FENACAM'14, Fortaleza, 11.-13. November, 2014

Status, Challenges and Trends for Marine Aquaculture in Norway.

O Status Atual, Desafios e Tendências da Aquicultura Marinha na Noruega, com Ênfase para o Cultivo de Salmonídeos

Roger Richardsen
SINTEF Fisheries and Aquaculture,
Trondheim, NORWAY

www.sintef.no/fish
Roger.Richardsen@sintef.no

SINTEF – Brazil Cooperation in Aquaculture Research

- Project funded by the Norwegian Research Council (2014 -2017)
- Main topic: **Potential for (marine) aquaculture in Brazil**
  - Marine juvenile production technology
  - Marine Algea
  - Markets and techno-economic performance
  - Private /public capacities for developing marine aquaculture
- Cooperation to four peer universities and institutions in Brazil

- **Scientific and user advisory group:**
- *Eric Routledge, EMBRAPA, Brazil*
- *Alberto Nunes, The Institute of Marine Sciences, LABOMAR, Brazil*
- *Trina Galloway, SINTEF do Brasil*

Cooperação em Acuicultura

Dr Joao Felipe Matias
Exec. Secr. ANA
Red de Acuicultura de las Americas

Universidade Federal do Rio Grande do Norte
UFRN – NATAL
Dr. Rodrigo Carvalho ,
Lab of Fish Processing and Aquaculture Nutrition

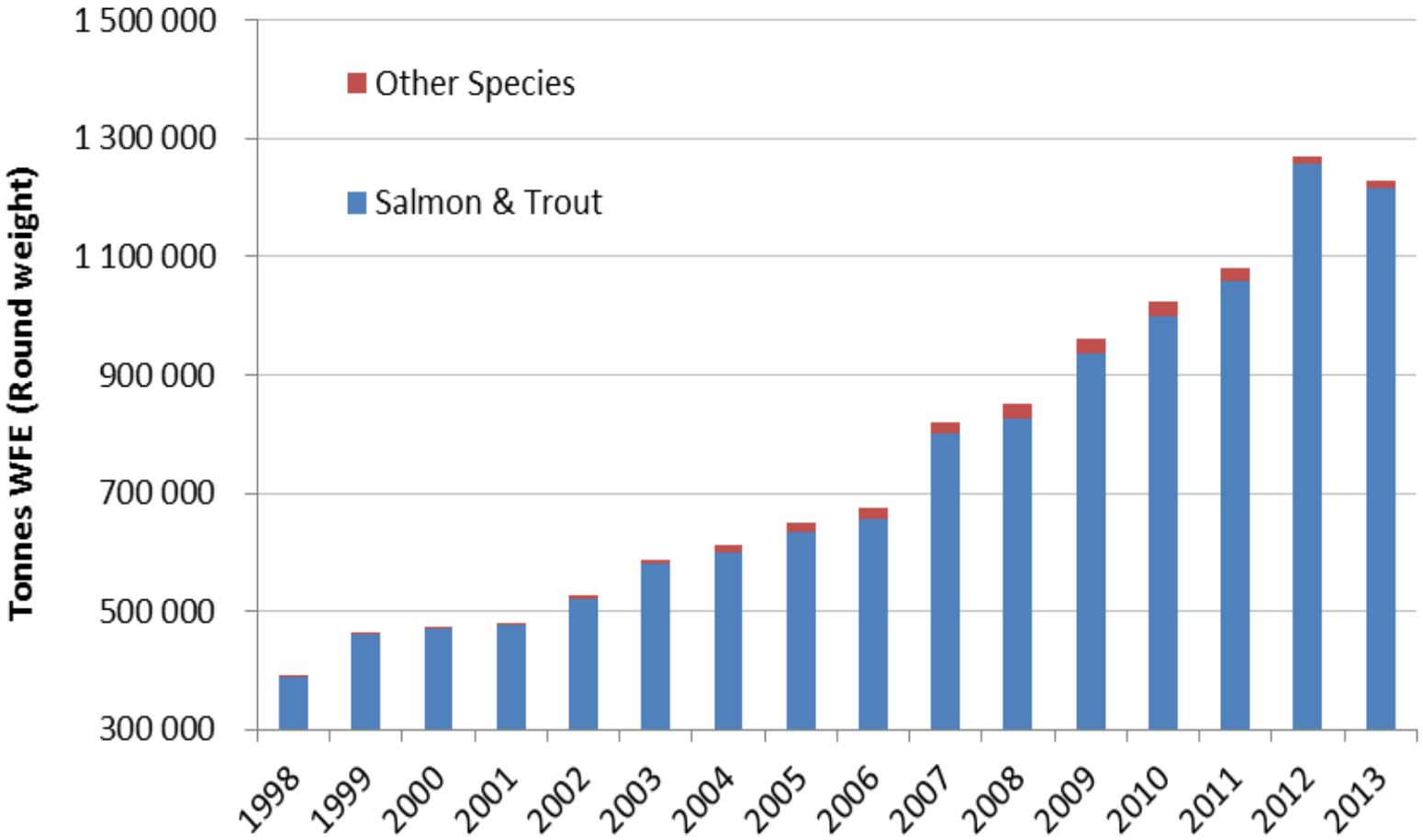
Universidade Federal do Paraná, Curitiba
Centro de Estudos do Mar - Pontal do Paraná
Prof.a. Érica A.G. Vidal

Universidade Federal Santa Catarina
Dr. Leila Hayashi

Marine Aquaculture in Norway - Topics

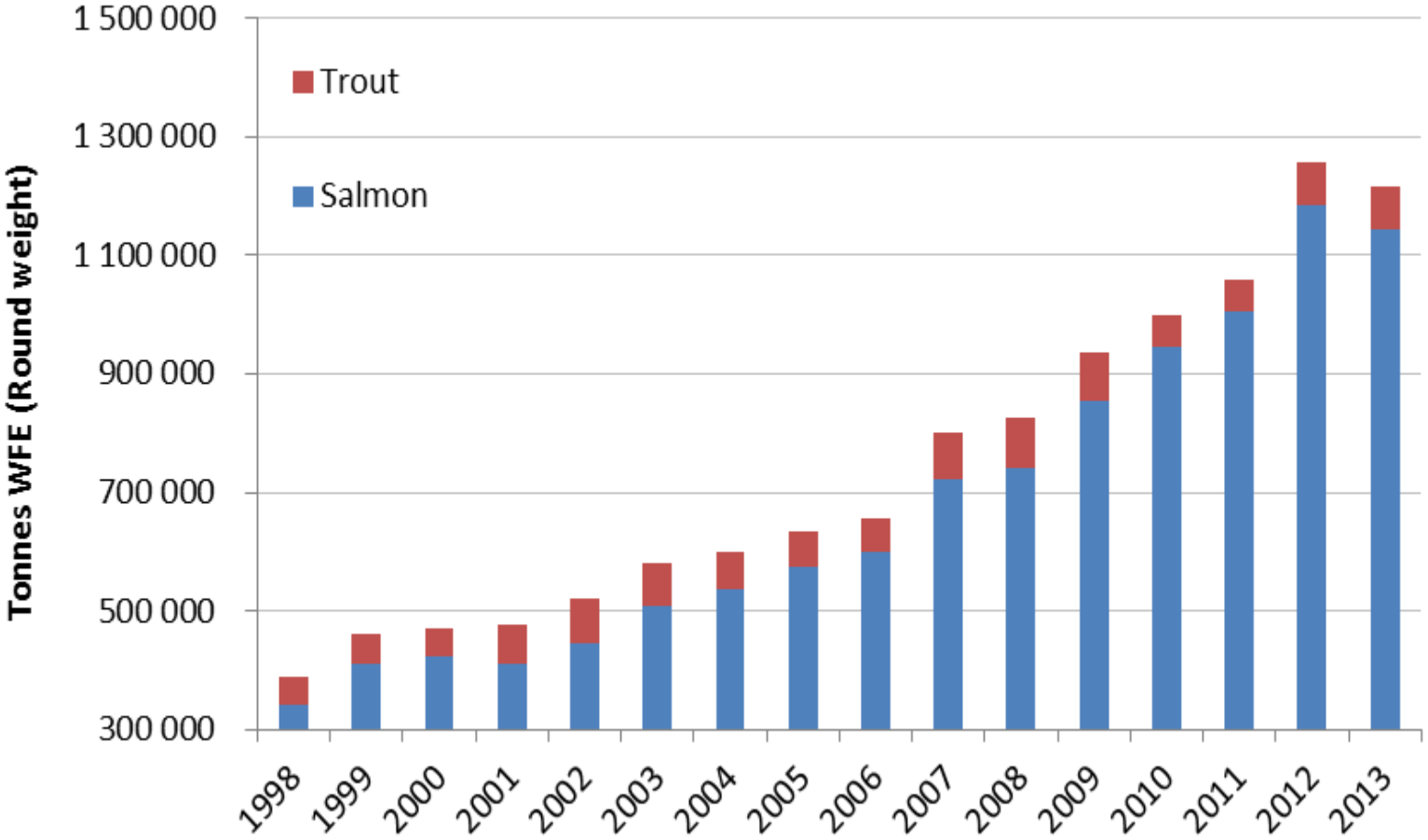
- Status : Growth and good markets
  - From small scale to industrial production
  - Still commodity supplier
- Challenges: Sustainability – Easy to say – difficult to apply! Who pays ?
- Trends: Technology shift about to come but, costly search for alternatives
  - Landbased ? Open Ocean? Closed floating devices ? Intensive R&D
- Future : Global need for fish as food

