INCLUSIVE FORUM ON
CARBON MITIGATION APPROACHES
PAPERS

The effects of climate policies on emissions

Evidence from a comprehensive and systematic review of the ex-post empirical literature

OECD
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Inclusive Forum on Carbon Mitigation Approaches Papers

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Inclusive Forum on Carbon Mitigation Approaches Papers

The IFCMA Papers series brings together outputs from the initiative's work to take stock of different carbon mitigation approaches, map policies to the emissions they cover, and estimate their impact on greenhouse gas emissions, as well as its work on analysing methodologies for computing the carbon intensity of goods and sectors. Comments on IFCMA Papers are welcome at IFCMA@oecd.org.

Background

The Inclusive Forum on Carbon Mitigation Approaches is the OECD's flagship initiative to help optimise the global impact of emissions reduction efforts around the world through better data and information sharing, evidence-based mutual learning, and inclusive multilateral dialogue.

By taking stock of different carbon mitigation approaches, mapping policies to the emissions they cover, and estimating their comparative impact in terms of emissions reductions, the IFCMA is enhancing understanding of the effect of the full spectrum of carbon mitigation approaches deployed around the world and their combined global impact. The IFCMA is also identifying and addressing challenges related to the calculation of sector- and product-level carbon intensity metrics, relevant to the design and evaluation of mitigation policies, and to steer firms' and consumers' decisions towards lower-emission products. This work supports better international coordination to avoid the proliferation of different standards, help minimise compliance costs for business, and avoid disruptions to trade.

To advance its technical work, the IFCMA brings together delegates from the climate, tax, and structural economic policy communities from 60 IFCMA members and numerous countries participating as Invitees around the world.

Abstract

This paper systematically reviews ex-post empirical studies assessing the effects of climate change mitigation policies on emissions. It synthesises evidence from 187 studies covering five broad sectors—agriculture, forestry and land use (AFOLU), buildings, industry, power, and transport—providing about 450 estimates of policy impact. Estimates are harmonised to ensure comparability and expressed as annual percentage changes in emissions relative to a no-policy scenario. The findings suggest that most policies effectively reduce emissions, with a median effect of about -5% per year, though with substantial variation across studies. The results exhibit significant heterogeneity across policy instruments, sectors, and regions, reflecting differences in policy design, implementation, and contextual factors. The analysis highlights key evidence gaps and lays the foundation for future meta-analytical work on the determinants of policy effectiveness.

Keywords: Climate Change, Mitigation Policies, Policy Effectiveness, Emissions Reduction, Systematic Review, Meta-analysis, Evidence Synthesis

JEL classification codes: Q48 – Energy: Government Policy; Q54 – Climate; Natural Disasters and Their Management; Global Warming; Q58 – Environmental Economics: Government Policy; H23 – Taxation and Subsidies: Externalities; Redistributive Effects; Environmental Taxes and Subsidies; R48 – Transportation Economics: Government Pricing and Policy

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Executive Summary

This paper provides a literature review of ex-post empirical studies assessing the effects of policies on emissions. The goal is to compare systematically the effectiveness of a wide range of policies in reducing emissions across five broad sectors (agriculture, forestry and land use (AFOLU), buildings, industry, power and transport) and identify evidence gaps. The approach used follows the methodology of systematic evidence reviews, which aims at comprehensiveness, transparency and procedural objectivity, thus minimising susceptibility to bias.

This systematic review includes 187 papers in English and published in scientific journal or as working papers. These papers provide about 450 estimates of the effects of policies on emissions or other selected outcomes that can be converted in a transparent way into emission changes. Estimates are expressed as the annual percentage change in emissions compared to a scenario with no policy to make them comparable across studies. A formal protocol for the selection and appraisal of papers ensures that the evidence collection is transparent and comprehensive.

The descriptive analysis of the estimates suggests that most policies are effective in reducing emissions, with a median annual effect of -5% and a majority of studies reporting statistically significant negative effects. The effect is fairly even across policy categories and sectors. However, the dispersion of estimated effects within sectors and policy instruments is large. Three broad factors could help explain this dispersion: policy design; contextual factors; and methodological differences across papers.

