Environmental and economic perspectives of wastewater-fed high rate algal ponds

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The EU aims to reduce dependence on fossil fuels. One possible mean for that might be high rate algal ponds (HRAPs) which photosynthesize biofuel, e.g. algae. HRAPs might effectively replace fossil fuels in future if economic viability is achieved. Today, the only identified economically viable solution for HRAP is wastewater treatment. The EU Urban Waste Water Directive, in turn, has set strict requirements for N and P concentration in wastewater effluent. These requirements remain challenging for many settlements. We studied the potential of HRAPs to meet both waste water and energy targets in Estonia, a EU member state. We identified pollutants limiting the achievement of water quality requirement while assessing also the effluent conditions for the growth of microalgae in HRAPs. Of 979 wastewater outlets, 56% indicated P concentration higher than 2 mg/l, a norm for most settlements while N concentration exceeded the norm of 15 mg/l in 35% of the outlets. Hence, the main problem was pollution with P. Considering that algal cells may contain, depending on conditions, N/P molar ratio between 4:1 and 40:1, in total 78% of all outlets served suitable nutrient conditions for algal growth. In total 8% of analyzed outlets had critical N deficit while 15% showed P deficit. Considering both selection criteria – high N or P content as well as suitable N/P ratio – in total 51% of all outlets matched for the possible treatment with HRAP. However, of the total Estonian consumption of solid fuels, such wastewater-fed HRAPs cannot theoretically cover more than 0.06%. We conclude that while they might possibly contribute towards better water quality, they cannot significantly reduce the demand for fossil fuels.

Biography

Kristjan Piirimäe, PhD, studies as a researcher on surface water quality management in Tallinn University of Technology, Estonia. He also teaches international master courses on eco-design and environmental impact assessment. Piirimäe has studied microbiology, hydrobiology and GIS modelling. He participates in a EU-funded BONUS programme project “Cost efficient algal cultivation systems – A source of emission control and industrial development (Microalgae)”. Piirimäe has worked on spatial planning of biogas stations and decision support in environmental management. He has worked on large-scale quantification of nutrient pollution, wastewater amounts and biogas sources.

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