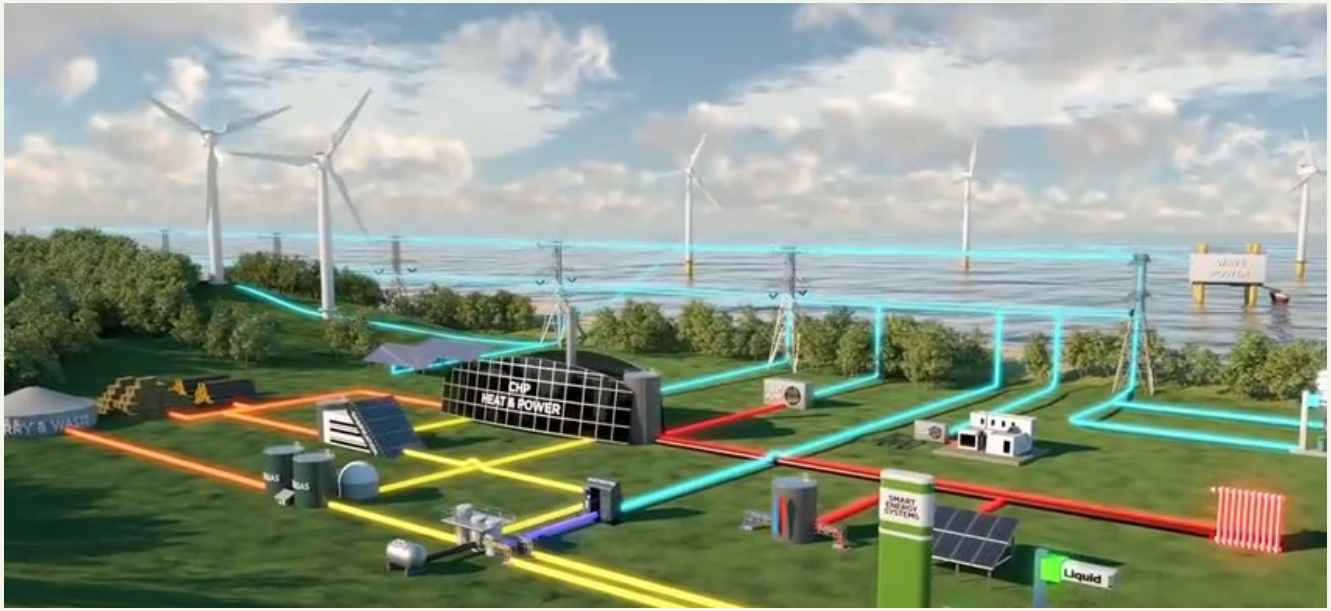


The 70% reduction target in 2030 and 100% renewable energy in 2045

Brian Vad Mathiesen, Aalborg Universitet

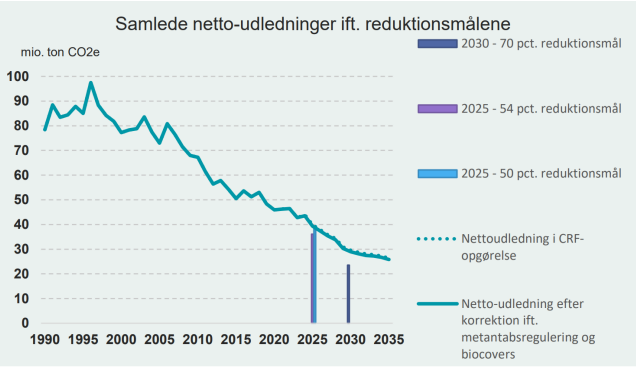
Annual Danish Conference on Environmental Economics, August 24, 2023

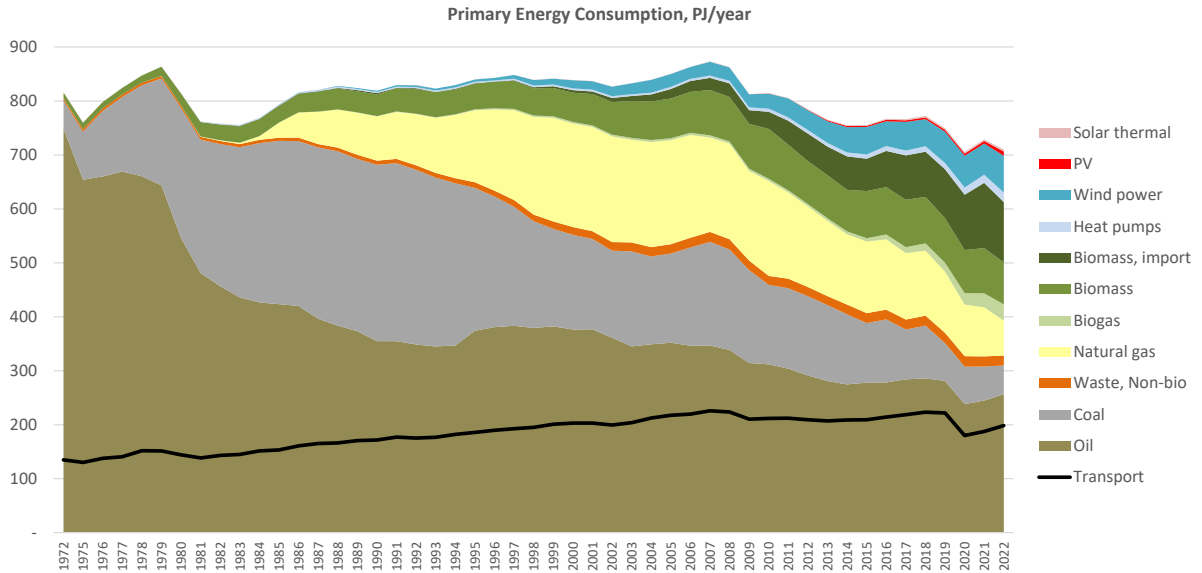
Panel session: Challenges of our future energy system

