Measuring Carbon Footprints:
Analysing Emissions Across the Surfboard Lifecycle

THE CARBON COST OF SURFBOARDS

WAVECHANGER
X CARBONHALO

2022

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The featured products, services and organisations shown in this publication are intended to give an overview of what's currently available and potentially on the horizon, to the best of our knowledge. The content of this guide has in no way been paid for or sponsored.

wavechanger.org carbonhalo.org uts.edu.au

01

INTRODUCTION

In the quest for affordability, peak performance, and the mass production of boards to meet the surging demand among enthusiasts, the surfboard manufacturing landscape, particularly in terms of materials and technologies, has transitioned from artisanal, handcrafted masterpieces to standardised, disposable commodities. It's only in recent times that a shift in this tide is discernible, prompting a collective pause for reflection and a fundamental question...

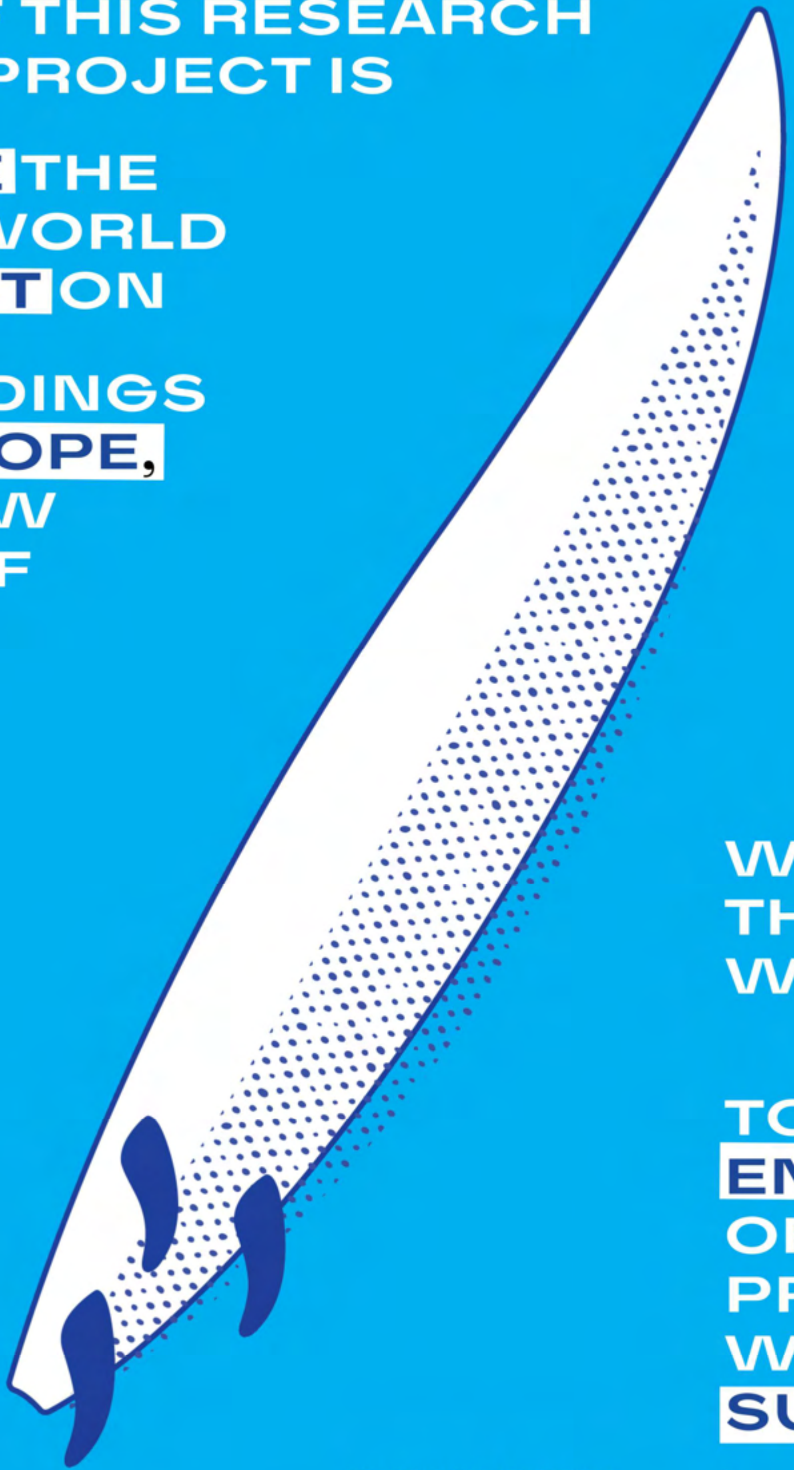
WHAT IS THE REAL COST OF SURFING?

The repercussions extend well beyond mere economic factors, encompassing a broader spectrum of concerns. These encompass the impacts on our landfill sites, the delicate balance of coastal ecosystems, the vitality of marine biodiversity, and emphasise the undeniable social responsibility that both the surfing industry as a whole and every individual surfer bear.

THE AIM OF THIS RESEARCH AND DATA PROJECT IS

TO **ENABLE** THE SURFING WORLD TO **REFLECT** ON

THESE FINDINGS AND, WE **HOPE**, **PLAN** A NEW COURSE OF **ACTION**.



02

PROJECT PURPOSE

WE **TRUST** THAT THE INFORMATION WILL HELP

TO **REDUCE** THE **ENVIRONMENTAL IMPACT** OF THE MATERIALS AND PROCESSES INVOLVED WITH **MANUFACTURING SURFBOARDS**.

03

DATA SOURCES

Whilst this report is not a formalised study, the entire team are extremely passionate about surfing and the environment, and wanted to ensure that the information represented here is accurate. Where possible, Australian data has been used. For instances where Australian data was not available or could not be found, internationally recognised data from industry bodies and emissions databases has been utilised. Examples of data include industry specific data to extract material densities, supply chain experts for transportation factors, certified emissions factors for materials and construction processes, and equipment specifications to determine power consumption. For labour and effort, surfing industry experts - including shapers and suppliers - have been consulted. For surfboard usage, some assumptions have been applied to account for the occasional to the avid daily user. A complete list of source information can be found within the appendix to this document.

04 SURFBOARD EMISSIONS

We've looked at four of the most common types of surfboards and calculated the carbon emissions of each board, expressed in kilograms of carbon dioxide or kg CO^2. Each calculation factors in the materials used and their embodied energy, the construction method, the distribution (packaging and transportation), the usage and lifetime maintenance, and finally the waste and disposal factors.

TYPICAL 8FT MINI MALIBU
(EPS BLANK + EPOXY RESIN)

=198 KG CO_2

TYPICAL 6FT SHORTBOARD
(EPS BLANK + EPOXY RESIN)

=165 KG CO_2

TYPICAL 7FT SOFT TOP
(EPS BLANK + EVA FOAM)

=167 KG CO_2

TYPICAL 9FT LONGBOARD
(EPS BLANK + EPOXY RESIN)

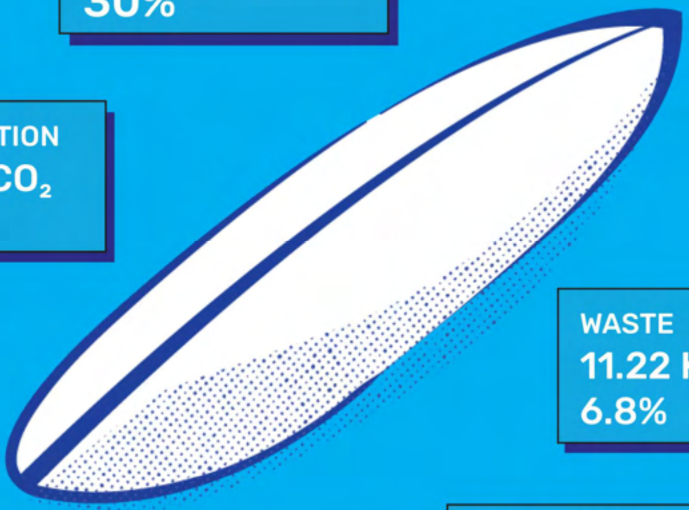
=217 KG CO_2

Refer to pages 40-43 for detailed calculations

HAVE YOU EVER WONDERED WHERE MOST OF THE CO2 IS CAPTURED WITHIN YOUR SURFBOARD?

