

Better off Blue

#BetterOffBlue17

Creating synergies for a biobased society

Sustainable Water Solutions for Aquaculture
“RAS2020-Land-based Farming for the Future”

Dr. Michael Bech. Krüger A/S Denmark



Krüger – water treatment for 115 years



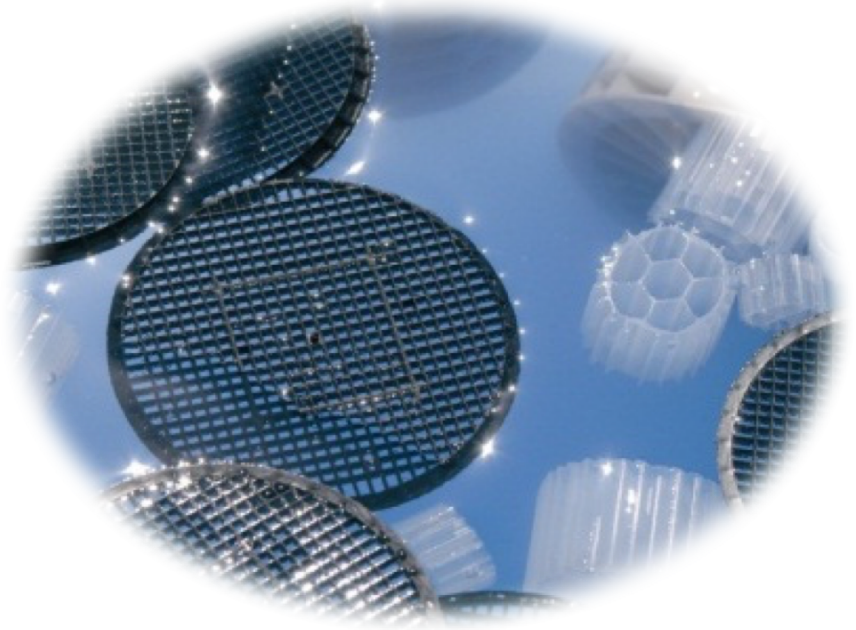
- Krüger 450 employees 3 offices in Denmark
- Owned by Veolia – 200.000 employees in 60 countries– specialized in water treatment
- All aspects of water treatment drinking water, waste water treatment, transport of water etc.
- Competence center within Veolia for aquaculture in cooperation with Krüger Kaldnes, Norway.
- Recirculation technology requires the same skills
- Veolia has been involved in aquaculture for the last 30 years, and Krüger since 2012

