Decarbonization in the Industry Sector

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Global Warming of 1.5°C

Limiting warming to 1.5°C above preindustrial levels would require unprecedented rates of transformation in many areas, including in the energy and industrial sectors.

Industry consumes about one third of global final energy and contributes, directly and indirectly, about one third of global GHG emissions

Modelling indicates that industry cannot emit more than 2 $GtCO_2$ in 2050, corresponding > 70% GHG emission reduction compared to 2010 if global temperatures are to remain under 1.5°C.

Global Warming of 1.5°C

The deep emissions reductions required in energy-intensive industry to limit global warming to 1.5°C can be obtained through

- electrification
- hydrogen
- bio-based feedstocks and substitution
- carbon dioxide capture, utilization and storage

Energy efficiency in industry is more economically feasible and an enabler of industrial system transitions but would have to be ***complemented with Greenhouse Gas-neutral processes or Carbon Dioxide Removal (CDR) to make energy-intensive industry consistent with 1.5°C****.*

Industrial System Transitions

Mitigation options are limited by institutional, economic, technical, environmental, socio-cultural and geophysical constraints.

System	Mitigation option	Evidence	Agreement	Ec	Tec	Inst	Soc	Env	Geo	Context
Industrial system transitions	Energy efficiency	Robust	High							Potentials and adoption depends on existing efficiency, energy prices and interest rates, as well as government incentives.
	Bio-based & circularity	Medium	Medium							Faces barriers in terms of pressure on natural resources and biodiversity. Product substitution depends on market organisation and government incentivisation.
	Electrification & hydrogen	Medium	High							Depends on availability of large-scale, cheap, emission-free electricity (electrification, hydrogen) or CO2 storage nearby (hydrogen). Manufacturers' appetite to embrace disruptive innovations
	Industrial CCUS	Robust	High							High concentration of CO2 in exhaust gas improve economic and technical feasibility of CCUS in industry. CO2 storage or reuse possibilities.

Global Warming of 1.5°C

Depending on the industrial sector, mitigation consistent with 1.5ºC would mean, across industries,:

- a reduction of final energy demand by one-third
- an increase of the rate of recycling of materials
- the development of a circular economy in industry
- the substitution of materials in high-carbon products with those made up of renewable materials (e.g. wood instead of steel or cement in the construction sector)
- a range of deep emission reduction options, including use of bio-based feedstocks, low-emission heat sources, electrification of production processes, and/or capture and storage of all CO_2 emissions by 2050

Global Warming of 1.5°C

CO_2 capture in industry : more feasible than CCS in the power sector or from bioenergy sources, although CCS in industry faces similar barriers

Almost all of the current full-scale (>1Mt CO_2 yr^{-1}) CCS projects capture CO_2 from industrial sources

Compared to the power sector, retrofitting CCS on existing industrial plants would leave the production process of materials relatively untouched, though significant investments and modifications still have to be made. Some industries, in particular cement, emit CO_2 as inherent process emissions and can therefore not reduce emissions to zero without CC(U)S

Global Warming of 1.5°C

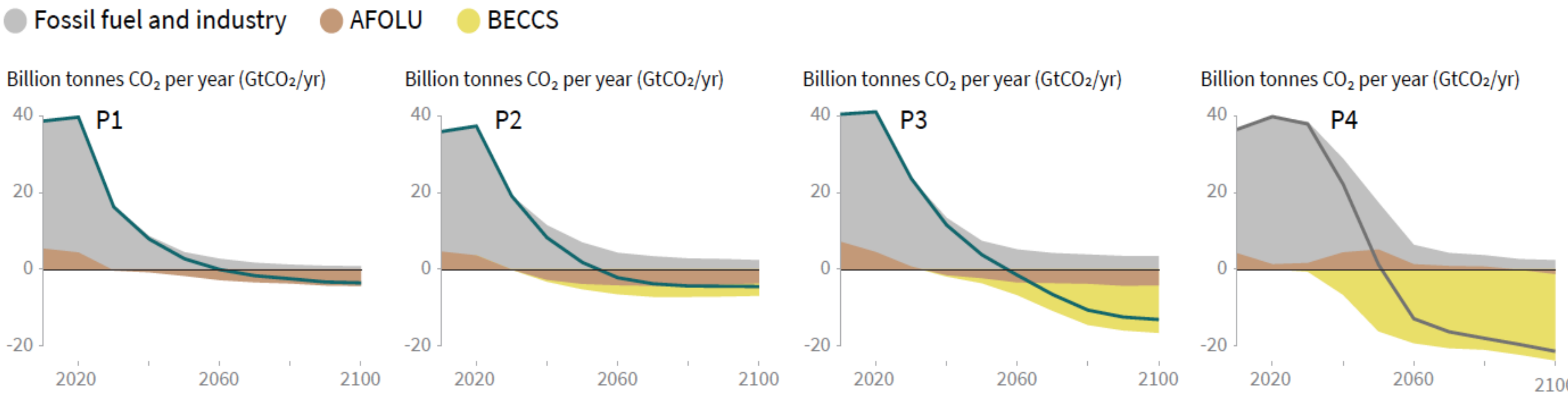
By 2050 :

