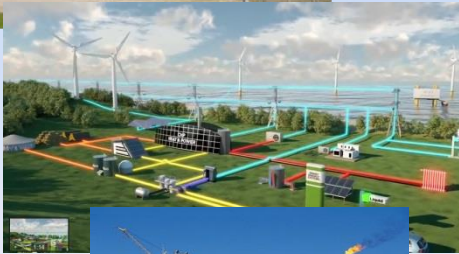




**Biogas Danmark  
Konferencen 2023**

Vingsted Hotel- og Konferencenter  
Onsdag den 6. december 2023

 Biogas Danmark



# Biogassens rolle i fremtidens danske energisystem

Professor Henrik Lund  
Aalborg Universitet

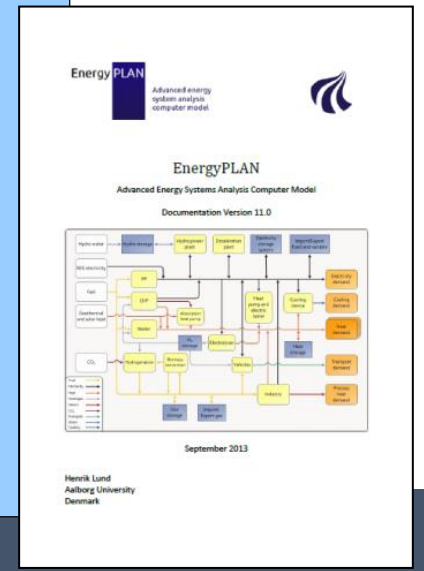
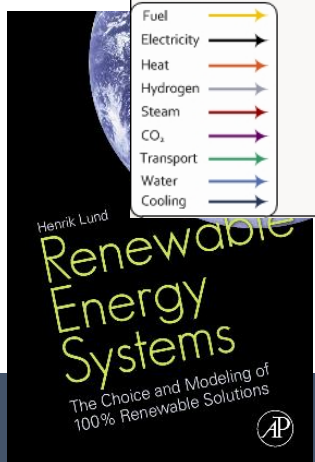
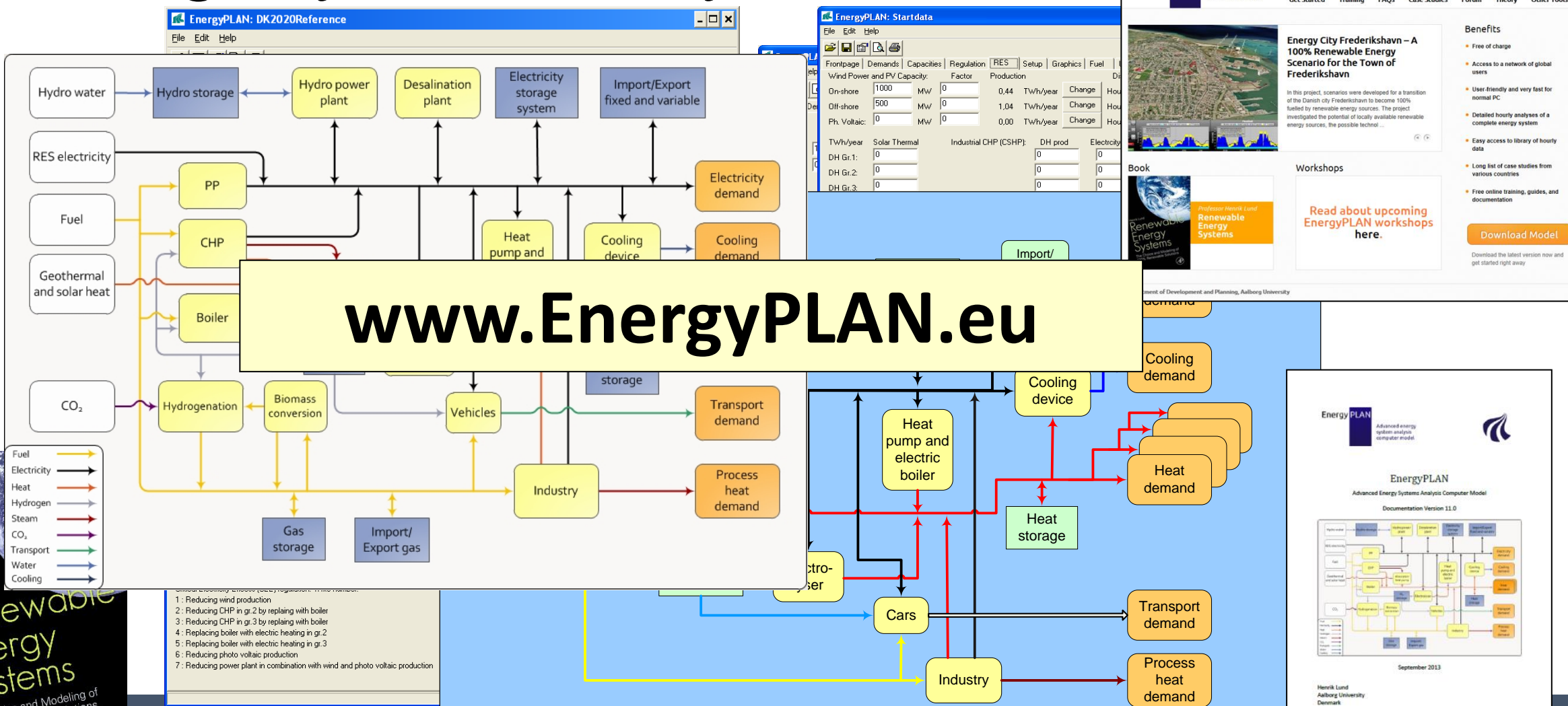


