



# Analyse av energibruk i ishaller

# Generelt

A close-up, low-angle shot of a hockey stick and a puck on an ice rink. The stick is dark with a lighter blade, and the puck is black. The ice surface is textured and shows some faint markings.

- **Ola Lie Andersen og Frank Christian Rangul**
- **HIST, Maskin, VVS**
- **SIAT, NTNU**
- **Bjørn Aas - Oppdragsgiver**
- **Oddbjørn Sjøvold - Veileder**

# Innledning

A background image showing a hockey stick and a puck on an ice rink. The stick is positioned diagonally from the top right towards the center, and the puck is in the middle of the ice surface.


- **45 offisielle ishockeyhaller i Norge**
- **Finnes ingen energistatistikk – Ingen nøkkeltall**
- **Hypotese om at det brukes unødvendig mye energi**
- **Avfukting**
- **Ventilasjon**

A close-up, low-angle shot of a hockey stick lying on an ice rink. The stick is positioned diagonally from the top right towards the center. The ice surface is highly reflective and shows numerous scratches and scuffs. The lighting is soft, creating a subtle shadow of the stick on the ice.

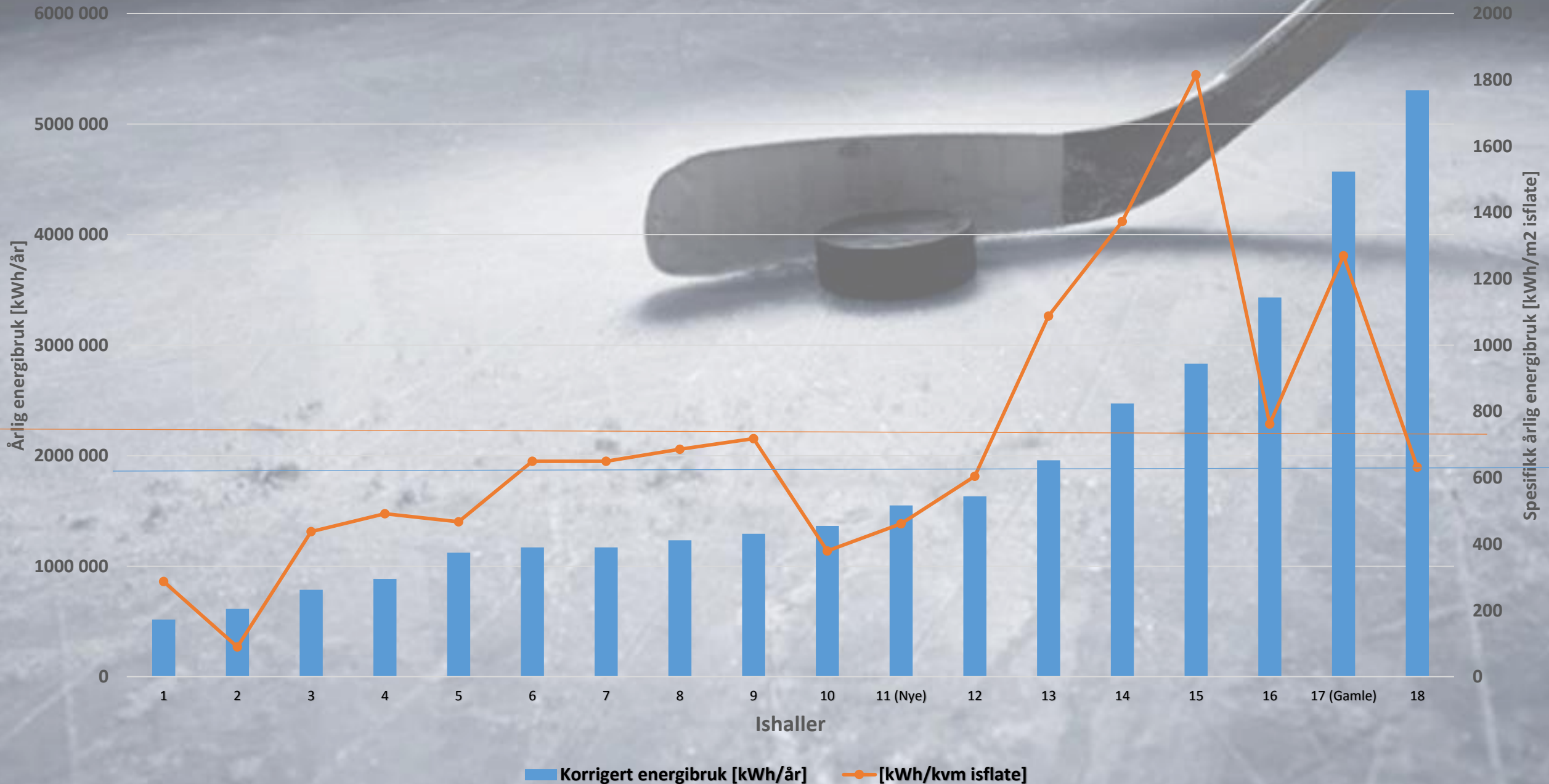
# **Energistatistikk**

**- Et idrettsbygg?**

# Nøkkeltall

A photograph of a hockey stick and a puck on an ice rink. The stick is positioned diagonally across the upper right portion of the frame, with its blade resting on the ice. A single puck is placed on the ice in front of the blade. The background is a blurred view of the ice rink's surface.
$$\left[ \frac{\text{Årlig kWh}}{m^2 \text{isflate}} \right]$$

