IEA Bioenergy
Technology Collaboration Programme

From anaerobic wastewater treatment to resource factory – VEAS

Case Study

IEA Bioenergy: Task 37: 03 2026

Norway's largest wastewater treatment plant pioneers BECCS

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BACKGROUND

Veas is a publicly owned inter-municipal company responsible for the treatment of wastewater from approx. 650,000 inhabitants and businesses in the Oslo region, equivalent to the wastewater generated by approximately 800,000 people. Located on the western side of the Oslofjord, it is Norway's largest wastewater treatment facility and is jointly owned by the municipalities of Oslo, Bærum and Asker.

Established in 1976, with operations starting in 1982, Veas was founded with the objective of improving water quality in the Oslofjord by removing organic matter and nutrients from municipal wastewater before releasing it in the Oslofjord. The plant has been under continuous development and remains a pioneering plant today, with a strong focus on societal benefits and sustainability. In 2024, 79 percent of nitrogen and 92 percent of phosphorus was removed. In addition to wastewater treatment, the facility recovers energy in the form of heat and biogas, produces fertilizer and soil improver from sewage sludge, and captures biogenic CO2 from its biogas upgrading process.

PROCESS CONFIGURATION

Wastewater from Oslo, Bærum, Asker and Nesodden is transferred to Veas through a 42-kilometre-long underground tunnel system. This tunnel is constructed with a consistent gradient, enabling gravity-based transport of untreated wastewater to the treatment plant in Slemmestad. In the tunnel, energy is recovered using heat exchangers. In 2024 this system supplied approximately 118 GWh of heat to Oslo's district heating network.

When the wastewater enters the treatment plant, it first undergoes mechanical pre-treatment, during which garbage, coarse materials, and sand are removed. Chemical treatment is then applied to capture phosphorus using iron- and aluminium based coagulants. By adding polymers, larger particles are formed, containing bound phosphates and organic matter. The resulting flocs are separated through gravity in large sedimentation basins, producing a concentrated sludge stream.

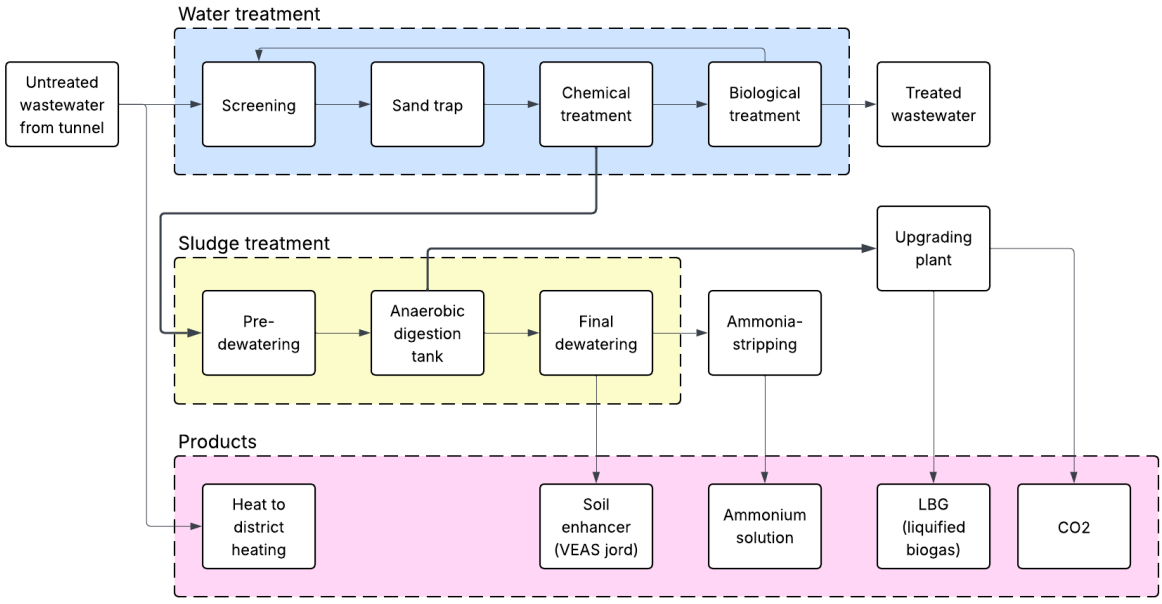

Figure 1. Simplified flowchart of Veas' plant and processes

Next, the sludge is transferred to anaerobic digesters for biogas production. The resulting biogas is upgraded to biomethane. In 2024 Veas produced approximately 10.6 million Nm^3 biogas. Except for production disturbances, the entire biogas output is upgraded and sold externally as bio-LNG.

