



Green
Mountain

How Green Mountain tackled the many challenges of data center heat reuse and what they learned along the way.

Data Center Forum – October 5th

Tor Kristian Gyland – CEO og Green Mountain

Green Mountain
MOUNTAIN



Green Mountain

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Green Mountain



Financially secure, strong financial growth and performance



Uptime Tier III, ISO9001, 14001, 27001, ISAE 3402 & PCI-DSS



World-Class Efficiency



100% renewable energy



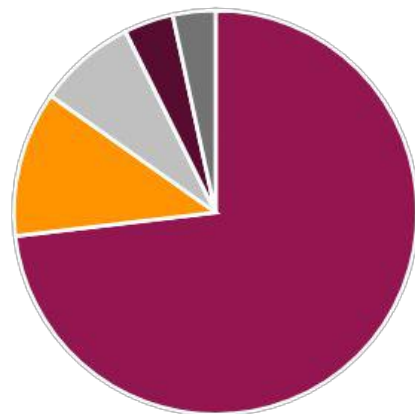
Superb client satisfaction



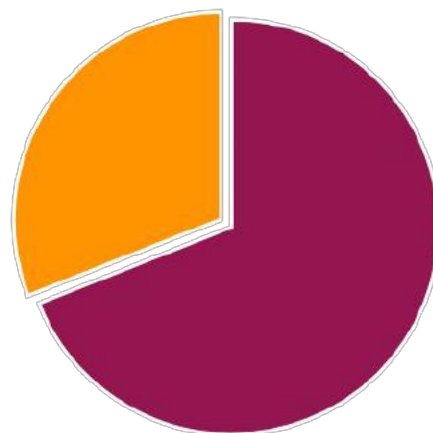
Operational Excellence with 100% uptime



Lowest cost of power in Europe



■ Service Providers/Cloud (73%)
■ Bank & Finance (12%)
■ AI/HPC (8%)
■ Public sector (4%)
■ Enterprise (3%)



■ International (69%) ■ Domestic - Norway (31%)



