



AquaGreen

part of a greener future

Etablering af Pyrolyse anlæg hos Lemvig Vand

30. maj 2024



AGENDA

01	Lidt om Lemvig Vands strategiske overvejelser	Stefan
02	Hvilken forskel gør pyrolyse?	Henning
03	Overvejelserne bag beslutningen	Stefan
04	Hvordan virker et HECLA Setores anlæg	Henning
05	Etablering på renseanlægget, hvad skal der til?	Stefan
06	Hvad bliver det næste?	Henning
07	Spørgsmål	

Lemvig Vands strategi



STRATEGI 2025

MISSION

Det er Lemvig Vands mission at sikre rent drikkevand, rense spildevand, samt at kunne håndtere teknisk vand og klimavand, og dermed beskytte vigtige samfundsværdier, for kunder og borgere.

VISION

Med udgangspunkt i relevante verdensmål er det Lemvig Vands vision at være en nationalt anerkendt vandforsyningsvirksomhed, der til privatkunder og erhvervs-kunder i hele Lemvig Kommune:

sikrer høj kvalitets drikkevand og renser spildevand effektivt, til konkurrencedygtige priser.

Det er Lemvig Vands vision at være en effektiv vandoperatør med hensyn til teknisk vand og Klimavand i overensstemmelse med Lemvig Kommune.
Det er Lemvig Vands vision at være agil, være innovativ via Klimatorium, for til enhver tid, at have en effektiv drift, også set i forhold til andre vandselskaber.



Samarbejde og udvikling



Klimaentreprenør

Vi vil være Lemvig Kommunes partner på håndtering af vand, både når det gælder drikkevand, spildevand og håndtering af "klimavand".



Reduceret klimaaftryk

Vores mål er, at vi er klimapositive så hurtigt som muligt og senest i 2030.



Omkostningsbevidsthed

1

Hvorfor pyrolyse?

At være en klima entreprenør og reducere forsyningens CO₂ udledning.

- En reduktion af CO₂e udledningen med 450 t pr år

En del af planen mod klimaneutralitet og Lemvig Vands overordnede strategi.

Udfordringer med PFAS-holdigt spildevandsslam fra Harbøre ift. vejledende grænseværdier.

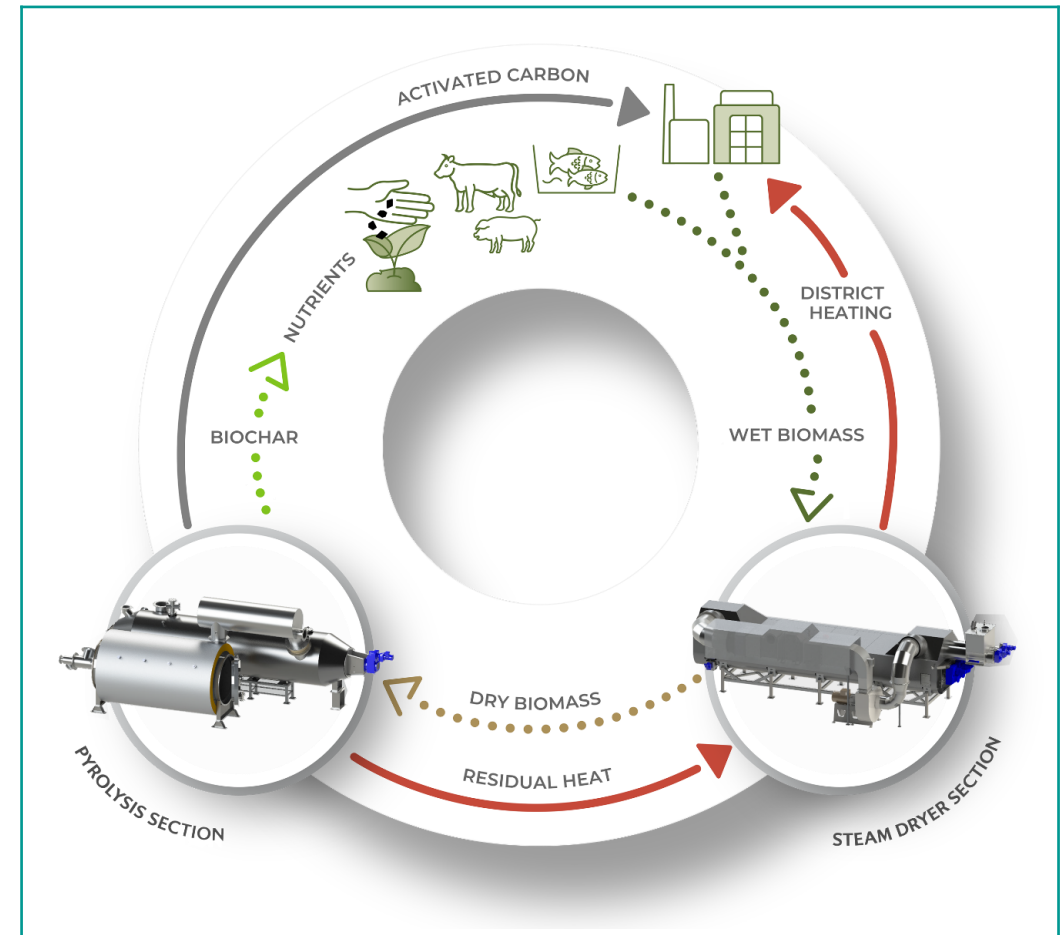
Reducere de stigende omkostninger til disponering af slam. Særligt ift. PFAS.

At slammængde reduceres til 1/10, og kunne håndtere slammet lokalt -> mindre håndtering, mindre transport.

Producere et brugbart EBC certificeret biochar produkt, der kan disponeres uden omkostninger eller tilmed en fortjeneste.

Reducere øvrige miljøfremmede stoffer, tungmetaller og medicinrester.

Pyrolyse af spildevandsslam er en proces, der resulterer i at slammængden i Lemvig Vand reduceres fra 3.700 t afvandet slam (21% tørstof) til 350 t biochar.