Large evidence gaps exist, especially for non-economic instruments and regions outside North America and Europe. Evidence on the effects of economic instruments is more widely available – in particular for emission trading schemes (ETSs), taxes and some subsidies – than for other instruments, such as regulations and voluntary approaches. Also, evidence is concentrated in the buildings, industry and power sectors.

The descriptive sectoral analysis reveals that:

- In the buildings sector, the median effect is large, in absolute values, for carbon taxes and other taxes, such as fuel taxes (between -10 and -15%). The median estimated effect of building codes and subsidies is smaller (median effect at -5% and -2%, respectively) than other policies, although with large variation across estimates. Most available evidence covers economic instruments while few studies focus on labels.
- In the power sector, carbon taxes are estimated to be among the most effective instruments (median effect -10%). ETSs and renewable subsidies can also be effective (median effect -6%). A large share of the evidence concentrates on economic instruments while it is scanter for regulatory and voluntary instruments.
- In the industry sector, ETSs are the most effective policy instrument (median effect -8%), although estimates range widely. ETSs are also the most studied instruments while little evidence exists for regulatory instruments.

- In the transport sector, most evidence covers carbon taxes and ETSs with median effects at -7% and -5%. Few papers evaluate the effects of national transport policies on emissions and important evidence gaps remain.
- In the AFOLU sector, few studies assess direct policy effects on emissions. Diverse forestry policy mixes and payment for ecosystem services can be effective in reducing deforestation. While most evidence concerns protected areas, these policies are not always effective in reducing emissions or deforestation.

This paper provides a descriptive analysis (e.g. median and dispersion) of the available estimates of the policy impact on emissions as reported in ex-post empirical studies. The literature is growing fast and a “living evidence bank” could ensure that future evidence is integrated in the analysis as it becomes available. Furthermore, this review lays the foundations for a possible future meta-analysis by the IFCMA that could explore quantitatively the relative importance of factors affecting estimated policy effectiveness, including policy design and stringency, country-specific factors, while also considering the number of available studies and their methodological differences.

1 Introduction

Limiting climate change requires further action to close the gap between the ambitious greenhouse gas (GHG) emission reduction targets that countries have set themselves and the policies to achieve them (IPCC, 2021[1])**.** In recent years, many countries have ramped up mitigation efforts, by adopting diverse mitigation policies (D'Arcangelo, Kruse and Pisu, 2024[2]), but these efforts still fall short of what is needed. Insufficient knowledge about the effectiveness of policies in reducing emissions in real world situations hampers progress in this area.

One main objective of the OECD Inclusive Forum on Carbon Mitigation Approaches (IFCMA) is to improve such knowledge and help policymakers to identify the most effective mitigation policies and policy packages in different contexts. This paper contributes to this objective by systematically reviewing the ex-post empirical evidence of the effects of a wide range of mitigation policies on emissions. This work area is independent from but closely connected to the other activities of the IFCMA. These aim at compiling a database of mitigation policies and the emissions they cover as well as estimating the impact of policies on emissions with the help of models. The findings of this paper shed light on the quantity and quality of evidence regarding the impacts of the large number of policies and policy categories that the IFCMA stocktaking covers. The work is also intended to help fill modelling gaps by providing average and range estimates of the effects of specific policies that may prove too difficult or time consuming to model (at least for some countries). Future work will build on this analysis by exploring the determinants of policy effectiveness, including country- and policy-specific contextual factors. Extending the analysis to the effects of climate policies on socio-economic outcomes would provide more comprehensive information on the effects of climate policies, which could allow for assessing the costs and benefits of climate policies.

