INTERNAL REPORT · 13 NOVEMBER 2026

The Danish plant

A zeolite factory that develops and packs its own products, makes its own electricity from manure, and brings nitrogen and phosphorus back from local water. What it is, how much power it uses, how large the biogas plant must be, and how far the trucks must drive.



2.2 GWh
of electricity a year for the whole plant*

280 kW
gas engine covers it*

27,900 t
of manure a year*

10 km
radius, at a fifth of the manure*

€55 m
site, plant and two years*

The business plan describes the Danish plant as the showroom of the zeolite circle (section 9.1). This report works that picture through in numbers. It rests on nine knowledge chapters in **knowhow/factory/** and on one calculation model. The costs are our own estimates: no supplier, seller or authority has been asked.

> **How to read it.** Figures marked * are our own estimates. Where a figure was measured or published, the page says by whom. "Open" means nobody knows yet.

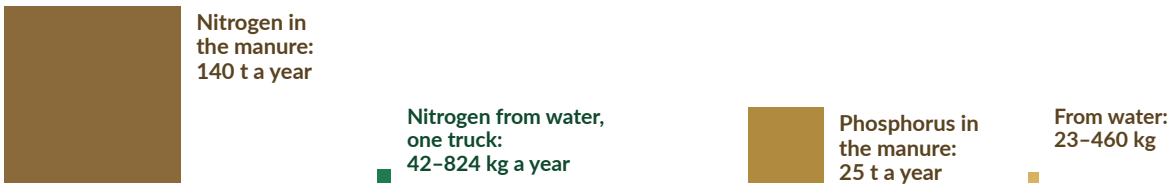
SUMMARY

Twelve findings

1. **The whole plant uses about 2.1 GWh of electricity a year*** at 50,000 t of rock: 1.75 GWh in the core factory, 0.32 GWh in the modules. With the biogas plant's own use it is 2.24 GWh.
2. **A 280 kW gas engine covers it***, on 560,000 Nm³ of methane from 27,900 t of manure, if 15% is deep litter. On slurry alone it takes 44,900 t.
3. **The manure is within 10 km***: 203 km² of land round Fredericia, at a fifth of what is there. One tanker carries it in three loads a day.
4. **Solar on every roof makes 1.6 GWh by itself***, 70% of the need. With both, the plant sells power, or the biogas plant is built at a quarter of the size.
5. **Made in the year is not used in the hour.** An engine running day and night covers 58% of the use hour by hour*. The grid connection stays.
6. **The engine's heat equals its electricity.** 2,348 MWh a year*. The digester takes 698. The rest could replace gas in the rock dryer, if the engine runs with the dryer.
7. **The water loop is small in kilograms.** One truck brings in 42–824 kg of nitrogen a year from water*; the manure brings 140 t. The loop is a demonstration and a paid service.
8. **Teabag chips must be milled, and the digester takes only part.** 2–4 kg per tonne of feed favoured digestion in the literature: 56–112 t a year. The rest joins the digestate afterwards.
9. **Phosphorus needs a calcium mineral.** Iron holds it too firmly and lanthanum for good. What a calcium mineral catches at stream strength has never been measured.
10. **The fertiliser is the manure.** In a pellet of digestate fibre, zeolite and the phosphorus mineral, over 99% of the nutrients come from the fibre. It is still the one product in the range that may be called a fertiliser.
11. **Used teabag material is waste in law until decided otherwise.** That settles whether it may go on a field or into a product. It is the first question to ask.
12. **It costs about €55 m all in*** (€38–78 m): €43.3 m to buy the site and build, €11.7 m of equity for two years of running with no income counted. No quotes.

WHAT WE WOULD BUILD, ON THESE FIGURES

Solar on every roof from the first day. A biogas plant of about 27,900 t a year with a 280 kW engine, once the manure is signed. One tanker, one hook-lift truck and one crane truck. A pellet line of 500 t a year when the garden product has a buyer. Before any of it: the farms within 15 km, the legal standing of used teabag material, and the tests T1, T2 and P1.



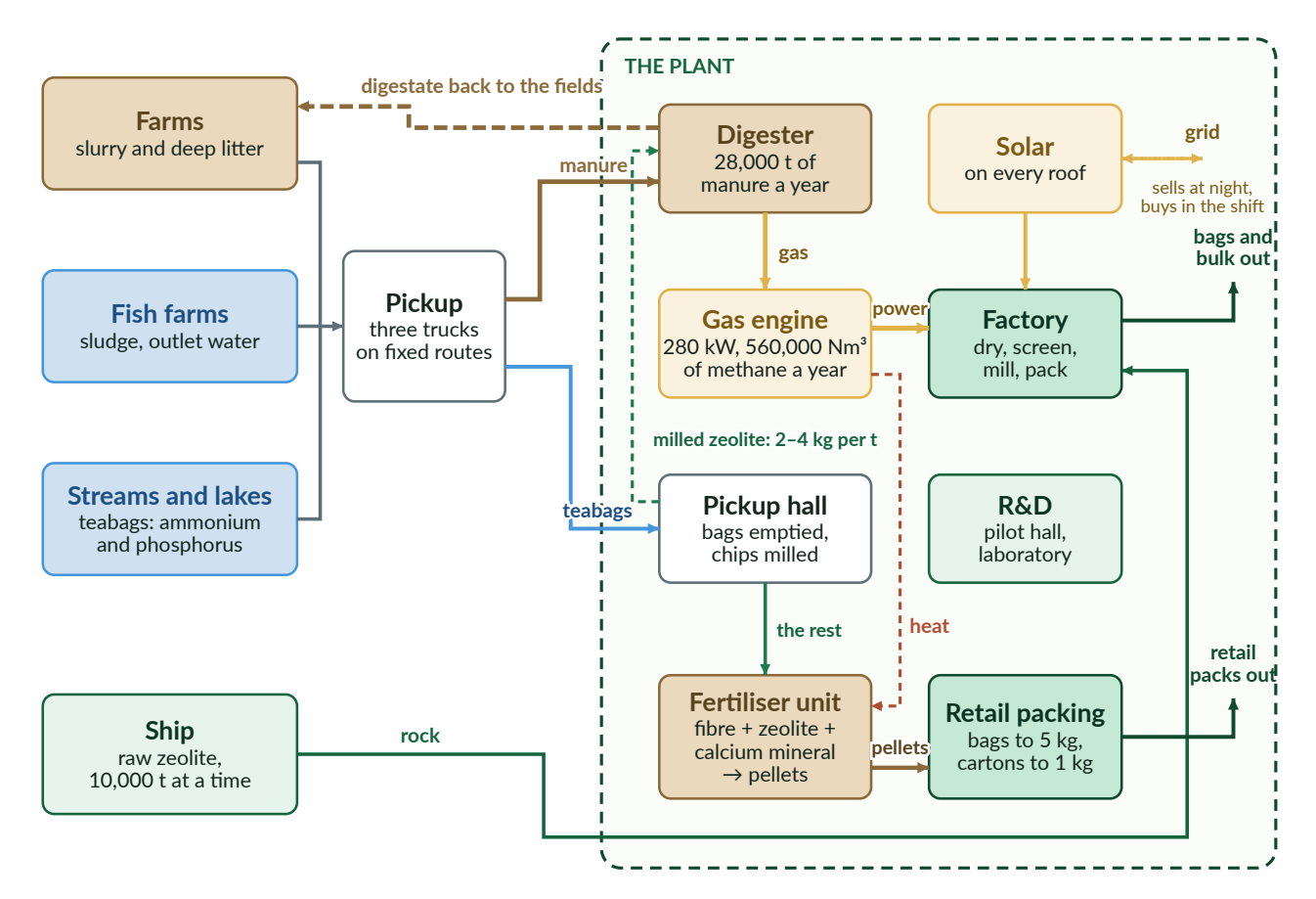
Areas to scale. The small squares show the high end of the range.

