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Biogas in Norway and its role in the new circular bioeconomy

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Nordic Biogas Conference

Oslo, 10.04.2019

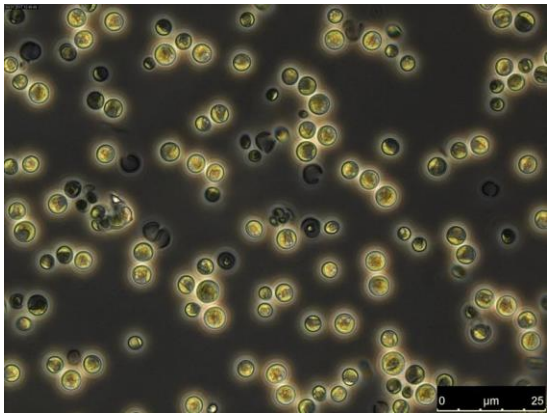
One of Norway’s largest research institutes

A stretched-out country with a varied growth season. 1700 km from Lindesnes til Nordkapp in a straight line, 2500 km by car.

680 employees in different locations.
Annual turnover 77 million Euro.
Owned by the Ministry of Agriculture and Food.

Photo: Ragnar Våga Pedersen

Bioeconomy is the transformation of biological resources…



Photos: Anette Tjomsland, Nina Elisabeth Nagy og Colorbox

…into useful products and services

Photos: Erling Fløistad, Steve Buissinne, Pixabay

LINEAR VS CIRCULAR BIOECONOMY

Linear economy

⇒ Sees resources as waste

Circular

⇒ Sees waste as a resource

EXAMPLES OF ADDING VALUE TO SECONDARY RESOURCES WITHIN THE «BLUE-GREEN» CIRCULAR BIOECONOMY

Foto: mikroalger fra https://prosjektmikroalger.wordpress.com/2014/05/01/biopharmia/. Fiskefôr fra Anne-Lise Aakervik. Soya fra Brasil fra iiStockphoto. Resten fra Nibio/Bioforsk

What makes Norway unique?

http://www.brunost.ch/brunost-ost/

p%C3%A5-Olav-Duun-v
russefeiring%C2%BB-15770424.ece

https://en.wikipedia.org/wiki/Bunad

What *really* makes Norway unique (in a biogas context)?


