# Final report

## Project details

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| **Project title** | Udvikling og test af totalkoncept til afpudsning og bjærgning af biomasse fra vinterraps i efteråret for anvendelse til biogasproduktion |
| **File no.** | 64020-1114 |
| **Name of the funding scheme** | EUDP |
| **Project managing company / institution** | Teknologisk Institut |
| **CVR number** (central business register) | 56976116 |
| **Project partners** | CNH Industrial Denmark, Lars Langskov Nielsen, Jørgen Stougaard |
| **Submission date** | 21 March 2025 |

## 1. Summary

### Project summary

As a part of the project leaves of winther rape seed were harvested 2 out of 3 years. The last year conditions were too wet to harvest. The leaves were ensiled and used for biogas production. Methane potential was analysed by DTI, and loss of rape seeds during the following harvesting season was monitored. Also, the functionality of the machinery was monitored by CNH, and suggestions for optimization were defined. Finally an economic analysis was carried out.

**The purpose of the project**.

The purpose of the project was therefore to develop and demonstrate a total concept for the cultivation and trimming of winter rapeseed leaves in the autumn for biogas production using a harvester wagon consisting of a combined forage harvester from Kongskilde and a harvester wagon from TIM. It was also a purpose to gain knowledge about the cultivation of the rapeseed, including sowing and trimming time, just as the hypothesis was that growth regulation and weed spraying can be saved by early sowing of the winter rapeseed.

**Results, conclusions and perspective**

At the start of the project, it was hoped that 3 tonnes of dry matter per hectare could be salvaged. However, the results show that a maximum of 2 tonnes of dry matter per hectare can probably be expected. However, this is also enough for the salvage to be worthwhile, with the assumptions used here.

It was also expected that a weed spraying could be saved by early sowing. It may be possible to do so, but it will be necessary to spray weeds after salvaging the rapeseed leaves, since the field there is completely open, which otherwise gives the weeds far too good conditions, which in itself can lead to a decrease in seed yield. On the other hand, there is no reason for growth regulation of the rapeseed if the leaves are harvested in the autumn, quite the opposite, as it is an advantage that the rapeseed develops with maximum leaf mass before it is harvested.

It will certainly be an advantage if it is made possible to compensate for the removed nitrogen by supplementary fertilisation in the spring.

It will be necessary to optimize the harvester wagon so that waste can preferably be avoided completely. A number of optimization proposals are listed above, but the best thing would be for the machine to be able to harvest the rapeseed leaves by installing a disc cutting table on the chopper instead of the current pick-up. This one has a hard time getting it all when it is lying on the ground. Thus equipped, the harvester wagon will also be perfectly suited for salvaging catch crops for biogas. And here, the lead means less, since the catch crops must be destroyed at some point anyway. Therefore, a reconfiguration of the forage harvester wagon is definitely worth considering for CNH International Denmark.

It is also clear that it will not always be possible to salvage the rapeseed leaves without too much damage to the crop, as wet conditions will lead to deep ruts where the plants will be pressed down and will die. It will therefore be difficult to plan with certainty the salvage of rapeseed leaves as a raw material for biogas production. But in autumn with favorable conditions, it will definitely be a good and profitable supplement.

Finally, it should be emphasized that silage with rapeseed leaves is relatively easily marketable, which is an advantage in terms of regulating biogas production.

It is therefore concluded that ensiled rapeseed leaves salvaged in the autumn are a profitable option to supplement the biomass supply to biogas plants in Denmark – at least when conditions allow.

## Projektresumé

Som en del af projektet blev der høstet blade af vinterraps 2 ud af 3 år. Det sidste år var forholdene for våde til at høste. Bladene blev ensileret og brugt til biogasproduktion. Metanpotentialet blev analyseret af Teknologisk Institut, og tab af rapsfrø i den efterfølgende høstsæson blev overvåget. Maskinernes funktionalitet blev også overvåget af CNH, og forslag til optimering blev defineret. Endelig blev der gennemført en økonomisk analyse

**Formålet med projektet**

Formålet med projektet var derfor at udvikle og demonstrere et totalkoncept til dyrkning og afpudsning af vinterrapsblade i efteråret til biogasproduktion ved anvendelse af en snittervogn bestående af en sammenbygget finsnitter fra Kongskilde og en afskubbervogn fra TIM. Det var desuden et formål, at opnå viden om dyrkning af rapsen, herunder så- og afpudsningstidspunkt, ligesom hypotesen var, at der kan spares en vækstregulering samt ukrudtssprøjtning ved tidlig såning af vinterrapsen.

**Resultater, konklusioner og perspektiv**

Ved projektets start var det forhåbningen, at der kunne bjærges 3 ton tørstof pr. ha. Men resultaterne viser, at der sandsynligvis maksimalt kan forventes bjærget 2 ton tørstof pr. ha. Dette er imidlertid også nok til at bjærgningen kan betale sig, med de her anvendte forudsætninger.