# Årlig energibruk for et utvalg norske ishaller



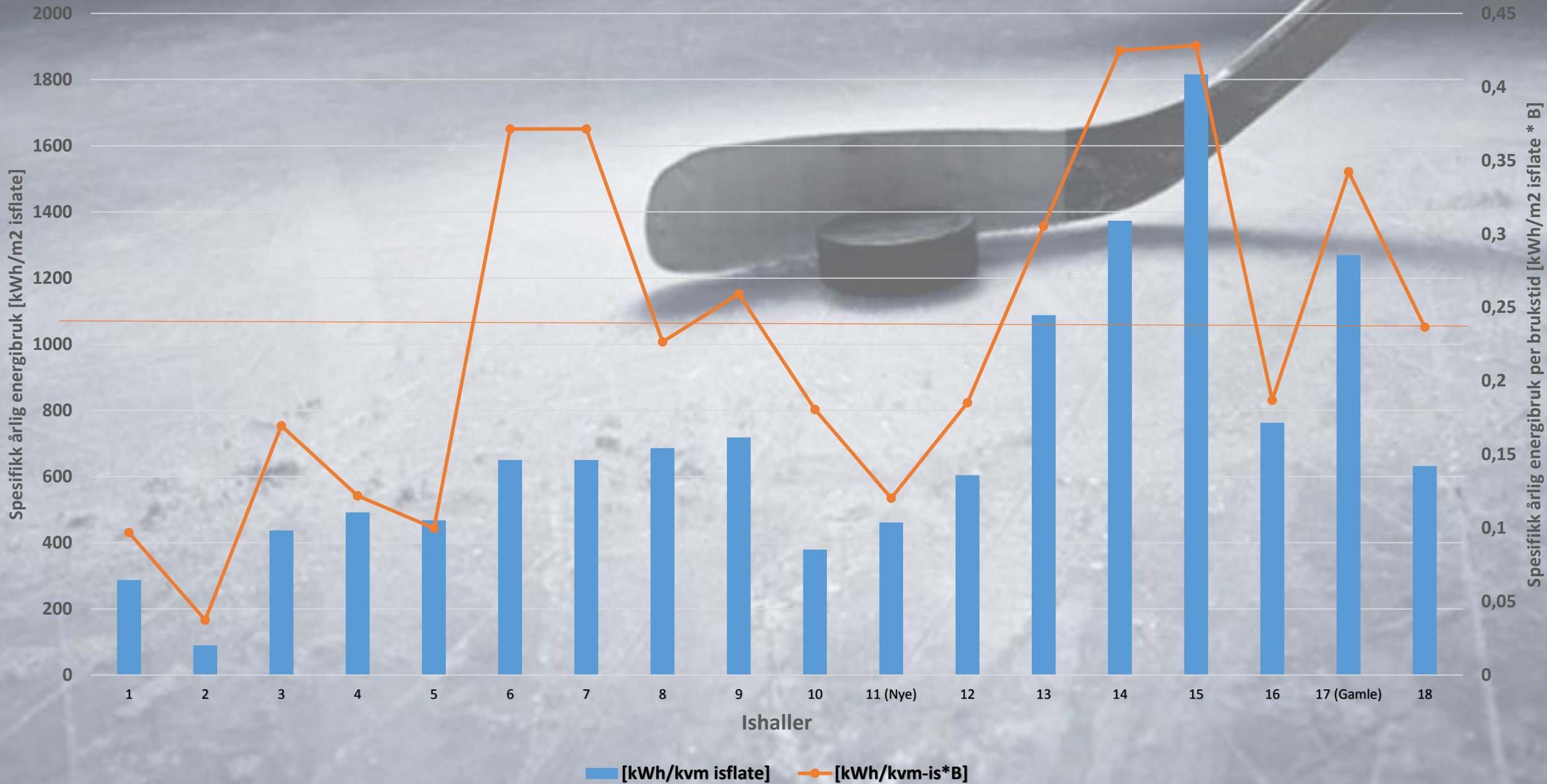
# Nøkkeltall

A hockey stick and puck are positioned on an ice rink. The stick is lying horizontally, and the puck is placed in front of it. The background is a blurred ice surface with some faint markings.