Green Mountain

Existing DC

Planned DC

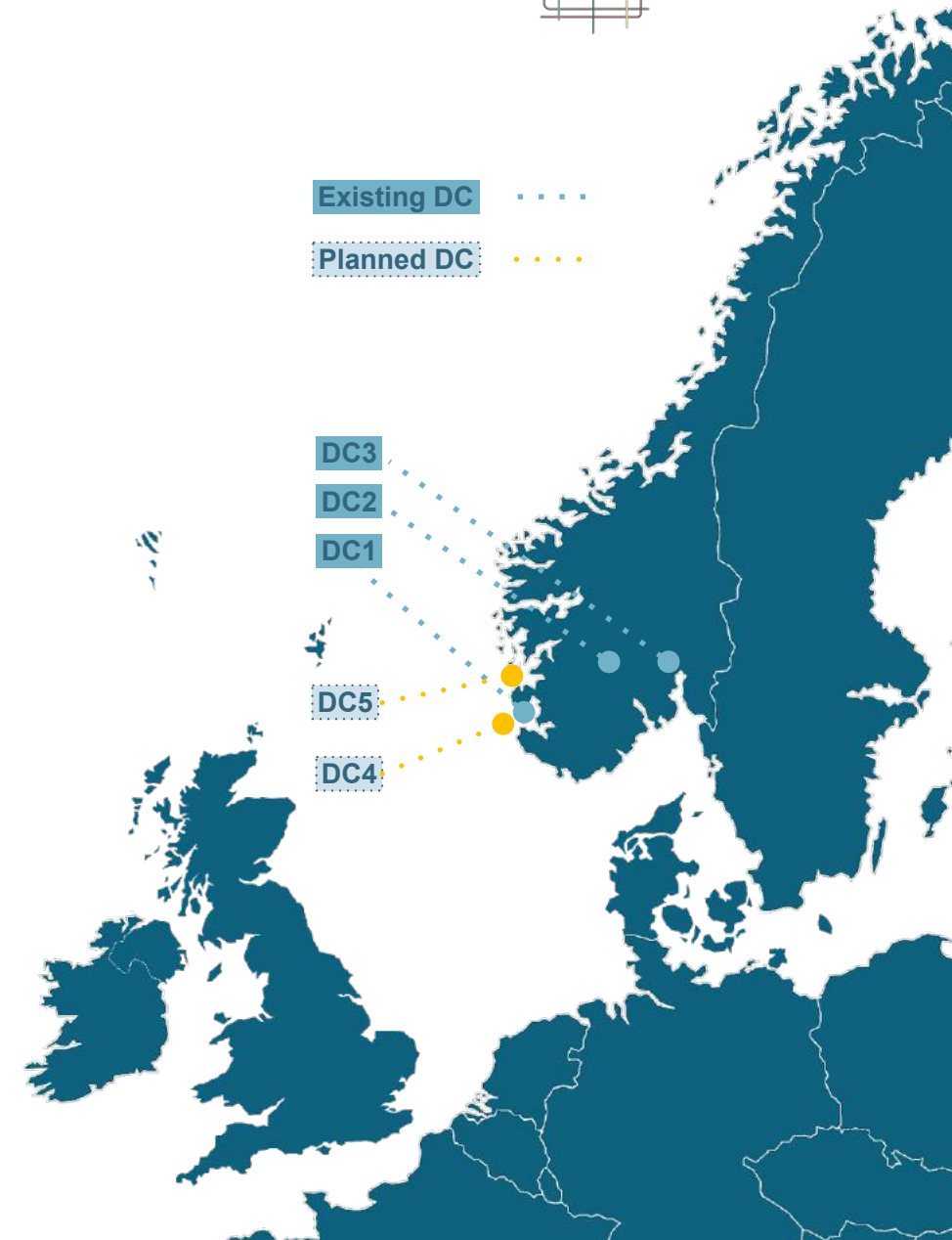
DC3

DC2

DC1

DC5

DC4



Energy efficiency for climate



Brussels, 14.7.2021
COM(2021) 558 final
2021/0203 (COD)

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
on energy efficiency (recast)

(Text with EEA relevance)

{SEC(2021) 558 final} - {SWD(2021) 623 final} - {SWD(2021) 624 final} -
{SWD(2021) 625 final} - {SWD(2021) 626 final} - {SWD(2021) 627 final}

- To meet the new EU 2030 climate target, energy efficiency needs to be prioritized. To increase the effort, the European Commission put forward, in July 2021, a [proposal for a new directive on energy efficiency](#) as part of the package “[Delivering on the European Green Deal](#)”
- The pact proposes that administrations recognize that heat is a source of energy and worth using, even if the infrastructure to do so requires investment.

Energy efficiency for climate



- The Norwegian government is currently evaluating regulations that exceeds the EU directives
 - Power plants, industrial plants, energy production plants and district heating/district cooling networks with more than 20 MW of total heat output, i.e. oil, gas and bioenergy, etc., shall be covered by the obligation to perform cost-benefit analysis.
 - In addition, the Ministry proposes that new data centres with more than 2 MW total electrical power, and other facilities with more than 20 MW total electrical power, should be covered by the obligation to carry out cost-benefit analysis for submission to the relevant authority for approval.



Etter liste

Deres ref	Vår ref	Dato
	21/280-	17. februar 2021

Høringsnotat energieffektiviseringsdirektivet artikkel 14.5

Vedlagt er høringsnotat om endringer i energiloven om krav til kost-nytteanalyser for utnyttelse av spillvarme fra termiske kraftverk, industri, datasentre og andre anlegg.

I tråd med Granavoldenplattformen forbereder Olje- og energidepartementet innleggelse av direktiv 2012/27/EU om energieffektivitet (EED) i EØS-avtalen. Et forslag til endringer i energiloven om energikartlegging i store foretak og krav til måling og fakturering av energibruk har vært på høring (november 2018). Dette er en tilleggshøring for å kunne gjennomføre krav i direktivet til å gjøre kost-nyttevurdering av utnyttelse av spillvarme.

