Weekly Summary

Economics of Climate Change

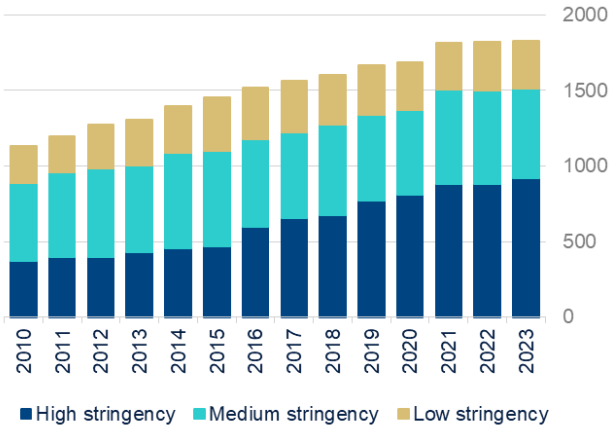
January 24, 2025

Climate Policies Effectiveness: What Works Best?

Climate policies have reduced emissions and advanced low-carbon technologies but still fall short of meeting global goals. Achieving the transition toward decarbonization requires effective, context-specific policy mixes, with carbon pricing well-coordinated with subsidies and regulations playing a key role.

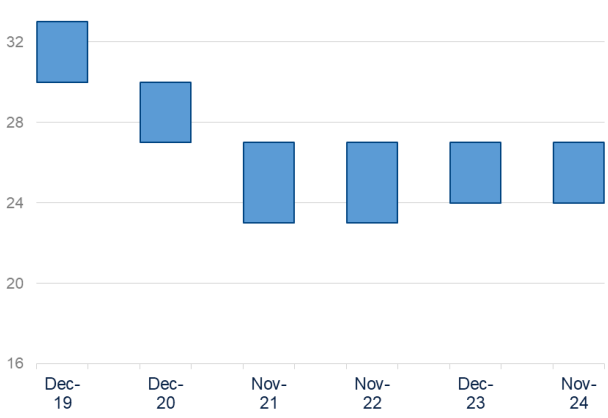
More policies, no recent improvement. The last decades have been marked by an increase in climate policies on emissions reduction. Since the mid-2000s many countries of the Global North, and more recently across the world, have increased their mitigation measures sharply. Global climate policy action, measured as a combination of policy adoption and stringency, expanded by 10% on average each year over the 2010- 2021 period. In 2022 and 2023, this expansion slowed to 1% and 2% respectively.[1] (**Figure 1**).

Gráfico 1. **OECD AND OECD PARTNER COUNTRIES.** NUMBER OF ADOPTED CLIMATE POLICIES BY STRINGENCY DEGREE



Source: BBVA Research from The Climate Action Monitor 2024 | OECD

Gráfico 2. **WORLD. IMPLEMENTATION GAP IN 2030 FOR NET-ZERO GOAL** (GTCO2E)



Source: BBVA Research from Climate Action Tracker

1: The Climate Action Monitor 2024 | OECD

However, over this period, emissions have not evolved consistently with a net-zero path by 2050. In fact, according to the Climate Action Tracker (CAT) analysis, the projected implementation gap[2] for 2030 relative to a net-zero pathway by 2050 has not narrowed over the past four years: it remains roughly between 24 and 27 $GtCO_2e$, a half of the total annual CO2 emissions in 2023 (**Figure 2**).[3]

What works best? Despite more than two decades of experience with thousands of diverse climate policy measures around the world, there is not a consensus about its efficiency in neither science nor policy on one key question: **Which type of policy measures can cause meaningful emission reductions?** This article pretends to shed some light by reviewing and comparing papers tackling this question through alternative approaches: *Stechemesser et al. (2024). Climate policies that achieved major emission reductions: Global evidence from two decades* compares a comprehensive climate policy database with breaks in the emission reduction trend of different countries; and *Hoppe et al. (2023). Three decades of climate mitigation policy: what has it delivered?* is a broad meta-analysis of empirical literature, with approximately 1,500 studies compared.[4]

Did all kinds of policies impact the same way? *Stechemesser et al. (2024)*[5] analyzed the effectiveness of 1,500 climate policies, using machine-learning to detect 69 significant emissions reduction (breaks) between 1998 and 2022 in 41 different countries. Their findings indicate that **policy mixes are generally more effective than standalone measures in addressing emission gaps**.

