

## Climate Finance & Carbonomics 101 for Lawyers

November 19, 2022

#### **Prof. Dr. Ulf Henning Richter** ulf.richter@carbon10bx.io



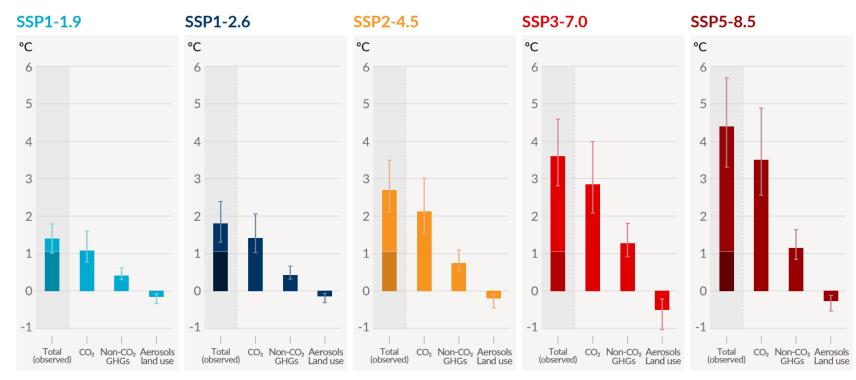
## **Climate Finance**

### **IPCC AR6 on Climate Change**

#### Projected Mean State Change in 21st Century

b) Contribution to global surface temperature increase from different emissions, with a dominant role of CO<sub>2</sub> emissions

Change in global surface temperature in 2081-2100 relative to 1850-1900 (°C)



INTERGOVERNMENTAL PANEL ON Climate Change Climate Change 2021 The Physical Science Basis

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Summary for Policymakers



"Compared to 1850–1900, global surface temperature averaged over 2081–2100 is **very likely** to be higher by 1.3°C to 2.4°C under the low GHG emissions scenario considered (SSP1-2.6), by 2.1°C to 3.5°C in the intermediate scenario (SSP2-4.5), by 2.8°C to 4.6°C under the high GHG emissions scenario (SSP3-7.0), and by 3.3°C to 5.7°C under the very high GHG emissions scenario (SSP5-8.5)."

#### Setting the Scene: The Limits of Growth

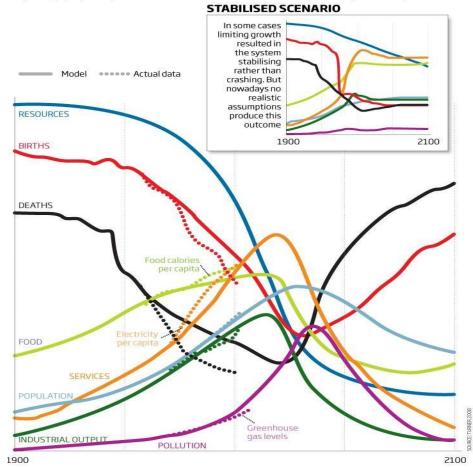


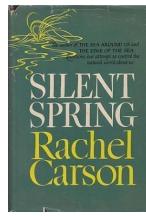
#### Scientist, activists, tree huggers warning of the consequences of uncontrolled growth.

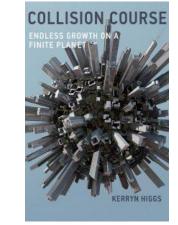
#### ©NewScientist

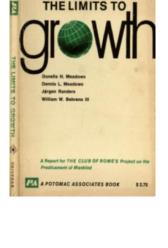
In most runs of the World3 computer model, rapid growth is followed by sharp decline. So far the standard run (main graphic) corresponds well with measurements of real-world equivalents (dotted lines)

Boom and bust

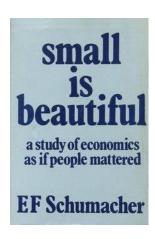


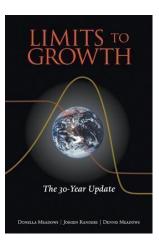






Cradle





Source: https://deepresource.files.wordpress.com/2012/02/limitsscenario.jpg

# COP21, the Paris Agreement and the Art of the Possible vis-à-vis 2100 Warming Predictions



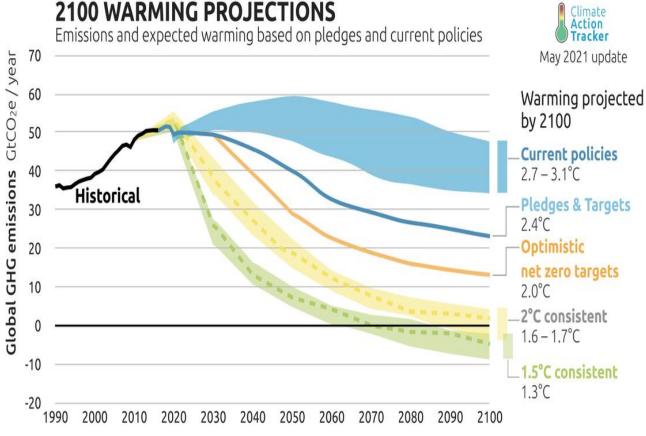
The1.5°C goal requires remaining within a 570 gigaton (Gt) CO2 cumulative 2018–50 carbon budget.



#### **Mitigation & Transparency**

- Peak emissions "as soon as possible" and achieve "net-zero" greenhouse gas emissions by the last half of the century.
- Limit global warming to "well below" 2 degrees, or even to 1.5 degrees Celsius.
- Legally-binding mechanism for countries to "ratchet up ambition" at regular five-year intervals starting in 2020.



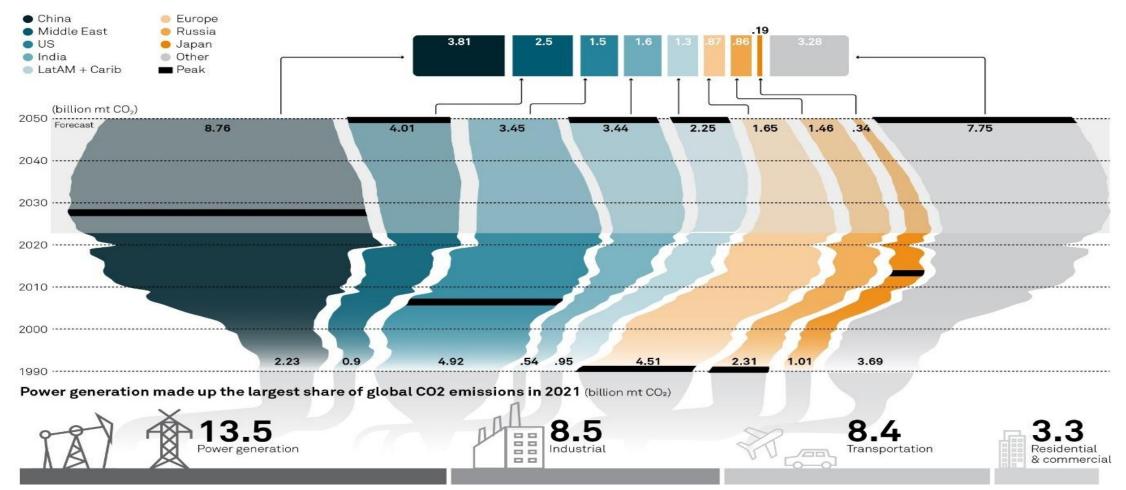


Source: https://climateactiontracker.org/press/global-update-projected-warming-from-paris-pledges-drops-to-two-point-four-degrees/

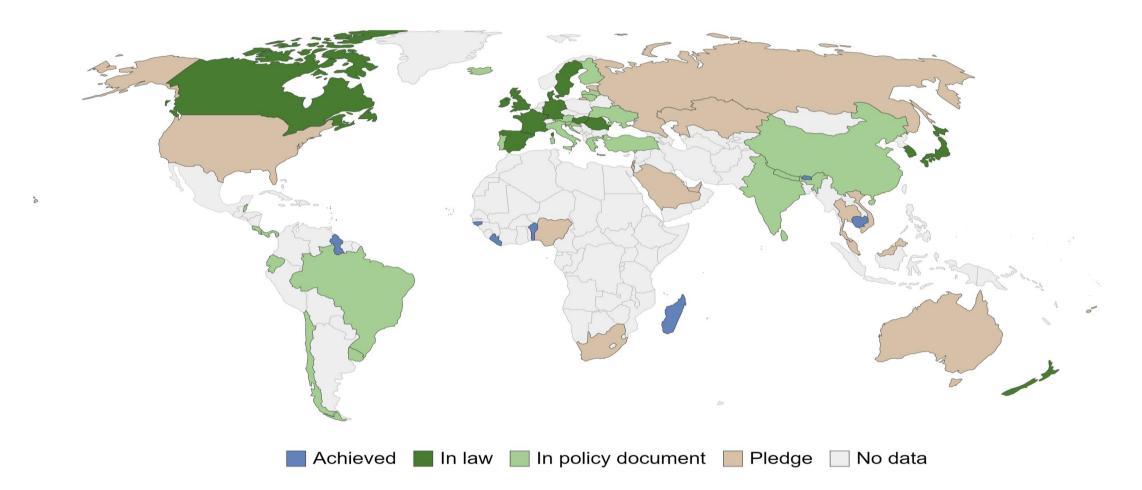
### **TARGET: Peak Emissions**

Regions peaking /having peaked at different points in time with power generation. Industrials and transportation responsible for the lion's share.

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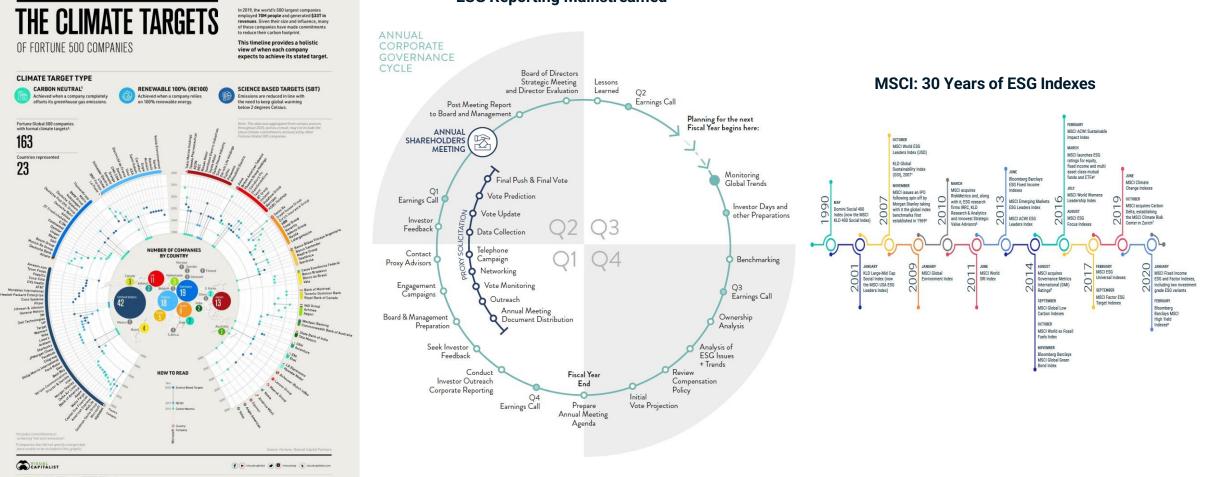
## Status of Net-Zero Carbon Emission Targets (2021)



Source: Net Zero Tracker. Energy and Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero. Last updated: 2nd November 2021.