Foto: Fylkesmannen i Sogn og Fjordane


Foto: Regjering.no

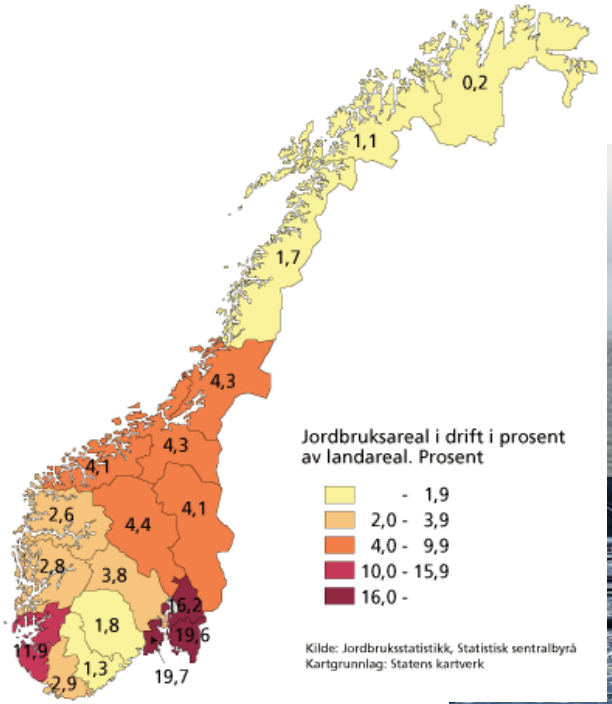



Foto: Store Norske Leksikon


Foto: Wikipedia


Foto: Ragnar Våga Pedersen

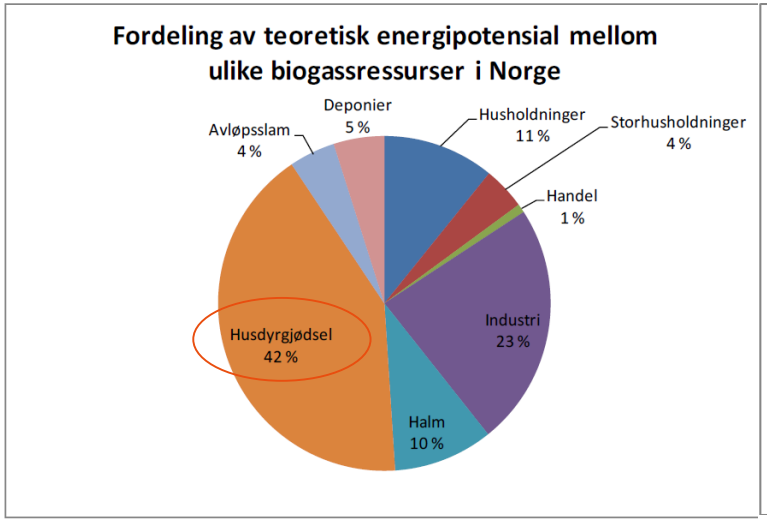
Fish sludge, AD and the bioeconomy

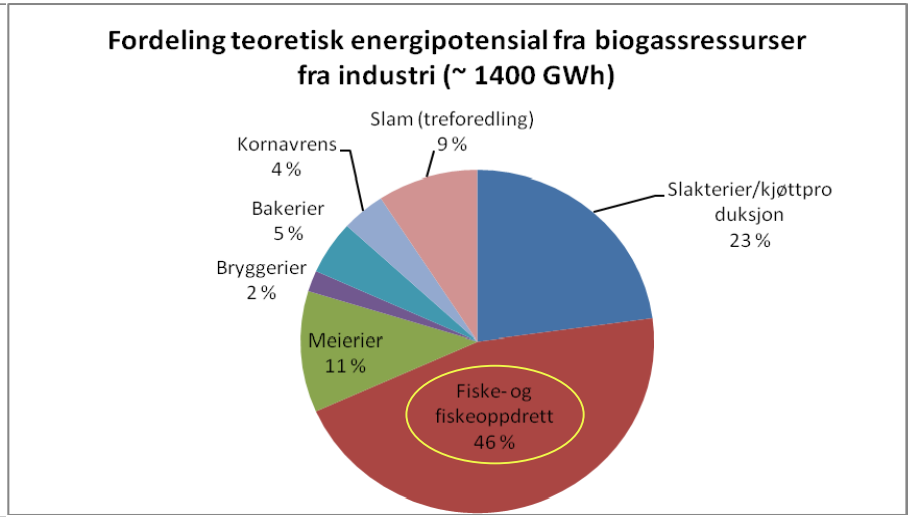

Foto: Erling Wåge


Foto: AKVA group


Foto: Anette Tjomsland

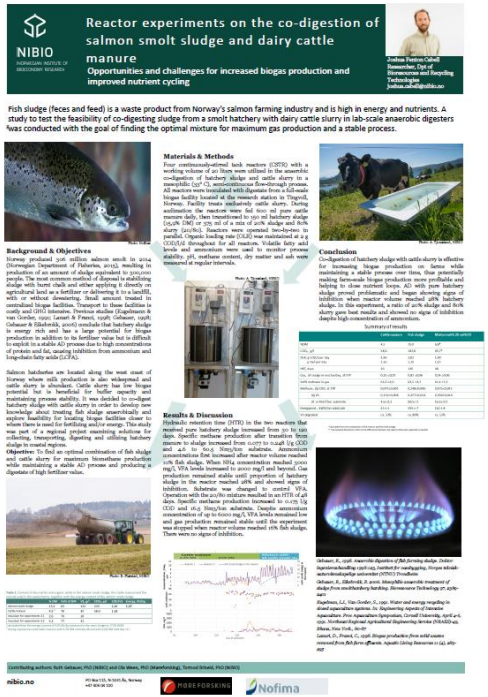
Fish sludge + manure = a match made in heaven?