This is the first paper to collect, harmonise and compare the effects of climate policies across a wide range of sectors and policy instruments. The policy scope of this evidence synthesis spans several pricing and non-pricing policies around the world and five broad sectors (i.e. agriculture, forestry and land use (AFOLU), buildings, industry, power and transport). This approach departs from previous literature reviews of mitigation policies, which have mostly concentrated on selected climate policies, often carbon pricing, or specific sectors (Green, 2021[3]; Haites, 2018[4]; Laing et al., 2014[5]; Venmans, 2012[6]). The evidence synthesis also squarely focuses on the effects of policies on domestic emissions. Other studies have instead reviewed the joint effects of climate policies on environmental and economic outcomes (Dechezleprêtre et al., 2019[7]; Dechezleprêtre and Sato, 2017[8]) and on global emissions taking into account leakage channels (Grubb et al., 2022[9]), i.e. the shift of emissions across jurisdictions caused by the introduction or intensification of domestic climate policies. In addition, several meta-analyses have analysed the elasticity of fuel use to fuel prices (Labandeira, Labeaga and López-Otero, 2017[10]; Havranek, Irsova and Janda, 2012[11]).

The large policy scope of this review and its narrow focus on emissions lead to its two main contributions. First, this study assesses the amount of evidence available on the whole range of mitigation policies and identifies evidence gaps for many of them. This can spur additional efforts to evaluate the effectiveness of increasingly prevalent but still under-researched policies. Second, it reports in a comparable way the available empirical point estimates, and their dispersion, of the effects of mitigation policies on emissions across policies and sectors. This makes it possible to compare the effectiveness of the same or similar policies across sectors, and different policies within the same sectors. Such comparisons can ultimately improve understanding on the factors – such as specific policy-design features, degree of implementation and enforcement, and other contextual factors – driving policy effectiveness within and across sectors and countries. Ultimately, this can inform more effective mitigation policy choices or identify potential reform areas to improve the effectiveness of implemented policies.

This evidence synthesis follows the methodological approach of systematic reviews (Box 1). This relies on a suite of evidence-based methods aimed at minimising susceptibility to bias by increasing comprehensiveness, transparency and procedural objectivity (Haddaway et al., 2020[12]). This approach to evidence synthesis is widely used in healthcare and underpins evidence-based medicine as it is more systematic and rigorous than traditional literature reviews. It is becoming more common in other fields including in climate and environmental research. Döbbeling-Hildebrandt et al., (2024[13]) provide the first systematic review of the effects of the introduction of carbon pricing schemes on emissions. Systematic reviews of evidence are also available for the effect of electricity pricing (Khanna et al., 2023[14]) and behavioural interventions on energy consumption (Khanna et al., 2021[15]) and the effects of behavioural interventions on transport (Javaid et al., 2022[16]).

Box 1. Systematic reviews in climate policy evaluation

Carrying out a systematic review involves gathering, critically evaluating, and synthesising available evidence in a transparent and rigorous way to answer a specific question. To achieve this objective, reviewers use pre-defined methods to identify potential biases in the evidence and in the review process, and adopt transparent and well-documented actions to correct or avoid them. This approach allows for minimising biases while enhancing the reproducibility of findings compared with less structured approaches to selecting, evaluating and synthesising the evidence of traditional literature reviews.

The main steps of a systematic review are the following:

- formulating the scope and research question of interest;
- identifying all relevant evidence following a pre-determined search strategy;
- determining which studies are relevant and should be included according to pre-defined eligibility criteria;
- conducting a critical appraisal of study validity to determine the quality of evidence and the risk of bias; and
- harmonising, synthesising and reporting the data following transparent and well documented criteria.

In the context of climate policy, systematic reviews can be used to evaluate the effectiveness of policy instruments in reducing greenhouse gas emissions, as well as to assess their effects on other socio-economic outcomes. Furthermore, systematic reviews can highlight areas where there is a lack of evidence, which can inform future research priorities. By appraising and synthesising the findings from the literature on climate policies, systematic reviews allow policymakers to make informed decisions based on the best available information.