### Fortune 500 Climate Targets, ESG and Sustainability





#### ESG Reporting Mainstreamed

Source: https://www.visualcapitalist.com/climate-targets-of-fortune-500-companies/ Wilcox & Sodali, 2019

#### **European Green Deal**

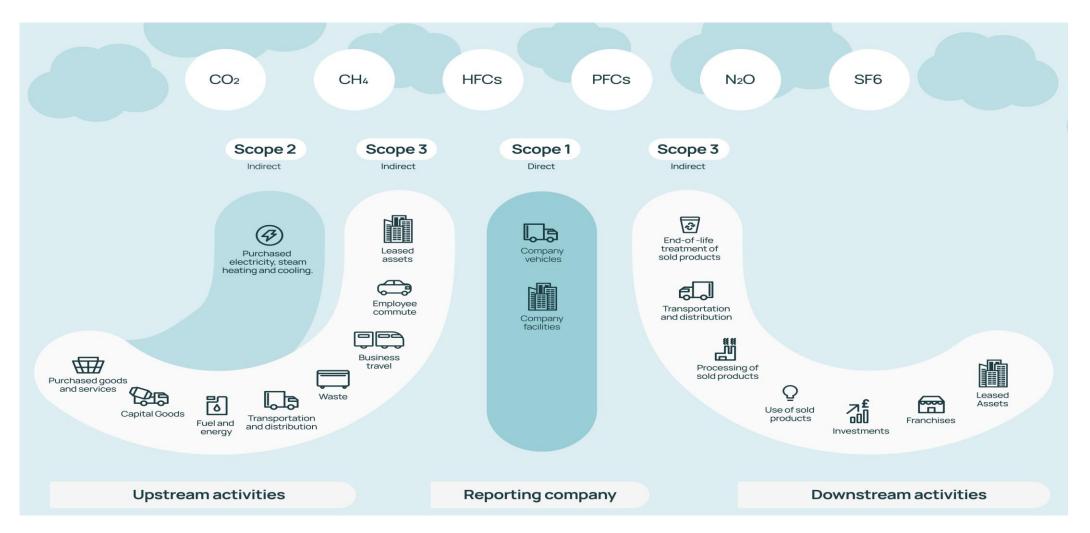


Source: https://euinasean.eu/eu-green-deal/

- The overarching aim of the European Green Deal is to reach net-zero greenhouse gas emissions within the EU and deliver a pollution-free environment by 2050.
- Advances in transport, agriculture systems and ecosystems and biodiversity are all required, as well as efforts to further develop a circular economy that ensures products can be reused and recycled.
- From 2021 to 2027, 35 percent of the EU's research funding will be dedicated to developing climatefriendly technologies.

### Scope 1-3 Emissions: Decarbonizing the Value Chain

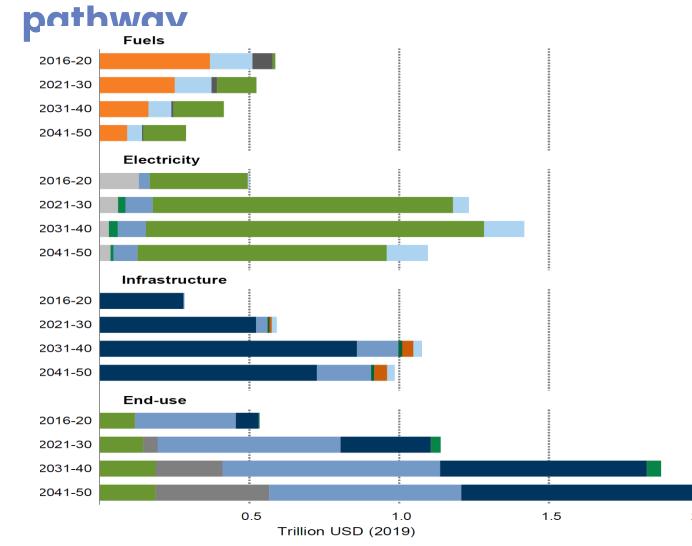


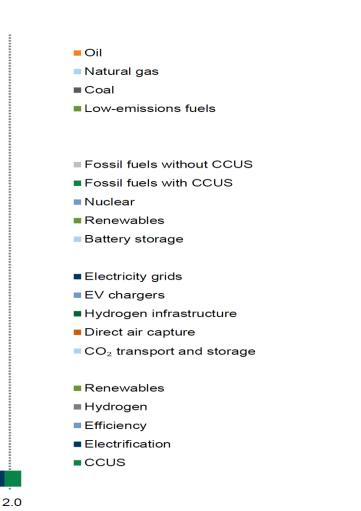


Source: https://www.zevero.earth/post/what-are-scope-1-2-and-3-emissions

#### Global Average Annual Energy Investment Needs by Sector and Technology Based on IEA's Net Zero

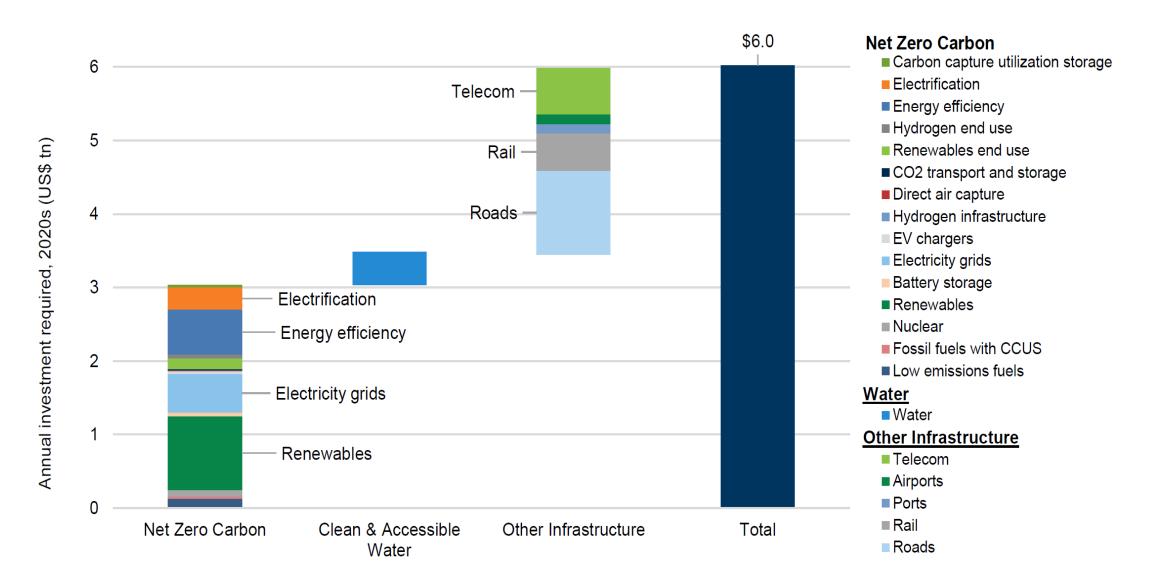




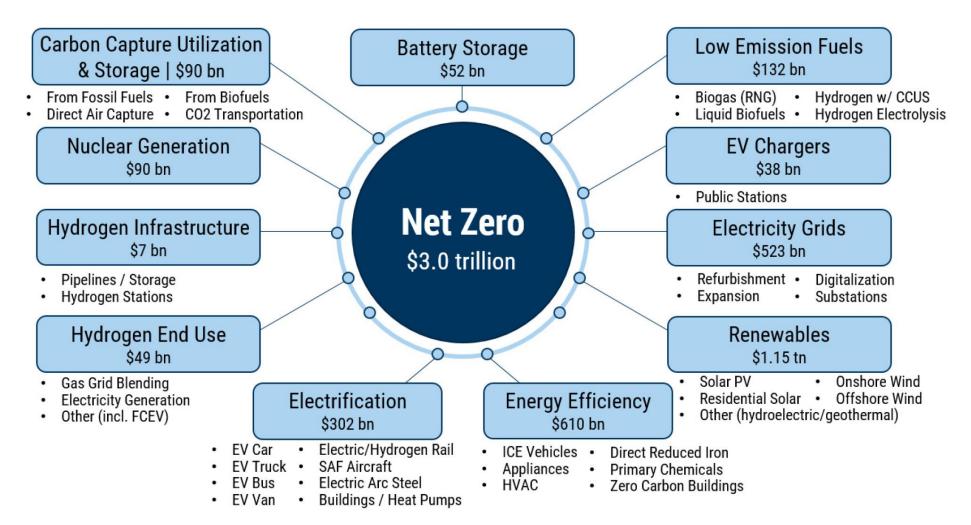


#### Annual Investment Required, 2020-2030





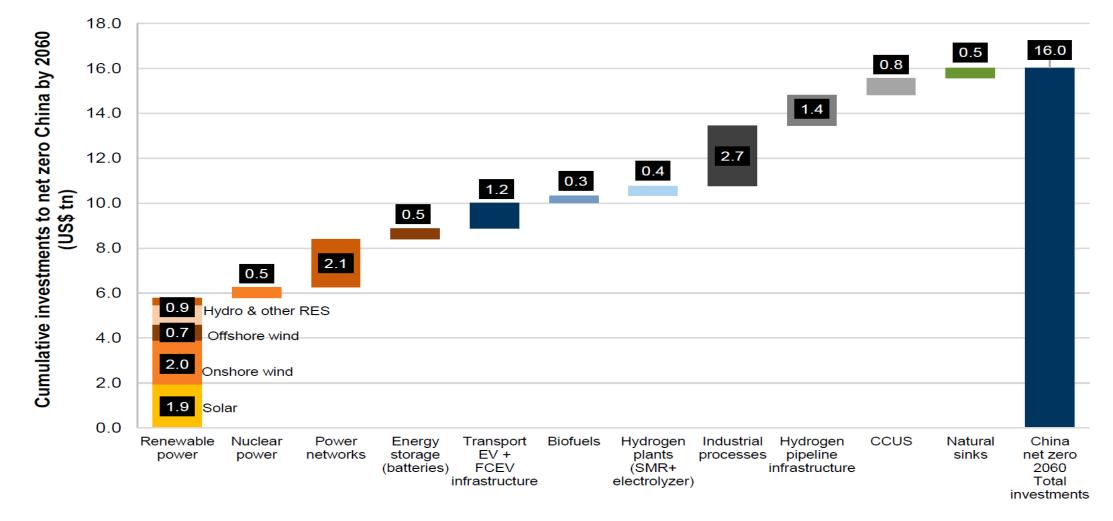
# Green Infrastructure Investments According to Goldman Sachs (2021)



