

# EUDP Demo project

**Journal nr:** 64020-2113      **Start:** 30.06.24      **End:** 30.06.24

**Titel:** Increased energy production and new green products from biogas plants

**Program:** Energy technology Development and Demonstration program

**Project partners:** Advanced Substrate Technologies      Project manager  
Rokkedahl Agro  
Aalborg Forsyning  
AU-Agro



Energiteknologisk udvikling og demonstration

**The project core is Circular Bio-Economic Partnership between biogas, green protein, production of organic fertilizers for agriculture and biofiber substrates for plant and mushroom production.**

Biogas plants are not able to utilize a bigger part of energy potentials the biomass input to biogas. Dry matter and nutrients in the digestate is not sustainably utilized. This entails loose of in special N and thus lost production potential in the primary food production.

The project aims to solve this complex of problems based on a new mindset and with specific solutions solved in a circular bio-economic partnership and with demonstration of new technologies.

The concept opens up for production of organic liquid fertilizer with low dry matter content and reduced pH.

This entails that loose of ammonia on field is considerable reduced leading to increase in the plant available N with interesting increase in production of grass for green protein and other agricultural products – wheat and more.

## **Project resumé**

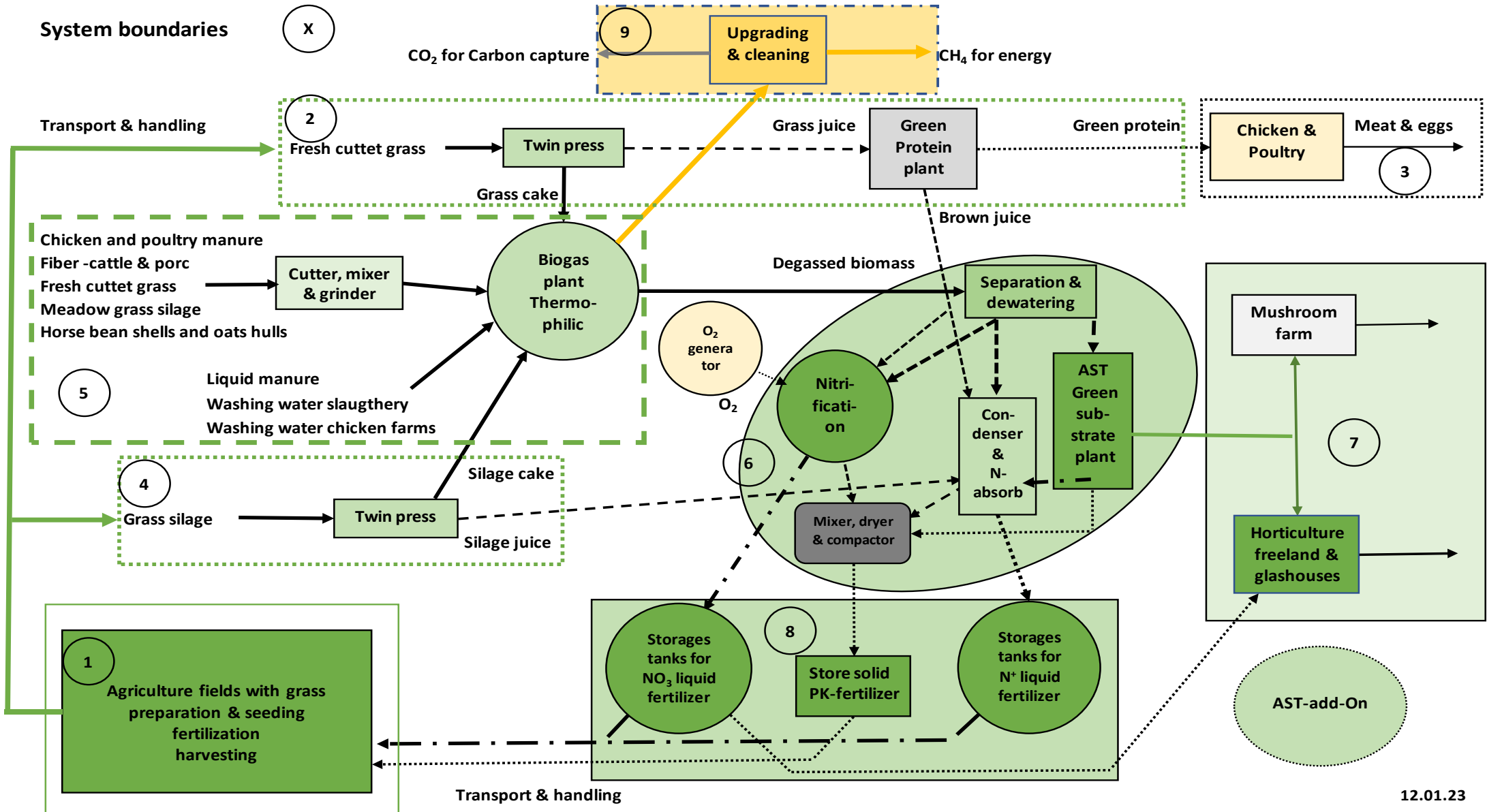
In the project has been implemented and installed new technologies (condenser and heat pump) integrated with the AST-add-On plant with treatment of degassed fiber from biogas plant on Viderupgaardsvej 15B, Nibe – and supply of surplus heat to production (Rokkedahl Agro) and district heating (Aalborg Forsyning).

