Nofir

BRINGING VALUE TO MARINE WASTE

SUMMARY REPORT

Life Cycle Assessment applied to fishing gear scrap

A system for collecting and recycling discarded equipment from the fishing and fish farming industry

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Executive summary

This report provides a summary of the Nofir system environmental performances related to discarded equipment from fishing and fish farming industry collection and recycling.

Life Cycle Assessment (LCA) methodology[1] is used to calculate relevant environmental impacts associated to Nofir activities. Two main output streams are identified: collection and preparation of fishing waste for further recycling processes and upcycling of a certain fraction of this waste to sport nets completely ready for installation. The analysis is from cradle to gate. For each output material the functional unit is 1 kg of material processed by Nofir and ready to be delivered to the next user. Primary data for the LCA model comes from customised questionnaires through the solar year 2021 (1st of January 2021 - 31st of December 2021).

Additionally, the LCA is used to highlight the good practices of Nofir in collecting and refining fishing scrap, preventing it to be wasted or lost in the sea. A comparison between Nofir alternatives and virgin material alternatives is analysed.

Results are summarised in Figure 1, where is provided the quantification of benefits coming out from the Nofir collection activities of fishing and fish farming equipment at their end of life.

Figure 1 – Overall project's results per 1 kg of average output materials: a comparison with alternative scenarios[2]

[1] LCA is a method for the systematic evaluation of the environmental aspects of a product or service system through all stages of its life cycle. LCA provides an adequate instrument for environmental decision support and a reliable LCA performance is crucial to achieve a life-cycle economy.

[2] As for the spot nets comparison, due to the different level of maturity of the two solutions compared, the result should be taken with caution.

1. Nofir system

Nofir aims at establishing a robust, reliable, and sustainable system for collecting and recycling discarded equipment from the European and non -European fishing and fish farming industry.

Main suppliers of Nofir are net washing facilities, net lofts, and waste facilities from Norway mainly, United Kingdom and Denmark. In the Lithuanian plant the workers manually divide and cut ropes and nets, organize the input material in homogeneous pieces, both by size and by material. As a secondary project, Nofir is implementing the production of sport nets, taking advantage of the high quality of the nets and ropes they receive as input, trying to give them a second life. The nets are cut of the wanted dimension and manually assembled and sewn together with accessories and new ropes.

The analysed system put together the following role and duties:

- Transport means from collection to dismantling.
- UAB Nofir: a fishnets dismantling/materials classification facility in Lithuania.
- UAB Nofir: sport nets manufacturing.
- UAB Nofir: packaging of the final products and storage.
- Transport of plant waste to incineration with energy recovery.

Life Cycle Assessment has the primary purpose of evaluating the sustainability of the Nofir system through the quantification of the life-cycle environmental performance resulting from a life cycle inventory analysis applied to the defined system.

Main key indicator of the analysis is the Global Warming Potential (GWP). Global warming is the phenomenon of rising surface temperature of the planet, with a particular focus on the Earth's atmosphere and ocean waters. The indicator, expressed in CO2 equivalent mass, evaluates the emissions of all greenhouse gases (GHGs) that contribute to global warming along with CO2 according to the characterization factors of the Intergovernmental Panel on Climate Change (IPCC). The GWP indicator is the most suitable indicator for these analyses as it provides a representative and robust figure of the environmental impact of the contribution under consideration.

2. LCA study overview

Life Cycle Assessment (LCA) is a scientific method to evaluate the environmental burden associated with a process or activity by identifying and quantifying energy, (raw) materials and semi-products use as well as emissions and waste to the environment by means of a life-cycle-thinking perspective. ISO 14040 and 14044 International Standards define the LCA approach and framework.

2.1. Functional Unit

Nofir system aims at recovering most of the fishing and fish farming equipment at the end of life by recycling or reuse actions.

The equipment is dismantled and divided into homogenous plastic or metal types at Nofir UAB factory in Lithuania and then addressed/delivered to reuse or recycling processes at Nofir partners' facilities.

For each output material the functional unit is 1 kg of material processed by Nofir and ready to be delivered to the next user (recyclers for secondary material blend, sport sites for refurbished sport nets), packaging excluded.

In Table 1 is shown the average breakdown of the secondary materials output of the system.