$$\left[ \frac{\text{Årlig kWh}}{m^2 \text{isflate} * \text{brukstid}} \right]$$

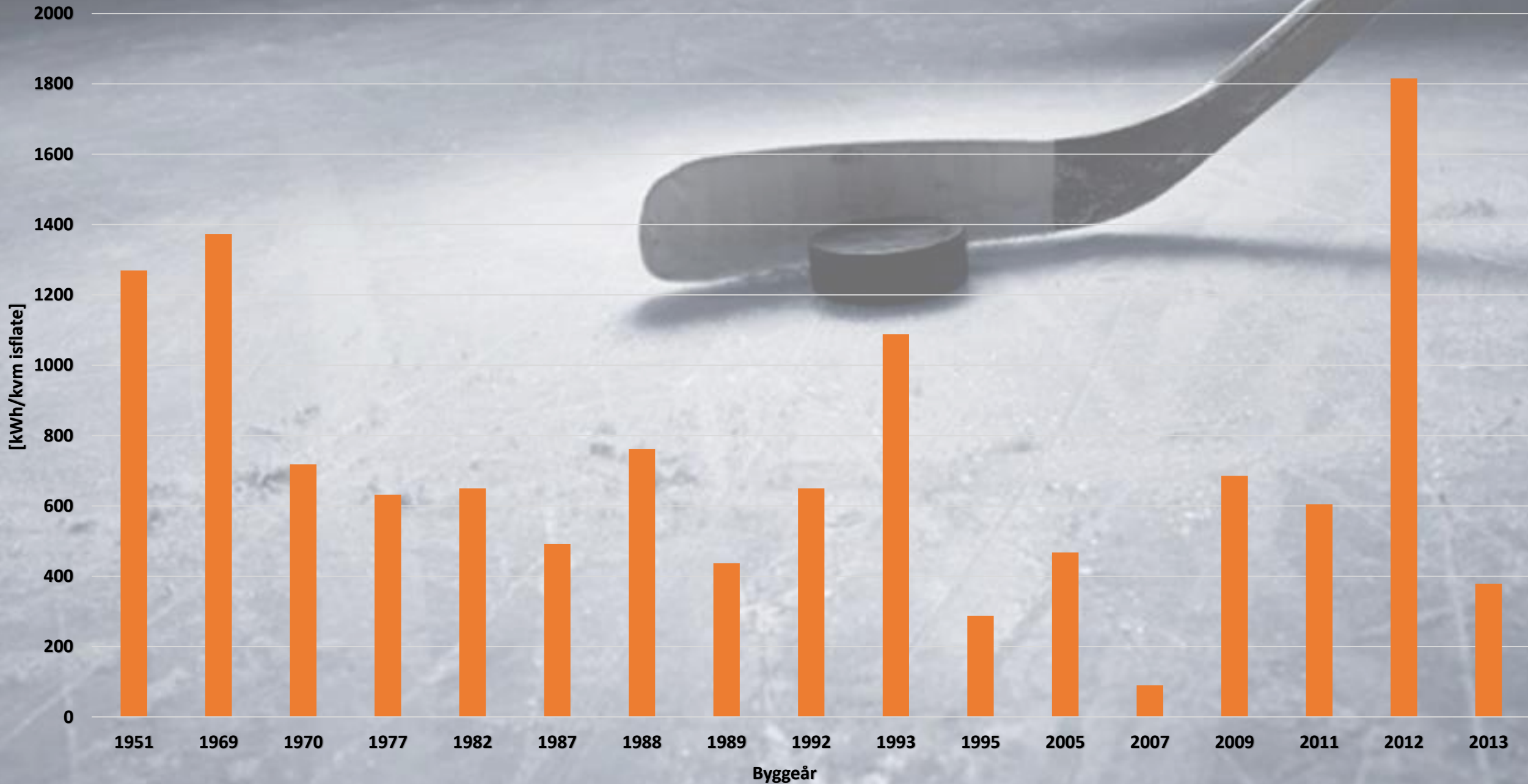
# Årlig energibruk for et utvalg norske ishaller basert på isflate og brukstid

(Brukstid: Timer åpent med is per år)