# AST Concept

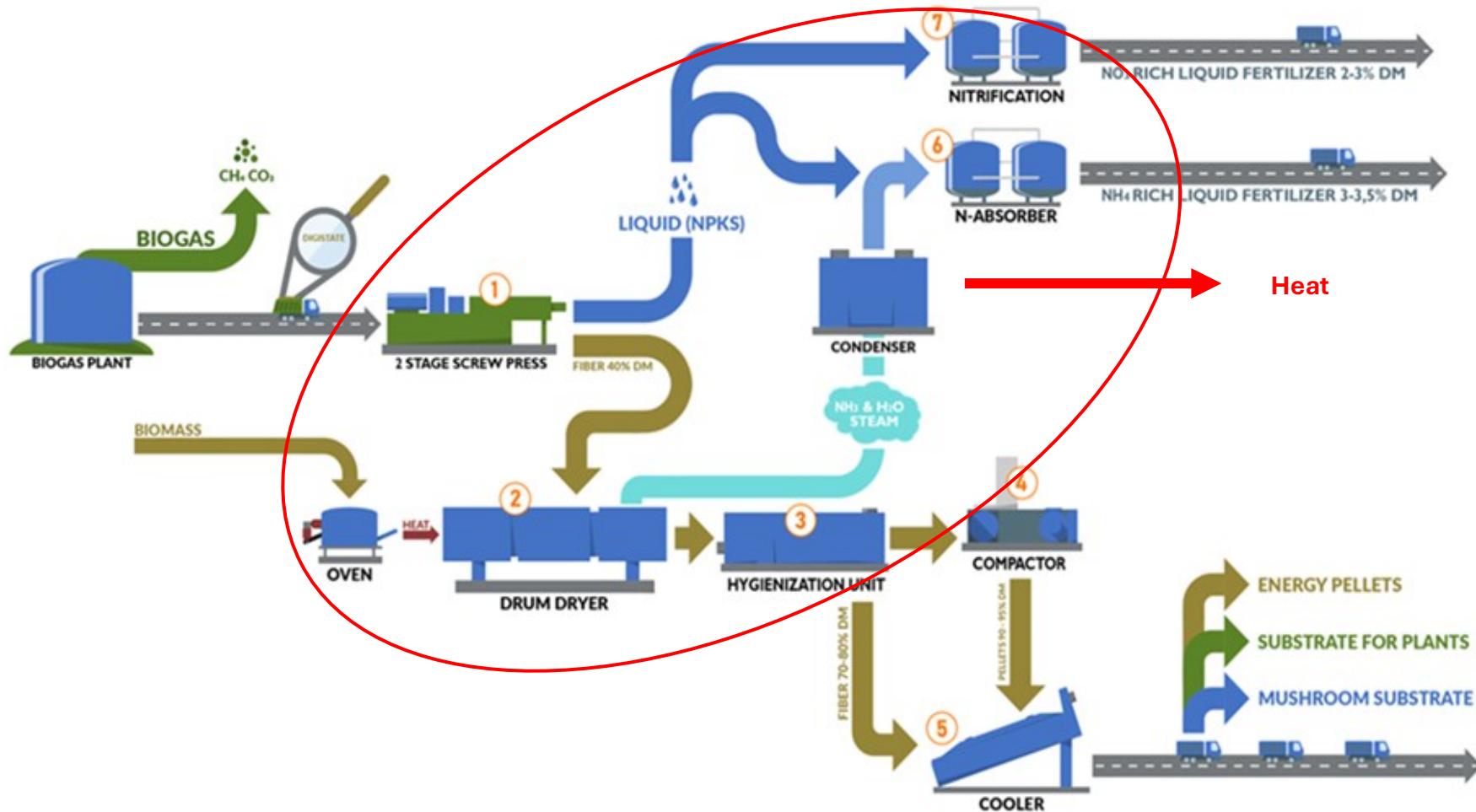
## Circular Bio-economic Partnership

## Biogas + Green Protein + Green Substrate & more

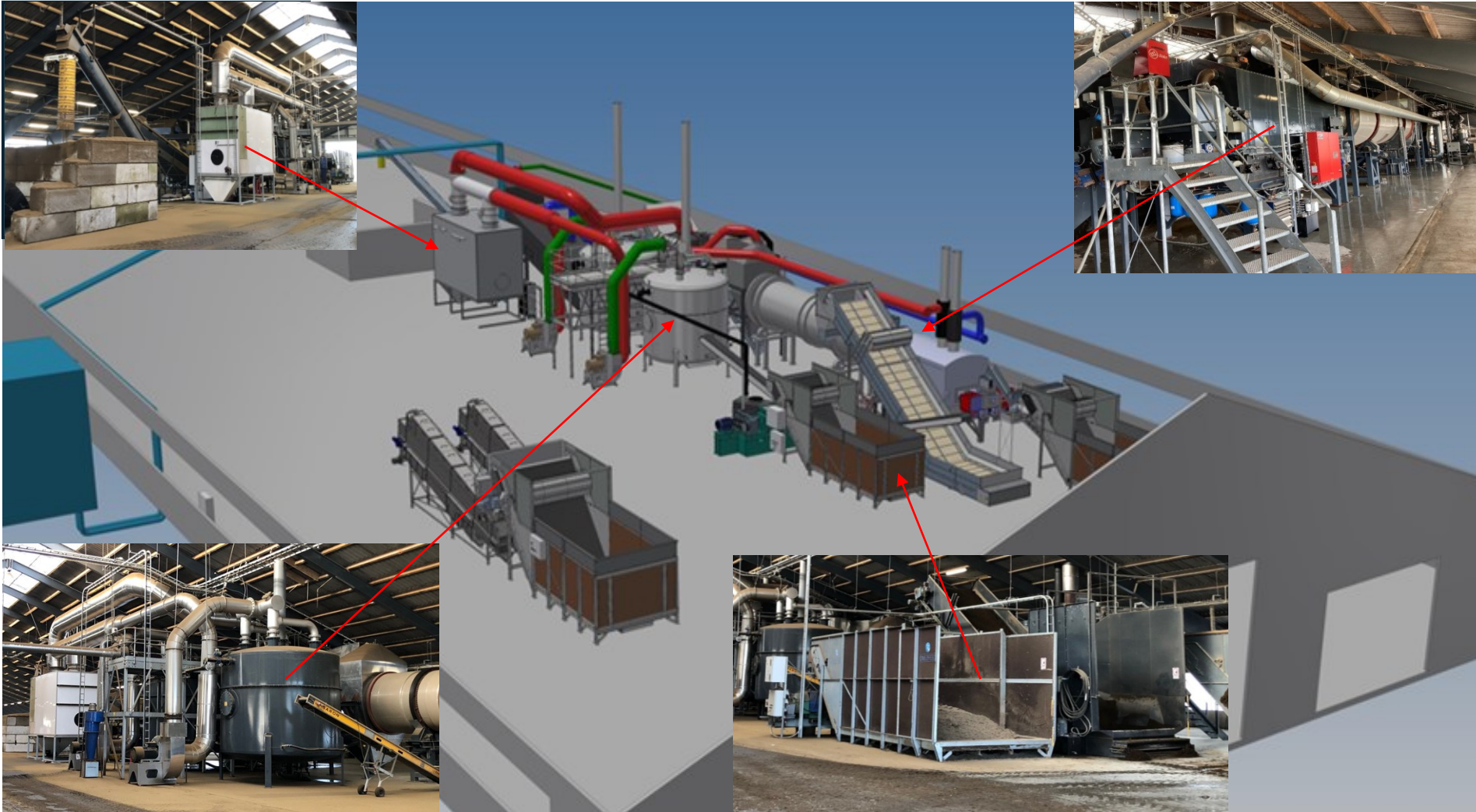
System boundaries



# Technologies and flows in the AST system concept



# AST's first commercial Add-On plant



The first AST Add On plant was built in Nibe, Denmark with a capacity of 3 tons evaporation per hour and a corresponding 3 tons per hour of dried fiber production capacity. The plant was extended to 4 ton/h evaporation and a new condenser installed and in operation in December 2023.

Heat pump installed and in operation August 2024 supplying heat to nearby chicken houses and local district heating network.

