



HyperthermicsTM

THE GREEN SHIFT REVOLUTION

Hyperthermics - More biogas, faster!

Avfallsforum Ulsteinvik 13.04.2023

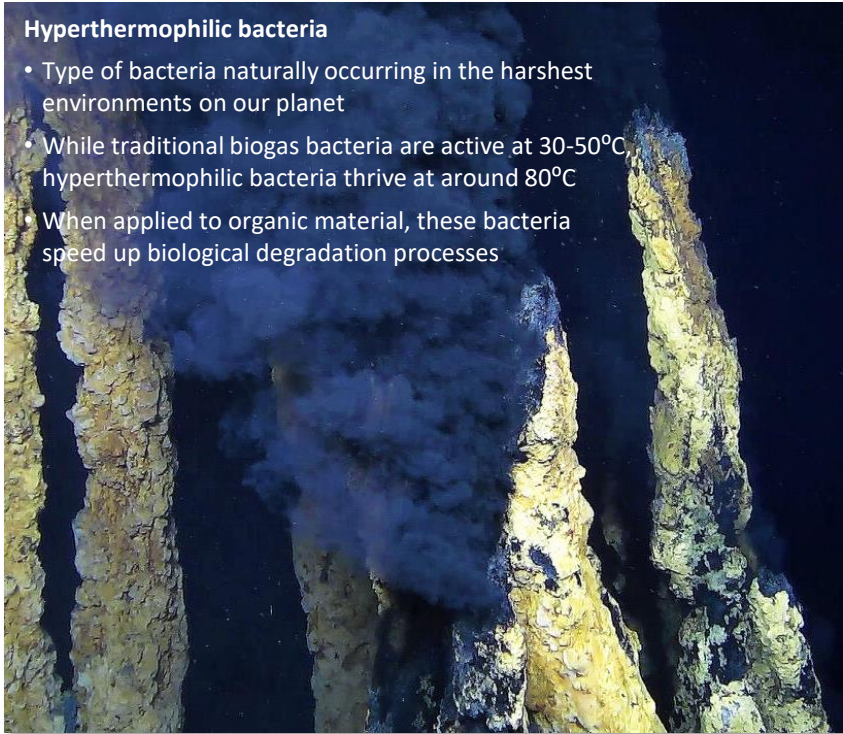
Hyperthermics develops technology for increased biogas production, and for protein recovery from waste streams



Hyperthermics' business idea is rooted in the application of hyperthermophile bacteria for industrial purposes

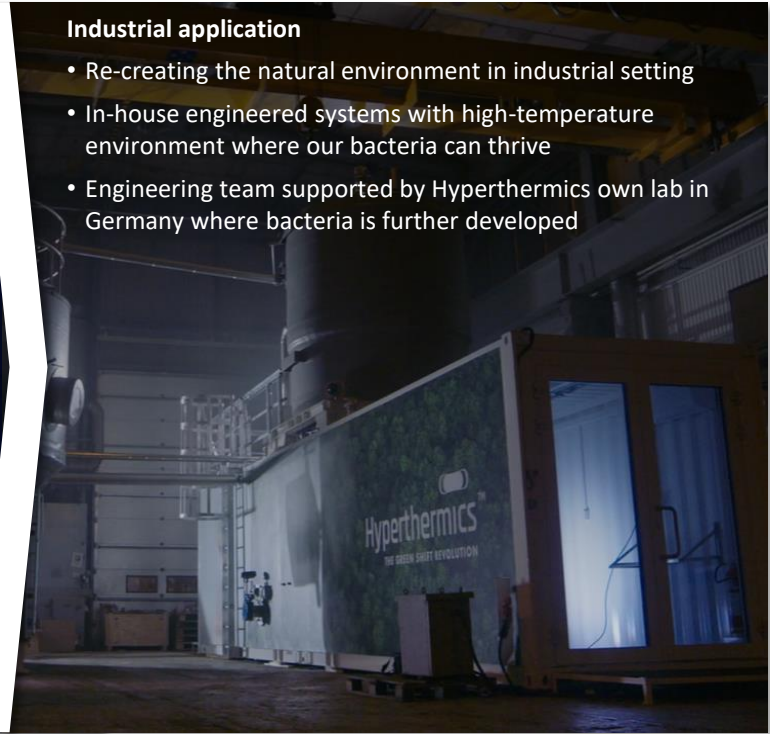
Hyperthermophilic bacteria

- Type of bacteria naturally occurring in the harshest environments on our planet
- While traditional biogas bacteria are active at 30-50°C, hyperthermophilic bacteria thrive at around 80°C
- When applied to organic material, these bacteria speed up biological degradation processes