Table 1 - Nofir system output material average composition

	PA6	PA66	PE	PP	METAL	LEAD	HDPE
Mass Share	83%	1%	4%	9%	1%	2%	Ca. 0%

2.2. System boundaries

The boundaries start from the collection of fishing net equipment at their end-of-life (EoL), then consider all transport and dismantling operations at Nofir UAB facilities. The boundaries stop at Nofir gate, before shipping. (Figure 2).

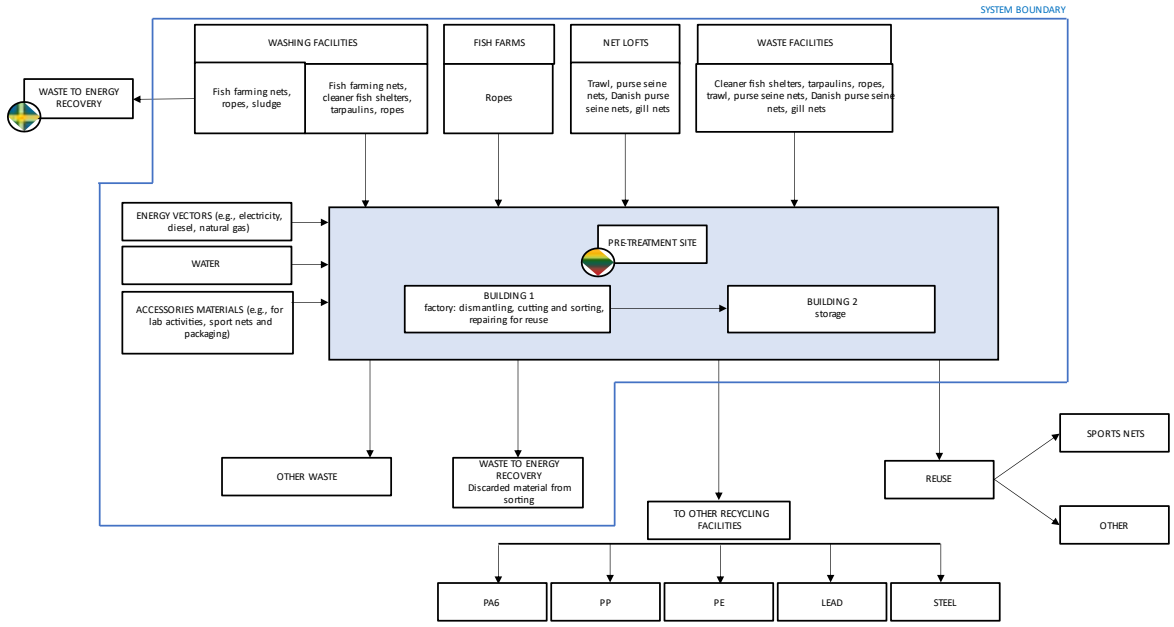

Figure 2 - Life cycle flow chart for Nofir system boundaries

2.3. Allocation rules

Allocation occurs anytime a system is producing more than a single output. In this case it is necessary to choose a technique to proper split the environmental burdens among the output flows, given the impossibility to monitor specific consumptions for every product type.

According to the available data, plant consumptions are allocated based on the economic value of each product and the respective share in turnover in the reference year. Allocation has been used on input data and plant consumptions which include water and energy consumption and waste management. Allocation was not used in data specific to each of the output flow such as specific material or energy consumption, packaging materials, distribution scenarios, as they were already specific for the investigated products.

2.4. Results

The output consists in a set of parameters to describe the environmental burden of the investigated system; life cycle inventory results are usually organized in terms of energy requirements and environmental consequences in order to identify the impacts' origins and contributors.

A specific analysis of the indicator GWP has been performed to evaluate the practices of Nofir in comparison to a "business as usual" scenario.

Secondary materials

Object of the analysis was to define the impact of Nofir activity, which includes:

- Input waste materials.
- Laboratory materials.
- Packaging materials.
- Transport of all raw materials and ancillaries.
- Plant consumption of the Lithuanian plant.
- Plant waste management: transport to destination and incineration with energy recovery.

With the focus to put into perspective the activity of collecting and addressing to recycle fishing and fish farming waste, Nofir secondary material results were compared with another possible scenario. This scenario represents the possible end of life for fishing gears in absence of Nofir work. To do so, more steps were added to complete the picture of the stream of materials handled by Nofir:

- Energy recovery energy production: electricity (Lithuania).
- Energy recovery energy production: thermal energy (Lithuania).
- Transport to recyclers.
- Recyclers activity.