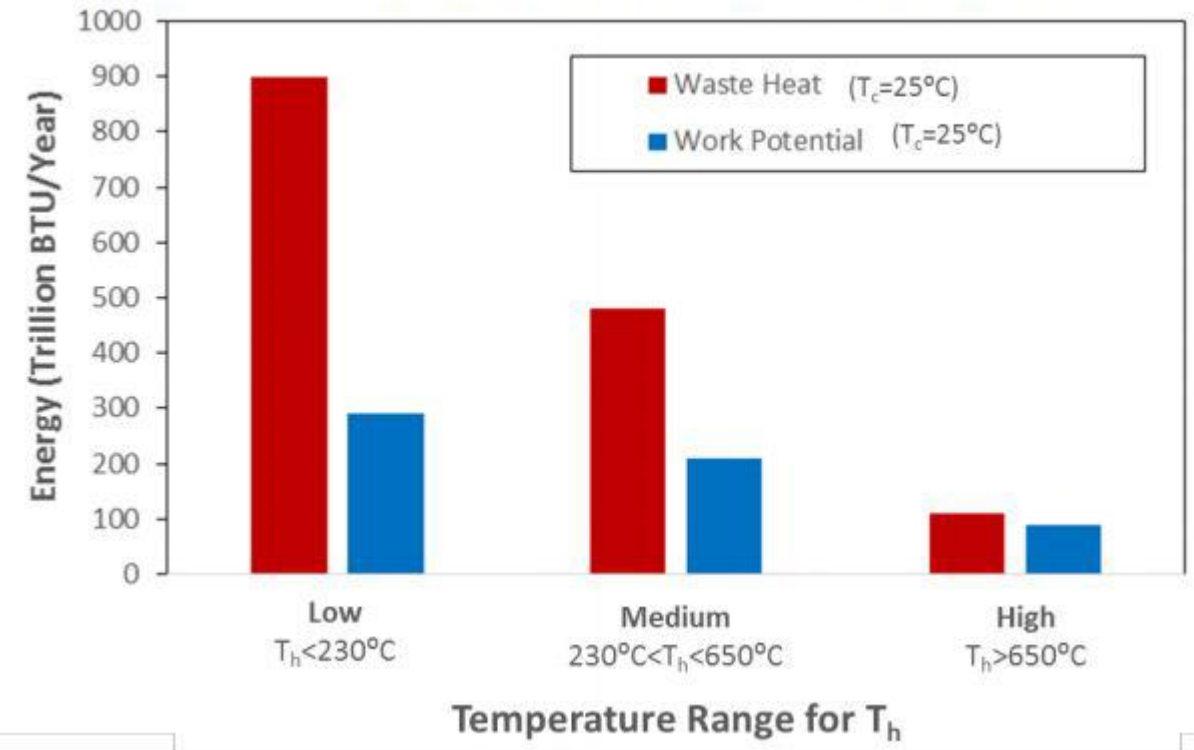
Departementet foreslår nye bestemmelser i energiloven som pålegger de som planlegger å drive, eller foreta omfattende (vesentlige) oppgraderinger av visse energi- og industrianlegg, å gjennomføre en kost-nytteanalyse av utnyttelse av spillvarme. Kost-nytteanalysene skal sendes inn til godkjenning hos myndighetene, og at det skal være forbudt å bygge anlegget/foreta oppgraderingen før godkjenningen foreligger. Videre foreslår departementet en hjemmel til å pålegge at anlegget skal bygges eller oppgraderes slik at spillvarmen utnyttes, der fordelene med dette er større enn kostnadene.

I tråd med EED artikkel 14 nr. 5 foreslås det at kraftverk, industrianlegg og energiproduksjonsanlegg og fjernvarme- og fjernkølenett med mer enn 20 MW samlet tilført varmeeffekt, det vil si olje, gass og bioenergi mv., skal omfattes av plikten til å utføre kost-nytteanalyser. Plikten utløses ved planlegging av nye anlegg og omfattende oppgradering av eksisterende anlegg. Med omfattende oppgradering menes en oppgradering hvor kostnadene er høyere enn 50 prosent av investeringskostnadene for et nytt sammenlignbart anlegg.