@BrianVad

CO_2-Emissions and Primary Energy Consumption

Klimastatus og fremskrivning 2023 (KF23)

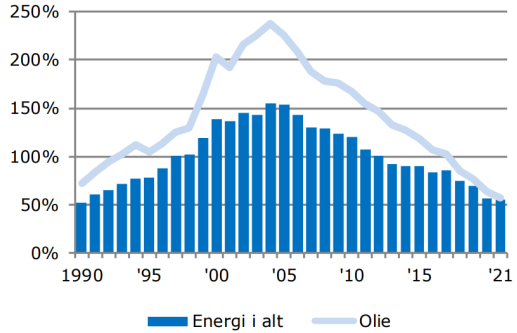


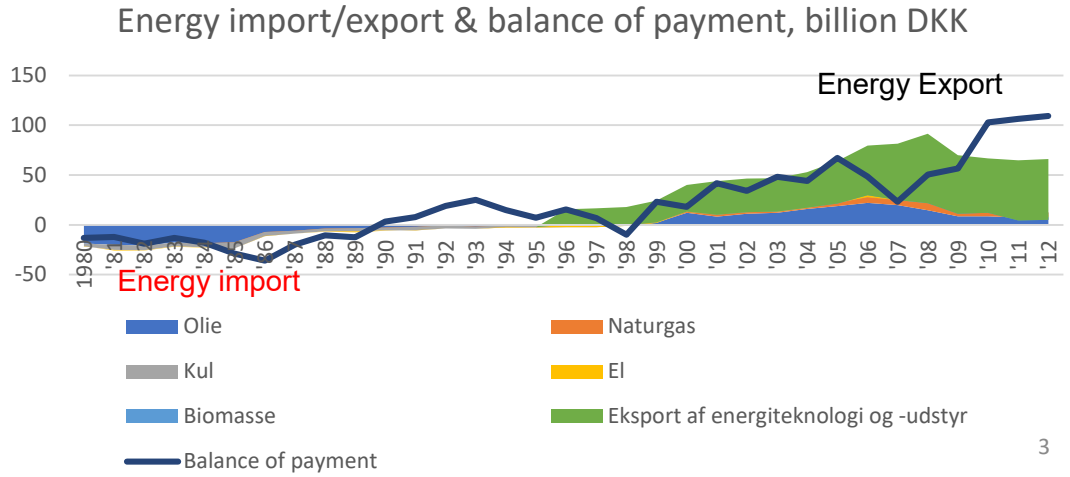


Danmarks Statistik, 2023

The results of 40 years of Energy Planning

- Results:
  - Cost-efficient energy supply
  - Good effect on the balance of payment
  - New jobs and companies
  - High selfsufficiency – until recently at least





