Methane emission measurements in Norwegian sheep and goats

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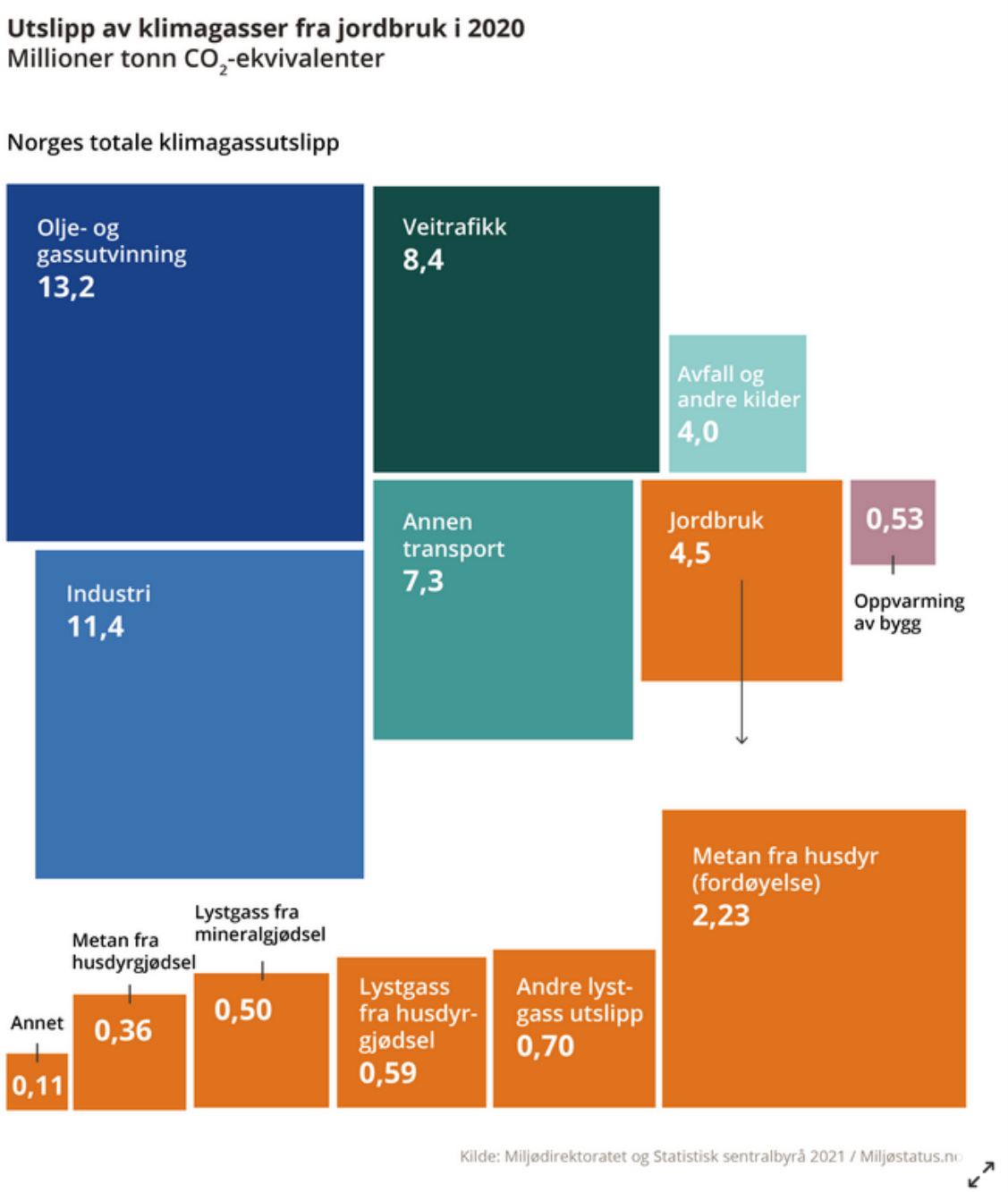
Why focus on methane?

