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TRANSITION(S)

STRATEGY | FINANCE | TRAINING

Green Finance:
from concepts to advanced instruments

Session 1: the economics of climate change

Informations about this lecture

Presentation

- Selected professional experience
  - Transition(s) : Founder and Manager
  - World Energy Council : Associate Expert
  - EDF : Senior financial analyst preparing investment decisions for the Board ; world record for cheapest solar power plant bid ; responsible for the training in corporate finance at the world level
  - Enedis : Strategy analyst, M&A
- Training
  - HEC Paris, Master, Finance, specialisation in Energy and Raw Materials
  - Sciences Po Paris, Master, Public Affairs, *cum laude*
- Other
  - Member of the HEC MSc in Finance admission board
  - Marcel Boiteux Price in Energy Economics
  - *Climate Reality Leadership* training with Al Gore in 2020

Publications

S. Méritet, J.B. Vaujour, *Economie de l'Energie*, Dunod, Topos, 128 pages, 2015.

Marcel Boiteux Prize of the Association for Energy Economics

Groupe d'Etudes Géopolitiques (collectif), *Dans l'urgence climatique, penser la transition énergétique*, Gallimard, Folio Actuel, 288 pages, 2022.

TBA

J.B. Vaujour, *Carbone et Entreprise : Objectif Net Zero, Les clés d'une décarbonation efficace et créatrice de valeur*, Dunod, 416 pages, 2023.
Approuvé en comité éditorial - En cours de rédaction

TBA

S. Méritet, J.B. Vaujour, *Economie de la transition énergétique*, Dunod, 228 pages, 2023.
Approuvé en comité éditorial - En cours de rédaction

Syllabus

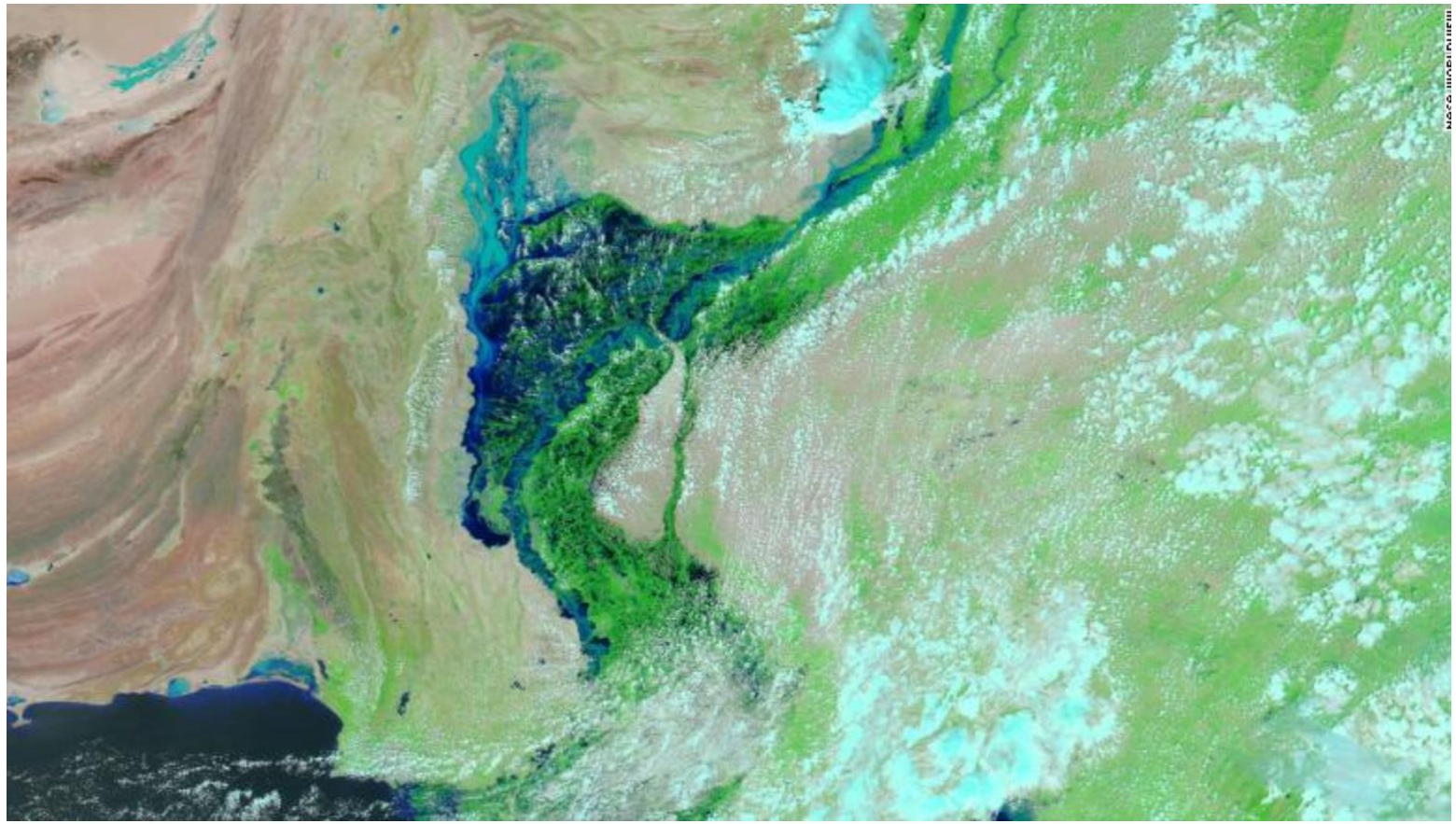
- Session 1 : Climate change economics
- Session 2 : Financial management of climate risk
- Session 3 : Green valuation
- Session 4 : Banks and climate change
- Session 5: Introduction & data
- Session 6: ESG investing & its performance
- Session 7: Climate risks
- Session 8: Other topics: quantitative models, shareholder activism

Evaluation

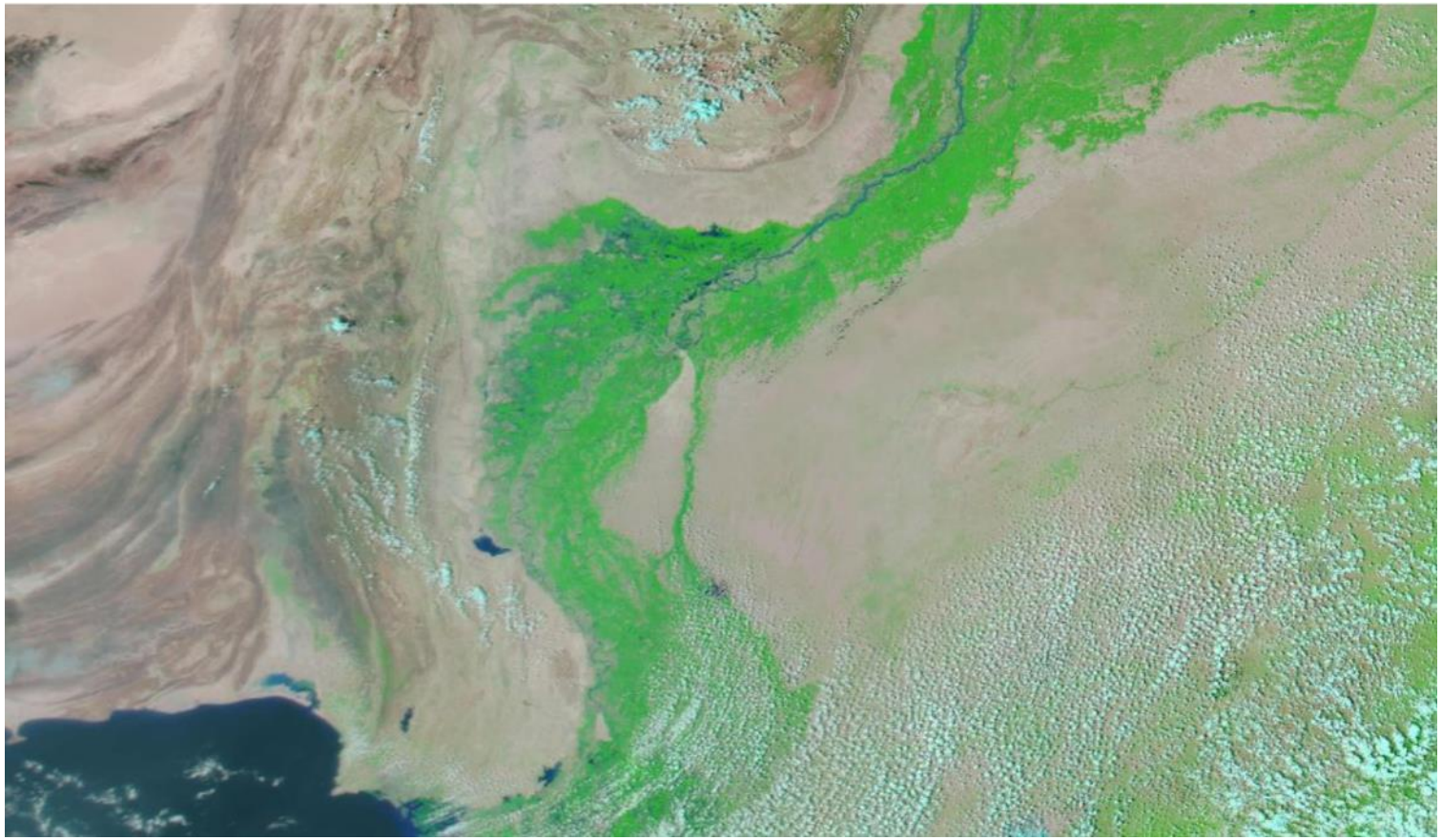
- Individual essay
- Pick one topic
- Present a written answer to the topic for October 31st at the latest (email to: coqueret@em-lyon.com or jb.vaujour@transitions.earth)
- Concision is valued: 10 pages maximum
- Should provide your assesment of the issue based on factual elements and/or calculations if required

- Carbon-related financial indicators and their limits
- Carbon pricing techniques used by listed companies
- Designing environmental stress tests for the banking sector
- **Micro study:** green portfolios: the case of European firms
- **Macro study:** the links between economic and ESG indicators
- Pick your own topic (to be validated with teacher first)

Preliminary remarks



Source: https://edition.cnn.com/2022/08/31/asia/pakistan-floods-forms-inland-lake-satellite-intl-hnk/index.html



Source: https://edition.cnn.com/2022/08/31/asia/pakistan-floods-forms-inland-lake-satellite-intl-hnk/index.html

Source: https://www.climatechangenews.com/2022/08/26/visuals-extreme-drought-dries-up-rivers-globe-satellite-images/

Source: https://www.francetvinfo.fr/meteo/secheresse/avant-apres-visualisez-l-ampleur-de-la-secheresse-en-france-depuis-l-espace_5280064.html

Does the environment have an influence on finance?

The « environment » is a loose concept

- Crucial to understand and define the boundaries of what we will be discussing
- Environmental concerns cover a variety of topics that are loosely related
- The issue is often constructed to fit a narrative
- Series of man-made changes and catastrophes that negatively affect our societies and reduce economic output
- **Nobody really knows how to measure it or where the conceptual framework should stop, however there is a large consensus on the economic importance of the subject**
- **The IPCC reports (2021, 2022) make it clear that urgent action is required both to reduce our emissions in order to limit global warming and to start adapting our economies to the consequences of climate change**

Source: AON, Weather, Climate and catastrophe insight 2021, 53 pages, 2022.

Three issues shape the debate : climate change, loss of biodiversity and resource depletion