Energy storage costs

Thermal energy storage is cheaper

Bigger is cheaper

Ellagre

€125/kWh

€300/kWh

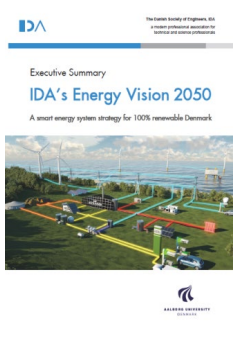
TESLA
POWERWALL

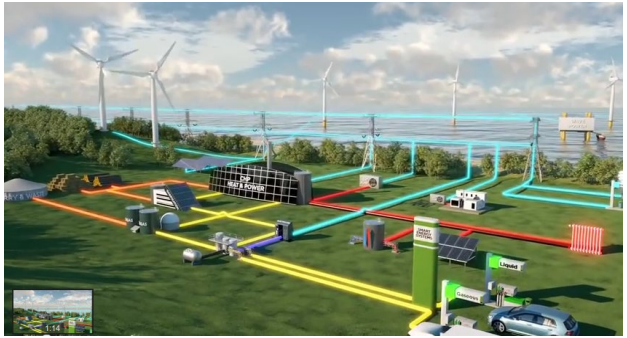
Termiske lagre

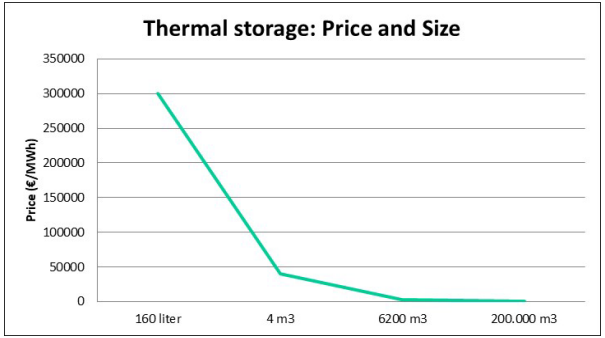
€1/kWh

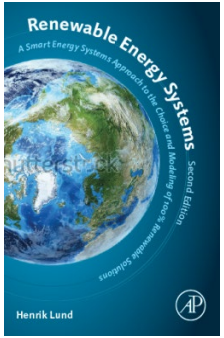
€90/kWh

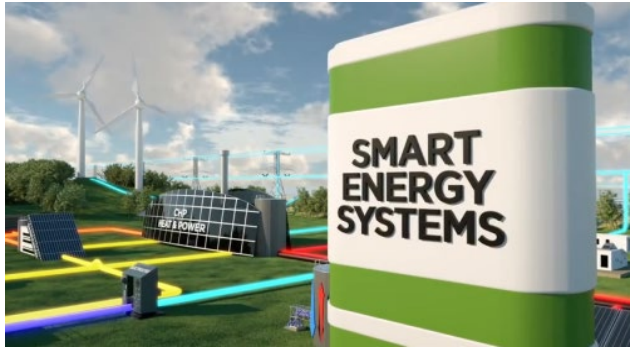
Smart Energy Systems

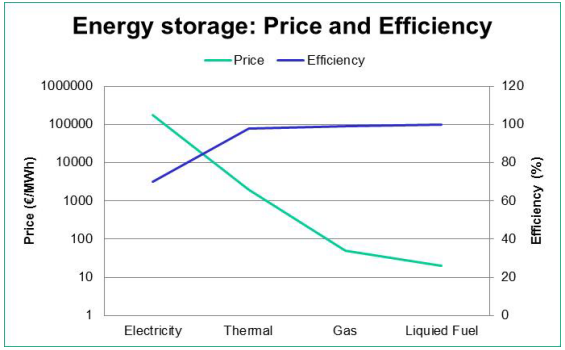


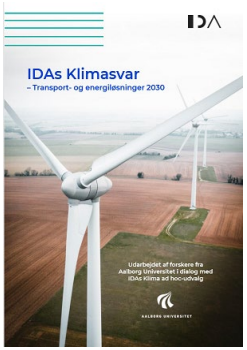


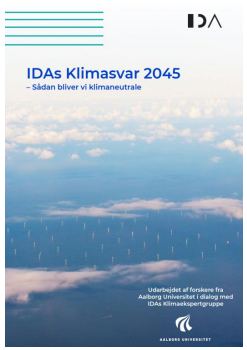








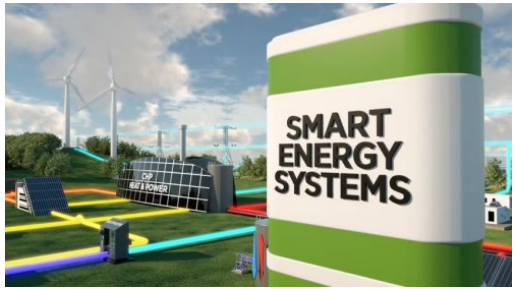


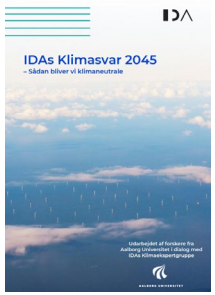


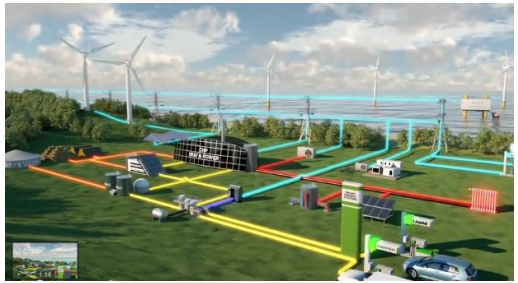
IDAs Klimasvar: Towards 2045

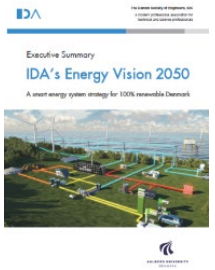
Achieving the 70 per cent target with a CO2-reduction in 2030 in line with achieving 100 per cent renewable energy and climate neutrality in 2045.

- In 2030 the choice of technologies should enable the next steps after 2030.
- Towards 2030 we need to focus on developing technologies we need after 2030 even though they are needed to a lesser extent in 2030.





