins
- Minerals
- Micronutrients
- Pharmaceutical active substances
- Static substances
- Fibers

Legal Framework



The hierarchy of waste prevention and management in EU legislation and policy of Waste Framework Directive

- Waste Framework Directive (2008/98/EC)
- Landfill Directive (1999/31/EC)
- Danish Waste to Soil Regulation
- Germany Bio-waste Ordinance
- Germany Fertiliser Ordinance



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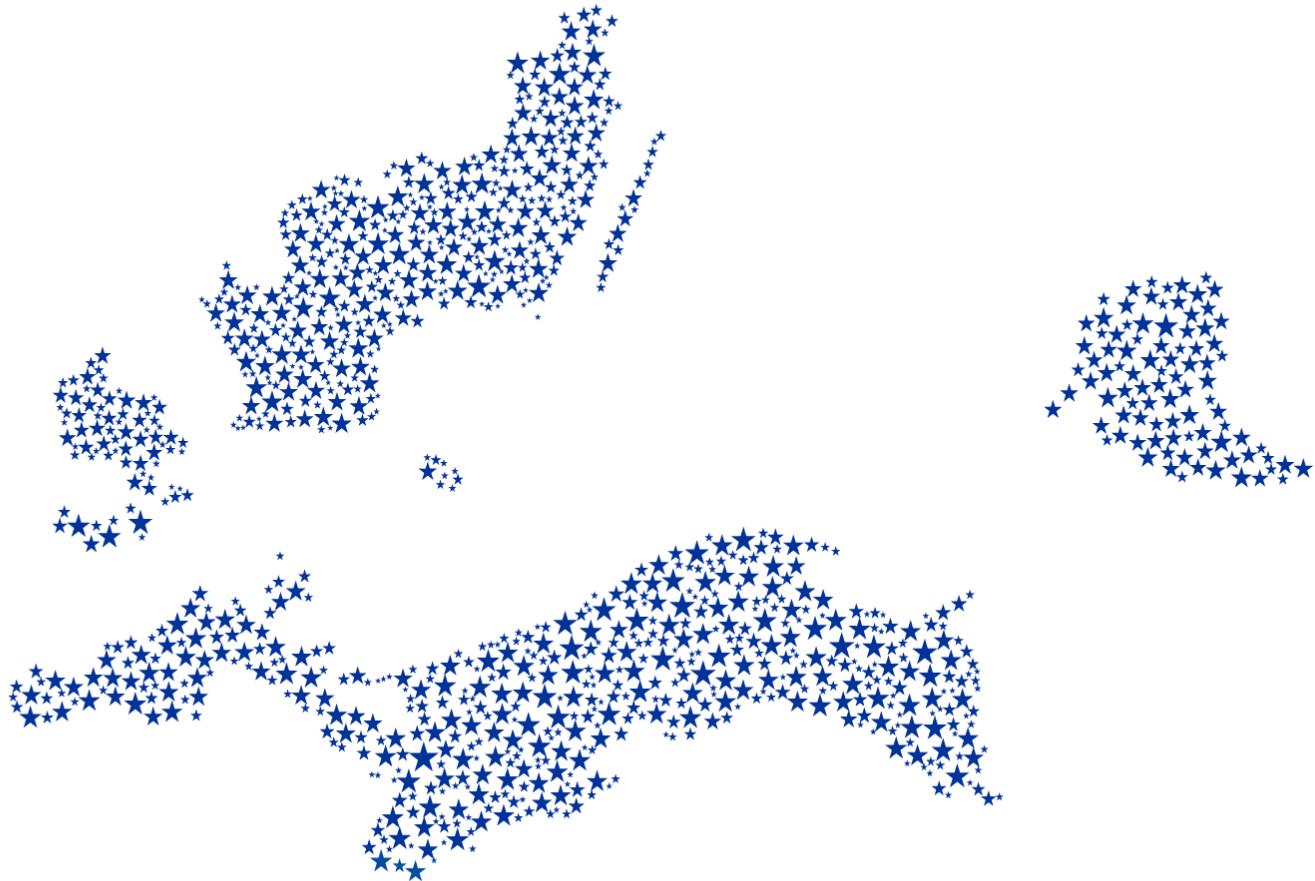


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Thank you!



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