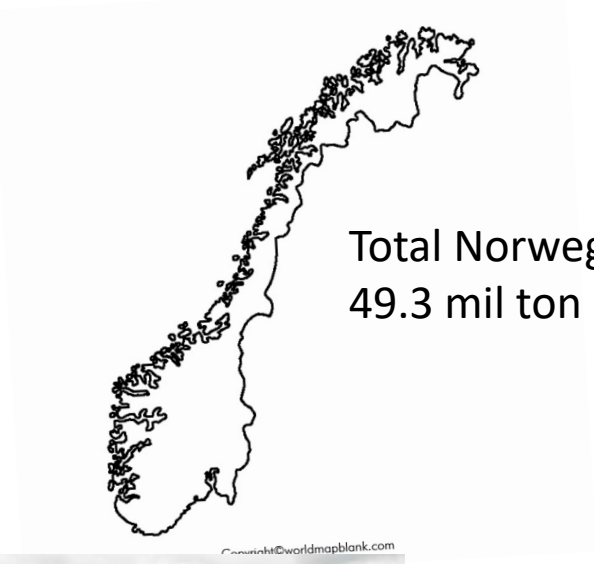
- Focus on Greenhouse Gases (GHG) due to global warming
- Agriculture: 9.1% of total GHGs in 2020
- ~50% of emission from agriculture is enteric methane
- ~1% of national emission is from enteric methane emission from sheep
- Norwegian agriculture sector has made agreement with the government to reduce GHG emission by 10% by 2030
- Breeding and feeding are mitigation option



Figuren viser klimagassutslipp fra jordbruk, sammenlignet med de totale klimagassutslippene i 2020. | *Kilde: Miljødirektoratet og Statistisk sentralbyrå 2021/Miljøstatus.no*

Why focus on methane?

- Increase in global warming due to GHG emission
- Agriculture: 9.1% of total GHGs in 2020
- ~1% of national emission from enteric methane emission in sheep
- Norwegian agriculture sector has made agreement with the government to reduce GHG emission by 10% by 2030 relative to 2020



Total Norwegian GHG emission:
49.3 mil ton CO_2-eq (100%)

Emission from agriculture:
4.5 mil ton CO_2-eq (9.1%)

Emission from sheep:
0.5 mil ton CO_2-eq (1%)

Mitigation options

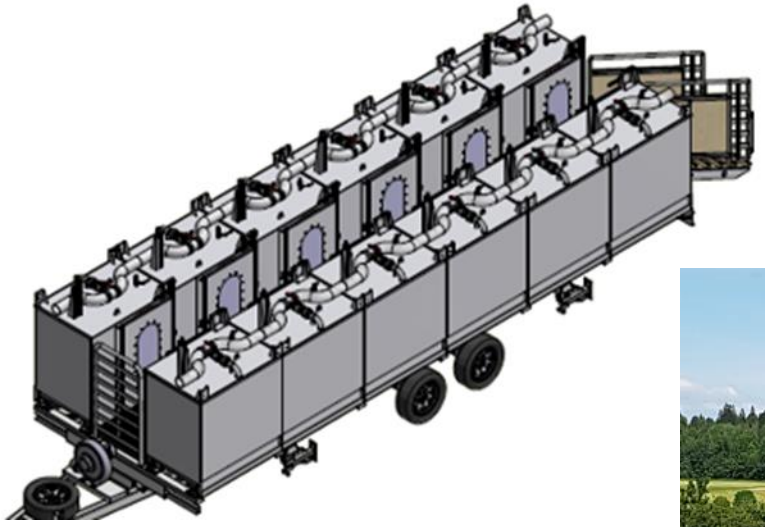
Breeding

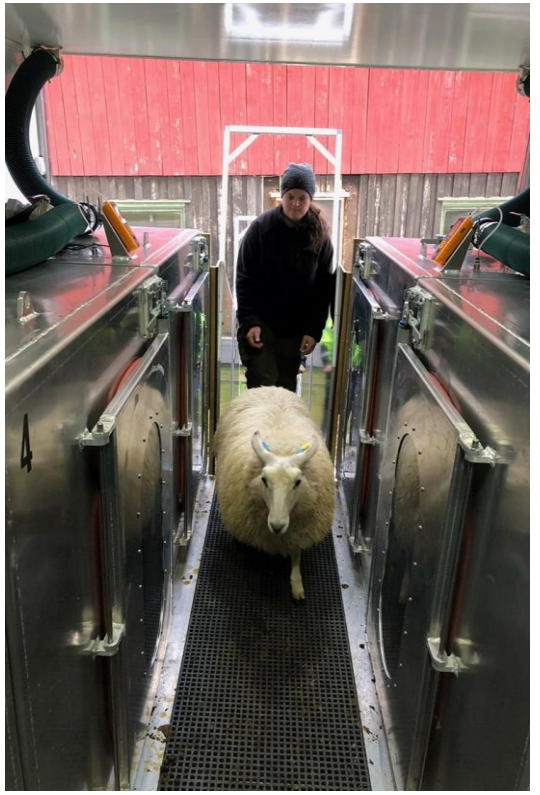
- Improved productivity
  - Increase in number of lambs weaned
  - Increase in lamb growth
- Feed efficiency
- Direct reduction of methane emission