Sources: (Collaboration for Environmental Evidence, 2022[17]; Haddaway et al., 2020[12]; Page et al., 2021[18])

In line with the spirit of the systematic review approach, the selection of papers, their critical appraisal, and the harmonisation of estimates has aimed at ensuring transparency, objectivity and replicability. The procedural and methodological steps undertaken in this review and the resulting geographical and sectoral coverage are described in Section 2. Initially, 294 papers were identified as potentially relevant but 187 were retained based on an assessment of the type and reliability of estimates. With regard to the geographical coverage, most of the papers (about 70%) focus on North America and Europe; around a fifth (22%) focus on Asia and Latin America, and just 5% on Africa and Oceania. About 57% of the papers assess policies from IFCMA countries.[1] About 85% of the papers evaluate economic instruments, specifically subsidies, taxes, and emission trading systems (ETSs). Regulatory instruments are the second most evaluated instrument category, but account for only 12% of papers, with most of them evaluating protected areas in the AFOLU sector.

Comparing the amount of evidence available for specific policies with the frequency of their actual implementation reveals that the evidence gaps vary greatly across policies. OECD data on mitigation policy implementation and their stringency (Nachtigall et al., 2024[19]), available only for a subset of countries and policies considered in this evidence synthesis, forms the base for this analysis. The comparison between evaluated and implemented policies reveals that the evidence gaps are larger for carbon taxes than ETSs. For instance, no policy evaluation is available for about half of the countries with a carbon tax in the electricity sector. The evidence gap is even larger for carbon taxes in transport (76%), buildings and industry (each at about 80%). Among subsidies, evaluations of feed-in tariffs (FIT) and financing mechanisms for energy efficient retrofitting in the buildings sector exist for only about 20% of countries that have implemented such policies. The evidence gap is especially large for regulatory instruments, as evaluations cover less than 5% of countries that have implemented such policies. No evaluations are available for other regulatory instruments, such as minimum energy performance standards and building codes, which are implemented according to available OECD data.

Across sectors, the descriptive analysis of the available estimates included in this review points to a median annual estimated effect of policies on emissions of -5.4%. As shown in Section 3, this effect is fairly even across sectors. However, estimated policy effectiveness varies widely within each policy instrument. This large dispersion points to factors, such as policy design and stringency, contextual factors (e.g. complementary policies, macroeconomic conditions) and methodological differences (e.g. quasi-experimental vs correlational studies), as important drivers of policies' effectiveness in reducing emissions. Difference in evaluation methods across studies also might explain this dispersion.

The sector specific descriptive analysis shows large variation of different types of policies within each sector. The main findings of this part of the analysis (Section 4) are:

- **In the buildings sector, available estimates suggest that carbon taxes and other taxes, such as fuel taxes are effective in reducing emissions, (median effect between -10 and -15%).** Estimated emission reductions are lower for building codes (median effect -5%) and subsidies (median effect -2%), but with large variation across estimates, especially for subsidies. Estimated emission reductions are high for labels (median effect -20%), although estimates are few and cover a narrow geographic region. Most of the available evidence on the buildings sector covers economic instruments.
- **In the power sector, carbon taxes are estimated to be among the most effective instruments in reducing emissions (median effect -10%), followed by ETSs and renewable subsidies (median effect -6%).** A large share of the evidence in the power sector focuses on economic instruments, with few evaluations on regulatory and voluntary instruments.

[1] At the time of drafting, IFCMA membership consisted of the following jurisdictions: Argentina, Australia, Austria, Barbados, Belgium, Bulgaria, Cameroon, Canada, Chile, Croatia, Czech Republic, Colombia, Costa Rica, Denmark, Estonia, European Union, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Jamaica, Japan, Kazakhstan, Latvia, Lithuania, Luxembourg, Malta, Mauritius, Mexico, Monaco, Morocco, Netherlands, New Zealand, Nigeria, Norway, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Türkiye, United Kingdom, United States, Uruguay, and Zambia.

