

# Policy and technology trends of NETs (Negative Emission Technologies)

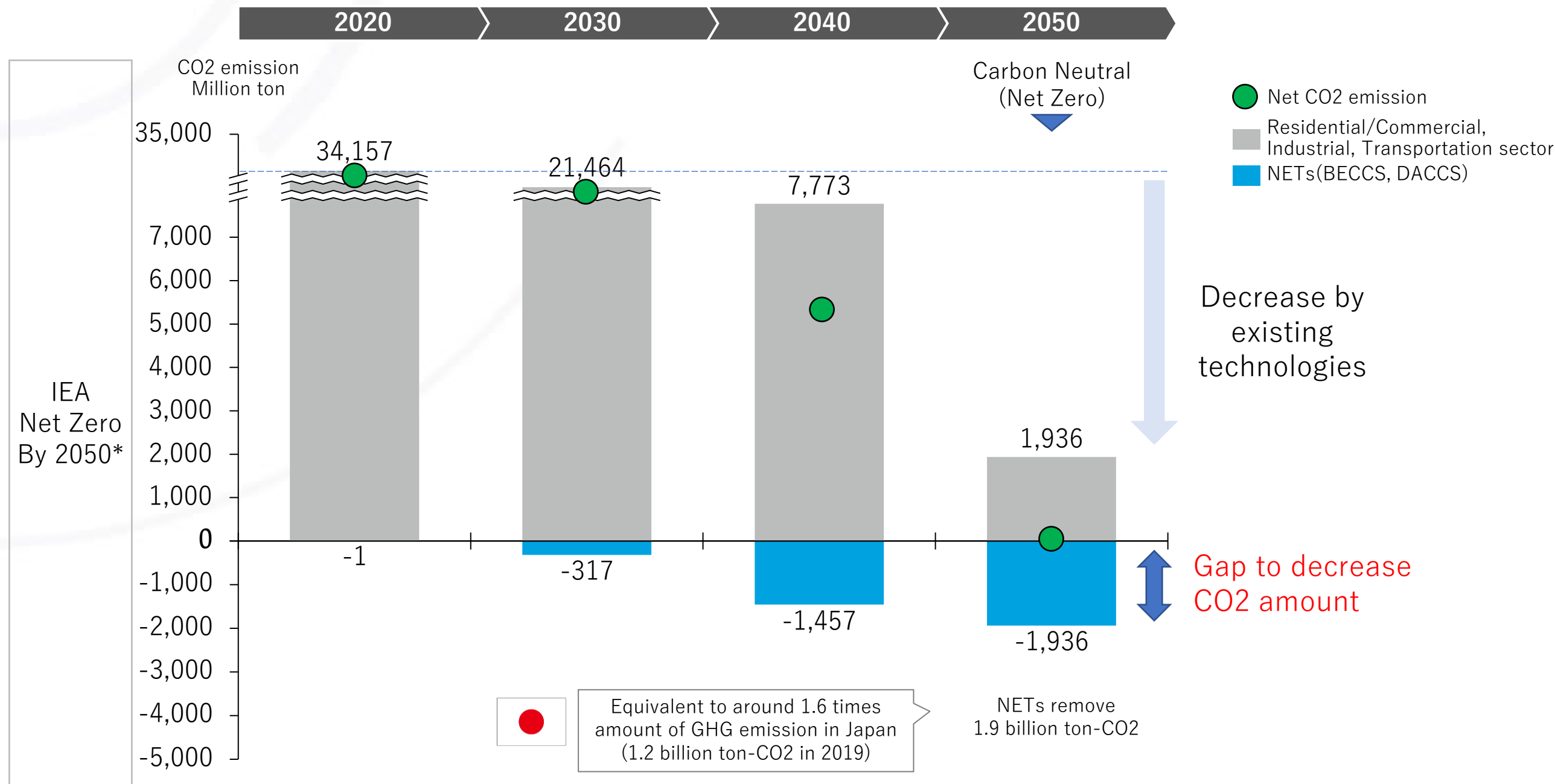
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# NETs(Negative Emission Technologies) 1/3

To achieve carbon neutrality by 2050, it is necessary to introduce NETs removing CO2 that cannot be reduced by existing technologies