* our own estimate, not a measurement or a quote · 2 / 20

THE IDEA

One site where the circle closes

Rock comes in by ship and goes out as products. Manure comes in by truck, makes the plant's power and goes back to the fields. Teabags come home from the water with a little nitrogen and phosphorus, and leave again in the digestate or in a pellet.



WHAT IS NEW AGAINST THE COSTED PLANT

- Research and development, with a pilot hall.
- A retail packing line for bags and cartons.
- A pickup service of three trucks.
- A biogas plant with a gas engine; solar on the roofs.
- A small fertiliser unit.
- A store for six months of rock.

What the visitor is shown. The plant's electricity comes from manure. The nitrogen that went through the digester is back on the fields. A bag from a stream is opened and its contents weighed.

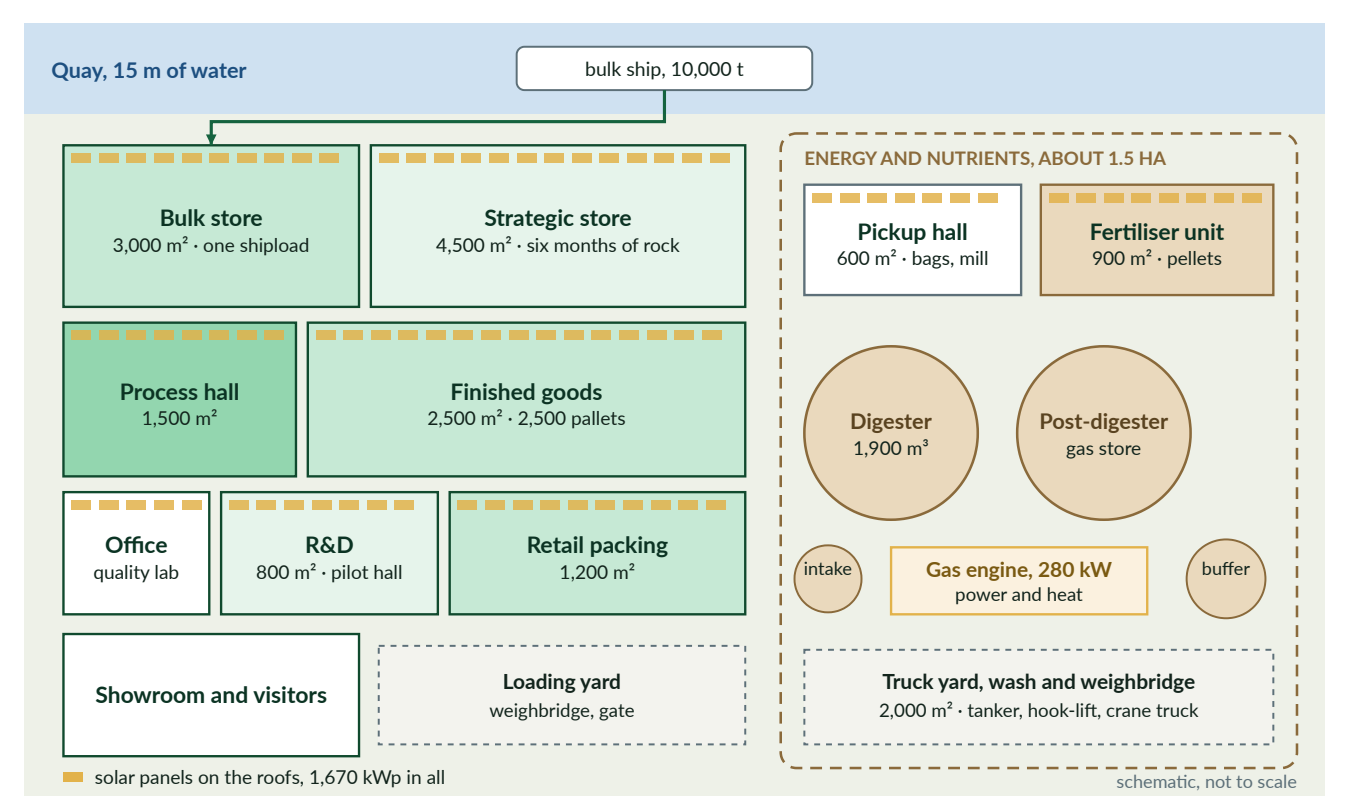
What the visitor is not told. That zeolite makes the gas, that the bags clean a stream, or that the pellet is made of recovered nutrients. None of that is true.

The plant may say	Never
Our electricity is made from manure, over the year	Zeolite makes the gas
The nitrogen in the manure goes back to the fields	The plant cleans the water around it
The bags take ammonium out of the water they stand in	Fewer algae; a restored lake or stream

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THE SITE

About 4.5 hectares, twice the costed plot



Part	Floor or ground	People*
Core plant, as costed	7,400 m²	16
Strategic store, extra hall	4,500 m²	—
Research and development	800 m²	4
Retail packing	1,200 m²	6
Pickup hall and truck yard	2,600 m²	4
Fertiliser unit	900 m²	2
Biogas plant	about 1 ha	2
Whole site	**about 4.5 ha***	**about 34**

Open: where. The cost document ranks Fredericia first for its deep quay. A biogas plant takes about 120 t of manure each working day by road, and the port lies beside the town. Either one site outside the town with rock trucked from the quay, or two sites joined by a cable and a heat pipe. Nobody has asked the port or the municipality.



The areas outside the core are sized from the throughputs on the following pages, not from a design.

* our own estimate, not a measurement or a quote ·

THE FACTORY

The core: dry, screen, mill, pack

Ship 10,000 t, under 10 mm → **Bulk store** one shipload; six months later → **Dryer** 25 t an hour, gas burner → **Screens** five granule grades → **Mill** 5 t an hour, two powders → **Silos** ten of 100 t → **Packing** big bag, sack, small pack

This is the plant of the cost document, unchanged: 50,000 t a year on one shift of 2,000 hours, 100,000 t on two shifts without new buildings. It was put at about €19.7 m*, with no quotes.

Step	Rate
Drying	25 t/h; takes off about 4 points of moisture
Screening	25 t/h, five fractions
Milling	5 t/h, a fifth of the tonnage
Packing	two big-bag stations, a sack line with robot, a small-pack line
Dust	extraction on every transfer; a regulated exposure



The strategic store. Six months of rock is 25,000 t at full capacity: 4,500 m² more bulk hall beside the costed 3,000 m². At 10,000 t a year, six months is 5,000 t and the costed store is enough. The second half of secure supply is a second source.