ALTERNATIVE SCENARIO - Virgin material scenario.

This scenario sees the creation of 1kg of virgin materials with the same mass share of the Nofir output, reported in Table 1. The scenario considers the burden associated to transport old fisheries gear to incineration and incineration impacts. Therefore, the scenario includes:

- Incineration with energy recovery of the discarded fishing nets (1kg).
- Virgin materials production (1kg).
- Energy recovery energy production: electricity (Norway).
- Energy recovery energy production: thermal energy (Norway).

This scenario was generated out of secondary data obtained by Ecoinvent database.

Results are reported in Figure 3. Data supporting the isograms below are reported in Table 2.

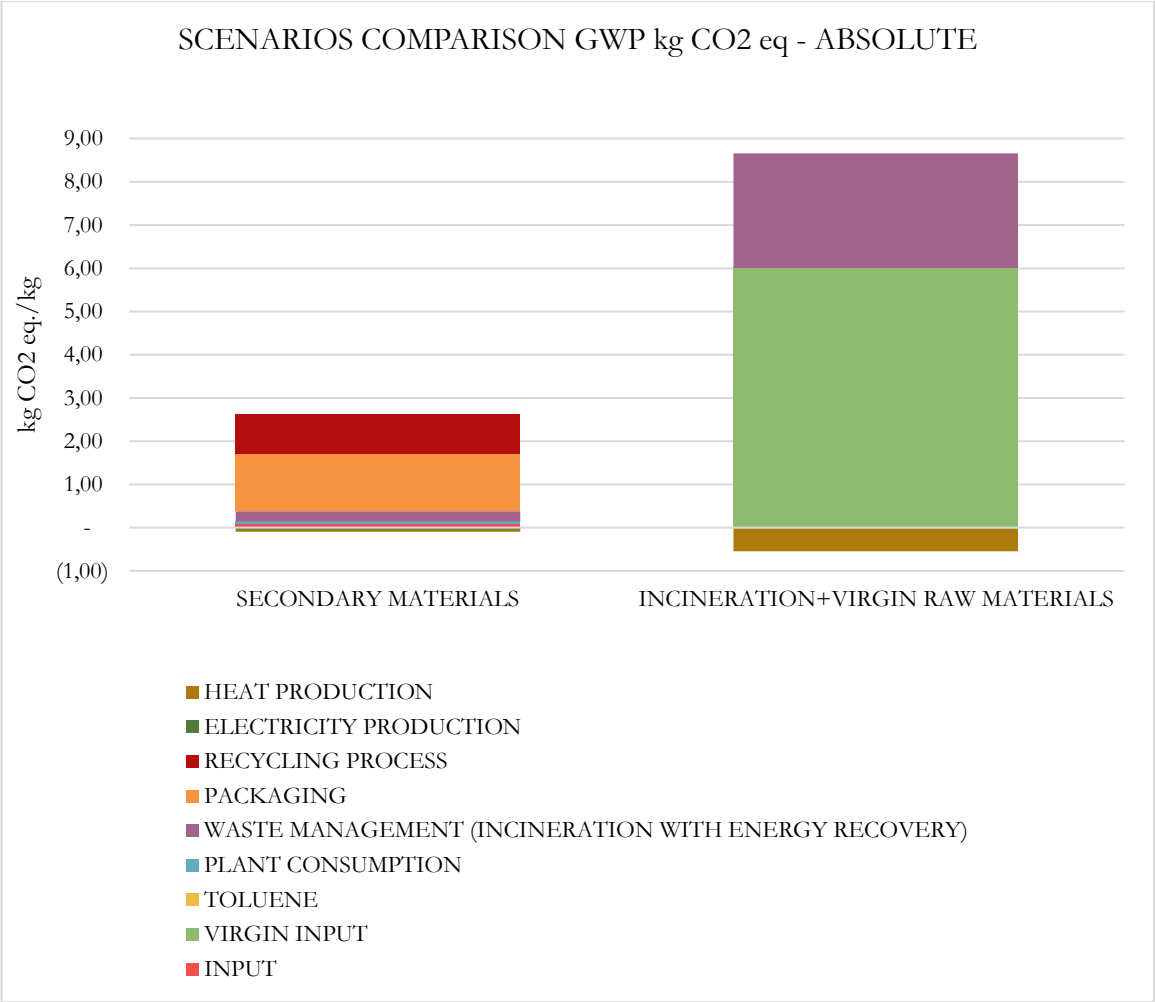

Figure 3 - Comparison between scenario with Nofir and scenario without Nofir. Module contribution included

