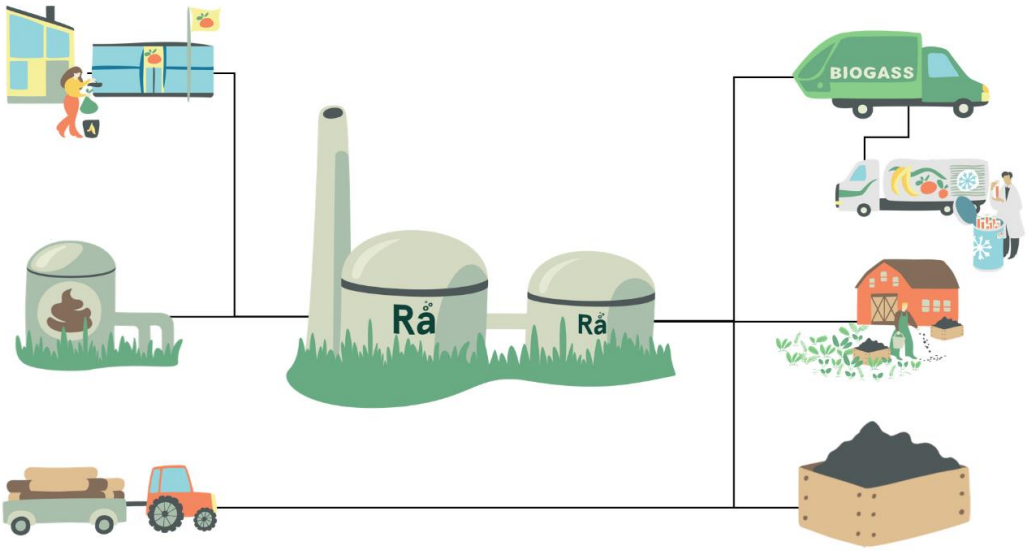
Rå Biopark

Specification



Rå Biopark AS

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Summary

Avfallsservice AS and Remiks Miljøpark AS are two waste management companies in the "Troms and Finnmark" region of Northern Norway. They jointly own a waste management operation called Origo Skibotn AS located in Skibotn, Storfjord municipality. Origo Skibotn AS operates a landfill as well as a composting plant which treats wet organic waste.

This document presents a concept of how a biogas Plant can be realised in Skibotn in the face of both geographical and demographic challenges in the region. The project has been given the title Rå Biopark. We aim to build a biogas plant in the region, finding a balance between making the Plant large enough to make the specific costs of the biogas plant affordable but not so large that the cost or carbon footprint of transporting the feedstock and output products outweigh the environmental benefits.

Rå Biopark will be a project for sustainable biogas production in Northern Norway. This document is an outline proposal for how to realise the Rå Biopark project. Rå Biopark was established as a company in July 2022 to further develop the project. Rå Biopark will manage the project preparation and procurement of technology/construction work according to the Public Procurement Act. Rå Biopark is owned by six different waste management companies namely Remiks Miljøpark AS, Avfallsservice AS, Reno-Vest IKS, Hålogaland Ressursselskap IKS, Finnmark Ressursselskap AS and Lofoten Avfallsselskap IKS.

Rå Biopark will treat food waste from households and sewage sludge from in 41 municipalities in the region, as well as wet organic waste from industrial and commercial sources, fish aquaculture sludge and other smaller fractions. In summary, the Plant must be designed with a capacity to treat 63.100 tons of wet organic waste per year.

The products which are going to be produced in Rå Biopark are liquid biogas (LBM), liquid bio-CO_2 and fertiliser granules/pellets. The Plant will provide the region with access to a climate-neutral fuel that is second to none in terms of well to wheel carbon footprint.

Rå Biopark will be able to produce ca. 60 GWh (H_s) of biogas per year. This amount can replace over 4.700.000 litres of diesel, and the emissions reduction from this replacement is estimated to be an annual reduction in emissions of almost 12.700 tons of CO_2 equivalents[1].

Rå Biopark intends to solve the challenges connected with Digestate handling by implementing a full Digestate treatment technology to increase the value of the Digestate, and at the same time reduce the amount to be transported by at least 90%.

Above and beyond that Rå Biopark plans to become a green, regional circular economy hub by using the momentum generated by the biogas plant project to develop other connected synergistic projects at the Site and in the region. We hope that Rå Biopark will create the nurturing and enabling environment for Greentech, biotech, biofuel and food production businesses.

[1] Assuming a LCV = Hi (MJ/kg) of 50 for methane and 43,4 for diesel (), density of diesel 0,838 kg/l (reference), and energy consumption per km (kWh_{el}/km) for a 40 ton truck of 2,74 for diesel and 3,24 for methane (reference) and 325 g CO_2-eq./kWh_{el} of well to wheel emissions for diesel (reference)

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Glossary

In the tender documentation, the intention has been to use terms and concepts consistently. There are some exceptions to this, however, and in some cases other terms and concepts may be used.

The glossary below is not a list of definitions, but a glossary of terms which serves to explain the terms, concepts and abbreviations used by the Client in the tender documentation.

Term	Explanation
Availability	Operational Availability = ((tA+tN+tD+tW)/tP) x100 tA = The total actual active operating time of a particular Lot or function measured using the Plant Control System. tN = The total time that the Lot or function is technically available but not running due to a lack of input material provided that the Lot is not subject to cleaning, planned or unplanned maintenance during this time measured by using the Plant Control System. tD = The total time that the Lot or function is unavailable directly as the result of actions by the Purchaser's personnel that are contrary to the Technical Manual provided by the Contractor pursuant to section 15.5 measured by using the Plant Control System. tW = The total time that the Lot or function is unavailable (except for those reasons covered in tD) whereby a designed workaround agreed between the Client and Contractor (which must be described in the Technical Manual provided by the Contractor pursuant to section 15.5) is enabled and is operating, and which avoids the negative consequences of non-availability, as measured by using the Plant Control System. tP = The total expected running time of the Lot or function. The total expected running time of the Lot or function = Plant Operating Hours unless otherwise specified
Battery Limits Connection Points Termination Points	The Battery Limit is the outer boundary of the Plot. The Battery Limit is the interface between Works (existing or to be built) delivered by the Client and Works built by the Design and Build Contractor (DBC). At the Battery limits are several interfaces for example where water or electricity is supplied by the Client to the DBC and where wastewater is delivered by the DBC back to the Client. These interfaces are called Connection Points. Termination Points are distinct from Connection Points. Termination Points in contrast are interfaces between the scope of supply of the DBC and the scope of Supply of Suppliers of Other Lots such as Lot D or Lot E.
Biofuel	LBM, liquid, or gaseous fuel for transport that is produced from biomass.
Biomass	Biodegradable fraction of products, waste, and residues of biological origin from agriculture, forestry, fisheries, and aquaculture. Waste of fossil origin is not included in the project.
By-Products	Materials directly produced by the Plant and its Lots.

Capacity Projected Estimate "§"	This means the throughput, processing capacity or production Capacity for which a Lot or Sub-Lot must be designed. The respective Lot/Sub-Lot must be able to operate stably at this defined Capacity. Capacity may be defined for daily, annual or for other time periods. At the time of publishing ITT 1 the Client has estimated the respective Capacity as regards flows, throughputs, loads etc. of solids, liquids, gases and energy. These are "Projected Estimates" which the Client estimates will be inputs into Lots and/or be transferred from one Lot to another Lot. As the procurement process further advances there may be changes in parameters that affect other Lots. The final, contractually defined value the respective Capacity may differ from the Projected Estimate initially published and would then replace and supersede the current Projected Estimates. The symbol "§" next to a particular number also conveys this meaning.
(The) Client	Rå Biopark AS, the company that will own and operate the Plant.
Contaminant	Contaminant means an unwanted item, component or fraction which is present in feedstock, and which should ideally be mostly removed from the feedstock in pre-treatment processes before feeding into the fermenters and which may still be present in digestate after leaving the fermenters. Contaminants impair in some way the functioning of (parts of) the plant and/or reduce the value of Products produced by the plant. Above all the term is to be understood in the context of digestate quality, as explained in sections 6.4 and 6.8. See also Visible Contaminant.
Contractor	The contract party for this contract which will design and build the Plant (including Lots A, B, G and H), also referred to as the Design and Build Contractor, also abbreviated to "DBC" (see below). The terms Supplier, Contractor, Design and Build Contractor and DBC are used interchangeably in ITT 1.
Customer	Business partner or co-operation partner of Rå Biopark, generally an offtaker of Products produced at the Plant
Design and Build Contractor (DBC)	The Contractor who is awarded with the Contract for ITT 1 i.e. for the Minimum Scope
Digestate	Feedstock that has undergone digestion in Fermenters which are also known as anaerobic digesters via the process of fermentation (anaerobic digestion) .
Essential Functions	These are absolutely essential functions which the Plant must have in order to fulfil its technical objectives, as described in section 5.1
Expected Value	An Expected Value is an operational parameter which influences the economic feasibility of the plant, albeit less strongly. The Supplier must submit Expected Values in its Commercial Offer and the Contractor must ensure adherence to the Expected Values during the Performance Tests. The Client will not use financial remedies in the event that Expected Values are not reached. See also Guarantee Value.
Feedstock	Any material, primarily organic waste, which must be processed in the Plant.

Guarantee Value	A Guarantee Value is an operational parameter which strongly influences the economic feasibility of the plant. The Supplier must submit Guarantee Values in its Commercial Offer and the Contractor will ensure adherence to the Guarantee Values during the Performance Tests. The Client will have financial remedies available in the event that Guarantee Values are not reached. See also Expected Value.
Invite To Tender (ITT)	Means this procurement procedure, ITT 1, whereby we invite Suppliers to Submit their Tender or Commercial Offer
Line	The Plant is divided into 2 separate Lines (Line 1 and 2) which is relevant for Lot A, part of Lot D, and Lot G and which is explained in section 6.2.
Lot	One of a small number of major functional components that will be built, and which jointly combine and interact technically to form the Plant.
Minimum Scope Other Lots and Suppliers thereof	The following Lots must be offered together by the Supplier as a single Tender/Commercial Offer: - Lot A - Lot B - Lot G and - Lot H. In this case the Supplier acts as a technology integrator and as a "DBC". We also use the term "DBC" for this Supplier. The "Other Lots" are the 2 Lots not included in the Minimum Scope and are as follows (separate Invite to Tender process): - Lot D (built by "Supplier Lot D") - Lot E (built by "Supplier Lot E")
Parts with limited working life (Spare Parts)	The Suppliers must deliver contractual Works with a defect notification period and an additional Warranty on the Works delivered. The Warranty should be 2 years from Taking Over. The Works delivered may include some Parts with Limited Working Life, which are otherwise commonly known as wear parts and/or spare parts. Parts with limited Working Life are defined as Parts whose expected lifetime is less than the defect notification period. We will use the abbreviated term "Spare Parts". We do not otherwise distinguish between or individually define wear parts and spare parts.
Plant	The complete Plant that will be built in Skibotn.
Plot	See Site
Products	Valuable materials with commercial marketability or utility which are produced from By-Products.
Rå Biopark AS	The project company which has been set up and incorporated to develop this Plant. The company will act as the Client towards Contractors.

Site	The location where the Plant will be built, at Skibotn, Troms/Finnmark county, Northern Norway (refer to section 25). Within the Site there is an area defined by a blue line (the Battery Limit) in the Client's General Arrangement plan which is the Plot. The Plot is the area handed over to the Supplier for the duration of the construction project to build the Works delivered by the Supplier within the Plant.
Substrate	Any liquid medium which is to be converted into biogas and Digestate inside Lot A.
Sub-Lot	A functional component that is part of a Lot that will be built, and which jointly combine and interact technically to form the Lot. This term is used interchangeably with the words "equipment," "unit" and "technology."
Sub-supplier and sub-Contractor	Companies which are intended to deliver part of the Supplier's Commercial Offer/contract works are termed Sub-Suppliers, Sub-Contractors or contract assistants.
Supplier	This term is both used to describe those parties who participate in the competition submitting tenders and the successful supplier who then upon contract award enters into the contract with the Client. As a contract party we use the term "DBC" or "Design and Build Contractor" is also used in some documents as a synonym. For more information regarding group of companies acting as a supplier and sub-Contractors see document "Tender rules".
Tank	Means any gas tight and watertight large container structure which contains Substrate, namely Mixing Buffer Tanks, Fermenters and Digestate Buffer Tanks
Visible Contaminants	Visible contaminants are objects that are >2 mm, i.e. those that do not pass a 2 mm mesh sieve, and consist of: - Glass - Plastics (all forms of transparent and non-transparent films, hard plastics and similar items) - Metal - Rubber - Composites (e.g. combinations of plastic and metal) - Biodegradable polymers (bioplastics) - Paper Stones (gravel), bones and eggshells are not defined as Visible Contaminant.
Waste	Substance or material which the holder discards or intends or is obliged to discard.
Works	All of the goods, services, including technology, labour, designs, documentation delivered by a Contractor for the Client for the benefit of this Plant.

Table 1: Glossary of terms used in this document.

Abbreviations

Abbreviation	Explanation
CBG	Compressed Biogas
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
CRC	Carbon Removal Certificates
CH_4	Methane
CO_2	Carbon dioxide
DBC	Design and Build Contractor
EV	Expected Value
GV	Guarantee Value
GWh/ MWh/ kWh	Gigawatt hour/ Megawatt hour/ Kilowatt hour
H_2S	Hydrogen sulphide
HTC	Hydro Thermal Carbonisation
ITT	Invite To Tender
$LBCO_2$	Liquified Bio-CO_2
LBM	Liquified Biomethane
LFD	Liquid Fraction Digestate
NH_3	Ammonia
NH_4	Ammonium
oTS, oDS, oDM	Organic solids = Organic Dry solids = Organic Dry matter
PT	Performance Test
SFD	Solid Fraction Digestate
TBD	To be determined. In this context means that the Client has not yet defined a particular value but rather that the Supplier must define a value (either an Expected Value and/or Guarantee Value) for a particular parameter and performance test. It means that a parameter must be agreed upon by Contract signature.
TS, DS, DM	Total solids = Dry solids = Dry matter
TT	Taking Over Test

Table 2: Abbreviations used in this document.

1 Overview of this document

The objective of this document is to describe in a concise way, for Suppliers who are tendering for ITT 1 and who are planning to submit a Commercial Offer what are Rå Biopark's needs and requirements. This document also forms the basis of the obligations of the Contractor's performance according to the Contract at a later stage and in the event of a Contract award.

All Suppliers must read the entirety of this document with certain exceptions described in *Table 3*. Depending on which Lot the supplier is tendering for, some sections may not be relevant.

Please note that we have used this one single document to describe all aspects of the development of a Plant at the Site. This procurement will be managed with several procurement processes resulting in several Contracts which in turn will include one or more Lots as is described below.

While we have written separate chapters for each of the Lots, it is particularly important that each supplier of an individual Lot not only look at the *Table 3* but also that they read section 15 which applies to every Supplier, irrespective of which Lot they will supply.

Sections of this document which are non-essential:	for Suppliers of these Lots:
2, 8, 9, 10, 11	Minimum Scope (Lots A, B, G, H)

Table 3: Explanation: Which parts of this document are non-essential for which suppliers

2 General project introduction

2.1 Background

In Northern Norway two municipal waste management companies, Avfallsservice AS and, Remiks Miljøpark AS, jointly own a company called Origo Skibotn AS. Origo Skibotn AS operates a plant for management and treatment of wet organic waste and is the preferred and the only currently available solution for sustainable management of wet organic waste in the region. Origo AS operates a composting plant and a landfill.

A composting process produces nutrient-rich soil that can be used as a soil improver. Unfortunately, there is not a high return on the compost product produced, which can be attributed to challenges related to quality and also to considerable distances between the Site and potential compost offtakers. Potential Customers such as farmers, cannot afford to buy the product due to high transport costs. Please refer to section 25 for further information about the Skibotn Site.

As owners of Origo Skibotn AS (thereby the largest actors in the treatment of wet organic waste in the region), Remiks Miljøpark AS and Avfallsservice AS have been working to achieve a better waste treatment solution.

Based on previous work, including studies carried out by Troms County Municipality, a feasibility study was carried out in 2019, which concluded that it was possible to establish a biogas plant in the current region. However, there were some challenges related to geography and population density that needed to be addressed. In 2021, Troms and Finnmark County Municipality funded a feasibility study which has resulted in the establishment of a Special Project Vehicle called "Rå Biopark AS". This project intends to produce products that are demanded by the circular economy and foster sustainable waste management concepts that are currently being worked to implement locally. The project is anchored in Tromsø Municipality's Climate, Environment and Energy Plan (2018-2025), which includes measures related to the development of biofuels based on food waste and sewage sludge which can be found here.

This project has received a great deal of political support both at the local and national government level. Politicians in the local community are promoting the project, which was also presented to and received very favourably by the Norwegian Minister of Trade and Industry in July 2022.

2.2 Current stage of project development

The project referred to in this report as Rå Biopark, is a concept that describes how a large-scale biogas plant can be realised in Northern Norway. In our region, agriculture has a limited capacity to absorb Digestate from a large biogas plant compared to agriculture in other parts of the country further south, where the density of farmers is greater, and the growing season is longer. Operating companies in northern Norwegian waste industry were only able to choose between continuing with composting of wet organic waste or investing in small biogas plants. However, small biogas plants cannot achieve the economies of scale that are required, meaning that to achieve profitability the price for delivering waste materials to the Plant becomes unacceptably high. As a result of this, operators in Northern Norway have continued with composting while operators in areas further south with a higher density of farmers in the vicinity have been able to upgrade their treatment of wet organic waste to biogas production.

The concept described in this summary considers how a biogas plant can be realised in Northern Norway, even with the geographical and demographic challenges in the region. The biogas sector is more or less limited to installations on the southern third of the country. You can see in the overview of biogas plants that only two smaller plants have been established in Northern Norway.

The Rå Biopark project aims to solve the challenge of marketing Digestate by drying and concentrating the Digestate with the final aim of manufacturing fertiliser Products.

Figure 1: Biogas plants in Norway as of December 2022.

The information described in this document includes technological factors and targets, economic factors determining the business case and affecting choice of technology, available feedstock, framework conditions, climate and environmental benefits, etc., which have contributed to developing a concept for biogas production in Northern Norway that is economically and environmentally sustainable.

2.3 Project and procurement Organisation

The pre-project was carried out by the partnership between two public sector waste management companies, Remiks Miljøpark AS and Avfallsservice AS. Other co-operating companies in the commercial/private sector and Tromsø Municipality of Water and Sewage Works participated in the pre-project.

During the pre-project phase, many other public sector waste management companies in the region have shown interest in participating in the project. As a result, it was decided to form and incorporate a new company called Rå Biopark AS. This company has been given the responsibility for the design and procurement of technology and construction work under the Public Procurement Act.

The following six companies have become shareholders of Rå Biopark:

1. Remiks Miljøpark AS
2. Reno-Vest IKS
3. Lofoten Avfallsselskap IKS
4. Avfallsservice AS
5. Hålogaland Ressursselskap IKS
6. Finnmark Ressursselskap AS

2.4 Regional cooperation

The project involves extensive cooperation in the region, and the following municipalities are involved in the project and have expressed interest in participating in the establishment of the Plant through their respective regional waste management companies:

Waste management company	Municipality	
Remiks Miljøpark AS	Tromsø	Karlsøy
Avfallsservice AS	Kvænangen Kåfjord Lyngen	Nordreisa Skjærvøy Storfjord
Reno-Vest IKS	Andøy Bø Hadsel	Lødingen Sortland Øksnes
Hålogaland Ressursselskap IKS	Harstad Narvik Evenes Tjeldsund	Gratangen Ibestad Kvæfjord Lavangen
Lofoten Avfallsselskap IKS	Flakstad Moskenes	Vestvågøy Vågan
Finnmark Ressursselskap AS	Hammerfest	

Table 4: Municipalities delivering waste to the Rå Biopark project

Figure 2: Local Waste management companies participating in the Rå Biopark project.

This figure shows the regional distribution of the various waste management companies involved and the territories that they cover.

In addition to the municipalities above, other municipalities in Mid-Troms and municipalities in West-Finnmark may also supply waste to the Plant.

2.5 Opportunities

The Rå Biopark project is expected to significantly increase the utilisation of resources in the region. Today, the utilisation of the resources contained in organic waste is limited to composting only. A nutrient-rich soil product is produced from organic waste, but the associated emissions from the composting process, together with challenges related to the quality of the end product, make an upgrade of this treatment method desirable. The Rå Biopark project will contribute to the reduction of CO_2 emissions by reducing the requirement for fossil fuels for bus, heavy-duty transport and the marine sector. In addition to this the phasing out of composting will eliminate emissions from open windrow composting, replacing the process with an enclosed system where most emissions are converted to products. There has been a desire to establish a biogas plant in the region for some time, and several actors have worked – and are still working – to develop concepts that may be feasible with the conditions we have in the region.

We believe that it is important that the waste industry and the shareholders of Rå Biopark continue to take ownership of the resources contained in the waste and work together to ensure that as few of these resources are wasted as possible. If the Rå Biopark biogas project is realised we will have the opportunity to be at the forefront of biogas development in the Artic region.

An important factor in terms of resource use is the national target that 65% of collected waste should go to material recovery by 2035. A new regulation requires 100% of food waste to be recycled from 2023, and stakeholders expect a transitional phase before the target is reached. Collection of household food waste has a long tradition in the region, and most municipalities have had systems for separate collection in place for around 15-20 years.

The market for the products that are planned to be produced at Rå Biopark is growing, and with an ever-increasing focus on carrying capacity and reduction in greenhouse gas emissions, this growth is expected to continue to a greater degree in the years to come. Several actors in the private sector see the importance of reducing their own carbon footprint and ensuring that products and services supplied meet Customer requirements in terms of carrying capacity. Through meetings and dialogue with parties that may supply waste to the Plant in the future, their desire to contribute to a sustainable production has been verified. Many potential Customers have shown interest in buying products from the Rå Biopark, and the market seems willing to replace fossil CO_2 and fossil fuels with climate-friendly products. Contributing to a circular economy where waste is delivered to Rå Biopark and biogas, for example is purchased, would be a major advantage for an operator supplying goods to climate- and environmentally conscious Customers.

Technological developments also suggest that the time is now ripe to invest in a biogas plant in the region. Investment in biogas plants is associated with low uncertainty as this technology has been verified through long-term operation at thousands of locations around the world of which dozens are in Norway. The technology required for pre-treatment of feedstock is also well established. Today in Skibotn the food waste is pre-treated before the feedstock is composted. As a result, the risks associated with the operation of pre-treatment are reduced since the process is already known in principle.

2.6 Today's situation at Origo Skibotn AS

The composting plant at Origo Skibotn AS, receives food waste from 19 municipalities in the Troms and Finnmark counties, as well as waste from some municipalities north of Nordland[2]. At today's composting plant, a nutrient-rich soil is produced from food waste and sewage sludge through open windrow composting. The method ensures that the waste is recycled so that important nutrients do not disappear from the cycle. Apart from high nitrogen losses, open windrow composting, does not make use of the energy potential, and thus the resources contained in the waste. The current plant has been in operation since 1999 and is operated by four full-time operators. The current environmental permit for outdoor composting of food waste at the location is due to expire at the end of 2025. If Rå Biopark can build a biogas plant it will lead to a significant increase in feedstock processed.

[2] Norway is divided up into counties. See here for an explanation. The Rå Biopark project covers the northernmost county/ies of Troms and Finnmark as well as parts of the neighbouring county Nordland to the South/West of Troms and Finnmark

2.7 Regional benefits

The establishment of the Rå Biopark will have a major regional impact. The Plant will need to be implemented with the associated handling and utilisation of Digestate as a raw material to produce products in order to be in line with the wishes and objectives of the stakeholders, national authorities and regional authorities regarding a transition to a circular economy and local utilisation of raw materials that would otherwise be wasted. The establishment of the Rå Biopark will provide great opportunities regionally. By establishing a biogas plant in an industrial area, we can enable further technological development, even food production. The establishment of a biogas plant will provide the region with access to a climate-friendly fuel that is second to none.

Other direct benefits are concrete gains from the establishment of skilled jobs, environmental technology, and industry in the region. These include:

- Development of competence, environmental and professional networks across sectors
- Skilled jobs are a driver of growth, and a good geographical spread of such jobs will be an important contribution in the drive towards more centralisation.
- A practical arena for knowledge and competence building - at all levels of the knowledge sector - from university to kindergarten.
- Creating a demand for biological material in the region and stimulates increased use of land for bioenergy, activities that are mentioned as important measures in the Government of Troms and Finnmark's bioenergy strategy for Northern Norway[3].

2.8 Added value

The project delivers added value by building competence around the production of biogas. Other sectors such as aquaculture, hydroponics, agriculture and forestry could benefit from a reference investment and the know-how to be built up in Skibotn in order to reduce risks and facilitate necessary measures and investments in the same direction.

2.9 Increased economic activity

For the Nord-Troms region in particular, the establishment of skilled workplaces and industry is particularly important. Creating jobs in district municipalities and regions is important to maintain a viable municipality and to reverse the negative demographic development that is taking place.

The establishment of a biogas production plant at Skibotn will maintain and build on the region's position as a centre of competence for waste reception and handling and create skilled employment opportunities in the municipality.

The proximity to Northern Finland and Northern Sweden also represents a significant opportunity, especially related to existing local industries that can recover products, but also in the handling of waste from these neighbouring countries.

[3] Green Heat in the North - Bioenergy Strategy for Northern Norway (https://www.statsforvalteren.no/contentassets/d27d302776354e34a1c90fd53fdf0530/bioenergistrategi-for-nord-norge.pdf)

2.10 Framework conditions

The waste industry in Norway and Europe is heavily regulated, with stricter and stricter regulations having been introduced constantly over the last 20 years to prevent polluting emissions and establish regulations that ensure that materials do not go to waste.

2.10.1 Environmental emissions permit

The establishment of the Rå Biopark requires permission from the national pollution control authorities, through the State Trustee's own emissions permit and/or the Environmental Protection Agency. Such permits for comparable facilities have been granted in the past for biogas plants as well as for Digestate treatment technology. As a result, emission permits are not considered an obstacle to establishment, as local/regional use of waste and biological material is a priority area for the environmental authorities.

The current composting plant has permission to receive large quantities of wet organic waste, which will make the task of acquiring the new environmental emissions permit simpler. We currently expected to receive the environmental permit by March 2024.

2.10.2 Requirements for separation and recycling of food waste

In 2018, the Norwegian Environmental Protection Agency already prepared a proposal for a new Chapter 10a of the Waste Regulation on the separation and recycling of biological waste and plastic waste.

The background behind the regulation is the EU Waste Framework Directive, which was revised with new requirements in 2018, and which is binding for Norway through the EEA Agreement. Norway was then obliged to develop measures that promote recycling, provide for separate collection of biological waste and plastics by 01.01.2023, and to achieve 65 percent preparation for reuse and recycling of household and similar waste from the food industry by 2035. As mentioned, this new regulation requires 100% of food waste to be recycled from next year. This was introduced and decided the June 7th, 2022, with a two-year adaptation period for the waste industry.

The consequence of the regulation will be that more municipalities (for example in the region where Rå Biopark will offer its services) will have to start collecting food waste separately from residual waste. In addition, several segments of the food industry that currently do not sort out food waste will be required to sort out this type of waste. This will make additional organic waste available for treatment at Rå Biopark.

2.10.3 Material recovery from wet organic waste

By 2035, 65% of household and similar food waste must be recycled. The EU Waste Directive recognises composting of organic waste for soil improvers as recycling, but there is no guarantee that this form of treatment will be approved in the future. Organic waste is very heavy and accounts for a large proportion of the waste thrown away in an average household. Increasing recycling of this fraction will therefore be crucial to reach the 65% recycling target by 2035.

2.11 Climate and environmental benefits

2.11.1 Waste management and Environmental protection

In the run-up to 2020, the European Commission decided that the EU should increase its climate protection target towards 2030, by raising ambitions from a 40% reduction target for greenhouse gas emissions to a 55% reduction. As in the EU, the Norwegian government has also strengthened its climate targets towards 2030 and in January 2021 the government presented its climate action plan towards 2030, which also aims to cut up to 55% of Norway's emissions compared to 1990. In the plan the Norwegian government states that more sustainable and environmentally friendly transport in the business sector is an important measure to achieve the goal, something that is also widely agreed politically. This applies not only to the urban core and short distances, but also to long-distance transport. Some of these national and regional targets could be met by electricity/electric cars, but not all. The strategy for emissions will be to implement a variety of different technologies and fuels, especially in Northern Norway, where transport distances can be long. Biogas, like electrification and green hydrogen produced from renewable sources, will be an alternative that can play an important role in the work of transforming Northern Norwegian industry to more sustainable mode of operation, based on local and regional resources.

As a regional hub, the Rå Biopark will also be a driving force and important supporting player to reach the national targets of 55% reduction in greenhouse gas emissions.

Rå Biopark will offer the best waste management for organic waste in the region. Today, wet organic material goes to composting. There are a few small, local composting facilities around Northern Norway. In 2016, Avfall Norge presented a report (see link here) concerning greenhouse gas emissions from biogas production in the South-Eastern part Norway. In the same report, they also look at greenhouse gas emissions from biogas made from biological waste. Their conclusion is that biogas produced from biological waste reduces greenhouse gas emissions because alternative treatment methods of this waste contribute to higher emissions. In addition, there are further greenhouse gas emissions reductions due to biogas replacing fossil fuels and fertilisers. The environmental benefits from the collection of wet organic waste and the production and use of biofuels and biogas are mainly linked to the following areas.

- Reduced emissions of greenhouse gases e.g., CH_4, NO_X from composting.
- Replace artificial fertilisers with bio-fertilisers to reduced CO_2/NOx emissions and odour.
- Replacing fossil fuel use in the transport sector that provides reductions in CO_2 and particulate emissions or other non-renewable energy production.

Furthermore, the report points out that the biggest greenhouse gas reduction comes from replacing fossil fuels in the transport sector. This is also in line with a report the EU presented on the optimal use of biogas from waste in 2016. In 2021, a recommendation was made to Parliament by the Energy and Environment Committee to remove barriers to increased production and use of biogas. One consequence of this Act is the use of the term "zero waste" in governmental contexts. Biogas will now be equated with electricity and hydrogen and will apply to all adopted and future plans that use the term "zero emissions."

In addition, in 2019, the Environment Directorate made a comparison of greenhouse gas emissions from different types of fuel. This also shows that biogas produced from waste has significant greenhouse gas emissions reductions when substituting fossil fuels.

For the transport sector, these climate action plan targets mean that vehicles that currently use diesel will have to switch to alternative fuels such as LBM. Rå Biopark will be able to produce circa 60 GWh (H_s) of LBM p.a. This could replace over 4.700.000 litres which avoids 12.700 tons of CO_2 equivalents. of diesel. As mentioned earlier, the main greenhouse gas reduction from the production of biogas is the replacement of diesel. For trucks and buses, you can drive as far on one kilogram of LBM as with 1,22 litres of diesel.

The composting plant at Skibotn already uses all the power available at the Site. This means that a new line must be laid to supply Rå Biopark.

There are several steps in the concept that require thermal energy. The Fermenters are heated to maintain the correct temperature. The organic waste must be pasteurised, either before or after fermentation, the offices heated and the SFD potentially needs to be dried. These needs can be partly met by surplus heat from other steps within the Plant. Cooling the gas is one such process that requires a lot of electrical energy and produces a lot of heat. This heat can be supplied to a heat exchanger and distributed to those parts of the process that require thermal energy. The same applies to gas upgrading and liquefaction.

It is worth nothing that compared to other countries and other regions of Norway the electricity price is unusually low. As a result, it is common to use electricity as a source of energy for heat production. It is very common for houses and industrial space heating/hot water supply to be completely powered by electricity. Electricity in Northern Norway comes with a very low carbon footprint due to a high portion of hydroelectric generation. a low specific carbon emissions of only 18 grams of CO_2 per kWh_{el}.[4] [5]However since green certificates of origin are sold from Norway to other foreign markets, strictly speaking the figure is higher, at 405 grams of CO_2 per kWh_{el}.[6].

$LBCO_2$ or green CO_2 is a name for a product that originates from a renewable source i.e. biological material in the form of food and sludge. This is CO_2 from a closed cycle, which will not contribute to a net increase in the atmosphere when it is released again. This makes the product very attractive to industries that need CO_2. Marketing locally produced CO_2 would reduce transport related carbon emissions for Customers who would otherwise have to purchase CO_2 that has been transported using fossil fuels over a considerably longer distance. A local production will therefore be able to benefit the climate due to reducing the transport carbon footprint. The product will be sufficiently purified so that it can be used in food preservation and production. Other possible uses are refrigeration units on long-distance transport and dry ice production for the fishing industry.

[4] Source: https://www.eea.europa.eu/data-and-maps/indicators/overview-of-the-electricity-production-3/assessment

[5] Source: https://www.nve.no/nytt-fra-nve/nyheter-energi/stromforbruk-i-norge-har-lavt-klimagassutslipp/

[6]Source:https://www.nve.no/energi/virkemidler/opprinnelsesgarantier-og-varedeklarasjon-for-stromleverandorer/varedeklarasjon-for-stromleverandorer/

3 Tendering strategy

3.1 Minimum Scope and Lots

In preparing this tender we divided up the entire Plant into different Lots. This enabled the Client to have an informative and useful dialogue with the market about technology and performance as to relates to the requirements of this project.

We will maintain this division into Lots and the terminology for various reasons as follows.

The division into defined Lots will enable a harmonised approach to and evaluation of pricing, especially since in most cases Suppliers must not only give a price per Lot, but a price breakdown within each Lot. It is likely that the DBC will use Contractors for Lots B and Lot G. Responsibilities defined by the Client for the supplier of Lot B are to be understood as responsibilities which the DBC or the consortium led by (or including) the DBC has towards the Client. Maintaining a division into Lots makes it easier to ensure continuity.

In the process of executing this project, the DBC will be entirely free to decide which Works will be performed by which partner or Sub-Contractor. It is not the responsibility of the Client to determine which Works will be performed by which Contractor or consortium member.

We are now seeking to engage with Suppliers who can deliver as a single DBC all of the Lots included in what we call the Minimum Scope, namely

- Lot A
- Lot B
- Lot G
- Lot H

Furthermore we are seeking to engage with Suppliers who can deliver so-called "Other Lots" not included in the Minimum Scope (which will be published as separate competitions (Invites To Tender) and result in separate contracts), namely

- Lot D
- Lot E

Here is an overview of what is included in which Lot.

Name of Lot	What is included	Status
Lot A	Waste acceptance, pre-treatment, buffering, mixing, feeding Biogas production/ AD reactors Removal of plastics from Digestate ABPR treatment Main and overarching Control System, electrics, steelworks & integration Odour Treatment and Management System Mechanical separation of Digestate Biogas storage membrane, biogas flare	Minimum Scope
Lot B	Raw biogas cleaning, upgrading, liquefaction and storage of CH_4 and CO_2	Minimum Scope
Lot D	Production of Nutrient Liquor Production of water for dilution and infiltration Production of ammonium solution/salt	Other Lot
Lot E	Dryer for wet fertilizer from Lot D	Other Lot
Lot G	Civils works/ construction	Minimum Scope
Lot H	Electrical boiler, heat production Heat distribution & recovery	Minimum Scope

Table 5: List of Lots included in this Invite to Tender ITT 1, content and status

The diagram below shows a simple and high-level explanation of the division and interaction between Lot G (civil works) and the other so-called Technology Lots namely Lots A, B, D, E and H.

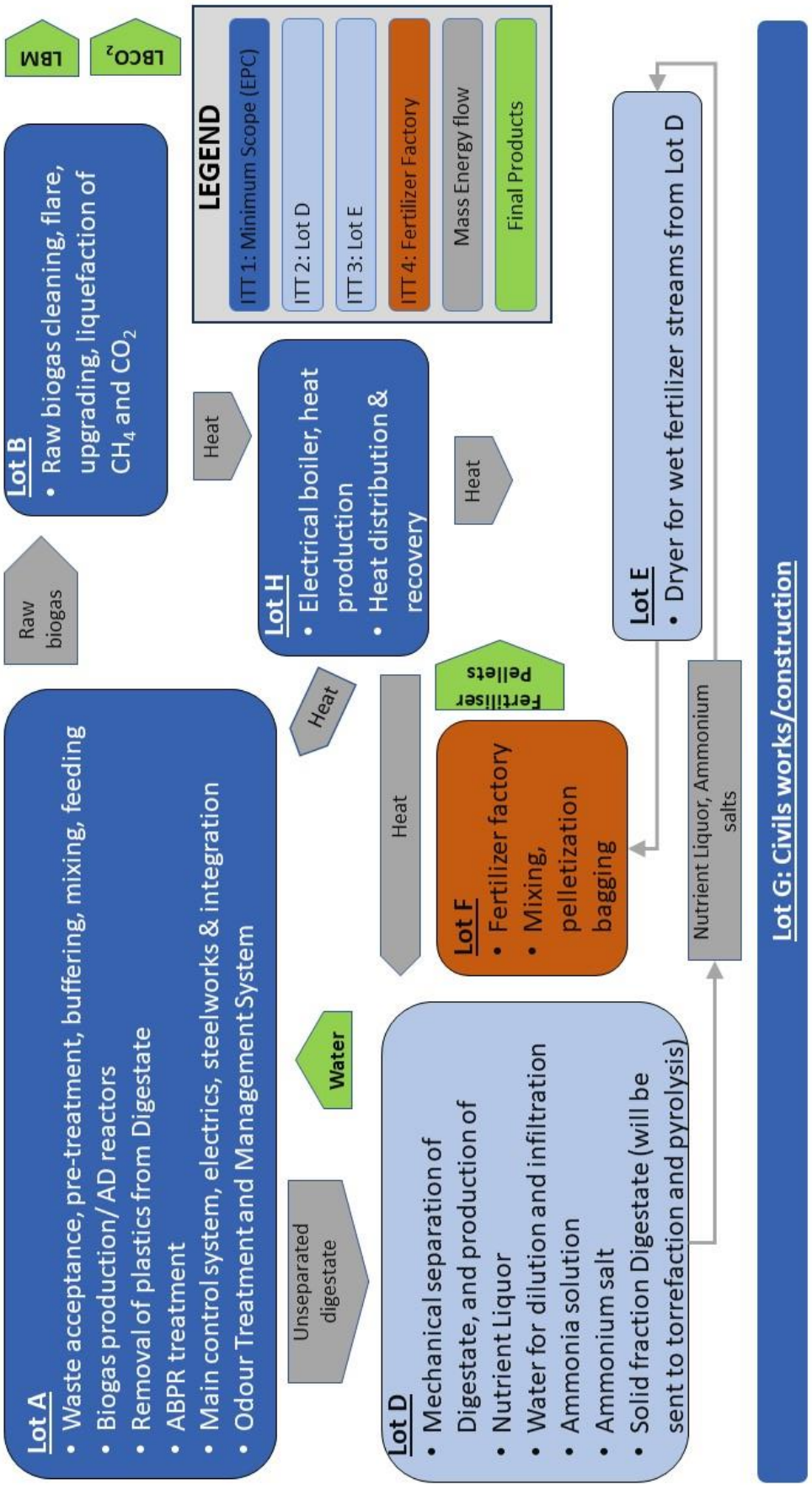


Figure 3: Diagram of Lots included in ITT 1 and ITT2, ITT3 and ITT4

The Minimum Scope Lots must be offered together by one single Supplier (organisation) as a single Tender/Commercial Offer. In this case the Supplier acts as a technology integrator or so-called Design and Build Contractor ("DBC").

The Other Lots are the Lots not included in the Minimum Scope. A Supplier may submit a Tender/Commercial Offer for one or more of the Other Lots in a separate Invite To Tender.

3.2 Functional ITT

We have published a functional ITT. Although we have included obligations and recommendations, the intention is to describe a functional requirement in all ITT documents. Therefore we have described inputs materials and the desired output products, including Projected Estimates for their specification and quantity, but generally it has not been and still is not our intention to dictate or prescribe towards Suppliers how to design their technology.

3.3 Final Investment Decision and project phases

At the time of issuing ITT 1 the Rå Biopark project is still in the project development phase. Activities such as project funding, obtaining permits, analysing, and optimising project commercial and technical feasibility, securing feedstock and forward selling Product are all still ongoing. We call this phase of project development Phase 1.

After receiving the first Commercial Offers for ITT 1 as well as several other information items, studies and updates, the Board of Rå Biopark (in which all project shareholders are represented) will make a Final Investment Decision (FID) for this Plant. The FID is currently planned for the March 2024. The date of the FID is subject to change. Subsequent progress in the ITT is contingent upon a positive Final Investment Decision.

Once this Invite to Tender has been released, Phase 2 will begin. In phase 2 the Contractor will finalise the engineering and design for the overall Plant. The Client will sign Contracts with Contractors, Contractors will complete detailed design and the Plant will be constructed and commissioned.

A Total Project Budget has been internally defined. If after completing the ITT process the total value investment volume of all of the Contracts that we propose to award to the chosen Contractors exceeds the Total Project Budget amount then we reserve the right to cancel some parts (i.e. Lots) within ITT 1 or the entire procurement process.

3.4 Scope of ITTs

We have designed a concept for the Plant which Rå Biopark plans to build at Skibotn. This concept envisages the production of liquid Biomethane, LBCO$_2$, and at a later date, biochar and fertiliser. Different technologies will be used to produce these Outputs or Products and these have been divided up into different Lots. There will be different ITTs for different Lots. These are as follows.

Number of ITT	Lots included	Estimated date of ITT publication (start of pre-qualification phase)
ITT 1	Minimum Scope: Lots A, B, G, H	As per "tender rules.docx" section 1.7
ITT 2	Other Lot: Lot D	01.02.2024
ITT 3	Other Lot: Lot E	15.03.2024
ITT 4	Lot F	01.06.2025
ITT 5	Lot C	01.10.2024

Table 6: Overview ITTs

We feel it is important for all Suppliers for all Lots to understand the Rå Biopark project in its entirety, especially since there are interfaces between all of the Lots.

We have therefore included information on Lots D, E, F and C in this document, even though these Lots will be parts of subsequent ITTs.

We have described a possible process flow diagram together with the respective division into Lots in Appendix A.302.

3.5 Projected timeline for ITT 1

Please refer to the document "Tender rules.docx" section 1.7 for the Planned procurement process schedule for ITT 1.

3.6 Currency, exchange rate risk

Suppliers must give pricing information in either Euro or NOK as follows

Item	Currency
CAPEX for Minimum Scope (Lot A, Lot B, Lot H)	EURO
CAPEX for Minimum Scope (Lot G)	NOK
OPEX Operational costs including consumables: This is calculated automatically based on Guarantee Values and Expected Values given by the Supplier. The Client has provided the unit cost of these operational cost factors in *Table 14*. The costs are all in NOK except for 2 items which are consumables whose price is given in EUROS by the Client).	NOK/EURO
All price information given by the Supplier concerning Spare Parts and Consumables	EURO
OPEX Capital Repairs (all Lots including Lot G) (which will not evaluated as part of cost)	EURO
Revenue LBM, revenue $LBCO_2$, Revenue Fertiliser This is calculated automatically based on Guarantee Values and Expected Values given by the Supplier. The Client has provided the respective sale price in NOK of these Products in *Table 15*.	NOK

Table 7: Which currency to use for which cost/price information

Using the scheme described above, Suppliers will be able to submit a complete offer without having to enter into unnecessary Foreign Exchange Rate risk and this has been the intention of designing the cost/pricing aspect of the evaluation scheme this way.

In order to carry out the final evaluation across all CAPEX, OPEX and revenue information, the Client has to convert all information into one single currency.

All figures must be given in Euros and if required.

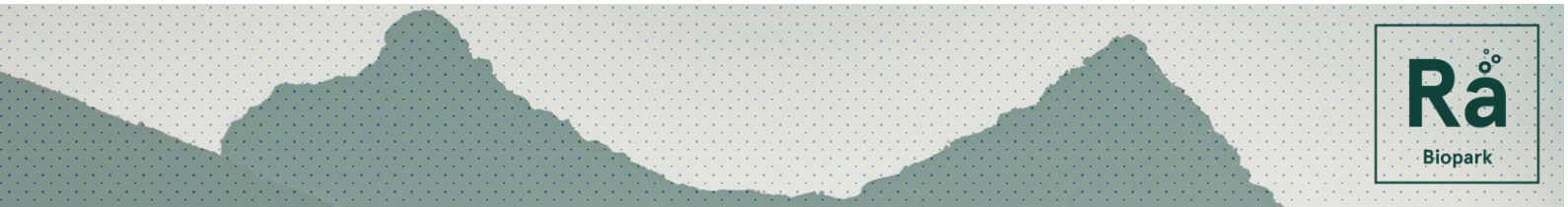
For all purposes such as purposes of evaluation an assumption will be made as regards the NOK/EURO exchange rate. The Client will inform Suppliers which value will be assumed but the expectation is that the exchange rate which is current at a defined point in time during the negotiation process will be assumed.

4 Available feedstock

4.1 Summary of Feedstock for Lot A

In the table below an overview is presented of the feedstock that the Client considers feasible for treatment in the Rå Biopark Plant.

Feedstock	Expected quantity (tons p.a.) (§)	Line	Consistency on delivery	Risk that feedstock be delivered (partially) frozen	Feedstock currently delivered to composting plant?	Expected size of single delivery in tons/delivery		Number of deliveries per year (§)
						Maximum (§)	Average (§)	
Household SSO	14.900	1	Not pumpable	Yes	Yes	35	30	497
Organic waste HoReCa	2.600	1	Not pumpable	Yes	Yes	35	15	173
Food production waste	2.000	1	Not pumpable	Yes	Yes	35	30	67
Depackaged pre-consumer supermarket	1.000	1	Not pumpable	Yes	Yes	27	25	40
Grease trap fat	900	1	Pumpable	No	No	35	10	90
Waste vegetable oil	50	1	Pumpable	No	Yes	27	25	2
Brewery malt dust	400	1	Not pumpable	No	No	35	10	40
Brewery spent grains	1.500	1	Not pumpable	No	No	35	10	150
Brewery beer	1.300	1	Pumpable	No	No	35	10	130
Brewery spent yeast	250	1	Pumpable	No	Yes	27	10	25
Fish oil glycerine	200	1	Pumpable	No	Yes	27	25	8
Cattle slurry	2.000	1	Pumpable	No	No	30	28	72
Goat manure	500	1	Not pumpable	No	No	30	28	18
RAS fish farm sludge	13.500	1	Pumpable	Yes	Yes	27	25	540



Fish silage	1.700	1	Pumpable	Yes	Yes	27	25	68
Fish processing waste (cake)	2.000	1	Not pumpable	Yes	No		30	67
Fish processing waste (rotasieve)	2.000	1	Not pumpable	Yes	No	35	30	67
Oily fish factory wash	500	1	Pumpable	Yes	No	35	30	17
Sewage sludge cake	15.800	2	Not pumpable	Yes	Yes	35	30	526
Total	63.100				Yes	35	30	2597

Summary of deliveries:	Deliveries per year of solids for Line 1	1119
	Deliveries per year of liquids for Line 1	952
	Deliveries per year of solids for Line 2	526

Table 8: Rå Biopark feedstock – Projected Estimates of feedstock tonnages

Calculations have been made of the energy potential of the respective feedstocks. This is based on analyses which have been performed on most of the feedstocks and based on standard values for other feedstocks which have not been analysed.

The Client's Projected Estimate of the biomethane production potential of the above-mentioned feedstock is 59,7 GWh p.a. (H_s = HHV).

4.2 Seasonality of Feedstock for Lot A

Some of the most significant feedstocks (in terms of quantity) which are described in section 4.3 below more detail are not delivered in constant quantities. The following feedstocks will show significant seasonality and variation in terms of its supply.

- Household SSO
- Organic waste HoReCa
- Food production waste
- Brewery spent grains
- Grease trap fat
- Sewage sludge cake
- Fish sludge

We currently expect the other feedstocks to be relatively constant in terms of supply, but it may also be variations according to different seasons. The Supplier must bear in mind this variability in supply when defining the design, concept and Capacity, and must design and build the Works to be able to handle seasonal variations. We provide monthly data that shows the seasonality for this feedstock in Appendix A.201.

To summarise, the maximum percentage deviation from an average monthly value are as follows.

Feedstock	Minimum (as % of average value)	Maximum (as % of average value)
Household SSO	79,6%	128,5%
Organic waste HoReCa	62,6%	147,0%
Sewage sludge cake	36,8%	159,5%

Table 9: summary of variability/seasonality in supply of major feedstocks

We are currently planning to enter into a co-operation with a partner whereby the partner would construct holding tanks for fish sludge. This would allow us to receive varying amounts of fish sludge as per our requirements according to the approach described in this section.

This would allow us to counteract variation in the above-mentioned feedstocks specifically in order to have a methane production which is as constant as possible. Even if we do that the volume of biogas and quantity of feedstock, nitrogen and digestate will still vary.

4.3 Description of individual Feedstocks for Lot A

4.3.1 Household SSO (Source Separated Organics)

Households collect organic waste which is segregated at source. Households in this part of Norway have been segregating at source since about 2001 so there is a great deal of experience and acceptance in the populace. Collection frequency is approximately once per week in most cases and in some cases once every 2 weeks.

4.3.1.1 Bags

The household waste is collected in a bag inside a separate bin. The bags come from different waste management companies. Most of them are between 5 and 15 litres but some may be up to 40 litres in size. The bags are made of biodegradable plastic.

Some of the waste companies (Hålogaland Ressursselskap IKS and Lofoten Avfallsselskap IKS) separate the food waste in bag in separate bin (separate sorting with own bins). Most of the waste companies (Remiks Miljøpark, Reno-Vest, Avfallsservice and Finnmark Ressursselskap) however separate the food waste in one kind of bag whereas the other kinds of waste (paper, glass, plastic) are collected in a separate bag but these are all put together into the same bin. These individual bags are colour-coded and are optically sported (Optibag system) and are sorted out at the Waste Treatment Facility. After sorting the bags containing household waste are moved to the Site.

The bags come from different waste management companies. Most of them are between 5 and 15 litres but some may be up to 40 litres in size. The 2 suppliers of biodegradable bags are Naturabiomat AS and BioBag.

Biodegradable plastic bags from both Naturabiomat AS and BioBag contain corn starch and degradable polyester. The amount of non-fossil material can vary depending on how environmentally friendly the customer wants to be. The normal level of corn starch is between 14-20%. The material which is used in these bags is Mater-Bi, which is polymer that does not agglutinate, which makes it easier for the microorganisms to digest. Mater-Bi is a non-fossil raw material from an Italian manufacturer. The level of Mater-Bi varies depending on what the tender contains. HRS do not have any specification about the level of Mater-Bi, but the HRS bags contain approximately 30% Mater-Bi and 70% percent of fossil plastic. The bag is certified according to standard EN13432 and meets the requirements for degradable certification.

Non-biodegradable plastic bags from BioBag are regular plastic bags and contain fossil plastic.

Figure 4: Pictures of bags used for collection of source-separated organics

4.3.1.2 Waste characterisation

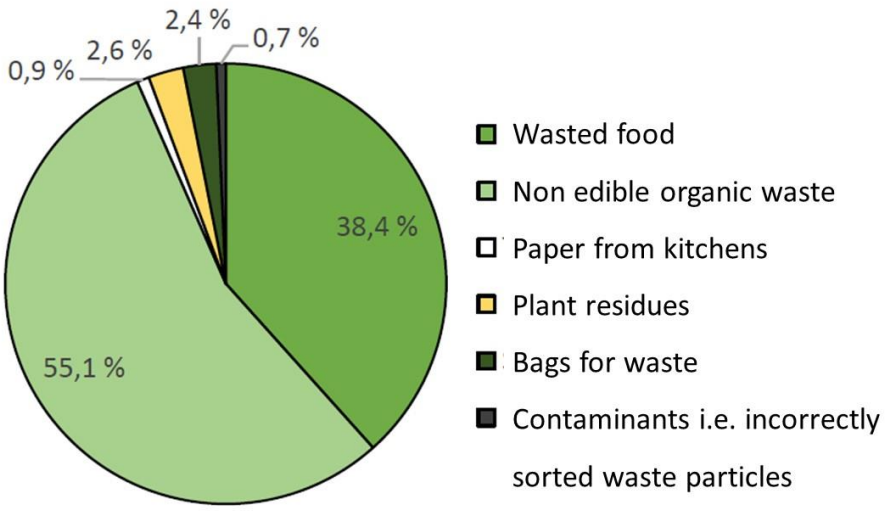


Figure 5: Waste characterisation 2022 for Tromsø/Remiks AS Husholdning organic waste

The figure above shows the composition of the contents of "green bags" (used for household organic waste) in percentage by weight. Wasted food makes up 38,4%, while non-useable food waste makes up 55,1%. Food waste is defined as human food that at one point or another could have been eaten, as opposed to inedible food waste such as bones, shells, peels, coffee grounds and the like. In this analysis, a distinction was made between usable food waste (food waste) and non-useable food waste. Incorrect sorting, sacks/bags for waste, plant residues and paper towels from the kitchen make up a total of 6,6%.