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THE FACTORY

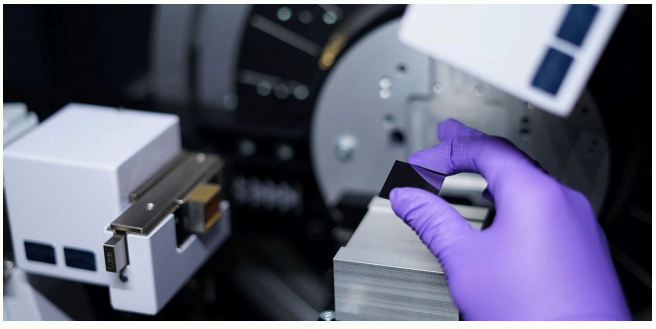
Research, development and retail packing

RESEARCH AND DEVELOPMENT, 800 M²*

The costed plant has a quality laboratory. It checks batches; it does not develop products. The module adds:

Room	What happens there
Pilot hall	A 200 kg/h dryer, screen, mill, mixer and pellet press. New grades and blends in lots of 50–500 kg
Wet laboratory	Column tests with real water: ammonium, and the phosphorus minerals
Digester bench	Six to twelve small digesters: settling and gas yield, with and without zeolite
Growth room	Pot trials with loaded zeolite, digestate and pellets
Showroom	Where the visitor's route starts

Four gates before a partner may sell a new product: a mechanism that fits the chemistry, published evidence, a legal status in the EU, a trial of our own material.



RETAIL PACKING, 1,200 M²*

Line	Packs	A year*
Bag line	Printed stand-up bags, 0.5–5 kg, 25 a minute	3,000 t
Carton line	Printed boxes to 1 kg with inner bag, 40 a minute	2,000 t
Small formats	Sachets, aquarium bags, refrigerator containers	by hand
End of line	Check weigher, metal detector, shelf-ready trays	

About 5,000 t a year on one shift, a tenth of the plant. One line is enough for years.

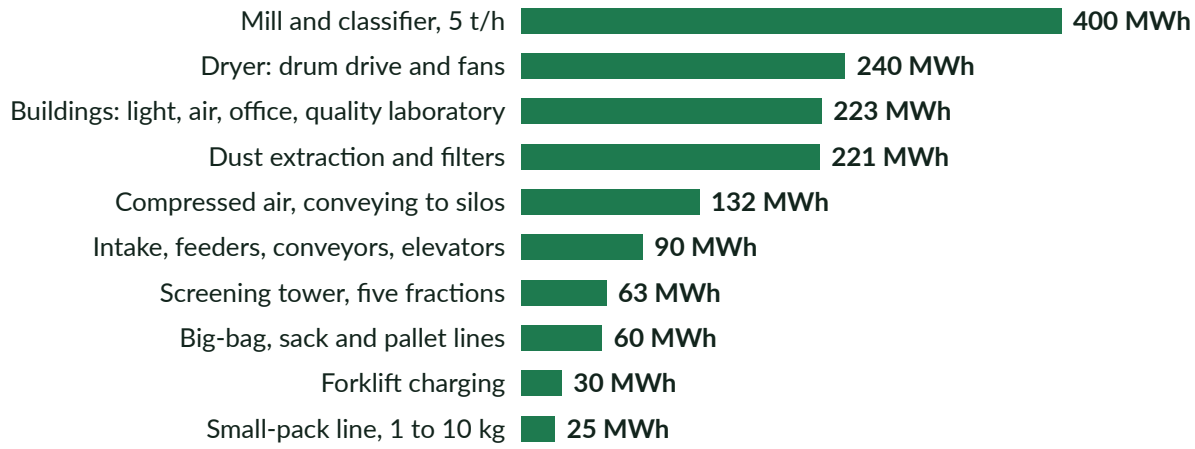
First products	What stands in the way
Refrigerator container	Research ordered; no freshness claim yet
Pavement grit	Trial waiting. Gives grip; does not replace salt
Garden soil improver	Zeolite is not a fertiliser
Garden fertiliser pellets	Page 17
Cat litter, aquarium bags	Open: not yet in the range

* our own estimate, not a measurement or a quote

ELECTRICITY

The whole plant: 2.2 GWh a year

The cost document plans with 35 kWh per tonne. No machine list exists, so we built one*: installed power, the share drawn while running, and 2,000 shift hours.

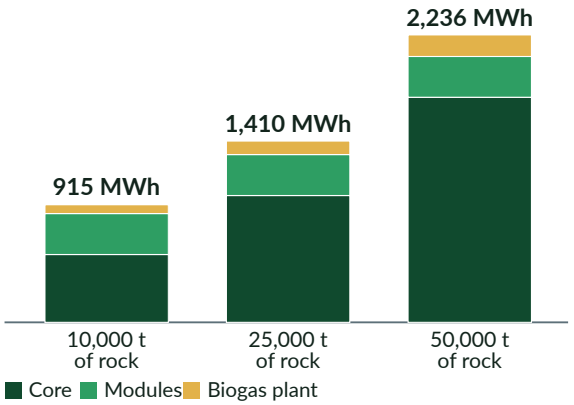


The core factory, MWh a year at 50,000 t*. Sum: 1,484 MWh, or 29.7 kWh per tonne. We keep the planning figure of 1,750 MWh: start-up, idling and forgotten motors always add.

Module*	MWh	Basis
Research and development	130	30 kW in working hours; 8 kW always
Retail packing	69	70 kW, 55% load, 1,800 h
Strategic store	29	light and air, 4,500 m²
Pickup hall	15	bag washing, chip mill
Fertiliser unit	75	press, fans, pellet press

	MWh a year
Core factory	1,750
Modules	318
Biogas plant's own use, 6 kWh per tonne of feed	167
To be made	**2,236**

Milling is the largest use: 40 kWh for each tonne milled. A range with more powder uses more power.



By throughput*. A small plant uses more per tonne: 52.8 kWh in the core at 10,000 t, 35.0 at 50,000 t.

