

Low emission offshore ocean aquaculture value chain



ROOTED IN NATURE

SalMarAkerOcean



moreld
aqua



FishGLOBE



OVUM



stiim



ABB



Veterinærinstituttet
Norwegian Veterinary Institute



US
Universitetet
i Stavanger



NTNU



UF UNIVERSITY OF FLORIDA



Høgskulen
på Vestlandet

Nor Shipping, Lillestrøm, June 7, 2023

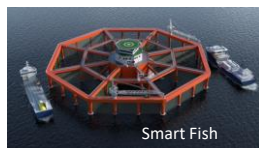
More information: <https://gronnplattform.stiimaquacluster.no/english/>

Business partners

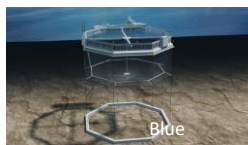
SalMarAkerOcean



- Turnover Salmar 2020: NOK 13 billion
- Fully integrated multinational aquaculture company
- Production of food fish, post-smolt and juvenile fish
- Development permit Ocean Farm 1, Smart Fish Farm 1



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- Turnover 2020: NOK 4.4 billion (excluding Shetland)
- Fully integrated international aquaculture company
- Production of food fish, post-smolt and juvenile fish
- BlueFarm Development Permit



- Turnover 2020: NOK 7.3 billion in Norway. NOK 26.5 billion globally.
- Globally leading feed supplier
- Parent company Nutreco is in development permit (Roxel Aqua)
- Post-smolt feed closed sea facilities
- Green floating feed for underwater feeding at sea
- Transport of feed and gentle feed transport on board in waters with large wave heights
- Diagnostic tools for large fish populations



- Parent company turnover: 6.8 bill.
- Moreld: Offshore energy service
- Moreld Aqua: Aquaculture, including design, digitization and autonomy
- GM Aqua Design (Aquaculture at Sea)



- Turnover: NOK 70 million (B2021)
- Develops and delivers closed sea facilities
- R&D permit and development permit
- Now produces post smolt (4th insert)
- Global sales focus



- Turnover: NOK 4.4 million
- Builds first post-smolt unit now
- Delivers closed sea facilities
- Green permit and 6 development permits



- Turnover: NOK 20 million
- Knowledge supplier aquaculture. Active role in knowledge sharing for offshore aquaculture
- Leads the **Stiim Aqua Cluster** with 130 member organizations, including the companies in this project



Research institutions



- Project management main project
- Technoeconomic and life cycle analyses
- Digitization infrastructure
- Responsible Research and Innovation lab
- Decision support



- Management KSP work package 2
- Biosafety and survival
- Real-time infection monitoring
- Biomarkers and microbiome
- Fish health, welfare and stress



- Fish welfare and health



- Project management KSP project, AP5
- Markers environmental effect water column and benthos
- Fish welfare postsmolt
- Real-time monitoring
- Digitization and autonomous operations



