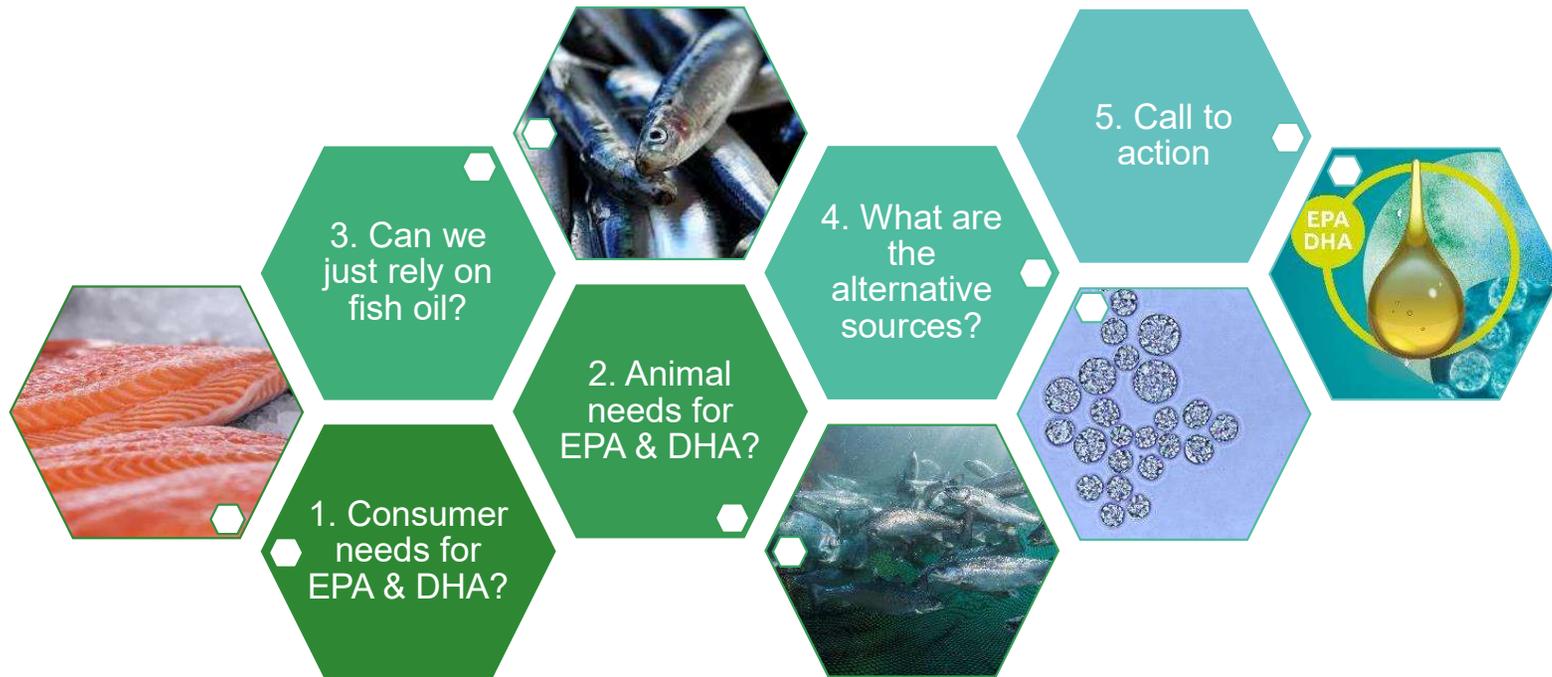


ALGAE-BASED PRODUCTS CONTAINING OMEGA-3 EPA AND DHA



Ian Carr, Veramaris
SeaFish ACIG Meeting, London
18 September 2019

Algae-based products containing Omega-3 EPA and DHA

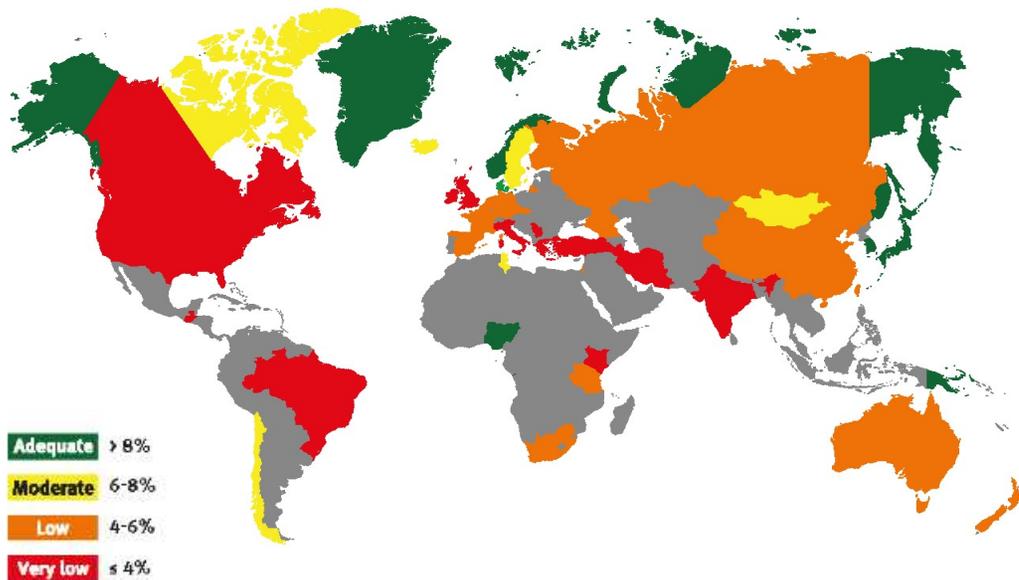


1. Consumer needs for EPA & DHA?



Omega-3 Index

Global EPA and DHA status map shows low levels for most of the world



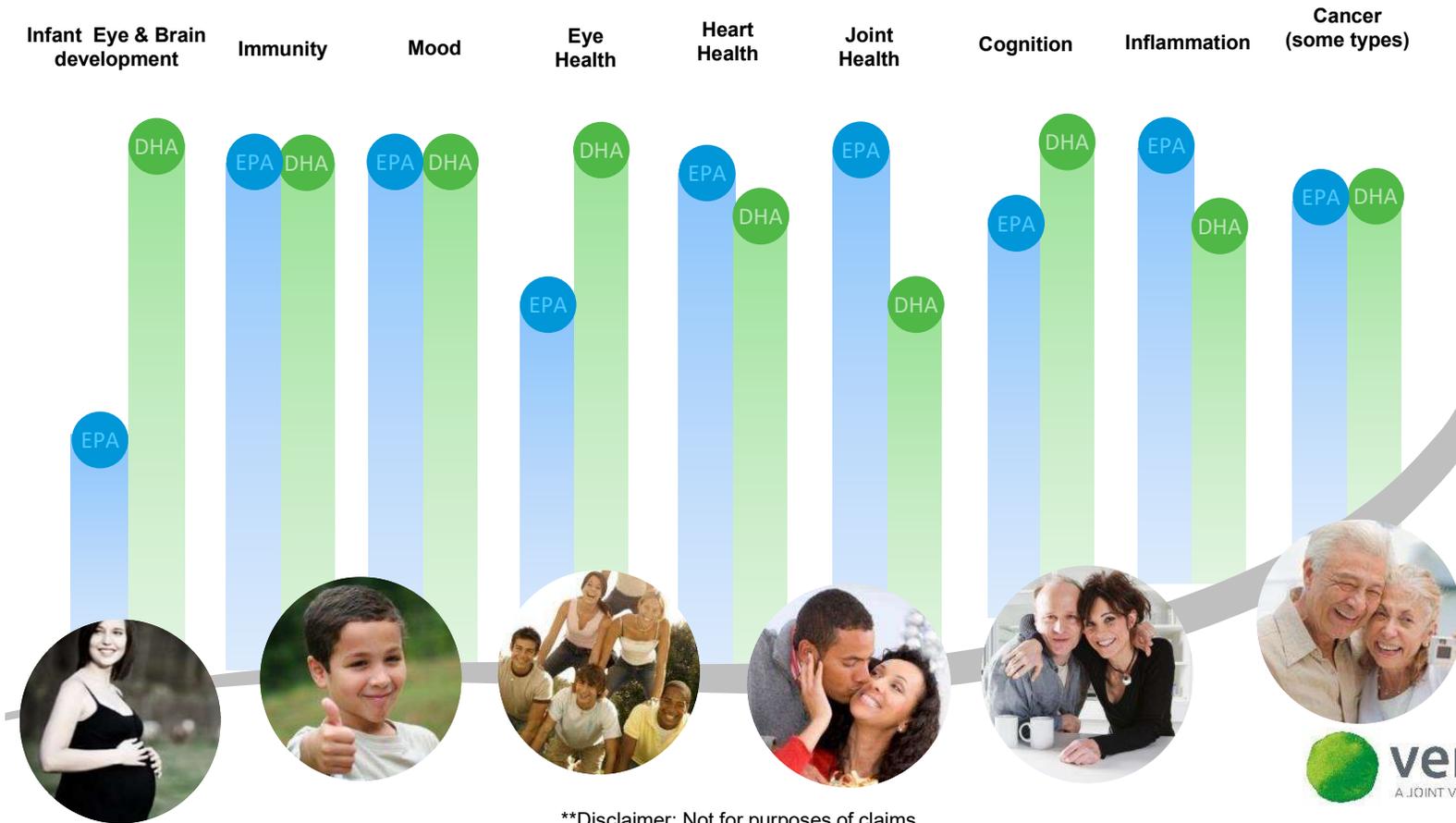
Low omega-3 levels are widespread – particularly in the Western World.