Examples of Veolia products

HYDROTECH Micro screens



ANOXKALDNES™ MBBR



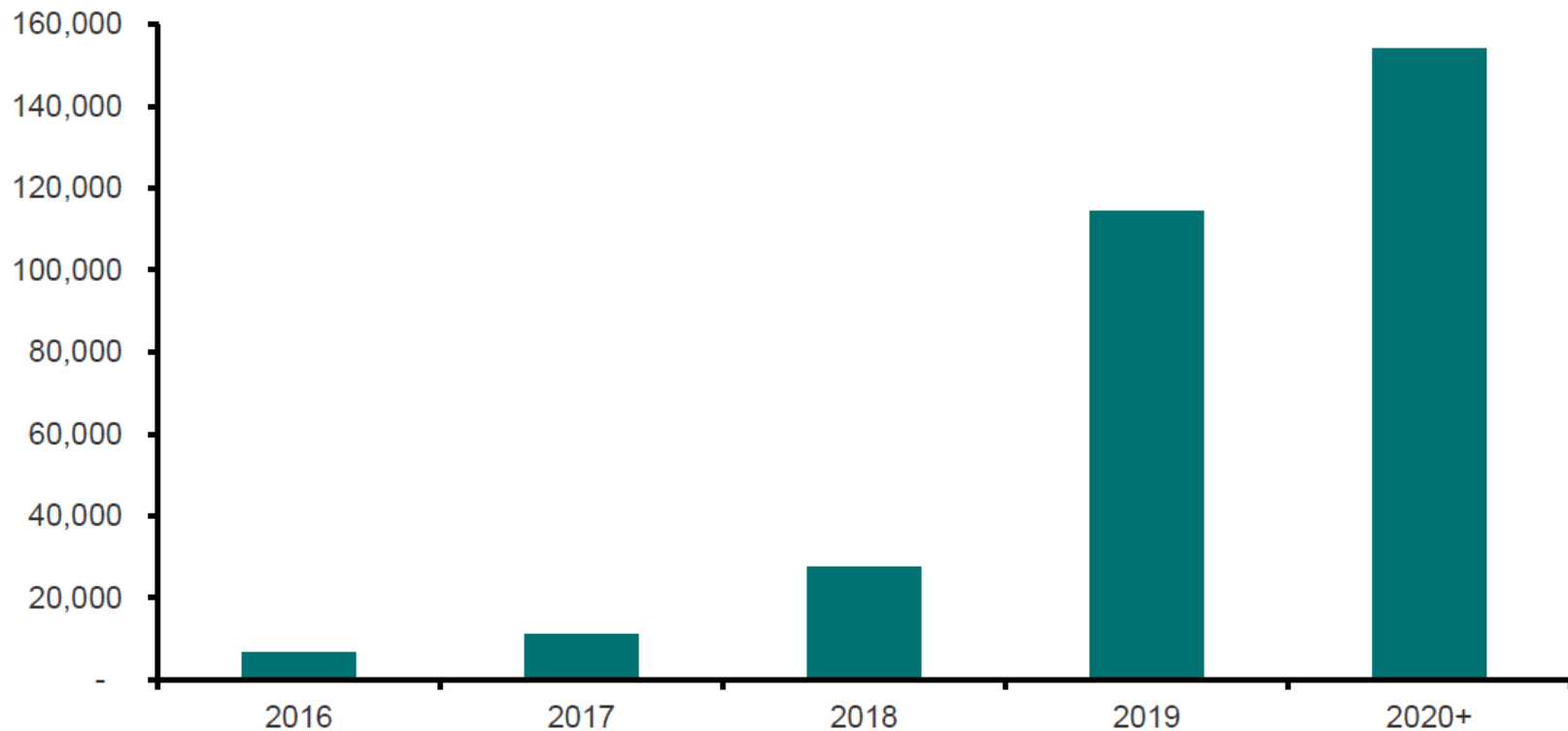
Tendencies within aquaculture

- Aquaculture has passed fisheries in volume and still increasing
- Salmon prices 50 % higher than two years ago
- Production price per kilo fish on land approaches seabased cages
- License prices for seabased sites increasing - 2014 NOK 66 mill
- Increasing costs and loses due to lice, diseases, toxic algae etc
- Salmon smolt cultured to increasing size on land
- Increasing awareness of environment and the unlimited discharge
- In conclusion – landbased aquaculture is increasing because of economy, safety of production, technology and environmental issues