Table 2 - Summary of the comparative scenarios

	NOFIR		ALTERNATIVE SCENARIO 1	
STEP	IMPACT ON GWP [kg CO_2 eq./kg]	NOTES	IMPACT ON GWP [kg CO_2 eq./kg]	NOTES
NOFIR INPUT	+0.09	Calculated considering the burden free fishing gear waste + its transport to Lithuania	-	-
VIRGIN INPUT	-	-	+6.00	Calculated considering the manufacturing from virgin materials of 1kg of materials (see Table 13)
TOLUENE	<0.001	Calculated considering the toluene fraction associated to sport nets production (allocation of lab materials)	-	-
PLANT CONSUMPTION	+0.05	Calculated through allocation of the whole plant consumption on the secondary materials	-	Included in the raw material (virgin input) production
WASTE MANAGEMENT	+0.24	Impact due to incineration of the plant waste, share due to secondary materials	+2.65	Impacts due to the incineration of 1 kg of fishing gear waste (no matter the country,

				considering incineration with energy recovery)
PACKAGING	+1.32	Impact due to packaging materials for distribution of secondary materials to recyclers	-	Included in Virgin materials
RECYCLING PROCESS	+0.92	Emission due to the recycling process of 1 kg of Nofir output (Aquafil EPD)	-	-
ELECTRICITY PRODUCTION	- 0.05	Emission avoided in the production of electricity, from incineration, opposed to the national Lithuanian mix	-0.02	Emission avoided in the production of electricity, producing 3.48 MJ/kg from incineration opposed to the national Norwegian mix.
HEAT PRODUCTION	- 0.05	Emission avoided in the production of heat, from incineration, opposed to heat from traditional natural gas furnace.	-0.53	Emission avoided in the production of heat, producing 7.03 MJ/kg from incineration opposed to heat from traditional natural gas furnace.

According to the emission values reported above, it is possible to calculate the two total value of GWP: 2.51 kg CO_2 eq./kg for Nofir system and 8.10 kg CO_2 eq./kg for the alternative scenario. It is important to highlight that the "input" voice associated to Nofir system makes a reference to the collection system: the material itself enters burden free in the system, therefore, the 0.09 kg CO_2 eq./kg (4% of the total) is associated entirely to the transport to the Lithuanian plant.

Thanks to Nofir activity, there is a saving of 5.6 kg CO2 eq. for each kg of produced material in comparison to burning (incineration with energy recovery) all the waste and generating new polymers out of fossil sources.

Sport nets

Focus of this comparison is to understand if the refurbishment activity performed by Nofir brings effective environmental benefit in comparison to the production of sport nets from virgin sources.

This comparison is meant to show the potential benefit of the fishing and fish farming net refurbishment, but it does not represent a complete and reliable comparison.

Being sport nets production at a pilot stage, Nofir plant data do not fully represent the truth of a well-established manufacturing process, which takes some time to establish.

On the other hand, literature material for sport net LCA is not common, therefore, the data available for the comparison were not enough to build a reliable counterpart.

For this reason, the system boundaries considered are tighter than the one used in the previous chapter: only raw material and specific manufacturing consumption are included. It is possible to

observe that the small impact due to Nofir nets is due to the absence of environmental burden tied to the raw materials. Fishing gears enter the Nofir system as a waste, therefore the impact of their production is charged on the previous system (the one that used them as they are). Sport nets derived from fossil on the other hand, appear to be very impactful due to the nature of their origin. Results are shown in Figure 4.