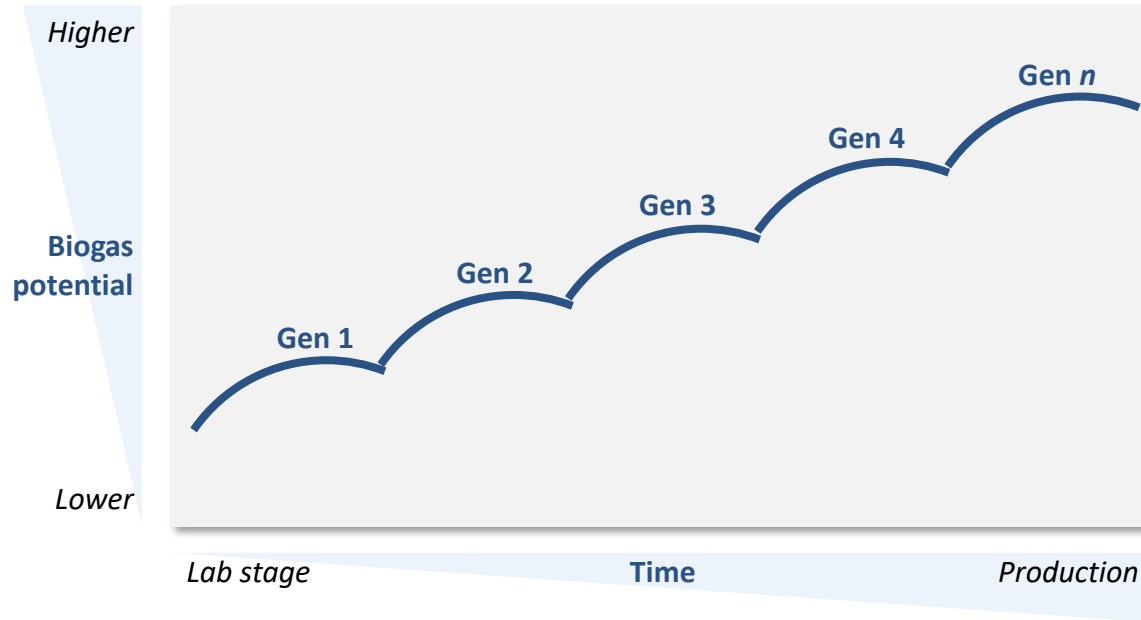
Industrial application

- Re-creating the natural environment in industrial setting
- In-house engineered systems with high-temperature environment where our bacteria can thrive
- Engineering team supported by Hyperthermics own lab in Germany where bacteria is further developed



Through exposure, our live bacteria will adapt to specific substrates over time and improve performance

Adaptation of bacteria to specific substrates (illustrative)