- Digitization and satellite-based monitoring
- Semi autonomous operations



- Technoeconomic analysis
- Decision support



- Management CCP WP6
- Fish welfare in waves
- Robust fish



- Development of robust fish
- Fish welfare and health

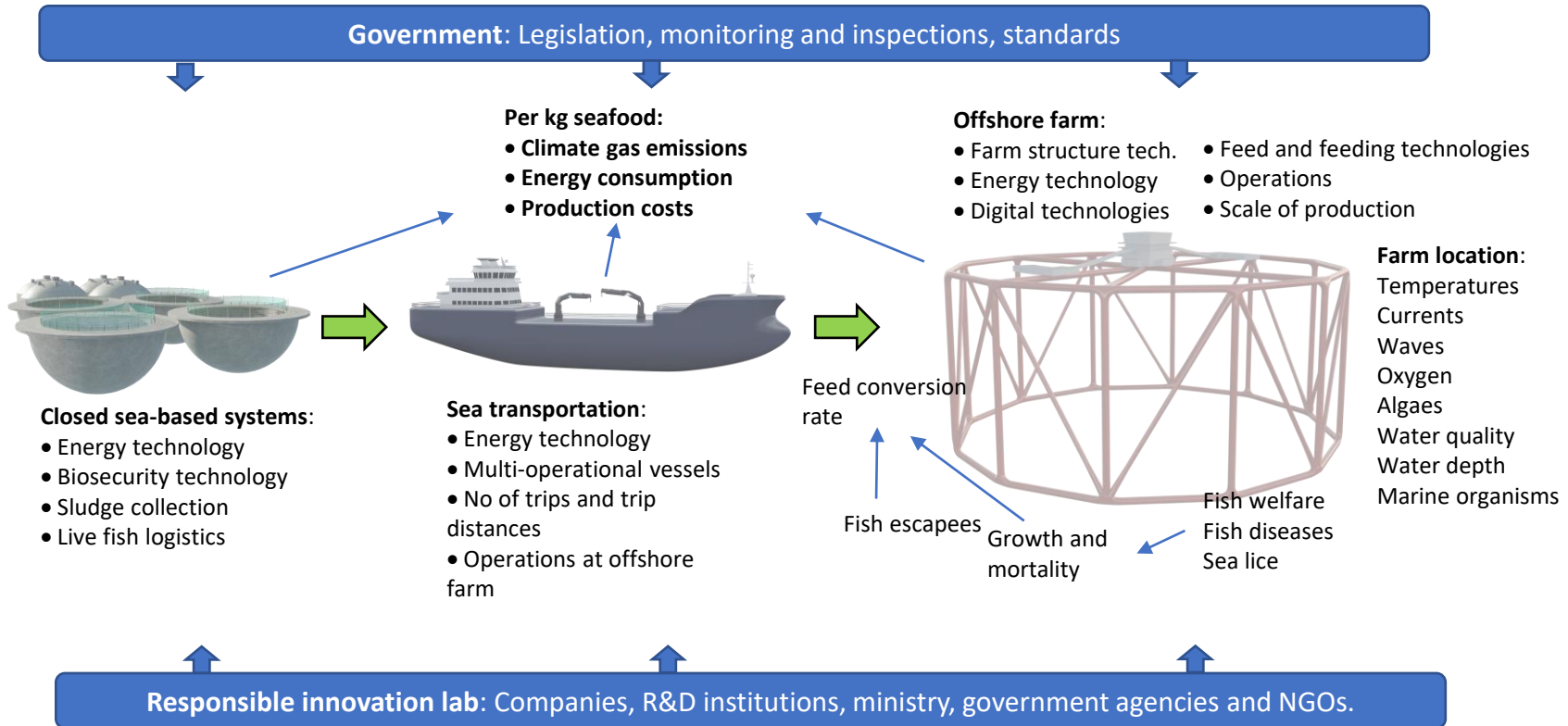


- Biomarker studies



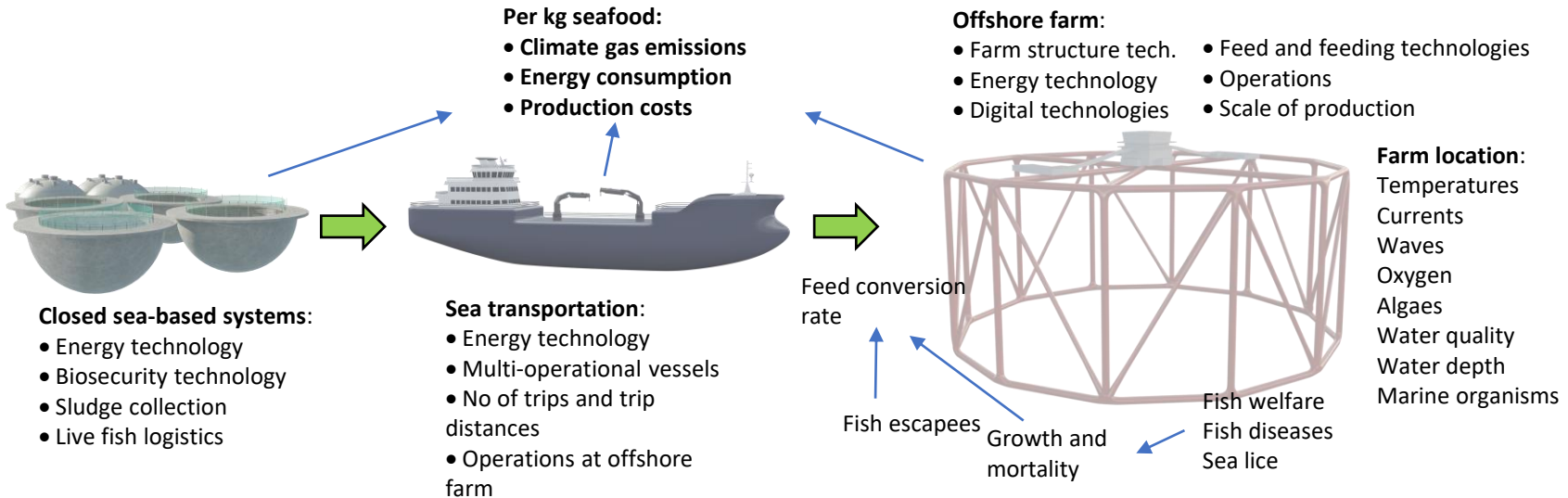
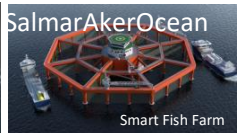
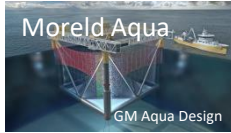
- Responsible Research and Innovation
- Risk analysis
- Decision support

