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Eco-efficiency of on-site water reclamation at a large brewery

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Breweries are large water consumers and recognizes a need for improved water efficiency. Meanwhile the food industry is facing a major challenge in reducing environmental impacts and improve profitability, i.e. a need for eco-efficient production. The goal of our study was to assess the environmental and economic performance of a possible radical change to the water management for a large Danish brewery that will reclaim up to 80% of the on-site process water production. Our Eco-efficiency method combines assessment of economy with life-cycle assessment (LCA) to evaluate if the process would generate more value through technology and process changes whilst reducing resource use and environmental impact. The case study is based on a proposed on-site 'Energy and Water reclamation plant' that will take advantage of the large volume of process released by the brewery. Besides water reclamation, it is proposed to recover heat energy from the process water while treating the effluent water to a higher quality than by conventional process water treatment. The resource recovery solution includes a membrane bioreactor (MBR) in combination with RO treatment, heat pumps for thermal heat recovery, and sludge digestion for biogas production. Our assessment considers the entire water chain from extraction of groundwater, until the treatment of sludge from process water. The functional unit is daily treatment of 1,990 L of process water equivalent to a production of 1,710 L of beer and soft drinks.

For comparison, we assessed a baseline scenario (Fig. 1) where the brewery daily imports 3,765 m^3 drinking water from and discharges 1,990 m^3 process water to a public water utility. Two alternative scenarios of the 'Energy and Water reclamation plant' were assessed: A) On-site Energy and Water reclamation plant with effluent discharge to the Sea and B) a similar system but with re-use of water at the production facility. The proposed alternatives were described in detail and an inventory of mass and energy flows established.

In the economic evaluation both proposed scenarios of the 'Energy and Water reclamation plant' lead to markedly savings for the brewery with largest savings