



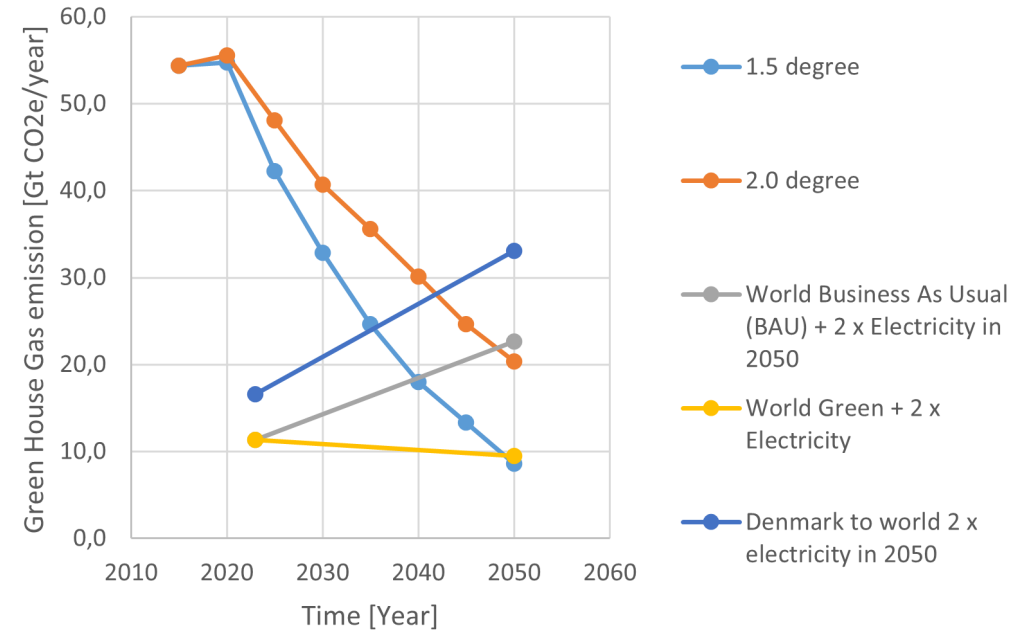
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# **Decarbonizing the electricity systems case - DTU Quantitative Sustainability**

# Investigating decarbonizing the electricity system

1	World Green	Type	Electricity mix start $f_{s,i}$	Electricity mix end $f_{e,i}$
2			[%]	[%]
3	Hard coal	PC, without CCS	39	10
4	Hard coal	IGCC, without CCS	0	0
5	Hard coal	SC, without CCS	0	0
6	Natural gas	NGCC, without CCS	23	23
7	Hard coal	PC, with CCS	0	0
8	Hard coal	IGCC, with CCS	0	0
9	Hard coal	SC, with CCS	0	0
10	Natural gas	NGCC, with CCS	0	0
11	Hydro	660 MW	0	0
12	Hydro	360 MW	15	15
13	Nuclear	average	9	9
14	Concentrated Solar Power (CSP)	tower	1	1
15	Concentrated Solar Power (CSP)	trough	0	0
16	Photo Voltaic (PV)	poly-Si, ground-mounted	5	5
17	Photo Voltaic (PV)	poly-Si, roof-mounted	0	0
18	Photo Voltaic (PV)	CdTe, ground-mounted	0	0
19	Photo Voltaic (PV)	CdTe, roof-mounted	0	0
20	Photo Voltaic (PV)	CIGS, ground-mounted	0	0
21	Photo Voltaic (PV)	CIGS, roof-mounted	0	0
22	Wind	onshore	7	36
23	Wind	offshore, concrete foundation	0	0
24	Wind	offshore, steel foundation	1	1
25	Total		100	100
26				
27	Start & End year		2023	2050
28	Start & End production [kWh/year]	World	2,25E+13	4,50E+13
29	Start & End population [Citicenz]	World	8,00E+09	8,E+09

UN scenarios of GHG emission with 1.5 and 2.0 degree temperature increase at 2100



- Select 2 countries, Denmark & the World, and find the mix of electricity-producing technologies of the last two years.
- Describe the change in the mix in the last two years.
- Calculate the CO<sub>2</sub> emission of the countries when scaled to planet scale as well as the world.
- Suggest proposals for the mix of electricity technologies in 2050 for the 3 countries & the world and calculate the CO<sub>2</sub> emissions
- Evaluate if the proposed mix of electricity-producing technologies will violate the planetary boundary of the Paris Agreement
- Discuss if your proposals seem realistic

