BBVA Research

Transition towards decarbonization.

Challenges, levers and investment needs

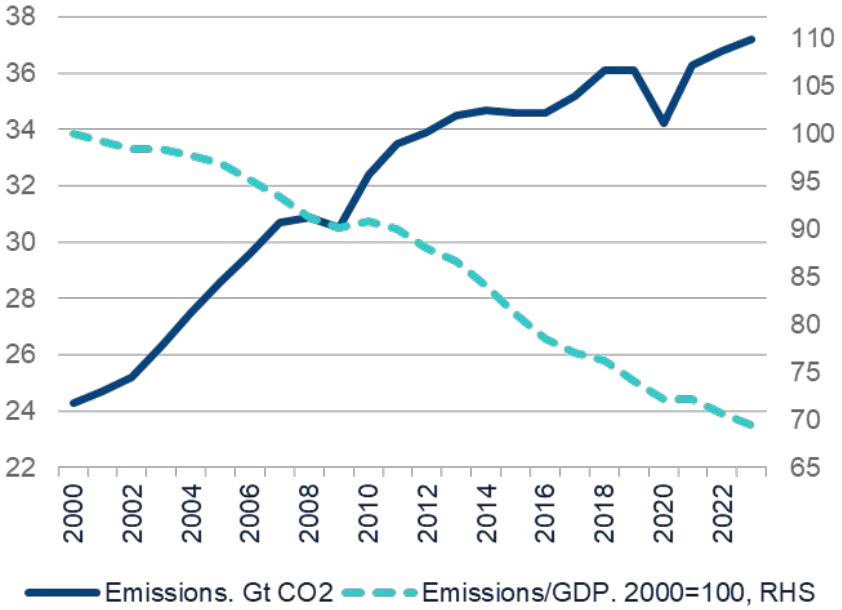
AIReF. Los retos de la reforma de la gobernanza económica de la UE.
Necesidades de inversión presentes y futuras, ¿es suficiente lo previsto dentro de la reforma del marco fiscal?

4 Julio 2024

Creating Opportunities

GHG emissions are growing less than the global economy, but are still accumulating in the atmosphere and thus aggravating climate change

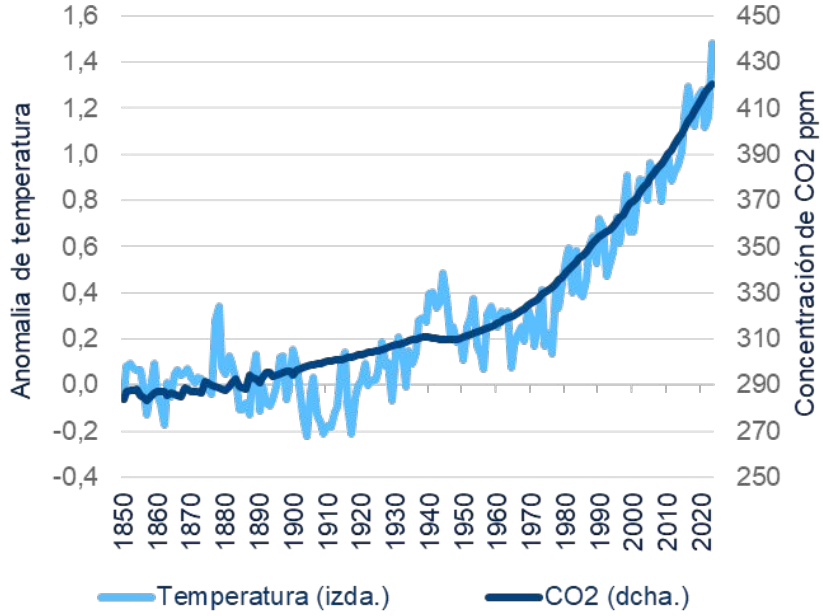
GLOBAL CO2 EMISSIONS FROM ENERGY COMBUSTION AND INDUSTRIAL PROCESSES



Fuente: BBVA Research a partir de IEA 2023

CO2 CONCENTRATION AND GLOBAL TEMPERATURE 1850-2023

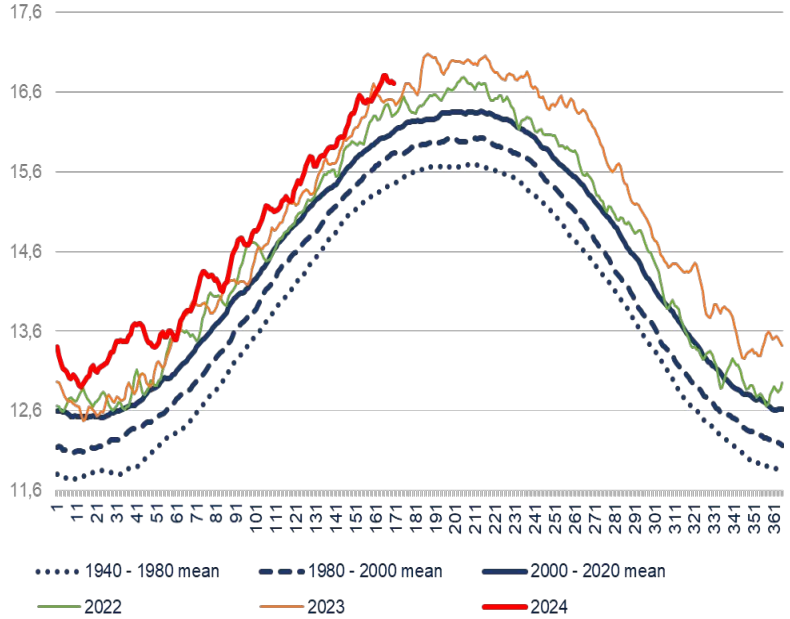
CO2 PPM AND TEMPERATURE GAP VS 1850-1990 AVERAGE



Fuente: BBVA Research a partir de Copernicus, NOAA y OurWorldinData.

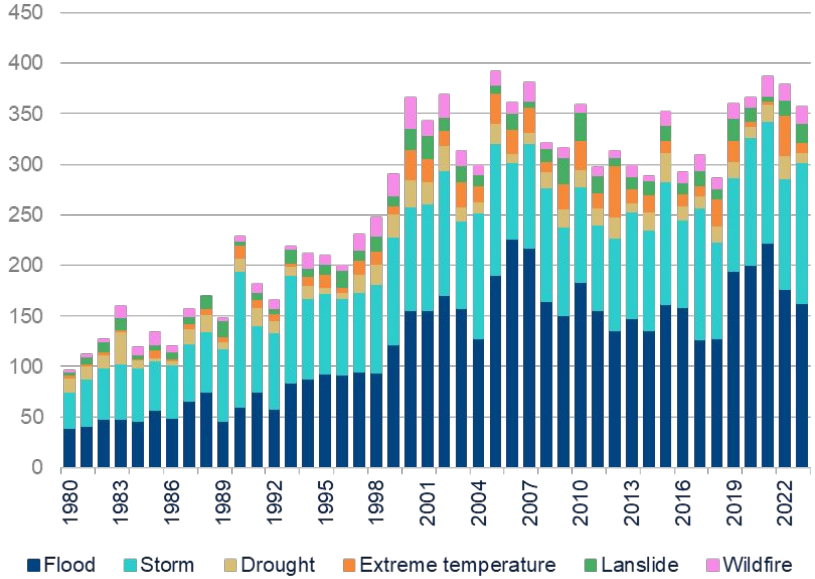
GHG-induced temperature rise accelerates, increasing frequency of extreme weather events

WORLD TEMPERATURE EVOLUTION (ºC)
1940-2024



Fuente: BBVA Research a partir de Daily 2-meter Air Temperature.