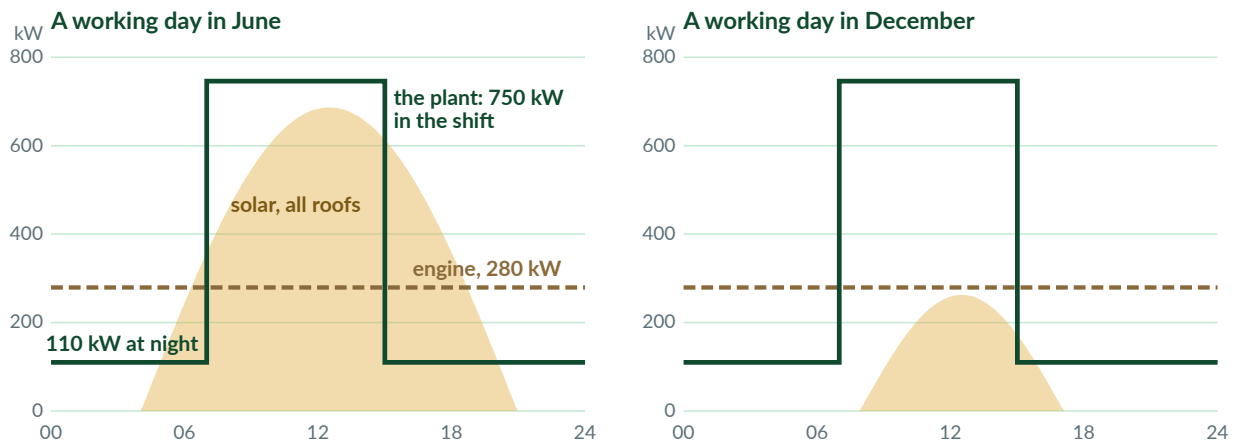
The plant draws about 690 kW in the shift and about 10 kW at night; the 1 MW connection of the cost document fits. **The dryer's heat is gas, not electricity:** 2,250 MWh a year, outside the energy goal. Page 9 shows what the engine's heat could do about it.

Option: three battery trucks at 60,000 km each add 234 MWh, a tenth more.

* our own estimate, not a measurement or a quote ·

ELECTRICITY

Solar, and the difference between a year and an hour



Two working days*. Green line: what the plant draws. Dashed: an engine running day and night. Yellow: solar on every roof.

SOLAR*

	Core roof	All roofs
Roof	7,400 m²	15,400 m²
Panels	800 kWp	1670 kWp
A year	762 MWh	1,585 MWh

65% of the roof usable, 6 m² per kWp, 950 kWh per kWp a year. Two calculators give 921 and 1,054 for Denmark.

The business plan's "roughly 1 GWh" for the core roof was high. It is about 0.76 GWh. December gives about a fiftieth of the year.

THREE WAYS OF RUNNING*

Way	Engine	Covered in the hour
Engine day and night	280 kW	58%
Small engine, solar on all roofs	65 kW	70%
Engine in the shift only, gas stored	1120 kW	67%

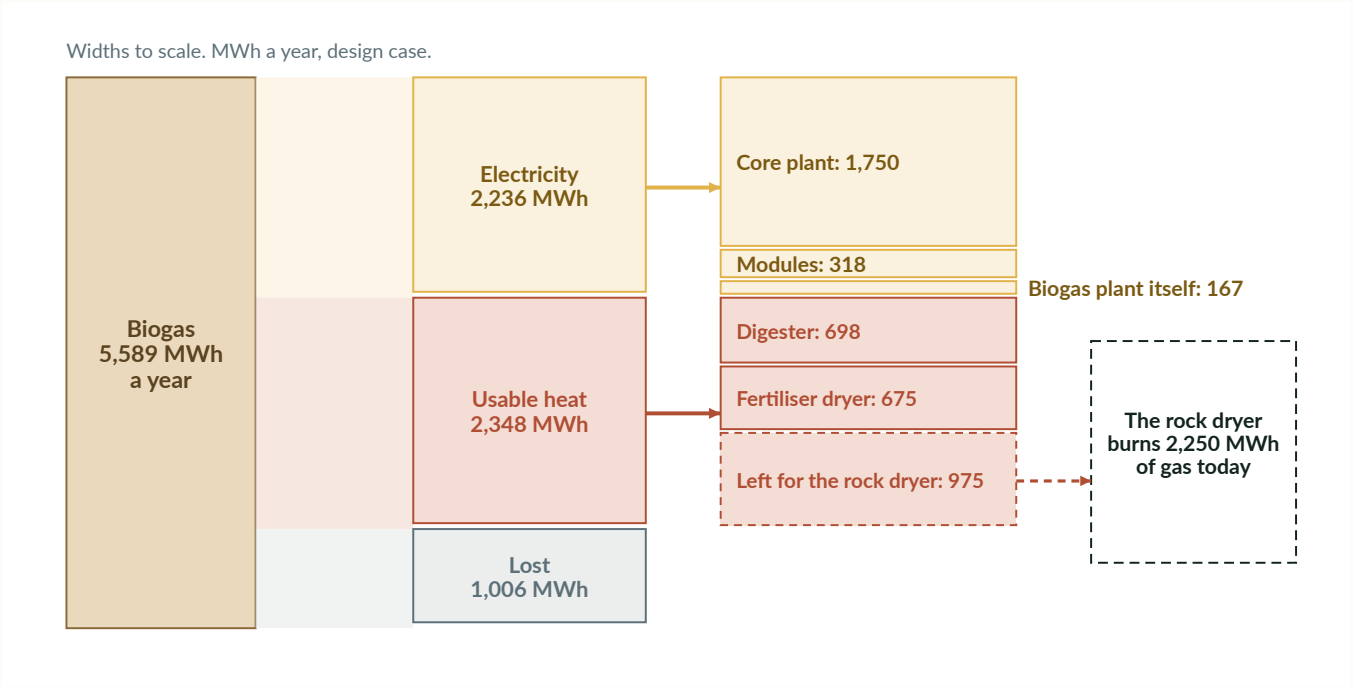
In the first way the plant sells 1,146 MWh at night and buys 933 MWh in the shift. Over the year it balances, which is the goal as you defined it. It is a net-zero user, not an island.

Open: what a kWh sold at night earns against one bought in the shift, and the tax on power made for own use.

* our own estimate, not a measurement or a quote · 8 / 20

HEAT

The engine's heat is worth as much as its power



A gas engine turns about 40% of the gas into electricity and about 42% into heat that can be used*. About half of that heat is in the exhaust at some 450 °C; the other half is cooling water at 90 °C.

Heat, MWh a year*	
From the engine	2,348
Digester, 25 kWh per tonne of feed	698
Fertiliser unit, to dry the fibre	675
Left over	975
The rock dryer burns, as gas	2,250

The catch is the clock. The rock dryer runs 2,000 hours. An engine running day and night gives less than a quarter of its heat in those hours. To put the heat in the dryer, the engine must run with the shift: four times the size, with gas stored overnight.

