Technology Towards 2020- are there any limits with biology?

A Collaborative Research and Innovation Centre

Our vision: Feeding the future with sustainable aquaculture solutions

Tor Solberg
Uni Research

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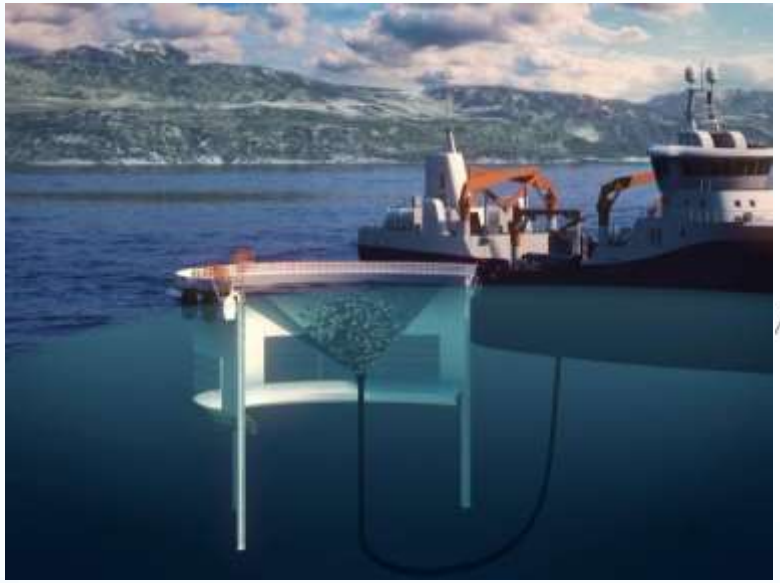
Are there any limits with biology?

Absolutely!

However these vary with platform and species.

Closed systems in sea



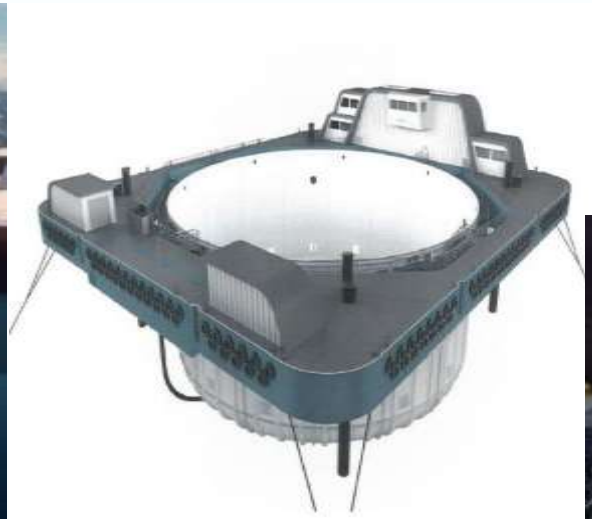
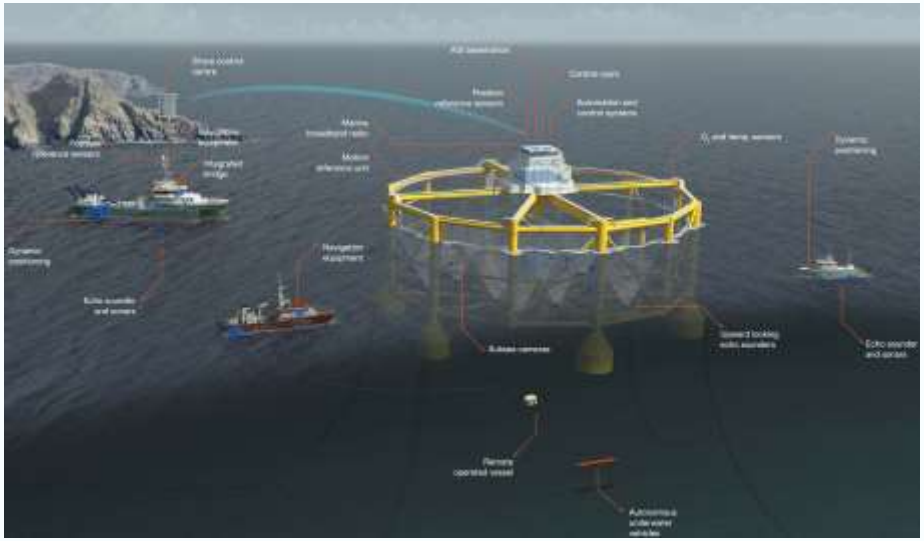


