

KELPPRO

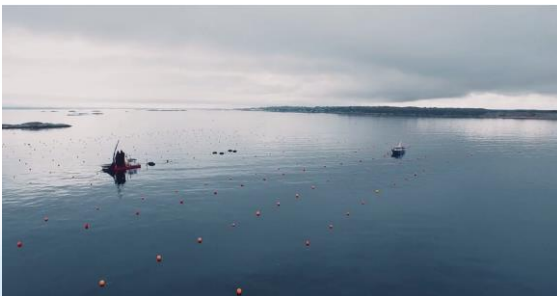
Kelp industrial production: Potential impacts on coastal ecosystems

- a research proposal funded by the RCN HAVBRUK2 program in Dec 2016



- **Project lead:** NIVA (Kasper Hancke)
- **Scientific partners:** SINTEF, NTNU, ApN, IMR, University of Southern Denmark (SDU)
- **Industrial partners:** Seaweed Energy Solutions (SES), Hortimare
- Duration: 2017-2020 (4 years)
- Budget: 8.5 MNOK in total

Kasper Hancke, PhD, Researcher at NIVA
KELPPRO Kick-off meeting, Oslo Science Park 22. March 2017



Kasper: Education and positions

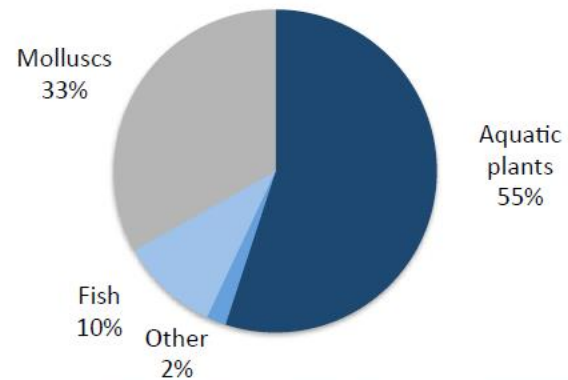
- **2002 MSc in Aquatic Microbial Ecology**, Uni. of Copenhagen
- **2003-2007 PhD in Arctic Marine Ecology**, NTNU, Norway
- **2007-2010 Post doc on Ocean optics and bio-optics**, IMR, Norway
- **2010-2011 Research coordinator** at NTNU, Norway
- **2011-2014 Post doc Benthic & pelagic biogeochemistry**, Uni. of Southern Denmark (SDU)
- **2015-2016 Researcher in Sea ice ecology**. Aarhus Univ.
- **2016 – Researcher in coastal ecology**. NIVA

Scientific keywords

- 1) Biological Oceanography and Marine Biogeochemistry
- 2) Algae Ecology and Physiology
- 3) Photobiology and Bio-optics
- 4) Coastal ecosystems ecology and modelling