Coastal regions of countries and populations that traditionally rely on hunting, fishing and gathering for sustenance tend to have **moderate** to **adequate** omega-3 levels.

Source: Stark et al. (2016), Global survey of the omega-3 fatty acids, docosahexaenoic acid and eicosapentaenoic acid in the blood stream of healthy adults, Progress in Lipid Research

A lifetime of benefits

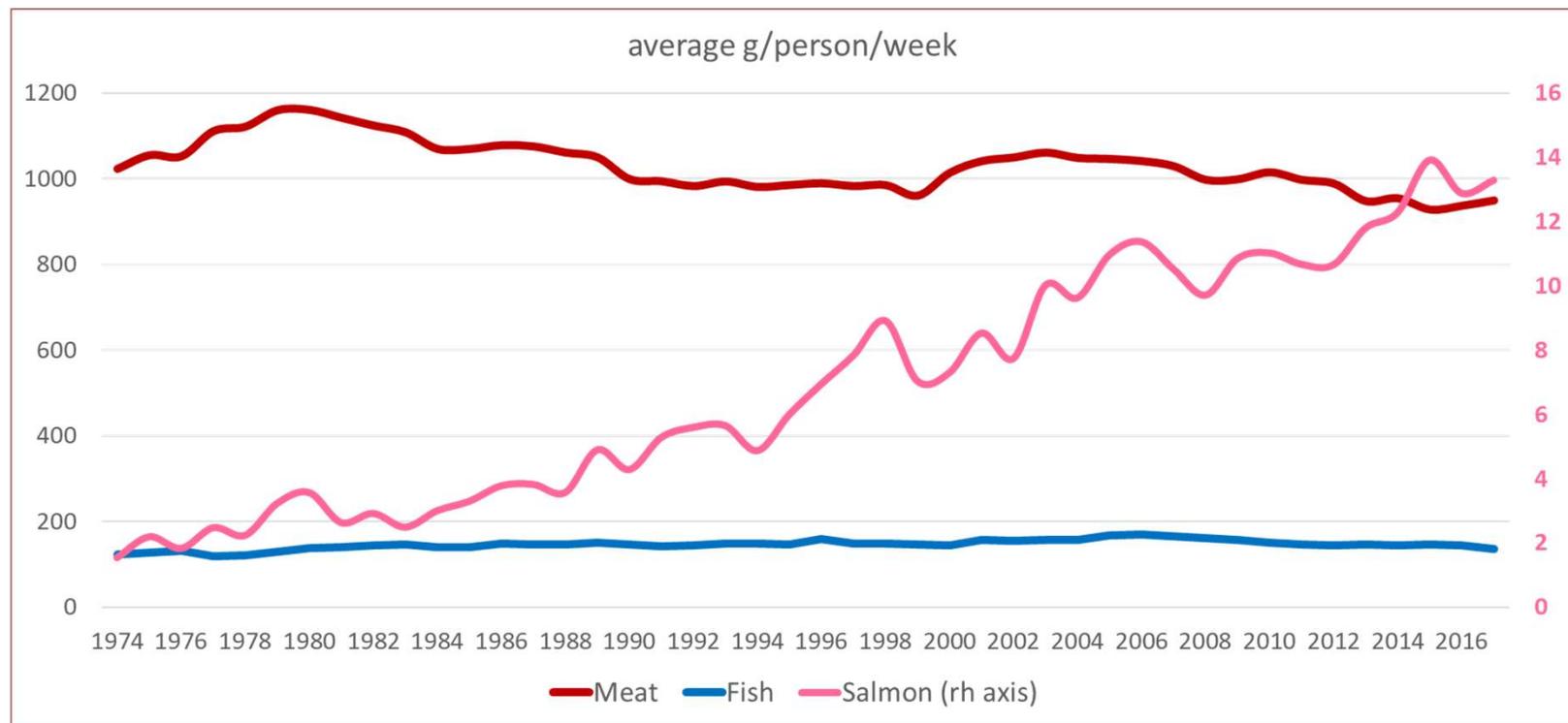
Omega 3 helps to ensure the health and welfare of people