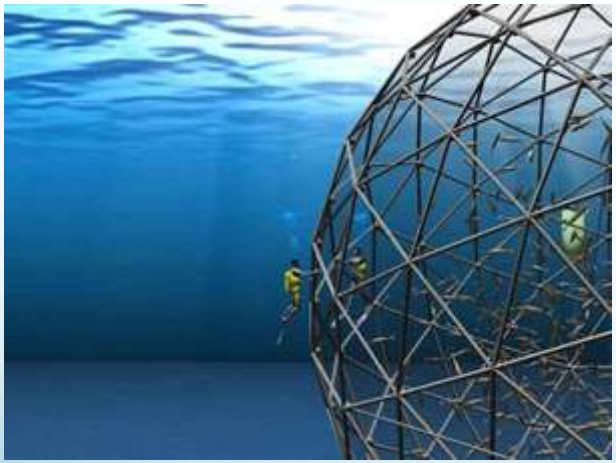
Photo: Lerøy
SeaFood Group

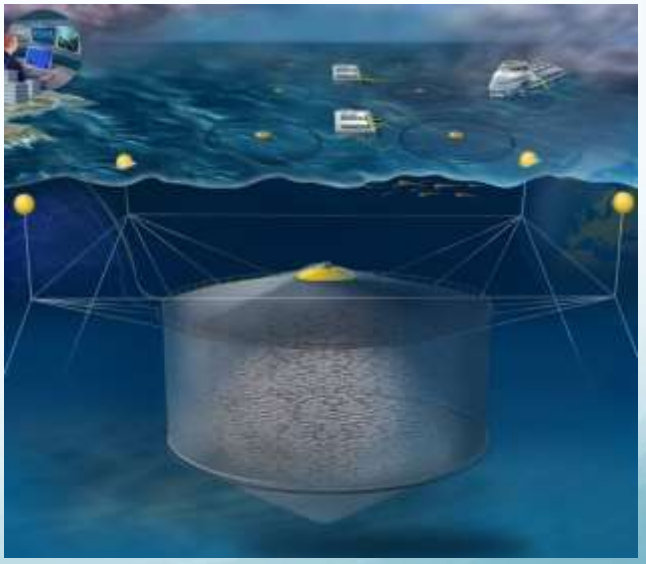
Photo: Hauge
Aqua

Large RAS running or being built

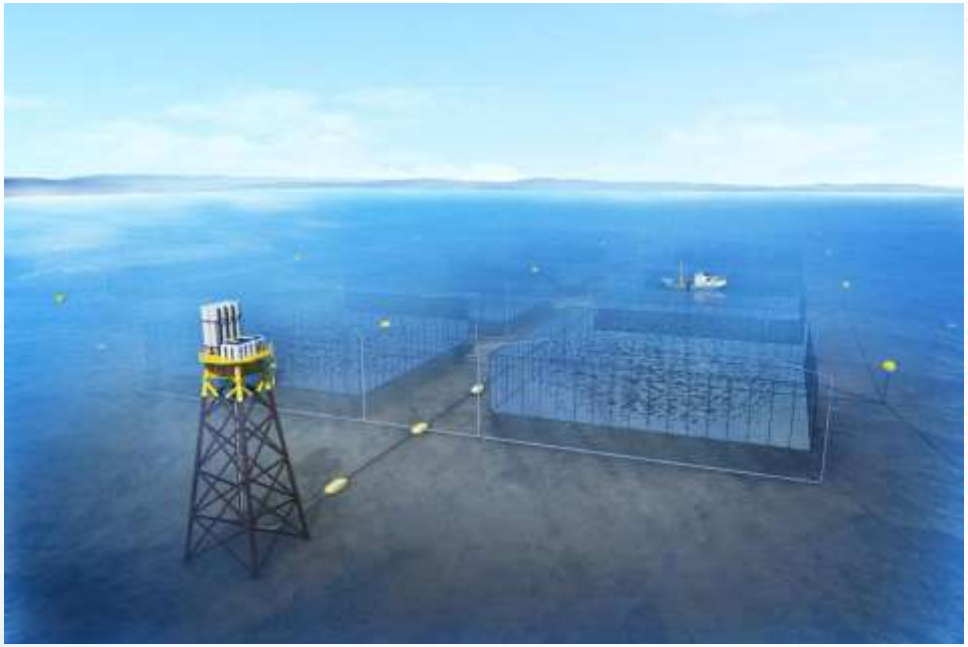
Large offshore platforms