Table 1. **FINDINGS ON CLIMATE POLICY COMBINATIONS BY SECTOR AND COUNTRY GROUP**

Sector	Developed Countries	Developing Countries	General Findings
Transport	• Pricing is most effective individually (20%)(*) • Subsidies + pricing are highly complementary (33%)	• Regulation is most effective individually (33%) • Regulation + subsidies + Pricing are complementary (33%) • Regulation + information are complementary (33%)	Transport has the most potential for complementarities
Electricity	• Regulation, most effective individually (33%) • Pricing, key in policy mixes (50%)	• No complementarities detected • Subsidies are the most powerful individually (67%)	
Industry	Pricing is most effective individually (43%)	Pricing shows synergy with other policies (50%)	Pricing plays a prominent role, with subsidies as effective complements
Building	Subsidies slightly dominate (individually and combined)	Regulation slightly dominant	A broad set of instruments can be similarly effective across countries

* The percentages represent the share of successful policy interventions or mixes observed in the study for a given sector and country group. They show how often a particular policy or combination of policies was associated with a positive outcome in an emission reduction break from the total of policies that have been implemented in each sector.
Source: BBVA Research from *Stechemesser et al. (2024).*

2: The gap between expected emissions under a current policies and actions scenario and those consistent with net zero.
3: It is worth noting that CAT highlights how rapid growth in renewable energy could enable a faster decline in emissions after 2030, despite the current increase in emissions. While emissions for the 2020s are projected to be higher, faster renewable energy growth offsets this trend. Progress in climate action is hindered because renewables are not sufficiently displacing fossil fuels. Further details: Global Update - November 2024 - As the climate crisis worsens, the warming outlook stagnates.
4: It is worth noting that a question not addressed by the literature reviewed in this document is why certain policies are implemented or not. It seems reasonable to think that the most costly policies in economic terms or in terms of electoral preferences, such as pricing policies compared to subsidies, are more difficult to implement.
5: Stechemesser, A., Koch, N., Mark, E., Dilger, E., Klösel, P., Menicacci, L., ... & Wenzel, A. (2024). Climate policies that achieved major emission reductions: Global evidence from two decades. *Science*, *385*(6711), 884-892. see: https://www.science.org/doi/abs/10.1126/science.adl6547

The study highlights that **command-and-control measures**, such as emission standards and technology mandates, **are the most frequently implemented policies** across sectors except in transport, where market-based instruments like carbon pricing dominate, particularly in developed economies. **Taxation,** effective in creating substantial emissions reduction on its own, contrasts with other popular instruments - such as subsidies, bans, and energy efficiency mandates - which generally show smaller average effects when used in isolation.

The research also underscores regional imbalances, noting a lack of data for developing countries, especially in Africa and Asia, which limits comprehensive global assessments.

It advocates for tailoring policies to specific sectors and economic contexts while leveraging complementary instruments. For instance, pricing mechanisms like taxes and emissions trading schemes are highly effective in profit-driven sectors such as industry and electricity in developed economies, whereas sectors influenced by private consumer behavior, like transport and buildings, require additional instruments to address behavioral factors like rebound effects.

Policy sequencing is another key insight, with regulation and subsidies found to be more effective in the early stages of climate action by fostering economic interest and lowering technological costs. As markets mature and distortions are resolved, price-based instruments become more impactful.[6]

The study calls for more systematic evaluations of policy synergies and optimized climate policy designs that balance environmental, economic, and social considerations. It stresses the urgency of improving climate policy by tailoring interventions to regional contexts, addressing underexplored regions, and designing sector-specific combinations of instruments to maximize impact. These insights offer critical guidance for future policymaking to achieve long-term climate goals.