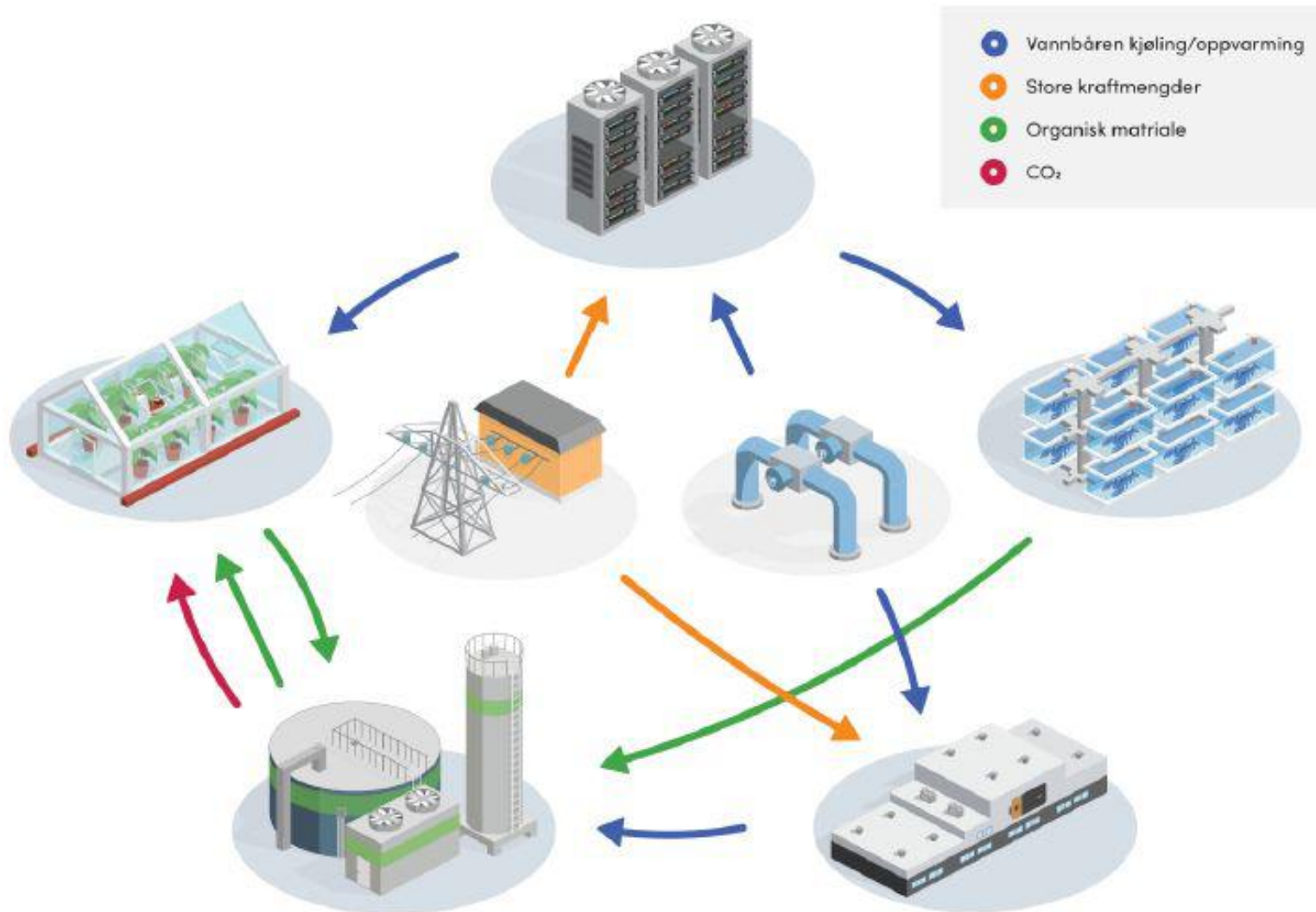
What challenges do we have?

- Data centers produce low grade heat
- Data centers tend to use indirect air-air cooling solution
 - Air is not the best media to transfer energy
- Data centers are being built outside city centers where there is limited infrastructure ready to reuse the heat
 - Not easy to transport the energy
- Challenges in getting value for all parties

Figure 1: Unrecovered Waste heat in different hot side temperature ranges (Industrial Sector)³



