

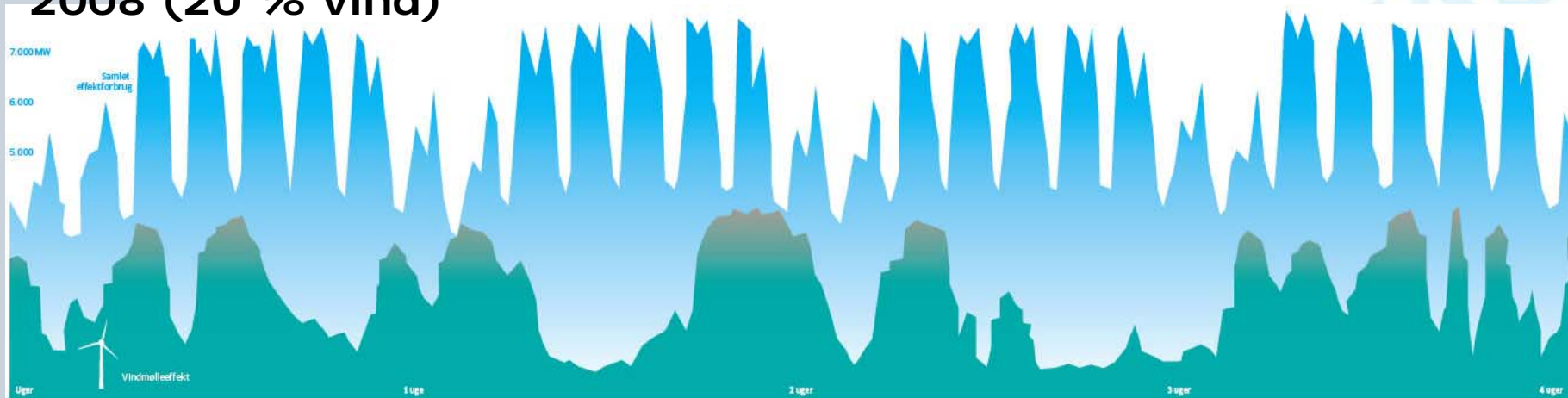
Varmepumper i fremtidens energisystem

Morten Boje Blarke

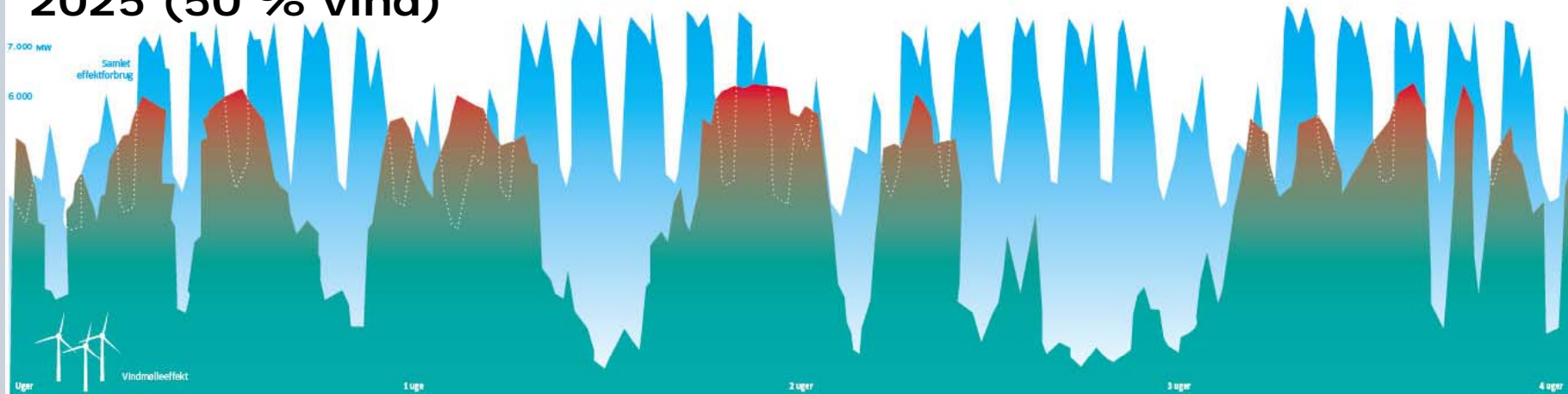
Adjunkt, Civilingeniør, Ph.D. i Bæredygtige energisystemer
Institut for Planlægning, Aalborg Universitet

Udfordringen fra vindkraft

2008 (20 % vind)