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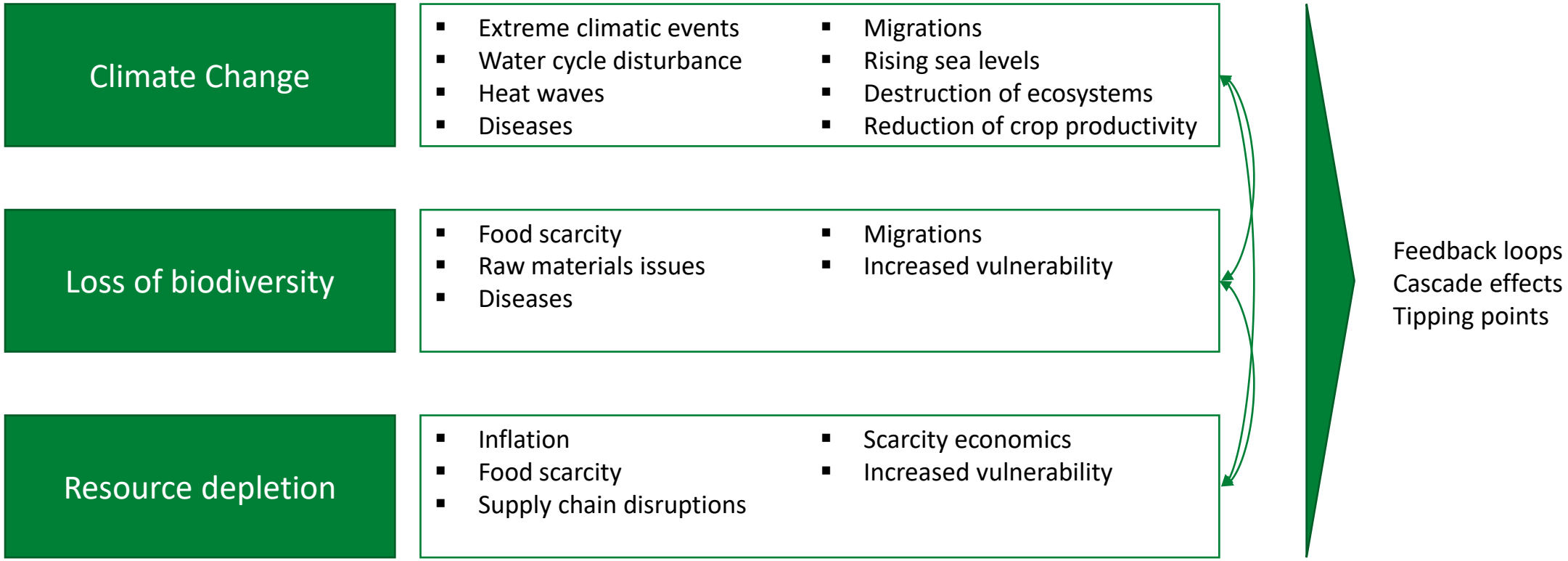
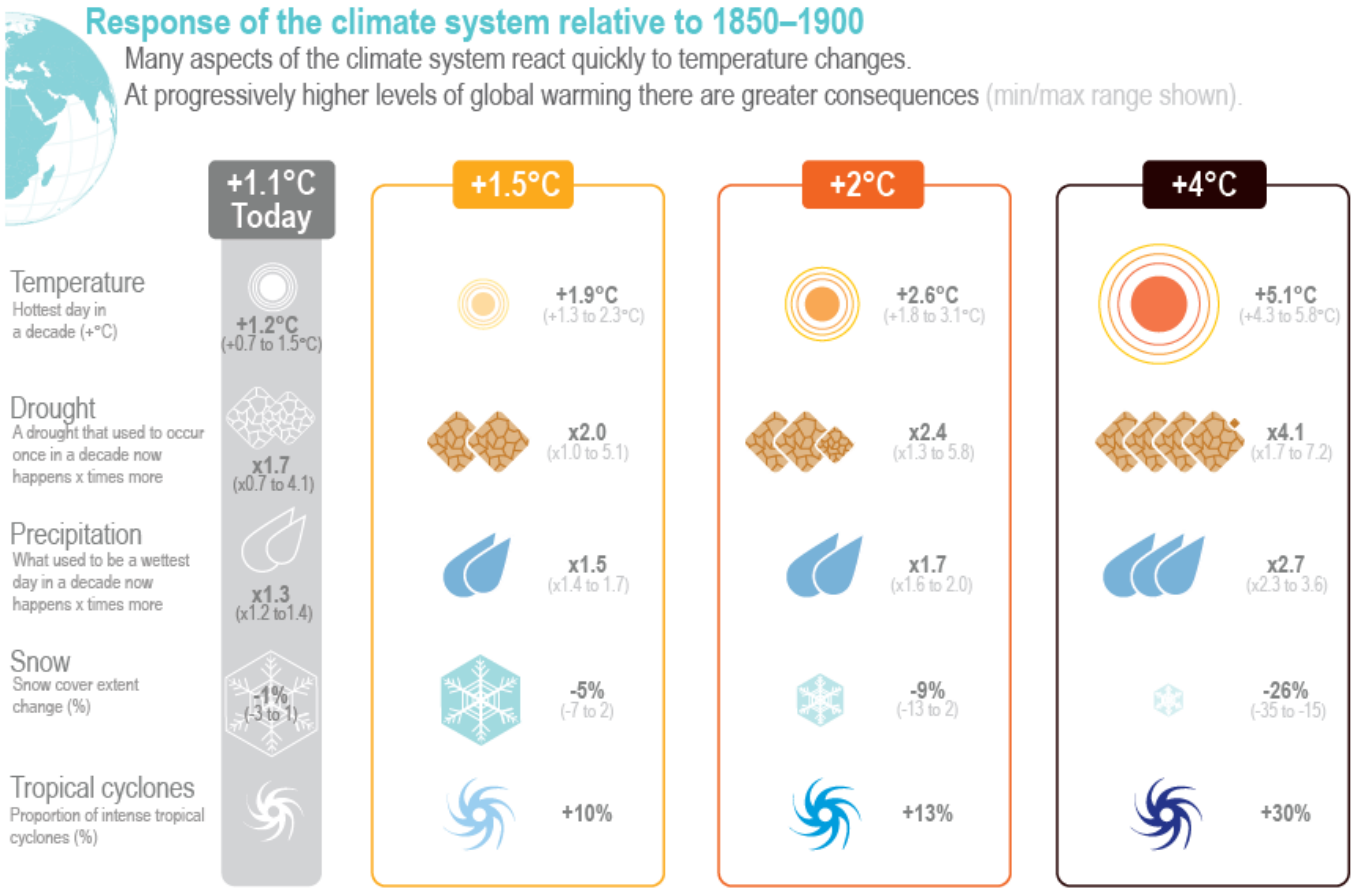
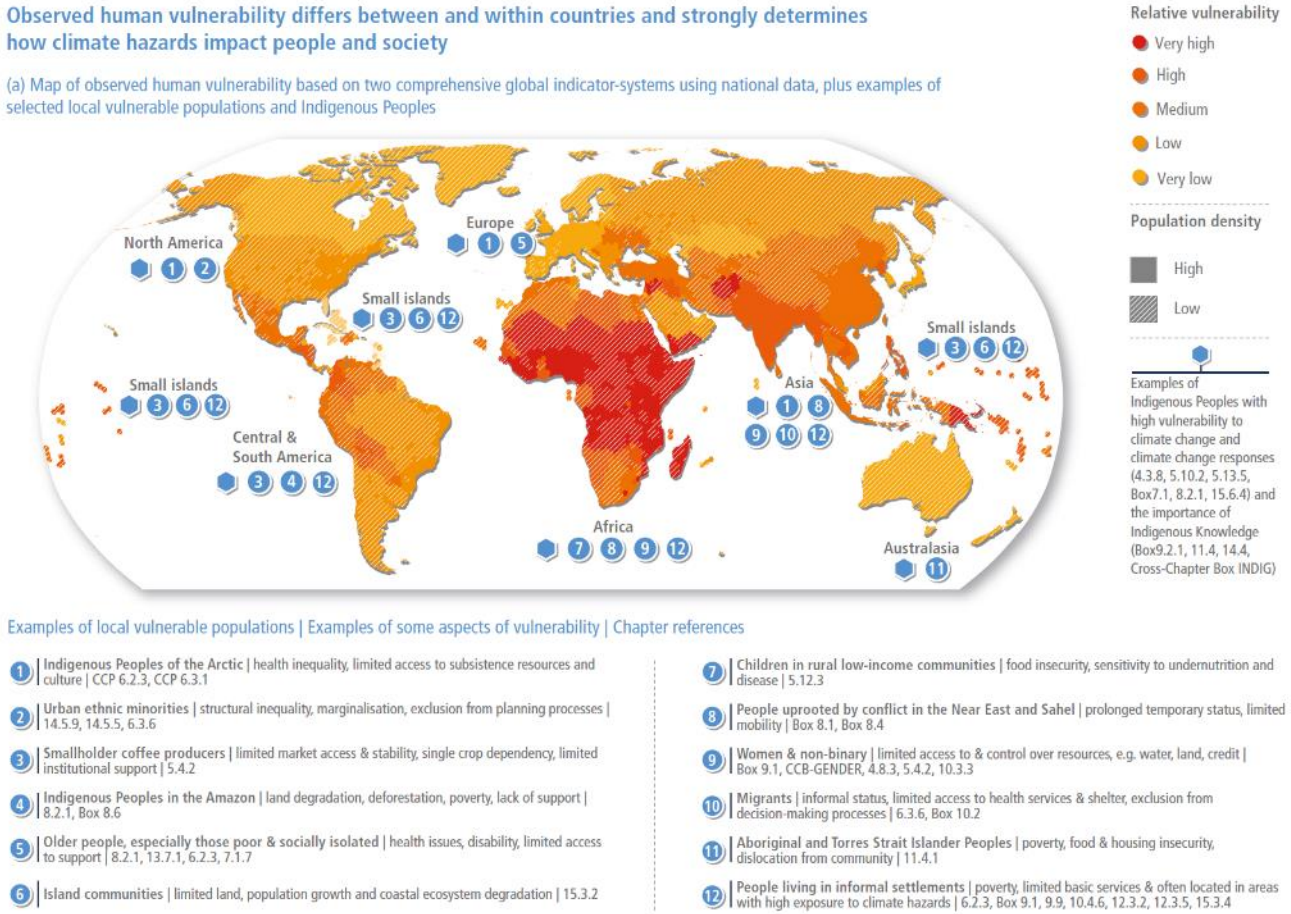


Why we need to act on climate



Source: IPCC, 2021: Technical Summary. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

Climate change is a multi-focal threat: geography



Source: IPCC, 2022: Technical Summary. [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

Climate change is a multi-focal threat: systems

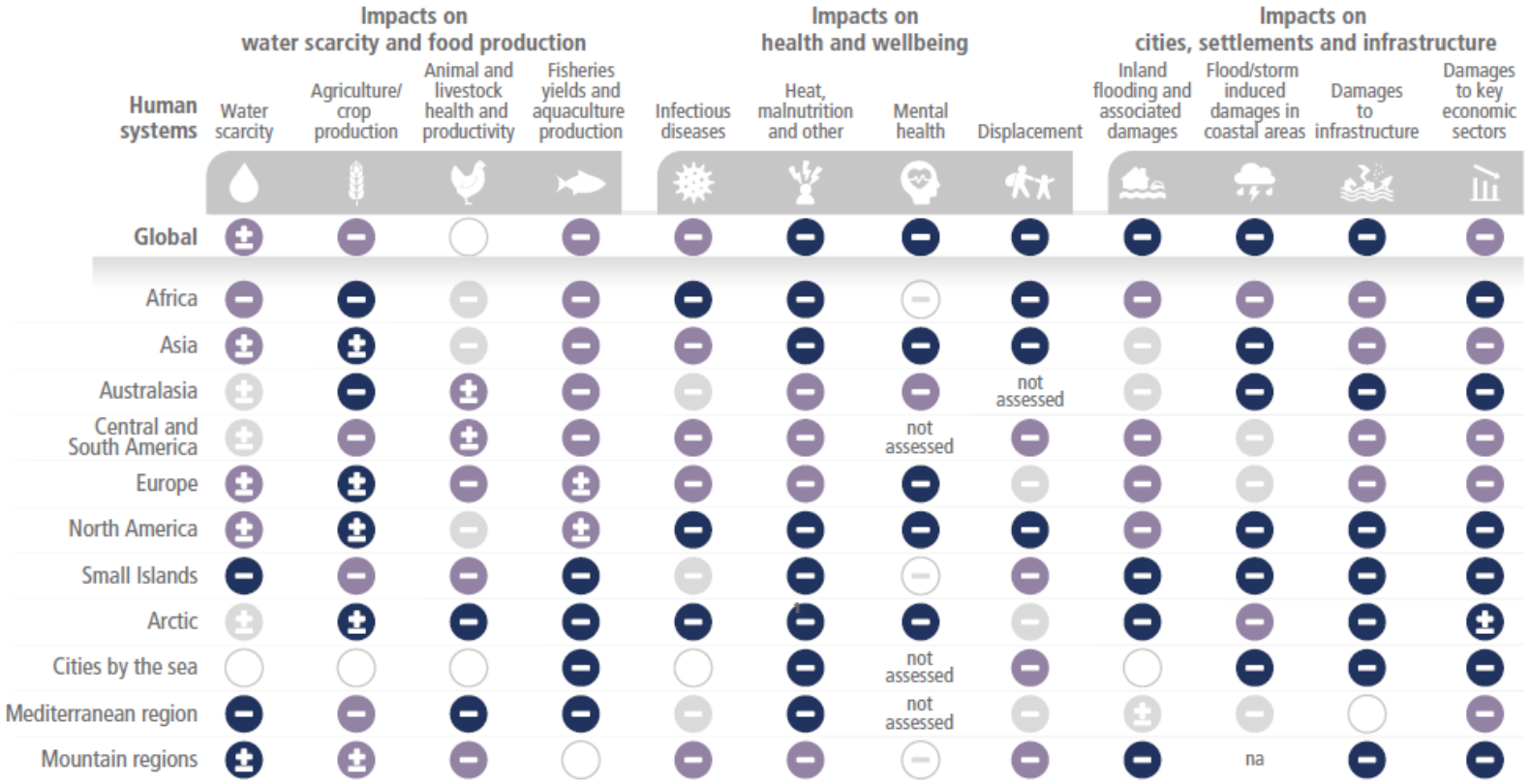
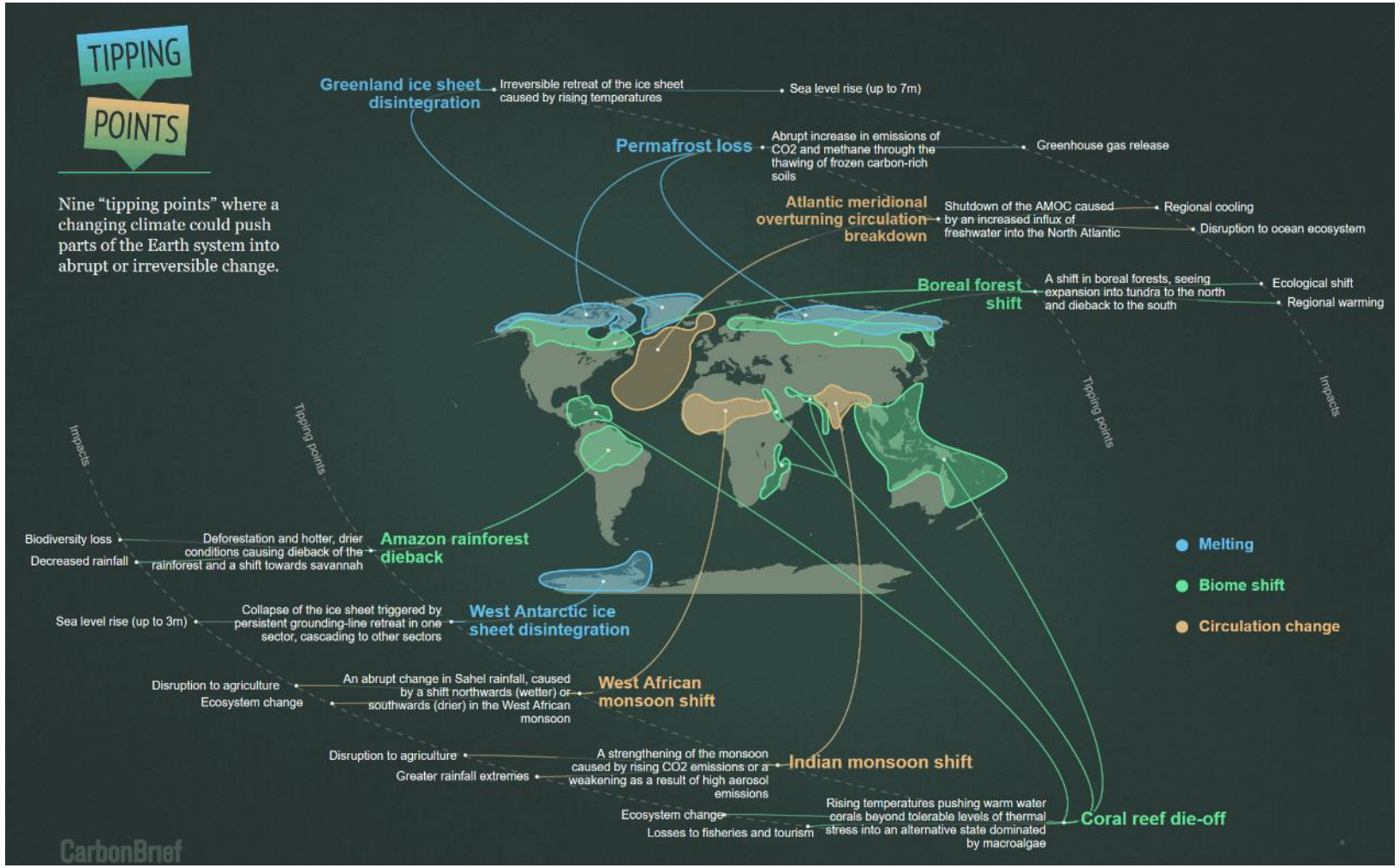