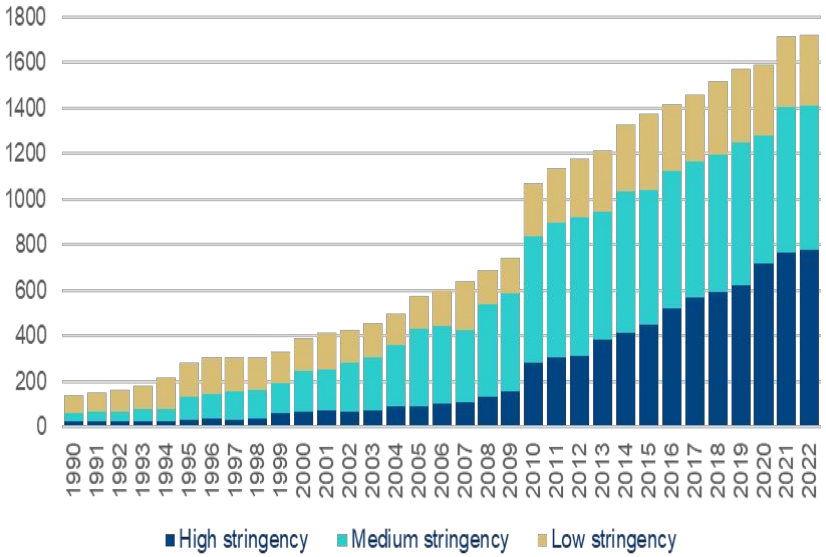
WORLD CLIMATE-RELATED ACUTE EVENTS
1980-2023



Fuente: BBVA Research a partir de EM-DAT

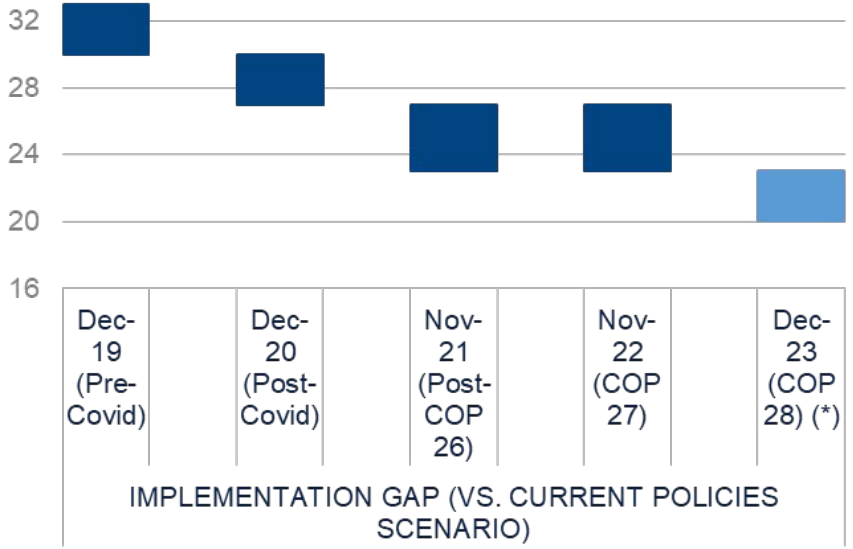
Climate policies improve in number and ambition, but they are still insufficient to achieve 'net zero' by 2050

ADOPTED CLIMATE POLICIES AND STRINGENCY DEGREE (1990-2022)



Source: BBVA Research from IPAC | International Programme for Action on Climate | Dashboard - OECD
Notes: The improvement in 2010 is due to data availability from 2010 onwards. High stringency includes stringency values 8-10, medium stringency 4-7 and low stringency 1-3.

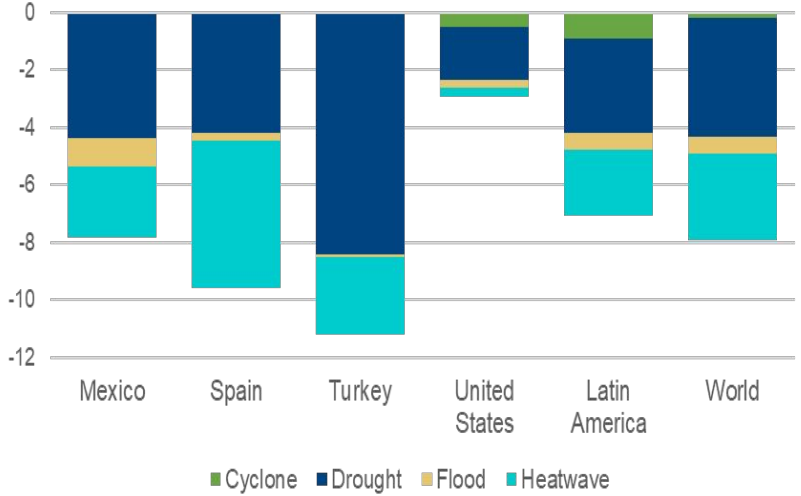
WORLD. IMPLEMENTATION GAP FOR NET-ZERO GOAL (2030 Gap, GtCO2E)



(*) likely achievable on top of current NDCs based on current signatories. See "COP28 initiatives will only reduce emissions if followed through", CAT Dec-23.
Source: BBVA Research from Climate Action Tracker

No further climate action is not an option

IMPACT ON GDP IN 2050 BASED ON A CURRENT POLICIES SCENARIO DIFFERENCE IN PP (2017 PPP)
IMPACT RELATIVE TO A REFERENCE SCENARIO W/O CLIMATE CHANGE



- The NGFS Phase IV of climate scenarios introduces an updated and improved assessment of acute physical risks, including heatwaves, droughts, river floods, and tropical cyclones.
- The projected economic impact of these hazards could lead to an **8% World GDP loss** by 2050 under a Current Policies scenario.
- Beyond the size of the impact, in the process of calibration improvement, most countries face the long-term effects of droughts and heatwaves.