Please note that this is only to give an indication of the degree of impurity. Furthermore, this is one sample (albeit a recent one) from the waste collected by Remiks Husholdning AS from Tromsø. This waste makes up 25% of the household organics planned for the Plant.

Contents of green bags	Tromsø 2018	Karlsøy 2018	Tromsø 2022	Karlsøy 2022
	Average	Average	Average	Average
Food waste	92,9 %	95,5 %	93,4 %	90,8 %
Paper	0,0 %	0,0 %	0,0 %	0,0 %
Paper packaging	0,2 %	0,2 %	0,0 %	0,0 %
Beverage carton	0,3 %	0,0 %	0,0 %	0,1 %
Plastic packaging	0,5 %	0,8 %	0,2 %	0,4 %
Glass packaging	0,0 %	0,0 %	0,0 %	0,0 %
Metal packaging	0,1 %	0,0 %	0,0 %	0,2 %
Electronic waste	0,0 %	0,0 %	0,0 %	0,0 %
Hazardous waste	0,0 %	0,0 %	0,0 %	0,0 %
Other waste	5,7 %	1,9 %	6,3 %	8,4 %
Total	100 %	98 %	100 %	100 %

Table 10: Detailed waste characterisation: Tromsø and Karlsøy 2018/2022

This data is taken from one waste sorting analysis, several of which are provided as Appendices A.202, A.203, A.204, A.205, A.206, A.207, A.208 and A.209 to this document.

4.3.1.3 Biogas and chemical analyses

Various Biogas potential tests with corresponding other data for the feedstock are included in Appendices A.200 to A.279 to this document.

4.3.2 Organic waste HoReCa (hotels, restaurants, catering)

This waste comes from various hotels, catering facilities and restaurants.

This waste will also contain impurities/Contaminants. It will be delivered as a solid feedstock in plastic bags.

4.3.3 Food production waste

This is an assorted mix of various by products from the local food production industry, including industries such as dairy and algae production. This stream is not yet defined.

4.3.4 Depackaged pre-consumer supermarket organics

This stream is pre-consumer food products from e.g. supermarkets which is past its sell by date or for any other reason has become a waste.

It is important to note that as of 01.01.2023, supermarkets (or any other businesses delivering such waste) in Norway must remove the packaging from the waste at the supermarket source. As a result we do not expect any of this waste to be inside packaging or to contain packaging.

4.3.5 Grease trap fats

This is water which contains fats/ oils/ grease from restaurant/ catering grease traps. Suppliers should be aware that this material produces biogas very quickly and therefore needs to be handled with some care as regards handling and feeding, and the design must reflect this.

4.3.6 Waste vegetable oil

This is used vegetable oils from restaurants/ catering which has been used for frying. Suppliers should be aware that this material produces biogas very quickly and therefore needs to be handled with some care as regards handling and feeding, and the design must reflect this.

4.3.7 Brewery malt dust

This feedstock is the residual unused dry malt from cleaning the malt storage from a local brewery.

Analyses of this material are included as Appendices A.220, A.221, A.224, A.274 and A.275 to this document (including a biogas potential test).

4.3.8 Brewery spent grains

This feedstock is the residue from the barley grains used from the beer brewing process from a local brewery.

Analyses of this material are included as Appendices A.218, A.219, A.224, A.274 and A.275 to this document (including a biogas potential test).

4.3.9 Brewery Beer

This feedstock is non-marketable beer with from a local brewery.

4.3.10 Brewery spent yeast

This material is from a local brewery. Yeast is reused several times and when the yeast culture loses efficiency it is disposed. The amount of suspended solids is high and differs between batches. In addition the material is sticky and diluted on collection.

Analyses of this material are included as Appendices A.216, A.217, A.224, A.274 and A.275 to this document (including a biogas potential test).

4.3.11 Factory By-product glycerine

This is glycerine produced by a local factory which produces fish oils.

This material quicky becomes hot if exposed to air and on delivery needs to be transferred as quickly as possible into an airtight storage tank. Suppliers should be aware that this material produces great volumes of biogas very quickly and therefore needs to be handled with great care as regards handling and feeding, and the design needs to reflect this.

Please refer to Appendices A.270, A.271, A.272 and A.273 for further information.

4.3.12 Cattle slurry

This is liquid cattle slurry from local dairy farmers. It contains no bedding.

4.3.13 Goat manure

This is goat manure including some straw bedding from local farmers. The Client can shred this material to the desired size using shredding technology which we already have at the Site. An analysis has been provided in Appendix A.276.

4.3.14 RAS fish farm sludge

The Norwegian economy is historically heavily reliant on fishery as a source of (export) revenue. In line with global food consumption trends, a very significant increase in production of fish is projected and intended in the Norwegian economy. The main part of this projected growth will come from "on land" aquaculture i.e. fish farms. Such fish farms, if operating with state-of-the-art technology, recirculate the water in the tanks, producing quantities of fish sludge as the main waste product.

Fish sludge is the feed residues and fæces from the land-based RAS hatcheries for Atlantic salmon farming. RAS stands for Recirculatory Aquaculture System. RAS is a technology where water is recycled and reused after mechanical and biological filtration and removal of suspended matter and metabolites. Unlike flow-through technology for hatcheries, RAS technology is better set up to collect the fish sludge. The volume of suspended solids in the water depends on the production growth cycle of the fish. The peak production seasons in the Troms area are May and later in the Summer. The second peak production cycle varies from hatchery to hatchery and is between July and September. Such on land aquaculture farms are primarily for growing fish in the initial stages of growth (hatcheries) whereas later in the growth cycle these fish are transferred to sea cages.

In the future more and more of these sea cage farms will collect fish sludge as well in which case such sludge is likely to be wetter and more saline in composition.

Although production of fish and therefore fish sludge is seasonal, some will be stored in tanks in the off season and will be preserved by adding formic acid in order to reduce the pH to 4. Thus, the quantity delivered will be relatively constant, but the pH will be normal for this material in the summer but much lower in the off season. The material is pumpable.

This material also contains sand which is added to the fish feed to make the fish feed sink and is therefore present in the fish sludge as well. Analysis data is provided in Appendices A.232, A.233, A.250, A.264, A.265 and A.267.

This material will be preserved by adding formic acid to a pH of 4.

4.3.15 Fish silage

Fish silage consists of Category 2 material that is not permitted for human consumption or for feed production but is legally permitted as raw material for use in biogas production. This material arises from mortality in salmon production related to viruses, diseases or infestations such as salmon lice or large environmental challenges like algal blooms. The fish waste related to the mortality event is ground up and treated with formic acid to reduce pH and preserve by ensiling. Each salmon farmer checks at least once a day for mortality and the dead fish are removed. Dead fish are ensiled with a pH below 4 using formic acid within a time period of maximum 48 hours.

In some cases, the grinding and ensiling process does not happen. In such cases, the higher pH or lack of immediate grind and ensiling causes the production of rotten fish silage.

This feedstock is pumpable.

4.3.16 Fish processing waste (Rotasieve)

Once fish silage is produced it is further processed to make various products, namely oil, fish protein concentrate (FPC), and cake. One of the separation processes uses a tricanter. The structure and function of a tricanter are similar to those of a decanter (two-phase separation), except is a three-phase separation of oil, water and solid fractions. The different densities of the (immiscible) liquids and the solid mean that all three phases can be discharged simultaneously using a tricanter. All products that have gone through the tricanter have also undergone heating of 85°C for 25 minutes and thus comply with the Norwegian Food Safety Authority (Method K, ref. EC 142/2011). The oil is split in two fractions, firstly technical oil and secondly oil that goes to feed animals farmed for fur. FPC is the hydrolysate product after evaporating the water from the tricanter and goes primarily to pig feed.

This fraction comes from the first mechanical separation of the silage pumped into the processing facility. The silage is warmed by the heat of the building and is at a temperature which is sufficiently high to keep the silage moving through the unit. There is a rotating sieve with 3mm openings that the silage goes through. The by product from this step is this waste fraction. It will have the most impurities and include poorly ground up bones.

This material is delivered cyclically because the production facilities work in shifts/campaigns, whereby the production facility operates for 12 production days continuously followed by 2 weeks of stand-by.

Analysis data is provided in Appendices A.262, A.263 and A.266.

4.3.17 Fish processing waste (cake)

This feedstock (called "grakse" in Norwegian) is the unwanted solid fraction from tricanter process described in section 4.3.16. It has undergone heating of 85°C for 25 minutes and has less impurities than the Rotasieve feedstock but contains pieces of latex gloves etc.

This material is delivered cyclically because the production facilities work in shifts/campaigns, whereby the production facility operates for 12 production days continuously followed by 2 weeks of stand-by.

Analysis data is provided in Appendices A.260, A.261 and A.266.

4.3.18 Wash water

This is wash water which is collected from a fish feed factory near the Site.

4.3.19 Sewage sludge from municipal wastewater treatment plants

The sewage plants all operate exclusively with primary aerobic treatment so there is no secondary (anaerobic) treatment at the wastewater treatment plants. Small Contaminant particles such as plastics and grit may be included in the sludge.

Biogas potential tests for the feedstock are included as Appendices A.214, A.215, A.223, A.234, A.235, A.236, A.237, A.238, A.239, A.240, A.241, A.242, A.243, A.251 and A.252 to this document.

Historical data on sewage sludge from 2019, 2020 and 2021 from 5 different wastewater treatment plants in the region measuring pH, dry matter, PCBs and 7 heavy metals are also included in Appendices A.278 and A.279 to this document.

The Contaminant that this feedstock contains is primarily sand and other small particles.

Ca. 2.000 tons p.a. of this sewage sludge is the content of septic tanks from habitations which are not connected to a centralised wastewater treatment plant (""septic tank sludge"). Similar to the sewage sludge from centralised wastewater treatment plants, the septic tank sludge is treated with mechanical separation before transport to increase the dry matter content.

Separate analyses have not been carried out on septic tank sludge but we expect the biogas production and composition to be largely the same as with sewage sludge from centralised plants.

Although none of the sewage plants have secondary stages so this sludge is only primary sludge, allowance has been made for a future extension of one particular sewage plant which is projected to be extended with an additional secondary treatment stage. This would produce an additional 1.800 tons of secondary sludge. This tonnage has been allowed for in the quantities described above since the secondary sludge has not been produced yet it has not been sampled.

4.3.20 Green waste from parks and gardens.

This is the green fraction of garden waste which is currently composted at the Site. The Client is currently planning to separate the green, more digestible material from the woody material in the future and when the Plant is built. However this feedstock has not been analysed in detail as regards quantity and real gas potential. As a result it is not included in Table 8 above describing the of feedstock . Please refer to section 4.4.3 for further details.

4.4 Description of Feedstock for torrefaction and pyrolysis

This section is primarily added for the sake of completeness. There are various other fractions which will be delivered to the site which will NOT be processed in the biogas plant Lot A. These are listed below. It is planned that these materials will be sent to a torrefaction project which will be built in Narvik which is also being developed by the Client.

4.4.1 SFD produced by Lot D

The mechanical separation process in Lot A will produce SFD and LFD. There are 2 separate Fermenter processing Lines in Lot A: Line 1 and Line 2. As a result there will also be 2 separate SFD fractions, SFD from Line 1 and SFD from Line 2. The Projected Estimate is that this material will have a dry matter content of 33% after mechanical separation in Lot A.

SFD from Line 1 will be the input for Lot C at Skibotn.

SFD from Line 2 will be sent to a torrefaction plant which is still to be built in Narvik.

4.4.2 Waste wood (Grade A)

This material is heterogenous in terms of its source and quality. Varying amounts of pre-treatment may be required to remove nails/screws/paint etc. and for particle size reduction which the Client will do. This material mainly consists of old pallets which are generally class A.

4.4.3 Green and woody garden waste currently going to composting

The composting plant at Skibotn is currently being used to compost not only food waste and sludge but also green/woody garden waste. In the future green waste from parks and gardens could be used as a feedstock for the Plant.

This feedstock is quite variable in quality/consistency and in terms of seasonality/availability.

The Client will carry out sorting and necessary pre-treatment/shredding for this material with existing machinery. This will take place at/in existing locations/ halls/ concrete pads on the Site.

Thus we will produce

1. Ca. 300 tons p.a. of grass/digestible organic material for Lot A as well as
2. Ca. 700 tons p.a. of shredded woody waste for the torrefaction plant.

4.4.4 Seasonality of green/woody waste currently going to composting

	2022		2021	
Month	Woody waste	Green garden waste	Woody waste	Green garden waste
January	46	-	62	-
February	-	-	-	-
March	-	-	-	-
April	-	-	-	-
May	-	50	23	-
June	20	115	142	-
July	78	103	136	75
August	124	-	102	24
September	20	24	139	96
October	300	144	103	-
November	42	-	99	83
December	-	-	-	-
Total	629	435	807	278

Table 11: Seasonal availability of materials currently going to composting

5 Plant Essential Functions and commercial parameters

5.1 Essential Functions

The Client wishes to select a Contractor who will design and build the Plant. While the Specification for the Plant is described throughout this document, there are certain functions which the Client requires the Supplier to ensure which are more important than other parameters. These functions are named Essential Functions and are as follows.

No.	Responsible Supplier	Description
EF1	DBC	Feedstock acceptance capacity in waste reception area is as described in section 6.3 *Table 16*.
EF2	DBC	Quality of Liquid Fraction Digestate is as per section 6.8 *Table 21*.
EF3	DBC	Quality of Solid Fraction Digestate is as per section 6.8 *Table 21*.
EF4	DBC	The plant performs hygienisation as described in section 6.10
EF5	DBC	The Plant produces LBM with quality as per section 7.5
EF6	DBC	The Plant produces $LBCO_2$ with quality as per section 7.6
EF7	DBC	The Production Capacity of LBM from is as per *Table 22*
EF8	DBC	The Production Capacity of $LBCO_2$ from is as per *Table 22*
EFD1	Lot D	Lot D can produce Infiltration Water as per section 9.9.2 *Table 24*
EFD2	Lot D	Lot D can process LFD with capacity as defined in *Table 23*
EFE1	Lot E	Lot E can evaporate water with capacity as defined in *Table 25*

Table 12: Plant Essential Functions

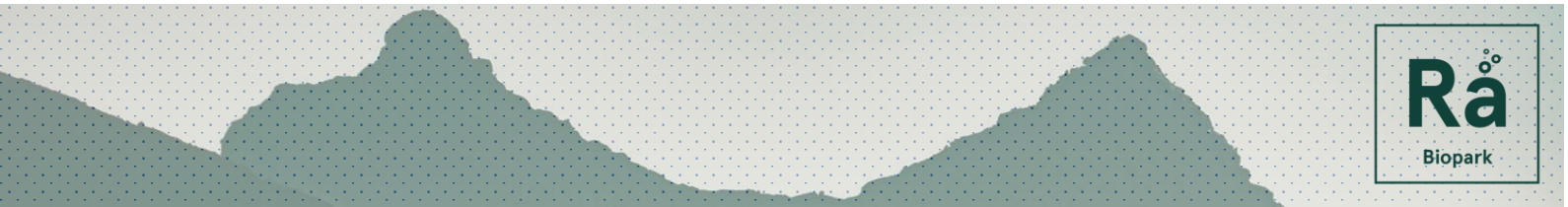
5.2 General Plant operating parameters

Item	Information
Workdays (for the evaluation we assume 255 Workdays p.a.)	Monday till Friday except for Norwegian public holidays, every week, 52 weeks per year
Waste Delivery Hours or "WDH"	On Workdays 08:00 – 17:00 Monday - Thursday 08:00 – 15:00 on Fridays
Manned Operating Hours or MOH i.e., staff present at Site.	On Workdays 07:00 – 19:00 Monday - Thursday 07:00 – 15:00 on Fridays
Staff available on standby only	All times which outside of MOH
Plant Operating Hours (POH)	24 hours a day, every day, deemed to be 8.760 hours p.a. (even in a leap year)
Expected operating times for Lot and Sub-Lots	As per Suppliers' recommendations requirements or specifications
Design Lifetime for Lot A, B, D, E, H	Minimum 20 years
Design Lifetime for Lot G	Minimum 30 years
Business Case Period (BCP) i.e. number of years used to evaluate Operational Costs and Revenue	15 years

Table 13: Overview of further Plant design parameters

5.3 Commercial parameters – OPEX

Code	Item	Projected Estimate	Assumed cost unit
ELE	Electricity (all-inclusive multi-year projection average annual price including price for energy purchased and for installed capacity)	650	NOK/MWh$_{el}$
HEL	Heat (which will be produced with electricity)	650	NOK/MWh$_{th}$
DRY	Operational Cost of removing one ton of water in a conventional drying process, for example to make dry fertiliser products	650	Per ton water removed
LNO	All work done at the plant by any employee in the Client's Operations Team is divided into one of 2 categories. This first category LNO is the requirement for all work required for normal operations i.e. to ensure that the plant is functioning. It includes any management or administrative work, organisation, physical use of machinery, data recording and interpretation, and other manual work such as moving or loading materials and regular cleaning. The average labour cost per hour across all categories of staff and skill sets in the Clients Operations Team will be used for the evaluation.	650	NOK/hour
LSM	All work done at the plant by any employee in the Client's Operations Team is divided into one of 2 categories. LSM is the second category. It concerns the work required for any daily, weekly, seasonal, annual, minor or major service and maintenance work (including checks and inspections) as well as work required for repairs, fault correction, trouble shooting, problem solving and contingencies which will be done by the Client's Operations Teams, whereas the average labour costs across all staff will be used for the evaluation.	650	NOK/hour
OVW	Additional cost of overtime outside of agreed working hours (between 06:00 and 21:00) (but on Workdays) that the Supplier must consider in estimating LNO and LSM.	150 %	Normal cost = 100%
OVH	Overtime after agreed working hours (between 21:00 and 06:00) (but on weekends or on public holidays) that the Supplier must consider in estimating LNO and LSM.	200 %	Normal cost = 100%
WTE	Costs of reject disposal including transport (if going to WtE plant) and costs of disposal of sand, grid, or sediment from emptying Fermenters, tanks.	1.500	NOK/wet ton
LAN	Costs of reject disposal (if going to landfill).	1.000	NOK/wet ton
SAN	Costs of disposal of reject from feedstock pre-treatment if consisting only of sand, grid, or sediment.	0	NOK/wet ton



TRA	Costs of transporting fertiliser to market. This factor will be used to evaluate in further detail the Client's cost of selling fertiliser products.	1.000	NOK/ton of Product
REC	Any use of Infiltration Water from digestate treatment (Lot D) which would otherwise be used for infiltration. The maximum amount of Lot D effluent water from digestate treatment (at infiltration quality) that is available is 95.000 m3 p.a.	Zero cost	
H2O	Consumption of Fresh Water (rainwater, well water or river water).	10	NOK/m^3
SUL	Cost of Sulphuric acid used in Lot D for making ammonium sulphate, and used in scrubbers in Lot D for removing ammonia from polluted air.	120	EUR/dry ton
ALK	The cost of any alkali used for adjustment of pH specifically and only in Lot D, which will be deemed for the purposes of evaluation to be sodium hydroxide or sodium hydroxide solution as per the Supplier's specification.	1.000	EUR/dry ton
CON	CON stands for consumables. This includes different categories of materials which are consumed over the lifetime of the plant. Examples are given as follows whereas these examples are not an exhaustive or prescriptive list. 1. Chemical reagents such as acids or alkalis for scrubbers or for evaporators. 2. Chemical reagents such as iron salts which are used to regulate and mitigate the amount of sulphur compounds in the fermenter and/or in the biogas produced. 3. Chemical reagents required to produce defined fertilizer products. 4. Solvents and adsorbents such as activated charcoal which are used to regulate and mitigate the amount of sulphur compounds in the biogas produced. 5. Materials such as lubricants (oil, grease) which are required to ensure smooth correct functioning of installed technology or coatings which must be regularly applied to ensure that installations or construction works are properly protected. 6. Reagents which prevent clogging, unwanted precipitation or other blockages. 7. Additives (enzymes, trace elements or other) which are required to ensure the optimum environment inside the fermenter as regards the microbial and chemical environment. and any other material/substance which is not a Spare part and which is regularly consumed during operations.	TBD	TBD

Table 14: Overview Plant OPEX purchasing costs

5.4 Commercial parameters - revenue

Code	Item	Assumed cost number	Assumed cost unit
LBM	LBM (road fuel quality as per spec.)	1,066	NOK/kWh H_i
		14,85	NOK/kg
CO2	$LBCO_2$ (food grade quality) (EXW without transport)	1.200	NOK/ton EXW
FRA	Fertiliser nutrients for sale: N as ammonia water (ammonium hydroxide)	21.000	NOK per dry ton of N
FAN	Fertiliser nutrients for sale: N in the form e.g. ammonium sulphate N contained in SFD	7.000	NOK per dry ton of N
FPO	Fertiliser nutrients for sale: P_2O_5 in the form of SFD produced by Lot A P_2O_5 in the form of a precipitated Product produced by Lot D.	7.000	NOK per dry ton of P_2O_5
To simplify the evaluation procedure, the value of nutrients produced in the form of Nutrient Concentrate resulting from Mechanical Vapour Recompression processes will be deemed to be zero.			

Table 15: Overview of unit sales prices for Plant revenue sources

6 Lot A: organic waste treatment/ valorisation and biogas production

6.1 Scope of Work

The Supplier must deliver the Scope of Work for the contract for Lot A which is a complete, turn-key process system for:

- Waste acceptance and pre-treatment, buffering, mixing and dosing
- Fermentation and production of biogas
- Removal of residual plastic from the feedstock before digestion, and from the digestate
- Stable constant production of biogas and management of Condensate produced from biogas, and flaring if required
- Odour Management and Treatment
- treatment in line with ABPR/Pasteurisation/hygienisation
- Mechanical Separation of digestate

fulfilling and compliant with all stated purposes, objectives, and requirements.

The Scope of Work must include:

- design (basic and detailed engineering)
- all materials, machines, equipment, structures and services purchased by the Client
- complete electro-mechanical installation
- Main Control System, electrics, steelworks and integration
- commissioning / start-up services, operations until Taking Over and trial period
- training of Client's personnel, operational assistance and other reasonable related services
- all documentation necessary to properly install, operate and maintain (including, inspection, repair, etc.)
- quality assurance
- HSE compliance

The Work must be designed, manufactured and installed according to the most recent relevant codes, standards, legal rules and regulations of Norway and the EU.

The design of machinery and equipment must facilitate inspection, cleaning, maintenance and repair. Continuity of operation with high availability and lowest maintenance requirements are of prime concern. The design must incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the plant. The machinery and equipment must be designed to operate satisfactorily under all variations of load, temperature, humidity, moisture, corrosive and other conditions as may be met in normal operation. The complete Plant must run without undue vibration and with the least practicable noise.

All equipment performing similar duties must be of the same type and manufacture in order to limit the stock of Spare Parts required and maintain uniformity of the Plant. The Client reserves the right to advise the Contractor of preferred type and manufacture to secure the above-mentioned requirements.

6.2 Division of Lot A into Separate Lines (Line 1 and 2)

If Sewage sludge or septic tank sludge is used as an input into the Plant the SFD produced may be more difficult to market as fertiliser. This is because Sewage sludge or septic tank sludge may contain higher levels of heavy metals, antibiotics and pharmaceuticals which again may mean that the Digestate is subject to more or different regulations.

As a result of that, this material must be digested in one separate Line together which we call Line 2. All other materials must be digested in a so-called Line 1. The Substrate in Line 2 must not come into contact with the Substrate in Line 1.

All Digestate must be converted to dried solid Products or treated effluent because it will not be possible to spread Digestate to land. If belt dryers are used for drying LFD and SFD and/or fertiliser pellets, the air from the Reception Hall could potentially first be used as input air for the dryer, diverting/bypassing straight to the Odour Management and Treatment Lot if the dryers are not operating – if this approach is approved by the dryer manufacturer.

We have described this in the diagram in Appendix A.302.

6.3 Waste reception

The Contractor must design and build Works which can receive all delivered feedstock in a manner that is safe for the environment, with minimal emissions to the environment as well as for all people working at the Plant either as permanent staff or service personnel/Operations Team personnel etc. visiting the Plant temporarily.

Trucks take between 10 and 40 minutes to discharge the truck and wash (27 minutes on average). Washing the truck may take longer in the Winter. Please refer to Appendix A.142 for further details on logistics.

The Plant must be able to receive feedstock as follows:

Line	Capacity during WDH (Tons per workday	
Line 1 (Solid Feedstock)	160	
Line 2 (Solid Feedstock)	160	
Line 1 (Liquid Feedstock)	120	
Line 2 (Liquid Feedstock)	0	
Average capacity for Performance Test, calculation of Liquidated Damages		
Both lines, all feedstock	1.211	Tons of feedstock per calendar week
Both lines, all feedstock	242	Tons of feedstock per Workday

Table 16: Capacity for Waste reception for Lot A

6.3.1 Waste delivery logistics

Please note that the construction and installation of the Reception Hall is included in Lot G. Please refer to section 12.3. The DBC therefore has a responsibility to ensure that all these requirements are fulfilled when designing the plant and must also read and fulfil the requirements which are written in Chapter 12.

The Reception Hall must be large enough so that

- one truck delivering solid feedstock for Line 1 plus
- one truck delivering solid feedstock for Line 2 plus
- one truck delivering liquid feedstock

can all fit in the Reception Hall at the same time.

Trucks taking solid feedstock to the Site will transport a train of (up to) 3 containers. Such trucks will decouple the train outside the Reception Hall and then only move into the Reception Hall with one single container for tipping.

Dimensions of container (solid waste):

- Volume: 35 m3
- Own weight: 14.200 kg
- Max. payload 17.725
- Max permitted payload: 32.000 kg

Dimensions of truck with 1 container (solid waste):

- Length 33 m (trailer with container)
- Width 3,05 m
- Height (container not lifted) 4,5 m
- Height (container lifted) 14 m clearance necessary (tipped at a 45 ° angle)

Dimensions of tanker (liquid waste) (truck with trailer):

- Length 19,5 m
- Width 2,55 m
- Height 4,1 m

See also Appendix A.142.

The Reception Hall must allow all trucks delivering waste to completely enter the Reception Hall.

The trucks must be able to reverse into the Reception Hall, park, and unload container/s in a bay. There must be room for at least 2 trucks unloading containers with solid waste in 2 bays at any one time.

Liquid Feedstock Reception Tanks for liquid waste must be installed indoors inside the Reception Hall. The Plant must have a pump station in the Reception Hall for emptying trucks with liquid waste. The pump will be operated by the truck driver or the Plant operator.

However, it must be possible for a truck delivering liquids to also park outside and next to the Reception Hall and also deliver liquids from that point.

The Reception Hall must include:

- Frozen waste defrosting technology
- Leachate management (open drainage channels)

6.3.2 Frozen feedstock

All waste management companies which will deliver waste to the Rå Biopark Site will be obliged to reduce the amount of waste that is delivered in a frozen state as far as possible. In reality frozen waste cannot be completely avoided as freezing may also take place in transit, especially due to the distances covered in delivery. If necessary, waste management companies will use specialised oil as a coating on the inside layer of the containers to prevent frozen waste from "sticking" to the truck. Up to 5 percent by mass of delivered waste could be delivered in a frozen state. The Supplier must design equipment to defrost such frozen waste. The aim in designing equipment is only that frozen waste should not cause any damage to the equipment during operations.

Table 8 shows which feedstocks this applies to.

Technical Question 1
The Supplier must explain their experience with (if any) as well as their proposed solution for dealing with frozen feedstock.

6.3.3 Feedstock reception and dosing

6.3.3.1 Expedited feeding into fermenters

The Supplier must design and build the technology in this section so that solid feedstock are transferred from Solid Feedstock Reception Units into the Mixing Buffer Tank/s as soon as reasonably possible, so as to avoid emissions, whereby the Client states no specific quantitative objective in this regard.

6.3.3.2 Overview

The Supplier must install Solid Feedstock Reception Units for reception and buffer storage of feedstock and for feeding that feedstock to the subsequent technology/unit.

The Reception Hall must house at least 2 Solid Feedstock Reception Units for solid feedstock.

- (at least) one for solid feedstock for Line 1
- (at least) one for solid feedstock planned for Line 2 (sewage sludge, septic tank sludge)

All handling of feedstock after tipping must be automated, expect in the event of an outage/workaround, in which case it is permitted.

The Solid Feedstock Reception Units must be enclosed in some way ("Enclosure"). This could be done

- with a quick closing vertical door,
- with a wall and ceiling or
- (especially a bunker below ground is planned) it could be equipped with a cover/lid

to minimise the diffusion of odours to the hall and the surroundings. The enclosure must be closed at least when waste is not being tipped or access to the Solid Feedstock Reception Units is required for other reasons; and in normal operating conditions it will always be closed when the Reception Hall gate is open. If one or more Reception Hall gates and the Enclosure are open at the same time, an alarm must be triggered and sent to the central Control System. One way of achieving this objective could be to construct airlocks (please refer to "Airlock Sub-Lot" described in section 12.5.3.

6.3.3.3 Solid Feedstock Reception Units

At least 2 separate Solid Feedstock Reception Units are required, one for each of the 2 Lines. These units must be able to receive feedstock, provide buffer storage for the delivered solid feedstocks and feed the feedstock to the next unit/equipment, then becoming inputs to Line 1 and Line 2 respectively.

As an approach to enable redundancy, the "Line 1" Solid Feedstock Reception Unit can be used to feed "Line 2" and vice versa, however after such a "workaround" event, the Line 1 Solid Feedstock Reception Unit must be completely washed and this must be considered in the Supplier's design.

There is a requirement to reduce to an absolute minimum the amount of human intervention required between delivery of feedstock by the truck driver in the Reception Hall and feeding of feedstock into the Plant. Wheel loaders must not be included in the standard procedure for waste delivery and feeding.

The Client recommends using Cranes as an approach for moving feedstock for Line 1 but other methods would be acceptable if they operate in a highly automated fashion. Overall, the Supplier must design a high degree of automatisation in this Sub-Lot.

Drive-in bunkers would also be a potential approach for Solid Feedstock Reception Units.

Due to the requirement of keeping Line 1 and 2 separate, if the Supplier suggests only using cranes, 2 separate crane grabs must be used for Line 1 and Line 2.

Nonetheless it must be possible and safe for Operations Team members to physically intervene everywhere easily and safely in order to remove unwanted / unexpected / difficult Contaminants / objects (carpets, car, batteries, bins etc.). Human intervention directly in a Solid Feedstock Reception Unit is not permitted since it is hazardous work. To pick up larger objects a service crane is required which must be delivered within Lot A.

The Solid Feedstock Reception Units must be able to withstand the physical impact of emptying food waste from the container even if some of the contents are frozen. The Solid Feedstock Reception Units may be used to defrost frozen waste.

The Solid Feedstock Reception Units must be able to withstand the physical impact of heavy and large items that may arrive as unsorted waste together with the food waste. The Solid Feedstock Reception Units must be equipped to prevent such items from being transported to parts of the Plant that are not designed to withstand this. The Solid Feedstock Reception Units must be designed to minimise the impact of foreign bodies and ensure easy troubleshooting.

It is expected that a significant amount of leachate, meltwater etc. will arise in the Solid Feedstock Reception Units. The Supplier must design the Sub-Lot to be able to remove this leachate and meltwater.

It must be possible to wash the Truck (including container, wheels) inside the Reception Hall, immediately after tipping, using water, hoses and steam jets in the Reception Hall. Items for truck washing must be constructed by the Contractor for Lot A.

Leachate, meltwater and wash water must be pumped either into the Buffer Mixing Tanks, Fermenters or Liquid Feedstock Reception Tanks.

6.3.3.4 Liquid Feedstock Reception Tank

At least 2 Liquid Feedstock Reception Tanks are required, both for Line 1. One Liquid Feedstock Reception Tanks must be used exclusively for fish sludge. We are currently not expecting any liquid feedstock for Line 2.

Lot A must include pumps for emptying the truck.

Some of the Liquid Feedstock Reception Tanks may need special management i.e. requiring a certain temperature or airtight buffer storage (oils, flotation fat, glycerine). The Contractor must explain any such management needs in the operations and maintenance manual.

We also refer to the comments concerning fish sludge in section 4.3.5 and 4.3.16. The Supplier must design the Lot so as to prevent any deliveries of fish sludge that have an inhibitory effect due to e.g. high levels of heavy metals from disturbing the biology of the entire Plant e.g. by being able to prevent a delivery with a very high content of such inhibitory heavy metals from being pumped into the Fermenters. This is the reason for the requirement to have one Liquid Feedstock Reception Tanks used exclusively for fish sludge. The laboratory will have a small continuous feed fermenter unit which will be purchased by the Client and which can be used to test feedstock.

Tank volume is determined by maximum peak single delivery as well as maximum feeding speed, the latter being particularly important for glycerine.

A tanker carrying liquid waste must be able to empty to the Liquid Feedstock Reception Tank within 10 minutes.

The Supplier must include space in the overall design and layout for an additional Liquid Feedstock Reception Tank. Please refer to section 12.2.12.

6.3.4 Guarantee Value for Availability

The Supplier must guarantee a high availability for waste reception function. Waste is considered to be delivered if it can be delivered inside the Reception Hall. To enable this high availability the Supplier is encouraged to not only employ technology that is robust with a high degree of availability but also to design redundancy in the form of work arounds. A tipping floor with wheel loaders would be an acceptable approach to deliver redundancy.

6.4 Contaminant removal (plastics, light fraction)

6.4.1 Introduction/general information

Since 2000 we have been receiving at the Site (Origo Skibotn composting plant) SSO (Source Separated Organics) which arises in the region. This material along with other similar streams (HoReCa and pre-consumer supermarket waste) contains significant amounts of contaminant. Since 2019 we have been using a Cesaro Mac Tiger to remove contaminants from these streams. This technology is specifically designed to remove lighter plastic contaminant fractions. These contaminants are removed in the form of so-called reject. The reject contains quite a significant amount of organic matter.

6.4.2 Contaminant removal unit (reject collection and post-processing)

The DBC must design and build the Works to remove as much of the Contaminants from the feedstock as possible before the feedstock enters the fermenters.

Recently we have been recording the amount of reject and we have come to the conclusion that the mass of reject (wet weight) in the waste stream that we receive is between 5% and 8% of the mass of the waste treated (wet weight).

According to our analyses and estimates, the dry matter content (dry solids of any kind, plastics, organics, sand) of the reject we currently produce is 25%. We estimate that approximately 20% of the dry solids is organics but we have not analysed this.

After pre-treatment the treated food waste does still contain a certain amount of contaminants, but we have not measured the weight or surface area of the contaminants.

Technology solutions exist which remove light fraction contaminants such as plastic as well as heavy fraction contaminants such as sand and grit. Some systems may be able to remove light fraction and heavy fraction contaminants in separate streams. Fundamentally we are open to all systems. Although we have also provided detailed waste sorting analyses in Appendices A.202, A.203, A.204, A.205, A.206, A.207, A.208 and A.209 to this document we only have practical experience of separating light fraction visible contaminants.

The fractions which are expected to be treated in the pre-treatment technology are:

Feedstock	Expected quantity (wet tons p.a.) (§)
Household SSO	14.900
Organic waste HoReCa	2.600
Food production waste	2.000
Depackaged pre-consumer supermarket organics	1.000
Total	20.500

Table 17: Feedstock fractions planned for treatment in pre-treatment technology

For the purposes of the evaluation it is important to establish an identical baseline for all suppliers. Only for the purposes of the evaluation we assume the following.

Suppliers must make the following assumptions in their Commercial Offer.

The above-mentioned 4 feedstock streams will contain heavy fraction contaminants, but the amount is unknown.

The above-mentioned 4 feedstock streams will also contain light fraction contaminants (which would be primarily plastics/paper) and the amount of these light fraction contaminants assumed to be is 300 tons p.a. of dry matter as a Projected Estimate.

The Supplier must design a pre-treatment solution that must remove unwanted Contaminants from the delivered feedstock in order to reduce as much as possible

1. the amount of contaminants in the feedstock before feeding to the fermenter
2. the amount and frequency of problems caused by the contaminants in the rest of the installation.
3. the effort and cost involved in removing Contaminant fractions from the digestate so as to increase their value of the end products and the commercial viability of the Products ("Pre-Treatment")
4. the amount of and disposal cost of the Contaminant fraction resulting from the Pre-Treatment process.

There are currently and there will in the future be 2 potential disposal routes for the reject produced by the pre-treatment technology.

1. Reject can be sent to landfill at the Skibotn site next to the Plant, which is operated by 2 of the shareholders of this biogas project
2. Reject can be delivered to a Waste to Energy (WtE) plant (incineration) in Tromsø.

We consider our costs of disposing of reject in the Waste to Energy plant to be high. Therefore we prefer the landfill disposal route which is lower cost. The reject must be treated by the pre-treatment technology so that the reject can be sent to landfill. This may mean that the Supplier must build a post-separation washing step. We already carry out a rudimentary dewatering process to reduce the mass of (and organic content of) the reject today. The Client recommends technologies such as a screw press which actively dewater the reject or can extract additional organic material from the reject as much as possible.

If the Supplier is unable to offer a solution which cleans the reject for disposal to landfill, this will not automatically be a reason for disqualification from the competition. In this event, the respective Supplier will however be evaluated more negatively, as follows:

The baseline assumption for the operational costs part of the evaluation (refer to section 21.3) is that 100% of the reject will be disposed in the landfill has a lower and more advantageous cost impact as explained in *Table 14*.

If a Supplier cannot offer a solution whereby reject can be sent to landfill, the assumption will be that 100% of the reject produced will be sent to the waste to Energy plant, which we expect will have higher and less advantageous operational cost impact.

The two different disposal routes have different requirements as regards post-processing requirements for the reject, as follows:

Disposal route:	Requirements as regards reject post processing
Landfill in Skibotn	The total organic carbon (TOC) is lower than 10 per cent by weight of dry solids and The amount of biodegradable organic dry solids is lower than 20% of dry solids and It is not economically or technically possible to recycle the reject
WtE plant in Tromsø	No specific requirements, other than to reduce the quantity (by reducing dry matter content)

Table 18: Potential post treatment options for reject from the Contaminant removal unit

For both disposal routes, dry matter content must be raised as high as possible bearing in mind economic feasibility, but only using mechanical separation/press. The Supplier must state as a Guarantee Value the dry matter content that can be guaranteed in the reject.

We already carry out a rudimentary dewatering process to reduce the mass of reject today. The Client recommends technologies such as a screw press which actively dewater the reject or can extract additional organic material from the reject as much as possible.

The amount of reject produced by the pre-treatment technology will depend on

1. the degree to which the pre-treatment technology can capture the contaminants.
2. the amount of organic material present in the reject which is also captured by the pre-treatment technology along with the contaminants (after any potential reject post-processing step which the Supplier may have).
3. The dry matter content of the reject i.e. the amount of water present in the reject along with the contaminants (after any potential reject post-processing step which the Supplier may have).

These factors depend on the Supplier's technology and should be known to the Supplier.

This will allow the Supplier, based on the Client's assumption that there is 300 tons of dry solids of light fraction contaminants p.a. and based on information given in the Appendices A.202 to A.209 to this Specification to state in their Commercial Offer the following 2 Expected Values (which are not Guarantee Values).

1. the expected amount (wet tons p.a.) of reject which will be produced.
2. the amount of visible contaminant present in the cleaned feedstock stream after the pre-treatment technology, whereas this must be expressed as percentage of Contaminant dry solids present in treated feedstock dry solids.

The Supplier's Expected Value for the amount of wet tons will be used in the evaluation of Operational costs.

In their Commercial Offer the Supplier must give the following Guarantee Values:

1. Minimum dry matter content of reject
2. Maximum amount of easily decomposable organic material dry solids within total dry solids.
3. Maximum amount of Total Organic carbon within total dry solids.

The amount of easily decomposable organic material dry solids within total dry solids in the reject will be determined with a residual gas potential test (which is an established procedure in Germany). In order to convert an analysis value for biogas production into a calculated amount of easily decomposable organic material dry solids within total dry solids in the reject we will calculate the loss of mass due to biogas production and will attribute 85% of the mass loss to organic material, and 15% due to water.

Furthermore the carbon content of methane and carbon dioxide will be used to calculate the mass of carbon included in the organic material, whereby the biogas volume is given from the biogas potential test, and the methane concentration of the biogas will allow calculation of the amount of methane, whereby the remainder is assumed to be all carbon dioxide.

Materials such as bones, seeds, fruit stones and woody material may be present in the reject but are unlikely to contribute to gas production, and according to this method would not in that case be registered as organic, biogas -yielding material and will therefore not be considered to be easily decomposable organic material.

Please also refer to the definition of Contaminant in the Glossary.

here is a requirement to reduce to an absolute minimum the amount of human intervention required in the Contaminant removal unit. Nonetheless it must be possible for Operations Team members to easily and safely intervene everywhere physically, in order to remove unwanted /unexpected/ difficult Contaminants / objects (carpets, batteries bins etc.). Overall, a high degree of automatisation is required.

The Client will supply a collection container to collect the "reject" from the depackager/Contaminant removal unit. It is not required to remove metal from the reject.

Technical Question 2
The rate of capture of Contaminants must be as high as possible. The Supplier must explain how they will demonstrate the effectiveness of Contaminant removal and how they would suggest that this effectiveness of Contaminant removal would be measured and tested. It may be that no single technology can completely remove all plastics from household organic waste before being transferred to the Fermenters. Suppliers' responses to this question will form part of the evaluation process.

At the Skibotn Site composting plant we currently use a bag opener/ depackager/ Contaminant removal unit which is a "Tiger HS20" manufactured by Cesaro Mac from Italy and which was purchased as a new unit in 2019.

After building the Plant using a new Contaminant removal plant/depackager, the existing depackager will be moved over and installed next to the new machine to create redundancy.

This will be done as a follow-on project or a change order: the Supplier does not to include or calculate the costs of this work in its Commercial Offer. The Supplier must make preparations in the overall design to accommodate this limited to allowing space in the Reception Hall.

We currently do not believe that it would make economic sense to build bale-making technology at the Site to bale the reject.

While this section discusses reject in general but also specifically light fraction reject plastic, the Supplier should also refer to section 6.6.4 if the Supplier is able to produce a separate and discrete heavy fraction which primarily contains sand and grit removed from feedstock before feeding into the fermenters.

6.5 Fermenter loading

The Supplier must design the Works to be able to process the following load such that the total amount of feedstock (coming from all Solid Feedstock Reception Units, Liquid Feedstock Reception Tanks and Buffer Mixing Tanks into the Fermenters) is as a minimum:

Feedstock	Capacity per calendar day, 24-hour period (§)	
	Tons wet weight	Tons dry weight
Line 1	160	35
Line 2	80	10
	Capacity per 28 calendar day period	
Line 1	4.400	1.100
Line 2	2.000	10
	Capacity per 365 calendar days	
Line 1	47.300	10.900
Line 2	15.800	2.400

Table 19: Fermenter feeding/ loading Capacity Fermenter loading for Lot A

6.5.1 Buffer Mixing Tanks

There will be not only a significant seasonality in supply of some feedstock to the Plant over the course of the year but also a variation during the course of the week.

The Client recommends that Suppliers design one or more Buffer Mixing Tanks to ensure that the supply of Feedstock/Substrate into the Fermenters remains as stable and constant (hourly) as possible and in order to be able to variably mix the different feedstocks which are delivered and in order to ensure a biological process and biogas production which is as stable and smooth as possible. This will allow feeding of the fermenters over the weekend when no feedstock will be delivered.

6.6 Fermentation

6.6.1 Stable biogas production

The Supplier must design the Works so that it can process the received feedstock with a fermentation process leading to a biogas production which is as stable as possible given the expected significant variation on a daily/weekly/monthly/seasonal basis as regards feedstock quantity/quality and mixture.

6.6.2 Maximised Biogas production

The Supplier must design the Works so that biogas production from the feedstock is maximised.

6.6.3 Wet Anaerobic digestion technology

Technology is to be designed for wet to semi-solid organic waste materials. Technology is not to be designed for dry, solid, ligno-cellulosic green or garden waste (this input is highly seasonal and there is only a small quantity which is already being and may continue to be treated at the existing co-located composting plant).

6.6.4 Prevention of and management of sedimentation

The Client expects that some feedstocks treated at the plant will contain significant amounts of sand and contraries that have a tendency to sediment out in a Fermenter.

Technical Question 3

The Supplier must describe in the Commercial Offer

1. whether their technology includes a solution to remove such heavy, sandy gritty materials and impurities before feedstock enters the Tanks and if this is the case,
2. how the solution works explain/demonstrate its efficacy with data from existing reference plants.
3. whether their technology includes a solution to remove such sandy materials inside the Tanks without an outage of (i.e. without emptying) the Tanks and if this is the case
4. how the solution works and explain/demonstrate its efficacy with data from existing reference plants.
5. whether the Supplier believes that Tanks will have to be emptied to remove sand, and in that case,
   - describe the Tank Cleaning procedure as well as an estimate for the total costs of such a procedure
   - how much time in total is required between decommissioning the fermenter *before* and completing recommissioning *after* cleaning
   - how often Tank Cleaning must be done in the first 20 years after commissioning

   supported with data from existing reference plants and based on their interpretation of our information about feedstock).

Please note that when evaluating quality of the Supplier's solution offered we will assume that

- any clean sand/grit fractions removed during feedstock pre-treatment will have a disposal cost of zero (cost item SAN as mentioned in *Table 14*)
- any sand/grit/sediment fractions removed during tank cleaning will have a disposal cost as described in the item (WTE) in *Table 14*.

Suppliers are not required to, but may have a feedstock pre-treatment technology which is able to produce sand/grit/sediment as a discrete heavy reject stream, as described in section 6.4.

Only in the event that the Supplier is able to produce a heavy reject fraction the Supplier must give an Expected Value for the following 3 values

1. the dry matter content of the heavy fraction product
2. the amount in wet tons p.a. of sand/grit heavy fraction that would be produced
3. the organic dry matter content of the heavy fraction produced.

6.6.5 Retention time

The Client recommends that the Lot be designed so as to maintain at least a minimum retention time in both Lines which is as constant as possible. We believe that this will lead to a more stable biological process.

Technical Question 4
The Supplier must define what the design retention time is in Line 1 and 2. If the Supplier considers this measure to be unimportant then the Supplier must explain why making use of relevant real operational data from similar reference plants with seasonally variable quantities of organic wastes which have been operating for at least 24 months.

For the sake of clarity, retention time in this case means hydraulic retention time and must appear in the mass balance and calculation of hydraulic retention time and factor in any liquid which is used for recirculation for added whatever purpose. If liquid fermenter content (Substrate) before mechanical separation is used for recirculation it does not affect hydraulic retention time. The Supplier must state the 2 given retention times as Expected Values.

The Digestate Buffer tank can be used to ensure retention time is maintained (see section 6.7.3.)

Stated Expected Values as regards retention time are for information only. A supplier will not receive an evaluation if a comparatively shorter or longer retention time is offered.

6.6.6 Managing Fermenter Ammonia nitrogen

After conducting many analyses on the feedstock planned for the plant (which are all attached in Appendices A.200 to A.279) the Client believes that without dilution, the concentration of ammonia in the Fermenters will be very high. Ammonia is known to be an inhibitor of the anaerobic digestion process.

Technical Question 5
The Supplier must state how they would use any previous experience with designing and building (and if relevant, servicing and operating) biogas plants which have such high Fermenter ammonia concentrations. The Supplier must state whether they have an approach for limiting, mitigating or dealing with ammonia in the Fermenter and if this is the case must describe this approach. The Supplier must state as an Expected Value which total concentration of ammonium/ammonia in the Fermenter the Supplier recommends during commissioning. It is known that biogas plants can adapt to higher levels of ammonia after the initial commissioning period, and that this process (and indeed tolerance of ammonia) can be assisted with the use of additives. The Supplier must state whether they have experience with adaptation and, if this is the case, the Supplier must - describe how long such an adaptation process may take (best case, worst case) - describe how the Supplier could be co-operate with the Client during this adaptation phase, in terms of scope of the Supplier's work and expected costs. - recommend which additives or products could be used to mitigate the negative effects of a raised Fermenter ammonia concentration and what their estimated costs would be - explain how high the Fermenter ammonia concentration may be after such an adaptation phase and/or when using such recommended products/additives. The Supplier may for example include details about amount of seeding sludge for digester inoculation, its origins and other characteristics as this can influence the adaptation phase.

6.6.7 Fermentation process

This Sub-Lot must include Fermenter technology (i.e. anaerobic digestion technology). These must include items such as mixers, fittings, valves, portholes fitted with lights and cameras, sensors for temperature, level, biogas composition, plus all structural steelworks e.g., steps, ladders, platforms, bridges for access, maintenance, repairs.

The operating temperature in the Fermenters should be low (i.e. mesophilic temperature range) so as to reduce the effect of inhibition from ammonia since it is estimated that the nitrogen concentration in the feedstock will be high. If the Supplier has a reliable solution whereby a higher temperature is possible and/or advantageous and/or recommended by the Supplier, the Supplier must describe and explain this solution and provide evidence is that this solution has been successful.

The Fermenter must include at least

- Monitoring of tank pressure, protection against harmful overpressure and underpressure.
- Agitator technology that ensures complete agitation of the entire contents
- All pipe connections to the tank must be fitted with flanges and shut-off valves
- (If the connection pipe for the supply of Substrate is located lower than the maximum filling level) a non-return valve
- Biogas flow meter, adapted to the operating conditions of the Plant
- Flow meter for Substrate in and out
- Instrumentation necessary for the continuous online observation of relevant process conditions in the fermentation process. This includes, but is not limited to:
    - Temperature
    - Gas composition, quantity and pressure (for each fermenter)
- Emergency overflow for uncontrolled foaming to be routed to ground level.
- Unit/s to add liquid or solid chemicals/additives/reagents to individual tanks.
- Anti-foaming solution/ technology.
- Sampling points with ball valve DN50 for all flows to and from the Fermenters.
- Level gauge
- Piping such at it is possible to remove Fermenter content from two different levels (bearing in mind the possibility of sedimentation).
- Two sight glasses (with light and camera, where the camera feed is visible via the Control System) mounted above the maximum liquid level, with flushing jets).
- Lockable bottom discharge valve with DN 150 sludge truck coupling with spade valve
- Manhole at the bottom for inspection and manual cleaning, minimum width 800 mm.
- Additional piping connections at the bottom with 2 pcs DN 200, 2 pcs DN 150, all equipped with manual spade valves that can be locked. All spade valves must be terminated with a flange plate.

Furthermore

- The tank must be constructed in a way that allows access for mechanical equipment when manual cleaning is required from ground level.
- It must be possible to safely reduce the liquid level in the tank to 50% without risk of causing corrosion.

Technical Question 6

The Client recommends using skimmer technology to remove floating Contaminants. The Supplier may have alternative approaches as regards floating contaminants. The Supplier must

1. state whether it intends to use skimmers and if not either
   a. explain the alternative approach it uses or if there is no alternative approach
   b. explain why the Supplier has no alternative approach making use of relevant real operational data from similar reference plants built by the Supplier which have been operating for at least 24 months.

The Client's Operations team will regularly sample the content of the Fermenter Tanks and Digestate Buffer Tanks in order to measure pH, alkalinity concentration and concentration of volatile fatty acids (VFA) and ammonium. If the Supplier has a reliable solution that performs continuous online observation of these parameters (pH, alkalinity concentration and concentration of volatile fatty acids (VFA) as an economically feasible, tried and tested standard, then the solution must be included.

For ease of maintenance, due to the high wind speeds and danger of storm at the Site and high snow loads, the Supplier must construct the Fermenters (as well as Mixing Buffer Tanks and Digestate Buffer Tanks) with a solid roof on top of the tank. A gas storage membrane must not be used as a roof.

The Client recommends that the minimum amount of technological installations should be installed inside the tank. The Client recommends the following approaches.

- That heat to be supplied via external heat exchangers as opposed to internal heating pipes inside the Fermenter
- That any mixers installed in the tanks should be easy to remove without emptying the tank and with the absolute minimum interruption (in terms of frequency and duration over the operating lifetime) to the biogas production process.
- The use of Central axial roof mounted as mixers and/or:
- The use of peristaltic pumps as mixers.

6.7 Digestate Buffer Tanks

6.7.1 Digestate buffer storage

The Supplier must design, calculate and build tanks for buffer storage of Digestate (at least one for Line 1, at least one for Line 2) which are large enough to hold a minimum of 10 days' = 240 hours' of production of unseparated Digestate from each respective Line. The Contractor must assume the maximum amount of daily Digestate production in this calculation. In this regard we refer to the seasonal variations in the amount of inputs.

One of the main purposes of these Digestate Buffer Tanks is to enable redundancy as regards Lot D i.e. the Digestate produced in Lot A can be stored even if Lot D is not available (provided the Digestate Buffer Tank is empty at the start of the Lot D outage).

As a result of these considerations, heating, mixing and gas production/ gas management functions are required as is the case with a Fermenter. However Digestate Buffer Tanks must be designed to cope with frequent changes in level.