Figure TS.3 | Observed global and regional impacts on ecosystems and human systems attributed to climate change. Confidence levels reflect uncertainty in attribution of the observed impact to climate change. Global assessments focus on large studies, multi-species, meta-analyses and large reviews. For that reason they can be assessed with higher confidence than regional studies, which may often rely on smaller studies that have more limited data. Regional assessments consider evidence on impacts across an entire region and do not focus on any country in particular.

Source: IPCC, 2022: Technical Summary. [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

The whole « Earth System » is under pressure

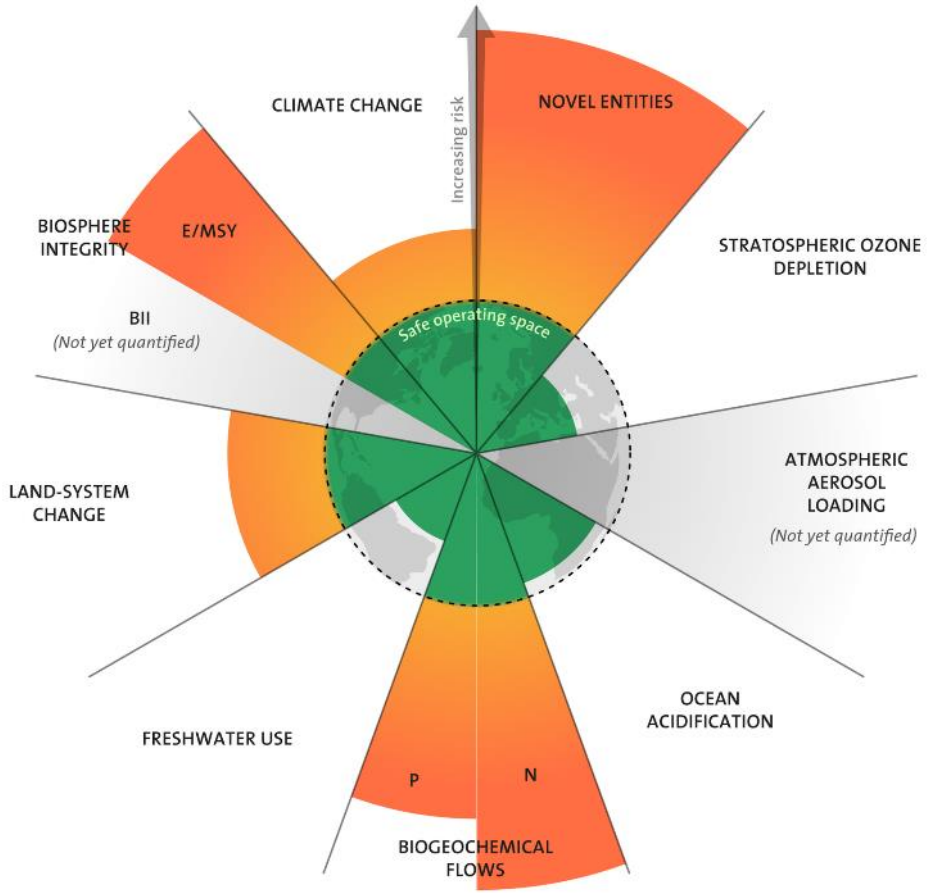


Source: https://www.carbonbrief.org/explainer-nine-tipping-points-that-could-be-triggered-by-climate-change/

Planetary boundaries have been crossed with far-reaching consequences

- **Tipping points** are a metaphor used to describe a systemic shift to a new equilibrium
- Extremely difficult to identify and to define thresholds of risk
- Based on the work of the Stockholm Resilience Center on the Earth System
- 9 planetary boundaries have been identified so far, 5 of them have already been crossed
- Effects are on massive and long time-scales, impossible to predict the consequences based on current knowledge

- **The whole environmental system on which our economy rests is set to experience radical changes in the coming decades with an extremely low visibility on how these changes will unfold**



Source: Azote for Stockholm Resilience Centre, based on analysis in Persson et al 2022 and Steffen et al 2015

Extreme events occur with a higher frequency

- Climate change is shifting the probability distribution of extreme events with **more skewness and kurtosis than a normal distribution**
- This is occuring both at the global and local level
- In concrete terms, it means we are more likely to see extreme events linked to **fat-tails** in risk distributions (IPCC)

- There have been twenty-two 1-in-1,000 year downpour events in the U.S. since May of 2010
- Hurricane Harvey in 2017 was a 1-in-500,000 year event

- **Extreme Value Theory** (EVT) is now used to derive probability distributions for extreme events with low probabilities
- Two different approaches are used. In the block maximum approach, the probability distribution parameters are estimated for maximum values of consecutive blocks of a time series (e.g., years). In the second approach, the estimation is based on events that exceed a high threshold (peaks over threshold approach)

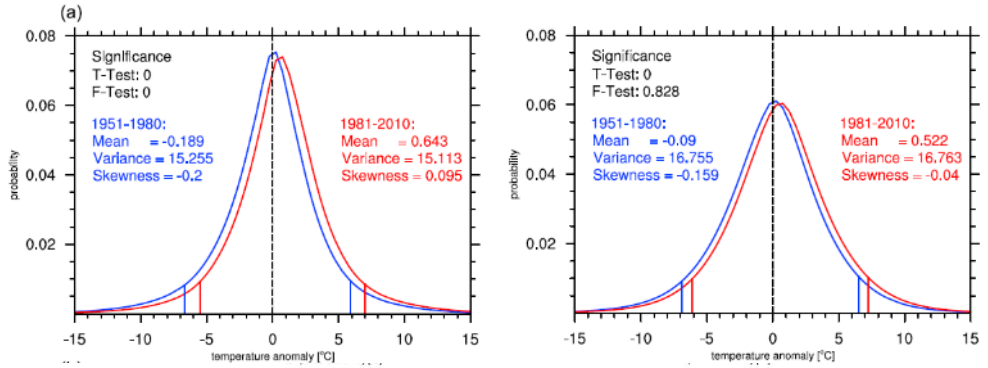


Figure 2. Probability density functions for two periods 1951–1980 (blue) and 1981–2010 (red) of anomalies of (left) daily minimum temperature and (right) daily maximum temperature. Statistics related to the shape, scale and location parameters are also shown. The distribution functions are presented for (a) the globe

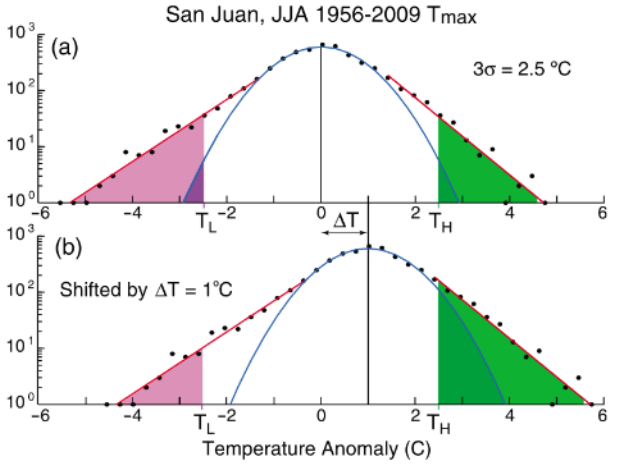
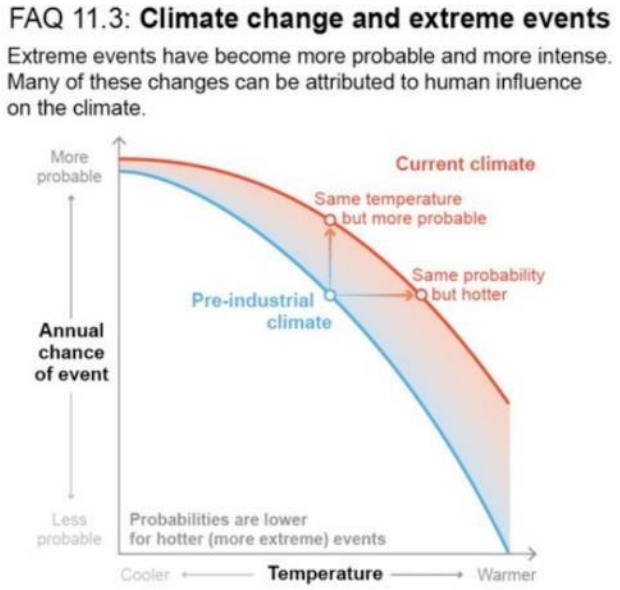


Figure 2. (a) Probability distribution function (shown as frequency of occurrence) for anomalies of daily maximum surface air temperature at San Juan, Puerto Rico (black dots). The blue curve shows a Gaussian core fit to values above 30% of maximum; the red lines show exponential fits to the low-side and high-side tails. The regions representing exceedances of a threshold value $T_H = 3\sigma = 2.5°$ C, on the high side, or $T_L = -3\sigma$ on the low side, are shown in green and purple respectively (dark shading for the corresponding region if the tails followed the Gaussian fit to the core). Exceedance probabilities are integrated between T_H or T_L and the furthest bin with nonzero values in the respective tails (note shaded regions are not area proportional on this log plot). (b) Ratio of the probability of low-side exceedance of T_L as a function of the shift ΔT of the distribution to probability in the un-shifted case, comparing this ratio for the observed tail (black), for an exponential fit to the tail (red) and for a continuation of the Gaussian corresponding to the core (using the same integration interval as for the observations).

Sources: Donat, Alexander, The shifting probability distribution of global daytime and night-time temperatures, in Geophysical Research Letters, vol 39, 2012, 5p | Ruff, Neelin, Long tails in regional surface temperature probability distributions with implications for extremes under global warming, , in Geophysical Research Letters, vol 39, 2012, 6p. | Climate Reality Project | IPCC Seneviratne, Changes in climate extremes and their impacts on the natural physical environment. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate, Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 109-230.

Additional elements on the frequency of extreme events



FAQ 11.3, Figure 1: Changes in climate result in changes in the magnitude and probability of extremes. Example of how temperature extremes differ between a climate with pre-industrial greenhouse gases (shown in blue) and the current climate (shown in orange) for a representative region. The horizontal axis shows the range of extreme temperatures, while the vertical axis shows the annual chance of each temperature event's occurrence. Moving towards the right indicates increasingly hotter extremes that are more rare (less probable). For hot extremes, an extreme event of a particular temperature in the pre-industrial climate would be more probable (vertical arrow) in the current climate. An event of a certain probability in the pre-industrial climate would be warmer (horizontal arrow) in the current climate. While the climate under greenhouse gases at the pre-industrial level experiences a range of hot extremes, such events are hotter and more frequent in the current climate.