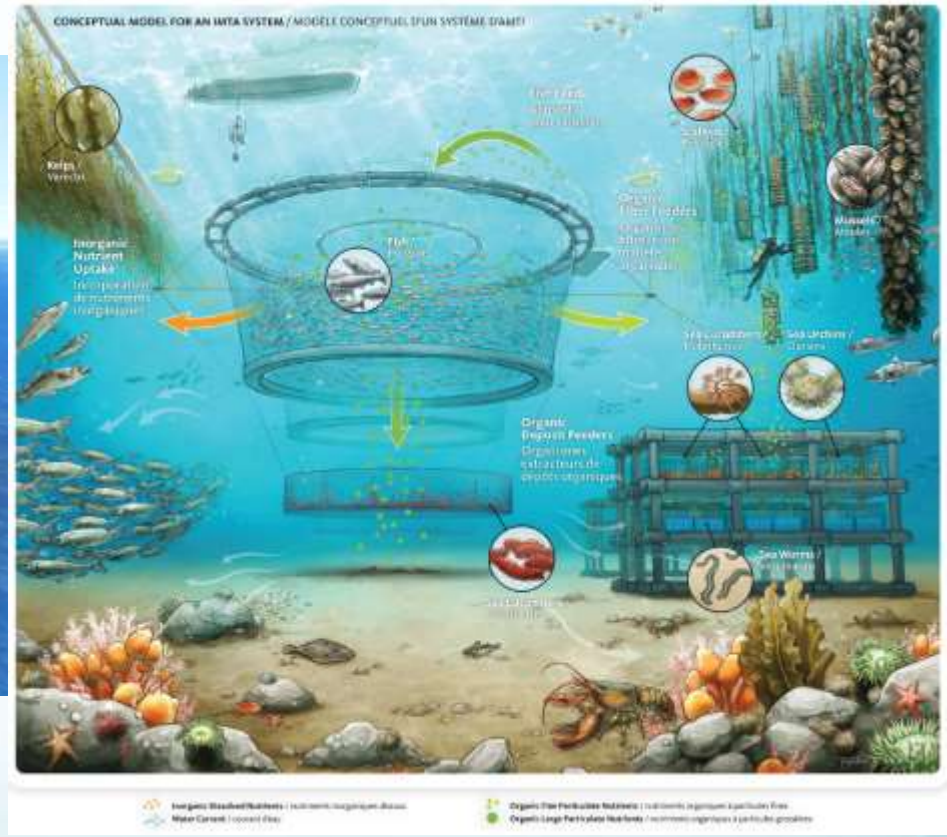






Large multi-culture platforms





Many species with different biological requirements

Even modified or selected strains within a species can have different biological requirements

