seecon

Centralised wastewater treatment systems in cold climates

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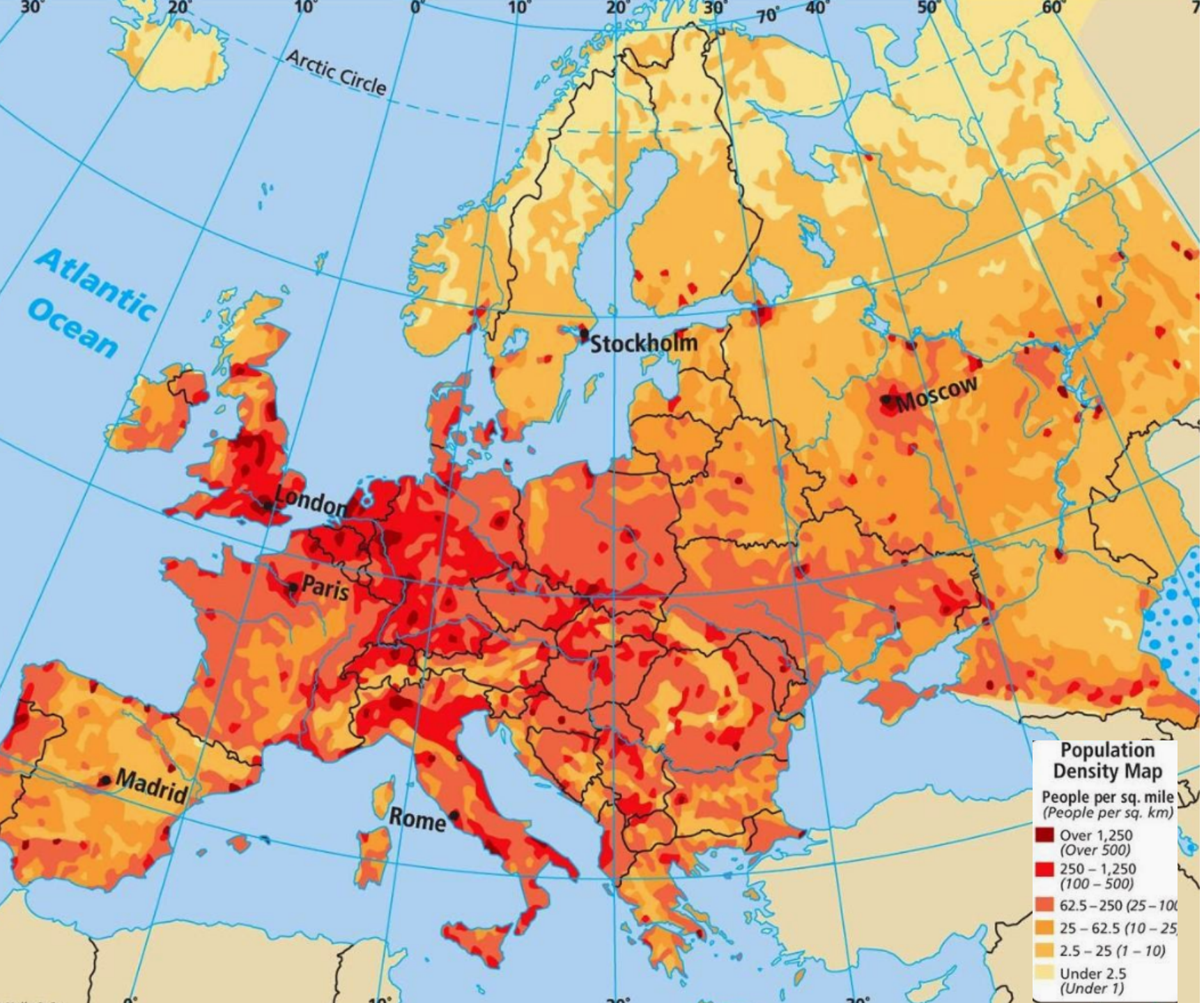
Population Density