# Grøn omstilling - klima neutralitet ..... men hvordan...???!?

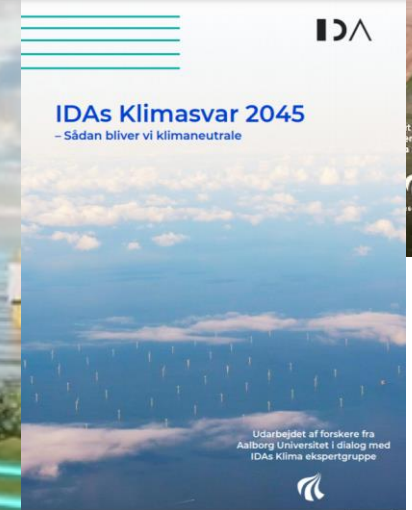
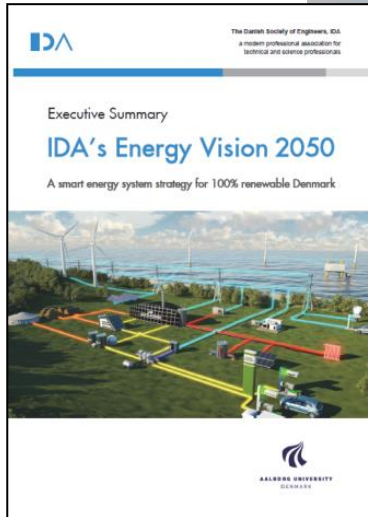
The collage features several key documents:

- Renewable Energy Systems: A Smart Energy Systems Approach to the Choice and Modeling of 100% Renewable Solutions** (AP)
- Coherent Energy and Environmental System Analysis** (November 2011)
- CEESA** (Center for Energy Efficient Systems and Energy Analysis)
- Power to the People 09 06 09**
- Ingeniørforeningens Energiplan 2030**
- IDA's Energy Vision 2050** (Executive Summary)
- Varmeplan Danmark 2010** (Forudsætningskatalog for samfundsekonomske analyser på energiområdet)
- Renewable Energy Systems: The Choice and Modeling of 100% Renewable Solutions** (Henrik Lund)
- Future Climate** (Future Climate Consulting)
- IDA's Klimaplan 2050** (Tekniske energisystemanalyser og samfundsekonomske konsekvensvurdering)
- Grøn energi** (ENERGINET)
- SYSTEMPERSPEKTIV 2035** (Perspektiver for effektiv anvendelse af vedvarende energi i det danske energisystem på længere sigt)

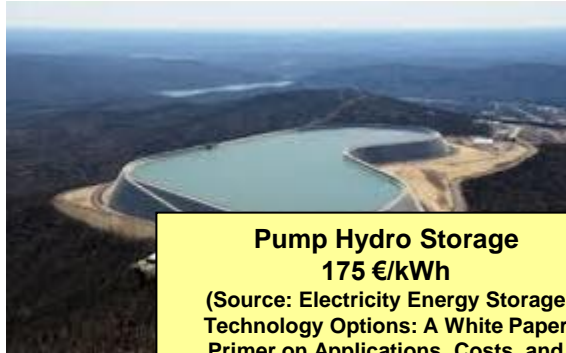
# Energi System Analyse Model



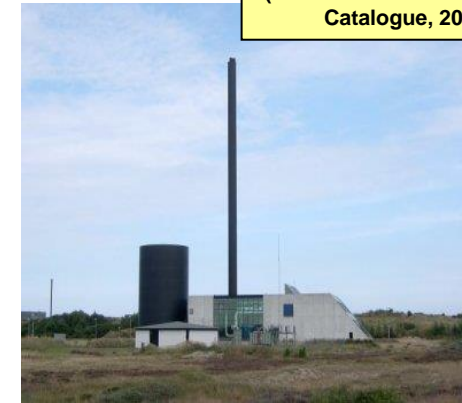
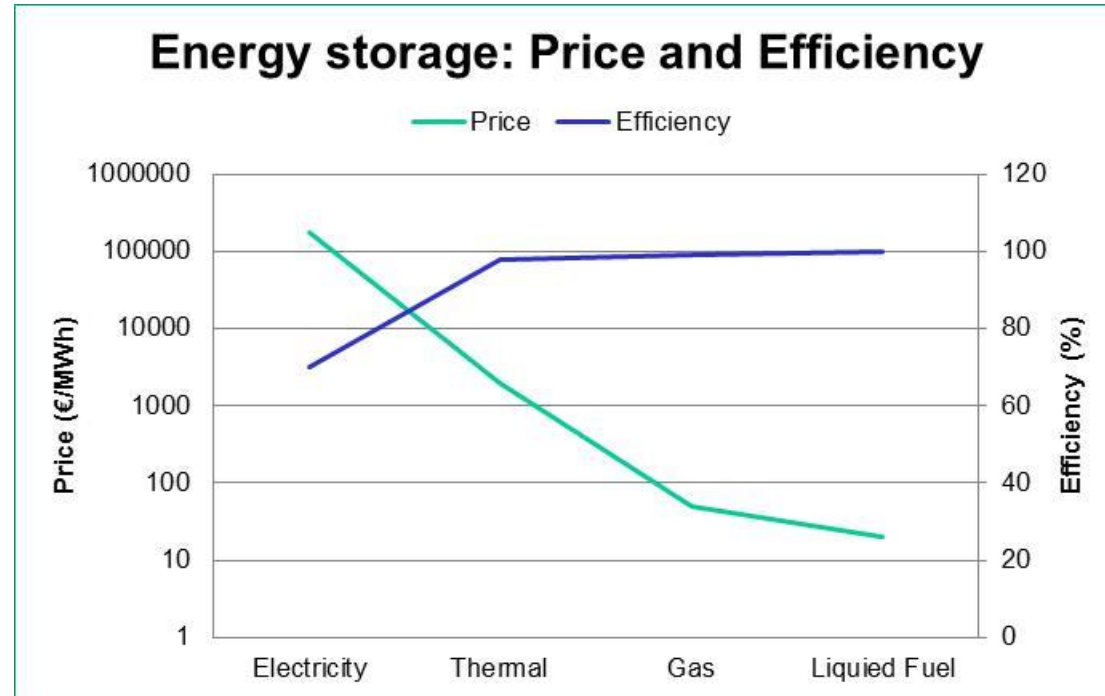
# Holistisk tilgang til det smarte energi system



# Energilagre



**Pump Hydro Storage**  
**175 €/kWh**  
 (Source: Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits. Electric Power Research Institute, 2010)