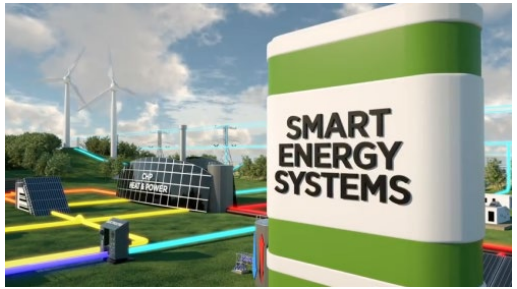


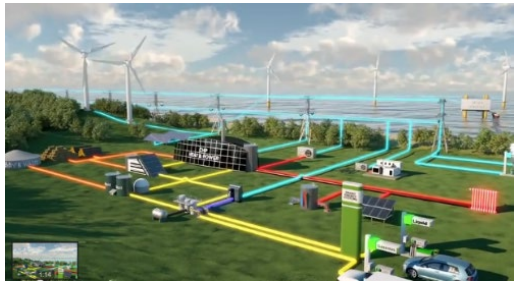


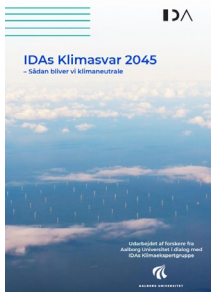
IDAs Klimasvar: A part of Europe

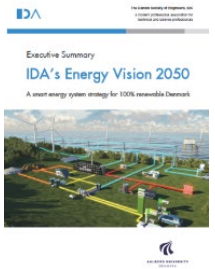
The Danish way of achieving the 70 per cent reduction target in a manor where other countries in Europe and globally can achieve the same long term targets.

- Denmark needs to consider its part of international aviation and navigation transport and reduce emission here even though they are not a part of the UN accounting method.
- Denmark needs to achieve its targets within a sustainable level of biomass consumption
- Denmark should contribute with flexibility and reserve capacity in the electricity grid in a European context.

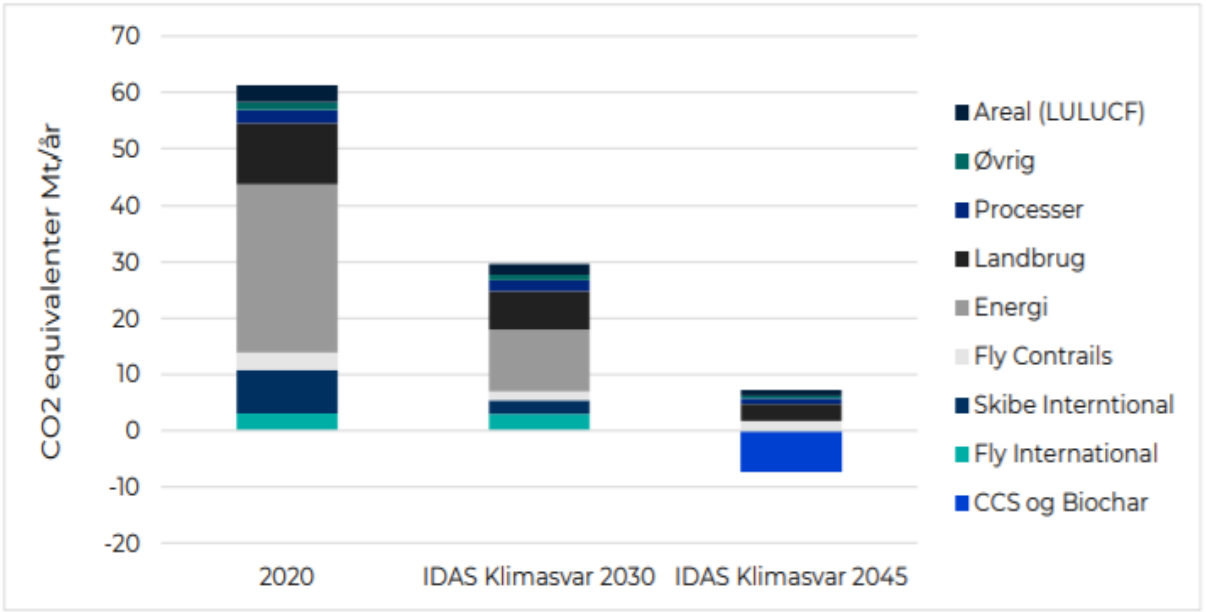








Denmark Climate neutral in 2045 (UN method)