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Our planet is under pressure

AquaGreens mission:

To address four planetary challenges

Phosphorus

- Phosphorus is a scarce resource
- Nutrients are re-circulated

Groundwater

- Groundwater is protected
- Harmful pollutants eliminated

CO₂ emissions

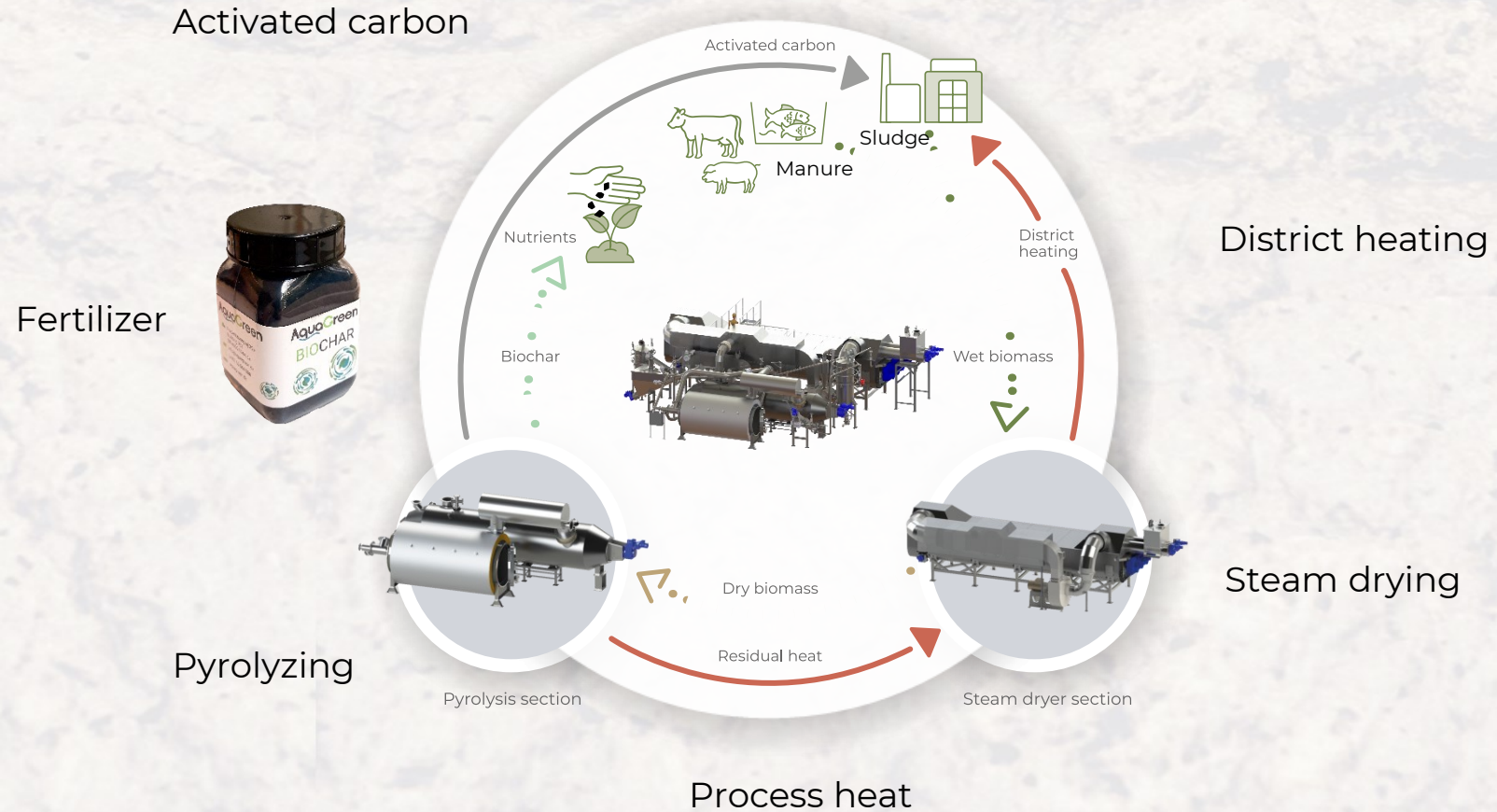
- Greenhouse gases eliminated
- Carbon is captured and stored

Renewable energy

- District heating produced
- Green gas can be produced
- Biofuel and methanol

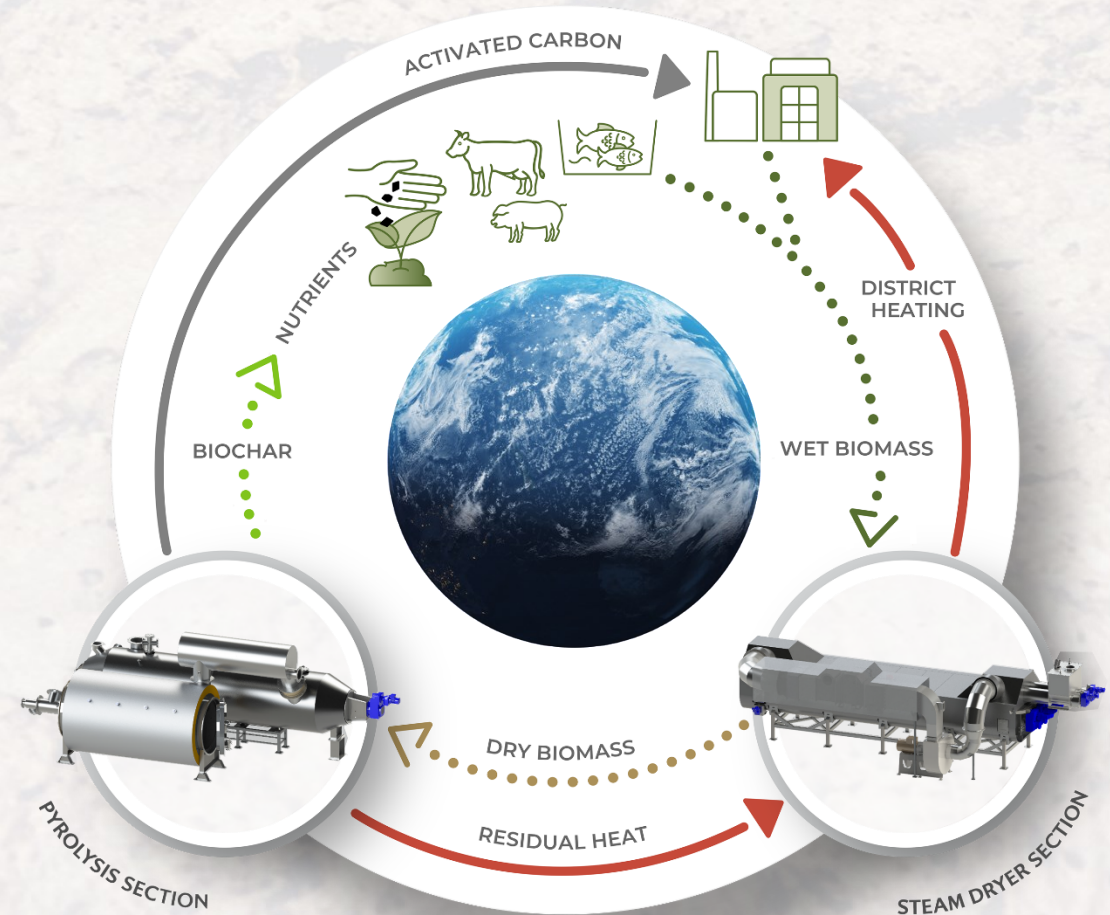


How do we address the global challenges?



You eliminate environmental pollutants

- Environmental pollutants are eliminated
 - Micro plastics
 - Medical residues
 - PFAS
 - PCB, PCDD/F, LAS, etc.
 - Low PAH
- Heavy metals are immobilized
- Malodor is eliminated
- Transportation reduced with 90%
- Sustainable energy produced



GOODBYE PFAS, PESTICIDES & PHARMACEUTICALS RESIDUES

The Danish EPA issued guiding limit values for PFAS content in Biosolids in November 2021
Overnight 20% of Danish sludge became contaminated.