**Disclaimer: Not for purposes of claims

Oceans of opportunity

UK in-home salmon consumption continues an upward path



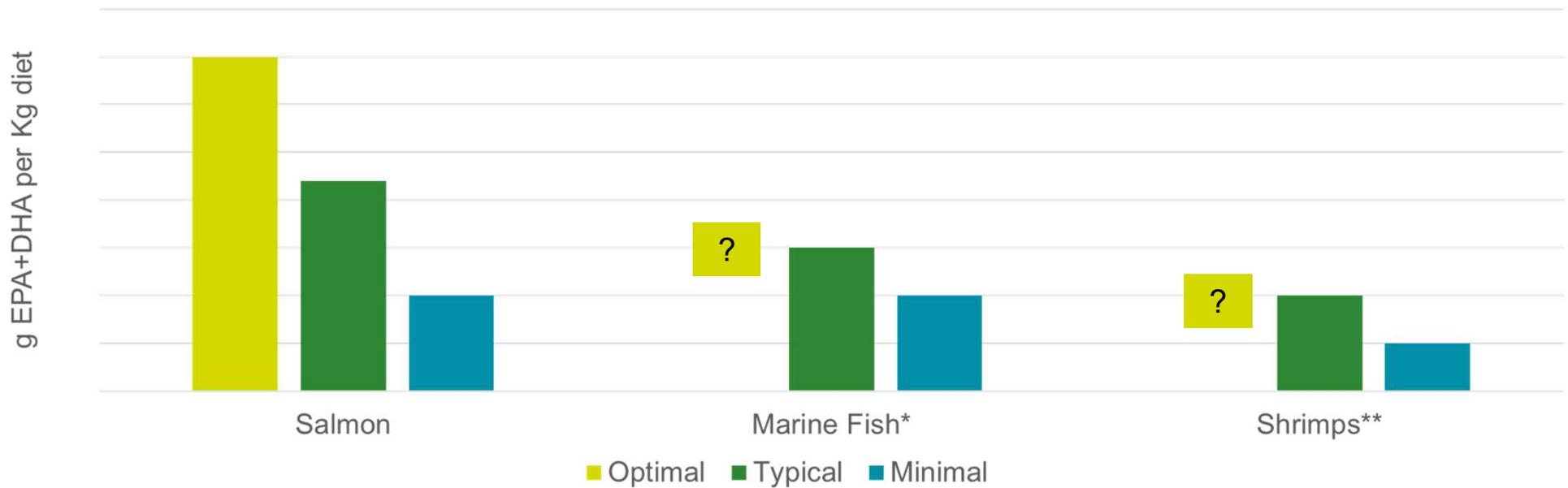
2. Animal needs for EPA & DHA?



HEALTHY FISH

Salmon, shrimp and marine fish all need EPA & DHA via the diet

Indicated EPA & DHA requirements for salmon, shrimp and marine fish



SOURCE: Veramaris internal review

*Nutritional requirements vary between marine fishes

**Typically higher for *monodon* than for *vannamei*

HEALTHY FISH

EPA & DHA needed to ensure health and welfare of farmed salmon

SCIENTIFIC REPORTS

OPEN Individual differences in EPA and DHA content of Atlantic salmon are associated with gene expression of key metabolic processes

Received: 14 November 2018
Accepted: 14 February 2019
Published online: 07 March 2019

Siri S. Horn^{1,2}, Anna K. Sonesson¹, Aleksei Krasnov¹, Hooman Moghadam³, Borghild Hillestad¹, Theo H. E. Meuwissen⁵ & Bente Ruyter¹



RESEARCH ARTICLE

Low levels of very-long-chain *n*-3 PUFA in Atlantic salmon (*Salmo salar*) diet reduce fish robustness under challenging conditions in sea cages

Marta Bou^{1,2*}, Gerd M. Berge³, Grete Baeverfjord³, Trygve Sigholt⁴, Tone-Kari Østbye¹ and Bente Ruyter^{1,2}

British Journal of Nutrition (2017), 117, 30–47
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doi:10.1017/S0007114516004396

Requirements of *n*-3 very long-chain PUFA in Atlantic salmon (*Salmo salar* L): effects of different dietary levels of EPA and DHA on fish performance and tissue composition and integrity