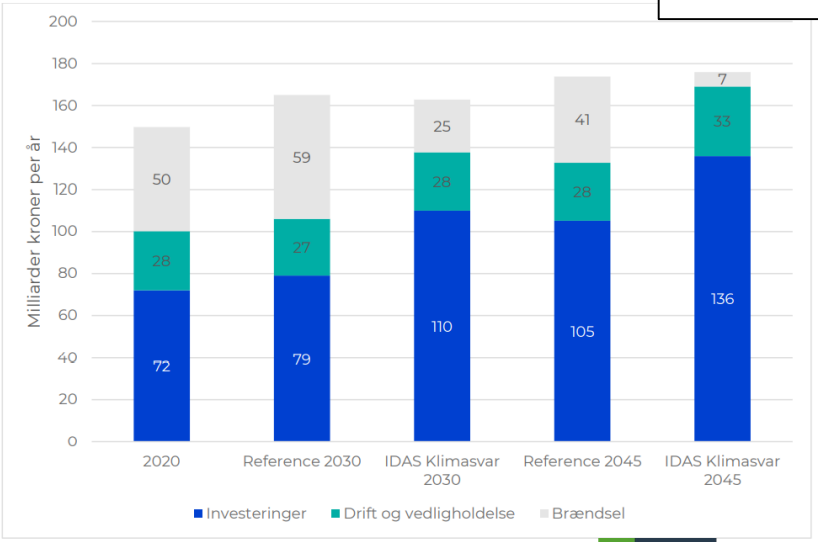


Investments needed towards 2030 and 2045

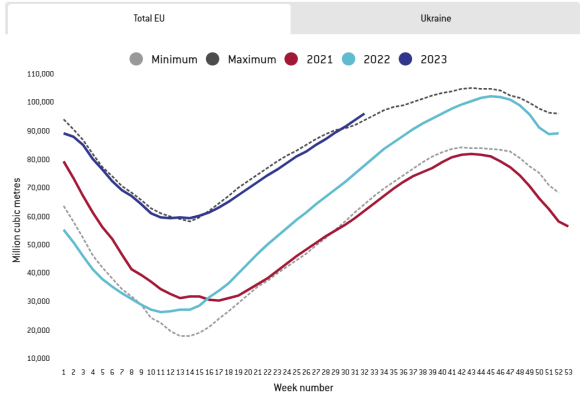
Tabel 1. De største investeringer i perioden 2020 til 2030 og fra 2030 til 2045

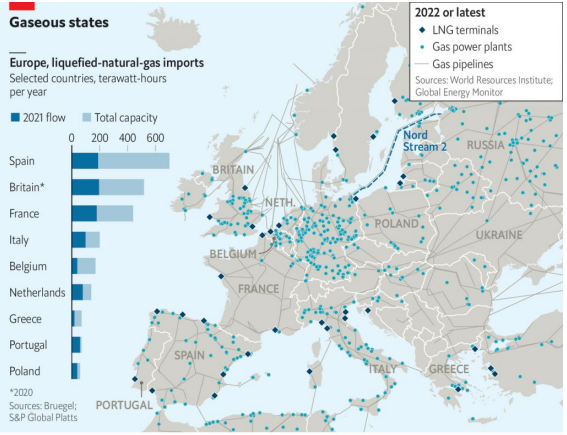
	Fra 2020 til 2030		Fra 2030 til 2045	
	Investerings-behov	Årlige af-skrivning og rente i 2030	Investe-rings-behov	Årlige afskriv-ning og rente i 2045
	Milliarder DKK	*Millioner DKK/år*	*Milliarder DKK*	*Millioner DKK/år*
Bygningsrenovering	124	5.360	185	7.986
Offshore og onshore vindmøller	78	4.173	102	5.150
El-køretøjer (ekstra inkl. e-roads)	73	6.896	52	4.947
Individuelle varmepumper	70	5.114	7	946
Industri (besparelser og elektrificering)	36	2.570	28	2.079
Fjernvarmeudvidelse og 4G fjernvarme	30	1.467	7	462
Solceller	21	937	22	969
Biogasanlæg	18	1.223	12	857
Nye gasfyrede værker	16	897	1	18
Ladestandere, elnet og ITS	14	825	25	1.463
Store varmepumper	9	499	28	1.594
Elektrolyse og brintlager	8	501	78	3.531
Geotermi	8	440	8	410
Bølgekraft	5	303	5	303
Forgasning, pyrolyse og elektrofuels	5	316	25	1.579
Intelligent fleksibelt elbehov	3	235	1	93
Solvarme, overskudsvarme og varmelagre	3	176	2	97
Fjernkøling	2	89	0	0
Gasnet 2030 hhv. brintnet 2045	2	89	10	390
Sum	**525**	**32.110**	**598**	**32.874**

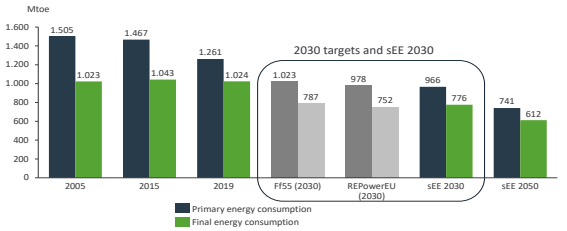
Figur 5. Samfundsøkonomiske omkostninger 2020, 2030 og 2045