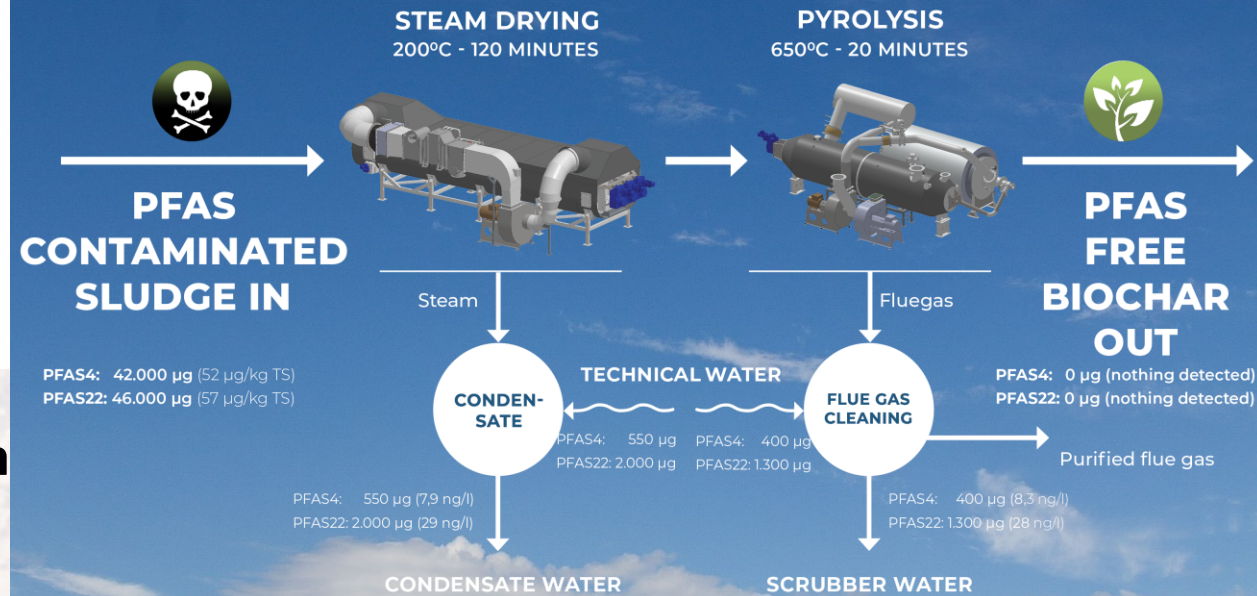
EU has included limit values for PFAS in sludge in the Sewage Sludge Directive.

Odsherred Forsyning pyrolysis results:

- 6-8 PFAS compounds in the biosolids
- 26-41 pharmaceuticals, 0-12 pesticides in the biosolids
- No PFAS detectable in the biochar
- No PFAS detectable in the flue gas
- 99%+ removal of pharmaceuticals in the biochar
- No pesticides in the biochar

RESULTS FROM PYROLYSIS OF SLUDGE CONTAINING PFAS

SOURCE: EUROFINS / FORCE TECHNOLOGIES / AQUAGREEN



Emissions: Flue gas measurements - passed

Accredited flue gas measurements

Substance	Unit	Value	Limit value	Status
CO	mg/m ³ (ref)	81	100	Passed
NO _x	mg/m ³ (ref)	34	200	Passed
TVOC	mg C/m ³ (ref)	1,2	20	Passed
HF	mg/m ³ (ref)	1,0	4	Passed
HCl	mg/m ³ (ref)	60	150	Passed
SO ₂	mg/m ³ (ref)	150	200	Passed
Particles	mg/m ³ (ref)	8,9	30	Passed
Hg	mg/m ³ (ref)	0,0056	0,050	Passed
Σ Cd & Tl	mg/m ³ (ref)	0,0011	0,050	Passed
Σ As, Co, Cr, Cu, Mn, Ni, Pb, Sb	mg/m ³ (ref)	0,016	0,50	Passed
Dioxines (I-TEQ)	ng/m ³ (ref)	0,0011	0,10	Passed

Biosolids biochar – meets sludge limit values

Fårevejle Wastewater Treatment Plant key data

Metal content – meets Danish limit values

Additional facts:

- 20-30% water added to biochar to avoid dust
- No PFAS, pharmaceuticals, micro plastics, PCB, PCDD, PCDF, LAS, DEHP etc. in the biochar
- Low PAH (< 0,4 mg/kg dm)
- 5-7 % P and 2-3% N in the biochar

Results

Metal	Value	Limit	Unit	
Pb	43	120	mg/kg ts	✓
Pb/P	810	10,000	mg/kg TP	✓
Cd	1.5	0.8	mg/kg ts	
Cd/P	28	100	mg/kg TP	✓
Cr	62	100	mg/kg ts	✓
Cu	650	1,000	mg/kg ts	✓
Hg	<0.01	0.8	mg/kg ts	✓
Hg/P	< 0.2	200	mg/kg TP	✓
Ni	43	30	mg/kg ts	
Ni/P	810	2,500	mg/kg TP	✓
Zn	1,800	4,000	mg/kg ts	✓

Nutrients are recirculated and the climate is protected

Biochar is a fertiliser and soil improver

- Valuable nutrients: 5% P, 2% N, 1% Mg
- Biochar holds water and drains
- Gives soil structure and enhances microbial growth

Biochar is good for the environment

- **No leaching of phosphorus** – not water soluble
- **Retains polluting compounds**

Biochar is good for the climate

- **CO₂ is stored**

Applications

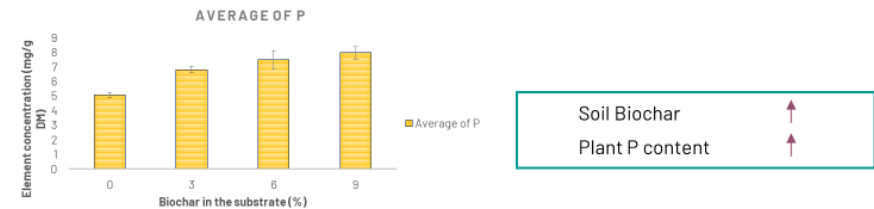
- Urban landscaping, agriculture
- Climate positive construction materials
- PFAS and pharmaceuticals removal from wastewater

P content increased with biochar addition to soil

Based on full-grown harvest data

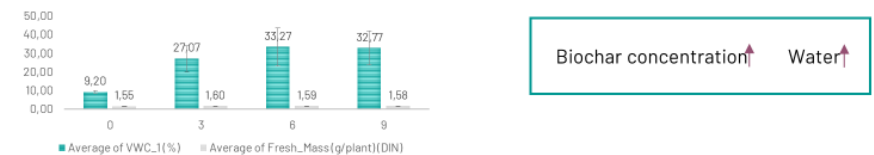
Phosphorus content in the plant material – pyrolysis 665 °C

P in the plant tissue increase with 60% from 5 to 8 mg/g DM

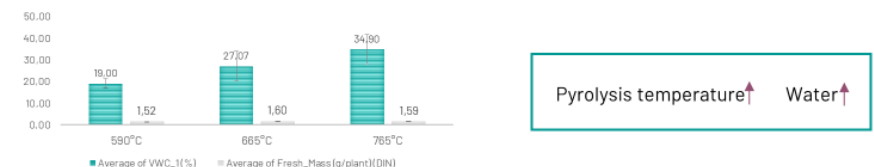


3% biochar triple soil water content

665 °C biochar vs. no biochar: Water content in soil and plant mass



3% biochar: water in soil and plant mass vs. pyrolysis T



IPCC: “We must capture CO₂”

Biochar *is* part of the solution

Producing and storing biochar is, according to IPCC, the UN panel for climate change, one of three ways to save the climate by capturing and removing CO₂ from the atmosphere.