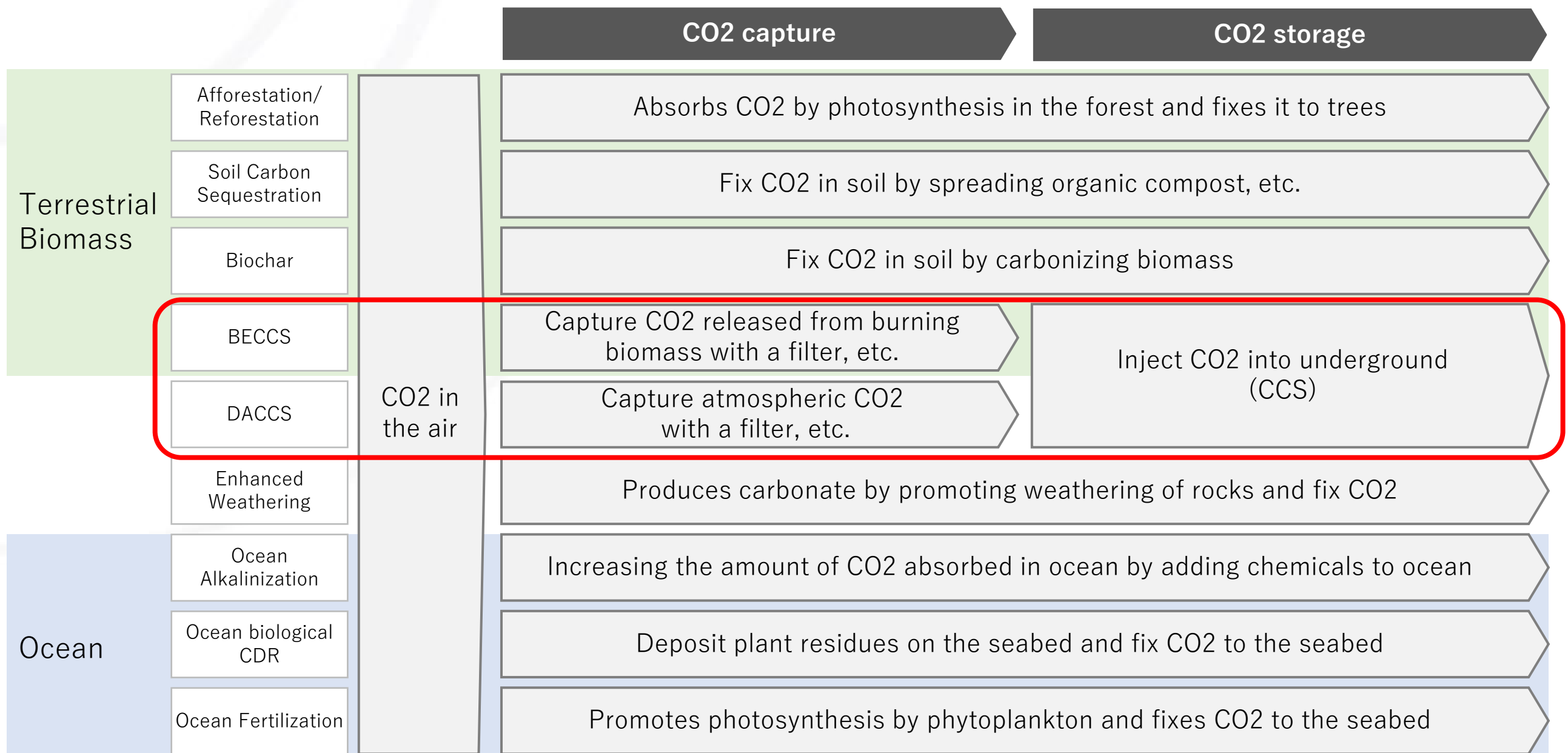
# NETs(Negative Emission Technologies) 2/3

