

ProAlgae2013

Industrial production of marine microalgae as an EPA- and DHA-source for use in fish feed

Hans Kleivdal



Matilde S Chauton



Kjell Inge Reitan



The ProAlgae project


- Background - *why*
- Aims - *what*
- Methodology - *how*

Limited sustainable feed resources

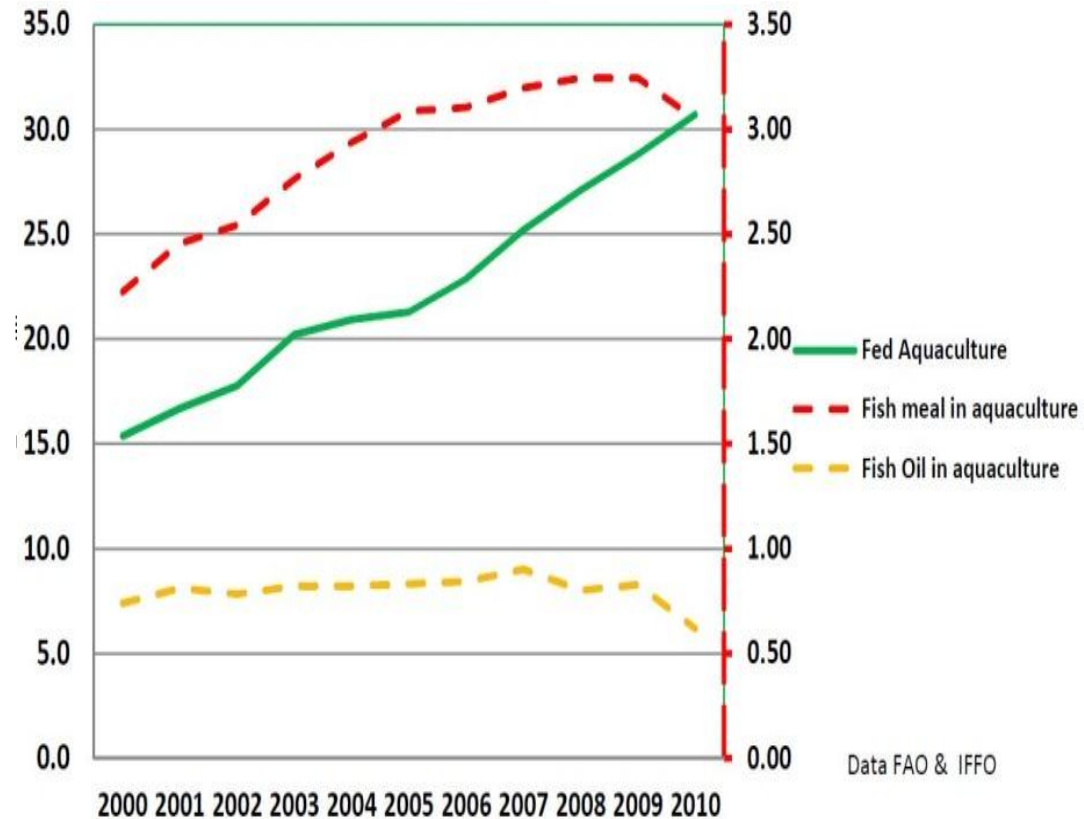
GROWING FOOD for nine billion

FOOD PRODUCTION WILL HAVE TO INCREASE BY 70 PERCENT TO FEED A POPULATION OF NINE BILLION PEOPLE BY 2050. THAT MEANS A STAGGERING *ADDITIONAL* ONE BILLION TONNES OF CEREALS AND 200 MILLION TONNES OF MEAT WILL NEED TO BE PRODUCED ANNUALLY BY 2050. IN ORDER TO INTENSIFY PRODUCTION BY THAT MUCH ON OUR FINITE EARTH, IMMENSE EFFORT WILL HAVE TO GO INTO NEW, BETTER AND MORE INTENSIVE WAYS OF PRODUCING OUR FOOD. WE WILL HAVE TO REFLECT ON THE WISE WAY FORWARD AND SUPPORT WHAT NEEDS TO BE DONE.