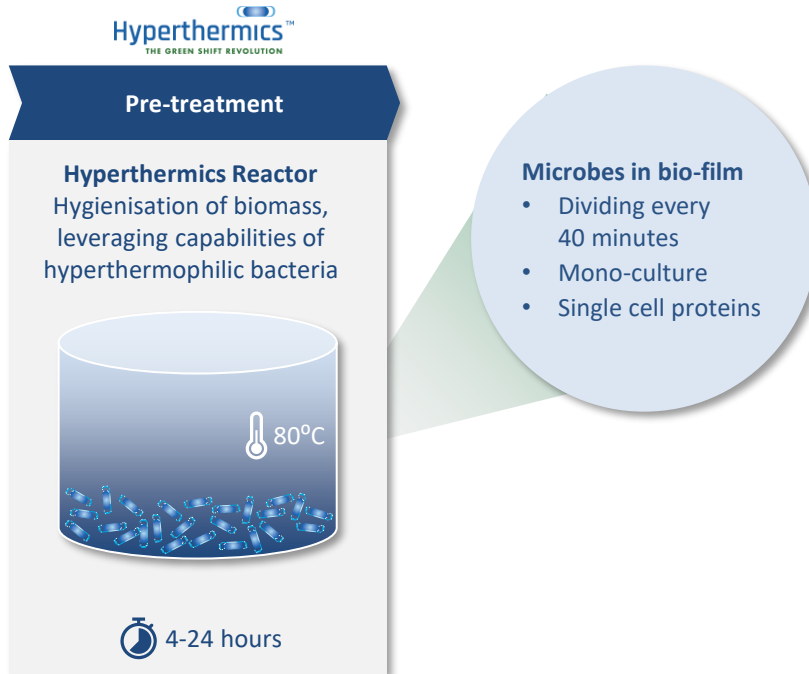
Right bacteria strain for substrate is identified in our lab

Intensive “training” of strain for optimal performance

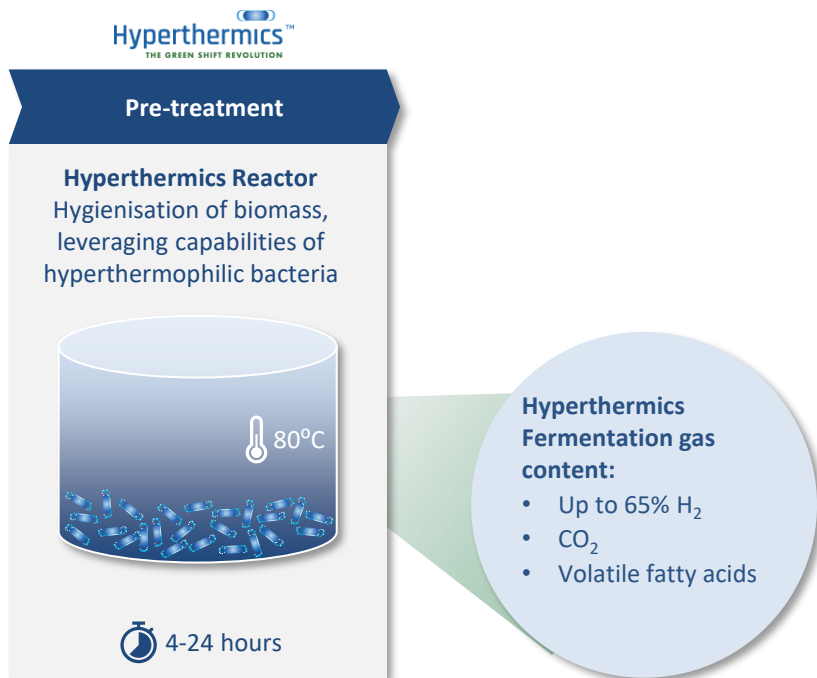
Further adaptation of bacteria in industrial application