The three ways are:

- Planting trees, which has limited and temporary effect
- Direct air capture of CO₂ which is expensive and unproven
- Production of **biochar**, which is proven and reliable

“ all scenarios outlined in the IPCC SR15 report rely on carbon removal, foreseeing significant amounts of carbon capture and storage”

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Valg af teknologi

- For at vælge den teknologi der er bedst egnet for Lemvig Vand, er der lavet et omfattende analysearbejde, for at afdække de muligheder der er på markedet.
- Det er Lemvig Vands vurdering pyrolyse er bedste nuværende tilgængelige teknologi på markedet.
 - Selvbærende proces ift. energi forbrug til pyrolysering
 - CO2 reduktion i form af binding af kulstof til Biochar
 - Nedbrydning af miljøfremmede stoffer herunder Pfas, medicin rester jf. Miljøstyrelsens anbefalede grænseværdier.
 - Bevarelse af fosfor og næringsstoffer - gødnings produkt.
- "Den eneste bæredygtige løsning, til en fornuftig økonomi og etableringspris, og eneste nuværende der samtidig nedbryder PFAS, medicinrester og andre miljøfremmede stoffer samtidig."
- Pyrolyse er også velanset af Miljøstyrelsen, som også har lagt økonomi i investeringer og teknologi i danske virksomheder der arbejder med pyrolyse.



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An aerial photograph of a town in Denmark, showing a mix of residential buildings, green fields, and a road. The image is slightly blurred, creating a soft background for the text.

Steam drying and pyrolysis

FÅREVEJLE RENSEANLÆG

DENMARK

The Steamdrying and pyrolysis plant at Harboøre Renseanlæg

HECLA® Setores 1.000/50.000 PE

2) Biomass is dried using super-heated steam at 200°C

Excess steam is condensed as hot water for local or district heating

Process takes approx. 2 hours

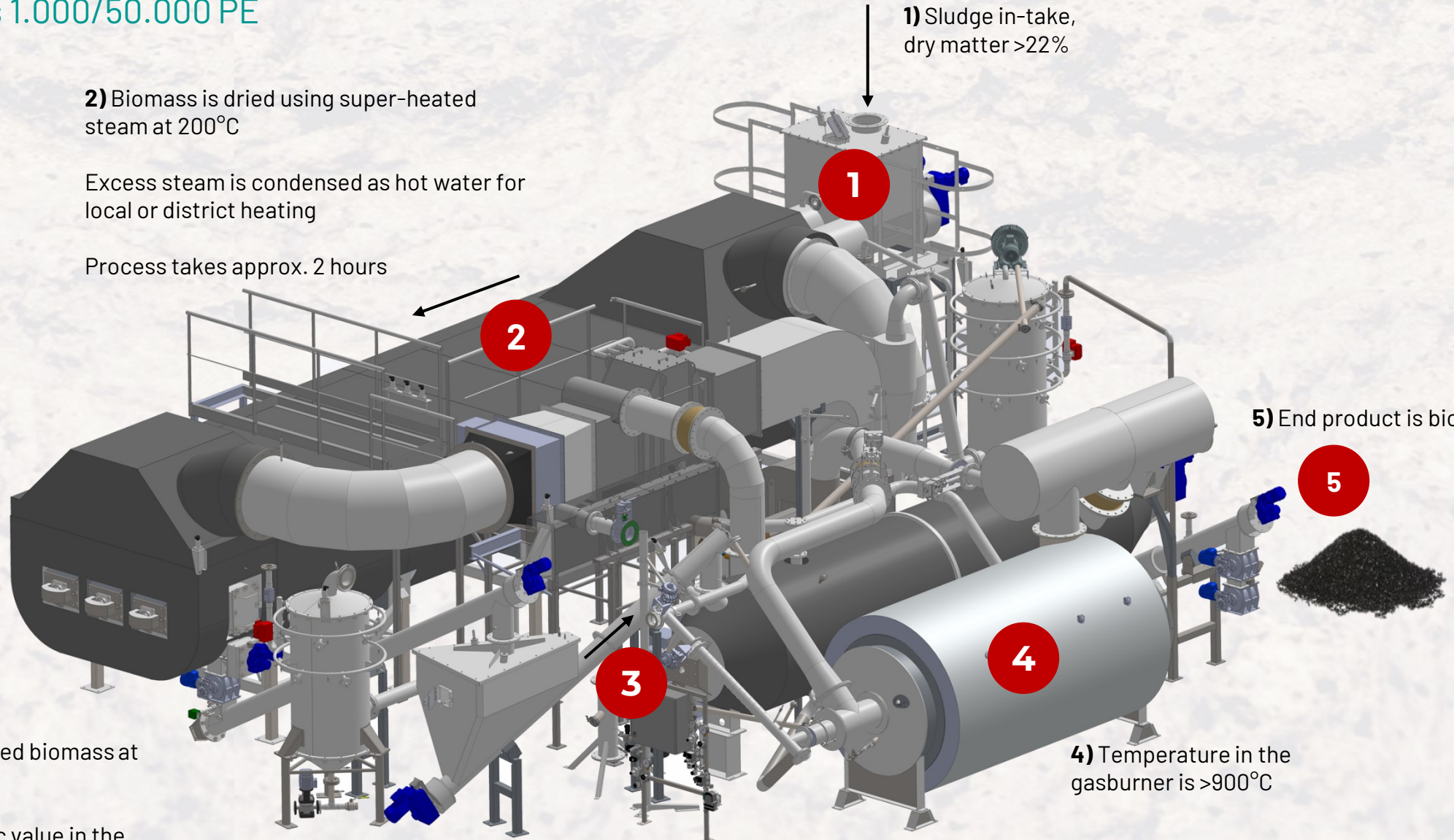
1) Sludge in-take, dry matter >22%

5) End product is biochar.

3) We pyrolyse the dried biomass at 650°C for 20 minutes.

We utilize the calorific value in the sludge by burning the pyrolysis gasses.