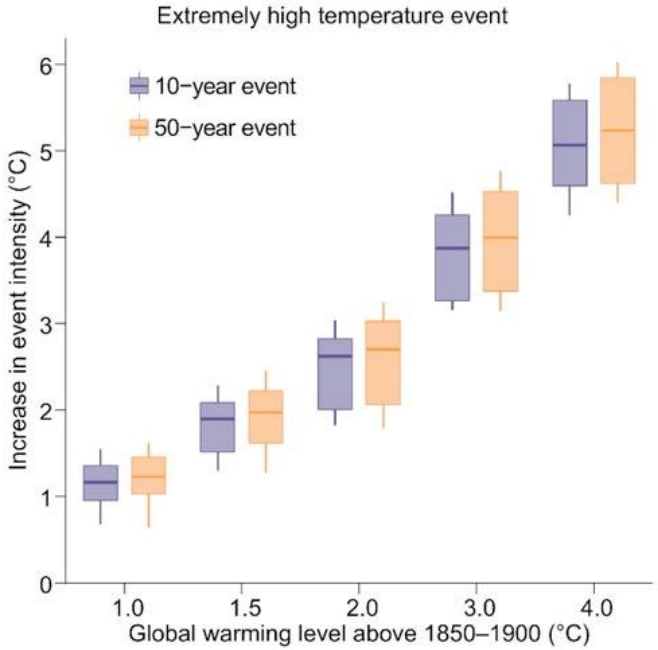


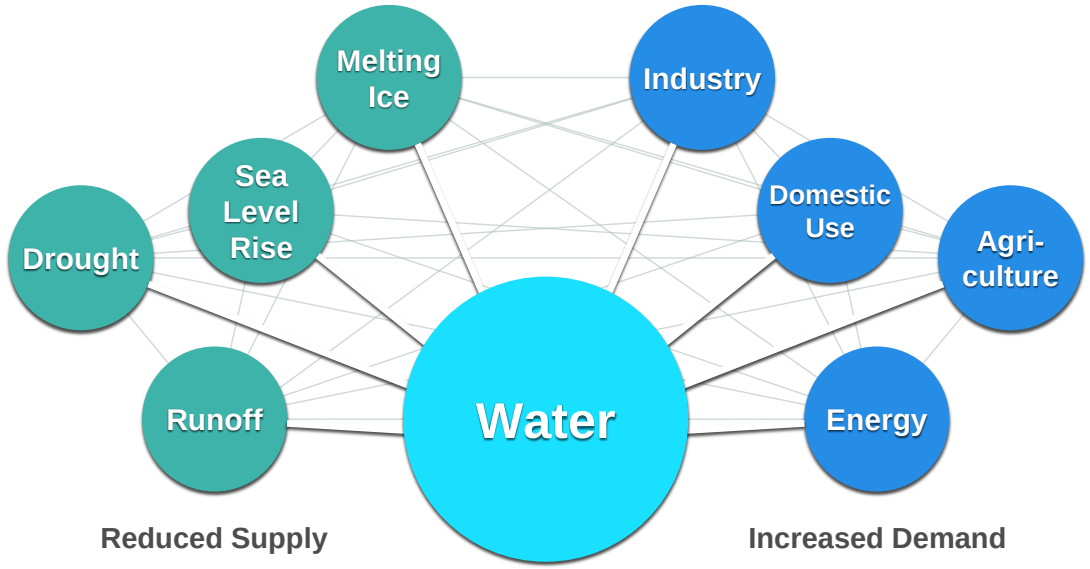
Figure 11.12: Projected changes in the intensity of extreme temperature events under 1°C, 1.5°C, 2°C, 3°C, and 4°C global warming levels relative to the 1851-1900 baseline. Extreme temperature events are defined as the daily maximum temperatures (TXx) that were exceeded on average once during a 10-year period (10-year event, blue) and that once during a 50-year period (50-year event, orange) during the 1851-1900 base period. Results are shown for the global land. For each box plot, the horizontal line and the box represent the median and central 66% uncertainty range, respectively, of the intensity changes across the multi model ensemble, and the whiskers extend to the 90% uncertainty range. The results are based on the multi-model ensemble from simulations of global climate models contributing to the sixth phase of the Coupled Model Intercomparison Project (CMIP6) under different SSP forcing scenarios. Based on (Li et al., 2020a). Further details on data sources and processing are available in the chapter data table (Table 11.SM.9).

Source: IPCC, Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, + FAQ 11-3.

The economic consequences are far-reaching – the case of water

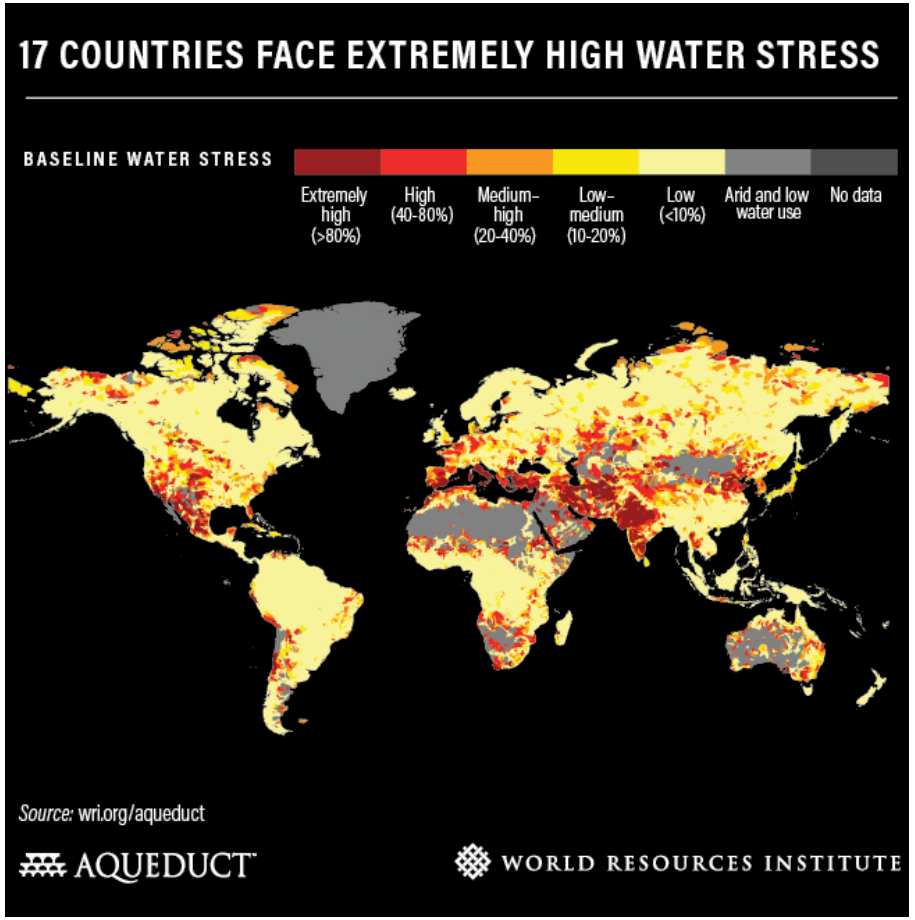
- Fresh water underpins much of human activities
- 70% of demand comes from agriculture and much of the world's food production relies on irrigation
- 2/3 of world population should be living in water-stressed countries by 2025 (France among them)
- Rising temperatures at the same time reduce water resources (less snow, less ice, more droughts and runoffs…) and increase water demand for agriculture and domestic use

- The problem is self-sustained and some regions of the world could face extreme challenges to maintain local food production and to accomodate the water consumption of the population
- Providing solutions to water scarcity requires massive investments in desalination plants that in turn require important energy supplies to operate (most often from fossil fuel plants)
- As this is a **systemic risk**, no sector of the economy is immune



Sources : https://www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress | https://www.cfr.org/backgrounder/water-stress-global-problem-thats-getting-worse

Background information on water stress in the world



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National Water Stress Rankings

EXTREMELY HIGH BASELINE WATER STRESS

1. Qatar
2. Israel
3. Lebanon
4. Iran
5. Jordan
6. Libya
7. Kuwait
8. Saudi Arabia
9. Eritrea
10. United Arab Emirates
11. San Marino
12. Bahrain
13. India
14. Pakistan
15. Turkmenistan
16. Oman
17. Botswana

HIGH BASELINE WATER STRESS

18. Chile
19. Cyprus
20. Yemen
21. Andorra
22. Morocco
23. Belgium
24. Mexico
25. Uzbekistan
26. Greece
27. Afghanistan
28. Spain
29. Algeria
30. Tunisia
31. Syria
32. Turkey
33. Albania
34. Armenia
35. Burkina Faso
36. Djibouti
37. Namibia
38. Kyrgyzstan
39. Niger
40. Nepal
41. Portugal
42. Iraq
43. Egypt
44. Italy

MEDIUM-HIGH BASELINE WATER STRESS

45. Thailand
46. Azerbaijan
47. Sudan
48. South Africa
49. Luxembourg
50. Australia
51. Tajikistan
52. Macedonia
53. South Korea
54. Bulgaria
55. Mongolia
56. China
57. Guatemala
58. Estonia
59. France
60. Kazakhstan
61. Mauritania
62. Germany
63. Lesotho
64. Denmark
65. Indonesia
66. Peru
67. Venezuela
68. Cuba

LOW-MEDIUM BASELINE WATER STRESS

69. North Korea
70. Romania
71. United States
72. Zimbabwe
73. Dominican Republic
74. Haiti
75. Japan
76. Angola
77. Sri Lanka
78. El Salvador
79. Tanzania
80. Netherlands
81. Ecuador
82. Lithuania
83. Philippines
84. South Sudan
85. Ukraine
86. Poland
87. Chad
88. Senegal
89. United Kingdom
90. Georgia
91. Nigeria
92. Argentina
93. Czech Republic
94. Russia
95. Bolivia
96. Ethiopia
97. Bosnia and Herzegovina
98. Swaziland
99. Moldova
100. Somalia

LOW BASELINE WATER STRESS

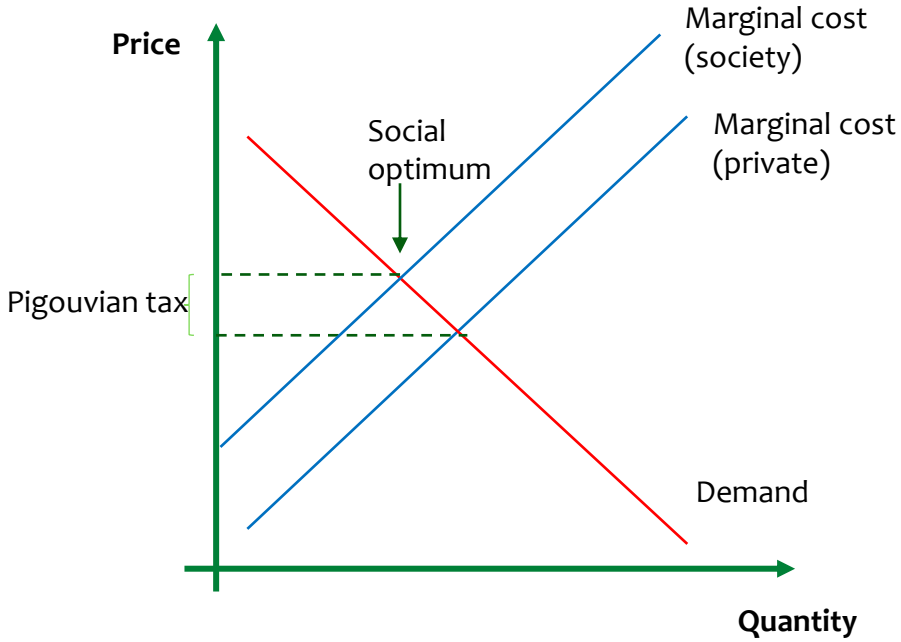
101. Rwanda
102. Liechtenstein
103. Guinea-Bissau
104. Mozambique
105. Vietnam
106. Kenya
107. Costa Rica
108. Canada
109. Serbia
110. Zambia
111. Switzerland
112. Brazil
113. Hungary
114. Ghana
115. Belarus
116. Madagascar
117. Slovenia
118. Colombia
119. Myanmar
120. Belize
121. Montenegro
122. Malawi
123. Mali
124. Finland
125. Slovakia
126. Ireland
127. Sweden
128. Bangladesh
129. Cambodia
130. Burundi
131. Latvia
132. Malaysia
133. Honduras
134. Austria
135. Uganda
136. Panama
137. Nicaragua
138. Guinea
139. Benin
140. Croatia
141. Papua New Guinea
142. New Zealand
143. Democratic Republic of the Congo
144. Côte d'Ivoire
145. Cameroon
146. Gambia
147. Laos
148. Central African Republic
149. Sierra Leone
150. Paraguay
151. Uruguay
152. Togo
153. Norway
154. Republic of Congo
155. Bhutan
156. Timor-Leste
157. Brunei
158. Gabon
159. Equatorial Guinea
160. Guyana
161. Iceland
162. Jamaica
163. Liberia
164. Suriname

Note: This is based on UN member countries. Palestine is a non-member observer and would place between Lebanon and Iran. Some small island nations could not be added to the rankings because of limitations of the model. Scores for these countries are available separately.
Source: wri.org/aqueduct

Source: https://www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress

Translating environmental challenges in an economic framework : externalities

- The cost of environmental damages are not priced in economic transactions
- This is called an **externality** (Pigou, *The Economics of Welfare*, 1920), i.e. a cost or a benefit that is incurred by an economic actor that is not a party to the transaction
- CO2 emissions resulting from a ship sailing from Shangai to Rotterdam are contributing to climate change and to negative consequences for me and you while we have no business with its cargo
- The price paid by the consumer is therefore below the socially optimal price that would cover all externalities
- Conversely, when it comes to natural capital, it means that we tend to overexploit it and to underinvest in its preservation and renewal since usage is free
- Externalities can be **unidirectional** (care about our descendants) or **reciprocal** (biodiversity destruction)

