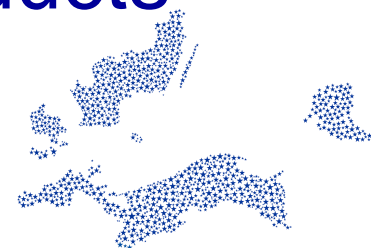




Cluster On Anaerobic digestion environmental Services and nutrients removal

Thermal decomposition of the seaweed and an analysis of the formed products

6th COASTAL BIOGAS conference



Justas Eimontas
Lithuanian Energy Institute,
9 December, 2021

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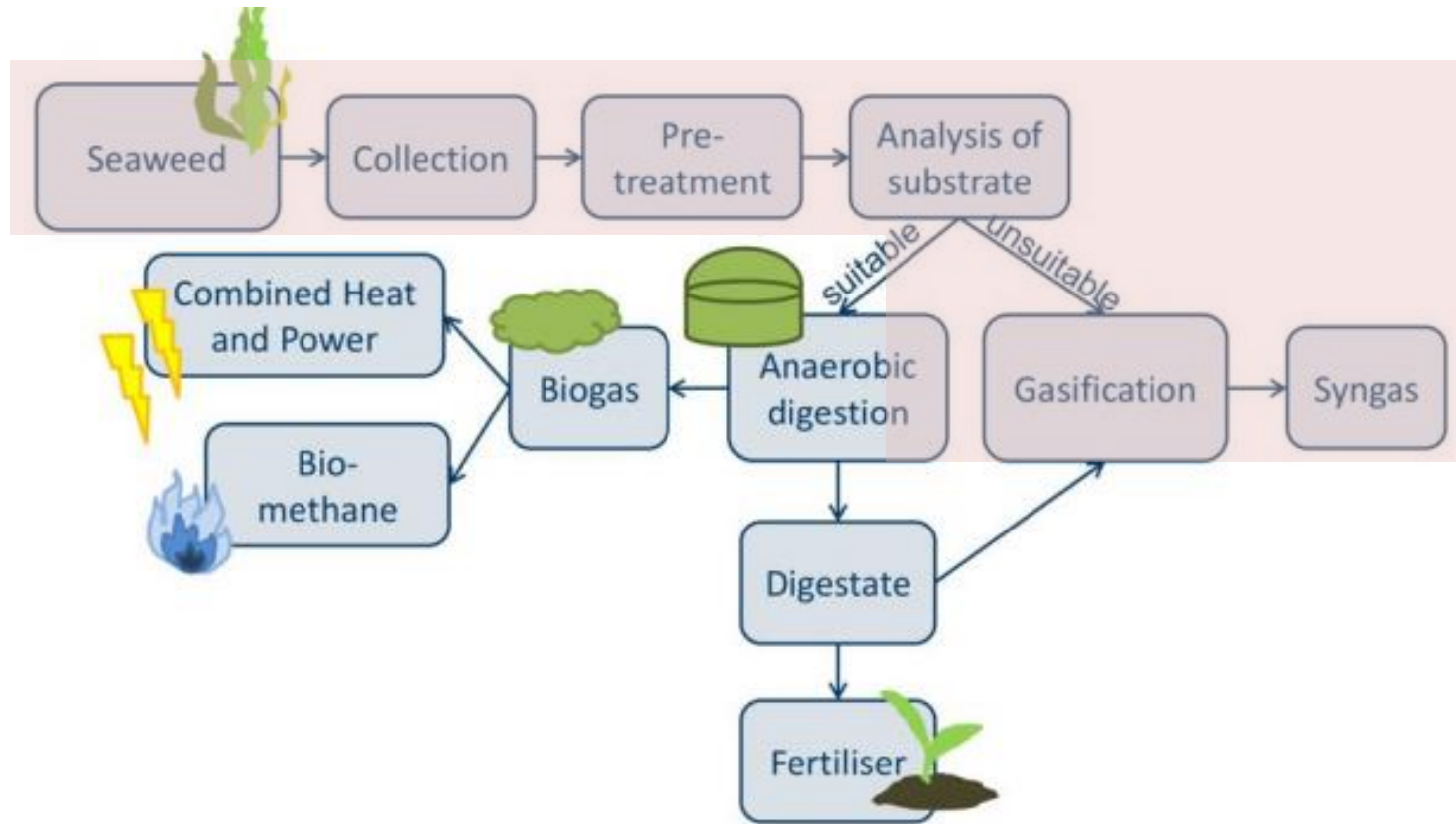


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Presentation from COASTAL Biogas coordinator, Anne Roßmann, available at [1st Conference – Sweden | COASTAL Biogas](#)

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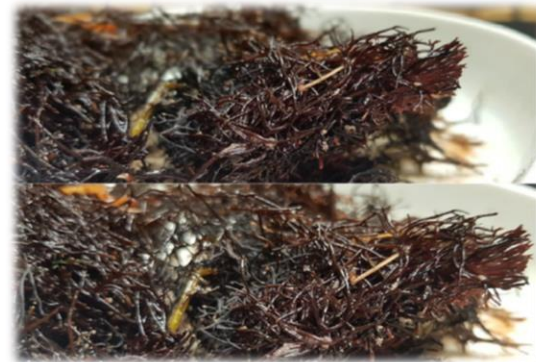
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Feedstock collection and preparation