Open offshore value chain and sustainability issues

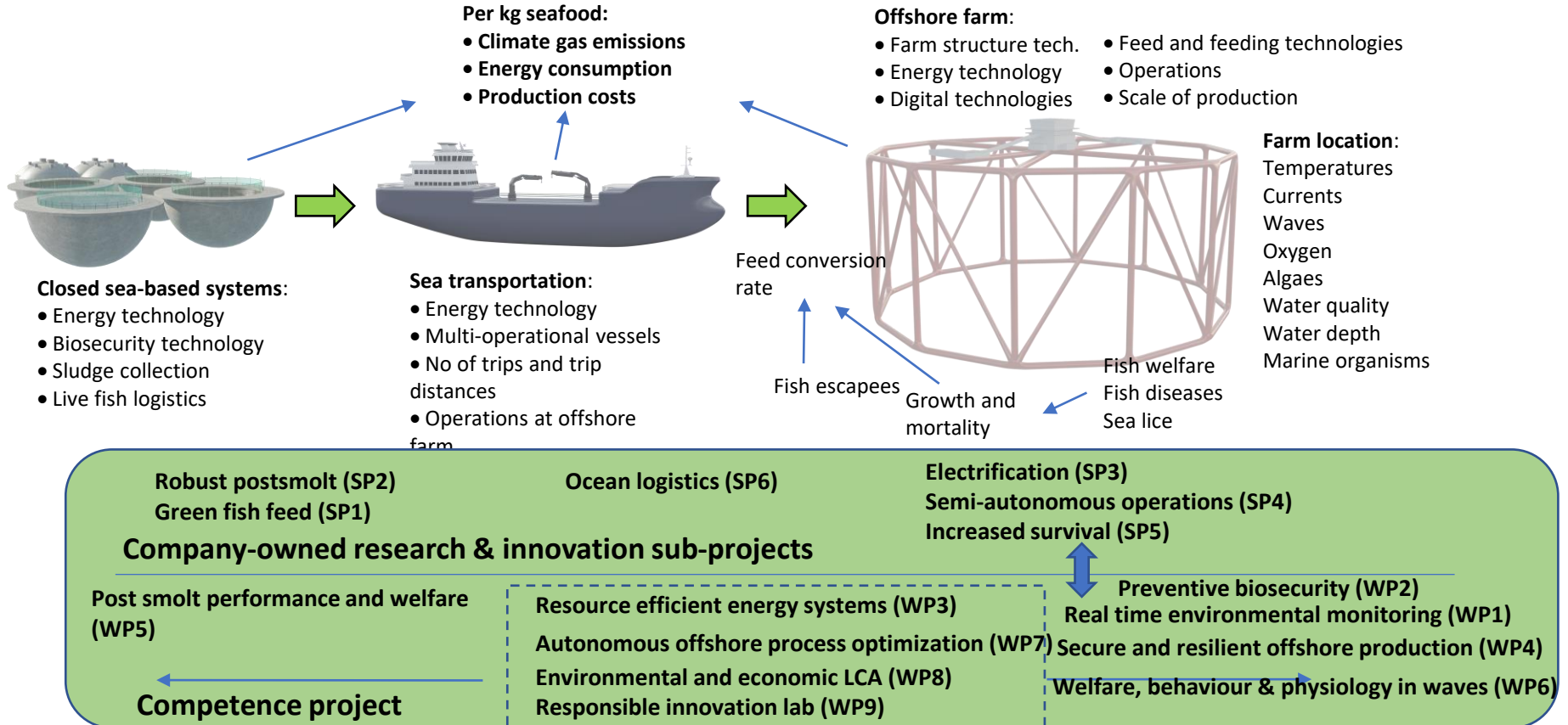


Companies and R&D institutions

Technology suppliers: Nutreco Skretting, Moreld Aqua, ABB, a.o. **R&D:** Norce, VI, HI, UiS, HVL, NMBU, NTNU, UiB, Simula, Univ. Florida, Univ. Melbourne



Green platform project structure



The project includes a *Responsible Innovation Lab (RIL)* that involves all stakeholders in offshore ocean aquaculture

RIL aims to develop proposals for governance of offshore aquaculture that take into account a broad range of sustainability concerns

Public sector
Ministry of Trade, Industry and Fisheries, Directorate of Fisheries, Norwegian Food Safety Authority, Norwegian Environment Agency, Norwegian Petroleum Directorate, Petroleum Safety Authority, a.o.

Other stakeholders
Fisheries, petroleum, maritime sector, NGOs, etc.



Private aquaculture sector
Aquaculture companies, technology and service supplier companies, employer organizations (Norsk Industri, Sjømat Norge), a.o.

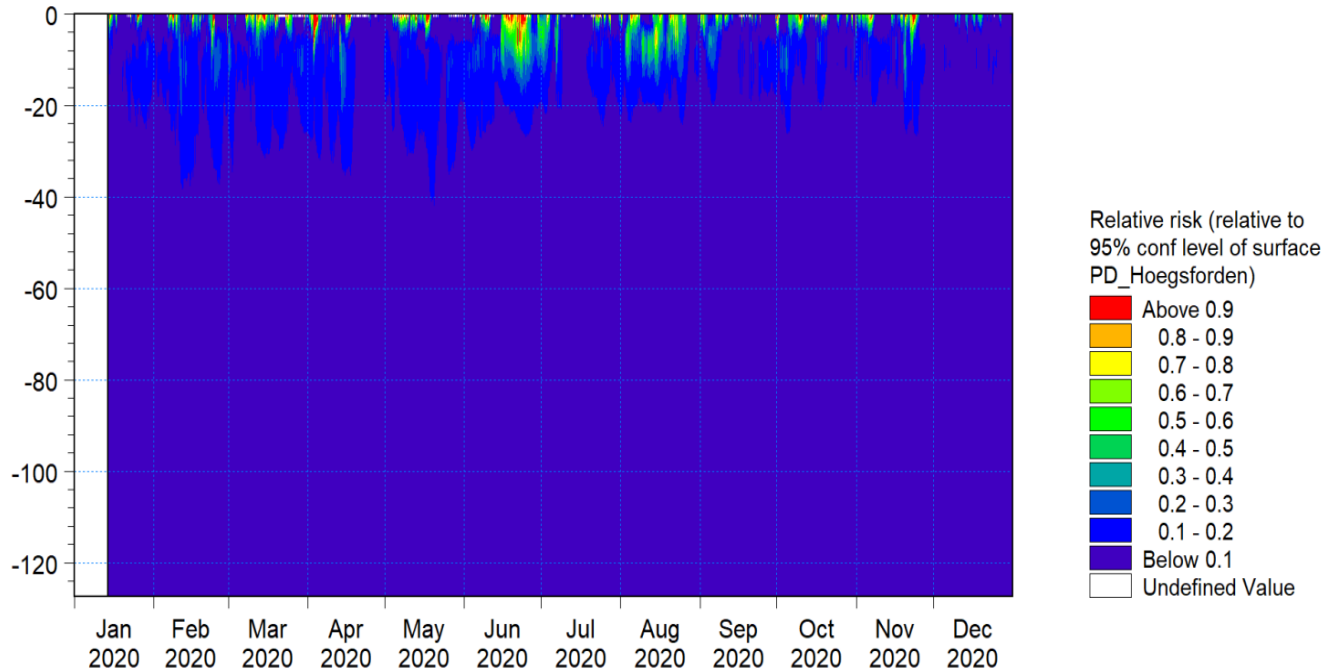
Universities and research institutions



Biosecurity of semi-closed containment systems

- Postsmolt from semi-closed systems one stage in supply chain
- Critical that the production and transportation of fish from these systems do not create biosecurity risks
- Depends partly on exposure to disease in water inlets