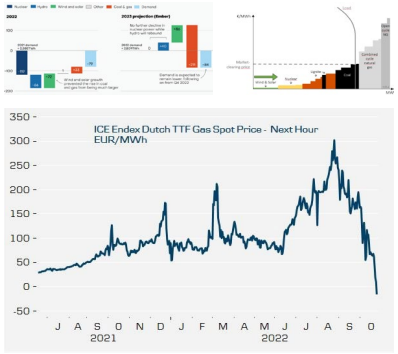


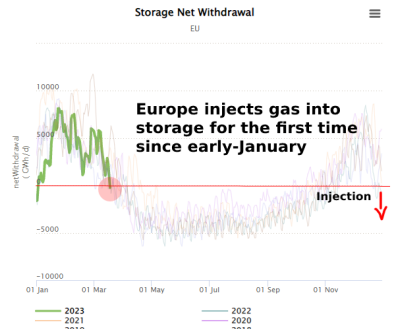
REPowerEU and the high prices has been a great succes – but will it last?











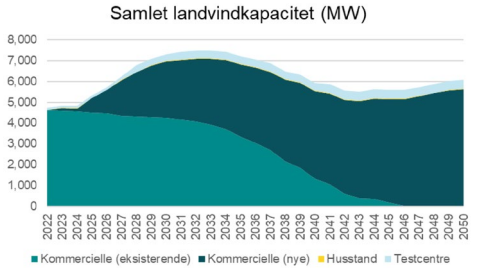
The energy crisis is not over!

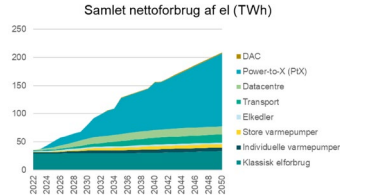
Short term

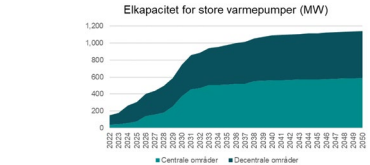
Strategic

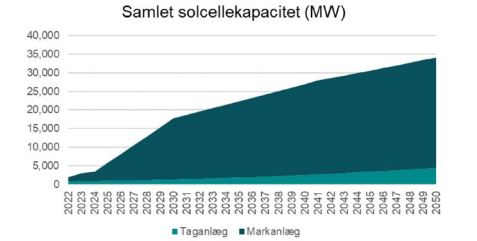
How can we mitigate the energy crisis and meet the 70% reduction target?