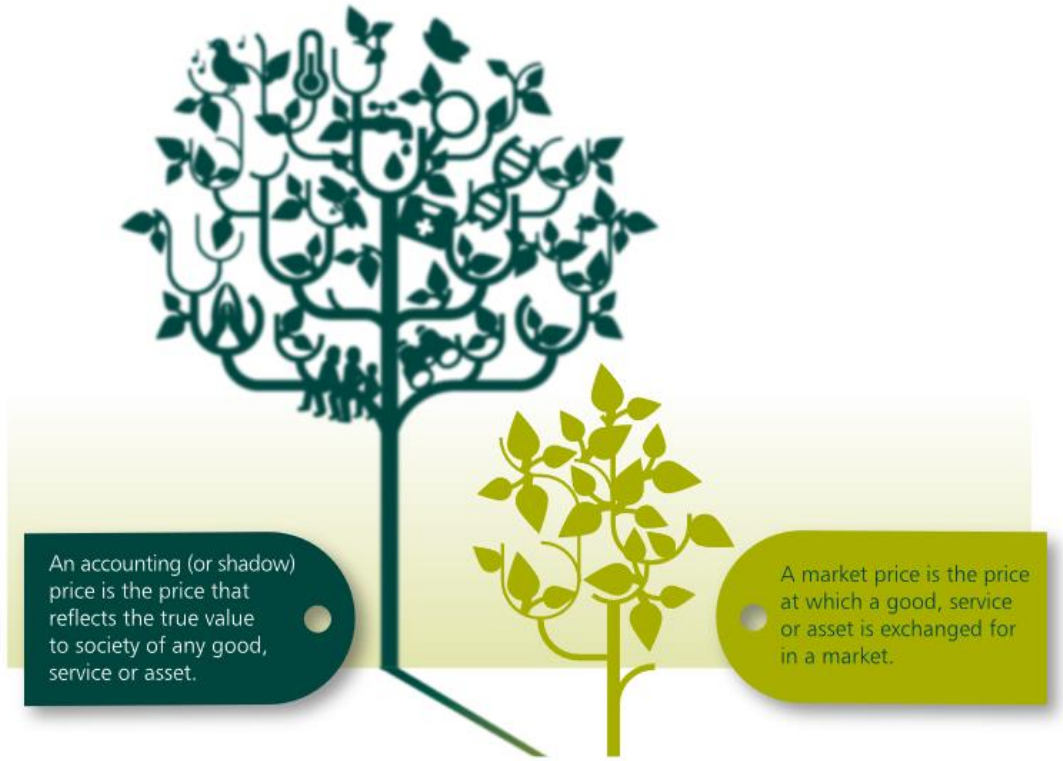


Shadow prices and valuation of the environment

- Many forms of environmental services do not have market prices because they are free
- The social worth of natural capital is reflected by **accounting or « shadow » prices**, reflecting the value of its scarcity
- Since there is no market, multiple methods are now being used to try and asses these accounting prices (see session III)

Valuation methods that involve estimating the use value of Nature by determining the productivity of its processes involve a blend of ecological and economic reasoning: The accounting value of a lake fishery can be approximated by the market value of catch over time; the social costs of air- or water-borne pollution can be estimated at least in part by measuring the losses to human health attributable to it; the minimum value of restoring a watershed can be inferred from the cost of building a water treatment plant; and so on.

- An enormous amount of work remains to be done to take into account all the dimensions of the economic impact of natural capital, especially when it comes to health and mental health benefits



Sources: Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. Abridged Version. (London: HM Treasury).

A refresher on the efficient market hypothesis

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- The Efficient Market Hypothesis (EMH) (Fama, 1970) is associated with the idea of a random walk where all price moves are independent from previous moves
- It is the conceptual basis of all passive investing (i.e. on average, you cannot beat the market), no amount of technical analysis can provide an investor with an edge
- All information is accounted for in the stock price
- Hypothesis similar to the EMH are also at the core of the theory of perfect competition (Arrow, Debreu, 1954) that underpins much of neo-classical economics

A generation ago, the efficient market hypothesis was widely accepted by academic financial economists; for example, see Eugene Fama's (1970) influential survey article, "Efficient Capital Markets." It was generally believed that securities markets were extremely efficient in reflecting information about individual stocks and about the stock market as a whole. The accepted view was that when information arises, the news spreads very quickly and is incorporated into the prices of securities without delay. Thus, neither technical analysis, which is the study of past stock prices in an attempt to predict future prices, nor even fundamental analysis, which is the analysis of financial information such as company earnings and asset values to help investors select "undervalued" stocks, would enable an investor to achieve returns greater than those that could be obtained by holding a randomly selected portfolio of individual stocks, at least not with comparable risk.

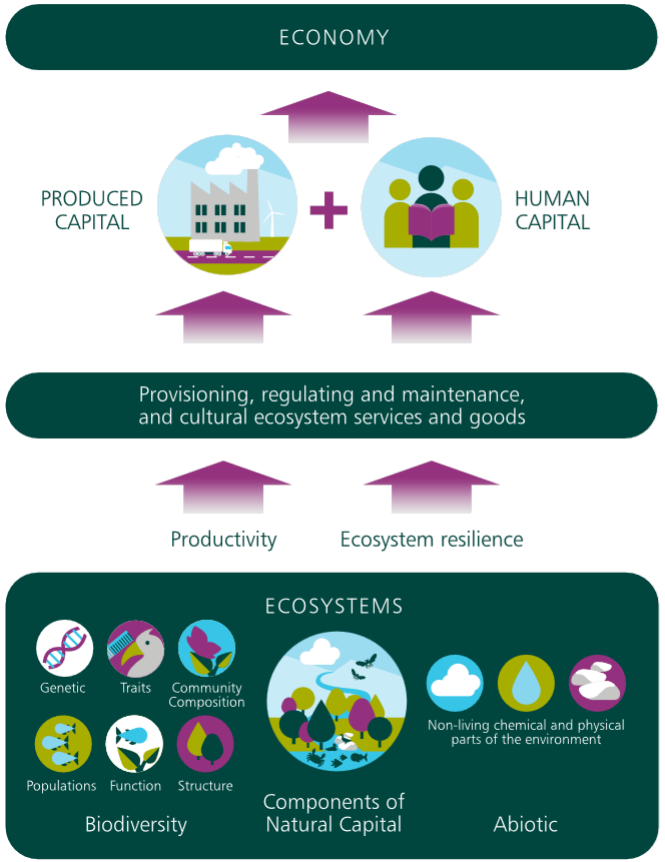
Sources: Malkiel, The Efficient Market Hypothesis and its critics, Journal of Economic Perspectives, Volume 17, Number 1, Winter 2003, Pages 59-82

Understanding the environment as a form of capital

- The environment can be analysed as an asset providing us with ecological services:
  - Food, shelter, health
  - Repository for our waste and pollution
  - Raw materials
  - « Cleaning » services for pollution (water quality for example)
- This « **natural capital** » needs frequent investments to be replenished and preserved
- Our current consumption of this capital is unsustainable and would require 1.6 Earth to be maintained

Between 1992 and 2014, produced capital per person doubled, and human capital per person increased by about 13% globally; but **the stock of natural capital per person declined by nearly 40%**

Biodiversity is declining faster than at any time in human history. Current extinction rates, for example, are around 100 to 1,000 times higher than the baseline rate, and they are increasing



Source: Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. Abridged Version. (London: HM Treasury)

Climate change challenges the intellectual apparatus on which modern financial economics is based

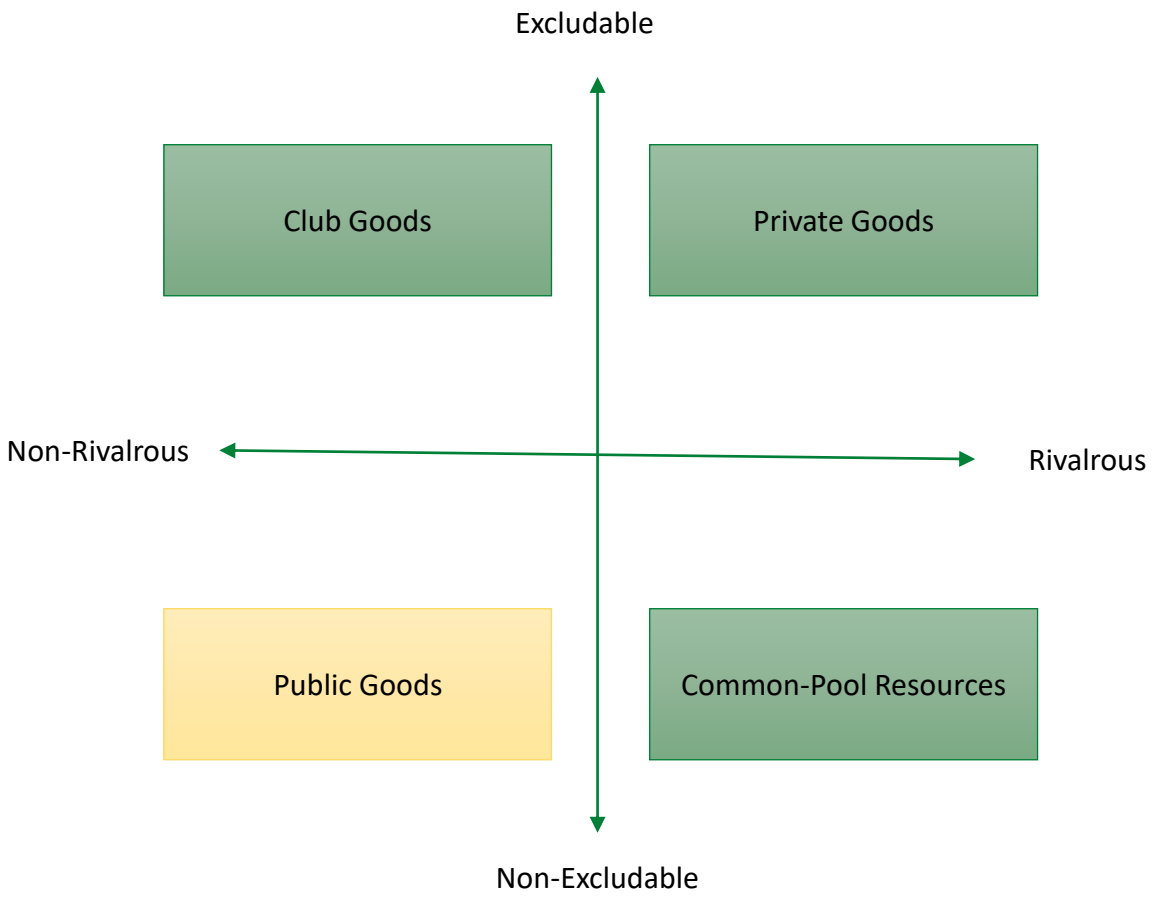
- Climate change introduces deep uncertainty both at the macro and micro-levels
- Environmental risk probability distributions do not follow normal distributions and present significant fat-tails
- Environmental risk is both idiosyncratic and systemic (i.e. non-diversifiable)
- Climate change is a market externality that is not fully priced-in
- Our current consumption of the natural capital on which our economy rests is absolutely unsustainable

- **So how do we proceed?**

How can we integrate the environment and the economy?

Putting the environment back into the market is difficult

- The main route that has been followed thus-far is to integrate the environment within the market using various mechanisms
- This has only been partially successful as the current climate crisis and environmental collapse demonstrate
- The main difficulty for this is that the environment can be viewed as a **public good** (Samuelson, *The Pure Theory of Expenditure*, 1954)
- In the absence of clearly definable property rights, public goods are a victim to the **tragedy of the commons** (Hardin, 1968): uncoordinated action of the individual actors lead to a depletion of the resources
- Only coordination either centralised (State) or decentralised (contracts) with enforceable rules can overcome this
- Coordination is rendered difficult by a strong **prisoner's dilemma** situation in which all parties have an interest in **free-riding**
- This is one of the main issues hampering international negotiations on climate change: it's not just a market failure but an institutional one



Multiple routes for coordination

Centralised coordination:

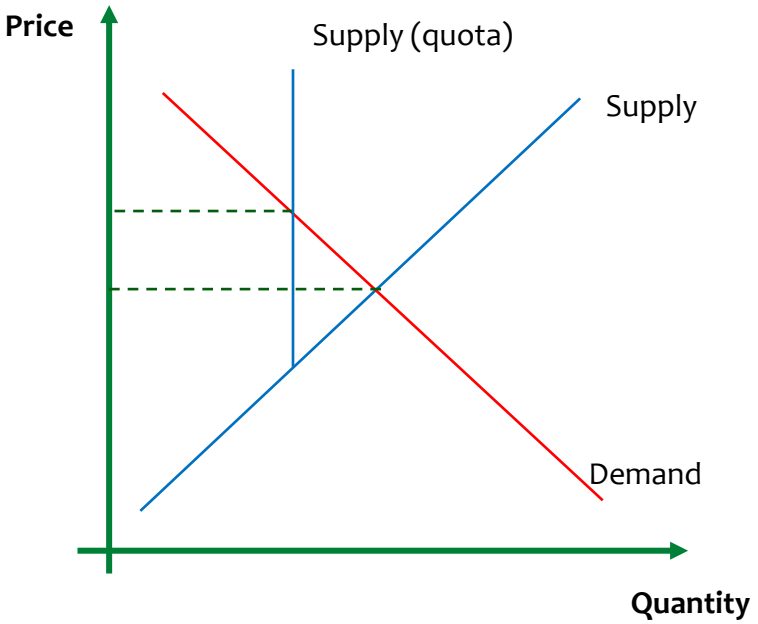
- Regulations
- Taxes
- Market-based solutions

Decentralised coordination:

- Market practices
- Self-regulation / Industry standards
- Contractual arrangements