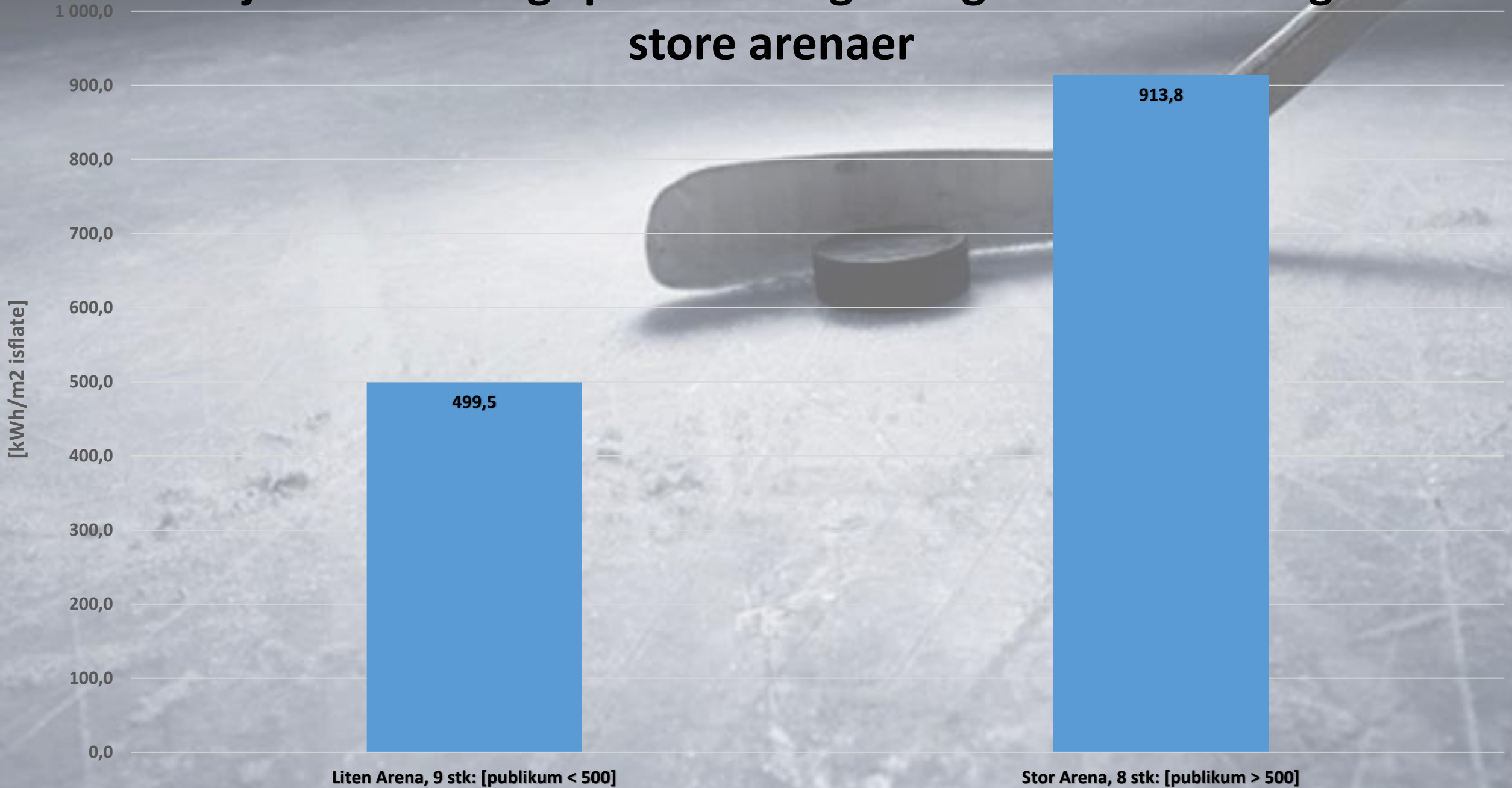




# Spesifikk energibruk etter byggeår



# Gjennomsnittlig spesifikk årlig energibruk for små og store arenaer



# Oppsummering



- De fleste norske ishockeyhaller  $>170$  kWh/oppvarmet areal\*år
- Prosessbygg?

# Avfukting

A background image of an ice hockey rink. A hockey stick lies on the ice, with a puck positioned near its blade. The ice surface shows various scratches and marks from play.

- **Avfukting – Senkning av vanninnholdet i luften**

- **Hvorfor?**

- **Sopp og råte**
- **Korrosjon**
- **Kuldeanlegget må yte mer**
- **Tåke**

# Ulike prinsipper

A hockey stick and puck are shown on an ice rink. The stick is positioned diagonally across the upper right portion of the frame, with its head pointing towards the center. A puck is placed on the ice directly in front of the stick's head. The background is a blurred view of the ice rink's surface, showing the characteristic grid lines.