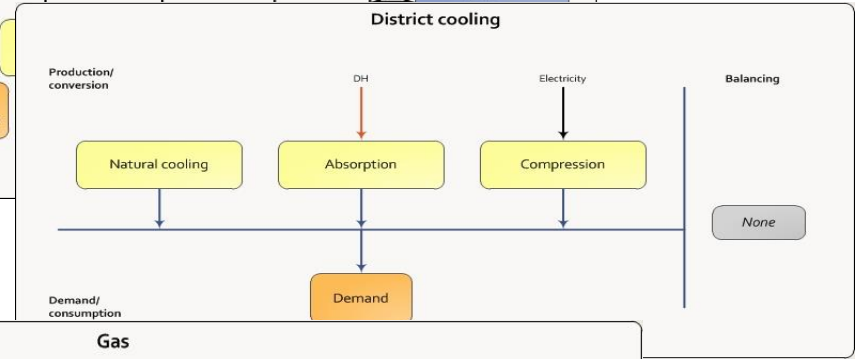
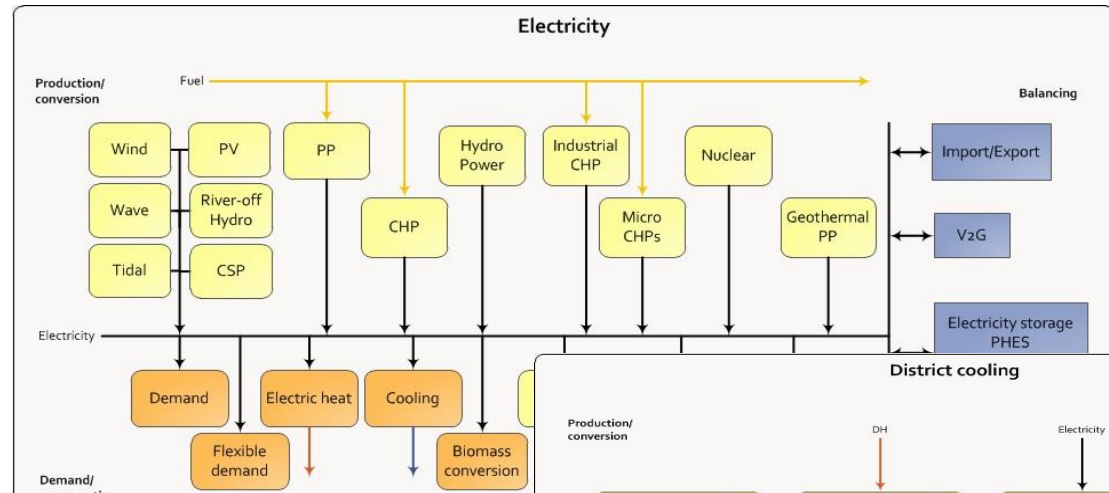
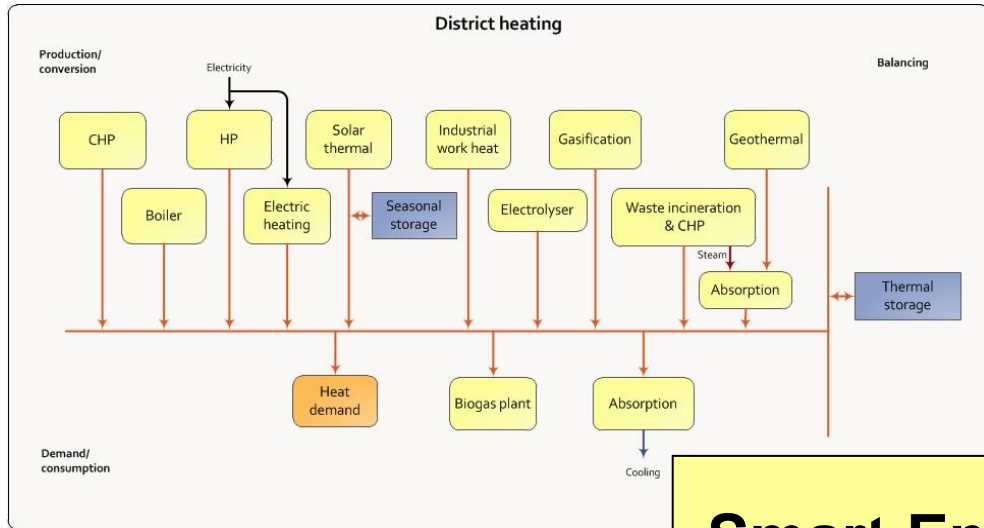
**Thermal Storage**  
**1-4 €/kWh**  
 (Source: Danish Technology Catalogue, 2012)