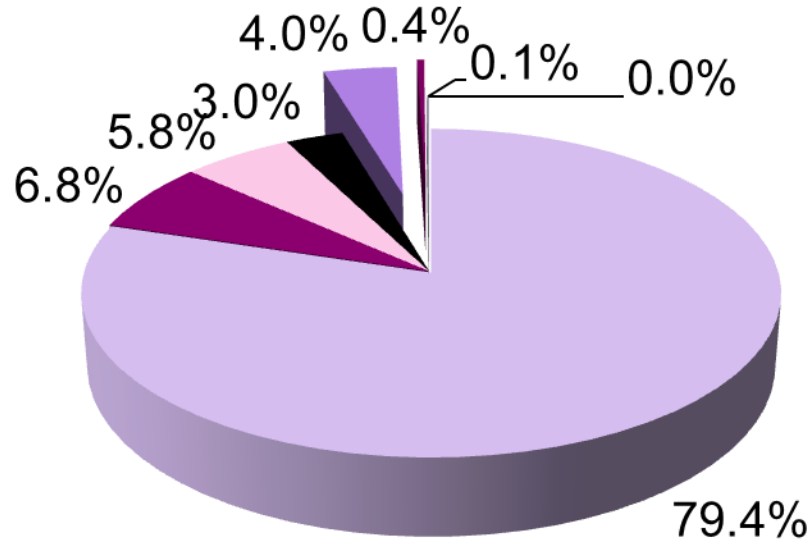
GROWING FOOD for nine billion



Global Aquaculture Production with fishmeal and fish oil usage



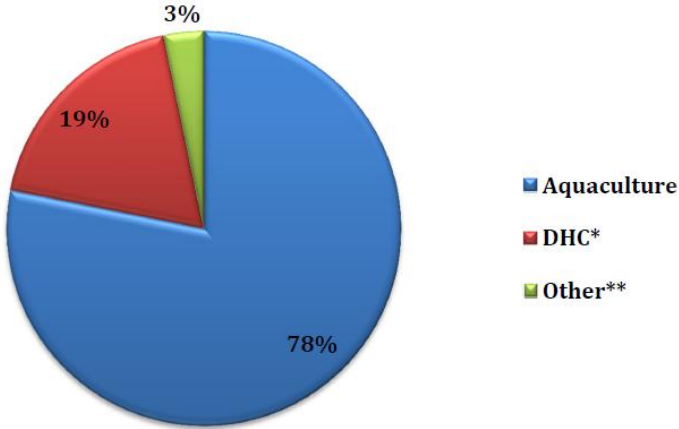
Limited sources of refined Fish oil



- Anchovy/Sardine
- Salmon
- Yeast
- Cod
- Algae
- Plant
- Tuna