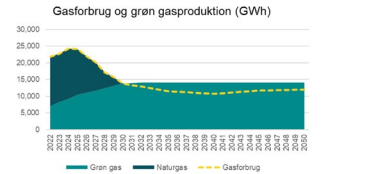
- **Need for a new framework?**

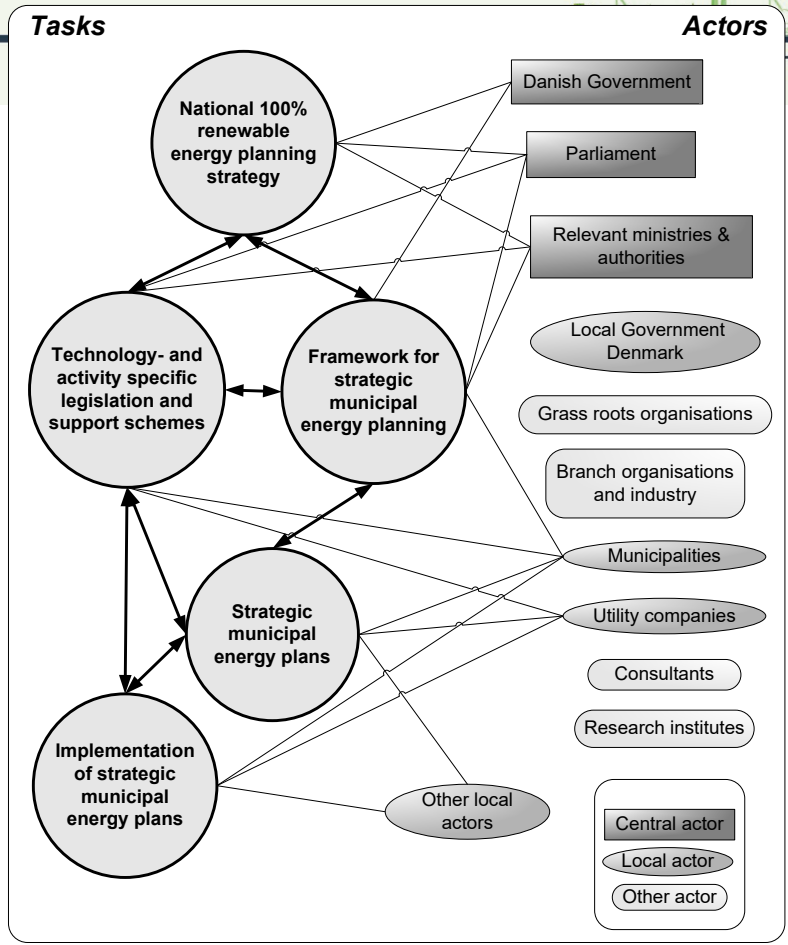








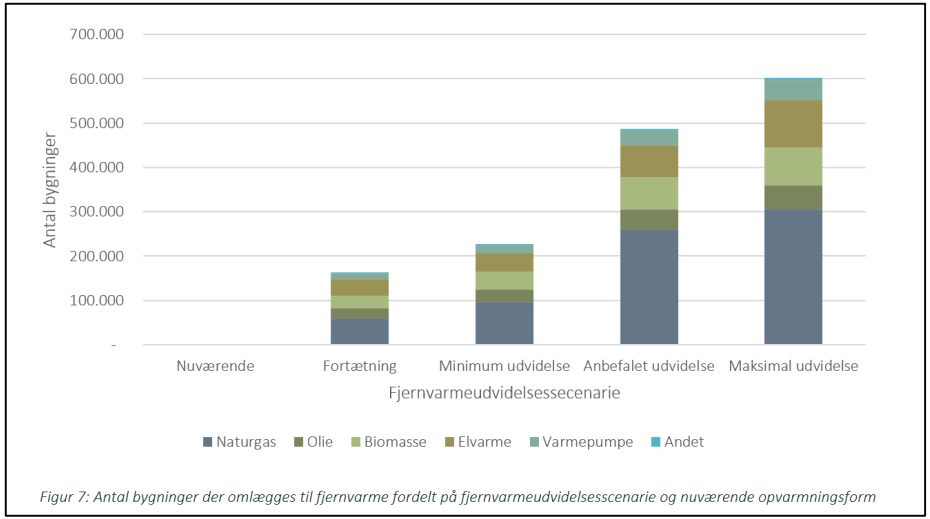




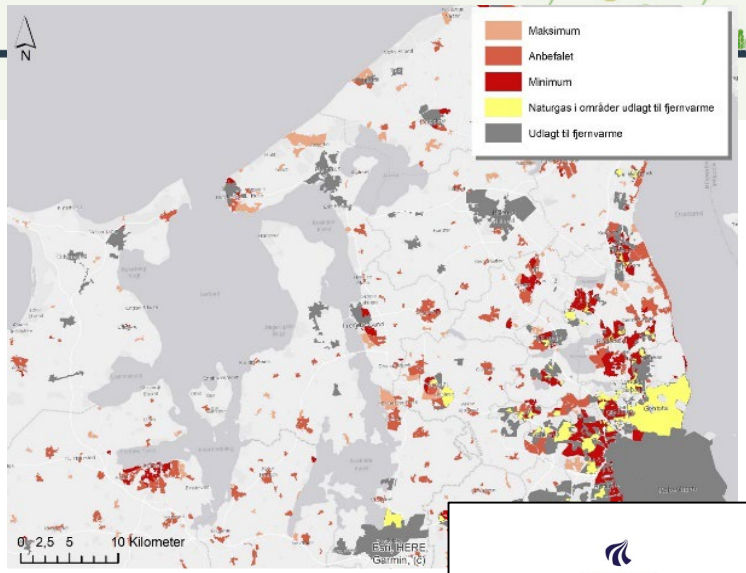
Sperling, Hvelplund og Mathiesen, 2011

District heating should expand to 63-70%

- Current: Current buildings registrered with district heating (~50%)
- Condensing: All buildings in areas with district heating planned (~59%)
- Minimum expansion: Expansion in urban areas with a heat density above 15 kWh/m^2 (~63%)
- **Recommended expansion:** Expansion in urban areas with a heat density above 10 kWh/m^2 (~70%)
- Maksimum udvidelse: Expansion in urban areas with a heat density above 5 kWh/m^2 (~74%)



Figur 7: Antal bygninger der omlægges til fjernvarme fordelt på fjernvarmeudvidelsesscenarie og nuværende opvarmningsform



Natural gas conversion:

- 260.000 to district heating
- 115.000 to individual heat pumps

Oil conversion :