4) Temperature in the gasburner is >900°C

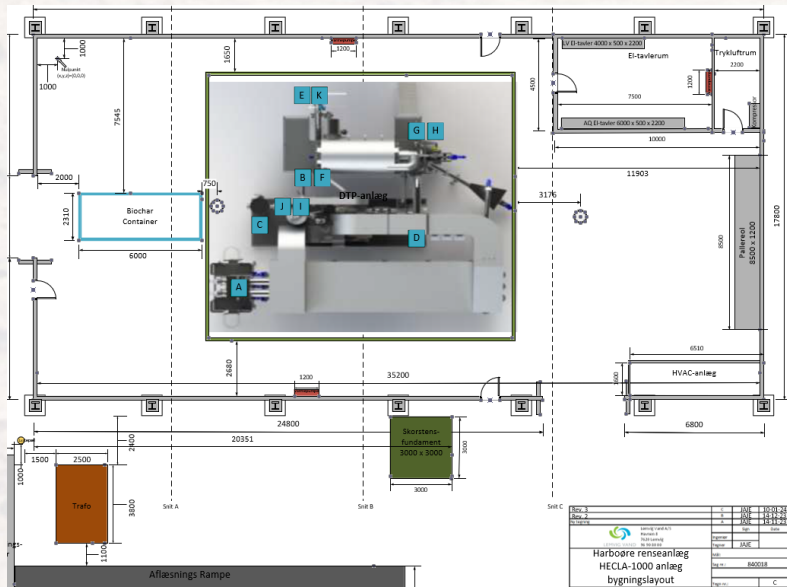


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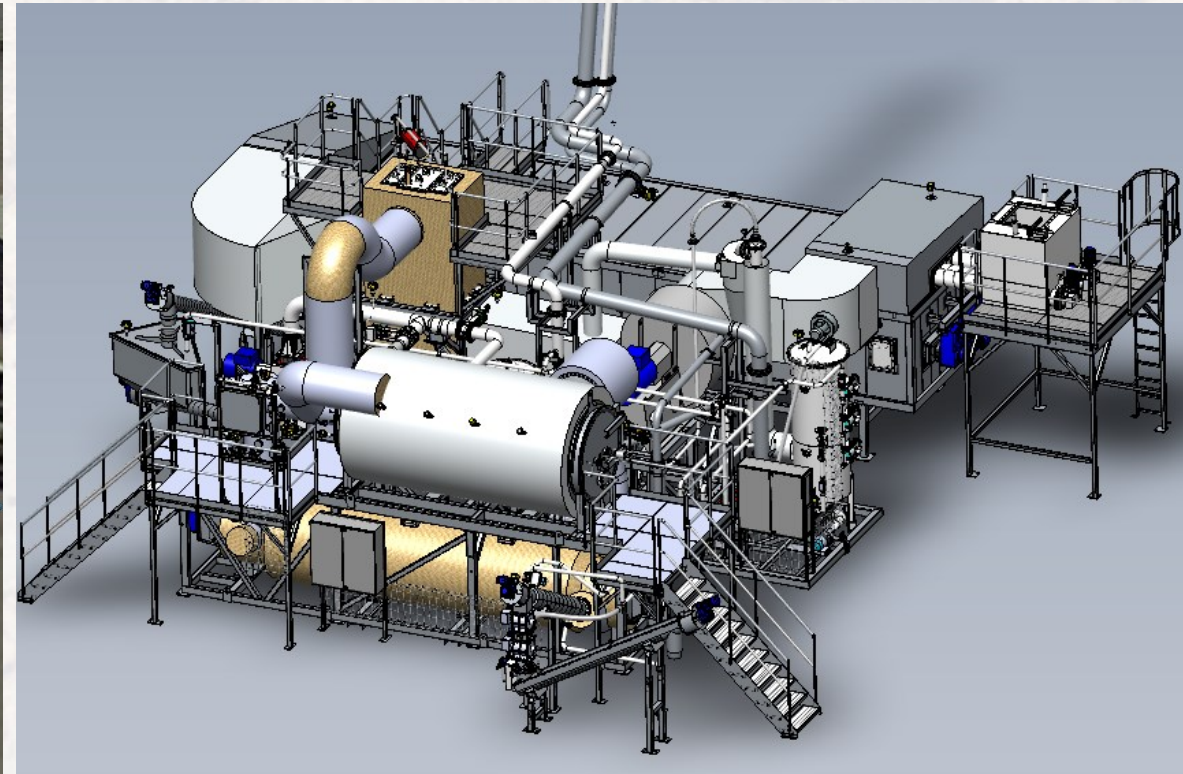
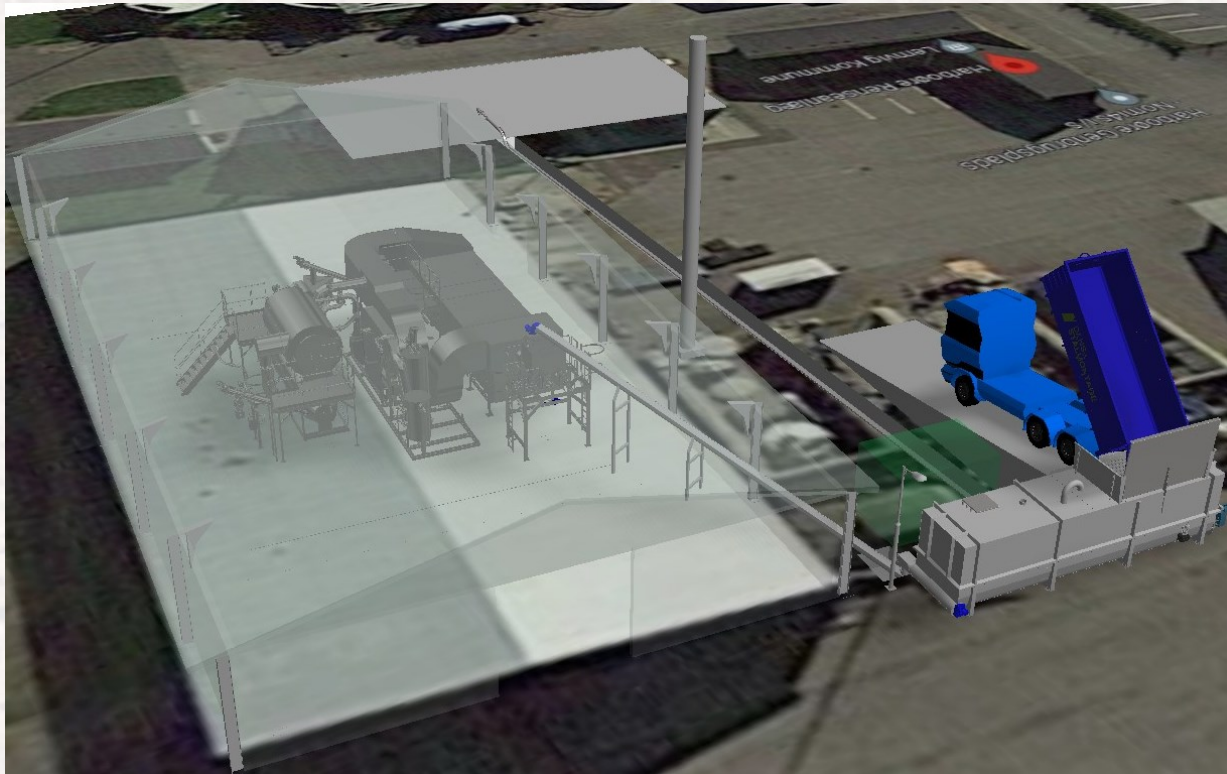
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Etablering på Harboøre Renseanlæg

- Harboøre Renseanlæg er det fremtidige renselanlæg og derfor det naturlige valg for placering. Det er forventningen at Lemvig og Harboøre renselanlæg snart skal sammenlægges.
- Udnyttelse af gammel slamhal for etablering af anlægget tæt på slam afvander.