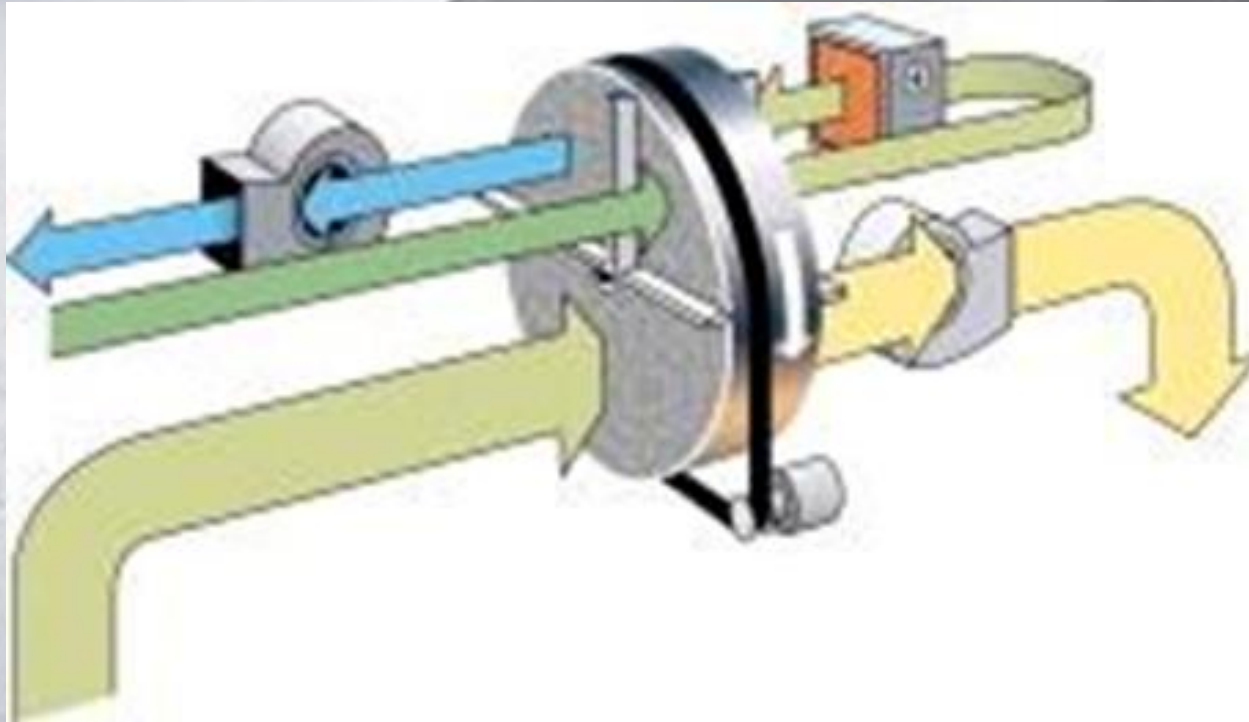
- **Sorpsjonsteknologi**

- Rotor
- Energikrevende
- Avfukter selv i lave temperaturer

- **Kondensteknologi**

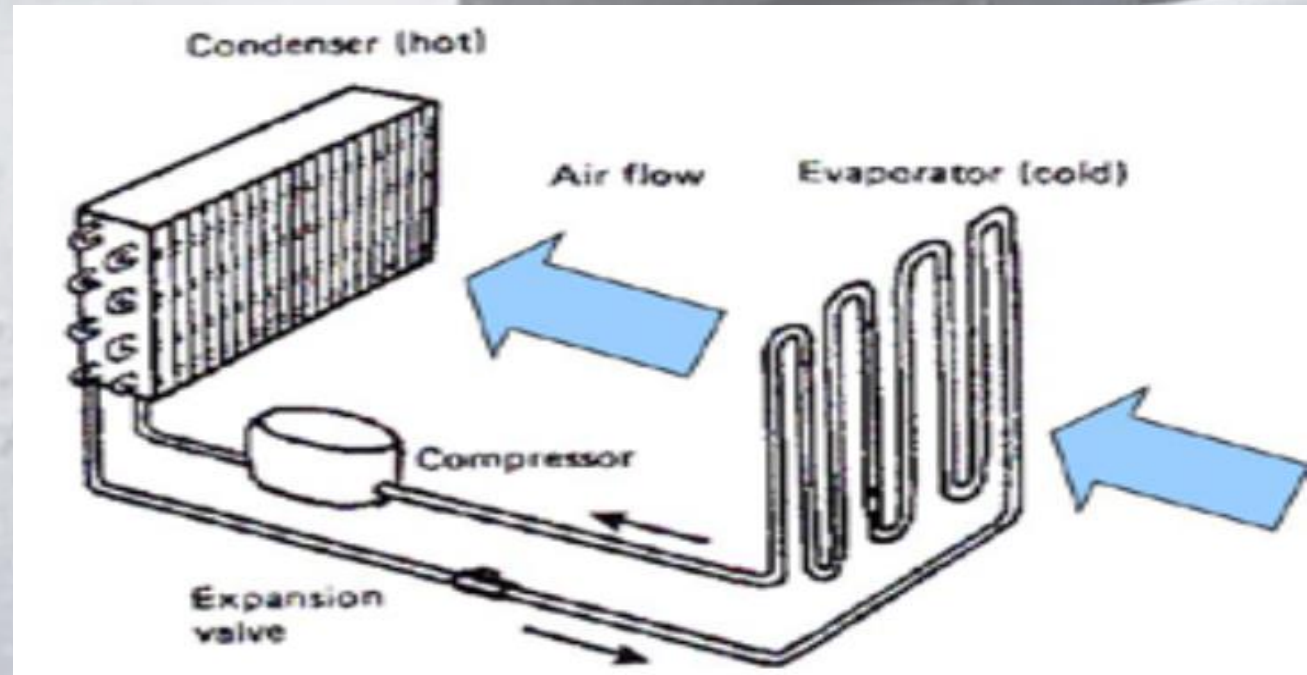
- Varmepumpe
- Rimelig i drift
- Mer temperaturavhengig

# Sorpsjonsteknologi



*Bildet er hentet fra Alfsen og Gunderson AS sin hjemmeside [www.ag.no](http://www.ag.no)*