Norwegian Aquaculture Output 1998 - 2013



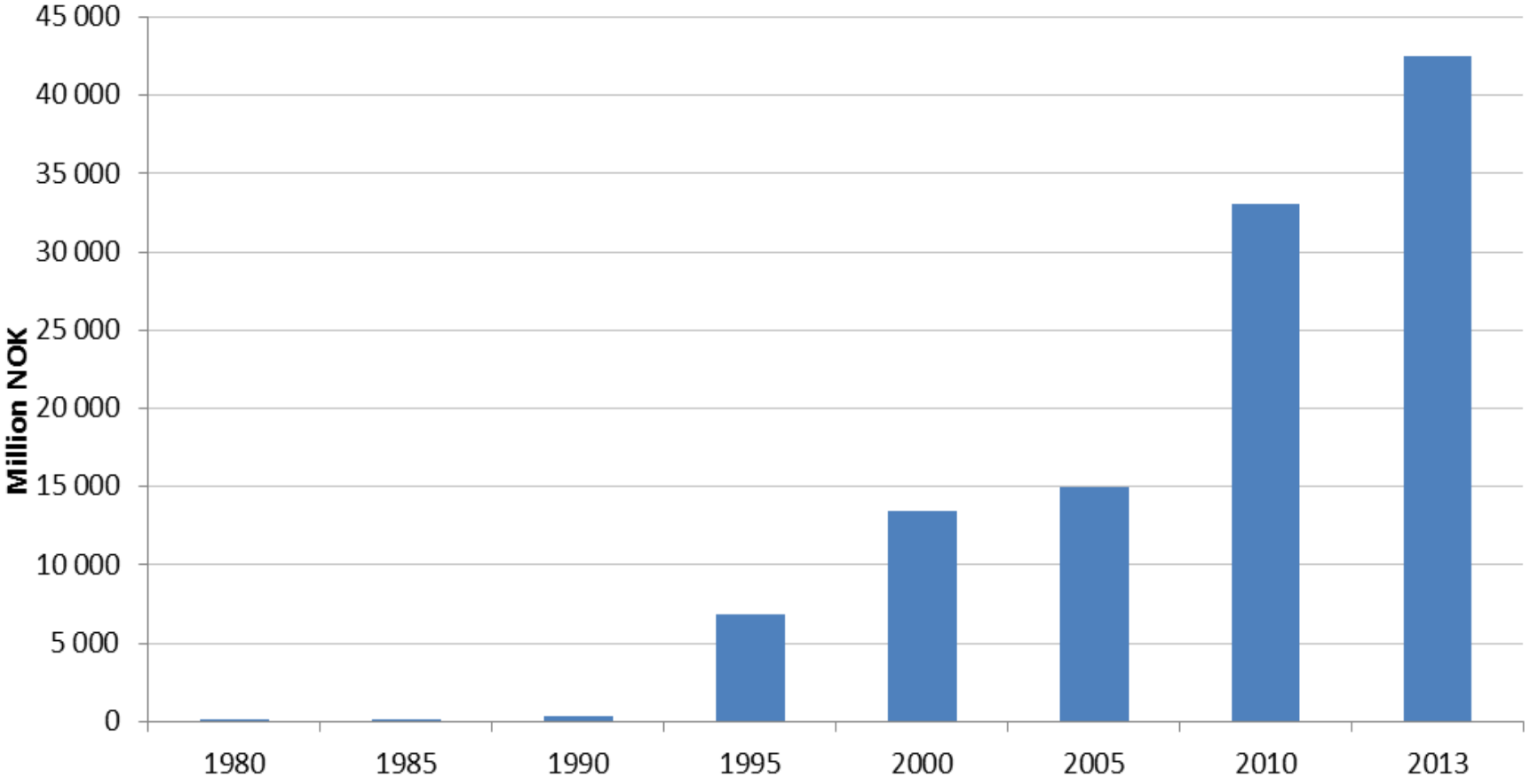
Source: Statistics Norway/Kontali Analyse

Atlantic Salmon & Rainbow Trout
The major species



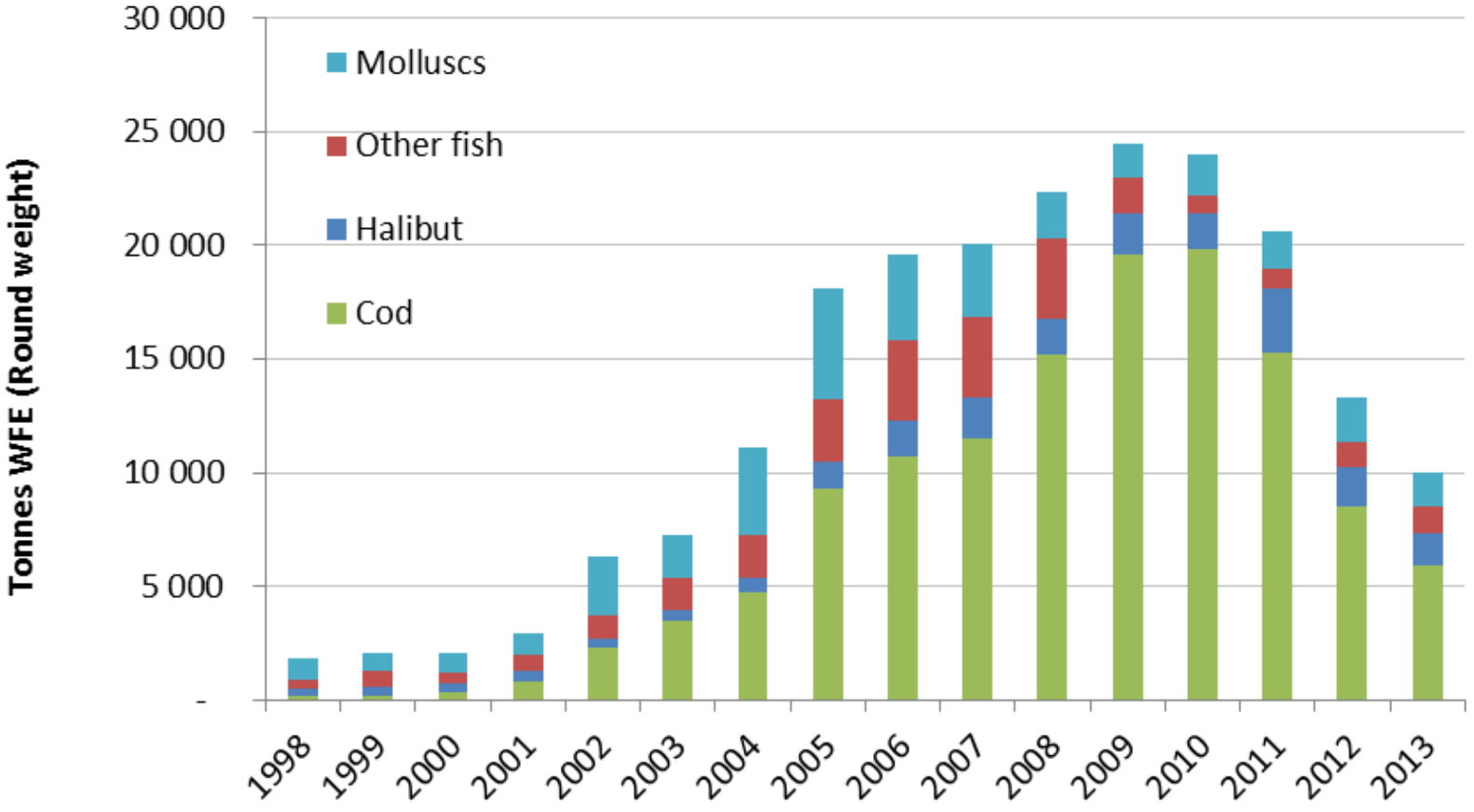
Source: Statistics Norway/Kontali Analyse