WHAT INDIVIDUAL COMPONENTS HAVE MORE OF A NEGATIVE IMPACT ON THE ENVIRONMENT?

BREAKDOWN OF EMISSIONS FOR A TYPICAL 6FT SHORTBOARD



MATERIALS
49.5 KG CO_2
30%

CONSTRUCTION
9.24 KG CO_2
5.6%

WASTE
11.22 KG CO_2
6.8%

DISTRIBUTION
5.94 KG CO_2
3.6%

+

USAGE & LIFETIME MAINTENANCE
89.1 KG CO_2
54%

= 165 KG CO_2

Refer to pages 38-43 for detailed calculations

CONSTRUCTION PROCESS:

05 HAND SHAPED VS CNC MACHINE

CALCULATED EMISSIONS FROM THE CONSTRUCTION PROCESS OF SURFBOARDS

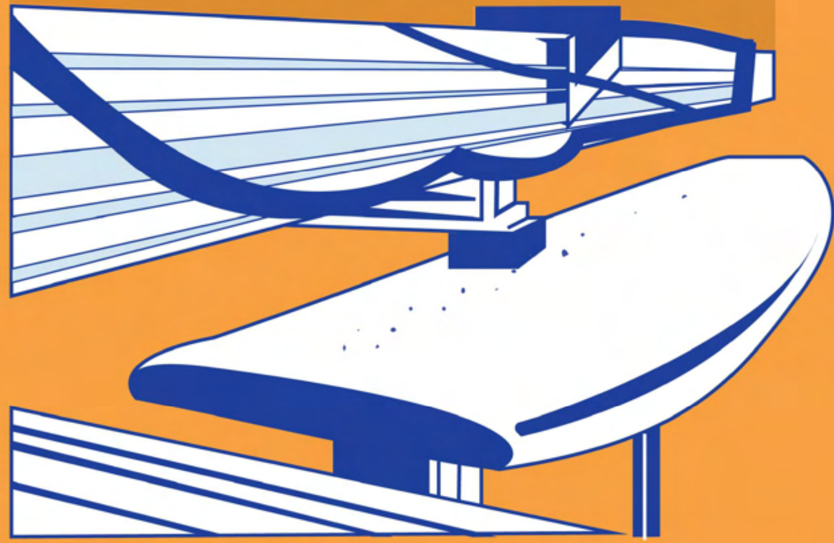
Based on CAD power, electrical planer, air-con and air-filtering, vacuum cleaner, lighting and power.

STANDARD 6FT SHORTBOARD HAND-SHAPED CONSTRUCTION:

4.93 KG CO_2

Based on CAD power, CNC machining, air-con and air-filtering, vacuum cleaner, lighting and power.

STANDARD 6FT SHORTBOARD CONSTRUCTION BY CNC MACHINE: **3.53 KG CO_2**



SURFBOARD LENGTH

	6FT	7FT	8FT	9FT
HAND SHAPE	4.93	7.40	12.34	19.74
MACHINE SHAPE	3.53	3.53	3.53	3.53
GLASS	4.27	5.33	6.40	7.47
HAND SHAPE & GLASS	9.20	12.73	18.74	27.20
MACHINE SHAPE & GLASS	7.80	8.86	9.93	11.00

Refer to pages 38 & 39 for detailed calculations of construction process

Based on glassing each side, curing, clean-up, hot coat, sanding, lighting and power.

STANDARD 6FT SHORTBOARD GLASSING/LAMINATION:

4.27 KG CO_2

06 SURFBOARDS vs OTHER CARBON EMITTERS

YOU COULD FILL

7 X 50M

OLYMPIC SIZED SWIMMING POOLS WITH THE GLOBAL TOTAL OF EXPANDED POLYSTYRENE FOAM USED IN SURFBOARD MANUFACTURING, EACH YEAR.****

THE CARBON EMISSIONS FROM A TYPICAL 6FT SHORTBOARD*

(165 KG CO_2)