Energy efficiency for climate

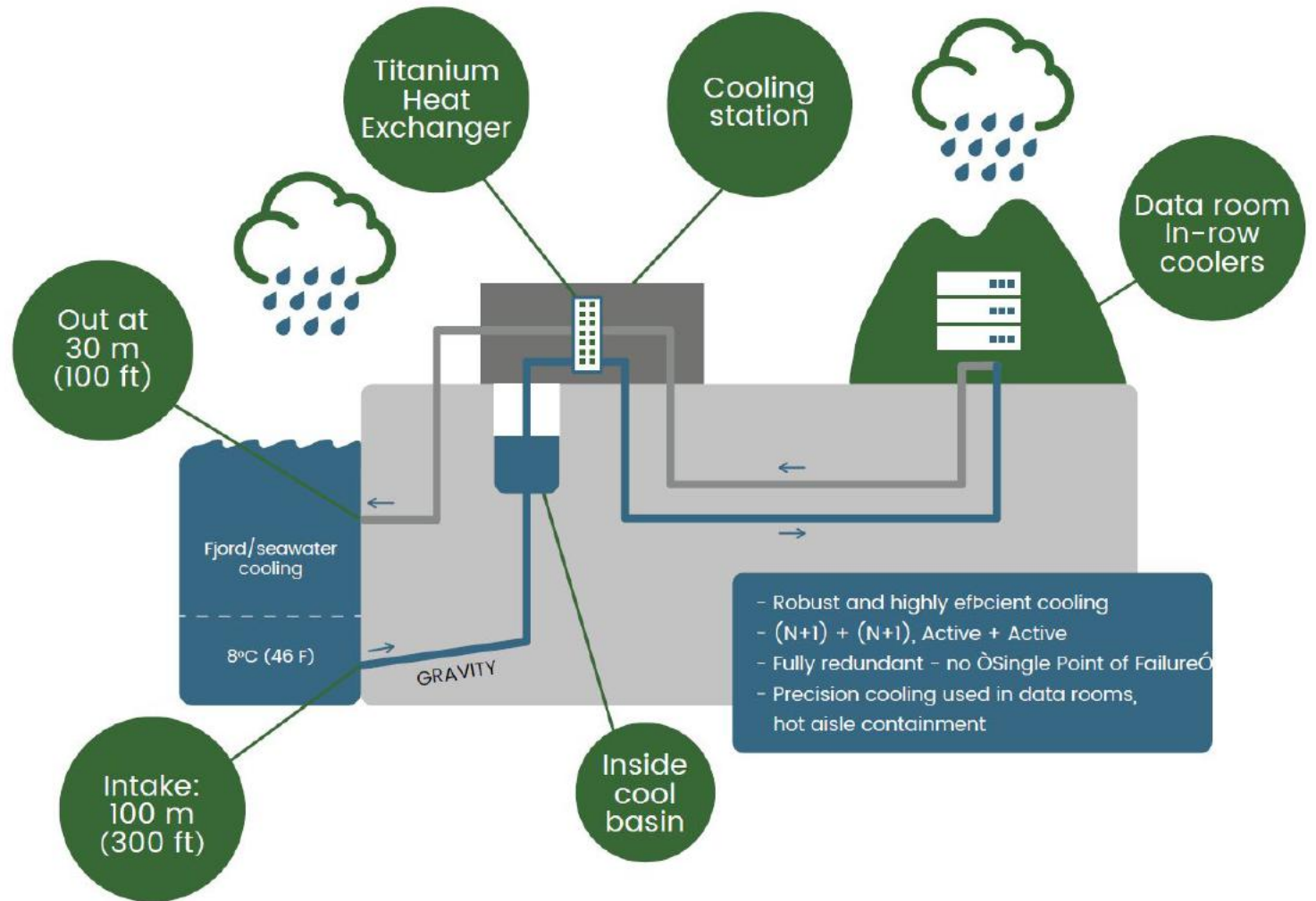


- The ambition is to build a truly circular economy
- The economy uses traditional waste to create opportunity and reduce emission
 - Data center
 - Hydroponic farming
 - Biogas plant
 - Onshore fish farm
 - District heating

Water Cooling

Energy Efficient Cooling Solution DC1 – Stavanger

- Fjord/seawater cooling solution
 - Securing ultra-low PUE
- Threshold fjord and stable water temperature all-year at 8°C (46 F)
- Water inlet at 30 m (300 ft.)
 - Minimizes algae production and secure ample access
- Full recycling through closed loop system
 - No water use
- Tide/gravity
 - No energy usage
- 3 kW of power gives equivalent of 1000 kW of cooling