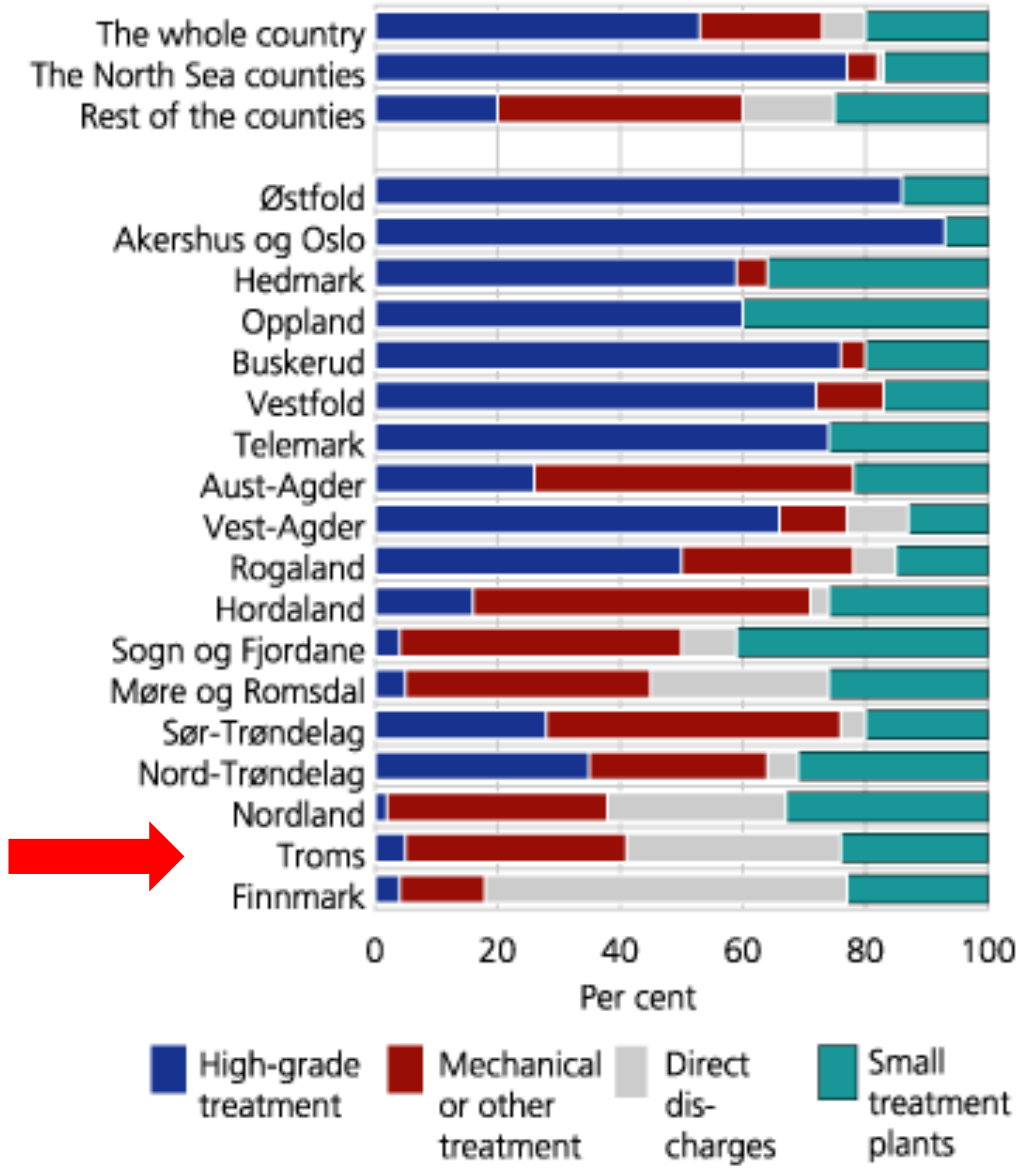


Type of treatment Status in 2001

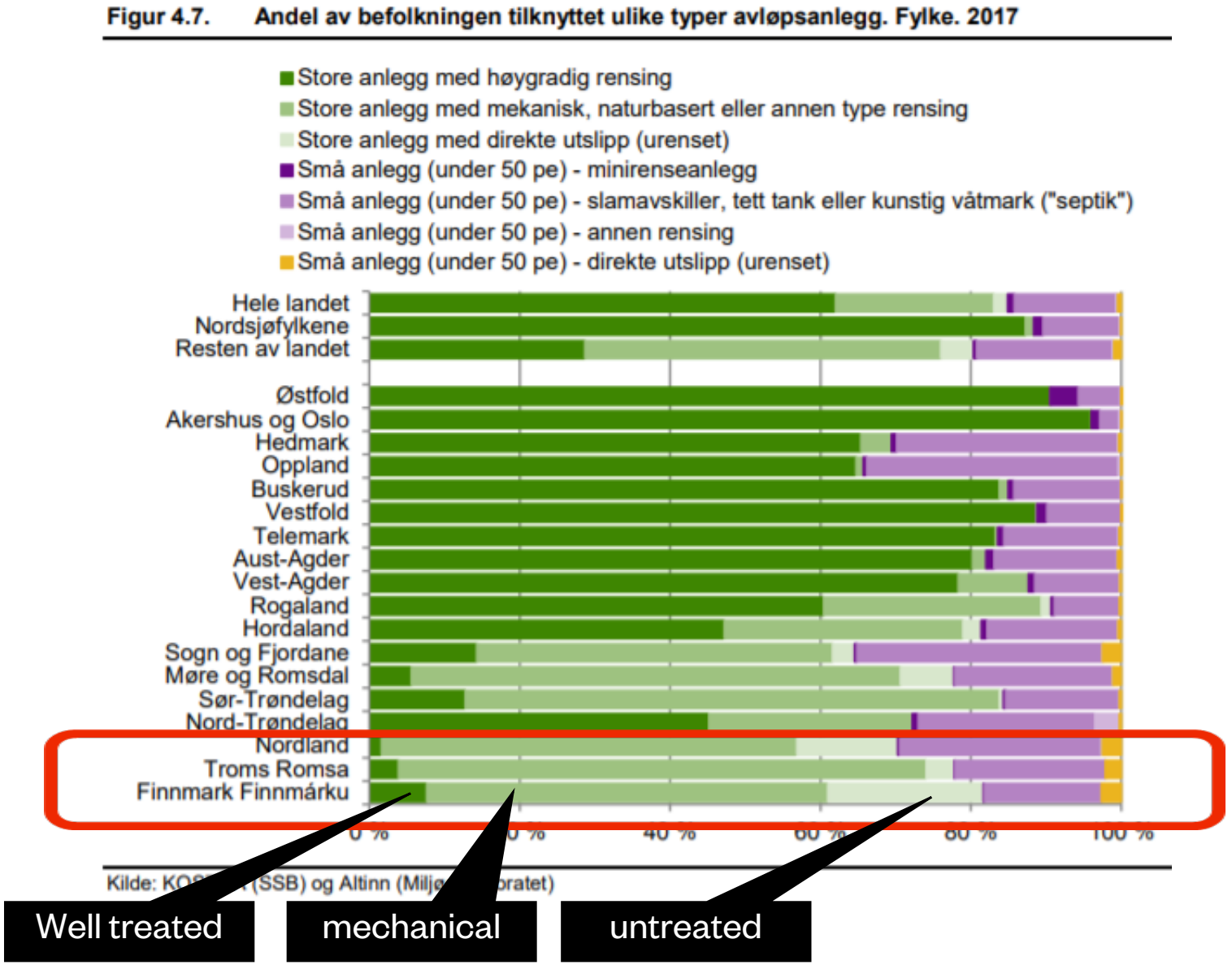
- The collection and treatment of waste water in all agglomerations of > 2´000 p.e.