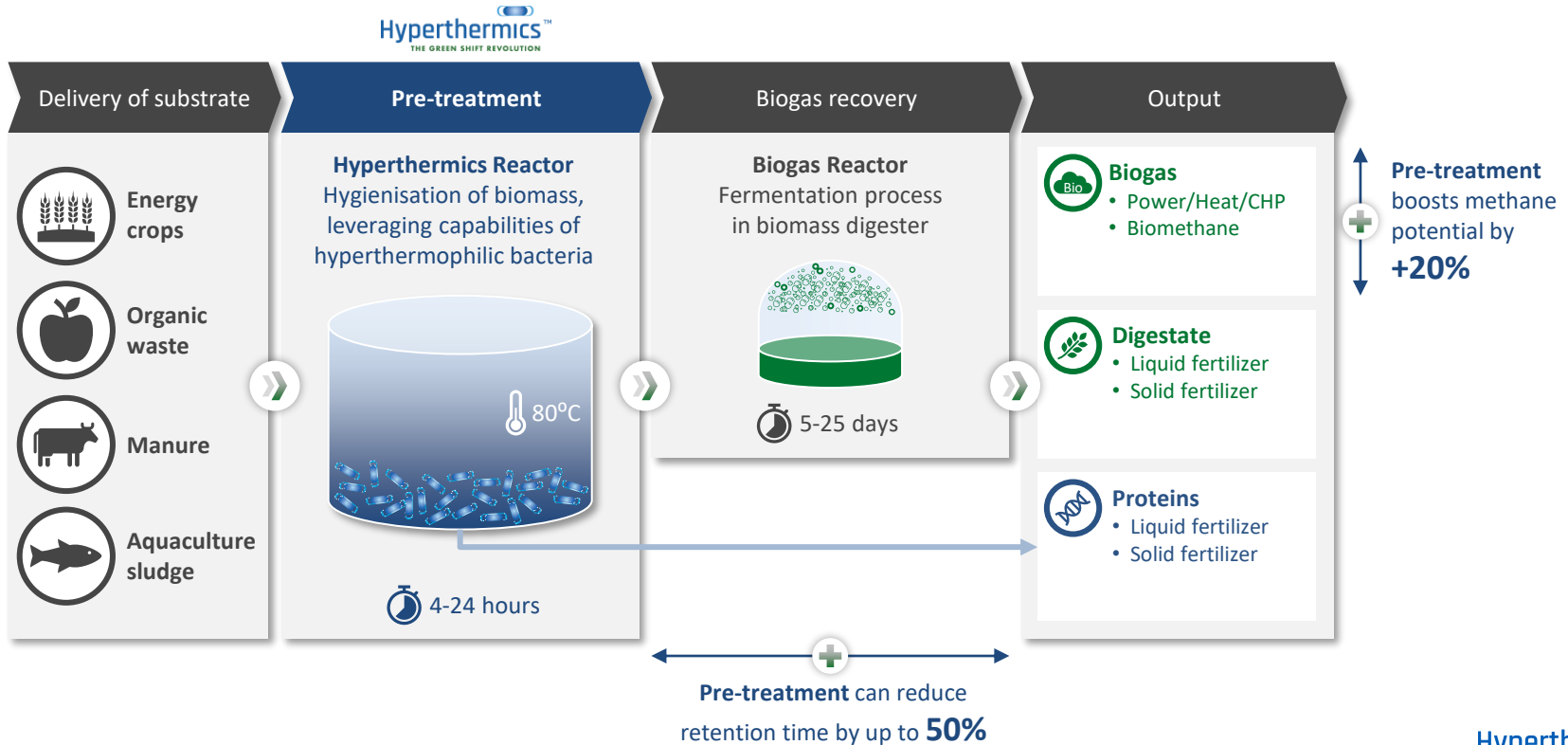
Hyperthermics is introducing a pre-treatment stage in the biogas process to maximize yield