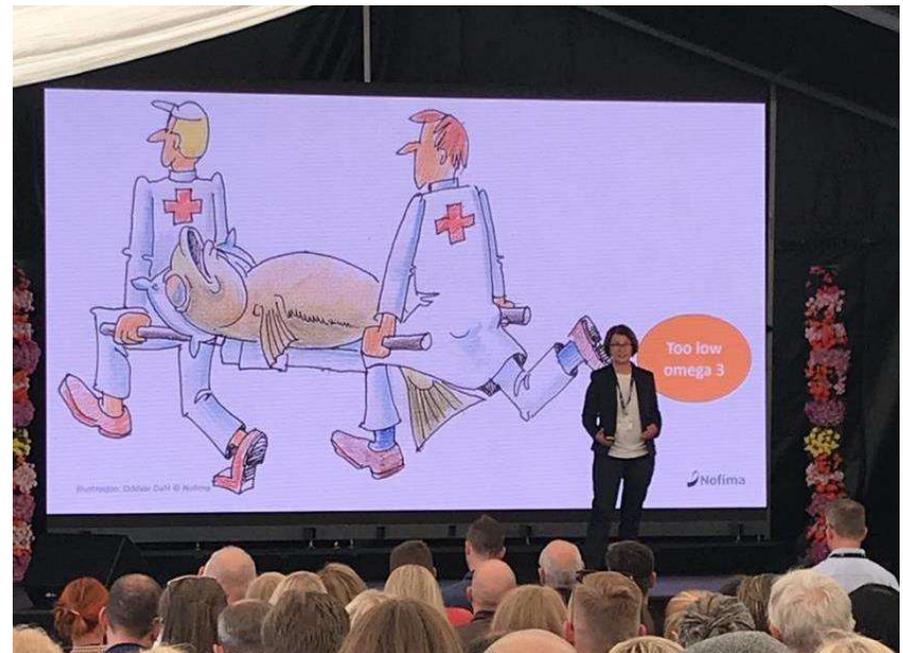
Marta Bou^{1,2*}, Gerd M. Berge³, Grete Baeverfjord³, Trygve Sigholt⁴, Tone-Kari Østbye¹, Odd Helge Romarheim⁵, Bjørn Hatlen³, Robin Leeuwis¹, Claudia Venegas⁶ and Bente Ruyter^{1,2}

- ✓ Growth
- ✓ Survival
- ✓ Immunity
- ✓ Reproduction
- ✓ Quality

HEALTHY FISH

What happens if there is not enough EPA & DHA in the diet of salmon?

- New results from study with Atlantic salmon at NOFIMA GIFAS facility
- Four low fishmeal diets tested
- Ranging 1% EPA+DHA to 3.5% EPA+DHA
- Fish grew from 400g to 5Kgs
- Benefits of higher omega-3 levels observed:
 - Higher average weight gain
 - Lower mortality during CMS challenge
 - Better welfare index (both internal and external)
 - Better colour
 - Less melanosis
- *Publication pending*

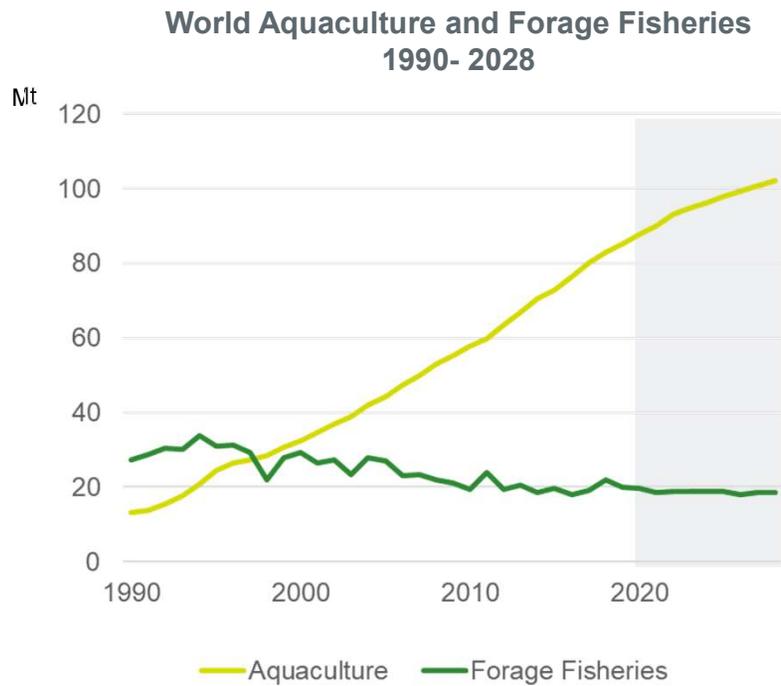


3. Can we just rely on fish oil?

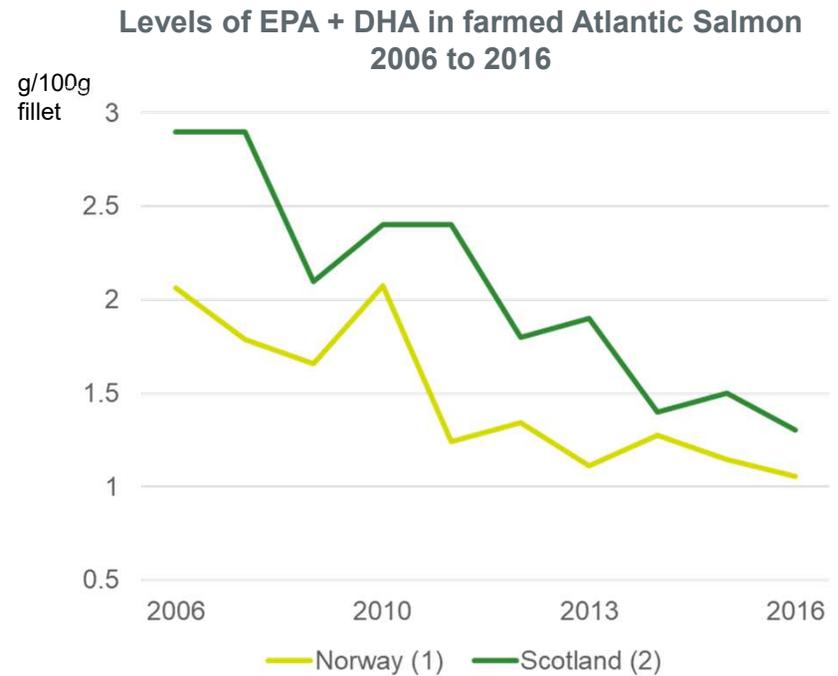


Supply and Demand Out of Balance

Limited fish oil is spread thinly across increasing volumes of aquafeed



Source:
OECD/FAO (2019)



Sources:
1) Seafood Data, NIFES
2) Sprague, M. et al. (2016).