6.7.2 Digestate Buffer Tank(s) as Redundant Fermenter tank(s)

Suppliers must design the Lot so that it is possible to use the Line 1 Digestate Buffer Tank/s as a spare Fermenter tank to generate redundancy. The Line 1 Digestate Buffer Tank/s (together) could then be used to hold the contents of another Fermenter tank, thus allowing the respective other tank to be emptied in the event of

- the respective other tank being emptied to be cleaned
- the respective other tank being emptied for repairs, checks, changes
- the respective other tank being emptied due to major disturbances in the Fermenter biology.

If the total volume of the Line 1 Digestate Buffer Tank(s) (collectively) must be at least as large as the largest Fermenter Tank to enable such a redundancy concept to be implemented.

6.7.3 Stable digestate forward flow

Furthermore the Digestate Buffer Tank could be used to manage unexpected spikes in feedstock supply (overflow). Also they can be used to ensure the minimum retention time as defined by the Supplier.

The Lot must be designed so as to deliver a flow of Liquid Fraction Digestate to Lot D which is as constant as possible (but only in terms of quantity) as described in *Table 23*. Digestate Buffer Tanks can be used to ensure this.

In spite of varying amounts of feedstock coming into Lot A as well as varying amounts of water required for dry matter adjustment and/or ammonia dilution, the suppler must ensure that the retention time in the Fermenters given by the Supplier as an Expected Value is ensured and also enable a production of Digestate which has been hygienised and cleaned of visible plastic and a forward flow of digestate which is as stable as possible as regards flow (but not consistency). Only the adherence to the retention time Expected Value will be checked in Performance Tests. Whether the Supplier gives a short or long retention time will not affect the evaluation either way.

6.8 Liquid Fraction Digestate Buffer storage

The Supplier must design, calculate and build a tank (or tanks) for buffer storage of post-separation Liquid Fraction Digestate of Line 1 and Line 2 combined. The tank/s must be large enough to hold a minimum of 3 days' /72 hours' of production of separated Liquid Fraction Digestate from both Lines. The Contractor must assume the maximum amount of daily Digestate production in this calculation. In this regard we refer to the seasonal variations in the amount of inputs. This tank must be insulated and must include heating to maintain the temperature of the Liquid Fraction Digestate

One of the main purposes of the Liquid Fraction Digestate Buffer Tank/s is to enable redundancy as regards Lot D i.e. the Digestate produced in Lot A can be stored even if Lot D is not available (provided the Digestate Buffer Tank is empty at the start of the Lot D outage).

6.9 Making high value nitrogen & fertiliser Products

6.9.1 SFD as nitrogen and phosphorus fertiliser

The Client has the objective of recovering nitrogen and phosphorus from the Digestate (albeit to a lesser extent for the nutrients present in the SFD produced from Line 2).

The Supplier must give an Expected Value for the amount of nitrogen (irrespective of which chemical form) which will be present in the solid Products produced by this Lot which will be recovered from the Digestate for use as an input for drying into Lot E. This value must be expressed as a percentage i.e. percentage of nitrogen by weight (irrespective of which chemical form the nitrogen is in) in all solid Products produced by Lot A as a percentage of nitrogen (irrespective of which chemical form the nitrogen is in) present in the feedstock before entering Lot A.

The Supplier must give an Expected Value for the amount of phosphorus (irrespective of which chemical form) which will be present in the solid Products produced by this Lot which will be recovered from the Digestate for use as an input for drying into Lot E. This value must be expressed as a percentage i.e. percentage of phosphorus by weight (irrespective of which chemical form) in all solid Products produced by Lot A as a percentage of phosphorus (irrespective of which chemical form) present in the feedstock before entering Lot A.

In order to evaluate the revenue impact of these fertiliser-related Guarantee Values the Client must assume Projected Estimates as regards chemical parameters of the Digestate before separation, as follows:

Parameter	Line 1	Line 2
Digestate quantity before separation m^3 p.a. (§)	124.000	31.000
TKN tons/year (§)	506	33
NH_3-NH_4^+-N tons/year (§)	292	20
P_2O_5 tons/year (§)	66	7,5
Average Dry solids concentration (§)	3,6%	3%

Table 20: Projected Estimates for digestate quantity, fertiliser content before separation

6.9.2 Quality criteria that apply for Digestate

6.9.2.1 Norwegian regulations

The regulations which govern the use of Digestate as fertiliser in Norway can be found here ("Forskrift om gjødselvarer mv. av organisk opphav").

These requirements which apply for plants in in Norway must be fulfilled in this project. However more stringent regulations apply as regards the amount of Contaminants, in particular Visible Contaminants (particles larger than 2 mm) in the Digestate. Please refer to section 6.9.2.4.

6.9.2.2 Bio-certified fertiliser

Technical Question 7

The Client may possibly have to produce bio-certified fertiliser in accordance with the Fertiliser Product Regulations.

For your information, if the Client wants to produce bio-certified fertiliser it will need to register their fertiliser with a Bio approval as per the EC regulation 2021/1165 and 2018/848 (organic labelling) needs to be followed.

Within the EC market, countries have different tolerances to heavy metals and other residues.

For example Scandinavian countries use the regional KRAV label.

https://www.krav.se/en/for-companies/certification-of-krav-organic-products/ ,

For excepted ingredients in bio fertilisers see the following: EC regulation 2018/848:

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R1165#d1e32-25-1

and EU regulation 142/2011 Annex V and XI:

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32011R0142#d1e32-38-1

This will require that certain chemicals, especially flocculants, may not be permitted during fertiliser production, and in particular that only a limited number of flocculants are permitted. For example, potentially only biodegradable flocculants would be permitted in this case.

The Supplier must state as an answer to this Technical Question

1. If the Supplier had experience using the bio-certified fertilizer compatible chemicals defined and can offer such chemicals
2. What the difference would be from a technical and performance point of view of using such permitted chemicals as compared to excluded chemicals.
3. What the difference would be from a commercial point of view of using such permitted chemicals as compared to excluded chemicals.

6.9.2.3 EU Regulations

New regulations are now in force or in the process of being adopted within the European Union. Our objective is to manufacture fertiliser from the Digestate in line with such EU regulations.

Such regulations include for example (not an exhaustive list)

EU regulation for fertilisers: EU2021/1165

which shows the accepted active ingredients.

2018/848

which explains all label requirements and

EU 1069/2009

which is the new regulation for solid organic fertilisers.

The Supplier must design their Technology so that the Products produce will adhere to such regulations.

6.9.2.4 Swedish regulations (regulation concerning Visible Contaminants)

The Supplier must guarantee that the amount of visible Contaminants in the digestate will not exceed the limits stated in this section.

There is a maximum limit for visible Contaminants present in the Digestate as it leaves the biogas Plant/Lot A. The digestate must comply with the Norwegian legislation on this topic. We refer to the Norwegian law (link) Part II Chapter III paragraph 10 number 6, where it is stated that (and in this quoted legal text "shall" has the meaning of "must")

> *"The total content of plastic, glass or metal pieces with a particle size greater than 4 mm shall not exceed 0,5 % by weight of the total dry matter."*

Above and beyond that the quality of the LFD produced by the mechanical separation must adhere to the Swedish SPCR120 regulation (link) as regards the limit for visible contaminants for liquid digestate. In the 2023 version of this regulation in section 3.7.3 it is written:

> *"The amount of visible impurities in liquid biofertiliser is determined by monthly samples and a moving average is calculated from the results of the last 12-month period [10]. In batch production, the amount of visible impurities is determined by batch samples and a moving average is calculated from the results of the last 12 batch samples [10]. The minimum frequency for continuous monitoring of visible impurities in solid biofertilisers shall be at least one sample per batch.*
>
> *The moving average for visible impurities in liquid bio-fertiliser shall not exceed 10 cm2/kg bio-fertiliser. The measured value for single sample results shall not exceed 20 cm2/kg. For each regular sample (primary sample) sent for analysis, a comparable reference sample must be saved and kept frozen. After 1-12 hours a new sample (secondary sample) is taken. The secondary sample is placed directly in the freezer. If the analysis result exceeds 20 cm2 /kg, the reference sample and the secondary sample are sent for analysis. The mean value from all three samples; the primary sample, the reference sample and the secondary sample shall replace the previous analytical result when calculating the moving average. The event shall be treated as a deviation. If the mean value of the three samples also shows > 20 cm2 /kg, the lot in question is rejected."*

Above and beyond that the quality of the SFD produced by the mechanical separation must adhere to the Swedish SPCR120 regulation (link) as regards the limit for visible contaminants for solid digestate. In the 2023 version of this regulation in section 3.7.3 it is written:

> *"The moving average for visible impurities in solid (>20 % TS content) bio-fertiliser shall not exceed 30 cm2 /kg bio-fertiliser. The measured value for single sample results shall not exceed 60 cm2 /kg. For each regular sample (primary sample) sent for analysis, a comparable reference sample must be saved and kept frozen. After 1-12 hours a new sample (secondary sample) is taken. The secondary sample is placed directly in the freezer. If the analysis result exceeds 60 cm2 /kg, the reference sample and the secondary sample are sent for analysis. The mean value from all three samples; the primary sample, the reference sample and the secondary sample shall replace the previous analysis result when calculating the moving average. The event shall be handled as a deviation. In the case where the average of the three samples also shows > 60 cm2 /kg, the lot in question is rejected."*

Finally the following regulation from the SPCR120 applies.

> *"The requirement for visible impurities shall not be satisfied by the application of techniques that reduce visible impurities to less than 2,0 mm."*

The relevant documents (valid from 01.01.2024 onwards) of the SPRC are appear as an Appendices A.400, A.401, A.402, A.403, A.404 and A.405 to this document (in Swedish and as English translations).

6.9.2.5 Guarantee Values concerning visible Contaminants

In summary, here are the Guarantee Values as regards visible contaminant in the form of a table.

Parameter	Unit	Value
Visible Contaminants in solid fraction digestate (post-separation)	cm^2 /% DM	30
Visible Contaminants in liquid fraction digestate (post-separation)	cm^2 /% DM	10
Plastic > 2mm in solid or liquid fraction digestate	g/kg DM	2,5
Metal > 2mm in solid or liquid fraction digestate	g/kg DM	3
Glass > 2mm in solid or liquid fraction digestate	g/kg DM	3
Sum total of plastic, metal and glass > 2mm in solid or liquid fraction digestate	g/kg DM	5

Table 21: Guarantee Values for digestate (maximum level of contamination)

6.9.3 Plastics removal separator

We expect some residual plastics to be present in the Digestate after the fermentation process. However there will be limits to the amount of plastic which may be present in the final product from Digestate treatment. Therefore the Supplier must include a separator to remove small plastic items from the Digestate before it is passed on to Lot D.

The rate of capture of Contaminants must be as high as possible. The Supplier must guarantee a rate of capture of Contaminants.

Technical Question 8
The Supplier must explain how they will demonstrate the guaranteed effectiveness of the removal of Contaminants from digestate before separation and how they would suggest that this effectiveness of Contaminant removal would be measured and tested.

This Sub-Lot must be designed so that Digestate from Line 1 and Line 2 is treated separately. The Sub-Lot for Line 1 may be used as a back-up/redundant solution for Line 2 in the event of an outage (and vice versa) provided the Sub-Lot for Line 1 can be easily and thoroughly washed after it has been used as a back-up for Line 2.

The plastic fraction from this Sub-Lot is considered to be reject. Please see section 6.4 for a further discussion of reject.

6.10 ABPR

The Supplier must design the Works so that the feedstock is treated as per the locally valid ABPR regime. The name of the responsible regulator in Norway is Mattilsynet.

6.10.1 Pasteurisation/hygienisation

All of feedstocks for the biogas plant will require treatment as per the ABPR legislation and status.

The Client has confirmed that pasteurisation/hygienisation can be done either before or after the Fermenter. Nonetheless in its own scenarios the Client has assumed that pasteurisation/hygienisation would happen after the digestion process in the Fermenter.

Assuming that that is the case, then the first step of processing the Digestate after fermentation will be a time and temperature treatment process. The common approach is as per Regulation 142/2011 Annex V, Chapter III (treatment at over 70° Celsius, maximum particle size 12mm).

The procedure must be in agreement with procedures approved by the responsible authority (Mattilsynet) and be deemed to be sufficient in terms of temperature and duration as a pasteurisation/ hygienisation step. We provide some data in this regard as an Appendices A.410, A.411, A.412 and A.413.

This Sub-Lot must ensure that no batches leave the Sub-Lot without approved hygienisation having been achieved and that this is documented in accordance with the requirements of the Animal By-Products Regulations. The documentation requirement can be fulfilled by logging data from the Control System showing temperature and residence time in the hygienisation stage during 7 calendar days of operation.

This Sub-Lot must be designed so that Digestate from Line 1 and Line 2 is treated separately. The Sub-Lot for Line 1 may be used as a back-up/redundant solution for Line 2 in the event of an outage (and vice versa) provided the Sub-Lot for Line 1 can be easily and thoroughly washed after it has been used as a back-up for Line 2.

Tanks must be insulated to minimise heat loss and protect personnel.

6.10.2 Method K

We would like to make specific reference to an approved ABPR-approved treatment method which is mainly used in Norway and which may not be known outside of Norway. We refer to method K which is an established approach used in the fish industry.

The following materials must be treated according to method K:

1. Fish processing waste (rotasieve) (we refer to section 4.3.16 for a description)
2. Fish silage in any form (we refer to section 4.3.15 for a description)

For the sake of clarity, the following materials do NOT have to be treated according to method K:

1. Fish processing waste (cake) (we refer to section 4.3.17 for a description)
2. RAS fish farm sludge (we refer to section 4.3.14 for a description)

The consequence of method K obligation is that both the Fish processing waste (rotasieve) as well as the Fish silage must be treated as follows

1. grinding and treatment to pH <4 which is NOT done by the Client but is done by the waste supplier where the material arises followed by
2. transport of the waste to our biogas plant Site where it is secured by keeping the pH below 4 for 24 h (the Supplier does not supply any technology for this) followed by
3. heat treatment at 85° for a minimum of 25 min which must happen before being fed into the Plant (the Supplier must supply technology for this step including an additional small Solid Feedstock Reception Bunker only for this feedstock)

The Supplier is responsible for designing the Works

so that these materials (which are not liquid) can be treated according to this method.

Please refer to section 15.2.3 on the topic of ABPR.

Although this primarily applies to the Liquid Fraction Digestate produced after the Mechanical separation, it is important to note here that due to considerations of heat recovery within the pasteurisation Sub-Lot, that the temperature of the Liquid Fraction Digestate when crosses the interface to Lot D must be between 55 and 60 degrees Celsius.

The Supplier must state as an Expected Value the heat consumption per ton of feedstock pasteurised according to method K (kWh_{th}/ton of feedstock pasteurised according to method K).

In order to pass the Taking Over Test for Hygienisation the Contractor must pass all tests required by the regulator on 4 separate occasions in different weeks. This applies to processing for method K materials as well.

6.10.3 Guarantee Value for Availability

The Supplier must give a Guarantee Value for the availability of the hygienisation/pasteurisation function. The pre-digestion method K treatment is excepted from this requirement. The minimum value is 98% of POH.

The Supplier must guarantee a high availability for the mechanical separation function as defined . Mechanical separation will be one of the key steps which allows us to convert unseparated digestate into a safe pathogen-free material which can be converted into 1. Solid Fraction Digestate (and then into Products) and 2. Liquid Fraction Digestate (and then into Products as well as infiltration Water. It is an essential step. To enable this high availability the Supplier is encouraged to not only employ technology that is robust with a high degree of availability but also to design redundancy in the form of one or more work arounds as part of a redundancy concept. The Digestate Buffer Tanks which are one of the few mandatory items in this tender are envisaged as a suitable acceptable approach to deliver redundancy.

6.11 Mechanical separation, separate treatment of 2 Lines of digestate

The Lot must include technology for mechanical separation. Furthermore the digestate from Line 1 and Line 2 must be separated in different separation units. Please refer to section 6.2 for an explanation.

This has the following consequences for the Supplier.

The mechanical separation must be designed so that Line 1 Digestate and Line 2 Digestate do not come into contact with each other i.e. both Lines enter and leave the mechanical separation via separate pipes.

6.11.1 Guarantee Values, Expected Values

For the mechanical separation Sub-Lot the Supplier must state as an Expected Value the capture rate for the solids present in the Digestate before separation.

Furthermore the Supplier must give the following 4 Guarantee Values

- the dry solids content that the Supplier can guarantee (at least 25%).
- the amount of SFD dry solids expected p.a.
- the Suspended Solids concentration in LFD (maximum 5 mg per litre).
- Availability of 98%

These are 4 of the most important Performance Parameters in the entire Plant.

The temperature of the Liquid Fraction Digestate when crosses the interface to Lot D must be between 55 and 60 degrees Celsius.

6.11.2 Unmanned operation of mechanical separation

The Client recommends using a mechanical separation unit which can be operated unmanned i.e. as near as possible to 24 hours a day and 7 days a week.

6.11.3 Removal of suspended solids

Mechanical Vapour Recompression is one highly efficient method to evaporate water from LFD that is considered in Lot D. The energy consumption required per ton of water evaporated is significantly lower than other methods of evaporating water. The Mechanical Vapour Recompression is faced with the limitation that water can only be evaporated as long as the remaining Nutrient Liqour is still pumpable.

We therefore suggest that to maximise the effectivity of any Mechanical Vapour Recompression process, processes with comparatively low energy requirement should be used in advance of the Mechanical Vapour Recompression process to remove suspended solids. Examples described here are mechanical separation and membrane separation.

6.11.3.1 Mechanical separation/mechanical drying (Solid-liquid separation)

The greater amount of SFD produced, the higher the CAPEX and OPEX will be for any post-processing technology.

The lower the dry matter content of the SFD produced is, the higher the CAPEX and OPEX will be for any post-processing technology.

Therefore the mechanical separation Sub-Lot must produce SFD with a dry solids content which is as high as possible and capture as SFD as much of the total solids present in the Digestate fed to the separation.

The SFD will be either

1. transferred to the Buffer Storage/Feeder included in the pyrolysis plant in Lot C (see section 8.3.1) (for Line 1 SFD) and
2. transported to the torrefaction project in Narvik (for Line 2 SFD).

In making Projected Estimates the Client has used information derived from analyses of feedstocks planned for the Plant. We provide an overview of the feedstocks in section Table 8 and furthermore supply data from various analyses in Appendices A.200 to A.279 to this document.

The Client cannot and will not guarantee that shown in analyses such as concentration of a particular Contaminant, dry matter, organic dry matter, gas yield, nitrogen etc. will be the same in reality as it is in the analyses given in Appendices A.200 to A.279.

6.11.4 Guarantee Value for Availability

The Supplier must guarantee a high availability for the mechanical separation function as defined . Mechanical separation will be one of the key steps which allows us to convert unseparated digestate into 1. Solid Fraction Digestate which we can convert into Products and 2. Liquid Fraction Digestate which can also be converted into Products as well as infiltration Water. It is an essential step. To enable this high availability the Supplier is encouraged to not only employ technology that is robust with a high degree of availability but also to design redundancy in the form of one or more work arounds as part of a redundancy concept. The Digestate Buffer Tanks which are one of the few mandatory items in this tender are envisaged as a suitable acceptable approach to deliver redundancy.

6.12 Emissions reduction

The emission of any other unwanted solids/liquids/gases from the Plant must be reduced as much as possible and/or it must be ensured that those emissions can be valorised as Products as much as possible.

6.12.1 Odour treatment

The emissions from the entire Plant measure must not result in odour emissions of more than 1 Odour Unit/m^3 measured at sensitive receptors (i.e. surrounding residential buildings in the neighbourhood) and this must be adhered to 99% of the time.

The Client has included the odour dispersion model as Appendices A.110 and A.111.

Based on this odour dispersion model a "Calculated Value for Odour Emissions" has been calculated. This will be the maximum amount of odour that can be emitted from the Odour Management and Treatment System after odour treatment when the Plant is running at full capacity without exceeding odour emissions at defined sensitive receptors as per the odour dispersion model.

The Norwegian Environment Agency (Climate and Pollution Agency)'s "Guidance on the regulation of odour emissions in permits pursuant to the Pollution Control Act" (TA-3019) is used as a basis for understanding the provision.

In making the design and calculation, the Supplier must ensure that all process technology built that could release odour emissions is built as an enclosed process that does not generate untreated emissions to the environment where technically possible. The process must be equipped with process ventilation and Odour Management and Treatment System to reduce odour emissions.

Please also refer to section 14.3 which concerns this topic as it relates to the whole Plant.

6.12.2 Odour Management and Treatment System for the entire Plant

All Lots and Sub-Lots where odour can be generated and potentially released to atmosphere must be connected to an Odour Management and Treatment System. The DBC has the responsibility of designing and building a complete and functioning Odour Management and Treatment System for the Plant. Typical odour emissions sources include (but are not limited to) Liquid Feedstock Reception Tanks, Solid Feedstock Reception Units, Mixing Buffer Tanks, waste pre-treatment equipment, waste transportation screws, and reject handling equipment etc. Both indoor and outdoor process elements must be included in the Odour Management and Treatment System.

Not only Sub-Lots and units inside Lot A but also within other Lots (such as the mechanical separation in Lot D and the dryer in Lot E) must be attached to the Odour Management and Treatment System.

If working on the principle of air extraction, the equipment must include negative air pressure, piping ducts, air scrubbers.

All Liquid Feedstock Reception Tanks as well as any Buffer Tanks which are not part of the group of Fermenters and whose fill level can change must be connected to the Odour Management and Treatment System.

To have a high quality and dependable Odour Management and Treatment System is a high priority for the Client.

The Client recommends that Suppliers consider modern/advanced BAT/BREF compatible technologies which can include technologies such as

- UV oxidation
- Particle separation
- Thermocatalytic oxidation

The Odour Management and Treatment System must treat the odour so that the odour emissions are released from a single emission point which is at a height: 5 m above the roof of a building of at least 10 m height whereby those emissions do not exceed 500 OUE/m^3.

This relates to the projected scenario in the Odour dispersion model which we have attached as Appendix A.110 and A.111 to this Specification on page 13 in Table 4 (picture in the top right).

6.13 Master Control System and electrics

Since this Plant is split into several different Lots the overall operation between different Lots is of vital importance for the success of the project. From the point of view of the overall Plant, each of the other separate "technological" Lots B, D, E, F and H will in most cases be discrete stand-alone "black boxes" which are fully integrated within themselves. The centre of the entire Plant is Lot A. As a result the Control System of Lot A is referred to as the "Overarching Control System". The responsibility for defining the interfaces between Control System of Lot A and Control Systems of other Lots resides with the Supplier of Lot A unless otherwise specifically defined.

This Sub-Lot must also include all electrical cabling including underground electrical cabling for Lot A and within the Battery Limits for Lot A.

Please refer to section 14.5 for further detail.

6.14 Piping

Piping and any other equipment must be designed so that it is possible to dose reagents that prevent the precipitation of struvite. Dosing points must be where there is a high risk of precipitation, typically in heat exchangers. Equipment for storage, dosing and filling of the reagent must be included in the Works.

Technical Question 9

The Supplier must explain their approach for piping as regards dimensions and which materials are used for which kind of pipes and whether pipes are installed below or above ground (and in that case how, and with which frost prevention measures such as insulation, trace heating).

6.15 Pumps

The Client recommends the use of peristaltic pumps for pumping feedstock, substrate and digestate. This is however not an obligation.

6.16 Biogas and condensate

6.16.1 Flare

The Contractor must build a flare which must be of a high industrial standard. The flare must be designed for continuous operation if its operation is required and must be able to safely and reliably flare off all biogas and biomethane up to the defined Capacity as per Lot B and for as long as the outage in Lot A or Lot B persists.

The technology delivered by Lot B must also be able to use the flare not only to flare biogas but also off-spec. biomethane. Therefore the technical design, engineering and Control System must correspond to the requirements defined by Lot B.

The flare must be able to measure the amount of biogas or biomethane which has been flared off.

The flare must be able to flare of all of the biogas produced that may have a methane concentration which is too low for the biogas upgrading technology in Lot B (such as is commonly produced during the biological commissioning process).

The flare must have a turndown ratio of 5 i.e. the flare must be able to burn only 20% of the defined Capacity as per Lot B

6.16.2 Biogas storage membrane

The biogas storage membrane must be a stand-alone structure, not mounted on top of a tank.

The Client recommends housing the biogas membrane inside a simple structure to protect it from the harsh, adverse weather conditions that prevail at the Site. This is however not mandatory. The Supplier must consider the cost of initial procurement as well as possible cost of replacement over the Business Case Period (15 years) of the plant must be used to create a solution with the lowest lifetime cost.

The Biogas storage membrane must be able to store a variable amount of biogas. Lot A must be designed so that it can supply Lot B with an amount of biogas which does not exceed the Capacity for Lot B and without biogas being released to the atmosphere via the or overpressure values.

6.16.3 Condensate management

The Supplier must design and implement in this Sub-Lot pipes and shaft/s (with the associated sensors, fittings and valves) for collecting, monitoring and buffer storage of all condensate originating from biogas that is produced within the Plant, not only within Lot A but also Lot B.

The DBC must design a solution which must collect all condensate arising within its Lot and deliver it to the Battery Limit point for wastewater defined on the Client's General Arrangement Plan. The Condensate will be treated in the septic tank also built by the Supplier.

6.17 Other design objectives

6.17.1 Sale of fertiliser outside of Norway (flocculants)

It must be possible to produce a SFD product which can be sold as a fertiliser not only in Norway but also in Sweden, Finland and Denmark. The technology installed by the Contractor must make that possible and must not prevent that possibility.

The Supplier must offer equipment where chemicals/reactants used (such as flocculants) are used which are permitted as per fertiliser regulations in Norway, Sweden, Finland and Denmark. The fertiliser regulations we are referring to are for conventional agriculture. We are not referring to the regulations for bio-certified fertiliser. Bio-certified fertiliser is a separate optional aspect mentioned in section 6.9.2.2.

6.17.2 Minimisation of unwanted methane leakage

The Lot must be designed and constructed so that state of the art best practices (Best Available Technology) are employed to reduce unwanted methane emissions leaving the plant via any source other than the specified intended outlets (flare, biomethane liquefaction technology).

The Supplier shall use a defined methodology to predict, quantify and measure such unwanted methane emissions. In the Supplier's Commercial Offer the Supplier must give an Expected Value as to what the volume of unwanted methane leakage is (nm^3 methane p.a.).

This requirement applies for Lot B as well (see section 7.8.2).

6.18 Inputs required

1. Organic waste feedstock
2. Electricity
3. Heat
4. Water for ammonia dilution,
5. Water for adjustment of dry matter
6. Water for cleaning purposes
7. Trace elements
8. Fermenter stabilisation additives
9. Iron salts for desulphurisation purposes
10. Oil, grease.

6.19 Outputs produced

1. Pasteurised Digestate (with most visible plastic removed) which after separation will be Solid Fraction Digestate and Liquid Fraction Digestate in fertiliser quality
2. Raw Biogas

7 Lot B: biogas cleaning, valorisation, liquefaction to LBM and $LBCO_2$

7.1 Lot purpose

The Supplier must build design and build Works which must remove all undesired impurities from raw biogas delivered by Lot A including but not limited to hydrogen sulphide, thiols, terpenes and other VOCs, ammonia, organic acids and convert raw biogas it to Liquefied Biomethane (LBM) as well as Liquefied Bio-CO_2 ($LBCO_2$) and ensure buffer storage as well as dispensing facilities for both of these products.

7.1.1 Potential technical approaches.

- Membrane
- Pressure swing adsorption (PSA)
- Pressurised Water Wash (PWW)
- Amine wash

7.2 Nominal Design capacity

Parameter	Projected Estimate (§)	Units
Biogas production p.a. going to biogas upgrading (§)	8.400.000	nm^3
Average methane concentration in biogas (§)	65%	%
Minimum methane concentration in biogas (§)	50%	%
Daily biogas production going to biogas upgrading (§)	27.000	nm^3 biogas/24 h
Range of methane concentrations that can be flared	Min. 35 <-> max. 100	%
Daily LBM production (§)	12	tons/day (24 h)
Daily $LBCO_2$ production (§)	18,5	tons/day (24 h)
Production of methane in raw biogas p.a. from Lot A(§)	3.875	tons/year
Production of CO_2 in raw biogas p.a. from Lot A(§)	5.950	tons/year
Turn down ratio for biogas upgrading	Minimum 50	%
Turn down ratio for LBM production	Minimum 50	%
Turn down ratio for $LBCO_2$ production	Minimum 60	%
Temperature of LBM in tank *which must be permanently maintained*	Max. minus 158 (at max. 0,5barg)	° Celsius
Operation mode CO_2 liquefaction	CO_2 liquefaction will only be operating if $LBCO_2$ product needs to be produced, so potentially not 100% of the time.	

Table 22: Capacity and Projected Estimates for Lot B

7.3 Biogas cooling and cleaning

This includes Biogas cooling/dewatering including removal of water, partial removal of hydrogen sulphide and other substances which may appear in the biogas such as thiols, terpenes, ammonia, organic acids and other VOCs.

7.3.1 Biogas filtration

The Client recommends the use of e.g. a ketone scrubber to remove terpenes and other VOCs, organic acids and/or activated carbon filters to remove sulphur and/or other filters/scrubbers.

7.3.2 Desulphurisation

Desulphurisation could be done with a combination of approaches i.e. both external scrubber and with additives. Examples may include but are not limited to:

- External biological desulphurisation: High oxygen unit producing sulphuric acid as a By-product for potential use as a useful Product (acid scrubber for air treatment) or
- External biological desulphurisation: Low oxygen unit producing elemental sulphur as a By-product for potential use as a useful Product (elemental sulphur as fertiliser Product) and/or
- Hydrogen Peroxide scrubber

7.3.2.1 Desulphurisation within Lot A

Please note that to have Desulphurisation within Lot A is a stated objective inside Lot A by means of e.g. addition of iron salts into the Fermenters/Digestate Buffer Tanks.

Oxygen must not be used inside the Tanks for desulphurisation.

7.3.3 Condensate management

A complete Sub-Lot for management of all condensates must be included in Lot B. In their design and calculation the Supplier must deliver condensate to the Battery Limit defined on the Client's General Arrangement Plan.

Condensate will be treated in the septic tank built by the Supplier.

Since the technology delivered by Lot A will also produce condensate: the condensate management must be dimensioned to manage this amount and must correspond to the requirements defined by the Supplier of Lot A.

The Projected Estimate for the amount of Condensate produced in Lot B is 500 m^3 p.a.

7.4 Biogas upgrading

The Supplier must deliver technology to remove CO_2 removal from the biogas to produce clean separate CO_2 and CH_4 Product.

7.5 LBM production

The Supplier must design and build the technology so that it produces LBM according to requirements for LBM fuelling stations as per the "EN 16723-2:2017" specification.

This places a maximum limit on the concentration of oxygen, among many other substances, which is relevant for e.g. desulphurisation.

The LBM will be sold at fuelling stations which are outside the scope of this Plant. Not only are the distances between the Skibotn Site and the projected fuelling stations (refer to section 24.3) long in terms of kilometres and hours driven, but also due to the relatively remote location of the fuelling stations we expect that significant time may elapse between delivering fuel and the fuel being sold to a Customer. As a result, it is a requirement for the LBM to be produced so that it can be transported and then stored at the fuelling station for as long as possible without any unwanted blow-off. That means that the Supplier for Lot B must not only produce LBM at a temperature of minus 158 degrees Celsius maximum, but that the temperature of LBM at minus 158 degrees Celsius maximum inside the tank must be maintained, meaning that any potential blow off produced by the tank must be recycled in Lot B and reliquefied and fed back to the LBM storage tank.

7.6 Production of food grade $LBCO_2$

The Supplier must design and build technology for production of $LBCO_2$ and must produce $LBCO_2$ at food grade quality. The composition of the CO_2-offgas and technology design in the biogas upgrading technology must be optimised to make the addition of technology for production of food grade $LBCO_2$ as smooth, simple and efficient as possible.

The Supplier must design the technology so that the $LBCO_2$ produced confirms to the specification defined by the EIGA (European Industrial Gas Association) and the ISBT (International Society of Beverage Technologists), which we have included below.

EIGA LIMITING CHARACTERISTICS

FOR CARBON DIOXIDE FOR FOODS AND BEVERAGES.

Component	Concentration
Assay	99.9% v/v min.
Moisture	50 ppm v/v max. (20 ppm w/w max.)
Ammonia	2.5 ppm v/v max.
Oxygen	30 ppm v/v max.
Oxides of Nitrogen (NO/NO2)	2.5 ppm v/v max. each
Non-volatile residue(particulates)	10 ppm w/w max.
Non-volatile organic residue (oil and grease)	5 ppm w/w max.
Phosphine ***	0.3 ppm v/v max
Total volatile hydrocarbons (calculated as methane)	50 ppm v/v max. of which 20 ppm v/v max non-methane hydrocarbons.
Acetaldehyde	0.2 ppm v/v max.
Benzene	0.02 ppm v/v max.
Carbon Monoxide	10 ppm v/v max.
Methanol	10 ppm v/v max.
Hydrogen Cyanide*	0.5 ppm v/v max
Total Sulphur (as S) **	0.1 ppm v/v max.
Taste and Odour in Water	No foreign taste or odour

* Analysis necessary only for carbon dioxide from coal gasification sources

** If the total sulphur content exceeds 0.1 ppm v/v as sulphur then the species must be determined separately and the following limits apply:

Carbonyl Sulphide	0.1 ppm v/v max.
Hydrogen Sulphide	0.1 ppm v/v max.
Sulphur Dioxide	1.0 ppm v/v max.

*** Analysis necessary only for carbon dioxide from phosphate rock sources

Where carbon dioxide complies with the specification then by definition the requirements for acidity and reducing substances as required by European Law are met.

Figure 6: Specification for production of $LBCO_2$

The technology offered must enable storage in a low-pressure vessel. Including dispensing facilities. The technology must also maintain the temperature of $LBCO_2$ inside the tank i.e. any potential blow off CO_2 must be reliquefied.

7.7 Product storage

7.7.1 LBM Buffer Storage

The Supplier must include in the Commercial Offer cryogenic tank/s for storage of LBM (total volume minimum 200 m^3).

7.7.2 $LBCO_2$ Buffer Storage

The Supplier must include in the Commercial Offer cryogenic tank/s for storage of $LBCO_2$ (total volume minimum 200 m^3) including a dispenser

7.8 Avoiding methane losses

7.8.1 Methane slip

There is no specific statutory limit for methane slip in Norway for the methane content of the offgas. Nonetheless for this Plant the Supplier must reduce methane slip to maximum of 1% by volume. If under normal circumstances the methane slip from the biogas upgrading would exceed this maximum value of 1% by volume then the Supplier must eliminate the methane slip in some way. It is solely the Supplier's responsibility to select the suitable technology for this.

If the Supplier uses an offgas combustion technology then the Supplier must

- include the operating costs (fuel consumption) for this additional technology and
- state the amount of heat that can be recuperated as hot water and at which flow/return temperature under normal circumstances.
- only use LNG as a fuel to support the combustion process if additional fuel is required to support the combustion process,.
- ensure that at least 50% of the heat produced can be recovered and passed to Lot H as hot water.

The Supplier must state the methane slip that is to be expected in the offgas as an Expected Value, both

1. In the operation mode where the CO_2 liquefaction is operating.
2. In the operation mode where the CO_2 liquefaction is NOT operating.

The Client believes that when the CO_2 liquefaction technology is installed the methane slip could be significantly reduced.

7.8.2 Minimisation of unwanted methane leakage

The Lot must be designed and constructed so that state of the art best practices (Best Available Technology) are employed to reduce unwanted methane emissions leaving the plant via any source other than the specified intended outlets (flare, biomethane upgrading offgas, from the liquefaction technology as LBM).

The Supplier must use a defined methodology to predict, quantify and measure such unwanted methane emissions. In the Suppliers Commercial Offer the Supplier must give an Estimated Value as to what the volume of unwanted methane leakage is (nm^3 methane p.a.). This requirement applies for Lot A as well (section 6.17.2).

7.9 Exclusion from scope

7.9.1 Fuelling stations

An operational company affiliated or otherwise associated with Rå Biopark will be constructing 3 fuelling stations to market LBM. The transport of LBM will be included in the fuelling station project, not in this project. For details refer to section 24.3.

7.10 Guarantee Values

The Supplier must offer Guarantee Values as follows.

Taking Over Tests:

1. LBM quality as described in section 7.5 (EN 16723-2:2017)
2. $LBCO_2$ quality as described in 7.6 (EIGA Limiting Characteristics)
3. Production Capacity, LBM output from Lot B, 12 tons per day
4. Production Capacity, $LBCO_2$ output from Lot B, 18,5 tons per day

Performance Tests

1. Availability (minimum 96%)
2. LBM recovery: percentage of Liquid Biomethane which is recovered as sellable LBM compared to the amount of methane in the raw biogas.
3. $LBCO_2$ recovery: percentage of CO_2 which is recovered as sellable food grade Liquid Bio-CO_2 compared to the amount of CO_2 in the raw biogas.
4. Electricity consumption of all technology in Lot B, assuming the Daily biogas production going to biogas upgrading is as detailed in *Table 22*, including biogas upgrading, production of fuel grade LBM production from all recovered methane (just liquefaction) and production of food grade $LBCO_2$ production from all recovered CO_2 (just liquefaction)
5. Noise emissions, within limits of noise dispersion model, as per Appendices A.120 and A.121.
6. Availability

7.11 Inputs required

1. Raw biogas
2. Electricity
3. Heat (if amine technology)
4. Process specific reagents such as Water (PWW), activated carbon (PSA) or and methanolamine (amine)
5. Activated carbon for filters
6. Trace elements, nutrients (biological desulphurisation)

7.12 Outputs produced

1. LBM
2. Off gas
3. $LBCO_2$
4. Condensate containing various impurities, organic acids and difficult to digest or even digestion-inhibiting VOCs/terpenes
5. Sulphuric acid and/or sulphur from desulphurisation
6. Low-grade heat from compressors, coolers, gas liquefaction unit or from pyrolysis unit.
7. Higher-grade heat (if amine wash technology)
8. Spent activated carbon

8 Lot C: SFD processing (for information only)

8.1 Lot purpose

The Digestate which is produced at the end of the AD process contains dissolved and suspended solids that contain valuable nutrients and carbon. Using separation process/es and other technology/ies the objective of this Lot is to concentrate the solids so that they can easily be processed or converted into an easily transportable, dry substance with a high value in a proposed fertiliser factory (Lot F described in section 11).

8.2 Specific design objectives

The Plant will have the fundamental limitation that the total amount of farmland within even a 30 km radius is negligible compared to the amount that would be required for spreading the Digestate as fertiliser. Additionally, our experience from operating a composting plant since 1999 has shown that while compost made from waste can be marketed the revenue is lower than might be possible at other locations in Continental Europe.

At the Site the Plant will be built next to an outdoor composting plant which has already been operational since 1999. We currently do not plan to continue using or expand the existing composting plant. Due to permit limitations in the environmental permit for the composting plant, any composting would have to be done indoors after 2025.

However, if a new composting plant IS built, then this would be a separate project outside the scope of this Plant. Therefore, Suppliers must not propose to construct a new composting plant or produce more compost within the Commercial Offer to ITT 1 or for Lot C. Since separately collected green waste will continue to be delivered at the Site in the future, the existing composting plant will be retained as a back-up if there is a major long term technical issue concerning Lot C.

8.2.1 Raising dry matter content and (potentially) integrated dryer

If we do not purchase a dryer in then the dry matter content of the input for Lot C will between 20% and 35%.

If however we elect to purchase a dryer then the dry matter of the input into Lot C will be ca. 85% and in that case Lot C will only include drying insofar as it is required from the point of view of the Supplier of Lot C.

Rather than converting carbon compounds in the Digestate by using composting into compounds with only short- or medium-term stability (humins), the primary objective is to use thermal processes (which can be net energy producers, and which may operate with limited or zero use of oxygen) to transform the carbon into dry compounds with a very long-term stability.

Potential processes could be:

- Dry Pyrolysis (Gasification) – to produce biochar (high carbon to oxygen ratio)
    - Updraft Pyrolysis/Gasification kiln
    - Downdraft Pyrolysis/Gasification kiln
    - Horizontal screw type Pyrolysis/Gasification kiln
    - Microwave Pyrolysis
    - Rotary kiln
- Wet Pyrolysis (Hydro Thermal Carbonisation) – to produce hydrochar

Since 2020 a completely new market has established itself for the creation and trade of carbon removal certificates, (or CRCs, as they are generically known) e.g. Carbonfuture Credits and CORCs (CO_2 Removal Certificates). This market has significantly increased in value and matured in the meantime. Producing biochar is an accepted approach for generating "carbon drawdown" i.e. for permanently removing atmospheric CO_2, much of which is now anthropogenic. This is one of the motivations for implementing pyrolysis to produce biochar. While suitable technology can deliver biochar using woody waste as a source with a high degree of certainty of producing carbon removal certificates, it must be verified that SFD can also produce biochar with a sufficiently high C:O ratio and in conformance with current methodologies/platforms such as e.g., Verra, Puro, Carbonfuture, CarbonGold etc.

Since many gardening and horticultural products are currently produced from peat (often sourced from Scandinavia) but the use of peat is being phasing out and banned, biochar can be used to replace this raw material.

We expect some residual plastics to be present in the Digestate. However we expect as much residual plastic as possible to be removed in Lot A (refer to section 6.9.3) *BEFORE* the main solids-liquids separation phase described in section 6.11.

Plastic may therefore still be present in the SFD. Therefore, a pyrolysis step is being considered in Lot C which will operate at a sufficiently high temperature to convert plastics to energy. Alternatively, HTC would be a viable approach if it has integrated equipment to remove microplastics.

Regarding the nutrients contained in the solids: the fundamental objective is to use processes such as the above-mentioned pyrolysis processes as well as thermal drying (belt dryer or similar) in order to raise the dry matter content of any By-products/Products produced to make them biologically stable yet safe to transport and by concomitantly increasing nutrient concentration and mass, therefore make them commercially more valuable and increase transportability.

Lot C may include equipment producing a concentrated nitrogen fertiliser product from the SFD (e.g. scrubber).

If the Supplier offers equipment for producing a concentrated phosphate fertiliser product from the SFD it must be offered within Lot D.

8.2.2 Material recycling and energetic valorisation

SFD produced from sewage sludge is not subject to the requirement to implement material recycling, so that this material and biochar produced from this material could be used as a fuel (energetic valorisation).

Construction/ demolition wood is not subject to the requirement to implement material recycling, so that this material and biochar produced from this material could be used as a fuel (energetic valorisation).

8.2.3 Potential torrefaction project

The Rå Biopark team is also working on another waste to value project in the region. In this project it is the intention to construct a torrefaction plant at a different site in the region (not at the Skibotn Site). Torrefaction is a technology which is quite similar to the pyrolysis technology described in this section. We assume that the torrefaction project will proceed.

The SFD produced from Line 2 in Lot A is also planned as a suitable feedstock for this plant, as well as potentially other woody, relatively dense fractions which are currently delivered to the plant and which are listed in section 4.4.

A decision on whether or not the torrefaction project will be built is expected by 01.12.2024 at the latest.

To summarise, it is the intention that the destination for the SFD produced in Lot A is as follows:

Line 1 SFD	→	Technology in Lot C as described in this chapter
Line 2 SFD	→	Torrefaction project

8.3 Sub-Lots

8.3.1 Buffer storage (possibly)

The Supplier must offer equipment for buffer storage and feeding the input. The Supplier must take into account that the mechanical separation technology could potentially only operate during Manned Operating Hours.

8.3.2 (If required) mechanical separation (Solid/liquid separation) technology

One of the final steps within Lot A will almost certainly be one or more units for mechanical separation. Lot C will effectively receive SFD as a Product from the Lot A mechanical separation and will further treat or dry as required within Lot C.

An additional mechanical separation unit is only required as far as the Supplier for Lot C deems this to be necessary and above and beyond the unit already supplied in Lot D.

Mechanical separation could be done using technologies including (but not limited to):

- Slow rotating modular unit
- Decanter centrifuge, with or without use of (bio-degradable) flocculants
- Press screw separator
- Filter press
- Hydrocyclone.

8.3.3 (If required) dryer

The dry matter content of the input for Lot C will between 20% and 35%. For dry pyrolysis units this will mean that the dry matter must be raised to a suitable level before pyrolysis. In that case the Supplier must integrate a dryer into the Lot offered to ensure a sufficiently high dry matter content.

8.3.4 Conveyors belts, feeding screws

With the aim of avoiding unnecessary labour and use of mobile machinery/diesel, transport of materials within the Plant must be as automated as possible while reducing any significant pollution from odour or dust by using enclosures and using the Odour Management and Treatment System.

There are 2 potential technologies which may be offered within Lot C namely:

1. Hydrothermal carbonisation/wet pyrolysis
2. Gasification/dry pyrolysis (potentially including integrated dryer)

These technologies are described separately in the following sub-sections as separate approaches.

8.3.5 Approach 1: Hydrothermal carbonisation

If gasification/wet pyrolysis is proposed the technology must include

- an integrated unit for removing plastic Contaminants
- technology for ensuring the correct dry matter content in the feed
- technology for mechanically dewatering the hydrochar
- technology to ensure that emissions to air are or can easily be reduced to an absolute minimum and in compliance with air emissions limits.

(Thermal dewatering/drying of hydrochar, if required/possible, will be included in Lot F).

8.3.6 Approach 2: Gasification/pyrolysis

If gasification/dry pyrolysis is proposed the technology must include

- an integrated unit for drying the input material such that the desired dry matter content as well as other parameters are achieved in order to ensure the success of the actual gasification/pyrolysis step.
- exhaust gas treatment so as to ensure compliance with local air pollution directives.
- a unit such as a scrubber to capture at least 90% of the ammonia which would otherwise have been released without the (e.g.) scrubber whereas emissions must be compliant with air emissions limits.

If one Supplier has suitable technology (with references) for both approaches 1 and 2, the Supplier may make one Commercial Offer for each approach.

8.3.7 Excluded items

The following items are excluded items here but may be included in Lot F "Fertiliser Factory" (refer to section 11).

8.3.7.1 Technology for making pellets or granules

8.3.7.2 Technology for bagging technology pelletised/granulated Products

8.3.7.3 Product buffer storage silos.

8.3.7.4 Potentially thermal dewatering:

If various combined Products after mixing and/or before/after pelletisation/granulation still require significant drying before the final Product is produced, then the dryer required (including acid/alkali air scrubbers) would be part of Lot F "Fertiliser Factory" (section 11).

If a Hydrothermal Carbonisation step produces a Product with a dry solids content lower than 70%, then the dryer required (including acid/alkali air scrubbers) would be part of Lot F "Fertiliser Factory" (section 11).

8.4 Inputs required

1. SFD from mechanical separation in Lot A
2. Heat
3. Electricity
4. Acid/alkali for acid/alkali air scrubbers.
5. If the calorific value of the biogas Digestate is too low to support gasification/dry pyrolysis, up to 800 tons of Category A waste wood (chipped/ prepared as per Supplier's specification) may be used to raise the calorific value and support the pyrolysis process.

8.5 Outputs produced

1. Ammonia salts from scrubbers
2. Biochar at max. 40 ° Celsius with a dry matter content of maximum 70% OR
3. Dewatered hydrochar at max. 40 ° Celsius with a dry matter content of maximum 70%.

9 Lot D: valorisation of liquid AD by-products/ treatment of effluent

(for information only)

9.1 Lot purpose

Lot A is assumed to be a wet AD process. Possibly significant quantities of Infiltration Water or Fresh Water will be added to reduce nitrogen and possibly to operate a decanter. We assume that there will therefore be a large quantity of Digestate with a low dry solids content. Any mechanical separation process will produce LFD, also in significant quantities.

Applying Digestate to agricultural land would be prohibitively expensive since to find sufficient agricultural land would mean transporting Digestate many hundreds of kilometres. We are currently NOT planning to spread Digestate, SFD or LFD to land in any significant quantities anywhere near the plant.

It should be noted that the composting plant which has been operated at the Site since 1999 as well as the landfill also operated at the Site produce a significant amount of leachate which contains a high organic loading. This effluent is currently treated in a series of aerobic ponds and the treated effluent from the ponds is introduced into the nearby river under the current permit.

We intend to implement water infiltration. Excess water can be released into the environment safely using water infiltration, meaning that a very high degree of effluent treatment is required. The water infiltration is excluded from the scope of this project.

It is important to note that we expect the nitrogen and therefore ammonia concentration in the anaerobic digestion (Lot A) to be very high, certainly higher than the commonly recommended safe levels for Fermenter operation. One approach to reduce the impact of high nitrogen is to use water for dilution. If this is the approach that the Lot A Supplier suggests, we would like to achieve this using recirculation of Infiltration Water produced in Lot D rather than by using additional Fresh Water from whatever source. The aim is to build a Plant which is as circular, self-contained, and sustainable as possible in this regard.

We intend to derive as much commercial value as possible from the nutrients present in the Digestate and we intend to maximise the sustainable use of resources and nutrient recycling with this approach.

As a result of new legislation within the EU there is an increased focus in recovering/retrieving/recycling from waste materials.

It may be possible to also manufacture dried product with a high phosphate content (such as struvite, vivianite, calcium phosphate) from either Digestate and/or LFD and/or SFD and/or Nutrient Liqour. If Suppliers have a technology solution which is commercially feasible this may be of interest. This is however not an obligation.

In this context reference is made to two recent market overviews for potential technologies which specifically remove phosphorus:

- A Review of Phosphorus Removal Technologies and Their Applicability to Small-Scale Domestic Wastewater Treatment Systems
- ESPP – DPP – NNP nutrient recovery technology catalogue

9.2 Technologies

After an initial market investigation and on having examined other biogas Plants in Norway and in Europe, we believe there are several technology approaches which can either individually or in combination achieve the stated objectives.

This list is by no means exhaustive and is not a positive list. It includes but is not limited to:

- Mechanical Vapour Recompression (MVR) to produce
    - Nutrient Liquor
    - water/condensate
    - ammonium sulphate or ammonium nitrate solution
    - ammonia water
- Reverse osmosis
- Ammonia stripping to produce
    - ammonium sulphate or ammonium nitrate solution
    - ammonia water
- Phosphorus removal
    - Using struvite precipitation
    - Using vivianite precipitation with magnetic removal
    - Using CSH (calcium Silicate Hydrate) to make calcium phosphate
- Microfiltration
- Ultrafiltration
- Nanofiltration
- Crystallisation
- Forward osmosis
- BOD aerobic scrubber
- Electro deionisation.
- Aerobic treatment
- Annamox treatment
- Membrane bioreactor (MBR)
- Dissolved Air Flotation (DAF)

9.3 Capacity and digestate composition

Based on the Client's current Projected Estimates the Plant must be able to receive Liquid Fraction Digestate as follows:

Parameter	Line 1 and Line 2
LFD input m^3 p.a. (§)	141.000
LFD input m^3 p.h. from Lot A (§)	16,42 on average assuming 98% availability Mechanical Separation in Lot A
NH_3-NH_4^+-N tons/year (§)	285
P_2O_5 tons/year (§)	7,3
Average Dry solids concentration (§)	0,57%
Variation in Dry solids concentration (§)	Min. 0,47% - Max. 0,67%
Average TKN kg/m^3 (§)	2,34
Average NH_3-NH_4^+-N kg/m^3 (§)	2,00
Average P_2O_5 kg/m^3 (§)	0,05
Variation in Daily input	Min. 370 m^3 per day, Max. 410 m^3 per day
Production	Every day and 24/7 i.e. NOT ONLY during POH and NOT ONLY on Workdays
Temperature	Between 55 and 60 degrees Celsius
Condensate for infiltration m^3 p.a. (§) (calculated by subtracting quantities of all other products namely 1. Nutrient Liquor and 2. Ammonia water (50%) and 3. Ammonium salt (50%) from the LFD quantity above.	133.640
Availability	Minimum 85% of POH
Capacity	20 m^3 per hour of LFD
Maximum allowable Outage	72 continuous hours of non-availability

Table 23: Projected Estimates for design and configuration of Lot D

These are average values over the course of the year. Values given for concentration will vary.

9.4 Variability of Digestate flow

The Lot must be designed to be able to receive a continuous flow of Digestate. The intention is that this flow will be as constant as possible (but only in terms of forward flow from Lot A). For the purposes of ITT 2, the Supplier must base the Commercial Offer on the Projected Estimate that that the forward flow of Digestate may vary as described in Table 23.

9.5 Division of Plant into 2 Lines

9.5.1 Separate treatment of 2 Lines of digestate up to mechanical separation

The Lot must treat the digestate forward flows coming from Lot A Line 1 and Lot A Line 2 separately. Please refer to sections 6.2 for an explanation.

This has the following consequences for the Supplier.

The mechanical separation must be designed so that Line 1 Digestate and Line 2 Digestate do not come into contact with each other i.e. both Lines enter and leave the mechanical separation via separate pipes.

9.5.2 Combined treatment of 2 Lines of digestate after mechanical separation

The Sub-Lot for the treatment of the LFD leaving mechanical separation in Lot A must be designed for the complete stream of LFD. It is not necessary to separately process LFD from Line 1 and Line 2.