- 44.000 to district heating
- 70.000 to individual heat pumps

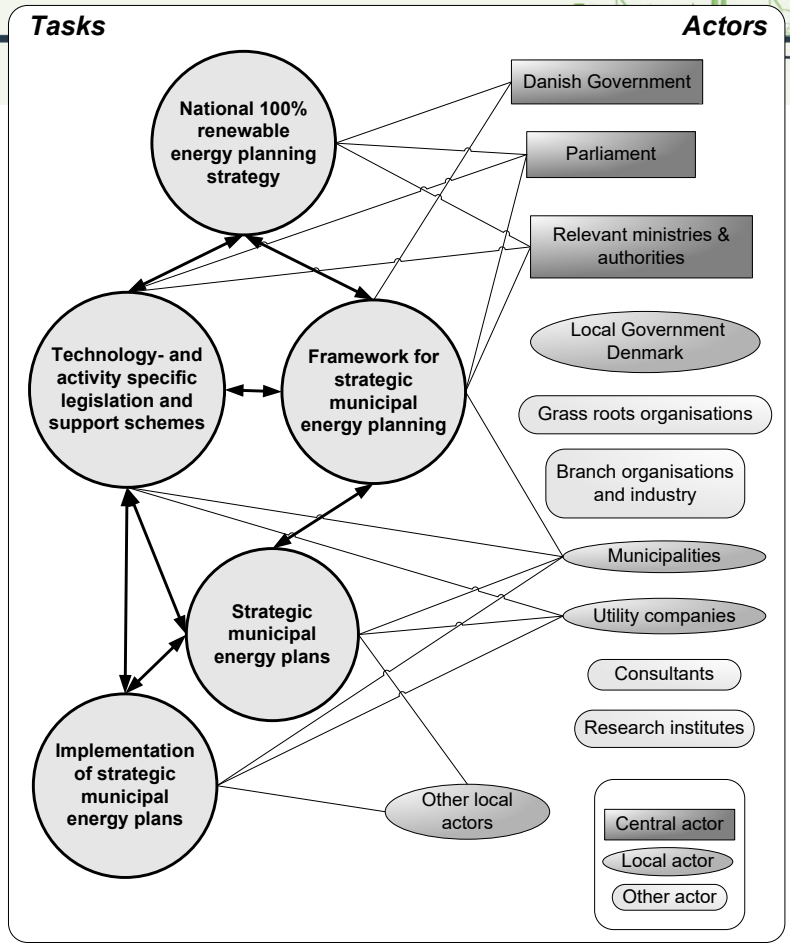
Biomass conversion:

- 74.000 to district heating
- 183.000 to individual heat pumps

How can we mitigate the energy crisis and meet the 70% reduction target?

- **Strategic energy planning**
  …away from short sighted and uninformed decision making
  …think holistic and long term
  ….consider your the role of municipalities, regional cooperation and the national level
  …. national framework to a local direction can ensure bigger markets
  …. Need for planning and 1 or 2 skilled dedicated employees pr. municipality and a central coordination
  .....a clear direction creates better competition and a higher information level. They are entitled to that!

- **Government:**
  ….New Renewable energy law?
  ….Strategic energy planning frame?
  ….Regional / local coordination towards national goal based on a strategic national plan to reach the goal?
  ....Municipalities must plan areas and local engagement?



Sperling, Hvelplund og Mathiesen, 2011

Tak for opmærksomheden

www.brianvad.eu | www.energyplan.eu/buildings | www.energyplan.eu/IDA2045

www.EnergyPLAN.eu | www.energyplan.eu/smartenergysystems/ | www.heatroadmap.eu

www.energyplan.eu/SmartEnergyEurope | www.4DH.eu | www.energyplan.eu/solar

www.energyplan.eu/varmeplan | www.sEEnergies.eu

8. MARTS 2022

Fast track væk fra naturgas i Danmark og Europa

Forsyningssikkerhed, energipolitik og energiplanlægning i et sikkerhedspolitisk lys

Af Brian Vad Mathiesen, professor Energiplanlægning Aalborg Universitet og Pernille Hagedorn-Rasmussen, chefkonsulent Ingeniørforeningen, IDA

Verden står nu i den 3. energikrise, og det er uvist, hvor længe denne krise vil vare. Dette notat beskriver handlemuligheder på fast track væk fra russisk naturgas og ud af fossil gas i det hele taget. Da den aktuelle krise kan fortsætte, og da vi også skal have løst klimakrisen, så er vejen ud af naturgaskrisen grøn. I notatet er tiltagene opdelt på tre tidsperspektiver: Akutte tiltag, tiltag med kortsigtet effekt og tiltag med effekt på mellemlang sigt. En del af forslagene er tiltag, der kan bringes i anvendelse på EU-niveau og en væsentlig del er målrettet danske politiske tiltag. Det vurderes, at den danske anvendelse af gas kan reduceres med op mod 79% på 5-8 år med målrettede tiltag. I Europa og EU er manøvren vanskeliggjort grundet den store afhængighed af gas til opvarmning og el. Det vurderes, at forbruget her kan nedbringes med 30% på 5-8 år. Det kræver dog store og radikale ændringer i industri og varmeforsyningen på kort sigt. I en akut situation kan Danmark/Europa nedbringe forbruget med henholdsvis 33% og 35% såfremt der er 10% energibesparelse på el og varme og såfremt 90% af industriproduktionen lukkes ned eller skifter til kul og olie. For at komme i en situation, hvor vi er 100% uafhængige af russisk naturgas, skal det samlede forbrug af gas i EU reduceres med cirka 31%. En reduktion i forbruget kan suppleres med import af naturgas fra andre dele af verden. Man skal være opmærksom på, at andelen af russisk naturgas svinger fra år til år i Europas og EU's samlede naturgasforbr

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