- Secondary treatment of all discharged from agglomerations of > 2´000 p.e., and more advanced treatment for agglomerations > 10´000 population equivalents in designated sensitive areas and their catchments.

Part of the population connected to different types of wastewater treatment plants. Counties. 2001



Type of treatment: Status in 2017



Well treated

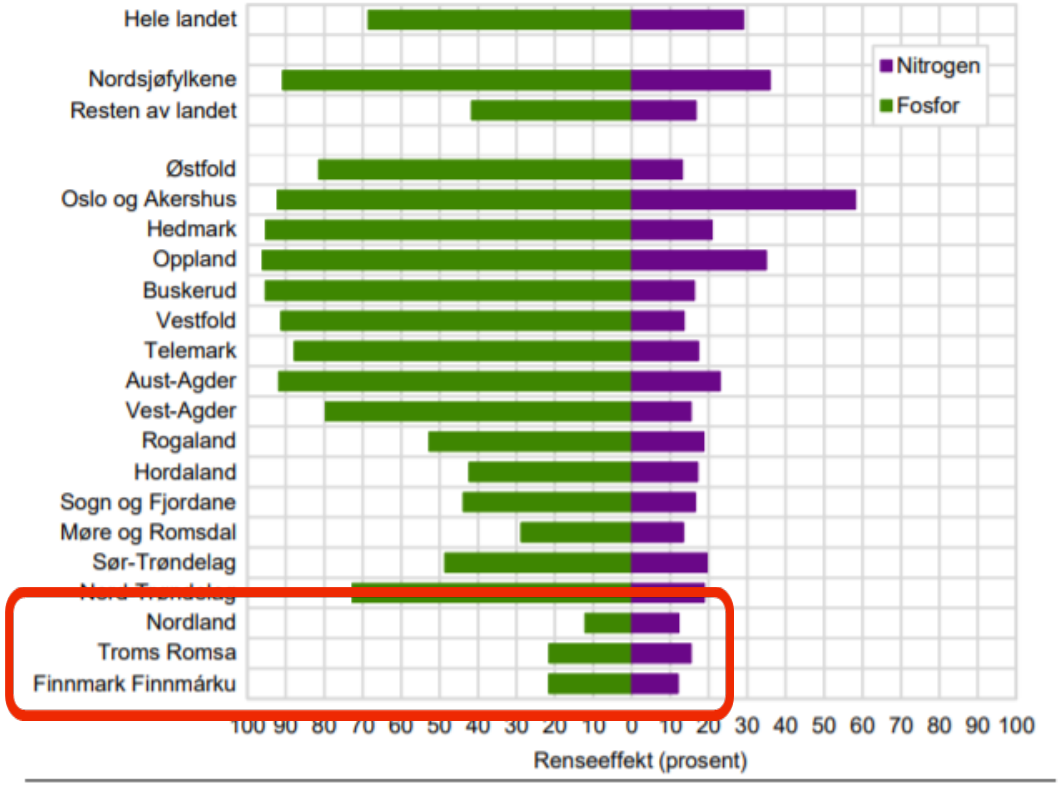
mechanical

untreated

Treatment efficiency N&P

Status in 2017

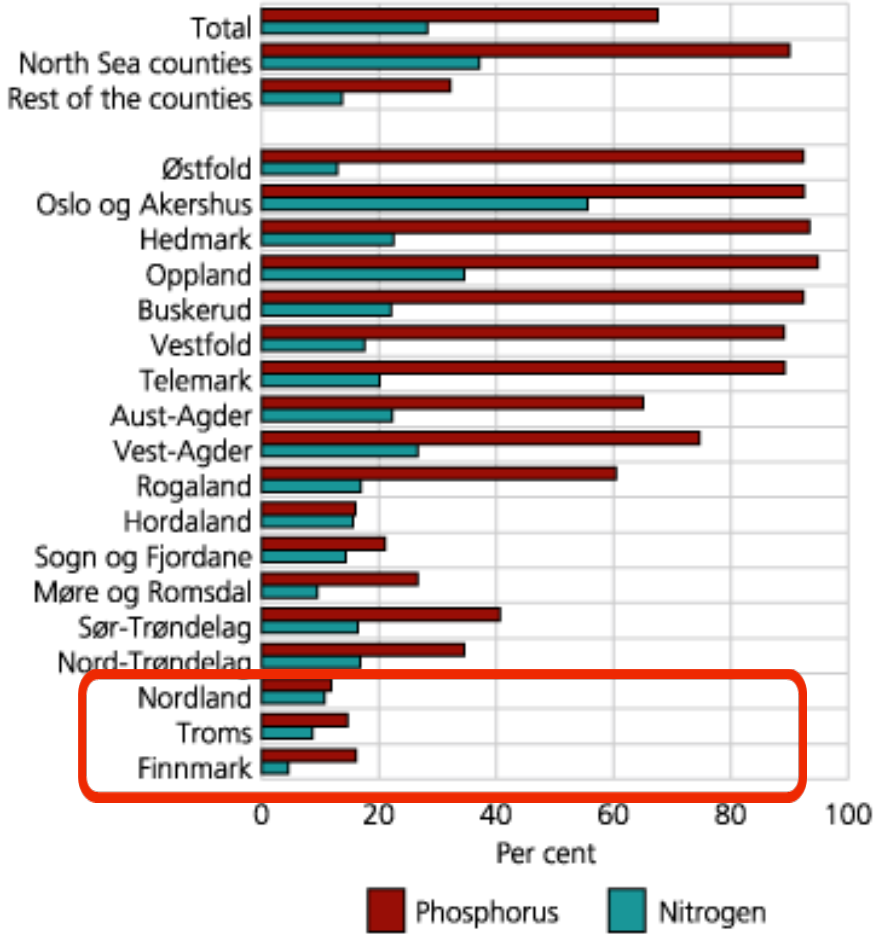
Figur 4.10. Renseeffekt for fosfor (TOT-P) og nitrogen (TOT-N). Avløpsanlegg ≥50 pe. Fylker og landet. 2017. Prosent