9.6 Regulations

9.6.1 EU Regulations

New regulations are now in force or in the process of being adopted within the European Union. Our objective is to manufacture fertiliser from the Digestate in line with such EU regulations.

Such regulations include for example (not an exhaustive list)

EU regulation for fertilisers: EU2021/1165

which shows the accepted active ingredients.

2018/848

which explains all label requirements and

EU 1069/2009

which is the new regulation for solid organic fertilisers.

The Supplier must design their Technology so that the Products produce adhere to such regulations.

9.7 Produce concentrated nitrogen products

The Client expects that a great deal of the nitrogen in the digestate will be in the form of ammonia. The Supplier must design a solution which can produce concentrated ammonia products. The solution offered must be flexible enough to offer 2 different kinds of products, namely

1. Ammonia salts and
2. Ammonia water

9.7.1 Technology for production of ammonium salts.

The Supplier must offer technology which produces an ammonium fertiliser salt (e.g. ammonium sulphate) solution. This is a minimum requirement. The Supplier must make a recommendation as to which acid reagent should be used at which concentration.

The ammonium salt solution Product concentration must be as high as possible while still ensuring that the ammonium salt solution can still be pumped into a dryer (Lot E). The Supplier must state the dry matter that will be reached as a Guarantee Value. The higher the concentration the better. This is potentially connected to wanting to reduce transport costs but primarily it is connected with reducing the drying costs that are involved in producing a solid dry ammonium salt crystal.

The ammonium sulphate solution must be produced at a temperature which is as high as possible, minimum 70 ° C.

Technical Question 10
The Supplier must state whether impurities are expected in the ammonium salt Product. If impurities are expected in the ammonium salt Product produced then the Supplier must state what impurities are expected. If the Supplier has experience in removing such impurities then the Supplier must suggest technological/chemical approaches for removing most or all of the impurities

9.7.2 Technology for production of ammonia water (NH4OH solution)

The Client has entered into a Memorandum of Understanding for the supply of high concentration ammonia water (ammonium hydroxide) for use as a reagent in SNCR processes in e.g. Waste to Energy plants.

The Supplier must offer a solution which can not only produce the ammonium salt described in section 9.7.1 also ammonia water (ammonium hydroxide solution).

It must be possible to switch between production modes for both Products meaning that

1. It must be possible to operate in the ammonium salt production mode at 100% load i.e. only production of ammonium salt.
2. It must be possible to operate in the ammonia water production mode at 100% load i.e. only production of ammonia water.

The ammonium hydroxide concentration must be as high as possible; however the ammonium hydroxide concentration must however not exceed maximum 24,5% by weight (since at 25% the product would then be classified as toxic to aquatic life).

The Supplier must state the concentration that can be guaranteed as a Guarantee Value.

The ammonia water solution must be produced at a temperature which is as low as possible, as a maximum at 40 ° C.

Technical Question 11
The Supplier must state whether impurities are expected in the ammonium hydroxide Product. If impurities are expected in the ammonium hydroxide Product produced then the Supplier must state what impurities are expected If the Supplier has experience in removing such impurities then the Supplier must suggest technological/chemical approaches for removing most or all of the impurities.

If the Supplier is unable to offer a solution for production of ammonia water, this will not automatically be a reason for disqualification from the competition. In this event, the respective Supplier will however be evaluated more negatively. This is because the Operational Costs are higher and the Revenue Potential is expected to be lower for the ammonium salt compared to ammonium hydroxide.

9.8 Produce concentrated phosphorus products

Phosphorus has the tendency to be captured to a high degree in SFD during the process of mechanical separation in Lot A. Some phosphorus will still be present in the LFD which is processed in Lot D. Phosphorus can be sequestered by methods e.g. using chemicals, to produce a precipitate which can also be marketed. The Supplier may, but is not obliged, to offer solutions which capture phosphorus in this way. Nonetheless the maximum concentration of phosphorus in the Infiltration Water must not exceed the value given in *Table 24*.

Please note that in the evaluation of technology solutions offered we will look at the revenue potential of the solution offered as well as the costs. However we will not distinguish between the product value of

1. phosphorus captured by mechanical separation in Lot A using flocculants and coagulants and
2. phosphorus captured by other chemical means.

The transport costs are a factor and there will be a difference between these 2 scenarios, however we expect this factor to be rather minimal, especially since we are considering costs for transporting (dried) SFD, which will be incurred anyway. Nonetheless the Supplier may consider implementing a technology as part of Lot D with which phosphorus can be captured by chemical means.

The technology proposed by the Supplier must be a technology which produces a Product which is known in the fertiliser market and which has already has a track record of being successfully marketed as a fertiliser Product.

The Supplier must give the following Expected Values:

1. Percentage of phosphorus in the LFD entering the Lot that can be recovered in the form of the Product.
2. Phosphorus content per ton of dry matter of the finished Product, calculated as P_2O_5.
3. Dry matter content of the finished Product.

For the purpose of evaluating the associated operating costs of marketing such phosphorus products, the Supplier must assume that the Client will dry the phosphorus Product up to a dry matter content of 90% in Lot E.

If the Supplier's technology has a method to reduce the concentration of heavy metals in the product, the method must be described and the concentration of heavy metals must be as low as is possible bearing in mind economic feasibility (calculated using parameters described in *Table 14* and *Table 15*.

9.9 Conversion of LFD to water for infiltration and Nutrient Liqour

Mechanical Vapour Recompression is a technology which is able to evaporate water from e.g. LFD with a low temperature and very low energy consumption. It produces clean condensate and a Nutrient Liqour as well as (as a variation) ammonium hydroxide solution and/or ammonium salt solution.

If some additional treatment is required (e.g. reverse osmosis) to make the condensate to be suitable for infiltration then this technology must be included.

9.9.1 Produce Nutrient Liquor

If the technology offered is an evaporation process, the technology must convert LFD into "Nutrient Liqour" with a dry matter content which must be as high as possible. The minimum dry matter content of the Nutrient Liqour must be guaranteed by the Supplier. At this dry matter content it must be possible to pump the Nutrient Liqour into a dryer (Lot E).

The Supplier must state the minimum dry matter content for Nutrient Liquor which it guarantees as a Guarantee Value in sheet 9 in the template "Attachment 2B - Price form.xlsx" provided.

The Nutrient Liquor must be produced at a temperature which is as high as possible, minimum 70 ° C, especially since the next processing step will be drying via evaporation of water.

9.9.2 Cleaning LFD to make Infiltration Water into water recipient.

The degree of effluent treatment that is necessary depends on the limitations of the environmental permit. The environmental permit for this Plant has not been awarded yet. Rå Biopark has submitted the application for the environmental permit which is attached to this Specification as Appendices A.136 and A.137. We have already been instructed that the restrictions stated in the BAT/BREF for water emissions from a biogas plant applies.

The emissions reductions targets as regards effluent/emissions to water are as per the document

"CELEX_32018D1147_EN_TXT.pdf"

titled

"BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR WASTE"

which can be downloaded here.

We specifically refer to BAT 20 table 6.1 in the above-mentioned document. The relevant portions of the current version current at the time of publishing this document are as follows:

BAT-associated emission levels (BAT-AELs) for direct discharges to a receiving water body

Substance/Parameter		BAT-AEL (1)
Total organic carbon (TOC) (2)		10-60 mg/l
Chemical oxygen demand (COD) (2)		30-180 mg/l
Total suspended solids (TSS)		5-60 mg/l
Hydrocarbon oil index (HOI)		0,5-10 mg/l
Total nitrogen (Total N)		1-25 mg/l (5) (6)
Total phosphorus (Total P)		0,3-2 mg/l
Phenol index		0,05-0,2 mg/l
Metals and metalloids (8)	Arsenic (expressed as As)	0,01-0,05 mg/l
	Cadmium (expressed as Cd)	0,01-0,05 mg/l
	Chromium (expressed as Cr)	0,01-0,15 mg/l
	Copper (expressed as Cu)	0,05-0,5 mg/l
	Lead (expressed as Pb)	0,05-0,1 mg/l
	Nickel (expressed as Ni)	0,05-0,5 mg/l
	Mercury (expressed as Hg)	0,5-5 µg/l
	Zinc (expressed as Zn)	0,1-1 mg/l

(1) The averaging periods are defined in the General considerations.

(2) Either the BAT-AEL for COD or the BAT-AEL for TOC applies. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.

(5) The BAT-AEL may not apply when the temperature of the wastewater is low (e.g. below 12 °C).

(6) The BAT-AEL may not apply in the case of high chloride concentrations (e.g. above 10 g/l in the waste input).

(8) The BAT-AELs only apply when the substance concerned is identified as relevant in the wastewater inventory mentioned in BAT 3.

Table 24: Required values for emissions to water recipients

These emission limits may be subject to change.

The temperature of the water for infiltration must be between 30 and 40 degrees Celsius as it leaves Lot D interface to the Client's infiltration system. If heat is recovered to make that possible it should be used within the Lot or it should be possible to export the heat recovered via Lot H.

If producing water as per the specification described in *Table 24* i.e. with very low contamination, then this water should ideally be used for AD process dilution purposes and if possible, for decanter flocculent solution or any other useful application e.g. use as wash water at the Plant/on Site which can reduce the consumption of clean Fresh Water which would otherwise be supplied from a tap, well or from captured rainwater.

9.9.3 Produce recirculation water for e.g. reduction of 1. Fermenter ammonia concentration and/or 2. Fermenter dry matter content

The technology in Lot A may need recirculation water for use in the Buffer Mixing Tanks/Fermenters to adjust dry matter content in the Substrate and/or to adjust ammonia concentration and/or for other purposes). One potential source for supplying recirculation water is Lot D. However if Lot D is producing effluent for recirculation, then there is always at least a perceived risk of the accumulation of certain salts or species that could potentially eventually inhibit the anaerobic digestion process in Lot A or have other adverse unwanted effects.

The Lot D Supplier must convert LFD into water for infiltration according to the specification described in section 9.9.2. The Client deems this water for infiltration to be suitable for use as recirculation water (exclusively in the Buffer Mixing Tanks/Fermenters to adjust dry matter content in the Substrate and/or to adjust ammonia concentration and/or for other purposes) but this assumption must be confirmed by the Supplier for Lot A.

The separation of Lot A into 2 Lines includes the mechanical separation for the SFD as part of Lot A. However the separation into 2 Lines stops after mechanical separation for the LFD. All of the LFD coming from Line 1 and Line 2 should be processed in one single mixed batch. Recirculation water produced from this single batch will be used either for e.g. reduction of 1. Fermenter ammonia concentration and/or 2. Fermenter dry matter content in either of the 2 lines.

The temperature of recirculation water must be between 65 and 70 ° C as it crosses the interface from Lot D.

9.10 Piping

Piping and any other equipment must be designed so that it is possible to dose reagents that prevent the precipitation of struvite. Equipment for storage, dosing and filling of the reagents must be included in the Works. Dosing points must be where there is a high risk of precipitation, typically in heat exchangers.

Technical Question 12
The Supplier must explain their approach for piping as regards dimensioning and as regards which materials are used for which kind of pipes and whether pipes are installed below or above ground (and in that case how, and with which frost prevention measures such as insulation, trace heating).

9.11 Assumptions, guarantees and evaluation

The baseline assumption for the revenue from fertiliser part of the evaluation (refer to section 21.5.3) is as follows:

50% of the ammonia product will be produced in the form of ammonia water (50% of the total mass of ammonia captured).

50% of the ammonia product will be produced in the form of ammonium sulphate (50% of the total mass of ammonia captured).

If a Supplier cannot offer a solution whereby ammonia water is produced the assumption for the evaluation will be that 100% of the ammonia product produced will be in the form of the suggested ammonia salt, which we expect will have a less advantageous net profit impact (revenue minus operational costs) and lower revenue potential.

The Supplier must give the following Guarantee Values.

1. Percentage of nitrogen present in the LFD entering the Lot that can be recovered in the form of ammonia water (if the technology offered were only making ammonia water).
2. Ammonia content i.e. concentration by weight of ammonia water.
3. Percentage of nitrogen present in the LFD entering the Lot that can be recovered in the form of an ammonia salt if the Client uses the reagent recommended by the Supplier (if the technology offered were only making ammonium salts) (whereby for evaluation purposes we will assume that Sulphuric Acid is used as a reagent at the costs described in *Table 14*).
4. Dry matter content of ammonia salt produced whereby the Supplier must assume that Sulphuric Acid is used as a reagent at whatever concentration the Supplier recommends.

For the purposes of the evaluation the Client will assume that the cost of sulphuric acid is as given in *Table 14* (item SUL).

Furthermore to simplify the evaluation the Client will assume that the stoichiometry of the reaction between ammonia and sulphuric acid will be 1:1 even if this is not the case in reality, so that capturing 1 ton of ammonia consumes 2,882 tons of sulphuric acid (dry solids) and produces 3,882 tons of ammonium sulphate (dry solids).

9.12 Inputs required

1. Liquid Fraction Digestate from Lot A
2. Electricity
3. Reagents, chemicals e.g., acid, alkali, trace elements, flocculants.

9.13 Outputs produced

1. Infiltration Water for introduction into water recipient
2. Water with limited or almost no contamination for use as wash water and/or for decanter flocculent solution and/or dry matter dilution/recirculation purposes
3. Water for AD dry matter dilution/recirculation purposes
4. Ammonia water
5. Ammonium salt solution
6. Concentrated Digestate nutrient liquor

10 Lot E: Dryer (for information only)

10.1 Lot purpose

Lot E includes technology for drying certain defined liquid materials.

Lot D will also convert LFD into Nutrient Liquor as well as ammonium salt solution. Lot E must include technology which must dry the Nutrient Liquor as well as ammonium salt solution.

At the time of publishing ITT 3, the Contracts for the Minimum Scope and Lot D have not been awarded. However the engineering for this Lot will depend on the final design which can only be defined once Contractors have been awarded with Contracts in the other Lots.

10.2 Specific design objectives

10.2.1 Materials to be dried in Lot E

Since Contracts for the Lots have not yet been awarded and the Plant is not yet operating, we cannot be certain about the quantity and initial dry matter content of the materials to be dried.

Therefore, in order to have an exact comparison between Suppliers, all Suppliers should design equipment based on the following Projected Estimates which the Client believes to be realistic.

Inputs from Lot D	Tons (wet weight) of input to Lot E	Peak daily Capacity	Temp-erature	Dry matter %		Quantity (m^3) of water to evaporate	
	Annual Capacity (§)	Tons/day (§)	° Celsius (§)	Initial (§)	Final (§)	Capacity p.a. (§)	Peak daily Capacity (§)
NH_4 salts	2.800	8	Min. 70	38%	90%	1.600	
Nutrient Liqour	5.400	17	Min. 70	15%	90%	4.500	
Phos. product from Lot D	Optional, max. 50		Ambient	30%	90%	34	
Total	8.200	25				6.100	20
For information only In the future the dryer capacity at the Skibotn site may be extended (e.g. with an additional dryer) to also be able to dry SFD produced in Lot A. This may happen if the torrefaction project is not realised (see section 8.2.3). If this is the case then the wet tonnage, initial and final dry matter are as described below.							
SFD	20.000 p.a. based on Client's Projected Estimate of 5.000 tons p.a. of dry solids			25%	85%		
SFD	2,33/hour (assuming 98% availability)			25%	85%		

Table 25: Projected Estimate of materials to be dried by Lot E

The forward flow of these materials from Lot D to this Lot is expected to be variable. Please refer to section 9.3.

10.2.1.1 Drying liquid materials

The Supplier may use a carrier material to assist the drying process, potentially as part of a ''dried product recirculation'' approach. However SFD from Lot A is not permitted for use as a carrier material for assisting the drying process for either the Ammonium sulphate solution and the Nutrient Liqour. The Supplier may use a carrier material to assist the drying process, potentially as part of a ''dried product recirculation'' approach.

Technical Question 13
Clean "carrier" materials are permitted for use in assisting the drying process for both the Ammonium sulphate solution and the Nutrient Liqour. The carrier material suggested by the Supplier must be is clean and must not be detrimental to the process of producing fertiliser. As an example, sawdust or straw particles could be acceptable "carriers." The Suppler must state whether such carriers are required. If this is case the Supplier must explain 1. which carrier material would be used and 2. the estimated quantity of carrier material required p.a.

10.2.2 Operation mode and heat transfer to Lot E

The Supplier must design, calculate and build equipment which is able to operate 24/7 i.e. it can operate even when the Operations Team is not present at the plant. The Supplier must assume that heat will be transferred between Lot H and Lot E with heated water (possibly under slight pressure) with a temperature of max. 103 degrees Celsius.

The Supplier is permitted to suggest alternative approaches for supplying heat to the dryer such as a thermal oil system. The final concept will be agreed during the negotiation potentially as a change request.

The Lot offered must also include the concept, design, engineering and construction not only for the production but also for the distribution of heat within the dryer.

10.2.3 Odour mitigation

The Supplier for E must include scrubbers for acid and/or alkali washing of exhaust gas from the dryer. The Supplier must read the sections concerning the Odour treatment and Management System (sections 6.12 and 14.3).

If the Supplier for E can guarantee that emissions from its technology after the scrubber/s are below the emissions limit for the Site, Lot E does not need to be connected to the Odour Management and Treatment System.

If the Supplier for E cannot guarantee that emissions from its technology after the scrubber/s are below the emissions limit for the Site, Lot E must be connected to the Odour Management and Treatment System.

10.3 Inputs required

1. Heat
2. Dryer exhaust gas treatment chemicals e.g., acid, alkali
3. Materials for drying

10.4 Outputs produced

1. Dried Nutrient Liqour and dried ammonium sulphate crystals

11 Lot F: fertiliser factory (for information only)

11.1 Lot purpose

The only form in which nutrients or concentrated nutrient solutions may leave the Plant for sale to Customers is in the form of dry stable solid materials in big bags, in 25kg bags on pallets or prepared for some form of bulk transport (one exception being ammonium hydroxide since it only exists as an aqueous solution).

To this end, some additional technology may be required, and the choice of technology will depend on the offtake contracts which have not yet been concluded at the time of publishing ITT 1.

11.2 Specific design objectives

The fertiliser Product must have a chemical composition that is as constant as possible especially as regards N, P and K content.

The fertiliser Product must have a minimum dry matter of 80% and on average 85%.

The fertiliser Product produced must comply with the quality specifications of the Norwegian regulations for biofertiliser (grade III according to the Norwegian regulations or better) especially as regards heavy metals.

The objective of the fertiliser factory is to ensure this in spite of the possibly variable amount and consistency of the input materials.

Regular testing is required in order to test the inputs into and the outputs out of the fertiliser factory.

11.3 Sub-Lots

These will be highly dependent on the equipment and approach offered and will also depend on the result of the dialogue with market actors as regards fertiliser Product marketing as described in section 24.2 and are not further detailed here. Some Sub-Lots can however already be defined.

11.4 Inputs required

Other internal/external By-products such as

1. Ammonia water from air scrubber or evaporator.
2. Elemental sulphur from external low oxygen desulphurisation plant from Lot B.
3. Dried ammonium salts from Lot E.
4. Dried Nutrient Liqour produced from Lot E.
6. Possibly binding agents.
7. Possibly other dry biomass to adjust consistency/composition etc.
5. Bags/wrapping material
6. Potentially at a later date, biochar or hydrochar from Lot C.

11.5 Outputs produced

(Bags of) different fertiliser Products

12 Lot G: general infrastructure, civils

12.1 Lot purpose

This Lot must include construction management and co-ordination services as well as construction works which are mainly structural.

Please refer to Appendix A.303. Appendix A.303 is not meant as a regulation of the internal organisation of the design and build Contractor (DBC), but is designed to show the division of responsibility between and planned interfaces between the Client, DBC and suppliers of lot D, E and F. It is also meant as a possible help for the DBC, with regards to planning and organising the works.

In short, Lot G must deliver all buildings, foundations, sumps, penetrations, floors piping and other infrastructure that will serve all process Lots (Lot A, B, D, E, F and H). Rig facilities and services for the various suppliers must be included here. This means that contracts outside ITT 1 (ITT 2-Lot D, ITT 3-Lot E, ITT 4-Lot F) must also be covered by the supplier or lot G. In cases where the scope of the other lots is not given, the DBC must estimate a scope.

In this stage, Suppliers outside ITT 1 must provide the necessary basis for design and construction and deliver this to the DBC in necessary time before construction. For Lots within ITT 1, it must be DBC's responsibility to have the correct basic data for planning and construction at all times.

12.2 General regulations

This section describes the overall regulations which apply to Lot G. The DBC must comply with the following regulations and specifications.

The buildings and all structural works constructions must comply with all Norwegian legislation and regulations. Below we have highlighted some laws and regulations the Client wishes to draw particular attention to, but it is the sole responsibility of the DBC to map and comply with all relevant laws and regulations.

12.2.1 Engineering

The Supplier must design and build all necessary Engineering of buildings and other infrastructure (roads, places, piping, HVAC (Heating, ventilation, and air conditioning), trenches, pipe beddings, etc.) must be conducted by the Contractor according to regulations from the authorities. Engineering for equipment loads i.e. from other Lots must be done according to information from the suppliers of those Lots, and according to legislation.

Particular focus must be given to the Norwegian Planning and Building Act. The Planning and Building Act is supplemented in particular by two important regulations:

- Regulations on technical requirements for construction works (TEK17)
- Regulations relating to building applications (SAK10)

TEK 17 refers to the use of certain standards (Norsk Standard, NS) that comply to the regulations and takes care of the demands from the authorities.

It is also agreed that the "SINTEF Byggforskserien" (SINTEF Building Research Design Guides) must apply and be used. The SINTEF Building Research Design Guides comply with the performance-based requirements in the Planning and Building Act, for instance Eurocode 1-8, and are an important reference to pre-accepted solutions in the technical regulations.

For an overall description on how to document the use of TEK 17, please refer to SINTEF Design guide 401.010 "Documentation on fulfilment of TEK 17, Functional requirements, performances, solutions and product documentation".

Most industry- and product specific design guides can also be used, as long as they comply with the valid technical regulations. It is the DBC's responsibility to fulfil this demand.

The Contractor must design and prepare all necessary drawings and models that are necessary for the completion and approval of the work.

For commission and testing of technical building installations, routines according to NS 6450 should be incorporated, as well as principles of systematic implementation strategy (Systematisk ferdigstillelse). Please refer to guidance BA2015 available at www.prosjektnorge.no.

12.2.2 Authorities, Responsible Applicant, independent control.

The DBC will provide the Responsible Applicant for the project. The Client will directly procure Independent Control for the engineering of the following subjects, as indicated by the above mentioned law referral:

- Fire engineering
- Geotechnical engineering
- Building physics engineering
- Structural engineering

The "Fire and explosion safety Act", (Brann- og eksplosjonsvernloven), with its regulations must be applied for all relevant issues regarding the buildings, constructions and installations. See also the guidelines on manufacturing and processing of dangerous substances from DSB (Directorate for Civil Protection and Emergency).

12.2.3 Design criteria

All the structures and buildings (without exception) must be designed according to the actual loads, and the loads determined by equipment and Eurocode suggestions, including acceptable displacements for equipment interfaces, as well as elastic deformations within an acceptable range.

12.2.4 Building tolerance

Allowances for the building is generally defined as Normal according to NS3420. If operation- or specific equipment demands are more severe, then the allowances must apply. Overall tolerances must be of a maximum of +/- 15 mm.

12.2.5 Design loads

Loads must be defined according to NS-EN 1990 and NS-EN 1991, all relevant parts.

Typical loads to consider (as information):

- Dead loads
- Live loads
- Snow loads
- Wind loads
- Disaster loads
- Liquid- and soil pressure.
- Seismic reactions
- Thermal reactions
- Structural fire resistance.
- Gas explosion.
- Other dynamic loads and quasi-static dynamic additions.

12.2.6 Design requirements

In general the DBC must design, build and present an adequate and functional solution for all buildings and constructions which supports the Plant as a whole. In addition to the already stated technical and functional demands, all details and surfaces must be designed for easy cleaning and maintenance.

In making the design the DBC should bear in mind the following considerations, whereas this list is not an exhaustive list:

- Functionality (for ease of the Operation Team Members' daily activities)
- Normal comfort (for instance floor heating in shower rooms)
- Acoustic design.
- Design of lighting.
- Access and security.
- Surveillance.
- Corrosion protection (from internal and external sources of corrosion)
- Fire protection and fire-proofing
- Environmental design
- Sustainability (in all matters)
- Safety at work (emergency showers, eye washing equipment etc.)
- External and internal lighting.
- External areas (design with the same considerations as mentioned above).
- Thermal bridges.
- Clean, dry building practice (According to RIF publication 6606-S)

12.2.7 Special process building requirements

Surfaces and equipment must withstand cleaning from steam, high pressure washer and/or Chloride substances. Building and process ventilation systems must be based on under-atmospheric pressure to prevent odour release problems. All extracted air must be treated in a way that prevents odour spreading to the surroundings.

In making the design the DBC should bear in mind the following considerations whereas this list is not an exhaustive list:

- Floors/flooring (considerations of easy cleaning and water run-off. Gate threshold reinforced edges)
- Walls (considerations of easy cleaning, water run-off).
- Ceilings (must also be sustainable, climate and water resistant)
- Materials (not organic or hydroscopic , corrosion resistant etc.)
- Vibration control.
- Details (all concrete edges must be mitred, all cranes should be supported in all directions to avoid vibrations and movements in the building).

12.2.8 Requirements of mechanical equipment

Ventilation in personnel zones must maintain above atmospheric pressure to avoid infiltration of odour from process zones.

Design criteria for the HVAC equipment should follow best practice, in addition to the regulated design criteria from the authorities. The internal and external loads must be stated. The mechanical equipment must be constructed in a way that optimizes energy consumption. The HVAC equipment must be zoned so as to achieve the following requirements:

- Maintain the specific requirements for ventilation, room temperature and noise level of the various rooms.
- To match the fire zoning as dictated by the fire safety requirements.
- Have full control regarding odour spreading to the environment.

12.2.9 Optimised layout

The Supplier must create a detailed optimised layout for the entire Plant, bearing in mind the specific needs, requirements, considerations and ideas of the other Contractors who are awarded with Contracts for other Lots. Based on that, the Supplier must Design that that part of the Plant which is in its scope in line with industry specific best practices concerning waste management facilities and specifically bearing in mind issue such as vehicle movements.

12.2.10 Client's Operation team

The Client's Projected Estimate for the size of the Operations team is up to 10 people.

12.2.11 Re-use of existing infrastructure

One portion of the existing Site has been allocated for this project. This area is the Plot. This allocated area already has a significant area which is covered in asphalt.

Above and beyond that, at least 4 objects are currently located on this Plot which we believe can be used in the new Plant namely:

Item	Object number in Client's General Arrangement Plan
Weighbridge	42
Road to composting plant and landfill	Not numbered
A workshop with storage for tools etc.	40
Hall for storage of reject	41

Table 26: Overview of existing objects at the site which are inside the Plot

12.2.11.1 Weighbridge (Object 42) and road to composting plant and landfill

There is an operating weighbridge at the Site.

Size: 18 x 3m

Manufacturer: Tamtron with overlying concrete weight.

Max weight: 60 tons

Weighing increment 20 kg

Minimum weight: 400kg

Weight indicator: Dini DFWKXTBC.

The weight can be extended to the same setup (9 and 15 m/split weighing) if desired.

The weight indicator is connected to a PC which runs the Tamtron W8 software. A Tamtron WT12 driver terminal has been set up at the Site.

Since the intention is to use the existing weighbridge described here, the consequence of this is that Supplier does not have to include any costs for a weighbridge in its Commercial Offer.

If the Supplier feels that it is necessary to move the weighbridge this is permitted. In this case the Supplier must include all costs for moving the weighbridge. However, the period of time where there is no weighbridge operating at the site must not exceed 5 Workdays.

If the Supplier feels that it is necessary to completely remove the weighbridge and build a new weighbridge, this is permitted. In this case the Supplier must build, complete and hand over to the Client a new weighbridge before decommissioning the existing weighbridge. The Supplier must include the full cost of procuring and installing the new weighbridge. The Client will bear the cost of waste disposal from the existing weighbridge (since this structure is below ground, as per NS8407 chapter 23).

In all other cases the existing weighbridge must remain in operation during the Contractor's construction activity at the Site at its current position.

12.2.11.2 Road to composting plant and landfill

There is an existing road which connects the existing entrance to the Site and the existing composting plant and landfill. This road must remain in operation during the Contractor's construction activity at the Site at its current positioning.

If the Supplier feels that it is necessary to completely remove the existing road to composting plant and landfill then the Supplier must build, complete and hand over to the Client a new road to composting plant and landfill before the existing road to composting plant and landfill is decommissioned and removed.

In this case the Supplier must include the full cost of procuring and installing the new road. The Client will bear the cost of waste disposal from the existing weighbridge (since this structure is below ground, as per NS8407 chapter 23).

12.2.11.3 Workshop (Object 40)

There is one workshop building which is divided into 2 separate sections. Approximate dimensions are

15 m long x 15 m wide x 10 m high

10 m long x 15 m wide x 10 m high

The Client believes that this building will be suitable for use as the workshop and storage area for consumables, reagents, tools and Spare Parts. This will however be a separate project. The work of surveying the workshop (Object 40 in the Client's General Arrangement Plan) and adapting it for its future use will be a separate project and is NOT included in this Contract.

The consequence of this is that Supplier should not include any costs for building a workshop or warehouse in its Commercial Offer.

Figure 7: Workshop at Skibotn Site

12.2.11.4 Hall (Object 41)

This hall is currently being used, but in the future will almost certainly be used for storing fertiliser products. Dimensions are 32 m x 20 m.

This will however be a separate project. The work of converting Hall 41 from its current use to a future use for storage of fertiliser products is NOT included in this Contract.

The consequence of this is that Supplier should not include any costs for building a storage facility for fertiliser products in its Commercial Offer.

12.2.11.5 Staging area/Rigging area

Outside of the area allotted for the plant construction (i.e. the Plot) to the Western side of the Site further space is available as a setting down/ lay down area and/or as an area to build offices/accommodation for personnel working at the site during the construction phase. This area can be provided by the Client free of charge. Details can be discussed during the dialogue during the negotiation phase. As an example there is an asphalt-covered strip (area approx. 1.800 m^2) immediately to the west of the 3 aerobic lagoons which can be used for this purpose.

12.2.11.6 Existing room/sanitary block and welfare area (Object 43)

Finally the Supplier should note the following: object 43 is currently the meeting room/sanitary block and welfare area for the Origo Skibotn composting plant team. It will be removed by the Client before construction starts. Therefore the Supplier may plan to use the area underneath and surrounding object 43 if this is required for movements of construction vehicles or for Works.

12.2.12 Planning for the future

The Supplier must make a Plant Layout for and also construct works for Lot D which will be procured in ITT 2. These works are described in section 12.5.7. Lot D/ITT2 will run parallel to and synchronised with ITT 1/Works delivered by the DBC.

The Supplier must make a Plant Layout for and also construct works for Lot E which will be procured in ITT 3. These works are described in section 12.5.8. Lot E/ITT3 will run parallel to and synchronised with ITT 1/Works delivered by the DBC.

The Supplier must make a Plant Layout which must include space for (but no other preparations for) for Lots that may be ordered in ITT 4 (Lot F) and ITT 5 (Lot C). Please refer to section 12.2.12.1 below.

The Supplier must make a Plant Layout as described in section 12.2.9 which must include space for (but no other preparations for) expansion of those parts of the Plant that are in the scope of supply of the DBC and which are specifically within Lot A, namely

- one additional Liquid Feedstock Reception Tank 300 m^3
- one additional Fermenter Tank 5.000 m^3
- one additional Digestate Buffer Storage Tank 5.000 m^3

12.2.12.1 Area for Lot C and Lot F ("SFD Project Plot")

The project will be extended to include Works for processing Solid Fraction Digestate.

The Works will be within and include

1. Lot C (Pyrolysis) and/or
2. Lot F (fertiliser factory) and/or
3. an additional dryer and/or
4. an additional biomass burner.

The Supplier must in its design leave one single rectangular plot of length 60m, width 40 m and area 2.400 m^2 space for these Works.

We call this plot the "SFD Project Plot".

These Works which will be the subject of later ITT competitions. This area should ideally be completely on the Plot where the biogas plant will be built (inside Battery Limits). However part of this rectangular area may lie outside the battery limits if this is absolutely required.

The intention is that SFD will be transferred from Lot A to the SFD Project Plot (and to the Works therein) via a conveyor belt. To reduce overall costs the conveyor belt should be as short as possible.

The Supplier should therefore design the layout so that the distance between the mechanical separator in Lot A and the edge of the SFD Project Plot is as short as possible: the Client recommends not more than 10 m, however a deviation is possible if there is a good reason.

Works to be designed and built by the Supplier

The following sections describe what Works the Supplier must construct within Lot G for the Client. These sections cover services and deliveries for which the Lot G Supplier has full responsibility. Some requirements specified by the Client are also mentioned here, and which come in addition to statutory and other functional requirements mentioned elsewhere or as a result of the Contractor's design.

This is divided up into

- Services such as management responsibilities, engineering etc. (section 12.3)
- Supporting infrastructure which is provided for the whole Plant and specifically for technology Lots both within the scope of the DBC (Lot A, B, H) and outside of that Scope (Lot D, E) (section 12.4)
- Civil works which are associated with technology Lots (section 12.5)
- Civil works which are not associated with technology Lots (section 12.6)
- Other peripheral or non-structural works (section 12.7)

12.3 Services

12.3.1 Services

The Supplier must perform

- General construction site management and safety.
- Site preparation and completion, including temporary workspace containers.
- All operation and rigging necessary for the site in all phases of the construction period, with necessary barracks for wardrobe facilities, lunch room, offices etc. for all Contractors working to build the Plant at Site. This includes the phase when Works for Lot D and Lot E are being executed. If the timeline of Lot D and-or Lot E is such that the aforementioned Site services, rigging etc. has to remain at the Site longer than would otherwise have been necessary as a result of the requirements of the DBC's scope of work, the Client and the DBC will agree on compensation.
- Winter works and snow removal,
- Maintaining a tidy work environment according to "Clean, dry building principles" (RTB Håndbok)
- Noise control according to regulations.
- Construction waste management according to regulations.

Preparation of site.

- The Supplier is responsible for carrying out necessary investigations and taking necessary measures, such as investigating whether there are structures, pipes, cables in the ground before start-up and costs for known modifications are included. Some info is provided by the Client in separate drawings.

Construction pit (earthworks)

- Geotechnical Note provided as Appendices A.100, A.101, A102 and A.103 by the Client forms the basis for geotechnical engineering. It is emphasized that the Contractor has full responsibility for mass balance on the entire plot, and must include the necessary masses of material added and material removed (mass balance) in its offer. Relevant mass landfill must be agreed with the Client (at existing facilities)

12.3.2 Engineering, project management, documentation

The Contractor is responsible for the detailed design as well as for supplying the documentation of all Works that the Contractor delivers. The detailed design will be based on specifications and requirements which are provided by the Contractors for all other Technology Lots namely Lots A, B, D, E, F and H.

12.4 Auxiliary systems

12.4.1 Fire protection

The Supplier must state the requirement for fire protection with a fire concept, which shall be produced by the Contractor's fire consultant, and according to relevant laws and regulations. Water for firefighting must be defined and quantified as a requirement and designed and built by the DBC.

The need for water storage for firefighting will be decided by the Supplier and its fire consultant. The specific fire loads are defined by the individual Suppliers of Lots A, B, D, E F and H.

It is of vital importance to the Client that sufficient fire protection is ensured for the biogas plant and contract works, as there is a significant risk for fires in such a facility. It is the Contractor's responsibility to ensure that the contract works in terms of fire protection is sufficiently and especially customized to this being a biogas plant. It is the Contractor's sole responsibility that sufficient fire safety measures are ensured. The Contractor must nevertheless focus especially on this topic, ensure sufficient fire protection and state in the Commercial Offer how this will be ensured, especially if TEK 17, pre-accepted solutions or other regulations do not ensure sufficient fire protection.

Technical Question 14
The Supplier must describe their approach to fire protection, designing and building the fire detection and fire prevention system for the Plant.

12.4.2 Outdoor Electrics

There are currently no specified requirements for outdoor electrical equipment and installations, for instance heating cables for snow melting, electrical car chargers, outdoor electrical outlets on building walls. This topic must be discussed during detailed engineering whereby the Client, the Client's Engineer and the Supplier must collaborate to determine and specify requirements. Such requirements could become the subject of change orders.

12.4.3 Fibre cable

As an intake cable to the building, fibre optic cable from the local fibre/network provider must be built by the Supplier. Works in connection with the establishment of a new route into the building must as much as possible, be coordinated with other disciplines. A trench must be dug between the building and the Connection Point shown in Appendix A.303, and cable conduits must be supplied. The cable is terminated to fibre network cabinet in the main distribution panel. All coordination regarding fibre supply is the responsibility of the Suppliers.

12.4.4 Water and wastewater

Lot G must include the central facilities for production, supply distribution of water TO - as well as for the collection and pumping to wastewater treatment FROM individual Lots within the Plant. We refer to section 14.1.

The Supplier must include in its Scope the design, engineering, supply and installation of any piping and equipment for distribution of any water (including Process Water and wastewater) to Lots also delivered by the DBC as well as to Termination Points defined by Lots D and E.

The supplier must also deliver and commission a waterworks that supplies clean water, including drinking water, for household to the extent necessary for the operation of the facility. The water source is stated by the Client to be a nearby river (Skibotn river). The water quality in the river varies with the season and with the flow of water. We do not currently have analyses of the water quality of the river water.

12.4.5 Outdoor water and wastewater

The Connection Points are shown in Appendix A.303. The DBC is responsible for engineering, excavation of trenches for and execution of all piping to the Connection Point.

Drains from toilet facilities etc. must run via drains out from the building. A brown water/grey water treatment facility with septic tank must be included by the DBC in the Scope of Works.

12.4.6 Infiltration Water produced by Lot D

Infiltration Water is produced in Lot D and a pipe must carry this Infiltration Water to the Connection Point for infiltration shown on Client's General Arrangement Plan in Appendix A.300. The DBC is responsible for engineering, excavation of trenches for and execution of this pipe.

12.4.7 Surface water

A complete local stormwater system must be provided by the DBC. Stormwater must be collected using pipes built for this purpose and directed to central point.

12.4.8 Electrics

Connection Points appear in the plans given as Appendices A.300 and A.301. Coordination vis-à-vis the grid supplier must be taken care of by the Contractor. It is the Contractor's responsibility to calculate the power requirement for the buildings, carry out coordination, agree on delivery points and laying cables from the substation to the building/facilities.

The Supplier must deliver the complete system for including

- Medium voltage distribution network to Termination Points defined by Suppliers for each Lot
- Low voltage distribution network to central Termination Points defined by Suppliers for each Lot
- Equipotential bonding for the entire site as per the Suppliers' specs for each Lot
- Back up electrical supply
- Uninterruptible power supply

As regards back-up electrical supply and uninterruptible power supply, the Supplier is responsible for defining which components require this back up/uninterruptible power supply. As regards the likelihood and potential duration (worst case) of a power outage, the Client, the Supplier and the Owner's engineer will collaborate in the engineering phase to define what assumptions will be made.

12.4.8.1 HVAC

The Supplier must deliver all installations for HVAC except for those Sub-Lots which are an integrated part of the Odour Management and Treatment System delivered within Lot A and described in section 6.12. The HVAC Sub-Lot must be designed and constructed in line with Norwegian regulations and with Suppliers' specifications.

12.5 Lot G: scope associated with technical works of other Lots

12.5.1 Halls in general

Any technology which cannot be or should not be installed outdoors must be installed inside a hall. Many factors will determine whether technology should be installed inside a hall such as

1. Adverse weather conditions at the Site (rain, high wind speed, snow, and darkness for many months).
2. Requirement to make service and maintenance work comfortable for the Operation Team and 3rd Party workers.
3. Requirement to prolong the operating life of the equipment.
4. Requirement to reduce emissions caused by odour and noise.
5. Legal and statutory requirements (including the environmental permit).

All halls must include:

- Quick-closing gate/-s to allow trucks to enter: these gates can be controlled with remote sensors by the truck drivers, and with red/green lights over the gates to indicate gate availability (minimum of 5 metres in height.)
- Cameras.
- Hazard detection systems (NH_3, H_2S, CH_4 etc)
- Fire alarm system
- Radio communication systems for all Operations Team members, allowing drivers and visiting technicians to communicate by radio. It is mandatory for all operators to carry handsets connected to the radio communication system. The radio communication systems must be included in the Supplier's scope of the Works.
- The open communication platform must ensure that all operators are informed simultaneously.
- Water supply points for general cleaning of floor.
- Space heating to keep the Reception Halls frost-free.
- General lighting
- 240V/400V electrical outlets
- Floors and foundations

12.5.2 Separation of one hall building into compartments

The Client recommends creating an integrated design whereby one single hall is built. The hall can then be divided up into compartments which can house different technology Lots. These compartments do not need to be separated by a full supporting wall from floor to ceiling. The Client recommends considering constructions methods which could save time and cost. One approach could be that the separation between compartments consists of a (for example) 3 metre high wall. A robust PE sheet could be stretched from the ceiling to the top of the wall to make the compartment. This could for example enable compartments with high odour emissions to be separated from compartments with lower odour emissions. Keep in mind that the deformations due to snow load and wind fluctuations may necessitate the use of a "telescope method" to take care of the varying distances. The way this is solved will vary with the chosen method.

12.5.3 Lot A hall (applies to Reception hall only)

Trucks which are delivering waste in the Reception Hall and which are tipping it into the Solid Feedstock Reception Unit must be able to drive the vehicle forward 2,5 m after tipping, with the trailer/container still raised so that the driver can move safely between the vehicle and the Solid Feedstock Reception Unit while cleaning the truck. In addition there must be a safety distance of 1 m between the front of the vehicle and the Reception Hall gate. The Supplier must design and build

- leachate management (drainage channels)
- water supply points in the Reception Hall are required for general cleaning of floor, cleaning of truck tires and cleaning waste spill from waste containers

12.5.3.1 Airlock Sub-Lot

Specifically in relation to the reception hall (section 12.5.3) the Client recommends using double doors (fast-closing doors) to better contain odours. The double door system would act as an airlock with one door at each end and would envelope the whole truck (back and front door) and would only open the back door to allow the truck though for tipping once the front door.

12.5.4 Control room

The Supplier must design and build an integrated airtight observation bay/control room at an elevated position inside the hall. The control room must be built with windows which allow the Operations Team to look into all of the compartments inside the hall with the objective of having a direct visual overview of the most critical equipment.

12.5.5 Civil works for Fermenter tanks/buffer tanks

Specialist biogas construction works for the Fermenter tanks, Mixing Buffer Tanks and Digestate Buffer Tanks is the responsibility of the DBC. This includes all tanks (for Fermenters, buffer storage structures) and includes roof, walls and bases). Cement suppliers in Norway are limited in number and they may be located very far from the Site. There may be an advantage in terms of cost and speed of construction if the tanks are prefabricated. The Client has no preference as regards the material or system which is used to construct the tanks.

12.5.6 Structural steelworks

The Supplier must design and build structural steelworks (steps, ladders, platforms, bridges) which are not delivered by or associated with process technology or not delivered by Suppliers of other Lots.

12.5.7 Works for Lot D

The DBC must supply Works for and in association with Lot D as follows, whereby all of the following information items are Projected Estimates.

12.5.7.1 Hall

The Supplier must construct a hall (or compartment of a Hall) to house the components delivered by the Lot D Supplier. The dimensions of the hall are expected to be 23 x 17 x 10m (§) (length x width x height). The insulation must be 100 mm thick as a minimum. When operating, the technology will have heat radiation of ca. 25 kW_{th}. At all times, especially when the technology is not operating, the temperature must be minimum 5 degrees Celsius and the technology must be prevented from freezing.

The heaviest component will have a footprint of 1 x 2,5m and a max load of about 75kN.

12.5.7.2 Room for Control System

The Control System Cabinet size footprints is expected to be

- 2 units of size 2 x 0,6m each (width x depth),
- 3 units 1 x 0,6m) each (width x depth)

12.5.7.3 Tanks

12.5.7.3.1 Nutrient Liquor intermediate storage

The Supplier must build a tank for the intermediate storage of Nutrient Liquor. Nutrient Liquor is expected to have a dry matter content of at least 15% and a Nominal viscosity 150 centipoise at 50°C. The Tank must be insulated and heated, to maintain a temperature of 50 degrees Celsius. The tank must have a volume of 100 m^3. Being a storage tank the fill level must be able to vary from full to empty.

12.5.7.3.2 Ammonium sulphate intermediate storage

The Supplier must build a tank for the intermediate storage of ammonium sulphate solution. The ammonium sulphate solution is expected to have a dry matter content of at least 30%. The Tank must be insulated and heated, to maintain a temperature of 50 degrees Celsius. The tank must have a volume of 100 m^3. Being a storage tank the fill level must be able to vary from full to empty.

12.5.7.3.3 Ammonia water intermediate storage

The Supplier must build a tank for the intermediate storage of ammonia water. The ammonia water is expected to have a dry matter content of at least 15%. The Tank must be insulated. The contents of the tank must not freeze. The tank must have a volume of 100 m^3. Being a storage tank the fill level must be able to vary from full to empty.

12.5.7.4 Termination points

12.5.7.4.1 Electrics

675 kWh_{el} per hour is required

12.5.7.4.2 Pipes

There will be up to 15 piping connections between the Lot D works and items which are outside of the building. These will be pipes for the

- Supply of LFD from Lot A
- Supply of odorous air to Odour Treatment and Management System in Lot A
- Supply of ammonia water to ammonia water storage tank in Lot G
- Supply of ammonium sulphate solution to ammonium sulphate storage tank in Lot G
- Supply of Nutrient Liquor to Nutrient Liquor storage tank in Lot G
- Supply of Fresh Water from Lot G
- Supply of heat (flow and return) from Lot H
- Supply of Infiltration Water to the infiltration system built by the Client

The PN of the pipes are expected to be mostly PN16, in one case PN10.

The Diameter of the pipes is expected to range between DN50 and DN125.

Piping for odorous air will be larger.

12.5.7.5 Odour load

The DBC must assume the following odour loading coming from Lot D and must and design and build the Odour Treatment and Management System accordingly.

	Mass	Volume
	kg/hr	m3/hr
CO_2	200	100
Air	250	200
Water vapour	20	10
NH_3	8	11
	70% of input	
	15% of input	
	1024 mbar a	
	55°C	
Total	500	350

Table 27: Odour load from Lot D

12.5.7.6 Noise

The DBC must assume the following noise emissions loading coming from Lot D and must and design and build the sound insulation accordingly.

1. One machine is expected to have noise emissions of 90-100 dB(a).
2. All other machines is expected to have noise emissions of 70-85 dB(a).

12.5.8 Works for Lot E

The DBC must supply Works for and in association with Lot E as follows, whereby all of the following information items are Projected Estimates.

12.5.8.1 Hall

The Supplier must construct a hall to house the components delivered by the Lot E Supplier. The dimensions of the hall are expected to be 26 x 11 x 6m (length x width x height).

The insulation will be 100 mm thick as a minimum. At all times, especially when the technology is not operating, the temperature must be minimum 5 degrees Celsius and the technology must be prevented from freezing.

The heaviest component is expected to have a weight of 30 tons, a footprint of 16m x 3m and an average load of about 6kN/m2.

12.5.8.2 Room for Control System

The Control System Cabinet size footprints is expected to be

- 2 units of size 2 x 0,6m each (width x depth)

12.5.8.3 Termination points

12.5.8.3.1 Electricity

The Supplier must allow for an electricity supply of 30 kWh_{el} per hour.

12.5.8.3.2 Pipes

There are expected to be up to 5 piping connections between the Lot E works and items which are outside of the building. These will be pipes for the

- Supply of odorous air (after scrubber) to Odour Treatment and Management System in Lot A
- Supply of ammonium sulphate solution from ammonium sulphate storage tank in Lot G
- Supply of Nutrient Liquor from Nutrient Liquor from storage tank in Lot G
- Supply of heat (flow and return) from Lot H

The piping is expected to be mostly PN16, in one case PN10.

The piping is expected to have a diameter ranging between DN50 and DN125.

The Piping for odorous air will be larger.

12.5.8.4 Odour load

The DBC must assume the following odour loading coming from Lot E and must and design and build the Odour Treatment and Management System accordingly.

	Mass	Volume
	kg/hr	m3/hr
Air		42.000
NH_3	10% of ammonia evaporated	

Table 28: Odour load from Lot E

12.5.8.5 Noise

The DBC must assume the following noise emissions loading coming from Lot D and must and design and build the sound insulation accordingly.

1. One machine is expected to have noise emissions of 85 dB at 1,5 m distance.

12.6 Lot G: scope not associated with technical works

12.6.1 Kitchen, common room, dining area

The Supplier must design and build a dining room for up to 10 people.

The dining area must include space for a table set up for 10 people and the kitchen area must have enough space for a stove, a fridge, dishwash-machine and a kitchenette.

12.6.2 Relaxation area

The Supplier must design and build a relaxation area Including 2 separate rooms each with beds with a shower and small kitchen.

12.6.3 Laundry

The Supplier must design and build a washing room, clothes dryer, storage space for towels etc. clothes, boots. A separate storage area is required for dirty zone and clean zone.

12.6.4 Offices

The Supplier must design and build

1. One open plan office space with desks and space for IT equipment for up to 8 people.
2. Two closed office spaces with desks and space for IT equipment for up to 2 people each.

12.6.5 Small meeting room

The Supplier must design and build a one small meeting room for meetings with up to 6 people.

12.6.6 Meeting and presentation room

The Supplier must design and build a meeting room designed for larger meetings as well as to make formal presentations/training sessions/events for visitors. This room must have sufficient space for 1 table to seat 10 people and (on moving the table/s to the side) to seat up to 25 people in a classroom format.

12.6.7 Sanitary and welfare facilities

The Supplier must design and build sanitary welfare facilities with separate sections for men and women. This must include changing rooms, toilets, showers and lockers. The design must include a split between the dirty zone and the clean zone and a shower between zones.

12.6.8 Sauna

The Supplier must design and build a Finnish sauna with space for up to 4 people.

12.6.9 Laboratory

The Supplier must design and build a room which will be used as a laboratory.

- 30 m^2 in total area.
- Must be connected to the HVAC system due to fumes produced by a small muffle furnace used for measuring dry matter and volatile solids.
- The instruments inside the laboratory will be separately purchased by the Client.

12.7 Lot G: peripheral and non-structural works

12.7.1 Roads, turning circles, car parks, paths

The Supplier must design and build all new asphalted areas, roads, pathways required for vehicles, mobile equipment, operational team and other personnel. These Works must include a suitably large turning circle for all vehicles delivering waste to the Site. Required turning circles for vehicles delivering waste to the Plant are defined in Appendix A.142.

The Supplier must build a car park with space for 10 cars and 1 coach. The turning circle for buses must therefore also be considered.

12.7.2 Landscaping

Areas within the project scope which are not developed with buildings or paved areas, but has been affected by construction work, for instance mass-landfill and gravel piles, must be smoothed out and restored to its original condition. Above and beyond that there are no requirements for the Supplier to do any landscaping work.

12.7.3 External/street lighting

The Supplier must design and build external street lighting, which must bear in mind the prolonged periods of darkness at the Site. Lighting must be provided as per Supplier's specs, within best practice for this kind of plant and at least according to regulations. For example please refer to SINTEF Building Design specification "554.231".

12.7.4 Collision protection

The Supplier must design and build Collision protection according to legal regulations. Walls and corners on buildings should be protected with buffers if they could be exposed to damage from impact from vehicles.

12.7.5 Gatehouse

The Supplier must design and build a new housing adjacent to the weighbridge area

The existing weighbridge should be used (please refer to section 12.2.11.1).

12.7.6 Fence

The Supplier must design and build a fence to enclose the Plant and separate the Plant from other activities at the site i.e. composting, landfill. The weighbridge and road to the landfill should be outside of the fence. The fence should also join up with the existing fence on the perimeter of the Site, meaning that a new fence is effectively only required on 2 sides of the Plot.

12.7.7 Second access (exit road)

The Client recommends that the Supplier must design and build a second access road to the Site from the main road. In combination with the existing access road to the Site this would mean that there would be a separate entrance road to and exit road from the Site. This is an open point and the Client relies on the Supplier as regards its experience and best practice from other similar projects.

12.7.8 All cameras, monitoring, surveillance

As specified by the other Lots.

The Supplier must design, procure and install sufficient cameras outside of buildings to monitor movements of vehicles that deliver waste to and collect Product from the plant, also at the weighbridge.

The Supplier must design, procure and install sufficient cameras to give an overview of technology installed separate halls, especially the Solid Feedstock Reception Units.

The Supplier must design equipment which allows the Client's operation team and visiting personnel to communicate via video (i.e. to give a video feed to) to 3rd parties at remote locations (for example also using Wifi-enabled GoPro cameras)

13 Lot H: heat production/distribution for entire Plant

13.1 Lot purpose

The Plant and its various Lots will have a very significant requirement for heat. Lot H will supply heat to these heat consumers.