***Hoppe et al (2023)*[7] highlight that mitigation policies have had a statistically significant impact on greenhouse gas (GHG) emissions reduction.** These reductions are evident either as absolute, real-world decreases within the sectors and boundaries studied or as counterfactual estimations relative to a world without such policies. By integrating multiple strands of empirical evidence, the study estimates that mitigation policies collectively reduced emissions by 2-7 GtCO2eq/year by 2020, equivalent to a 4-15% of total GHG emissions that year[8]. These mitigation policies have also **spurred investments and advancements in low-carbon technologies**, leading to global capacity expansion, and cost reduction. They have driven decreases in energy demand, energy intensity, carbon intensity, and deforestation rates, changes that are critical to achieving long-term mitigation goals.[9]

The study underscores that policy mixes are more effective than standalone instruments, but their success depends heavily on design and institutional context. Despite these positive impacts, existing policies remain

6: Additional research contributions on the most efficient sequencing of climate policies also reveals that starting with financial investments, such as subsidies or tax deductions ("carrots"), followed by environmental taxes ("sticks"), maximizes effectiveness while minimizing costs. Subsidies help firms, particularly small and medium-sized enterprises (SMEs), overcome initial financial barriers, paving the way for the acceptance of stricter measures. However, combining tax deductions and subsidies does not amplify benefits and instead increases costs unnecessarily, suggesting that policymakers should focus on one type of financial incentive. See: Tchorzewska, K. B., del Rio, P., Garcia-Quevedo, J., & Martinez-Ros, E. (2025). Carrot first, stick second? Environmental policy-mix sequencing and green technologies. *Technological Forecasting and Social Change*, *210*, 123835.
7: Hoppe, J., Hinder, B., Rafaty, R., Patt, A., & Grubb, M. (2023). Three decades of climate mitigation policy: what has it delivered?. *Annual Review of Environment and Resources*, *48*(1), 615-650. https://www.annualreviews.org/content/journals/10.1146/annurev-environ-112321-103821
8: Although the effect is statistically positive, the wide range of the impact makes the results somehow uncertain.
9: International agreements, such as the Kyoto Protocol and the Paris Agreement, have played a catalytic role in encouraging national policy actions and advancing global mitigation, despite limitations such as the absence of binding commitments.

insufficient to meet the Paris Agreement's target of limiting global warming to 1.5ºC. The 2030 emissions gap is projected to be 13-20 GtCO2eq, with disparities across regions and sectors.[10]

In summary, mitigation policies over the past three decades have made notable strides in reducing emissions, advancing low-carbon technologies, and reshaping energy use. However, they fall short of delivering the transformative change required to meet global climate goals, highlighting the need for more dynamic, equitable, and ambitious policy strategies.

To summarize the main key messages of both papers, **Table 2** presents the common outcomes and key differences in the conclusions of the two studies. Remarkably, both stress the importance of mixed policies, highlighting the role of pricing, as well as the necessity to consider the specific context to implement the best complementary policies.

Table 2. **COMPARISON OF THE KEY CONCLUSIONS IN BOTH PAPERS**

Common outcomes	**Key Differences**	
	Stechemesser et al. (2024). Climate policies that achieved major emission reductions: Global evidence from two decades	*Hoppe et al. (2023). Three decades of climate mitigation policy: what has it delivered?*
Critical role of complementary policies and policy mixes in achieving significant emissions reductions. **Standalone policies are often insufficient**. Well-designed combinations of measures, such as pricing mechanism, with subsidies, or regulations, can yield stronger results	Deeper analysis of **sector-specific outcomes** and policy interactions, focusing on the more effective **policy sequence**	Focus on quantifying the global impact of mitigation policies and identifying **carbon pricing** as an effective instrument
Importance of understanding the **specific context in which policies operate**. Effectiveness depends on factors like economic development, sector-specific needs, and behavior dynamics	Importance of **regional variation,** noting the differences in policy effectiveness between **developed and developing economies**	More **aggregated global perspective** without delving into regional disparities (but recognizing its importance)
Need to scale up and **strengthen policy efforts to meet global climate goals** and address existing emissions gaps, as well as need for equal attention to this problem in all regions of the world.	Potential of **scaling up best practices** as a short-term strategy to address emission gaps	**Not discussed** in the document