**NETs are technologies that contribute to the removal of CO2 by capturing and storing atmospheric CO2**

Afforestation/ Reforestation	Afforestation is to forest new areas, and reforestation is to forest areas that have decreased due to nature and human activities
Soil Carbon Sequestration	Technology for storing and managing biomass in soil (preventing CO2 leakage due to natural decomposition)
Biochar	Technology that carbonizes biomass and fixes carbon
BECCS	Technology to capture and store CO2 generated by biomass combustion
DACCS	Technology that directly captures and stores CO2 in the atmosphere
Enhanced Weathering	Technology that artificially promotes weathering by crushing and spreading rocks such as basalt. It absorbs CO2 in the process of weathering (carbonic acid chloride)
Ocean Alkalinization	A method of carbon removal that promotes the natural carbon absorption of the ocean by adding alkaline substances to ocean
Ocean biological CDR	A method of permanently isolating carbon contained in plant residues in the ocean (preventing CO2 leakage due to natural decomposition). It includes not only blue carbon but also external input such as biomass
Ocean Fertilization	Technology that promotes biological production and artificially accelerates CO2 absorption and fixation by using nutrient fertilization for the ocean and improved biological varieties. It expects to increase the amount of CO2 absorbed from the atmosphere

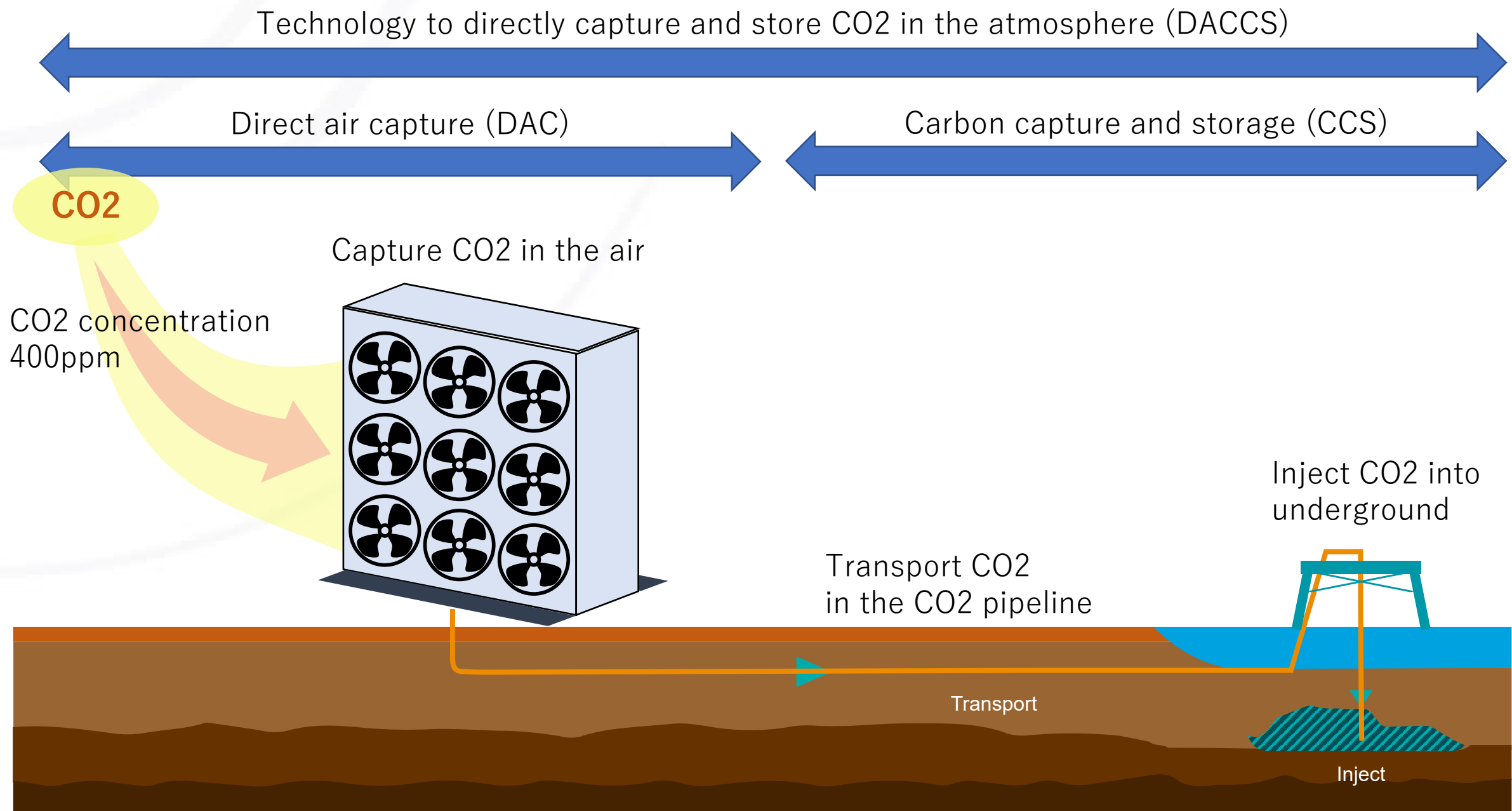
# NETs(Negative Emission Technologies) 3/3