Collection



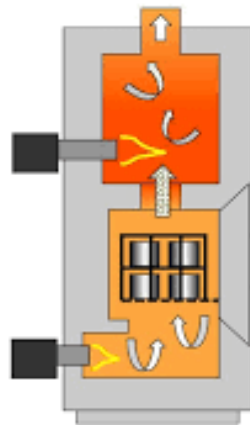
Washing



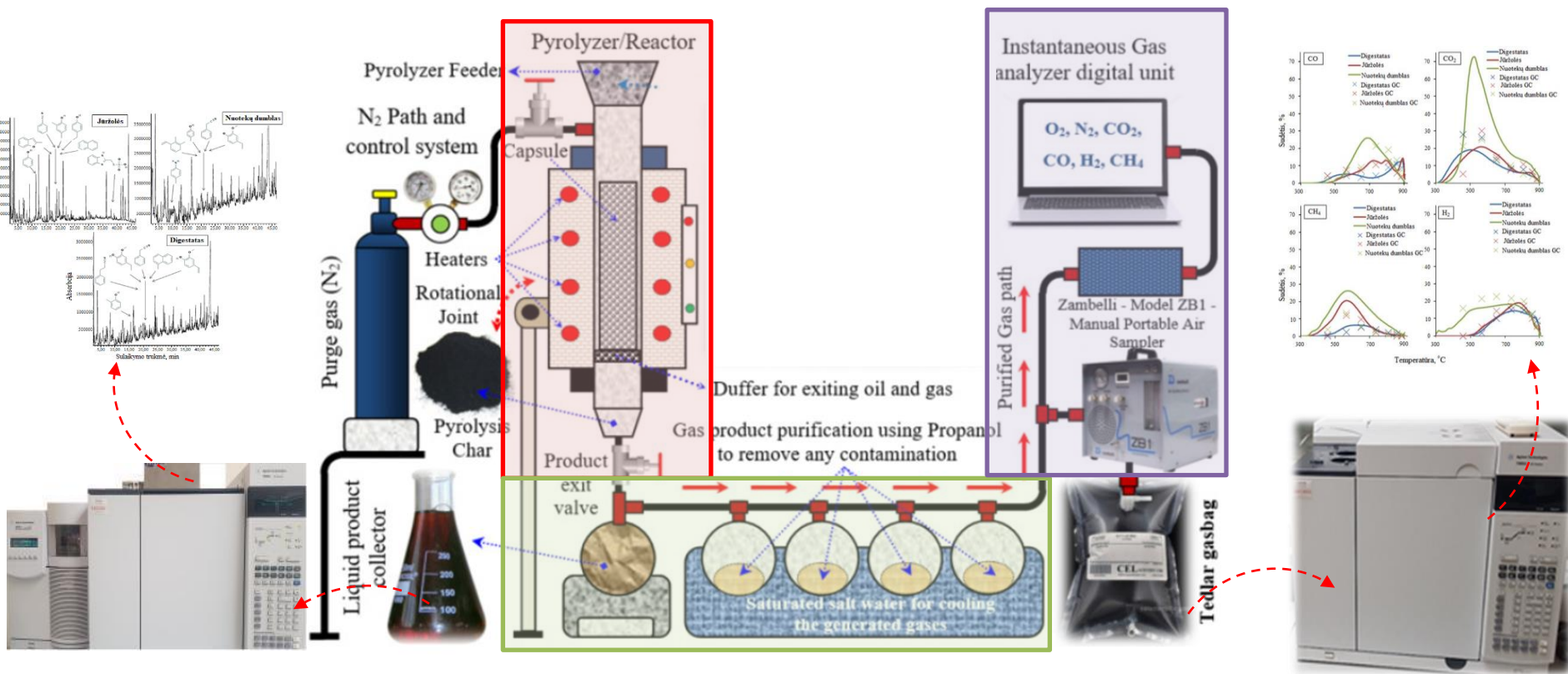
Drying



Thermal treatment