- **In the industry sector, ETSs are the most studied and effective policy instrument, with a median effect at -8% but wide variation across estimates.** Little evidence exists for regulatory instruments. Estimates also suggest that energy or emission auditing – an information instrument – has a sizeable effect in reducing emission (-7.4%). Estimated effects are smaller for other policies, such as voluntary approaches.
- **When comparing power and industry, ETSs appear to be more effective in the power than industry sector.** This could be attributable to different exposure to international competition, the higher recourse to free allowances in industry, and the ease with which electricity generators might adjust their fuel mix compared with industry producers.
- **In the transport sector, available estimates for carbon taxes and ETSs indicates sizeable emission reductions (median effects at -7% and -5%).** Few papers evaluate the effects of national transport policies on emissions. Evidence on public investments in rail infrastructure is also scant (with only two studies on the People's Republic of China, hereafter 'China'). Moreover, evidence is lacking on the effects of regulatory instruments. Many of them, such as congestion charges or ultra-low emission zones, are implemented at a local level; and studies generally assess their effects not on emissions but on local air pollutants and health outcomes.
- **In the AFOLU sector, few studies assess the direct policy effects on emissions.** The few estimates that exist, however, point to economic instruments and regulatory instruments as being impactful. Only two studies evaluate the impact of carbon taxes on emissions and find very dissimilar effects. Estimates suggest that zoning and protected areas, one type of framework standard, are effective in reducing emission (median -11%), but heterogeneity across estimates is large. Subsidies for agricultural practices have a more modest effect on emissions (-6.6%) with a narrow range of estimates. Estimates for Payments for Ecosystem Services suggest a small effect (-1%) on emissions, albeit only two estimates are available for this policy.

The findings of this review lay the foundations for further work that can control for potential factors affecting estimates included in the review. For instance, a formal meta-analysis could rigorously investigate the relative importance of the three broad determinants likely to explain the variation across estimates of policy effectiveness: policy design and stringency, countries' contextual factors and methodological differences across studies. Extending the evidence synthesis to other socio-economic outcomes would paint a more complete picture of the effects of mitigation policy on the economy. Furthermore, the IFCMA can play a key role in developing a platform to facilitate knowledge sharing on policy evaluations and systematic reviews of evidence with the aim of informing policy choices. Section 5 discusses these possible avenues of future work in more detail.

2 Methodology and scope

The literature on climate policies has grown rapidly over the past decades with more than fifty thousand papers published since 2020 (Callaghan, Minx and Forster, 2020[20])**.** Reviewing this literature in a way that is useful to policy makers hinges on comparing the effectiveness of a wide range of policies. This requires selecting studies that provide comparable estimates or, alternatively, estimates that can be made comparable with additional transparent calculations. Thus, studies in this review include:

- **Those focusing on climate change mitigation or mitigation-relevant policies**. Mitigation policies aim at reducing GHG emissions (e.g. carbon tax); mitigation-relevant policies have other stated objectives but may induce positive or negative changes in emissions (e.g. excise fuel taxes).
- **Ex-post empirical studies in English**. These encompass studies based on past data and assessing the effects of implemented policies by means of statistical and econometric techniques. As such, insights or evidence obtained through qualitative analyses, case studies and ex-ante models are excluded. The selection includes papers in English and published in peer-reviewed journals or as working papers. It excludes policy evaluations conducted by ministries or government agencies and not published in peer-reviewed journals or as working papers.
- **Those estimating the effect of policies on emissions or related outcomes**. This includes studies focusing on the impact of policies on GHG emissions or other variables, e.g. emission intensities, energy and fuel consumption, that can be converted into CO_2 or other GHGs with few calculation steps and few assumptions. The review separately collects evidence on three outcomes (home retrofitting uptake, domestic photovoltaic panel installation, and deforestation) that are frequently investigated in mitigation policy evaluations. This systematic review excludes studies focusing on socio-economic outcomes, such as employment, production, trade, or innovation, and other pollutants as they cannot be easily converted into emissions.
- **Those focusing on policies targeting an emission base relevant at the national level**. This includes national policies, as well as subnational and supranational policies that can be expected to have meaningful impacts on national emissions, but excludes local policies that target a small emission base. Studies assessing the effects of domestic policies abroad, such as those estimating emission spillovers and carbon leakage, are excluded. This criterion also excludes studies evaluating specific interventions that are not policies, such as the adoption of technologies or practices that are not directly linked to a policy. These studies are more frequent in the AFOLU, transport and buildings sector, and include, for examples, the evaluation of sustainable farm management practices, building techniques and transportation choices where adoption occurs outside the scope of explicit policy measures. It also excludes randomised interventions by private companies or utility providers to test, for example, the effectiveness of information provisions.
- **Those covering one of the following five sectors: industry, power, buildings, transport or AFOLU.** This includes studies on the entire sector or a relevant subset, such as forestry in AFOLU. Some studies cover both the industry and power sector, as some policies, notably ETSs, often cover entities across both sectors. This excludes studies that do not focus specifically on any of these five sectors, such as those investigating national emissions. It excludes studies on policies to mitigate emissions outside of these sectors, such as those from waste management and fugitive emissions.