MOWI Case Example

Continued dependency on marine raw materials

Does our salmon production deplete scarce marine resources?

Fish in- fish out (FIFO) express the number of kg of wild fish (excluding trimmings) it takes to produce 1 kg of salmon. The species used in fish meal and fish oil production are from reduction fisheries and trimmings not used for human consumption. In 2018 0.75 kg of low consumer preference wild fish (like anchovy and sardina) produced 1 kg of Atlantic salmon.



Marine raw materials

Our marine raw materials processed from whole fish will be sourced from suppliers who adhere to responsible fishery management practices and that are certified as sustainable (e.g. IFFO-RS or similar). Marine raw materials shall not origin from IUU catch or IUCN red listed fish species classified as endangered.

Where do our marine raw materials come from and are they from responsible and sustainable fisheries?

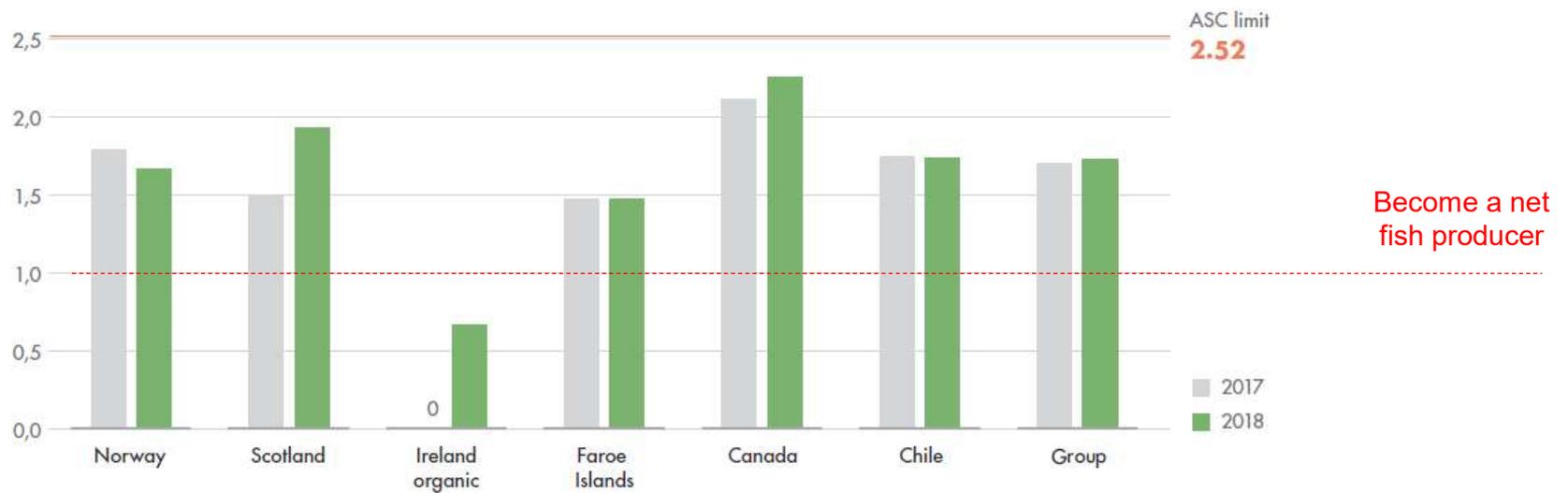
Fish meal	Species	Country of origin	Volume (t)	% of meal or oil used
Fishmeal, NE Atlantic	Blue whiting, capelin, Atlantic herring, North Sea herring, Norwegian spring spawning herring, sprat, pout, sandeel and trimmings from mackerel, capelin and herring	Faroe Islands, Iceland, Norway, Denmark	43 397	93.3%
Fishmeal, USA, menhaden	Gulf menhaden	USA	3 111	6.7%
Tot. fishmeal			46 508	100%

Fish oil	Species	Country of origin	Volume (tonnes)	% of total volume
Fish oil, Peru / Chile	Peruvian anchovy	Peru	2 971	8.2%
Fish oil, Turkey	European anchovy	Turkey	6 255	17.3%
Fish oil, Eastern Atlantic	Round sardinella, flat sardinella	Mauritania	8 147	22.6%
Fish oil, USA, menhaden	Gulf menhaden	USA	10 422	28.9%
Fish oil, NE Atlantic	Blue whiting, capelin, North Sea herring, Baltic herring, Norway pout, sprats and trimmings from mackerel, cod and herring	Iceland, Denmark	7 324	20.3%
Fish oil, refining by-product	Peruvian anchovy	Peru	1 004	2.8%
Total fish oil (tonnes)			36 123	100%