- Krill

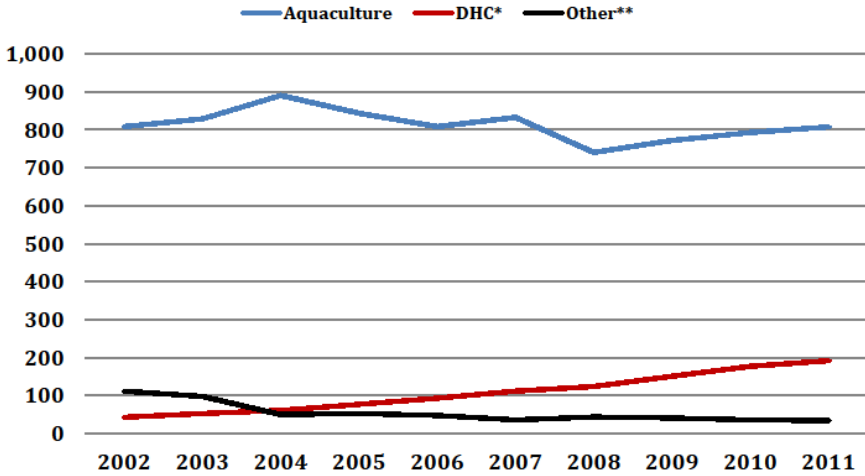
Increased direct human consumption

FIGURE T
**PERCENTAGE OF FISH OIL USAGE
 PER MARKET 2011**



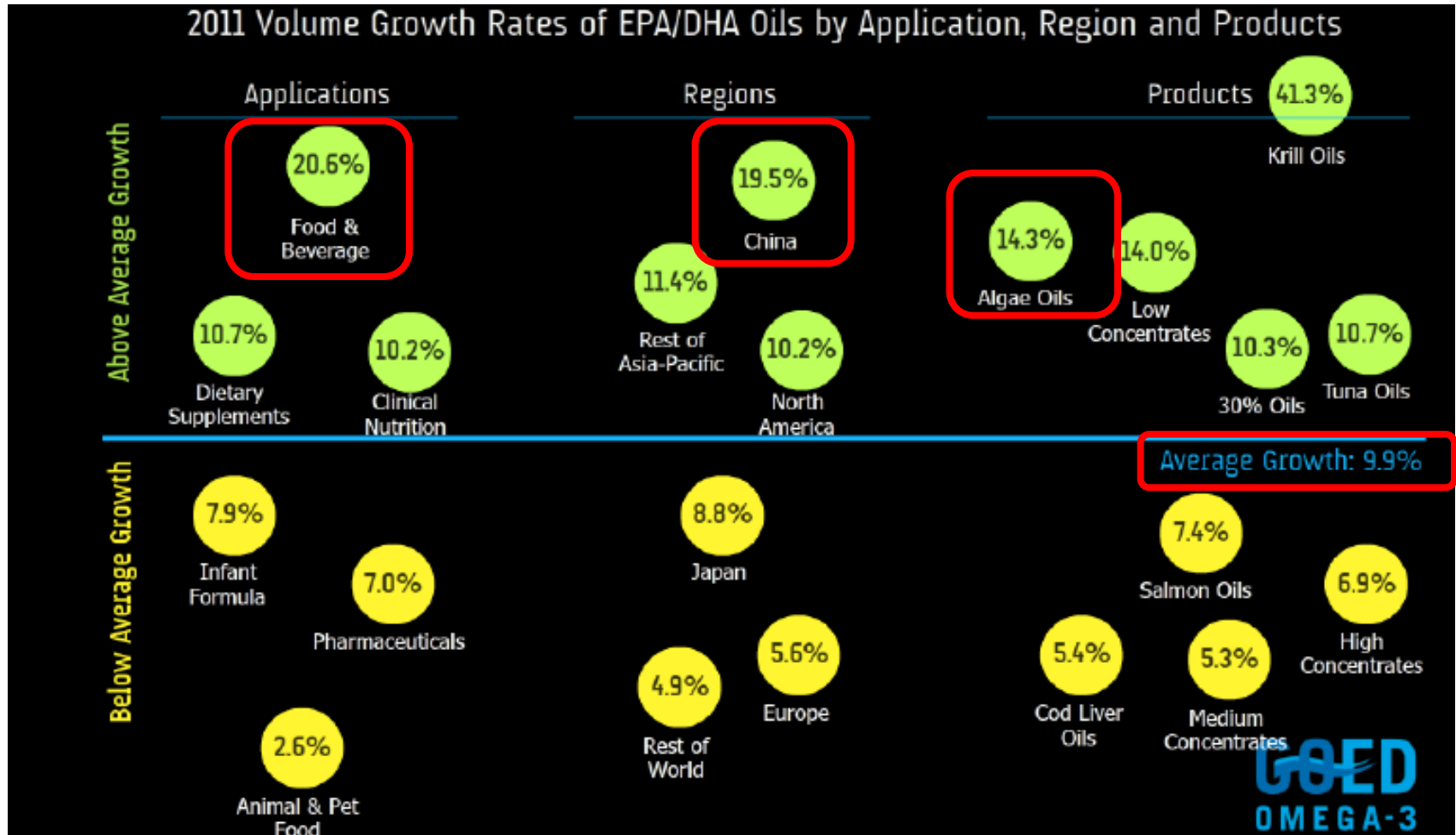
*Direct Human Consumption, **Other usage

FIGURE U
TRENDS OF USE FOR FISH OIL ('000 mt)