# Kondensteknologi

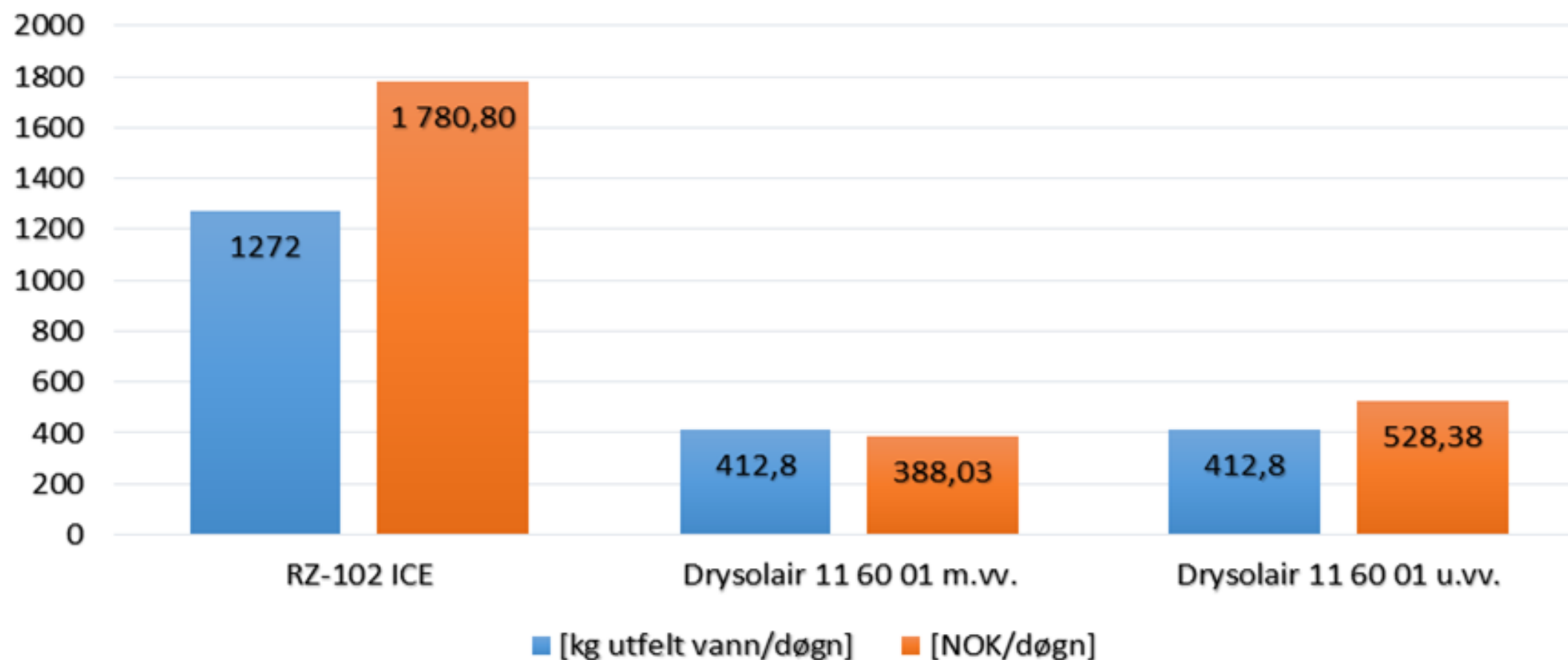


*Bildet er hentet fra [www.dantherm.com](http://www.dantherm.com)*

## Kostnad/nytte-analyse for utvalgte avfuktere

Romtilstand: 15°C og 70% RH

(Basert på 1 NOK per kWh og maksimal kapasitet)





# Styring av avfukter

- **Relativ fuktighet**
  - Temperaturavhengig
- **Absolutt fuktighet**
  - Duggpunkt



# Ventilasjon

- Ventilere for
  - Publikum – Utøvere
  - Materialemisjon
- Behovsstyring
- Oppvarming