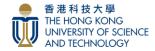


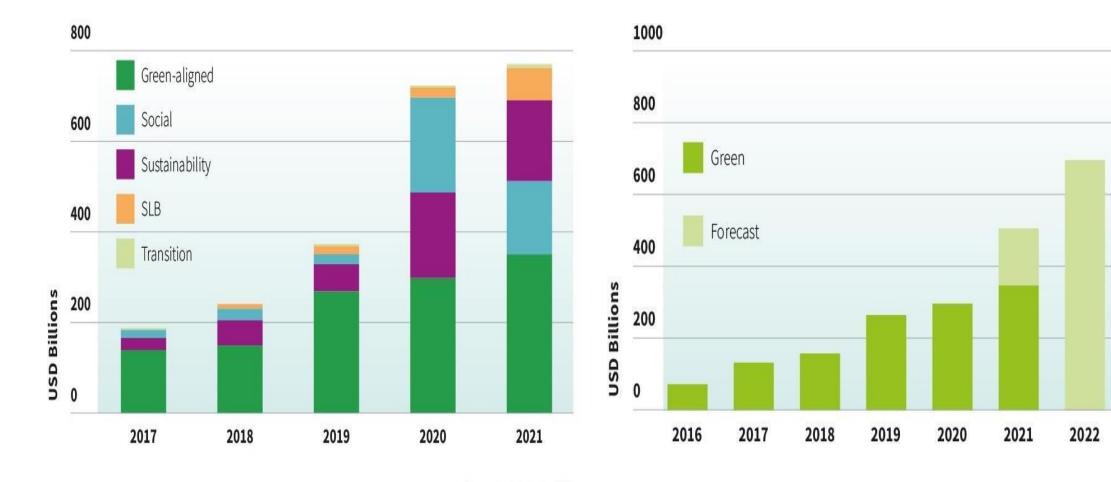
# Cumulative Investment Opportunity Across Sectors for China Net Zero by 2060 (US\$ tn)





#### **2021 Record Year for Green Finance**





© Climate Bonds Initiative, 2021

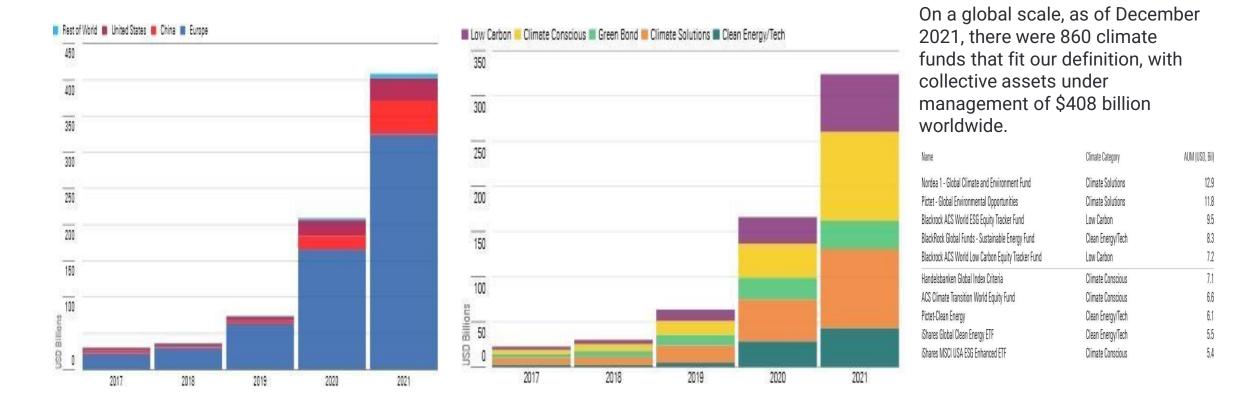
© Climate Bonds Initiative, 2021

2023

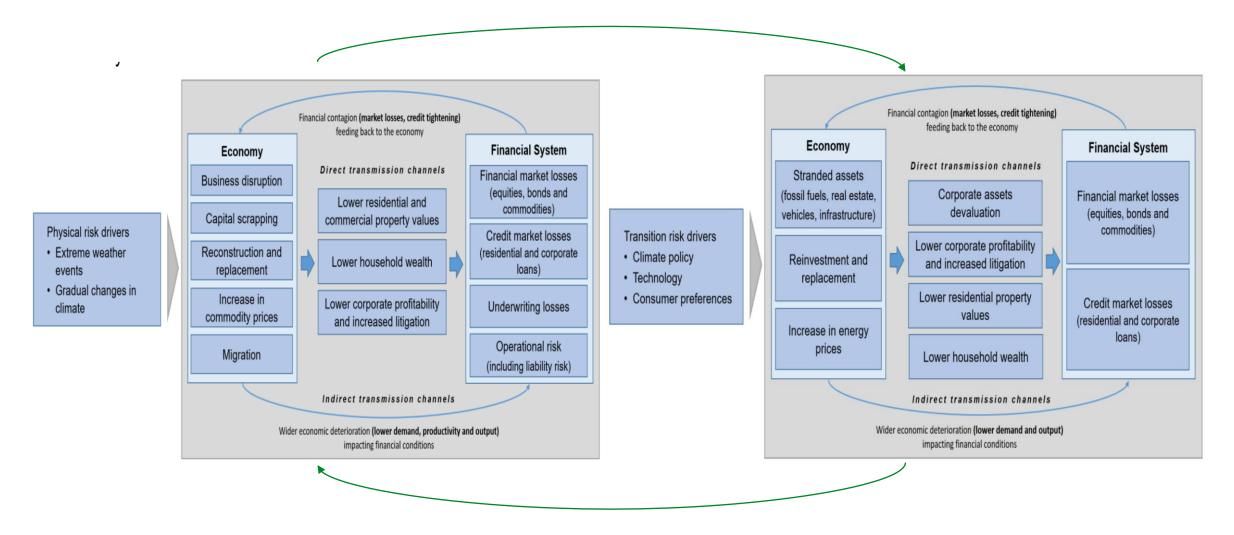
### Climate Investing in 2022 according to Morningstar

香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Europe remains the largest and most diverse climate funds market, followed by China, which for the first time last year overtook the United States as the second-largest climate funds market.



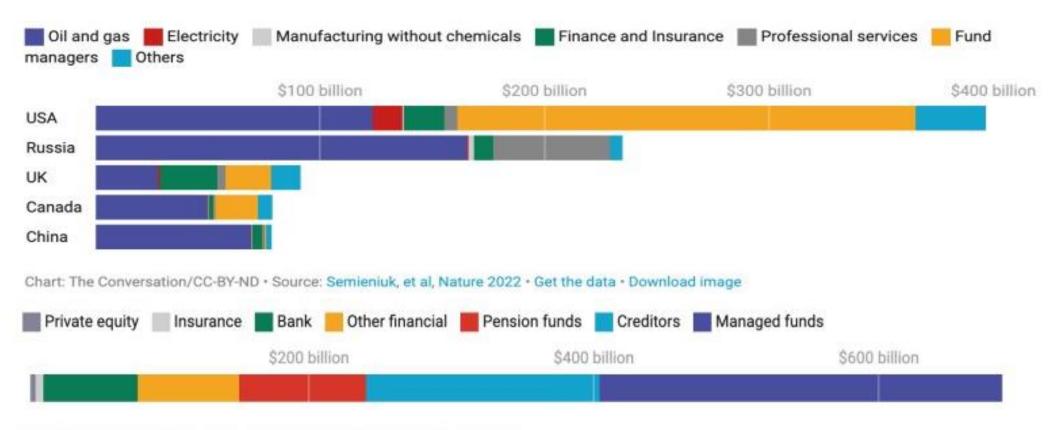
# Transmission of Climate-Related Risks to the Financial System



Source: Network of Central Banks and Supervisors for Greening the Financial System. (May 2020). "Guide for Supervisors Integrating Climate-related and Environmental Risks into Prudential Supervision."



#### **Corporate Owner Stranded Asset Losses: Top 5 Countries**



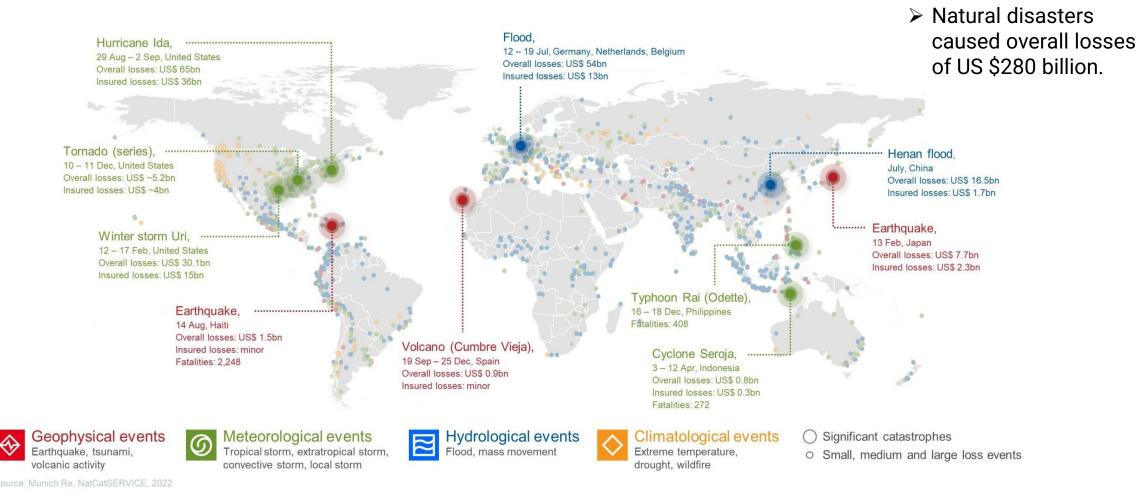
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Cumulative losses involving fossil fuel extraction in billions of U.S. dollars

Chart: The Conversation/CC-BY-ND · Source: Semieniuk, et al, Nature 2022 · Get the data · Download image

Source: https://asiatimes.com/2022/05/big-oils-stranded-assets-threaten-financial-calamity/

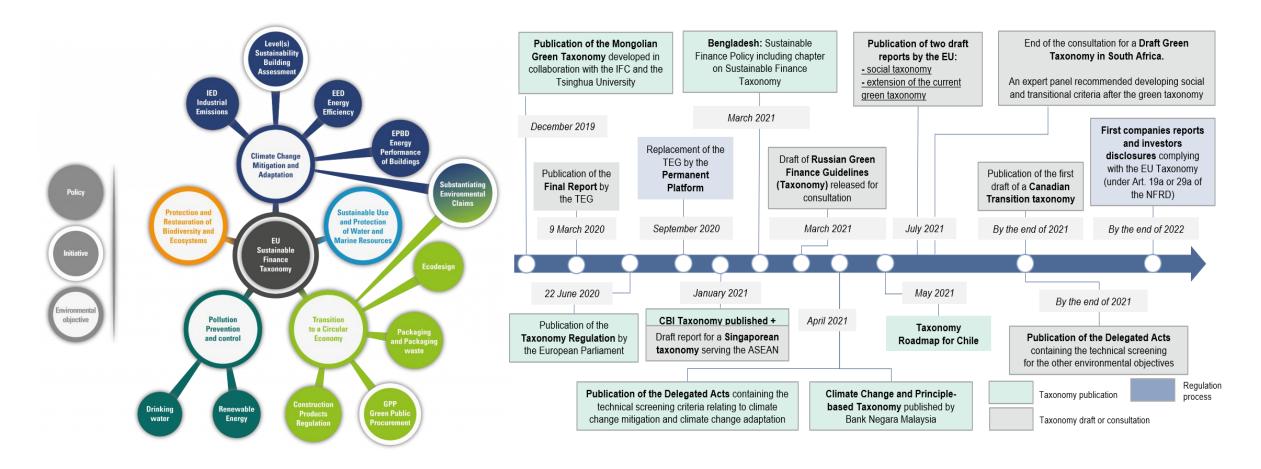
#### Relevant Natural Catastrophe Loss Events Worldwide 2021