3D model billeder



Myndighedsbehandling

- Krav til VVM-screening for miljøgodkendelse
 - 4 ugers høring
- Krav om Miljøgodkendelse
- Natura 2000, PFAS, skorstens emissioner og højde, massebalance og prøvetagnings program
- Krav om tilslutningstilladelse, midlertidig og permanent
- Projektbeskrivelse
- Byggetilladelse
- Brandteknisk vurdering
- Krav til skorsten og fundering KK2



Lemvig Kommune



LEMVIG VAND



Miljøministeriet
Miljøstyrelsen

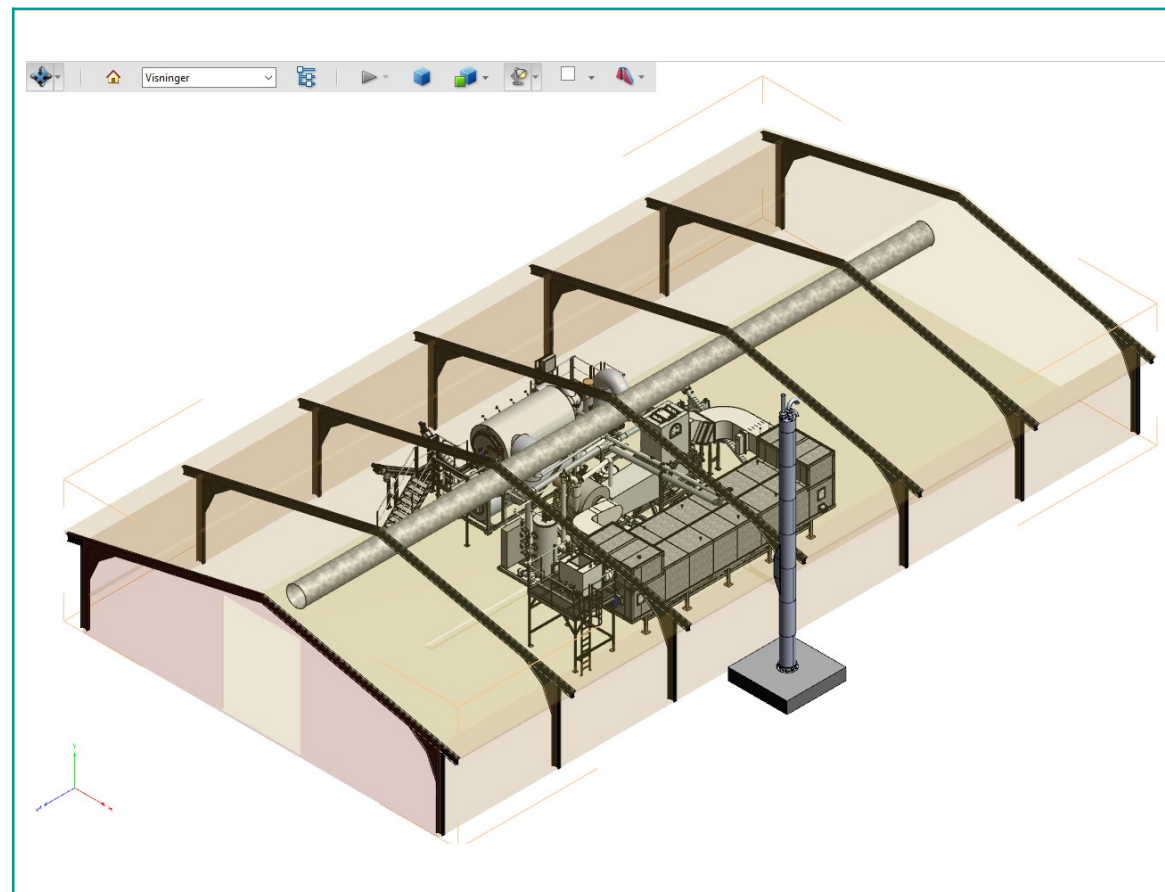


AquaGreen

Fag-entreprise opdelt og styret proces

Kommentarer

1. Ombygning af slamhal + omkringliggende arealer i 2. etaper
2. Slamforsyningsanlæg
3. VVS
4. El entreprise, fordelt til 2 leverandører
5. Naturgas/LPG forsyning
6. Brandsikring; rednings og alarmeringsudstyr
7. SCADA styring
8. CE mærkning
9. Pyrolyse og Biochar leverandør