EQUALS THE SAME EMISSIONS AS CONTINUALLY DRIVING A PETROL VEHICLE FOR

700 KM (435 MILES)

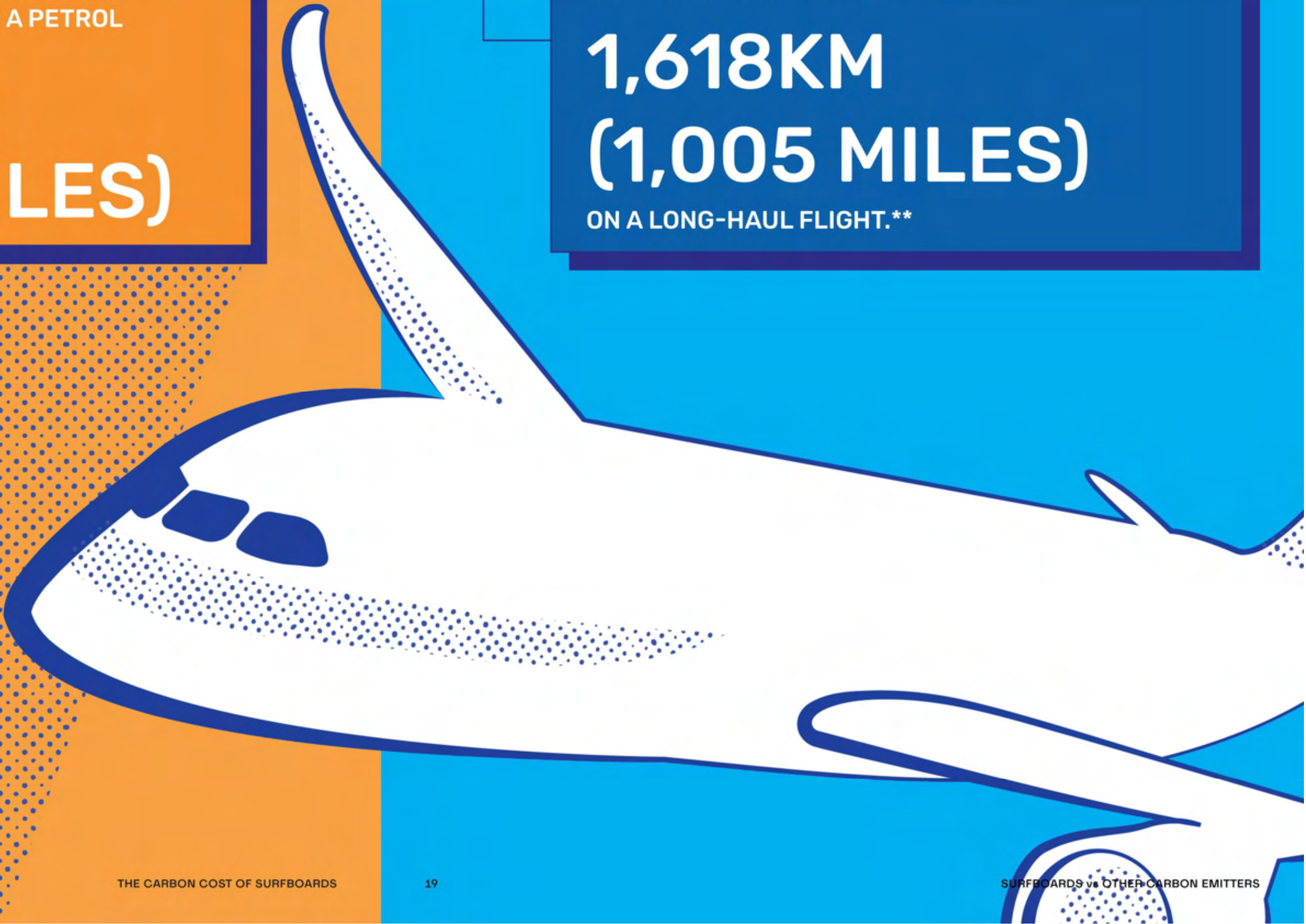
OR A SINGLE PASSENGER FLYING NON-STOP FOR

650 KM (404 MILES)

ON A SHORT-HAUL FLIGHT, OR

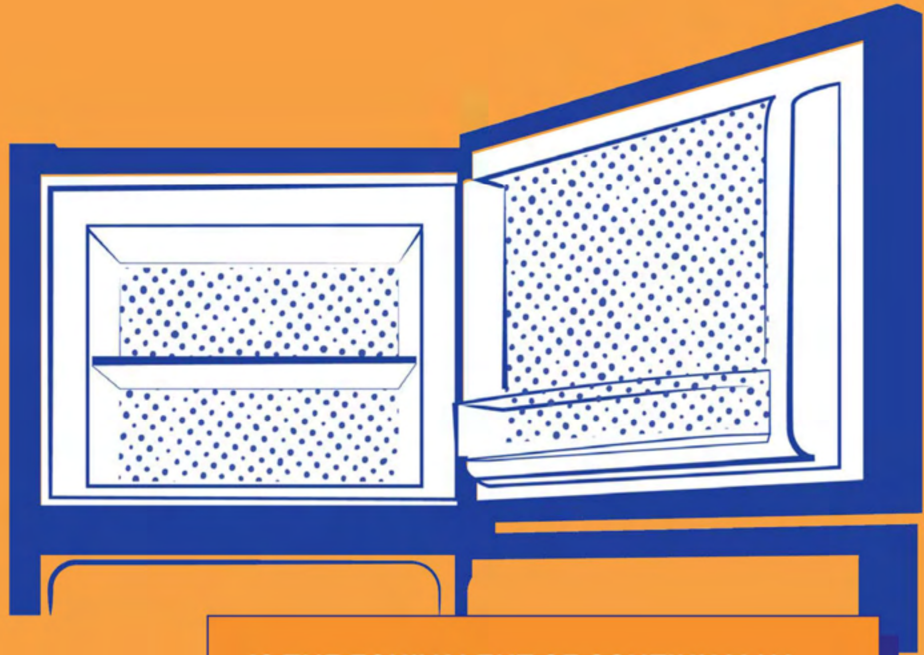
1,618KM (1,005 MILES)

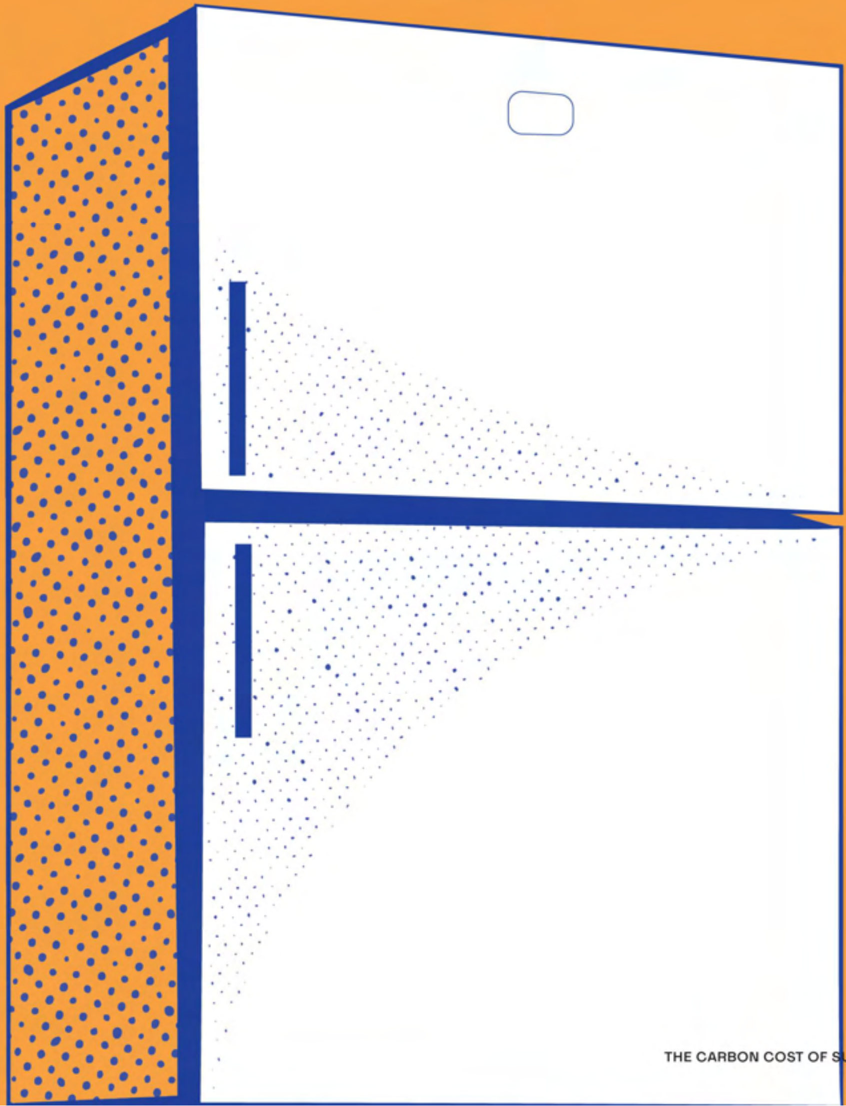
ON A LONG-HAUL FLIGHT.**



THE GREENHOUSE GASES (GHG) FOR THE SAME 6FT SHORTBOARD

(165 KG CO_2)





IS THE EQUIVALENT OF CONTINUALLY RUNNING A HOUSEHOLD FRIDGE FOR

320 DAYS.***

*TOTAL EMISSIONS FROM MATERIALS, CONSTRUCTION, DISTRIBUTION, LIFETIME USAGE + MAINTENANCE, AND WASTE.

**THE CARBON COST OF TRAVELLING ON LONG-HAUL FLIGHTS IS A LOWER FIGURE ON AVERAGE PER KILOMETRE BECAUSE OF THE HUGE AMOUNT OF EMISSIONS GIVEN OFF DURING TAKE-OFF AND LANDING.

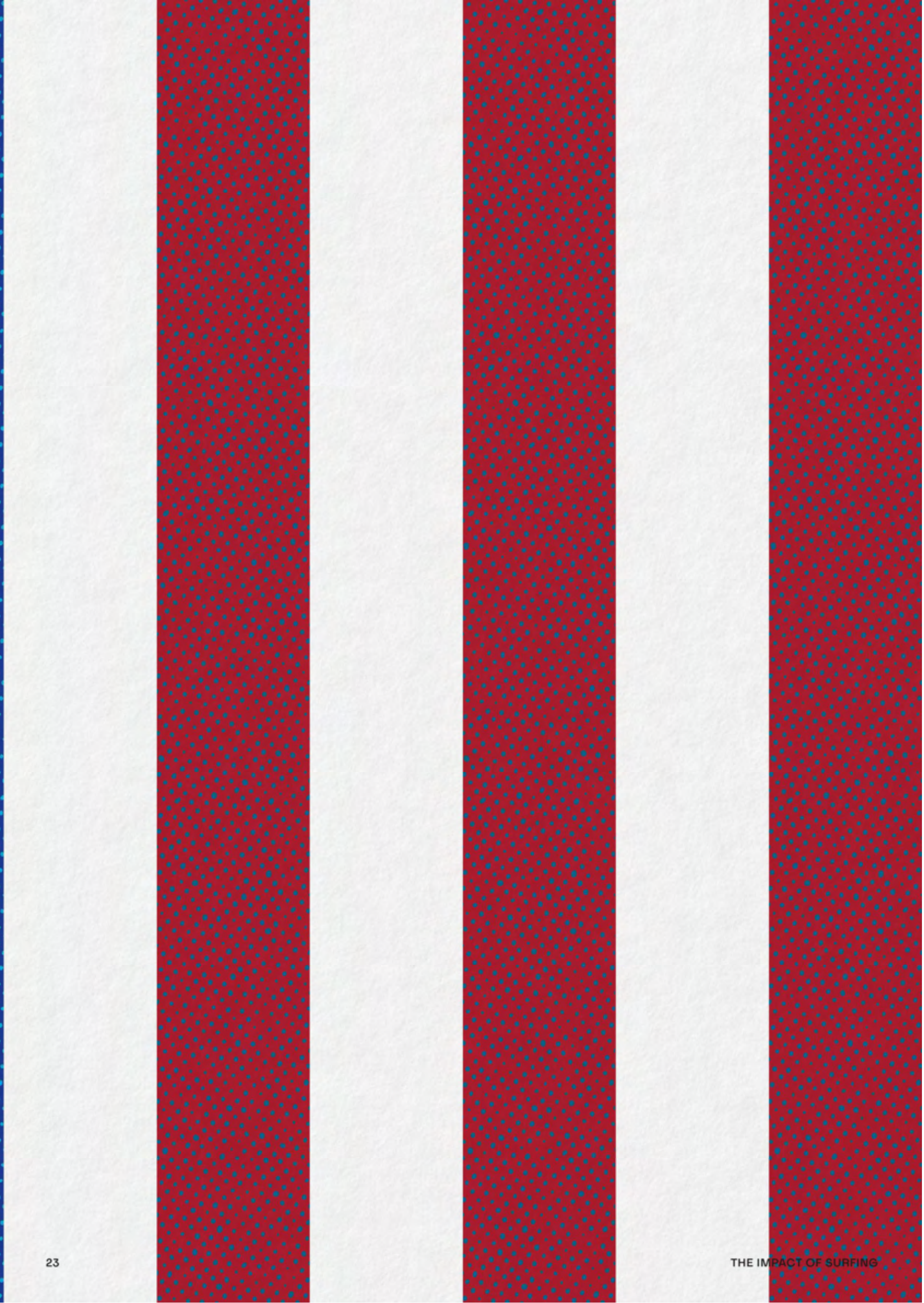
***BASED ON TYPICAL 180W HOUSEHOLD FRIDGE RUNNING FOR 1500 HOURS (POWER VARIES DEPENDING ON FRIDGE BEING OPEN/CLOSED)