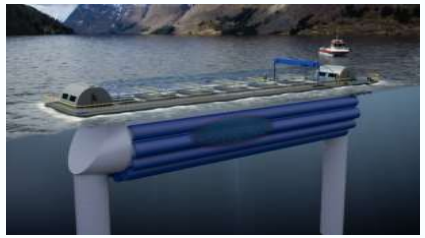
- Triploid salmon
- GMO

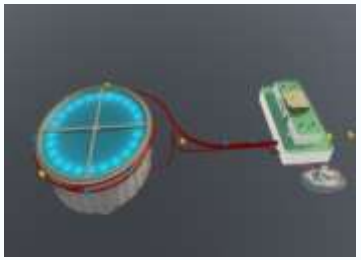
Environment on fish function

CtrlAQUA

REDUCE STRESSORS

OPTIMIZE REARING ENVIRONMENT





Semi-closed containment systems (S-CCS) development

Physical

Handling & Transport
Tank to Net pen,
Density, Noise

Light, Photoperiod.
Temperature, Salinity
Feed, Water Quality

Water quality

pH, O_2, Particles
°C, CO_2, $NH4^+$, Al …

Social

Competition
Aggression

Brain regulation

Neural response

Physiological & Endocrine responses

Functional outputs

Growth
Appetite
Smolt development
Reduced maturation
Robust
Welfare

- **Develop mental robustness indicators (Good welfare indicators)**
- **Develop biomarker diagnostic tools**
- **Innovating new assessment tools through modern technological advancements**