Projektstatus

Kommentarer

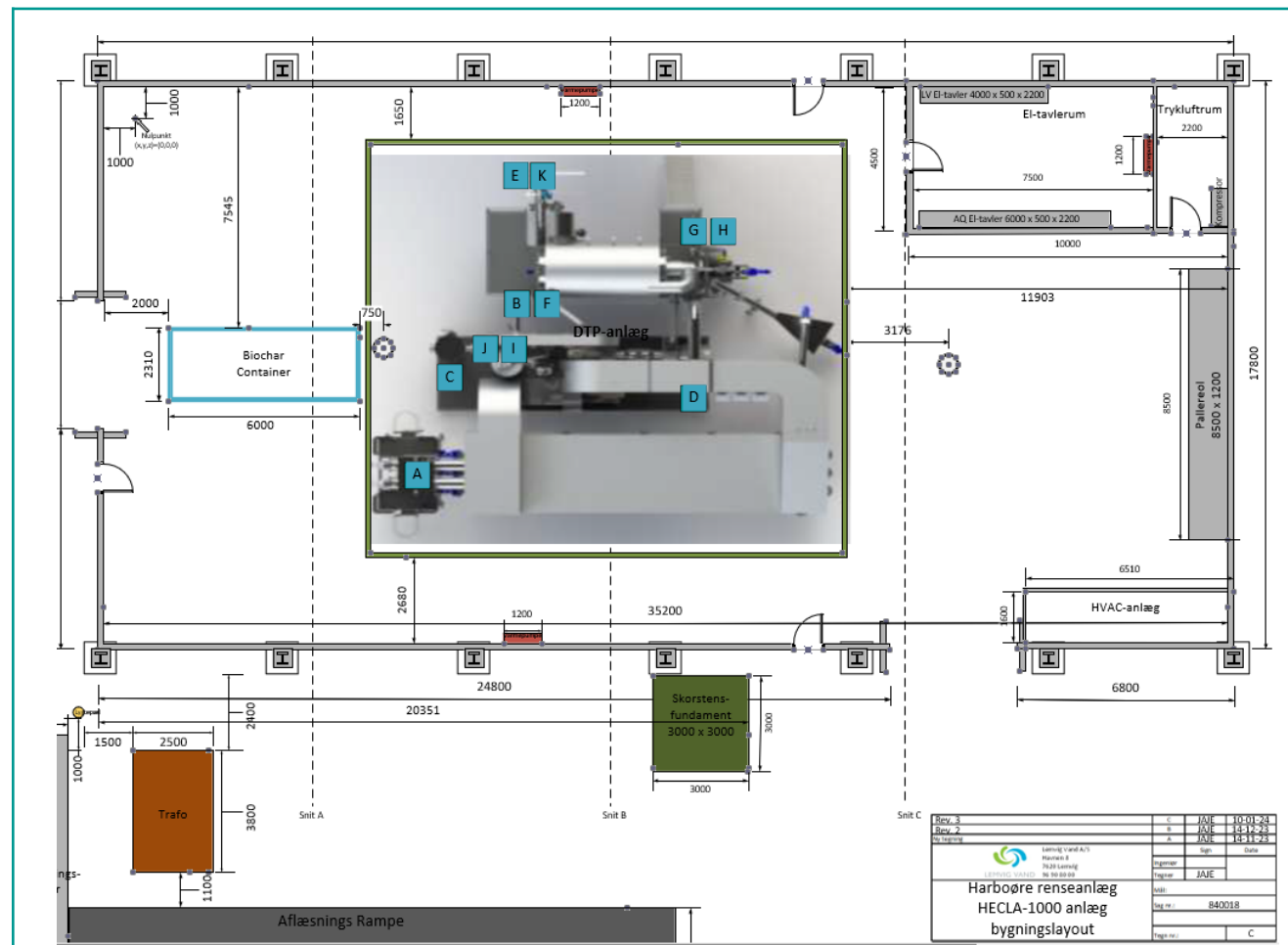
- Myndighedsbehandling færdig ultimo April
- Byggeri Etape 1. Pyrolysehal ombygning er færdig
- AquaGreen anlæg blev leveret 1. april og er efterfølgende monteret
- Byggeri Etape 2. Jord og beton påbegyndtes 1. april
- Gas leverandør på plads
- Alle fagentrepriser næsten på plads eller i udbud.
- SCADA programmering igangværende



Projektstatus

Kommentarer

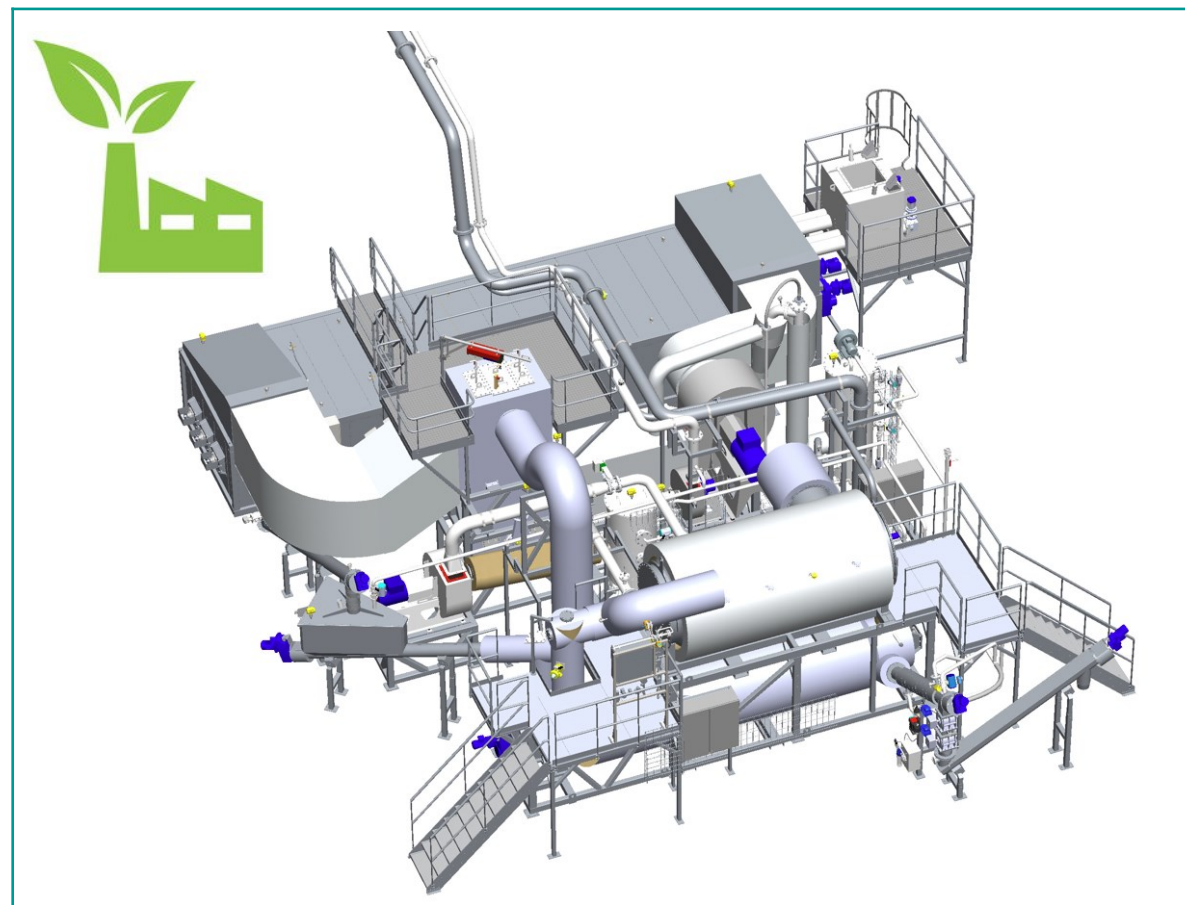
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Projektstatus

Kommentarer

- Montage færdig juni 2024
- Opstart og indkøring juni -> juli 2024
- Kommissionering, uddannelse og træning af personale juli -> sept. 2024
- Aflevering november 2024



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Hvad bliver det næste?

PFAS fokus

Miljøstyrelsen opjusterer: Antal PFAS-forurenede om **svt NYHETER**

Etter nye tilbakemeldinger fra sundhedsadelig PFAS-foru NORRBOTTEN

svt NYHETER

BLEKINGE

PFAS-föreningen jublar för skadestånd

Här Lars Wiklund om lämet i Boden där fiskar vis kemiska PFAS. Foto: Katerina Yewets/SVT

PFAS-larm i Boden fångad fisk inte skadad

UPPDATERAD 5 FEBRUAR

De PFAS-drabbade Högsta domstolen mottogs med jubel i Kallinge.

Nu avråds bodensare från att äta fisk från Högsta domstolen släppt fast att Miljöteknik är skadeståndsansvariga för PFAS-föreningen i dricksvatten i Kallinge har totalt 288 privatpersoner lämnat in stämningssökningar mot det kommunala V&B-bolaget.