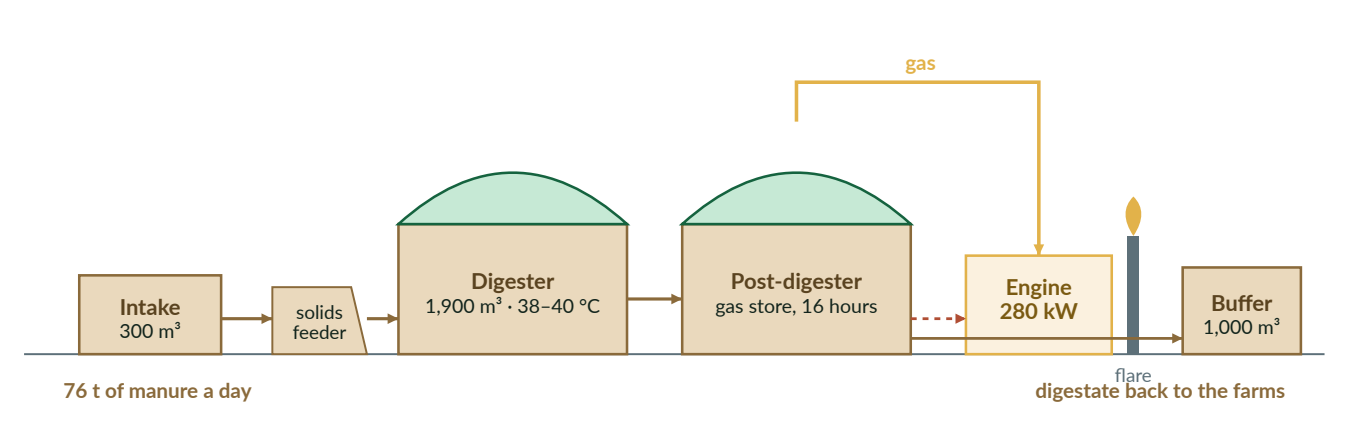
Two honest designs. A small engine that always runs and wastes most of its exhaust. Or a large engine with a gas store that runs when the dryer runs and could replace up to 43% of its gas. This is outside the electricity goal. It is here because the heat is free once the engine stands.

Open: the choice between the two. It belongs to whoever designs the plant.

* our own estimate, not a measurement or a quote

BIOGAS

A 280 kW engine on 27,900 t of manure



What the feed gives	Nm³ methane per tonne
Pig slurry	12
Cattle slurry	14.1
Deep litter, poultry manure	60
Our mix: 85% slurry, 15% deep litter*	20.1

Danish Energy Agency, biomass and yields, June 2024.

One Nm³ of methane holds 9.97 kWh.

Slurry is mostly water. A tonne gives about 52 kWh of electricity; a tonne of deep litter about 239. Deep litter is what every Danish biogas plant wants.



Design case*	
Manure a year	27,900 t
of which slurry	23,700 t
of which deep litter	4,200 t
A day	76 t
Methane a year	560,000 Nm³
Gas energy	5,589 MWh
Engine, 8,000 hours	280 kW
Digester, 25 days' stay	1,900 m³
Nitrogen passing through	140 t
Phosphorus passing through	25 t

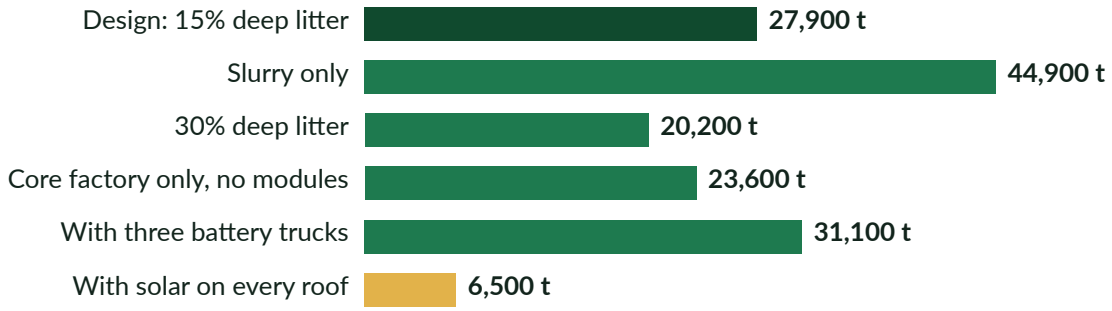
By Danish standards this is a small farm-scale plant. The largest take over 700,000 t a year.

The parts*. A covered intake tank of 300 m³; a feeder for 12 t of deep litter a day; a heated digester and a post-digester with 16 hours of gas; gas cleaning; the engine with heat recovery; a flare; a 1,000 m³ buffer. The long storage is in the farmers' own tanks. About one hectare.

* our own estimate, not a measurement or a quote · 10 / 20

BIOGAS

What moves the answer, and what zeolite does in the tank



Manure a year*. Solar changes the size more than anything else.

Our recommendation: size the biogas plant to cover the need alone. The plant is built to show that its power comes from the nutrient loop. Solar then makes it a net seller.

ZEOLITE IN THIS DIGESTER

- Zeolite helps where ammonia holds digestion back: poultry manure, deep litter, hot digesters. On healthy slurry there is little to gain.
- For piggery waste 2–4 g per litre helped; above 6 it harmed; at 10 it failed (Milán 2001).
- **No gas gain is counted in this sizing.** One laboratory batch is not a design basis.

Loaded zeolite	Tonnes a year
Dose that favours digestion: 2–4 kg per tonne	56–112
One teabag truck brings in	230–460

The digester cannot take all of it, and not as chips. Teabag chips are 5–10 mm and will sink, fill the tank and wear the pumps. They are milled first. What the dose does not take goes into the digestate afterwards, or into the pellets.

Loaded zeolite is already full of ammonium and cannot take up more. If zeolite is to help the digestion, fresh zeolite does it. The loaded zeolite passes through.

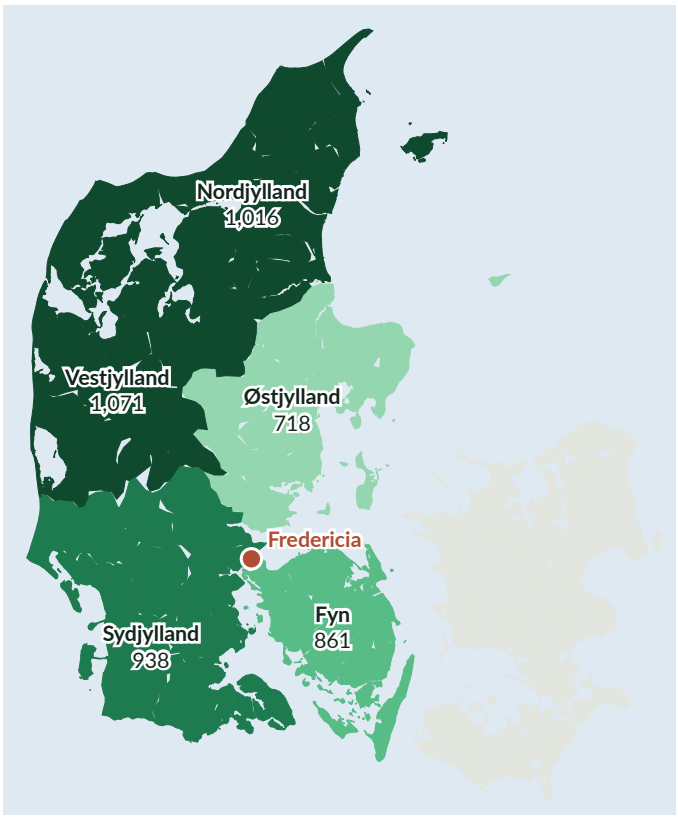
Open: approval to take manure from several farms; a mineral additive in the feed list.