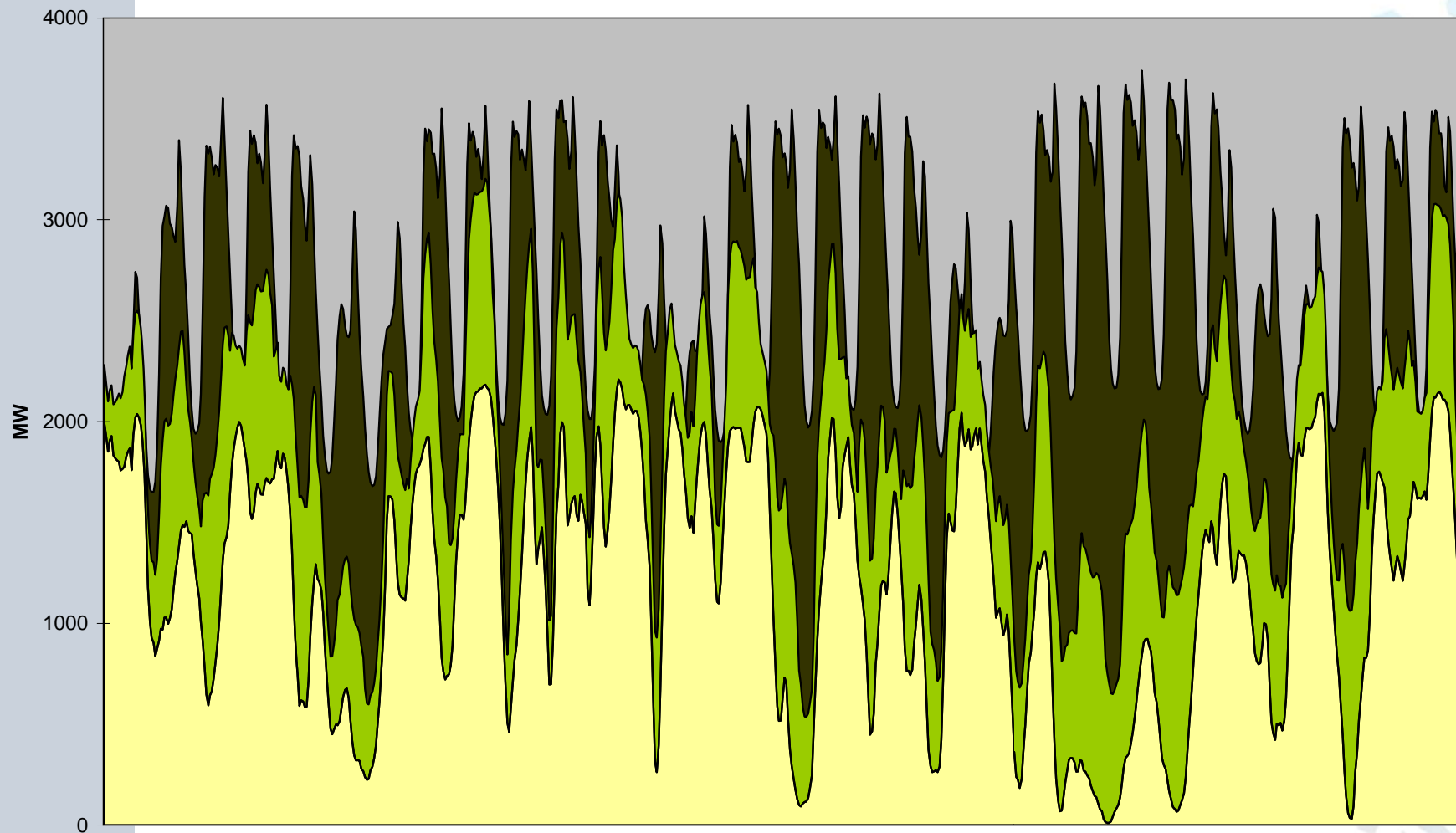


2025 (50 % vind)