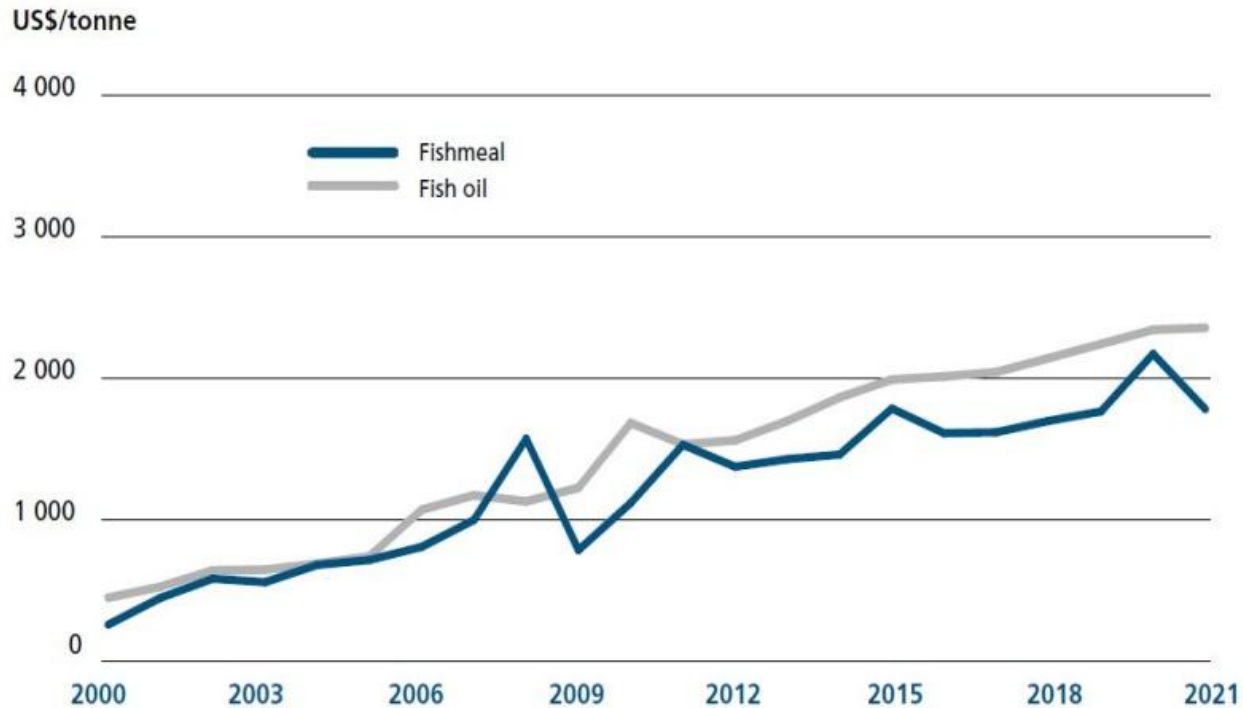


*Direct Human Consumption, **Other usage
 source: IFFO

Emerging applications of omega-3 fatty acids

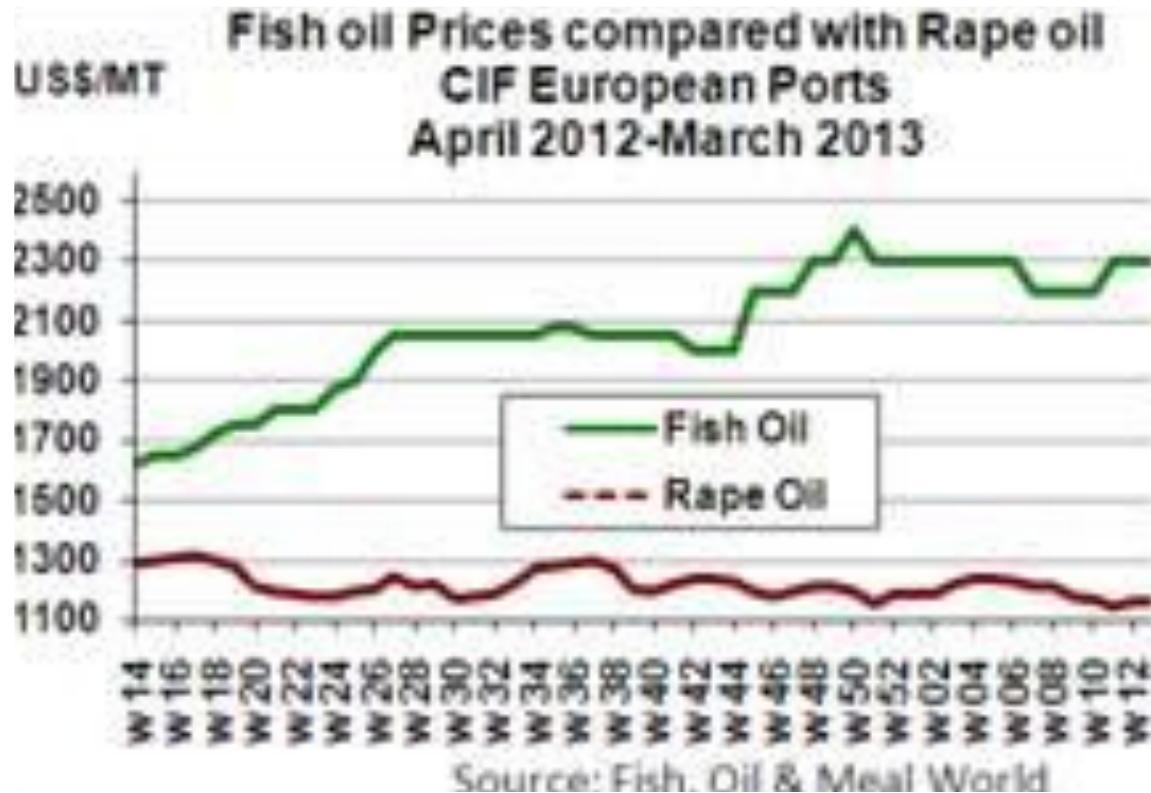


Fish oil price are expected to increase



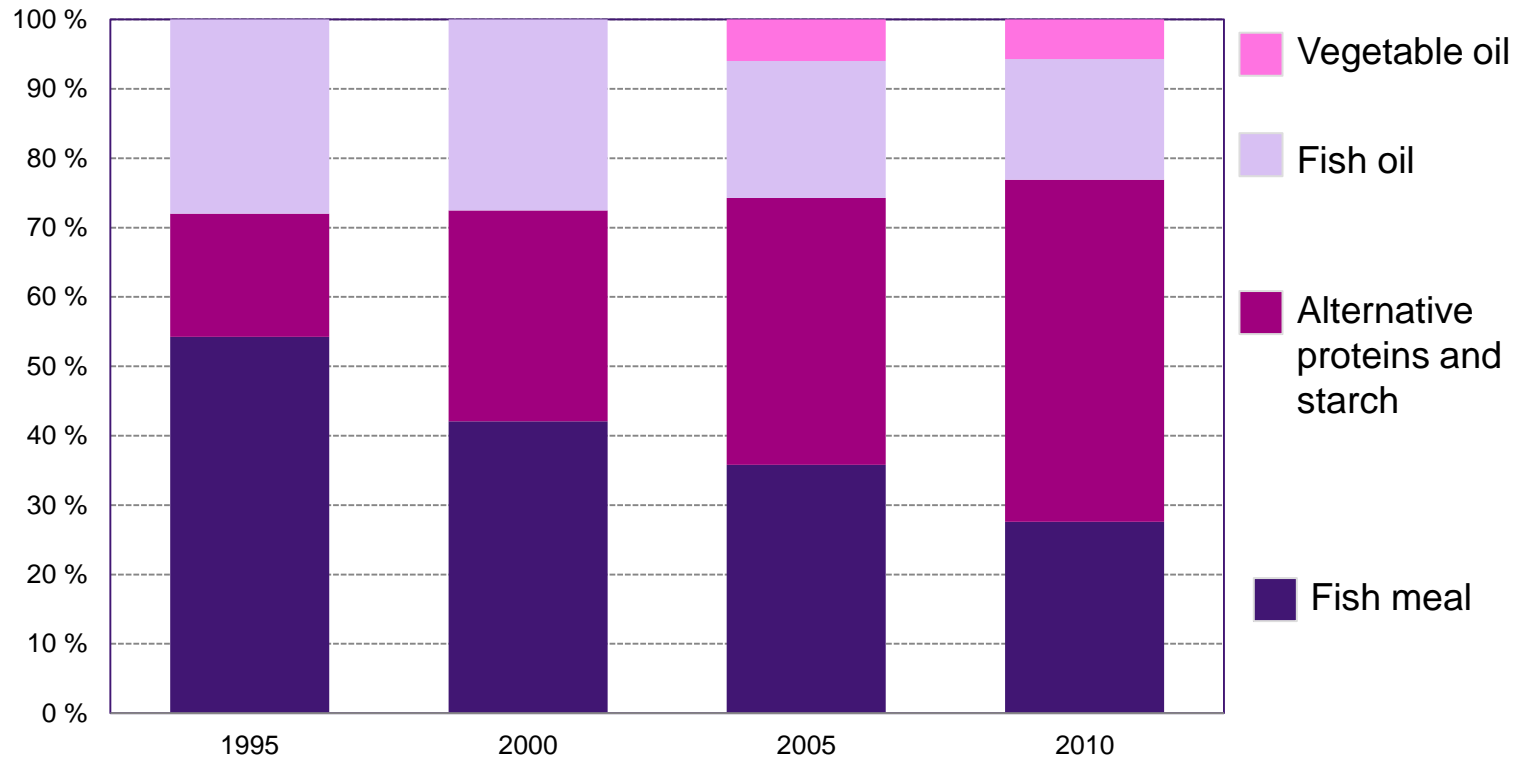
UN FAO Aquaculture and Fisheries, 2012

FO price is affected by limited supply



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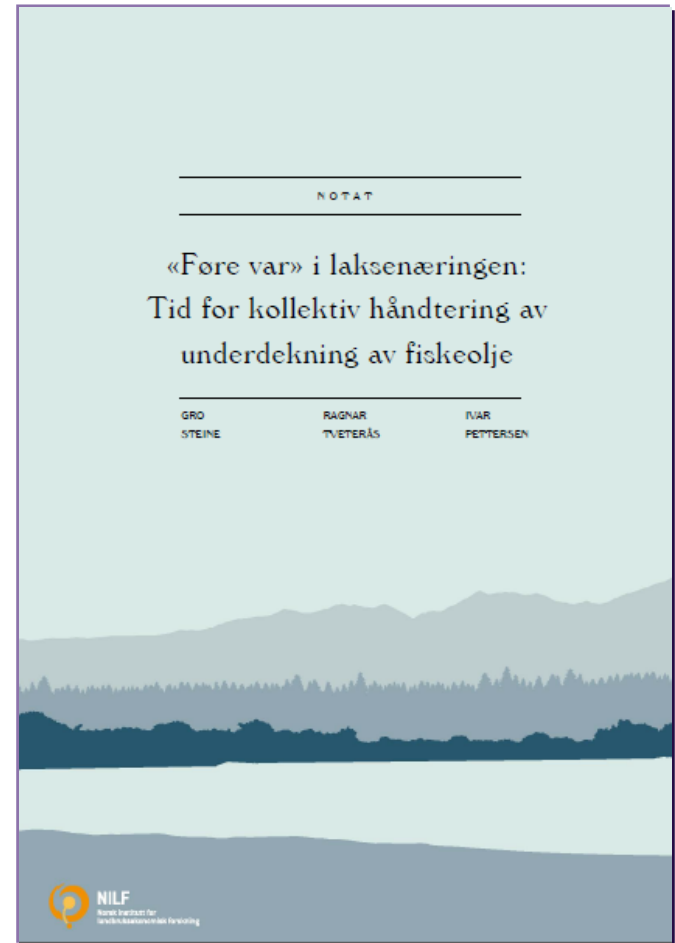
Fish oil is a vital ingredient of salmon feed



- Vegetable sourced replacements increase
- EPA and DHA contents reduced significantly in feed