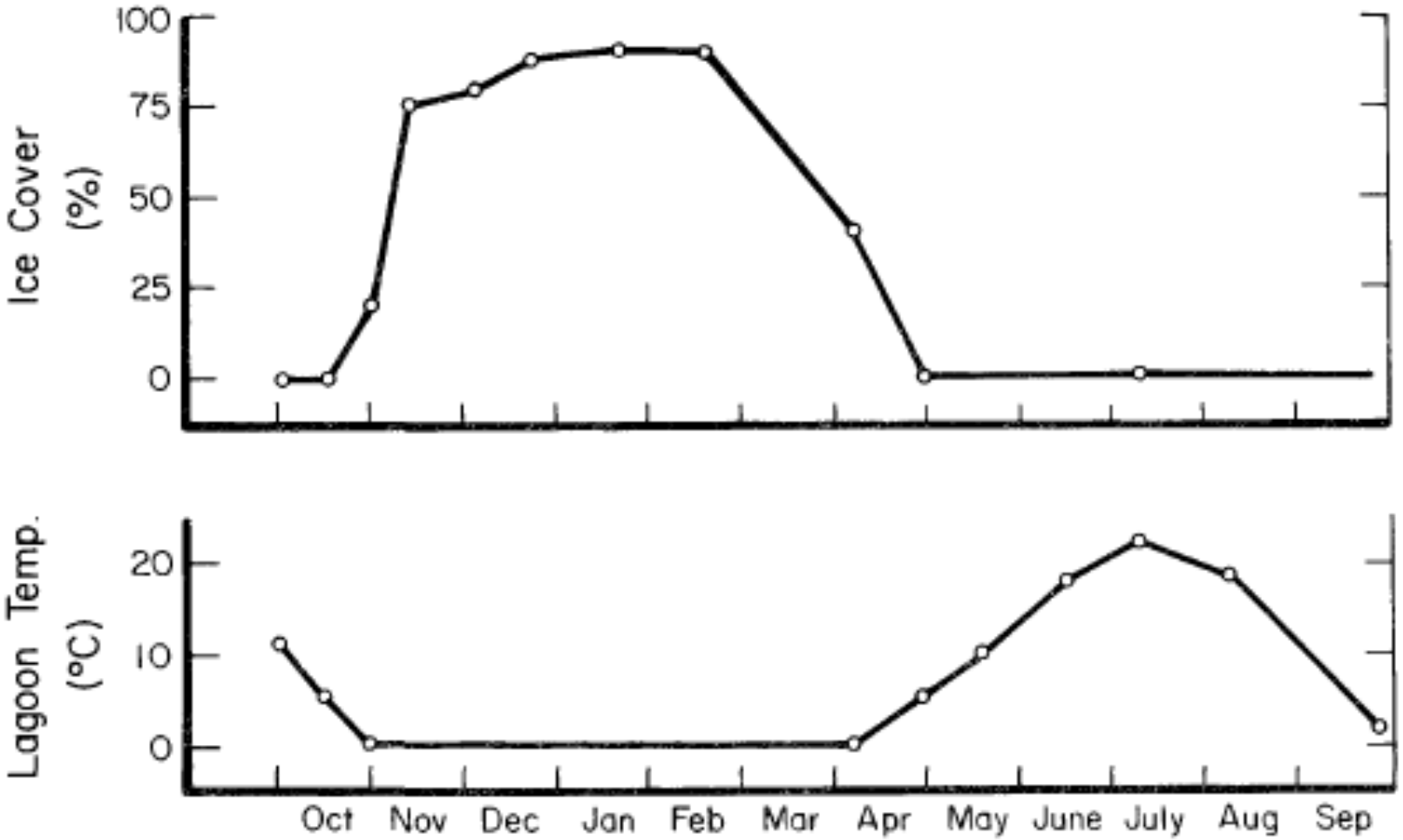
Kilde: Altinn, Miljødirektoratet

Status in 2001

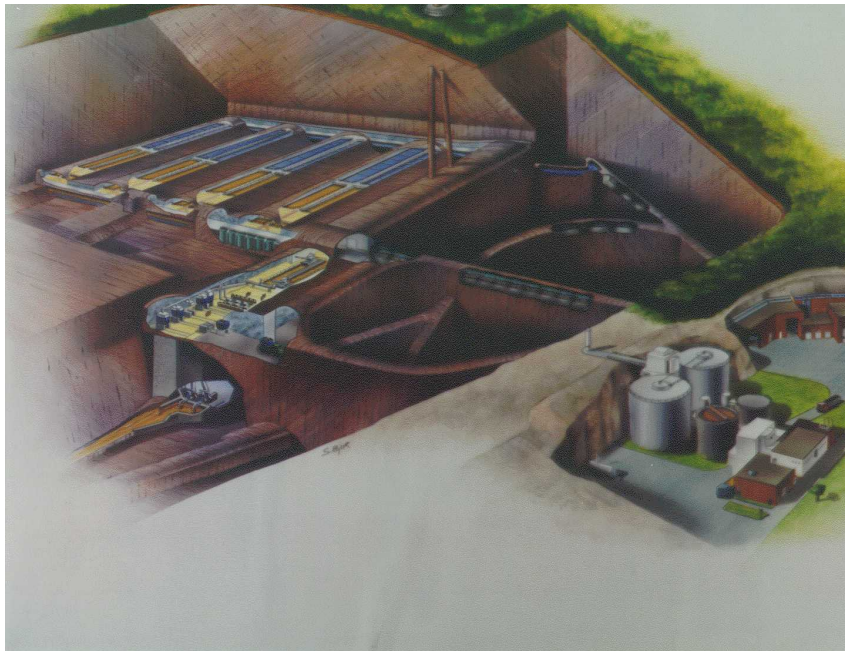
Estimated treatment efficiency for phosphorus and nitrogen. Counties. 2001. Per cent



