



## **ENVIRONMENTAL CONTRIBUTION** 2020-2021 SEASON

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# CONTENTS

- 01. Introduction..... 3**
- 02. Weight ..... 4**
  - A. Carbon equivalent:..... 5
  - B. Why is a NEEL trimaran light? ..... 6
- 03. Health and safety ..... 7**
- 04. Composite materials..... 8**
  - A. Gelcoat ..... 8
  - B. Resins ..... 9
    - 1. Polyester Resin ..... 9
    - 2. Bio-based resin ..... 10
    - 3. PET Resin ..... 11
  - C. Fabrics / Fibres ..... 12
  - D. Cores ..... 13
    - 1. PVC ..... 13
    - 2. PET ..... 14
- 05. Infusion process ..... 15**
- 06. Injection process ..... 16**
- 07. Greenwashing ..... 16**

# 01. Introduction

A vigorous drive to make NEEL-TRIMARANS a virtuous and pioneering company has been launched by company president Eric Bruneel and CEO Christian Mocquery.

Far from falling into "Greenwashing marketing", NEEL-TRIMARANS is driven by the conviction that we can, today, work on the environmental impact of our processes and products across five areas:

- Fauna, flora and therefore **our planet**.
- The **well-being of employees**, by implementing more ecological processes.
- **Our boats**, by converting to virtuous, technically advanced materials.
- The **company** itself, by raising employees' awareness about the importance of reducing waste in the use of virtuous materials, and empowering them to do so.
- The company, by implementing **processes and materials that consume less**.



## 02. Weight

By way of comparison:



| E---A 45                                  | L---N 46                                  | NEEL 47                                   |
|---|---|---|
| 14.0t                                     | 15.8t                                     | 10.6t                                     |
| 124 m <sup>2</sup> sail area close hauled | 123 m <sup>2</sup> sail area close hauled | 120 m <sup>2</sup> sail area close hauled |
| Speed of 9.0m <sup>2</sup> /t             | Speed of 7.8m <sup>2</sup> /t             | Speed of 11.3m <sup>2</sup> /t            |
| 2x diesel 50 hp                           | 2x diesel 45 hp                           | 1x diesel 60 hp                           |

These three boats are almost the same in terms of space, comfort and equipment.

However, their declared weights differ by around 50%, which implies greater or lesser use of the diesel drive unit.

|                                      | E---A 45        | L---N 46        | NEEL 47         |
|--------------------------------------|-----------------|-----------------|-----------------|
| <b>Engine</b>                        | 2x diesel 50 hp | 2x diesel 45 hp | 1x diesel 60 hp |
| <b>Source of information</b>         | Press test      | Press test      | Experience      |
| <b>Cruising speed</b>                | 7 knots         | 7 knots         | 8 knots         |
| <b>Consumption (litres per hour)</b> | 11.0 L/H        | 12.0 L/H        | 7.6 L/H         |



Diesel fuel consumption is **44 to 57% lower** on a NEEL trimaran, for the same use.

## A. Carbon equivalent:

1 litre of diesel weighs 835 grams.

Diesel is 86.2% carbon (C), which means there are 720 g of carbon per litre of diesel.

To burn this carbon into CO<sub>2</sub>, 1,920 g of oxygen are needed.

The sum therefore gives us 720 + 1920 = 2640 g of CO<sub>2</sub> per litre of diesel.

| E---A 45                              | L---N 46               | NEEL 47                |
|---------------------------------------|------------------------|------------------------|
| <b>50 hours per year over 20 year</b> |                        |                        |
| 29.04t CO <sub>2</sub>                | 31.68t CO <sub>2</sub> | 20.06t CO <sub>2</sub> |

In 10 knots of wind, a NEEL trimaran systematically reaches over 6 knots across the entire polar curve.

In 10 knots of wind, a production catamaran reaches only 6 knots at 100-110° to the wind, depending on its particular polar curve.

Clearly, these catamarans use more thermal propulsion than a NEEL.

According to French national statistics, 25% of sailing days occur when the wind is less than 10 knots. Our consumption table therefore becomes:

| E---A 45                               | L---N 46                               | NEEL 47                                |
|--|--|--|
| <b>62 hours per year over 20 years</b> | <b>62 hours per year over 20 years</b> | <b>50 hours per year over 20 years</b> |
| 36.00 t CO <sub>2</sub>                | 39.28 t CO <sub>2</sub>                | 20.06 t CO <sub>2</sub>                |



Due to its superior sailing performance, the carbon equivalent of diesel drive unit used by a NEEL will be 79 to 95% lower over a period of 20 years.