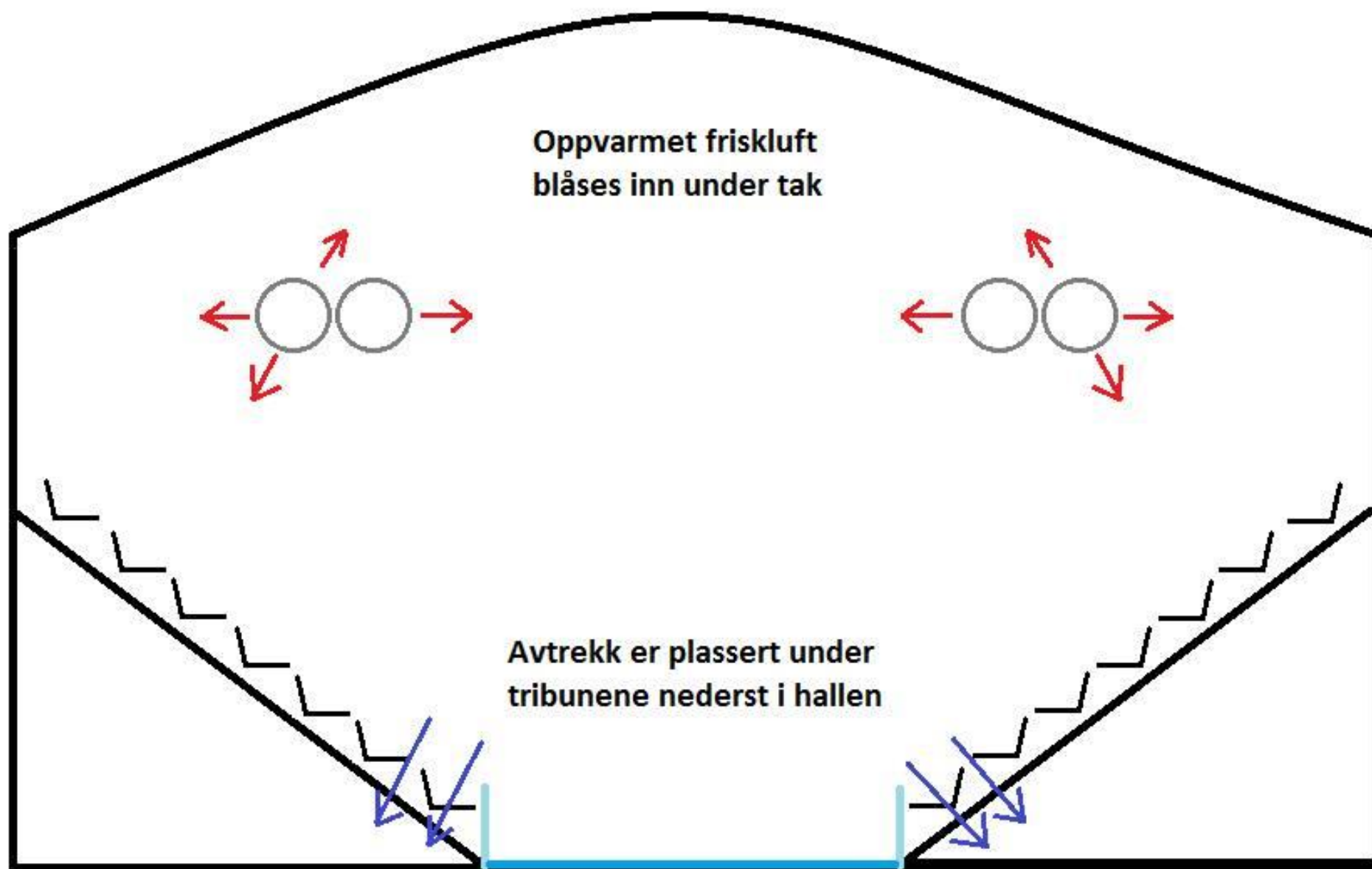


# Ventilasjonsprinsipper

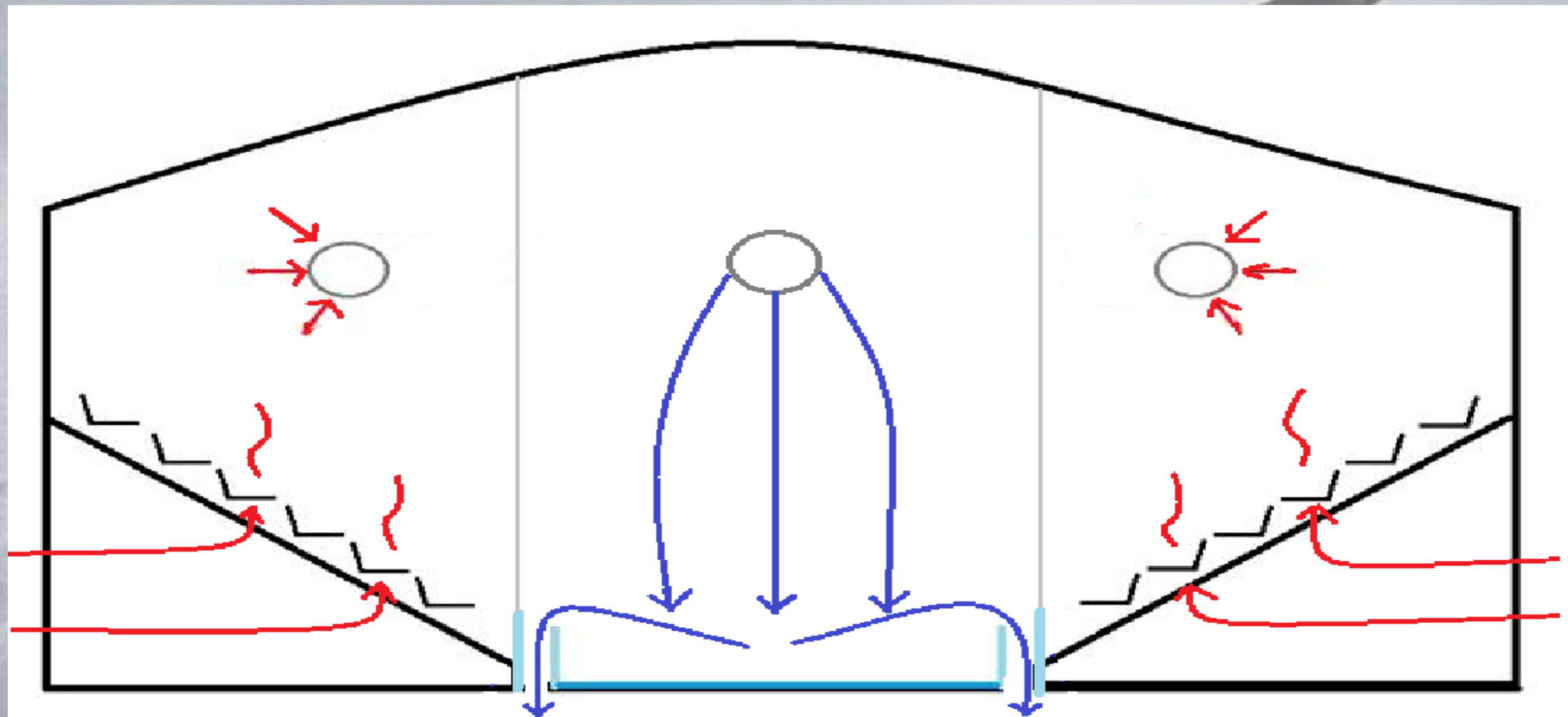
- **Omrøringsventilasjon**
- **Fortrengningsventilasjon**
- **Klimasoner**
- **Ventilasjonseffektivitet**