BECCS and DACCS comprise of CO2 capture process and CO2 storage process, while other NETs fix CO2 at one time



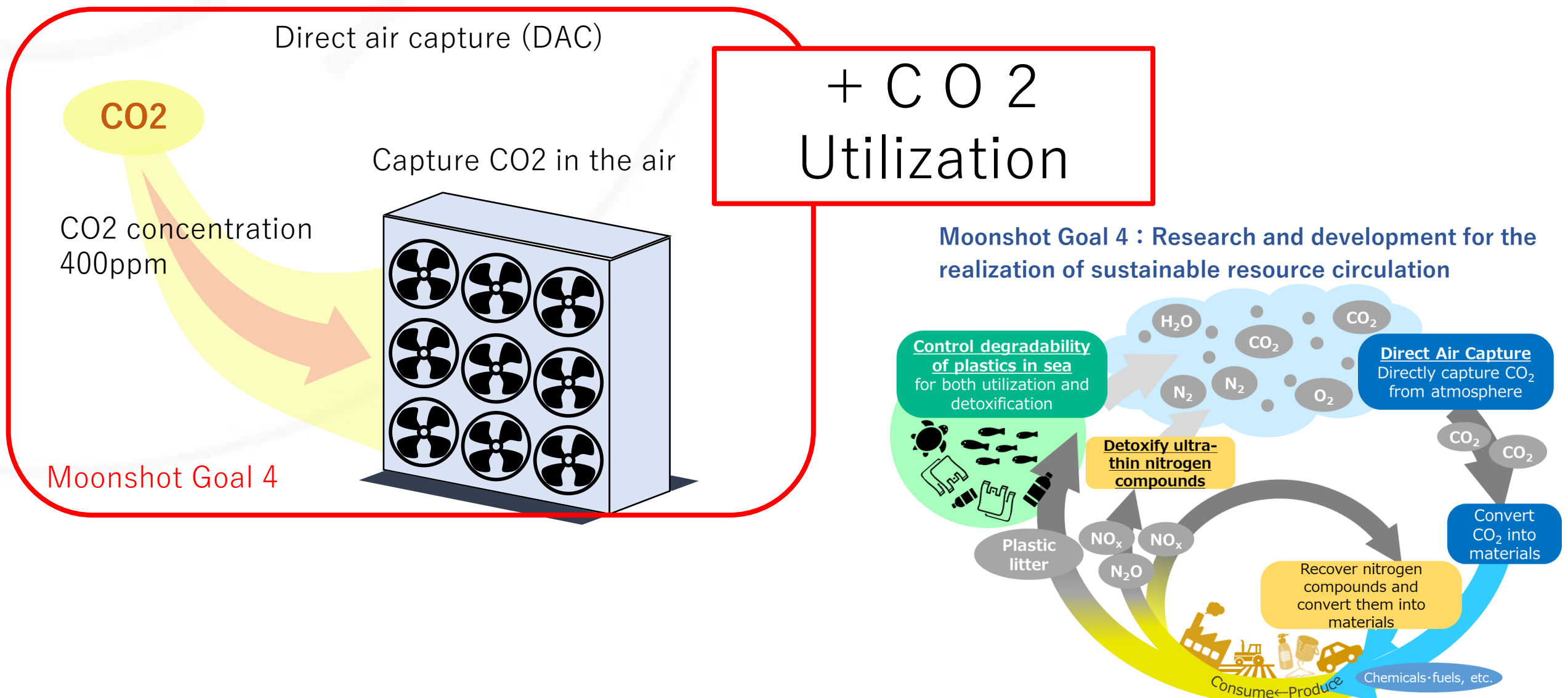
# DACCS(Direct Air Capture with Carbon Storage)