MOWI Case Example

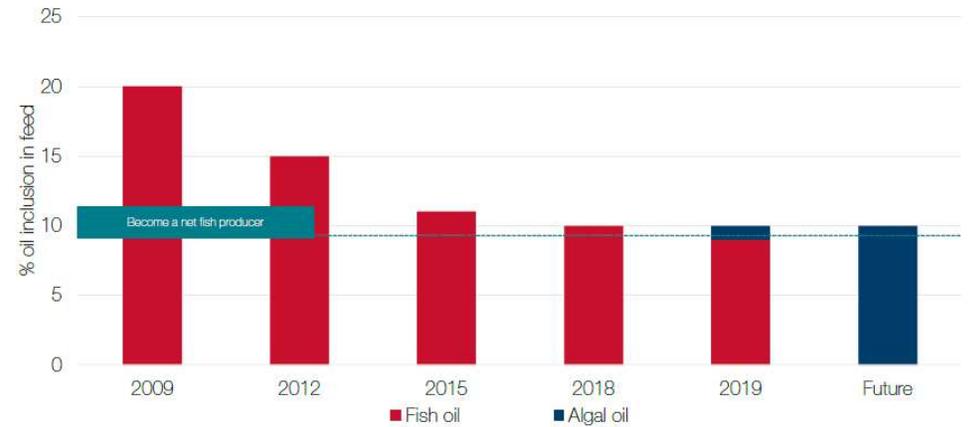
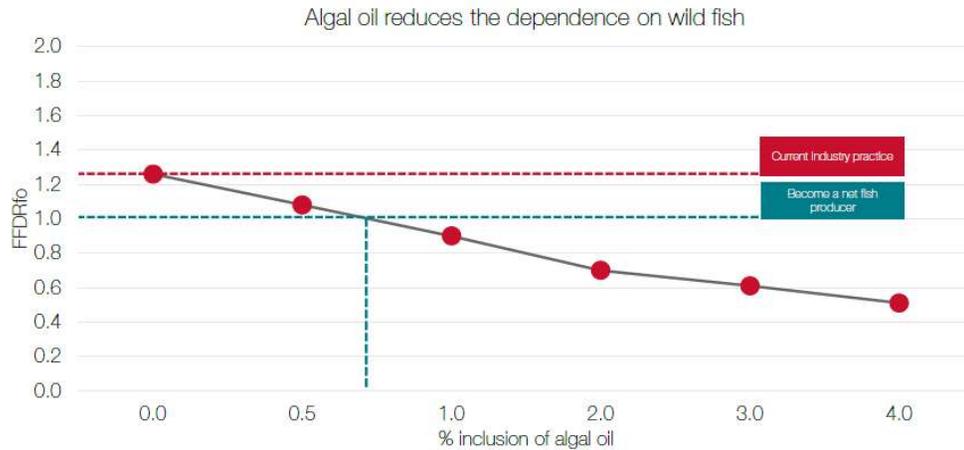
FFDRoil metric shows the extent of dependency on marine raw materials

Forage fish dependency ratio - oil
(Ex trimmings)