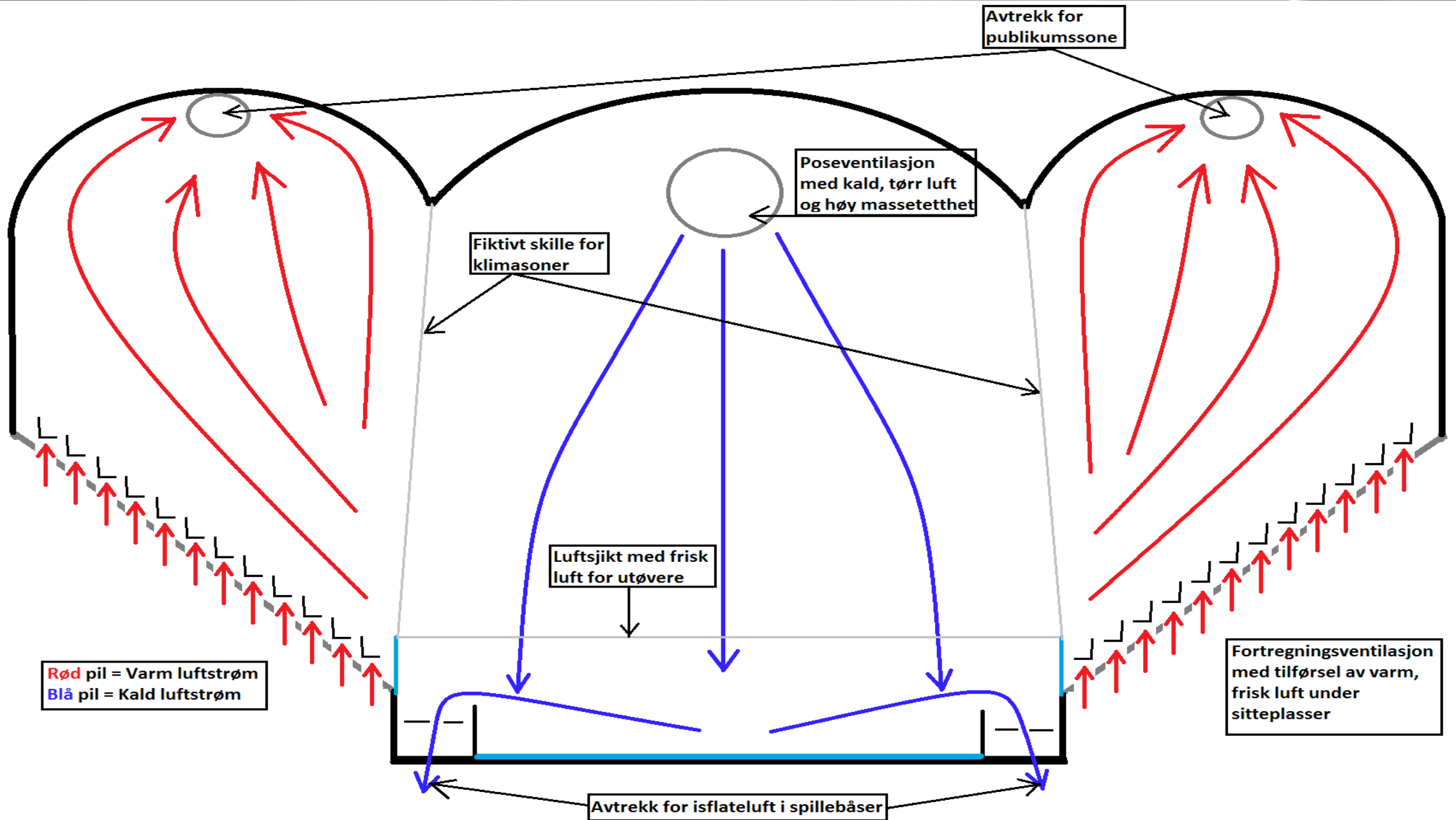
## Nåværende ventilasjonstilstand hos Leangen hovedhall



# Forbedringstiltak på Leangen Arena



# Tiltenkt optimal ventilasjonsteknisk løsning





- Bakgrunnsbilder er hentet ifra:
- [www.sentinel.com](http://www.sentinel.com)
- [www.centerstatehockey.com](http://www.centerstatehockey.com)