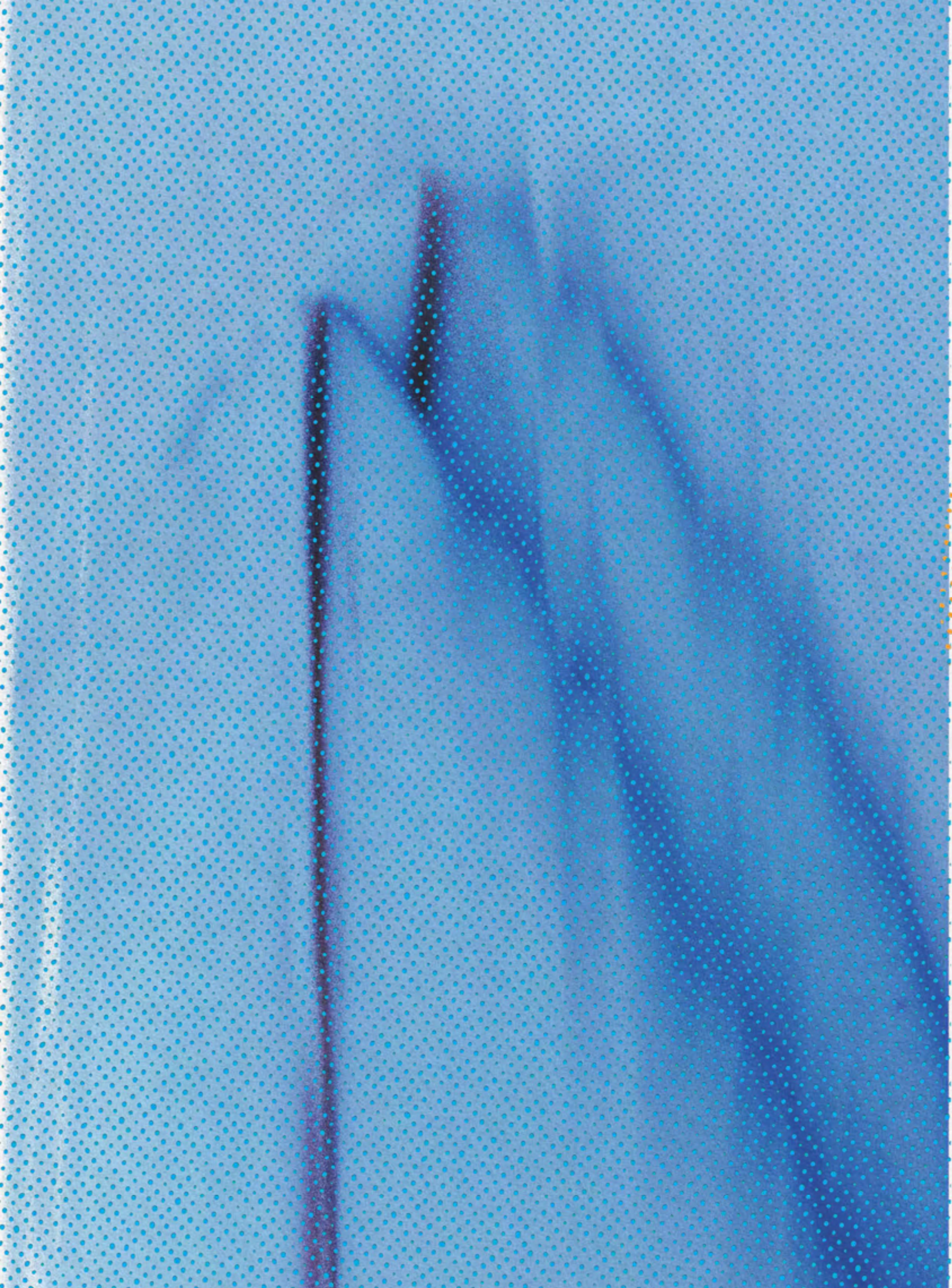
****BASED ON A TYPICAL SHORTBOARD CONTAINING 35 LITRES OF EPS FOAM. ONE OLYMPIC SWIMMING POOL = 2.5 MILLION LITRES

07

THE IMPACT OF SURFING

APPROXIMATELY **500,000 NEW SURFBOARDS** ARE SOLD EACH YEAR AROUND THE GLOBE, WITH ROUGHLY HALF THAT NUMBER BEING SOLD IN THE USA