What is 1 tonne of CO<sub>2</sub>?



?

## B. Why is a NEEL trimaran light?

The NEEL 47 marked a breakthrough in the way we approach production.

The equipment and comfort levels are the same as the competition, so the difference in weight is largely due to the composite elements.

The NEEL 47 is made up of:

- Hull
- Deck
- Hardtop and its countertop
- 4 bulkheads
- 3 washrooms
- 2 hull counter moldings
- 2 deck counter moldings
- 1 set of 17 composite parts

For the hull, there was not the slightest doubt: it had to be made by vacuum infusion.

For the deck, the hardtop and its countertop, infusion seemed appropriate; but given the structural constraints and the sampling results, the estimated weight of the parts was starting to build up considerably.

So, we used 40kg of carbon in judicious places and managed to lower the overall weight of these components by over 200kg.

### **200kg less means less fabric, less resin, less application time.**

An adage of ocean racing is "a vacuum weighs nothing and costs nothing". We could even add:



"A vacuum weighs nothing, costs nothing and is good for the environment, the boat, the company and its employees"

Following our success with the deck and hardtop, we applied the same process to the bulkheads and reduced their weight by 140kg through the use of carbon.

For the washrooms, counter moldings, and small rooms, we compared various manufacturing methods to find the right solution.

Our competitors in the industry generally manufacture these elements by RTM (resin transfer molding).

After a detailed comparative study, we chose to manufacture all the elements by vacuum infusion. By using less material for the same structural equivalence, thanks to a different manufacturing method, we have less material to buy and then to transform.

On the Isocost line (Materials and Labour), we gained 287kg on these parts.

According to estimates, the NEEL 47 would be 2.6t heavier if it were manufactured using the processes and materials used by other production sites.



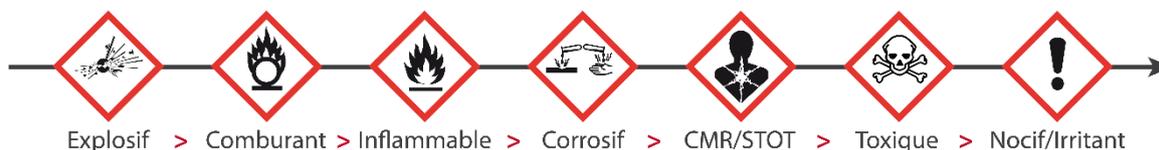
The very essence of NEEL boats is the pleasure of sailing. To optimise performance, the weight of the boat must be limited; and in fact, such optimisation has a positive environmental impact both in terms of the boat's manufacture and in its use.

## 03. Health and safety

All chemicals are subject to a regulated "safety data sheet".

This regularly updated safety data sheet documents the constituents and their harmfulness in great detail.

A series of regulatory icons are affixed to the container for the attention of the user:



At NEEL-TRIMARANS, there is **no product identified as toxic**.



As the safety data sheets are continually evolving according to French, European and worldwide directives, NEEL-TRIMARANS **carries out ongoing safety checks** with the purpose of eliminating and/or replacing any product that may fall into these two categories of hazardousness.

It is not only to employees that such products pose a risk. Waste disposal methods are sometimes poorly understood, and it is likely that these products can have a significant and uncontrolled impact on fauna, flora and our planet.

## 04. Composite materials

### A. Gelcoat

Gelcoat, the 1<sup>st</sup> material used in the manufacturing process, is a polyester-based product applied by spraying.