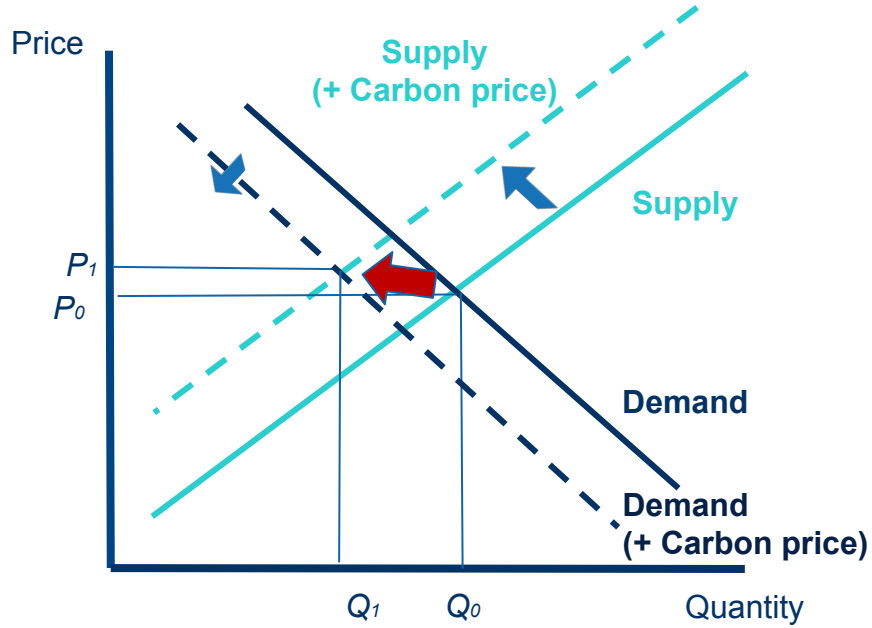
Source: BBVA Research based on NGFS Phase IV.

- The above figure shows how GDP is impacted across scenarios compared with a hypothetical (and impossible) reference scenario in which no transition or physical risks occur.
- The displayed results correspond to damages using the 80th percentile of the modeling results, with the 100th percentile representing the most severe impact. NGFS has not yet released the impact with the median, which would be more logical, and provides impacts with high percentiles, amplifying the damage.

Transition towards decarbonization:

1. Carbon pricing: Internalize the social cost of carbon

THE IMPACTS OF CARBON PRICING

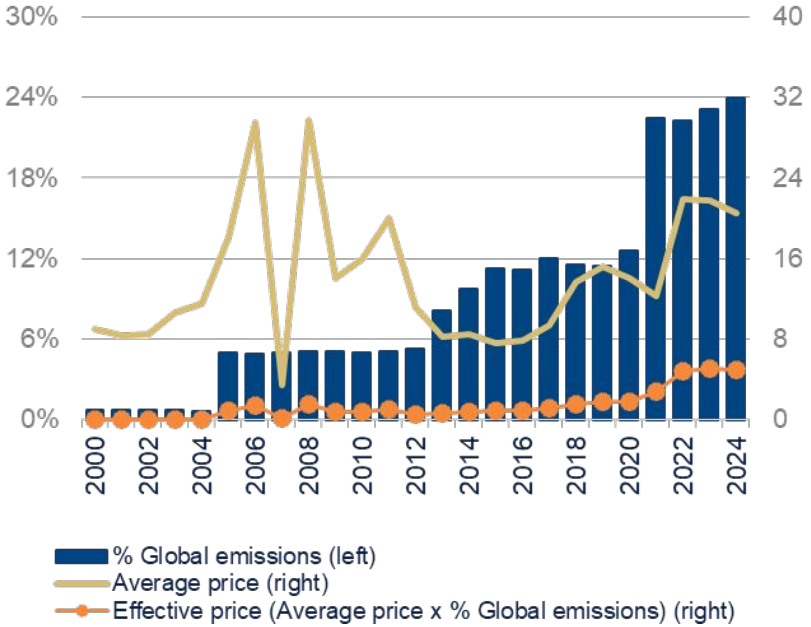


- Putting a price on carbon shifts the demand and supply curves of goods and services that are more intensive in their use, reducing their production and demand.
- Public policy intervention is necessary to correct the negative economic externality of GHG emissions (Andrés et al., 2024b).
- Carbon pricing instrument:
  - Emission standards.
  - Taxes.
  - Market instruments (allowances, credits).

Source: BBVA Research.

Carbon Pricing: Positive progress, but insufficient and challenging to ensure a just energy transition both within and across countries

WORLD. CARBON PRICING
(% OF TOTAL EMISSIONS AND AVERAGE OF DIFFERENT INITIATIVES, USD)



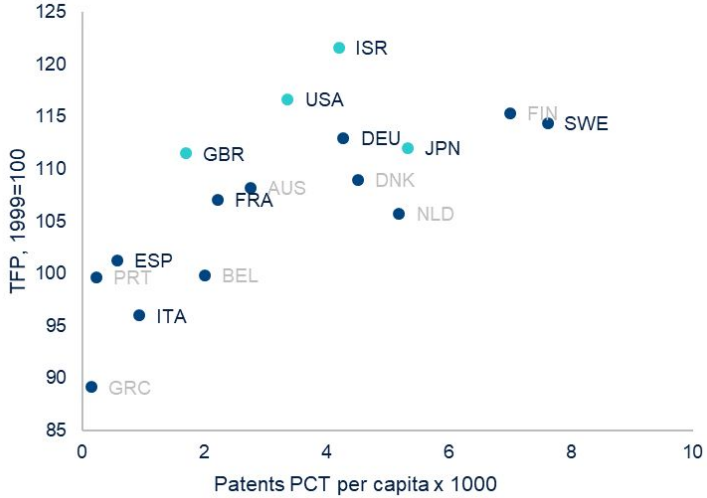
Source: BBVA Research from World Bank. State and Trends of Carbon Pricing 2024

- Carbon pricing policies will cover around 30% of global GHG emissions if current agreements are met.
- Prices remain low, below projections for achieving net-zero emissions by 2050.
- Distributive impact has to be managed:
  - Within countries: Exposure to decarbonization varies greatly by consumption level (evidence for Spain: Barrutiabengoa et al, 2023) SEE MORE
  - Across countries: Internalising the social cost of CO2 emissions reduced welfare in OECD countries from 2010 to 2019 by 2.1% on average, but with significant differences between countries (Andrés et al., 2023) SEE MORE

2. Innovate, 'green' investment to transform the economy

PATENTS AND PRODUCTIVITY

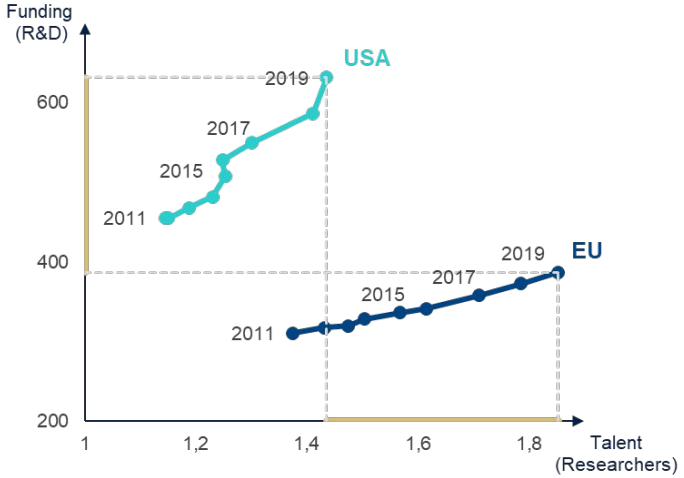
PATENTS PER CAPITA AND TFP



Source: Europe | European Deep Science Technologies: The time for Science Equity is now | BBVA Research y BeAble Capital

INNOVATION. TALENT AND FINANCE

NUMBER OF RESEARCHERS AND R&D FUNDING (*)



Source: BBVA Research from OECD data. (*) R&D in billion constant USD (2015 prices and PPPs). Researchers in billion total researchers, full time equivalent..