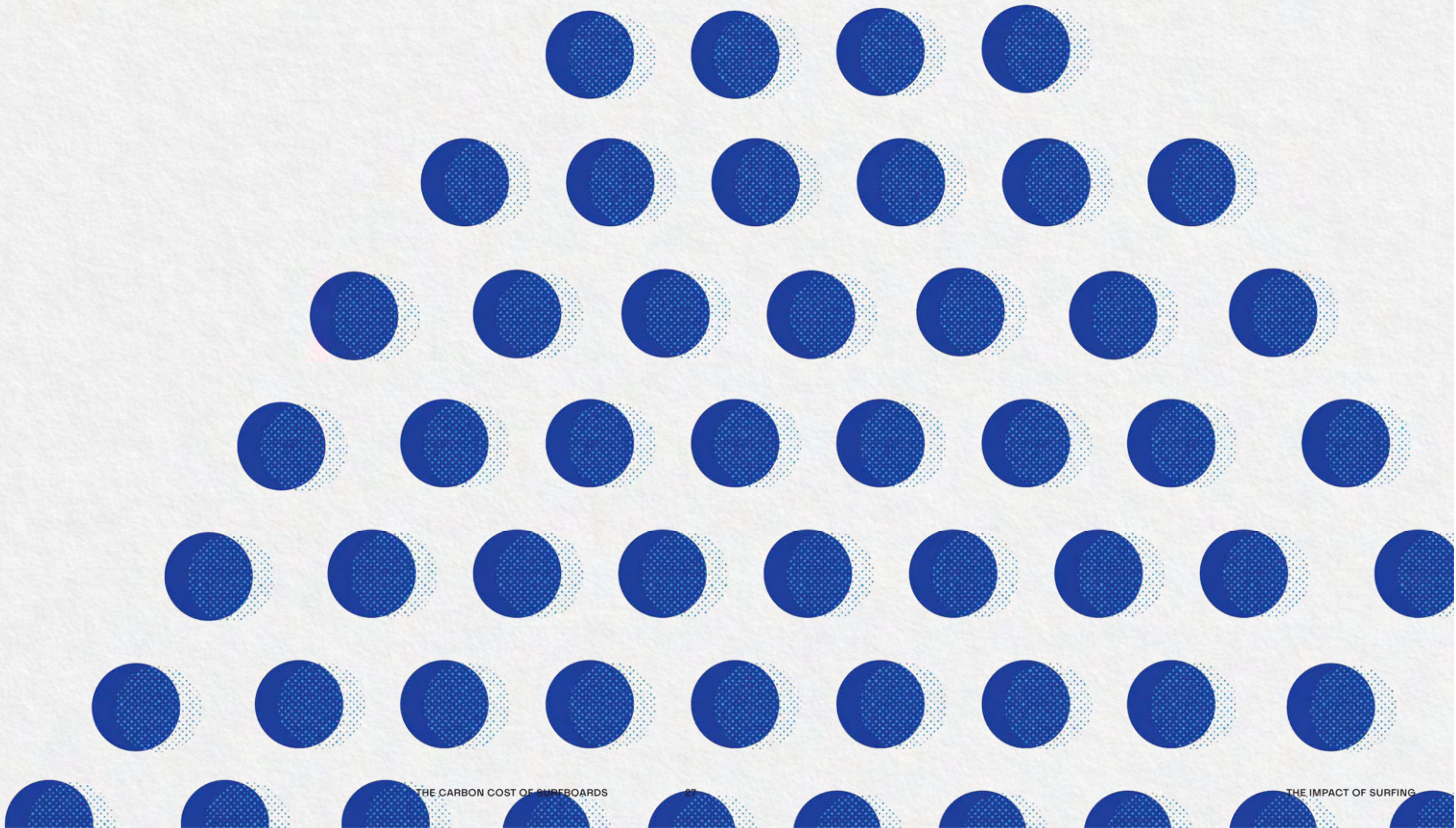




THE GLOBAL SURF INDUSTRY IS WORTH US $2.7 BILLION (AU$3.95 BILLION) FOR THE YEAR 2022

ESTIMATES FOR THE BREAKDOWN OF POLYSTYRENE (ONE OF THE MAIN TYPES OF FOAM USED IN SURFBOARD BLANKS) RANGE FROM 500 TO **1 MILLION YEARS.**

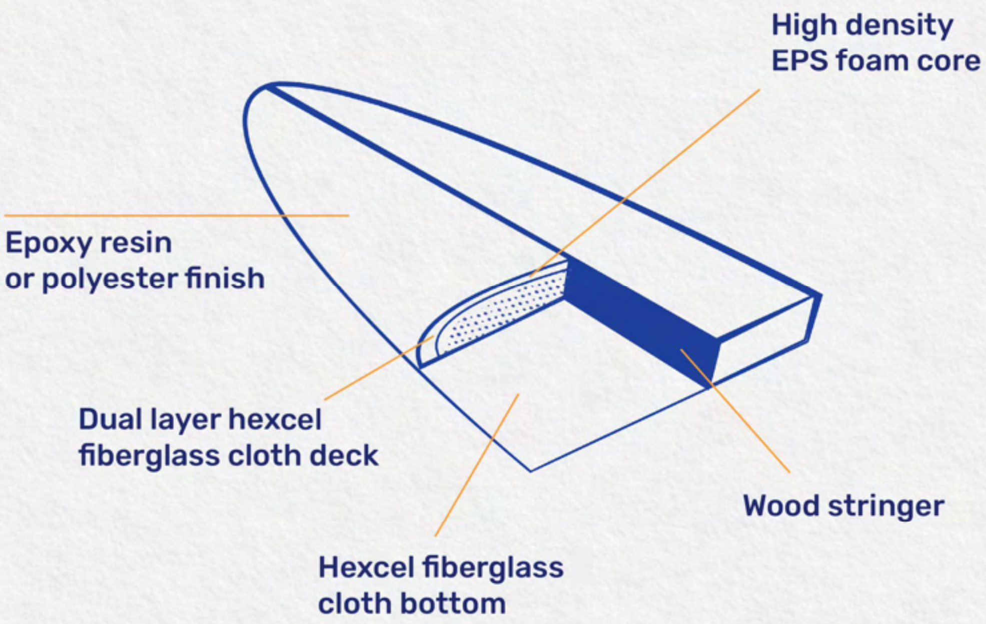
RATHER THAN DEGRADE, IT BREAKS INTO PIECES, WHICH IS OFTEN WORSE BECAUSE THOSE SMALL PIECES (OR MICROPLASTICS) WILL **SPREAD FAR AND WIDE.**



SURFBOARDS ARE NOTORIOUSLY DIFFICULT TO TAKE APART FOR RECYCLING.

THE FOAM BLANK (OR CORE) OFTEN CONTAINS A CENTRAL TIMBER SUPPORT PIECE CALLED A STRINGER.

THE OUTER FINISH OF POLYESTER OR EPOXY RESIN HAS FIBREGLASS CLOTH SET WITHIN IT, AND A SURFBOARD TYPICALLY HAS FIN BOXES AND A LEASH PLUG FIXED WITH GLUE AND ALSO SET WITHIN THE RESIN.



ONCE BROKEN OPEN AND THEY BEGIN TO FALL APART, MODERN SURFBOARDS ARE AN ENVIRONMENTAL DISASTER DUE TO THE PETROLEUM–BASED MATERIALS AND SHEER VOLUME OF THEM.

EVEN SURF WAX, TYPICALLY PARAFFIN–BASED, IS HARMFUL ONCE IT ENTERS THE OCEAN AS IT CLOGS REEFS AND IS MISTAKENLY EATEN BY MARINE LIFE.

08 SOLUTIONS

Going forward, if you're reading this and working in the surfing industry, here are some questions to ask yourself that could help reduce your emissions and overall carbon footprint.

1.0

Could you look to introduce locally sourced materials and even set-up (or share) an onshore/local manufacturing facility?

1.1

How about sourcing alternative materials that replace any existing petroleum-based, harmful substances. Natural materials such as paulownia, cork, bamboo, balsa wood, and even next-gen materials such as mycelium or algae. At the very least, look to include recycled content rather than using raw, virgin materials from non-renewable sources.

1.2

Can you reassess your product's packaging and look to reduce it or replace the harmful materials being used? Plastic can be replaced with cardboard, for example.

1.3

Is your product easy to recycle?
Can the number of parts and/or types of materials be reduced so that it avoids being a recycling nightmare? Some sports equipment, such as running shoes, are now being made with just one type of material. Adidas have developed a shoe made from only one type of Thermoplastic Polyurethane that can be recycled upon return.

1.4

Could you explore a leasing model, where users rent your product and return it once they've finished using it or when it breaks? The manufacturer can then reuse or recycle those materials, and in the worst case scenario, can dispose of them safely. The definition of a circular production facility.

1.5

This next one appeals to the users as well as the manufacturers. Can you look to reduce the carbon footprint of the lifetime usage and maintenance of your product? Fix your own surfboard, take care of it, and extend its life. Reduce the amount of toxic wax you use by buying cork traction panels. Reduce the frequency and distance of travel that's associated with surfing. Pass on unused/broken surfboards to those looking to learn to surf, or transform it into an art project, and do whatever it takes to avoid sending it to landfill.

1.6

For any unavoidable emissions, look to become carbon neutral with a provider such as Carbonhalo.
www.carbonhalo.com ↵
Offset your emissions with verified carbon credits that fund emissions reductions projects across the globe.

1.7

For more ideas and inspiration, visit www.wavechanger.org to access our learning resources; including podcast, blog and further research projects. Our mission is to lead the surf community to embrace sustainable solutions and reduce the environmental impact of surfing.