Expectations of landbased RAS

DNB Markets a division of DNB Bank Report Feb. 2017

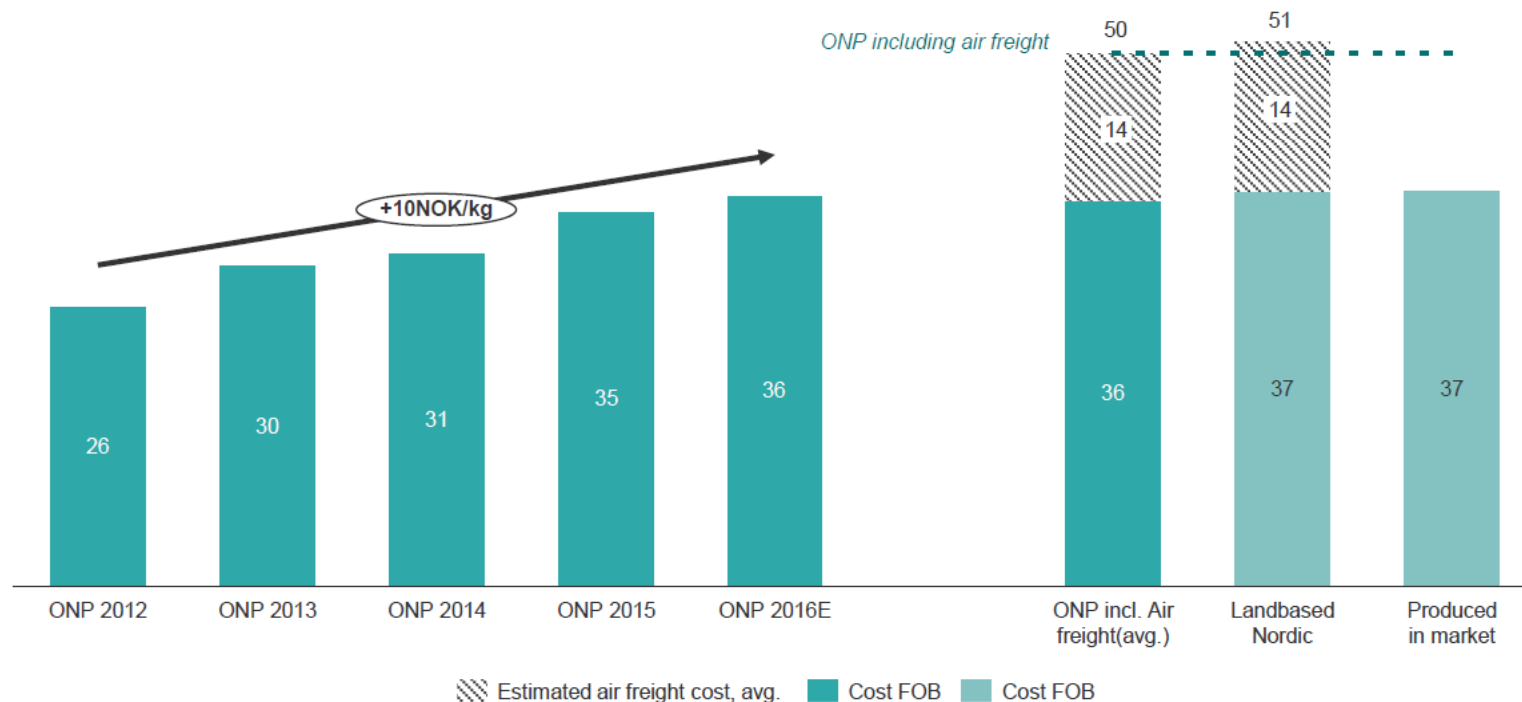
Figure 1: Capacity plans full on-growing of salmon (harvest volume, HOG, tons)



Expectations for the future of landbased RAS

DNB Markets a division of DNB Bank Report Feb. 2017

Figure 37: Cost trend (NOK/kg) and benchmarking versus land-based farming



Source: Directorate of Fisheries(actuals), Kontali(air freight), DNB Markets estimates