From: Raadal et al, 2008, *Potensialstudie for biogass i Norge* Østfoldforskning

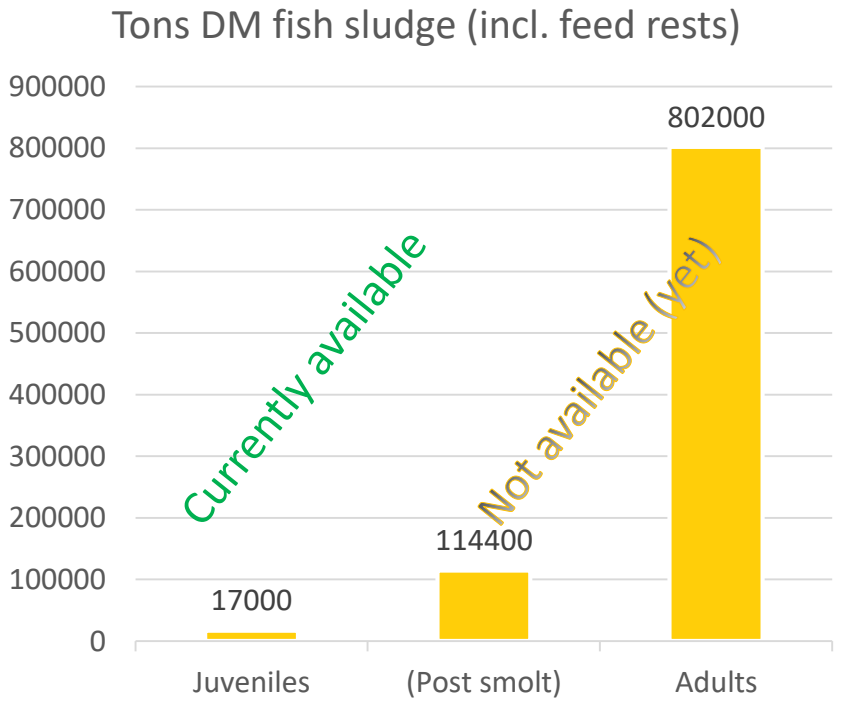
Co-digestion of fish sludge and manure



- Fish sludge high N – makes sole digestion problematic.
- Blend of 20% fish sludge and 80% almost 3X biomethane production with no sign of instability.
  - From 0,131 l/g VS to 0,304 l/g VS
- The same applies to fish silage (dead fish and off-cuts) – 20:80 ratio gave best results.
- Emerging technologies making sole digestion possible.

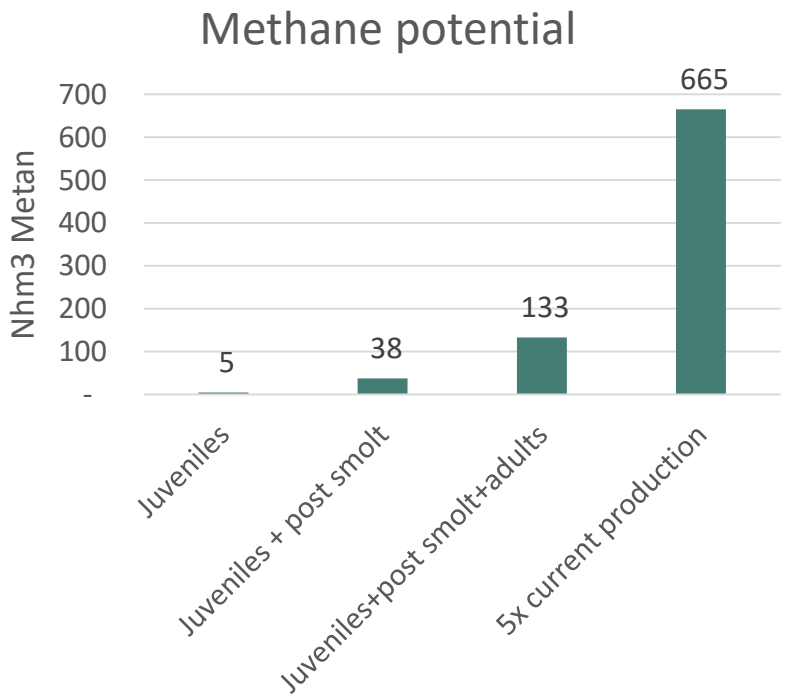
How much fish sludge is produced in Norway?