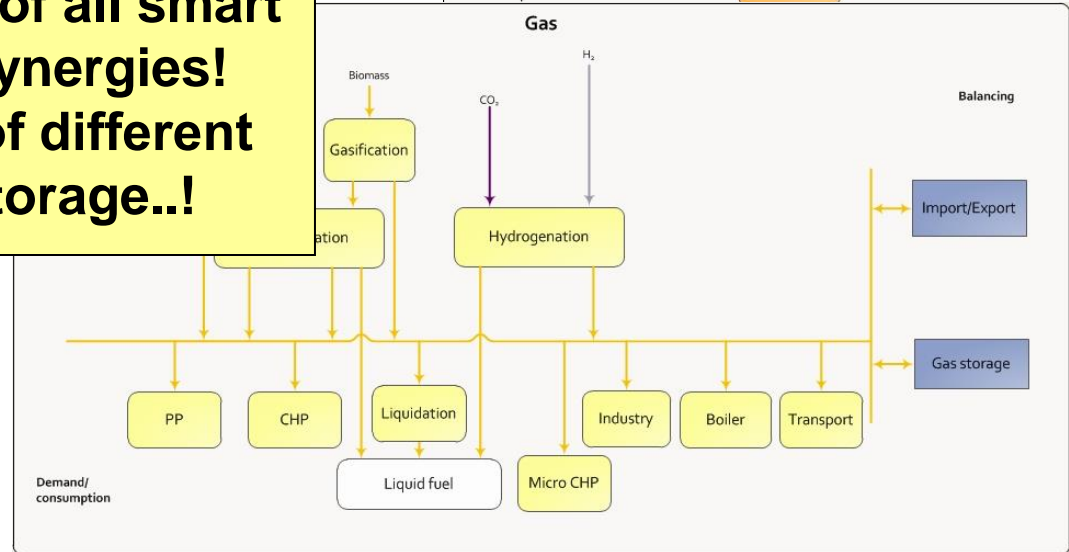
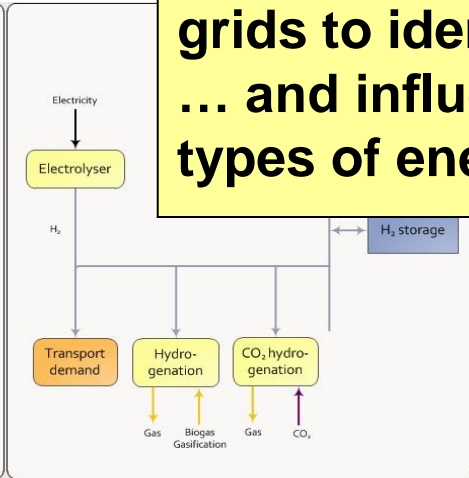
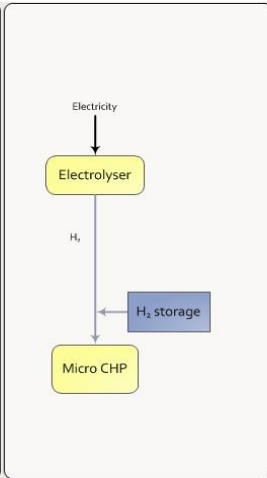
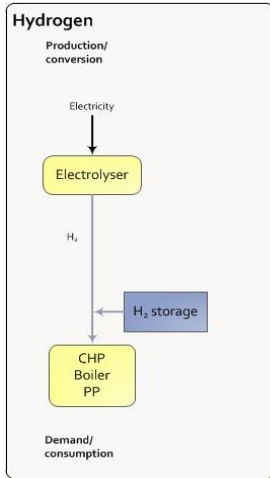
**Natural Gas Underground Storage**  
**0.05 €/kWh**  
 (Source: Current State Of and Issues Concerning Underground Natural Gas Storage. Federal Energy Regulatory Commission, 2004)

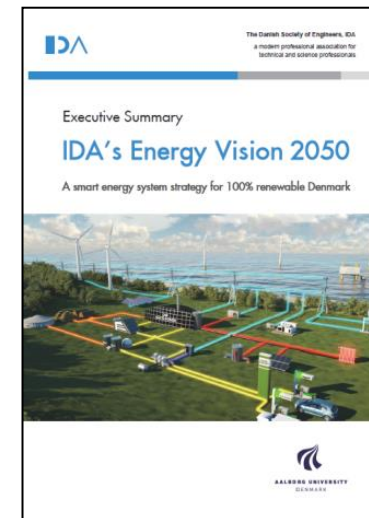


**Oil Tank**  
**0.02 €/kWh**  
 (Source: Dahl KH, Oil tanking Copenhagen A/S, 2013: Oil Storage Tank. 2013)

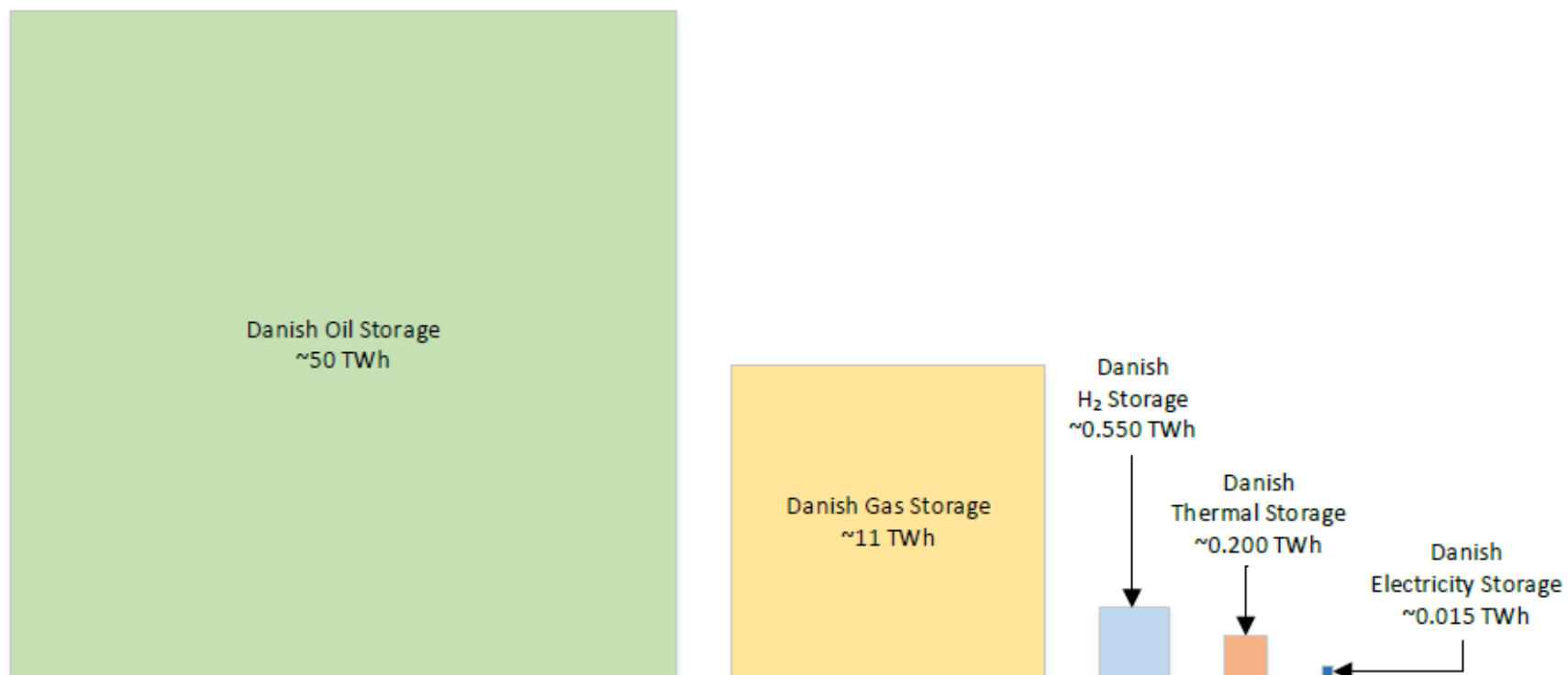


**Smart Energy Systems:  
Hourly modelling of all smart  
grids to identify synergies!  
... and influence of different  
types of energy storage..!**