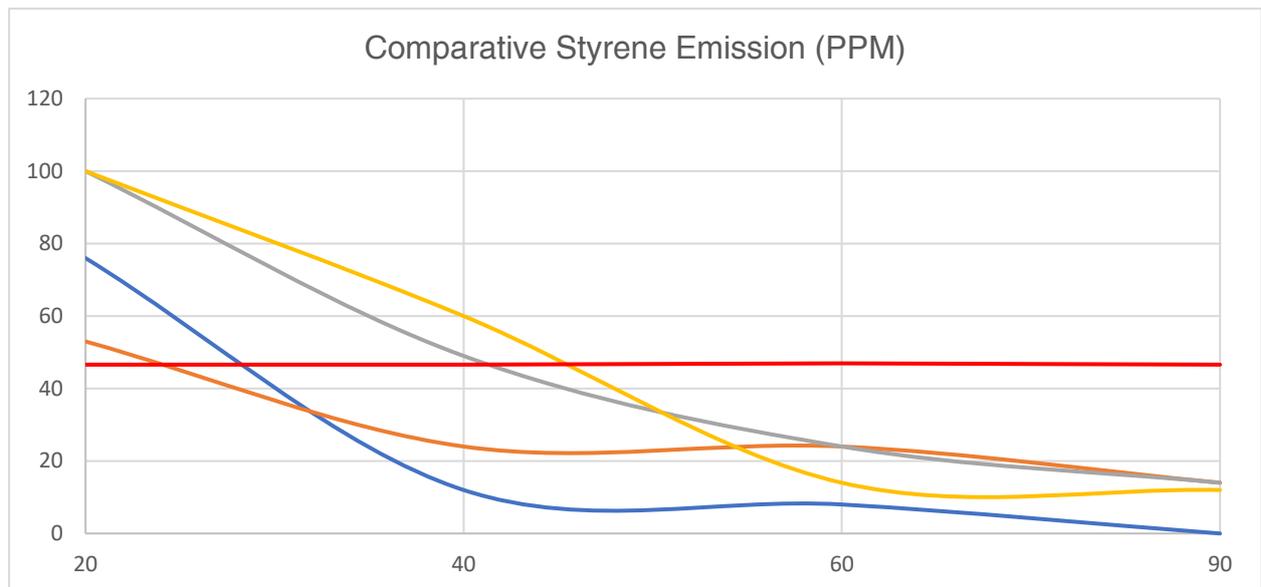
Poor quality gelcoats do not deserve a mention here: only Isophthalic NPG gelcoats are considered, with properties that yield maximum resistance to osmosis.

Extract from the internal test report of February 20, 2020:

History :

- Our supplier developed a gelcoat with low styrene content
- Major construction sites use alternative gelcoats manufactured abroad. These gelcoats are "sold" as containing less styrene and/or emitting less styrene.

Readings carried out in the workshop following comparative applications:



The results confirm the technical and safety data sheets. Some gelcoats are not "virtuous" gelcoats as the marketing and sales approaches would have people believe.

#### Conclusion

The gelcoat selected by NEEL-TRIMARANS for its **intrinsic technical qualities** and for its **very high level of solids content** is, to date, the **most effective solution** to control our styrene emissions, both in terms of value and duration.



Far from "Greenwashing" and rash ecological declarations, NEEL-TRIMARANS is busy working factually and independently to implement the best materials for the environment.

## B. Resins

### 1. Polyester Resin

Our polyester resins are exclusively Isophthalic and designed for vacuum infusion.

The environmental "Achilles' heel" of infusion resins is that they need to be fluid and are therefore diluted with styrene.

The INRS safety and toxicological datasheets are regularly updated.

Components can switch from "potential hazard" to "proven hazard". A regular review of health and safety data sheets allows us to limit danger by avoiding, for instance, CMR category 1 substances.

Note that the "at risk" moment is targeted: the period running from when the resin is unpacked to when infusion begins (before, the resin is in a standardised container; afterwards, it is in a vacuum bag).

In order to reduce this preparation time to a strict minimum, NEEL-TRIMARANS uses an 18l/min mixing machine, thereby avoiding the need for unpacking.