Innovation is the lever of productivity, shaping the long-term potential growth of an economy

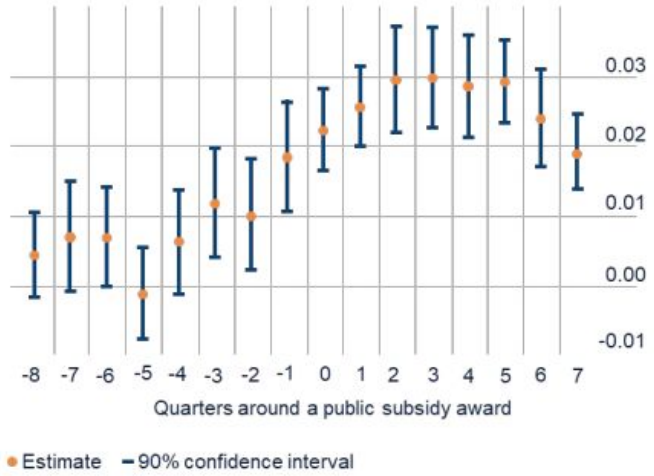
Europe leads in innovation closer to basic science, but there is room for improvement in financing, which facilitates activity and employment. (Venture capital: 0.03% EU GDP vs. 0.4% USA GDP)

“Deep Science”: Investment opportunity to decarbonize, with public participation and a single capital market in Europe

Public financing, mainly in the initial stages of projects, helps attract private investment.

SEE MORE

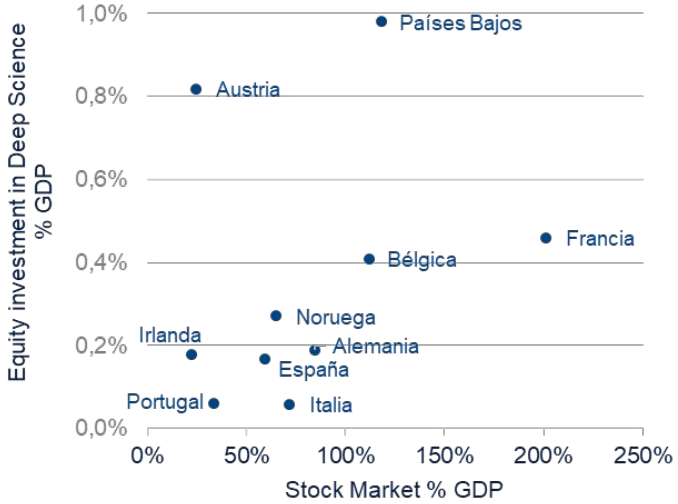
EFFECT OF RECEIVING PUBLIC AID ON THE PROBABILITY OF ACHIEVING PRIVATE FINANCING



Source: Giulio Cornelli, Jon Frost, Leonardo Gambacorta and Ouarda Merrouche. Climate tech 2.0: social efficiency versus private returns. BIS Working Papers 1072. February 2023.

In Europe, the transition of successful investments from venture capital to stocks is difficult, also with fragmented stock markets.

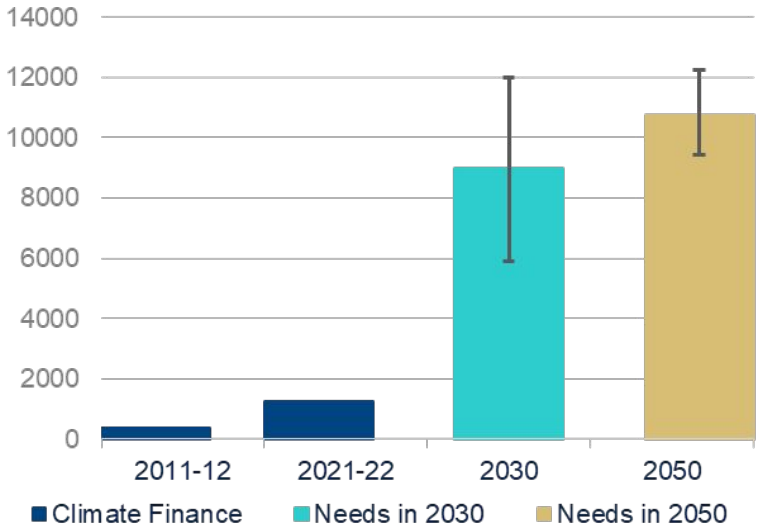
UE: EQUITY INVESTMENT IN “DEEP SCIENCE” AND EQUITY MARKET. 2023, % PIB



Source: Europe | European Deep Science Technologies: The time for Science Equity is now | BBVA Research y BeAble Capital

The amount of climate investment needs depends on the range of “needs” and the reference scenario

WORLD. CLIMATE FINANCE. GLOBAL TRACKING AND AVERAGE ESTIMATED ANNUAL NEEDS(*)
(USD BILLION)



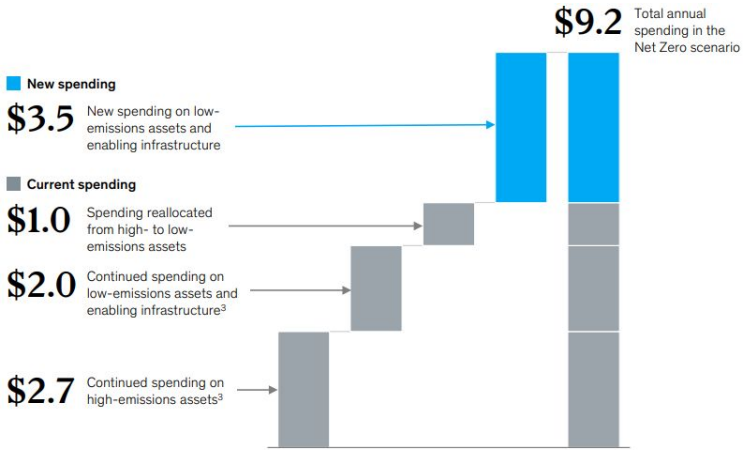
(*) Direct investments in climate-specific physical assets and excludes transition-related unabated fossil fuel finance. Estimates are based on secondary data collected from over 15 sectoral scenarios (see Methodology document for detail). Climate finance needs for 2023-2050 are expressed in 2022 USD to ensure comparability of estimates from several different scenarios.
Source: BBVA Research from Global Landscape of Climate Finance 2023

- **Climate Policy Initiative**: Average annual **climate finance(**) flows** reached almost USD 1.3 trillion in 2021/2022, nearly doubling compared to 2019/2020 levels.
- **Climate finance must increase by at least five-fold annually by 2030** (USD 9 trillion), as quickly as possible, to avoid the worst impacts of climate change.