Feed

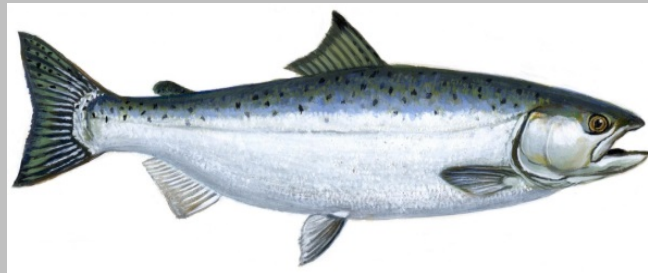
Content per 100kg

- Nitrogen 8kg
- Phosphorus 1kg
- Protein 50kg
- Fat 16kg
- Carbohydrate 17kg

Dimensioning of RAS is based on feed load to the system

Oxygen

35kg



Growth

- Weight 90kg
- Nitrogen 2.7kg
- Phosphorus 0.45kg

Waste Products

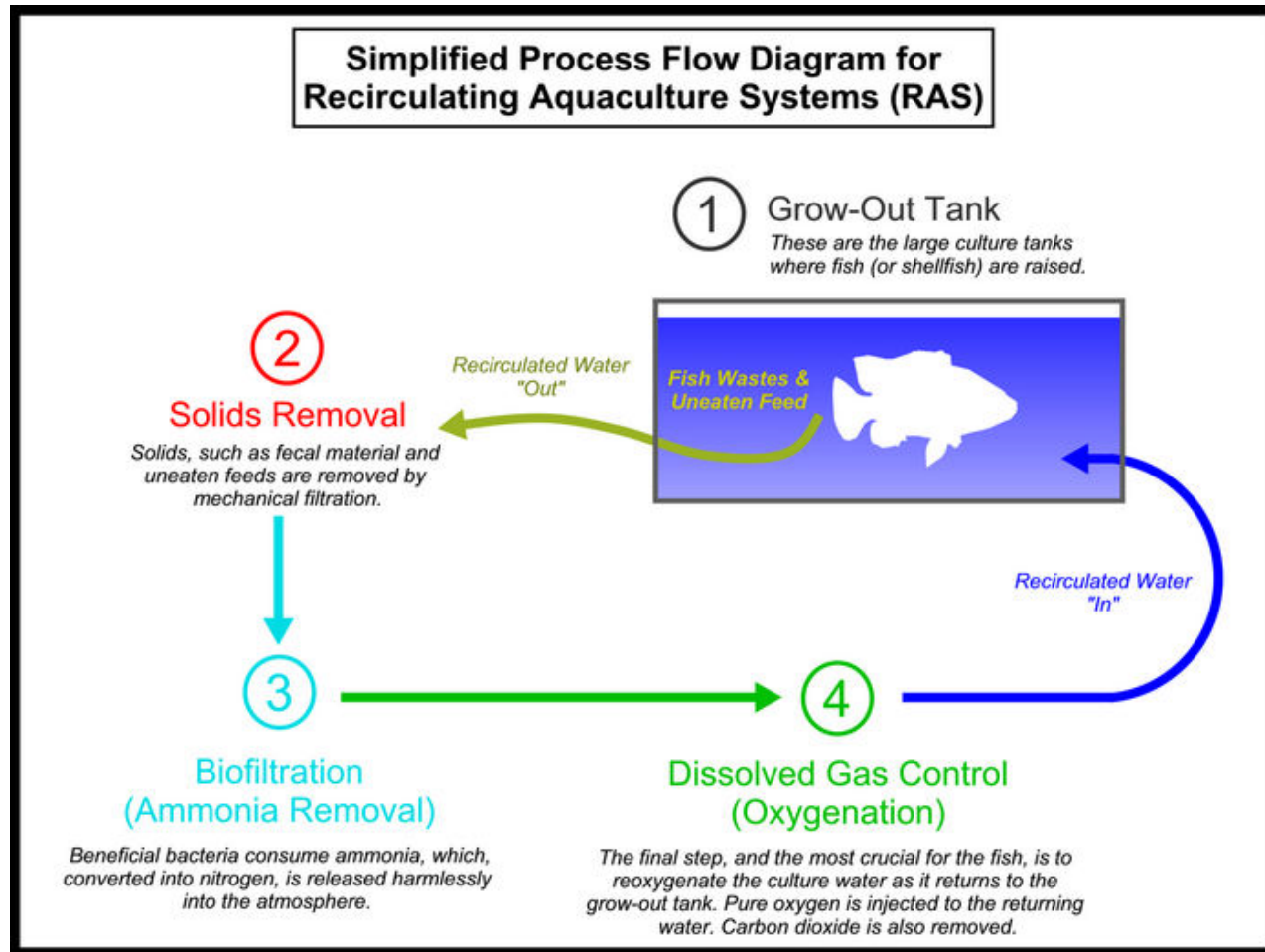
Dissolved

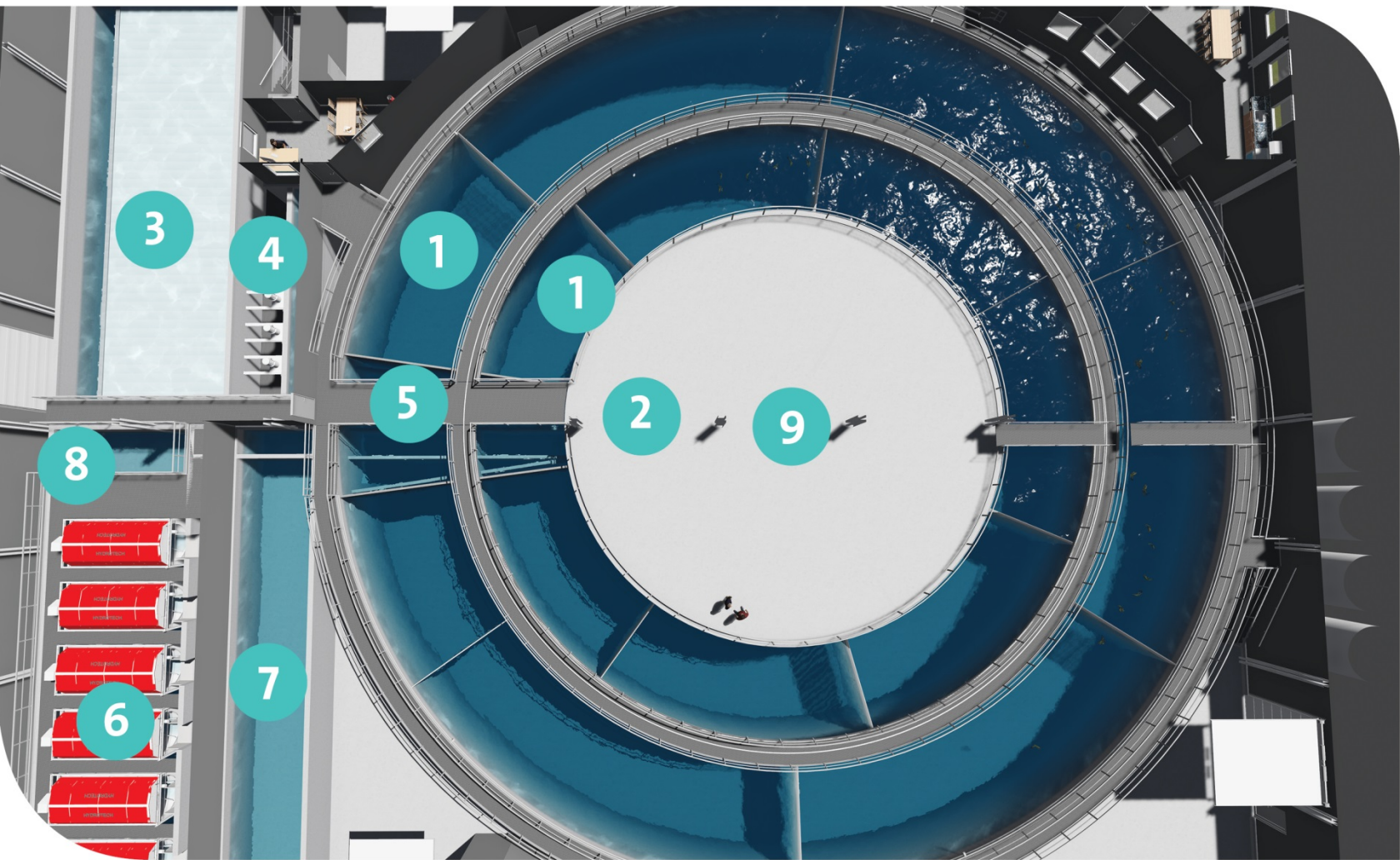
- Nitrogen 4.5kg
- Phosphorus 0.3kg
- CO₂ 50kg