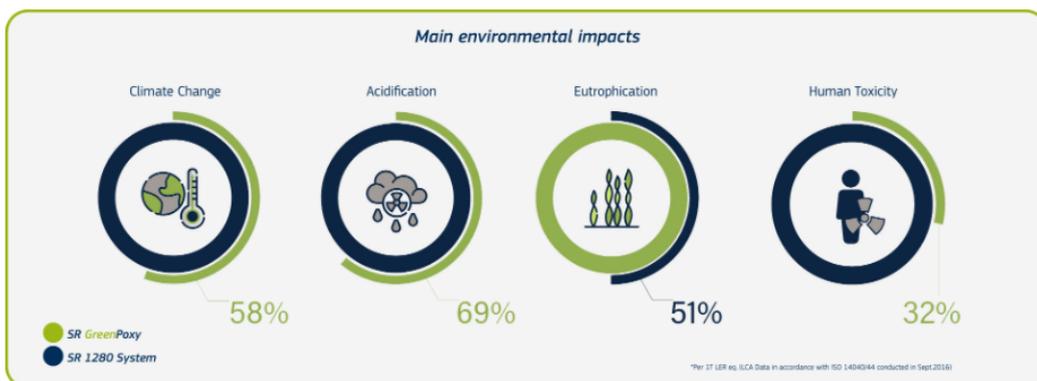
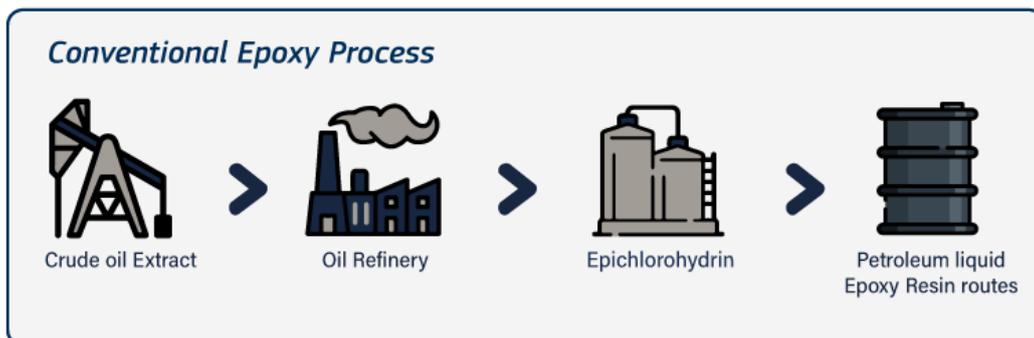
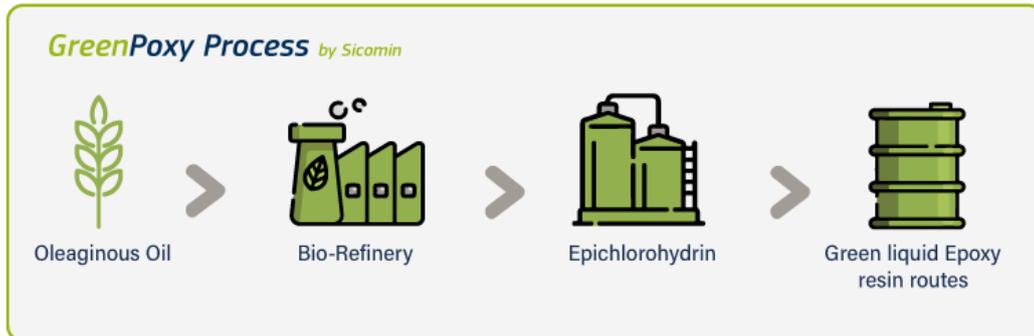
By investing in new equipment, NEEL-TRIMARANS seeks to reduce its emissions of VOCs Styrene as much as possible.

## 2. Bio-based resin



In partnership with Sicomin, a bio-based epoxy resin has been successfully tested.

56% of its contents is bio-based, derived from food waste.



The advantages of a partially bio-based resin compared to a petrochemical resin are shown in green.

Infusion via NEEL-TRIMARANS processes does not present any difficulty.

No fewer than 36 test-pieces have been produced and destroyed in flexion experiments since August 2020.

The expected results are:

- Iso cost
- Iso structure
- 20% lighter
- No water or moisture absorption
- + 30% longer life under load

In conclusion, this process will be used for the NEEL 43 bulkheads.



NEEL-TRIMARANS invests in R&D to carry out a transition to more virtuous materials.

### 3. PET Resin



In partnership with INEOS, PET resins will be tested in 2021.

A 220kg barrel of resin is equivalent to **1,800 recycled plastic bottles**.

This resin could replace thixotropic resin in non-structural contact lamination applications.



NEEL-TRIMARANS invests in R&D to carry out a transition to more virtuous materials.

## C. Fabrics / Fibres

A technical comparison of 16 natural and synthetic fibres was carried out in October 2019.

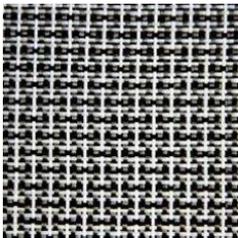
A wide range of fibres were tested and documented, including Sisal and ramie. Some of the fibres tested are also currently in development and/or found in limited quantities.