Case*	Manure a year	Methane a year	Engine	Digester
Design: 15% deep litter	27,900 t	560,000 Nm³	279 kW	1,900 m³
Slurry only	44,900 t	590,000 Nm³	292 kW	3,100 m³
30% deep litter	20,200 t	550,000 Nm³	274 kW	1,400 m³
Core factory only	23,600 t	470,000 Nm³	236 kW	1,600 m³
With three battery trucks	31,100 t	620,000 Nm³	311 kW	2,100 m³
With solar on every roof	6,500 t	130,000 Nm³	65 kW	400 m³

* our own estimate, not a measurement or a quote · 11 / 20

MANURE

How much manure there is, and where



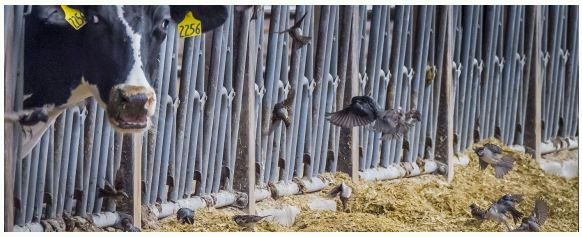
Denmark produces about 35 Mt of livestock manure a year, and about 35% already goes to biogas plants (secondary sources*). We shared the 35 Mt between provinces by their livestock units and divided by land area.

Province	Mt a year*	Tonnes per km²*
Vestjylland	7.68	1,071
Nordjylland	8.01	1,016
Sydjylland	8.24	938
Fyn	3.00	861
Østjylland	4.20	718
Denmark	**35.0**	**815**

Animals: Statistics Denmark, table HDYR07, 2025. Land: table ARE207. Livestock units: Eurostat coefficients. Zealand and Bornholm were not calculated.

Fredericia sits in Sydjylland, at 938 t per km², above the national average. The town itself has a port and a refinery; the farms are in Vejle, Kolding, Hedensted and Middelfart.

About 11% of the tonnage is deep litter and other solid manure*. That is the share the design case asks for, and not more.



* our own estimate, not a measurement or a quote · 12 / 20

MANURE

The catchment: about 10 km round the plant



10% of the manure inside the ring: 14.5 km, 406 km² of land
20% of the manure inside the ring: 9.8 km, 203 km² of land
40% of the manure inside the ring: 6.6 km, 102 km² of land

Rings: the radius that holds the design tonnage if we get 10%, 20% or 40% of the manure inside it*.

Fredericia lies on the Little Belt, so a third of the circle is water. We counted the land inside each radius on a 250 m grid over the municipal map. The Fyn side counts: two bridges cross at Middelfart.

Radius	Circle	Land
5 km	79 km²	56 km²
10 km	314 km²	210 km²
15 km	707 km²	433 km²
20 km	1,257 km²	803 km²

In area: 203 km² of land at a fifth of the manure, 406 km² at a tenth, 102 km² at two fifths. The share is the real unknown: farmers must want to, and a third of Danish manure is already contracted.

Case*	Manure a year	10% share	20% share	40% share
Design: 15% deep litter	27,900 t	14.5 km	9.8 km	6.6 km
Slurry only	44,900 t	16.7 km	11.6 km	7.6 km
30% deep litter	20,200 t	17.4 km	12.3 km	8.1 km
Core factory only	23,600 t	13.4 km	8.8 km	6.2 km
With solar on every roof	6,500 t	6.5 km	4.6 km	3.4 km

More deep litter does not shorten the drive. It cuts the tonnage, but deep litter is thin on the ground, so the circle grows.

Open: the farms within 15 km and their animals (the CHR register has them), and which biogas plants collect there today. This is asked before anything else.

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THE PICKUP SERVICE

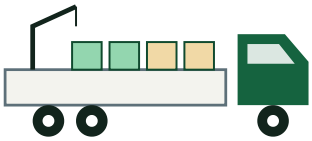
Three trucks, and what each does all year



1. Tanker, 32 t
3.2 loads a working day · 12,530 km a year
44% used



2. Hook-lift with containers
18 t of deep litter a working day;
fish-farm sludge, fibre, pellets



3. Crane truck
20 sites a day, 100 a week;
460 t of bag material a year

THE TANKER'S DAY*

Slurry in, digestate back on the same trip	23,700 t a year
Average distance to a farm, by road	8.5 km
Round trip with loading	1.1 hours
Loads a working day	3.2
One tanker could carry	54,100 t a year

Three trucks are enough. The tanker is under half used; a plant on slurry alone would still need only one. The crane truck is the full one: each further 100 water sites needs another.



THE CRANE TRUCK'S WEEK*

- 100 sites, each on its own weekday. A box of four bags is lifted, the bags changed, the box lowered.
- A water sample above and below the box on the first visit and every month. Bag tags scanned.
- 2 t a day comes home: half zeolite, half the phosphorus mineral, kept apart.
- At the pickup hall the bags are emptied, the mesh washed and refilled, the chips milled.

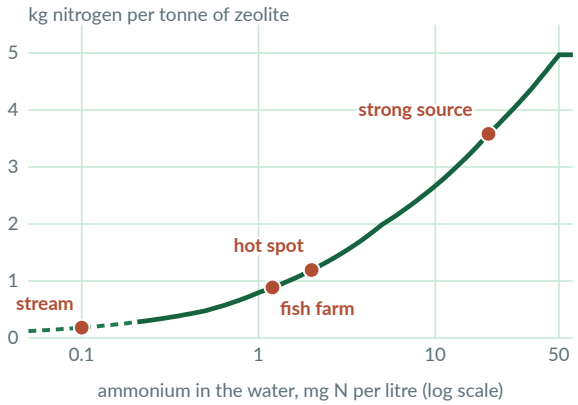
The round is driven for what the customer pays, not for the kilograms. A day's round brings home about 0.2 kg of nitrogen from ordinary streams and about 1 kg from hot spots. A site earns its stop as a service: an outlet with a permit limit, a lake inflow, a fish farm.

Open: the fish farms. Most Danish trout farms lie in mid and west Jutland, 40–100 km away, and are not mapped here. Disease rules for one fleet visiting many herds. Own trucks or a haulier.

* our own estimate, not a measurement or a quote ·

WATER

How much water the loop can clean of ammonium



What a tonne of teabag chips carries home, from the capture-unit model*. Dashed: below the model's range.

Zeolite takes up more ammonium the more there is in the water. In open water there is little, so the rock comes home nearly empty.

Fish farm: 1.2 and 1.36 mg measured at the outlets of two Danish model farms (DTU Aqua). Ordinary stream: our assumption; the measured median was not found. Danish streams hold 4.0 mg of total nitrogen per litre, nearly all of it nitrate, which zeolite does not bind (DCE, 2021).



One truck, 230 t of zeolite a year*	mg N per litre	Rock per kg of nitrogen	Nitrogen a year	Water holding that much
Ordinary stream	0.1	5.5 t	42 kg	418,000 m³
Below a fish farm	1.2	1.1 t	204 kg	170,000 m³
Hot spot	2	0.8 t	275 kg	137,000 m³
Strong source	20	0.3 t	824 kg	41,000 m³

The answer. One truck removes the ammonium of 0.04–0.4 million m³ of water a year: 42–824 kg of nitrogen. 2–10 million m³ pass through the bags, but each pass takes only 2–16% of the ammonium. A stream of 100 litres a second carries 3.2 million m³ a year.