Certain Lots within the Plant will also be producers of heat. Lot H must distribute this heat to consumers within the plant.

The Client has defined electricity as the energy source for Lot H.

13.2 Specific design objectives

13.2.1 Heat production and distribution

13.2.1.1 Permitted energy sources/fuel:

Electrical power is comparatively cheap at the Site. Electrically powered water boilers, immersion heaters, electrically powered external heat exchangers, or electrically powered air heaters for e.g. belt dryers will be the source of energy for heat production for the Plant.

13.2.1.2 Energy sources/fuel not considered here:

The following fuels are excluded from technologies considered in this Lot

1. Reject from the Contaminant Removal Sub-Lot in Lot A described in section 6.4.
2. Woody biomass (e.g., sawmill waste, forestry residues or wood chip) which is not further defined in ITT 1.
3. Wood chip/wood pellets
4. Biogas/biomethane (due to the high value)
5. Other solid fuels described in section 4.4.

13.2.1.3 Other heat producers in the Plant

There may be other heat sources at the Plant and they must be integrated into the overall concept except if it not economically feasible.

Once the concept and the General Arrangement Plan is established, it may turn out that the utilisation of some of the heat sources may prove not to be economically feasible, for example compressors in the upgrading unit. In such cases the above-mentioned obligation does not apply. These heat sources will include but may not be limited to the following:

Heat source	Heat available (§)
Lot B gas upgrading unit compressor/s, Lot B methane liquefaction.	Defined by DBC
Condensate for infiltration from Lot D (The temperature of the water for infiltration must be between 30 and 40 degrees Celsius as it leaves Lot D interface to the Client's infiltration system. If heat is recovered and it is not used within the Lot it will be available for Lot H.	Assume that from cooling condensate from 70 down to 50 degrees Celsius about 4.000 MW_{th} p.a. will be available
Water for recirculation produced in Lot D (refer to section 9.9.3)	80.000 m^3 (Line 1) and 15.000 m^3 (Line 2) of water p.a. at $65 < T < 70$ ° C

Table 29: Overview of other heat producers at the Plant

13.2.2 Technical Requirements

Heat must be provided continuously and be provided at a variety of different temperature levels and flows: the Supplier must offer equipment which makes this is possible.

The Commercial Offer must also include the concept, design, engineering and construction not only for the production but also for the distribution of heat to the consumers and also for the redistribution of heat from other heat producers.

13.2.3 Capacity Requirements

We expect that the Lots/Sub-Lots that will require a supply of heat are as follows:

Heat consumer	Heat consumer (Lot)	Peak consumption (§)	Annual consumption (§)
Tanks (Buffer Storage, Digestate Buffer, Fermenters)	A	Defined by DBC	
Pasteurisation	A		
Biogas upgrading, liquefaction	B		
LFD evaporation technology	D	500 kW_{th} (Σ)	0 MWh_{th}
Dryer	E	830 kW_{th}	6.000 MWh_{th}
Space heating (offices, sanitary block, workshop, laboratory)	G	Defined by DBC	
Space heating for halls such as Reception Hall, Digestate treatment, biogas upgrading, Solid Feedstock Reception Storage (defrosting function)	G, A, B, D		
Total peak heat production capacity Lot H			

(Σ) (for 1-2 h), and only at start up

Table 30: Projected Estimate of Heat to be supplied by Lot H (heat consumers)

At the time of publishing ITT 1 the equipment and Contracts for other Lots have not been awarded. However the engineering for this Lot will depend on the final design which can only be defined once Contracts have been awarded for the other Lots.

For the purposes of ITT 1 the Supplier should design the technology for Lot H according to the Projected Estimate for peak heat production of 2.730 kW_{th}.

13.3 Sub-Lots

These will be very technology/Supplier-specific: Lot must include all required Sub-Lots for example

1. Heat exchangers
2. Heat distribution, piping
3. Possibly hot water storage.

13.4 Inputs required

1. Electricity

13.5 Outputs produced

Heat

14 Auxiliary systems (valid for all Lots)

14.1 Water

The Supplier must include the design, engineering, supply and installation of any piping and equipment for distribution of any water (including Process Water) within the Supplier's own Lot in its offer. This must include, but is not limited to, water for dilution of incoming feedstock (if required), wash water and flushing water at any temperature and water for any other processes. It must be possible to rinse containers and tanks after unloading waste or manure, as well as the entire process building with high-pressure hot water rinse(s) suitable for washing vehicles.

The position of taps required for any kind of required water supply, emergency showers and drainage for wastewater must be included in Suppliers' designs.

Lot G must include the central facilities for production, supply, distribution (via piping network) of water TO - as well as for the collection and pumping to wastewater treatment FROM Termination Points for each individual Lot within the Plant.

14.2 Heat

The Supplier must include design, engineering, supply and installation of any piping or other materials and equipment for distribution of any heat within the Supplier's own Lot in its offer.

Lot H includes production and distribution of heat (for example using flow and return of hot water) throughout the Plant up to Termination Points for each Lot.

14.3 Odour Management and Treatment System

The responsibility for the design and implementation of the Odour Management and Treatment System lies within Lot A. Nonetheless it is important that all Suppliers understand that there is an obligation that emissions from the entire Plant measure must not result in odour emissions of 1 (or more) Odour Unit/m^3 measured at sensitive receptors (i.e. surrounding residential buildings in the neighbourhood) and this must be adhered to 99% of the time.

The Norwegian Environment Agency (Climate and Pollution Agency)'s "Guidance on the regulation of odour emissions in permits pursuant to the Pollution Control Act" (TA-3019) is used as a basis for understanding the provision.

Technologies producing odorous emissions must be designed as an enclosed process so that the emissions produced by the technology supplied do not reach the outside environment. The process must be equipped with process ventilation and odour treatment to reduce odour emissions.

The Supplier must design their technology so that emissions in the form of odour and dust are reduced as much as possible and so that the costs for the transport and treatment of odorous air are optimised. The position of Termination Points at which odorous air is extracted must be included in Suppliers' designs.

The Plant must be secured against diffuse emissions, especially at safety valves and other installations where there is a risk of leakage of process air.

Please also refer to section 6.12 which concerns this topic as it relates to Lot A.

14.4 Instrument air/compressed air production and distribution

The Supplier must include equipment for the production and distribution of instrument air (compressed air) of sufficient capacity and quality for all installations in their respective Lot.

The Client must have the possibility to connect other equipment acquired after the installation has been commissioned.

Any installations that are not housed in a heated building which are controlled by compressed air must be insulated to protect against condensation and frost.

The compressed air unit must have accumulated capacity to put the respective Lot in safe mode in case of power failure or interruption of the compressed air supply.

14.5 Control System, regulation, monitoring electrics

Each Supplier must include all Control Systems, electrical supply and equipment to regulate and control the technology they supply in their respective Lot; their scope of supply includes functional responsibility and must be delivered with complete equipment and software package for full operational monitoring, control and documentation. The Lot must be delivered fully programmed and configured. The degree of automation must be high enough to ensure that the Plant can be operated safely and reliably at all times, even when the Operations Team are not present.

All process electrics and process control must be installed in accordance with Norwegian laws and regulations and be of good industrial standard. All control cabinets must have 30% overcapacity. Overcapacity means free space, IO quantity (distributed on different inputs/outputs of all types). In addition, control cabinets must be dimensioned for extensions on the load side, both with overcapacity on the intake and group protection in the main and process sub-distribution. Physical space must also be planned and set aside for extensions of switchboards with associated cable routing.

The Client expects that there may be autonomous Control Systems within Lots B, D, E, F, and H. The DBC must integrate and exchange defined information, inputs and outputs between these Control Systems into the Overarching Control System in Lot A i.e. the Control Systems within Lots B, D, E, F and H must be connected to the Overarching Control System for Lot A as regards control, monitoring and logging, and it must be possible for great majority of operator interventions to be made from the Overarching Control System.

It must be possible to connect to the Control System from another location (remote connection) in a safe manner. It must also be possible to receive alarms from the Control System via SMS.

Video cameras are part of Lot G, but the signals from the cameras must be integrated into the Overarching Control System.

Completely mounted and connected PLCs (in the control panel) and signal transmission to the Overarching Control System must be included. Screens, parameter images, interlocking matrices, overlays etc. must be designed with a colour palette and symbols approved by the Client and must be included in the Control System and in the Overarching Control System. The screenshots must be developed in co-operation with the Client. Testing of signals (loop, function, HMI) must be carried out in accordance with the agreed Control System. All signals must be connected a "failsafe" manner.

For communication between different Lots, a watchdog or similar system must be set up to detect errors or deficiencies. This must be included in Lot A as well.

The Control System must be configurable with at least four different user groups, each with their own access rights. The Control System must also support the possibility of individual login. Access rights related to users and user groups must be defined in co-operation with the Client during the design phase.

The Plant must be equipped with local workstations where appropriate for the operation and maintenance of the Plant. In addition, it must be possible to connect to a mobile device (tablet or phone) via VPN or equivalent. All locations for loading and unloading must have their own panels with sufficiently good protective measures/quality that is adapted to the location, the equipment to be operated and the users. All equipment necessary for the construction and operation of a Plant that must fulfil its function and technical guarantees must be included.

All Lots must be controllable from the Overarching Control System. It must be possible to monitored and stop process equipment. This means that alarm signals, internal measurement values and relevant calculations are transferred to the Control System. Exceptions can be made if this is contrary to the operating philosophy of the Lot. In that case, this is something that must be decided in consultation with the Client.

The Control System must ensure that all valves must move to the safe position in case of a power failure. Where possible, the valve itself must move to the safe position independently of the Control System in the event of a power failure.

The design of the signalling system must be based on a risk assessment. This is carried out to identify and evaluate problems that may represent a risk to personnel or equipment, or prevent efficient operation. This will guide the choice of control, regulation, monitoring, process and safety technology - and will identify any requirement for redundancy.

In normal operation, everything must be controlled from the Control System.

The extent and type of instrumentation and equipment must be such that control, regulation and monitoring can be exercised from the Control System.

All manual operations in the Lot must be initiated by the operator from the Control System. If there are local panels connected to the Control System, it must be possible to perform such operations there, after logging in with the correct access level.

The Plant must be robust enough to cope with operational disturbances and it must be possible to bring the Plant to a secure state if required. This is not only the responsibility of the Supplier that delivers the Minimum Scope but also the responsibility of the Suppliers that deliver Other Lots.

Data security is very important and must be considered when choosing network solutions and topologies. For example, if several different communication buses are chosen, this often results in a large number of gateways. IP gateways are used as "translators" in cases where different machines communicate on different protocols/platforms. These often constitute "gateways" and are thus a favourite point of attack for hackers. Standardised platforms must therefore be chosen as much as possible to minimise the vulnerability of the Control System and network to external attacks.

Web clients and other access points must be protected by firewalls, and continuous maintenance and updates must be facilitated as the threat landscape is constantly changing.

The Control System must have a modern interface that allows data sharing between Lots without a high degree of customisation. The Control System must be kept up to date with the latest software updates, and the updates must be tested in an up-to-date test environment before implementation.

In its Commercial Offer the Supplier must include concise accurate descriptions for potential alternatives as regards hardware and software that form part of the Control System. In particular, this description must include the Supplier's standard choice and potential alternatives as regards

1. PLC
2. Bus protocol
3. Visualisation
4. Frequency converters
5. Relays and switches
6. Software to allow remote access by the Overarching Control System to Control Systems of other Lots

14.5.1 Additional specific functions

The Client requires that the Supplier include the following functions in the Control System, whereby this list is not an exhaustive list. The Control System must be able to

1. Integrate the existing weighbridge at the site.
2. Record data from the weighbridge to 3 different users, namely
    a. Rå Biopark
    b. Origo Skibotn composting plant
    c. Origo Skibotn landfill
3. Record the weight of input feedstock (measure weight of truck on arrival and departure) delivered to the plant.
4. Record the weight of Products produced by the plant (primarily digestate products) before they are sent to storage.

15 Project execution, scope and quality of Works (valid for all Lots)

15.1 Contract and commercial

The Contract that will apply for Lots procured under ITT 1 will be the NS8407. The Client will formulate and publish special conditions in addition to the general conditions of the NS8407.

The Design and Build Contractor (DBC) must deliver his Works as a turnkey supply, including all mechanical works, electrical works, Control System, steel works (e.g. structural supports, ladders, rails, access platforms for service), design, engineering, delivery as per Incoterms DDP Site, project management including supervision, installation, CE certification, documentation, and commissioning.

The remuneration will be a lump sum flat fee.

The Client intends to build a Plant that achieves a high Internal Rate of return (IRR) which will be calculated bearing in mind

- the total Plant CAPEX
- requirements for reinvestment (capital repairs)
- service and maintenance costs
- costs for consumables spares and any other Plant OPEX and
- also taking into consideration the parameters described in sections 5.1, 5.4 and 5.2. and
- Plant revenue

The Plant must derive value from the waste materials delivered by recycling as far as is economically possible or technically feasible.

The amount of waste produced by the Plant must be minimised.

15.2 Norwegian and EU regulations

In making their Commercial Offer, design and calculation, the Supplier bear in mind that it must deliver its Works (hereunder Project execution and technology design) according to Norwegian laws, regulations and standards and applicable EU directives and standards.

The Supplier must become familiar with all relevant Norwegian laws and regulations and is responsible for adherence to them.

In this section we have drawn attention to some of the relevant regulations. This list is NOT an exhaustive list of all regulations that apply. Reference is also made to chapter 12 regarding civil works in particular.

15.2.1 Odour emissions

The Norwegian Environment Agency (Climate and Pollution Agency)'s "Guidance on the regulation of odour emissions in permits pursuant to the Pollution Control Act" (TA-3019) is used as a basis for understanding the requirement.

In addition the Odour Treatment and Management Solution must fulfil the requirements for the purification of process air from anaerobic digestion of organic waste in the BAT Directive (Industrial Emissions Directive 2010/75/EU).

15.2.2 Noise

The Ministry of the Environment's guideline for the treatment of noise in land use planning, (T-1442) must be used as a basis for the implementation of the plan for noise abatement.

The Client has commissioned a noise dispersion and abatement study which is attached to this Specification as Appendices A.120 and A.121. The maximum limits for noise are as follows.

At the present time the noise emissions from the Plant have not been exactly quantified. An assessment has therefore been made of how much noise the facility can emit given continuous operation. The total permitted self-noise from the entire site is shown in the table below. Noise sensitive buildings are located west of the Site, and the shortest distance to the nearest cabin/holiday home is approx. 800 metres from the new Plant at the Site.

Noise source	Parameter	Operating time (hours)			Sound power level Lw, [dBA]
		Daytime (07:00 – 19:00)	Evening (19:00 - 23:00)	Night (23:00 – 07:00	
Rå Biopark biogas Plant in its entirety	Threshold value for authorised sound power level with and without activity at night	12	4	8 / 0	110 / 120

Table 31: Threshold value for authorised total sound power level

Neighbouring noise-sensitive buildings have noise lower than the limit values in the emission permit as long as the combined sources at Rå Biopark do not cause more noise than indicated in the table, i.e.

- max Lw =110 dB with any night work, and
- max Lw = 120 dB without night work.

It is important to emphasise that the sound power levels in the table represent a sum of all noise in a given area. It is important to limit the total noise activity so that the total noise from the entire area does not exceed the specified threshold value. In this way, the applicable limit values can be complied with. It is also possible to have noisy activities with higher sound power levels than indicated in the table as long as the time of use is limited so that the equivalent sound level is not too high.

Noisy equipment must generally be soundproofed by means of sound traps, embedding or strategic, shielded placement. For indoor operations, it will usually be possible to limit sound emissions to a greater extent than for outdoor operations, thereby minimising the impact of industrial processes on nearby sensitive noise receptors. Experience shows that the threshold values stated above can be complied with for this type of business, and on this basis we believe that the establishment of Rå Biopark is realisable in terms of noise.

15.2.3 Animal By-Products Regulation

The Plant must be established so that the design and process fulfil the requirements for treatment and reporting for category 2 and 3 material in the Regulation on animal by-products not intended for human consumption (Animal by-products Regulation).

The relevant laws that govern this topic can be found here.

https://lovdata.no/dokument/SF/forskrift/2016-09-14-1064

Please also refer to a document available under this link which is published by the responsible authority in Norway (Mattilsynet) ("Guidelines: Biogas plant: About the main rules that apply to biogas plants which convert animal by-products") which summarizes the relevant parts of the ABPR regulation as it applies to biogas plants and which we have also attached to this Specification as an Appendices A.412 and A.413.

For regulations concerning fertiliser please refer to section 6.8.

15.2.4 Workplace regulations

Regulations regarding the workplace, which are relevant for the design of the Plant which will be a workplace for the Client's operational team can be found here.

https://www.arbeidstilsynet.no/globalassets/regelverkspdfer/the-workplace-regulations

15.2.5 *Regulations on the handling of dangerous substances*

The Plant must be established in accordance with the requirements set out in the regulations for the handling of flammable, reactive and pressurised substances and the equipment and facilities used in the handling of dangerous substances (FOR 2009-06-08-602).

15.2.6 Safe construction

This is a requirement for safe construction all construction projects. According to TEK17/section 7-1, construction works must be designed, and executed in such a way as to achieve satisfactory prevention of damage or significant disadvantage from natural hazards. For all plans and measures below the marine boundary, the danger of landslides must be assessed against the requirements of TEK17 section 7-3. Furthermore, it is necessary to make a professional assessment related to the risk of presence of marine debris (quick clay - known as kvikkleire in Norwegian - and marine clay), including possible danger of landslides and sinkholes. Such a survey has recently been conducted, and the results report is attached to this document as Appendices A.100, A.101, A.102, A.103.

Another reference to examples of relevant requirements is also made to the Internal control regulations ("Internkontrollforskriften"), the Regulations concerning the Performance of Work (Forskrift om utførelse av arbeid) and the Construction Client Regulations ("Byggherreforskriften").

15.2.7 *Substances dangerous to health and the environment*

Products containing substances on the Environment Agency's priority list or more than 0,1% by weight of substances on the REACH candidate list must not be used.

If it is nevertheless considered necessary to use substances and products with contents from the above-mentioned lists in the construction phase, this may be done. In this case a deviation form is sent to the Client. The product cannot be ordered by the Contractor until the deviation form has been approved by the Client.

Upon request, the Supplier must be able to document that the materials/products used are free of substances harmful to health and the environment through using recognised certification procedures.

15.2.8 Regulations on the handling of dangerous substances

The Contractor must ensure that the contract is executed in accordance with the requirements set out in the regulations on the handling of flammable, reactive and pressurised substances and the equipment and facilities used in the handling (FOR-2009-06-08-602) and carry out the inspection, including third party inspection, necessary for registration of the Plant in accordance with the Directorate for Civil Protection and Emergency Planning (DSB). The Contractor is also responsible for producing the documentation necessary for the registration of the Plant towards the DSB and assisting the Client with the registration.

15.2.9 Best Available Technology

The Plant must be designed in accordance with the requirements of the IED 2010/75/EU (Integrated Pollution prevention and Control) and the Best Available Technology (BAT) Reference Document for Waste Treatment which is mentioned in section 9.9.2 of this document.

15.2.10 Further regulations

Furthermore the following EU directives apply (whereas this is not an exhaustive list)

- 2006/42/EU – Machinery Directive
- 2014/68/EU – Pressure Equipment Directive
- 2014/34/EU – ATEX Directive
- 1999/92/EU – (ATEX 137)
- 2014/35/EU – Low Voltage Directive.

15.3 Environmental protection and waste disposal

15.3.1 Control of Pollution

At all times the Contractor must take any and all necessary steps to ensure that the impact of his operations upon the environment in pursuance of the obligations under this Contract are adequately and sufficiently assessed, controlled, monitored, mitigated and remediated as required by all appropriate enforcement agencies, legislation and good industry practice.

During the Works the Contractor must comply with all relevant pollution control legislation relating to air, water (surface water and groundwater) and land. The Works must be carefully managed, rigorously controlled and implemented in accordance with the Site Environmental Management Plan.

The Contractor must notify the Client of all circumstances which must or might reasonably be regarded as a breach of his obligations under this section and must act at all times in good faith in respect of this section 15.3.

15.3.2 Minimisation of nuisance

The Contractor must take all necessary measures to minimise nuisance to nearby properties, e.g. noise, vibration, dust and odour throughout the completion of the Works.

The Contractor must wherever practicable design out the requirement for using hazardous materials during the fabrication, installation or maintenance of the plant. The Contractor must also specify recycled materials wherever there is no benefit in using virgin materials.

15.3.3 Waste Management & Disposal

During the site preparation and construction stages of the Works the Contractor must comply with all relevant waste management legislation.

The Contractor must comply with the Site Waste Management Plan. The Contractor must keep his working area clean and tidy and must clear waste on a daily basis to the appropriate skip on Site.

The Contractor must design the Plant and develop the operating procedure to comply with all relevant waste management legislation.

Where appropriate, any solid wastes rejected from the process must be stored with the process output residual fraction.

Liquid wastes must be directed to an appropriate discharge point.

During the design phase the Contractor must ensure that the materials chosen for construction can be safely disposed of at the end of the plant life. The Contractor must comply with the relevant legislation e.g. the WEEE directive for waste electrical and electronic equipment.

15.3.4 Permits & Consents

The Contractor must assist the Client by providing, all relevant technical advice and support required by environmental legislation prior to operation of the Plant.

15.4 Quality assurance and validation

15.4.1 General

The Contractor must have a Quality Assurance system in place 6 weeks after Contract award to cover all aspects of the Works. The Client recommends that the Quality Assurance system is third party accredited by an accredited organisation. An example of this would be ISO 9001.

The Contractor must prepare a Project Quality Plan in advance of starting work under the Contract. The Quality Plan must be sent to the Client for information within 5 weeks after contract signing, and must be duly updated throughout the contract period, if necessary. Any approval or accept of the Quality Plan must not transfer any risk or responsibilities to the Client.

The Project Quality Plan must detail the Quality Assurance and the Document Control to be followed throughout the term of the Contract and must adhere to the Change Management procedures described in the Contract.

The Project Quality Plan must define how the Works will be managed by the Contractor to ensure the safe and efficient delivery of the Plant.

The Project Quality Plan and subsequent revisions must also detail how testing and commissioning activities must be carried out including the safe operation of the Plant, adhering to the requirements set by the Client. The Project Quality Plan must contain all procedural information and the method of recording data and the production of test records.

The Contractor's sub-Contractors and suppliers must either have their own third party-accredited Quality Assurance systems in place or must work to the Contractor's Quality Assurance system.

The Client reserves the right to carry out inspections and audits of the system at the Contractor's premises, both on and off Site, and at those of his Sub-Contractors.

The Client's Audits must be treated as Internal Audits within the Contractor's Quality Assurance system. Any non-conformances identified by the Client must be dealt with under the Contractor's Quality Assurance system.

15.5 Training by Contractor

15.5.1 General

The Contractor must provide training to the Client's personnel in all relevant aspects of Plant operation, health and safety, quality assurance and control, maintenance procedures, instrumentation and Control Systems.

The Contractor must design and document the proposed training package to meet the requirements of this section 15.5 and must submit a Training Manual to the Client for approval at least one month prior to commencement of training.

This Training Manual must contain a schedule of dates on which the Client's personnel will be required.

15.5.2 Training

The content of the instruction and training package must be designed by the Contractor to ensure that the plant operational personnel become fully capable in all aspects of the operation of the works and all maintenance procedures associated with the Plant, Control Systems, instrumentation and all associated equipment.

The Contractor must provide theoretical and practical training for the Client's personnel to be completed in due time prior to the commencement of Taking Over tests as detailed in section 17.4. Training must be provided by appropriately qualified and experienced staff and made available at different levels as detailed in this section 15.5. Training must be carried out with the aid of specifically prepared materials that have been submitted as part of the Training Manual and have been agreed and approved by the Client.

The layout of this training must be a combination of formal theoretical instruction in a lecture room environment together with hands-on practical instruction on the Plant.

15.5.3 Plant Familiarisation

Aspects of installation, testing and commissioning activities must be attended by all operational personnel including supervisors, operators and Maintenance engineers.

Trainees must work alongside the Contractor's installation, testing and commissioning personnel to familiarise them with the Plant and individual Lots and Sub-Lots.

15.5.4 Facilities

The Contractor must provide any facilities, equipment, training aids, hand-outs and all other items required for training or, if the Contractor requires, make use of the offices and other on-Site facilities. All training equipment, aids, hand-outs and other materials must be provided at the Contractor's cost.

The Contractor, if so requested, must make available to the Client the use of the same training equipment that the Contractor must be using for their training, providing such use does not disrupt the Contractor's training schedule. The use of the Contractor's training equipment by the Client must be free of charge.

15.5.5 Assessment

On completion of each individual training course the Contractor must submit all the trainees to an appropriate assessment agreed and approved by the Client to ascertain their individual competence to undertake the work(s) for which they have been trained. This assessment must also have a significant practical component.

Trainee assessment must in part take the form of either a written or multiple-choice test, together with verbal discussion on all aspects of the Plant on which the trainee has been trained. Where a pass rate of at least 70% is not achieved, the trainee is to be retrained on the aspect in which they failed. The Contractor must inform the Client if any trainees require further training or that in his opinion (stating reasons), are not suitable for the aspect of work in which they are being trained. The Client's Operations Team Member must after the training all be in a sufficiently trained to be able to operate the Plant as a team.

The Contractor must provide each person with a Certificate of Competence identifying name of the trainee, the training course, the date of training and the name of the person and organisation who has provided the training.

15.5.6 Personnel

The titles and numbers of personnel that will be required practical and/or theoretical training are detailed in Table 32, together with the required level of content.

Title	Number	Level 1	Level 2	Level 3
Plant Supervisor / Laboratory Technician	4	✓	✓	
Operator	4	✓		
Maintenance engineer	7	✓	✓	✓

Table 32: Personnel to be Trained

In order for the Contractor to match the training package to the expertise/experience of the individuals concerned, a brief description of the outline responsibilities and typical experience of each category is as follows:

1. A Plant Supervisor will be responsible for the operation and safety of the Plant on a day-to-day basis and will report to the Site Manager. The Plant Supervisor will have had previous experience of operating process plants.
2. The Laboratory Technician will be responsible for sampling and basic analysis on Site and will report to the Plant Supervisor.
3. The categories of Operator will be as follows, each reporting to the Plant Supervisor:
   (a) Wheel loader or Hooklift Driver
   (b) General Labourer / Cleaner

Each Operator must be trained in all operational disciplines so that roles can be interchanged if/when individuals are absent.

Operators will have had previous experience in operating mechanical and mobile plants.

Maintenance engineers will be responsible for all preventative and corrective maintenance activities associated with the Plant and will report to the Plant Supervisor.

Maintenance engineers will have an engineering qualification and previous experience with maintenance systems, Control Systems and instrumentation.

Each Maintenance engineer must be trained such that any Maintenance Engineer can take on the Supervisor role if/ when the Plant Supervisor is absent.

15.5.7 Training Content

Level 1 training must include the basic objectives and principles of waste treatment, with specific reference to the Plant design, input and output materials and operational procedures. This training must be attended by all personnel including managers, supervisors, operators and Maintenance engineers.

The training content for Level 1 must as a minimum cover the following categories:

1. Introduction – A general overview of the Plant and layout including input/output materials and Plant capacity/capability.
2. Process – A brief description of each system and the process flow though the Plant.
3. Operating Philosophy – Details of operating systems and procedures including automated and manual processes and individual roles/responsibilities.
4. Health & Safety – A summary of relevant features of the Plant and operating requirements including start-up, shutdown and emergency procedures.

Level 2 training must include the detailed operation of the Plant with instruction covering the control philosophy, troubleshooting procedures, monitoring requirements and the means of optimising Plant performance. This training must be attended by all personnel including supervisors and Maintenance engineers.

The training content for Level 2 must as a minimum cover the following categories:

1. Systems – Appropriate operational training on all relevant systems including applied practical hands-on operational experience.
2. Maintenance Philosophy – A summary of the maintenance requirements for each system including daily activities and operational checks.
3. Control Philosophy – Details of the Control System architecture/terminology, user interfaces, automatic sequences and emergency shutdown criteria.
4. Instrumentation – A breakdown of measured parameters, data acquisition methods, details of monitoring points and calibration requirements.
5. Operational Issues – A detailed description of alarm conditions, isolation procedures, interlocks, incident logging/evaluation and standby equipment.
6. Risks Management – A review of the operational hazards and risks together with the mitigation steps and controls to manage them.
7. Technical Manual – An overview of the documentation package showing contents, layout and how to find/use information.
8. Health & Safety – Instruction relating to permits to work, manual handling, hazardous substances, spillage/clean-up and emissions control.

Level 3 training must include the operation and maintenance of all systems, fault finding, monitoring procedures and a means of optimising Plant performance. Training must also cover procedures and use of equipment necessary to carry out the Performance Testing. Level 3 training must be attended by all maintenance personnel.

The training content for Level 3 must as a minimum cover the following categories:

1. Systems – Detailed theoretical training on all equipment including system dependencies and applied practical maintenance experience.
2. Maintenance Philosophy – A description of preventative activities, corrective maintenance procedures and resources, spares, materials and tools required.
3. Fault Finding – Guidance relating to efficient and effective processes to troubleshoot and diagnose faults and a summary of availability and reliability.
4. Risk Management – A review of safe systems of access, maintenance and control including details of isolation and interlock procedures.
5. Technical Manual – A detailed breakdown of the document package including the location of flow diagrams, wiring schematics, and drawings.

15.6 Redundancy concept

Technical Question 15

In order to achieve the high levels of availability which are expected from the Plant it may be necessary to have contingency plans as a reaction to technical outages and downtime. The Supplier must design a concept which ensures high availability through contingency measures and potentially by using redundancy. Concepts should be summarised simply and may include but are not limited to "hot standby", "critical spare part on site", "workaround by implementing a defined measure", or "spare part sent by express delivery." The Supplier must explain this concept in their Commercial Offer, explaining

1. functions and/or items of equipment are affected
2. what the effect of an outage would be without a contingency plan or redundancy concept
3. maximum outage permissible
4. contingency plan or redundancy concept

15.7 Documentation (general requirements)

This section refers to the Plant documentation which the Contractor/DBC must submit in association with the Works under the Contract. It does not describe which documents must be submitted by the Suppliers as part of their Commercial Offer.

As part of the Contractor's scope of supply all Contractors (after the documentation package is approved) must deliver documentation of the Works delivered. Documentation must be submitted in two paper copies and in digital form in due time before Taking Over. The digital form must include a browser function in order to be able to search in and easily navigate between individual documents.

All drawings must be prepared using AutoCAD or other drawing package approved by the Client. All drawings must be provided in the (*.dwg) file type.

All drawings must be in the form of black lines on a white background and must bear the following information within the title block as a minimum:

1. Contractor's Name & Address
2. Project Name & Number
3. Contractor Drawing Number
4. Drawing Number
5. Drawing Title
6. Issue Number & Date
7. Revision Status
8. Sheet Number & Size
9. Scale

The document status must be one of the following as appropriate:

1. A – Final
2. B – Review
3. C – Preliminary
4. H – Historic Data
5. O – Obsolete
6. R – Record
7. S – Superseded

The Maximum drawing size will be A0 and minimum drawing size will be A3.

All drawings must be to scale and must include a graphical scale to aid the use of photographic reproductions.

All drawings must be fully labelled and dimensioned.

All dimensions must be in millimetres.

All levels must be in metres above ordnance datum.

All information on drawings must be provided in English with Metric Units.

The minimum text size used when plotting drawings must be as follows:

1. 3,5 mm for A0 and A1 drawings
2. 2,5 mm for A2 and A3 drawings

A drawing register must be provided to the Client in support of any drawing issue.

All calculations submitted by the Contractor to the Client for his approval must be neatly prepared on standard A4 calculation sheets.

All information, schedules and specifications submitted by the Contractor to Client for his approval must be provided on A4 sheets.

During the course of the Works, the Contractor must maintain a fully detailed record of all changes to the Contract Drawings. Drawings must be corrected at each stage of issue to correctly and accurately represent the Plant at that stage of design/construction. This must facilitate the easy and accurate preparation of "As Built" drawings that must in all respects be a true record of the Plant, to be contained within the Process Design Manual.

All technical drawings must be in both .dwg and .pdf format. Final drawings must be labelled "as built" and must be in accordance with the physical design of the Plant at Taking Over.

All tables, lists, instructions, drawings, etc. must be in editable format, not read-only.

All documentation necessary for operation and maintenance must be in Norwegian (Bokmål) and in English. Data sheets and other documentation that is rarely used may be provided in English if this is in accordance with legal requirements and approved by the Client. The equipment's component number, model and type designation must be shown in all associated documentation.

The agreed labelling methodology must be used for all documentation.

Final versions of all drawings and other documentation must be submitted as agreed in the document register.

The basis for calculation and dimensioning must be included in the documentation. The topics and areas to which this obligation will apply as well as the Suppliers' compliance with this obligation will be discussed during the negotiation procedure and do not have to be further detailed in the Suppliers' initial Commercial Offer.

The Works must include description and costs of critical Spare Parts, as well as expected ongoing type and cost of Spare Parts and requirement within the Client's Operations Team for Labour for Service and Maintenance as explained in sections 21.4.4, 21.4.3 and 21.3.9 respectively.

The Contractor of a particular Lot is responsible as a turnkey Contractor for all management operation and maintenance documentation from its Sub-Suppliers, as well as coordinating and collating the management operation and maintenance documentation from them.

Changes and discrepancies between working basis and execution/Site conditions and adaptations must be updated continuously during execution so that the installed/as-built documentation contains all relevant conditions.

The Documentation must include all certificates (personal certificates and certificates from the Contractor/Sub-Contractor) and procedures used during the construction of the installation, as well as all documentation used to obtain the necessary authorisations and declarations of conformity.

15.7.1 Maintenance plan

The maintenance instructions of the components must be summarised in a maintenance plan. The maintenance plan must include all requirements that the Client has to adhere to and work which the Client has to do in order for the Guarantees to apply.

15.7.2 Operating instructions

The operating instructions must describe the start-up, shut-down and normal operation of the Plant. A troubleshooting plan must be in place to facilitate quick action in case of problems. Preliminary operating instructions must be provided prior to mechanical completion.

15.7.3 CE certification

The Contractor must deliver CE certificates and declaration of conformity. The Contractor must issue a CE marking in accordance with the applicable directives and the CE markings must be valid when the Client takes over the installation. In case of any changes to the delivery, it must be ensured that the CE marking remains valid or is updated. The Contractor must issue a copy of the documented risk assessment required for each component and machine that is CE marked. Documented risk assessments, together with the documentation required by the applicable Directive, must be submitted to the Client before commissioning.

15.7.4 Other documentation

The Contractor must deliver documentation required for the permitting/authorisation of the installation, such as dimensional calculations for any safety valves, functional descriptions of safety systems, etc.

15.7.5 Reference Designation System (Labelling system)

The Client wishes to have one unified Reference Designation System (RDS) (also called Labelling System or plant identification system) for the entire Plant and certainly as a minimum for all Works delivered by the DBC. The methodology employed by the Supplier should conform to the relevant part of the ISO 81346 norm which is the series of norms which regulates the rules and structuring principles for reference designation systems (RDS) for industrial systems, installations and equipment and construction works.

In its Commercial Offer the Supplier must state which RDS they intend to use and which other methodologies they could use as an alternative.

15.8 Documentation content

15.8.1 Documentation required after Contract signature

The Contractor must submit the following Project Documentation for Approval/ Information shown Table 33 in within twenty (20) Calendar Days after Contract Signature.

Document	Description
Project Management Plan	Document illustrating the proposed Work Breakdown Structure, Organisational Structure, Resource Profile, Roles & Responsibilities, etc.
Progress Schedule	Document detailing the Programme of Work. This should be a further elaboration of the Progress Schedule document submitted during the Tendering process (reference is made to the general specifications Ns 8407 clause 21.2).
Quality Plan	Document describing systems for Quality Assurance, Testing & Certification, Document Control, Change Management, etc.
Disaster Recovery Plan	Indicating how the Contract will be completed satisfactorily in the event of an incident that causes major disruption to the operation of the Contractor's business

Table 33: Documentation for Approval/ Information 20 Days after Contract Signature.

15.8.2 Detailed Design Documentation for Approval / Information

The Contractor must submit the following Detailed Design Documentation for Approval / Information shown in Table 34 before the milestone M4 detailed in the Progress Schedule explained in section **Feil! Fant ikke referansekilden.**. An update to this Detailed Design Documentation shown in Table 34 must be provided by the Contractor to the Client before Taking Over in the form of a Process Design Manual to reflect the as-built status of the Plant.

Deadline	Document	Description
M4	Design Philosophy	A description of the approach taken towards the design of the Plant including any background data, assumptions, constraining parameters, operating principles, etc.
M4	Process Description	A description of the process detailing all systems including any and all manual and automated operations.
M4	Mass Balance	An overall mass balance for the Plant illustrating the inputs and outputs for each system.
M4	Design Philosophy	A description of the approach taken towards the design of the Plant including any background data, assumptions, constraining parameters, operating principles, etc.
M4	Energy Balance	An overall energy balance for the Plant illustrating the inputs and outputs for each system.
M4	Design Calculations	A series of calculations used to design the Plant including those for material recovery and purity rates, process flow, structural stress analysis, etc.
M4	Process Flow Diagram	A series of block diagrams illustrating the process flow between major equipment items for each system including any external interfaces.
M4	Piping & Instrumentation Diagram	A series of block diagrams illustrating the piping and instrumentation connections for each system including any external interfaces.
M4	General Arrangement	Equipment layouts including plans, elevations and sections that show access routes, elevated walkways/platforms, allocated storage spaces and pipe/cable/ductwork routing.
M4	Building & Structural Interfaces	Drawings detailing any and all connections to/through the floor slab or building structure including holding-down arrangements, floor loading, internal and external wall penetrations, finishes, cable trays, ductwork, louvers, etc.
M4	Utility & Service Interfaces	Drawings detailing any and all connections to/from utilities and/or services including power isolators.
M4	Equipment List	List of every piece of equipment to be supplied by the Contractor, not including spares.
M4	Equipment Data Sheets	A series of data sheets for every piece of equipment to be manufactured/fabricated/procured by the Contractor.
M4	Control Philosophy	A narrative of the control philosophy of the Plant
M4	Electrical Diagram	A series of electrical wiring diagrams showing all equipment motors, drives, etc. including connections to distribution panels and local control panels.

M4	Spares List	List of all parts supplied by the Contractor that are likely to require replacement over the life of the Plant including a description, proposed supplier and budget price.
M4	Procurement Specifications	A series of specifications for the supply of equipment/ systems by Sub-Contractors
M4	Material Data Sheets	A series of data sheets for any and all chemical and/or hazardous/toxic materials used anywhere on the Plant.
M4	Functional Design	The conversion of the Control Philosophy into code
M4	Human Interface with Control System	The detail of the HMI and SCADA screens, mimic designs and alarm presentation.
M4	Noise Schedule	Plan view of Plant illustrating the expected discrete noise emissions from all equipment.
M4	ATEX Report	ATEX report including risk assessment and ATEX zoning study.
M4	Outline Installation Method Statement	Document outlining how the installation of the Plant will be carried out and the Contractor's procedures for safe working on Site, including a high-level Risk Assessment for all installation activities.

Table 34: Detailed Design Documentation for Approval / Information

The Outline Installation Method Statements for the Plant must cover the proposed philosophy for construction and installation. These method statements must include installation route drawings, dimensions and weights of all major components and control panels, and identification of lifting requirements. Any requirements for extraordinary structures or lay down areas must be defined at this stage. The Outline Installation Method Statements will be incorporated into a package integration strategy by the Client and will form the basis of a Constructability Review to be held during the detailed design phase. The Contractor must attend this Constructability Review at the Client's office to discuss the Outline Installation Method Statements and review the proposed methods for installation and integration.

15.8.3 Lot G (Civil works)

The Contractor must submit the following Civil Design Documentation for Approval / Information shown in Table 35 before the defined milestones further detailed in the Progress Schedule detailed in section **Feil! Fant ikke referansekilden.**.

Milestone	Document name	Document content
M4	Main loading drawing	Drawing showing main floor loading
M4	Building & Structural Interfaces	Drawings detailing floor loadings (static and dynamic), main internal and external wall
M4	Utility & Service Requirements	Confirmation of Electrical Load data and other utility and service requirements
M4	Construction details	Confirmation of local plinths, minor openings and finishes, seals and grouts.

Table 35: Civil Design Documentation for Approval / Information

15.8.4 Final Documentation & Manuals for Approval / Information

The Contractor must submit the following Final Documentation & Manuals for Approval / Information shown in Table 36.

Document	Description
Process Design Manual	This document pack must include as-built updates for all Detailed Design Documentation shown in Table 3.
Technical Manual	Document giving step-by-step instructions how to operate the Plant safely, including: procedures for start-up, shutdown and fault-finding; and routine maintenance schedules for all systems with a detailed description of the maintenance task. See below for further details.

Table 36: Final documentation and manuals

The Technical Manual must contain the following categories of information in accordance with the applicable norm for creating Technical Manuals:

1. Purpose & Planning Information – General summary of information about the product including: purpose, health and safety, capability and performance, required services, operating environment, environment interaction and requirements for use.
2. Certificates – The Contractor must include the originals of all test certificates within the Technical Manual. Electrical Test Certificates must be provided as required by the IEC standards. Manufacturers' Test Certificates must be provided for all equipment subject to Pre-Installation Tests. Calibration Certificates must be provided for all instruments supplied and installed. The Contractor must submit to the Client any statutory certificate as may be required by any applicable standard.
3. Operating Information – Complete instructions for the safe operation of the Plant under normal, emergency and special conditions including: general operating information as an introduction to operating procedures; operating instructions providing full details of the procedures to be followed in preparing, starting and running-up the Plant under normal operating conditions in each mode; and the treatment of malfunctions with guidance on procedures to be followed in detecting, correcting and reporting any malfunction or failure.
4. Technical Description – Information to assist users in the application of instructions in other parts of the manual including: an overall assessment of the capability and complexity of the Plant; the function of all standalone and interdependent systems and their interfaces; detail required to decide staffing levels, to plan operating and maintenance schedules and to train and supervise the staff who operate, service and maintain the Plant; detail necessary to keep equipment and systems in good working order; and detail necessary for safe operation of the Plant and preliminary fault analysis.
5. Handling, Installation, Storage & Transit Information – Information required for the initial setting-up of the Plant and for its safe removal and reinstallation, if necessary. This must include information about: special skills, services and methods of connection, environment, hazards and safety precautions. In order to avoid risk of injury to people or damage to equipment, this information should be provided even if the Contractor is carrying out the initial installation.

6. Maintenance Instructions – Information to ensure that the Plant is correctly maintained and that maintenance tasks are carried out at the recommended intervals in order to keep the Plant operating to its specified performance for its specified life. This information must be sufficient to enable the Client to draw-up a suitable maintenance policy surrounding the scale and combination of preventative and corrective maintenance; and assess the resources required for a particular task.
7. Maintenance Schedules – Information necessary to plan the complete cycle of maintenance operation throughout the working life of the Plant. This must include all maintenance tasks performed at specific intervals of time, running hours or completed operation. All predictable tasks performed at specific intervals must be consolidated into the form of maintenance schedules that include estimates of staff-time and resources required in line with the requirements of the Maintenance Instructions and the Spare Parts List.
8. Spare Parts List – A list of all equipment including information necessary to identify and locate all parts, options and accessories, whether renewable or not, with details of sources of and mode of supply, that may be required during operations or maintenance of the Plant. Additional information must include: Spare Parts availability, recommended Critical Spare Parts together with an alternative source of supply.
9. Disposal Instructions – Information that will enable the user to dispose of any Spare Part or any other component that may need to be disposed of, of the Plant without risk of injury to people or damage to the environment. This must detail any action to be taken on completion of the useful life of any part or component of the Plant including advice about such matters as disposal and demolition, with warnings of any hazards.

The Technical Manual must be presented in accordance with the applicable norm for creating Technical Manuals. Two copies must be provided, produced in A4 with folded A3 drawings and must be loose-leaf bound with a hard cover. The Contractor must submit the Technical Manual in both hard copy and electronic format.

15.8.5 Training Manual for approval

The Contractor must submit a Training Manual for Approval prior to any training activity, and in both hard copy and electronic format. A training programme shall be included, together with course notes, handouts and any other supporting material. Five (5) copies shall be provided, produced in A4 with folded A3 drawings and shall be loose-leaf bound with a hard cover. The Contractor shall also supply training records for each Operator that the Client considers to be competent to operate the Plant. The Contractor must submit the Training Manual in both hard copy and electronic format.

15.9 Project execution requirements

15.9.1 General

The Works in this Contract consist of the design, provision, installation, testing, and setting to work of mechanical, electrical and instrumentation control and automation plant. Except to the extent that the Client must be responsible for the matters stated in section 16 (Responsibilities of Client) and in in Appendix A.303, the Contractor must be responsible for all matters necessary to achieve the requirements of the Contract, including the design, supply and erection of the Plant including its associated mechanical and electrical engineering, testing, first fill of lubricants, chemicals, commissioning and training.

The Contractor must do and provide whatever is necessary to fulfil his obligations under the Contract, and must assume responsibility for the process design and Performance Guarantees. The Contractor must carry out all the work and provide all the services, materials and other tasks as described in the Contract, including the requirements and items listed in this section 15.9.

Based on the information provided by the Client, the Contractor must ascertain all local conditions relevant to the Works and must be completely responsible for the design, supply and installation of the Plant including any associated structural work within the Battery Limits stated in the Specification.

The Contractor must carry out and provide whatever is necessary to fulfil his obligations under the Contract and must assume responsibility for the Detailed Design and performance guarantees. The Contractor must develop this proposal in accordance with the Specification requirements and to a level that provides all necessary design details for the supply and installation of the complete Plant for acceptance by the Client.

It is the Contractor's responsibility to determine the quantity and type of all components to be installed, ensuring that all systems provided are appropriate for purpose and that all equipment provided is suitable for the environment in which it will operate. Further details of the Documentation required including designs, equipment lists and interface information can be found in section 15.7 and section 15.8.

The Contractor must participate in Failure Mode Effect and Criticality Analysis (FMECA), Hazard Analysis (HAZAN) assessments and Hazard Operability (HAZOP) studies.

The finished Detailed Design produced by the Contractor must fully comply with the Specification (this document).

A list of required documentation is provided in section 15.7 and section 15.8, which includes all detailed designs, engineering assessments, calculations, drawings and documentation as necessary to complete the Works.

15.9.2 Supply of equipment

The Contractor must procure and manufacture the Plant in accordance with the detailed design. Each element of the Works must be manufactured in line with the standards, codes and regulations set out in the Specification. The Contractor must produce and acquire all appropriate documentation and records to demonstrate any and all certification.

The Contractor must be responsible for:

1. the enquiring, purchasing and supply of all materials and chemicals associated with the Plant;
2. all inspections both statutory and non-statutory;
3. any pre-installation tests and functional tests;
4. any Taking Over Tests and Performance Tests
5. all shipping and transportation to Site; and
6. any test certification.

15.9.3 Provision of Tools & Materials

The Contractor must supply all materials and equipment required for installation.

Any special tools (not including standard workshop tools) necessary for the safe operation and/or maintenance of the Plant must be provided by the Contractor.

The cost of these special tools must be included in the Contract Price.

15.9.4 Provision of Nameplates & Signage

The Contractor must supply all name boards, nameplates, notices, safety signs and equipment labels as necessary to complete the Works and to comply with all statutory requirements.

15.9.5 Installation

Prior to the commencement of any Works on Site, the Contractor must provide:

1. all equipment, tools and personal protective equipment (PPE);
2. details of any necessary off-site assembly of equipment and accessories;
3. delivery schedule of all material and equipment to Site;
4. additional Works lighting, heating and ventilation (if required);
5. additional storage (if required); and
6. details of co-ordination with other services and trades.

During Plant installation the Contractor must be responsible for:

1. the reception, off-loading, transportation and storage of equipment and materials on Site; and
2. connecting to Equipment interface points.

The DBC must ensure that all NS8407 regulations as regards Health and Safety requirements, provision of safety equipment, provision of lifting equipment, and vehicle movement and access.

15.9.6 Permit to Work system

Some activities will require a Permit to Work system, which will be at the discretion of the Design and Build Contractor. Installation Method Statements must form the basis of the description of the work to be carried out under this permitting system.

15.9.7 Provision of Manuals & Certification

In advance of equipment start-up, the Contractor must provide all operating manuals, maintenance schedules, certification of safety system testing and compliance certification for all regulatory mechanical testing (including pressure testing, testing of lifting beams, etc.) as detailed in sections 15.7 and 15.8 (Documentation).

15.9.8 Testing & Commissioning

The Contractor must test and commission the installed Plant in accordance with a Project Quality Plan which has been approved by the Client. This must include facilitating, where instructed by the Client, in the testing and commissioning of other systems that interface with the Plant.

All pre-installation tests, functional tests and Taking Over tests must be by the Contractor and witnessed by the Client and/or his nominated representative.

15.9.9 Costs of testing

Any necessary sensors, instruments, measurement and test devices required to measure adherence to any Taking Over Tests, Performance tests and Guarantee Values must be supplied with and installed in the Works delivered as part of all Lots. Exceptions hereto must be explained and justified.

For any testing which is required to measure adherence to any Taking Over Tests, Performance tests and Guarantee Values whereby external laboratories, and/or external hire or purchase of other measurement equipment and/or support from third parties is required, all costs arising therefrom must be borne by the Supplier.

The Client plans to have a laboratory at the Plant. The Client will equip the laboratory with analytical equipment that is commonly used in an installation of this kind, especially given the remoteness in terms of physical distance between the Plant and external analytical laboratory co-operation partners.

Although the equipment in the Plant laboratory has not been decided upon, the Client is in principle in agreement with the Supplier using the laboratory equipment at the Plant in support of carrying out Performance Tests and in support of commissioning activities. This use of Plant laboratory equipment would be free of charge to the Supplier.

15.9.10 Other

The Contractor must be responsible for:

1. co-ordinating with the Client regarding statutory inspections and licences; and
2. co-ordinating with the Client regarding any necessary statutory application and permit to discharge effluent.

The Contractor must provide to the Client any and all information necessary to support the preparation and satisfactory closure of any Planning Application, Building Permit Application or Environmental Permit Application or other required Permit.

15.9.11 Project Management

An online Project Collaboration Tool must be provided by and used by the Contractor for communication, document and drawing issue, distribution and transmittal procedures, providing a standardised document referencing and numbering system.

Project Collaboration Tool training must be made available to the Client and document control protocols must be assessable through the online system.

The Contractor must attend monthly Progress Review meetings in a format agreed with the Client throughout the term of the Contract.

Occasionally, Progress Reviews may be held at the Contractor's offices, on Site or by telephone/video conference.

17.5 The Contractor must prepare and issue monthly written and electronically delivered Progress Reports at least three (3) days prior to each Progress Review meeting. The content of the Progress Report must be agreed with the Client and must include the following as a minimum:

1. Progress summary monitored against the Progress Schedule;
2. Overview of the work performed in the previous month
3. Short term look ahead (work complete, in progress, not started);
4. Critical path activities and key milestones;
5. Forthcoming co-ordination activities;
6. Progress photographs with a date record;
7. Key issues or problems;
8. Early warning notice register; and
9. Evidence of orders placed.

15.9.12 Building Information Management (BIM)

The project must be executed using BIM for all disciplines.

BIM must be used for user participation, coordination, collision control, and production planning, among other purposes. The BIM model must be available for the client's inspection and control at all times during the design process.

The BIM model must be usable for further use after the owner takeover for future operation and maintenance. The digital original basis for the IFC model must be included in the O&M (Operation and Maintenance) documentation. In this model, all technical disciplines must be updated with actual components, both in terms of correct size and accurate technical information.

The Design and Build Contractor must have a dedicated BIM coordinator. A BIM manual with requirements for BIM project planning must be presented in writing to the client before contract signing . All costs related to establishment and operation must be included in the offer from the general Contractor.

The BIM model from each individual Supplier must have a level of detail that is sufficient so that the individual Suppliers can coordinate their elements with each other. It is not necessary for machine BIM models to be so detailed that industrial secrets are revealed, but the level of detail must be such that outer boundaries and Connection Points are visible.

The BIM model must serve as a “digital twin” of the facility, and all Contractors and suppliers must assemble their products according to the BIM model. The BIM model is the base for the production of assembly drawings, and no site adjustments can be tolerated unless they are checked out with the BIM coordinator.

15.10 Technical requirements

15.10.1 General technical requirements

The Health and Safety of all people at the Site, whether working there permanently or temporarily, or simply visiting, is of utmost importance.

The emission of any other unwanted solids/ liquids/ gases into the environment must be minimised as far as possible bearing in mind the economic feasibility of technology offered.

The technology used and the general design of the Plant must reduce the requirement for manual work as much as possible, though automatisation, optimised use of and integration between different technologies. The Plant must be designed and built with a view to achieving good reliability, robustness and ease of operation with a high degree of automation and autonomy.