Relative risk in Lysefjorden – from Høgsfjorden sites



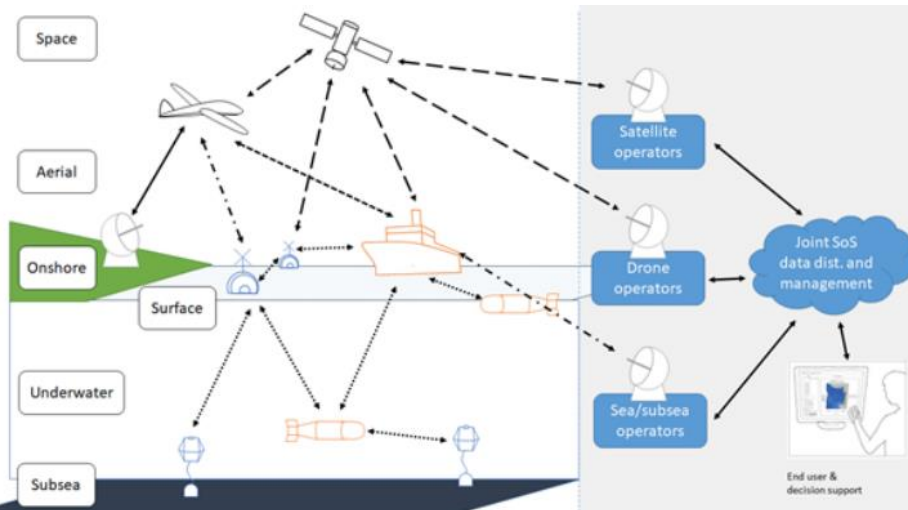
Surveillance of algae and jellyfish: Prediction and early warning



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Purpose

Establish a system for early identification and warning of occurrences of high algae or/and jellyfish concentration, as well as exposure prediction and decision support for use of countermeasures



- Automated data collection, image and data analysis for notification and visual representation of the current situation and predicted future situation.
- Analysis of data for water quality parameters in water column together with coastal current models, shows probable future distribution of the organism and exposure of facilities.
- Decision support for best protective measures based on which organisms, extent and time the site is exposed to.

How does offshore differ from inshore farming?

Conventional inshore farming value chain



- **Investments in grow out farm 150-200 MNOK**
- **Many mature technologies**
- **Experience-based understanding of biological and technological risks**

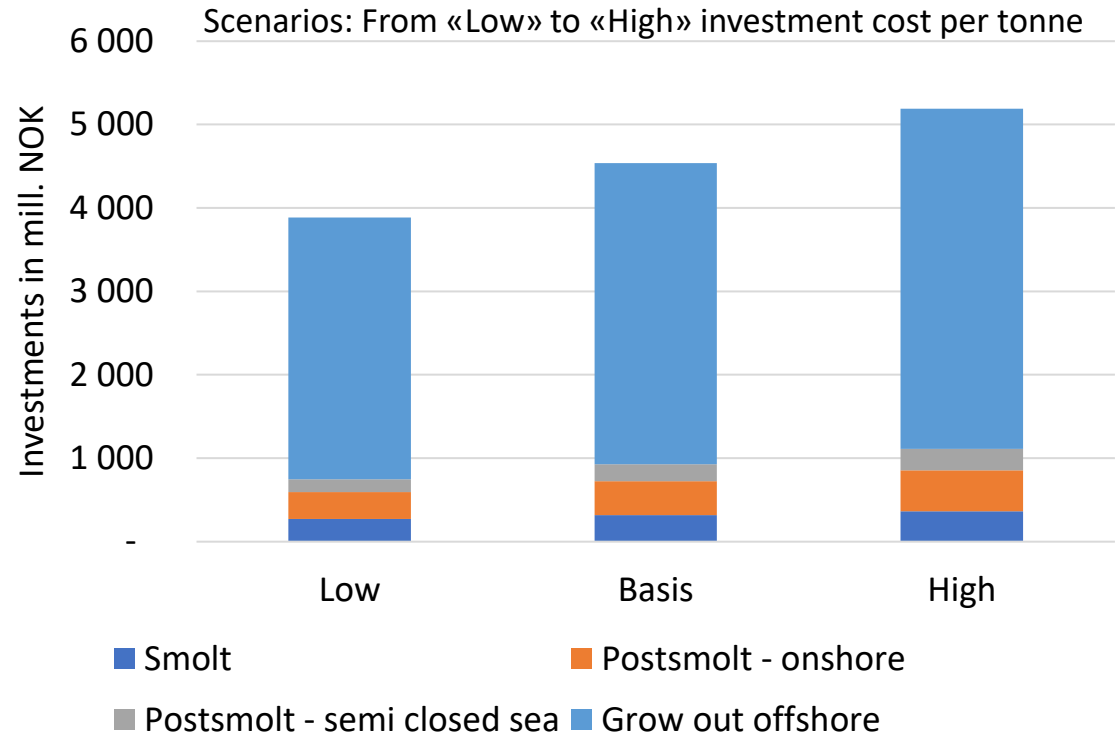
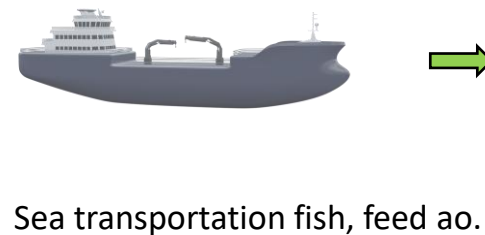
Offshore farming – value chain alternatives



- **Investments in growout farm 1-3 billion NOK**
- **Plus specific investments in postsmolt, well boats etc.**
- **Many untested technologies**
- **Uncertainty about biological and technological risks**