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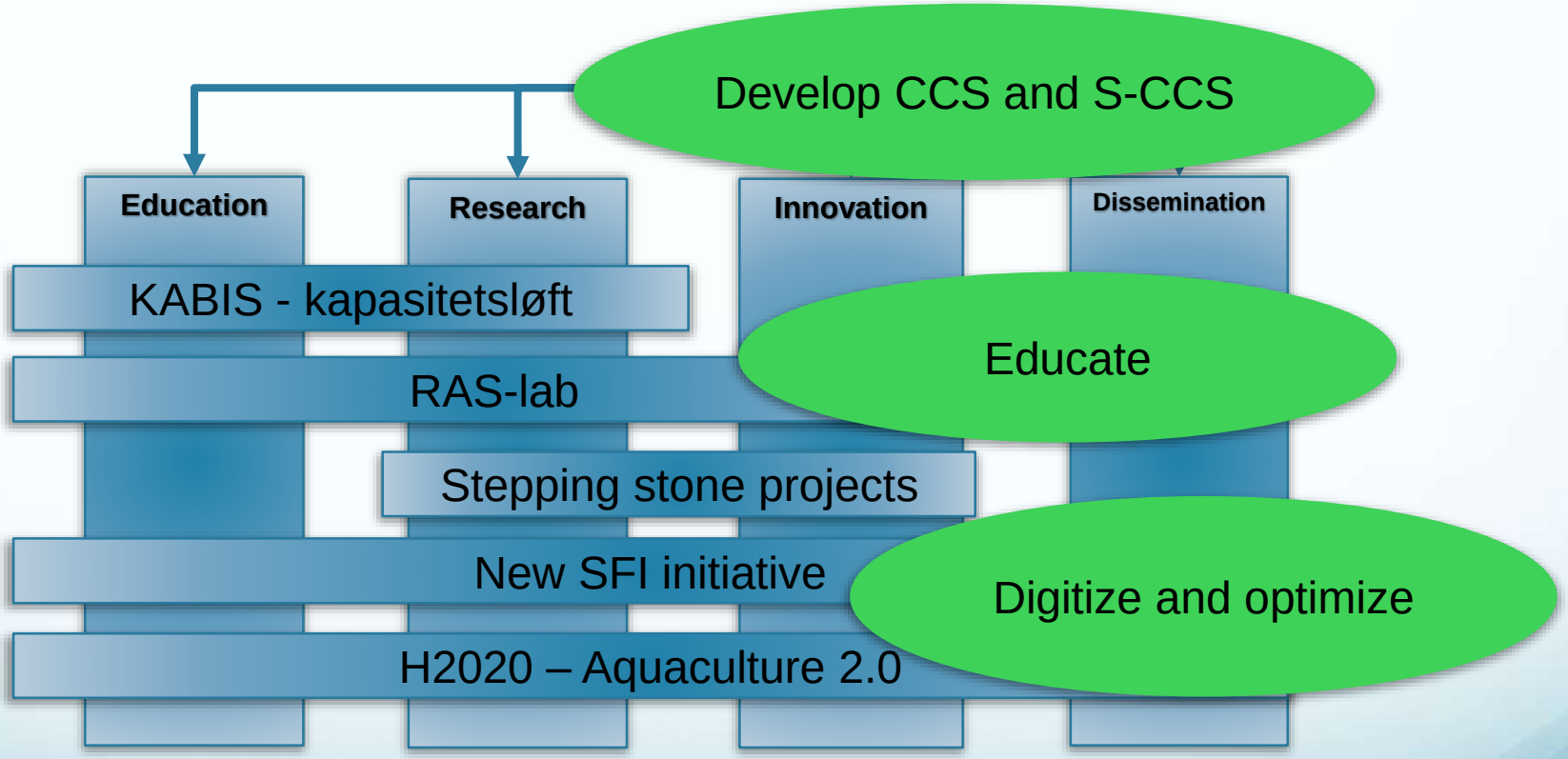
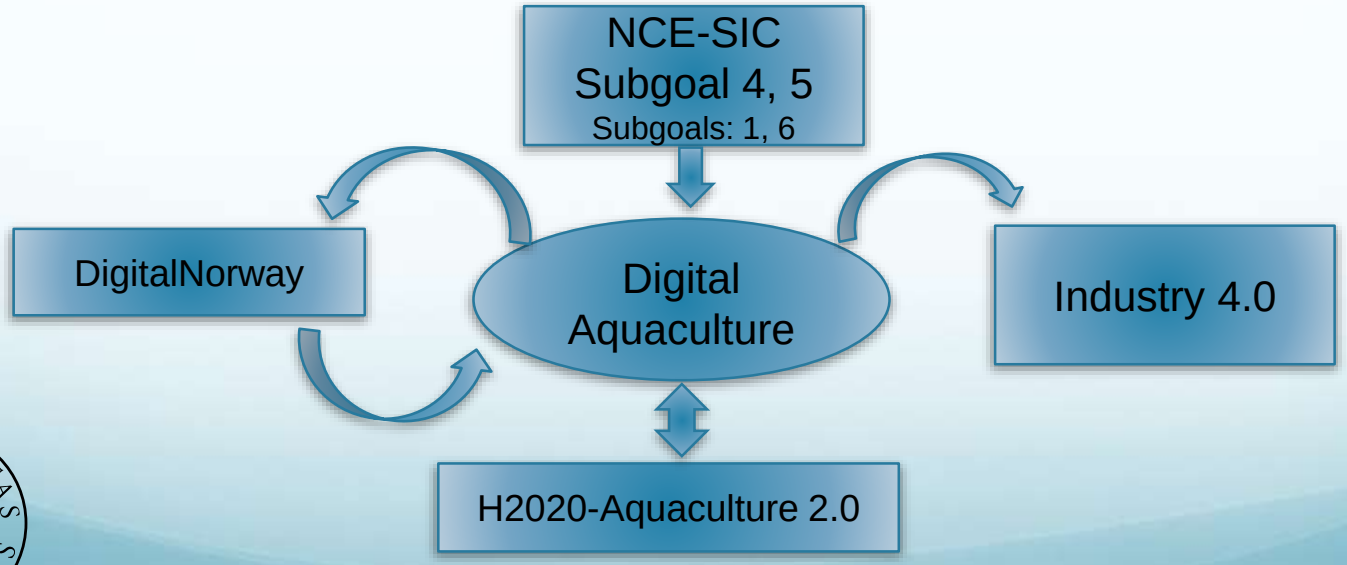
Our Strategy