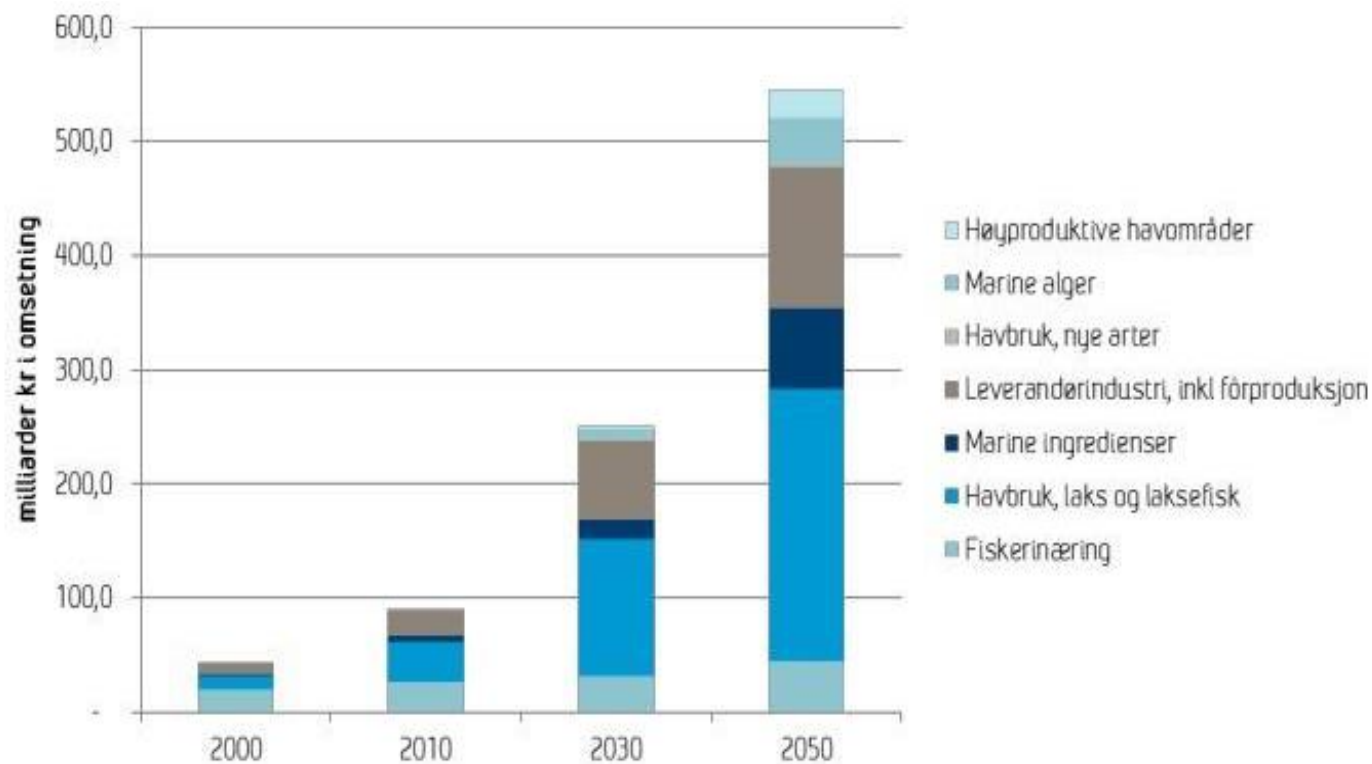
World marine aquaculture (47 Mton)



Sangou Bay, China

Source: SES presentation 2016

Marked potential



The macro algae industry is expected to increase from **NOK 1.2 mrd i 2010** to **NOK 40 mrd i 2050** (SINTEF - Verdiskapning basert på produktive hav i 2050).

Source: SES presentation 2016

Kelp industrial production: Potential impacts on coastal ecosystems

Aim:

Provide an **integrated assessment of positive and negative impacts** of industrial-scaled kelp farming on the marine ecosystem of coastal Norway

Objectives:

- 1) Measure environmental impacts of kelp production on coastal open water and sea floor ecosystems.
- 2) Assess consequences of kelp production facilities on natural kelp forest habitats and local environments.
- 3) Provide guidance on environmental impact assessment to Norwegian decision makers and managing agencies representing scenarios of present to future industrial kelp production.



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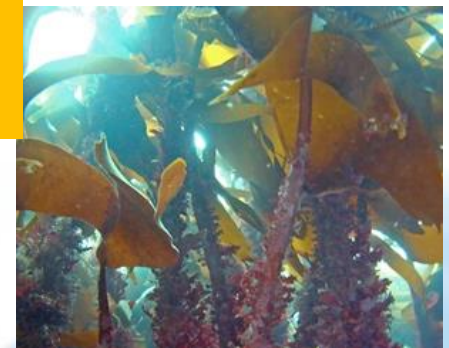
Aim:

Provide an **integrated assessment of positive and negative impacts** of industrial-scaled kelp farming on the marine ecosystem of coastal Norway

Three main questions:

- 1) Will future industrial kelp farming impact open water and sea floor habitats and ecosystem functioning?
- 2) Will farmed kelp detritus provide valuable bio-resources or pose a threat to natural coastal ecosystems?
- 3) Will kelp farming facilities provide ecosystem functioning as 'artificial' forest habitats?