The remaining digestate is mixed with lime before it is dewatered and sanitised. The end-product is Veas-jord, a soil-enhancing product containing 20 grams of phosphorus and 25 grams of nitrogen per kilogram of dry matter. Veas-jord is used as fertiliser and soil improver on cereal-growing land in the southeast of Norway. The liquid fraction of the digestate undergoes ammonia stripping for nitrogen recovery, which produces an ammonium sulphate solution, which can be used as fertiliser.

Table 1. Key numbers for 2024

Category	Amount (annual)
Wastewater treated	101.5 million m^3
Thermal energy recovered in tunnel to Veas facility	118 GWh
Biogas production	10.633.957 Nm^3
Soil enhancer production (Veas-jord)	45.005 ton
Ammonium solution as fertilizer	5.121 ton
CO_2 captured (goal for 2026)	7.000 ton
Chemicals used	21.854 ton

PIONEERING BECCS IN WASTEWATER TREATMENT

One of Veas' most recent sustainability efforts is the establishment of HOOP[1], an independent company created to commercialise negative emissions by capturing and storing biogenic CO_2 from the biogas upgrading process. After assessing 50 Scandinavian companies for CO_2 utilisation, HOOP concluded that CCS currently represents the only economically viable option. The company aims to become the first globally to sell biogenic CO_2 removal certificates derived from wastewater treatment, with a target of capturing 7.000 tonnes of CO_2 in 2025.

HOOP has chosen Bright Renewables to deliver the CO_2 upgrading plant and will, via a CO2-broker, connect its physical delivery to the existing Northern Lights CCS infrastructure[2]. The captured CO_2 will be transported by truck from Veas to Øygarden near Bergen, where it will be injected into a storage reservoir located 2600 meters below the seabed of the North Sea.

The sale of CO_2 removal credits is facilitated by Inherit, targeting a 94 percent storage efficiency per certificate issued. Full-scale operation is planned to start in 2026.

[1] www.hoopco2.com
[2] www.norlights.com

FUTURE OUTLOOK

Regulation has historically driven innovation at Veas, and this is expected to continue. The forthcoming implementation of revised EU directives, including the Urban Wastewater Treatment Directive, along with updated national regulations, will require enhanced nitrogen removal and the introduction of new treatment steps for micropollutant removal. Meeting these requirements will require process upgrades across the facility.

A key infrastructure development is the construction of a new sludge treatment facility, scheduled for completion in 2027. The current facility is located in a rock cavern that lacks sufficient space for parallel operation of old and new process equipment during the transition phase. This requires that a new 80-meter-long rock cavern will be created to house the new facility. The upgraded facility is expected to reduce odour emissions, decrease the volume of biosolid, reduce outgoing transport, lower operational costs, and expand processing capacity. This will enable Veas to accept sludge and substrates from additional municipalities in the future.

Veas is also a partner in the NOX2N research project, led by the Norwegian University of Life Sciences (NMBU), which explores a novel method to reduce N2O emissions from agricultural soils by enriching digestate with N2O -respiring bacteria[3]. In addition, Veas aims to further reduce its use of chemicals, including substituting conventional additives such as methanol with suitable waste streams as alternatives.

As a publicly owned facility operating at scale in a region facing increasing water quality challenges, Veas is positioning itself as a comprehensive resource recovery plant which delivers heat, fertiliser, biogas, and carbon capture alongside conventional wastewater treatment.

Contact of case story

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Further information on IEA Bioenergy TCP and IEA Bioenergy Task 37: Energy from Biogas

www.ieabioenergy.com
https://task37.ieabioenergy.com/

[3] Unlocking bacterial potential to reduce farmland N2O emissions | Nature