Export Value - Approaching NOK 45 Bln. (USD 7,5 Bln)



Source: Statistics Norway/Kontali Analyse

Other Marine Species - marginal production



Source: Statistics Norway/Kontali Analyse

Calculated Operating Margin- Salmon Farming Norway

Calculated Operating Margin

Average per unit

		2008	2009	2010	2011	2012	2013
Average – all companies	%	10,2	20,9	32,9	16,4	6,5	19,0 %
Gruppe 1 Small companies	%	**10,0**	20,1	33,1	16,2	4,2	
Gruppe 2 – Medium sized	%	8,0	15,3	**34,**0	**18,0**	6,5	
Gruppe 3 – Large Companies	%	7,6	**22,4**	32,6	16,3	**7,5**	15,3 %
Finnmark og Troms	%	9,1	17,3	29,9	14,5	7,9	
Nordland	%	13,9	21,6	33,9	17,0	9,3	
Trøndelag	%	14,7	20,0	32,8	15,4	6,7	
Møre og Romsdal	%	2,8	14,1	30,8	13,2	-3,9	
Sogn og Fjordane	%	9,1	23,1	34,0	20,9	6,9	
Hordaland	%	1,7	18,9	29,2	15,3	0,6	
Rogaland og Agder	%	0,2	20,8	30,5	16,2	6,6	

Source: Directorate of Fisheries

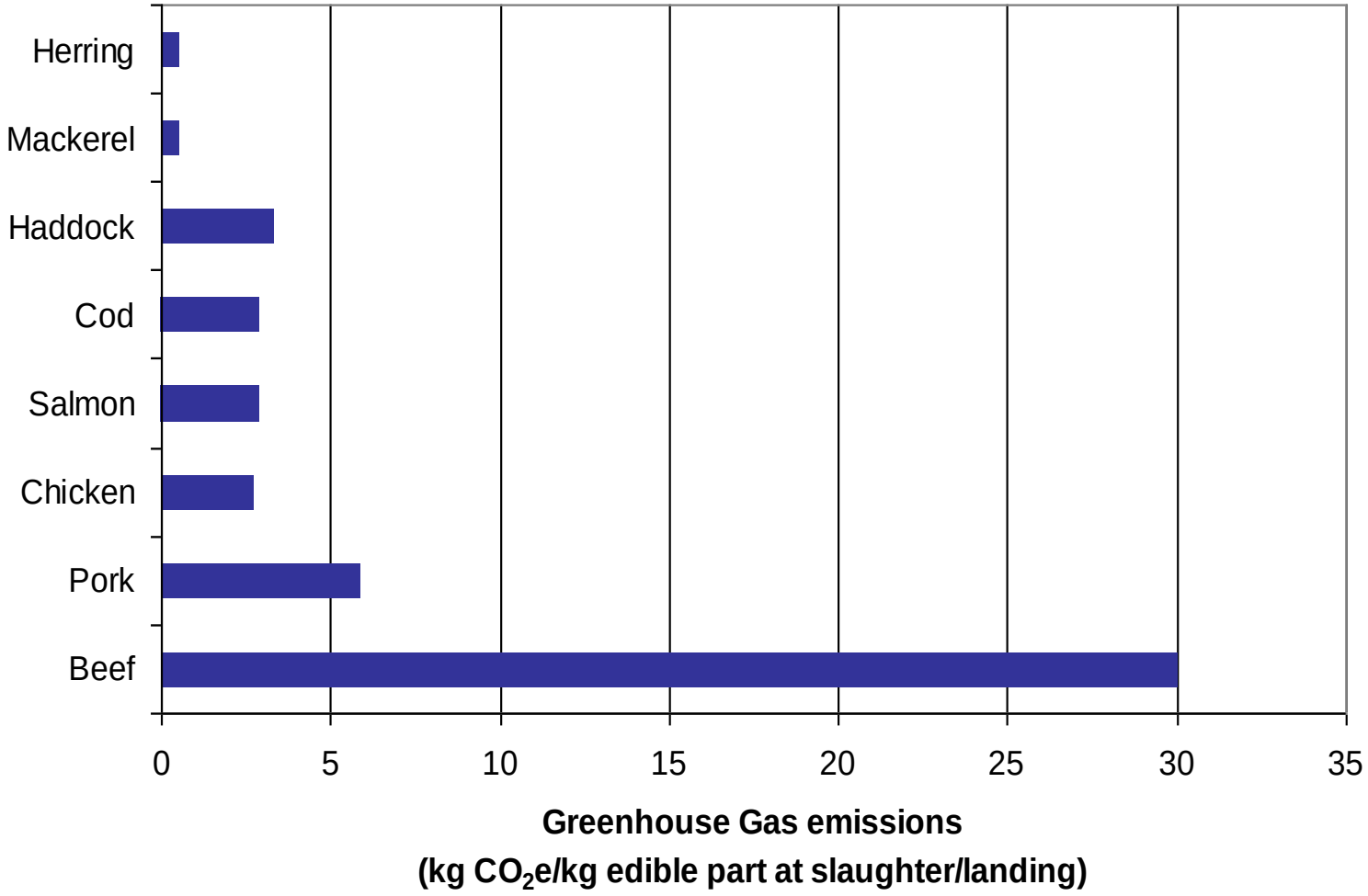
Sustainable farming – Need for new Production Models

- Lessons Learned
  - Environmental zone management
  - Farm fallow periods
  - Biosecurity along the entire value chain

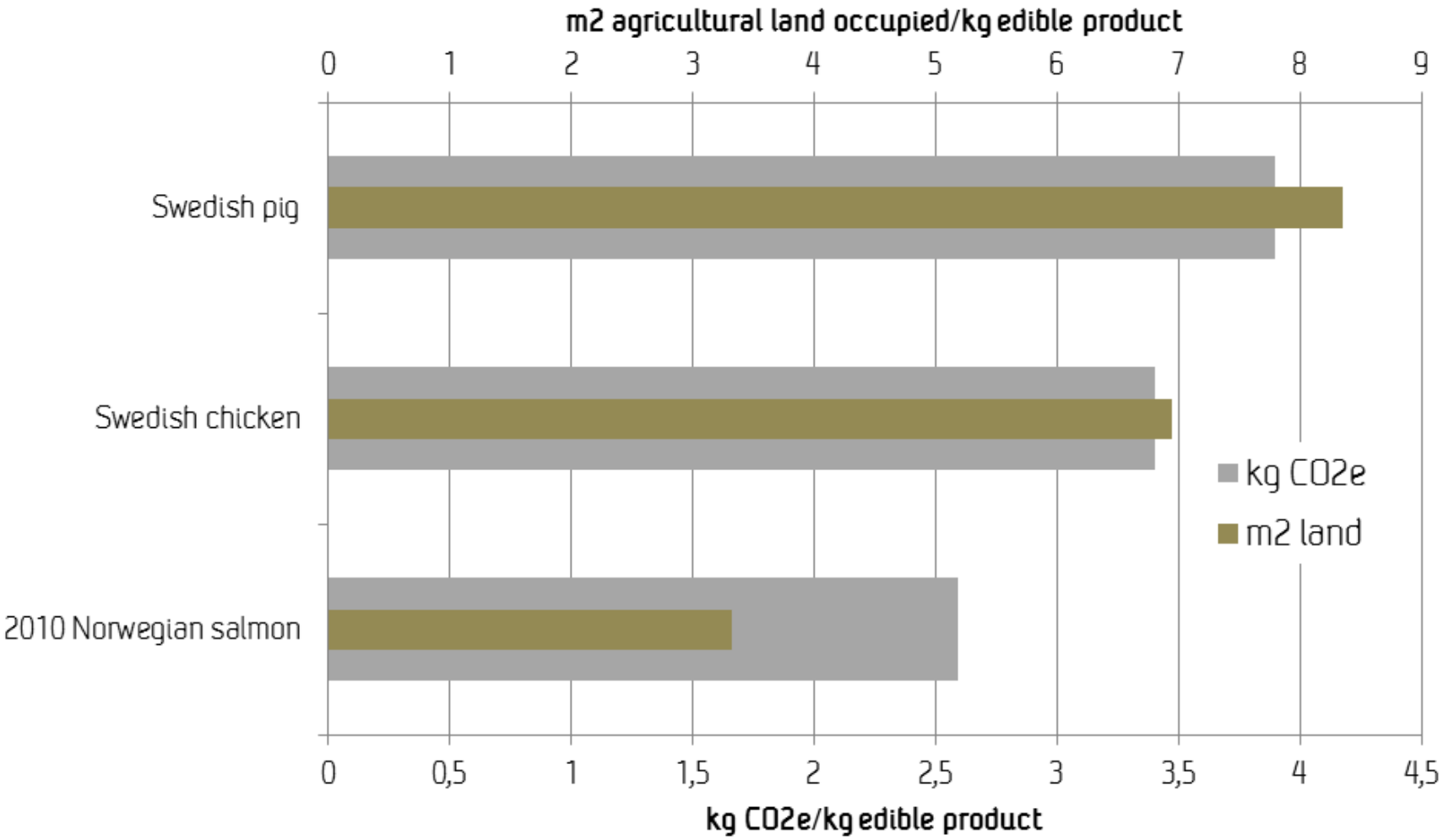
- New technology
  - Open Ocean Farming
  - New (stronger) net pens
  - "Double Net Pens / Closed floating Containments (regulated water intake)
  - Semi land-based production cycles
  - Land-based production