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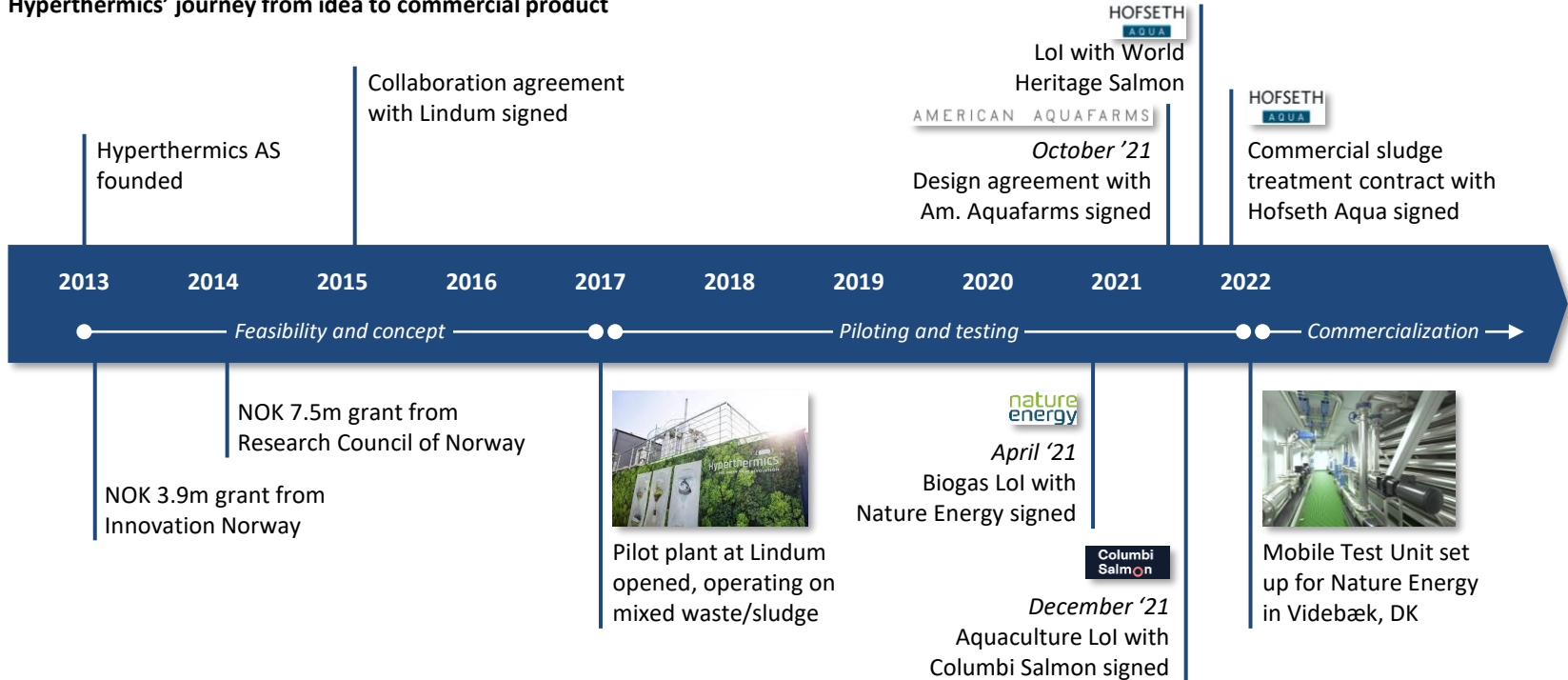


For owners of biogas facilities, we are introducing a pre-treatment step to boost gas output



Hyperthermics ready for commercial phase after 10 years of development

Hyperthermics' journey from idea to commercial product



We are currently working closely with Nature Energy on our Biogas Booster test plant at Videbæk in Denmark

Nature Energy

- World's largest biogas producer, Headquartered in DK
- Owns and operates 13 biogas plants across Denmark and 1 plant in the Netherlands
- Treats ~4.4 million tonnes of biomass annually and produced approximately 181 million m³ of biogas in 2022
- Ambitious expansion plans, targeting 10-15 new plants annually going forward
- Recently acquired by Shell (Q4 2022) at a valuation of NOK ~20bn

Shell Buys Nature Energy in \$2 Billion Push Into Biogas

- Shell buys Danish producer Nature Energy in green push
- Oil majors are looking to low-carbon gases to cut emissions

Videbæk facility

- Nature Energy's second largest facility with an annual capacity of ~27 million m³ methane
- Running on a standard agricultural mix consisting of cow manure, grass silage, straw, deep litter, molasses and dairy production waste



The test facility was completed in August 2022, and has been on-stream since

Overview



Inside view



We currently have a test facility in Denmark at the site of Nature Energy



Test Phase Objectives




- Verify technology and design
- Demonstrate increased gas production
- Demonstrate effect on bioreactor retention time