The case for regulations

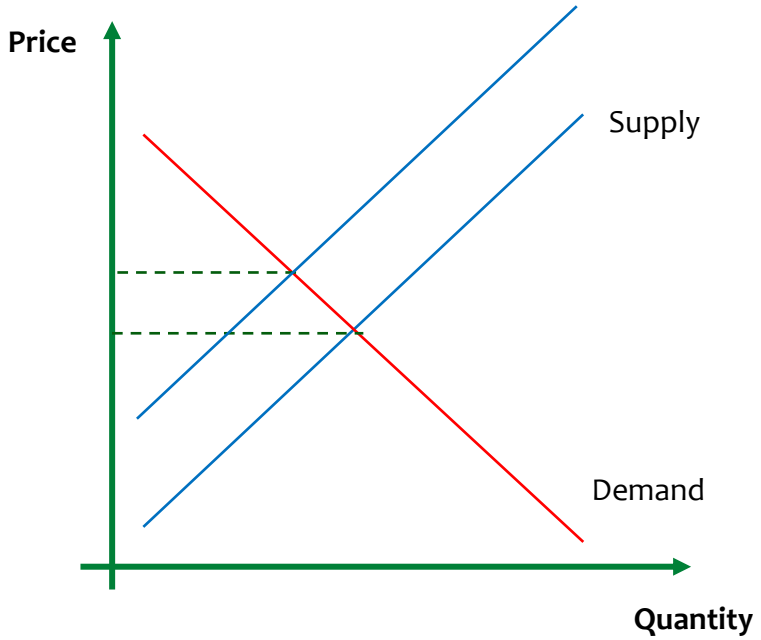
- Regulations come in very different shapes and sizes
- To the economist a regulation is a set of rules that all market participants are bound to follow
- Regulations can be positive (subsidies) or negative (restrictions, quotas)
- Subsidies will give a competitive edge to certain market players and/or technologies in order to accelerate their deployment
- They raise significant questions in terms of technological choices and market distortions (regulatory capture, competition) and are extremely delicate to fine-tune (technology agnostic auctions)
- Restrictions and quotas prohibit or restrain the commercialisation of certain products, thus creating scarcity and raising prices
- They are an effective tool for the most harmful activities but it is extremely difficult to calibrate ex-ante their social cost
- Both forms alter the market equilibrium and prices no longer reflect the preferences of the actors under perfect competition



The case of quota on production

The case for taxes

- Taxes increase the price of a good or service in order to reduce its use and provide incentives to shift to substitutes
- They do not act on the quantity provided but on their cost for the customer (i.e. there is no control over the final pollution level)
- Taxes provide the market with an explicit cost for the polluting activity, albeit set administratively (i.e. it does not reflect the value the market would give it): the question of the right price is central
- Taxes raise significant acceptability issues when no substitute products are available
- Consumption taxes are indiscriminate and affect disproportionately the least favoured segments of society
- The product of taxes can be used to subsidise these segments or to finance the development of less polluting substitutes



The social cost of carbon

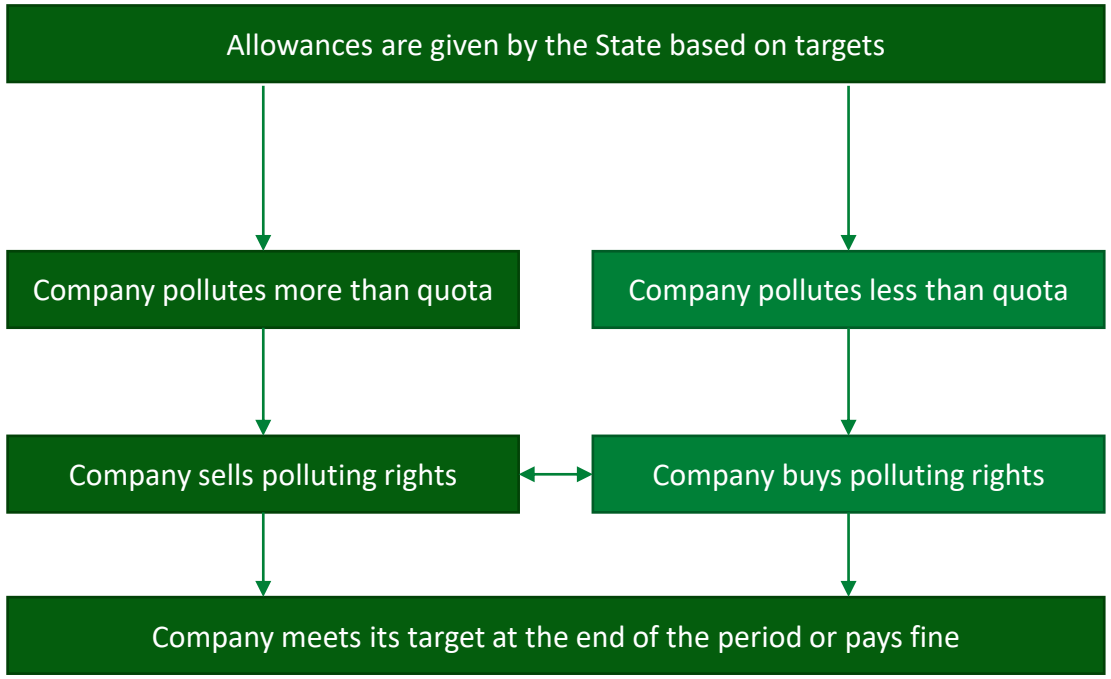
	Boiteux (2001)	Quinet 1 (2009)	Quinet 2 (2019)
2010	32	32	
2020	43	56	69
2030	58	100	250
2050	104	250	775
Growth rate	2.9%	4.9%	8.0%

Table: Social cost of carbon (in 2018 euros per metric ton of CO2) recommended in France by three different commissions. Source: France Stratégie.

Source: Christian Gollier, Du sang, des larmes et de la sueur : Les coûts de la transition énergétique, Collège de France, 2021

The case for market-based solutions

- The **Coase Theorem** (1960) explains that a Pareto optimum can be reached if property rights are attributed over a market externality, given low transaction costs
- This is the theoretical ground work for **carbon markets** where polluting rights have been given over the air
- The "**cap and trade**" mechanism allows for a centralised control over the desired level of pollution and a decentralised coordination over the most cost-effective way to achieve it
- Effectively designing such markets is nonetheless extremely complex and raises many issues (allowance allocation, size of target, leakages, international competition, fraud…)



The EU-ETS carbon market

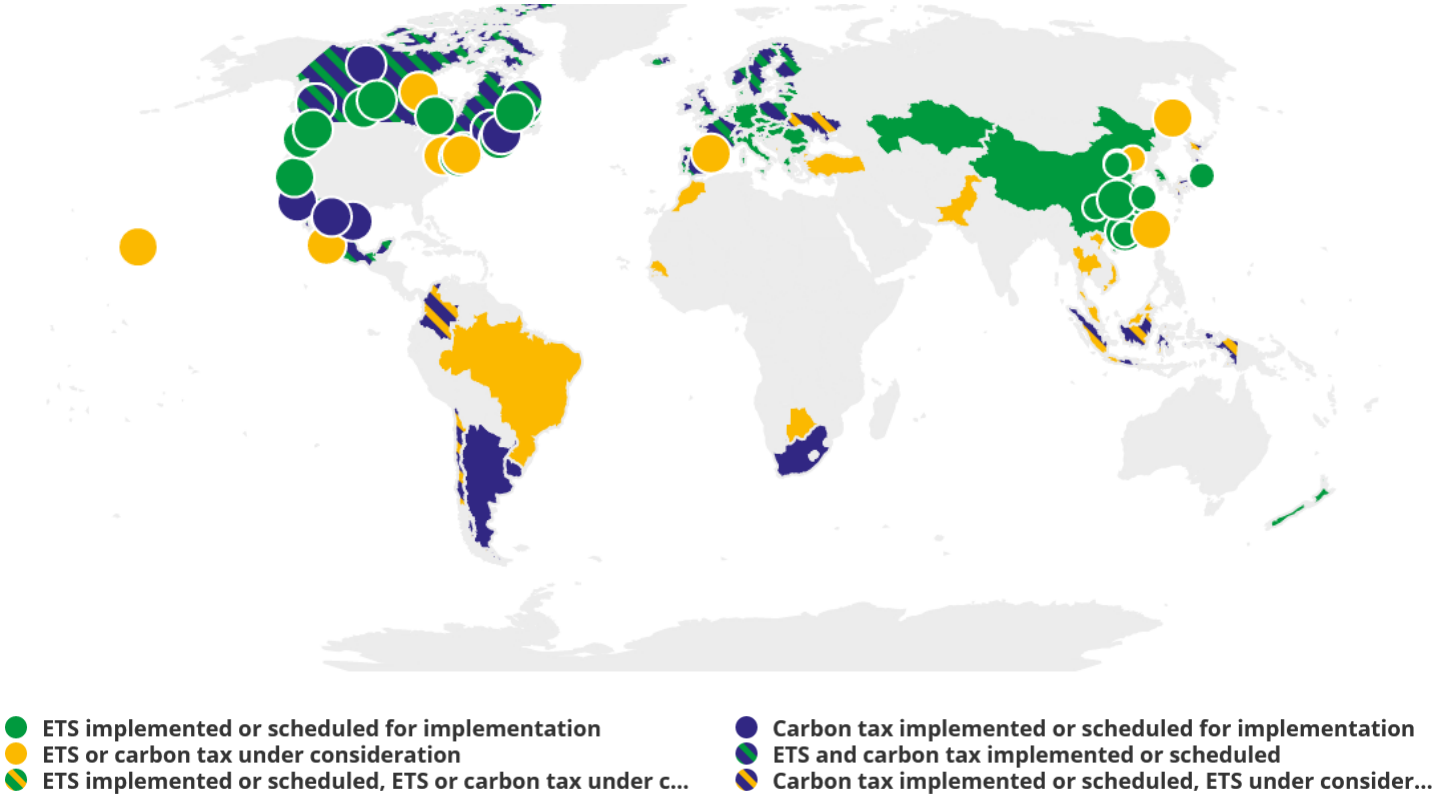
Sources: Trading Economics | EU Commission https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/development-eu-ets-2005-2020_fr | comments by the author

Carbon initiatives are spreading around the world

KEY STATISTICS ON REGIONAL, NATIONAL AND SUBNATIONAL CARBON PRICING INITIATIVE(S)

68	Carbon Pricing initiatives implemented
46	National Jurisdictions are covered by the initiatives selected
36	Subnational Jurisdictions are covered by the initiatives selected

In 2022, these initiatives would cover **11.83 $GtCO_2e$**, representing **23.11%** of global GHG emissions

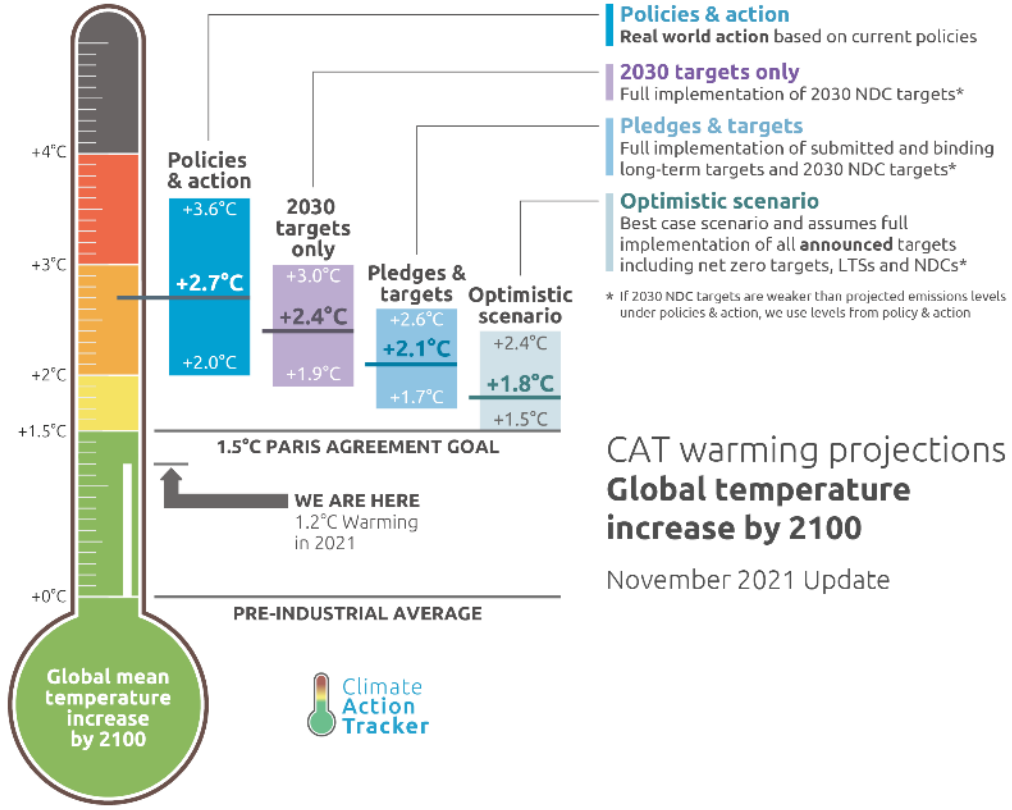


Sources: The World Bank, Carbon Pricing Dashboard ; https://carbonpricingdashboard.worldbank.org/

Achieving the Paris Agreement +1.5°C target still requires ambitious action

- One of the main difficulties is that there is a **double mismatch** :
- A **geographic and social mismatch** between those responsible for the increase in GHG concentrations and those who suffer the most from the effects of climate change
- A **temporal mismatch** between those who bear the costs today and those who benefit from the efforts (i.e. future generations)
- We will cover intertemporal issues during session 3 with valuation and discounting

- As climate change materialises, a new difficulty arises as mitigation and adaptation efforts run contrary:
- Mitigation efforts aim to reduce emissions and avoid the risk of rising temperatures
- Adaptation efforts aim to reduce the impacts of rising temperatures
- Mitigation efforts reduce the need for adaptation but investing in adaptation measures also reduces the need to act now