Why most WWTPs in Norway are covered

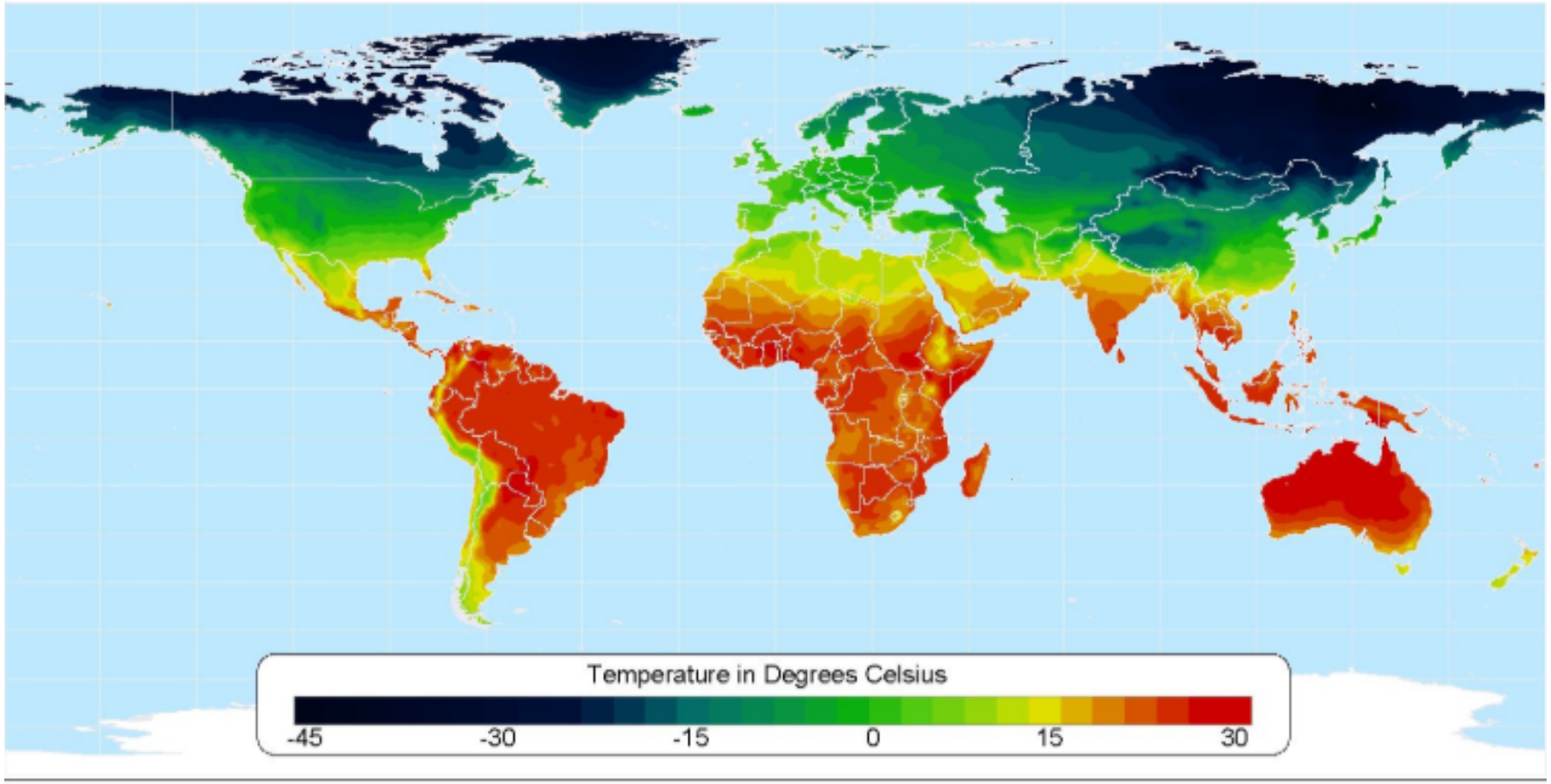


Why most WWTPs in Norway are covered



Average Temperature

Dec – Jan – Feb



Data taken from: CRU 0.5 Degree Dataset (New, et al.)

Atlas of the Biosphere

A paradox?

Air temperature ↑

Wastewater temperature ↓

A paradox?