- Extensive Research and Development needed for finding solutions to environmental issues. (Industry finance 50 % of total aquaculture research in Norway ; 400 Mill NOK

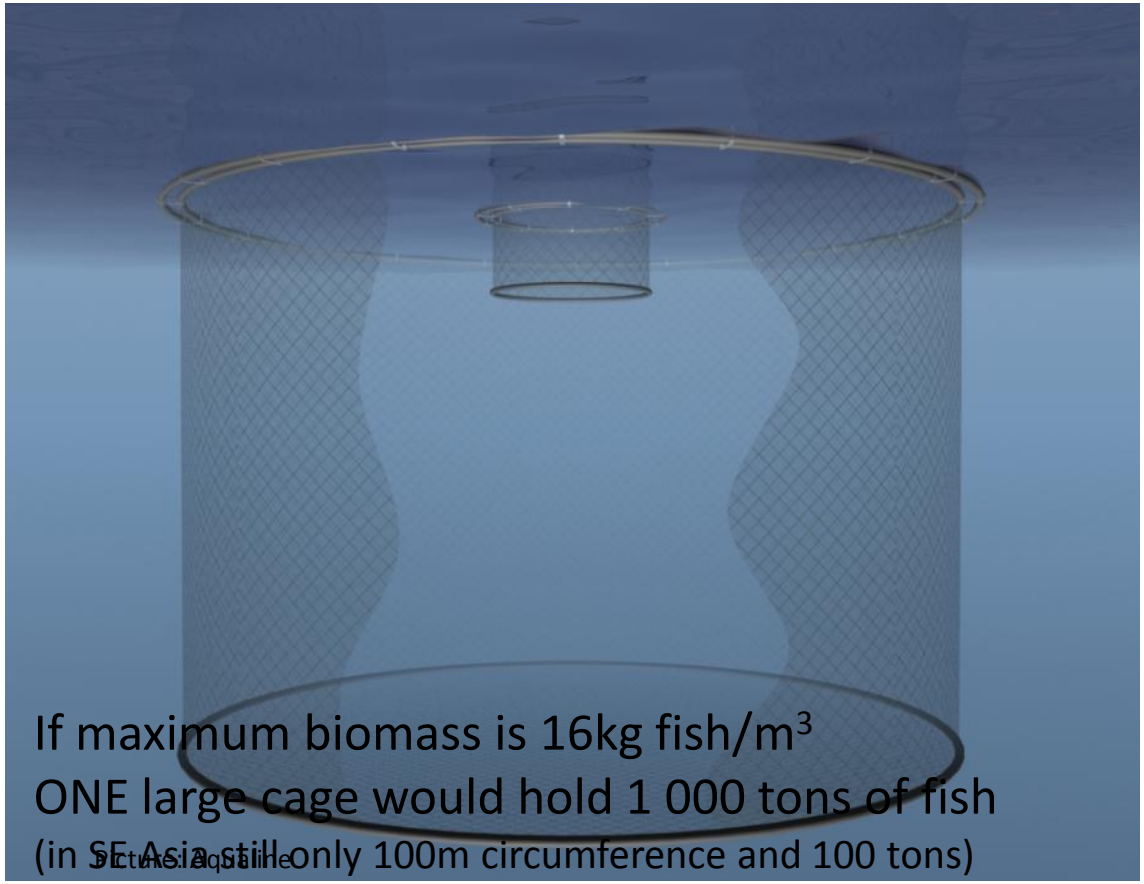
Seafood in perspective – Carbon footprints (Norway)



Carbon footprint – use of land



The ‘extreme’ development trend in cage size in salmon farming

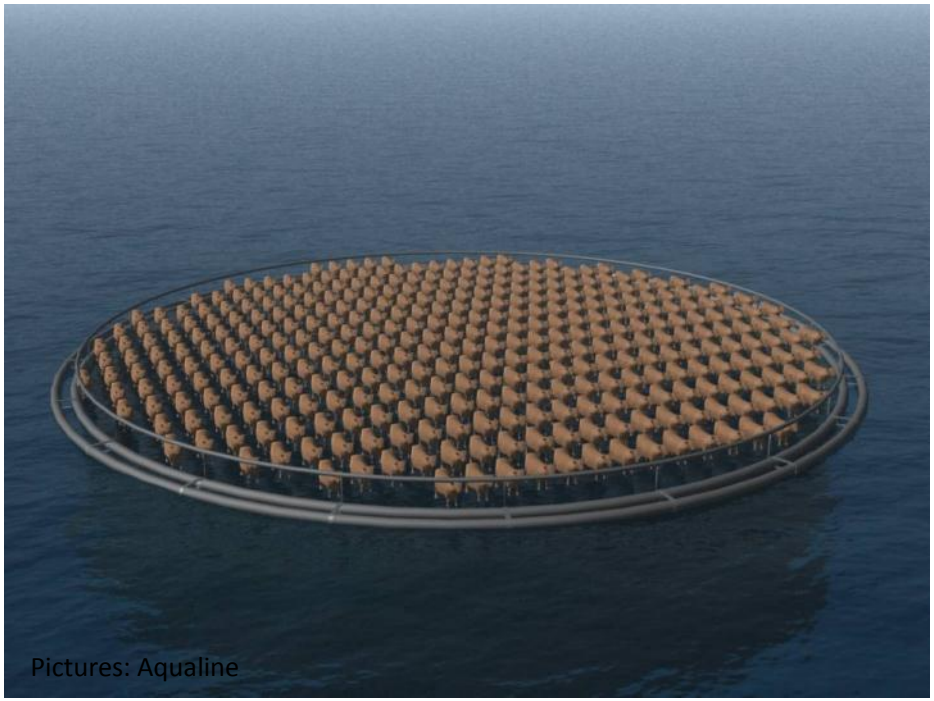


Volume increased 100 times compared to pioneer days in Norway:

40m circumference cage with 4 m deep net = 550 m^3

157m circumference cage with 30 m deep net = 60 000 m^3

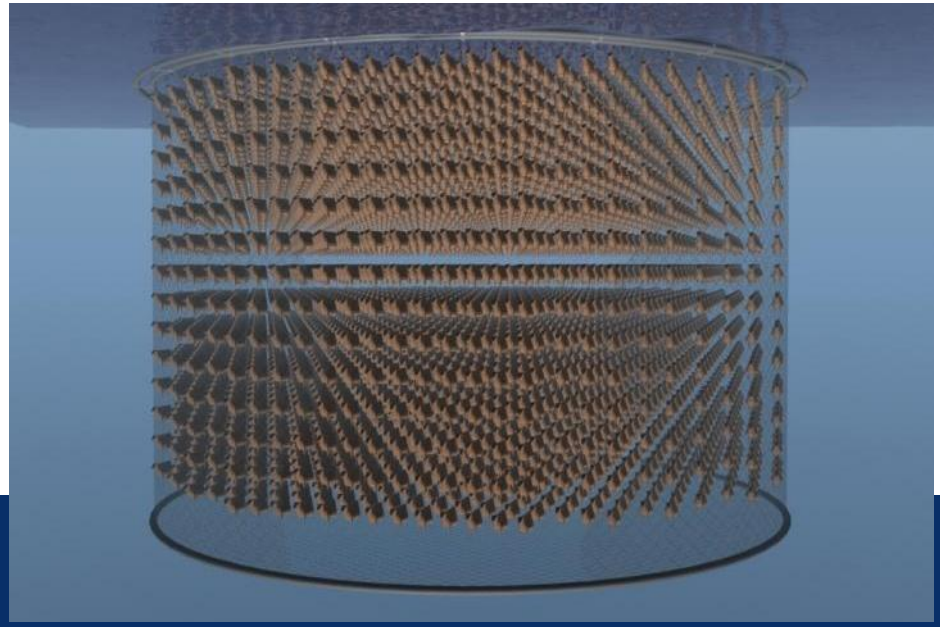
1 000 tons of fish biomass in one cage



If turning this fish biomass into ’cow units’ of 500 kg/cow:

It equals taking care of 2 000 cows; but the challenge is in addition to the large number that you cannot see them!