Particles

- Nitrogen 0.8kg
- Phosphorus 0.25kg
- BOD 63kg

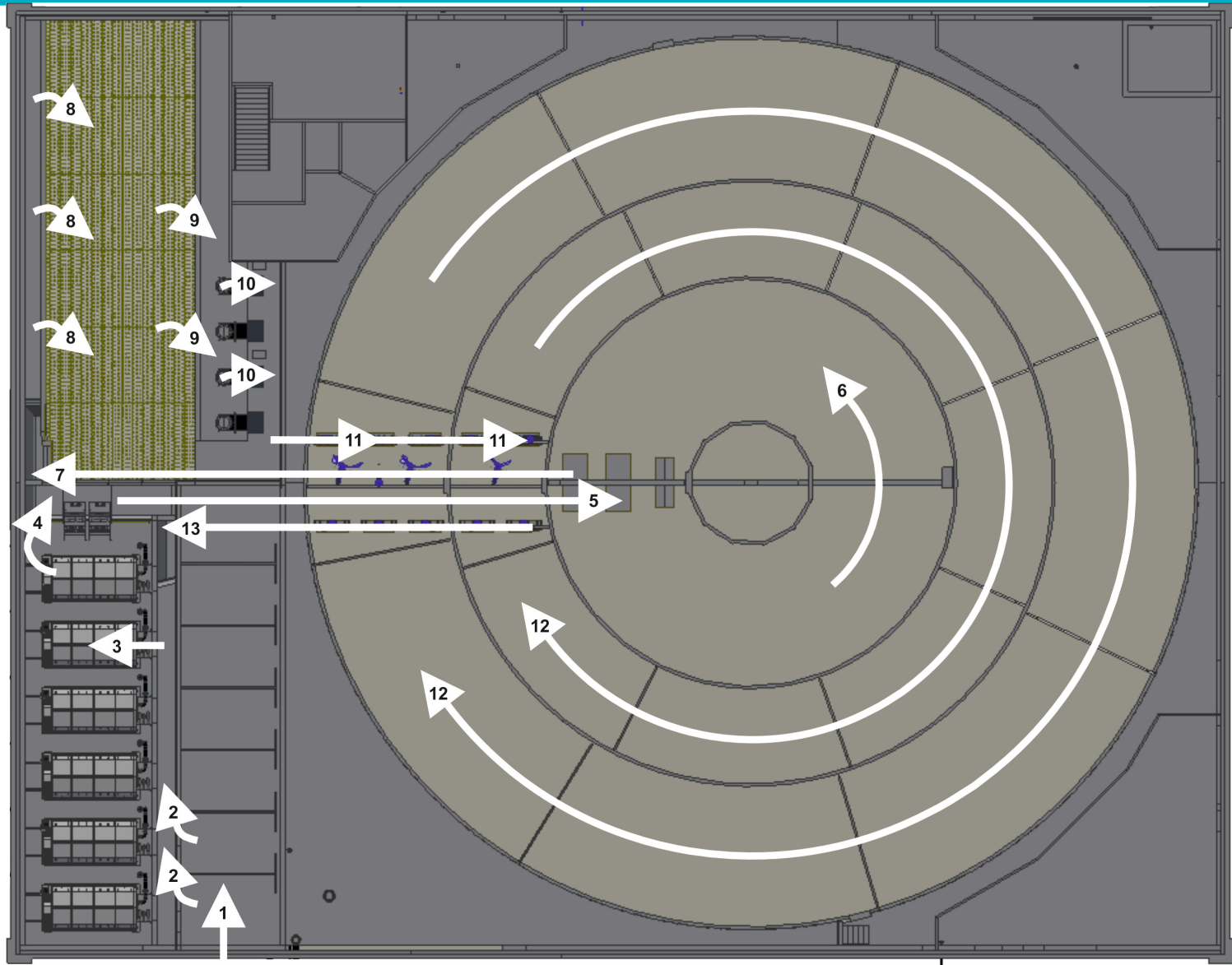
Recirculated Aquaculture System (RAS)



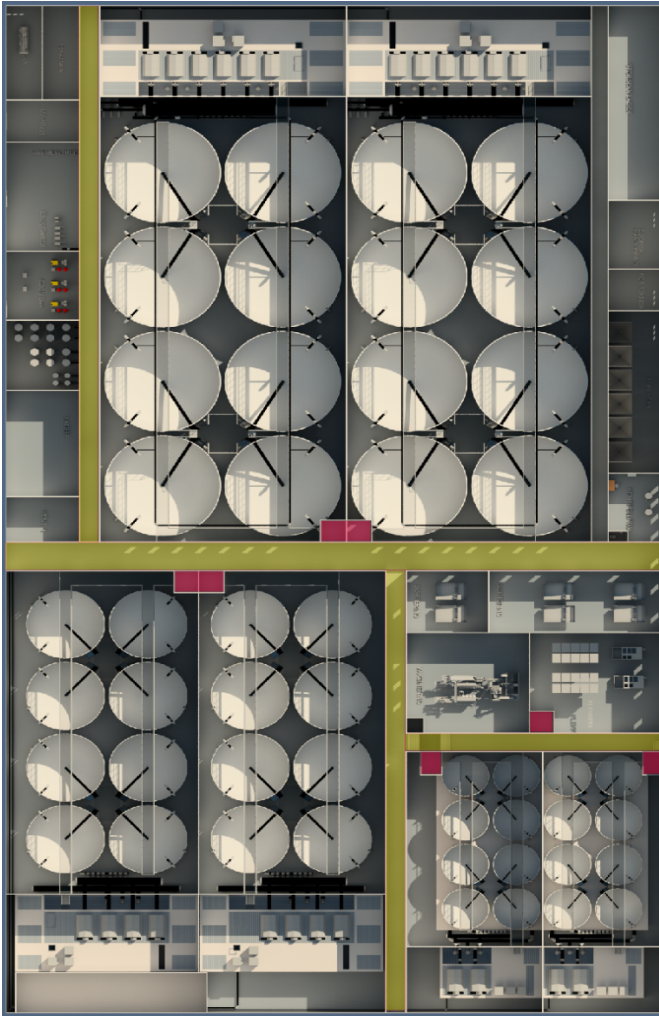


- | | | |
|--|--|---------------------------------------|
| 1. Fish tanks with movable compartments | 4. Propeller pumps into level weir | 7. Purging tank |
| 2. Biofilter MBBR reactor (Krüger Kaldnes – Veolia) | 5. Inlet channel and circulation propeller | 8. UV filter |
| 3. CO ₂ and N ₂ Degasser – (Krüger Kaldnes – Veolia) | 6. Drumfilters (Hydrotech – Veolia) | 9. Denitrification chamber (optional) |