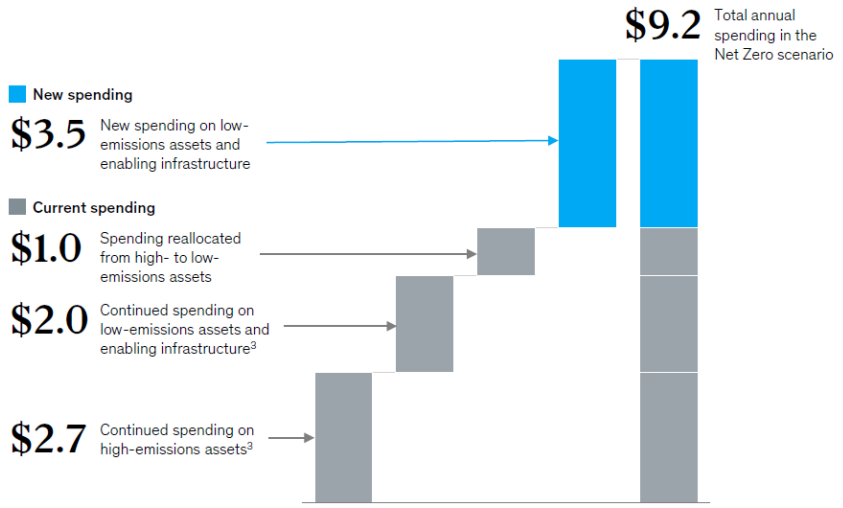
Sources: https://climateactiontracker.org/global/cat-thermometer/

Reaching Net Zero will be a massive financial effort

- McKinsey explored the costs associated with a scenario where 69 countries representing 85% of global emissions want to become carbon neutral by 2050
- Equivalent to half of global corporate profits, one-quarter of total tax revenue, and 7 percent of household spending
- These are mostly investments who yield a return and can be profitable
- **Financing these investments will be the greatest challenge of the financial industry for this century** (esp. in a rising rate environment)
- 200 million jobs created, 185 million jobs destroyed
- Effort will not be evenly shared as the most polluting sectors (20% of global GDP) will face dire perspectives
- Poorer countries and those reliant on fossil fuels are more exposed to negative consequences of changes

Spending on physical assets for energy and land-use systems in the NGFS Net Zero 2050 scenario would rise to about $9.2 trillion annually, or about $3.5 trillion more than today.

Annual spending on physical assets for energy and land-use systems[1] in the Net Zero 2050 scenario,[2] average 2021–50, $ trillion

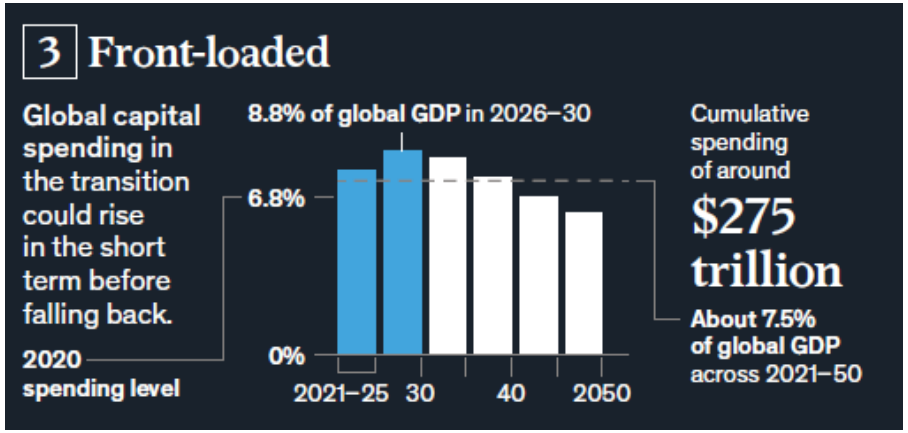


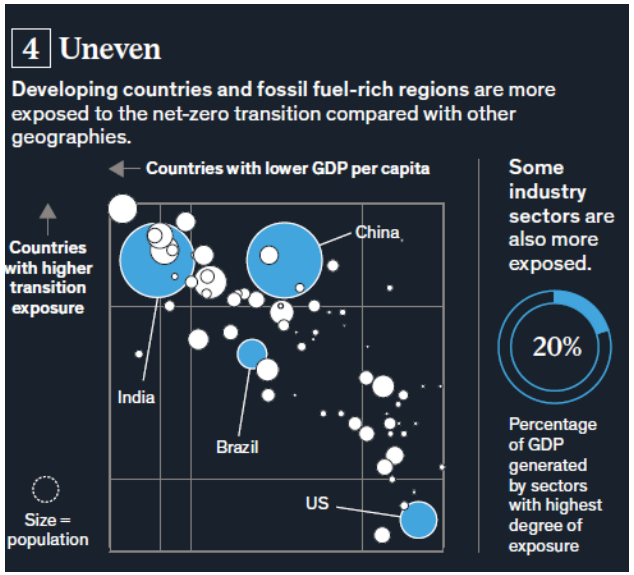
1. We have sized the total spending on physical assets in power, mobility, fossil fuels, biofuels, hydrogen, heat, CCS (not including storage), buildings, industry (steel and cement), agriculture, and forestry. Estimation includes spend for physical assets across various forms of energy supply (eg, power systems, hydrogen, and biofuel supply), energy demand (eg, for vehicles, alternate methods of steel and cement production), and various forms of land use (eg, GHG-efficient farming practices).
2. Based on the NGFS Net Zero 2050 scenario using REMIND-MAgPIE (phase 2). Based on analysis of systems that account for ~85% of overall CO_2 emissions today. Spend estimates are higher than others in the literature because we have included spend on high-carbon technologies, agriculture, and other land use, and taken a more expansive view of the spending required in end-use sectors.
3. Our analysis divides high-emissions assets from low-emissions assets. High-emissions assets include assets for fossil fuel extraction and refining, as well as fossil fuel power production assets without CCS; fossil fuel heat production, gray-hydrogen production; steel BOF; cement fossil fuel kilns; ICE vehicles; fossil fuel heating and cooking equipment; dairy, monogastric, and ruminant meat production. Low-emissions assets and enabling infrastructure include assets for blue-hydrogen production with CCS; green-hydrogen production using electricity and biomass; biofuel production; generation of wind, solar, hydro-, geothermal, biomass, gas with CCS, and nuclear power along with transmission and distribution and storage infrastructure; heat production from low-emissions sources such as biomass; steel furnaces using EAF, DRI with hydrogen, basic oxygen furnaces with CCS; cement kilns with biomass or fossil fuel kilns with CCS; low-emissions vehicles and supporting infrastructure; heating equipment for buildings run on electricity or biomass, including heat pumps; district heating connections; cooking technology not based on fossil fuels; building insulation; GHG-efficient farming practices; food crops, poultry and egg production; and land restoration.

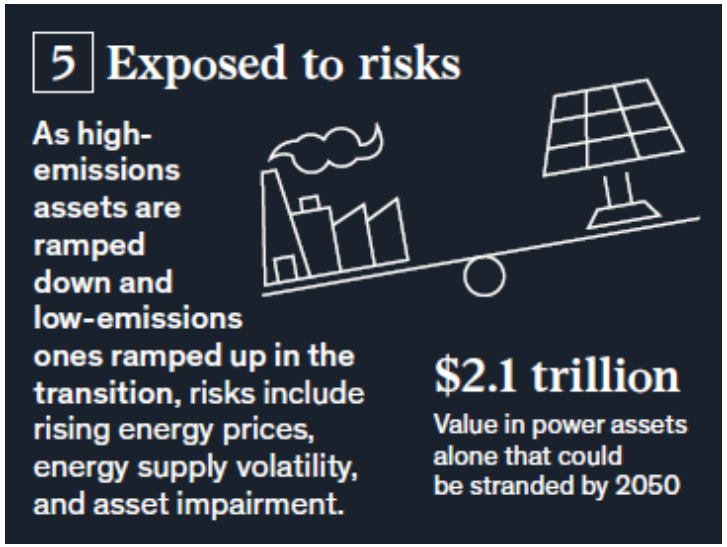
Source: McKinsey Center for Future Mobility Electrification Model (2020); McKinsey Hydrogen Insights; McKinsey Power Solutions; McKinsey–Mission Possible Partnership collaboration; McKinsey Sustainability Insights; McKinsey Agriculture Practice; McKinsey Nature Analytics; McKinsey Global Institute analysis

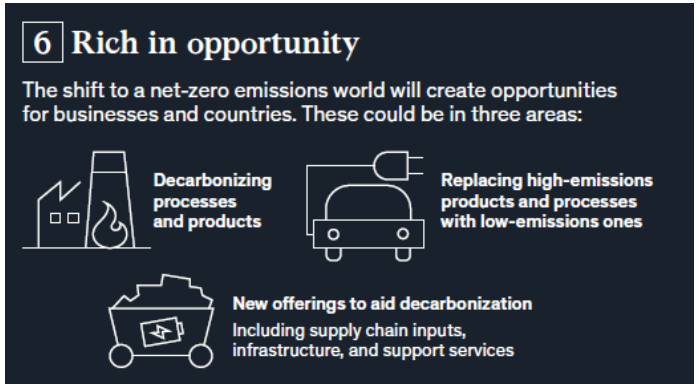
Sources: McKinsey, The Net-Zero Transition, What it would cost, what it would bring, 2022, Report, 224 pages.

Additional elements on Net Zero









Sources: McKinsey, The Net-Zero Transition, What it would cost, what it would bring, 2022, Report, 224 pages.

Many questions have been raised and remain without answers

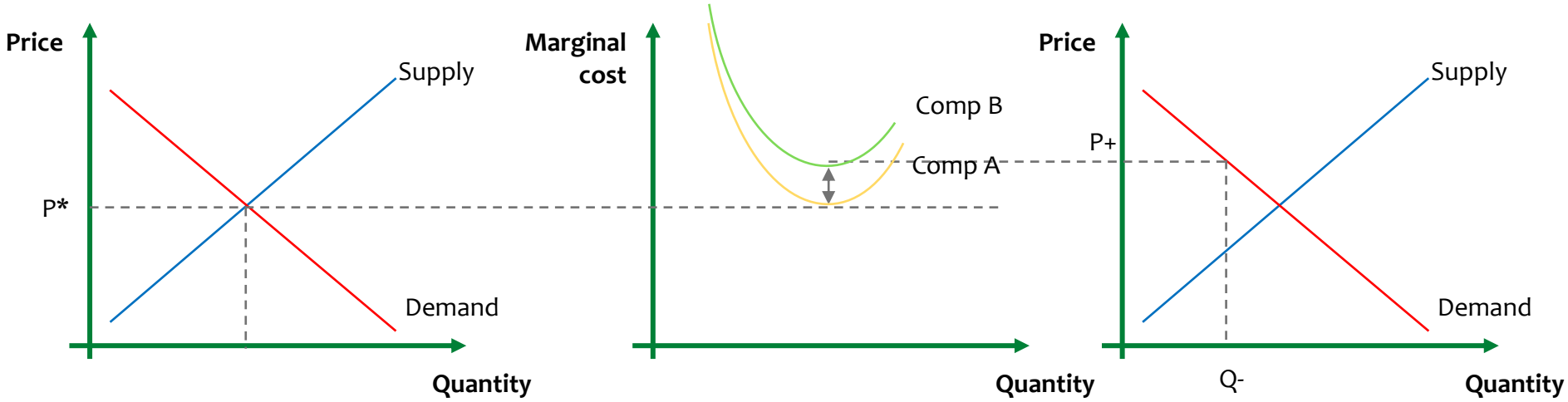
- Climate change and the green transition is the biggest economic challenge of the 21st century
- The fundamentals of our market economy do not allow for a full integration of this necessary effort without public intervention
- There is a radical uncertainty concerning both climate change and the policy measures that need to be deployed
- Currently the measures that are planned, even in the most optimistic scenarios, are insufficient to prevent dramatic evolutions
- Many (most) of the aspects of the current environmental crisis are left unaddressed

- At this stage, the main commitment is the Paris Agreement under which parties have agreed to implement national measures in order to limit temperature growth to 1.5°C by the end of the century. For Europe, it means reaching **carbon neutrality** by 2050.

How does this translate for the financial management of a company?

