Sequential cropping to produce truly sustainable biomethane
Global consulting company founded in 1984 with the mission to enable sustainable energy for everyone – since 2016, Ecofys is part of Navigant to help our clients navigate the energy transition.

As part of Navigant we have over 600 people skilled in energy, climate, environment, economy, communication, legal, and psychology. Industry, policy & regulatory operations and technology areas of expertise combined in unique ways.

Global footprint with offices in the Americas, Asia, Europe, Middle East. Ecofys operates from five offices in Europe (London, Utrecht, Cologne, Berlin, and Brussels).

Ecofys has over 30 years of experience in developing and evaluating policies, sustainability strategies, and scenarios for companies and sectors provides us with deep knowledge of markets and consumer behaviour.

Our strength lies in our strategic understanding of complex energy and climate transition issues: Ecofys connects the dots within the triangle between governments, energy players, and (energy-intensive) end-users.
Making the agricultural system fit for the future
Solving global challenges requires innovative agriculture

Challenges

1. Growth in global population and wealth increases demand for food, feed and fibre with 70% by 2050.
2. Full transport decarbonization impossible without biofuels (aviation, shipping, trucks)
3. Agricultural expansion is the main driver for deforestation and biodiversity losses
4. Agriculture is large contributor to carbon emissions, while climate change impacts productivity

Solution

> Increase of productivity and resilience combined with limiting of environmental impacts (GHG, land and water)
> Requires innovation and creativity
1. The Italian Biogas Consortium (CIB) developed a platform of technologies aimed at achieving ecological agricultural intensification and called it Biogasdoneright™ (BDR)

2. CIB asked Ecofys to assess their concept

3. Ecofys visited farms in northern Italy, collected data on one specific farm

4. We found that BRD offers significant advantages over conventional biogas

5. BDR biogas achieves high carbon savings and positive environmental externalities, e.g. increased carbon content of soils, increased soil fertility and lower input of chemical fertilizers

6. BDR allows Italian farmers to produce biogas from additional biomass while maintaining their existing food and animal feed production, thus avoiding indirect land use change risks
Biogasdoneright: producing feed and biogas feedstock through sequential cropping

- Sequential cropping: harvesting two crops instead of one on the same field in a single year
- Nutrients being recycled back to the field through biogas digestate
We assessed the following claims:

> Sequential cropping leads to additional, low ILUC risk biogas feedstocks
> This additional production can be achieved while maintaining and enhancing soil quality, with low impact on water availability and no negative impact on on-farm biodiversity.
> Biomethane produced from additional biomass has very high greenhouse gas saving compared to fossil energy.
> Positive business case for farmers to introduce sequential cropping
> Sequential cropping for sustainable biomethane is scalable
We focus on one farm: Palazzetto farm in the Po-valley
Summer maize silage plus winter triticale silage

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Large quantities of additional, low ILUC risk biomass

- We calculated historical yields in the ‘summer crop only’ situation and compared this with the yields in the sequential cropping situation.
- Different feed and biogas crops are compared by using ‘Forage units’.
- Results show that large quantities of additional biomass are produced without ILUC risk, not displacing existing feed production.
Positive impacts on soil quality

- Substantial increase in soil organic carbon and soil nutrients
- Land is covered all-year round, which reduces soil erosion risks
- Sequential cropping probably increases soil life
- Soil compaction minimised by applying digestate using a tube (picture)
- We recommend further research on soil nutrient budget
No negative impact on water availability

- Northern Italy has abundant rainfall and moist air
- No irrigation is used for the additional winter crop
- Summer crop irrigation is limited by investment in a drip-feed system
Small positive impact on on-farm biodiversity

- Small positive on-farm biodiversity impacts are expected after replacing monocropping with sequential cropping combined with nutrient recovery via biogas digestate
- Small positive impacts of the sequential cropping in terms of crop density and additional shelter for species and below-ground biodiversity

<table>
<thead>
<tr>
<th>Assessment approach</th>
<th>Indicator</th>
<th>Sequential cropping reference compared to monocrop reference</th>
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</thead>
<tbody>
<tr>
<td><strong>Management changes</strong></td>
<td>Changes in the management practices occur that have a negative effect on biodiversity?</td>
<td>No</td>
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<td></td>
<td>Changes in cover crop density, providing a change in shelter for small animals and insects?</td>
<td>Yes</td>
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<td></td>
<td>Changes in the risks of floods and related impact on natural habitat?</td>
<td>Yes, the likelihood of erosion is decreased</td>
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<td></td>
<td>The possible effects on belowground biodiversity level, e.g. worms, insects and bacteria in the soil due to differences in root systems?</td>
<td>Yes</td>
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<tr>
<td><strong>Observed changes</strong></td>
<td>Occurrence of animals on the fields</td>
<td>Slight increase</td>
</tr>
<tr>
<td></td>
<td>Occurrence of birds on the land in the spring</td>
<td>Slight increase</td>
</tr>
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</table>
Positive impact on GHG saving of biomethane

> High savings that increase further after the introduction of sequential cropping compared to ‘summer crop only’ due to less mineral fertilizer per tonne of biomass. With REDII fossil comparator savings will be even greater.

> Positive effect of soil organic carbon increases not yet taken into account.

**GHG emissions (gCO₂ eq/MJ biomethane)**

- Fossil fuel comparator = 83.8
- Maize monocrop+manure: 79.1%
- Maize+triticale sequential+manure: 86.5%
Positive business case and scalable concept

> Additional biomass production does not increase fixed costs, small increase of operational costs

> Compared to the conventional cultivation of maize silage the sequential cropping of maize silage and triticale silage leads to a reduction of both biogas feedstock costs and animal feed costs. We note a 21% decrease in feed costs and a 43% decrease in biogas feedstock costs.

> In a conservative estimate, we assume that at least 1 million of hectares can be used to introduce maize and triticale sequential cropping without displacing other crops in Italy and France alone. A much larger potential is expected if other crop combinations suitable for sequential cropping are taken into account and if the potential in other countries is taken into account.

> We recommend further research into the scalability of sequential cropping, especially in northern Europe.
Future role for biomethane: balancing the energy system and reducing total energy system costs

Demand pattern for gas and electricity

Capacity of the gas transportation infrastructure is much higher than electricity

Gas infrastructure (including storage) is designed to handle seasonal fluctuations
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Virtually:
sustainable energy
for everyone

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