09 APPENDIX

All EF not stated below	The Integrated Carbon Metrics (ICM) Embodied Carbon Life Cycle Inventory Database, "Wiedmann, T., Teh, S. H. and Yu, M. (2019) ICM Database - Integrated Carbon Metrics Embodied Carbon Life Cycle Inventory Database"
Fibreglass Layers	https://www.boardcave.com.au/information/surfboard-glass
Resin Chart	https://cdn.shopify.com/s/files/1/0689/1441/files/Surfboard_Glassing_Resin_Amounts_Per_Board_Length.pdf?7799691258 253686780
Catalyst Chart	https://cdn.shopify.com/s/files/1/0689/1441/files/Surfboard_Glassing_Resin_Amounts_Per_Board_Length.pdf?7799691258 253686780
PU foam density	https://cdn.shopify.com/s/files/1/2994/9530/files/Surfblanks _Density_Chart_2014.pdf?2360690609765356245
PU resin density	https://allnexproductseu.blob.core.windows.net/products/40/ 2d3d7a859f5d4316887b-3350b821e5b0/2021-08-25/POLYPLE X-SURF-BOARD-LAMINATING-RESIN_EN_A4.pdf
PU rubber cord density	https://www.gteek.com/Polyurethane-rubber-cord
Epoxy Resin density	https://shapers.com.au/content/Kinetix%20R110X%20surfboa rd.pdf
MEKP density	https://www.amcsupplies.com.au/wp-content/uploads/MEKP -Catalyst-SDS-1.pdf
PVC density	https://www.vynova-group.com/hubfs/02_Website_Pages/Pr oducts/PVC/Documents/vynova_polyvinylchloride_GB_rev010 0_2015-830.pdf?hsCtaTracking=1b4e11ef-1379-48c1-af73-2e0 7fcedcab6%7C53beaf85-8f40-4c2c-bbcb-71dd2f-9547bc
Fibreglass Fin layers	https://greenlightsurfsupply.com/pages/i-wan-to-make-fins-d o-you-know-how-make-layers-of-fiberglass-cloth-are-required- to-get-the-right-thickness-so-the-base-will-be-thick-enough-to -go-into-a-normal-fin-single-fin-base-also-how-much-resin
Surfboard Construction	https://greenlightsurfsupply.com/pages/green-light-surfboard- building-guide-page-3
Fin Data	https://www.surffcs.com.au/pages/fcs-fin-data
Carbon Fiber Density	https://www.opchealth.com.au/Content/Images/uploaded/P DFs/Carbon%20Fibre%20MSDS.pdf
EPS and XPS density	https://www.sanded.com.au/pages/core-basics
Stringer Size	https://surfblanksaustralia.com/pages/an-introduction-to-surf blanks-stringer-products
IXPE foam density	https://www.foamsales.com.au/products/polyethylene-roll
EVA foam density	https://www.foamsales.com.au/collections/polyethylene/pro ducts/eva-foam-sheets-sky-blue-colour
Epoxy Resin EF (search for epoxide resin)	https://www.carbonfootprint.com/factors.aspx
PVC EF	https://www.carbonfootprint.com/factors.aspx
EVA EF	https://www.alcas.asn.au/auslci-emissions-factors
Carbon Fiber EF	Suzuki, T., & Takahashi, J. (2005, November). Prediction of energy intensity of carbon fiber reinforced plastics for mass-produced passenger cars. In Proceedings of 9th Japan International SAMPE Symposium (pp. 14-19).
Neoprene density	https://www.landscapepros.com/wp-content/uploads/2021/0 1/Neoprene-SDS.pdf

Hypalon density	https://irp-cdn.multiscreensite.com/d4974b4a/files/uploaded /Chang%20Rubber%20-%20MSDS%20Hypalon%20Rubber%20 Sheet%20THHPL135665.pdf
Fibreglass waste EF	https://www.climatiq.io/explorer
Balsa Density	https://www.woodsolutions.com.au/wood-species/hardwood /balsa#:~:text=Balsa%20wood%20is%20the%20lightest.Baltic %20pine%20(Pinus%20sylvestris)
Plywood Density	https://www.australply.com.au/technical/characteristics#:~:te xt=Density%20and%20species%20of%20timber.-The%20densi ty%20of&text=The%20density%20of%20pine%20plywood.500 %20%2D%20650%20kg%2Fm3.
Nylon Waste EF (assumed as textiles)	https://www.alcas.asn.au/auslci-emissions-factors
Steel Waste EF	https://www.climatiq.io/explorer
Cardboard Emissions	https://www.climatiq.io/explorer
Cardboard Box Sizing	https://fefcobox.site/
Avg. Feight dist in Aus	https://www.freightaustralia.gov.au/sites/default/files/docum ents/commodity-report--vehicles.pdf
Road Freight EF	https://www.climatiq.io/explorer
Sea Freight EF	https://www.webcargo.co/knowledge-base/tools/freight-co2-emissions-calculator/
Cardboard Size Calc	https://fefcobox.site/

Appliance EF	https://www.digitaltechnologieshub.edu.au/media/huppewx4 /home-energy-use_calculating-ghg-emissions_electricial-appli ances.pdf
Surfboard repair quantity	https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.6 05.1046&rep=rep1&type=pdf
Surfwax EF	https://espace.library.uq.edu.au/data/UQ_28c5949/UQ28c59 49_OA.pdf?Expires=1661177871&Key-Pair-Id=APKAJKNBJ4MJ BJNC6NLQ&Signature=UQ3BjFiTOrhVqVN5tiul-QH4fRQMV0LN RyqSTwEExFcz4EaoL3fOR2UN-R2IGg3rbfLoWttZTIXqkBJp9la4P0 XYaYC2khxqjaz-tyP71QJSL~zsXVYloiiJaegi-j7GFqdVMP8nosGQ2l ulZrXAmkol8OfjTHyLeOocpdTOXf~lvCWK6mxVLd-fwnKD00~5Z PR7FR04z6lKsUPMnSC-K2kXQ9M-Rrekq-G0vsnK1GQwxtAxaJ88 a2XRDh77ahFa-Mo~0hSWrKFASglT0s4QSeoqaFlwCYD4Ale4hv3 7kiKjmQlMobiGmMPTA1bbClpE3j2n080kb1Z3yNVaL-paCFMPV 5HfQ__
Car EF	https://www.ntc.gov.au/transport-reform/light-vehicle-emissi ons

Analysis of the construction process of typical 6ft shortboard. Hand shaped, CNC machine, and glassing/laminating stages. Data calculated by Carbonhalo.

Carbon emissions measured as metric tons of carbon dioxide equivalent (CO_2e)

Standard 6ft Board – Construction process by Hand

Activity	Time	Average time (hours)	Watts	Power Consumption kWh	Emmissions CO2e
a. Computer for board design	20-30min	0.42	250	0.10	0.08
b. Hand Shaping using an Electric Plainer	2-3hrs	2.5	700	1.75	1.40
c. Sand Paper by hand	1hr	1			0.00
d. Air conditioner running for entire process (also doubles as an air filter / extraction)	4hrs	4	1000	4	3.20
e. Vacuum cleaner	10min	0.17	1400	0.23	0.19
f. Shaping bay will have lighting running also the entire time (LED) 4 light banks	4hrs	4	20	0.08	0.06
g. Estimated time for total construction including shaping	4hrs	4			
Allowance for board size increments for every ft increase in size.	30min	0.5			

Standard 6ft Board – Construction process by CNC Machine

Activity	Time				Emissions
a. Computer for board design	20-30min	0.42	250	0.10	0.08
b. CNC Machining (Model AKU) or (APS 3000)	15-20min	0.3	6160	2.05	1.64
c. Final shaping post CNC = Hand Sand	1hr	1		0.25	0.20
d. Air conditioning running for entire process	2hrs	2	1000	2	1.6
e. Estimated time for total shaping	2hrs	2			

Standard 6ft Board – Glassing after shaping

Activity	Time				Emissions
a. Glassing each side (2 sides)	30min each side	1		1.02	0.816
b. Curing time	1-3 hrs	2		2.04	1.632
c. Clean up edges and laps	30min - 1hr	0.8		0.77	0.612
d. Hot coat each side (2 sides)	10-15min each side	0.25		0.26	0.204
e. Sanding hot coat	45min - 1hr	1		1.25	1.002666667
f. Estimated total time for glassing 3 – 3.5hrs (excludes curing time)	3.5hrs	3.5			
Allowance for board size increments for every ft increase in size.	15min	0.25			
Electrical EF kg CO2/kWh	0.8				

	6ft	7ft	8ft	9ft
Hand Shape	4.93	7.40	12.34	19.74
Machine Shape	3.53	3.53	3.53	3.53
Glass	4.27	5.33	6.40	7.47
Hand Shape & Glass	**9.20**	**12.73**	**18.74**	**27.20**
Machine Shape & Glass	**7.80**	**8.86**	**9.93**	**11.00**

Carbon emissions measured as metric tons of carbon dioxide equivalent (CO_2e)

Product Stage			Construction Stage		Use Stage							End-of-life Stage				Benefits beyond system boundary
RAW MATERIAL SUPPLY	TRANSPORT	MANUFACTURING	TRANSPORT	CONSTRUCTION-INSTALLATION PROCESS	USE	MAINTENANCE	REPAIR	REPLACEMENT	REFURBISHMENT	OPERATIONAL ENERGY USE	OPERATIONAL WATER USE	DECONSTRUCTION DEMOLITION	TRANSPORT	WASTE PROCESSING	DISPOSAL	REUSE, RECOVERY, RECYCLING POTENTIAL
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D

Analysis of typical lifetime maintenance and usage of 6ft, 7ft and 8ft surfboards. Data calculated by Carbonhalo.