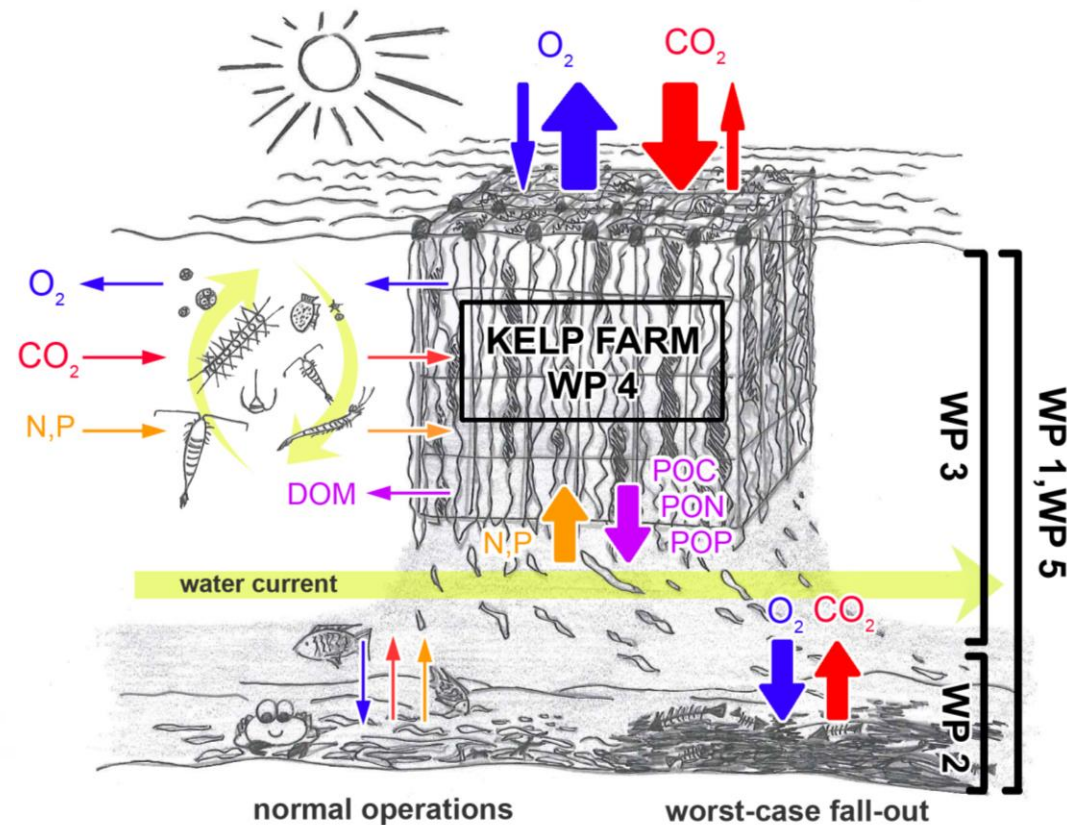
assessment to Norwegian decision makers and managing agencies representing scenarios of present to future industrial kelp production.



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Research focus:

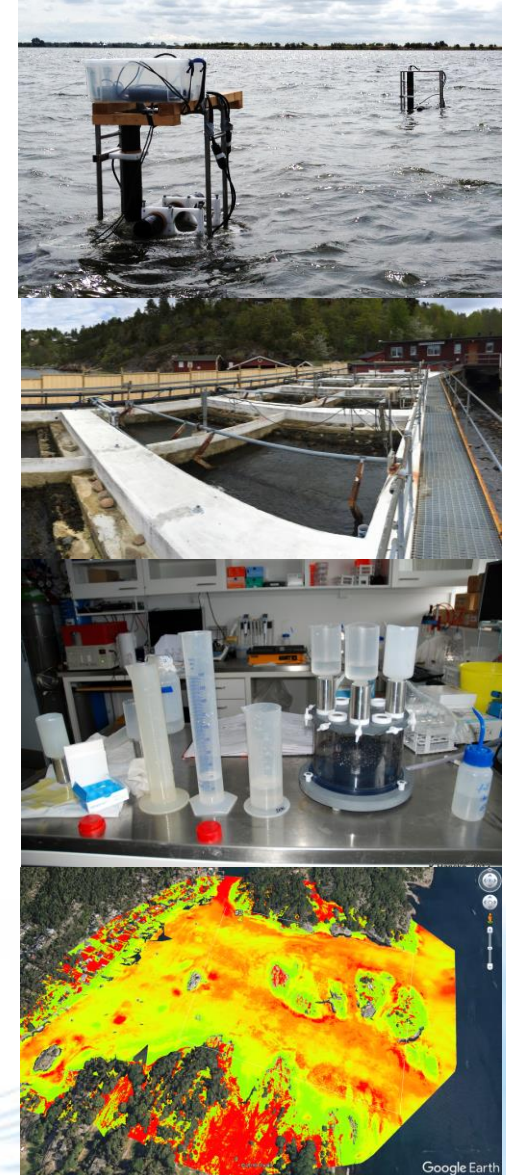
- **WP#1:** Industrial kelp cultivation scenarios
- **WP#2:** Effects of industrial kelp farming on sea floor ecosystems
- **WP#3:** Effects on open water ecosystems
- **WP#4:** Industrial kelp facilities as 'artificial kelp forests'
- **WP#5:** Integration and dissemination