That’s why!!! it takes a skilled ‘shepherd’ plus ‘something more’ to tend one cage



New technology: Closed floating containments

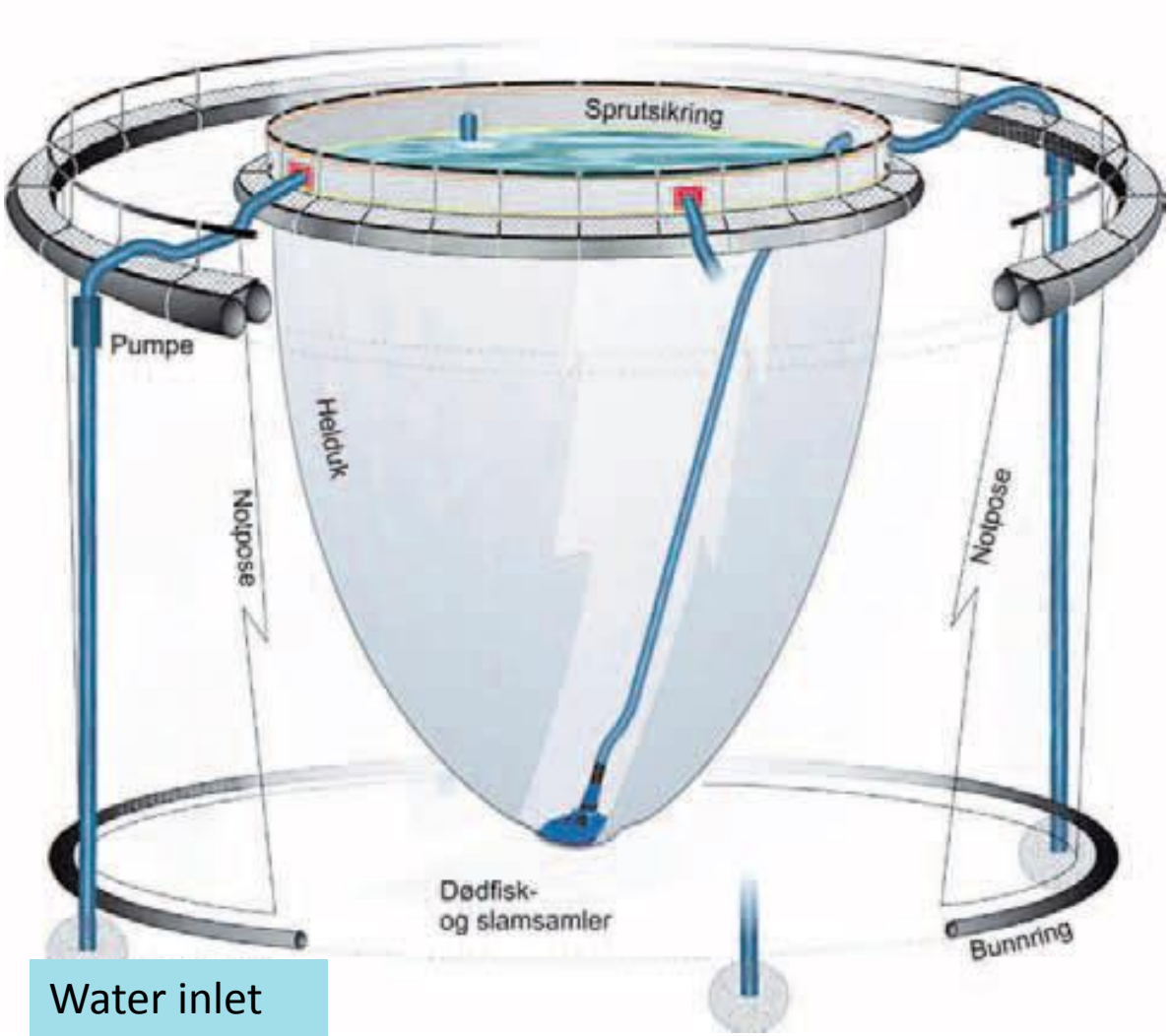
MSC AQUA AS AQUADOME®

Floating fish farm

- Reduce risk of escapes
- Prevent sea lice by pumping water from deeper layers

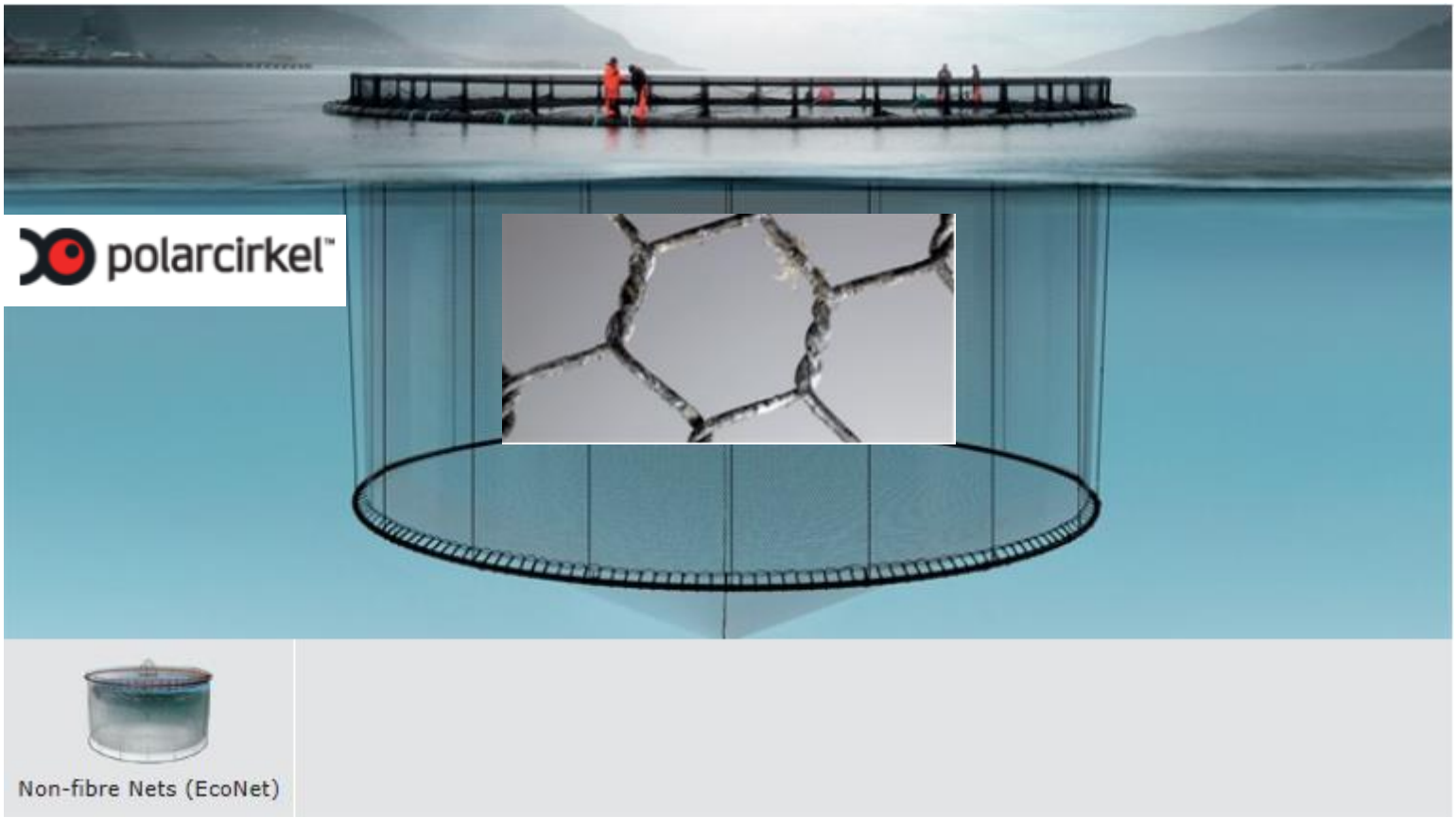
AquaDome® is built of composite plastic, GRP, which is a very sturdy material. It has strong operational, technical and labor-saving solutions made possible by the patented shape.
AquaDome® is designed as a hemisphere. The size is 27.7 meters in diameter, 15 m deep with an internal volume of 5560 m3.
Sufficient buoyancy is provided by the cavity in the combined float collar and walkway.
The design and choice of materials helps the AquaDome® withstand strong forces acting on it, in the form of currents, waves and icing.
The hemisphere shape makes it possible to equip the device with a semicircular arm of rigid material, which simplifies operations associated with the cleaning of the inside wall, and fish handling.