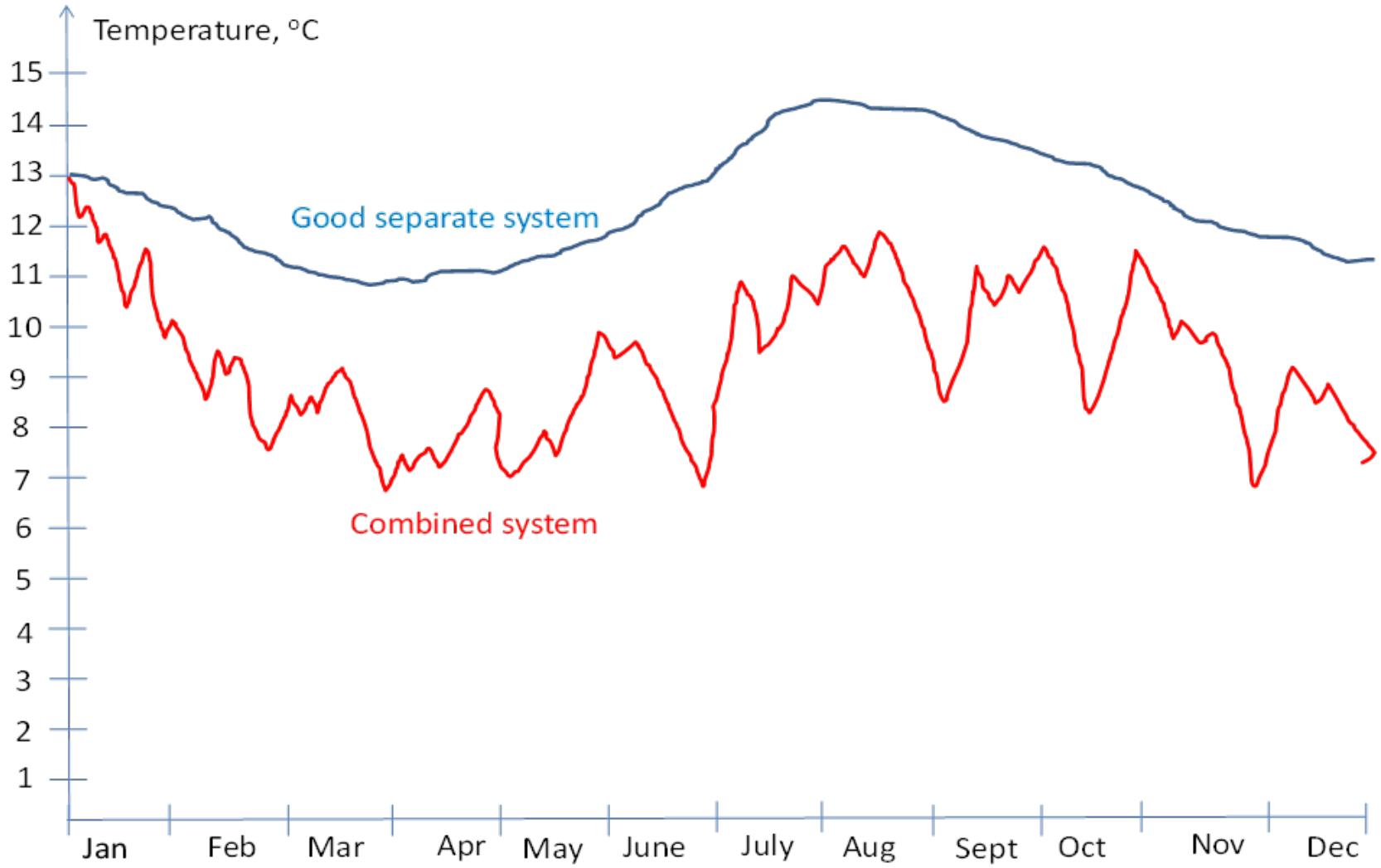
Air temperature ↑

Wastewater temperature ↓

Increased snow melting events

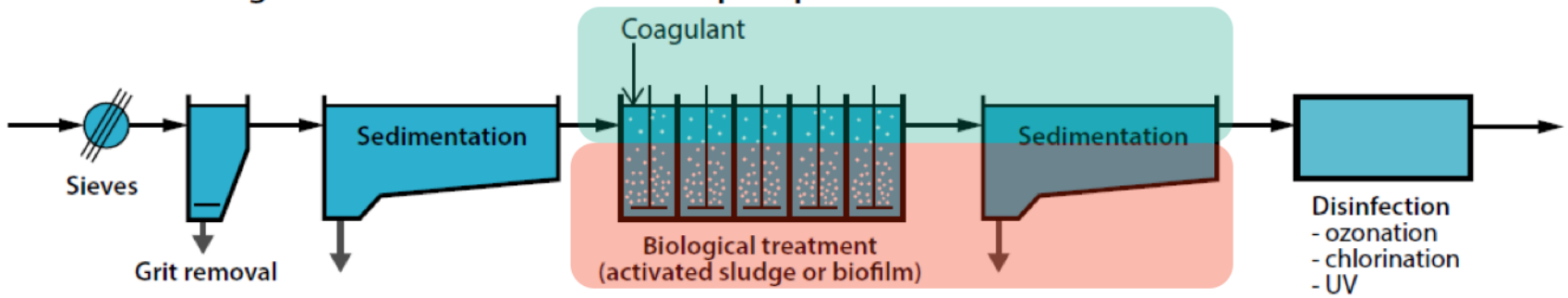
Combined sewers

Separate sewers vs combined sewers

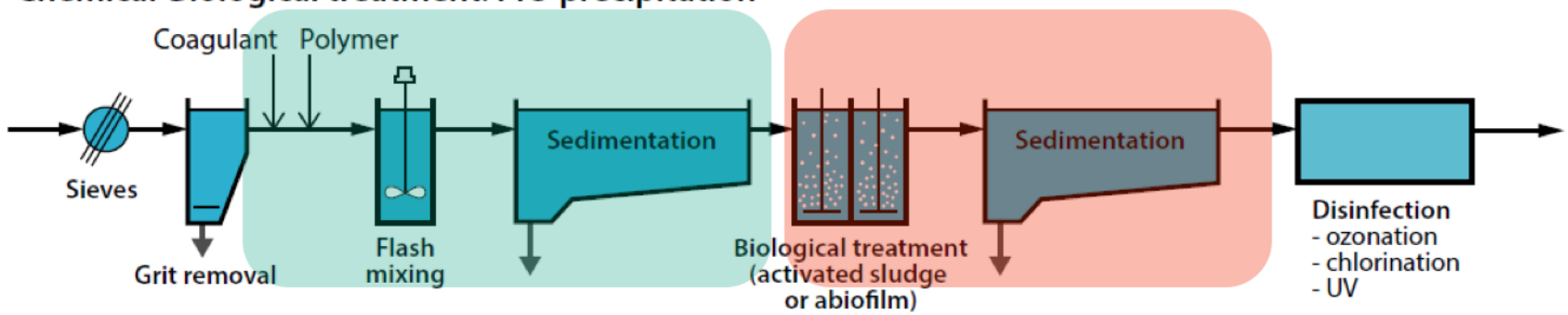


Good separate system vs Combined system or system with much external intrusion water