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Experimental approach and team

- Field investigations (NIVA, NTNU, ApN, SDU)
 - Two industrial kelp production facilities (industry-partners), i.e. Seaweed Energy Solutions (SES, Trøndelagskysten) and Hortimare (Sognefjorden)
 - Impact studies on open water uptake and dynamics of nutrients, CO₂, oxygen alongside effects on hydrological condition
 - Impact studies on sea floor ecosystems
 - Role as artificial 'kelp forests' habitats
- Mesocosms experiments (NIVA, ApN)
 - degradation and bioavailability of kelp detritus as function of detritus size and O₂ availability.
- Numerical modelling (SINTEF, NIVA)
 - Assessment of regional and local areas for kelp farming
 - Regional and local effects of kelp production
 - Pathways, deposit areas and fate of kelp detritus



Images by NIVA (K Hancke)

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Key scientific personal

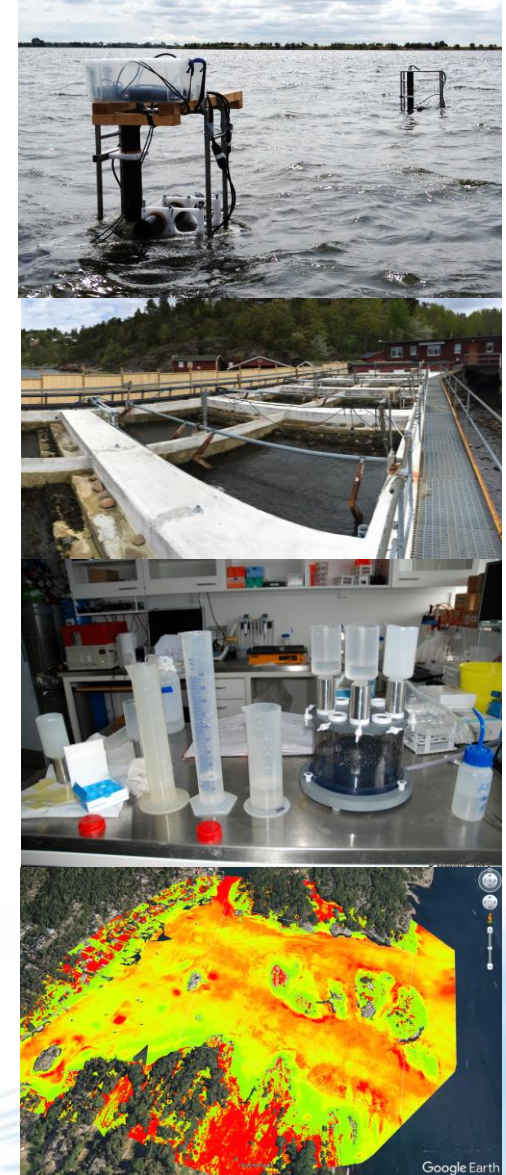
- **NIVA:** Kasper Hancke, Trine Bekkby, Hartvig Christie, Hege Gundersen, Eva Ramirez-Llodra, Gunhild Borgersen
- **SINTEF:** Ole Jacob Broch, Morten Alver, Aleksander Handå
- **NTNU:** Yngvar Olsen, Øystein Leiknes
- **ApN:** Reinhold Fieler
- **IMR:** Pia Kupka Hansen
- **SDU:** Ronnie N. Glud, NN post doc

Industry partners

- **SES:** Jon Funderud, Luiza Neves
- **Hortimare:** Job Schipper

Scientific Advisor Board

- Prof. Isabel Sousa Pinto, University of Porto, Portugal
- Dr. Dorte Krause-Jensen, Aarhus University, Denmark
- Prof. Alf Norkko, University of Helsinki, Finland