Go where the water is strong. A site at 2 mg per litre gives six to seven times the catch of an ordinary stream for the same drive.

The strongest water is on our own site. Digestate holds ammonium in grams per litre. There the mineral can load towards 15 kg of nitrogen per tonne: 100 t of fresh zeolite would hold up to 1.5 t.

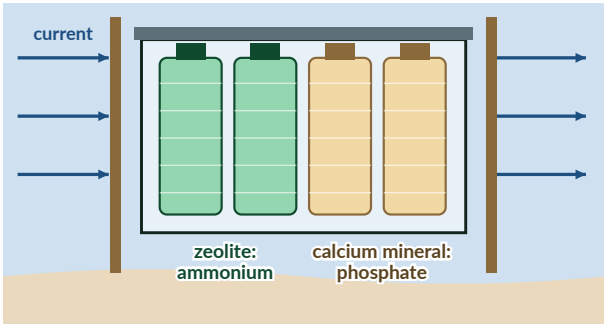
Open: tests T1 and T2 of the capture-unit report; what else the zeolite takes up in open water; permission per site; who pays.

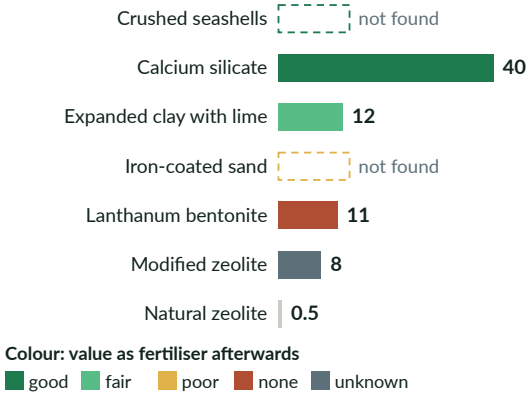
* our own estimate, not a measurement or a quote

WATER

A second teabag for phosphorus

Zeolite holds positive ions. Phosphate is negative, so zeolite does not bind it. A teabag that catches phosphorus holds another mineral.





The most each material has held, g of phosphorus per kg, at wastewater strength (review of filter materials, 2011; vendor; our notes). A stream is hundreds of times weaker.

- Danish streams in farmed catchments hold 0.099 mg of phosphorus per litre at the median; natural streams 0.059 (DCE, 2021).
- About 40% is dissolved. That is what a mineral can catch: about 0.04 mg per litre, 30 times thinner than ammonium below a fish farm.
- Two bags, not a mixed bag: the materials go to different places afterwards.

Use a calcium mineral. Calcium phosphate feeds plants slowly, and the spent mineral limes the soil. Iron holds phosphorus too firmly and lets it go in oxygen-free mud. Lanthanum locks it away for good. A modified zeolite would end the line "a natural, unmodified mineral".

Start with crushed seashells and one calcium silicate, side by side. Shells are cheap and already stand in Danish drain filters. Calcium silicate holds more but makes the water strongly alkaline at first.

Uptake in a week*	Phosphorus a year	Water holding that much	Share of the lake need
0.1 g per kg	23 kg	0.6 million m³	0.03%
0.5 g per kg	115 kg	2.9 million m³	0.14%
2 g per kg	460 kg	11.6 million m³	0.54%

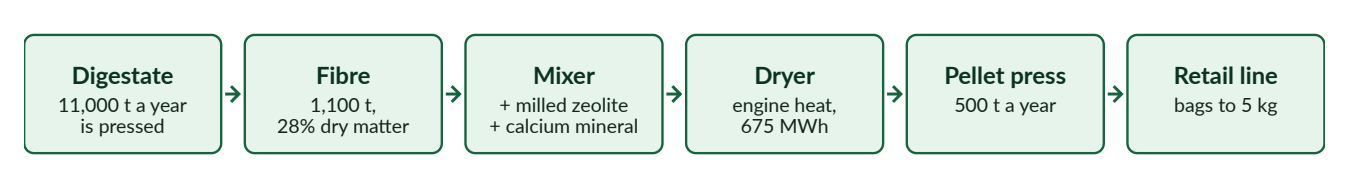
One truck, 230 t of mineral a year. The uptake has never been measured; these are three guesses. Danish lakes need about 85 t of phosphorus a year less.

Open, and first: a column test in real stream water (P1); pH below the bag (P2); a pot trial with the spent mineral (P3); heavy metals (P4). A bag that stays a season may catch more per kilometre than a weekly one.

* our own estimate, not a measurement or a quote · 16 / 20

THE FERTILISER UNIT

A small pellet line beside the digester





The pellet's dry matter*.

What the pellet holds*	Screw press	Decanter
Nitrogen	1.5%	1.5%
Phosphorus	0.6%	1.3%
as P_2O_5	1.4%	2.9%

A mineral garden fertiliser holds 10–20% nitrogen. This is an organic fertiliser of the kind sold as pelleted chicken manure, with a mineral that holds nutrients and water.

Why it fits. It is the garden fertiliser the retail line wanted. It uses engine heat when the rock dryer stands still. 500 t is 100,000 bags of 5 kg.



The fertiliser is the manure. 140 t of nitrogen and 25 t of phosphorus pass through the digester each year. The teabags add under one tonne of each. Zeolite is the carrier, not the content.

THE RULES, NONE CONFIRMED

- **Manure is an animal by-product.** A product for the public needs an approved plant and heat treatment.
- **A CE-marked fertiliser** may hold only listed materials. Digestate and fresh zeolite have their categories.
- **Used teabag material is waste** on a plain reading, and fits none of the categories on the face of it.

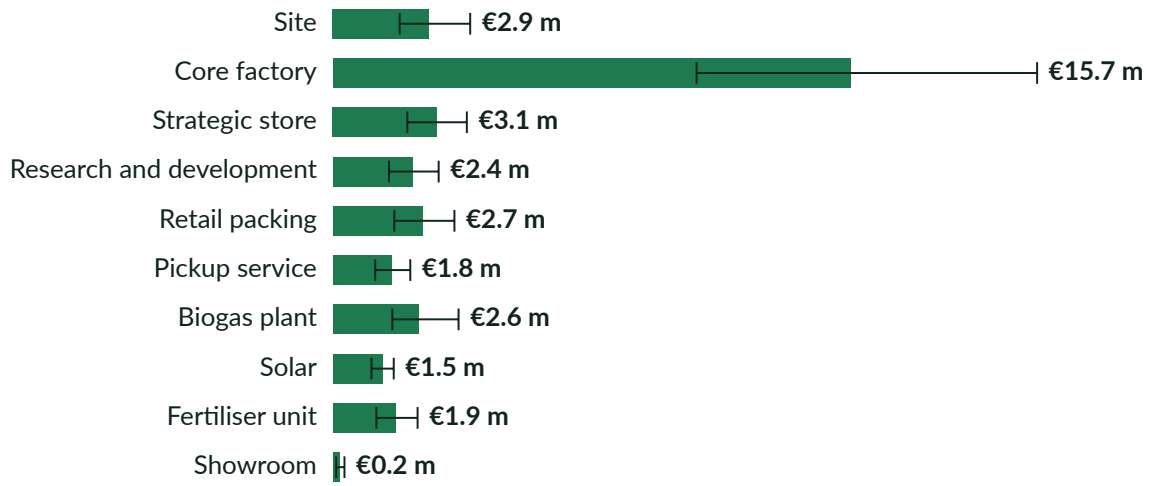
The plan that needs no answer: make the pellet from fibre and *fresh* zeolite. The spent teabag materials go to the field with the bulk digestate, as far as the waste rules allow.