- renewables (including bioenergy, hydro, wind and solar, with direct-equivalence method) supply a share of 49–67% of primary energy in 1.5°C-consistent pathways

- share from coal decreases to 1–7%, with a large fraction of this coal use combined with Carbon Capture and Storage (CCS)

The overall deployment of CCS varies widely across 1.5°C-consistent pathways with cumulative CO_2 stored through 2050 ranging from zero up to 460 $GtCO_2$ (minimum-maximum range), of which zero up to 190 $GtCO_2$ stored from biomass. … These ranges reflect both uncertainties in technological development and strategic mitigation portfolio choices.

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



P1: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Global indicators	P1	P2	P3	P4	Interquartile range
Pathway classification	No or low overshoot	No or low overshoot	No or low overshoot	High overshoot	No or low overshoot
CO_2 emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-59,-40)
↳ in 2050 (% rel to 2010)	-93	-95	-91	-97	(-104,-91)
Kyoto-GHG emissions in 2030 (% rel to 2010)*	-50	-49	-35	-2	(-55,-38)
↳ in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)
*Final energy demand ** in 2030 (% rel to 2010)*	-15	-5	17	39	(-12, 7)
↳ in 2050 (% rel to 2010)	-32	2	21	44	(-11, 22)
Renewable share in electricity in 2030 (%)	60	58	48	25	(47, 65)
↳ in 2050 (%)	77	81	63	70	(69, 87)
Primary energy from coal in 2030 (% rel to 2010)	-78	-61	-75	-59	(-78, -59)
↳ in 2050 (% rel to 2010)	-97	-77	-73	-97	(-95, -74)
from oil in 2030 (% rel to 2010)	-37	-13	-3	86	(-34,3)
↳ in 2050 (% rel to 2010)	-87	-50	-81	-32	(-78,-31)
from gas in 2030 (% rel to 2010)	-25	-20	33	37	(-26,21)
↳ in 2050 (% rel to 2010)	-74	-53	21	-48	(-56,6)
from nuclear in 2030 (% rel to 2010)	59	83	98	106	(44,102)
↳ in 2050 (% rel to 2010)	150	98	501	468	(91,190)
from biomass in 2030 (% rel to 2010)	-11	0	36	-1	(29,80)
↳ in 2050 (% rel to 2010)	-16	49	121	418	(123,261)
from non-biomass renewables in 2030 (% rel to 2010)	430	470	315	110	(243,438)
↳ in 2050 (% rel to 2010)	832	1327	878	1137	(575,1300)
Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218	(550, 1017)
↳ of which BECCS ($GtCO_2$)	0	151	414	1191	(364, 662)
Land area of bioenergy crops in 2050 (million hectare)	22	93	283	724	(151, 320)
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
in 2050 (% rel to 2010)	-33	-69	-23	2	(-46,-23)
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,4)
in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment.

** Kyoto-gas emissions are based on SAR GWP-100*

Thank you for your attention!

Summary for Policy Makers and Special Report can be accessed at: http://www.ipcc.ch/report/sr15/

Global Warming of 1.5°C

Despite all reaching net CO_2 emissions levels in 2050 that are close to zero, scenarios apply these four contributions in different configurations.

Depending on:

- societal choices and preferences regarding the acceptability and availability of certain technologies
- the timing and stringency of near-term climate policy;
- the ability to limit the demand that drives baseline emissions.

The different configurations have very different implications for sustainable development.