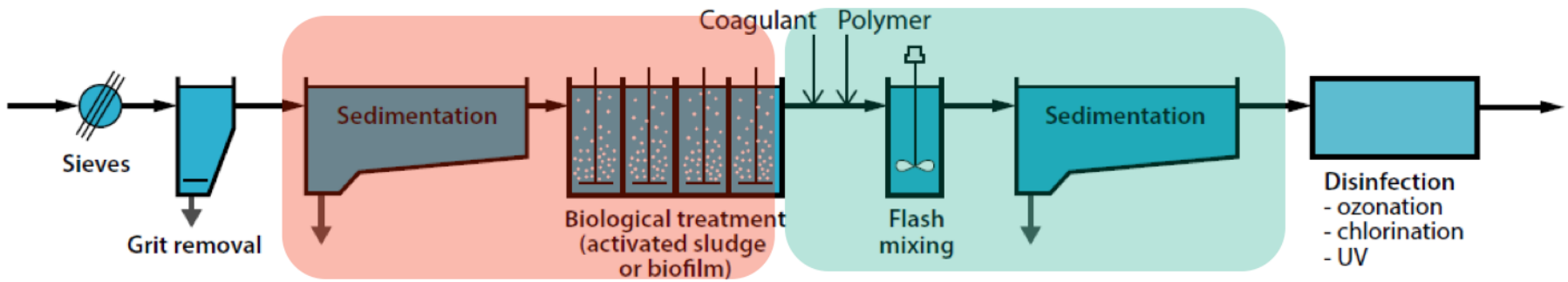
Chemical-Biological treatment. Simultaneous precipitation



Chemical-Biological treatment. Pre-precipitation



Chemical-Biological treatment. Post-precipitation



How may the challenges of varying temperatures – especially in connection with snow-melt, be solved?

- Use separate systems –
  do not mix wastewater with rainwater

- Select processes that can
  stand better variations
  in temperature

Impact of temperature on coagulation

- Floc formation during wastewater coagulation is known to be slower at lower temperatures

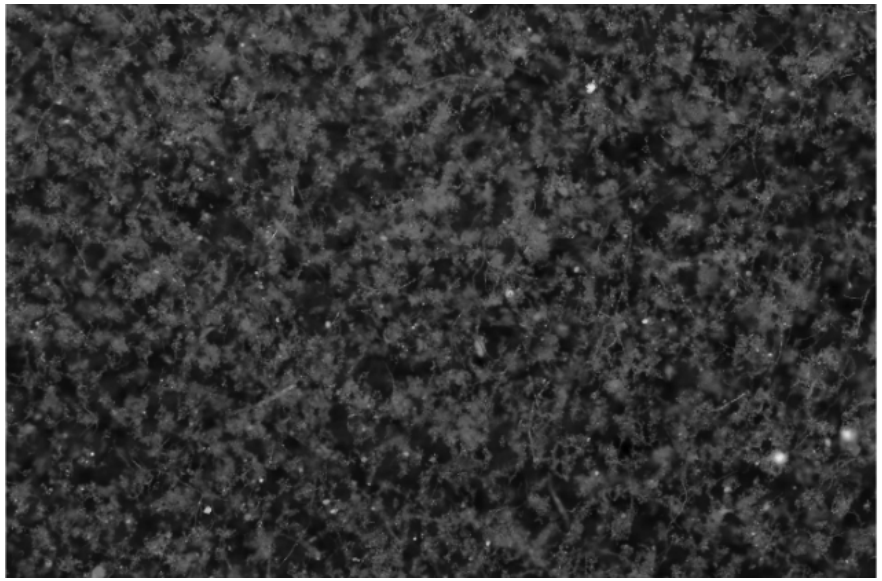
- Sedimentation / flotation can therefore be negatively influenced.