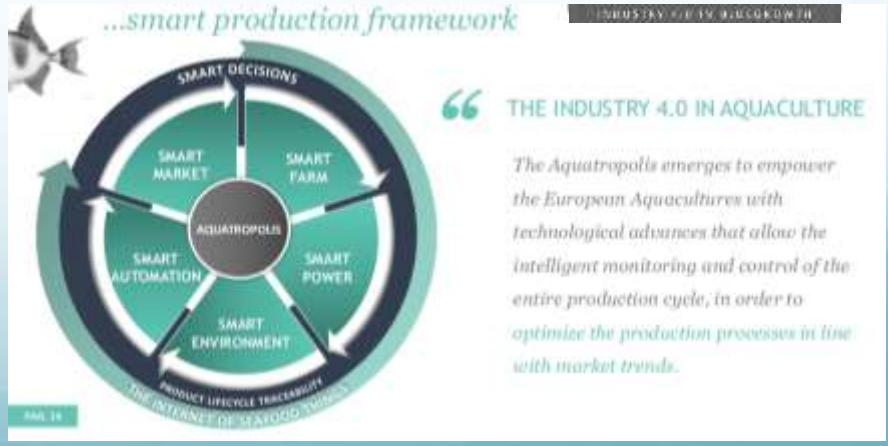
Digital Aquaculture for blue growth in aquaculture

Developing and integrating advanced fish feeds, monitoring and control systems to maximize feed consumption efficiency, fish growth and welfare while reducing feed waste and environmental impacts

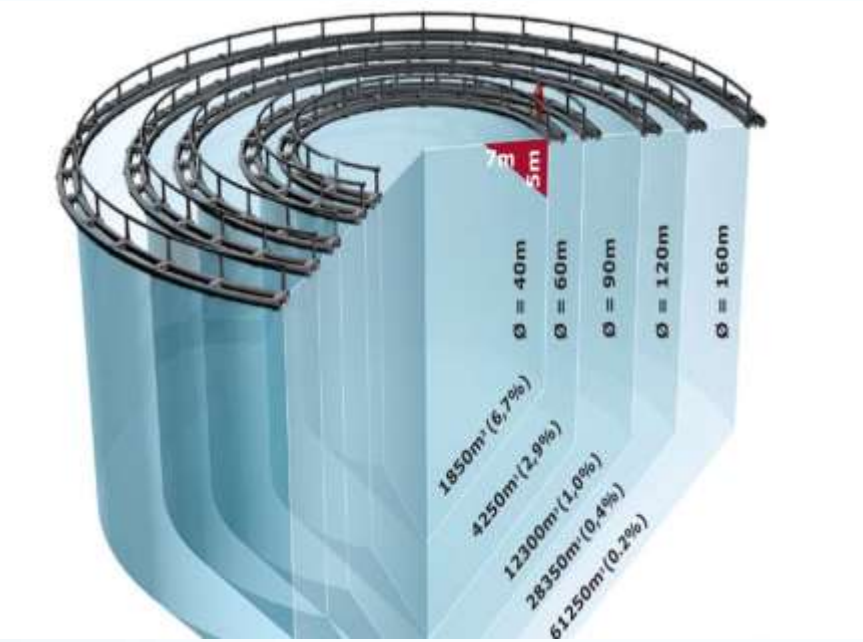


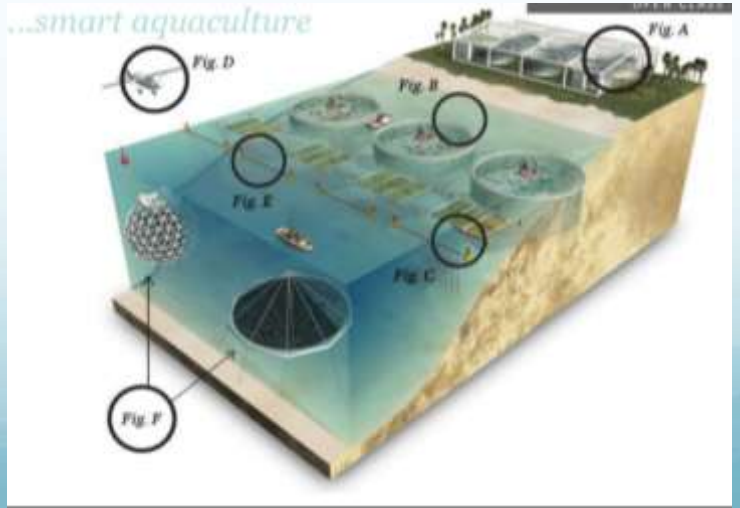
Industry 4.0

- **Industry 4.0** is the current trend of automation, digitalisation and data exchange in worldwide industries
  - cyber-physical systems, the Internet of things and cloud computing
- Industry 4.0 ⟺ "smart factory"