DACCS is a technology that realizes negative emission by capturing and storing CO2 in the air



# DAC project of Moonshot Goal 4

Moonshot Goal 4 program carries out research and development for both DAC and CO2 utilization technologies



Since DAC is an element of NETs, it is important to analyze trends in NETs

# Survey①: Trend in the number of research papers about NETs (2011-2021)



## Research papers of NETs are counted to grasp NETs technology trends

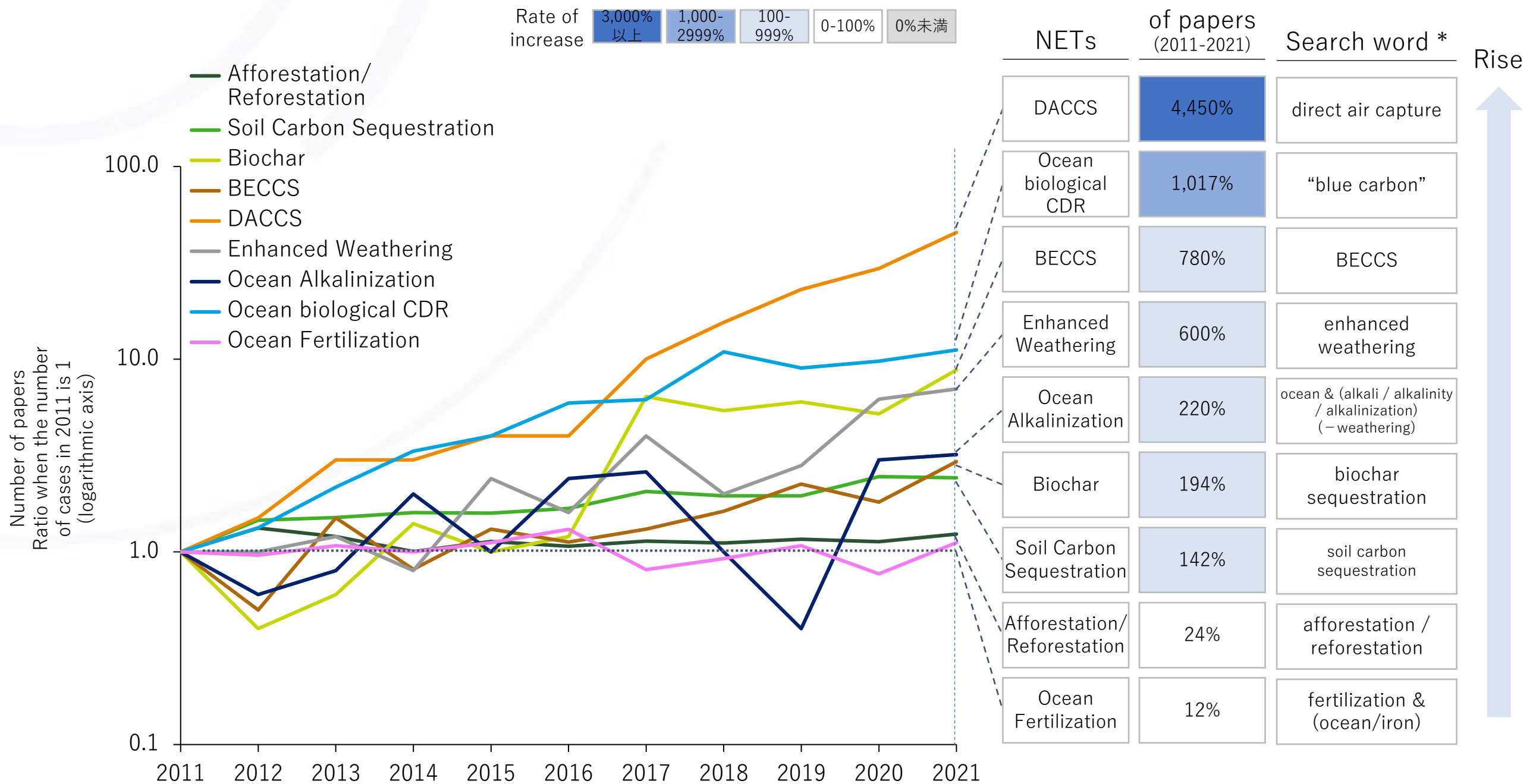
### Search conditions

NETs	Search word *	Reason for selecting search words
Afforestation/ Reforestation	afforestation / reforestation	Commonly used word as a classification of NETs
Soil Carbon Sequestration	soil carbon sequestration	Commonly used word as a classification of NETs
Biochar	biochar sequestration	Narrow down to use for the purpose of CO2 capture
BECCS	BECCS	Commonly used word as a classification of NETs
DACCS	direct air capture	Pay particular attention to DAC for implementing MS Goal 4
Enhanced Weathering	enhanced weathering	Commonly used word as a classification of NETs
Ocean Alkalinization	ocean & (alkali / alkalinity / alkalinization) (- weathering)	Commonly used word as a classification of NETs
Ocean biological CDR	"blue carbon"	Word that generally means the purpose of CO2 capture
Ocean Fertilization	fertilization & (ocean / iron)	Commonly used word as a classification of NETs



# Survey①: Trend in the number of research papers about NETs (2011-2021)

The number of research papers each NETs category in the last 10 years has been increasing