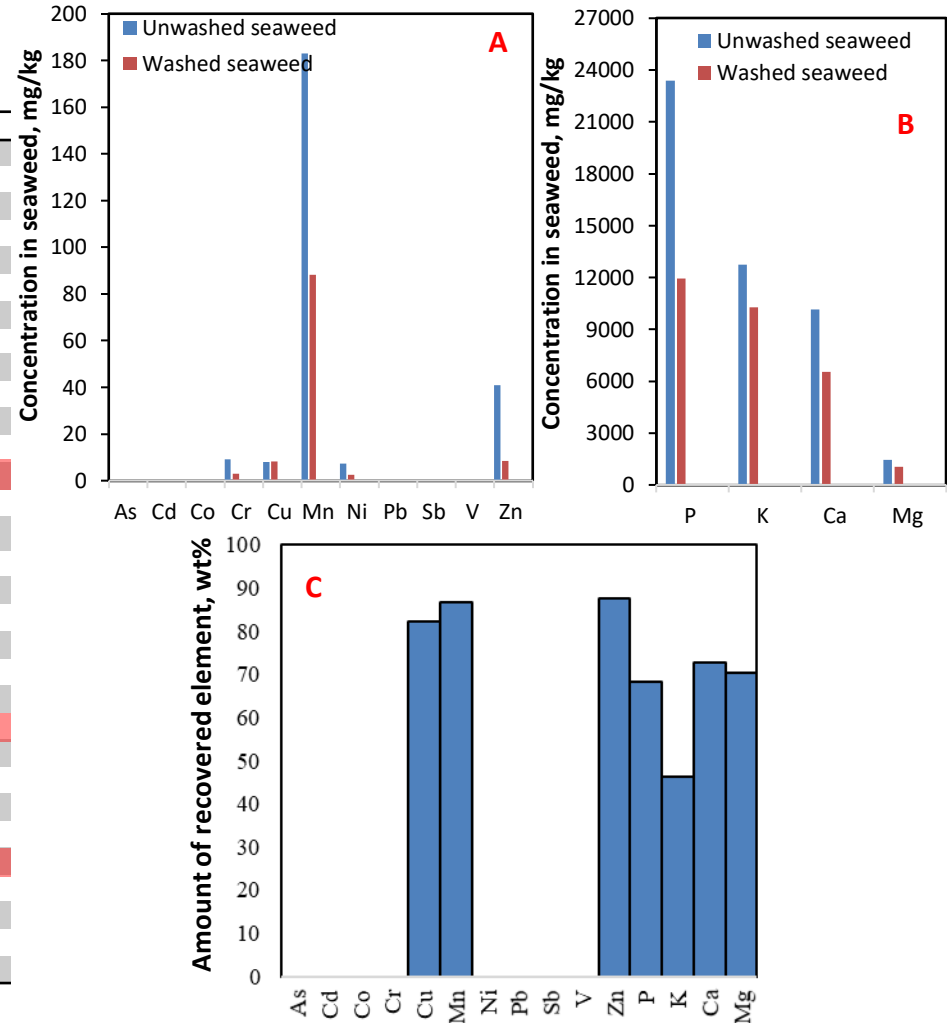


Thermal treatment in a laboratory-scale facility

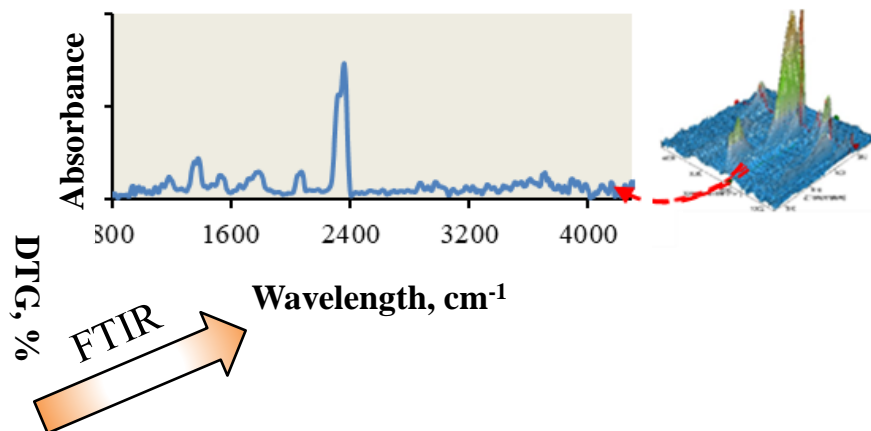
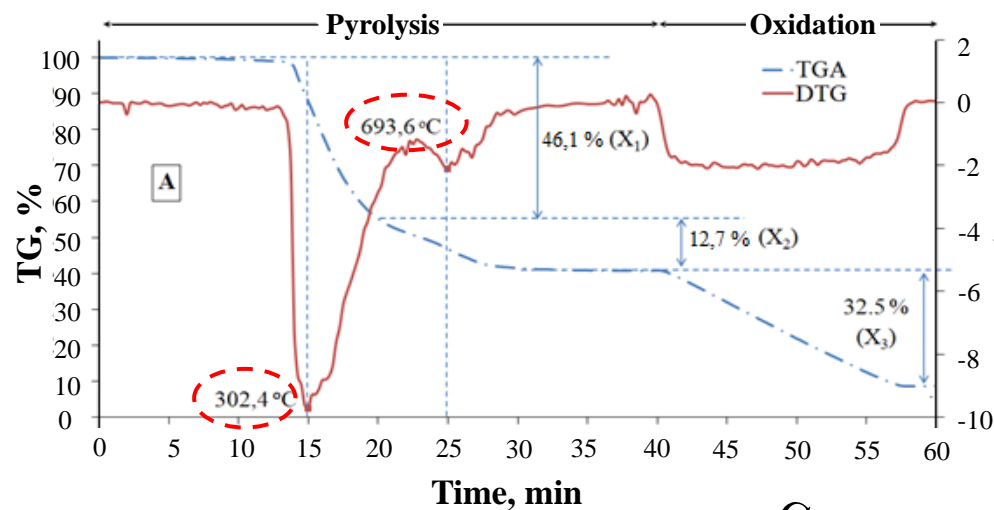