Source: https://www.insurancejournal.com/app/uploads/2022/01/munich-re-top-natural-catastrophe-loss-events-2021-scaled.jpg



#### The Global Race on Sustainable Finance Taxonomies



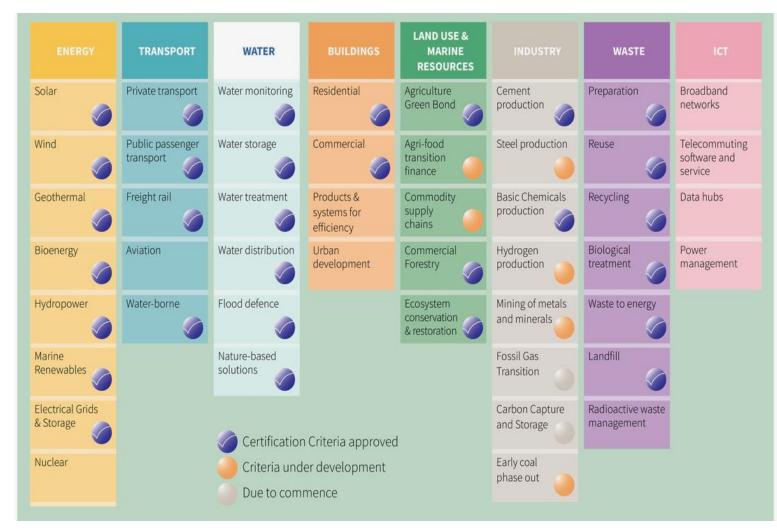
Source: https://www.construction-products.eu/publications/sustainable-finance-taxonomy/

Source: https://gsh.cib.natixis.com/our-center-of-expertise/articles/sustainable-taxonomy-development-worldwide-a-standard-setting-race-between-competing-jurisdictions

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## **Climate Bond Taxonomy**





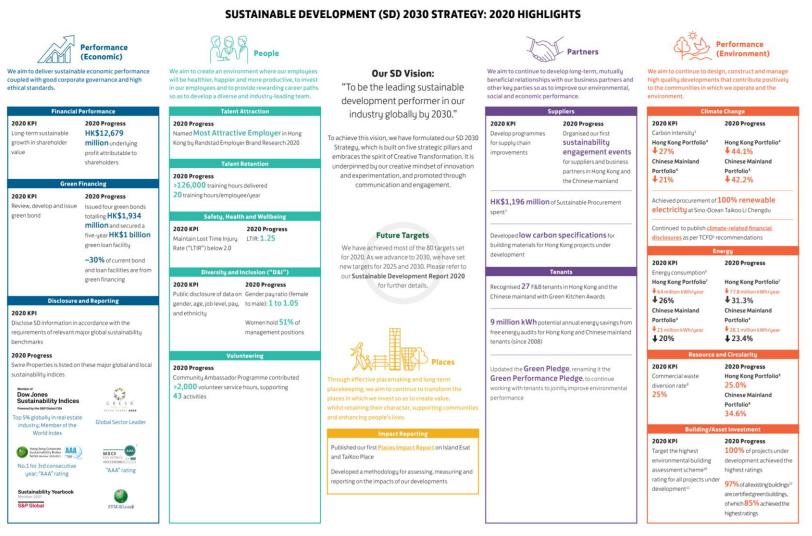
Source: https://www.climatebonds.net/standard/taxonomy

- The Climate Bonds Taxonomy is a guide to climate aligned assets and projects. It is a tool for issuers, investors, governments and municipalities to help them understand what the key investments are that will deliver a low carbon economy.
- The Taxonomy is grounded in the latest climate science and has been developed through an extensive multistakeholder approach, leveraging the work of our Technical and Industry Working Groups.
- The Taxonomy aims to encourage and be an important resource for common green definitions across global markets, in a way that supports the growth of a cohesive thematic bond market that delivers a low carbon economy.

### **Task Force on Climate-Related Financial Disclosures**

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- Corporate ESG disclosure policies refer to the regulatory measures defining issuers' obligations for recurrent publication of current and forward-looking data and analysis on key ESG issues.
- They aim to provide investors with information on corporate performance on ESG issues that will be used when making investment decisions and leading engagement with investee companies – activities regarded by investors and policy makers as part of their fiduciary duty.
- But without mandatory and standardised corporate ESG disclosure regulations, the resulting information is incomplete and not readily comparable, creating a major barrier for sustainable investment.



Source: https://www.hkex.com.hk/Listing/Sustainability/ESG-Academy/ESG-in-Practice/Climate-Change?sc\_lang=en

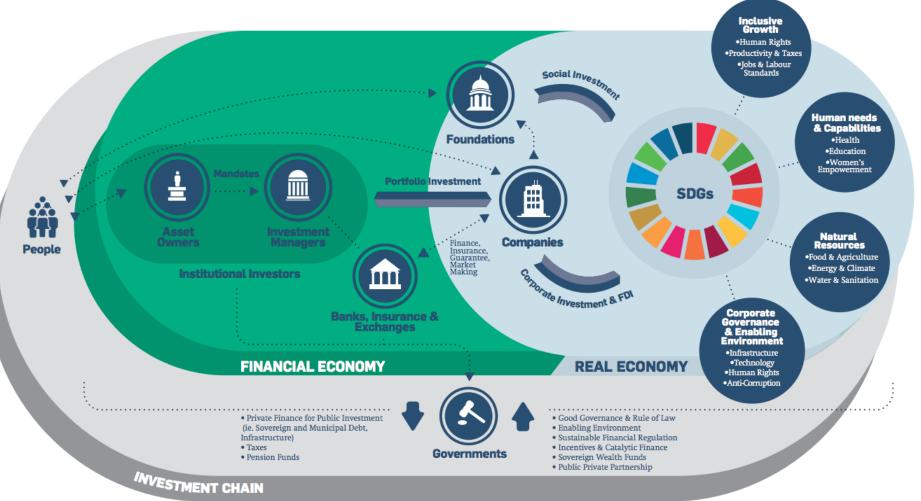
#### **UN Sustainable Development Goals**





Source: https://www.un.org/en/sustainable-development-goals

## Sustainable Development Goal (SDG) Bonds



 Natural
 > SDGs are led by the Principles for Responsible Investment (PRI) and the United

Principles for Responsible Investment (PRI) and the United Nations Environment Programme Finance Initiative (UNEP FI), and designed to support the Sustainable Development Goals (SDGs).

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 A diverse portfolio of SDG Bonds.

including sovereign,

municipal, corporate

and project bonds

nd emerging

markets.

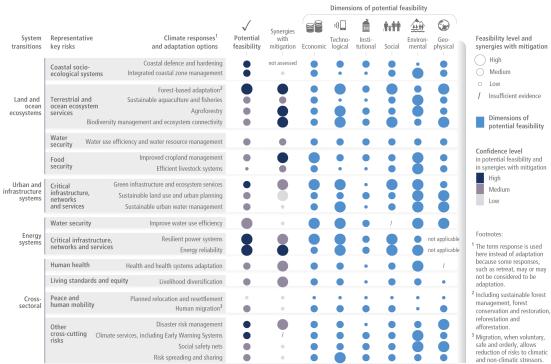
across developed a

Source: https://www.unglobalcompact.org/take-action/action-platforms/financial-innovation

#### **Climate Response & SDGs**



#### Diverse feasible climate responses and adaptation options exist to respond to Representative Key Risks of climate change, with varying synergies with mitigation Multidimensional feasibility and synergies with mitigation of climate responses and adaptation options relevant in the near-term, at global scale and up to 1.5°C of global warming







Footnotes: <sup>1</sup> The term response is used here instead of adaptation because some responses, such as retreat, may or may not be considered to be adaptation. <sup>2</sup> Induding sustainable forest management, forest conservation and restoration, reforestation and afforestation. <sup>3</sup> Migration, when voluntary, safe and orderly, allows reduction of risks to climatic and non-climatic stressors. <sup>4</sup> The Sustainable Development Goals (SOGs) are integrated and indivisible, and efforts to achieve any goal in isolation may trigger spregregies or trade-offs with other SOGs. <sup>5</sup> Relevant in the near-term, at global scale and up to 1.5°C of global warming.

Source: IPCC 2022



## **Carbon Markets 101**

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#### Carbon Credit Markets as of 16.11.2022

CarbonCredits.com Live Carbon Prices	Last	Change	YTD
Compliance Markets			
European Union	€73.51	-4.72 %	-8.36 %
California	\$28.99	-	-9.46 %
Australia (AUD)	\$32.00	-	-37.25 %
New Zealand (NZD)	\$88.25	+0.09 %	+28.93 %
South Korea	\$14.30	-0.78 %	-41.90 %
China	\$8.14	-0.52 %	+6.42 %
Voluntary Markets			
Aviation Industry Offset	\$3.10	-1.27 %	-61.25 %
Nature Based Offset	\$5.30	-	-62.36 %
Tech Based Offset	\$1.50	-	-70.47 %

#### **Type of Market Places**

- 1. Compliance Markets /Emission Trading Schemes (ETS)
  - $\circ$  "Cap-and-trade" regulations at regional, national and state levels.
  - Carbon allowances are issued by regional, national and international governmental organizations and
  - $\,\circ\,$  Traded in a secondary market.
  - $\,\circ\,$  Designed to assist climate policy in promoting emission reductions.

#### 2. Voluntary Markets

- Private entities buy carbon credits to offset some or all of their own carbon emissions.
- Carbon credits are issued in relation to climate change mitigation projects, either through carbon removals and through emissions reductions
- Largely unregulated at present.