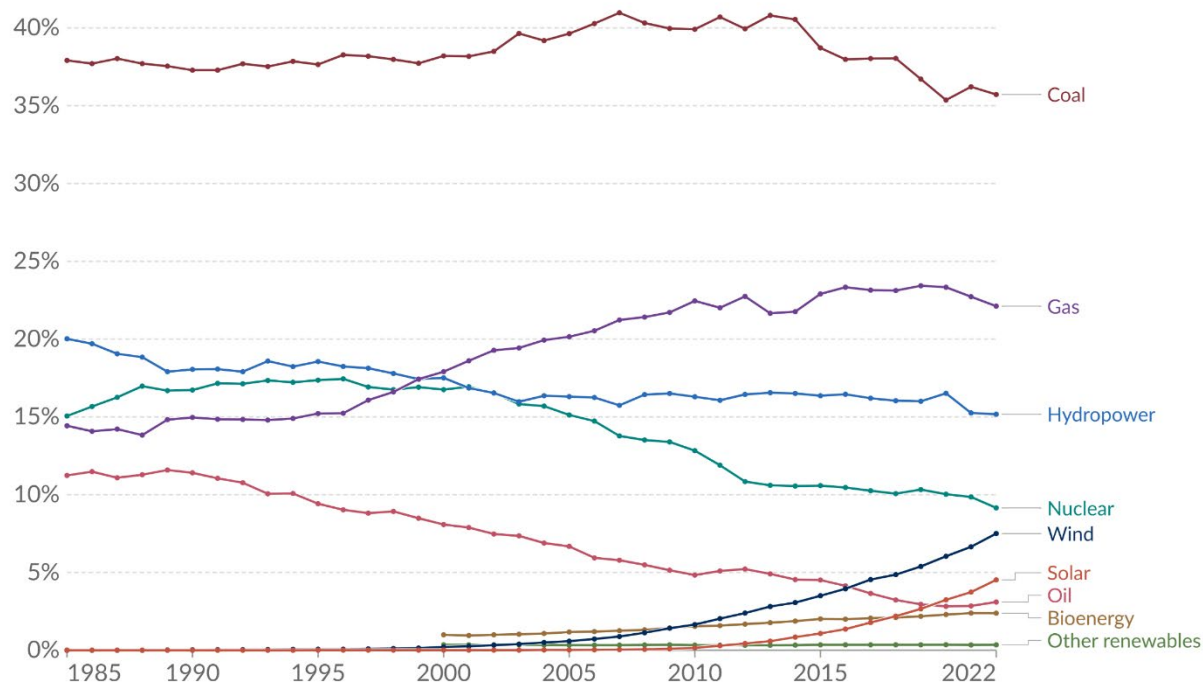
# Development of the mix of electricity-producing technologies of the planet