Det var også forventet, at der kunne spares en ukrudtssprøjtning ved tidlig såning. Det kan der måske også, men det vil være nødvendigt at ukrudtssprøjte efter bjærgning af rapsbladene, eftersom marken der er helt åben, hvilket ellers giver ukrudtet alt for gode betingelser, som i sig selv kan medføre en nedgang i frøudbyttet. Til gengæld er der ingen grund til vækstregulering af rapsen, hvis bladene bjærges i efteråret, snarere tværtimod, da det er en fordel at rapsen udvikler sig med maksimal bladmasse inden den bjærges.

Det vil givetvis være en fordel, hvis det gøres muligt at kompensere for det fjernede kvælstof ved supplerende gødskning om foråret.

Det vil være nødvendigt at optimere snittervognen så spild helst helt kan undgås. Der er ovenfor listet en række optimeringsforslag, men det bedste vil være at maskinen selv bliver i stand til at høste rapsbladene ved at der monteres et skiveskærebord på snitteren i stedet for den nuværende pick-up. Denne har nemlig svært ved at få det hele med, når det ligger på jorden. Således udstyret vil snittervognen også egne sig perfekt til bjærgning af efterafgrøder til biogas. Og her betyder føret mindre, eftersom efterafgrøderne under alle omstændigheder skal destrueret på et tidspunkt. Derfor er en omkonfigurering af snittervognen bestemt en overvejelse værd for CNH International Denmark.

Det er også klart, at det ikke i alle år vil være muligt at bjærge rapsbladene uden alt for store skader på afgrøden, idet vådt føre vil medføre dybe hjulspor, hvor planterne bliver presset ned og vil gå til. Det vil derfor være svært med sikkerhed at kunne planlægge bjærgning af rapsblade som råvare til biogasproduktionen. Men i efterår med gunstige forhold vil det afgjort kunne være et godt og rentabelt supplement.

Endelig skal det understreges, at ensilage med rapsblade er relativt letomsættelig, hvilket er en fordel med hensyn til regulering af biogasproduktionen.

Det konkluderes derfor, at ensilerede rapsblade bjærget i efteråret er en rentabel mulighed for at supplere biomasseforsyningen til biogasanlæg i Danmark – i hvert fald når forholdene tillader det.

# 2. Project objectives

The objective of the project was to develop a total concept of cultivation and harvesting of rape seed leaves for biogas production. The technology development element of the project was the harvesting machine

# Project implementation

The project mostly evolved according to plan. The first two years we harvested in October in sufficiently dry conditions. However, the third year conditions were too wet to harvest without making too much damage on the crop. We did not forsee the amount of biomass which could not be picked up by the machine. However, The machine can be optimised if configuration is changed.

# 3. Project results

In general the objectives were obtained. We know now how to cultivate, when and how to harvest, and we know the biomass and biogas potential per. hectare.

Best yields are obtained if rape seed is sowed at 1.st august and harvested in mid October. The machinery can be optimised to harvest up to 2 ton dry matter pr. Hectare. The concept is applicable for farmers who own a biogas plants or who want to sell biomass to a biogas plant.

The final report will be available on the DTI website shortly. Results were presented at EUBCE 2024 in Marseille, France in June 2024. An article will be published in Bioenergimagasinet, and newsletters from CNH and VELAS will be issued. Finally a video on utube can be found.

# 4. Utilisation of project results

The findings of the project will mainly be exploited by CNH Industrial Denmark, but also by VELAS, who is an advisory service for farmers.

There is a need for optimisation of the harvesting machinery, but it is doable. The machine in question was produced on demand and thus not serially produced, but this can change if there is a market pull.

# 5. Project conclusion and perspective

At the start of the project, it was hoped that 3 tonnes of dry matter per hectare could be salvaged. However, the results show that a maximum of 2 tonnes of dry matter per hectare can probably be expected. However, this is also enough for the salvage to be worthwhile, with the assumptions used here.

The methane yield from rape seed leaves were surprisingly high. Nearly 400 Nm3 CH4 per tonne organic dry matter, and the gas is recovered very quickly.

It was also expected that a weed spraying could be saved by early sowing. It may be possible to do so, but it will be necessary to spray weeds after harvesting the rapeseed leaves, since the field there is completely open, which otherwise gives the weeds far too good conditions, which in itself can lead to a decrease in seed yield. On the other hand, there is no reason for growth regulation of the rapeseed if the leaves are harvested in the autumn, quite the opposite, as it is an advantage that the rapeseed develops with maximum leaf mass before it is harvested.

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Finally, it should be emphasized that silage with rapeseed leaves is relatively easily marketable, which is an advantage in terms of regulating biogas production.

It is therefore concluded that ensiled rapeseed leaves salvaged in the autumn are a profitable option to supplement the biomass supply to biogas plants in Denmark – at least when conditions allow.

# 6. Appendices

https://www.youtube.com/watch?v=yK8ACgTpKqY

https://www.teknologisk.dk/projekter/afpudsning-af-vinterraps/44843?cms.query=raps+biogas