(**) Climate finance flows tracked in CPI report represent targeted climate mitigation and adaptation specific project-level allocation of capita

The amount of climate investment needs depends on the range of "needs" and the reference scenario

ANNUAL SPENDING ON PHYSICAL ASSETS FOR ENERGY AND LAND-USE SYSTEMS[1] IN THE NET ZERO 2050 SCENARIO[2] AVERAGE 2021–50.(USD TRILLION)



(1) 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, energy demand, and various forms of land use.
(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.
Source: The net-zero transition What it would cost, what it could bring. McKinsey. January 2022.

- **Climate Policy Initiative**: Average annual **climate finance(**) flows** reached almost USD 1.3 trillion in 2021/2022, nearly doubling compared to 2019/2020 levels.
- **Climate finance must increase by at least five-fold annually** (USD 9 trillion), as quickly as possible, to avoid the worst impacts of climate change.
- **McKinsey**: 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, **$3.5 trillion more than today.**
- Although **the amount of both analyses is similar**, they **differ in their definition** ("brown" energy spending) and **reference scenarios.**

UNCERTAINTY AND CLIMATE CHANGE ANALYSIS

(**) Climate finance flows tracked in CPI report represent targeted climate mitigation and adaptation specific project-level allocation of capita

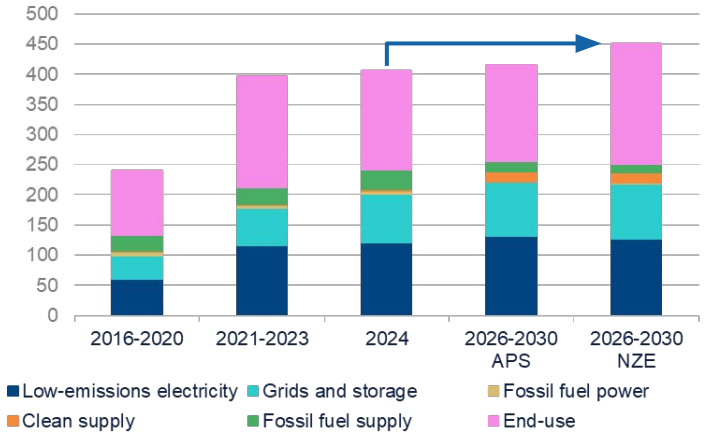
As regards the EU, uncertainty about investment needs remain; anyway, to meet ambitious targets there is a funding gap, both public and private

International Energy Agency: **USD 45 billions is the EU annual investment gap in the period 2026-2030** between current expenditure in clean energy & end uses to keep a consistent pathway with NZE.

ECB. EUR 600 billions is the EU annual additional investment need in the period 2025-31 to "move forward with the green transformation…"[1]

EU. ENERGY AND END-USE INVESTMENT IN THE APS(*) AND NET ZERO EMISSIONS BY 2050 SCENARIOS

(USD BILLIONS, 2023 MER)

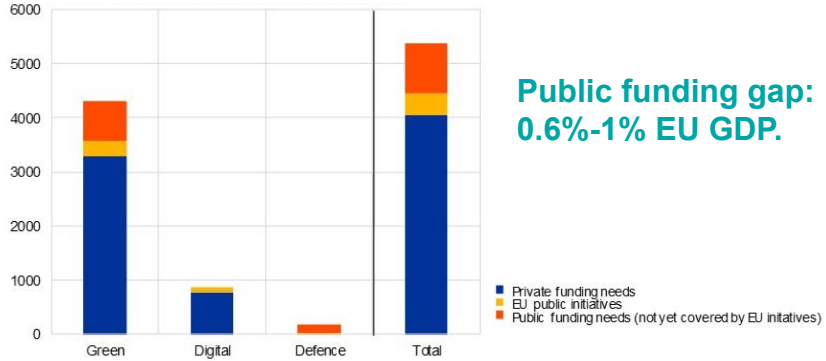


(*) APS: Announced Pledges Scenario

Source: BBVA Research from European Union – World Energy Investment 2024 – Analysis - IEA

EU. ADDITIONAL ACCUMULATED INVESTMENT NEEDS AND ITS FUNDING. 2025-2031

(EUR BILLIONS)



Public funding gap: 0.6%-1% EU GDP.

The chart shows the additional investment which is the difference between total investment needs and historical averages.

'(1) green investment needs include estimated investment under Fit-for-55 package, RePowerEU (excluding fossil fuel investments), Net-Zero Industry Act and environment protection.

Source: Mind the gap: Europe's strategic investment needs and how to support them

On public funding gap for the green transition, the new EU fiscal governance would be more favourable than previous framework

GOVERNMENT DEBT RATIOS AND PRIMARY BALANCE IN THE EU COUNTRIES. 2024
(% GDP)

The line separates the combinations of debt and primary budget balance into two regions. Above the line, the primary budget balance increases more rapidly than public debt, eventually reaching a steady state. Below the line, the opposite occurs: public debt increases more rapidly than the primary budget balance, leading to paths where public finances are unsustainable.
Source: BBVA Research from Comisión Europea (mayo 2024) and Doménech y González-Páramo (2017)

- **Fiscal positions** are well different across the EA, with some high-debt countries having large underlying fiscal deficits.
- **New EU Fiscal Governance**, anchored around primary expenditure pathways consistent with fiscal consolidation (plausible declining paths of debt), may give some **leeway for strategic investments**:
  - **Lessened annual fiscal adjustment** with credible investment and reform plans.
  - **1.5% GDP structural deficit is allowed**, higher than under previous rules.
- **As the public sector can only partially fund the green transition**, fostering private investment and advancing the **completion of the Banking and Capital Markets Union** will be essential.

FULL DETAILS

Much more than a new fiscal framework should come, as Letta Report highlights: single market deepening, streamlining administrative burden and targeted funding

LETTA REPORT. ENERGY TRANSITION, ENVIRONMENTAL SUSTAINABILITY AND COMPETITIVENESS

Topic	Challenge	Recommendation
Renewable Energy Transition	• High energy costs, fossil fuels dependency. • Electricity prices divergence. • Limited infrastructure for energy transition.	• **Market integration**, **cross-border electricity trading**, **deployment of renewables.** • **Robust, continent-wide infrastructure networks** for electricity, hydrogen, CCS.
Environmental Sustainability	• Fragmented standards & regulations. • Raw materials dependency. • Cleantech: High cost & slow adoption.	• **Streamline regulatory processes.** • **Critical Raw Materials Act**, **recycling**, **global partnerships for trade diversification.** • **New financial instruments**, Green Bonds, **Clean Energy Delivery Agency.**
Climate Change Mitigation	• Ambitious emission reduction targets. • Inadequate funding for green tech scale-ups.	• **Mobilize private and public investment**, establish a **Savings and Investments Union**, and **streamline funding access for clean technologies.** • Provide **targeted funding** for growth, project finance, and commercial rollouts without diluting ownership.
Competitiveness	• Uneven playing field for clean technology industries. • High 'green premium' for clean technologies.	• Adopt **proactive de-risking policies**, bolster clean tech manufacturing, and foster credit enhancement models. • **Reduce time to market for clean technologies**, simplify access to funds, and replicate successful execution models.