The Client recommends that all Lots operate or are able to/are designed to operate continuously and without the presence of staff. Suppliers may suggest and offer solutions where the Lot or defined Sub-Lots do not operate continuously, but if this is the case the Supplier must clearly identify the respective Lot/Sub-Lot which does not operate continuously and explain clearly and concisely why this is the case.

It must be possible to activate backup solutions by remote login. All Lots (including their Sub-Lots) must be controllable from the Control System and from the Overarching Control System.

The layout of the Lot delivered by Contractors as well as its spatial context within the Plant, both indoors and outdoors, must be designed to facilitate further development and expansion (please also refer to section 12.2.10).

The Lot delivered by Contractors must fulfil applicable legal requirements and be approved for operation in Norway. In preparing its Commercial Offer, the Supplier is responsible for ensuring that the Lot that the Supplier designs and calculates fulfils in all respects the requirements set by Norwegian authorities, laws and regulations, industrial practices and standards.

The choice of materials and components must be made with a view to ensuring that all Lots can be operated with the expected service life as presented in section 5.2

In order to increase standardisation, reduce costs for Wear and Spare Parts, and to generally improve the ease of operation, the Supplier must limit the number of variations of components in terms of size, type, make, etc. The Supplier must only include in its design and calculation only new equipment, whereas the single exception to this regulation is the existing Tiger/shredder (please refer to section 6.4) where space must be allocated for a reinstallation outside the scope of this project.

All equipment must be fabricated by a company that has a well-developed service capability and access to Spare Parts. Material quality must be selected so that it is sufficiently durable in terms of wear, erosion, corrosion, vibration and fatigue. Maximum delivery times for all Spare Parts and replacement units must be defined and guaranteed within the framework of a Service Contract. A sufficient number of the respective Critical Spare Parts must be stored at the Site.

The Plant must be designed and constructed in such a way that dismantling, replacement and repair of equipment can be easily carried out without stopping the Plant. If this is not possible, the downtime must be as short as possible. Equipment such as engines, gearboxes, valves, etc. must be easily accessible from ground level or platforms. Necessary service points and auxiliary equipment to maintain and replace equipment must either be included or, if is not included in the Supplier's design and calculation, the respective tool or piece of equipment that the Operations Team would need must be described by the Supplier.

Equipment that has an unscheduled stop must raise an alarm to the Control System.

The Plant must be organised for easy cleaning of floors and service platforms.

The distance between components and the wall must be in accordance with the specifications of the Supplier of the Lot. Space must be provided around all components so that operation, service and maintenance can be carried out with good ergonomics, and that at floor level, both at ground level and on platforms, it is possible to use a jack trolley with a standard pallet (800 mm wide) to transport equipment.

The Supplier must include in its design and calculation the necessary assembly supports and hole-making, as well as adequate sealing, including fire sealing of these. The sealant must provide adequate protection against damage to the building and equipment during the construction period. The Supplier must include in its design and calculation the necessary work and materials involved in making and restoring all assembly openings and penetrations.

The Client recommends that Redundancy should be provided for all critical equipment. If for various reasons this is not technically possible and/or commercially feasible, an additional component must be supplied for storage as a Critical Spare Part. Separately supplied equipment must be identified in the Critical Spare Parts list. Please also refer to section 15.6 as regards redundancy.

The Plant must be equipped with sufficient sensors, reporting (trend identification) from these sensors and necessary test points for operational monitoring, and that minimum requirements and guaranteed performance can be documented.

All process interfaces must be equipped with a manual shut-off valve and flange.

15.10.2 Railings and walkways

Railings and walkways must be in hot-dip galvanised mesh. Walkways must have a kick plate and have 2-way anti-slip gratings.

Platforms must be continuous with a clear walking height of 2,20 metres and without trip hazards. Platforms higher than 0,5 m above the floor must have handrails and kick rails.

Door panels and supports must be dimensioned for loads that may occur during servicing and transport. In indoor mezzanine levels, walkways and landings where spillages may occur, sealed aluminium plates must be used, with flushing edges and drains that can direct spillages to drains. Railings must be removable where service and maintenance may require access.

Provision must be made for alternative protection measures when parts of these structures must be dismantled for access to equipment during maintenance.

All equipment requiring daily inspection or where the inspection (involving a person physically being at that location) must take place at least once per month must have fixed working platforms. Components that have an inspection frequency above lower than once per month (i.e. interval between inspections is greater than one month) must have a fixed working platform if a ladder cannot be used but if a working platform or basket lift can be used. The Client will have a small mobile platform with telescopic arm and basket at the Site.

Ladders must not exceed a maximum inclination of 45°. At lower heights (<2m) vertical ladders may be used. The use of vertical ladders must be pre-approved by the Client.

15.10.3 Welding

Welding must be carried out according to good industrial standards. The Contractor's welding plan must be included in the Contractor's Quality Inspection Plan (QIP) which must be validated by the Client. Non-Destructive Testing (NDT) must be carried out on 10% of all welds. All welding procedures and the relevant certificates of the welders must be delivered to the Client before the start of the installation.

15.10.4 Manhole covers

Manholes must open outwards and be at least 800 mm across. Side-mounted manholes must have a swing arm. Stairs and handrails must be provided up to the manhole if necessary for safe access.

15.10.5 Piping

Pipes carrying Substrate must be fitted with flushing valves for emptying and flushing the pipes without dismantling pumps, fittings and other process equipment. Flush valves must be at least DN 25 and fitted with protective caps/plugs. Low points on Substrate lines must have the possibility of bottom draining.

Substrate pipelines must have large radius bends. Pipes must also be flanged at least every 6 metres to facilitate flushing and disassembly. Service points must be accessible with limited disassembly.

Pipelines should preferably be suspended so that valves and fittings can be removed without additional measures. Suspensions must be provided on both sides of fittings.

All high points must be fitted with de-aeration equipment and all low points must have drainage equipment.

All insulated pipes must be sheathed with aluminium or steel sheets.

Gas pipes must have a trap with a condensate trap at the lowest point. Flushing valve for gas discharge must be installed before and after each shut-off valve.

Instrument air lines must be made of acid-proof steel or rubber and fitted with mist lubricators.

Unless otherwise specified, all pipes must be made of acid-proof steel. Exceptions may be made for buried pipes, and pipes for clean water and ventilation ducts in agreement with the Client.

The Supplier must design and build piping taking into account the media contained therein as well as the local weather extremes, and must consider any requirement for trace heating for the piping. If trace heating is required the trace heating must be designed and constructed by the Supplier.

15.10.6 Insulation

Insulation must be carried out according to Norwegian standards which may be more stringent than the respective European standards due to the harsher climatic conditions.

All tanks, equipment and pipework having a surface temperature significantly different from the ambient temperature must be insulated and jacketed.

All hot surfaces with a surface temperature above 60°C in the vicinity of walkways and transport routes must be shielded from contact. Within 1,5 m of soft hydraulic oil hoses, hot machine parts, as well as electrical equipment with a protection class lower than IP54, must be protected from a potential direct oil jet.

All outdoor installations must be insulated against heat loss and protected from frost.

15.10.7 Tanks

All tanks must be able to withstand the medium that they are to contain for the duration of the design Lifetime.

For Fermenters, Buffer Tanks, Digestate Buffer Tanks, all fittings in contact with the Substrate must be made of acid-proof steel, minimum standard steel grade 316 whereas this does not apply to the material of the Fermenter tank itself. If other materials are used in the tanks, this must be approved in advance by the Client.

Tanks must be equipped with the necessary shut-off and hatches for emptying sediments at the bottom.

All tanks with rapidly changing fill levels, which expel air must be connected to the Odour Management and Treatment System.

All sealed tanks must be protected against harmful overpressure and underpressure.

Outdoor tanks must be equipped with snow guards and equipment to prevent the formation of icicles at the roof/wall junction. Gutters and downpipes must be frost-proofed with trace heating.

All outdoor tanks must be constructed in a way that prevents the accumulation of rainwater on top of the tank. Rain and melt water must be directed in a controlled manner down to ground level via downpipes. All external water drainage equipment must be fitted in such a way as to prevent ice formation.

15.10.8 Sampling points

Sampling points for all Substrate must be designed to allow flushing of the sampling line prior to sampling. Effluent must be returned to the process.

15.10.9 Rubber and plastic

At all locations where there are rubber seals, o-rings, protective caps, etc., a rubber or plastic grade must be used that is suitable for the medium that a biogas plant treats, with regard to particles, pH, content of nitrogenous liquids and gases, etc.

15.10.10 Valves

All valves on gas lines and Substrate lines must be supplied with a 4-port connection so that they can function as an end valve.

Valves must always be positioned so that they can be accessed from the floor or from a fixed working platform.

Flush valves must be of the ball valve type up to dimension DN 50.

Shut-off valves of the slide gate type to be used on Substrate or Digestate must have gate blades and valve body in stainless material.

Non-return valves must be used with care. Non-return valves must be of a type and installed so as to avoid shocks when starting and stopping the pump and to minimise the risk of clogging.

15.10.11 Rotating equipment

The Client recommends that all rotating equipment units which are also critical to the operation of the Plant must have 100% redundancy. In case of shutdown/failure of a duty rotating equipment unit set up with standby equipment unit, the standby equipment unit must replace the defective unit to that the guaranteed level of availability for the respective Lot can be reliably maintained.

The Client recommends that all rotating equipment be dimensioned in such a way that it operates at 70 % of Capacity at the design quantities for the Plant. The Supplier must declare exceptions to this recommendation.

15.10.12 Pumps

Frequency converters are to be supplied by the Supplier for each Lot and must be placed in the Control Room.

Dry-installed pumps must be placed on concrete foundations. The centre line of the pumps must be at least 700 mm above the floor. There must be good service accessibility between pump foundations. Spacing between pump foundations must be a minimum of 900 mm. Hose pumps must be placed at floor level.

All pumps must be equipped with valves before and after the pump. For Substrate pumps, one of the valves must be an automatic valve. Drain valves must be provided between the pump and the valve on both sides of the pump. Flush valves (DN 25) must be provided before and after the pump.

If centrifugal pumps are to be used, they must have pressure gauges on both sides and the Client recommends using dry-installed pumps from a maintenance point of view. The basic design of rear-mounted pumps must be adapted to this mode of operation with regard to, among other things, the motor cooling. Frequency controlled pumps must be able to operate continuously at the lowest specified flow rate without operational problems (clogging, overheating, etc.).

Above dry-installed pumps weighing more than 25 kg, preparations and arrangements (hooks, rings etc.) must be made to facilitate and enable the lifting and removal of the pumps. Pipework must be routed in such a way as to enable the pump to be lifted out completely.

Sump pumps must be supplied with level sensors and other instrumentation to enable automatic operation with start, stop and alarm levels. Signals must be integrated into the local Control System. Bilge pumps which pump media with potentially high levels of contamination must be equipped with cutting impellers.

Dosing pumps for chemicals should be diaphragm pumps with plug connection for signal and 230 V.

Dry-installed pumps must have a collecting vessel to collect leaks and seal water. The water must be channelled to a gutter/well in pipes.

15.10.13 Heat exchangers

Heat exchangers must be designed for optimum performance for the Substrates they are to heat and with varying volume flow through the Plant.

All heat exchangers must have shut-off valves on both the supply and return lines on both the primary and secondary sides. All heat exchangers must have venting and drainage on both the primary and secondary sides. On Substrate/water heat exchangers, the drain after the exchanger must have the same dimension as the associated pipework. The exchangers must have the possibility of CIP washing. All heat exchangers must have a flushing point before and after the heat exchanger.

15.10.14 Filters and strainers

All filters and strainers must have a drain valve with pipework to the appropriate position. All filters must be fitted with bypass or, if necessary, parallel filters for changing filters during operation.

15.10.15 Lifting equipment

For components over 25 kg that have a maximum inspection interval of at least once per month, and where the component has to be lifted during inspection, preparations and arrangements (hooks, rings etc.) must be made so as to facilitate and enable the lifting and removal of the component. Other components over 50 kg must have a lifting beam above the component for sideways movement.

15.10.16 Chemicals

Chemical handling equipment (tanks, dosing pumps, etc.) must be placed within a drain-free enclosure, or be equipped with its own collection vessel (spillage trough). The vessel must be capable of collecting the entire contents of the tank.

Chemical tanks must be equipped with manholes and necessary connections for filling, venting, bottom drainage, etc. Chemical tanks must be equipped with sensors for level measurement, including high/low level alarms. Tanks filled from lorries must be equipped with a visual high-level alarm clearly visible to the driver at the unloading site. Dosage rate from the chemical tank into the process must be independent of the filling level in the tank.

Internal and external dosing lines (if they are not rigid pipes themselves) must be placed in pipes to offer protection from the environment and protection against rupture. The location and design of the Plant must take into account both the accessibility of the transport vehicles and the accessibility of the service and worker protection.

Oils, glycol and other chemicals used must be handled in accordance with applicable laws and regulations.

15.10.17 Heating and cooling of the process

All process heating and cooling must have high and low point vents. These must be ducted to floor level and if possible, to a floor drain.

For systems filled with glycol-mixed water, the drain, vent and outlet from safety valves must be returned to the filling tank as far as possible. If it is not possible to return the liquid to the filling tank, the drain must be directed to a collection vessel so that glycol is not discharged to drains. The Supplier must limit the number of such vessels in its design and calculation.

15.10.18 Electrical installation

Exposed parts (e.g. cable trays, process and ventilation pipes, machine parts) must be made with the equipotential bonding network that is connected to the main earth. This must be realised by laying an equalising trunk cable from the equipotential bonding rail closest to the main/sub-distribution along the main routes, with outlets to the exposed parts. In special rooms or areas with a high requirement for equalising connections (e.g. EX-zone areas), consideration must be given to installing local earth rails with a separate earthing connection to the Control System cabinet.

Cable installations in the Plant must be installed according to industrial standards, using recognised and proven technology. Risk assessments must form the basis for the choice of design and technology in the various parts of the Plant.

Cable routing must not collide with ventilation or heating. Final routes must be determined in co-operation with Suppliers of other Lots and the Client. Space must be provided for extensions.

The design of switchboards, cable installations and cable routing must be carried out in such a way as to limit electromagnetic noise. This is included in the standards for control cabinet construction, but must also form the basis for the design of cable routes. For example, power cables must be separated from bus and control cables - either by laying them on separate cable trays or by using an EMC separating plate. Control cables with analogue signals must be shielded and connected to instrument earth based on a chosen earthing philosophy. Bus cables, like power cables, must be tested with suitable test equipment before commissioning.

All cables must be halogen-free.

15.10.19 Surface treatment and colours

Products used in surface treatment must fulfil the requirements of the environment in which the equipment is to be placed. A list of colours used and their colour codes must be attached to the final documentation.

The corrosion class must be C5.

All components that are surface-treated must be spot-painted after installation and the surface must be repaired so that the surface protection is not impaired.

15.10.20 Labelling

All labelling of valves, pipes and other components must be included. Labelling must be clear and easy to read and made of UV-resistant material that must be able to withstand the conditions of the Plant and not change over time. Where the component is concealed, the labelling must be duplicated or supplemented by a reference sign so that the component can be easily found.

Placement of the label/sign on equipment which is installed outdoors must be carried out in such a way that the sign does not accompany the equipment when changing it.

Pipelines must be labelled with the media and direction of flow, as well as the origin and destination of the pipeline.

15.10.21 Temperature

The Supplier must design and build the works so that the following temperature minima and maxima are maintained.

	Temperature ° Celsius	
Location	Minimum	Maximum
MCC room	19	26
Process halls	10	30
Offices	19	26

Table 37: Design parameters valid for all Lots for temperature at the Plant

15.10.22 Outdoor storage of By Products and Products

All Products and By Products produced at the Plant must be stored indoors. Outdoor storage of any materials is not planned. The Client currently assumes that Products will be stored in the hall designated as Hall 41 on the Clients General Arrangement Plan (see section 12.2.11.4).

16 Client's own Scope of supply

16.1 Client's Responsiblities

Within the scope of this project the Client's responsibilities are as follows:

- Define and secure feedstocks
- Define quality & quantity spec. of desired Outputs, Products
- Sell Outputs, Products
- Secure electricity supply
- Set up and Employ Operator Team
- Provide, define Battery Limits i.e. border of Plot for construction of Plant
- Obtain permits required from the authorities to be allowed to build and operate the Plant (e.g. building permit, Environmental Emissions Permit)
- Generic scope split between Minimum Scope and Other Lots
- Secure funding
- Non-delegable tasks during plant construction

16.2 Client's Scope of supply

Within the scope of this project the Client's will purchase the following items directly and outside the scope of ITT 1.

- Workshop tools
- Adapting the workshop
- Equipment for spare part storage
- Moving the existing welfare and sanitary facilities
- Personal equipment, clothing etc.
- Personal communication systems
- All equipment for kitchen
- All furniture
- Make available mobile equipment required for the daily operation of the Plant such as Front wheel loader, Forklift
- Make available Shredder
- Equipment for a laboratory
- Adaptation of existing hall (Item 41 in Client's General Arrangement) for storage of e.g. Fertiliser Products or other purpose.
- Infiltration plant outside of the Site for injection of Infiltration Water into watercourse.

17 Taking Over procedures, testing, commissioning and trial operations

17.1 Introduction

1 This section describes the step by step procedure for completing testing and Taking Over the Works as well as trial operations after Taking Over.

2 Wherever possible equipment should be tested as soon as it has been completed in the factory and before shipping to the Site, in order to avoid non-functioning technology being delivered to the Site, as described in section 17.2 (Pre-installation tests (Factory acceptance tests)).

3 Once equipment has been delivered to Site, it is installed after which construction is completed according to agreed checklists and procedures described in section 17.3). Following on from this Functional Tests are carried out to ensure that all installed technology can operate as planned (Functional Tests described in section 17.4.4).

4 The Supplier must ensure that the technology installed adheres to contractually agreed Guarantee Values. Adherence to Guarantee Values is measured both in Taking Over Tests and in Performance Tests.

5 The installed equipment and other works are tested to see if all functions are available at full load and to ensure that the Products produced by the respective process reliably and regularly adhere to the respective Product specification as described in section 17.4.5 (Taking Over tests) (abbreviated to TT). This includes functions which are absolutely essential for the plant (so called Essential Functions) which are further described in section 5.1. Fundamentally these are pass/fail tests, and if the Plant is lacking in any of the Essential Functions the Plant's ability to function in an economically feasible way is nullified as a result. Taking Over Tests are therefore designed to test whether the Supplier's technology adheres to the Guarantee Values given by the Supplier as regards Essential Functions.

6 Once the Taking Over tests have been completed the next phase is to carry out all Performance tests (abbreviated to PT). These are described in section 17.5 (Performance). Performance Tests are designed to test whether the Supplier's technology adheres to the Guarantee Values given by the Supplier as regards Operational Cost, consumption and availability. The Client will have a significant financial disadvantage if the Performance Tests are not met. These Guarantee Values are described in section 17.6.

7 The consequence of not passing Performance Tests will be an agreed mechanism and dynamic as regards Liquidated Damages which is described in section 17.6 (Performance guarantees and damages for failure) and further elaborated/specified in section 19.

8 After the Taking Over Tests and after passing most of the Performance Tests, the Taking Over process may start and should then be completed.

9 After Taking Over the Trial Operation period (12 months) begins. Certain Performance Tests can only be measured over a longer period of time and in stable operations. These are known as Tests after Taking Over. Therefore such Tests after Taking Over are performed in the Trial Operation period.

10 Above and beyond that the Supplier must give certain defined Expected Values. Expected Values are not Guarantee Values and do not have to be guaranteed. Nonetheless the adherence to Expected Values (abbreviated to EV) will also be measured both before and after Taking Over. Expected Values are described in section 0. Testing procedures for Expected Values will be agreed between the Client and the Supplier during negotiations.

17.2 Pre-installation tests (Factory acceptance tests)

1 Pre-installation tests must be designed, planned and conducted by the Contractor in accordance with the Quality Plan. Pre-installation tests must be carried out with the intention of demonstrating conformance with the requirements of the Specification prior to arrival on Site.
2 No Materials must be transported to Site until they have passed their respective pre-installation inspections and/or tests.
3 All pre-installation tests must be carried out in a suitable area, where controlled conditions can be maintained and so far as is reasonably practicable, under conditions that must simulate the expected conditions on Site.
4 The Contractor must provide manufacturer's type test certificates for all Materials and must make available for inspection all operating documentation, quality assurance records and certificates of conformance to standards or legislation where applicable.
5 Pre-installation tests must include:
5.1 simulated test of all motor control centres with relevant inputs and outputs to the Control System PLC to demonstrate the correct operation of all control logic; and
5.2 a simulated test of the supervisory control and data acquisition system with relevant inputs and outputs to demonstrate the correct operation of alarms and visualisation of Plant condition.
6 The duration of pre-installation tests must be appropriate for the equipment and systems being tested.

17.3 Criteria for mechanical completion and completion of construction

17.3.1 General

1 All construction and installation activities must be designed, planned and conducted by the Contractor and approved by the Client as part of the Quality Plan to be supplied by the Contractor. This corresponds to Milestone M8 in the Progress Schedule.
2 The Contractor must ensure that all quality assurance procedures have been followed in accordance with the Quality Plan and that the Works have been constructed in accordance with the agreed Construction Drawing(s) and the Specification.
3 The Plant will consist of several Lots and assemblies, some of which are operationally dependent on others. The Contractor's Progress Schedule must include a logical sequence in which completion of each Sub-Lot must be required and must allow adequate time for inspection and testing.

17.3.2 Criteria

1 Prior to the Contractor offering the Plant or parts thereof to the Client for inspection, he must ensure that the Works including all Materials, packaged units, process equipment and components have been constructed and installed in accordance with the agreed Construction Drawing(s) and the Specification.

2 The Contractor must ensure that:

2.1 all mechanical components are installed to the line and level shown on the agreed Construction Drawing(s);

2.2 all mechanical components have been correctly bolted in position, necessary guarding installed, cleaned, greased, oiled and connected in compliance with the manufacturer's guidelines;

2.3 pump/motor assemblies checked for alignment; level; setting of seals/couplings; operation of overload devices; setting of limit switches; directional response/rotation; instrument feedback/status indication and must have completed all necessary pre-start checks;

2.4 all statutory testing of installed/supplied and pressure systems together with all other required hydraulic and/or pneumatic pressure testing of equipment, tanks and pipework has been performed, and pressure systems have been registered with the Client and fixing of the Client's plant identification labelling completed. Two (2) copies of all certificates to be provided to the Client;

2.5 all electrical components have been correctly installed to the line and level shown on the agreed Construction Drawing(s);

2.6 all electrical components are suitably insulated and have been tested and accepted by a suitably qualified person;

2.7 all cables have been tested in accordance with the appropriate specification corresponding to applicable standards and installation complete certification;

2.8 all earth testing completed in accordance with the appropriate specification corresponding to applicable standards;

2.9 all continuity checks for each field circuit and loop checks for each instrument and other field device have been completed;

2.10 checking of pressure transmitters/switches and all other instrumentation, for correct rating and installation;

2.11 any pre-installation tests that could not be performed;

2.12 all instruments are properly calibrated and ready for use;

2.13 all walkways, gantries and ladders have been correctly connected and installed to the line and level shown on the agreed Construction Drawing(s) and there is safe access for operation and maintenance of all equipment;

2.14 draft issues of both the As Built Drawings together with Operating and Maintenance Manuals have been issued to the Client. The draft issue of the Operating and Maintenance Manuals must be sufficiently detailed to enable the plant to be operated and maintained in safety and ensure compliance with Health and Safety legislation. Single electronic and paper copies of each of the draft drawings and manuals must be submitted;

2.15 all equipment can be powered-up;

2.16 a competent person has inspected and verified all affected areas with respect to explosion safety, as required under relevant laws and regulations, hereunder, but not limited to the Regulation on health and safety in potentially explosive atmospheres (Forskrift om helse og sikkerhet i eksplosjonsfarlige atmosfærer).[7] This must include inspection (witnessed by the Client) of all equipment located within Hazardous Zoned Areas as defined by the relevant drawing, to check for compliance, completeness, and correct certification. A Hazardous Area Equipment Inspection Record must be prepared by the Contractor (and copied to the Client), listing all such equipment, including temporary and permanent equipment and ancillary fittings such as glands etc, and confirming that verification has taken place;

2.17 all warning signs and alarms are in place and other safety equipment is fully compliant with the Specification and all relevant regulations;

3 The Contractor must certify that the tests have been satisfactorily passed in accordance with the Quality Plan and must issue to the Client two copies of each Test Certificate (including those required by statute) relating to all Materials.

4 All inspection and test records required by the Quality Plan must be made available for inspection by the Client within seven (7) days of completion of each inspection or test.

5 The Contractor must remove from the Plant all construction debris and process material and ensure that it is left in a clean and safe state, free from all loose objects, obstacles and hazards.

6 The Contractor must issue a Safety Certificate for the Plant stating that it is safe for operation and maintenance in accordance with relevant statutory legislation, the Specification, and the Technical Manual.

7 The list is not exhaustive.

17.4 Taking Over tests

17.4.1 General

1 Following the mechanical completion and completion of construction, the function and operation of the Works must be tested by the Contractor in order to confirm compliance with the Specification.

2 Taking Over procedures must include the training of the Client's personnel, functional tests and Taking Over tests as detailed in this section 17.4.

3 All testing must be undertaken in accordance with the Quality Plan and requirements made by the Client (defined in Table 33) and must demonstrate that the Plant operates properly and safely in accordance with the Specification.

4 Safety systems for fire & gas detection are covered by specific regulations and must be properly tested and commissioned before operators are allowed to use the plant as a permanent working area and before takeover.

5 The Contractor must submit a testing programme as part of the Contractor's Quality Plan (defined in Table 33), for the Client's information agreement and approval by the Client. This testing programme must detail the availability of equipment and systems to be tested in accordance with this section 17.4, the duration of each test and when training will be provided.

[7] See also guidance from The Norwegian Directorate for Civil Protection (DSB): https://www.dsb.no/lover/farlige-stoffer/farlige-stoffer/veiledning-til-forskriftene/veiledning-til-forskrift-om-helse-og-sikkerhet-i-eksplosjonsfarlige-atmosfarer/

6 Records of each test must be agreed with the Client on the day that the test is completed and must be signed by both the Contractor and the Client.
7 The Contractor must submit a draft of the detailed testing, sampling and analysis methodologies and procedures in respect of the tests detailed in this section 17.4 to the Client at least nine (9) months prior to the Installation Completion milestone M8 date shown in the Progress Schedule in Table 46.
8 The Taking Over test period must be defined as the period in which all Taking Over tests must be carried out to completion.
9 The Plant is required to pass all tests detailed in this section 17.4 by the Taking Over milestone M10 shown in the Progress Schedule in Table 46.

17.4.2 Plant preparation and conditions

1 For the duration of all testing and up until Taking Over the Plant must be operated by the Contractor in compliance with:
1.1 the Contract;
1.2 the building permit;
1.3 the environmental permit; and
1.4 all other applicable legislation and permits.
2 The Contractor must ensure that all materials and equipment are suitably tagged or otherwise appropriately labelled.
3 The Contractor must ensure that all safety and emergency signage is in place.
4 The Contractor must ensure that all basic equipment integrity checks relating to start-up have been carried out prior to any testing.
5 The Contractor must not make any change to the Plant, or operate it in a manner purely to enable the passing of any tests, which is not permanent and sustainable for normal long-term operation.
6 The Contractor must ensure that the relevant Client's personnel have successfully completed all necessary training to be provided by the Contractor.
7 For the duration of testing in accordance with this section 17.4 the Plant will be operated and maintained by the Contractor's personnel as defined in the Specification in terms of their grade, role, number and availability.
8 The Contractor must not commence Taking Over testing until the Plant is operational and that the Client's personnel are suitably trained and familiarised with the Plant and their duties.
9 The Contractor must ensure that suitably qualified personnel are present on Site at the appropriate times in order to direct and supervise the operation of the Plant by the Client's personnel.
10 For the duration of the Taking Over Test period all equipment and systems must be operated within normal parameters and in accordance with the Technical Manual (defined in section 15.8.4).

17.4.3 Measurement and analysis

1 Methods of measurement and analysis must be standardised wherever possible.
2 Measurement devices may be analogue or digital, and temporary for the purposes of testing or permanently fitted to the Plant.
3 All measurement devices must be properly calibrated prior to and during each test period as necessary.
4 All readings from measurement devices must be used as recorded without any corrections applied so that neither party benefits from measurement tolerances.
5 During the Taking Over Test period the Contractor must undertake or arrange for taking samples as defined in the Specification using industry recognised and approved methods.
6 The Contractor must be responsible for the appropriate packaging, labelling, and storage of all samples.
7 Unless otherwise agreed between the Contractor and the Client, the Contractor must ensure that the analysis of any samples is undertaken by an independent laboratory that is suitably accredited for the required analysis and using appropriate standard industry recognised methods for the required parameters.
8 Following the laboratory analysis of any sample, the Contractor must issue a copy of the associated analysis results to the Client within five (5) Business Days from the receipt of the analysis results from the laboratory, in electronic data format (which may be read by software generally available in the market at the relevant time) or where the document cannot be sent electronically as two (2) hard copies.
9 All samples that do not require further analysis will be destroyed and disposed of by the Client after the associated test period as agreed between the Contractor and the Client.

17.4.4 Functional Tests

1 The Contractor must carry out defined Functional Tests to fully demonstrate that the functionality required by the Specification is met and that the Plant operates in accordance with the Technical Manual (defined in section 15.8.4).
2 Taking Over Tests must firstly be carried out (as far as possible and/or if required) without feedstock and then with a controlled input of feedstock as appropriate.
3 Functional tests must include the following as a minimum unless otherwise agreed between the Contractor and the Client:
3.1 functional testing of all Plant operations;
3.2 a speed and direction of movement check;
3.3 checking of push buttons, control switches and status indication lamps for correct function;
3.4 electromagnetic and magnetic interference tests;
3.5 material handling and flow from input to output;
3.6 run-to-empty test;
3.7 functional tests of local control panels and equipment;
3.8 functional tests of the PLC including alarm activation and emergency stops. Demonstration that each input to, and output from the PLC system operates correctly and provides the correct information on operator's display equipment. All alarms and trips must be tested by operation of the primary initiating device and against a calibrated reference source, both at the SCADA and telemetry;
3.9 operation tests of transmitters, sensors, switches and other instrumentation. The performance of instruments and their calibration at 0%, 25%, 50%, 75% and 100% of span;

3.10 functional test of all safety systems, including overload, fail safe, interlock and isolation tests;
3.11 demonstration of the operation of all safety devices;
3.12 demonstration of interlocking systems must be by simulating each condition from as close to the initiating device as practicable and checking the correct operation of each circuit;
3.13 demonstration of automatic operation and control of all equipment associated with the Works, including failsafe, power failure and auto re-start facilities;
3.14 demonstration of failure mode and Plant recovery including site power failure, individual drive failures and instrument failures;
3.15 testing of Plant application software, SCADA, control panels, instrumentation, MCCs and any bespoke programming code, including the actual Plant operation sequence and interlocks, as defined in the functional design specification;
3.16 Control System interfaces with connected systems and equipment provided by others as required and if available; and q) the validation of operating and maintenance arrangements and documentation.

4 Unless otherwise stated, the duration of each functional test must be appropriate for the equipment or system being tested.

5 After cold commissioning and hot commissioning has been completed according to mutually agreed checklists, Milestone M9 is reached.

17.4.5 Taking Over Tests

1 When all relevant and necessary functional tests have been passed in order to carry out the Taking Over Tests as defined in this section 17.4 all Plant components must undergo Taking Over testing in order to assess key aspects of each system against defined Taking Over Test criteria.

2 All of the Taking Over Tests are shown in Table 38 and must be carried out during the Taking Over Test period.

3 Each Taking Over test will only be deemed passed when the relevant pass criteria defined in Table 38 have been achieved and all of the relevant Plant preparation conditions and other requirements stated in this section 17.4 must have been met, otherwise the Taking Over Test will be deemed failed.

4 Following the failure of any Taking Over Test, the Contractor must submit details together with appropriate supporting evidence to the Client relating to the reasons for the Taking Over Test failure within five (5) Business Days from the completion of the associated Taking Over Test.

5 For a failure of any Taking Over Test only the Contractor must make adjustments and/or modifications to the Plant as necessary and once the Contractor has declared that the Taking Over Test can be repeated, that the Contractor remedied the problem/s encountered, and that the repeated Taking Over Test is expected to succeed. The Taking Over Test will be repeated as soon as is practicable.

6 The Contractor may repeat any Taking Over Test a total of two times (i.e. there may be a maximum of 3 Taking Over Tests).

7 Once the Contractor has repeated any Taking Over Test, the previous results from that Taking Over Test will be rendered null and void.

17.4.6 Taking Over criteria

1 Following the successful completion of the functional tests and Taking Over tests as detailed in this section 17.4 the Contractor must:

1.1 be responsible for collating all inspection data and test records into a formal documented record and must issue two (2) copies of this documented record to the Client within five (5) Business Days from the completion of all tests;

1.2 ensure that all instruments are properly calibrated and ready for use and must provide the Client with copies of all calibration and test certificates for all relevant equipment and instrumentation;

1.3 ensure that the Plant is left in a clean and safe state, free from all loose objects, debris, temporary works, obstacles and hazards;

1.4 provide the first fill of all consumables following testing;

1.5 supply the Documentation and manuals specified in section 15.8.4 (Final Documentation and Manuals) for the Plant as actually constructed; and

1.6 following a joint safety inspection of the Plant the Contractor issue a safety certificate for the Plant stating that it is safe for operation and maintenance in accordance with relevant legislation, the Specification and the Technical Manual.

17.5 Performance Tests

17.5.1 General

1 Performance Tests must be carried out to assess key aspects of the Plant against defined test criteria to demonstrate that the Plant is capable of sustained operation in accordance with the requirements in this Specification. 1.3 The Contractor must submit a draft of the detailed testing, sampling and analysis methodologies and procedures in respect of the tests detailed in this section 17.5 to the Client at least nine (9) months prior to the Mechanical Completion milestone M8 date shown in the Progress Schedule detailed in section Feil! Fant ikke referansekilden..

17.5.2 Plant Preparation & Conditions

2 For the duration of all testing the Plant will be operated by the Contractor in compliance with:

2.1 this Contract;

2.2 the planning consent;

2.3 the environmental permit; and

2.4 all other applicable legislation.

3 The Contractor must not make any change to the Plant, or propose its operation in a manner purely to enable the passing of any tests, which is not permanent and sustainable for normal long-term operation.

4 Unless specifically designed to operate as duty/assist, standby equipment will not be operated simultaneously with duty equipment other than for a limited period of time during change over.

5 For the duration of testing in accordance with this section 17.5 the Plant will be operated and maintained by the Contractor's personnel as defined in the Specification in terms of their grade, role, number and availability, assisted by Client's personnel who have been trained by the Contractor in accordance with the Contractor's Training Plan.

6 The Contractor must not commence testing until the Plant is operational and the Client's personnel are suitably trained and familiarised with the Plant and their duties.

7 The Contractor must ensure that suitably qualified personnel are present on Site at the appropriate times during testing.
8 For the duration of the Taking Over Test period and the Performance Test period all equipment and systems within the Plant will be operated within normal parameters and in accordance with the Technical Manual defined in section 15.8.4.
9 The Plant must be operated and maintained in accordance with the daily and weekly operating time parameters defined in the Specification.
10 Prior to the commencement of the Taking Over Test period and the Performance Test period the Contractor must ensure that recommended spares are on site.

17.5.3 Measurements & Analysis

1 Methods of measurement and analysis must be standardised wherever possible.
2 Measurement devices may be analogue or digital, and temporary for the purposes of testing or permanently fitted to the Plant.
3 All measurement devices must be properly calibrated prior to and during each test period as necessary.
4 All readings from measurement devices must be used as recorded without any corrections applied so that neither party benefits from measurement tolerances.
5 Periods of downtime caused by the breakdown of a single item of equipment will be considered within the actual running time of the Plant if it is agreed between the Contractor and the Client that the failure is not material in respect of the operation of the Plant against the required Test Criteria and the failed item of equipment is returned to service within twenty four (24) hours.

17.5.4 Performance Tests

1 All of the Performance Tests shown in Table 46 must be carried out on the Plant during the Performance Test Period with the exception of the Tests after Taking Over which are defined in section 17.8.
2 The pass criteria ("Test Criteria") are defined in Table 46.
3 Performance Tests will only be deemed passed when the relevant Test Criteria are achieved and all of the relevant Plant preparation conditions and other requirements stated in this 17.5 have been met, otherwise the provisions of section 17.5.5 will apply.

17.5.4.1 Performance Tests performed at full and partial loads

1 For Performance Tests which are performed not only at full but also at partial loads the following shall apply.
2 For 2 Performance Tests (namely PT11 and PT16) the Supplier must give a Guarantee Value not only at 100% but also at 90%, 80%, 70% and 60% of full capacity.
3 For the purposes of the Performance Test the intention is that performance will be tested at full load i.e. 100%. If however the Client declares that this is not possible, Performance will be tested at lower than 100%. The actual load during the Performance Test will be calculated by the Client and the Contractor. The values given by the Supplier for partial loads will be used for the Performance Test. Linear interpolation will be used to calculate Guarantee Values if the load does not exactly correspond to 90%, 80%, 70% or 60%.

17.5.5 Performance Test Repeat and/or Failure Mechanism

1 If any Test Criteria have not been met, the Contractor must submit details together with appropriate supporting evidence to the Client relating to the reasons for the performance criterion not being met within five (5) Business Days from the completion of the associated Performance Test Period (as appropriate).

2 If any Test Criteria have not been met the Contractor must either:

2.1 make adjustments and/or modifications to the Plant as necessary and repeat the Performance Test Period (as appropriate) as soon as practicable in order to repeat the failed Performance Test associated with the Test Criteria that have not been met together with all influenced Performance Tests; or

2.2 elect not to have the Performance Test associated with the Test Criteria that have not been met repeated and pay any liquidated damages due to the Client in accordance with section 17.6 (Performance Guarantees & Damages for Failure), provided that the result of said Performance Test is within related limits specified.

3 Once the Contractor has instructed the Client to repeat any Performance Test the previous results from said Performance Test will be rendered null and void.

4 Any Performance Test that is repeated (in accordance with regulations in this section 17.5) will be carried out at least 4 times in total during the Trial Operation period.

17.6 Performance guarantees and damages for failure

1 If the Plant does not pass all relevant Performance Tests detailed in section 17.5 (Performance Tests & Procedures) within the period stated in the Progress Schedule, and the Client decides to take over the Works, the Contractor must pay any liquidated damages due to the Client in accordance with section 19, provided that the results of the Performance tests are within the specified limits.

2 The liquidated damages for all Performance Tests are shown on the basis of the whole performance test period and will be applied against Performance Test failures for the whole Performance Test period. Liquidated damages are explained in detail in section 19.

3 Liquidated damages that are stated apply per incremental increase/decrease and will be calculated on a pro-rata basis up to the specified limit.

4 All deductions will be made against the Contract Price owed to the Contractor. Should the remaining payments owed to the Contractor in accordance with the Terms of Payment not cover the liquidated damage liability outlined above, the Contractor must pay to the Client the amount of liquidated damages within thirty (30) days of instruction to pay such liquidated damages.

5 Liquidated damages for failure will be limited to 10% of the Contract Price.

17.7 Taking Over

1 Following the completion of all necessary Taking Over Tests (as per section 17.4 and as per Table 38) as well as those Performance Tests (as per section 17.5 and as per Table 39) and all other required tests to confirm that Works are in accordance with the Specification, (however before the Tests after Taking Over have started) Taking Over shall commence.

2 Following the issue of the Taking Over Certificate by the Client, the performance of the Plant must be tested by the Client in the Trial Operation period to verify the guarantees stated in section 17.6 (Performance Guarantees & Damages for Failure).

NS 8407 clause 37 applies in full for the complete contract works. The testing and commissioning referred to in Appendix A – Specifications shall apply in addition to the general and special conditions and shall not alter the Client's rights or the Contractor's duties under the general or special conditions.

17.8 Tests After Taking Over

1 Certain Performance parameters can only be measured over a long period of time and above all, after most or all functions of the plant are operating in a stable and optimised fashion. These performance parameters must be measured in co called "Tests after Taking Over."

2 Tests after Taking Over are Performance Tests. They must be measured during the Trial Operation period.

3 There are 8 Tests after taking Over in total. The Tests after Taking Over are as follows:

3.1 For the Minimum Scope: PT1, PT2, PT3, PT4, PT 14, PT15.

3.2 For Lot D: PTD6

3.3 For Lot E: PTE1

4 Tests After Taking Over are also Performance Tests. Therefore all regulations that apply to Performance Tests also apply to Tests After Taking Over with the exception of regulations connected to timing and repeat of tests. Tests After Taking Over may be interrupted and restarted but not completely repeated.

17.9 Trial Operation

Trial operation will last 365 Calendar Days to ensure that all system and production capacities have been tested and verified throughout different seasons. This includes the entire production line and auxiliary systems including, among other, but not limited to, technical building systems and installations, process cooling, ventilation, Control Systems and other systems dependent on climate variability in the building.

Before start of trial operation, the Contractor must make a detailed schedule of the entire trial operation period. The schedule must include. all necessary activities such as planned production ramp-up phases, Performance Tests and analyzing and other critical activities for verifying objectives and requirements for the Plant. The detailed schedule must be delivered to the Client at least three months before Taking Over.

For auxiliary systems such as lighting systems, access control and ITV/CCTV a 3-month trial operation is sufficient.

The objective of the trial operation is to verify the operational functionality of the plant in accordance with specified design parameters. This includes activities such as to

- Identify and rectify any operational issues that may arise during the performance testing of relevant tests to be undertaken after takeover.
- Adjust and verify that all systems are stable, and completely automated, by testing throughout the entire trial period.
- Ramp-up and stabilize production at the defined capacity.
- Optimize the efficiency of the systems.
- Further development of operational procedures and instruction based on experience gained through the period.
- Verify that both product quality and production capacities are within the project specifications. This includes regular performance measurements of the biomethane production rates as well as the relevant Guarantee Value
- Verify that auxiliary systems have necessary capacity and correct functionality during all different seasons and outside conditions. This includes necessary tuning and adjustments due to seasonal variations.

The trial operation period starts after Taking Over.

The Client is responsible for running the plant during Trial Operation. The Contractor must ensure that suitably qualified and number of personnel are present on Site for at least three months after takeover as support at the appropriate times during operations, scheduled testing, and any necessary re-testing of systems. After four months and during the rest of the trial operations period, the Contractor must be sufficiently available digitally and physically for the Client to receive the necessary level of support. The Contractor must hold regular inspection visits to the Plant during the entire trial operation period to make sure that everything works correctly.

All activities during the trial operation period must be documented and recorded through test reports and or logs from the Control System. This includes reporting and logging any discovered deviations and necessary corrective actions. Deviations must be corrected within a reasonable time set by the Client.

A comprehensive evaluation must be conducted at the end of the trial operation period. The evaluation should focus on achieved objectives, identified challenges and recommendations for improvement of operation.

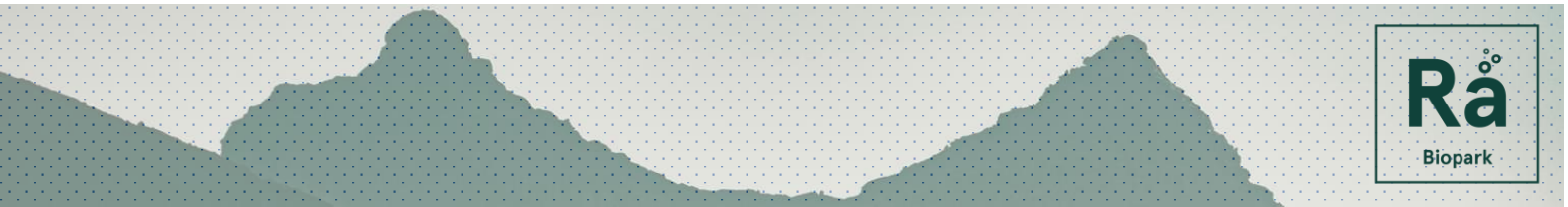
After successful trial operation, and no major deviations or faults are present in the systems, a final report must be made by the Contractor, including an assessment of all objectives and recommendations before proceeding into normal operation. The report must be approved by the Client and other relevant stakeholders before progressing into normal operation of the plant.

The complete regime for testing and trial operations will be detailed after contract signing.

18Taking Over Tests and Performance Tests

18.1Taking Over Tests

No.	Lot (s)	Name of performance parameter	Function, notes	Parameter
TT01	A	Feedstock acceptance capacity in waste reception area	As described in section 6.3 and Table *16*.	Pass/fail
TT02	A	Fermenter feeding/ loading capacity	As described in section 6.5 and *Table 19*.	Pass/fail
TT03	A	Liquid Fraction Digestate quality	As described in section 6.9.2 and *Table 21*.	Pass/fail
TT04	A	Solid Fraction Digestate quality	As described in section 6.9.2 and *Table 21*.	Pass/fail
TT05	A	Hygienisation	As described in section 6.10	Pass/fail
TT06	B	LBM quality	As per section 7.5 (EN 16723-2:2017)	Pass/fail
TT07	B	$LBCO_2$ quality	As per section 7.6 (EIGA Limiting Characteristics)	Pass/fail
TT08	B	LBM Production Capacity	As per *Table 22*	Pass/fail
TT09	B	$LBCO_2$ Production Capacity	As per *Table 22*	Pass/fail
TTD01	D	Capacity	As per section 9.3 and Table 23	Pass/fail
TTD02	D	Infiltration Water composition	As per section 9.9.2 and *Table 24*	Pass/fail
TTD03	D	Performance Odour Management and Treatment System	As per Contractor's specification, which becomes the design basis for the DBC	Pass/fail
TTE01	E	Performance Odour Management and Treatment System	As per Contractor's specification, which becomes the design basis for the DBC	Pass/fail
TT10	Entire Plant (Δ)	Performance Odour Management and Treatment System	Calculated Value Odour Emissions at defined emission point is reached as described in section 6.12, 14.3 and 15.2.1	Pass/fail
TTD04	D	Noise emissions for any technology built inside or outside of buildings	As per Contractor's specification (which becomes the design basis for the DBC for technology inside buildings)	Pass/fail
TTE02	E	Noise emissions for any technology built inside or outside of buildings	As per Contractor's specification (which becomes the design basis for the DBC for technology inside buildings)	Pass/fail
TTE03	E	Capacity	As per section 10.2.1 and *Table 25*	Pass/fail



TT11	Entire Plant (Δ)	Noise emissions	Within limits of noise dispersion model, see Appendices A.110 and A.111	Pass/fail
TTH01	H	Production Capacity	As per section 13.2.3 *and* Table 30	Pass/fail

(Δ) This Guarantee Value is guaranteed by the DBC for the entire Plant.

Table 38: Guarantee Values (Taking Over Tests)

18.2 Performance Tests

No.	Lot (s)	Name of performance parameter	Function, notes	Parameter	Unit
PT01	A	Availability of acceptance for all feedstock.	Availability of Essential Function 1 as per TT1 on WDH during Workdays as per Table 13 meaning (at 98,82%) max. 27 hours of non-availability, whereby maximum single outage event must not exceed 1 whole Workday of 9 hours. Availability of function must be given provided that limits for feedstock delivery as defined in *Table 16* and limits for fermenter loading as defined in *Table 19* are respected: section 6.3.4 also applies	Minimum 98,82	% of WDH
PT02	A	Availability of production of LFD according to quality as per TT3	Essential Function 2 as per TT3 is available, Availability as defined in Glossary, see also section 6.11.4.	Minimum 98	% of POH
PT03	A	Availability of production of SFD according to quality as per TT4	Essential Function 3 as per TT4 is available, Availability as defined in Glossary, see also section 6.11.4.	Minimum 98	% of POH
PT04	A	Availability of hygienisation as per TT5	Essential Function 4 as per TT5 is available, Availability as defined in Glossary, see also section 6.10.3	Minimum 98	% of POH
PT05	A	Residual Biomethane Potential (used to calculate the effectiveness of Biomethane production)	Residual Biomethane Potential Test over 28 days	Maximum 250	Nm^3 biogas/kg Digestate oDS (volatile dry solids)

PT06	A	Reject minimum DS content	Please refer to section 6.4.2.	TBD	% of WW
PT07	A	LFD suspended solids	As described in section 6.11.1	TBD, Max. 5	g/litre digestate
PT08	A	As described in section 6.4.2.	BOTH Amount of easily decomposable organics dry solids in reject total dry solids AND Amount of Total Organic carbon within reject total dry solids.	TBD, Max 20 TBD, Max.10	% organics DS compared to total reject DS % in reject dry solids
PT09	A	Amount of total dry solids contained in digestate	As described in section 6.11.1	TBD	Tons p.a.
PT10	A	SFD DS content	As described in section 6.11.1	TBD, Min. 25	%
PT11	A	Electricity consumption	As described in section 21.3.2.1 (#)	TBD	kWh_{el} per ton of feedstock processed
PT12	A	Heat consumption	Per ton of material pasteurised for all materials apart from those processed according to method K, as described in section 21.3.3.1	TBD	kWh_{th}/ton of feedstock pasteurised
PT13	A	Heat consumption	For all Feedstock Reception Units and all Tanks in kWh_{th} per day (Θ).	TBD	kWh_{th}/ day
PT14	B	LBM recovery	Percentage of methane which is recovered as fuel grade LBM compared to the amount of methane in the raw biogas produced in Lot A. The amount of methane in the raw biogas produced includes any methane lost in e.g. flaring or for any other measurable loss). Percentage recovery must take this into account. This Guarantee Value must also take into account Availability as described in the glossary i.e. both efficiency of process and availability must be sufficiently high to reach this target.	TBD	%

PT15	B	$LBCO_2$ recovery	Percentage of CO_2 which is recovered as food grade $LBCO_2$ compared to the amount of CO_2 in the raw biogas produced in Lot A. The amount of CO_2 in the raw biogas produced includes any CO_2 lost in e.g. flaring or for any other measurable loss). Percentage recovery must take this into account. This Guarantee Value must also take into account Availability as described in the glossary i.e. both efficiency of process and availability must be sufficiently high to reach this target.	TBD	%
PT16	B	Electricity consumption	For all technology in Lot B (incl. biogas upgrading, LBM production and $LBCO_2$ production) as described in section 21.3.2.2 (#)		kWh_{el}/nm^3 raw biogas
PTD01	D	Percentage N recovered as ammonia salt	As described in section 9.7	TBD	%
PTD02	D	Percentage N recovered as ammonia water	As described in section 9.7	TBD	%
PTD03	D	Nutrient Liquor DS content		TBD, Min. 15	%
PTD04	D	Ammonia salt ammonia content		TBD, Min. 6	% by mass
PTD05	D	Ammonia water ammonia content		TBD, Min. 15	Ammonia % by weight
PTD06	D	Availability	Both Essential Function EFD1 and EFD2 (defined in section 5.1) are available, whereby Availability is defined in the Glossary.	TBD, Min. 85	% of POH
PTD07	D	Electricity consumption	As described in section 21.3.2.3	TBD	kWh_{el} per ton of water in Infiltration Water quality produced
PTD08	D	Heat consumption	per ton of water in Infiltration Water quality produced.	TBD	kWh_{th} per ton

PTE01	E	Availability	Essential Function EFE1 as in section 5.1. is available, availability as per glossary	TBD, Min. 96	% of POH
PTE02	E	Efficiency	kWh_{th} of energy required per ton of water evaporated	TBD	$kWh_{th}/t\ water_{evap}$
PTH01	H	Efficiency	Energy consumption per kWh_{th} heat supplied	TBD, Min. 92	%

(#) A Guarantee Value has to be given, and must be tested not only at 100%, 90%, 80%, 70% and 60% of planned capacity.

(ϴ) A Guarantee Value must be given for each calendar month.

Availability is as defined in the glossary and will be as measured by the Plant Control System.

If a technology is offered where there is a factor which contributes significantly to operational cost is not listed in the table above then the Client will adapt this table: for example if the Gas Upgrading technology in Lot B requires heat as the major energy input for the upgrading process to work.

Table 39: Guarantee Values (Performance Tests)

19Taking Over Test and Performance Test procedures, damages

19.1Taking Over Tests (test procedures, damages)

No.	Lot (s)	Testing procedure	Consequence in the event of failure
TT01	A	Measured over 5 consecutive Workdays	Unlimited make good
TT02	A	Measured over 28 consecutive Calendar days	Unlimited make good
TT03	A	As per RI.SE test procedure	Unlimited make good
TT04	A	As per RI.SE test procedure	Unlimited make good
TT05	A	Using independent verification with an accredited 3rd party and their methodology. The average of 4 separate tests in total in different weeks.	Unlimited make good
TT06	B	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good
TT07	B	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good
TT08	B	The achieved value is the average of 4 separate tests in total in different weeks with 24 hours at full load	Unlimited make good
TT09	B	The achieved value is the average of 4 separate tests in total in different weeks with 24 hours at full load	Unlimited make good
TTD01	D	The achieved value is the average of 4 separate tests in total in different weeks with 24 hours at full load (2 tests when producing ammonium salts, 2 when producing ammonia water)	Unlimited make good
TTD02	D	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks (2 tests when producing ammonium salts, 2 when producing ammonia water).	Unlimited make good
TTD03	D	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks (2 tests when producing ammonium salts, 2 when producing ammonia water).	Unlimited make good
TTE01	E	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good
TT10	Entire Plant (Δ)	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good

TTD04	D	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks (2 tests when producing ammonium salts, 2 when producing ammonia water).	Unlimited make good
TTE02	E	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good
TTE03	E	The achieved value is the average of 4 separate tests in total in different weeks with 24 hours at full load	Unlimited make good
TT11	Entire Plant (Δ)	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good
TTH01	H	Using independent verification with an accredited 3rd party and their methodology. The achieved value is the average of 4 separate tests in total in different weeks.	Unlimited make good

(Δ) This Guarantee Value is guaranteed by the DBC for the entire Plant.