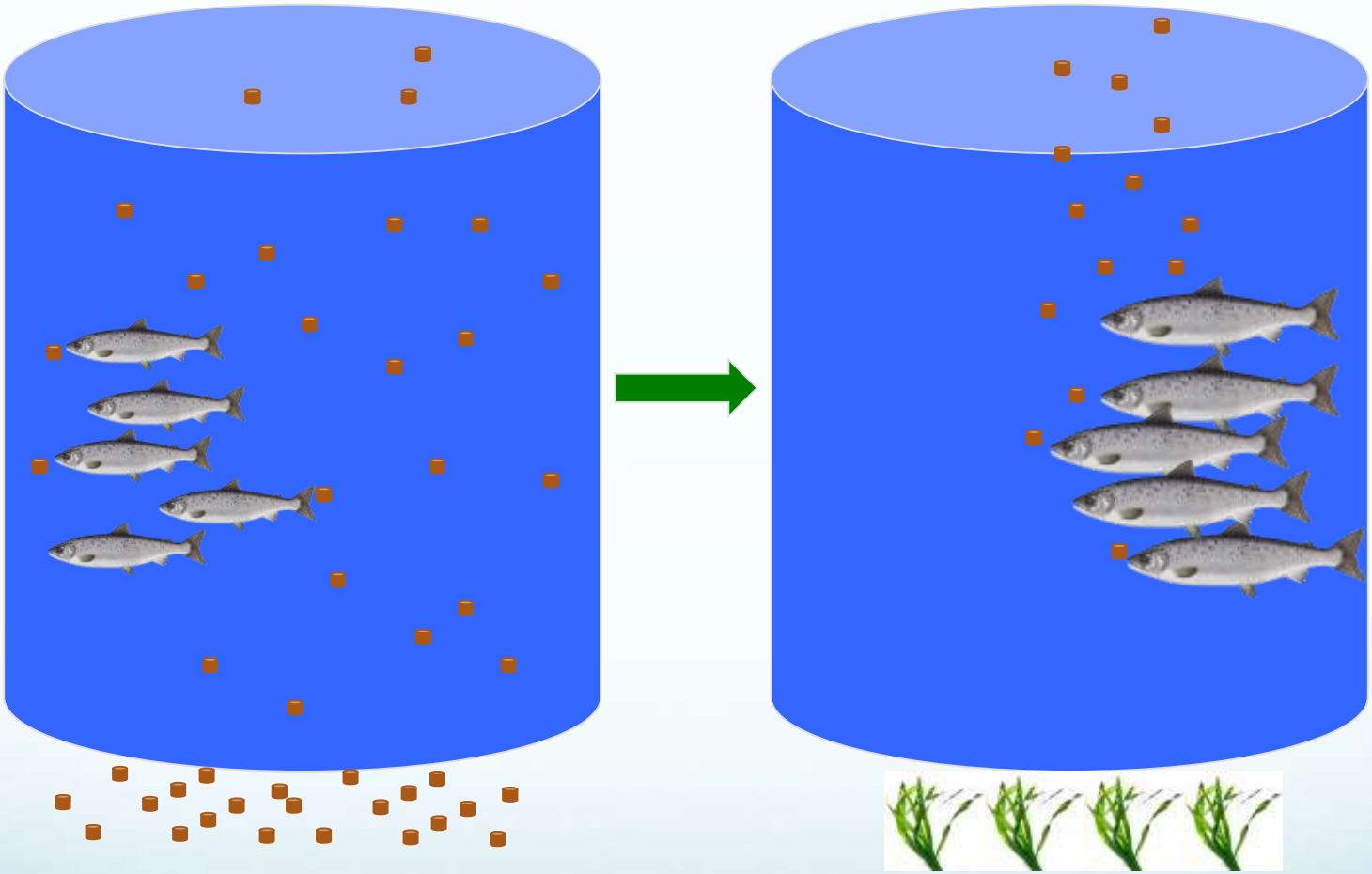


Digital Aquaculture for blue growth in aquaculture
Challenges associated with large rearing systems