Closed nets



Water inlet

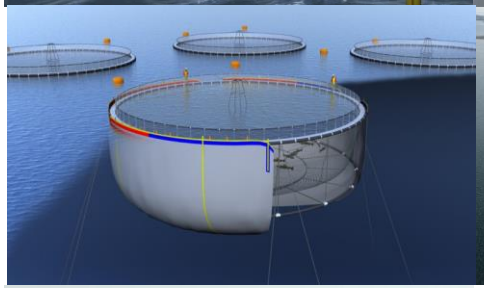
None-fibre Nets (ECONet)

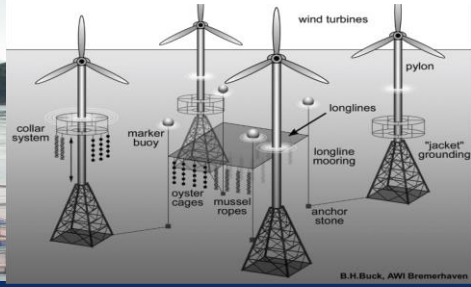


Blue –blue sector collaboration to increase innovation

- Transfer of knowledge , competence and solutions
  - Operations in the wave zone
  - Offshore wind
- Synergies in collaboration
  - Reliability and operability
  - Risk management and design
- Challenges and constrain
  - Operational limits for feeding
  - Operational limits for handling, delousing and changing nets
  - Transfer of fish
  - Biological limits
- Existing, closed containment or offshore
  - Need several kind of solutions


Illustration: Ocean Farming/Salmar





Ocean Fish Farming

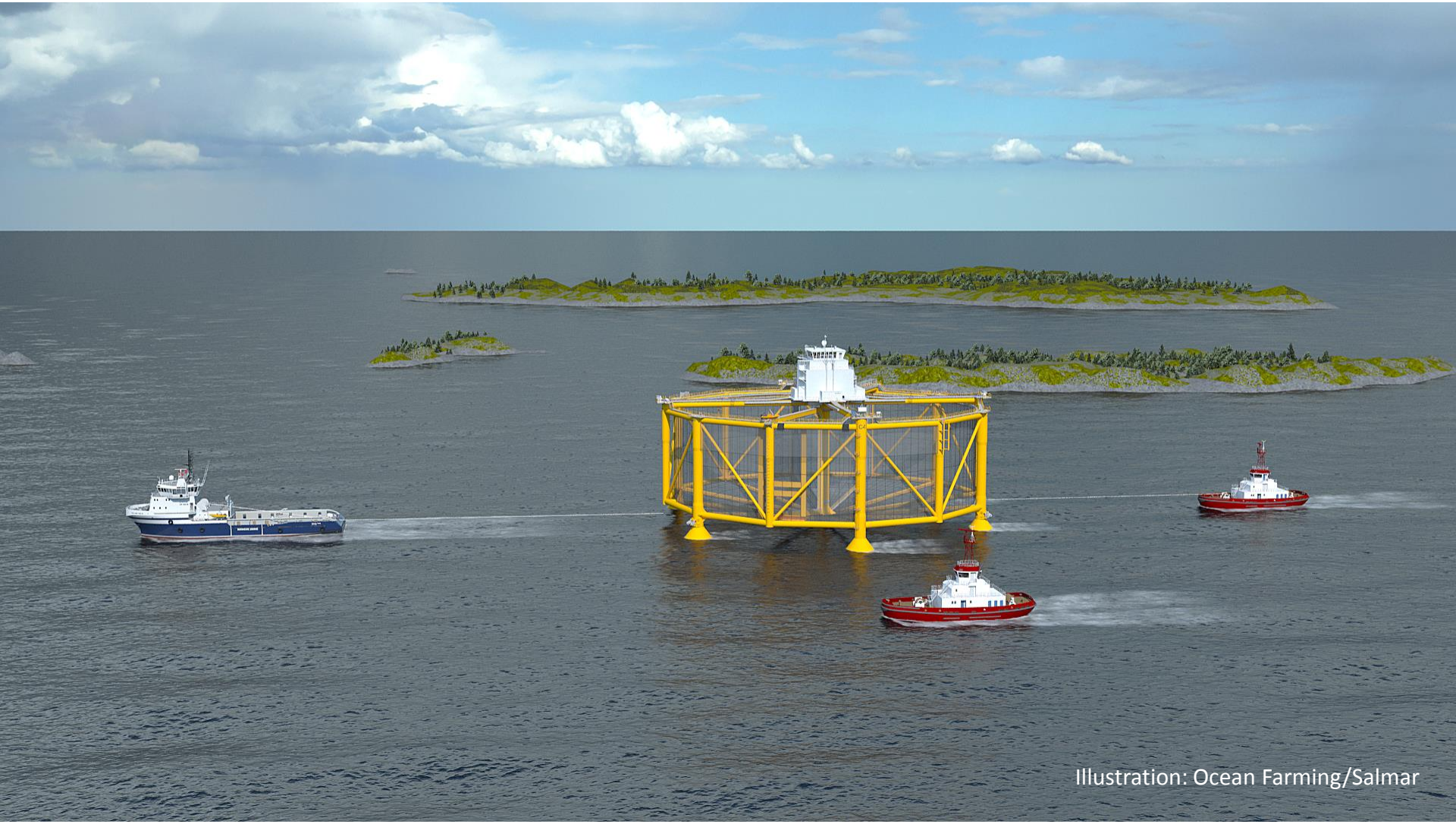
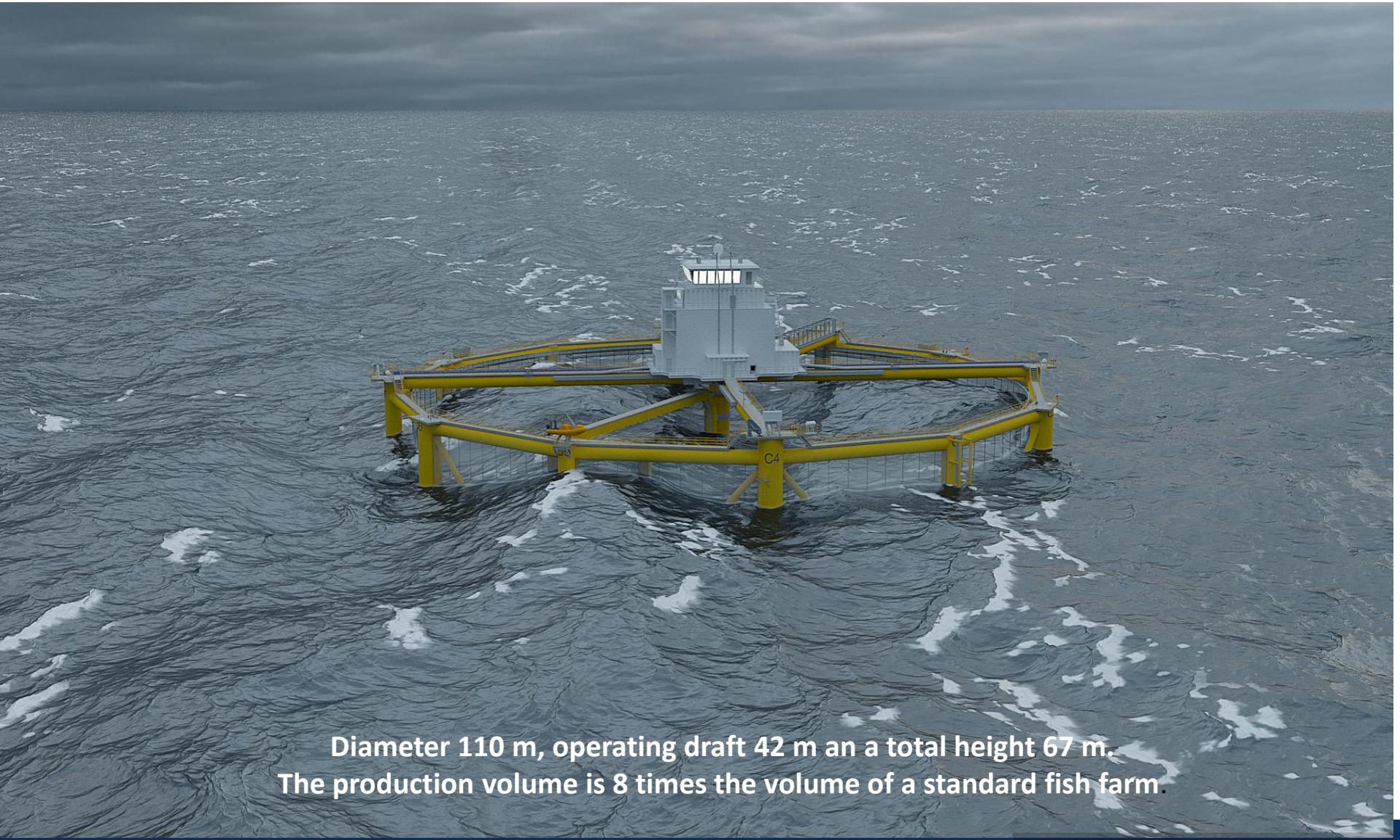