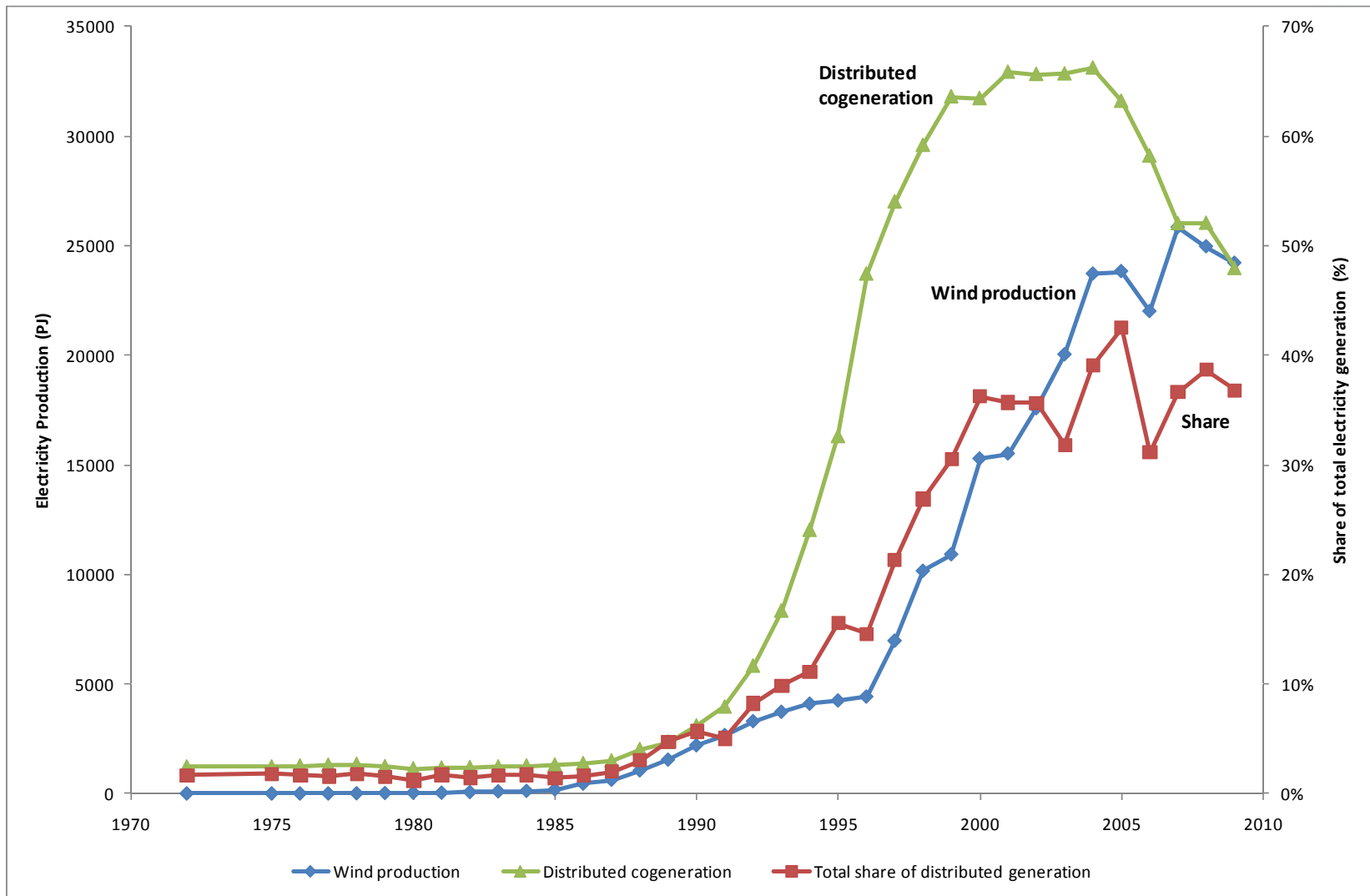
Vind, CHP, Elforbrug

Vest Danmark, januar 2007

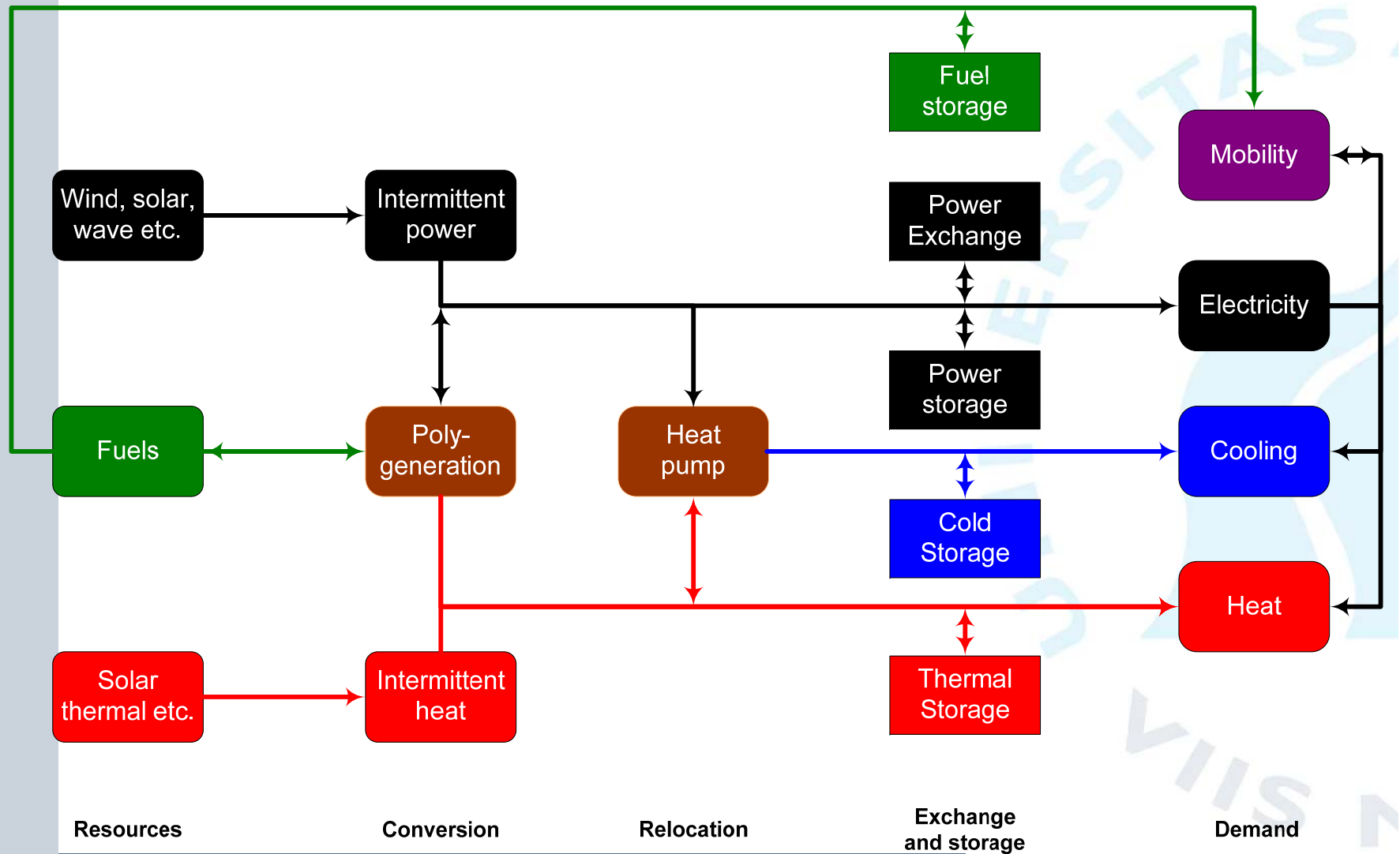


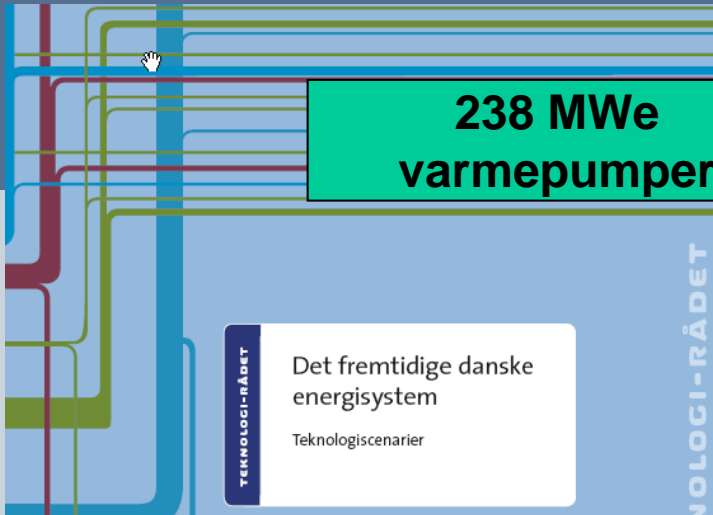
January 2007

Kraftvarmen giver efter for vind



Det diskontinuerlige energisystem





**238 MWe
varmepumper**

TEKNOLOGI-RÅDET
Det fremtidige danske
energisystem
Teknologiscenarier

TEKNOLOGI-RÅDET



**450 MWe
varmepumper**

Projekt nr. 2010 - 02
Titel: Varmeplan Danmark 2010
Udført af: Rambøll Danmark i samarbejde med Aalborg Universitet