Digital Aquaculture for blue growth in aquaculture



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A Vision from the industry

- Trond Kathenes (CIO - Grieg Seafood)

Digital Aquaculture for blue growth in aquaculture

Aquaculture
Fish and Feed

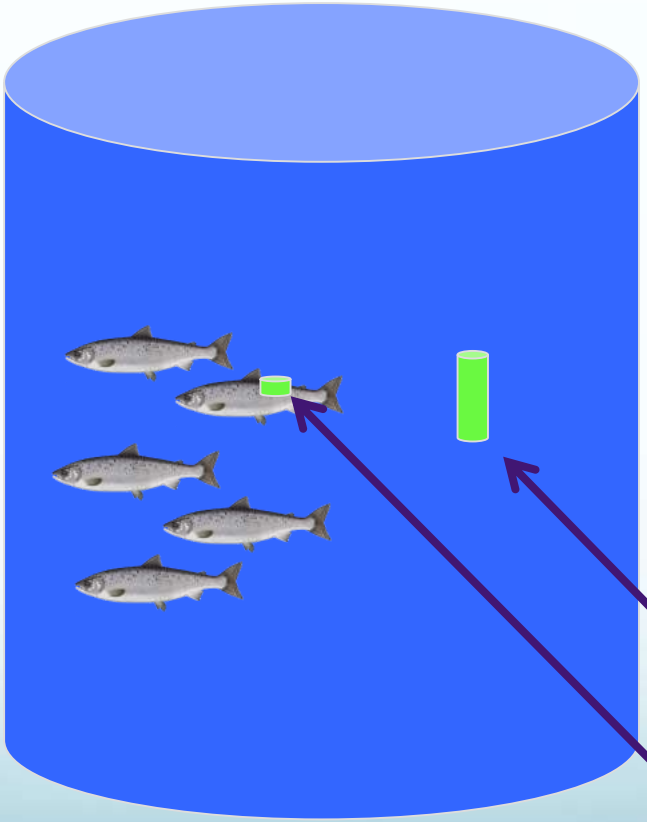
Technology
Sensor Development

Digitalization and Integration
AQUACLOUD , NCE-SIC & IBM

Fish

Behaviour/Imaging
Feeding-fish location
Welfare-swimming
Sea-lice
Physical damage
Health/disease
Biomass
Feed sensing

Physiology
Stress
Appetite
New feed development
Feed sensing (olfaction/vision)



Sea cages, S-CCS, RAS

Physical

Water quality
O2,CO2,TAN, pH

Water Currents

Wind Currents

Light quality
Spectra/intensity

Drones/Sensors

Fish Sensors

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Digital Aquaculture for blue growth in aquaculture

Fish Biology
Physiology
Robustness
Stress
Appetite
Feed sensing
(visual &olfaction)

Behavior
Feeding-fish location
Welfare-swimming
Sea-lice
Physical damage
Health/disease
Biomass
Feed sensing

Feed development
Feed sensing
Functional feeds
Feed delivery design

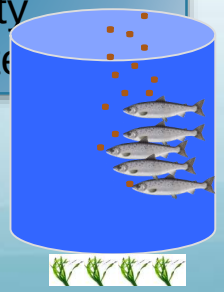
Sensor development
Imaging
Physiological

Environment monitoring
Water quality
Water currents & waves
Wind currents
Light quality
Feed waste

Data Cloud Integration
Fish
Environment
Feeding

Big Data Analytics

Information Decision-making (e.g.smart feeding)



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Summary: Know the limits & use the technology

- ***Pairing the biological requirements with these very different rearing platforms is essential to optimize production and welfare***
- ***New digital technologies will provide improved real-time assessment of the production sites, allowing for larger and more remote systems to have increased control, efficiency and security of the fish production and welfare***
- ***Innovating new rearing platforms will rely on the expertise from different sectors to integrate biology with engineering***
- ***Educate those running the new platforms***

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Marine Developmental Biology

Integrative Fish Biology

Molecular Ecology

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