Carbon emissions measured as metric tons of carbon dioxide equivalent (CO_2e)

Dings			
Component	Quantity (Polyester Lamination)	Quantity (Epoxy Lamination)	Unit
4oz Fiberglass	8.36E-02	8.36E-02	m^2
Resin	5.44E-04	5.06E-04	m^3
Catalyst	1.18E-05		m^3
Electrical Consumption	2.3	2.5	kWh
Emissions	5.48E+00	6.94E+00	kg

Wax	Quanity	Unit	
Wax block	0.1	kg	1 bar per application for shortboard + 1/4 block per ft
Number of wax applications	7		Once every 2 months of surfboard lifetime (~1year) + 1 block for fresh coat every surf
Basic Wax EF	0.718	kg/kg	

	6ft surfboard	**7ft surfboard**	**8ft surfboard**
Emissions	0.5026	0.62825	0.7539
Drivetime	Monthly	Weekly	Daily
Use freq	12	50	250
Avg Dist	30	15	6
Passenger Car EF (kg/km)	0.1495		
Emissions	53.82	112.125	448.5

Avg Lifetime of board is ~1year

Breakdown of typical emissions of individual surfboard components. Data calculated by Carbonhalo.

Data based on a traditional 6'0" shortboard

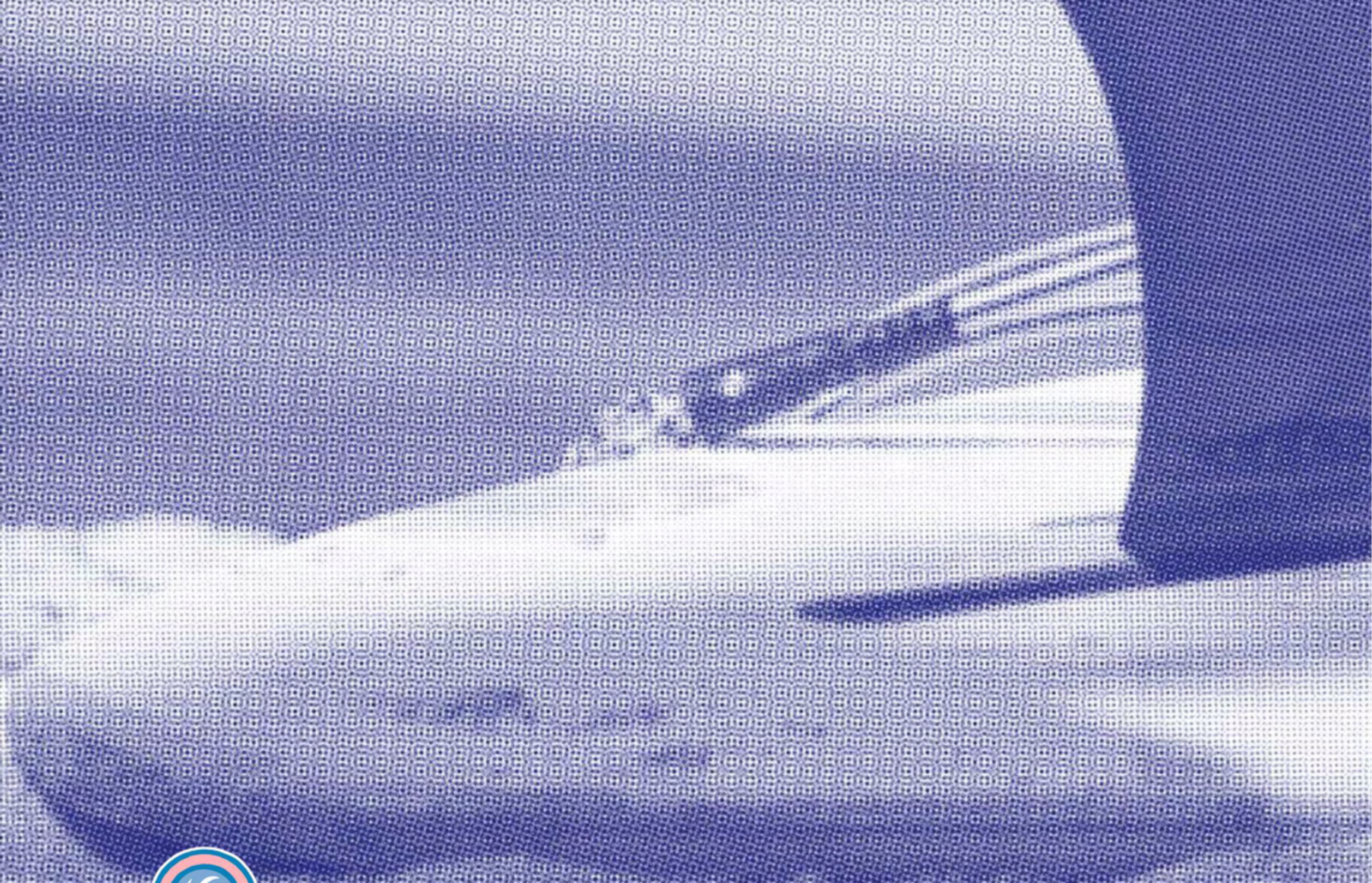
Blank Width	22 5/8
Blank Thickness	3.875
Number of Stringers	1
Number of Fins	3