Letta's report makes a case for single market deepening, critical to:

- **boosting investment** to finance Europe's needs;
- **lowering decarbonisation costs**;
- **strengthening Europe's** ability to **defend** itself;
- and **making it easier for companies to grow and achieve scale**.

How?

- Simplifying and reducing **EU administrative burden**
- **Reinforcing market integration:** energy, savings & investments union
- **Targeted public funding** for R&D and innovation.

Source: A Single Market to strengthen Europe, including energy and climate policies. BBVA Research. 7 June 2024.

Transition towards decarbonization. Takeaways

Challenges

- Unequivocal evidence of anthropogenic global warming over the past 150 years.
- Climate policies are advancing insufficiently to make a net-zero scenario likely.
- Inaction is not an option: Increasing physical climate risks, in addition to transition risks if coordinated, and long-term oriented policies, are not deployed.

Levers

- Carbon pricing: Positive progress, but insufficient and challenging to ensure a just energy transition within and across countries.
- Innovate, “green” investment to transform the economy: In Europe there is room to improve the investment opportunity to decarbonize with public participation and a single capital market.

Investment Needs

- The amount of climate investment needs depends on the range of “needs” and the reference scenario.
- Uncertainty is the signature feature of climate change in measurement, modelling, and in deriving economic impacts on the economy.
- EU: To meet ambitious targets there is a funding gap, both public and private.
- EU, tackling the funding gap: The new EU fiscal governance would be more favourable than previous framework, but much more is needed: Single market deepening, streamlining administrative burden, targeted funding.

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4 Julio 2024

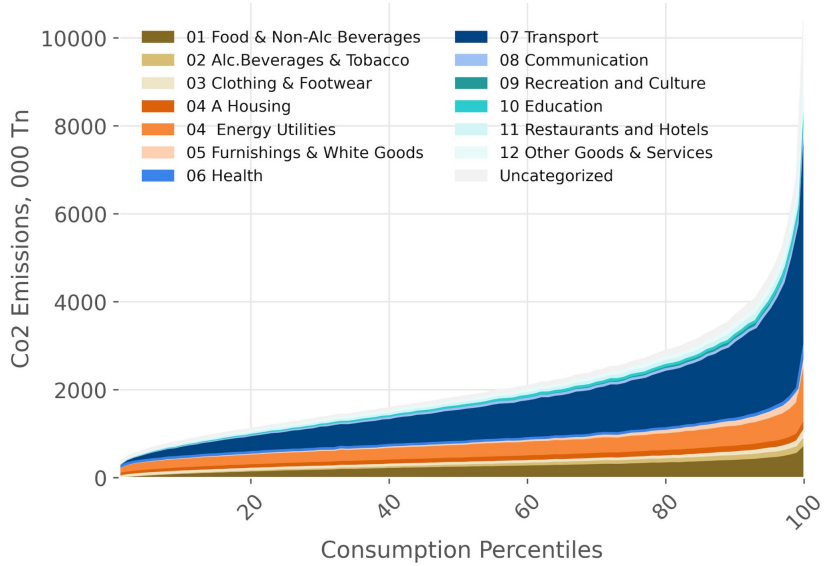
Creating Opportunities

Internalize the costs of carbon for society and redistribute its impact … within countries

RETURN

CONSUMPTION AND CO2 EMISSIONS IN SPAIN. 2021

HOUSEHOLD CONSUMPTION EXPENDITURE PERCENTILES AND EMISSION LEVELS



Exposure to decarbonization varies greatly by consumption level (evidence for Spain)

- Distributional Accounts for Greenhouse Gas Emissions (GHG) for Spanish Households combining a Standard Input-Output approach and a novel rich BigData database based on financial transactions.
- A notable inequality exists in CO2 emissions, which is closely aligned with consumption but tends to be lower compared to income.
- The primary contributor to emissions inequality is the higher consumption of transport among affluent individuals. In contrast, housing CO2 emissions by households (including shelter services and energy utilities) demonstrates a more balanced distribution, with relatively higher consumption and GHG emissions utilization observed in the lower percentiles of consumption.

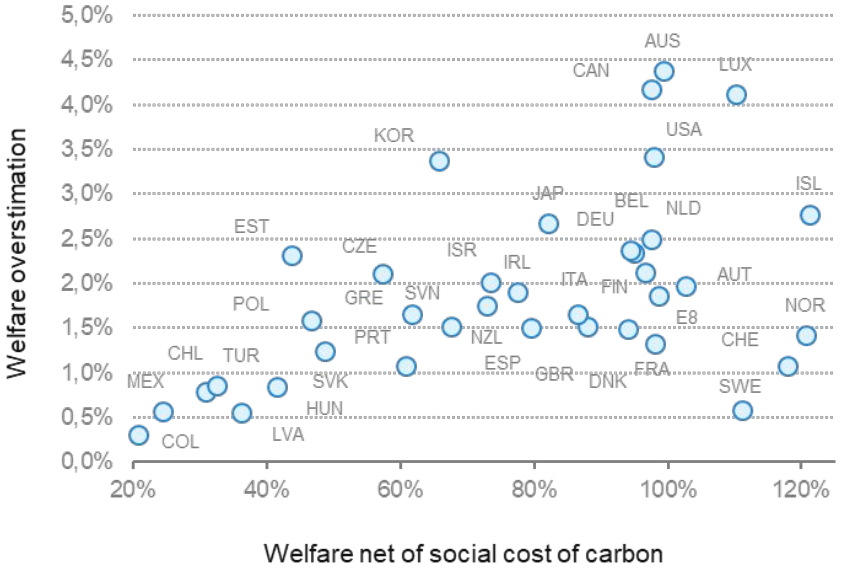
Source: BBVA Research, The Spanish Households' Carbon Footprint Inequality in High Definition & Real Time

Internalize the costs of carbon for society and redistribute its impact … and across countries

RETURN

OECD COUNTRIES. WELFARE OVERESTIMATION DUE TO NOT INCLUDING CO2 EMISSIONS.