Table 40: Taking Over Tests: test procedures, damages

19.2 Performance Tests (test procedures, damages)

No.	Lot (s)	Testing procedure	Explanation	Consequence in the event of failure in NOK *(number of years)*	Dynamic
PT01	A	Measured during the entire duration of the Trial Operation period.	The amount of 1 average Workdays delivery of the particular feedstock will be calculated. If all feedstocks cannot be accepted, one average Workday's worth of feedstock will be calculated, as described in *Table 16*. The feedstock amount will be multiplied by the number of Workdays of unavailability above and beyond 3 Workdays p.a. The costs of disposal are as per the cost item WTE in *Table 14*.	2.904.000 *(8)*	For each additional full Workday p.a. of unavailability
PT02	A	Measured during the entire duration of the Trial Operation period. With regular checks on LFD quality as per RI.SE certification.	For availability 98% (8.585 hours p.a.) 1% less availability = 87,6 hours fewer. If LFD cannot be used as digestate it will be sent to WTE plant. Average production of LFD is assumed to be as per *Table 23*. 1% less availability = 87,6 hours of LFD production cannot be marketed and must be disposed of in the WtE plant. The costs of disposal are as per the cost item WTE in *Table 14*.	10.575.000 *(5)*	For each full percentage point reduction in availability below guaranteed availability percentage
PT03	A	Measured during the entire duration of the Trial Operation period. With regular checks on SFD quality as per RI.SE certification.	For availability 98% (8.585 hours p.a.) 1% less availability = 87,6 hours fewer. If SFD cannot be used as digestate it will be sent to WTE plant. Average production of SFD is assumed to be as per *Table 25*. 1% less availability = 87,6 hours of SFD production cannot be marketed and must be disposed of in the WtE plant. The costs of disposal are as per the cost item WTE in *Table 14*.	1.500.000 *(5)*	For each full percentage point reduction in availability below guaranteed availability percentage

PT04	A	Measured during the entire duration of the Trial Operation period. With regular checks as per regulator's requirements.	For availability 98% (8.585 hours p.a.) 1% lower availability = 87,6 hours fewer. If digestate cannot be hygienised it will be sent to WTE plant. Average production of digestate is assumed to be as per *Table 20*. 1% less availability means 87,6 hours of LFD production cannot be marketed and must be disposed of in the WtE plant. The costs of disposal are as per the cost item WTE in *Table 14*.	11.625.000 *(5)*	For each full percentage point reduction in availability below guaranteed availability percentage
PT05	A	The achieved value is the average of 4 separate tests in total in different weeks.	Assuming that 75% of the Dry Solids (DS) in the digestate is organic Dry Solids (oDS) then the specific residual biomethane yield (above and beyond Guarantee Value) is multiplied by Supplier's Guarantee Value for the Amount of total solids contained in digestate and then multiplied by 75% to give a biomethane quantity which is multiplied by biomethane price LBM as per the revenue item LBM in *Table 15*.	239.668 *(8)*	For each full percentage deviation of biomethane per kg digestate DS above and beyond the Guarantee Value.

PT06	A	The achieved value is the average of 4 separate tests in total in different weeks.	1.000 p.a. tons is the minimum amount of reject that is currently made at the site) and will be used as an assumption. It will be assumed that the Supplier will guarantee 30% (meaning 300 tons of dry matter as stated in section 6.4.2). A percentage reduction in dry matter content will increase tons of reject wet weight and therefore disposal costs. The costs of disposal will be calculated by multiplying the Client's operational cost item for reject disposal (if it can be sent to landfill) by the cost item LAN in *Table 14* if the Supplier guarantees this disposal route. The costs of disposal will be calculated by multiplying the Client's operational cost item for 1. reject disposal to the WtE plant (cost item WTE in *Table 14*) if the Supplier does not guarantee disposal to landfill. 2. reject disposal to Landfill (cost item LAN) in *Table 14* if the Supplier does guarantee disposal to landfill.	275.862 (LAN) *(8)* 413.793 (WTE) *(8)*	For each percentage point reduction of the Guarantee Value percentage

PT07	A	The achieved value is the average of 4 separate tests in total in different weeks.	The total suspended solids content in LFD will be as per the Supplier's Guarantee Value. The quantity of LFD will be as per the Projected Estimate in *Table 23*. The amount of suspended solids p.a. is calculated. It will be assumed that the Liquid Fraction Digestate after mechanical separation will be processed in Lot D via evaporation and concentration to make Nutrient Liquor which will have a concentration of 15% suspended solids. After concentration the nutrient concentrate will be dried up to the Client's specification in *Table 25*. A higher suspended solids concentration means that more solids and therefore more Nutrient Liqour must be dried. The costs for the additional energy required for drying will be calculated as per the operational cost item DRY.	203.667 *(8)*	For each full percentage deviation from the Guarantee Value
PT08	A	The achieved value is the average of 4 separate tests in total in different weeks.	It will be assumed that additional costs will be incurred based on the difference between the operational cost items WTE and LAN. This difference will be multiplied by 1.000 tons (which is the amount of reject that currently arises at the Site)	4.000.000 *(8)*	Pass/fail
P09	A	SFD quantity and Dry Solids content will be measured on Workdays for 4 weeks (20 Workdays). The achieved value is the average value.	Using the Supplier's Guarantee Value for dry matter content in the digestate (but assuming the minimum dry matter content expected for SFD as per section 6.11) and assuming that all digestate will be dried as per the Client's specification in *Table 25*, the additional amount of water that must be dried will be calculated and multiplied by the operational cost item DRY	780.000 *(8)*	For each full percentage deviation from the Guarantee Value

PT10	A	SFD Dry Solids content and organic Dry Solids content will be measured on Workdays for 4 weeks (20 Workdays). The achieved value is the average value.	Assuming the amount of digestate dry solids as per *Table 25*, assuming the Supplier's Guarantee Value for dry matter content in the digestate, and assuming that all digestate will be dried as per the Client's specification *Table 25*, the additional amount of water that must be dried will be calculated and multiplied by the operational cost item DRY.	4.333.333 *(8)*	For each full percentage point reduction of the Guarantee Value percentage
PT11	A	As per Control System data. Measured for 28 consecutive Calendar days.	Additional electricity consumption per ton of feedstock, based on Client's Projected Estimate for yearly feedstock tonnage as per Table 8 and at 100% load.	491.400 *(8)*	For each full 5 percentage step increase of the Guarantee Value
PT12	A	As per Control System data. Measured for 28 consecutive Calendar days.	Additional heat consumption caused based on Client's Projected Estimate for yearly digestate production as per *Table 20*, multiplied by Operational Cost item HEL given by the Client	343.200 *(8)*	For each full percentage deviation from the Guarantee Value
PT13	A	As per Control System data. Measured for 28 consecutive Calendar days.	Additional heat consumption caused multiplied by Operational Cost item HEL given by the client	202.800 *(8)*	For each full percentage deviation from the Guarantee Value
PT14	B	Measured during the entire duration of the Trial Operation period.	Percentage of biomethane which is recovered as sellable LBM compared to the amount of methane in the raw biogas produced in Lot A. The amount of methane in the raw biogas produced includes any methane lost in e.g. flaring or for any other measurable loss). Percentage recovery must take this into account as well as Availability.	2.877.188 *(5)*	For each full percentage point reduction in the Guarantee Value percentage

PT15	B	Measured during the entire duration of the Trial Operation period.	Percentage of CO_2 which is recovered as sellable food grade Liquid Bio-CO_2 compared to the amount of CO_2 in the raw biogas produced in Lot A. The amount of CO_2 in the raw biogas produced includes any CO_2 lost in e.g. flaring or for any other measurable loss). Percentage recovery must take this into account as well as Availability.	357.000 *(5)*	For each full percentage point reduction in the Guarantee Value percentage
PT16	B	As per Control System data. Measured for a continuous period of 28 Calendar days.	Additional electricity consumption caused based on Client's Projected Estimate for yearly quantity of biogas given in *Table 22* (with all methane and CO_2 being liquefied), multiplied by Operational Cost item ELE given by the Client	410.644 *(8)*	For each full percentage deviation from the Guarantee Value
PTD01	D	The achieved value is the average of 2 separate tests in total in different weeks.	Loss of revenue assuming 50% of the ammonia is captured in this form, multiplied by the unit revenue item FAN given by the Client, assuming an annual quantity of ammonia present in the LFD as per the Client's Projected Estimate given in *Table 23*.	63.840 *(8)*	For each full percentage reduction to the Guarantee Value percentage
PTD02	D	The achieved value is the average of 2 separate tests in total in different weeks.	Loss of revenue assuming 50% of the ammonia is captured in this form, multiplied by the unit revenue item FRA given by the Client, assuming an annual quantity of ammonia present in the LFD as per the Client's assumption given in *Table 23*.	191.520 *(8)*	For each full percentage reduction to the Guarantee Value percentage
PTD03	D	The achieved value is the average of 4 separate tests in total in different weeks.	The additional amount of water that must be evaporated per year multiplied by the operational cost item DRY given by the Client	1.745.714 *(8)*	For each full percentage reduction to the Guarantee Value percentage
PTD04	D	The achieved value is the average of 2 separate tests in total in different weeks.	Additional amount of water that must be evaporated per year multiplied by the Operational Cost item DRY given by the Client	1.976.000 *(8)*	For each full percentage reduction to the Guarantee Value percentage

PTD05	D	The achieved value is the average of 2 separate tests in total in different weeks.	Assuming that 50% of the ammonia is captured in this form, and assuming an annual quantity of ammonia present in the LFD as per the Clients assumption given in *Table 23*, the Additional amount of Product produced that must be transported per year multiplied by the Operational Cost item TRA given by the Client in *Table 14*	434.286 *(8)*	For each full percentage reduction to the Guarantee Value percentage
PTD06	D	Measured during the entire duration of the Trial Operation period.	For availability 85% (7.446 hours p.a.) 1% less availability = 84% = 87,6 hours fewer. The yearly quantity of digestate as per *Table 23* is assumed and a maximum flow per hour calculated based on the availability given by the Supplier. The hourly flow rate is multiplied by the 87,6 hours of availability for each percentage point reduction in availability, to give the total flow that must be treated elsewhere. This is multiplied by the unit cost of alternative treatment (send to waste to energy plant) which is the Cost Item WTE in *Table 14*.	4.147.059 *(5)*	For each full percentage reduction to the Guarantee Value percentage
PTD07	D	As per Control System data. Measured for a continuous period of 28 Calendar days (14 days producing ammonium salts, 14 days producing ammonia water).	Based on Client's Projected Estimate for condensate water for infiltration then calculating the additional electricity consumption caused then multiplied by Operational Cost item ELE given by the Client	208.478 *(8)*	For each full percentage deviation from the Guarantee Value

PTD08	D	As per Control System data. Measured for a continuous period of 28 Calendar days (14 days producing ammonium salts, 14 days producing ammonia water).	Based on Client's Projected Estimate for condensate water for infiltration then calculating the additional heat consumption caused then multiplied by Operational Cost item HEL given by the Client	494.000 *(8)*	For each full percentage deviation from the Guarantee Value
PTE01	E	Measured during the entire duration of the Trial Operation period.	For availability 96% (8.410 hours p.a.) 1% less availability = 95% = 87,6 hours fewer. The yearly quantity of materials to be dried is assumed as per *Table 25*. The hourly flow processed is calculated by dividing the yearly quantity of materials to be dried by the number of guaranteed hours of availability. The hourly flow is multiplied by 87,6 to give the amount of material that must be diverted from the dryer. The additional cost of transporting the fertiliser (due to having to transport the water that was not dried) is calculated by multiplying by the Operational Cost Item TRA given by the Client.	508.333 *(8)*	For each full percentage lower than the Guarantee Value percentage
PTE02	E	As per Control System data. Measured for a continuous period of 28 Calendar days.	The annual volume of water to be evaporated is as per the Client's Projected Estimate in Table 25. The additional heat required per year as a result of the lower efficiency is calculated. The Additional heat consumption caused then multiplied by Operational Cost item HEL given by the Client	317.200 *(8)*	For each full percentage deviation from the Guarantee Value

PTH01	H	As per Control System data. Measured for a continuous period of 28 Calendar days.	The annual volume of heat required is assumed as per DBCs assumptions for their own works and as per *Table 30* for Lot D and Lot E. The additional electricity required per year is calculated. The additional electricity consumption caused then multiplied by Operational Cost item ELE given by the client	938.261 *(8)*	For each full percentage point reduction in the Guarantee Value percentage

Table 41: Performance Tests: test procedures, damages

20 Expected Values

As part of its Commercial Offer the Supplier must give the following Expected Values. Expected Values are not Guarantee Values. Nonetheless the adherence to and achievement of these Expected Values will be measured before Taking Over and also during the Trial Operation period, and the Contractor should provide reasonable grounds for major deviations from Expected Values. There will be no commercial consequence to the Contractor in the event of not passing Expected Values during testing.

All Expected Values will be used in the Client's assessment, either of Quality or in the evaluation of Cost.

20.1 Expected values (except consumables)

No.	Lot (s)	Expected Value	Units	Refers to section	Use of information in the evaluation?
EV01	A	Retention time Line 1	Days	6.6.5	For information
EV02	A	Retention time Line 2	Days	6.6.5	For information
EV03	A	Unwanted methane leakage	nm^3 methane p.a.	6.17.2	Quality
EV04	B	Unwanted methane leakage	nm^3 methane p.a.	7.8.2	Quality
EV05	A	Expected amount of Reject which will be produced.	wet tons p.a.	6.4.2	Cost
EV06	A	The amount of visible contaminant present in the cleaned feedstock stream after the pre-treatment technology (total content of plastic, glass or metal pieces with a particle size greater than 4 mm as a percentage % by weight of the total dry matter)	%	6.4.2	Quality
EV07	A	Dry matter content of the heavy fraction product	% dry solids per total wet weight	6.6.4	For information
EV08	A	Amount in of sand/grit heavy fraction that would be produced	Wet tons p.a.	6.6.4	Quality
EV09	A	Organic dry matter content of the heavy fraction produced.	% organic dry solids per total wet weight	6.6.4	Cost
EV10	A	Ammonia N content in fermenter	mg NH4-N per litre fermenter content	6.6.6	Cost

EV11	A	The expected value of H_2S content in raw biogas before cleaning and upgrading) which the Supplier is suggesting should be targeted.	H_2S in ppm	21.3.10.5	Quality
EV12	A	The Supplier state whether the Infiltration Water, which will be as per the specification given in Table 24 could be suitable for dilution of these flocculants, coagulants (which will only be a non-binding statement, subject to testing and verification).	Yes/no	21.3.10.4	For information
EV13	A	Percentage N recovered in Solid Fraction Digestate: Total mass of nitrogen in any form in total solids in SFD divided by total mass of nitrogen in any form in incoming digestate before separation (expressed as N)	%	6.9.1	Cost
EV14	A	Percentage P recovered in Solid Fraction Digestate: Total mass of phosphorus in any form in total solids in SFD divided by of total mass of phosphorus in any form in incoming digestate before separation (expressed as P2O5)	%	6.9.1	Cost
EV15	A	Heat consumption per ton of feedstock pasteurised according to method K	kWh_{th}/ton of feedstock pasteurised according to method K	6.10.2	Cost
EV16	A	Total Solids capture rate: Total mass of total solids in SFD as a percentage of Total mass of total solids in incoming digestate before separation	%	6.11.1	Cost
EV17	B	Methane slip for Lot B when operating without CO_2 liquefaction	% Methane in offgas.	7.8.1	Quality
EV19	B	Methane slip for Lot B when operating with CO_2 liquefaction	% Methane in offgas.	7.8.1	Quality
EV19	A	Consumption of infiltration water (REC)	m^3 p.a.	21.3.8	Cost
EV20	A	Consumption of Fresh Water (H20)	m^3 p.a.	21.3.7	Cost
EV21	B	Consumption of Fresh Water (H20)	m^3 p.a.	21.3.7	Cost
EV22	H	Consumption of Fresh Water (H20)	m^3 p.a.	21.3.7	Cost
EV23	A	Amount of labour required (LNO)	hours p.a.	21.3.9	Cost
EV24	B	Amount of labour required (LNO)	hours p.a.	21.3.9	Cost

EV25	G	Amount of labour required (LNO)	hours p.a.	21.3.9	Cost
EV26	H	Amount of labour required (LNO)	hours p.a.	21.3.9	Cost
EV27	A	Amount of labour required (LSM)	hours p.a.	21.3.9	Cost
EV28	B	Amount of labour required (LSM)	hours p.a.	21.3.9	Cost
EV29	G	Amount of labour required (LSM)	hours p.a.	21.3.9	Cost
EV30	H	Amount of labour required (LSM)	hours p.a.	21.3.9	Cost
EVD01	D	Total mass of phosphorus in any form in total solids in phosphorus Product as a percentage of total mass of phosphorus in any form in incoming LFD (expressed as P2O5)	%	9.8	Cost
EVD02	D	Phosphorus content per ton of dry matter of the finished phosphorus Product, calculated as P2O5 content in dry tons relative to total dry tons	%	9.8	Cost
EVD03	D	Dry matter content of the finished phosphorus Product, Calculated as dry matter content in dry tons relative to total wet tons	%	9.8	Cost
EVD04	D	Consumption of Fresh Water (H20)	m^3 p.a.	21.3.7	Cost
EVD05	D	Amount of labour required (LNO)	hours p.a.	21.3.9	Cost
EVD06	D	Amount of labour required (LSM)	hours p.a.	21.3.9	Cost
EVE01	E	Electricity consumption	kWh_{el}/ton water evaporated	21.3.2.4	Cost
EVE02	E	Consumption of Fresh Water (H20)	m^3 p.a.	21.3.7	Cost

Table 42: Expected Values

20.2 Expected values (only consumables)

No.	Lot (s)	Item	Specification: Description incl. quantity related to unit price:	Unit price in EUROS	Consumption in units per year	Refers to section	How is the Expected Value used in evaluation?
EV31	Lot A	All consumables required for mechanical separation of digestate (flocculants, coagulants etc.).				21.3.10.4	Cost
EV32	Lot A	Consumables used for desulphurisation.				21.3.10.5	Cost
EV33	Lot A	Trace elements, other fermentation process additives				21.3.10.6	Cost
EV34	Lot B	Consumables used for desulphurisation.				21.3.10.5	Cost
EVD07	Lot D	Consumption of alkali (ALK)	Dry tons p.a.			21.3.10.2	Cost
	Lot A	Consumables as defined by the Supplier, 1,2,3 etc.					Cost
	Lot B	Consumables as defined by the Supplier, 1,2,3 etc.					Cost
	Lot G	Consumables as defined by the Supplier, 1,2,3 etc.					Cost
	Lot H	Consumables as defined by the Supplier, 1,2,3 etc.					Cost
	Lot D	Consumables as defined by the Supplier, 1,2,3 etc.					Cost
	Lot E	Consumables as defined by the Supplier, 1,2,3 etc.					Cost

Table 43: Expected Values (consumables only)

21 Evaluation procedure

21.1 Overview

21.1.1 Explanation of the evaluation procedure.

Cost is one of the evaluation criteria. The evaluation of Cost is described below (although a few aspects of the "offered solution" part of the evaluation are also described).

The award criteria in general (as well as the weighting) are explained document "Tender rules" where further explanations of evaluation criteria (above and beyond cost) are given.

In the description below it is explained (partly) how the Client plans to evaluate the Commercial Offers. This procedure may be subject to change. Nevertheless, the evaluation model will be set before the opening of the first tender. The suppliers will not receive all detailed information on how the Client will evaluate the tender.

21.2 Evaluation procedure: Capital expenditure (CAPEX)

21.2.1 Overview CAPEX

The total CAPEX offered by each supplier will be evaluated. Total CAPEX will include the cost of critical Spare Parts as well as the cost of Spare Parts until taking Over. This will be the only Commercial Offer which the Supplier must offer.

21.2.2 CAPEX breakdown

The Supplier must give the CAPEX cost as a binding price for each individual Lot.

If the Supplier gives a price breakdown, the price breakdown items given by the Supplier in the Pricing Form must correspond exactly to items which have the same name) and which must be described in detail) in the Supplier's Commercial Offer.

The Supplier is completely free to choose how it constructs the price breakdown. The advantage that we are expecting is that the Supplier's Commercial Offer must be as informative as possible because it can correspond to the Supplier's usual way of presenting and defining and describing commercial information.

It is permitted to include one price breakdown item called OTHER.

The Supplier is free to define how many individual price breakdown items the Supplier gives.

Normal operations requires the provision of Spare Parts, a term defined in the glossary. Those Spare Parts required before Taking Over (see section 21.4.5) and those required to guarantee the availability guaranteed by the Supplier both before and after Taking Over (which are called Critical Spare Parts) (see section 21.4.4) must be stated in sheet 3 in the template "Attachment 2B - Price form.xlsx" provided and will be considered for the purposes of this evaluation as CAPEX.

21.3 Operational Cost

As part of its Tender in response to ITT 1 the Supplier must supply all information that the Client will require to enable the Client to make an overall commercial assessment of

Operational Cost over the Business Case Period (15 years after Taking Over) of the Plant's respective Lots.

We need to understand the Total Cost of Ownership of any technology or process. This will feature heavily in the evaluation since we will evaluate the full operational costs over the Business Case Period (15 years after Taking Over) without considering any indexation.

To better understand this section, Suppliers must read the definitions given in *Table 14* which describes the commercial parameters considered in evaluating OPEX.

We have divided OPEX into 2 categories which are further described and explained in this section.

1. Operational Costs per year (this section) including Consumables
2. External cost of service and maintenance (section 21.4) including Spare Parts

For the purposes of the evaluation, the OPEX will be evaluated as the sum total of the above-mentioned 2 categories over 15 years.

Capital Repairs over 15 years (as described in section 21.7) will NOT be included in the evaluation of OPEX, but as part of the evaluation of Solution offered.

21.3.1 Operational Costs

Operational Cost will be calculated by the Client based on the Suppliers' estimates of the consumption of energy, heat, labour, water. It also includes the Supplier's Expected Value for service and maintenance costs that will arise within the Client's Operations Team as opposed to the *External* Cost of Service and Maintenance from 3rd parties (which will be as price given as part of the Supplier's Commercial Offer as described below in section 21.4).

The Suppliers must give Guarantee Values and in some cases Expected Values concerning annual consumption in the respective sheets of template "Attachment 2B - Price form.xlsx" provided. Such annual consumption values of course depend on the throughput of material though a particular technology. The Client has provided with Supplier with annual figures for Capacity in this document. These are the assumptions that must be used by the Supplier for annual consumption and are in turn the values the Client will use for the evaluation.

As described in *Table 14* we have define the unit cost of Operational Costs such as electricity, heat, water, labour etc. In our template "Attachment 2B - Price form.xlsx" provided, the Suppliers' Guarantee Values and Expected Values given for consumption are multiplied with unit costs to give operational costs per year and then over 15 years.

21.3.2 Electricity (ELE)

The Supplier must give the following Guarantee Values regarding Electricity consumption

21.3.2.1 For Lot A

The Supplier must give the following Guarantee Values regarding Electricity consumption:

1. for the complete scope of Lot A, kWh_{el} per ton of feedstock processed

For Lot A the electricity consumption is based on the assumption that the type and proportion of feedstock fed into Lot A is as approximately per Table 8 and the quantity of feedstock is as per the figure given for Average capacity for Performance Test in *Table 16*.

The Supplier must also give Guarantee Values for specific electrical consumption values at 100%, 90%, 80%, 70% and 60% of the figure given for Average capacity for Performance Test. See also section 17.5.4.1.

21.3.2.2 For Lot B

The Supplier must give the following Guarantee Values regarding Electricity consumption for:

1. kWh_{el}/nm^3 raw biogas.

However the Guarantee Value given for electricity consumption will include not only the electricity consumption for biogas upgrading technology but also for the methane liquefaction technology, for the CO_2 liquefaction technology and for all other technology (complete scope of Lot B)

For Lot B the electricity consumption is based on the assumption that all electrical consumption is measured at daily production capacity as defined in *Table 22*. Such figures will be defined as 100% of daily production capacity. See also section 17.5.4.1.

The Supplier must also give Guarantee Values for specific electrical consumption values not only at 100% but also at 90%, 80%, 70% and 60% of daily production capacity.

21.3.2.3 For Lot D

The Supplier must give the following Guarantee Value regarding Electricity consumption:

1. kWh_{el} per ton of water in Infiltration Water quality produced.

The Guarantee is based on the assumption that the digestate composition is as described in *Table 23*.

If the Guarantee Value given will vary depending if the composition of the Liquid Fraction Digestate varies the Supplier must explain why and quantify the variation of the Guarantee Value and how and with which dynamic it vary depending on defined parameters (also to be defined by the Supplier).

21.3.2.3.1 Regulation concerning operation mode Lot D

This Guarantee Value will probably vary depending upon whether ammonium sulphate is produced as a nitrogen product or ammonia water, then it will (both for the purposes of the evaluation as well as during the Performance Test) be assumed that there is a 50% split between both operation modes as per the calculation procedure explained in section 21.5.3.2. This will be reflected in the testing procedure as well. During the 28 Calendar Day testing period Lot D will be operated in 2 different modes for 14 Calendar Days each, namely mode 1. Producing ammonia water and mode 2. Producing ammonium salts. Consumption in both modes will be measured. The mass of Ammonia captured in both modes will be measured. Absolute values for electricity consumption in each mode will be weighted to as to calculate at the total consumption, and then the specific consumption (per m^3 of Infiltration

Water produced) under the assumption that 50% of the ammonia (by mass) is captured as ammonia water and 50% of the ammonia (by mass) is captured as ammonium salt.

21.3.2.4 For Lot E

The Supplier must give the following Guarantee Values regarding Electricity consumption:

1. for the complete scope of Lot E, kWh_{el} per ton of water evaporated

21.3.3 Heat (HEL)

21.3.3.1 For Lot A

For all Guarantee Values related to heat consumption the following applies. If hot water or hot Infiltration Water is used as an input in a process (e.g. as recirculation water in Lot A or as dilution water in Lot A fermenters or pasteurisation) then the amount of heat transferred will be calculated and will be deemed to be heat consumption.

The Supplier must give the following Guarantee Values regarding Heat consumption:

1. Heat consumption kWh_{th}/ton of material pasteurised for all materials apart from those processed according method K

The Supplier must state

- whether the pasteurisation process is before or after fermentation
- which quantity of material per year the Supplier expects to process in the pasteurisation technology, whereby material means feedstock plus any liquid required (if pasteurisation is before fermentation) and material means digestate (before mechanical separation) (if pasteurisation is after fermentation).

2. Heat consumption of all Solid Feedstock Reception Units plus all Liquid Feedstock Reception Tanks plus all Tanks (i.e. any tank which contains Substrate, namely Mixing Buffer Tanks, Fermenters and Digestate Buffer Tanks) in total, expressed as a Guarantee Value for kWh_{th} per day. For the Performance Test for this Guarantee Value the quantity of feedstock fed into the Plant (in tons per week) will not exceed the figure given for the Average capacity for Performance Test give in *Table 19*.

For this particular Guarantee Value 2. the following applies. Heat consumption depends on external climatic conditions which vary considerably over the year. The Supplier must give different heat consumption guarantee values for different calendar months, whereby the Supplier must use as assumptions the data given regarding climatic conditions in section 25.10 and in Appendix A.140.

The Supplier must give an Expected Value for heat consumption kWh_{th}/ton of feedstock pasteurised according to method K (section 6.10.2)

21.3.3.2 For Lot D

The Supplier must give the following Guarantee Values regarding Heat consumption:

1. kWh_{th} per ton of water in Infiltration Water quality produced.

This only applies to heat supplied externally from Lot H. If Lot D uses steam but this steam is self-generated internally, inside Lot D using electricity then this will count towards the electricity consumption.

For this Guarantee value the same assumptions apply as described in section 21.3.2.3.1 as regards the 2 different operation modes.

21.3.4 Costs of reject disposal (if going to landfill) (LAN)

21.3.4.1 For Lot A

If the Supplier is able to treat the reject so that it can be sent to landfill, the Supplier, as part of their Commercial Offer, must confirm their ability to guarantee both of the following Guarantee Values.

1. Reject contains maximum 20% of easily decomposable organics dry solids in reject total dry solids.
2. Amount of Total Organic carbon within reject total dry solids is maximum 10%.

The Supplier must give an Expected Value for the amount (in wet tons p.a.) of reject. In the evaluation this will be multiplied by the Operations Cost item LAN given in *Table 14*.

For Suppliers that are not able to guarantee both of these Guarantee Values should refer to section 21.3.5.

21.3.5 Costs of reject disposal including transport (if going to WtE plant) (WTE)

21.3.5.1 For Lot A

If the Supplier does not confirm their ability to guarantee both of the Guarantee Values described in section 21.3.4 regarding organic dry solids in reject and Total Organic Carbon in reject then we will assume that the reject cannot be sent to landfill.

The Supplier must give an Expected Value for the amount (in wet tons p.a.) of reject. In the evaluation this will be multiplied by the Operations Cost item WTE given in *Table 14*.

21.3.6 Costs of reject disposal if it is sand/grit/sediment (SAN)

Suppliers are not required to, but may have a feedstock pre-treatment technology which is able to produce sand/grit/sediment as a discrete heavy reject stream, as described in section 6.6.4.

1. In the event that the Supplier is able to produce a heavy reject fraction the Supplier must give an Expected Value for the dry matter content of the heavy fraction product
2. give an Expected Value for the organic dry matter content of the heavy fraction produced.

21.3.7 Consumption of Fresh Water (H2O)

If for any Lot Fresh Water is required for any reason this must be stated. Fresh Water is most likely to be which will be river water with filtration and pre-treatment as per technical Supplier's specifications, but may well be surface water or rainwater that has undergone elementary filtration (to reduce grit or sand content).

All Lots must give Expected Values for the consumption of Fresh Water (H2O) which is used for any purpose. The Supplier's Expected Values for the consumption will be multiplied by the operational cost item H2O in *Table 14*.

21.3.8 Consumption of Infiltration Water (REC)

In terms of operational costs it would be desirable and would be a very significant advantage for the Client if instead of using Fresh Water (H2O) (as per section 21.3.7) Infiltration Water from digestate treatment (Lot D) for infiltration can be used in Lot A. The specification for Infiltration Water will be as per *Table 24*.

Only the Supplier for Lot A must give an Expected Value for the consumption of Infiltration Water which is used for any purpose. The Supplier's Expected Values for the consumption will be multiplied by the operational cost item REC in *Table 14* which is calculated as zero, which will therefore reduce the operational Cost.

21.3.9 Labour cost

21.3.9.1 Existing and future Operations Team

The Client is fortunate in being owned by 6 experienced regional waste management companies. At the Site there is a team which operates a waste management facility at the proposed Site. This facility has been in operation for some 20 years. Many of the waste and most of the kinds of waste proposed in this project are already being processed at the Site. In summary we expect to be in a position to build up a good operational team for this project. Furthermore we intend to work closely with the Contractor early in the construction phase as regards training and know how transfer. Works placements for future Operations Team members at other relevant biogas plants are also envisaged.

The Client needs to understand the requirement for labour in order to work out how many new team members must be employed by the Client. The Supplier must give the Client an expected Value for the requirement for labour due to the technology they will deliver.

In giving data about labour requirement as described in section 21.3.9.2, the Supplier must assume that the Client's Operations Team has been fully trained, initial trouble shooting after Taking Over has been done, and that the Operations Team is experienced, familiar with the work to be done. The Supplier must not assume the situation we have immediately following Taking Over but must assume the status that has been reached one year afterwards.

21.3.9.2 Categories of labour cost (LNO and LSM)

As regards Client Operations Teams labour as an operational cost, some explanations are required. All work done at the plant by any employee in the Client's Operations Team will for the purposes of the Tender submitted and for the evaluation be divided into one of 2 categories. This first category (Labour for Normal Operations or "LNO") is the requirement for all work required for normal operations i.e. to ensure that the plant is functioning. It includes any management or administrative work, organisation, normal physical use of machinery, data recording and interpretation, and other simpler manual work such as moving or loading materials and regular cleaning.

The second category (Labour for Service and Maintenance or "LSM") concerns all work required for any service and maintenance. More specifically this means work required for any daily, weekly, seasonal, annual, minor or major service and maintenance work (including checks and inspections) as well as work required for repairs, fault correction, trouble shooting, problem solving and contingencies which will be done by the Client's Operations Teams.

21.3.9.3 Overtime

The Supplier's Estimated Value for both categories of Client Operations Team, labour requirement must be a number of hours. We would require this information in order to be able to plan the personnel requirement. The estimate must include all skill profiles and all kinds of work.

Overtime at evenings and weekends could be required due to the constraints of daily business in operations. As much as we would welcome being able to completely avoid any requirement for Operations Teams to work overtime, we expect that it will be unavoidable in reality. In making estimates for number of hours of labour, Suppliers must bear in mind additional costs due to overtime at evening and weekends. These factors are mentioned in *Table 14*. These 2 factors are

1. factor "OVW" for after-hours work during the week, which is plus 50% factor and
2. factor "OVH" which is for work on public holidays and weekend which plus 200%)

and must be factored into the estimate of the number of hours i.e. 5 hours labour at the weekend (OVH) would mean 10 hours.

21.3.9.4 Expected Values

To summarise all Suppliers for all Lots must give an expected Value (which is not a Guarantee Value) for

1. LNO: all work required for normal operations i.e. to ensure that the plant is functioning (including any management or administrative work, organisation, physical use of machinery, data recording and interpretation, and other simpler manual work such as moving or loading materials and regular cleaning).
2. LSM: work required for any daily, weekly, seasonal, annual, minor or major service and maintenance work (including checks and inspections) as well as work required for repairs, fault correction, trouble shooting, problem solving and contingencies which will be done by the Client's Operations Teams.

The average labour cost per hour across all categories of staff and skill sets in the clients Operations Team will be used for the evaluation.

What is much more important here is the sum total of LNO and LSM to estimate total labour requirement. Having an exact split between LNO and LSM is much less important.

21.3.10 Consumables

We refer to the definition of Consumables in Table 14.

Consumables are necessary for the effective operation of technology supplied by the Supplier.

All Suppliers must give 3 items of information as regards the ongoing OPEX associated with Consumables.

1. A recommended specification (including description) of one commercially available sale unit - for example
- 1 m^3 of sulphuric acid H_2SO_4 at 93% concentration w/w.
- 1 big bag of Iron (III) hydroxide ($Fe(OH)_3$) containing 1.000 kg
- 1 sack of trace elements containing 50 kg of trace elements.
- 1 container containing 10 tons of activated carbon
2. the current unit price of the respective reagent are (DDP Site) per given unit based on current quotes from suppliers of the respective reagent in the marketplace (whereby this price is for information only and it is not to be guaranteed in any way).
3. an Expected Value (which is not a Guarantee Value) for the amount of consumption of Consumables.

21.3.10.1 Sulphuric acid

This is one of 2 cases where the Client defines the cost of a consumable.

Sulphuric Acid is defined as the reagent for capturing ammonia as an ammonium salt in Lot D according to a consumption rate defined by the Client as explained in section 9.11 (which appears as SUL in *Table 14*).

21.3.10.2 Sodium hydroxide

This is the second of 2 cases where the Client defines the cost of a consumable.

Sodium Hydroxide is defined as the reagent for adapting pH in Lot D (which appears as ALK *Table 14*).

If the Supplier for Lot D requires any alkali for its process, it must give as an Expected Value the consumption in dry tons p.a. assuming the capacity of digestate treatment as per Table 42.

21.3.10.3 To be excluded from the Supplier's calculation of consumables

In the following cases the Supplier does not have to and should not give information on consumption of Consumables.

1. Consumption and cost of acid, if used for capture of ammonia during digestate treatment in Lot D is calculated automatically. The Supplier does not need to give any statements, Guarantee Values or Expected values in this regard.
2. Consumption of all reagents in scrubbers (most commonly acid and alkali) if they are associated with or part of Odour Treatment and Management Systems, or dryers, if the reagent is used whereby the focus is on avoidance of emissions).

21.3.10.4 Consumables for mechanical dewatering

The Supplier must state the specification, estimated cost and (as an Expected Value) the specific consumption of any and all consumables required for mechanical separation of digestate in Lot A (flocculants, coagulants).

The Supplier must also state whether the water for infiltration, which will be as per the specification given in *Table 24* could be suitable for dilution of these flocculants, coagulants (which will only be a non-binding statement, subject to testing and verification before commissioning).

21.3.10.5 Reagents for desulphurisation

This will include both reagents such as iron salts which are added to the fermenters in Lot A as well scrubbing column reagents such as activated charcoal in Lot B.

We estimate that all feedstock for the biogas plant may contain 50 tons of sulphur per year. Suppliers will probably be aware that only a small percentage of sulphur becomes 21.3.10.5 in biogas during the digestion process. The analyses given in Appendices A.200 to A.279 also contain information on H_2S content of biogas produced in the batch tests.

In estimating the consumption of reagents in total the Supplier must state

1. The expected value of H_2S content in raw biogas before cleaning and upgrading) which the Supplier is suggesting should be targeted.
2. The specification, estimated cost and (as an Expected Value) the yearly consumption of all consumables used for desulphurisation both for Lot A and for Lot B separately.

21.3.10.6 Trace elements and other additives

The Supplier for Lot A must give the specification, estimated cost and (as an Expected Value) the yearly consumption of all consumables which are used as additives for the fermentation process, above and beyond consumables for desulphurisation mentioned in section 21.3.10.5.

21.3.10.7 All other consumables for all Lots

Above and beyond the Consumables which we have mentioned above, we expect that the technology supplied will require further Consumables.

The Suppliers must give an exhaustive list of Consumables or types of Consumables that will be required in the Plant, since this must and can only be defined and specified by the Suppliers.

21.4 External cost of service and maintenance

The Supplier must completely declare in detail all preconditions which have to be fulfilled by any Parties in order to ensure that the particular Guarantee Values (particularly availability, but there may be others) can be achieved. Such preconditions *could be for example*

1. Client must sign a contract for operations support/ service/ maintenance/ monitoring/ consulting ("Service Contract" – see section 21.4.2) with the Contractor
2. Client stores defined strategic/emergency spare parts at the Site (so-called "Critical Spare Parts" – see section 21.4.4).
3. Client regularly performs certain defined maintenance/service tasks etc. (which must be quantified as an operational cost "LSM," (please refer to section 21.3.9.2)

whereas this is not an exhaustive or prescriptive list.

21.4.1 Commercial offer for external cost of service maintenance

The Supplier must submit a commercial Offer with a price for service and maintenance for a period of 2 years after Taking Over.

The Supplier must structure the Commercial Offer with minimum 2 and maximum 5 price positions

1. Spare Parts, i.e. all Materials including costs of transport, and as described with a detailed breakdown in sheet 5 in the template "Attachment 2B - Price form.xlsx" provided by the Client as described in section 21.4.3
2. Labour i.e. the totality of the Supplier's costs for the Supplier or 3rd Party personnel including travel, transport and lodging.
3. Up to 3 additional cost items if required, which must be specified in detail and which must explain the distinction costs in that particular item and 1. Spare Parts and 2. Labour.

The Supplier must state the costs to the Client of such external Service and Maintenance contract. This must include all costs for management, administration, labour (both off Site and on Site) use of tools and software, reporting, reasonable estimates for travel to the Site and for lodging for the Suppliers' staff.

The offer must not only include costs for regular and preventive service and maintenance but also for costs incurred unexpected repairing outages and breakages and other generally unforeseen and non-plannable interventions which also reduce availability. The Supplier must estimate costs for repairing outages and breakages and other generally unforeseen and non-plannable interventions based on other similar existing installations that the Supplier has built and assuming an average amount of such interventions. The costs must also include costs for replacement of technology within warranty/guarantee.

The requirement for Labour from the Client's Operations Team ("LSM") as described in 21.3.9.2 is the Client's labour cost associated with this activity, and is therefore not included in external cost of service and maintenance.

21.4.2 Service Contract (optional for the Client to trigger)

The Supplier must include in the Commercial offer for external Service and Maintenance a model or draft Service Contract. The Client's preferred contractual partner is the Supplier itself. The Contractor may as an alternative suggest an appointed party, recommended by the Contractor as the respective counterparty for such a Service Contract. We currently expect that the scope, terms and conditions and duration of such a Service Contract would be discussed and negotiated at the same time as the negotiations for the Contract governing the delivery of the Works, or possibly after thereafter.

At the same time we would like to point out that due to our geographic location, we expect and will require that our Operations Team - after appropriate training during and after commissioning - will become fully trained, independent, and self-reliant as possible. This will ideally happen with the support delivered by the Contractor (and/or it's appointed Service Contract counterparties)

The draft version of the contract for this Plant does not have to include all detailed Annexes. Only the final version of such a Service Contract must include an exhaustive list of work, services, responsibilities which must be supplied by the Client's team i.e. it is NOT required in the initial draft supplied as part of the Supplier's Commercial Offer). Assumptions as regards the Client's team must be made and must be stated clearly.

21.4.3 Spare Parts after Taking Over (breakdown)

The Works must include the totality of all Spare Parts that will be required after Taking Over as an annual cost.

This price is a binding price for a period of 2 years after Taking Over.

The Supplier must supply detail as follows.

For each item where the overall expenditure on the item is € 5.000 over 2 years or more (net prices, DDP Site, at the time when the Supplier submits their Commercial Offer) the respective item must be detailed. In this case the Supplier must

1. Define the Lot with which the Spare Part is associated (by selecting from the drop-down menu "Lot X (INDIVIDUAL ITEM")
2. Give the name of the Spare Part
3. Give a very brief description of the item's function
4. Give the unit price
5. Give the number required over 2 years as part of a binding price in their Commercial Offer.
6. Give the estimated number (non-binding) required over 15 years .

For all other item where the overall expenditure on the item is below € 5.000 over 2 years (net prices, DDP Site, at the time when the Supplier submits their Commercial Offer) the costs for all these items do not need to be detailed. In this case the Supplier must only give as one sum of money the aggregated price of such items (at the time when the Supplier submits their commercial offer) both a binding price over 2 years and quantity estimate over 15 years. The Supplier must enter this information in sheet 5 in the template "Attachment 2B - Price form.xlsx" provided by selecting from the drop-down menu "Lot X ALL OTHER ITEMS."

The Supplier may add lines if required, but must do this by using the copy paste function.

Spare Parts which are used for several Lots may be split between Lots.

All figures must be given in Euros. If certain materials' prices are only available in NOK the exchange rate for NOK/EURO as defined in section 3.6 must be assumed.

Spare Parts after Taking Over are counted as OPEX. They must be distinguished from Critical Spare Parts (21.4.4) and Spare Parts during Commissioning until Taking Over (21.4.5) which both count as CAPEX.

21.4.4 Critical Spare Parts

The Works must include a complete set of Critical Spare Parts which according to the Supplier must be kept and stored by the Client in its own stock to ensure that performance guarantees as regards availability can be fulfilled.

This must be given as a lump sum flat fee.

The will be considered to be a "one off" CAPEX cost, not as an OPEX cost for the evaluation.

The Supplier must describe the costs in sheet 3 of "Attachment 2B - Price form.xlsx" provided.

21.4.5 Spare Parts during commissioning until Taking Over

The Works must include the complete set of Spare parts that will be required until Taking Over.

This must be given as a lump sum flat fee.

The will be considered to be a "one off" CAPEX cost, not as an OPEX cost for the evaluation.

The Supplier must describe the costs in sheet 3 of "Attachment 2B - Price form.xlsx" provided.

21.5 Revenue

The Supplier must give information to enable the Client to calculate what the revenue of the Plant is expected to be. This will come from Guarantee Values which the supplier must state in sheet 9 in the template "Attachment 2B - Price form.xlsx" provided as follows.

There are 3 revenue sources whose calculations are described below, namely liquid biomethane (LBM), Liquid Biogenic CO_2 ($LBCO_2$) and fertiliser whereas there are several different fertiliser products.

21.5.1 Revenue from biomethane

The Client's expectation of LBM production is 3.875 tons p.a.

The amount of biomethane which can be generated by the Plant depends on many factors which involve both Lot A and Lot B.

1. Quantity and quality of feedstock delivered by the Client
2. The amount of biomethane produced from the feedstock by the Plant in Lot A.
3. The amount of biomethane recovered from the biogas in Lot B.
4. The amount of production of liquid biomethane from biomethane after upgrading.

The degree to which raw biogas produced in the fermenters in Lot A can be recovered as fuel grade liquid biomethane after upgrading will be a Guarantee Value named "LBM recovery" which is given by the Supplier as mentioned in section 7.10.

The amount of biogas produced by the Plant in Lot A in turn depends primarily on

1. the feedstock processed in the Plant (for which the Client is responsible) as well as the
2. stability of the biological process and the quality, effectiveness and design of the technology installed (both of which lie within the responsibility of the Contractor).

The biogas potential of the feedstock is difficult, cumbersome, and expensive to regularly measure and calculate during the Taking Over Test period. The Client believes that it is much easier, quicker, cheaper, and fairer to measure the Residual Biomethane Potential in the digestate produced (this is the Guarantee Value "Residual Biomethane Potential" mentioned in section 21.5.1.

The annual production of methane in raw biogas in Lot A (as input for Lot B) will be considered to be the Production Capacity value given in *Table 22*.

The Projected revenue from selling LBM thus therefore has 2 components.

<u>1: LBM production (Lot B)</u>

This is the greatest factor in the overall calculation. It is the product of the Annual production of methane in raw biogas from Lot A (3.875 tons per year) and the Supplier's Guarantee value for LBM Recovery in %.

<u>2: Residual biomethane production (Lot A)</u>

- This will depend on the amount of biomethane which is NOT produced (i.e. which remains as Residual Biomethane Potential in the digestate.
- This is calculated as the Suppliers' Guarantee Value for annual tonnage of Digestate Dry Solids (and assuming that 75% of the Dry Solids (DS) in the digestate is organic Dry Solids (oDS)) multiplied by the specific Residual Biomethane Potential for digestate per ton of digestate organic Dry Solids.
- The Revenue not realised in biomethane production will be calculated as an annual amount.

As an example, if the supplier gives the following Guarantee Values

LBM Recovery in %	=	99%
Residual Biomethane Potential	=	75 nm^3 methane/ton of digestate oDS.
Digestate Dry Solids	=	5.000 tons p.a.
Digestate oDS content	=	75%
Digestate organic Dry Solids	=	3.750 tons p.a.

Residual Biomethane Potential p.a. is then equal to

3.750 t.p.a. oDS x 75 nm^3 methane/ton of digestate oDS =

281.250 nm^3 methane x 0,7173 kg per nm^3 (at STP 273,16 K and 1 atm) CH_4 =

201,741 tons methane p.a.

LBM production (Lot B) = 3.875 x 99%	=	3.836,25 tons p.a.
Residual biogas production (Lot A)	=	201,741 tons p.a.
LBM production (Lot B) – Residual CH_4 production (Lot A) =		3.634,509 tons p.a.

3.634,509 tons p.a.is then multiplied by the unit sale price for LBM given in *Table 15*.

21.5.2 Revenue from liquefied CO_2

The Client's expectation of food grade $LBCO_2$ production is 5.950 tons p.a.

The amount of food grade $LBCO_2$ which can be generated by the Plant depends on many factors which involve both Lot A and Lot B.

1. Quantity and quality of feedstock delivered by the Client
2. The amount of CO_2 produced from the feedstock by the Plant in Lot A.
3. The amount of CO_2 extracted from the biogas in Lot B.
4. The amount of production of food grade liquid CO_2 from CO_2 after upgrading.

The degree to which raw CO_2 produced in the fermenters in Lot A can be recovered as fuel grade liquid biomethane after upgrading will be a Guarantee Value named "$LBCO_2$ recovery" which is given by the Supplier as described Table 39 in section 18.2.

The only factor which is considered for this revenue stream is the Supplier's Guarantee Value as regards $LBCO_2$ recovery.

The basic assumption is the Client's assumption as regards the Production Capacity for Annual production of CO_2 in raw biogas from Lot A (mentioned in *Table 22*) which is 5.950 tons p.a.

Assuming the Supplier's Guarantee Value for

$LBCO_2$ Recovery in %	=	99% then
Annual $LBCO_2$ production	=	5.890,5 tons p.a.

5.890,5 tons p.a. is then multiplied by the unit sale price for $LBCO_2$ given in *Table 15*.

21.5.3 Revenue from fertiliser and associated Operational Costs

21.5.3.1 Fertiliser revenue and operational costs from Lot A

21.5.3.1.1 Revenue

For Lot A, revenue will be automatically calculated based on the following procedure

1. For Lot A, the value "Percentage N recovered in Solid Fraction Digestate" will be used.
2. The Client's Projected Estimate mentioned in *Table 20* for the total quantity of TKN tons/year (§) present in the digestate BEFORE separation (Line 1 and Line 2 added together) will be used as the starting quantity.
3. The Guarantee Value "Percentage N recovered in Solid Fraction Digestate" multiplied by the Client's Projected Estimate for the total quantity of TKN gives the total amount of TKN that will be recovered in SFD in Lot A.
4. The total amount of TKN that can be recovered in SFD in Lot A is multiplied by the unit sale price item (FAS) (Fertiliser nutrients for sale: N in the form e.g. ammonium sulphate, N contained in SFD) mentioned in *Table 15* to give the revenue from N contained in SFD in Lot A.
5. For Lot A, the value "Percentage P_2O_5 recovered in Solid Fraction Digestate" will be used.
6. The Client's Projected Estimates mentioned in *Table 20* for the total quantity of P_2O_5 tons/year (§) present in the digestate BEFORE separation (Line 1 and Line 2 added together) will be used as the starting quantity.
7. The Guarantee Value "Percentage P_2O_5 recovered in Solid Fraction Digestate" multiplied by the Client's Projected Estimate for the total quantity of P_2O_5 gives the total amount of P_2O_5 that can be recovered in SFD in Lot A.
8. The total amount of P_2O_5 that can be recovered in SFD in Lot A is multiplied by the unit sale price "Fertiliser nutrients for sale: P_2O_5 in the form of SFD produced by Lot A, P_2O_5 in the form of a precipitated Product produced by Lot D" (FPO) mentioned in *Table 15* to give the revenue from P_2O_5 contained in SFD in Lot A.

21.5.3.1.2 Costs

For Lot A, the costs associated with realising the above-mentioned revenue will be automatically calculated based on the following procedure

1. The amount of total dry solids in the digestate produced in Lot A will be as per the Guarantee Value PT09 "Amount of total solids contained in digestate" given by the Supplier as mentioned in Table 39.
2. The amount of SFD (wet weight) produced by Lot A is derived from the amount of total dry solids present in the SFD (as per 1. above) produced in Lot A and the Guarantee Value PT10 "SFD DS content" given by the Supplier as mentioned in Table 39, whereby the amount of SFD DS divided by the dry matter content gives the amount of SFD wet weight (Line 1 and Line 2 together).
3. The wet SFD must be dried. In the dryer the dry matter content "SFD DS content" given by the Supplier of Lot A will be increased up to a dry matter content as given in *Table 25*. The amount of water to be evaporated is calculated by subtracting the final mass (wet weight after drying) from the initial SFD mass (wet weight before drying).
4. Only the energy costs of drying will be considered as the cost of drying. To do this the operating cost for evaporating one ton of water in a dryer (DRY) as defined by the Client in *Table 14* will be used. This will be multiplied by the amount of water to be evaporated as explained in 3. above.
5. Finally the costs of transporting the dried SFD will be estimated. To do this the operating cost for transporting one ton of dried fertiliser Product (TRA) as defined by the Client in *Table 14* will be used. This will be multiplied by the amount of dried SFD produced as calculated in 4. above.
6. The sum of costs of drying as per 4. above plus the costs of transport as per 5. above give the total costs.

21.5.3.2 Nitrogen fertiliser revenue and operational costs from Lot D

21.5.3.2.1 Revenue

For Lot D, revenue from selling nitrogen products will be automatically calculated based on the following procedure.