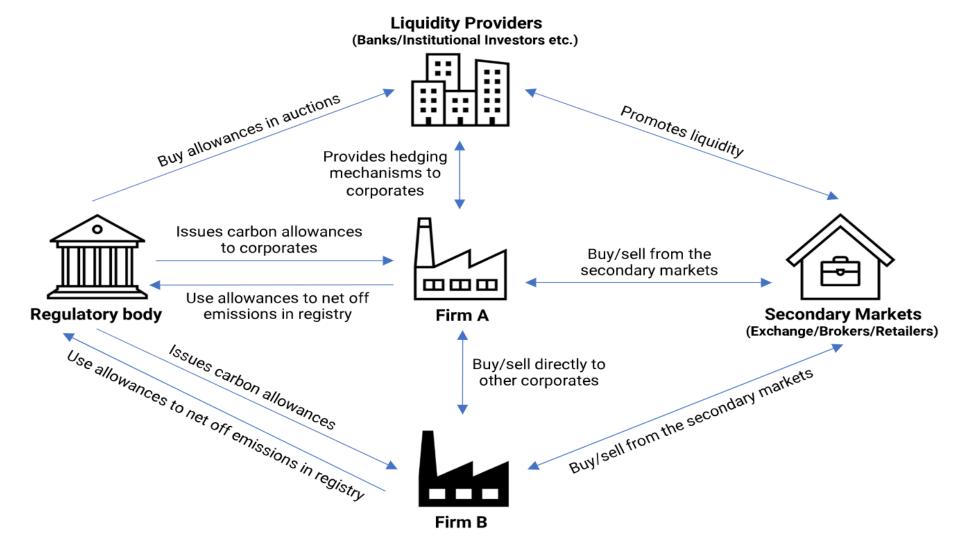
#### 3. Compliance Offset Markets

- Fall under Article 6.4 of the Paris Agreement with the United Nations acting as the supervisory authority.
- Clean Development Mechanism under the Kyoto Agreement would previously have fallen into this category.
- UNFCCC REDD+ projects

## **Compliance Carbon Markets' Trading Flow**



Tesla's carbon credit revenues totaled USD \$354 million in Q1 2021.

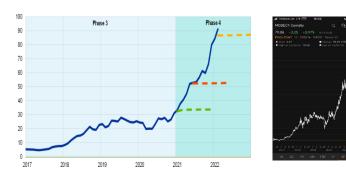


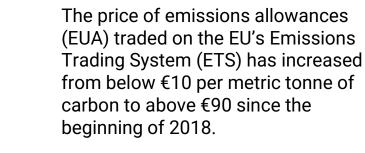
Source: https://www.msci.com/www/blog-posts/introducing-the-carbon-market/03227158119

## Global Compliance Markets to grow to USD \$5-6 **Trillion by 2030**

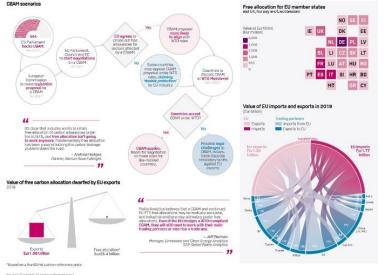
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Value of 2021 Global Carbon Markets: USD \$851 billion with EU ETS: 90% of global value with carbon credits best performing asset class in 2021. **CNC vs CEC prices** 





Source: https://www.ecb.europa.eu/pub/economic-bulletin/focus/2022/html/ecb.ebbox202203\_06~ca1e9ea13e.en.htm

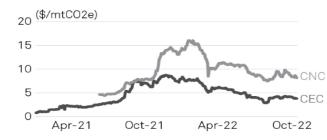


urce: Eurostat, Europeen Cor

The European Parliament on March 10, 2021,  $\geq$ backed a Carbon Adjustment Border Mechanism (CBAM) which would place a charge on the carbon content of emissionintensive goods imported into the EU from 2023 on.

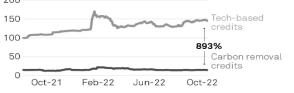
- The CBAM aims to level the international playing field for European raw material producers and is intended to replace free carbon allowances for those industries under the EU Emission Trading System.
- However, industrial companies want to maintain free allowances, setting the stage for claims of "double protection" and potential legal challenges from Europe's trading partners under the WTO.

Nature-based credit (CNC) prices rose by 199% in 2021, and have traded at a significant premium to CORSIA-eligible credits (CEC).



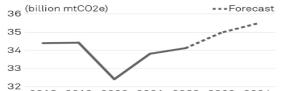
Tech-based vs removal credits Tech-based carbon capture credits trade at 893% premium to carbon removal credits in October 2022, reflecting higher project costs.

200 <sup>(\$/mtCO2e)</sup>



#### World CO2 emissions

Global CO2 emissions from combustion are forecast to exceed pre-covid levels by 2023, according to S&P Global Commodity Insights' Aug. 2022 Reference Case.

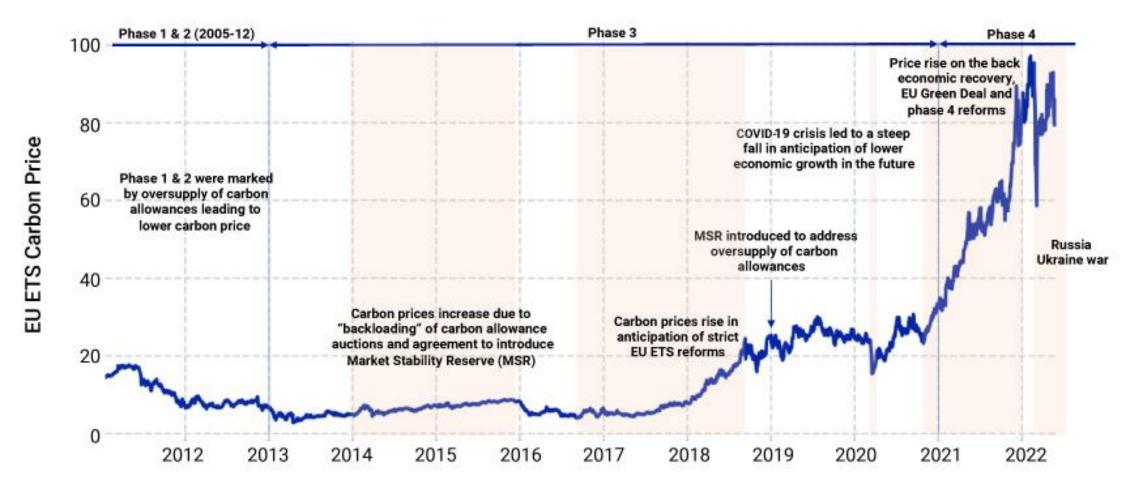


2018 2019 2020 2021 2022 2023 2024

Source: https://www.spglobal.com/commodityinsights/ PlattsContent/\_assets/\_images/latest-news/20210408\_cbam.jpg

## **Timeline of EU ETC Carbon Price**





Source: Sample period: Jan. 18, 2011, to May 31, 2022. EU ETS carbon price is based on 12-month constant-maturity futures prices.

Source: https://www.msci.com/www/blog-posts/introducing-the-carbon-market/03227158119

## **China's National ETS : Theory and Practice**

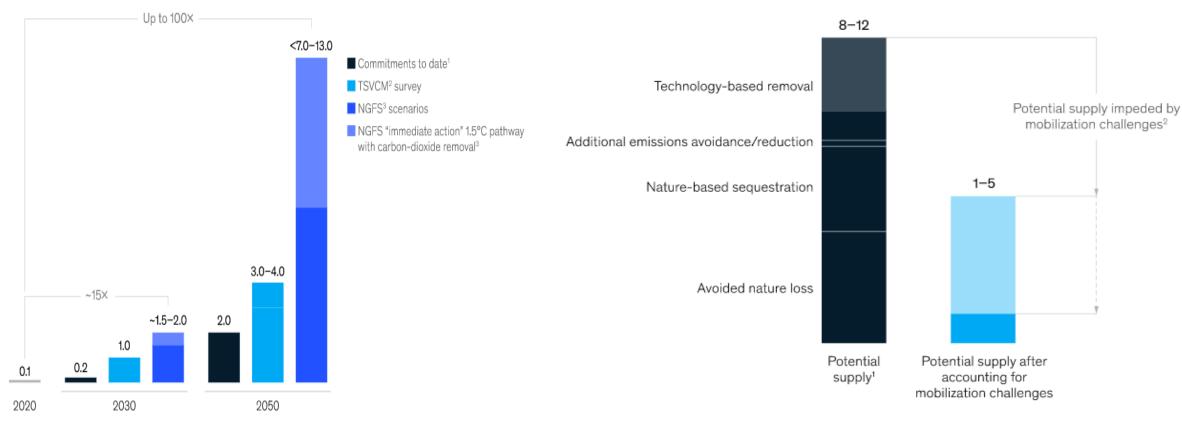


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Source: Zhang, et al. (2022)

# Voluntary Demand Scenario for Carbon Credits 2050 (GtCO2)

Carbon allowance prices to reach a minimum of **\$200 per ton of CO2** to match the Paris Agreements with Voluntary offsetting 15x by 2030. Voluntary offsetting will grow by 100x by 2050.



2050 Demand Scenario

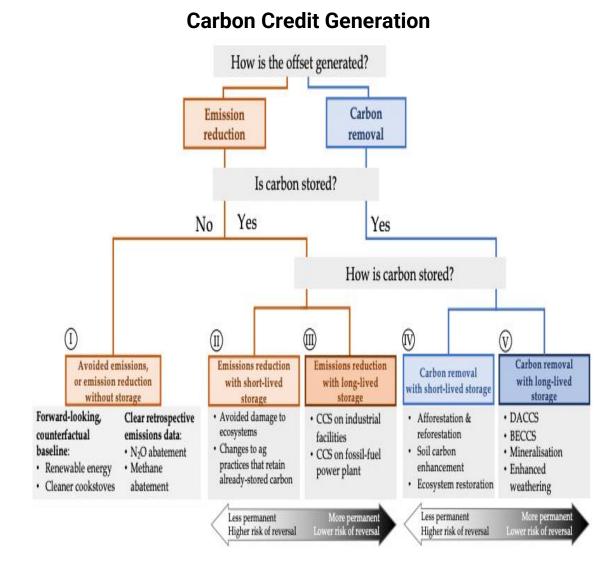


Source: https://www.mckinsey.com/business-functions/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge

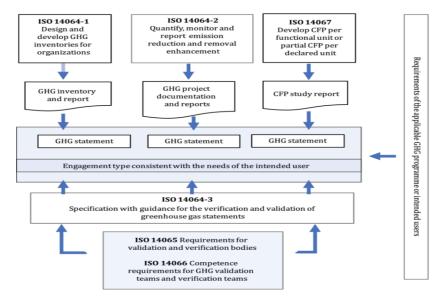


### **Generation, Retirement & Types of Carbon Credits**

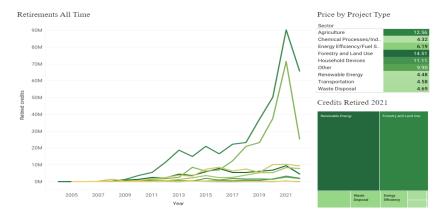




#### ISO 14060 Family of GHG Standards



#### Source: https://www.iso.org/obp/ui#iso:std:iso:14064:-2:ed-2:v1:en



## **Value Chain Partners**

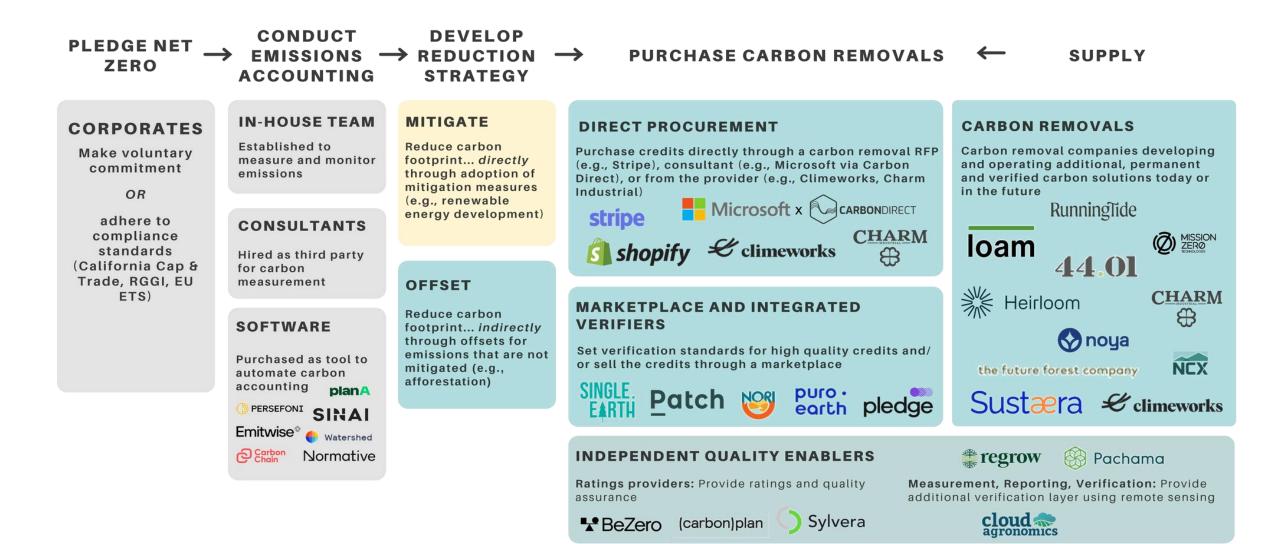
Cooperation / strategic partnerships with experienced Carbon Credit originators, Service Providers and Financial Sector Operators and Regulators.





#### **The Evolving New Voluntary Carbon Market**





#### **Voluntary Carbon Credits Market Places Expanding Fast**



Carbon markets have attracted a number of heavyweights with Hong Kong lagging behind.





Blackstone announced a US\$400 Million investment into Xpansiv on 06 July 2022 (U.S.).

Adam Neumann raised US\$70 million to sell tokenized carbon credits on the blockchain (U.S.).

AirCarbon Exchange (ACX) received substantial investment by Deutsche Börse AG (DB1), amount not disclosed (Singapore).

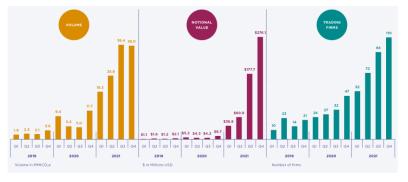
Ripple confirmed that it is one of the founding partners of Thallo, a Web 3 carbon credit marketplace based on the XRP Ledger on 04 October 2022 (U.S.).

Climate Impact X (CIX) has a paid-up capital of \$42.4 million USD as of 11 August 2022. Investors include, Temasek, SGX, DBS and Standard Chartered (Singapore).

HKEX launched Core Climate on October 28, 2022, an international carbon marketplace designed to allow for the trading of voluntary carbon credits and instruments.

The London Stock Exchange is launching our Voluntary Carbon Market to facilitate financing at scale into projects that mitigate climate change.

#### **Xpansiv CBL Voluntary Carbon Market Metrics**



Source: FMSB (2021)

2021 Xpansiv Carbon Volume Rises
 288% Driven by Surge of Corporate
 Net-Zero and ESG Demand

### London Stock Exchange's Voluntary Carbon Market



CONFIRMATION AND/OF

Must be disclosed in the Admission

Document or Designation Circular.

Document or Designation Circular Main Market

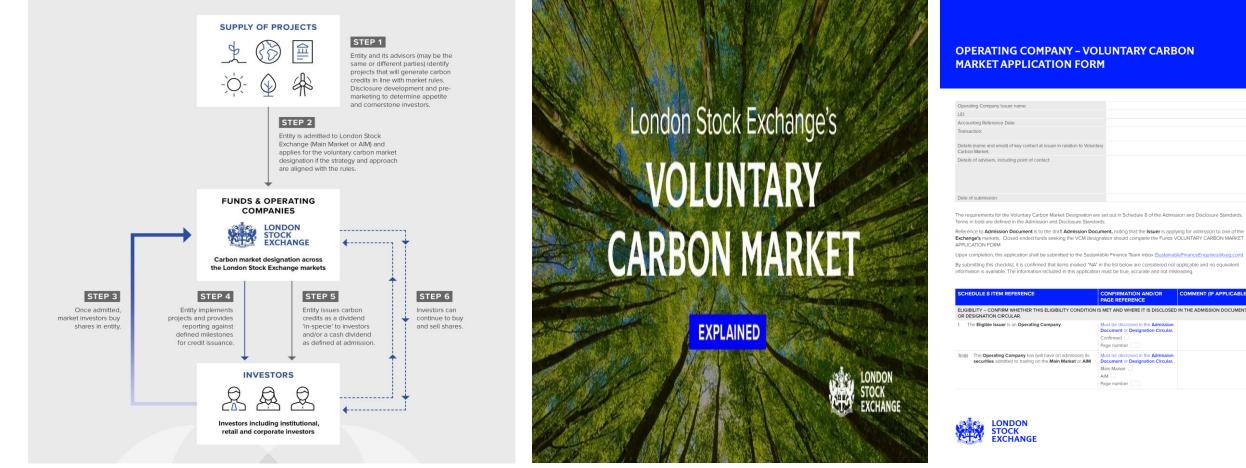
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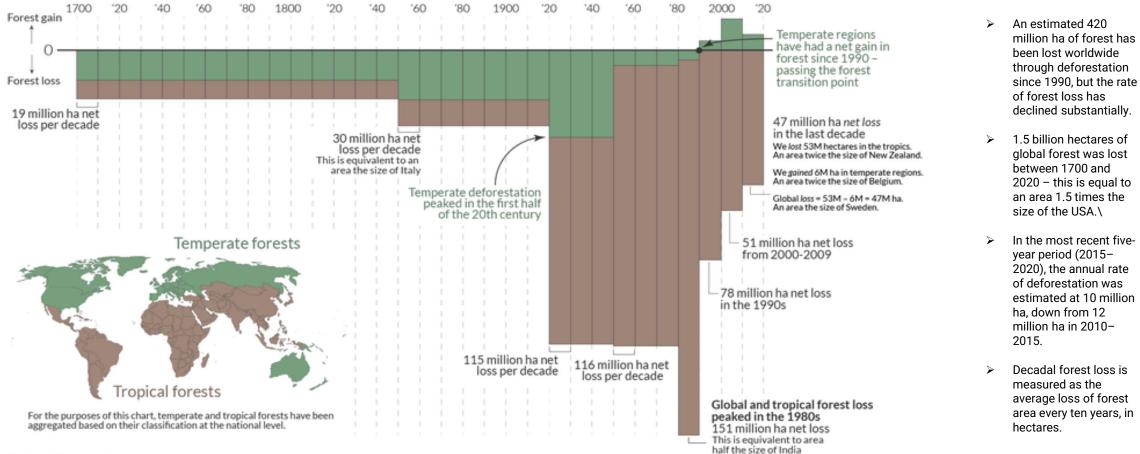


#### Source: https://www.londonstockexchange.com/raise-finance/equity/voluntary-carbon-market

### **Reverse Decadal Global Deforestation**



Stopping deforestation and reforesting our planet is imperative to stop the destruction of habitats, loss of biodiversity and fight climate change.



OurWorldinData.org - Research and data to make progress against the world's largest problems.

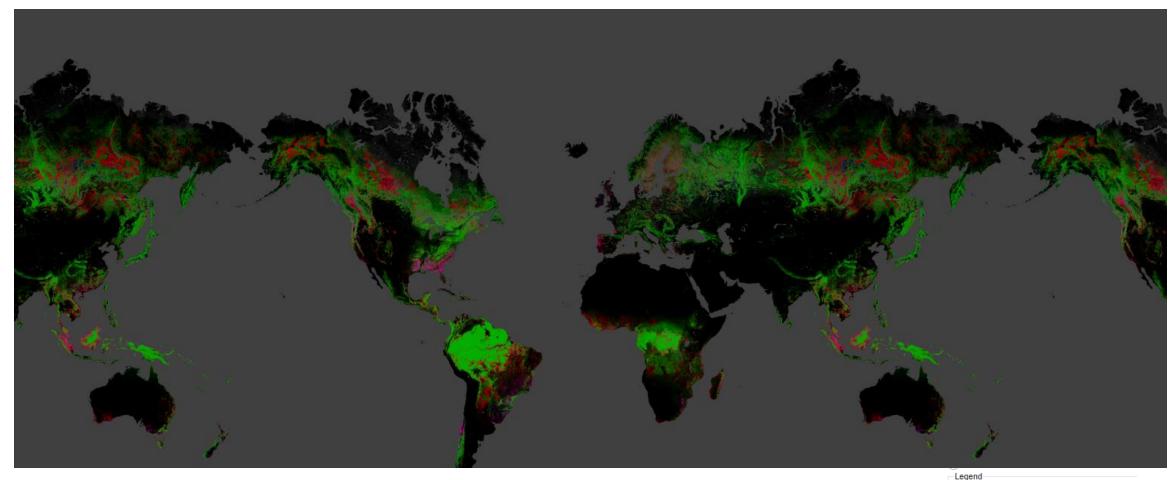
Data sources: Based on pre-1990 data from Williams (2006), Deforesting the Earth. Post-1990 data from UN FAO Global Forest Resources Assessment (2020).

Licensed under CC-BY by the author Hannah Ritchie.

# Global Deforestation (2000-2019)



Wildfires, replacement through agriculture and commercial plantations, and increasing land grabbing in poor regions main cause of rapid destruction of forests.