Source: BBVA Research from *Stechemesser et al. (2024) and Hoppe et al. (2023).*

10: The Global South, in particular, has received less attention in the last decades, while structural barriers such as fossil fuel dependency and entrenched economic interests hinder progress toward decarbonization. Achieving climate neutrality will require more ambitious, well-designed mitigation policies that address these challenges.

Box 1. Carbon Pricing Effectiveness

Döbbeling-Hildebrandt et al. (2024)[11] conducted a systematic review and meta-analysis of ex-post evaluation focused on assessing the **effectiveness of carbon pricing alone in reducing emissions**. Analyzing 483 effect sizes from 21 carbon pricing schemes across 80 studies, the research highlights the complexities of isolating the effect of carbon pricing due to overlapping policies, regional differences, and cofounding factors.

Table B1.1 **CARBON PRICING POLICIES STUDIED**

Policy	Jurisdiction	Introduction	Sector coverage	Emission coverage	Mean price	Studies	Effect sizes
Chinese pilot ETS						46	179
o/w Hubei pilot ETS	Hubei, China	2014	industry	27%	$3	4	13
o/w Beijing pilot ETS	Beijing, China	2013	industry, power, transport and buildings	24%	$8	2	3
o/w Shanghai pilot ETS	Shanghai, China	2013	industry, buildings, transport	36%	$4	2	3
o/w Guangdong pilot ETS	Guangdong, China	2013	industry, aviation	40%	$5	2	2
o/w Shenzhen pilot ETS	Shenzhen, China	2013	industry, power, buildings, transport	30%	$7	1	2
o/w Tianjin pilot ETS	Tianjin, China	2013	industry, buildings	35%	$4	2	2
EU ETS	30 European countries	2005	power, manufacturing industry, aviation	38%	$20	13	77
Swedish carbon tax	Sweden	1991	transport, buildings	40%	$103	2	77
BC carbon tax	British Columbia, Canada	2008	industry, power, transport and buildings	70%	$18	7	39
Saitama ETS	Saitama, Japan	2011	industry, power, buildings	17%	$108	3	20
Tokyo ETS	Tokyo, Japan	2010	industry, power, buildings	20%	$106	4	14
Quebec ETS	Quebec, Canada	2013	industry, power, transport and buildings	77%	$9	2	10
RGGI	11 northeastern US states	2009	power	14%	$3	8	10
UK carbon price support	United Kingdom	2013	power	24%	$22	4	10
Finnish carbon tax	Finland	1990	industry, transport, buildings	36%	$6	2	8
Swiss ETS	Switzerland	2008	industry, power	11%	$18	1	5
Australian carbon tax	Australia	2012*	industry, power	60%	$24	1	2
California CaT	California, USA	2012	industry, power, transport, buildings	74%	$12	2	2
Korea ETS	Korea	2015	industry, power, buildings, domestic aviation, public sector, waste sector	74%	$15	2	2
Cross-country						4	18
Total						101	483

Emission coverage" is the share of a jurisdictions emissions covered by the carbon price in 2022. The number of studies exceeds the number of reviewed articles, as some articles include more than one relevant study. Mean prices are unweighted average prices in constant 2010 US$ during the period analysed by the studies in the sample. Effect sizes represent the number of evaluations used to measure the impact of each carbon pricing policy on emissions reductions. They are presented as a percentage difference between the counterfactual emissions without the policy and the observed emissions with the policy in place.
Source: BBVA Research from Döbbeling-Hildebrandt et al. (2024).