Varmeplan Danmark 2010
Hovedrapport



**3-400 MWe
varmepumper**

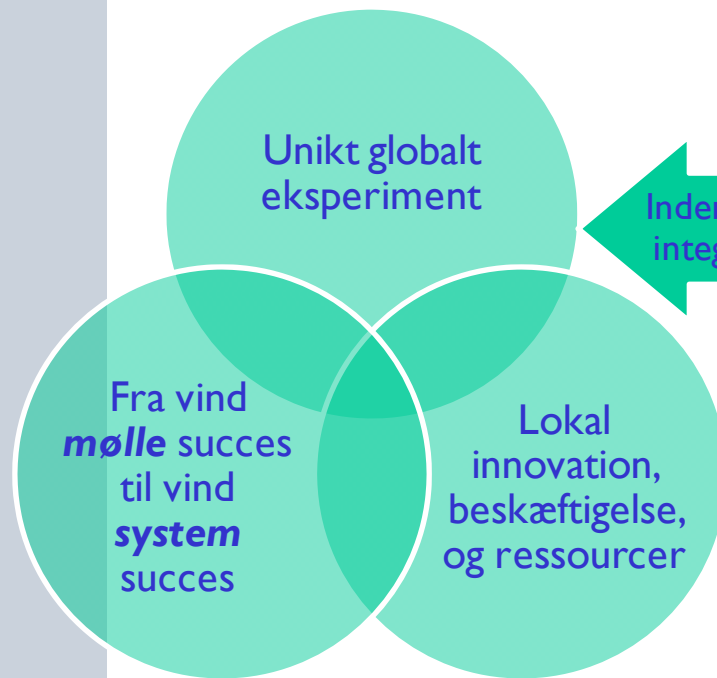


ENERGISTRATEGI 2050
- fra kul, olie og gas til grøn energi

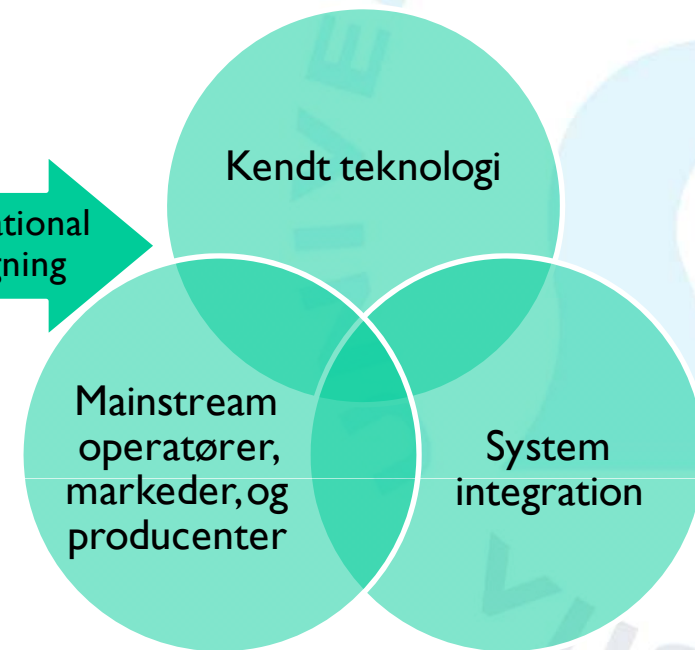
**Pulje til demonstrationsprojekter for store
varmepumper i fjernvarmesektoren på i alt 10
mio. kr. samt analysere rammevilkårene for
og konsekvenserne af indpasning af store
varmepumper**

To strategiske modeller for integration af vindkraft

Indenlandsk integration (Smart Grid)



Transnational udbygning (Super grid)



Indenlandsk integration

Transnational udbygning

To strategiske modeller for fremtidens fjernvarmeproduktion

Elproducerende

- Tri-generation (fokus på køling og spildvarme)
- Kompressionsvarmepumper
- Elkedler
- Biogas
- Næppe økonomi i solvarme, geotermi

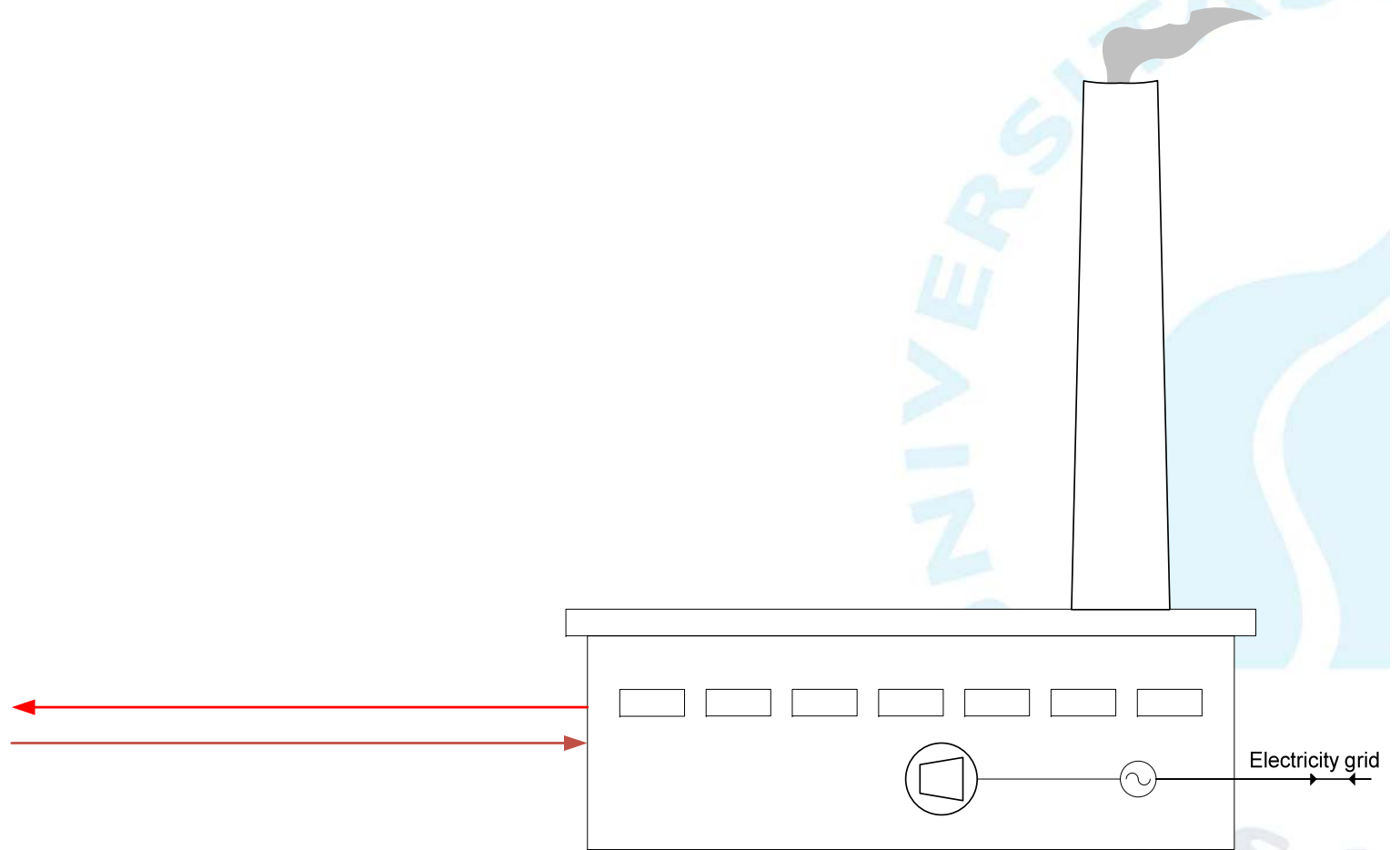
Ikke-elproducerende

- Samproduktion af kulde (evt. varmegenvinding) og varme
- Kompressionsvarmepumper
- Solvarme
- Geotermi (evt. absorptionsvarmepumper)
- Biomasse