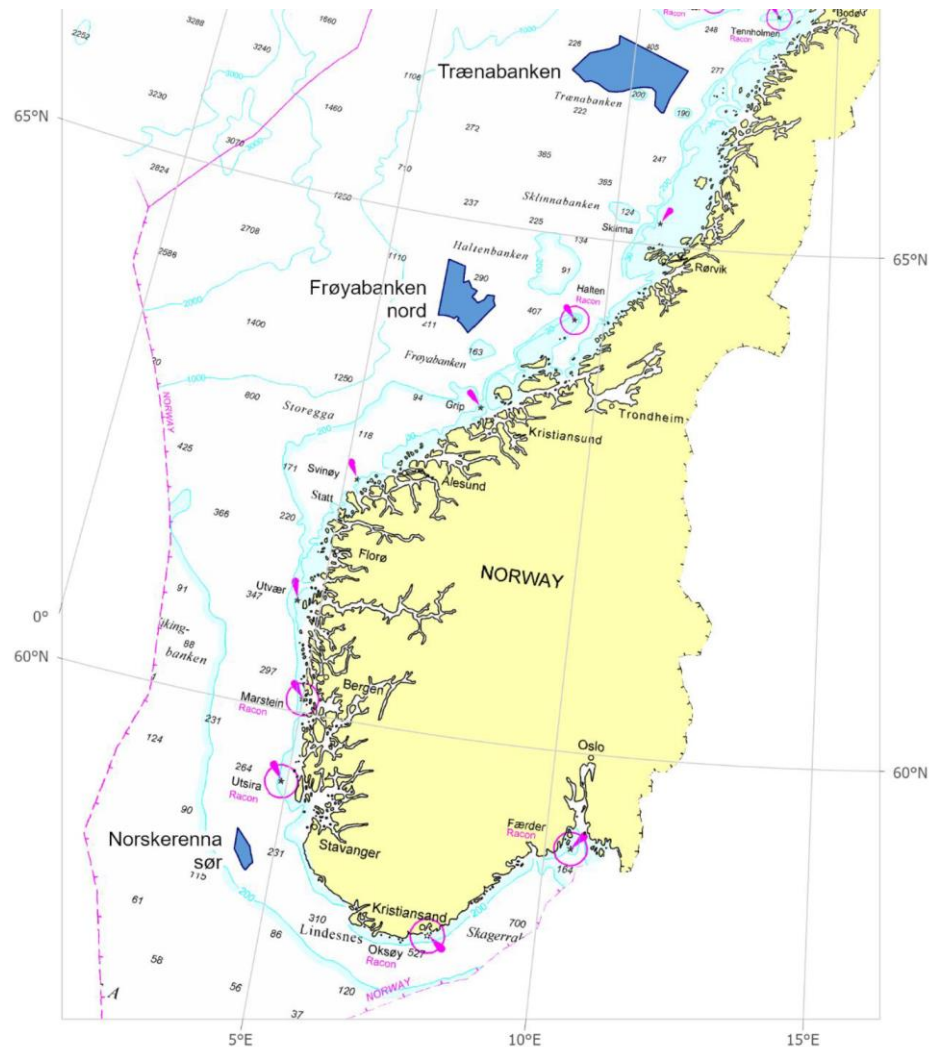
Investments in 20K offshore aquaculture value chain

- Production: 20 000 tonnes
- Post smolt production divided between onshore and closed inshore
- Includes investments of other value chain and indirect suppliers at each stage



Three areas allocated

- Norskerenna sør
- Frøyabanken nord
- Trænabanken



Assessment of offshore area Norskerenna Sør: Forthcoming report - Value creation and roadmap

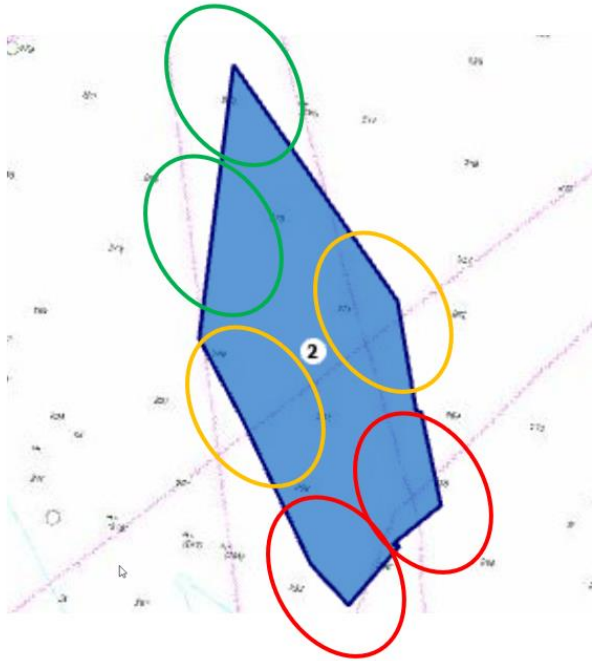
Verdiskapingspotensialet og veikart for utvikling av Norskerenna Sør



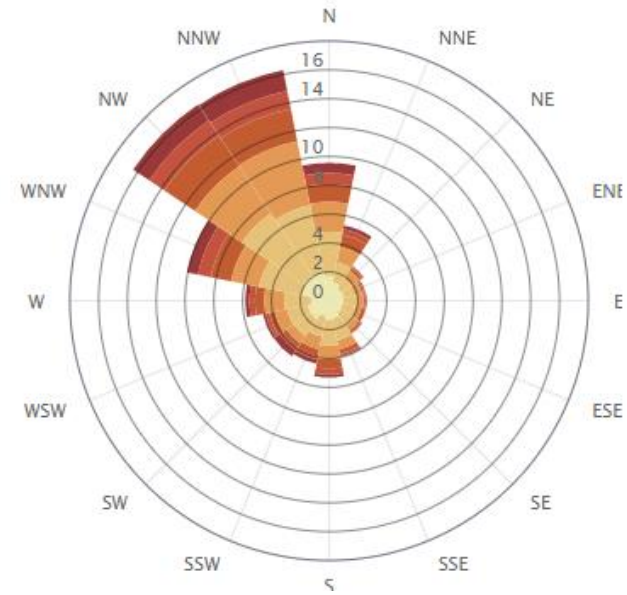
«Prosjektet skal utrede forhold for teknologi og biologi på området Norskerenna Sør. Det skal kartlegges hvilken infrastruktur som må på plass i verdikjeden, samt analysere verdiskapingspotensialet en fremtidig utbygging vil gi regionen. Prosjektet skal gi anbefalinger for tiltak som må på plass for en realisering av Norskerenna Sør som et fremtidig område for havbruk til havs».