We focused our attention on:

- Innegra
- Kevlar
- Carbon
- Linen
- Glass
- Basalt

The research results and test reports are available. The synthetic analysis is as follows:

### > Innegra



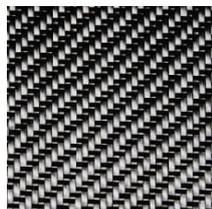
**Innegra** is a "specialist" fibre, both for customers and for those who drape it. With its finesse and technicality, this fabric belongs to fields distinguished by innovation and "advanced technical marketing". The final product therefore comes under a superior category in terms of quality (and cost).

### > Kevlar



When combined with other reinforcements (glass, carbon), it offers excellent resistance to puncture. The infusion process plays a crucial role in preventing water absorption. Like carbon, adding **Kevlar** reduces the quantities of resin involved.

### > Carbon



Fibre used for reinforcement. Reduces samples required by a factor of 4 compared to Glass-E. Technical advantages as well as environmental ones since resin requirements are also divided by 4

## > Linen



- **Aesthetics:** without going into bleached linens, or unproductive pre-painted substrates, the aesthetic result does not meet our expectations.
- **Mechanical:** excellent in the vibratory analysis, the 100% linen fabric is disappointing in structure, with an unpleasant feeling of "softness".
- **Production:** Fabrics over 600g/m<sup>2</sup> are not as easy to source for industrialisation as we had imagined.
- **Ageing:** no-one has a distinct understanding of how this fabric ages nor of the consequences of its hydrophilicity.

## > Glass



To overcome the deficiencies of linen while achieving more virtuous production, a glass / linen hybrid is under development. It is scheduled to be tested in early 2021. In all likelihood, it will be used for the interior counter moldings. Note that linen has a carbon footprint **6 times lower** than that of glass if only the product is considered. In terms of grey energy\*, the gain is only 15%.

\* *Grey energy or embodied **energy**, is the amount of **energy** consumed during the life cycle of a material or a product: production, extraction, transformation, manufacture, transport, work, maintenance and finally recycling, with the notable exception of use.*

## > Basalt



Useful for applications that involve very high temperatures or stealth. Very high density compared to carbons (+50%).

It is relatively difficult to manufacture as crushed volcanic rock has to be melted in order to extract the fibres. Its carbon footprint – and thus environmental impact – is unknown since no research papers have been published on the subject.

## D. Cores

### 1. PVC



These PVC cores/foams have been used for 40 years in ship building and in the advanced composite sector. They have an excellent weight-to-mechanical resistance ratio.

PVC presents an environmental disadvantage due to its blowing agent: Carbon dioxide (CO<sub>2</sub> / produced by the reaction of water with Isocyanate components).

Since environmental constraints are growing increasingly drastic, European PVC foam factories have no future.

PVC cannot be recycled because sanding, crushing or heating would again release isocyanates, substances classed as "proven toxic".

## 2. PET



PET core is a type of thermoplastic and recyclable, closed-cell foam with very good mechanical properties, excellent resistance to fire, and extraordinary resistance to fatigue. This foam is chemically and thermally very stable.

The weight-to-mechanical resistance ratio is slightly lower than its PVC counterpart.

On the other hand, its resistance to fatigue / ageing (important on a moving boat) is about 30% greater, according to research.

Currently, partially recycled foams fail to provide us with the desired mechanical characteristics. For 2021, the two world leaders in the industry aim to reach a 25 to 35% proportion of recycled materials in their manufacturing whilst achieving the same mechanical resistance.

In all cases, **these PET foams are recyclable.**

The Techni Yacht shipyard achieved a world first in 2016 with the manufacture of an 85-foot, 29-tonne light catamaran certified Bureau Veritas, using exclusively PET foam. Five more catamarans of **60 to 90 feet are due to follow.**

- In 2018, NEEL-TRIMARANS broke new ground with the integration of 20% PET foam in the manufacture of the NEEL 47.
- In 2020, the LEEN 56 was made entirely from PET foam.
- In 2021, the NEEL 43 will have 46% PET foam in its manufacture.

Architects who were at first very conservative on this subject now **recognise the qualities of these PET foams.** Shipyards make widespread use of it for interior parts and superstructures.



By using PET foam, NEEL-TRIMARANS is committing to the approach of employing virtuous alternative products.

## 05. Infusion process

Vacuum infusion molding, or infusion for short, is a **modern process** developed to make use of composite materials. The reinforcement materials are first laid-up dry on the mold and sealed into a vacuum bag. The vacuum created, then pulls resin into the mold to impregnate the materials. This technology enables the production both of monolithic parts and sandwich parts.