Heat efficiency	50 %
Electric efficiency	40 %
Fuel-to-energy efficiency	90 %
Intermittency-friendliness	0,50

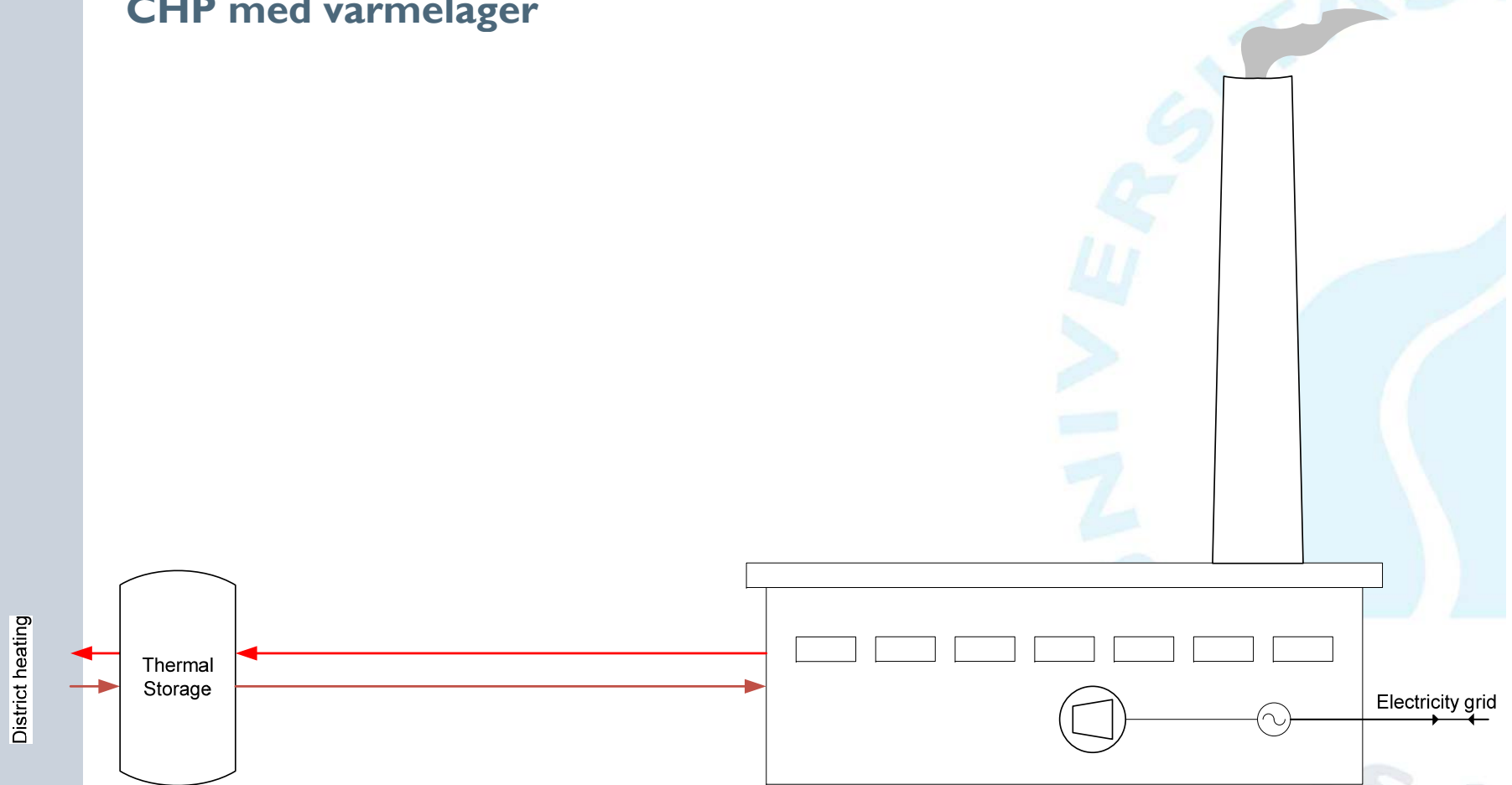
CHP

District heating

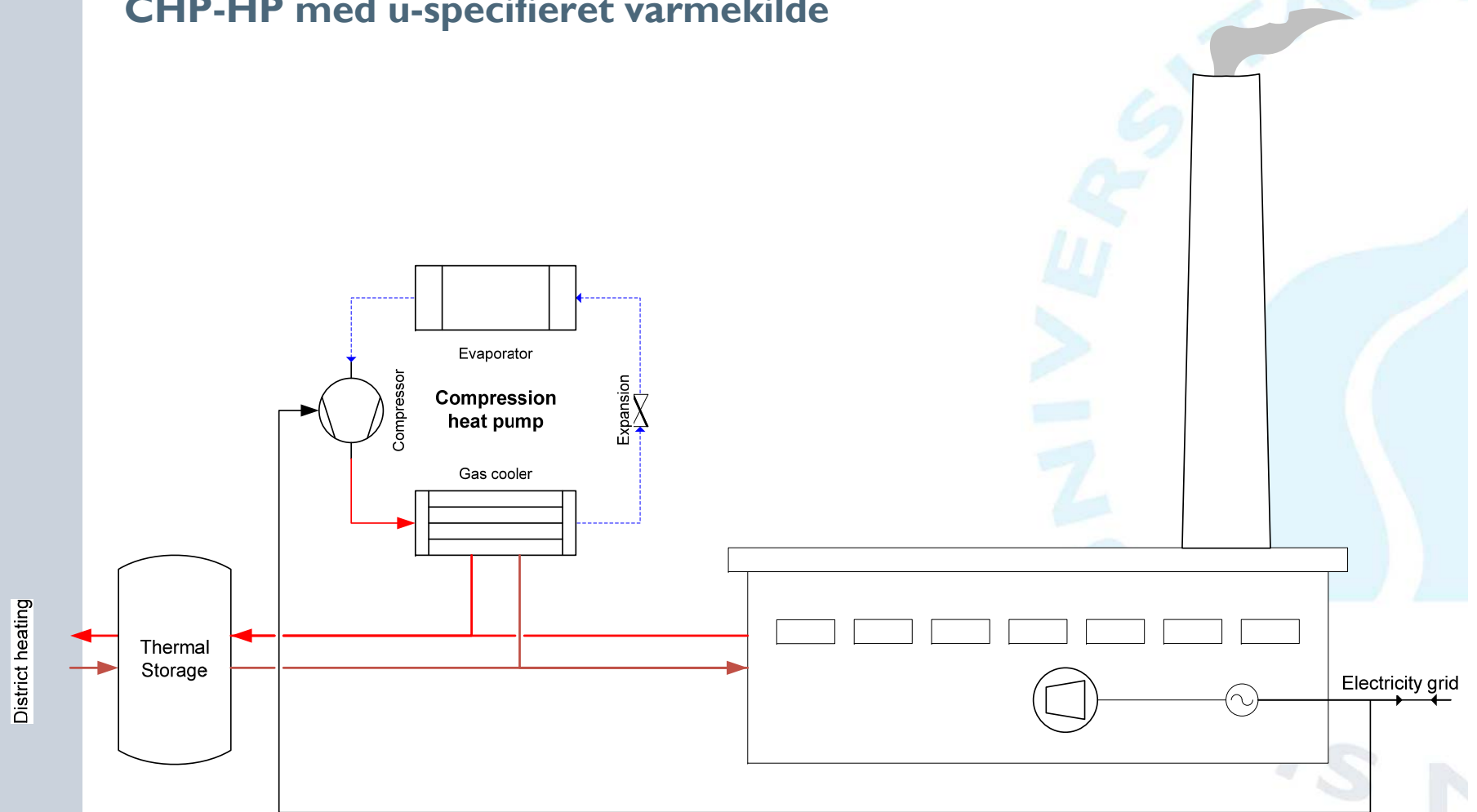


Heat efficiency	45 %
Electric efficiency	40 %