RAS2020 – Flow pattern



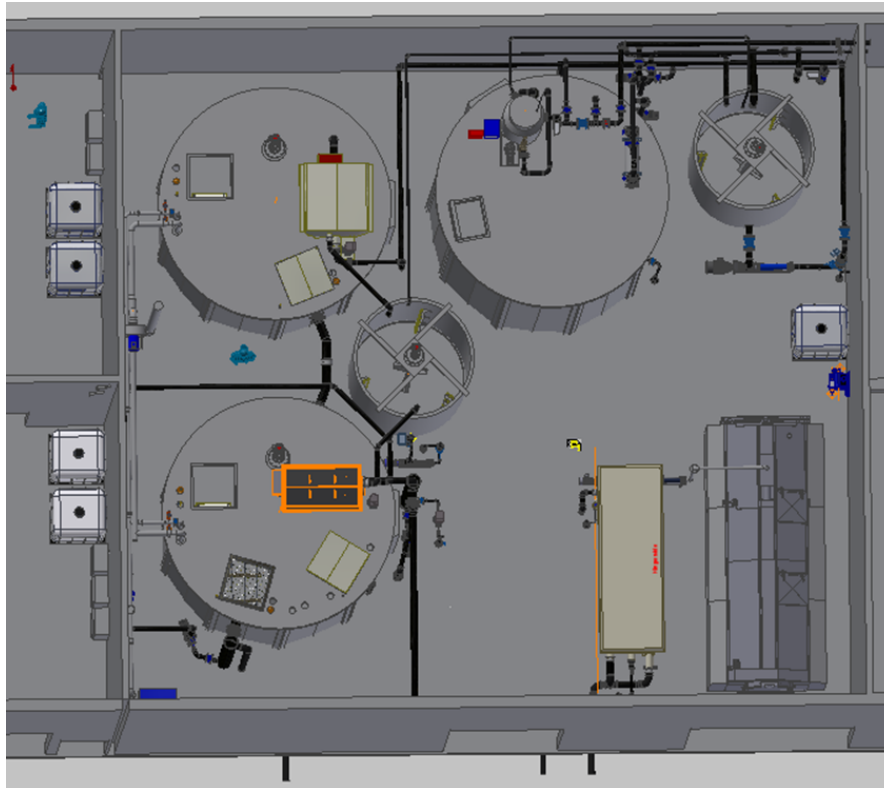
Biosecurity



- Own production of smolt
- Quarantine
- Intake system
- Purge tanks - geosmin

Waste water treatment system (WWTP)

	Cage culture 1000 tons Annual discharge (Tons)	RAS - BAT level (Tons)	RAS - BAT x 0,5 (Tons)	RAS cleaning to Danish level for public WWTP (Tons)
Tot-N	47,5	27	13,5	3,5
Tot - P	6	1,4	0,7	0,7
BOD	220	14	7	3,5