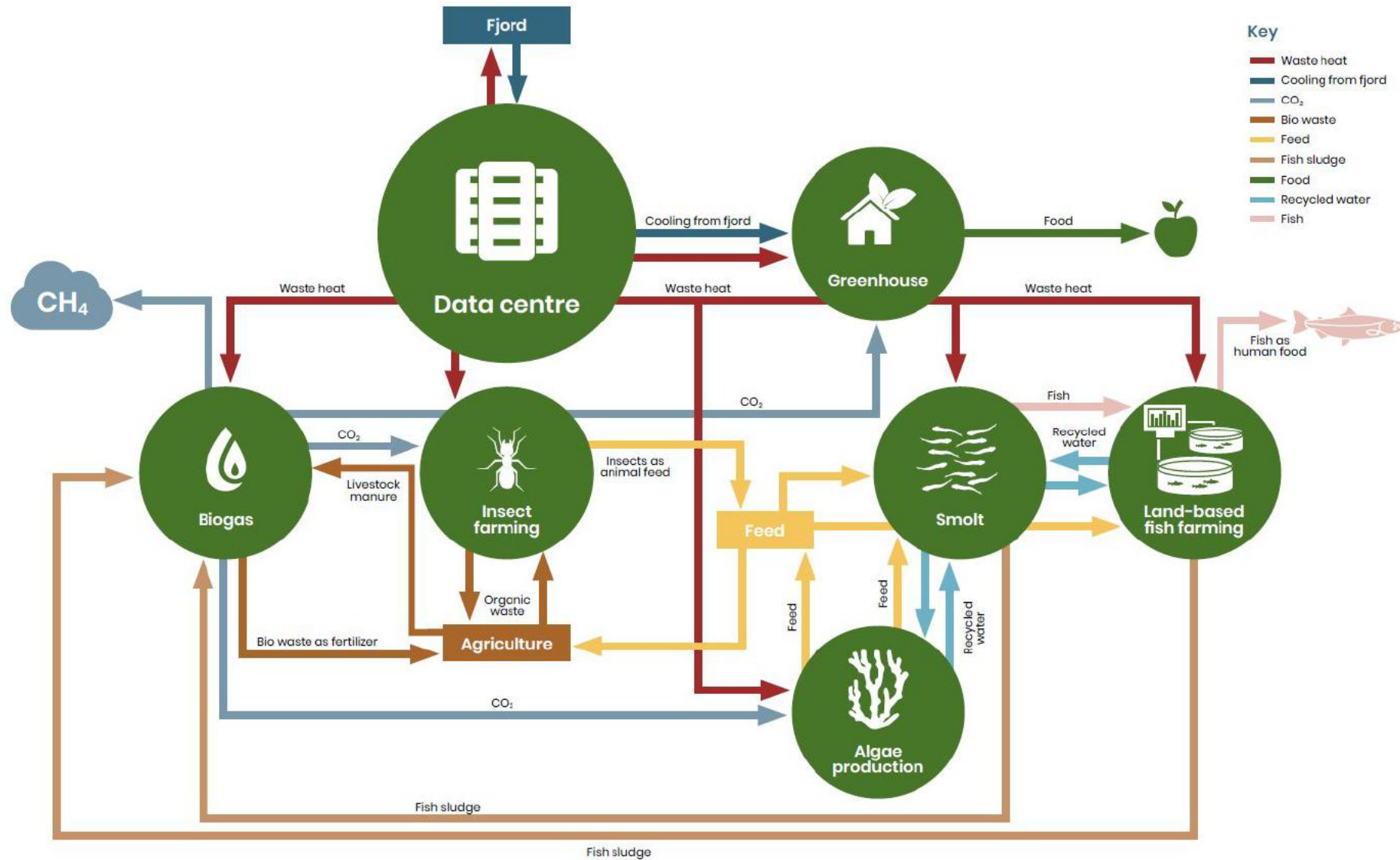


Circularity put into a system



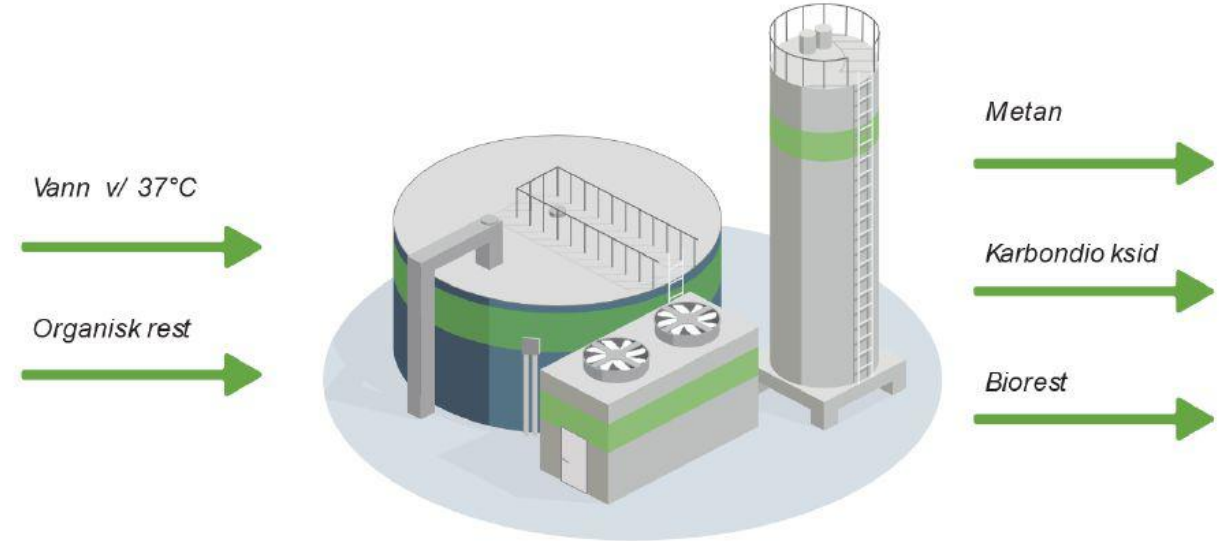
- 5 master students spent the summer to investigate and evaluate how a data center at Kalberg could create new business opportunities based upon the residual heat from the data center
- A follow-up from last year where 5 new students did the same assessment
- Thorough evaluation of the different challenges and opportunities

The Eco System



Biogas plant

- Agriculture is responsible for 8.8% of the CO² emissions in Norway
- Use the cow manure to produce methane
- Output
 - Methane → Gas power plant
 - CO²/bio rest → Greenhouse



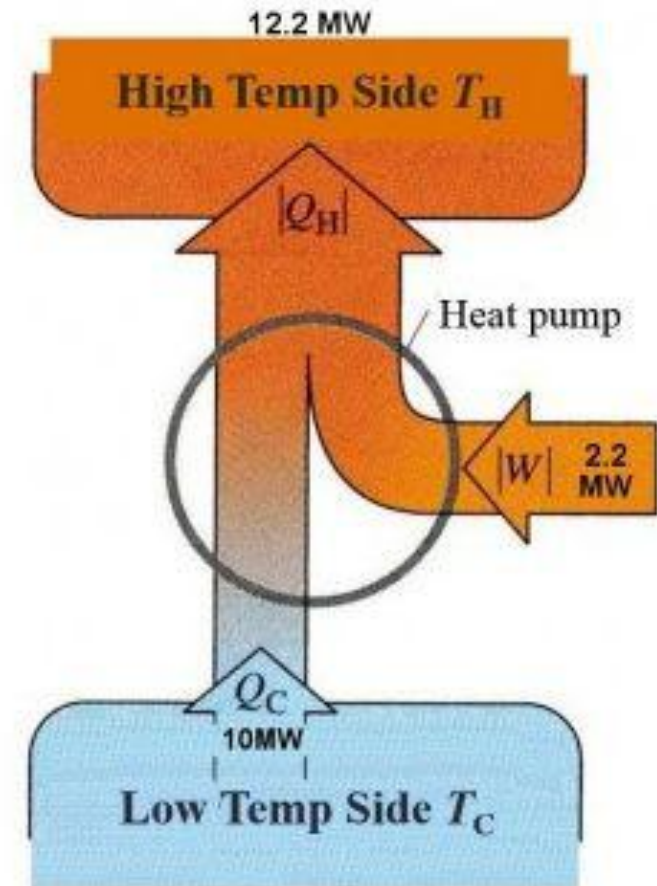
Greenhouse

- Adds additional complexity to secure win-win scenarios
 - A greenhouse needs light, heat and CO²
 - 50.000m²
 - 316kWh/m² ~ 1.8 MW
 - Heat 0.45MW
 - Light 1.35 MW
 - 2500 tons of CO²
- Output
 - 400 tons organic waste



District heating

- Use the heat from the datacentre into a district heating infrastructure
- Challenges
 - Low grade heat from the DC
 - Temperature of the water has to be increased
 - Currently fossil fuels is widely used to increase the heat in Norway
 - 50-75% of the current mix is delivered by fossil fuels (a challenge that needs to be resolved)
 - High investment cost
 - Lack of infrastructure in Norway
 - We should challenge the government