## Energy Storage Capacities in 100 % RES Denmark 2050 (IDA)

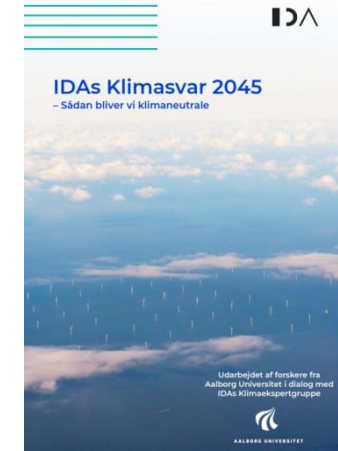
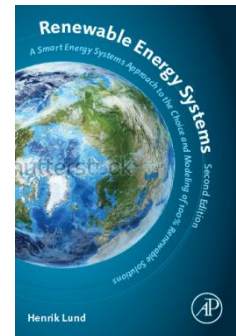
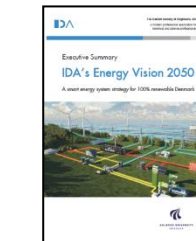


# IDA's Klimasvar: - en del af Europa

Danmark bør opfylde målsætningerne om vedvarende energi og CO2-reduktion på en måde, så det passer ind i, at resten af Europa og i sidste ende, at resten af verden kan gøre det samme.

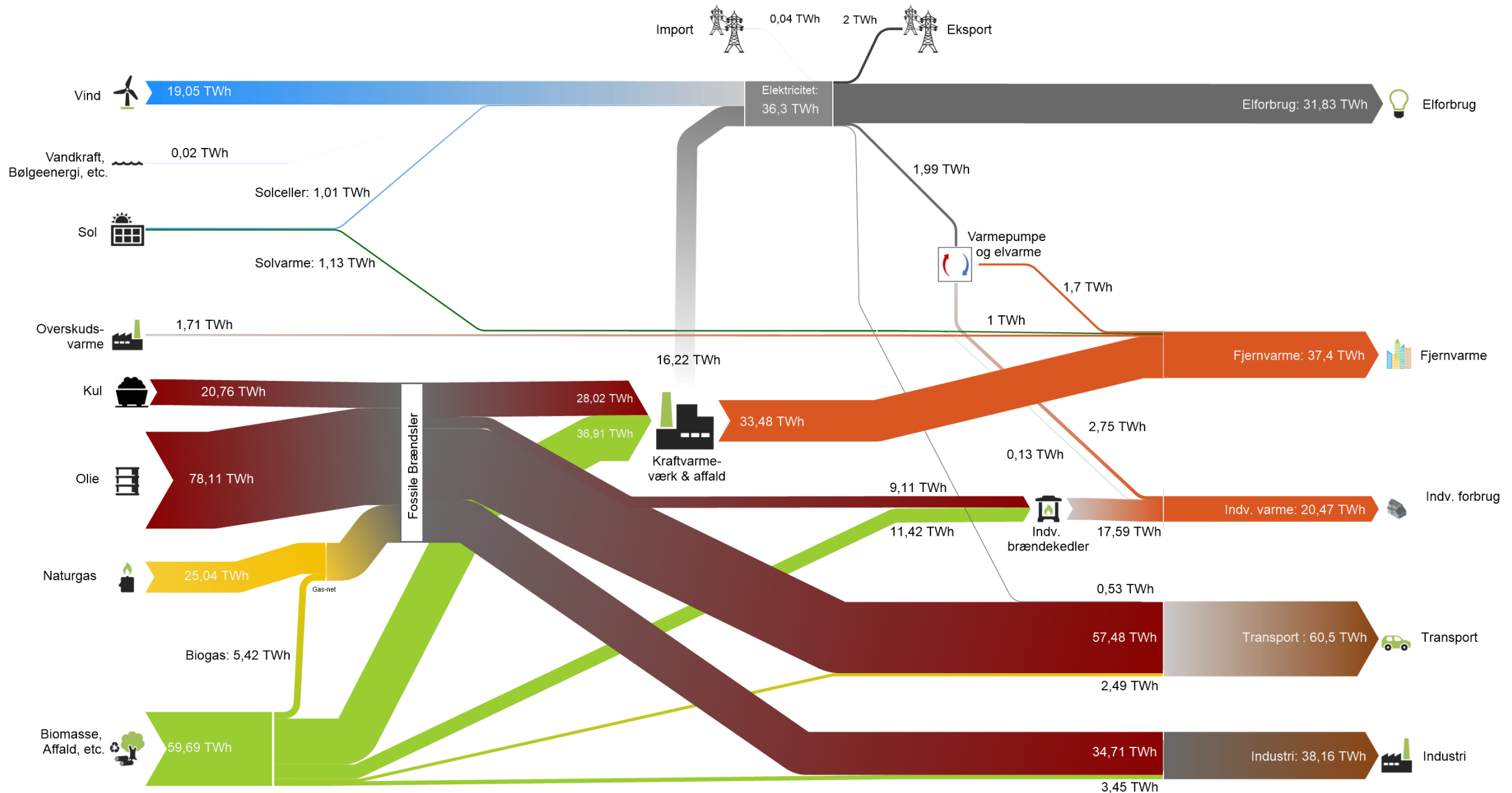
Det betyder:

- at vi skal forholde os til Danmarks andel af bl.a. den **internationale fly- og skibstransport** og bidrage til at nedbringe klimagasser fra disse transportformer, også selvom de ikke er med i FN-måden at opgøre vores forpligtigelser på.
- at vi skal holde os inden for Danmarks andel af **verdens bæredygtige biomasse** ressourcer.
- at vi skal bidrage med vores andel af både fleksibilitetsydelse og reservekapacitet på **el-nettet i en europæisk sammenhæng**.