Assessment of offshore area Norskerenna Sør: Forthcoming report

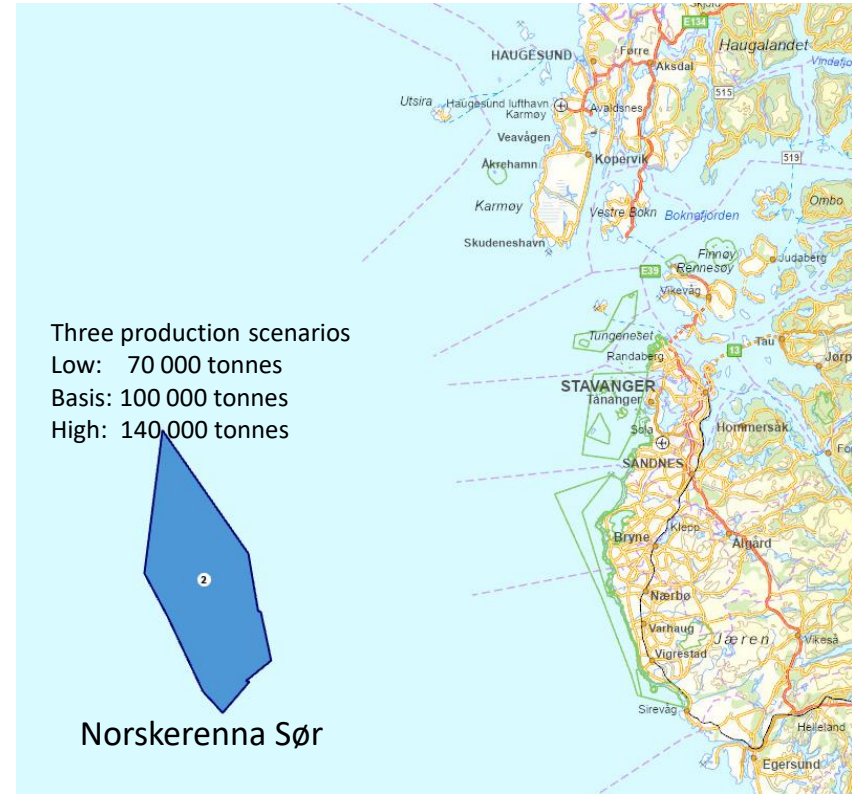
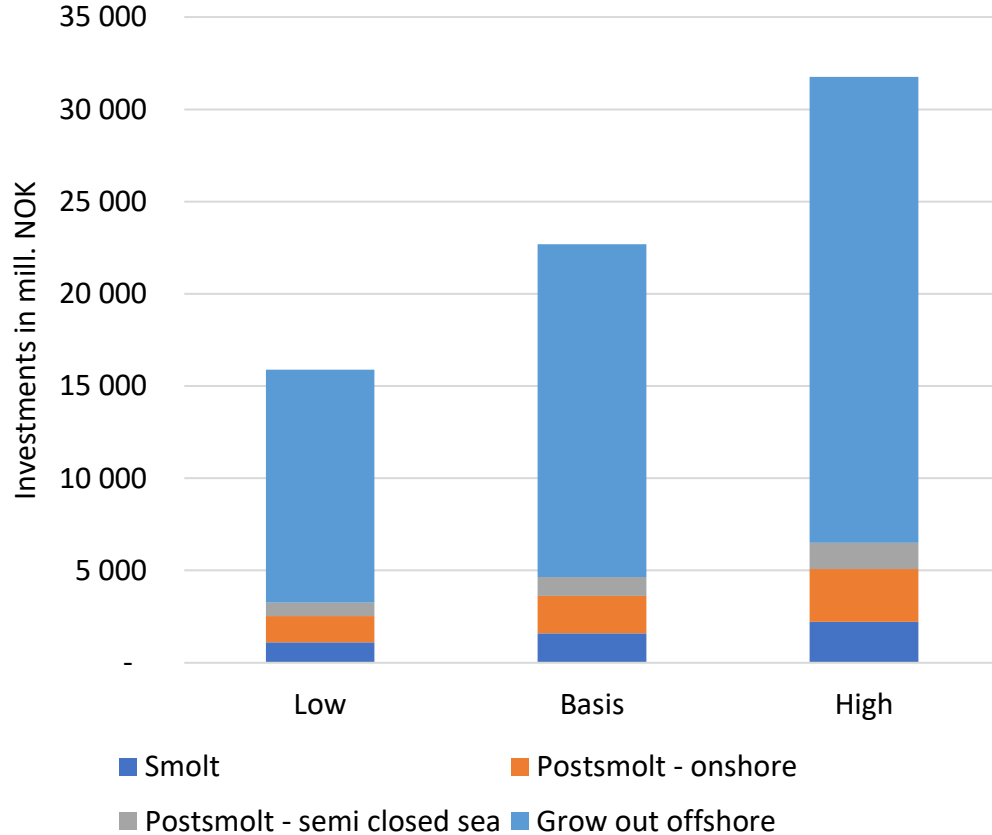


Potential farm sites:
Stage 1 – red, Stage 2 - yellow, Stage 3 - Green.