Marine Harvest - Steinsvik

- 5,3 million 250g smolt/år
- 10.900 m³ opdræts volume
- 8,9 tons foder per dag



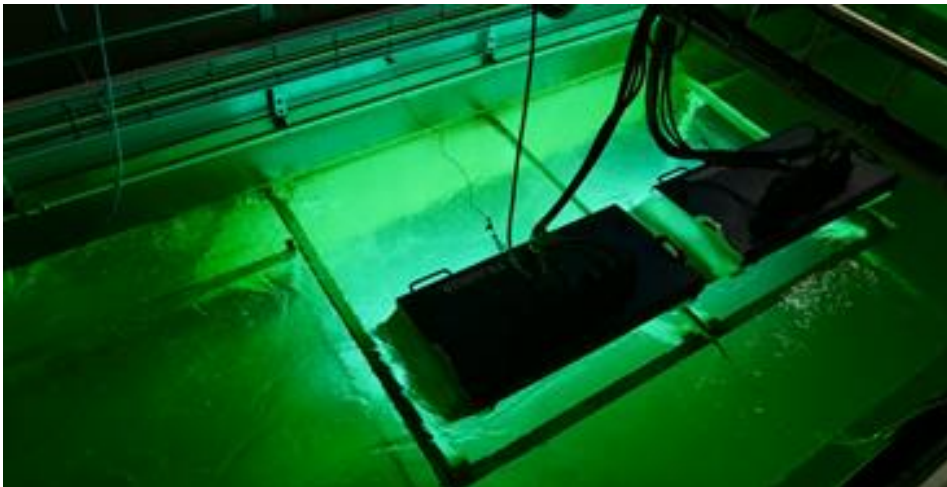
Marine Harvest - Steinsvik



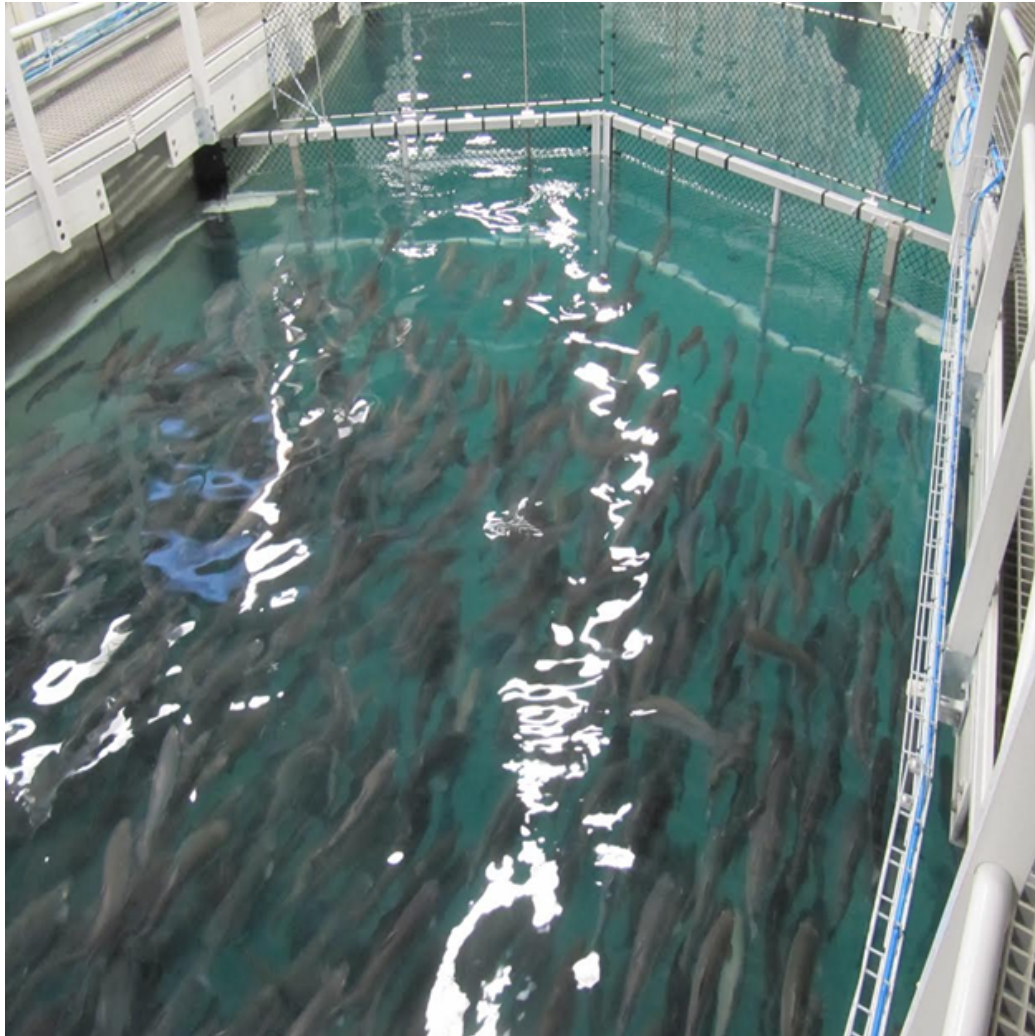
Sashimi Royal – Kingfish production



Sashimi Royal – recirculation system



SAF first harvest of top quality trout



Swiss Alpine Fish (SAF)



Thank you for the attention !