Traditional breeding work

New trait in the breeding goal??

Ten portable accumulation chambers in a truck





- From trailer to truck
  - Easier to drive on icy mountain roads
  - Possibility for heating
  - 10 larger chambers → adult sheep

Breeding Project

SMAll RuminanTs breeding for Efficiency and Resilience

Tasks

- Measure methane emission on 6000 animals once in ~60 flocks
- Genotype all animals with methane emission measurements
- Compute heritability for methane emission
- Correlate methane emission to other traits in the breeding goal

Phenotypic recordings

- Body Weight, kg
- Chamber and group
- CH_4, ppm in ~50 min
- O_2, % in ~50 min
- CO_2, % in ~50 min
- Time of measurements
- Airpressure outside chamber
- Temperature, C

Heritabilities and genetic correlations

	σ_a	CH_{4adj}, g/hr	42-d_{adj} (dir.)	42-d_{adj} (mat.)	140-d_{adj} (dir.)	140-d_{adj} (mat.)
CH_{4adj}, g/hr	0.112	***0.17 (0.04)***				
42-d_{adj} (dir.)	0.897	-0.07 (0.11)	***0.11 (0.01)***			
42-d_{adj} (mat.)	0.776	0.32 (0.09)	-0.19 (0.05)	***0.08 (0.01)***		
140-d_{adj} (dir.)	2.291	0.19 (0.10)	0.71 (0.03)	0.05 (0.05)	***0.13 (0.01)***	
140-d_{adj} (mat.)	1.703	0.11 (0.10)	-0.18 (0.06)	0.82 (0.03)	0.00 (0.06)	***0.07(0.01)***

Conclusion

- Heritability of PAC CH_4 emission was 0.17
- Breeding for reduced PAC CH_4 emission is a mitigation option
- Genetic correlation to maternal genetic effect of 42-day weight was 0.32 and significantly different from zero

- **Antagonistic relation between CH_4 and 42-day weight requires appropriate weighting in the overall selection index**

Methane emission in goats
- a pre-project

- Goats are ruminants that emits methane
- Methane has never been measured in portable accumulations chambers (PAC) in Norway

- **AIM:**
- Is it possible to measure methane emission on Norwegian Dairy goats?
- Does measurements result in elevated milk somatic cell counts of measured goats

Materiel

- Two herds
- 20 goats per herd
- <u>Group 1:</u>
  Five goats from first and five goats from second lactation
- <u>Gruppe 2:</u>
  Five goats from first and five goats from second lactation

Day	**Evening milk Samples**		**Methane emission measurements**	
	Group 1	Group 2	Group 1	Group 2
First	YES	YES	NO	NO
Second	YES	YES	YES	NO
Third	YES	YES	NO	NO

Conclusion from Methane emission in goats - a pre-project

- It is possible to measure methane emission on Norwegian Dairy goats in PAC

- Obtained emissions of similar level as of sheep of the same size

- Based on this study →
  Measurements did not result in an elevated milk somatic cell count of measured goats

The Method Project

Forskningsmidlene
for jordbruk og matindustri

AIM

- To estimate 24-hour emissions for sheep and for goats
- Study repeatability in emissions across days
- Study predictability of hourly emission when measuring 30 min, 45 min and 60 min
- Study diurnal variation in emissions

The Method Project
- Material

Forskningsmidlene
for jordbruk og matindustri

- Five sheep farms
- 30 ewes on each farm, 3 groups of 10 ewes with equal age distribution
- Each group of 10 ewes measured every 6th hour for 72 hours

- Three goat farms
- 30 does on each farm, 3 groups of 10 does with equal age distribution
- Each group of 10 does measured 3 times per day for 72 hours