Feedstock characterization and bio-char investigation

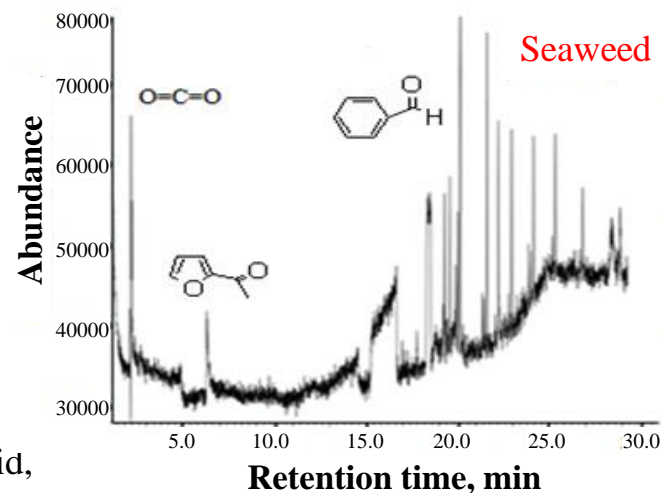
	Unwashed seaweed	Washed seaweed	Seaweed char
Ultimate analysis			
Carbon, % (d.b.)	34.58	46.93	60.10
Hydrogen, % (d.b.)	5.16	4.73	0.52
Oxygen, % (by diff.)	6.79	29.61	1.90
Nitrogen, % (d.b.)	3.65	4.13	2.66
Sulphur, % (d.b.)	3.54	5.13	2.79
Chlorine, % (d.b.)	0.43	0.05	0.08
Proximate analysis			
Moisture, % (a.r.)	57.32	62.56	-
Moisture, % (Uptake)	2.27	0.60	2.42
Volatiles, % (d.b.)	41.82	58.30	11.28
Fixed carbon, % (d.b.)	12.01	32.23	56.69
Ash, % (d.b.)	43.90	8.87	29.61
HHV (MJ/kg) (d.b.)	17.21	17.54	22.35
LHV (MJ/kg) (d.b.)	16.43	16.51	22.21
Heavy metals and minerals analysis (d.b.)			
As mg/kg	n.d. *	n.d. *	n.d. *
Cd mg/kg	n.d. *	n.d. *	n.d. *
Co mg/kg	n.d. *	n.d. *	n.d. *
Cr mg/kg	9.1	2.9	n.d. *
Cu mg/kg	8.1	8.2	41.4
Mn mg/kg	183.1	178.2	539.7
Ni mg/kg	7.41	2.5	n.d. *
Pb mg/kg	n.d. *	n.d. *	n.d. *
Sb mg/kg	n.d. *	n.d. *	n.d. *
V mg/kg	n.d. *	n.d. *	n.d. *
Zn mg/kg	40.9	29.4	116.8
P mg/kg	23373	11952	25750
K mg/kg	12737	10286	8841
Ca mg/kg	10163	6532	17364
Mg mg/kg	1451	1063	2533



Microthermal analysis



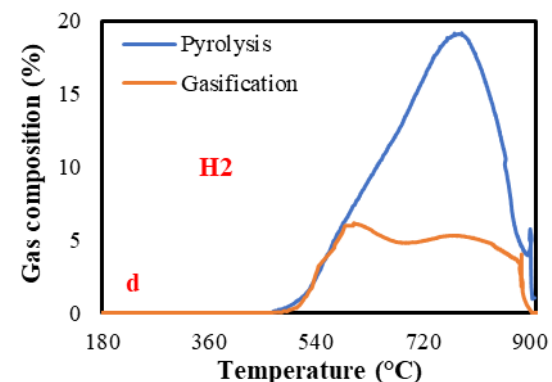
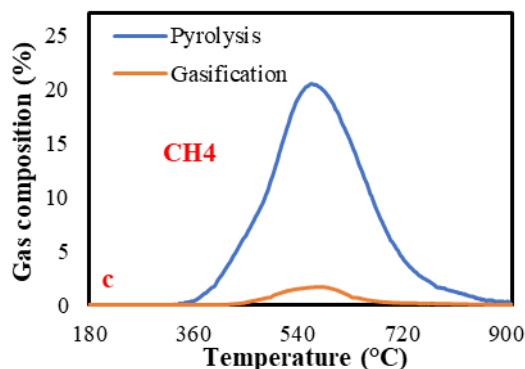
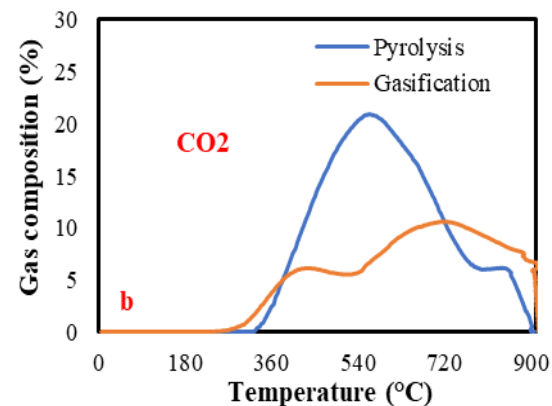
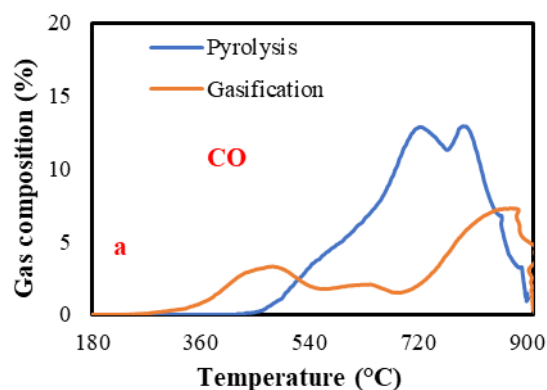
GC/MS