Illustration: Ocean Farming/Salmar

Ocean Fish Farming

Illustration: Ocean Farming/Salmar

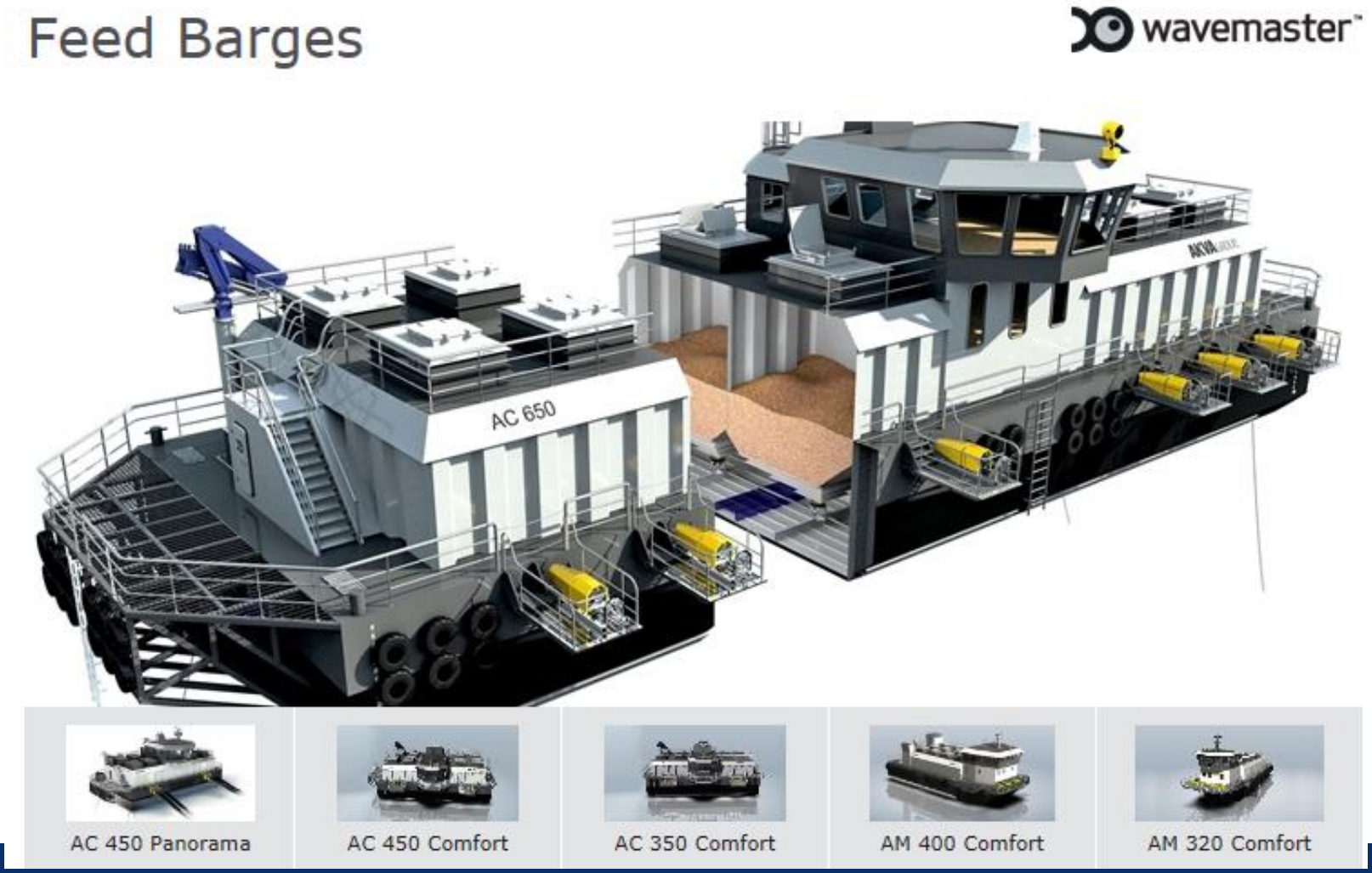
Ocean Fish Farming



Diameter 110 m, operating draft 42 m an a total height 67 m.
The production volume is 8 times the volume of a standard fish farm.