  ↑ sedimentation volumes

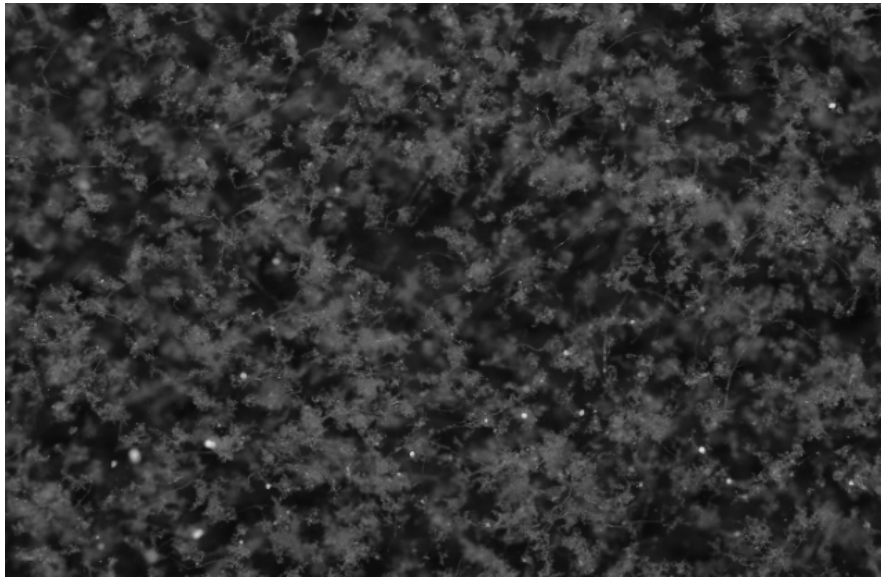
  ↑ coagulant/flocculent demand

Temperature impact on floc building

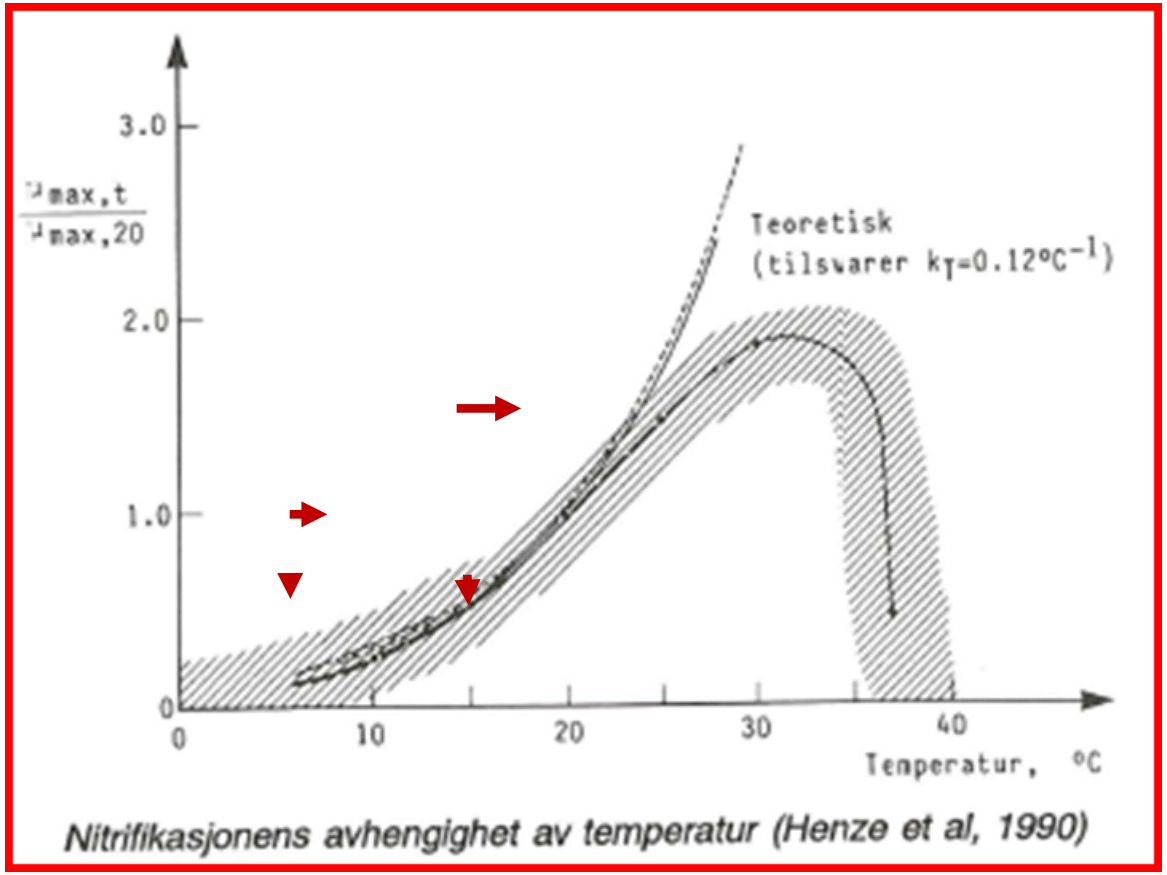
Floc building slows down at lower temperatures



5 °C - smaller flocs



20 °C - larger flocs



Nitrifikasjonens avhengighet av temperatur (Henze et al, 1990)

Enzyem producing bacteria

Cold climate:

↓ Efficiency

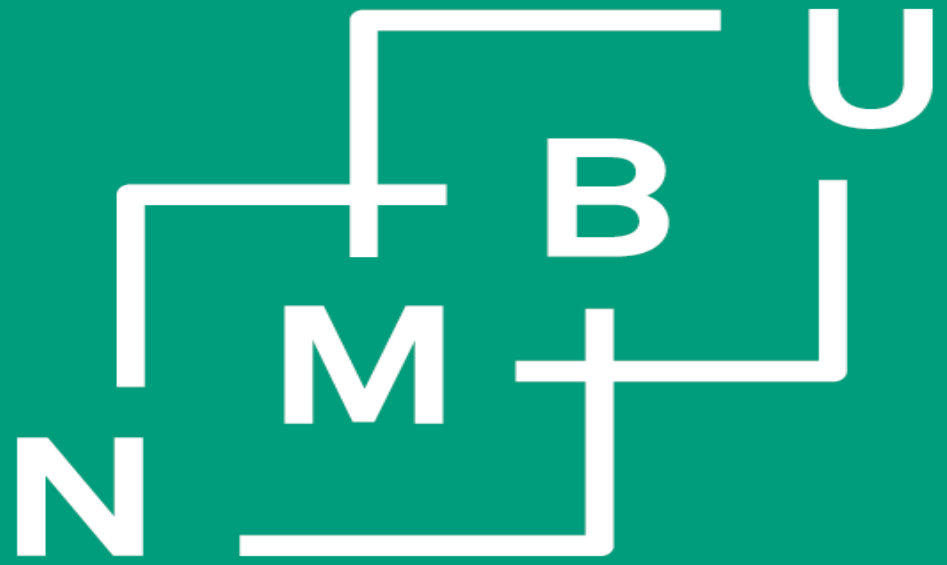
↑ Cost

↓ 10 degrees = ↓ of 50% of Nitrification rate

will require bigger reactor volumes to achieve the same treatment efficiencies

Summary and conclusions

- Climate change results in challenges with the volumes and WW temperatures
- The main challenge with WWT in cold climates is not the low temperature as such, but the large variation in temperature
- The Norwegian experiences with pre-treatment by the use of fine-mesh sieves in cold climates are good
- Chemical coagulation has several advantages over biological processes for secondary treatment in cold climates
- Combined biological/chemical treatment by the use of MBBR directly followed by coagulation/separation is extensively used and preferred in Norwegian cold climate plants
- If nitrogen removal is required , combined pre- and post-denitrification based on MBBR and coagulation is preferred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