Fuel-to-energy efficiency	85 %
Intermittency-friendliness	0,53

CHP med varmelager



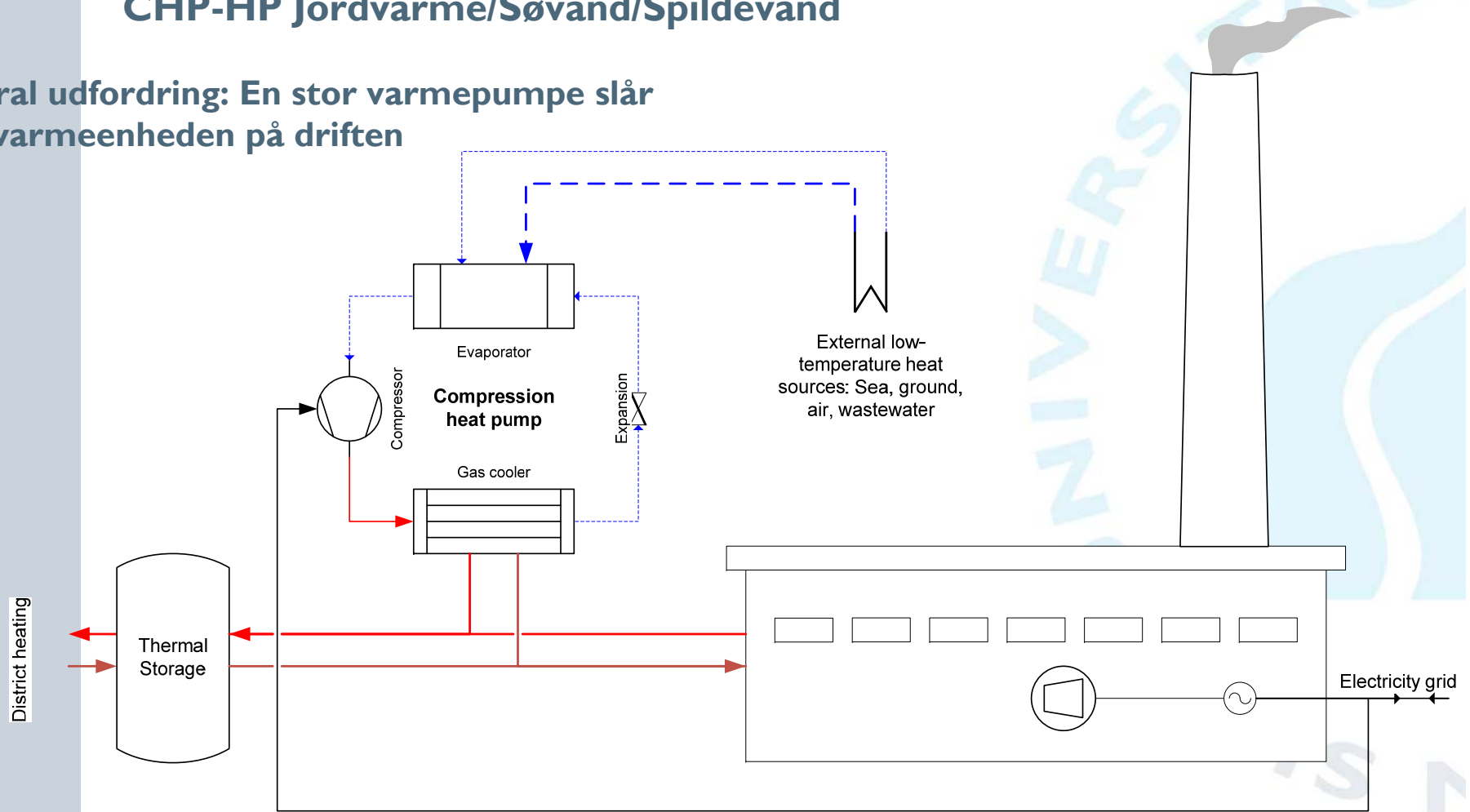
CHP-HP med u-specificeret varmekilde



Heat efficiency	60 %
Electric efficiency	35 %
Fuel-to-energy efficiency	95 %
Intermittency-friendliness	0,60