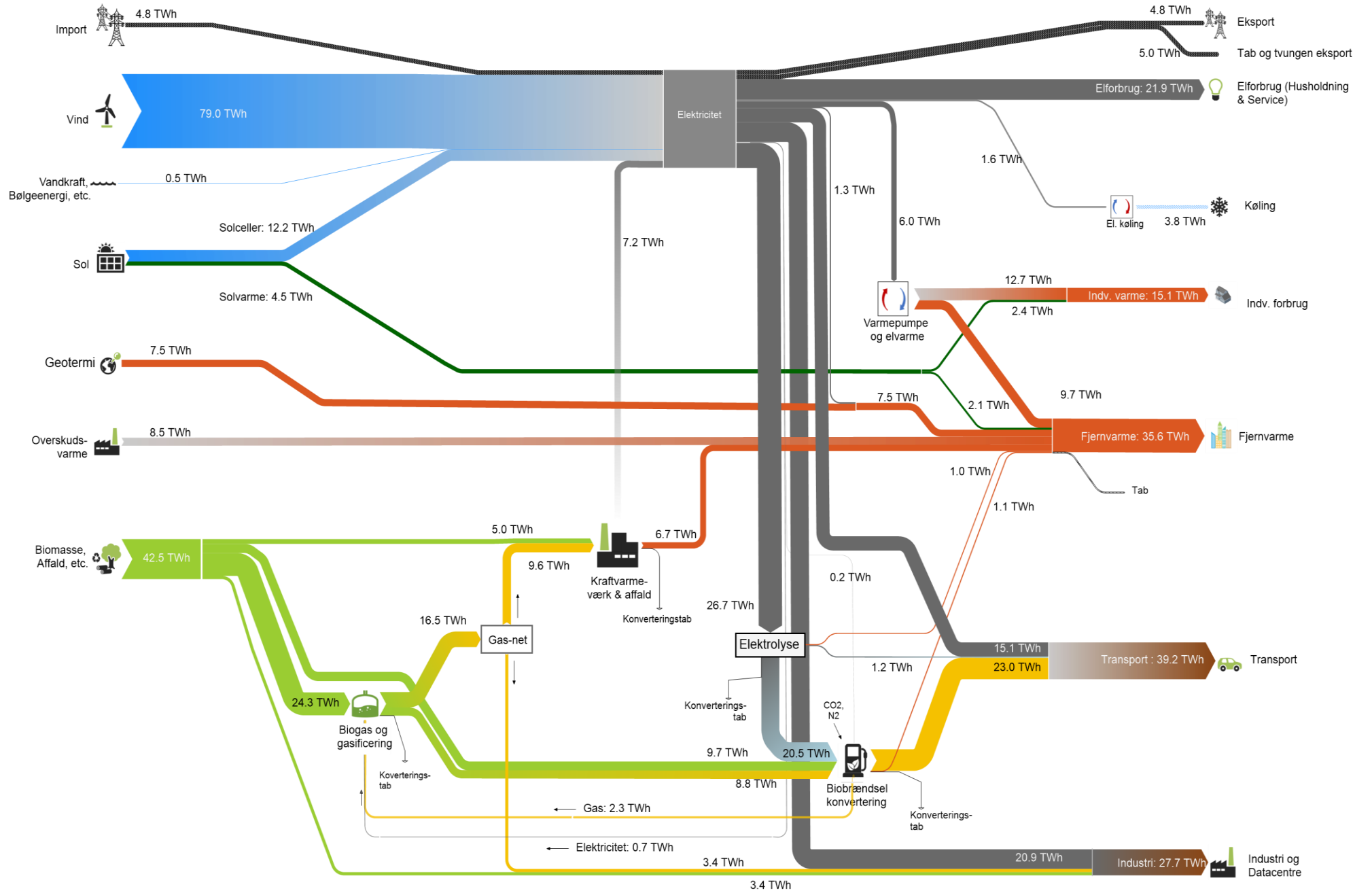
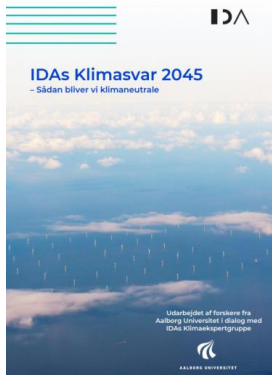