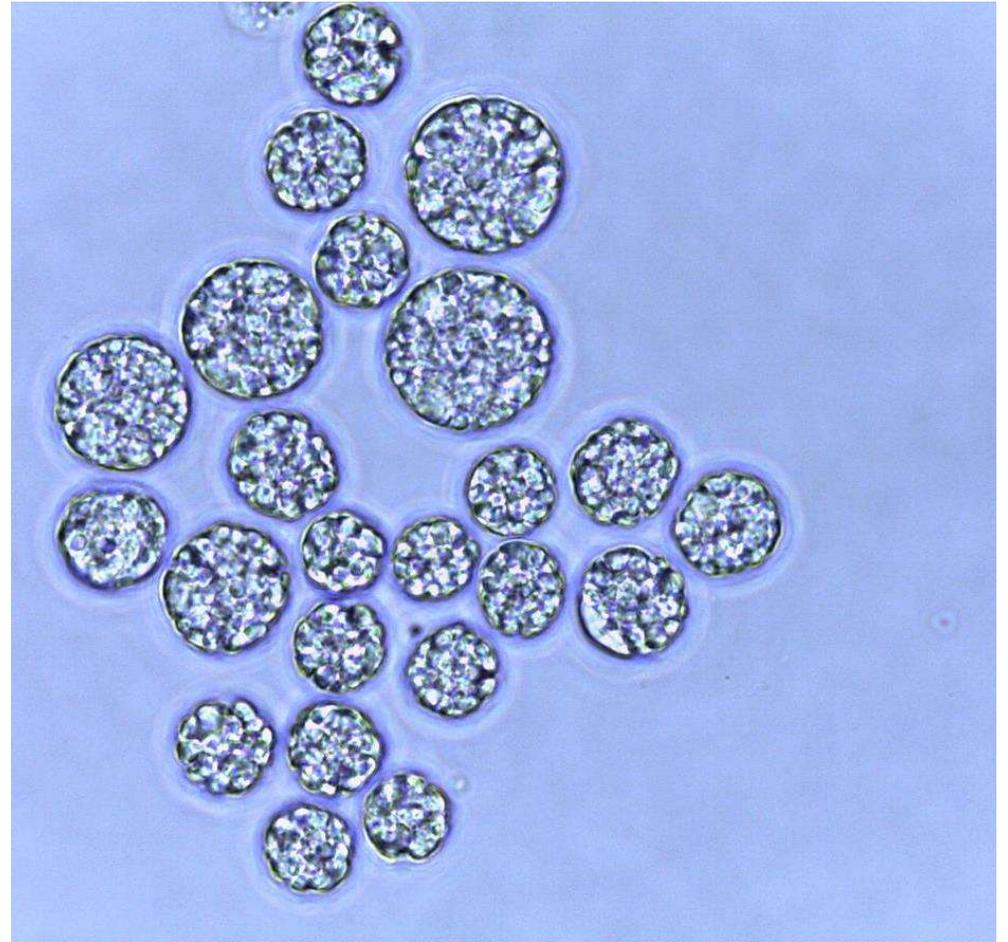
Skretting

Clearly shows how algal oil can help to further reduce dependency on wild fish



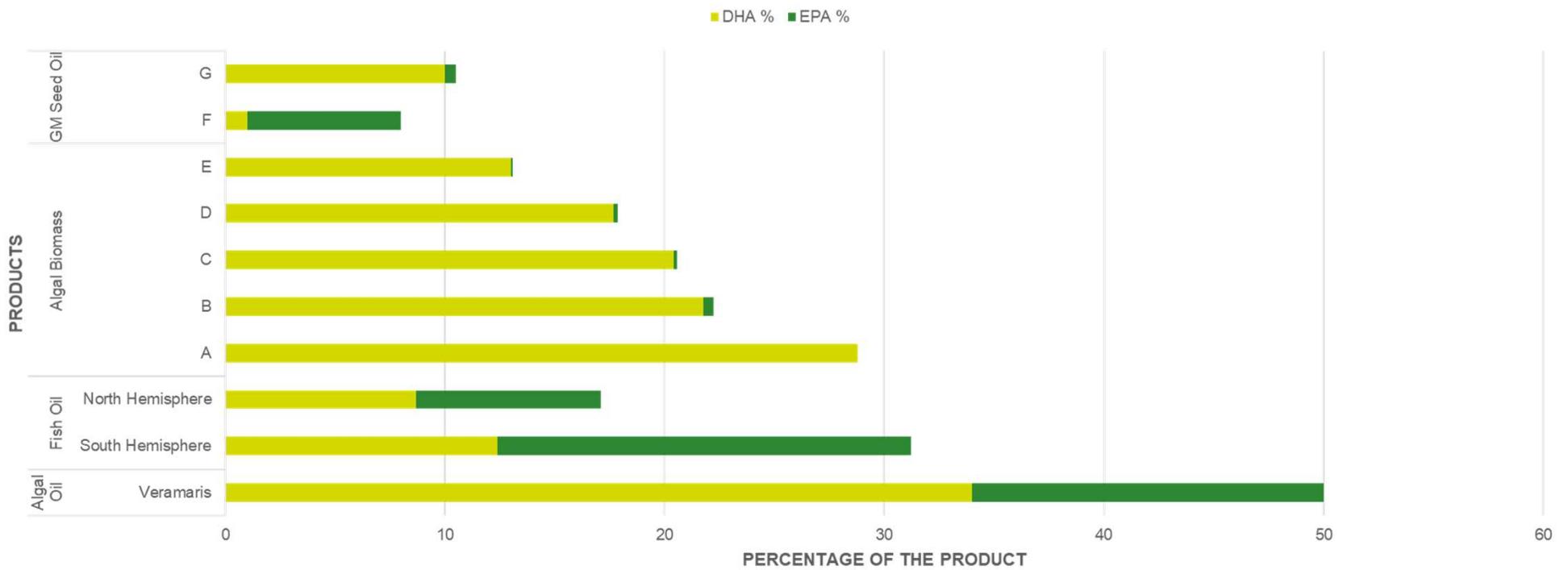
With <1% AO, its already possible to be a net producer of salmon

4. What are the alternative sources?



Competitive Landscape

Viable alternatives already exist for the supply of omega-3 long-chain PUFAs

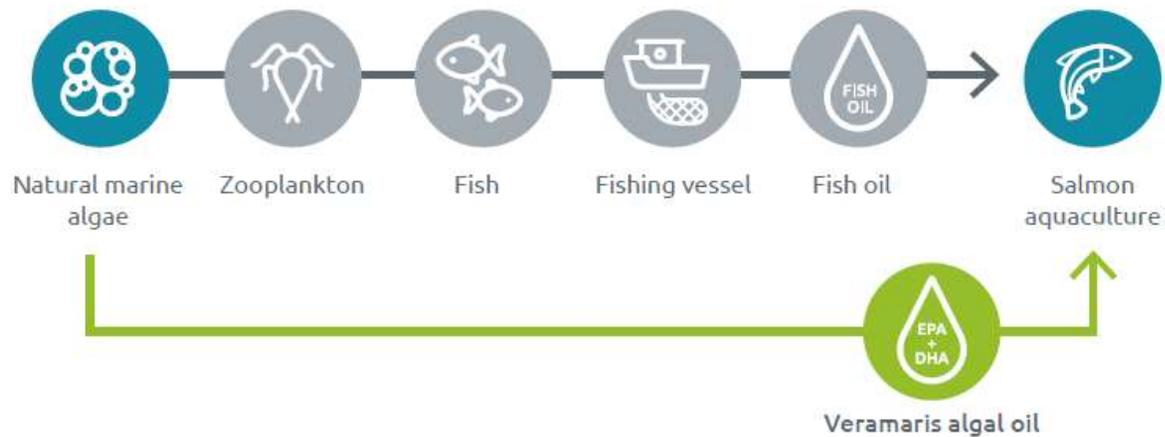


Sources:

Tocher et al (2019) Omega-3 Long-Chain PUFA EPA and DHA: Bridging the Gap between Supply and Demand;
 Pike and Jackson (2010) Fish oil: production and use now and in the future

Shortening the Natural Food Chain

Marine algae are the original producers of Omega-3 EPA & DHA



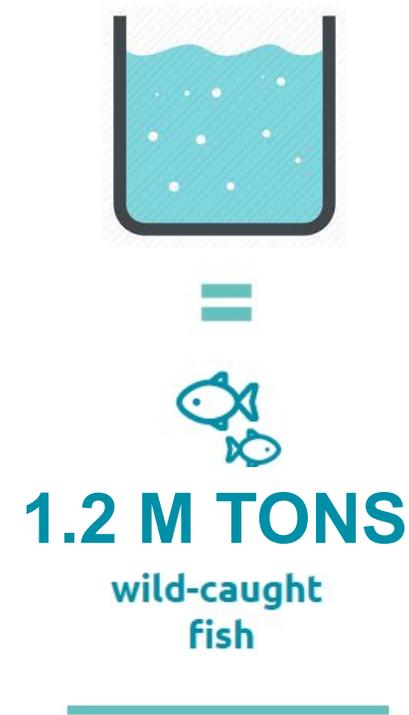
Healthy Food

Healthy Fish

Healthy Oceans

Alternative Oil

The more sustainable option



Horizon Scanning

Changes to the recommended tolerable weekly intake (TWI) for undesirable contaminants

Dioxins and Related PCBs: Tolerable Intake Level Updated by EFSA

22 Nov 2018 Source: European Food Safety Authority (EFSA)

21 November 2018 - EFSA has confirmed the conclusion of previous assessments that dietary exposure to dioxins and dioxin-like PCBs – environmental pollutants present at low levels in food and feed – is a health concern. Data from European countries indicate an exceedance of EFSA's new tolerable intake level across all age groups.