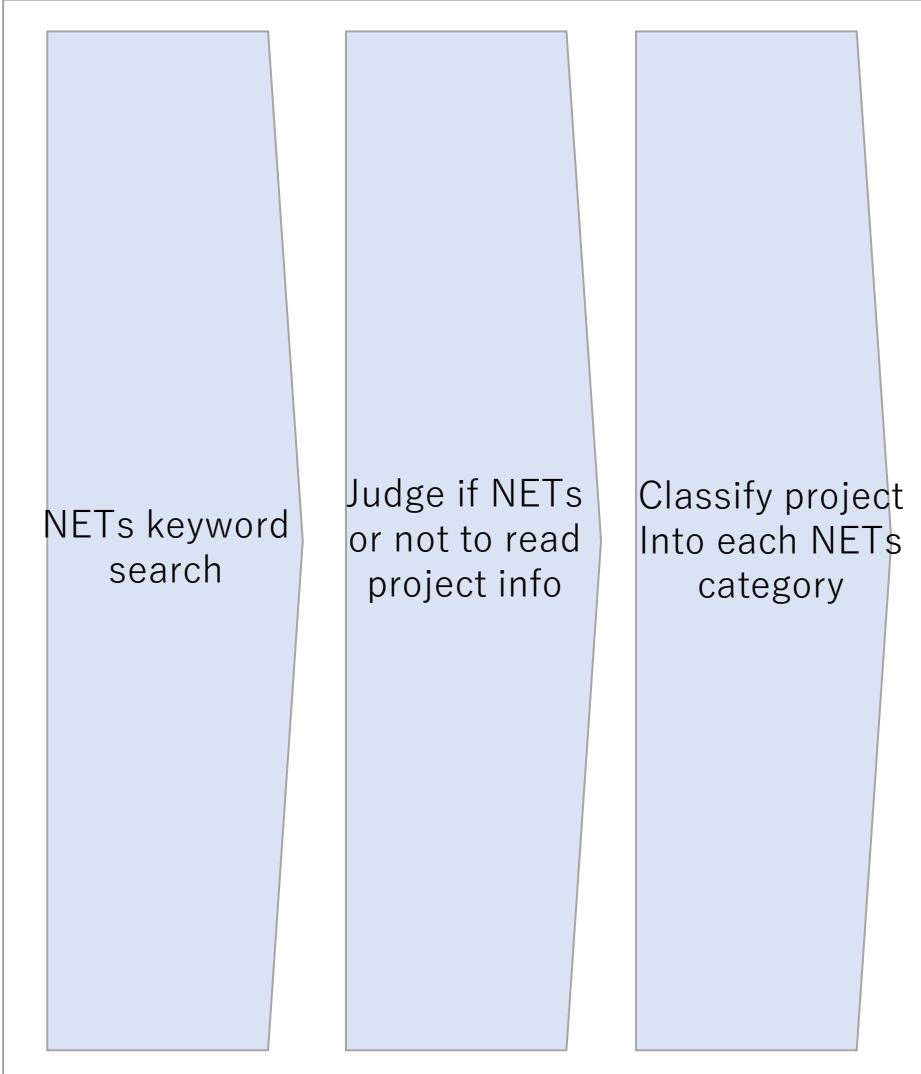






# Survey②: Trend in national funding NETs projects of Japan, Europe and US

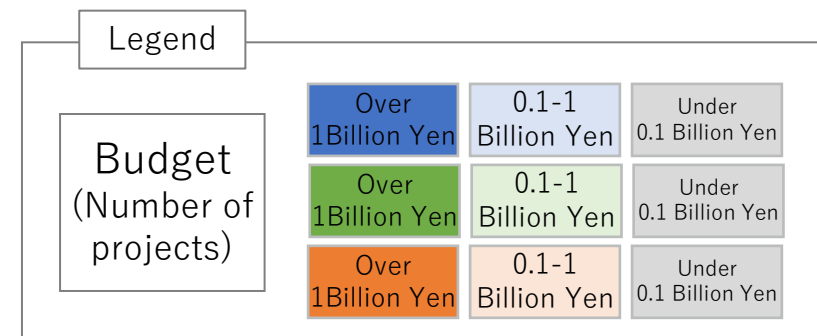
Funding amount of national projects in Japan, Europe and US are calculated to grasp NETs technology trends

## Search conditions

Area	Period	Search data	Budget to be aggregated	Project selection flow
Japan 	National funding projects in progress as of 2018 or adopted after 2018	Innovation dashboard (METI/MOE/MAFF)	FY2020 budget (FY2019 budget if unknown)	
Europe 		Cordis (Horizon2020)	Budget for the project period	
US 		DoE (ARPA-E, /NETL)		

# Survey②: Trend in national funding NETs projects of Japan, Europe and US

## Budget allocation to DACCS is large in Japan, Europe and United States



		NETs classification								
Area	Search data	DACCS Direct Air Carbon Capture and Storage	BECCS Bioenergy with Carbon Capture and Storage	Soil Carbon Sequestration	Biochar	Afforestation & Reforestation	Enhanced Weathering	Ocean Alkalinization	Ocean biological CDR	Ocean Fertilization
National projects	Japan* 	3.07 Billion yen (9)	2.98 Billion yen (9)	0.15 Billion Yen (1)	0.04 Billion Yen (1)	0.23 Billion Yen (3)	0 Billion Yen (0)	0 Billion Yen (0)	0.08 Billion Yen (1)	0 Billion Yen (0)
	Europe 	4.60 Billion Yen (5)	0.80 Billion Yen (3)	1.91 Billion Yen (6)	3.09 Billion Yen (6)	2.48 Billion Yen (12)	0.54 Billion Yen (4)	0 Billion Yen (0)	0.04 Billion Yen (2)	0.02 Billion Yen (1)