Source: http://earthenginepartners.appspot.com/science-2013-global-forest

Forest Loss 2000–2019 Forest Gain 2000–2012 Both Loss and Gain Forest Extent

# **Key Considerations for Forestry Carbon Credits**



Key questions to be addressed for the generation of carbon credits:

- 1. Methodology
- 2. Eligibility
- 3. Additionality
- 4. Baseline
- 5. Permanence & Leakage
- 6. Verification
- 7. Project Boundary

### **UNFCCC REDD & REDD+**

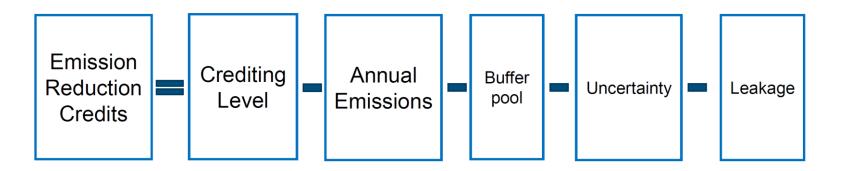
REDD+ WEB PLATFORM										
HOME		FACT SHEETS	SUBMISSIONS		FO HUB FORUM		MEETINGS	CONTACT		
Country	Date (Year)	<b>Results</b> (t CO2 eq <i>l</i> year)	Assessed forest reference level (t CO2 eq/year)	Quantities for which payments were received (t CO2 eq/year)	Entity	paying for results	Links to documentation			
÷	÷									
Argentina	2014	44,409,046	101,141,848	18,731,707 (period 2014- 2016)	Green Clima proposal)	te Fund (funding	FCCC/SBI/ICA/2020 Biennial update rej of REDD+ results (E FCCC/TAR/2019/AF	oort with submission SUR 3)		
	2015	59,006,338	101,141,848	-	-		Submission on pro	Submission on proposed reference		
	2016	61,757,321 101,141,848 -			- Modified sub reference leve			0.5		
Brazil	2006	529,930,490.25	1,106,027,616.63	23,911,039.60 1,542,650.58	Government (see explana Petróleo Bra	atory note)	FCCC/SBI/ICA/2019 Biennial update rej of REDD+ results (E FCCC/TAR/2014/BI	oort with submission SUR 1)		
	2007	497,761,219.37	1,106,027,616.63		-		<ul> <li>Submission on pro level (Amazon bion</li> </ul>			
	,						Modified submissio	on on proposed		
	2008	440,022,301.24	1,106,027,616.63	-	-		1st Safeguards info	rmation summary		
	2009	741,687,139.44	1,106,027,616.63	28,347,560.00 3,188,874.00	Government (see explana Government		2nd Safeguards information summ National REDD+ Strategy Info Hub Brazil			
	2010	761,621,104.20	1,106,027,616.63	33,363,022.00	Government (see explana	-				

- UNFCCC Conference of the Parties (COP) introduced REDD in 2007 to help guide activities in the forest sector.
- REDD stands for "reducing emissions from deforestation and forest degradation".
- REDD+ refers to the additional "role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries".
- > UNFCCC REDD+ mechanism produces sovereign credits.
- Designed to compensate developing nations for reversing deforestation and eventually conserving their forests, it comes with a strict set of requirements to be met by each nation before sovereign credits can be issued.
- Reported data include measurements of a country's forest reference level and creation of a national greenhouse gas inventory.

# The Architecture for REDD+ Transactions (ART)

- Participant must be a national government or subnational government with national government approval
- Registration of subnational accounting areas that meet TREES eligibility requirements allowed until December 31, 2030
- The boundaries of subnational accounting shall correspond with one or several administrative jurisdictions no more than one level down from national level
- Subnational areas shall encompass a minimum area of 2.5 million hectares of forest

## Emission reduction (ER) credits =

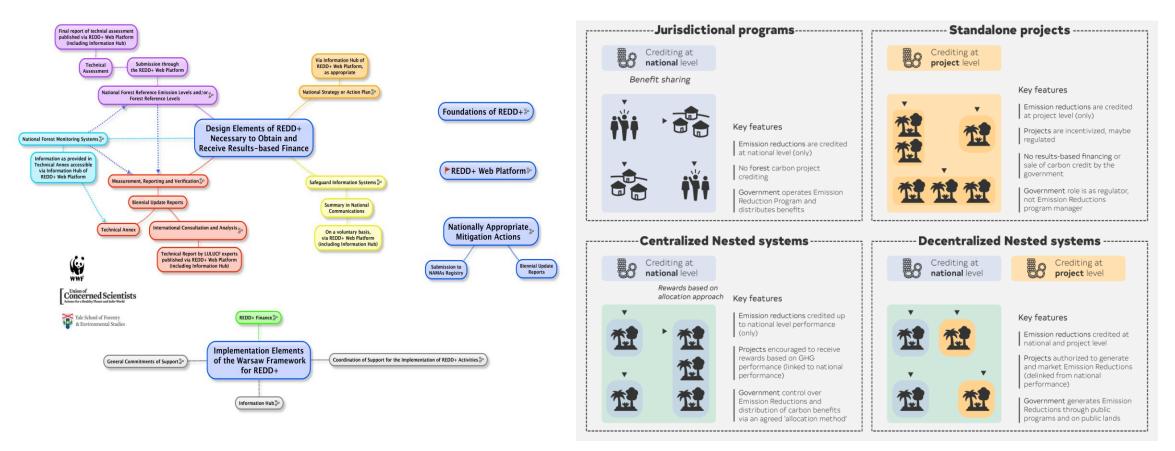




### **UNFCCC REDD+**

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Nested systems require robust accounting systems, clarity on land titles and carbon rights, and institutional frameworks that support nested REDD+.



Source: https://wwf.panda.org/wwf\_news/?222333/Mapping-UNFCCC-REDD-2014-a-visual-guide-to-the-systems-and-structures-supporting-REDD-within-the-UNFCCC

Source: https://vcmprimer.org/chapter-14-how-does-redd-nesting-work/

# Selected Methodologies for Forest Conservation Projects

- CDM AR-ACM0003 Afforestation and reforestation of lands except wetlands
  - Adoption of afforestation and/or reforestation activities on any land that does not fall into the category of wetland.
- CDM AR-AM0014 Afforestation and reforestation of degraded mangrove habitats
  - Adoption of afforestation and/or reforestation activities in wetlands that constitute a degraded mangrove habitat.
- VER VM0003 Methodology for Improved Forest Management through Extension of Rotation Age
  - Improvement of forest management practices to increase the carbon stock on land by extending the rotation age of a forest or patch of forest before harvesting. By extending the age at which trees are cut, projects increase the average carbon stock on the land and remove more emissions from the atmosphere.

#### VM0045 Methodology for Improved Forest Management Using

#### Dynamic Matched Baselines From National Forest Inventories

 Improved forest management (IFM) practices and employs standardized approaches for demonstration of additionality and derivation of project baselines to simplify application of the methodology.

#### VM0009 Avoided Ecosystem Conversion

• Prevented conversion of forest to non-forest and of native grassland and shrubland to a non-native state.

#### VM0005 Conversion of Low-productive Forest to Highproductive Forest

 Avoiding re-logging and/or the rehabilitation of previously logged forest. Rehabilitation is achieved by implementing silvicultural techniques to increase forest density, such as cutting climbers and vines, liberation thinning, or enrichment planting.

#### GS Afforestation/Reforestation (A/R) GHG Emissions Reduction & Sequestration Methodology



### VM0045: Additionality



(1)

$$ER_t = (A_t \times \overline{ER_t} + LK_t) \times (1 - UNC_t)$$

Where:

$ER_t$	Net GHG emission reductions in year $t$ (t CO <sub>2</sub> e)
$A_t$	Project area in year t (unit area)
$\overline{ER_t}$	Mean GHG emission reductions in year $t$ (t CO <sub>2</sub> e per unit area per year)
LK <sub>t</sub>	Leakage in year t (t CO <sub>2</sub> e)
UNC <sub>t</sub>	Uncertainty in year t (percent)

- Project proponents must demonstrate regulatory surplus in accordance with the rules and requirements regarding regulatory surplus set out in the latest version of the VCS Methodology Requirements.
- > Composite baselines derived per the procedures set out in Section 6 represent the without project activity, or baseline scenario.
- Updating the composite baselines periodically throughout the project crediting period produces a dynamic and spatially variable performance benchmark in terms of periodic carbon stock change. At each monitoring event, where equation 1 yields a positive value, the project is deemed additional;

### VM0045: Baseline Emissions



- Baseline quantification is focused on measured carbon stock change in the composite baselines, representing the absence of the project activity. Each project sample unit *i* has a corresponding paired composite baseline *i*, composed of one or more constituent baseline plots *j*.
- Harvest or disturbance emissions include carbon emitted from live tree above- and belowground biomass, dead wood, and harvested wood products (i.e., carbon not retained in harvested wood products for 100 years or more after harvest).
- For each constituent baseline plot, carbon stock change is calculated at the re-measurement time, *mt*, and annualized as:

 $\Delta LAG_{bsl,i,j,mt} = (LAG_{bsl,i,j,t} - LAG_{bsl,i,j,t-X_{bsl,i,j,t}}) \times (1/X_{bsl,i,j,t})$  $\Delta LBG_{bsl,i,j,mt} = (LBG_{bsl,i,j,t} - LBG_{bsl,i,j,t-X_{bsl,i,j,t}}) \times (1/X_{bsl,i,j,t})$  $\Delta DW_{bsl,i,j,mt} = (DW_{bsl,i,j,t} - DW_{bsl,i,j,t-X_{bsl,i,j,t}}) \times (1/X_{bsl,i,j,t})$ 

Where:	
$\Delta LAG_{bsl,i,j,mt}$	Annual change in live aboveground biomass stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> calculated at re-measurement time <i>mt</i> (t CO <sub>2</sub> e per unit area per year)
LAG <sub>bsl,i,j,t</sub>	Live aboveground biomass stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> at time <i>t</i> (t CO <sub>2</sub> e per unit area)
$LAG_{bsl,i,j,t-X_{bsl,i,j,t}}$	Live above ground biomass stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> at time $t-X_{bsl,i,j,t}$ (t CO <sub>2</sub> e per unit area)
$\Delta LBG_{bsl,i,j,mt}$	Annual change in live belowground biomass stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> calculated at re-measurement time <i>mt</i> (t CO <sub>2</sub> e per unit area per year)
$LBG_{bsl,i,j,t}$	Live belowground biomass stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> at time <i>t</i> (t CO <sub>2</sub> e per unit area)
$LBG_{bsl,i,j,t-X_{bsl,i,j,t}}$	Live belowground biomass stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> at time $t-X_{bsl,i,j,t}$ (t CO <sub>2</sub> e per unit area)
$\Delta DW_{bsl,i,j,mt}$	Annual change in dead wood stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> calculated at remeasurement time <i>mt</i> (t CO <sub>2</sub> e per unit area per year)
$DW_{bsl,i,j,t}$	Dead wood stocks in the baseline scenario at constituent baseline plot <i>j</i> in composite baseline <i>i</i> at time <i>t</i> (t CO <sub>2</sub> e per unit area)
$DW_{bsl,i,j,t-X_{bsl,i,j,t}}$	Dead wood stocks in the baseline scenario at constituent baseline plot $j$ in composite baseline $i$ at time $t-X_{bsl,i,j,t}$ (t CO <sub>2</sub> e per unit area)
$X_{bsl,i,j,t}$	Length of measurement interval ending at time <i>t</i> for constituent baseline plot <i>ij</i> (years)

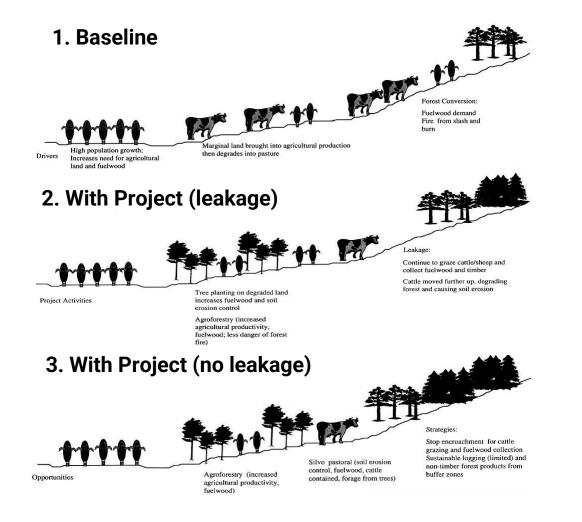
(2a)