Dioxins and dioxin-like PCBs are toxic chemicals that persist in the environment for years and accumulate at low levels in the food chain, usually in the fatty tissues of animals. Their presence in food and feed has declined in the last 30 years thanks to the efforts of public authorities and industry.

5. Call to action



Value Creation Opportunity

New supplies of omega 3 EPA & DHA enable control of three critical levers, without adding additional supply-side risk

	TYPICAL*	FUTURE	CONTROL with VERAMARIS Algal Oil
1 Health (Omega 3 EPA+DHA)	1g/100g	>1.75 g /cooked portion	<ul style="list-style-type: none"> ✓ Veramaris algal oil gives control to sustain or restore levels and types of omega 3 in the salmonid fillet ✓ EPA & DHA claims are more powerful for consumers than total omega 3
2 Food Safety (Contaminants)	0.6pg/g	<0.2pg/g	<ul style="list-style-type: none"> ✓ Veramaris algal oil ensures that everyone in the family, also children, can eat as much salmon as they like while staying below the newly recommended EFSA tolerable weekly
3 Sustainability (FFDR oil)	1.7	Become a net fish producer <1	<ul style="list-style-type: none"> ✓ Veramaris algal oil gives control over FFDR oil metric ✓ One ton of Algal oil preserves 60 tons of wild fish in the oceans

*Typical levels are intended only to indicate current industry practice. Actuals vary considerably between producers.

What Can You Do To Make Change Happen?

Opportunities now for further attention

TODAY

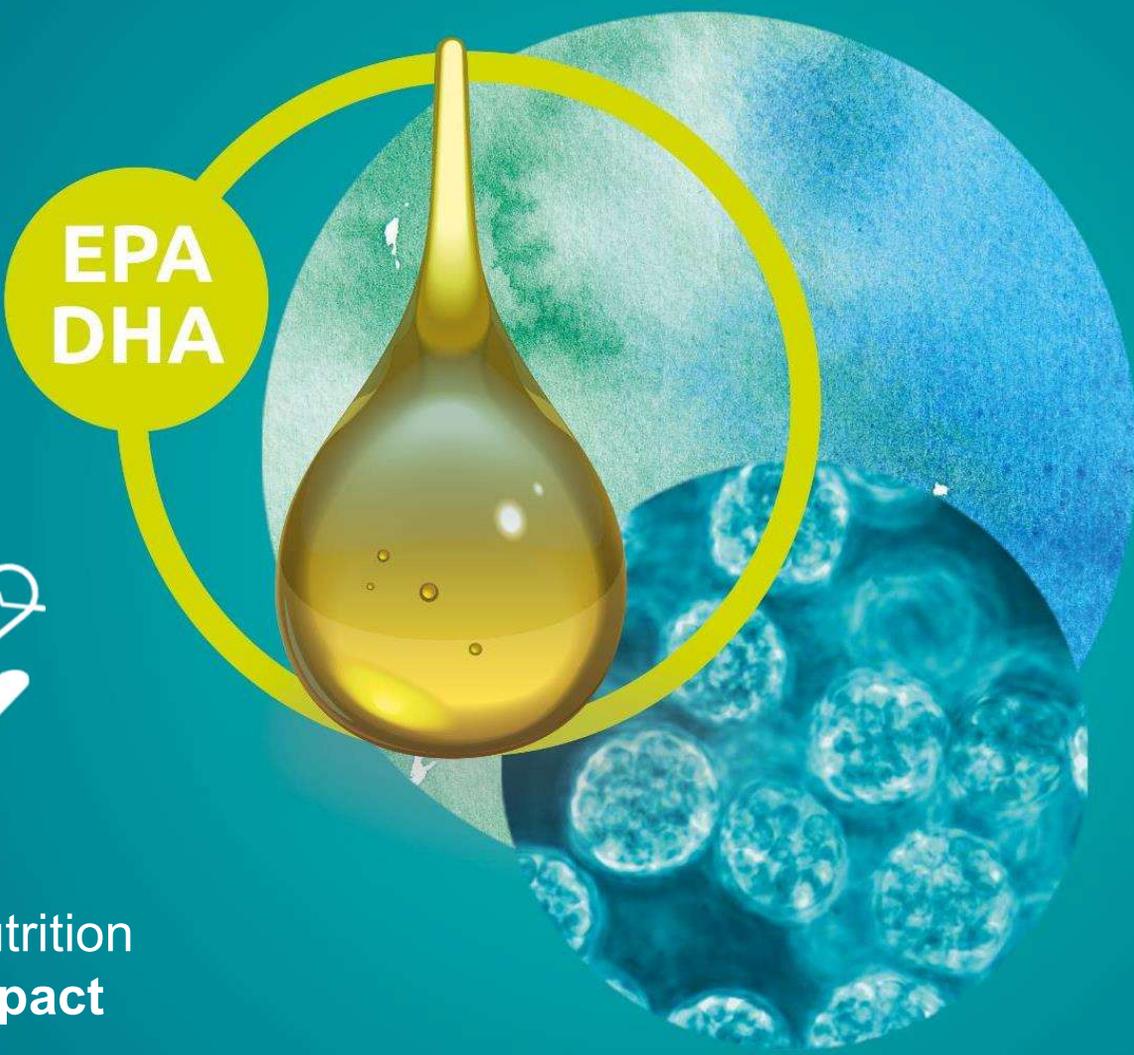
- Start with reviewing the farmed seafood that you are sourcing today
- How much EPA & DHA does it contain?
- How will you sustain or restore these levels in future?
- Are you prepared for new regulatory limits on PCBs and Dioxins in farmed seafood?
- How much wild fish is used to produce 1KG of farmed seafood?
- What claims are you making already?

TOMORROW

- How would you like to improve your farmed seafood claims?
- How can you improve your seafood story-telling?
- Could you be more declarative in your sourcing specification for healthiness and sustainability of farmed seafood?
- Have you set targets to deliver farmed seafood category growth based on differentiation?



Enabled by **Veramaris** Marine Algal Oil
breakthrough technology



**EPA
DHA**

**Maximum Nutrition
Minimal Impact**