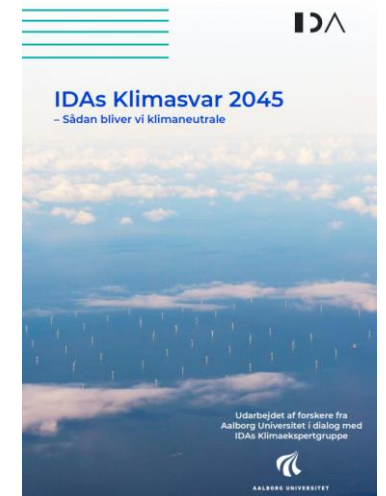
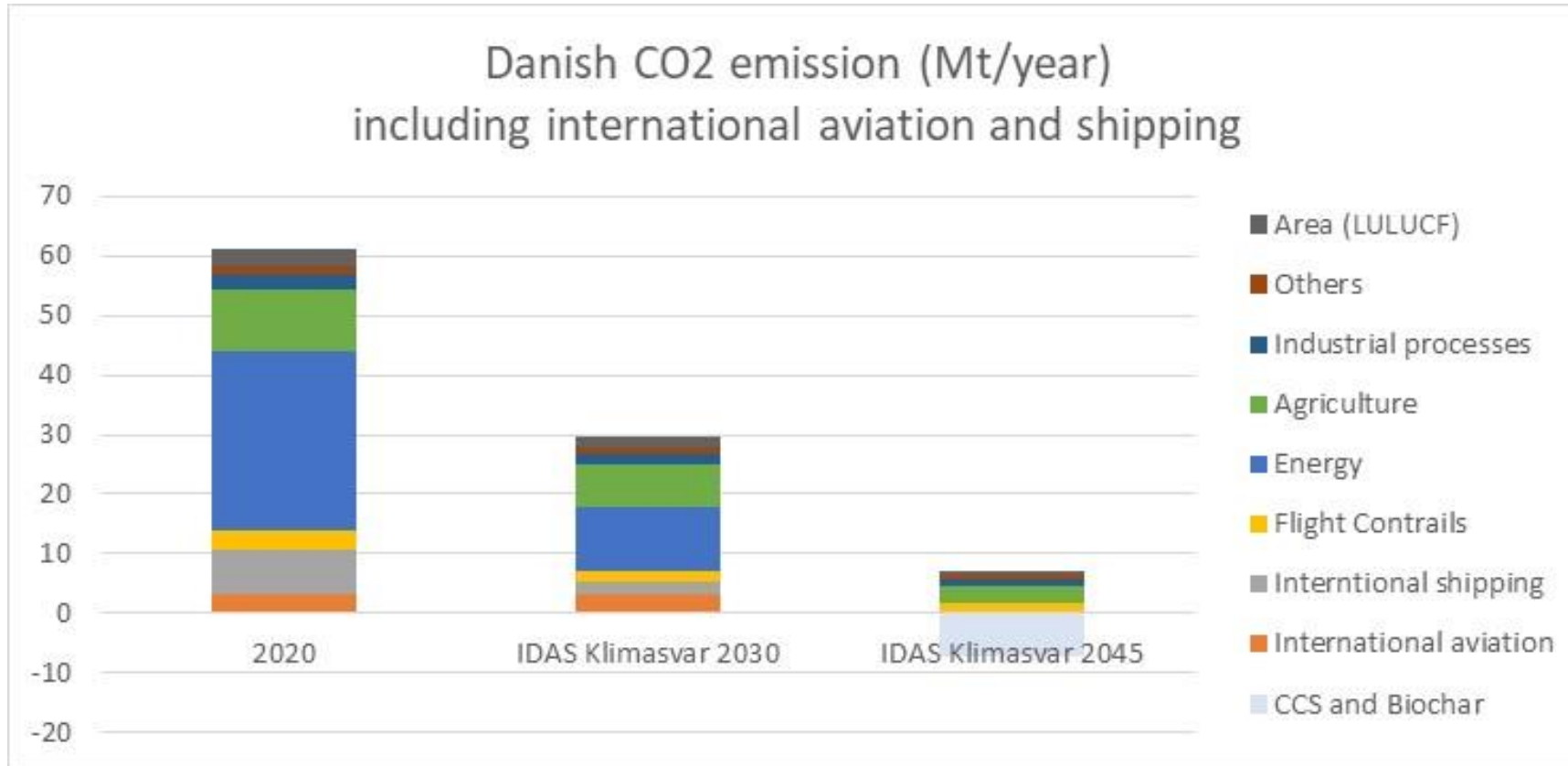
# 2020



# 2045



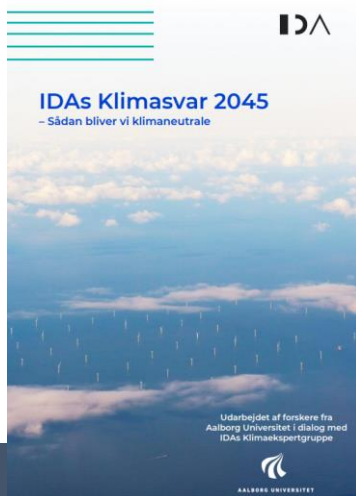
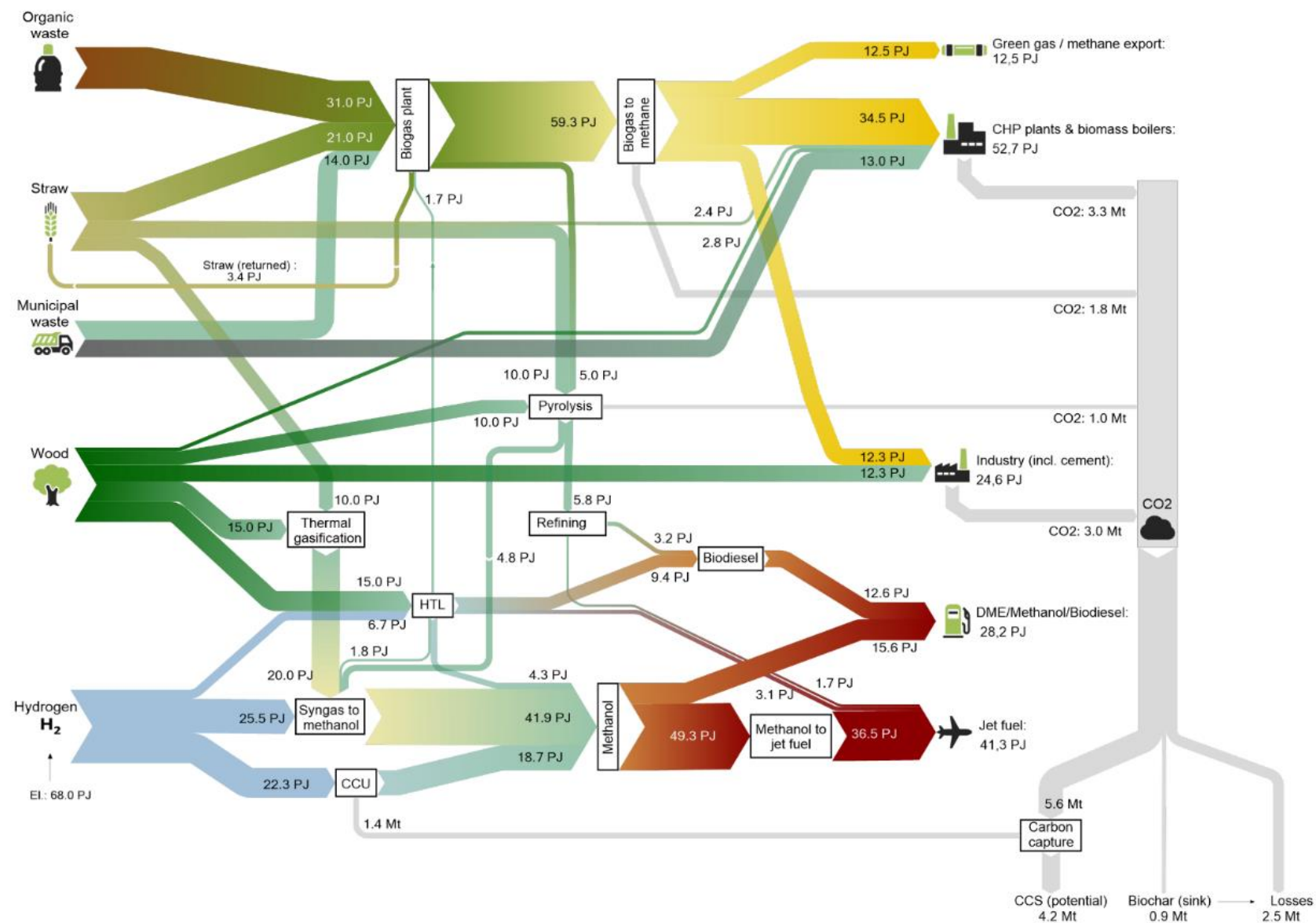
# A fully decarbonized Denmark 2045