Images by NIVA (K Hancke)

Time plan / Gantt diagram

KELPPRO gantt diagram	2017				2018				2019				2020			
NFR HAVBRUK2, 2017-2020	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
T1.1 Areas for kelp production	x	x														
T1.2 Specification of cultivation scenarios	x	x	x													
T2.1 Estimate export of kelp detritus				x	x											
T2.2. Transport pathways and 'deposit areas' for exported kelp					x	x										
T2.3 Impact studies on sea floor biodiversity and function						x	x									
T2.4 Impact of kelp detritus; tipping point between food source or ecosystem threat						x	x									
T2.5 Fate and bio-availability of exported kelp									x	x	x					
T3.1. Quantification of nutrient (N, P) and C (CO ₂) uptake and retention in kelp	x	x	x													
T3.2. The effect of kelp farming on the carrying capacity	x	x	x													
T3.3 The potential of bioremediation by kelp farming								x	x	x						
T4.1. Abundance, species composition and function										x	x					
T4.2. Distribution of unwanted and red-listed species										x	x					
T4.3. Genetic diversity in natural kelp											x	x	x			
T5.1. Synthesis an integrated assessment												x	x	x		
T5.2. Provide guidance													x	x	x	
T5.3 Ensure efficient communication		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kick-off workshop		x														
Concluding workshop															x	
Annual meetings		(x)			x				x						(x)	
post doc (SDU)									x	x	x	x			x	
post doc (NTNU)	x	x	x	x											x	
Scientific publication				x	x	x	x	x	x	x	x	x	x	x	x	x
End-user guidance and reporting				x				x				x	x	x	x	x
Conferance contributions							x								x	
Website and public outreach	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Budget

Cost plan

	2017	2018	2019	2020	Sum
Payroll and indirect expenses	798,000	1,188,360	1,315,760	280,000	3,582,120
Procurement of R&D services	1,654,700	560,000	1,016,500	550,000	3,781,200
Equipment	247,200	312,000	114,000	0	673,200
Other operating costs	64,800	73,600	254,200	120,000	512,600
Totals	2,764,700	2,133,960	2,700,460	950,000	8,549,120

Cost code

	2017	2018	2019	2020	Sum
Trade and industry	53,800	10,000	10,000	20,000	93,800
Independent research institute	1,789,400	1,718,360	1,685,760	710,000	5,903,520
University and university colleges	589,500	10,000	70,000	80,000	749,500
Other sectors	312,000	385,600	368,200	120,000	1,185,800
Abroad	20,000	10,000	566,500	20,000	616,500
Totals	2,764,700	2,133,960	2,700,460	950,000	8,549,120

From the Research Council

	2017	2018	2019	2020	Sum
Student fellowship	0	0	0	0	0
Doctoral fellowship	0	0	0	0	0
Post-doctoral fellowship	519,500	0	556,500	0	1,076,000
Grants for visiting researchers	0	0	0	0	0
Grant for overseas researchers	0	0	0	0	0
Research positions	0	0	0	0	0
Hourly-based salary including direct costs	798,000	1,188,360	1,315,760	280,000	3,582,120
Sum payroll and indirect expenses	1,317,500	1,188,360	1,872,260	280,000	4,658,120
Procurement and R&D services	1,135,200	560,000	460,000	550,000	2,705,200
Equipments	247,200	312,000	114,000	0	673,200
Other operating costs	64,800	73,600	254,200	120,000	512,600
From the Research Council	2,764,700	2,133,960	2,700,460	950,000	8,549,120



Budget

	NIVA	SINTEF	ApN	NTNU	SES	SDU	HI	Equipment	COSTS	TOTALT
2017	798,000	502,000	419,400	589,500	53,800	20,000	70,000	247,200	64,800	2,764,700
2018	1,188,360	510,000	10,000	10,000	10,000	10,000	10,000	312,000	73,600	2,133,960
2019	1,315,760	140,000	220,000	70,000	10,000	566,500	10,000	114,000	254,200	2,700,460
2020	280,000	150,000	170,000	80,000	20,000	20,000	110,000	0	120,000	950,000
TOTALT	3,582,120	1,302,000	819,400	749,500	93,800	616,500	200,000	673,200	512,600	8,549,120



But now! - let's set sail and start the journey...!



... and if you ask about my role in the KELPPRO project....?