The advantages of infusion over contact molding (or the "hand lay-up" process) are:

- A higher proportion of fibre: the process uses no more than the exact amount of resin required, thus obtaining a better **strength-to-weight ratio**.
- The production of large parts in "one shot".
- Reproducibility in part production.
- Better protection of operators from emissions of solvents such as styrene. VOC standards.
- Empty vacuum bags systematically recycled by 



Through the almost exclusive use of infusion, NEEL-TRIMARANS **seeks to limit its VOC emissions**.

In the second half of 2019, an ambitious plan to improve the infusion process was launched.

In January 2020, a new infusion process "owned by NEEL-TRIMARANS" was rolled out, enabling:

- A 57% **reduction** in the cost of consumables
- A 15% **reduction** in waste weight
- A 50% **reduction** in the amount of resin lost during infusion
- 1 tonne **less pure** styrene per year
- A **gain in productivity** (fewer consumables to handle).

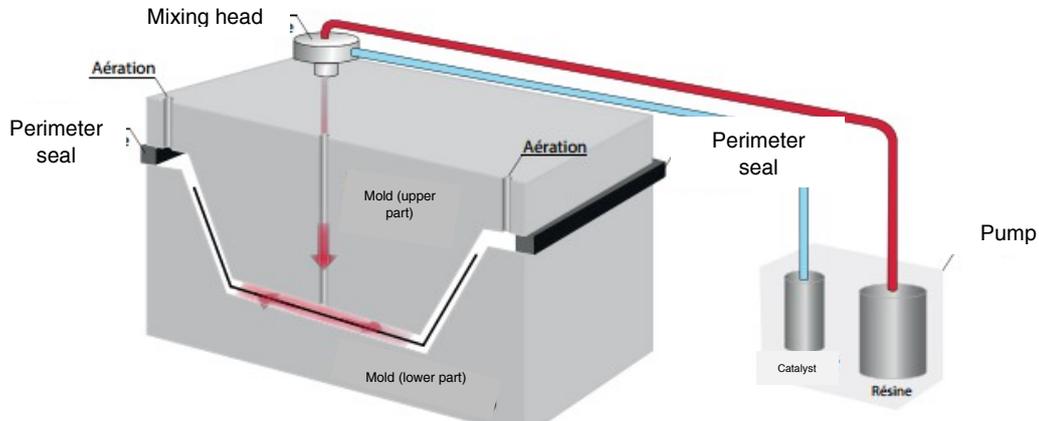


Through its internal developments, NEEL-TRIMARANS is demonstrating that priorities of **hygiene, industrialisation, cost** and **environment** can be combined to great advantage.

A new study on infusion consumables will be carried out in 2021. For some parts, the goal is to do away with surface consumables by integrating the distribution ramps in the cores / foam. The only residual consumable would then be the vacuum bag, itself recycled.

## 06. Injection process

Composite injection is a closed-molding process of lamination. **No styrene escapes during the process.**



A technical development has been implemented for parts of the NEEL 43.



By investing in new processes, NEEL-TRIMARANS seeks to reduce its emissions of VOC styrene.

## 07. Greenwashing

Not a month goes by without some kind of big "revolutionary" announcement on the subject of ship building. A boat made of linen, hemp, basalt, bamboo, PET resin, thermoplastic, etc. **There's no longer any doubt** that one or more technologies will emerge over the next few decades.

However, we ourselves, and our customers/boat owners, need to know how to decipher these "innovations" properly. The subjects of these announcements are often only "demonstrators" with no limit on budget or production hours, and with their fair share of past, present and future non-conformities.

NEEL-TRIMARANS builds owner/charter/passenger boats along actual production lines. There is no such thing as a **100% eco-friendly boat** (to date). Neither the processes nor the materials allow this on an industrial scale.

NEEL-TRIMARANS is a responsible company **that cares about the planet and works daily to implement more virtuous processes and materials**. Our factual and thoughtful approach we have adopted enables NEEL-TRIMARANS to play its part in sustainable development\*.

\* Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.



With regard the environment, NEEL-TRIMARANS has a sensible, no-nonsense policy: "Let's change for genuine reasons, making sure that change is for the better".

**JUST  
MAKES  
SENSE.**



[www.neel-trimarans.com](http://www.neel-trimarans.com)

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