CHP-HP Jordvarme/Søvand/Spildevand

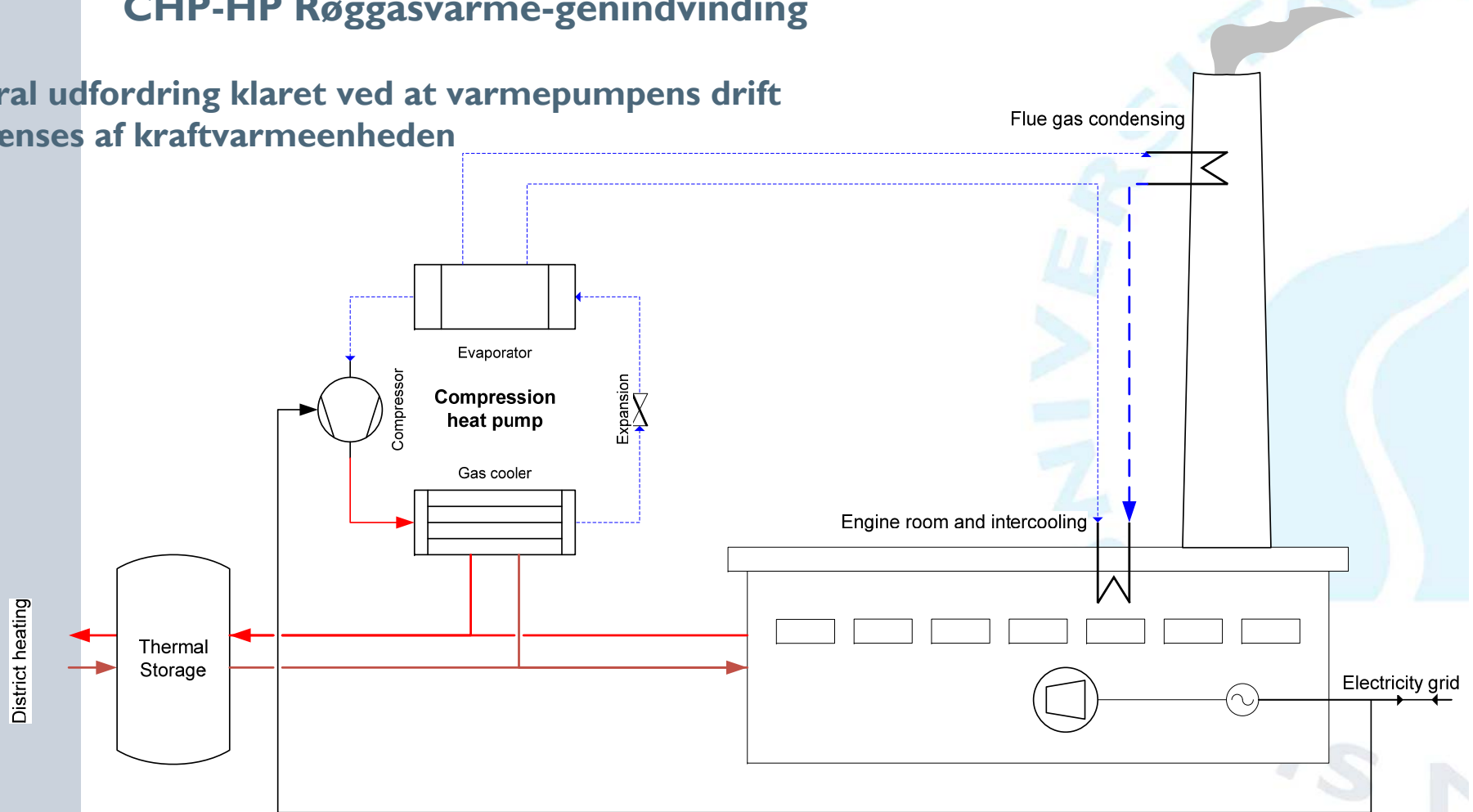
Central udfordring: En stor varmepumpe slår kraftvarmeheden på driften



Heat efficiency	65 %
Electric efficiency	35 %
Fuel-to-energy efficiency	100 %
Intermittency-friendliness	0,55