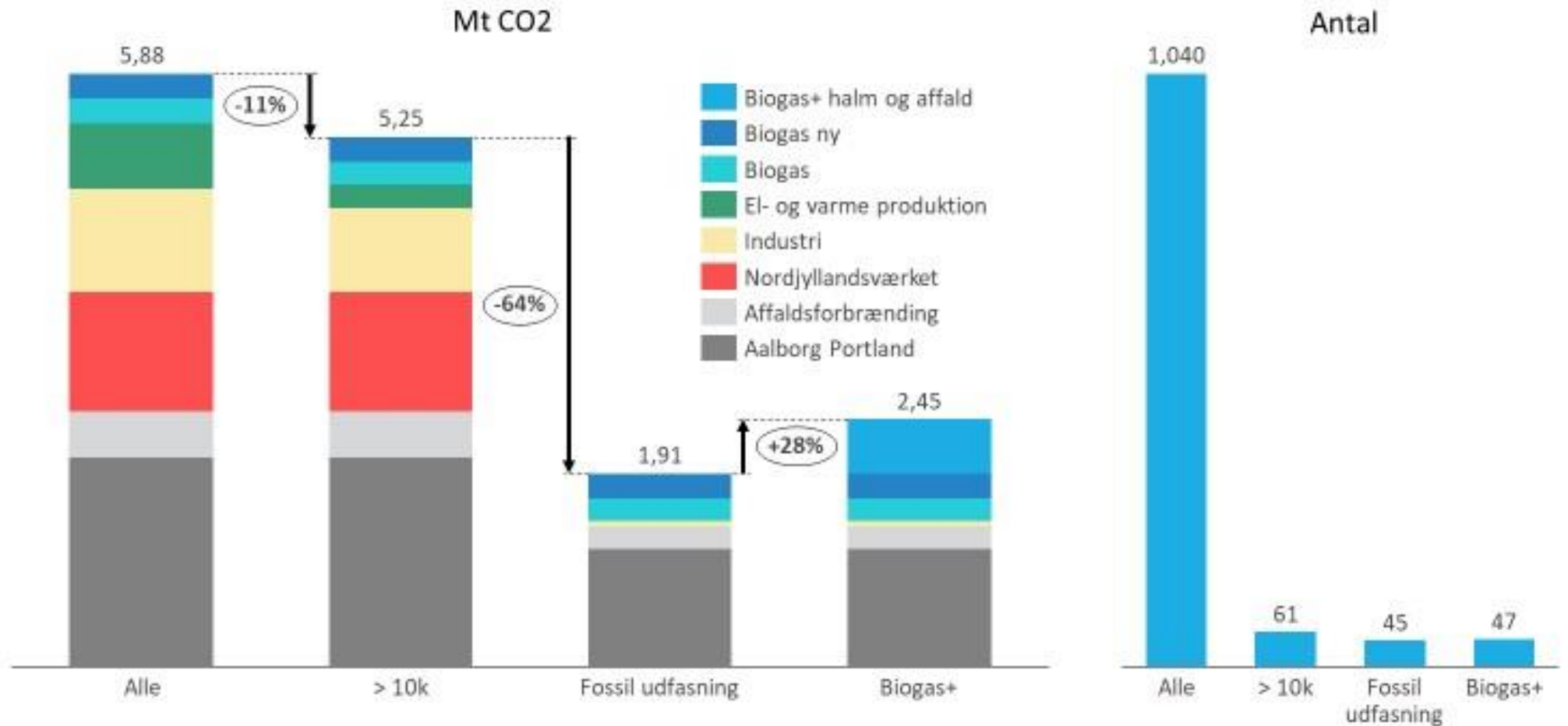
# Biomasse 2045

## Overview:

*(153 PJ minus  
eksport 13 PJ =  
140 PJ svarende  
til 23 GJ/capita)*



# Estimering af fremtidens CO<sub>2</sub>-punktkilder



# Biogas i Danmark i fremtiden

- Vigtigt teknologi ift. udnyttelse af bæredygtig biomasse
- Slutprodukt vi har brug for i fremtiden (gas/flydende grønt brændsel)
- Dobbelt miljøfordel
- Moden teknologi
- CO<sub>2</sub>-kilder som ikke forsvinder
- God punkt-kilde (nem og billig at udbytte)



# CARMA (Carbon Management)

## Project partners and competences



---

### University partners



### Industry partners



Website: [missiongreenfuels.dk](http://missiongreenfuels.dk)



**Biogas Danmark  
Konferencen 2023**

Vingsted Hotel- og Konferencenter  
Onsdag den 6. december 2023

 Biogas  
Danmark



# Biogassens rolle i fremtidens danske energisystem

Professor Henrik Lund  
Aalborg Universitet