- Omega-3 levels in marketed salmon reduced

Managing the shortfall - exploring replacements

- Joint aquafeed industry report
 - *Limited pelagic supply*
 - *Increased DHC*
 - *Dramatic shift 2014*
 - *2017: 4 mill t salmon feed needed*
- Strategic decision point
- Choice of alternative EPA&DHA sources will depend on:
 - *Fish oil price development*
 - *Prod. costs and cost development*
 - *Technical feasibility*
 - *Sustainability*
 - *Consumer acceptance*



Alternative omega-3 sources for aquafeed

Commercially Available

In Development

Fish



Anchovy
Sardine
Mackerel
Tuna
Cod
Salmon
Menhaden
Trout
Pollock
Hoki
Halibut
Sandeel
Angelfish
Saithe

Squid



Market Squid
Argentine
Shortfin Squid

Zooplankton

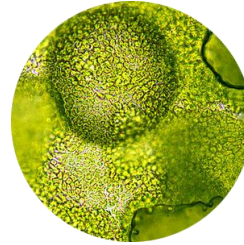


Antarctic Krill
Pacific Krill
Northern Krill



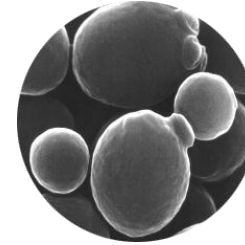
Growing volumes
< 5000 t by 2017
Niche market

Algae



Schizochytrium
Cryptocodinium
Euglena

Fungi



Y. Lipolytica



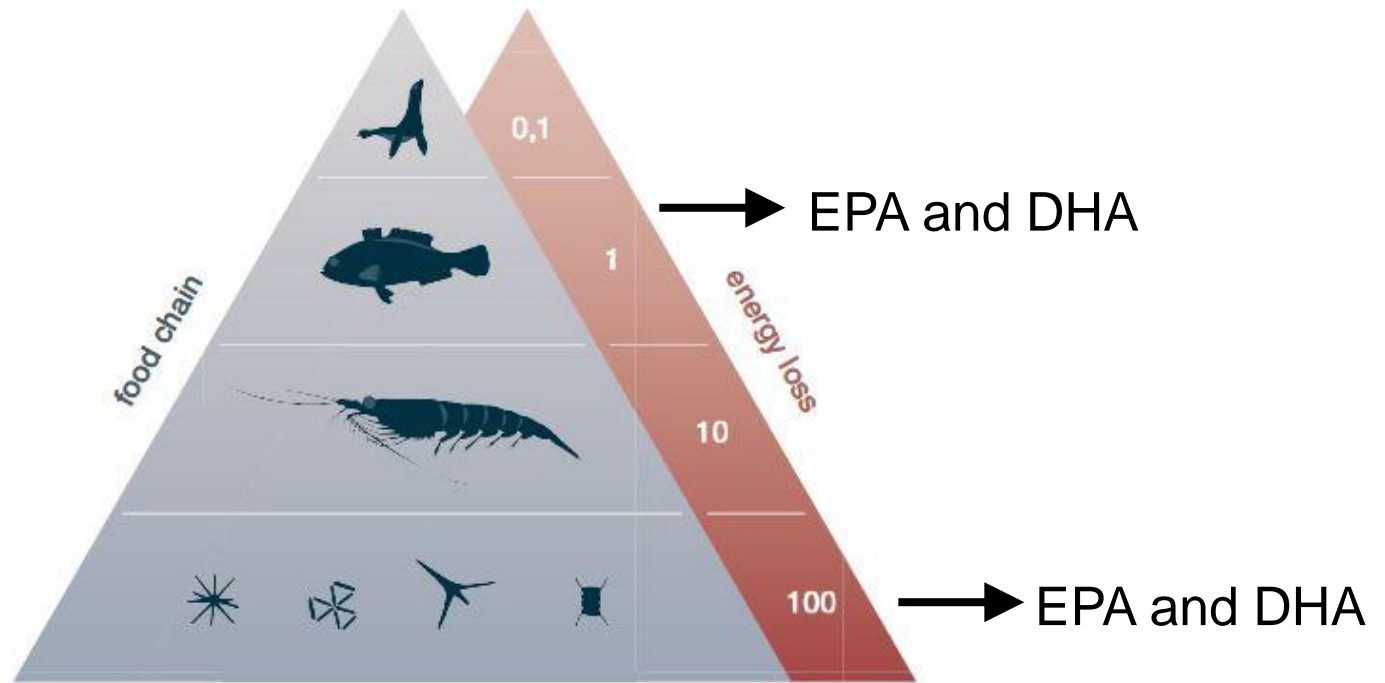
DuPont production
GM yeast 55% EPA
GM salmon feed
Used in Verlasso salmon
GM fed salmon on US market