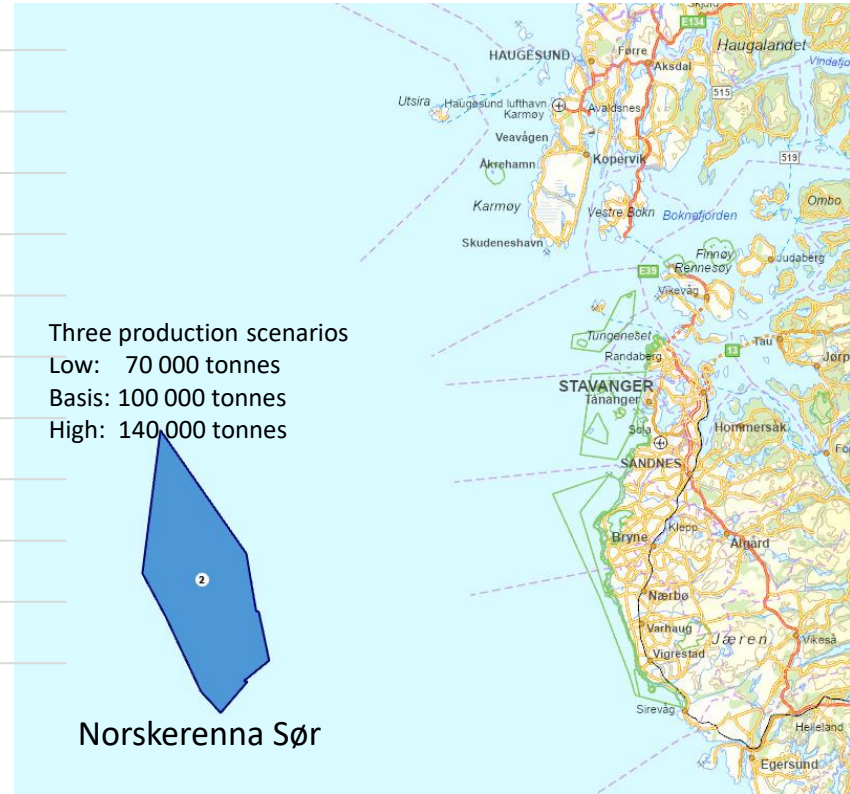
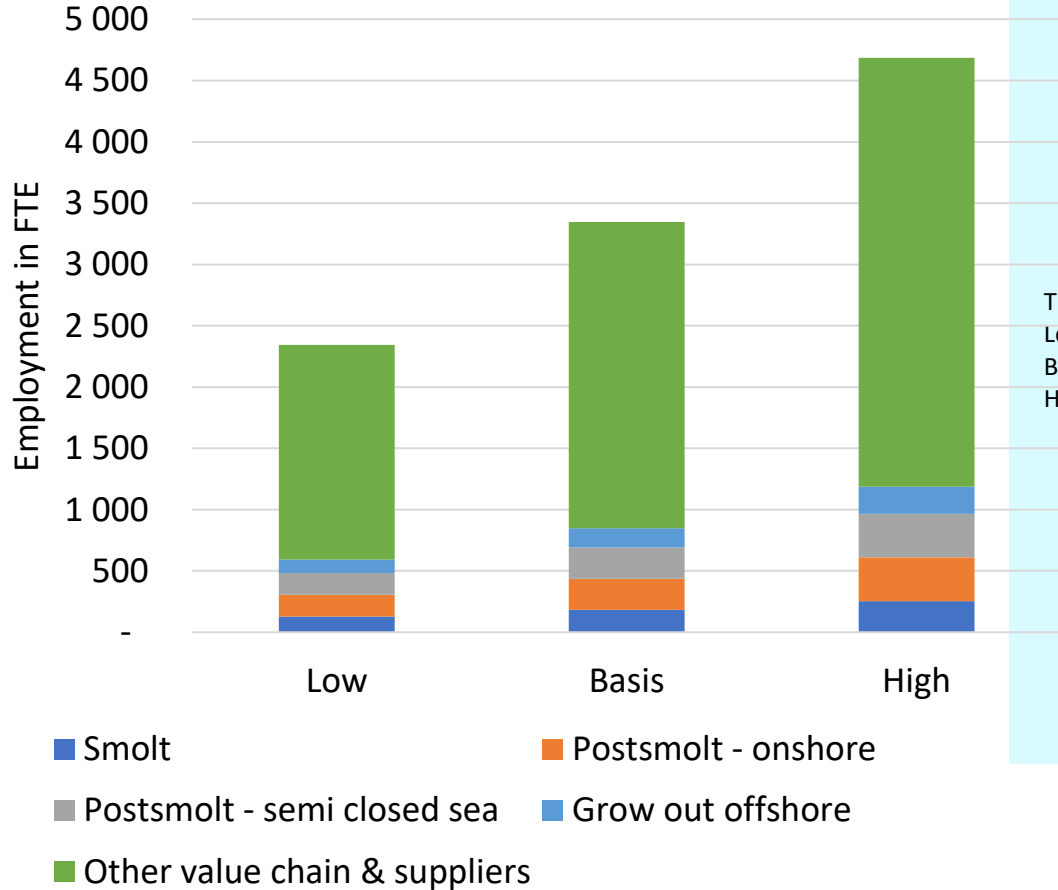


Current rose

Offshore area Norskerenna Sør: Investments



Offshore area Norskerenna Sør: Employment

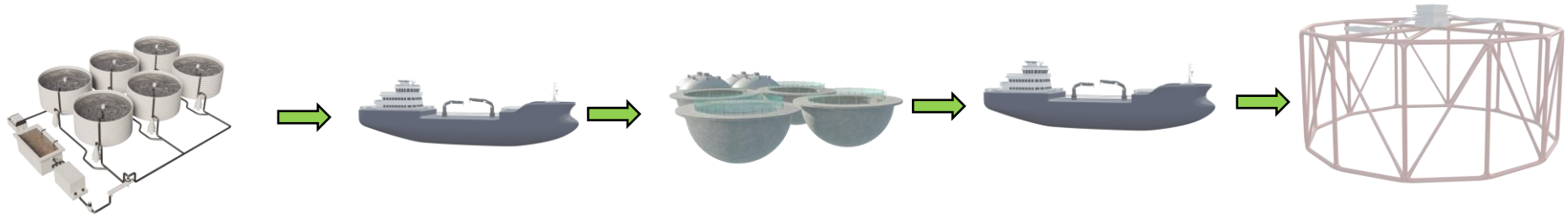


Critical success factors for society and industry

- High standards fish welfare and biosecurity
- High capacity utilization investments
- Time consistency of tax regime and other regulations

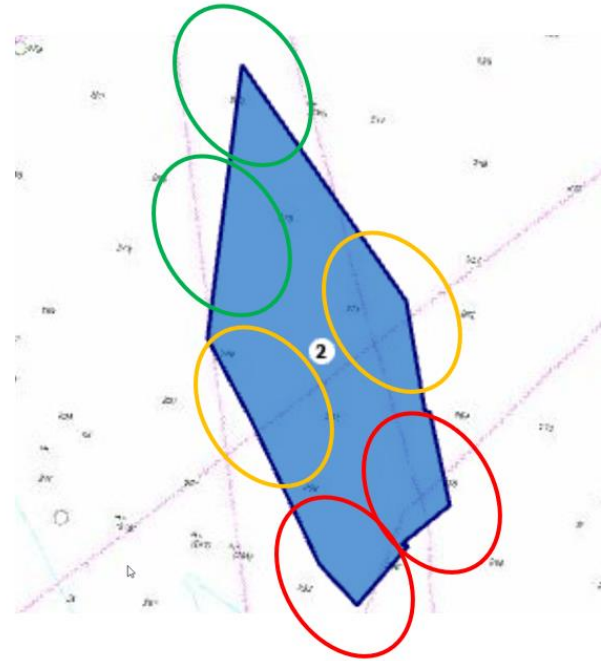
High standards fish welfare and biosecurity