Preliminary Results

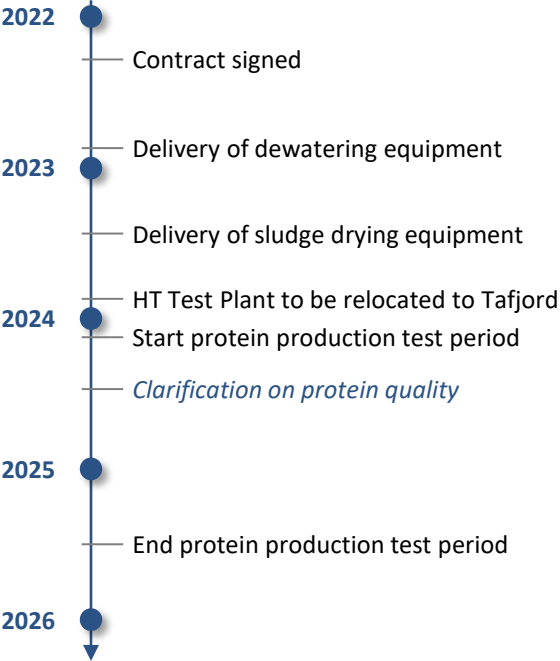
- Technology and design works
Continuous production mode achieved early
- Positive indications on gas production
Measuring strong increase in gas production
- Soon to experiment with reduced retention time

Expect to sign first commercial biogas booster contract in 2023

Update on other customer projects

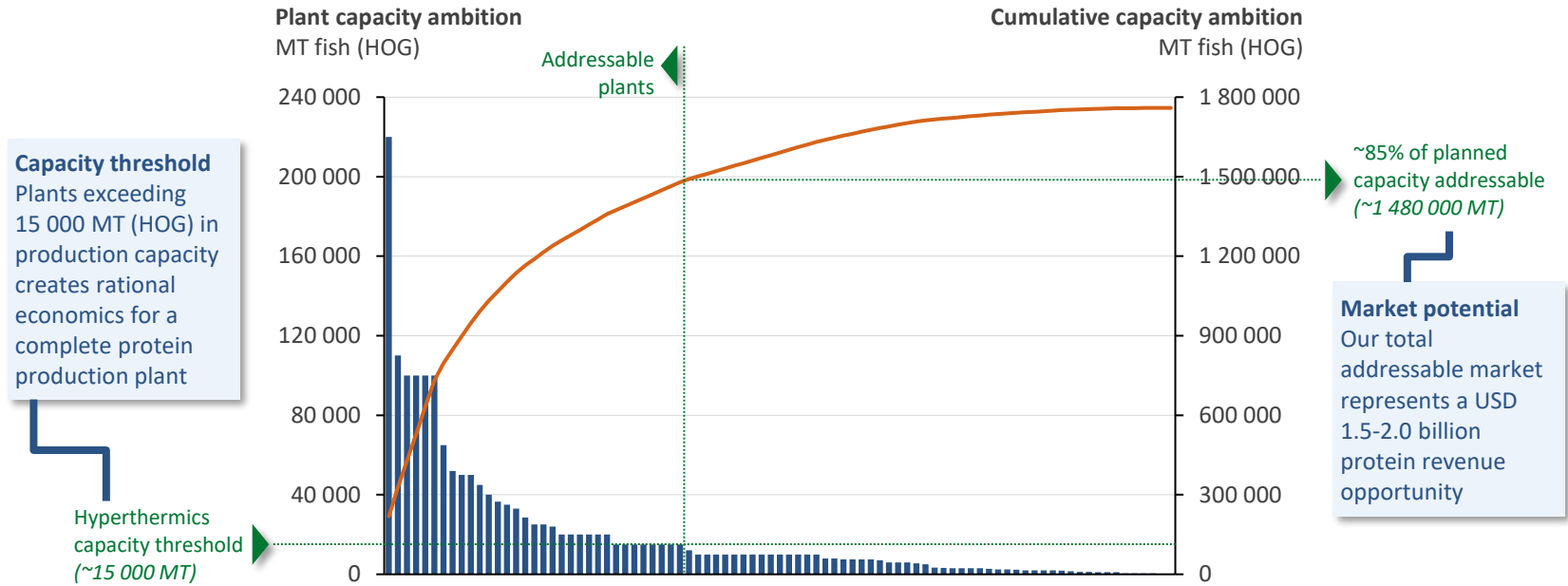
Customer	Segment	Project type	Project stage	Description
	Proteins	Test/pilot	First units delivered	<ul style="list-style-type: none">• Pilot project at Hofseth Aqua smolt facility in Tafjord, Norway• Delivery consists of dewatering and drying equipment for permanent installation on site• In addition, Hyperthermics will move mobile test plant from Denmark to Tafjord to trial protein production• Dewatering unit sold on commercial terms, and was delivered in December, 2022
	Proteins	Commercial	Pre-study	<ul style="list-style-type: none">• Delivery of commercial protein production facility for Atlantic Sapphire's Phase 2 in Homestead, FL• Pre-study optimize energy efficiency will be conducted during H1 2023
	Proteins	Test/pilot	Planning	<ul style="list-style-type: none">• Pilot project at Biokraft Skogn (owned by Scandinavian Biogas) for protein production from biosludge• Biokraft project organization recently changed and we have received signals that activity will pick up again