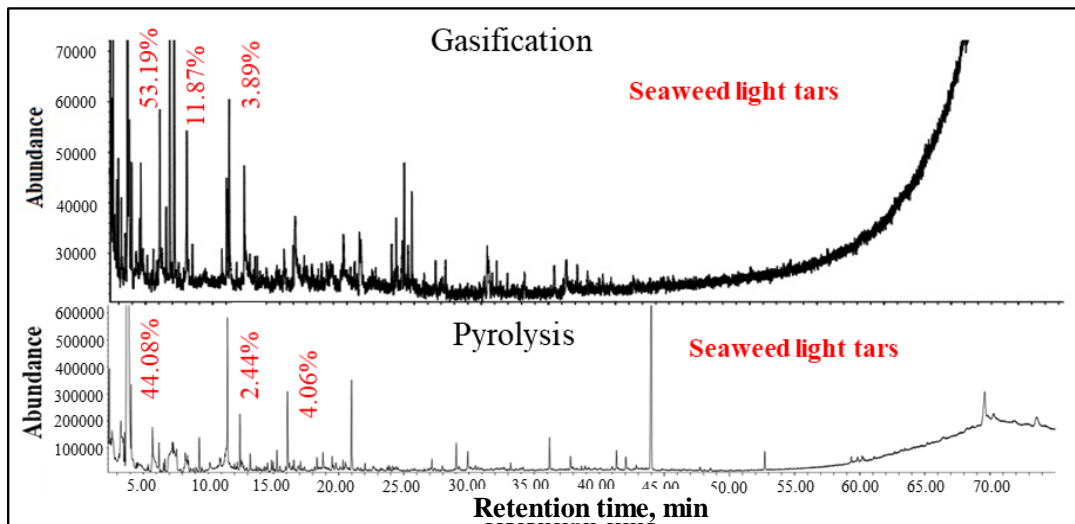
Carbon dioxide, polysubstituted acetic acid,
polycyclic hydrocarbons, alcohols

Gaseous products analysis

Sample	Pyrolysis	Gasification
Oil, wt%	17.22	0.1
Gasses, wt%	43.69	92.7
Biochar, wt%	39.09	7.2



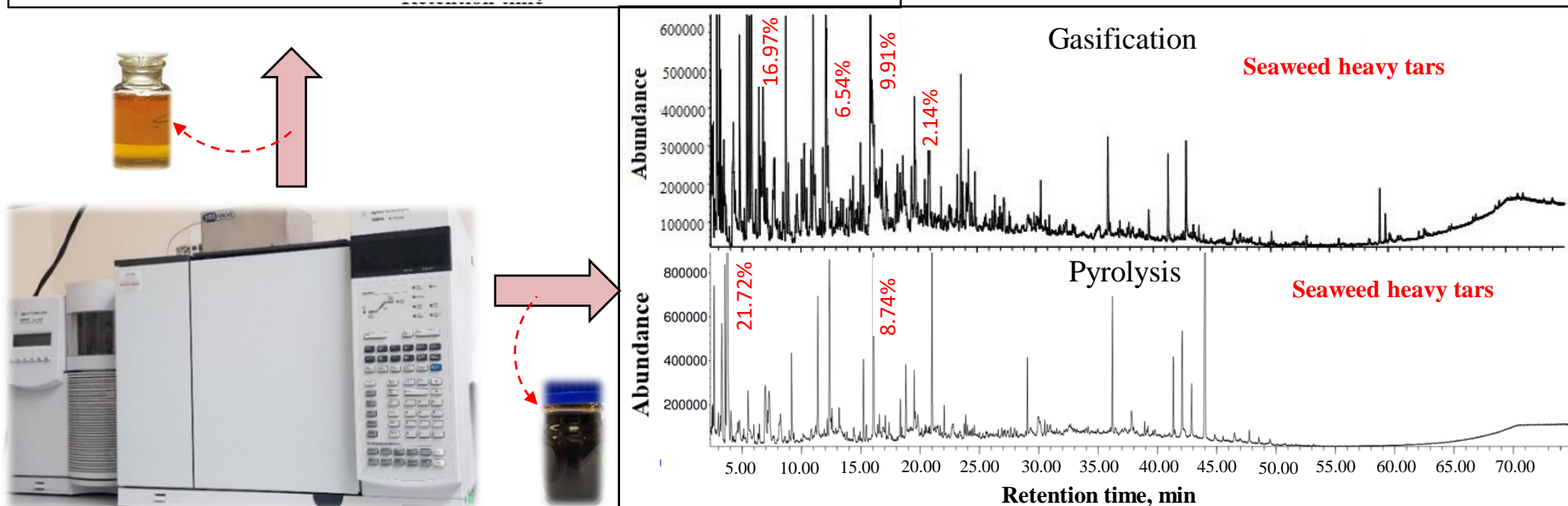
Liquid products analysis



Toluene and benzene derivatives, such as ethenone, styrene, ethylbenzene

Sample	Pyrolysis	Gasification
Oil, wt%	17.22	0.1
Gasses, wt%	43.69	92.7
Biochar, wt%	39.09	7.2

Variously substituted phenolic compounds, styrene, pyridine, benzonitrile, and some alcohols