Board Component	Component Information	Component Types	Materials	Material Information	Density (kg/m^3)	CO2 emmisions factors (CO2 kg/kg)	Waste CO2 emissions factor	Width (m)	Thickness (m)	Volume (m^3)	Mass (kg)	Waste Modifier	Multiplier	Usable Emissions for Component	Waste Emissions for Components	Uncertainty Factor %	Material Emissions	Shipping Location	Material Packaging	Material Packaging Quantity & Requirement	Material Packaging Emission Factors	Transportation Emissions	Distribution Emissions	Final Disposal	Total Emissions for Component
Blank	Foam Core	Polyurethane blank	Polyurethane (PU)	Can use either type of resin	37	4.73	0.1146	0.574675	0.098425	0.0000	0.0000	25%	1	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00944	0.73167	0.00000	0.007	0.000	0.01
		Expanded Polystyrene blank	Expanded Polystyrene (EPS)	Can only use epoxy resin	28	4.78	0.139	0.574675	0.098425	0.0000	0.0000	25%	1	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00944	0.73167	0.00000	0.007	0.000	0.01
		Extruded Polystyrene blank	Extruded Polystyrene (XPS)	Can only use epoxy resin	32	4.78	0.139	0.574675	0.098425	0.0000	0.0000	25%	1	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00944	0.73167	0.00000	0.007	0.000	0.01
Soft-top Deck	Soft cover for Soft-tops	IXPE Deck	IXPE Foam	Not Required	30	2.01	0.132	1	0.005	0.0000	0.0000	15%	0	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00000	0.73167	0.00000	0.000	0.000	0.00
		EVA Deck	EVA Foam	Not Required	30	2.88	0.1	1	0.005	0.0000	0.0000	15%	0	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00000	0.73167	0.00000	0.000	0.000	0.00
Soft-top Bottom	Hard undershell for Soft-tops	Hard Undershell	HDPE sheet	Not Required	940	2.01	0.132	1	0.0005	0.0000	0.0000	15%	0	0.00	0.00	0.000	0.000	China	Cardboard	0.00000	0.73167	0.00000	0.000	0.000	0.00
Stringer	Rigid piece that runs down the centre of the board. Shortboards generally only have 1 stringer. EPS blanks do not require stringers.	Balsa Stringer	Balsa		160	75.6	0.0144	0.004	0.098425	0.0000	0.0000	30%	1	0.00	0.00	0.000	0.000	China	Timber pallet	0.00002	0.00000	0.00000	0.000	0.000	0.00
		Plywood Stringer	Pine Plywoood		600	1,200	0.0144	0.004	0.098425	0.0000	8.6598	30%	1	0.00	0.04	0.000	0.037	Aus	Timber pallet	0.00002	75.56443	0.00000	0.001	0.000	0.04
		PU Stringer	High density PU		48	4.73	0.1146	0.004	0.098425	0.0000	0.0000	30%	1	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00008	0.73167	0.00000	0.000	0.000	0.00
		EPS Stringer	High density EPS		48	4.78	0.139	0.004	0.098425	0.0000	0.0000	30%	1	0.00	0.00	0.000	0.000	Aus	Cardboard	0.00008	0.73167	0.00000	0.000	0.000	0.00
		PVC Stringer	PVC		1400	3.1	0.0775	0.004	0.098425	0.0000	0.0000	30%	1	0.00	0.00	0.000	0.000	China	Cardboard	0.00008	0.73167	0.00000	0.000	0.000	0.00
Lamination	Seals the blank with fibreglass cloth and resin, uses either polyester or epoxy resin.	Polyester (PE) Lamination	4oz Fiberglass	2 layers on top, 1 layer underneath	0.1356228	3.45	0.0220462199	N/A	0.6858	N/A	0.0000	15%	1	8.42	0.95	2.525	11.893	Thailand	Cardboard	0.00000	0.73167	0.00000	0.083	0.142	12.12
			6oz Fiberglass	Not Required	0.2034342	3.45	0.0220462199	N/A	0.6858	N/A	0.0000	15%	0					Thailand	Cardboard	0.00000	0.73167	0.00000			
			Polyester (PE) Resin	Requires UV light or MEKP as a catalyst	1100	5.97	0.1	N/A	N/A	0.0014	1.5615	10%	1					China	Metal Can	0.00257	2.55888	0.07273			
			Methyl Ethyl Ketone Peroxide	Require 1% of PE resin volume in lamination	1170	1.8	0.1	N/A	N/A	0.0000	0.0166	10%	1					China	HDPE container	0.00017	2.14200	0.00303			
		Epoxy Lamination	4oz Fiberglass	2 layers on top, 1 layer underneath	0.1356228	3.45	0.0220462199	N/A	0.6858	N/A	0.0000	15%	1	12.38	1.40	3.714	17.493	Thailand	Cardboard	0.00000	0.73167	0.00000	3.641	0.217	21.35
			6oz Fiberglass	Not Required	0.2034342	3.45	0.0220462199	N/A	0.6858	N/A	0.0000	15%	0					Thailand	Cardboard	0.00000	0.73167	0.00000			
			Epoxy Resin	Does not require catalyst	1700	5.7	0.1	N/A	N/A	0.0014	2.4132	10%	1					China	HDPE container	0.00234	2.14200	3.63638			
Topcoat	Final coat to saturate the fiberglass cloth and fill gaps in the weave. Hotcoat only used with polester lamination and sealcoat only used for epoxy lamination	Hotcoat	Polyester (PE) Resin		1100	5.97	0.1	N/A	N/A	0.0009	0.9759	10%	1	5.27	0.60	1.581	7.447	China	Metal Can	0.00161	2.55888	0.04546	0.053	0.089	7.59
			Methyl Ethyl Ketone Peroxide	Require ~1.6% of PE resin lamination volume	1170	1.8	0.1	N/A	N/A	0.0000	0.0166	10%	1					China	HDPE container	0.00011	2.14200	0.00303			
		Sealcoat	Epoxy Resin	Does not require catalyst	1700	5.7	0.1	N/A	N/A	0.0009	1.5082	10%	1	7.74	0.87	2.321	10.933	China	HDPE container	0.00147	2.14200	2.27274	2.276	0.136	13.34
Fins	Shortboards generally three fins	Fibreglass Fins	6oz Fiberglass	Tri fins ~26 layers. Single/Longboard ~36 layers	0.2034342	3.45	0.0220462199	0.00244	N/A	0.0008	0.0674	50%	3	3.84	3.93	1.153	8.926	China	Cardboard	0.00019	0.73167	0.02041	0.021	0.061	9.01
			Polyester (PE) Resin	Requires UV light or MEKP as a catalyst	1100	5.97	0.1	N/A	N/A	0.0004	0.3904	50%	3												
			Methyl Ethyl Ketone Peroxide	Require 1% of PE resin volume in lamination	1170	1.8	0.1	N/A	N/A	0.0000	0.0042	50%	3												
		Carbon Fibre Fins	Carbon Fibre		2000	1.67	0.1	0.00635	N/A	0.0001	0.1619	50%	3	5.54	5.70	1.663	12.906	China	Cardboard	0.00019	0.73167	0.02041	0.021	0.114	13.04
			Epoxy Resin		1700	5.7	0.1	N/A	N/A	0.0004	0.6033	50%	3												
		Resin Composite Fins	6oz Fiberglass	2 Layers either side of core	0.2034342	3.45	0.0220462199	0.00244	N/A	0.0001	0.0104	50%	3	1.11	1.13	0.332	2.571	China	Cardboard	0.00019	0.73167	0.02041	0.021	0.019	2.61
			Polyester (PE) Resin	Requires UV light or MEKP as a catalyst	1100	5.97	0.1	N/A	N/A	0.0001	0.0976	50%	3												
			Methyl Ethyl Ketone Peroxide	Require 1% of PE resin volume in lamination	1170	1.8	0.1	N/A	N/A	0.0000	0.0010	50%	3												
			Polyurethane (PU)		37	4.73	0.1146	N/A	N/A	0.0007	0.0253	50%	3												
Leash		Leash	Polyurethane rubber cord		1200	4.73	0.1146	N/A	0.007	0.0000	0.0000	5%	1	0.58	0.04	0.175	0.796	China	Cardboard	0.00053	0.73167	0.01401	0.014	0.160	0.97
			Nylon Velcro Cuff	Cuff ~30cm	1140	8.29	0.96	0.04	0.002	0.0000	0.0274	5%	1												
			Neoprene Padding		1230	3.42	3.16	0.05	0.002	0.0000	0.0369	5%	1												
			Stainless Steel Swivel	One either end of leash	N/A	2.55	0.00888327	N/A	N/A	N/A	0.0065	5%	1												
			Nylon Velcro Rail Saver	Rail saver ~ 40cm	1140	8.29	0.96	0.025	0.002	0.0000	0.0228	5%	1												
			Hypalon Padding		1350	2.01	0.132	0.025	0.002	0.0000	0.0270	5%	1												
Leash Plug		Leash plug	Nylon		1140	8.29	0.96	0.03	0.014	0.0000	0.0113	5%	1	0.09	0.01	0.027	0.124	China	Cardboard	0.00003	0.73167	0.00022	0.000	0.010	0.13
			Stainless Steal		7500	2.55	0.00888327	0.003	0.021	0.0000	0.0011	5%	1												
Fin Inserts	Some fins can be join to the board duing lamination and do not need inserts	Plug	Nylon	2 per fin	1140	8.29	0.96	0.03	0.015	0.0000	0.0121	5%	6	0.57	0.00	0.171	0.743	China	Cardboard	0.00007	0.73167	0.00024	0.000	0.066	0.81
		Box	Nylon	1 per fin	1140	8.29	0.96	0.03	0.015	0.0001	0.0573	5%	3	1.35	0.00	0.406	1.760	China	Cardboard	0.00022	0.73167	0.00112	0.001	0.156	1.92

Carbon emissions measured as metric tons of carbon dioxide equivalent (CO2e)

IT'S ONLY RECENTLY WE'RE SEEING THAT THE TIDE IS CHANGING TO PAUSE, EVALUATE AND ASK – WHAT IS THE REAL COST OF SURFING?

COST BEYOND ECONOMICS, THAT CONSIDERS THE COST TO OUR LANDFILL SITES, COASTLINES, MARINE-LIFE AND AN INESCAPABLE SOCIAL RESPONSIBILITY OF THE SURFING INDUSTRY AND EVERY SURFER.



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