

# EFFICIENCY ASSESSMENT REPORT

## SYREN SYSTEM

Acidification technology for animal slurry during application, in which ammonia emission, is reduced 50-70% and GHG reduction of 200 kg ha

**Solution ID:** 1002  
**Company:** BioCover

**Country:** Denmark  
**Export Date:** 17.02.2020

## ASSESSMENT RESULTS



**APPROVED**

### FEASIBILITY

- Credibility of concept	YES
- Scalability	YES

### ENVIRONMENT

- Environmental benefits	YES
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### PROFITABILITY

- Client's economic incentive	YES
- Seller's profitability	YES

## GENERAL COMMENTS FROM THE SOLAR IMPULSE FOUNDATION

The solution ID1002 is declared by the Solar Impulse Foundation as labelled Solar Impulse Efficient Solution after going through the following selection steps :

- It is falling into the eligibility scope in terms of (1) Minimum Maturity and (2) Type of solution. Moreover, the solution is owned and developed by an entity Member of the World Alliance that is operating in accordance with the Solar Impulse Foundation's ethical position.
- The Solution Submission Form was assessed by 6 independent Experts with at least 5 years of Experience in one of the sectors of application of the Solution and valid and coherent answers with justifications were collected enabling the deliberation of a majority opinion on each of the 5 criteria.
- Based on Experts deliverables, the Solutions Team concluded that the solution's assessments had been satisfactory and that the five criteria obtained a majority of "YES".
- After a final verification performed by both the Experts and Solutions team representatives, the validity of the assessment performed and the requirements for the five criteria were confirmed, resulting in the solution being awarded the Solar Impulse Efficient Solution Label.

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## FEASIBILITY

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This section captures the ability of the solution to be credible (based on a resilient technology or concept) and captures if the solution is already or has the potential to be scaled up and deployed concretely in the real world (vs. in lab). The Experts were required to answer two questions on (1) credibility of design and (2) scalability of the solution.

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## EXPERTS REVIEWS

### CREDIBILITY OF DESIGN

Can the technology behind the solution be constructed and operated as designed?

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YES

**Expert justification** - Lowering pH value in manure in order to stabilise ammonia turning it from a gas to solid state (ammonium) has been researched and demonstrated over the past decade. The SyreN technology has been patented and proven in a live environment. Mitigating the risk of getting in contact with sulphuric acid, the innovator has developed a closed and specialised supply chain for delivery- and use of sulphuric acid. The combination of a closed supply chain and an automated operation makes the system user friendly.

YES

**Expert justification** - The technology behind the solution is being built and operated as planned. It ensures compliance with many EU directives (Nitrates, Habitat, Air Pollution, NEC Emission Ceiling) on the application of sludge by injection or acidification. It responds to the urgent need to find a response to ammonia emissions from industrial livestock farming. The 49% reduction in ammonia emissions is very significant.

YES

**Expert justification** - The concept is credible. Slurry acidification is an established method in agriculture, but not widely spread according to reviewers' knowledge. The innovator brings in the innovation of pH sensors, hardware and software to enable the actual implementation of this concept. Including an apparently sophisticated business model.

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### SCALABILITY

Is the manufacturing (if a product) or distribution (if a service) of the solution at scale technically feasible?

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YES

**Expert justification** - The usage of injecting sulphuric acid in order to mitigate ammonia emissions has been researched and demonstrated. The developed SyreN solution is a closed system that creates new regional business opportunities. Although legislation might be a constraint in order to scale.

YES

**Expert justification** - Manufacturing and distribution are scalable (hardware and software). The market is a bit tricky and very heterogeneous in Europe and worldwide (farmers). The approach via licencing seems smart in this context. Overall, manufacturing, distribution have been proven with over 100 systems in place.

YES

**Expert justification** - Yes, scalability has already been demonstrated. The technology exists in several configurations to adapt to different settings and scale situations. For example, SyreN Light, which is situated in the rear linkage of a 100-150 HP tractor and can be used with a 6-15 m<sup>3</sup> tanker. The front-mounted SyreN system is locked to a particular tractor, unless the owner has bought a second tractor fitting kit to increase his flexibility of use. The VERA certification allows to implement the technology as planned regardless of configuration. Finally, from a regulatory standpoint SyreN System is fully ADR compatible. As

of now, only Germany has ADR requirements. In all other countries, a tractor-slurry tanker combination is exempt from ADR. In Denmark, 95 % of their customers are contractors that do not have a problem with ADR.

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## ENVIRONMENT

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This section captures the ability of the solution to have a direct positive impact on the environment over its entire lifecycle compared to a reference without any significant negative impact transferred. The Experts were required to answer one question on the environmental benefit of the solution.

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## EXPERTS REVIEWS

### ENVIRONMENTAL BENEFITS

**Can the solution deliver an incremental environmental benefit versus a reference case, considering the lifecycle (production, use and disposal stages) of its value chain?**

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#### No

**Expert justification -** Using chemicals that could negatively influence the environment (ground- / surface water) in order to mitigate ammonia emissions that are the result of large scale industrial animal farming is not a solution but rather a possible relocation of the problem. This solution is not without controversy. Acidification of manure with sulphuric acid can cause high sulphate concentrations in groundwater and surface water, with consequent ecological problems in surface water. The solution is not in accordance with the EU Water Framework Directive that states to limit or avoid input of polluting substances in ground- and surface water. The National Institute for Public Health and the Environment in The Netherlands is not in favour of the solution.