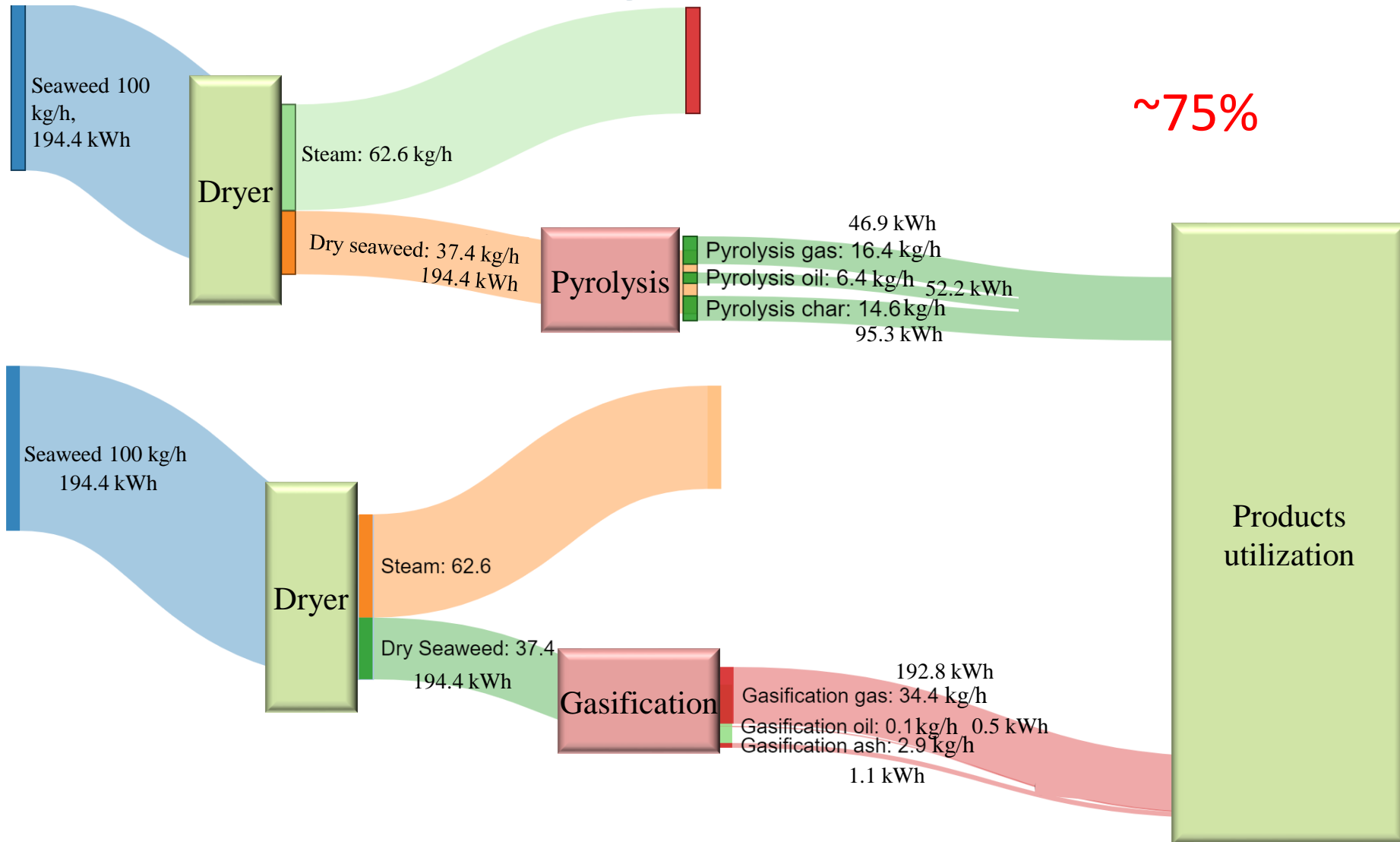
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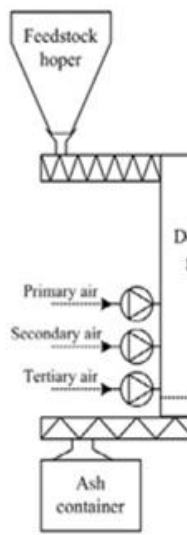
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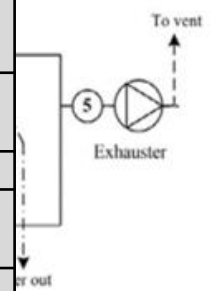
Pyrolysis & gasification mass and energy balance



Theoretical evaluation of plasma assisted gasification



Parameter	After gasifier		After plasma reactor	
Fuel load, kg/h	1		1	
Plasma power, kW	-		2.30	
Air flow, m ³ /h	1.63		3.67	
Produced gas yield, m ³ /kg	1.57		2.11	
Produced gas LHV, MJ/m ³	1.87		2.52	
Produced liquids in gas yield, g/m ³	62.92		0.14	
Produced liquids in gas LHV, MJ/m ³	29.2		-	
Average produced gas composition, vol.% (dry)				
	Measured (section 1.5)	Recalculated without nitrogen	Evaluated (based on previous studies)	Recalculated without nitrogen
CO ₂	9.3	44.9	7.1	25.6
CH ₄	1.5	7.2	0.2	0.7
H ₂	2.6	12.3	8.0	28.6
CO	7.1	34.4	12.6	45.1
C ₂ H ₂	0.0	0.0	0.0	0.0
C ₂ H ₆	0.3	1.2	0.0	0.0
C ₃ H ₈	0.0	0.0	0.0	0.0
N ₂	79.2	-	72.1	-



Striūgas N, Valinčius V, Pedišius N, Poškas R, Zakarauskas K. Investigation of sewage sludge treatment using air plasma assisted gasification. Waste Manag 2017. <https://doi.org/10.1016/j.wasman.2017.03.024>.