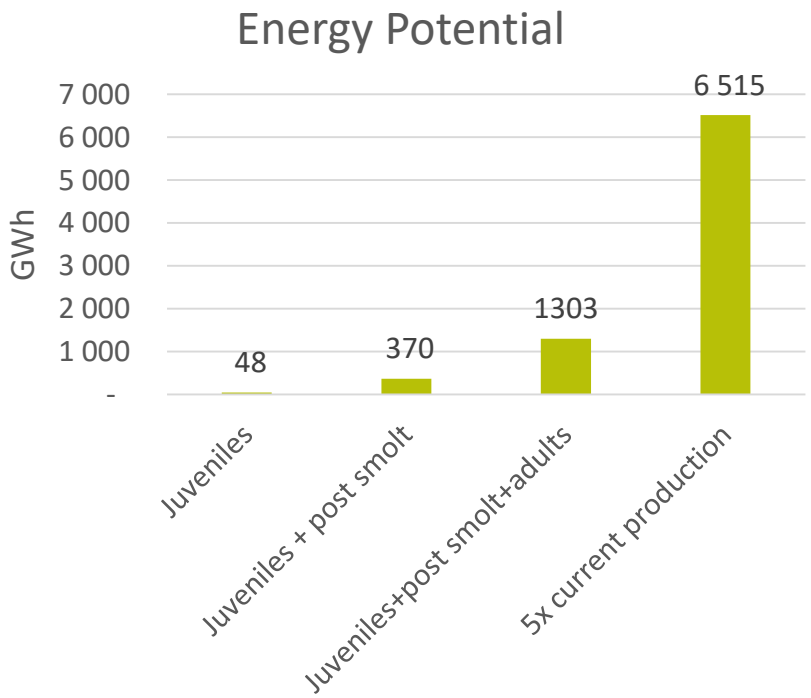
- **304 million** salmon juveniles in 2018[1] (freshwater sludge, available)
- **1 331 000 ton** salmon in 2018[1] (marine sludge, currently unavailable)
- Goal of increasing production five-fold by 2050.
- An increasing amount will be land-based or within closed pens.



1: Fra Fiskeridirektoratet, Braaten et al (2010) og Rosten et al (2013), Svein Martinsen (pers. komm.).
2: http://www.miljostatus.no/tema/hav-og-kyst/overgjodsling/utslipp-av-naringssalter-fra-fiskeoppdrett/

Theoretical biogas potential of fish sludge





Biogas isn’t just about gas…

Recycling of nutrients, reduced pollution, increased food production

Foto: Stian Sørensen

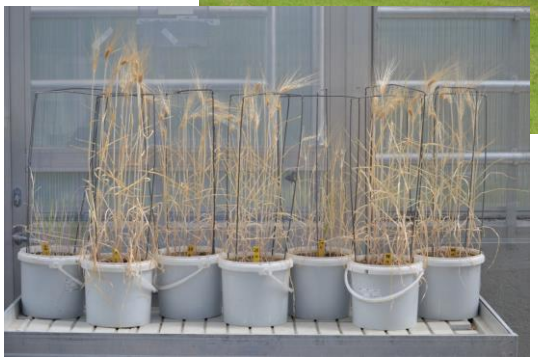
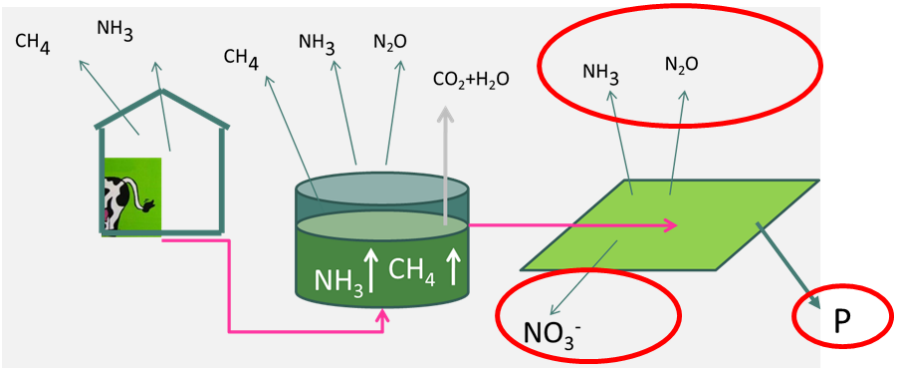


Foto: Trond Knapp Haraldsen



8-9000 tonn fosfor/år i fiskegjødsel[1]

1 Hamilton, H. A., Brod, E., Hanserud, O. S., Gracey, E. O., Vestrum, M. I., Bøen, A., Brattebø, H. (2016). Investigating Cross-Sectoral Synergies through Integrated Aquaculture, Fisheries, and Agriculture Phosphorus Assessments: A Case Study of Norway. Journal of Industrial Ecology, 20(4), 867–881. https://doi.org/10.1111/jiec.12324