GM Plants



Stearidonic Ω-3 (SDA)
DHA&EPA up to 20%
Several years away
Still low productivity

Sustainable sourcing



- Sourcing the lower trophic biomass
- Avoid 90% energy loss between levels

Norwegian Seafood Research Fund

Project invitation to develop:

A "state-of-the-art" report describing the international knowledge status on production of marine microalgae, at relevant industrial scale and as a raw material in feed – intended as a base for decision making.



ProAlgae

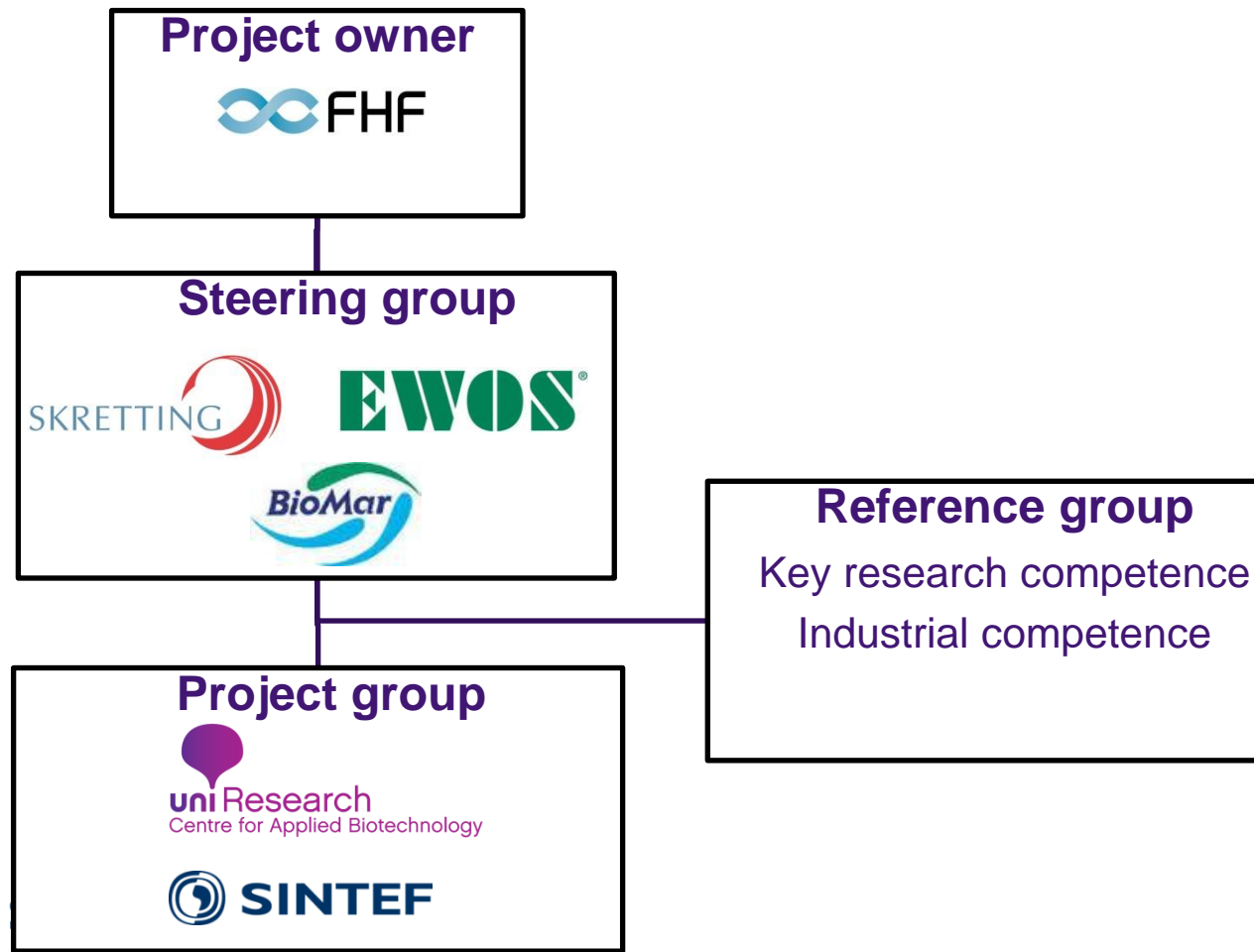
Industrial production of marine microalgae as an EPA- and DHA-source for use in fish feed