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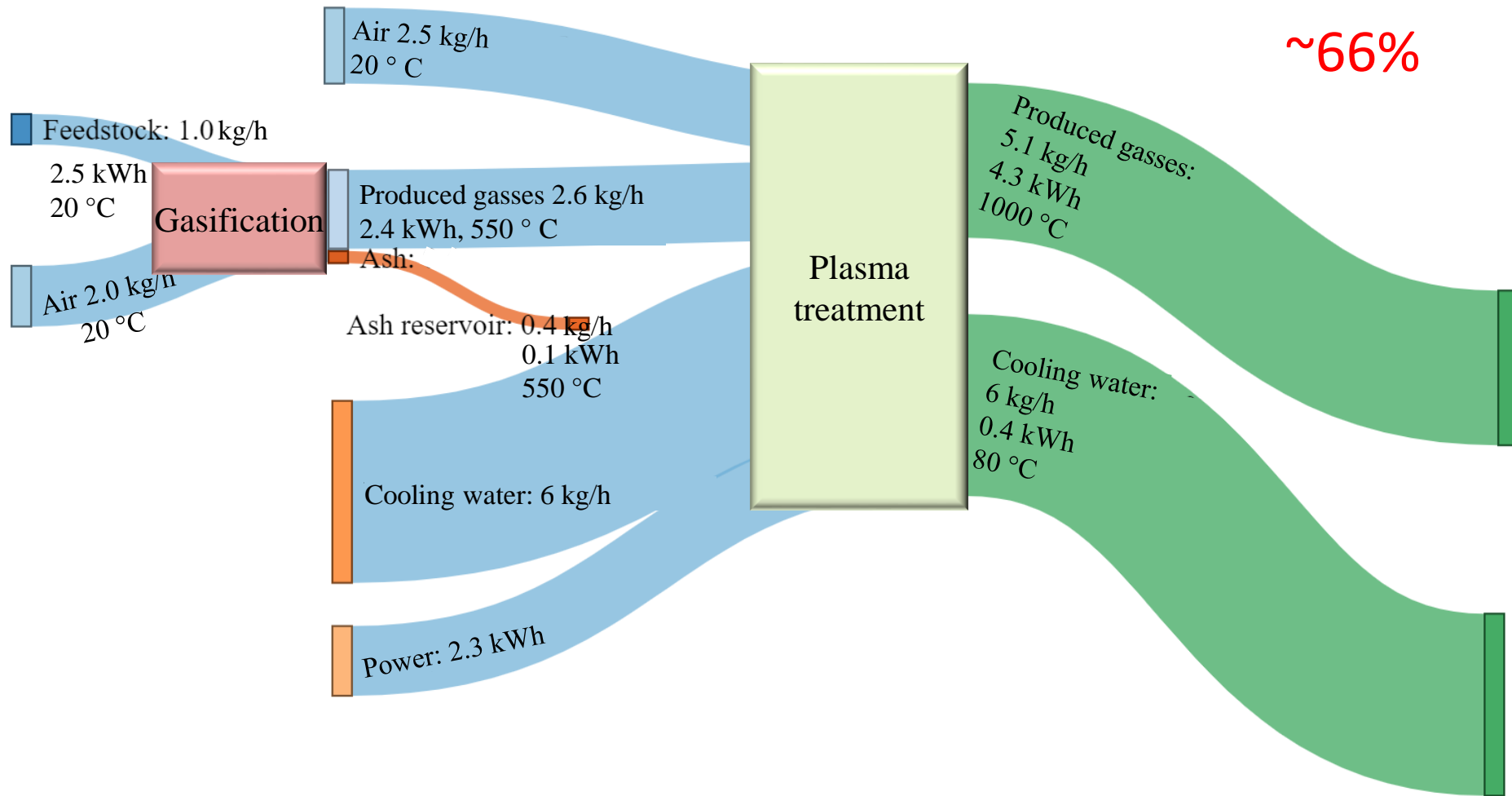