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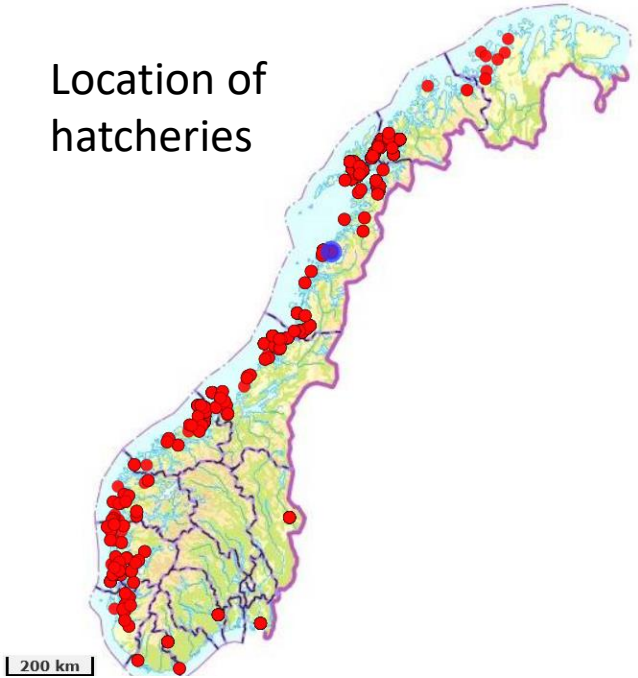
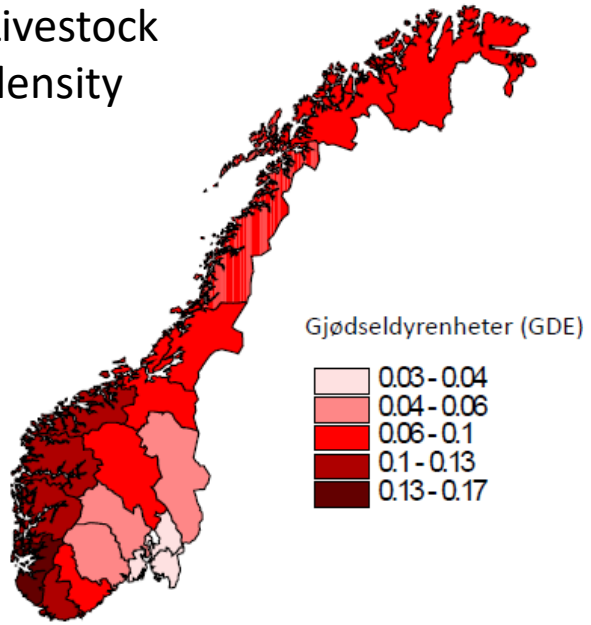
The challenge of P

Location of hatcheries

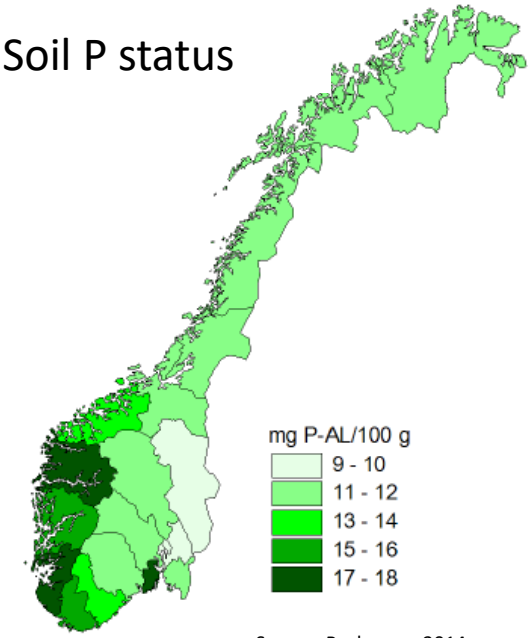


Source: Norwegian Fisheries Department

Livestock density



Soil P status



Source: Bechmann 2014

8-900 tons P released in the form of fish sludge per year.[1]

1 Hamilton, H. A., Brod, E., Hanserud, O. S., Gracey, E. O., Vestrum, M. I., Bøen, A., Brattebø, H. (2016). Investigating Cross-Sectoral Synergies through Integrated Aquaculture, Fisheries, and Agriculture Phosphorus Assessments: A Case Study of Norway. Journal of Industrial Ecology, 20(4), 867–881. https://doi.org/10.1111/jiec.12324

Anaerobic digestion: a hub in the circular bioeconomy

Municipal/household waste

Livestock manures

Aquaculture/fisheries waste

Sewage sludge

Etc…

Anaerobic digestion
+++

Liquid, solid digestate (fertilizer)

N and P ++

Biochar

Protein, amino acids?

Energy (biofuel, electricity/heat, hydrogen)

Compost

Barriers to making circular bioeconomy a reality

- Regulatory and legislative
- Bioaccumulation (heavy metals, POP, dioxins), microplastic
- Antibiotic resistance, prions, pharmaceuticals
- Economics and market
- Logistics

AD can in combination with other processes address many of these challenges

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Thank You!

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