Share of electricity production by source, World

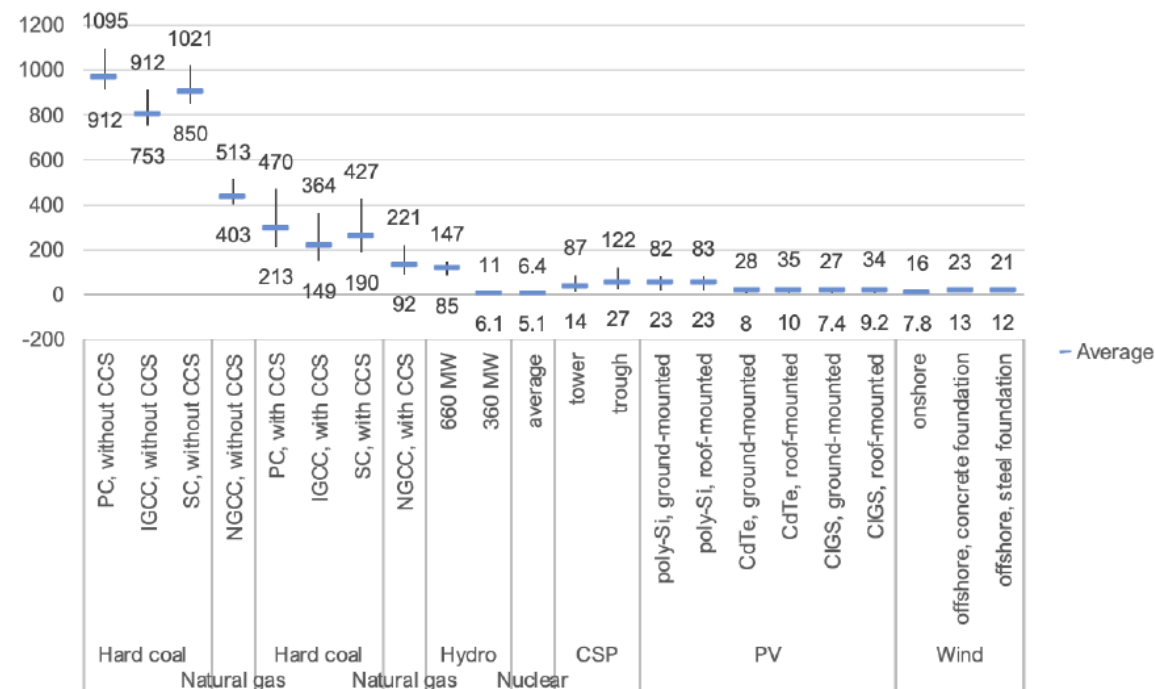
Our World  
in Data

**Figure 1** Lifecycle greenhouse gas emission ranges for the assessed technologies

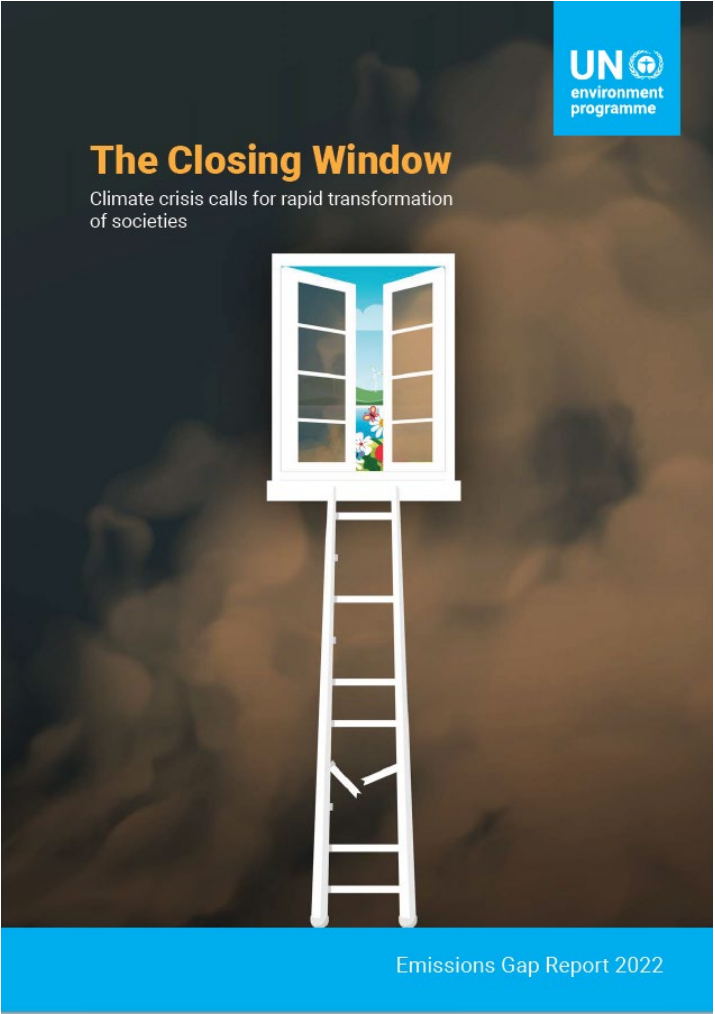
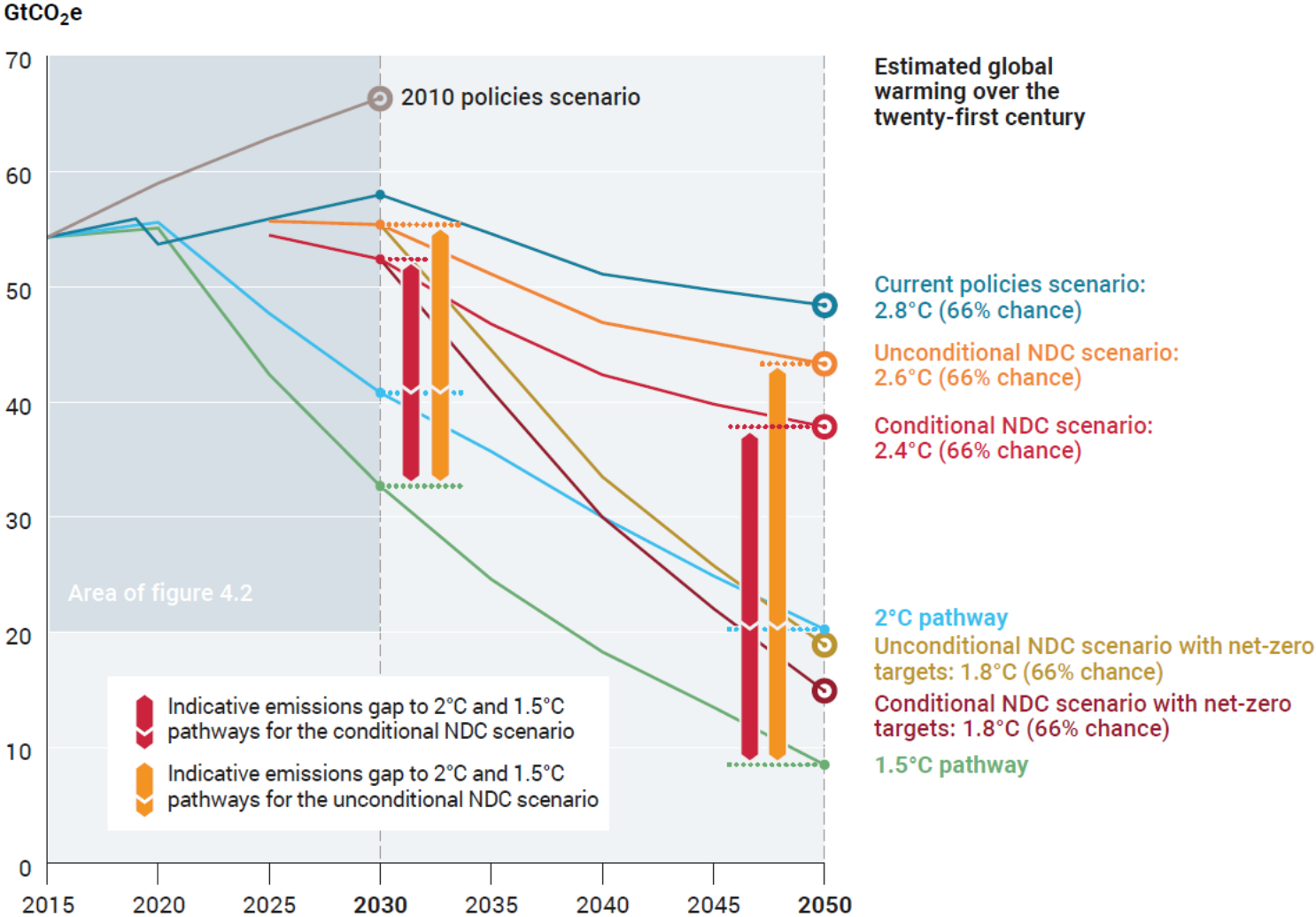


Data source: Ember's Yearly Electricity Data; Ember's European Electricity Review; Energy Institute Statistical Review of World Energy  
OurWorldInData.org/energy | CC BY

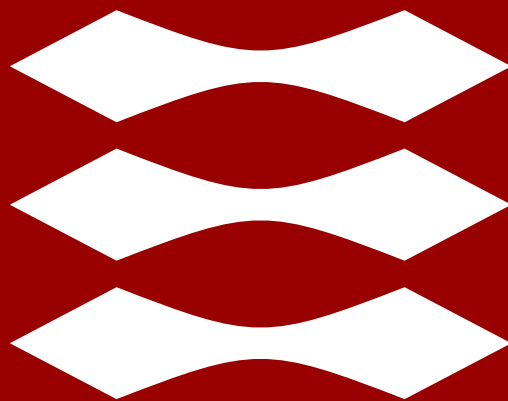
Lifecycle GHG emissions, in g CO<sub>2</sub> eq. per kWh, regional variation, 2020



# The planetary boundary of CO<sub>2</sub> emissions



# DTU



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