Soon launching test period for Protein production at new Hofseth facility in Tafjord



Fish farms >15 000 MT (HOG) capacity are addressable with our technology – implicitly, 85% of global planned capacity

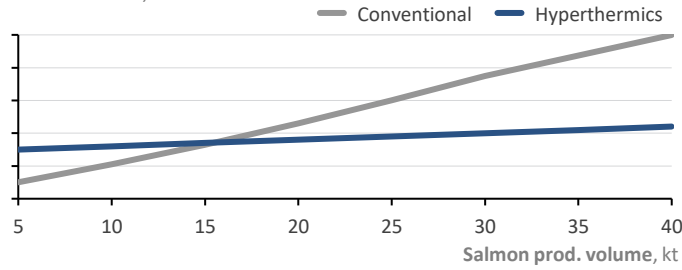
Global planned capacity for land-based fish farming (Status 2022)



Our solution improves sludge treatment economics for fish farmers, and is more sustainable than alternative solutions

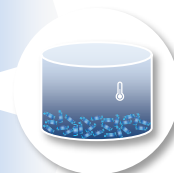
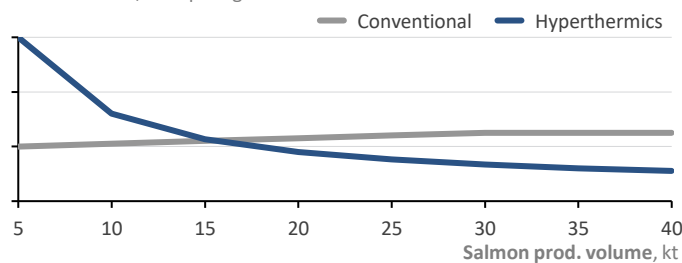
Overall sludge costs