1. The amount of ammonia present in the LFD that can be converted into Products is as per the Client's Projected Estimate "NH_3-NH_4^+-N tons/year $_{(§)}$" given in *Table 23*.
2. As explained in section 9.11, the evaluation will be done under the assumption that 50% of the ammonia product will be produced in the form of ammonia water, and 50% of the ammonia product will be produced in the form of ammonium sulphate, whereby the assumption is based on the total mass of ammonia captured in each of the 2 products.
3. Total flows of LFD into the 2 product streams will depend on the 2 Guarantee Values "Percentage N recovered as ammonia salt" (PTD01) and "Percentage N recovered as ammonia water" (PTD02) and the assumptions for the respective flows will be calculated by the Client, to give dry ton amounts for 1. Ammonia as ammonium sulphate and 2. Ammonia as ammonia water, since the assumption is that sulphuric acid will be used to make ammonium salts as described in section 9.11.
4. The revenue resulting from sale of ammonia as ammonia water is calculated by multiplying the dry ton quantity of ammonia as ammonia water (as per 3.) by the unit sale price FRA given by the Client in *Table 15*.
5. The revenue resulting from sale of ammonia as ammonium sulphate is calculated by multiplying the dry ton quantity of ammonia as ammonia water (as per 3.) by the unit sale price FAN given by the Client in *Table 15*.

21.5.3.2.2 Costs

For Lot D, the costs associated with realising the above-mentioned revenue from nitrogen products will be automatically calculated based on the following procedure.

1. The ammonia content in the ammonium sulphate product produced in Lot D will be as per the Guarantee Value "Ammonia salt ammonia content" given by the Supplier as mentioned in Table 39. Based on the amount of ammonia captured in the form of ammonium sulphate, the Client will calculate the amount of ammonium sulphate solution (ammonium sulphate solution ammonia quantity divided by ammonium sulphate solution ammonia content %). Total Dry solids content is calculated assuming that the ammonium sulphate solution only contains ammonium sulphate and water.
2. To sell ammonium sulphate it must be dried to make crystals. The ammonium sulphate solution therefore must be dried in a different Lot (Lot E) from the dry matter content calculated in 1. above up to a dry matter content as described in *Table 25*. The amount of water to be evaporated is calculated by subtracting the final mass (wet weight after drying) from the initial ammonium sulphate solution mass (wet weight before drying).
3. Only the energy costs of drying will be considered as the cost of drying. To calculate this the Operating Cost for drying one ton of water (DRY) as defined by the Client in *Table 14* will be used. This will be multiplied by the amount of water to be evaporated in making ammonium sulphate crystals as explained in 3. above.
4. The costs of making ammonium sulphate resulting from consumption of sulphuric acid will also be considered. The specific consumption of sulphuric acid will be as per the assumption given by the Client in section 9.11. The costs of sulphuric acid are as given in *Table 14* (item SUL). Specific consumption multiplied by specific costs gives total cost of sulphuric acid.
5. The costs of transporting the dried ammonium sulphate will be estimated. To do this the operating cost for transporting one ton of fertiliser Product (TRA) as defined by the Client in *Table 14* will be used. This will be multiplied by the amount of dried ammonium sulphate crystals produced as calculated in 1 and 2. above.
6. The amount of ammonia water is calculated by the Client by using the quantity of ammonia (dry solids) previously calculated and then dividing it by the Guarantee Value "Ammonia water ammonia content" given by the Supplier as mentioned in Table 39.
7. The costs of transporting the ammonia water will be estimated using the operating cost for transporting one ton of fertiliser Product (TRA) as defined by the Client in *Table 14* will be used which is then multiplied by the amount of ammonia water calculated in 6. above.

21.5.3.3 Phosphorus fertiliser product revenue and operational costs from Lot D

21.5.3.3.1 Revenue

For Lot D, revenue from selling phosphorus products will be automatically calculated based on the following procedure.

1. The amount of phosphorus present in the LFD that can be converted into Products is as per the Client's Projected Estimate "P_2O_5 tons/year $_{(§)}$" given in *Table 23*.
2. The amount of P_2O_5 that can be captured from LFD as a P_2O_5 product will be calculated using the Guarantee Value "Percentage P_2O_5 recovered in Product produced" given by the Supplier as mentioned in Table 39, multiplied by the quantity of P_2O_5 originally present in the LFD according to the Client's Projected Estimate as per 1. above.
3. The revenue resulting from sale of P_2O_5 Products is calculated by multiplying the dry ton quantity of P_2O_5 Products (as per 32.) by the unit sale price FPO given by the Client in *Table 15*.

21.5.3.3.2 Costs

For Lot D, the costs associated with realising the above-mentioned revenue from P_2O_5 Product will be automatically calculated based on the following procedure.

1. The quantity as wet weight of P_2O_5 product will be calculated by dividing the quantity of recovered P_2O_5 as per 2. above by the Supplier's Guarantee Value "Phosphorus content per ton of dry matter of the finished phosphorus Product" and then dividing it by the Supplier's Guarantee Value "Dry matter content of the finished phosphorus Product."
2. To the P_2O_5 Product it must be dried in a different Lot (Lot E) from the dry matter content calculated in 1 up to a dry matter content as described in *Table 25*. The amount of water to be evaporated is calculated by subtracting the final mass (wet weight after drying) from the initial P_2O_5 Product mass calculated in 1 (wet weight before drying).
3. Only the energy costs of drying will be considered as the cost of drying. To calculate this the Operating Cost for drying one ton of water (DRY) as defined by the Client in *Table 14* will be used. This will be multiplied by the amount of water to be evaporated in making dried P_2O_5 Product as explained in 2. above.
4. The costs of transporting the dried P_2O_5 Product will be estimated. To do this the operating cost for transporting one ton of fertiliser Product (TRA) as defined by the Client in *Table 14* will be used. This will be multiplied by the amount of dried P_2O_5 Product produced as calculated in 2. above.
5. The Supplier must also give the amount and costs of any reagent/s used in any process which produces such a P_2O_5 Product. This information concerning specific consumption and unit reagent cost must be included in the Supplier's information submitted concerning Consumables.

21.6 Award criterion: Project organisation, execution and key personnel

As part of the award criterion "Project organisation, execution and key personnel" the delivery time will be evaluated by looking at the Supplier's Progress Schedule.

The total time of execution will be evaluated, which is specifically the duration in calendar days between Milestone M2 and Milestone M10 (the fewer days the better).

21.7 Award criterion: Offered solution (aspect Capital Repairs)

As part of the award criterion "Offered solution" the requirement for Capital Repairs will be evaluated. That means that Capital repairs will NOT be evaluated as part of OPEX. Data given by Suppliers will not have to be guaranteed.

In order to either ensure the expected operating lifetime of technology or civil works, or to extend operating lifetime, it may be necessary to replace certain items included in the technology or civil works which are not Spare Parts (Spare Parts being defined in the glossary). Generally speaking, such items are more expensive than Spare Parts. Furthermore the time interval between replacement is more difficult to predict but such items must be replaced much less often than Spare Parts. We call the reinvestment in such items "Capital Repairs."

For the purpose of this Tender, the ensuing evaluation, and subsequently in any Service Contract, any item required after Taking Over must either belong to the category "1. Spare Part" or "2. Capital Repairs." The Supplier must clearly identify which of the 2 categories any item will belong to.

The Supplier must indicate the estimated Capital Repairs that will be required but divided into 3 time periods of 5 years each namely

1. Year 1 to 5 after Taking Over
2. Year 6 to 10 after Taking Over
3. Year 11 to 15 after Taking Over

For each item where the overall expenditure on the item is € 50.000 within any of the 3 above-mentioned 5-year time periods or more (net prices, DDP Site, at the time when the Supplier submits their Commercial Offer) the respective item must be detailed. In this case the Supplier must

1. Define the Lot with which the Capital Repair item is associated (by selecting from the drop-down menu "Lot X (INDIVIDUAL ITEM")
2. Give the name of the Capital Repair item
3. Give a brief description of the item's function
4. Give the unit price
5. Give the estimated number required in each of the respective 5-year time periods

For all other item where the overall expenditure on the respective Capital Repairs item in the respective 5-year time periods item is below € 50.000 (net prices, DDP Site, at the time when the Supplier submits their Commercial Offer) the costs for all these items do not need to be detailed. In this case the Supplier must only give as one sum of money the aggregated price of such capital Repairs items (at the time when the Supplier submits their commercial offer).

The Supplier must enter this information in sheet 12 in the template "Attachment 2B - Price form.xlsx" provided by selecting from the drop-down menu "Lot X ALL OTHER ITEMS."

The Supplier must describe Capital Repairs costs in sheet 12 of "Attachment 2B - Price form.xlsx" provided.

The Supplier may add lines if required, but must do this by using the copy paste function.

Capital Repair items which are used for several Lots may be split between Lots.

All figures must be given in Euros. If required, the NOK/EURO exchange rate as defined in section 3.6 must be assumed.

22 Documents to be submitted by Supplier

22.1 Commercial Offer

The Supplier's Commercial Offer will be the main descriptive document which explains in detail the Supplier's technological and commercial solution, including text, graphics, diagrams, and scope descriptions.

The Supplier must include in the main Commercial Offer document:

1. Description of technology
2. Description of scope of items in Price Breakdown
3. Table showing main technology suppliers and civil works-construction companies used.
4. Explanation of approach to design and project management including Software tools used, project management methodology and solutions such as BIM.
5. Explanations relevant to topics described in the award criteria explained in chapter 5 of the document "Tender rules.docx."

The Supplier must include as separate documents (Attachments) to the main Commercial Offer document the following

No	Name	Reference/Instructions
1	Project execution organisation structure and plan	Tender rules section 5.1.3
2	CVs of key personnel for project execution	Tender rules section 5.1.3. Supplier can use "Attachment 4 - CV and reference projects for key personnel – template.docx" provided or own template
3	Service contract draft	Section 21.4 and Tender rules section 5.1. 4
4	Deviations to Client's draft of Plant Construction Contract or to any requirements stated by the Client in the Specification.	Tender rules section 2.4. Supplier must use "Attachment 5 - Deviations and Reservations – template.docx" provided
6	Answers to Technical questions posed in this Specification	Section 22.2 (no template provided)
7	Process Flow Diagram (PFD)	Section 22.3 (no template provided)
8	Mass Flow Diagram (MFD)	Section 22.4 (no template provided)
9	Plant Layout	Section 22.5/ Supplier must use A.301 as a template
10	Progress Schedule	Section Feil! Fant ikke referansekilden.
11	Guarantee Values	Section 22.7/ Supplier must use sheet 9 in template "Attachment 2B - Price form.xlsx" provided
12	Expected Values (except Consumables)	Section 22.8/ Supplier must use sheet 10 in template "Attachment 2B - Price form.xlsx" provided
13	Expected Values (only Consumables)	Sections 22.9/ Supplier must use sheet 7 in template "Attachment 2B - Price form.xlsx" provided
14	List of Reference Projects	Section 22.10/ (no template provided)
15	Capital Repairs	Section 21.7/ Supplier must use sheet 12 in template "Attachment 2B - Price form.xlsx" provided

Table 44: List of Attachments to Supplier's Commercial Offer

22.2 Technical questions

The terms "Technical question" refers to Information specifically requested (as regards the following points specifically requested in the following sections in this document).

There are 14 of these questions which appear only in this document and they are marked by a box with a double border shown below

Technical Question
The Supplier must describe in the Commercial Offer…

Number	What is required	Section
1	Frozen feedstock	6.3.2
2	Measurement of contaminant removal	6.4.2
3	Prevention of and management of sedimentation	6.6.4
4	Retention time	6.6.5
5	Ammonia inhibition	6.6.6
6	Skimmers in fermenters	6.6.7
7	Bio-certified fertiliser	6.9.2.2
8	Removal of plastics from digestate	6.9.3
9	Piping (Lot A)	6.14
10	Nitrogen salt/impurities	9.7.1
11	Ammonia Water production	9.7.2
12	Piping (Lot D)	9.10
13	Drying liquid materials	10.2.1.1
14	Fire protection	12.4.1
15	Redundancy concept	15.6

Table 45: Summary of technical questions requiring response in the Tender

The Supplier must use their own template as a word document to answer the Technical Questions.

22.3 Process Flow Diagram (PFD)

The Supplier must submit as an attachment to its Commercial Offer a Process Flow Diagram (MFD). The PFD will be a Block diagram showing how processes are physically connected. It should be a precursor of a full Piping and Instrumentation Diagram (P&ID).

22.4 Mass Flow Diagram (MFD)

The Supplier must submit as an attachment to its Commercial Offer a Mass Flow Diagram (MFD). The MFD must show yearly mass flow of all solids, liquids gases throughout the Plant as well as the respective DM content and N, P, K content for solids/liquids. The MDF must be in the form of an Excel sheet. It must correspond with Guarantee Values given by the supplier, as well as Expected Values which are relevant.

22.5 Supplier's Plant Layout

This is the Suppliers 2D representation of the layout design for the Plant. It must be based on the electronic plan given by the Client (which in contrast is called the Client's General Arrangement Plan). The Client has made an exemplary design in the General Arrangement Plan. The Supplier is not in any way bound by the design made by the Client. Apart from details within the Specification, particularly in section 25 (regarding the Site) and section 12 (Works included in Lot G), the only binding requirements are

1. to build the Plant within the Battery Limits i.e. the outer limit of the area on the Site which is allocated to the construction project to build the Plant ("the Plot").
2. To connect the plant to Interface/Delivery points at the Battery Limits.

The heights of main structures is to be stated in a separate file in association with the Plant Layout (meaning that a 3D layout not required as part of the plant Layout). The Supplier must use information provided in Appendix A.301 as a basis.

22.6 Progress Schedule

This document is the Supplier's Project execution plan which shows the time progress of all Works to be supplied by the Supplier.

The Supplier must include the following milestones in the Progress Schedule as a minimum:

Milestone number	Description
M1	Contract Signature (see payment schedule P1)
M2	Client hands over Site to Supplier.
M3	Plans and start-up documents received, accepted (see payment schedule P2)
M4	Delivery of complete basic and detail engineering (see payment schedule P3) Completion of Outline Civil Design
M5	Client submits all data required concerning Lot D and Lot E needed by the DBC to enable DBC to complete basic and detail engineering for Lot G Works required for Lot D and Lot E
M6	Completion of all Works required for construction start by Lot D Contractor are completed
M7	Completion of all Works required for construction start by Lot E Contractor are completed
M8	Construction and Mechanical completion (see payment schedule P5)
M9	Completed commissioning (hot commissioning) and take over testing (see payment schedule P6)
M10	Taking Over of Works (see payment schedule P7)
M11	Acceptance (at end of Trial operations period – 12 months) see payment schedule P8)

Table 46: Table of milestones to be included in the project plan

No template is provided. The Progress Schedule must be submitted in Microsoft Project.

The milestones M2, M5, M6, M7 must be placed in the Progress Schedule according to the Supplier's scheme. The chronological order for these milestones does not need to be the same as the numeric order.

Apart from the above-mentioned milestones and other milestones the Supplier may define, we expect that the Supplier will include information in the Progress Schedule about the timing of activities such as

1. Design activities
2. Design reviews
3. Production activities
4. Factory testing dates
5. Delivery dates
6. Installation activities
7. Testing and commissioning activities and

22.7 Guarantee Values

The Supplier must give the Guarantee Values required. These are described in the sections describing the individual Lots (See sections 6, 7, 9, 10, and 13) and in sections 17.4.5, 17.5, 17.6, 18.2, and 19.2 about Performance Parameters and Performance Test Procedures.

22.8 Expected Values (except consumables)

The Supplier must give the Expected Values required. These are described in the sections describing the individual Lots (See sections 6, 7, 9, 10, and 13) and in sections and 20.1.

22.9 Expected Values (without consumables)

The Supplier must give the Expected Values required. These are described in the sections describing the individual Lots (See sections 6, 7, 9, 10, and 13) and in sections and 20.2.

22.10 List of relevant reference projects

Suppliers are requested to name and describe relevant reference projects. No template is provided.

23 Interfaces

This table aims to give a simplified and high-level overview of interfaces between the Minimum Scope (which includes Lots A, B, G and H) and Other Lots (namely Lot D and Lot E).

23.1 Media transferred/exchanged

Interface	Media transferred
A ⇔ D	(A to D) Separated hygienised clean Liquid Fraction Digestate (buffered in Lot A) (D to A) Cold/warm/hot water condensate for recirculation or other purposes Digestate or LFD with low nitrogen for recirculation
A ⇔ D, E	(A to all) Signal cables (All to A) Odorous air
H ⇔ D, E	(H to all) Heat (flow)
G ⇔ D, E	(G to all) All kinds of water Main Power supply cables (All to G) All kinds of wastewater
D ⇔ E	(D to E) Ammonium salt solution for drying Nutrient Liquor for drying possibly phosphorus precipitation product for drying
D, E ⇔ A	Odorous air

Table 47: Overview of interfaces between Lots and media transferred/exchanged

23.2 Interfaces between Lot G and all other Lots

As soon as possible after ITT 1 has been published, the Client must publish a separate document which must describe in a generic way the interfaces (in terms of scope, design, and responsibility) between the Contractor of Lot G and the Contractors for all other Lots.

23.3 Termination Points

23.3.1 Interconnecting Piping

A particular Lot will deliver various defined liquid media and various gaseous media via pipes to other Lots. Such media includes process water, heating water, wastewater, substrate, digestate, odorous air, biogas and biomethane to name a few examples. The defined interfaces for such pipes between Lots are called Termination Points defined in the Supplier's Plant Layout.

23.3.2 Interconnecting Cables

A particular Lot will be connected by cabling to other Lots in order to supply power and deliver signals. The defined interfaces for such cables will be Termination Points defined in the Supplier's Plant Layout.

24 Potential co-operations with market actors

24.1 Introduction

Above and beyond constructing the Plant, Rå Biopark needs to establish various co-operations in order to guarantee that the Plant will be commercially successful in the long term. These are described in this section.

24.2 Fertiliser Product marketing

As described in sections 6, 9 and 10, all outputs of organic material, nutrients and Nutrient Liquor that can be manufactured from the Digestate in Lot C, D and E will be converted into solid fertiliser Products in Lot F, primarily because it is economically unfeasible to dispose of all of the untreated Digestate or to spread all of the Digestate to agricultural land near the Plant.

We have therefore initiated a market dialogue to find the right partner/s for a partnership/co-operation for this area. The objective of the partnership/co-operation is to develop the technology for a Fertiliser Factory (Lot F described in section 11) as well as to market the fertiliser Products produced.

The link to the market dialogue is here for your information.

24.3 Marketing of LBM and fuelling station infrastructure

Most biogas plants in Europe use the biogas to make heat and electricity on Site (cogeneration) and the electricity is fed into the grid at an agreed tariff/FIT and the heat is sold locally. Increasingly the gas is upgraded and injected into the local gas grid again at an agreed tariff/FIT. Neither of these approaches are possible for this Plant which is why we have to sell the methane as road fuel into the transport sector, whereas the local market is primarily interested in LBM as a product.

We have therefore initiated a market dialogue in order to find the right partner/s for a partnership/co-operation for this area. The objective of the partnership/co-operation is to build and operate 3 fuelling stations for LBM in the Northern Norwegian region. The 3 fuelling stations will be located at or near:

1. Alta
2. Tromsø
3. Bjerkvik

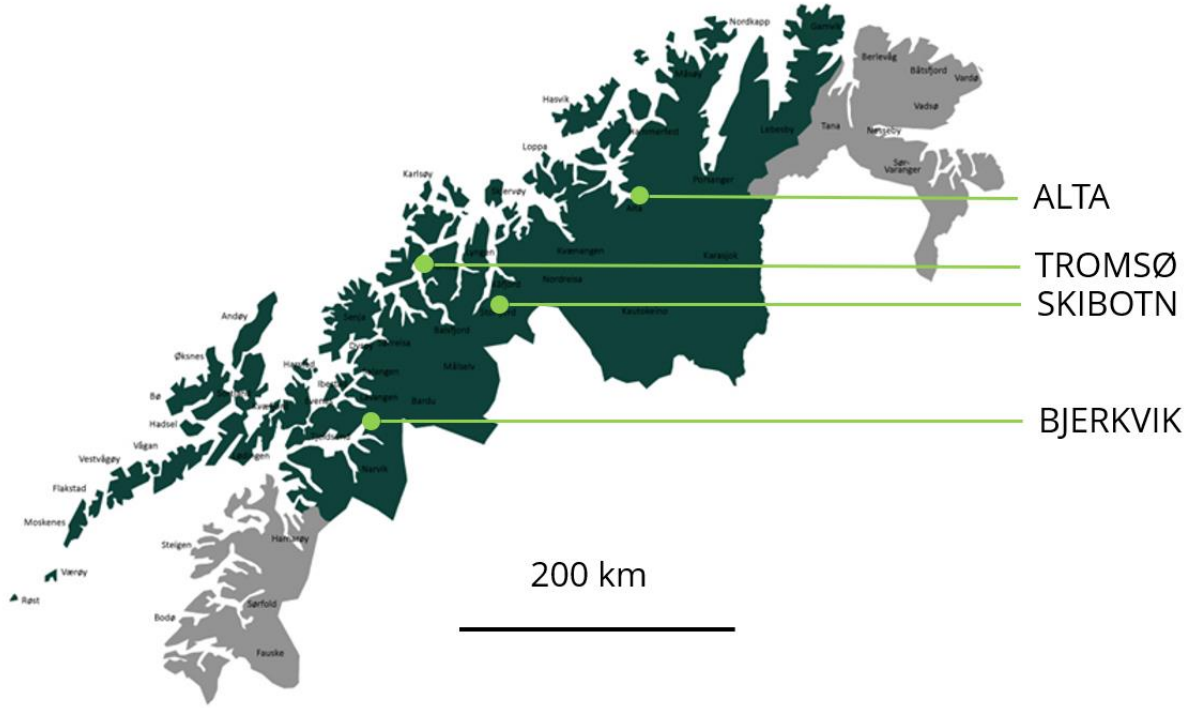


Figure 8: Locations of proposed LBM fuelling stations

Please note that in Q1 2022 Rå Biopark applied for grant money from Enova so as to obtain financial support for the purchase of 15 refuse collection vehicles as well as for the 3 above-mentioned fuelling stations. In Q2 2022 we were informed that our grant money application was successful. Please refer to the press releases on this topic below.

Please find below press releases concerning Enova and Rå Biopark:

18 millioner i støtte til biogass i nord - Radio Nordkapp

18 millioner i biogass-støtte - altaposten.no

The link to the market dialogue is here for your information.

The current status at the time of publishing this Invite To Tender is that we have signed a Letter of Intent to supply LBM.

Please find below a press release about this Letter of Intent:

Co-operation sale of LBM

24.4 Marketing of $LBCO_2$

Since we intend to produce biomethane in this Plant, using upgrading technology, we will also produce a relatively pure CO_2 Product. CO_2 is commonly used as an industrial gas but generally speaking it is produced from fossil sources and thus contributes to global warming. We believe that there could be several parties in the Northern Norway region which would be interested in purchasing the CO_2 especially since our product would be produced from biogenic sources and therefore would not contribute to global warming. We have already signed a Letter of Intent with one local consumer, who would be interested in purchasing a significant quantity of the CO_2.

Nonetheless Rå Biopark and their associated companies/shareholders have no experience on the production and marketing of CO_2.

We have therefore initiated a market dialogue in order to find the right partner/s for a partnership/co-operation for this area. The objective of the partnership/co-operation is to market the $LBCO_2$ produced and potentially also to design and build the technology for cleaning the CO_2 (within Lot B as described in section 7.6).

The link to the market dialogue is here for your information.

We have entered into a co-operation with another Norwegian company called Hoop. The topic of this co-operation is to jointly produce and market biogenic CO_2.

In addition we are open to co-operation concerning projects involving Carbon Capture and Storage.

24.5 Sale of ammonia water

The Client intends to sell ammonia water as a reagent for flue gas NOx reduction (SNCR process) for Waste to Energy plants within the waste management sector. The Client has signed a Memorandum of Understanding with a potential offtaker to this effect.

25 Information about the Site

25.1 Pictures and cartographic information

Figure 9: Geographical map of surroundings of the Site (Site marked with blue circle)

Figure 10: Aerial photo of the Site

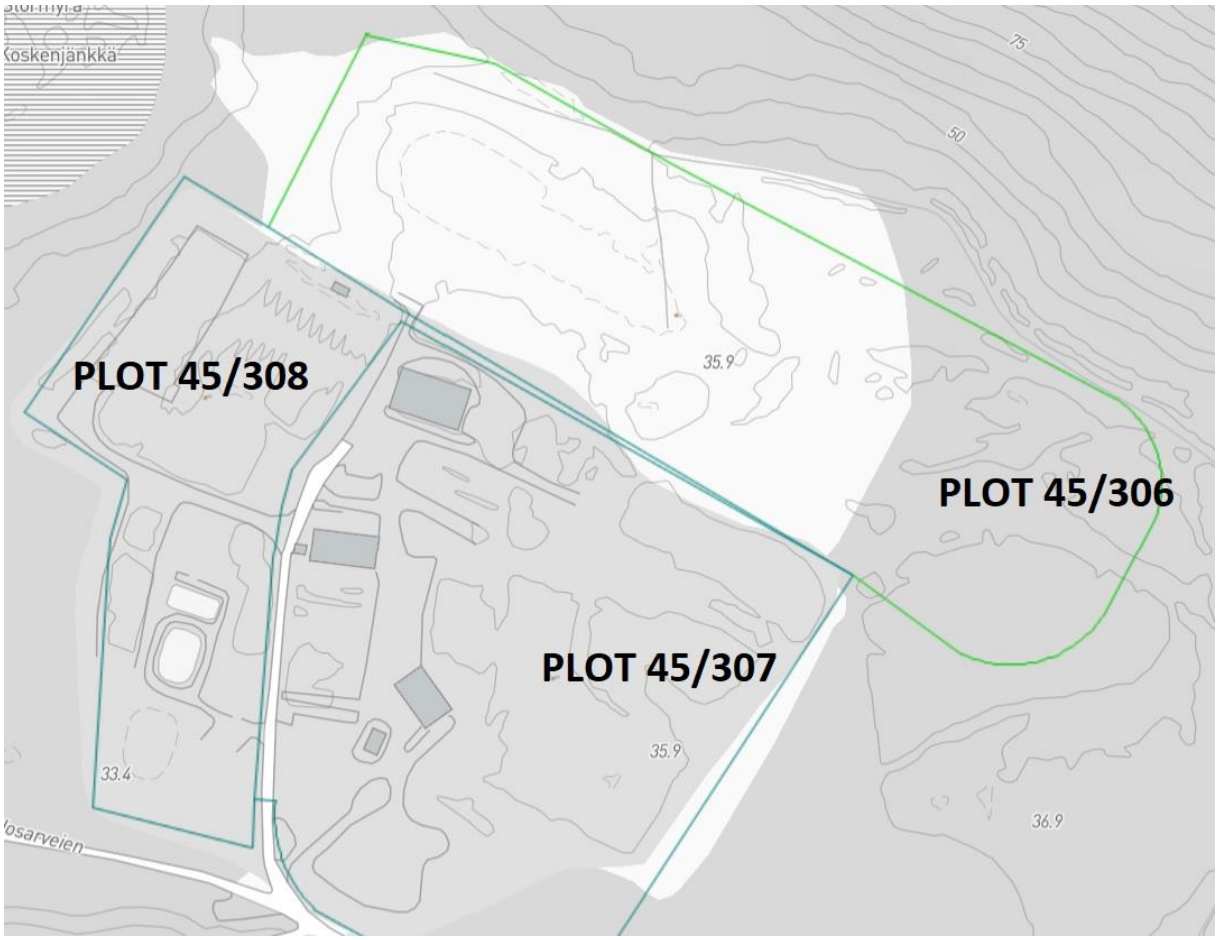


Figure 11: Cadastral map of Site showing plots

Figure 12: 3D map of Site showing topology

25.2 Composting plant currently at Site

Figure 13: Aerial photo of Site from the Northeast showing composting plant activities

Number	Explanation
1	New excavated aerobic leachate treatment pond,
2	Old treatment pond which is now an aerobic leachate (sedimentation) pond first aerobic leachate step
3	Aerobic leachate (sedimentation) pond second stage.
4	Maturation of compost (clean zone).
5	Sifted compost batch after phase 2 for clearance after analysis of pathogenic bacteria.
6	Dirty zone with composting windrows phase 2.
7	Buffer storage of wood chips and wood.
8	Asphalt-covered area which has been used in the past for the temporary storage of RDF bales (residual waste) for incineration at the Kvitebjørn WtE plant in Tromsø. Currently the asphalted area is not used. Infiltration ditches are located under the green area behind the pump house by the sedimentation pond final step.

Table 48: Overview of main composting plant process steps as legend to Figure 13:

25.3 Area at the Site allocated for constructing the Plant

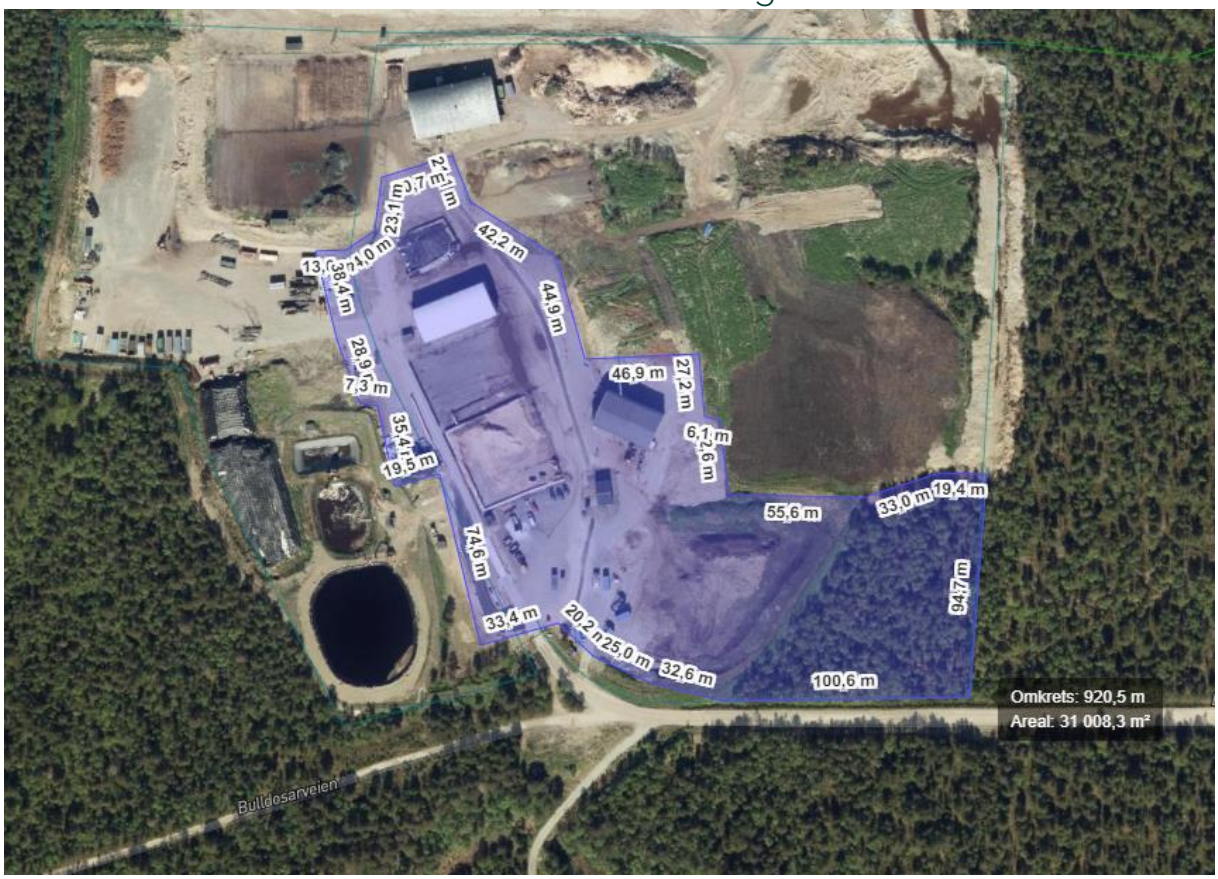


Figure 14: The area at the Site which will be dedicated for the Plant (the Plot)

A portion of the Site has already been designated as the plot where the Plant will be built.

The area covers ca. 31.000 m^2.

25.4 Approximate topography of site

At the end of 2022 we carried out a drone survey of the Site which yielded an approximate topographical overview of the Site. The Norwegian Mapping Authority also has a web site where elevations at any point can be approximately viewed: www.hoydedata.no.

Please see *Figure 15* included here for a summary.

Figure 15: Approximate topography at the Site

25.5 Client's General Arrangement Plan

In order to make an initial feasibility assessment of space requirement compared to space availability at the Site and also to better prepare the soil survey, the Client made its own Client's General Arrangement Plan. Please see below an excerpt of that plan. These plans are attached as Appendix A.300. We have added an excerpt of this plan below.

Figure 16: Excerpt of Client's General Arrangement Plan

25.6 Re-use of existing infrastructure

Certain items currently at the Site must be reused in, integrated into or considered in planning the new Plant at the Site. For a description please refer to section 12.2.10.

25.7 Most important Site information

Item	Information
Co-ordinates (entrance)	69,34553 ° North 20,28953 ° East
Link in Norwegian online map resource	https://kommunekart.com/?urlid=c4a05ff1-f235-4cbb-a382-863d25920ab6
Address	Bulldosarveien 271, 9143 Skibotn, Norway
Current owner of Site	Origo Skibotn AS, organisation number 916 584 865
Project developer	Rå Biopark AS, organisation number 929 464 842
Municipality	Storfjord (NO-5425)
District	Nord-Troms
County (Fylke)	Troms og Finnmark
Country	Norway
Ownership	Owned by Norske Skog and the current operator, Origo Skibotn AS (who own and operate the composting plant) have a long-term lease agreement to use the Site.
Height above sea level	33m (entrance)
Distance to the sea (Lyngenfjord)	9,5 km by road and 4,5 km (line of sight)
Plots	45/306 and 45/307 and 45/308
Designated location for Plant	Only plot 45/307 , NOT plot 45/306. Plot 45/308 only if for some reason there is no alternative.
Complete area of plots	45/307 = 64.913 m^2 and 45/308 = 32.168 m^2 Total 97.081 m^2
Approximate area of Plot (area for construction of the Plant)	31.000 m^2
Activities on plot 45/306	This is an existing landfill, and it will continue to be operated in the future, after the Plant has been built
Activities on plot 45/307	1. Organic waste reception plus Contaminant removal 2. Drying of reject from Contaminant removal process 3. 2nd stage compost maturation
Activities on plot 45/308	1. Outdoor windrow composting 1st stage (intensive) 2. 2nd stage compost maturation 4. (occasionally) buffer storage of RDF bales

Table 49: Main Site information

25.8 Infrastructure

The infrastructure will ensure efficient and environmentally friendly operation and provide for all support functions. The Site is located close to the E6 and E8 motorways and approximately 47 km from Nordkjosbotn, where traffic from the E6 diverges in the direction of Tromsø.

25.8.1 Electricity

At the Site we already have a power (single or three phase, 230 or 400 V). The transformer is 315 KVA. We are planning to apply for further electrical power supply capacity at the Site.

25.8.2 Water

25.8.2.1 Drinking water

The Site has no supply of drinking water from the municipal network. Drinking water has up until now been collected from the nearby river. See descriptions for Lot G for future plans for production of drinking water.

25.8.2.2 Process water

Process Water, washing water and flushing water will be supplied from the local river. A well at the Site is not currently planned. Possibly water could be collected from captured precipitation. We have no current or historical analyses of such water sources. Suppliers must bear in mind that the chemical composition of such water can vary, cannot be guaranteed, and can vary considerably from the composition of water in the Supplier's home region.

If technology offered by Suppliers requires any water for whatever reasons and the composition of the water has certain limitations, the Supplier must state the specification of Process Water required. Otherwise we will assume that the Suppliers' technology can use from the local river, and/from a well at the Site, and/from captured precipitation as Process Water.

25.8.2.3 Wastewater

This refers only to

- wastewater from e.g. the sanitary block,
- condensate from Lot B
- any water fraction that cannot be used as an input in the biogas plant
- any water fraction which cannot be treated in Lot D due to the risk of unwanted contamination of potential fertiliser products.

Currently the Site is not connected to a sewage treatment plant. Wastewater of human origin must be collected in a septic tank. Please refer to section 12.4.4.

In theory it is possible that some water fraction could be treated by using the aerobic treatment ponds already at the Site. Suppliers should not assume this without discussing this with the Client and any discussions in this regard will take place during clarifications, after the ITT has been published, or during negotiations.

25.9 Permits

25.9.1 Zoning plan

The current zoning plan and regulations for the Site are attached as Appendices A.132 and A.133. There will be a process for applying for a new and updated zoning plan.

25.9.2 Environmental permit

The current environmental permit for the composting plant at the Site is attached as Appendices A.130 and A.131. We have applied for a new environmental permit as part of this project. The Environmental Permit Application Document is also attached in Appendices A.136 and A.137.We expect to receive the permit by March 2024.

The Supplier must design their technology so that it adheres to the limits in the new environmental permit described within the environmental permit.

25.9.3 Permit from the Directorate for Civil Protection and Emergency (DSB)

The Client will be responsible for registration with and applications to DSB in relation to the Act on protection against fire, explosion, and accidents involving hazardous substances, and on the fire department's rescue tasks (Fire and Explosion Protection Act) and the Regulations on the Handling of Hazardous Substances (Regulation on the handling of flammable, reactive, and pressurized substances, as well as equipment and facilities used in their handling) to document that the facility is in accordance with the regulations.

The Contractor must provide technical support in contact with DSB, hereunder provide information and documents in the application process. This will include both application for I) Application for consent for the construction of facilities/facility components (Phase I) and II) Application for consent to commission facilities/facility components / introduce hazardous substances into the facility (Phase 2).[8] The design of the Plant and contract works must be finalized before the application can be sent. The processing time for application related to Phase 1 may be between 3–6 months. Thus, the Contractor must calculate for this in their progress schedule since the application process and processing time may impact the progress of the construction process. In essence, the construction phase cannot start before this consent and permit is given (Phase 1) with some possible minor exceptions. The process related to the applications will need to be clarified between the Client and the Contractor during the negotiation process or in the cooperation period after contract signing.

25.10 Climate data

Month	Average temperature	Normal ° C	Total precipitation mm	Normal mm	Highest wind speed m/s	Strongest gust m/s
Jan-22	-5,3	-5,6	111,8	44	7,8	20,2
Feb-22	-6,8	-5,6	29,6	35	8,3	21,6

[8] For guidance to the application process, see for example: https://www.dsb.no/lover/farlige-stoffer/farlige-stoffer/veiledning-til-forskriftene/temaveiledning-om-innhenting-av-samtykke/

Mar-22	0,6	-2,9	66,1	40	7	21,7
Apr-22	1,4	1,5	25,2	22	5,3	15,3
May-22	7	6,5	31,1	22	7,4	21,1
Jun-21	12,5	10,6	37,6	32	4,9	13,6
Jul-21	14	13,6	14,5	46	5,4	17,9
Aug-21	12	12,3	22,6	48	4,9	13,4
Sep-21	8,1	8,1	42,2	43	8,6	21,5
Oct-21	3,3	2,4	43,3	41	9	20,6
Nov-21	-2,8	-1,8	32,6	35	6,2	16,7
Dec-21	-7,8	-3,9	33,1	40	5,2	15,4
	AVG	AVG	TOTAL	TOTAL	HIGHEST	HIGHEST
	3,0	2,9	489,7	448	9,0	21,7

Table 50: Recent climatic data for the Skibotn Site

The Site is very far north but the climate is nonetheless positively influenced by the marine location/ gulf stream. The location is one of the drier locations in Norway and has one of the highest counts of non-cloudy days.

Being located in the Arctic, there are prolonged periods of continuous light and continuous darkness as follows:

Item	Information
Midnight sun days	34
First midnight sun date	5th June
Last midnight sun date	8th July
Days with no sun	88
Last sunset	8th November
First sunrise	4th February

Table 51: Key solar data for Skibotn

Please also see additional data in the document A.150 attached as an Appendix to this Specification.

25.11 Soil survey conditions

Due to the previous detection of clay in the area where the Plant is planned to be built, ground investigations of the industrial area in Skibotn have been carried out.

The surveys were carried out in September/October 2021 by Arktisk Geotek AS, however at a different part of the Site. The reports from the survey are attached as an Appendices A.104, A.105, A.106 and A.107

A further survey was carried out at that part of the Site which is now envisaged for the Plant construction project)the Plot) and these are attached as Appendices , A.100, A.101, A.102, A.103 to this document.

No explosive material was detected in the investigations. Based on the terrain conditions in the area, any presence of explosive material will remain untouched in the subsoil. There is no potential for development of area landslides associated with planned construction activity.

26 Appendices to this Specification

Disclaimer

The Client, Rå Biopark, has provided several Appendices within the framework of this Invitation to Tender which are in Norwegian or Swedish.

The Client has in some cases provided an English translation of such documents at his own cost.

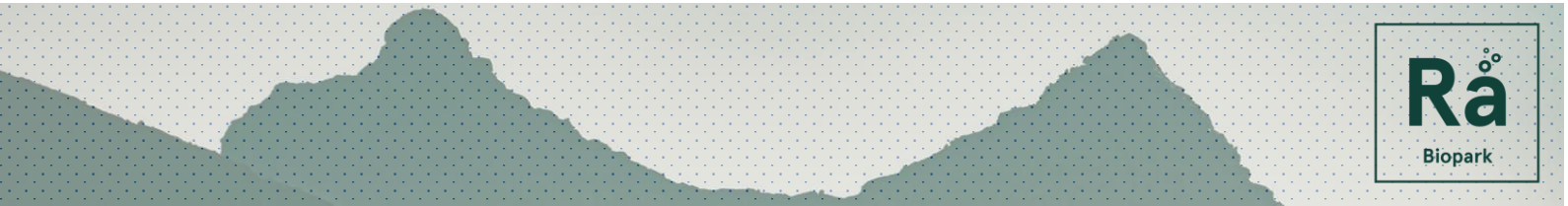
All such documents have been identified in the list of Appendices below as "(English translation)."

The Client accepts no responsibility for the accuracy of the translation of such documents.

Suppliers are free to use the English language translations but must do so ENTIRELY AT THEIR OWN RISK. The Client assumes no responsibility for any errors and consequential damages incurred by the Supplier due to errors in the translation.

Table

Document number	Document name	Explanation
A.1 Site Information and permits		
	Soil surveys	
A.100	Geotechnical survey (data report) from 23.11.2023 (English translation)	
A.101	Geotechnical survey (data report) from 23.11.2023 (original Norwegian version)	
A.102	Geotechnical survey (evaluation) from 23.11.2023 (English translation)	
A.103	Geotechnical survey (data report) from 23.11.2023 (original Norwegian version)	
A.104	Geotechnical survey (data report) done at an adjacent plot on the Site from 18.11.2021 (English translation)	
A.105	Geotechnical survey (data report) done at an adjacent plot on the Site from 18.11.2021 (original Norwegian version)	
A.106	Geotechnical survey (evaluation) done at an adjacent plot on the Site from 18.11.2021 (English translation)	
A.107	Geotechnical survey (data report) done at an adjacent plot on the Site from 18.11.2021 (original Norwegian version)	
	Odour dispersion model	
A.110	Odour dispersion model for odour emissions from the site for different levels of odour emission (English translation)	
A.111	Odour dispersion model for odour emissions from the site for different levels of odour emission (original Norwegian version)	
	Noise dispersion model	
A.120	Noise dispersion model for noise emissions from the site (English translation)	
A.121	Noise dispersion model for noise emissions from the site (original Norwegian version)	
	Permits and applications	
A.130	Latest permit for the existing composting plant from 2021 (English translation)	
A.131	Latest permit for the existing composting plant from 2021 (original Norwegian version)	
A.132	Note on current zoning plan valid for the Site (English translation)	
A.133	Note on current zoning plan valid for the Site (original Norwegian version)	
A.134	Temporary permit for the existing composting plant from 2021 (English translation)	
A.135	Temporary permit for the existing composting plant from 2021 (original Norwegian version)	



A.136	Application for environmental permit for a biogas plant at the Skibotn site from 20.09.2023 (English translation)
A.137	Application for environmental permit for a biogas plant at the Skibotn site from 20.09.2023 (original Norwegian version)
A.138	Zoning plan for organic waste treatment plant (English translation)
A.139	Zoning plan for organic waste treatment plant (original Norwegian translation)
A.140	Zoning map
	Other site-related information
A.150	Selected local design specifications related to statics and climate
A.151	List of mobile equipment currently being used at the Site (composting plant) (collected September 2023)
A.152	Dimensions, current frequency of delivery and time required for tipping for truck fleet of all companies (shareholders and non-shareholders) who deliver waste to the Skibotn site (composting plant) (collected June 2023)
A.153	Collected statistics regarding tonnage and timing of deliveries for all current deliveries of 1. Wet organics and 2. Green woody waste to the Skibotn site (composting plant)
A.154	Environmental report for ORIGO Skibotn (landfill and compost facility) (English translation)
A.155	Environmental report for ORIGO Skibotn (landfill and compost facility) (original Norwegian version)
A.2 Feedstock analyses	
	Generic data, waste sorting analyses and summary
A.200	Summary of all physico-chemical analysis data from Testing Campaigns 1,2 and 3
A.201	Information on seasonal variation in defined feedstocks planned for the Rå Biopark Biogas project
A.202	Household waste composition analysis from Remiks from 2015 (English translation)
A.203	Household waste composition analysis from Remiks from 2015 (original Norwegian version)
A.204	Household waste composition analysis from Remiks from 2018 (English translation)
A.205	Household waste composition analysis from Remiks from 2018 (original Norwegian version)
A.206	Household waste composition analysis from Remiks from 2022 (English translation)
A.207	Household waste composition analysis from Remiks from 2022 (original Norwegian version)
A.208	Household waste composition analysis from RenoVest from 2022 (English translation)
A.209	Household waste composition analysis from RenoVest from 2022 (original Norwegian version)

	Testing campaign 1 (Summer 2022)
A.210	Analysis Household SSO from HRS Test 17513 (inhibition test)
A.211	Analysis Household SSO from HRS Test 17513 (biogas potential test)
A.212	Analysis Household SSO from Remiks Test 17520 (inhibition test)
A.213	Analysis Household SSO from Remiks Test 17520 (biogas potential test)
A.214	Analysis Sewage sludge cake from Tromsø Test 17521 (inhibition test)
A.215	Analysis Sewage sludge cake from Tromsø Test 17521 (biogas potential test)
A.216	Analysis Brewery spent yeast Test 17567 (inhibition test)
A.217	Analysis Brewery spent yeast Test 17567 (biogas potential test)
A.218	Analysis Brewery spent grains Test 17568 (inhibition test)
A.219	Analysis Brewery spent grains Test 17568 (biogas potential test)
A.220	Analysis Brewery malt dust 17569 (inhibition test)
A.221	Analysis Brewery malt dust 17569 (biogas potential test)
A.222	Physico-chemical analysis for test 17513
A.223	Physico-chemical analyses for tests 17520, 17521, 17566
A.224	Physico-chemical analyses for tests 17567, 17568, 17569
	Testing campaign 2 (Autumn 2022)
A.230	Analysis Household SSO from Remiks Test 27247 (inhibition test)
A.231	Analysis Household SSO from Remiks Test 27247 (biogas potential test)
A.232	Analysis RAS fish farm sludge Test 27249 (inhibition test)
A.233	Analysis RAS fish farm sludge Test 27249 (biogas potential test)
A.234	Analysis Sewage sludge cake from Langnes Test 27250 (inhibition test)
A.235	Analysis Sewage sludge cake from Langnes Test 27250 (biogas potential test)
A.236	Analysis Sewage sludge cake from Strandvegen Test 27251 (inhibition test)
A.237	Analysis Sewage sludge cake from Strandvegen Test 27251 (biogas potential test)
A.238	Analysis Sewage sludge cake from Breivika Test 27252 (inhibition test)
A.239	Analysis Sewage sludge cake from Breivika Test 27252 (biogas potential test)

A.240	Analysis Sewage sludge cake from Tomasjord Test 27253 (inhibition test)
A.241	Analysis Sewage sludge cake from Tomasjord Test 27253 (biogas potential test)
A.242	Analysis Sewage sludge cake from Narvik Test 27254 (inhibition test)
A.243	Analysis Sewage sludge cake from Narvik Test 27254 (biogas potential test)
A.244	Analysis Household SSO from RenoVest Test 27256 (inhibition test)
A.245	Analysis Household SSO from RenoVest Test 27256 (biogas potential test)
A.246	Analysis Household SSO from LAS Test 27257 (inhibition test)
A.247	Analysis Household SSO from LAS Test 27257 (biogas potential test)
A.248	Analysis Household SSO from Remiks Test 27258 (inhibition test)
A.249	Analysis Household SSO from Remiks Test 27258 (biogas potential test)
A.250	Physico-chemical analyses for tests 27247, 27248, 27249
A.251	Physico-chemical analyses for tests 27250, 27251, 27252
A.252	Physico-chemical analyses for tests 27253, 27254, 27255
A.253	Physico-chemical analyses for tests 27256, 27257, 27258
	Testing campaign 3 (Spring 2023)
A.260	Analysis Fish processing waste (cake) Test 13841 (inhibition test)
A.261	Analysis Fish processing waste (cake) Test 13841 (biogas potential test)
A.262	Analysis Fish processing waste (rotasieve) Test 13842 (inhibition test)
A.263	Analysis Fish processing waste (rotasieve) Test 13842 (biogas potential test)
A.264	Analysis RAS fish farm sludge Test 13843 (inhibition test)
A.265	Analysis RAS fish farm sludge Test 13843 (biogas potential test)
A.266	Physico-chemical analyses for tests 13840, 13841, 13842
A.267	Physico-chemical analysis for test 13843
	Other analyses
A.270	Analysis glycerine (impurities: alcohols)
A.271	Analysis glycerine (impurities: heavy metals)
A.272	Analysis glycerine (impurities: PCDD PCB)

A.273	Glycerine safety data sheet
A.274	Various analyses from Mack brewery (English translation)
A.275	Various analyses from Mack brewery (original Norwegian version)
A.276	Physico-chemical analysis of goat manure (English translation)
A.277	Physico-chemical analysis of goat manure (original Norwegian version)
A.278	Analyses of various Sewage sludge cake samples from 2019, 2020, 2021 incl. Heavy metals, pH, PCB, TDS (English translation)
A.279	Analyses of various Sewage sludge cake samples from 2019, 2020, 2021 incl. Heavy metals, pH, PCB, TDS (original Norwegian
	Analyses of feedstock not planned for the project
A.280	Analysis Kieselguhr Test 17566 (inhibition test)
A.281	Analysis Kieselguhr Test 17566 (biogas potential test)
A.282	Analysis RAS fish farm sludge Test 27248 (inhibition test)
A.283	Analysis RAS fish farm sludge Test 27248 (biogas potential test)
A.284	Bleaching earth absorbent Safety Data Sheet (English translation)
A.285	Bleaching earth absorbent Safety Data Sheet (original Norwegian version)
A.286	Analysis bleaching earth absorbent, heavy metals
A.287	Analysis bleaching earth absorbent, heavy metals
A.288	Analysis bleaching earth absorbent, heavy metals
A.289	Analysis bleaching earth absorbent, heavy metals, PCB, PCDD
A.290	Analysis bleaching earth absorbent, heavy metals, PCB, PCDD
A.291	Analysis bleaching earth absorbent, heavy metals, PCB, PCDD
A.292	Analysis Fish Protein Concentrate 13840 (inhibition test)
A.293	Analysis Fish Protein Concentrate 13840 (biogas potential test)
A.294	Analysis Sewage sludge cake from Narvik Beisfjord Test 27255 (inhibition test)
A.295	Analysis Sewage sludge cake from Narvik Beisfjord Test 27255 (biogas potential test)
A.3 Client's pre-engineering	
A.300	Client's General Arrangement Plan (.zip file including 2 .pdf files and 2 .dwg files)
A.301	Digital survey as basis for Supplier's Plant Layout (.zip file including 2 .pdf files and all .dwg files)

A.302	Client's Process Flow Diagram
A.303	Split between Scope of Client, DBC and Suppliers of Other Lots
A.4 Selected Regulations	
	SPCR120
A.400	Avfall Sverige SPCR120 protocol for digestate quality 2024 version (English translation)
A.401	Avfall Sverige SPCR120 protocol for digestate quality 2024 version (original Swedish version)
A.402	Avfall Sverige SPCR120 protocol for digestate quality: Appendix 1 (English translation)
A.403	Avfall Sverige SPCR120 protocol for digestate quality: Appendix 1 (original Swedish version)
A.404	SPCR120 Method for the determination of visible contaminants in digestate and pretreated food waste (English translation)
A.405	SPCR120 Method for the determination of visible contaminants in digestate and pretreated food waste (original Swedish version)
	Norwegian responsible authority for ABPR
A.410	A general introduction to the EU regulations on animal by-products (English translation)
A.411	A general introduction to the EU regulations on animal by-products (original Norwegian version)
A.412	A guide to the most important rules applying to biogas plants with ABPR treatment (English translation)
A.413	A guide to the most important rules applying to biogas plants with ABPR treatment (original Norwegian version)

Table 52: Overview of Specification Appendices