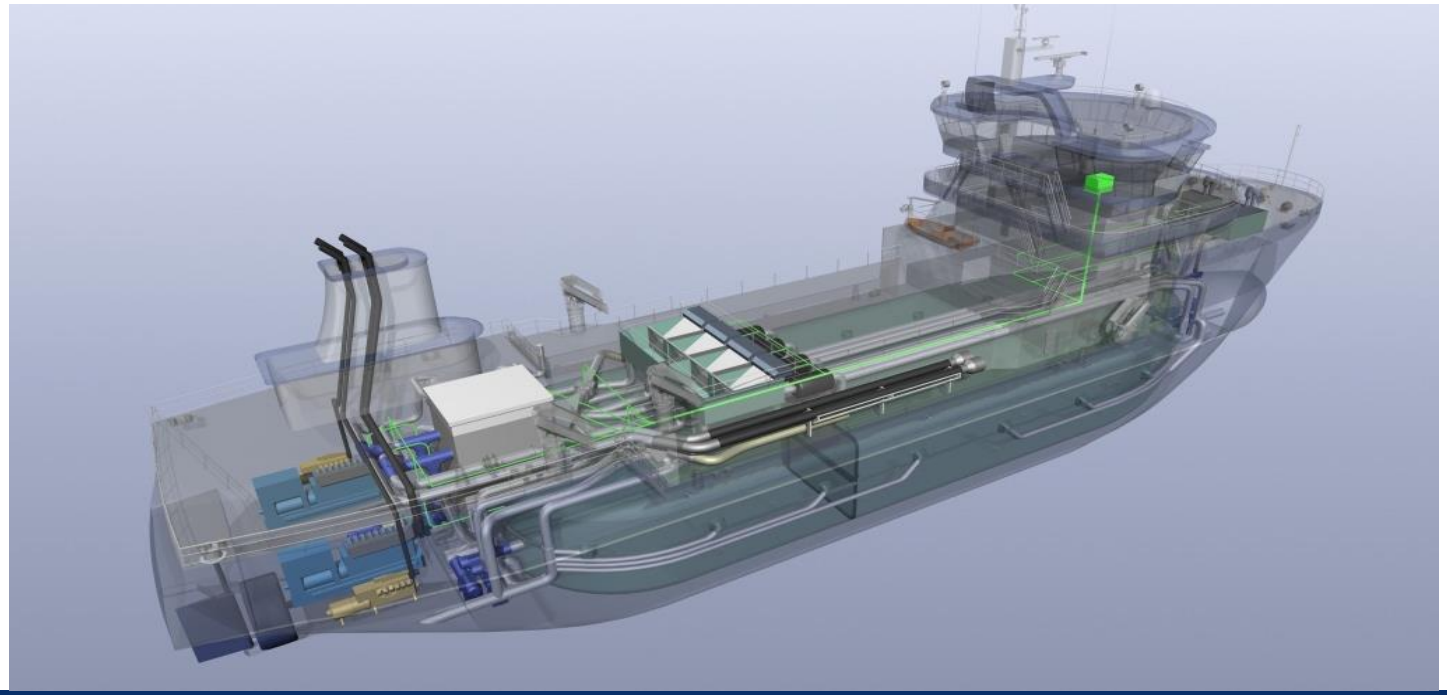
Illustration: Ocean Farming/Salmar

Standard Feed Barges



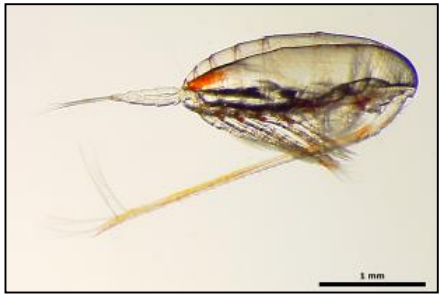
Next generation Well-boat Technology

- Biosecurity, efficiency, fish welfare, gentle fish handling and the environment
- Closed water systems – cleaning and disposal
- Pharmaceutical treatments
- Improvement of the interaction with fish farms
- DP (dynamic positioning) systems and other navigational aid



Need for Feed -> Harvesting zooplankton?

- The *Calanus finmarchicus* is available in huge amounts in the North-East Atlantic
- Annual biomass Norwegian waters approx 120 Million tonnes
- Compared to cod: ~40 times more Calanus
- High value ingredients for both
  - Feed industry
  - Pharmaceutical industry
- Norwegian fishing fleet is extremely innovative

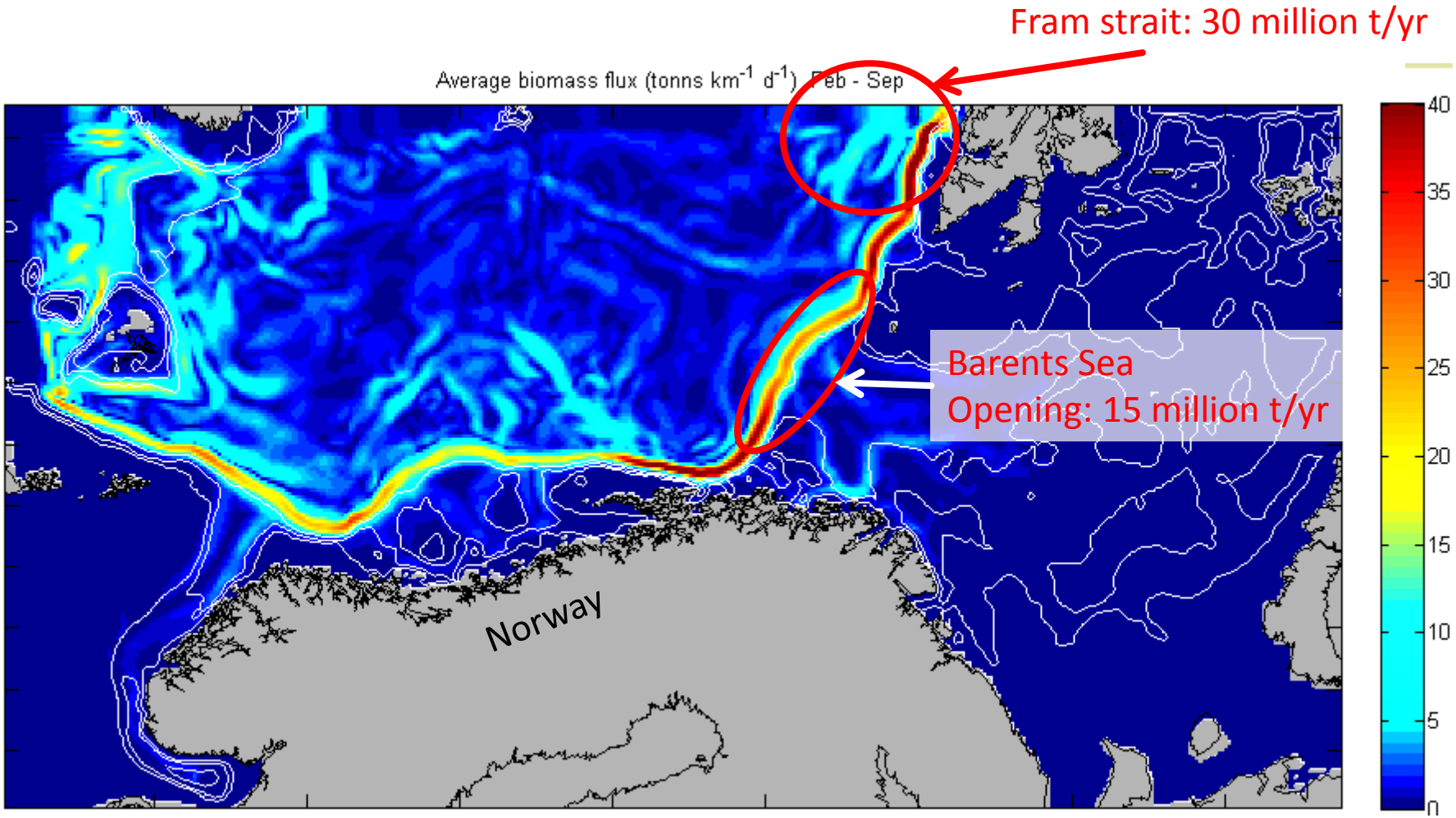


Calanus finmarchicus
(Photo: Dag Altin, BioTrix)

Calanus catches in trial fishery
(Photo: Snorre Angell, Calanus AS).

Calanus trawl. (Photo: SINTEF)

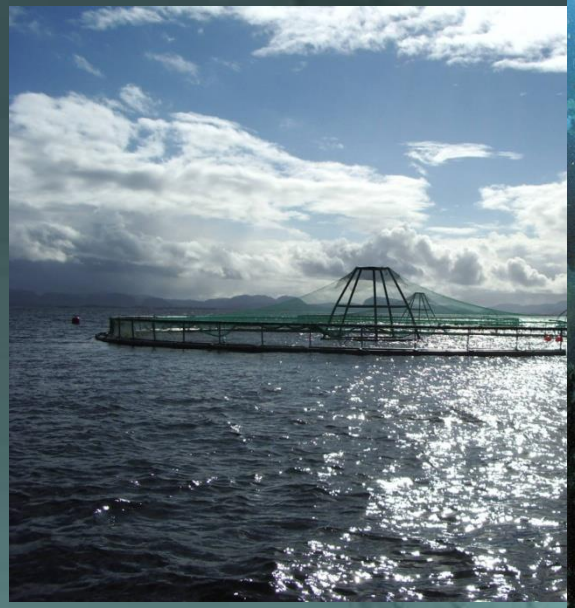
Average calanus biomass transport (Feb-Sept)



Source: Norwegian Directorate of Fisheries, seafood.no, DKNVS/NTVA (2012): "Value created from productive oceans in 2050"

Another growth opportunity: **Seaweed cultivation**

Integrated Multi-Trophic Aquaculture



Intensive fed aquaculture (salmon)

Filtering species culture (mussels)

"Photosynthetic aquaculture" (seaweed)

Future potential of growth

- Global need for food ; Wild catch of fish supply cannot increase !
- Aquaculture needs to produce around 4 % more marine proteins each year to satisfy demand up to year 2020 (FAO forecast)
- Only 2 % of food production comes from the ocean

  - *Salmon farming saw a strong global harvest growth between 1996 and 2005, with a CAGR *) of 9,6 %, but "biological carrying capacity diminish growth".*
    A.H Aarskog, CEO, Marine Harvest

  Future growth in salmon farming expected to CAGR of 2,9 % between 2014 -2020

- Norwegian Fish Farmers Association goal; 2,7 million tons by 2025

*) CAGR = Compound Annual Growth Rate