# Results og conclusions

## Condenser and heat pump

- by implementing condenser 75-80% of the energy needed for drying can be recovered
- by implementation of heat pump surplus heat can be supplied to production and district heating
- condenser and heat pump in combination secure attractive energy efficiency with COP > 5 for heat pump and COP ~ 11 for the combined solution
- absorption of the N-steam from drying and use of brown juice from green protein production and/or juice from grass silage make it possible to produce  $\text{NH}_4$  liquid fertilizer with pH < 6.5



Condenser on Viderupgaardsvej 15B, Nibe



Heat pump on Viderupgaardsvej 15B, Nibe

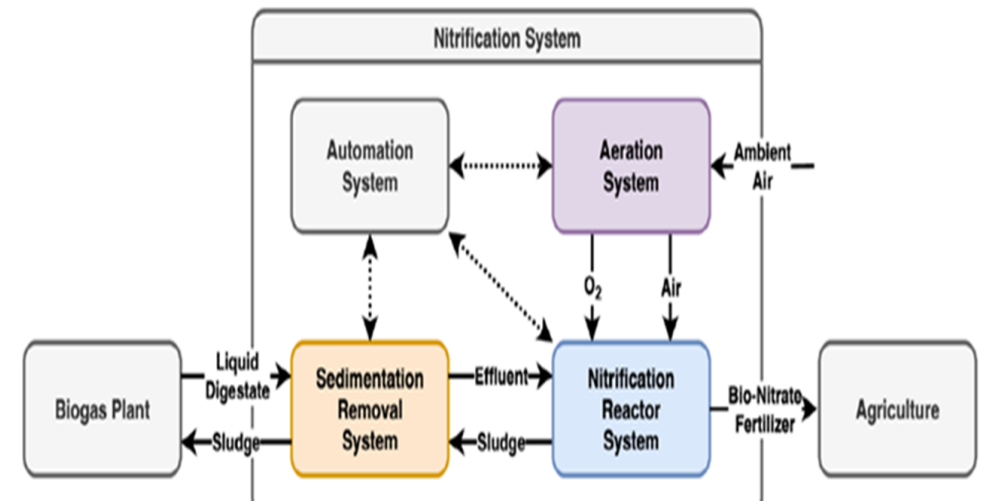
# Results og conclusions

## Nitrification

By nitrification on reject liquid after separation and sedimentation can be produced organic liquid fertilizer with relevant nutrients content for use during growing season

Use of  $\text{PKNO}_3$  (phosphor, potassium and nitrate) liquid fertilizers in organic production can result in:

1. increase in effective utilization of added N with 26 kg N/ha ~ 35%
2. reduced loose of ammonia on fields = reduced  $\text{N}_2\text{O}$  emission ~ 111 kg  $\text{CO}_2$ -equivalent/ha
3. total use of N can be kept unchanged
4. increase in yields from present 80 ton/ha to 101 ton/ha ~ increased quantity for green protein
5. corresponding increase in wheat yields from 6 ton/ha to 8,1 ton/ha.



# Perspectives

The setup goals and milestones have all been reached and in plus new interesting partners in a "Circular Bio-Economical Partnership" have been attracted and test plant for documentation of nitrification as new core technology in the full concept has been erected.

The circular bio-economic partnership between biogas, green protein and fertilizer production via AST-add-On & nitrification implies big and positive resource- and climate consequences – increase in production, reduced ammonia loose and reduced utilization of N in primary agricultural production.

From economical point of view the added values related to grass for green protein and the direct related production of biogas and fertilizer products can be increased with 28% and with 24% in added value per ha to the primary producers of grass for protein.

Based on the findings a specific cooperation with Ausumgaard, Green Protein and Frandsbjerg Invest has been initiated with the scope to implement the project results in a specific production environment with existing biogas plant, green protein production, ecologic agricultural production and 12 MW wind turbines.

If successful it will be a full-scale demonstration project with a wide range of actors.

A demonstration project that will open up for export of the AST concept and technologies.

With demonstration in full scale the basis for more plant in Denmark and many plant in EU over the coming 5 – 10 years.

Raw material for green protein	New NPKS-fertilizer		Reference	Difference	
Grass value on field	0,90 DKK/FE	10,56 MDKK	8,55 MDKK	2,01 MDKK	
Harvest	0,04 DKK/FE	0,47	0,38	0,09	
Transport	400 DKK/load	2,32	1,87	0,45	
Raw material an green protein		13,35 MDKK	10,8 MDKK	2,55 MDKK	
	154 DKK/ton	86.879 ton	154 DKK/ton	70.312 ton	
Product value					
Green protein	1.783 ton	14,00 MDKK	1.443 ton	10,67 MDKK	3,33 MDKK
Grass cake	28.507	9,26	23.071	7,50	1,76
Methane from grass cake	30.012 MWh	15,01	24.289 MWh	12,14	2,87
NPKS-fertilizer from grass cake		4,49		3,63	0,86
Brown juice - NPKS value	49.901 ton	3,58	40.385 ton	2,90	0,68
Contribution margin split on actors					
Green protein		9,93 MDKK		7,37 MDKK	2,56 MDKK
Biogas		5,74		4,65	1,09
Fertilizer		8,07		6,53	1,54
In total - green protein, biogas and fertilizer		23,74 MDKK		18,55 MDKK	5,19 MDKK
					28%
Increased turnover at primary producers		12.064 DKK/ha	875 ha	9.763 DKK/ha	2.301 DKK/ha
					24%