Acting for the environment is a business decision

- Any deflection of resources from the primary economic objective of the company (i.e. make profits) is a cost that has to be paid for by either the shareholders, the clients or the employees (Friedman, 1970)
- This use of resources has an impact on the market position of the company as it deteriorates its price competitiveness
- In a situation of perfect competition (multiple producers without any market power), only a shift in demand can change corporate behaviours
- In a real life situation, the level of competition on the market will determine who will bear the cost



In the absence of regulation, markets decide

- Emmanuel Faber, CEO of Danone
- Entreprise à Mission
- “One Planet, One Health” strategy
- Carbon adjusted earnings per share indicator

$$EPS_{Carbon\ Adjusted} = EPS - \frac{Cost\ of\ Carbon}{NOSH}$$

With:

$$Cost\ of\ Carbon = Emissions * Price\ of\ Carbon$$

N.B.: Danone used an internal price of carbon of €35/t

- Danone’s performance was lagging behind its main competitors
- Emmanuel Faber was ousted by minority shareholders in 2020

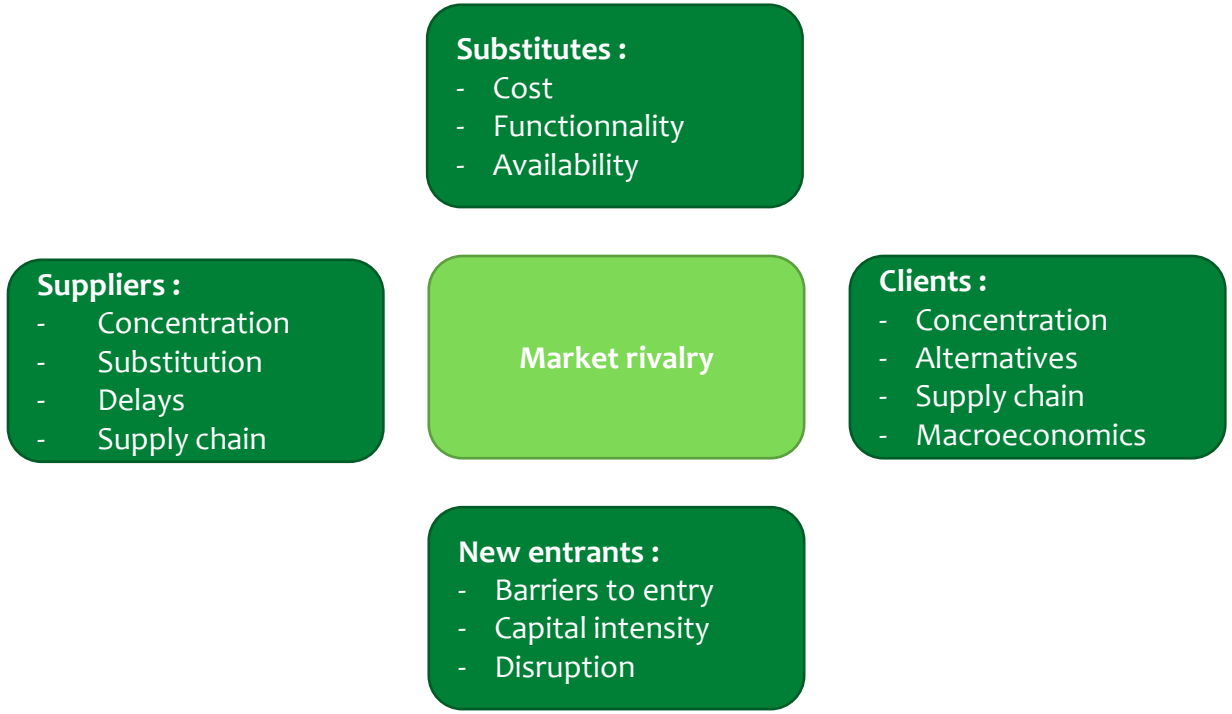
Sources: Danone 2020 Annual Report, https://integrated-annual-report-2020.danone.com/wp-content/uploads/2020-Danone-Methodology-Note.pdf

Acting for the environment is a strategic decision

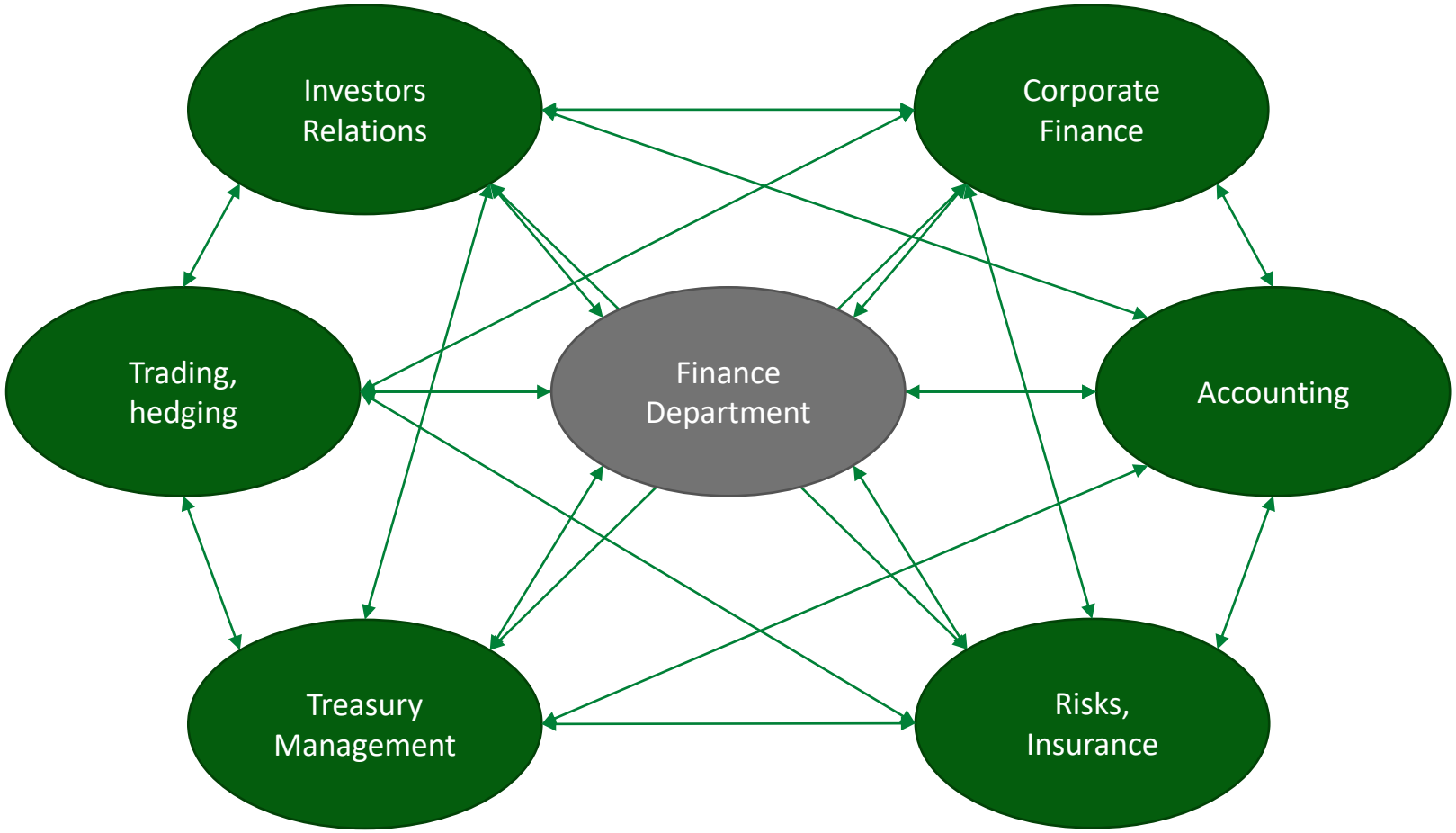
- In the absence of regulation, to be sustainable, a business decision to act for the environment must **create value for the company** (or at least maintain competitivity)
- Each company is part of a **value chain** and its environmental approach must be proportionate to what its environment allows (i.e. hyper-competitive unregulated markets are not environmentally friendly)
- This where **ESG departments** come in as they have to reconcile competing forces and work with all the stakeholders of the company
- ESG is not the sole responsibility of the ESG department but a collective internal effort

- **So where does the finance department stand on this?**

Porter's 5 forces



The many different jobs of a finance department



Internal Control

Legal, Compliance

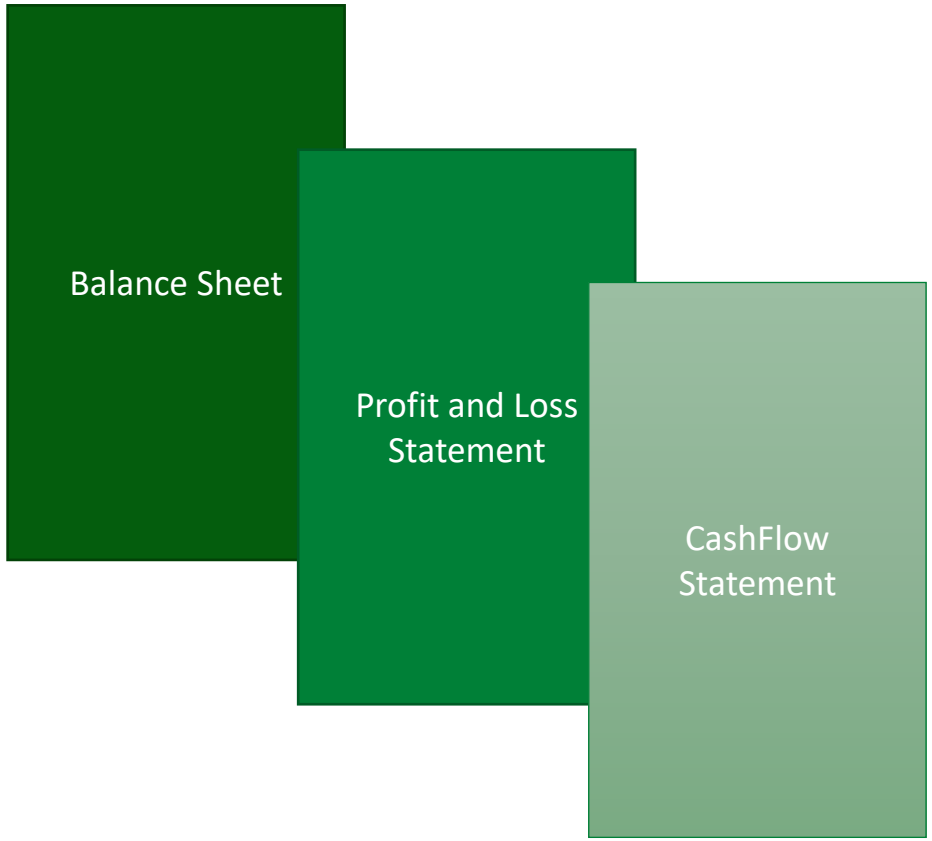
Auditor

Banks

A refresher on financial statements

- **Balance Sheet** provides an overview of the value of the assets of a company and of the way they have been financed
- **P&L** details the resources and expenses of the company and its result increases (decreases) the value of the balance sheet
- **Cashflow statement** focuses on the cash transactions of the company discarding the non-cash items of the P&L
- Financial statements are **backward-looking**, except when they assess the value of assets and liabilities
- Management discussion may contain **forward-looking items** as they have to disclose to shareholders any information that may have a material impact on the company

IFRS definition of materiality :
Information is material if omitting, misstating or obscuring it could reasonably be expected to influence decisions that primary users of financial statements (hereafter, investors) make on the basis of those financial statements, which provide financial information about a specific company



Sources: Vernimmen, Valuation, IFRS

IFRS requirements can partially accomodate climate change

- *"Companies must consider climate-related matters in applying IFRS Standards when the effect of those matters is material in the context of the financial statements taken as a whole"*
- In preparing financial statements, management makes judgements and estimates. It is required to disclose the elements that led it to its conclusions, i.e. it is required to disclose climate related matters that were considered
- IAS 1 requires a company to disclose any material information that would not be covered in the financial statements even though it would be fully compliant with IFRS Standards. If the standard disclosures do not allow investors to fully understand the financial performance of the company, the company is required to consider making additional disclosures
- In the absence of specific requirements about environmental matters, this is a first doorway to include environmental disclosures in the financial statements

IFRS Standard	
IAS 1	Sources of estimation uncertainty and significant judgements
IAS 2	Write-down of inventories to their net realisable value
IAS 12	Recognition of deferred tax assets in light of future taxable profit
IAS 16/38	Estimated residual value and useful life of assets; R&D costs and investments
IAS 36	Impairement of goodwill and assets
IAS 37	Provisions or contingent liabilities
IAS 7	Financial Instruments : Disclosures
IAS 9	Financial Instruments
IAS 13	Fait Value Measurement
IAS 17	Insurance Contracts

Sources: IFRS, Effects of climate-related matters on financial statements, November 2020, https://www.ifrs.org/content/dam/ifrs/supporting-implementation/documents/effects-of-climate-related-matters-on-financial-statements.pdf

Examples of climate-related impacts on financial statements

Updating cashflow forecasts	▪ Expected impact of climate change and mitigation measures (carbon tax) ▪ Used in models to evaluate impairements ▪ Reduces operating margin and/or pass-through to customers
Disaggregation disclosures	▪ IFRS 15 Revenues from contracts with customers ▪ Requires to disaggregate revenues into different categories depending on their economic comparability ▪ Climate change may asymmetrically affect current categories, requiring a disaggregation
Decommissioning provisions	▪ Explain how provisions take climate transition into account ▪ Provide alternative estimates should different calendars be put in place
	▪ …

Sources: PWC, Climate change: Assessing how it could impact the financial statements, https://www.pwc.co.uk/services/audit/insights/assessing-how-climate-change-could-impact-financial-statements.html

Environmental disclosures are becoming compulsory

- In the great effort to provide markets with enough information to fully price-in climate change, the current IFRS architecture remains limited
- It does not oblige companies to disclose their own environmental performance
- States and regulators have (partially) stepped-in to force companies to disclose their environmental performance
- France has been at the forefront of those efforts :
  - 2001: Nouvelle Régulation Economique law forces listed companies to publish with their financial statements considerations about the social and environmental consequences of their activities
  - 2010: Grenelle II law introduces a right to environmental information and extends the reporting obligation to all companies above 500 employees
  - 2015: TECV law forces asset managers and institutional investors to disclose how they integrate ESG concerns in their investment strategy
- In 2014 the EU adopted the **Non-Financial Reporting Directive** (NFRD) and is now proposing a Corporate Sustainability Reporting Directive (CSRD)

FSB FINANCIAL STABILITY BOARD

TCFD | TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

Governance	**Strategy**	**Risk Management**	**Metrics & Targets**
Disclose the organization's governance around climate-related risks and opportunities.	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.	Disclose how the organization identifies, assesses, and manages climate-related risks.	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.

Sources: Ansidei, Leandri, La Finance Verte, La Découverte, Repères, 2021, 128 pages. | TCFD website: https://www.fsb-tcfd.org/

Introduction

- Tell me about yourself
- Why did you choose this class?
- What are your professional goals?
- What are your expectations from this class?