Inne på Blekinge tingsrätt råder febril aktivitet veckan för full. Tiden efter att Högsta domstolen släppt fast att Miljöteknik är skadeståndsansvariga för PFAS-föreningen i dricksvatten i Kallinge har totalt 288 privatpersoner lämnat in stämningssökningar mot det kommunala V&B-bolaget.

Men hovrätten rev upp domen, och menade att en förhöjd risk för PFAS-relaterade sjukdomar inte går att klassa som en personskada.

PFAS-fokus

Brussels, 1 March 2024 (OR_en)

7108/24

ENV 230
SAN 118
COMPET 241
CONSOM 84
AGRI 140
CODEC 822

OUTCOME OF PROCEEDINGS

From: General Secretariat of the Council
To: Delegations
No. prev. doc.: 684/24 + COR 1 REV 1
No. Clin. doc.: 14322/22 + ADD 1 - COM(2022) 541 final + Annex
Subject: Proposal for a Directive of the European Parliament and of the Council concerning urban wastewater treatment (recast)
Letter to the Chair of the European Parliament Committee on the Environment, Public Health and Food Safety (ENVI)

Following the Permanent Representatives Committee meeting of 1 March 2024 which endorsed the final compromise text, delegations are informed that the Presidency sent the attached letter, together with the final text agreed in Cooper, to the Chair of the European Parliament Committee on the Environment, Public Health and Food Safety (ENVI).

It is mandatory for all EU countries to start measuring PFAS within 3 years

7108/24 TREE:LA L:zam EN

05.02.2024: PFAS-drabbade får rätt till skadestånd för förgiftat dricksvatten i SVT Nyheter

05.02.2024: PFAS-larm i Boden – sjöarna där fångad fisk inte ska ätas i SVT Nyheter

05.02.2024: Hundratals nya stämningar mot Miljöteknik – riskerar enormt skadestånd i SVT Nyheter

Carbon Removal Credits + CO₂ skatter

Grøn skattereform

Endelig afrapportering

● Council of the EU, Press Release, 20 February 2024, 10-10

Climate action: Council and Parliament agree to establish an EU carbon removals certification framework

Council and European Parliament negotiators reached a **provisional political agreement** today on a regulation to establish the first EU-level certification framework for carbon removals, carbon farming and carbon storage in products. The voluntary framework is intended to facilitate and speed up the deployment of high-quality carbon removal and soil emission reduction activities in the EU.

Once entered into force, the regulation will be the first step towards introducing a comprehensive carbon removal and soil emission reduction framework in EU legislation and contribute to the EU's ambitious goal of reaching climate neutrality by 2050, as set out in the European climate law.

The deal reached today is provisional, pending formal adoption by both institutions.

Main elements of the agreement

Scope of the regulation

The regulation will include an open definition of carbon removals, in line with the Intergovernmental Panel on Climate Change (IPCC) and which only covers atmospheric or biogenic carbon removals. It will cover the following carbon removal and emission reduction activities and differentiate between four corresponding types of units:

- **permanent carbon removal** (storing atmospheric or biogenic carbon for several centuries)
- **temporary carbon storage in long-lasting products** (such as wood-based construction products of a duration of at least 25 years and that can be monitored on-site during the entire monitoring period)
- **temporary carbon storage from carbon farming** (e.g. restoring forests and soil, wetland reclamation, direct reforestation)
- **soil emission reduction from carbon farming** which includes carbon and nitrous oxide reductions from soil management, and activities that must overall reduce the carbon emissions of soils or increase carbon removals from biological matter management of activities as wetland management, soil tillage and cover crop practices, reduced use of fertilizer combined with soil management practices, etc.)

Compared to the Commission's proposal this means an extension of the scope of the regulation to soil emission reductions, temporary carbon storage from carbon farming

As a result of the agreement, the Commission will propose a regulation to establish a **certification process** and **voluntary units of certification**, but included further clarification as to how the certification process works.

As a consequence of carbon farming, this regulation has added reductions to the value included in a carbon farming certificate, which will be used to offset carbon emissions from other sectors.

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Carbon Removal Credits + CO₂ skatter

21.02.2024: Grøn skattereform - endelig afrapportering | Skatteministeriet (skm.dk)

20.02.2024: Climate action: Council and Parliament agree to establish an EU carbon removals certification framework - Consilium (europa.eu)

As a result of the agreement, the Commission will propose a regulation to establish a **certification process** and **voluntary units of certification**, but included further clarification as to how the certification process works.

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Biochar og aktivt kul

PFAS limit values

Brussels, 24 May 2023 (OR_en)

9668/23

ENV 833
AGRI 272
SAN 252
COMPET 476
CONSOM 190

COVER NOTE

From: Secretary-General of the European Commission, signed by Ms Martine DESPREZ, Director
date of receipt: 23 May 2023
To: Ms Thérèse BLANCHET, Secretary-General of the Council of the European Union
No. Clin.doc.: SWD(2023) 187 final

Subject: COMMISSION STAFF WORKING DOCUMENT EVALUATION Council Directive 86/273/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture

16.02.2024 (EU) NEWS RELEASE

Danske leverandører vil spille god på nye PFAS-regler: 'Vi har en dansk styrkeposition'

Organisationer og cleantech-selskaber ventede sig rigtigt på EU's nye PFAS-regler, som vil sænke grænserne for PFAS i miljøet og i produkter. Det betyder, at danske virksomheder kan sælge deres produkter til et højere prisniveau end i andre lande.

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Deal on more efficient treatment and reuse of urban wastewater

Press Release (EN) 29-01-2024 - 1238

Medical residues

- Better monitoring of chemical pollutants, pathogens and antimicrobial resistance
- Production of pharmaceuticals and cosmetics and member states to finance costs of additional treatment for micro-pollutants
- Water reuse of treated urban wastewater to prevent water scarcity

Parliament and Council agreed on Monday on new rules for the collection, treatment and discharge of urban wastewater to better protect the environment and human health.

Negotiators agreed to apply secondary treatment (i.e., the removal of biodegradable organic matter) to urban wastewater before it is discharged into the environment, to all agglomerations of 1 000 population equivalent (p.e.) or more by 2035. By 2039, EU countries will have to ensure the application of tertiary treatment (i.e., the removal of nitrogen and phosphorus) in all plants covering 150 000 p.e. and above, and by 2045 in plants covering 10 000 p.e. and above. An additional treatment removes a broad spectrum of micropollutants (quaternary treatment) will be mandatory for all plants over 150 000 p.e. and above (10 000 p.e. based on a final assessment) by 2045.

The agreed deal requires member states to provide the reuse of treated wastewater from all urban wastewater treatment plants where appropriate, especially in water-stressed

29.01.2024: Deal on more efficient treatment and reuse of urban wastewater | News | European Parliament (europa.eu)

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| 02 | Hvilken forskel gør pyrolyse? | Henning |
| 03 | Overvejelserne bag beslutningen | Stefan |
| 04 | Hvordan virker et HECLA Setores anlæg | Henning |
| 05 | Etablering på renseanlægget, hvad skal der til? | Stefan |
| 06 | Hvad bliver det næste? | Henning |

07 Spørgsmål

Spørgsmål



END