- Industry, government, research:
 - Build knowledge and innovate together
 - Systematic, comprehensive, transparent data collection and analysis
 - Develop biosecurity risk assessments and regulations
- Aquaculture producer - empower Chief Biology Officer (CBO)

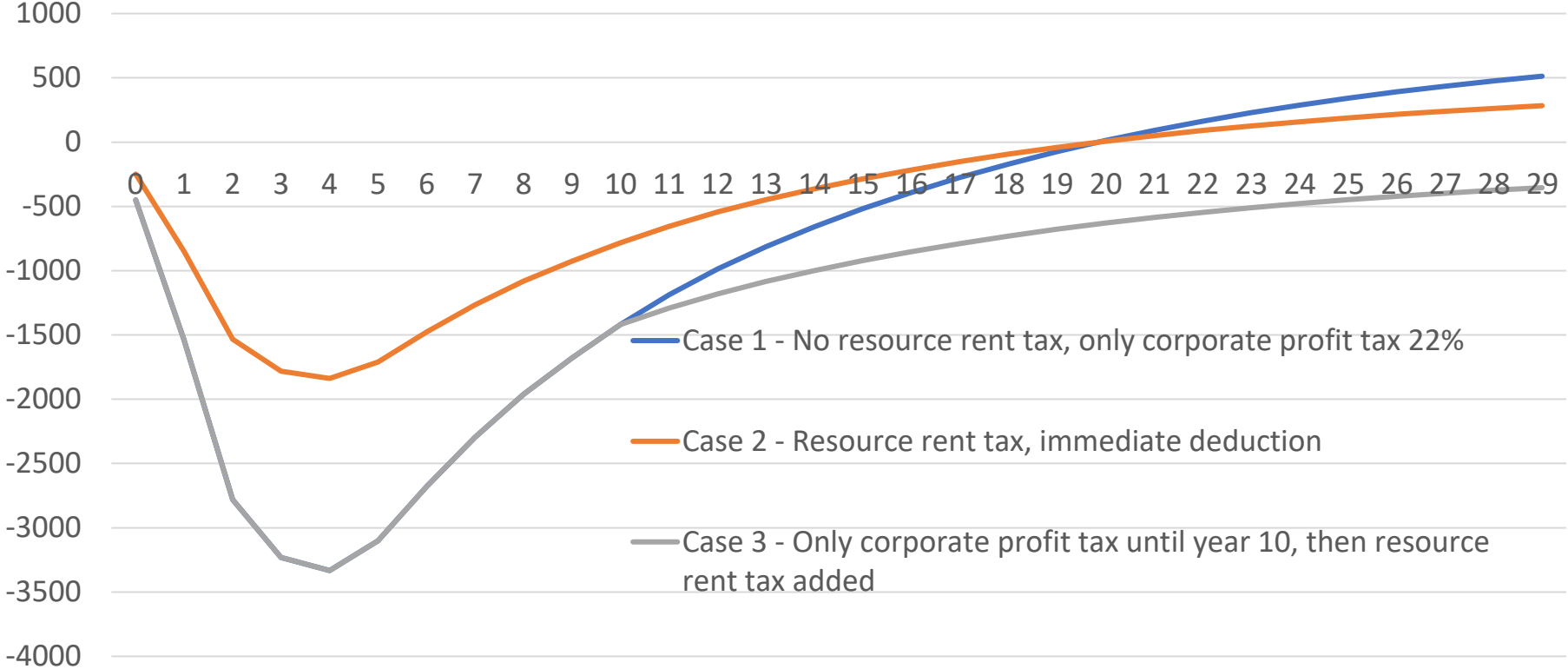


High capacity utilization investments

- Capital cost per kg ↓
- Regulatory design has a critical role
- Production and fallowing regimes based on biology
- Sufficient farm sites



Time consistency of tax regime and other regulations



Critical success factors for society and industry

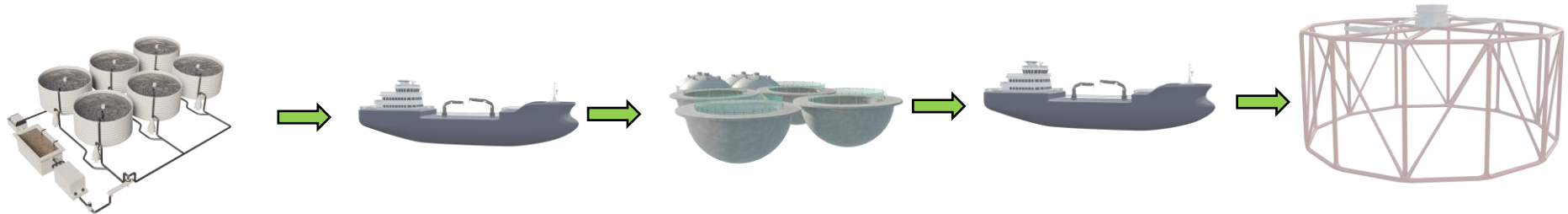
- High standards fish welfare and biosecurity
- High capacity utilization investments
- Time consistency of tax regime and other regulations

We will succeed – it's a question of speed

- Vast open oceans available
- Growing global demand for attractive seafood protein
- Huge biological & technological challenges
- A broad and deep competence base with all the necessary tools will solve these
- It's more a question of speed

It's the pilot, stupid!

- Only a large scale pilot value chain can give us the pivotal knowledge we need to realize the potential
- A preliminary regulatory framework and a tax regime that gives sufficient confidence critical to gain traction



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