Tuna farming

- Tuna needs seawater with a temperature between 24-26° C
- An onshore fish farm has a potential of producing 1000 tons a year
- Tuna is expensive and in 2019 a record price of NOK 26 millions was achieved for a fish weighing 278 kg.
- Output
 - Fish sludge



Energy efficiency for true climate benefit



Vil varme oppdrettshummer med energi fra datasenter

Det norske datasenterselskapet Green Mountain og Norwegian Lobster Farm inngår et samarbeid. Energi fra datasenteret skal varme opp et landbasert oppdrettsanlegg for porsjonshummer.



SIRKULÆRT SAMARBEID: Administrerende direktør Tor Kristian Gyland i det norske dataselskapet Green Mountain skal samarbeide med styreleder Alf Reime og dagl... vis mer
Norwegian Lobster Farm

Dataselskap og sjømatelskap skal samarbeide

– Dette er virkelig en vinn-vinn-løsning, sier Hima Seafood-sjef Sten Falkum om samarbeidsplanene på Rjukan.

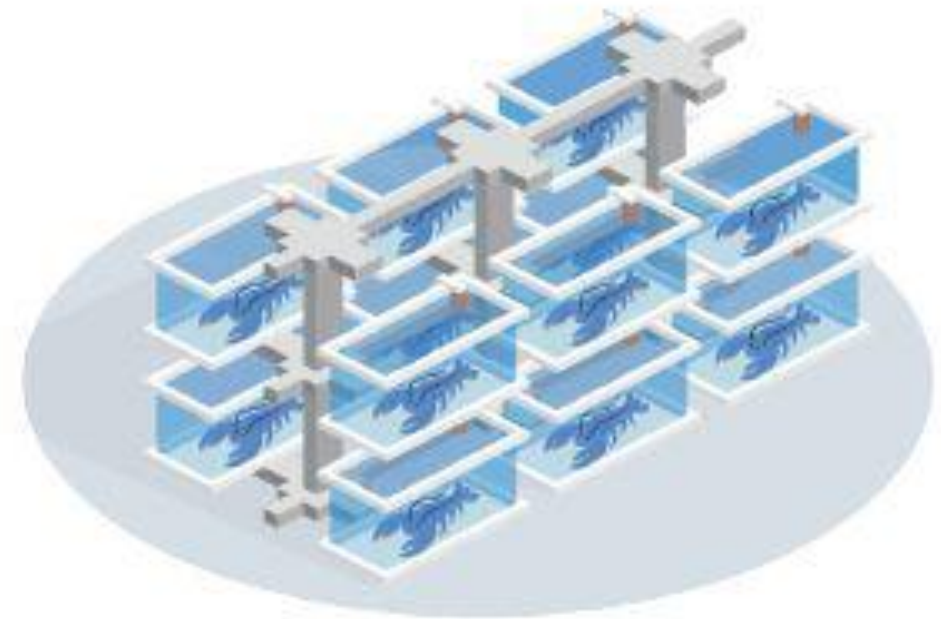


TENKER NYTT: Green Mountains datasenter på Rjukan.

FOTO: VOLKSWAGEN / GREEN MOUNTAIN

Lobster farming at one of our new sites

- Potential of producing 900 tons of lobsters annually
- Needs a seawater temperature of 20° to optimize production
 - Reduced the time to market for plate size lobster from 60 to 18/24 months
- The need for energy if you only have access to 8° seawater equals 30 MW, with the use of a heat pump this can be reduced to 6 MW (80 % reduction)
- Output
 - Provides 360 tons of fish sludge
 - According to NIBIO, mixing in 20% of fish sludge in a biogas facility will double the production



Trout farming at DC2 Telemark

- HIMA seafood is planning a production facility with an annual capacity of 9000 tons
- Needs fresh water at 12 - 15°
 - Heating during winter -> GM cooling needs will be reduced improving the efficiency
 - Cooling during summer? -> GM can cooperate with HIMA to improve the efficiency
- Energy need of 7.3MW



Opportunities



- Our ambition is to create value for all parties
- Identify all opportunities at our locations
- Our experience is that fish farming is one of the best sources of our waste heat
- We believe that more innovation is needed for other areas to make them commercial viable



Questions?



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**Thank you
for your attention!**