#### YES

**Expert justification -** Yes it can. Next to emission reductions of GHG (CH<sub>4</sub>, N<sub>2</sub>O, maybe CO<sub>2</sub>) and different sources (N<sub>2</sub>O direct fertilizer, N<sub>2</sub>O production fertilizer, CH<sub>4</sub> at application and others), it reduces eutrophication (deposition of N into the environment). The innovator quantifies 200 kg CO<sub>2</sub> per ha (per year). But this is, according to reviewers understanding only the CO<sub>2</sub> from the change in lime application. It doesn't include the N<sub>2</sub>O effects, CH<sub>4</sub> (some studies show reduced emissions, some same). The solution also offers the possibility to apply nitrification inhibitors for the slurry which additionally would have big emission reduction effects in terms of N<sub>2</sub>O-N and thus tCO<sub>2</sub>eq.

#### YES

**Expert justification -** Yes, I am convinced this technology can bring a positive environmental contribution thanks to the high level of monitoring. Technology is VERA verified with 49% ammonia emission reduction at pH 6.4 documented in + 100 trials. The system provides regulatory compliance for EU nitrate directive, EU habitat directive and NEC (national emission ceiling) directive. Innovator claims this potentially reduces total mineral nitrogen production by 20% and use of phosphorus at 10%, leading to a 0.4 % world CO<sub>2</sub> emission reduction. These figures seem realistic. There are no additional significant emissions from the use of acidification. 50 % increase in Hydrogen Sulphide is experienced up to 2 minutes after application. After that, Sulphur emission is similar to other slurry application systems. +30 official tests were conducted on the solution since 10 years. Result is additional 30 kg S pr. Ha emission. Recommendations are from 15 to 45 kg per. ha depending on soil and crop. These amounts are not very significant for ecosystems. The amount of sulphur in the sulphuric acid is replacing mineral fertiliser application and thus the related lifecycle environmental impacts. Overall the innovator claims a reduction of 200 kg CO<sub>2</sub> per hectare and 15-50 kg ammonia emission reduction per hectare and year as verified by VERA. Total 20% reduction in PM 2.5 and PM 10 was estimate by Lüneburg University. These studies could not be found in English for sake of verification but I trust these values.

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### Additional feedback / advice for the member

I suggest you to publish a detailed LCA study in english on your technology vs competitor technologies - the figure you provide are realistic but disorganised and cannot be easily verified - A reliable and comprehensive LCA provides sound elements to prove the environmental sustainability of your solution

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## PROFITABILITY

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This section captures the capacity of a solution to deliver an economic incentive for the client and to generate profits for the seller in a 5-year timeframe, regardless of its marketing strategy, its positioning towards competitors, the novelty of the idea and the resources and experience of the team. The Experts were required to answer 2 questions on (1) Client's economic incentives and (2) Seller's profitability of the solution.

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## EXPERTS REVIEWS

### CLIENT'S ECONOMIC INCENTIVE

**Can the solution: 1) have the same or lower purchasing price than a reference case? OR 2) create return on investment over the lifetime of the solution despite a higher purchasing price? OR 3) create an economic incentive (value for money) for the client which is not directly related to savings? OR 4) become cheaper than the reference after a change in regulation that is reasonably foreseeable in the next five years in the targeted region(s) and sector(s) of implementation?**

YES

**Selected option** - None

**Expert justification** - Applicable on 2 - 3. The user business case of the system in itself is profitable for large scale industrial cattle farms (pigs, poultry). Being able to reduce ammonia emissions, increase crop yield and saving on the purchase of fertilisers results in a positive ROI. Although is previously stated in the assessment and also acknowledged by the innovator, the solutions depends heavily on regulation since chemicals are being used.

YES

**Selected option** - 2 - The solution has a higher purchasing price but creates a return on investment to the client over its lifetime.

**Expert justification** - Yes because the economics is: The client invests into a device (or buys as service). The client buys sulfuric acid (and maybe nitrification inhibitors). The client (agriculture) saves spendings on fertilizer (N). The client increases income (harvest). The client possibly gets subsidies for reducing eutrophication. Overall the bottom line can be very profitable for the client, also depending on the size of the operator (ha).

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### SELLER'S PROFITABILITY

**Could the solution itself be profitable for the seller within 5 years, with a sale's price at which clients would buy it? Please evaluate this regardless of the marketing strategy, the people behind it, the competitors and the novelty of the product.**

YES

**Expert justification** - Certain countries within and outside the EU seem to have embraced the acidification of manure in order to meet EU emission targets. Some countries like Denmark are considering to make acidification mandatory.

YES

**Expert justification** - Yes. The innovator states that the business model is profitable already. Overall more than 100 units have been brought to the market already. This is plausible as well. The main barriers for fast and large scaling seem to be (as the innovator states as well): - a heterogeneous, conservative, slow market - customers have different needs depending on region, size (ha) etc. - thus a diverse set of business model how to bring the product to market is needed.

YES

**Expert justification** - There is evidence that the solution is already profitable and the current and forthcoming regulatory context is likely to strengthen this position. Patents have given

BioCover exclusivity on the market. Target market for the solution is Europe and North America. Projection is to have a market share of 60% for acidification. This corresponds to a SOM of 60.000 systems. Currently 150 units are in operation. New regulation in Denmark only will require 600 additional units by 2022. Similar trends are expected in Germany and Netherland and other EU countries. So I am confident that by 2025 the technology can serve a good portion of the SOM and thereby be profitable in the long run.

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