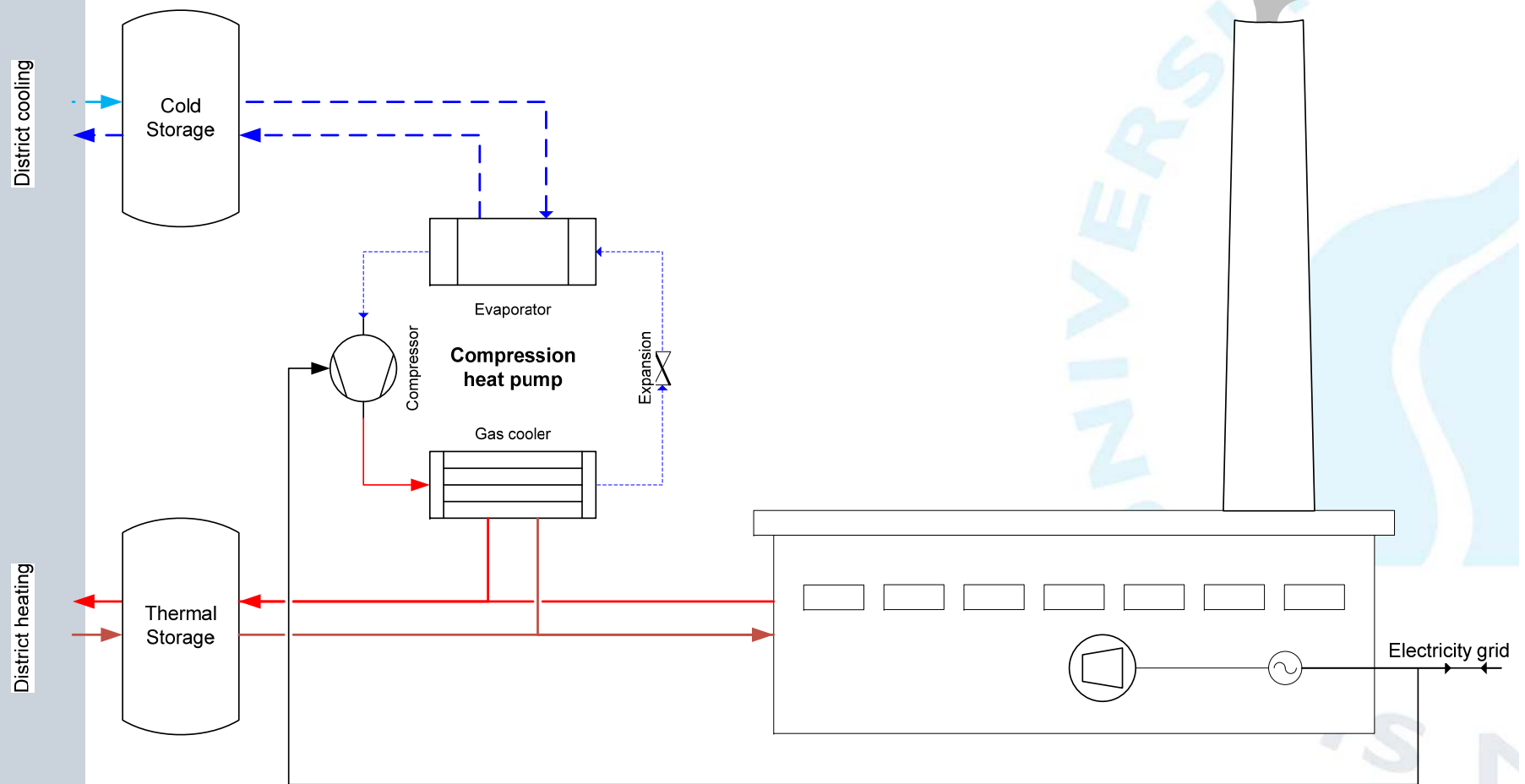
CHP-HP Røggasvarme-genindvinding

Central udfordring klaret ved at varmepumpens drift begrænses af kraftvarmeheden



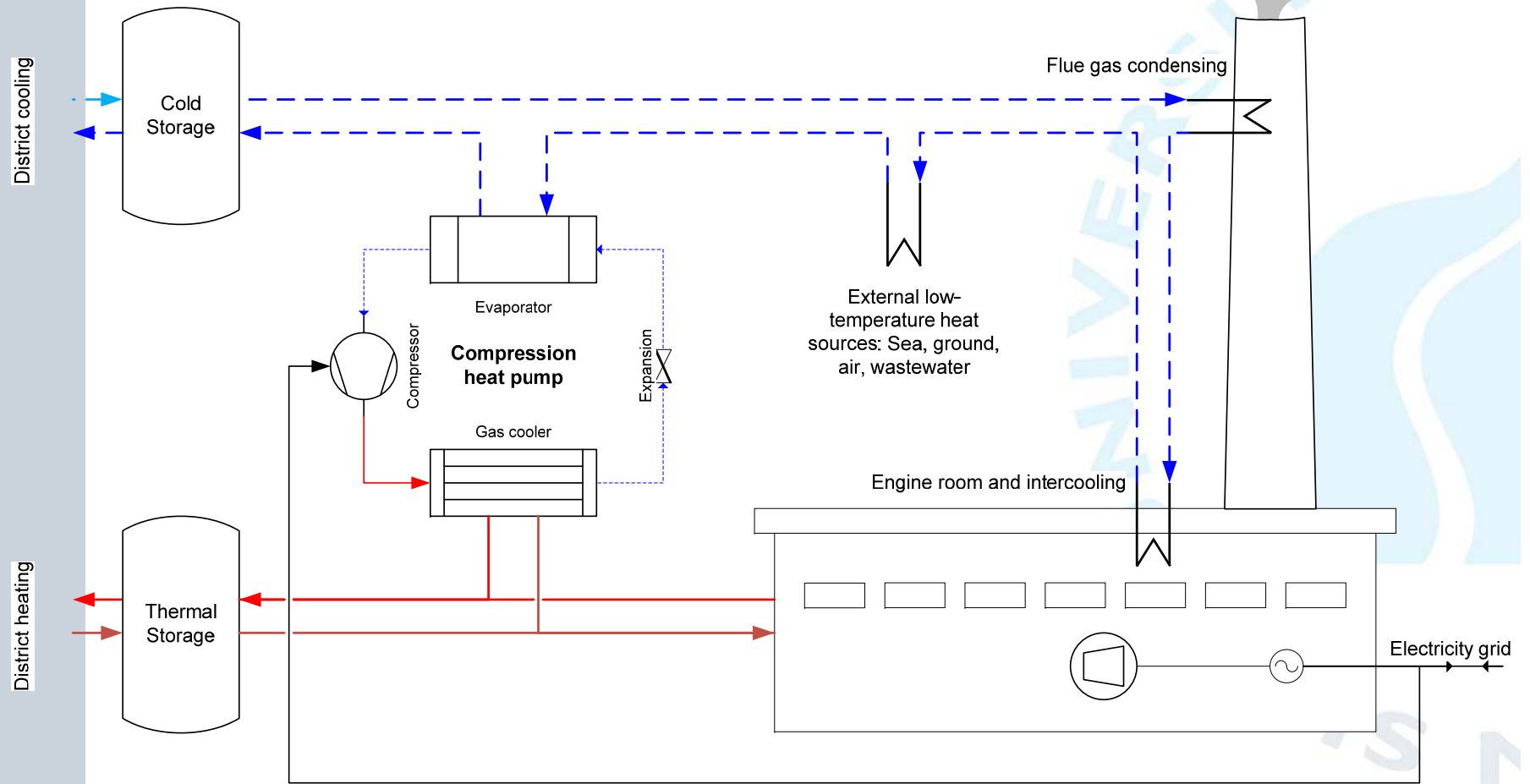
Heat efficiency	60 %
Electric efficiency	35 %
Fuel-to-energy efficiency	105 %
Intermittency-friendliness	0,60

CHP-HP med fjernkøling og kuldalager



Heat efficiency	65 %
Electric efficiency	35 %
Fuel-to-energy efficiency	110 %
Intermittency-friendliness	0,60

Vindvenlig C – HP-HP (Super effektiv) – men mange driftsprofiler



Nye lovende kompressions-varmepumpe teknologier

- Transkritisk CO₂ (Advansor)
- Single-screw NH₃ (CoolPartners)