The study found that introducing a carbon price has led at least for 17 of the policies schemes analyzed led to immediate and substantial emissions reductions for at least 17 of these policies, with statistically significant decreases ranging from -5% to -21% across schemes (-4% to -15% after correcting for publication bias). These findings demonstrate that **carbon pricing can achieve meaningful reductions in greenhouse gas emissions across diverse contexts, regardless of regional or design differences**.

However, the extent of reductions depends on policy design- well designed policy mixes are more effective than standalone policies-, local conditions, and the presence of complementary measures. Interestingly, the study found no direct correlation between the magnitude of carbon prices and the scale of emissions reductions, as these outcomes are mediated by abatement costs, policy contexts, and other factors. Even low carbon prices can yield significant results by signaling government commitment to climate action. For example, China's emission trading schemes achieved substantial reductions despite low carbon prices.

Overall, the study reinforces the role of carbon pricing as a cornerstone of climate mitigation strategies, emphasizing the importance of complementary measures and adaptive policymaking. This aligns with findings from the other studies discussed in this article, underscoring the need for coordinated and dynamic approaches to address climate change effectively.

In conclusion, while climate policies over the past decades have delivered meaningful reductions in greenhouse gas emissions and spurred advancements in low-carbon technologies, they remain insufficient to bridge the emissions gap and meet global climate goals. Evidence of several studies highlight the critical importance of well-designed and complementary policy mixes, tailored to specific sectors and contexts, in maximizing their effectiveness. Regional disparities in policy implementation and limited data from developing countries underscore the need for more inclusive global assessments and targeted support for underrepresented regions. Urgent, adaptive, and context-sensitive policymaking will be paramount in closing the emissions gap and driving a just and sustainable global transition.

Highlights of the Week

- **Global | Met Office: Atmospheric CO2 rise now exceeding IPCC 1.5C pathways - Carbon Brief.** The rate at which atmospheric CO2 is increasing is now outpacing the pathways set out by the Intergovernmental Panel on Climate Change (IPCC) that limit global warming to 1.5C.

- **OECD | The crucial role of insurance in managing wildfire risks.** Insurance plays a vital role in managing wildfire risks as climate-related disasters intensify, with wildfires causing rising economic losses and straining insurance markets. Key challenges include affordability, accessibility, and data gaps.

- **Europe | EU's solar and wind growth pushes fossil-fuel power to lowest level in 40 years - Carbon Brief**. Over the past decade, coal power use in the European Union (EU) has fallen by 61%, according to Carbon Brief analysis of new figures from energy analysts Ember

- **Europe | Carbon pricing, border adjustment and renewable energy investment: a network approach - Documentos de Trabajo - Análisis económico e investigación - Banco de España.** A €100/tonne increase in the EU carbon price reduces emissions by up to 24% but can lower GDP (up to −0.4%) due to higher energy costs and carbon leakage; however, investing in renewable energy mitigates GDP loss and electricity price increases, while a Carbon Border Adjustment Mechanism (CBAM) reduces carbon leakage but slightly impacts GDP and inflation.

- **EE. UU. | Las claves de la salida de EE. UU. del Acuerdo de París: ¿Qué ocurrirá con la lucha climática ahora? El País**. Con su salida, EE. UU. se une a la pequeña lista de países que no forman parte del Acuerdo de París, en la que están Irán, Libia y Yemen. Pero, ¿qué impacto tendrá este abandono para la lucha climática?

11: Döbbeling-Hildebrandt, N., Miersch, K., Khanna, T. M., Bachelet, M., Bruns, S. B., Callaghan, M., ... & Minx, J. C. (2024). Systematic review and meta-analysis of ex-post evaluations on the effectiveness of carbon pricing. *Nature Communications*, *15*(1), 4147.

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