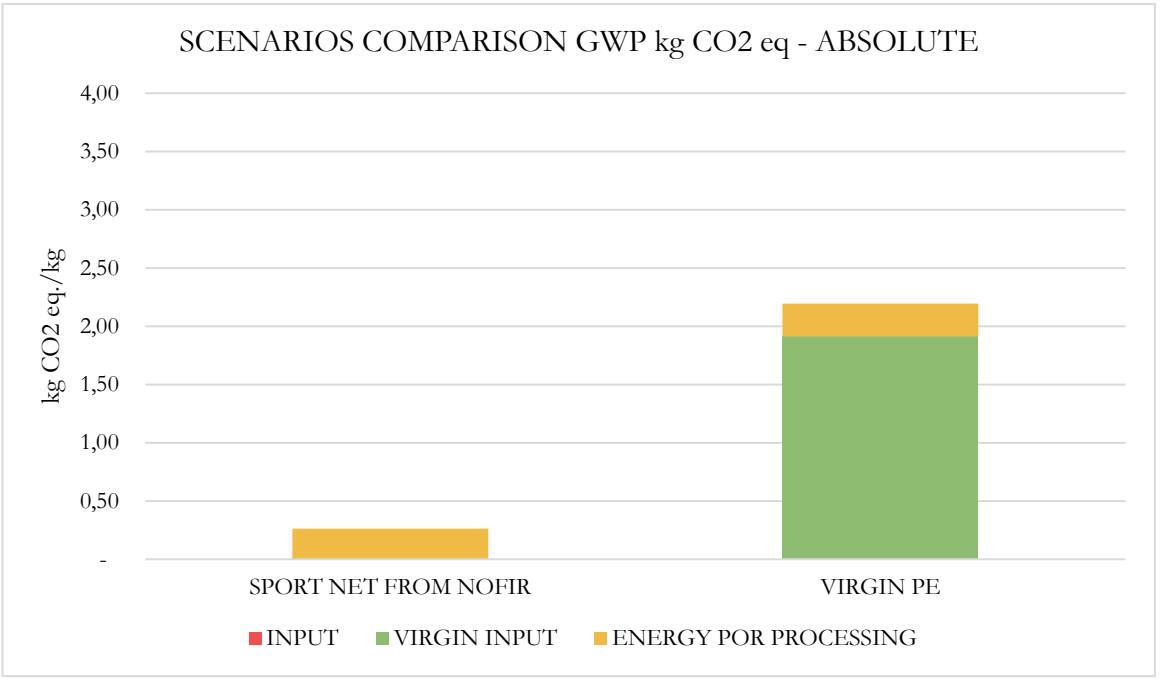

Figure 4 - Comparison between scenario with Nofir and scenario without Nofir. Module contribution included

According to the emission values reported above, it is possible to calculate the two total value of GWP: 0.26 kg CO_2 eq./kg for Nofir system and 2.19 kg CO_2 eq./kg for the alternative scenario. Thanks to Nofir activity there is a saving of ca. 2 kg CO2 eq. for each kg of produced sport net in comparison to manufacturing a brand-new net from virgin sources.

3. Critical Review

The following executive summary refers to a "Audit Report Follow-Up Review for product EPD" report, prepared by Luca Giacomello after a full ISO 14040/44 Third Part Verification on the LCA activities here introduced.

7 Results of LCA VERIFICATION

I hereby confirm that, according to the checks performed, in accordance with the limits of the scope of my appointment, nothing has come to my attention to suggest any data errors or deviations from the requirements by the above-referenced LCA and its project report, in terms of:

- the underlying data collected and used for the LCA calculations,
- the way the LCA-based calculations have been carried out to comply with the calculation rules,
- the presentation of environmental performance indicators included in the LCA, and
- any other information included in the study

with respect to the procedural and methodological requirements included in the EN ISO 14040:2006/A1:2020, EN ISO 14044:2006/A2:2020, as well as with general reference to the General Programme Instructions of the International EPD® System.

I confirm that, in accordance with the limits of the scope of my appointment, the company-specific data has been examined as regards plausibility and consistency. The declaration owner is responsible for its factual integrity and that the product does not violate relevant legislation.

Date	Signature – LCA verifier	Signature – LCA Owner
07/04/2023		

References

- Life Cycle Assessment applied to fishing gear scrap, 2023, Nofir
- General Programme Instructions for the International EPD®System v. 4.0, 2021-03-29
- EN ISO 14040:2006/A1:2020
- EN ISO 14044:2006/A2:2020
- www.maps.google.it/maps
- www.ecotransit.org
- SimaPro 9.4.0.2 software