(2b)

(2c)

# Permanence & Leakage (II)







- Leakage is defined here as the unexpected loss of estimated net carbon sequestered.
- In some cases leakage may be positive that is, more net carbon reductions were achieved.
- Leakage can be the result of incorrectly estimating the project's impact or of unexpected effects such as a population increase in the project region, during the course of a project.
- Carbon vs. Harvest leakage effect



# **Project Spatial & GHG Boundaries**



Table 1: Selected Carbon Pools<sup>4</sup>

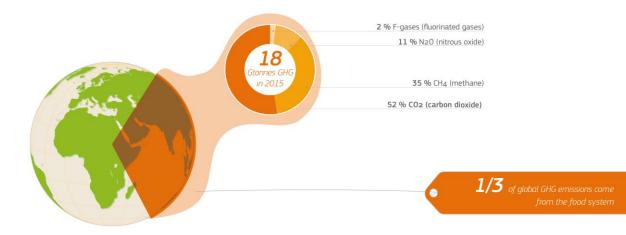
Source	Included? Yes Conditional on	Justification/Explanation		Source		Included?	Justification/Explanation	
Aboveground tree biomass		Required pool. Expected to be subject to significant change due to the project activity. Where this pool is subject to significant decrease			CO <sub>2</sub>	N/A		
Aboveground woody non-					CH <sub>4</sub>	N/A		
tree biomass	project activity	due to the project activity (e.g., due to site preparation), it must be included in the project scenario (and may be included or excluded in the baseline scenario). Otherwise, this pool may be included only where it is possible to account in both the project and baseline scenarios (i.e., aboveground non-tree woody biomass must be included in the national forest inventory	Project	Emissions from nitrogen- containing soil amendments or from decomposition of plant materials with fixed nitrogen	N <sub>2</sub> O	Conditional on project activity	N <sub>2</sub> O emissions from nitrogen-containing soil amendments are included in the scenario where nitrogen fertilizer is applied as part of the project activity. N <sub>2</sub> O emissions are conservatively set to zero in the baseline.	
		data used for the composite baseline).	and		Other	N/A		
Aboveground non-tree herbaceous biomass	No	Not required due to insignificance	Baseline	Burning of tree biomass (emissions from burning non-tree biomass not included because they are <i>de minimis</i> )	CO2	Conditional on project activity	CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O emissions from fire are included in the baseline and project scenario where incidence and/or severity of fires is impacted by the project activity (e.g., in the project scenario where the project activity involves burning woody biomass, or in the project and baseline scenarios where the project activity is aimed at altering	
Belowground biomass	Yes	Expected to be subject to significant change due to the project activity	B		CH4	Conditional on project activity		
Dead wood	Yes	Required pool. Accounting boundary restricted to standing dead wood (lying dead wood not included).			N <sub>2</sub> O	Conditional on project activity		
Litter	No	Not required due to insignificance						
Soil organic carbon	No	Not expected to be subject to significant change due to the project activity						

Table 2: GHG Sources Included in or Excluded from the Project Boundary<sup>5</sup>

Source: Verra (2022)

# Food Systems are Responsible for a Third of Global Anthropogenic GHG Emissions



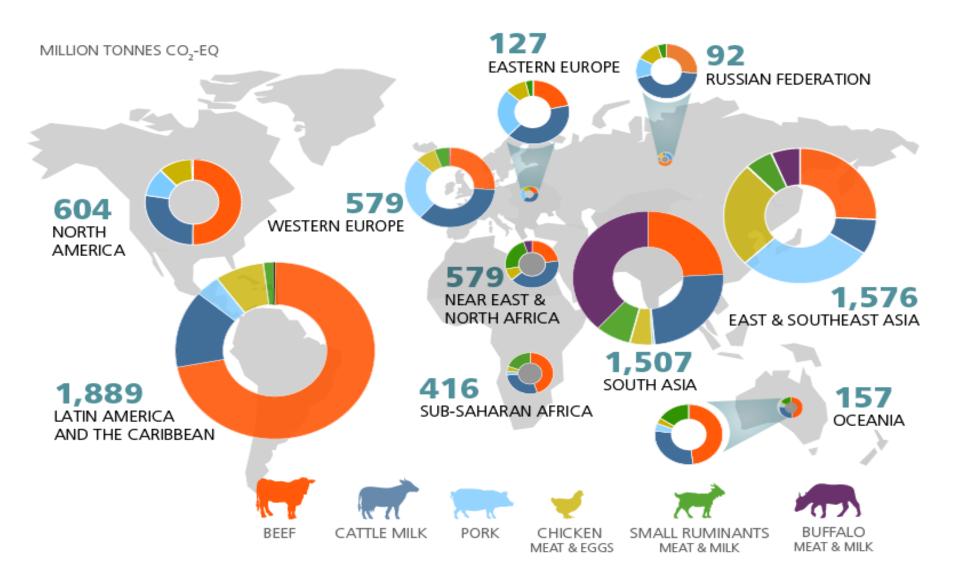


- In 2015, food-system emissions amounted to 18 Gt CO<sub>2</sub> equivalent per year globally, representing 34% of total GHG emissions.
- 71% contribution from agriculture and land use/land-use change activities.
- Remaining 29% are supply chain activities: retail, transport, consumption, fuel production, waste management, industrial processes and packaging.



# **Agriculture GHG Emissions by Source**





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### **SDG14: LIFE BELOW WATER**

#### **Related to:**

- SDG 1, 2, 3, 6: Poverty reduction, food security and health in the Pacific depend on local agriculture and shoreline fisheries, threatened by climate changes including sea level rise, storm severity, temperature, and ocean acidification. Clean freshwater • and sanitation systems are threatened by inundation and salinization.
- SDG 5, 10: The impacts of climate change are uneven across gender and location,

with impacts more strongly felt by developing nations.

SDG 9, 11: Resilient infrastructure and sustainable cities and communities rely on an understanding of, adaptation to, and mitigation of climate change.

SDG 7, 12, 13, 14, 15: Responsible consumption and production, including clean energy and avoidance of degradation of biodiversity, rely on and are part of climate action.



Source: https://www.globalgoals.org/goals/14-life-below-water/

# Categories of Nature-Based, Blue-Carbon Solutions

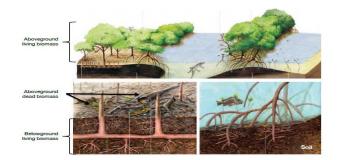


#### Nature-based solution (NBS) type:

- Increase carbon storage; eg, restoration
- Avoid emissions or loss of carbon sink; eg, protection from threat

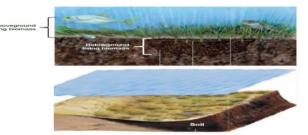
Established NBS, proven stocks and sinks	Emerging NBS, potential stocks or sinks			Nascent NBS, potential indirect carbon impact (not exhaustive)			
Salt marsh Mangrove Seagrass	Kelp forests	Bottom- trawled sediments	Seaweed farms	<b>Predators</b> Support vegetated coastal carbon stocks and sinks by maintaining ecological balance	Mesopelagic fauna Support deep-sea sequestration by exporting biomass from surface layers	Whales Support deep-sea sequestra- tion by enhancing phytoplank- ton carbon absorption	
						Surface layer	

#### Carbon pools in mangrove ecosystems



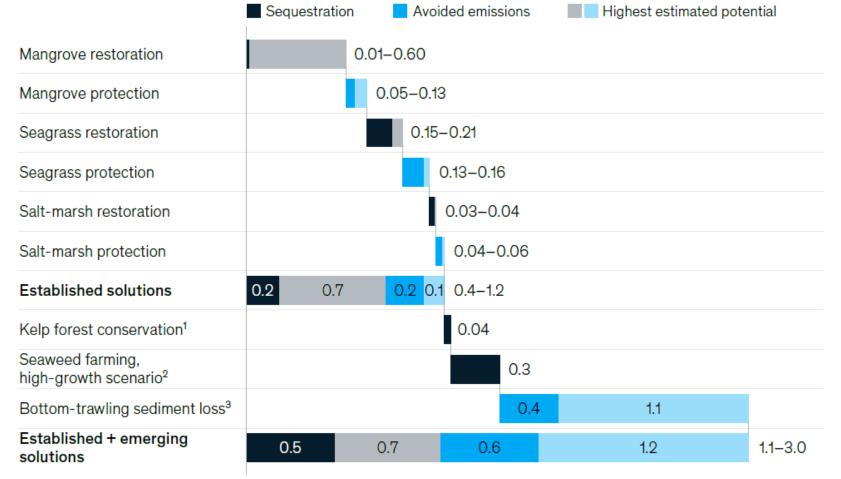






Source: McKinsey, 2022.

### Abatement potential from established and emerging blue-carbon solutions by 2050, GtCO equivalent per year



1. High-level, high-uncertainty estimate.

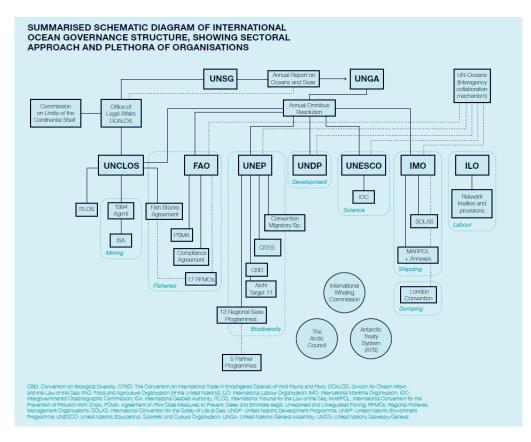
**CARBON10B X** 

- Seaweed farming sequestration depends on area of implementation and is potentially much higher. Potential shown is the reported 14% per annum growthbased estimate in the ocean as a solution.
- Lower bound is estimated as the longterm abatement potential (40% of current emissions rates) of emissions from bottom trawling in areas shallower than 50 meters.

Source: McKinsey, 2022.

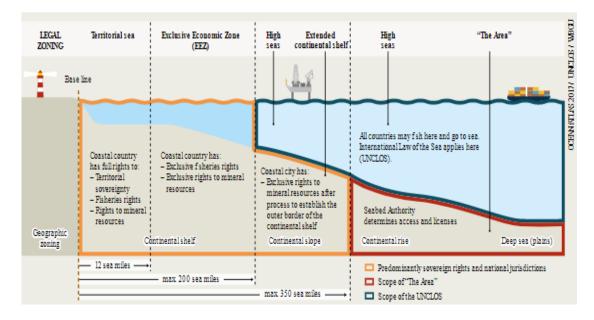
# **Global Ocean Governance is Highly Fragmented**





#### Organizations Relevant to Ocean Governance

### Maritime Zones According to UNCLOS (Baehr, 2017)



#### Source:

https://commons.wikimedia.org/wiki/File:How\_the\_Lawyers\_Think%E2%80%94Maritime\_Zones\_an d\_the\_International\_Law\_of\_the\_Sea.svg



# Thank you very much for your attention!