Absolute terms, NOK



Sludge economics

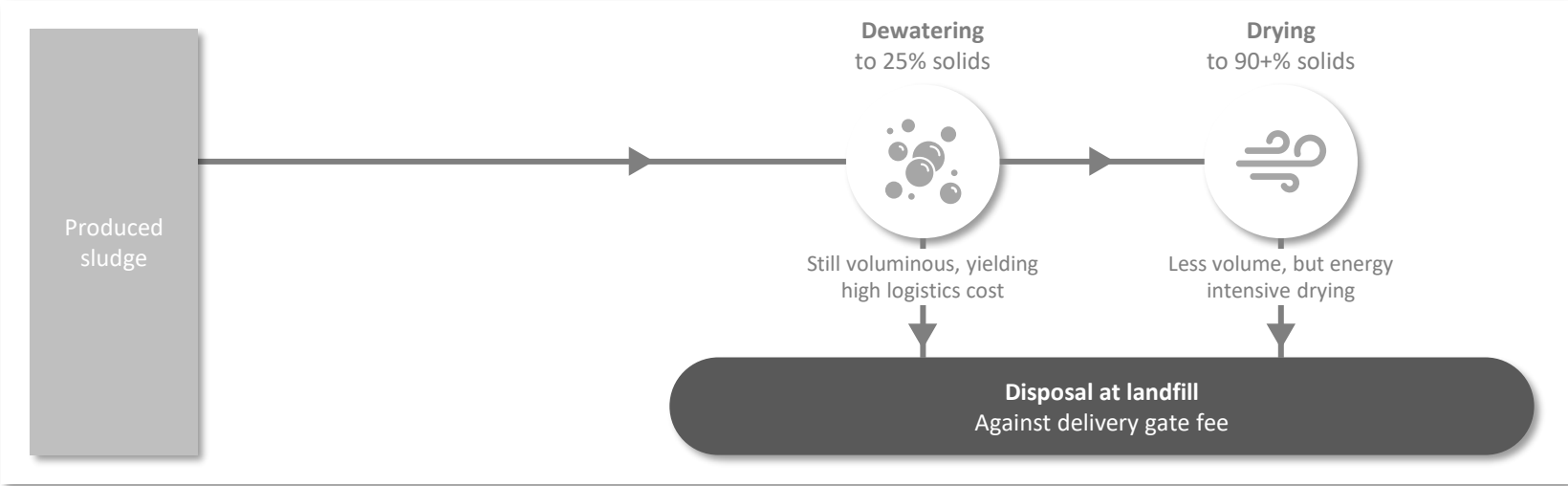
Relative terms, NOK per kg salmon



-  **Predictable** sludge cost with attractive economics
-  Recovery of valuable **proteins** for sale to pet-food industry 
-  Higher overall **energy efficiency** than conventional solutions 
-  On-site sludge treatment facility with **limited footprint**

Customers want sustainable and cost efficient solution for sludge treatment

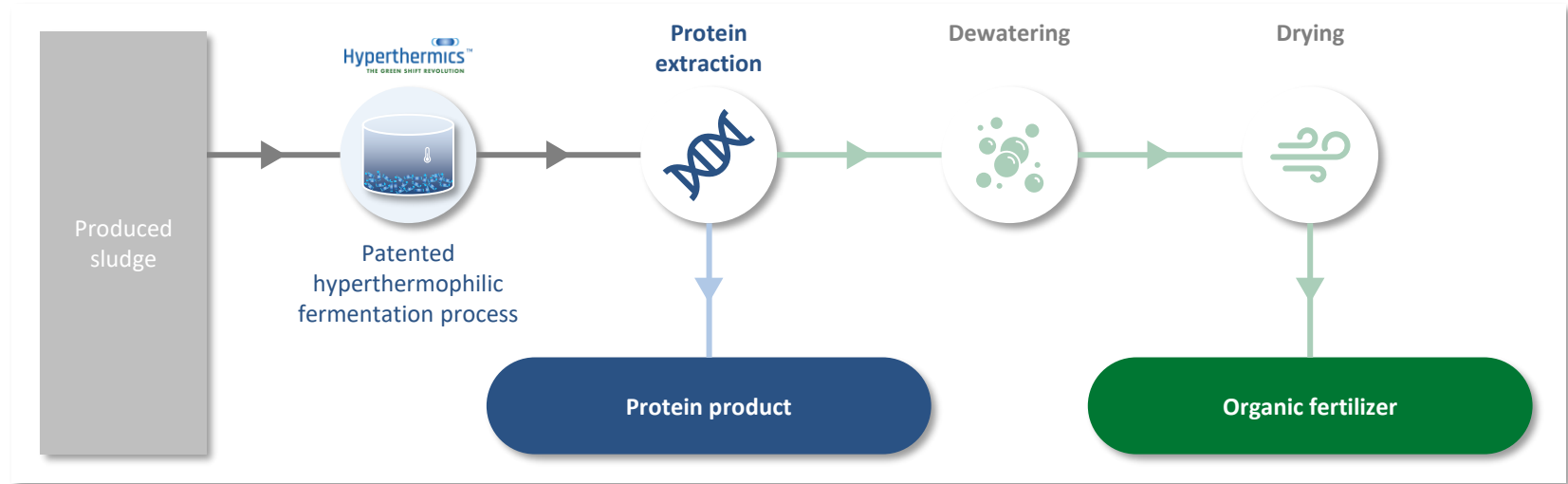
Traditional sludge treatment process (illustrative)



Traditional sludge treatment process fails to capture valuable proteins, energy and nutrients in sludge

The Hyperthermics' solution recovers valuable proteins from the sludge and is competitive with traditional solutions

Hyperthermics' sludge treatment process (illustrative)



With Hyperthermics' solution the proteins are recovered and the remaining fraction can be used as a fertilizer

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