	US 	6.11 Billion Yen (42)	1.33 Billion Yen (6)	5.46 Billion Yen (15)	0 Billion Yen (0)	0.06 Billion Yen (1)	0.05 Billion Yen (1)	0.23 Billion Yen (3)	0 Billion Yen (0)	0 Billion Yen (0)

※ Please note that it is not possible to make a comparison between countries because the budget shows a single year for Japan and the total project period for Europe and United States

## LCA evaluation of CO2 balance for the entire process and potential of cost reduction should be discussed

Item	Recognition of DAC current status	Discussion point
CO2 balance of the entire process	<ul style="list-style-type: none"> <li>✓ In some cases, natural gas is used as fuel</li> <li>✓ It is necessary to evaluate CO2 balance of the entire process</li> </ul>	<p>CO2 balance of the entire process should be negative</p> <p>⇒ LCA is valued in Moonshot Goal 4</p>
Cost of CO2 capture and storage	<ul style="list-style-type: none"> <li>✓ CO2 capture and storage cost of one of DAC manufacturers is said to be 600 to 1,200 USD/tonCO2*1 depending on the scale and it is generally considered to be high</li> <li>✓ The cost target for CO2 capture and storage by DAC is 172 USD/tonCO2*2 (median in 2050)</li> </ul>	<p>Necessary to reduce the cost of CO2 capture and storage or utilization</p>

## Competitive strength of DAC technology will be conducted in comparison to other NETs