Average 2010-19. Welfare relative to the US's



Source: J. Andrés, J.M. Barrutiabengoa, J. Cubero and R. Doménech, Global | Social Welfare and the Social Cost of Carbon | BBVA Research. April 2023

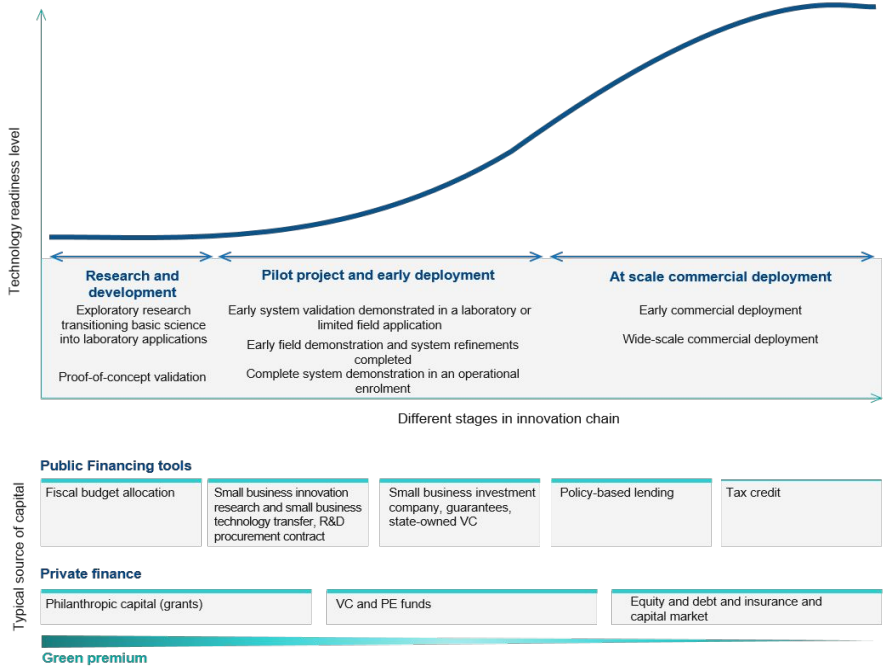
Our results show that internalising the social cost of CO2 emissions reduces welfare in OECD countries from 2010 to 2019 by 2.1% on average, but with significant differences between countries.

- A nonlinear relationship exists between social welfare and the discount rate used in the social cost of carbon.
- Calibration of damage parameters giving a higher probability to catastrophic scenarios (due to higher heating) significantly reduces welfare.
- The negative welfare effect is greater in OECD countries when consumed emissions are considered instead of produced emissions. On average, consumed emissions reduce social welfare by an additional -0.6%, from 2010 to 2019.

De-risking: Targeted funding in terms of instruments and sources depending on the degree of technology readiness

RETURN

TECHNOLOGY READINESS LEVEL AND STAGES IN INNOVATION CHAIN (GREEN PREMIUM)



Each stage of the **innovation chain** requires a **tailored combination of public and private financing** to support the unique needs and risk profiles of developing renewable and clean technology projects.

- **R&D:** mainly public sources. Fiscal budget allocation, procurement contracts.
- **Pilot & early deployment:** mix of public and private funding. Business guarantees, state-owned venture capital, venture capital, private equity funds.
- **Commercial deployment:** mainly private sources. At early stages, tax credits, policy based lending, equity, debt, capital markets.

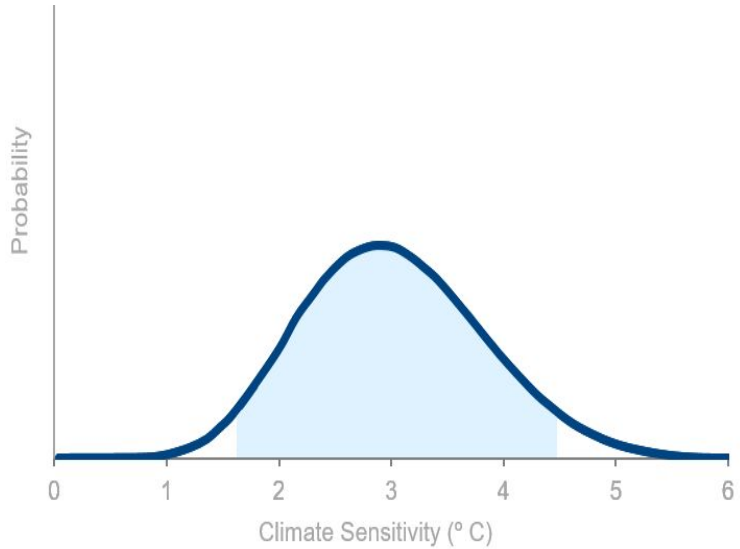
Source: Funding the green technology innovation pipeline: Lessons from China, WEF; it is included in Global | Cost of Capital, Renewables and Cleantech | BBVA Research. 14 June, 2024

Uncertainty is the signature feature of climate change: in measurement, modelling, …

Measurement uncertainty

CLIMATE SENSITIVITY TO CO_2

(Meta analysis; area: 90% of probability interval)

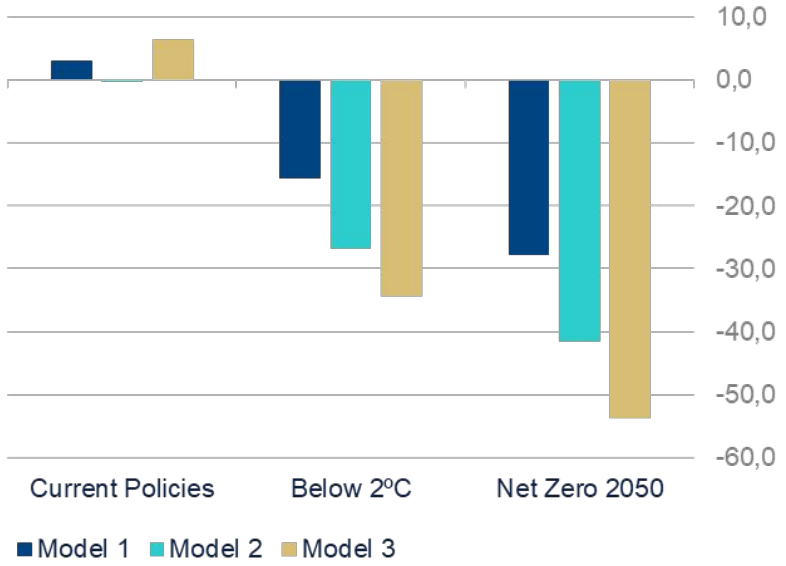


Source: Andrés y Doménech (2020) based on Knutti, Rugenstein and Hegerl (2017).