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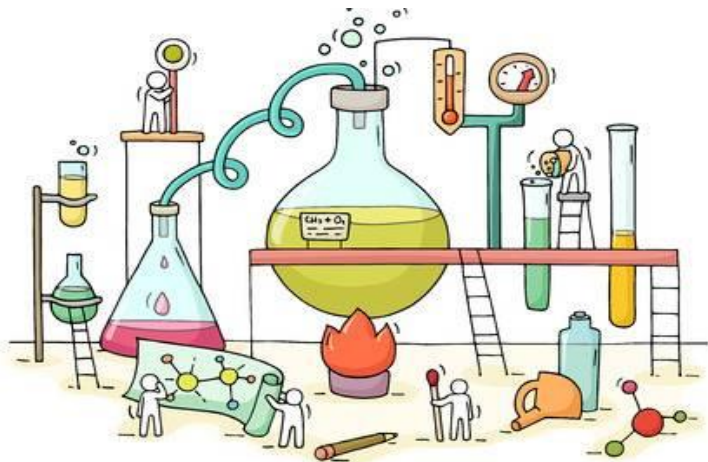
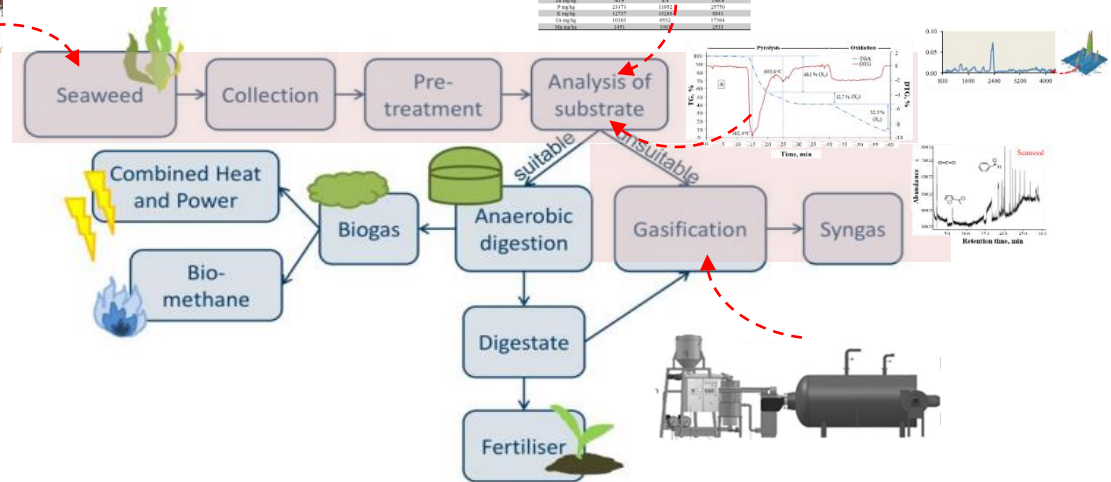
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Theoretical evaluation of plasma assisted gasification

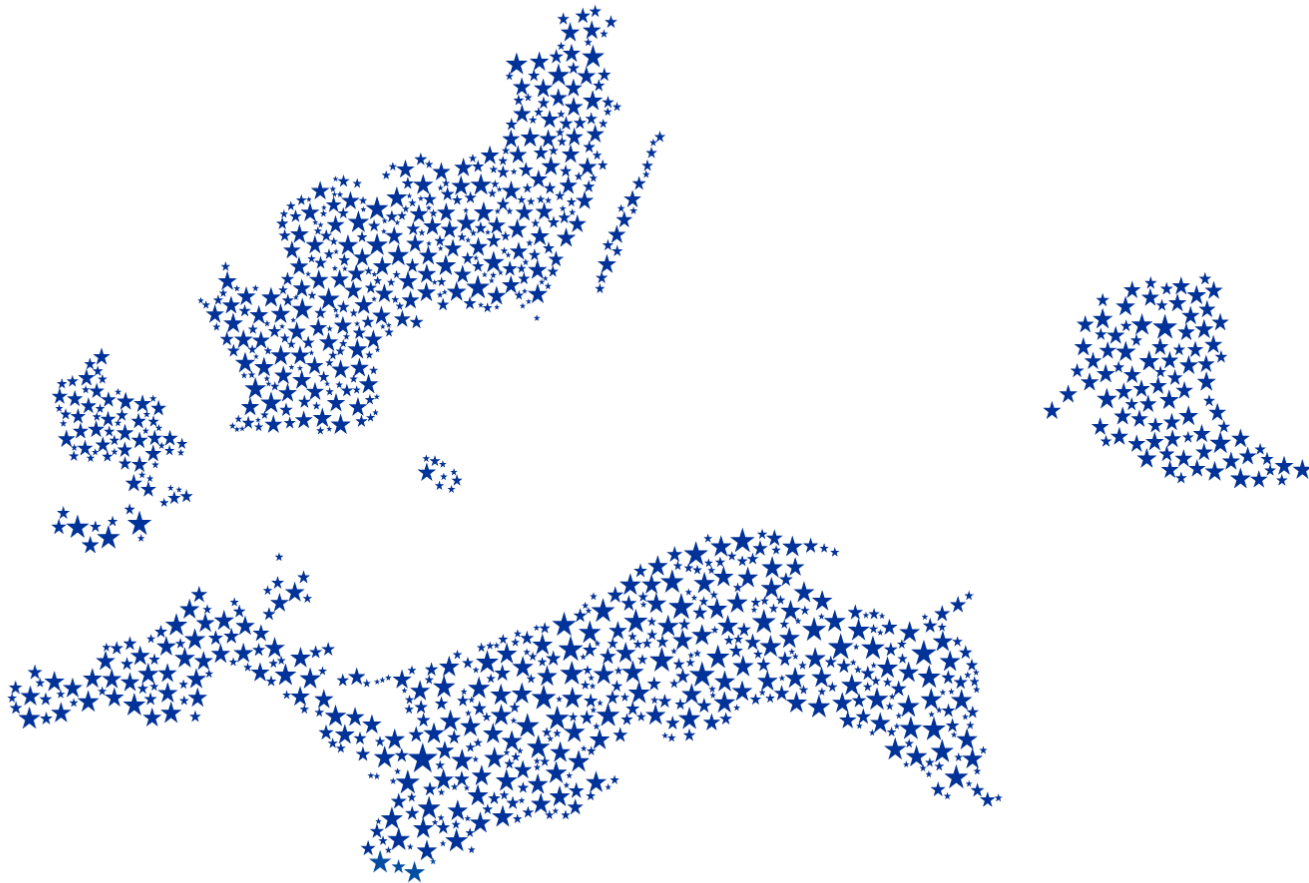


Conclusion

All investigated types of thermal treatment showed potential as seaweed utilization technologies obtaining additional energy carriers.



Thank you!



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