Open: does zeolite hold ammonia back in the dryer? It is the one place where it could change what the pellet holds. A bench test for the R&D unit.

* our own estimate, not a measurement or a quote · 17 / 20

ECONOMY

To buy the site and build: about €43.3 m



Million euro*, before engineering and contingency. Bar: base. Line: low to high. No quotes.

Thousand euro*	Low	Base	High
Site: land, purchase, ground works	2,018	2,911	4,151
Buildings and machines	22,480	31,890	43,120
Design, engineering, 6–10%	1,376	2,607	4,410
Approvals and permits	300	500	800
Contingency, 10–20%	2,461	5,355	9,861
Site bought, plant built	**28,634**	**43,263**	**62,341**

The site. 45,000 m² at 250–500 kr per m²*: €1.5 m–3.0 m. One listing: 5.9 ha between Taulov and Erritsø, on the motorway, at about 300 kr per m². An asking price, not a sale.

Buying points inland. Danish ports lease their land and rarely sell it. A bought site is most likely a commercial plot some 8 km from the quay, with the rock trucked in. That also gives the biogas plant its distance to the town.

IN THE ORDER OF BUILDING*

When	Million euro
With the core factory	31.4
When sales need the stock	4.0
When the trials show the loop	2.2
When the manure is signed	3.3
When the pellets have a buyer	2.4
All	**43.3**

Each stage with its share of engineering, permits and contingency. The first holds the site, the core factory, research and development, retail packing, solar and the showroom.

The first stage is three quarters of the money. The loop itself, pickup, biogas and fertiliser unit, is €7.9 m. The core factory alone was put at €19.7 m in the cost document, on a leased plot.

Solar is the cheapest power on the list: €1.5 m for 1.6 GWh a year. The biogas plant costs €2.6 m for 2.2 GWh and needs manure, trucks and people. It is built for what it shows.

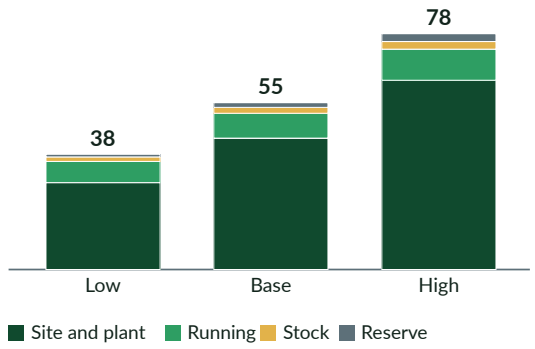
* our own estimate, not a measurement or a quote · 18 / 20

ECONOMY

Two years of running, and €55.0 m all in

Thousand euro*	Year 1	Year 2
Staff	2,210	2,890
Insurance, IT, laboratory tests, administration	400	400
Maintenance, 3% of machines	240	479
Research and trials: materials, outside analyses	200	200
Start-up: commissioning, training, waste	300	100
Unloading and port dues	88	175
Other: trucks, power bought, biogas service, land tax	219	309
Running cost	**3,656**	**4,553**

Assumed: 12,500 t of rock in the first year and 25,000 t in the second; 26 people, then 34, at €85,000 each (Eurostat 2025); solar from the first day; biogas from the second year. No lease: the land is bought.



All in, million euro*.

Thousand euro*	Low	Base	High
Two years of running	6,978	8,209	10,262
Six months of rock, 12,500 t	1,500	2,000	2,525
Reserve, 10–20%	848	1,531	2,557
Equity for two years	**9,326**	**11,741**	**15,344**

No income is counted. This is what must be in the bank if the plant earned nothing. Not in it: the rock that is processed and sold (about €6.0 m), packaging, trucking from the quay, interest and the cost of selling. Those are paid by the sales. Staff is 62% of the running cost.

What the two years could earn. At the business plan's margin of €202 a tonne, 37,500 t would carry about €7.6 m*: 92% of the running cost.

But the tonnes are the assumption. The plan's researched base case is 3,800 t a year in year 5. Its own rule stands: the full plant is built when the tonnes exist, and the lean start, about €4.5 m, comes first.

THE ORDER OF BUILDING*

With the core
site, factory, R&D, retail packing, solar
€31.4 m

Sales need stock
strategic store
€4.0 m

Trials show the loop
pickup hall, trucks
€2.2 m

Manure is signed
biogas plant, engine
€3.3 m

Pellets have a buyer
fertiliser unit
€2.4 m

* our own estimate, not a measurement or a quote ·

OPEN QUESTIONS AND SOURCES

What must be asked, tested and priced

ASK

- The farms within 15 km, and which biogas plants collect there.
- The port and the municipality: one site or two; distance to neighbours.
- The Danish Agency for Agriculture: is used teabag material waste, and under which rule may it go on a field?
- A fish farm and a water company: what is ammonium or phosphorus removed at one outlet worth?
- The grid company: sale at night, purchase in the shift, tax on own power.

TEST

- T1, T2: capacity and loading time of our chips in real water.
- P1–P4: the phosphorus minerals.
- B3, B4: settling and gas yield in a digester.
- Ammonia held in the pellet dryer.

PRICE

- Quotes for every line of pages 18 and 19: a builder, the process line, a biogas supplier, a solar installer, a pellet line, and the plot itself.
- Grants and green loans: not examined.

THE KNOWLEDGE BEHIND THIS REPORT

Nine chapters in knowhow/factory/, one model in src/report/factory/model.py. The build fails if a chapter and the model disagree.

READ IN THE SOURCE

- Statistics Denmark, tables HDYR07 (livestock, 2025) and ARE207 (area), downloaded 13 Nov 2026
- DCE, Aarhus University: Vandløb 2021, report 527
- Danish Energy Agency: biomass and yields, 19 Jun 2024; technology catalogue for renewable fuels, chapter 81
- Our capture-unit report and cost document
- DAGI, the Danish administrative map (municipal outlines)

READ IN SEARCH SUMMARIES, TO BE CHECKED

- Vohla et al. 2011, filter materials for phosphorus (Ecological Engineering 37)
- Vandermoere et al. 2018, iron-coated sand filters (Water Research 141)
- DTU Aqua reports on model fish farms (Tvilho, Nørå)
- Aarhus University: manure norms 2025/26; drain-filter trials
- Milán 2001, Montalvo 2006: zeolite doses in digesters
- Dutch agricultural office 2025: share of Danish manure in biogas
- Vendor and calculator figures: lanthanum bentonite, solar yield, engine efficiency

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