Aims:

- “State-of-the-art” report of the international status of knowledge on industrial production of marine microalgae.
- Describe the possibilities to produce EPA and DHA in microalgae for use in feed at an economically viable cost.
 - *Investigate scientific knowledge basis, with emphasis on the potential and limitations*
 - *Identify future research needs and possibilities to develop a commercially viable production to support aquafeed production.*

Norwegian Seafood Research Fund - FHF

ProAlgae (2012-2013)



Method

Part 1 – Assessment of status and opportunities

- Input from the steering committee
- Workshop with reference group.
- Describe international status and opportunities (visits and meetings)
- Preliminary results to the steering committee

Part 2 – Assess the scientific basis, research needs and opportunities

- Collaborative investigation with contributions from the reference group
- Dissemination: Report and open Workshop

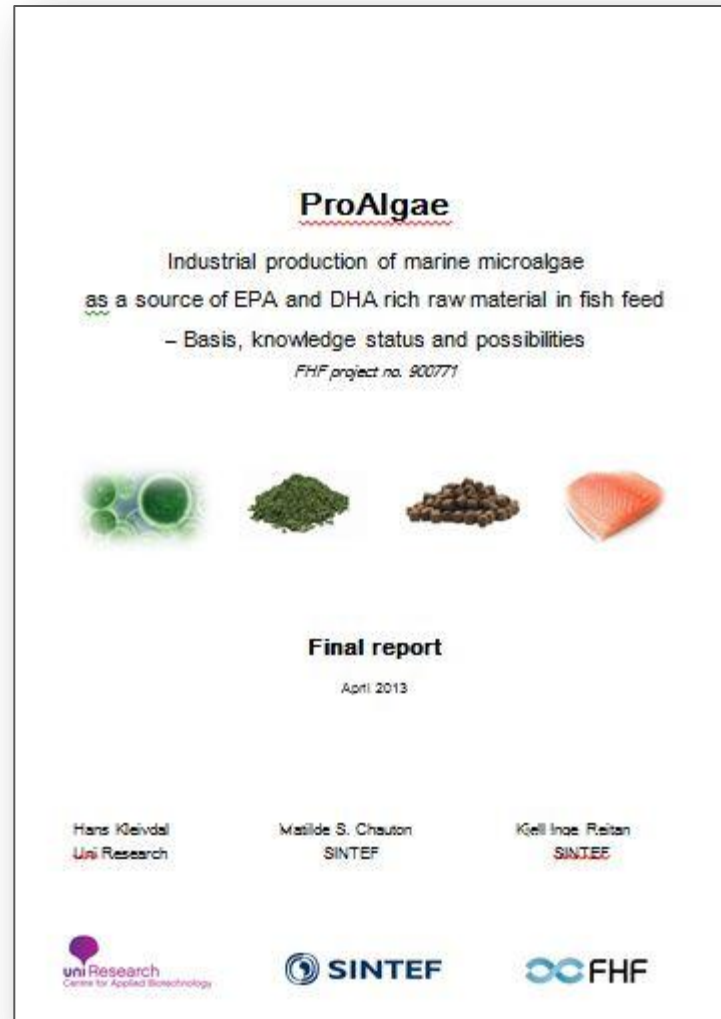
ProAlgae Reference group



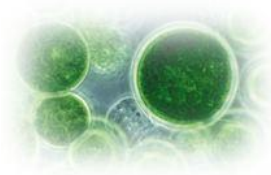
Fitoplancton Marino



The ProAlgae report



The
biology
potential



Algae
production



Processing
and feed
development



Application



Algal
metabolism

Biodiversity
Selection
Optimization

Growth
conditions
Bioengineering

Upscale

Harvest
Dewatering
Processing

Feed
development &
formulation

Feeding trials
Documentation