Modelling uncertainty

GHG EMISSIONS

% 2020-2030



Source: BBVA Research, NGFS Scenarios

…, in the derivation of economic impacts, depending on alternative economic policies and elasticity assumptions

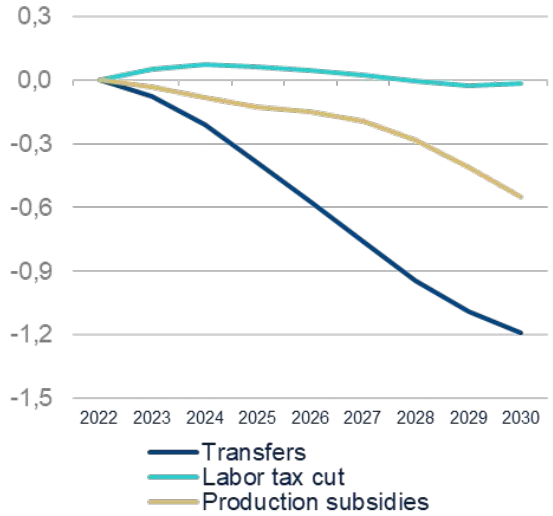
RETURN

Economic Impacts

CARBON TAX RECYCLING OPTIONS

Impact of Recycling Options in the United States GDP

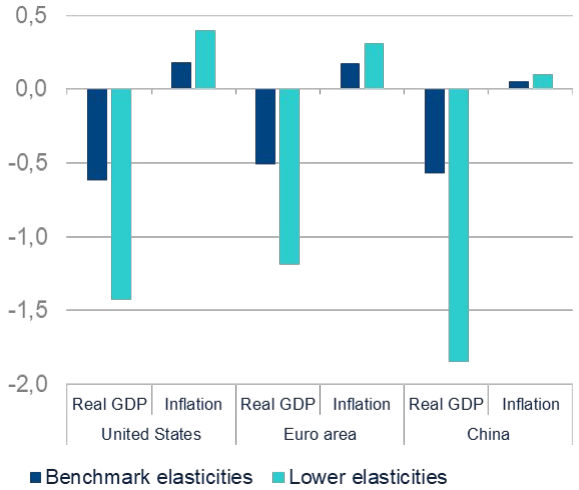
(% deviation from baseline)



SUBSTITUTION ELASTICITIES

Impact in 2030 of a GHG Tax under Different Elasticities

(% and pp, deviation from baseline)



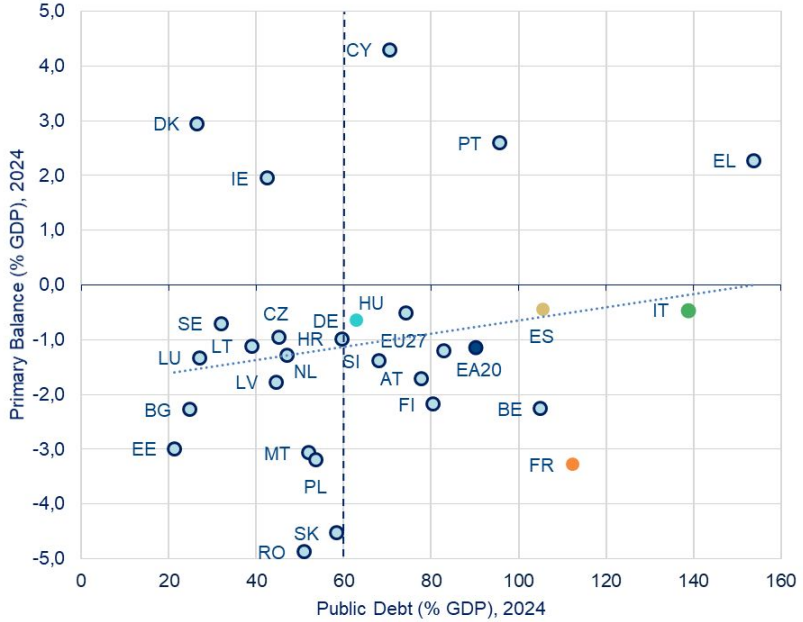
Source: BBVA Research, IMF Oct 2022

Departing from 2024 budgetary situation and considering future ageing costs, consolidation plans must be implemented urgently

RETURN

Public debt and primary balance across EU27: EC 2024 forecasts

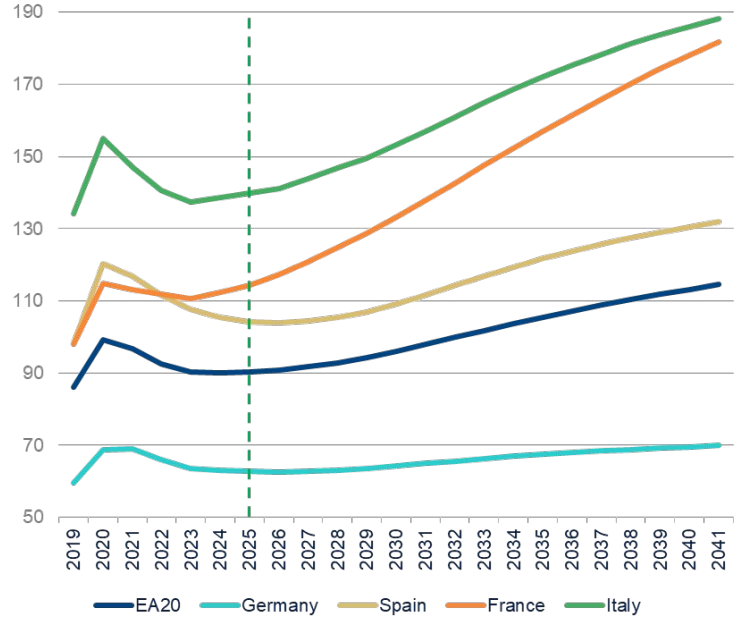
(% GDP)



Source: BBVA Research from European Commission (Spring 2024 forecasts).

No-fiscal-policy-change debt across EU including ageing costs (EC macro scenario): 2024 primary balance

(% GDP)



Source: BBVA Research from European Commission (Spring 2024 forecasts) and Ageing Report 2024.

Reformed EU fiscal rules framework (29th Apr. 24) + EC DSA evaluation scheme:

RETURN

Country-specific fiscal plans (4 or 7 years) based on technical trajectory (TT) of net primary expenditure growth (operational single indicator). EC will provide TT if debt (% GDP) > 60% and budget balance >= -3%.

Safeguards and requirements:

1. **Debt sustainability safeguard:**
   - TT ensure debt decreases during adjustment period (out of EDP) by a **min. annual average** of:
     i. 1pp. if debt >= 90%
     ii. 0.5pp. if debt between 60 & 90%
2. **Deficit resilience safeguard:**
   - **Common resilience margin:** reach SBB = -1.5% pot. GDP while rest of criteria fulfilled during adjustment period
   - **Under EDP:** min. 0.5 SPB adj. (interest waiver) | **Out of EDP:** min. 0.4 SPB adj. (4-year) & min. 0.25 (7-year) (**all % pot. GDP**)
3. **DSA criteria:**
   - **Deficit:** brought and remains below 3% of GDP over the medium term
   - **Debt reduction:** adjustment and stress scenarios debt declines 10-year after adjustment
   - **Stochastic:** debt declines with probability at least 70% 5 years after adjustment period (compared with end-of-period debt)

DSA scheme European Commission (DSM 2023):

- **4 or 7 year deterministic adjustment scenario (adjust GDP growth rate by feedback adjustment effect).**
- **10 year no-fiscal-policy-change deterministic adjustment and stress scenarios (adverse r-g, lower SPB & financial stress).**
- **5-year stochastic evaluation around adjustment scenario (after adj. period): EC VCV Matrix (Berti, 2013).**