The identification of relevant papers for this review followed a three-stage approach. First, existing literature reviews were consulted to identify papers complying with the criteria above. Table A A.1 lists the existing literature reviews used in this step. Second, a systematic search of established literature repositories, such as Web of Science and Google Scholar, based on specific search terms relating to climate policy and its impacts identified additional papers to step 1. Other papers were identified by parsing the references of the papers selected this way. Third, policymakers and practitioners were invited to suggest relevant studies at the plenary IFCMA meeting in November 2023. All these steps were conducted between May 2023 and June 2024 by independent experts in the empirical literature of the sectors covered by this study (i.e. buildings, power, industry, transport and AFOLU).

In total, 294 papers were initially identified as relevant, based on title, abstract and keywords. Two experts independently read the papers and further refined the selection. The main reasons for excluding papers were the following: the paper was not evaluating already implemented mitigation or mitigation-relevant policies, the focus of the paper was not on ex-post evaluation, or the paper did not study the effects of policies on emissions or related outcomes. This final selection trimmed the number of papers included in this review to 187. Annex G lists the reviewed papers, providing bibliographic references along with the period of evaluation and the country of implementation.

Two independent experts conducted a critical appraisal of each study. The critical appraisal aimed at assessing the risk of bias in the empirical estimates, based on data quality and the method employed to identify a plausible causal relationship. Studies that did not employ a credible causal identification strategy were excluded. For example, empirical analysis that either do not have an appropriate control group or do not take into account potentially confounding factors are likely to over- or under-state the effects of a policy on emissions. These papers were thus excluded.

A limitation of the approach used to identify studies is that it may overrepresent highly cited studies and studies by authors within larger established research networks. This may lead to overlook recent studies, less well-cited studies or papers published in less well-known journals and then poorly cited (despite the validity of their approach and reliability of results). Focussing on studies written in English may result in identifying more studies from some geographical regions, notably North America and Europe. Finally, policy evaluations by ministries or government agencies and not published in peer-reviewed journals or as working papers are excluded, despite their potential usefulness, because no search engine is available to systematically retrieve this type of evidence. A manual search covering all IFCMA countries governments' websites would have likely provided selective and incomplete results.

Country and sector coverage of reviewed papers

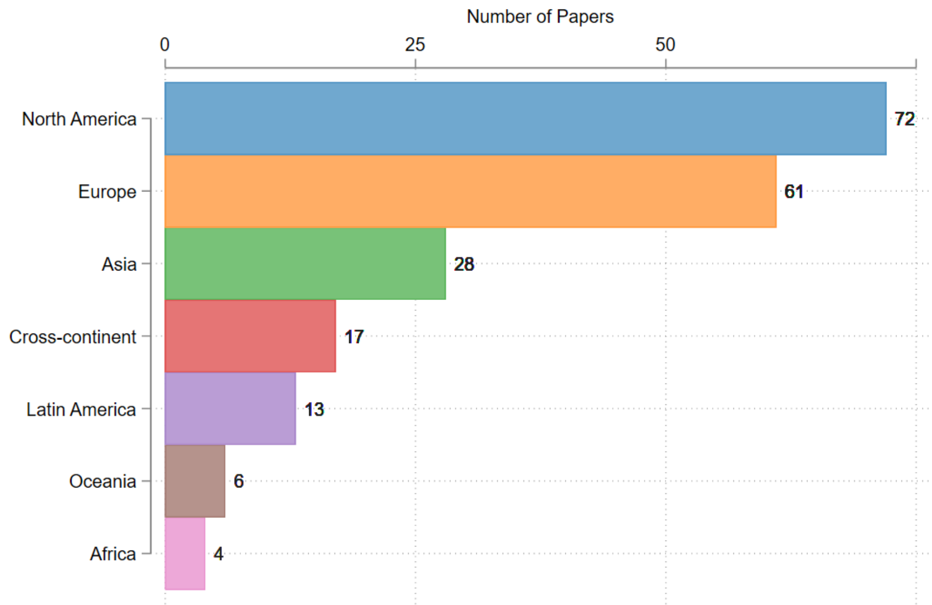
The coverage of the 187 papers within the scope of this review across countries, sectors and years is the following:

- Most papers evaluate polices implemented in North America (72 papers) and Europe (60). Less evidence is available for Asia (27) and Latin America (14). Few papers cover Oceania (6) and Africa (4) (Figure 1, Panel A). About 57% of reviewed papers assess policies in IFCMA members. Several of the studies on non-IFCMA members are from IFCMA invitee countries, including China among others.
- Most papers focus on the buildings (56), industry (48) and power (54) sectors. Fewer studies analyse policies in transport (26) and AFOLU (22) (Figure 1, Panel B and Table A B.1 in Annex B). Some papers (23) evaluate policies spanning multiple sectors, notably studies evaluating the EU ETS as this covers both the industry and power sectors.
- Most papers about the industry and power sectors cover policies implemented in Europe, the Americas and Asia. Evaluations of the buildings and transport sectors primarily include policies

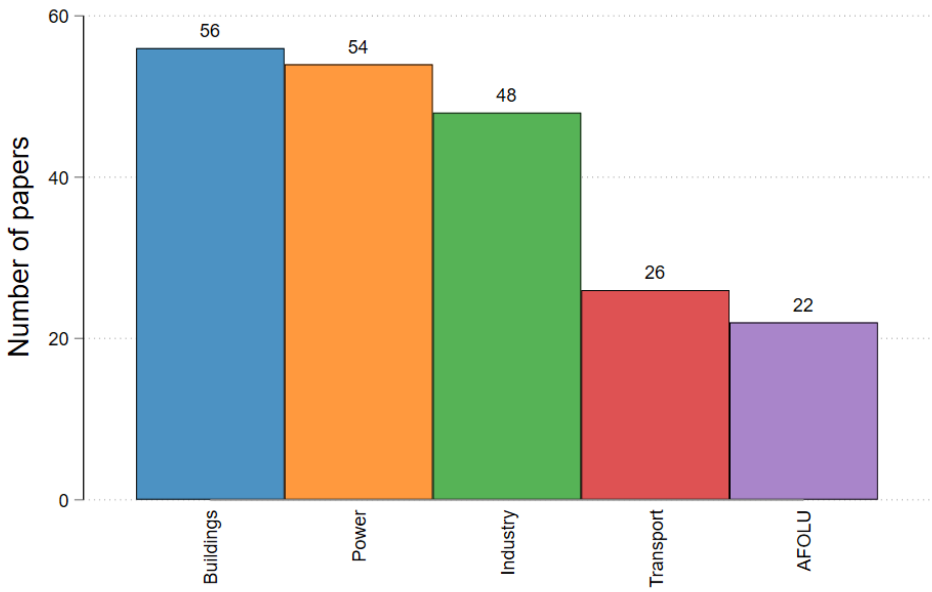
implemented in the Americas and Europe, with some papers on Oceania, Asia and Africa. Studies on AFOLU sector policies cover the Americas, Asia and Africa (Figure A B.1). In each sector, more studies cover IFCMA countries than non-IFCMA countries. The exception is AFOLU, as several studies cover African and South American countries that are not presently IFCMA members (Figure A B.2).

Figure 1.Most of the papers focus on North America and Europe and cover the buildings, power and industry sectors

Panel A: Number of papers by region



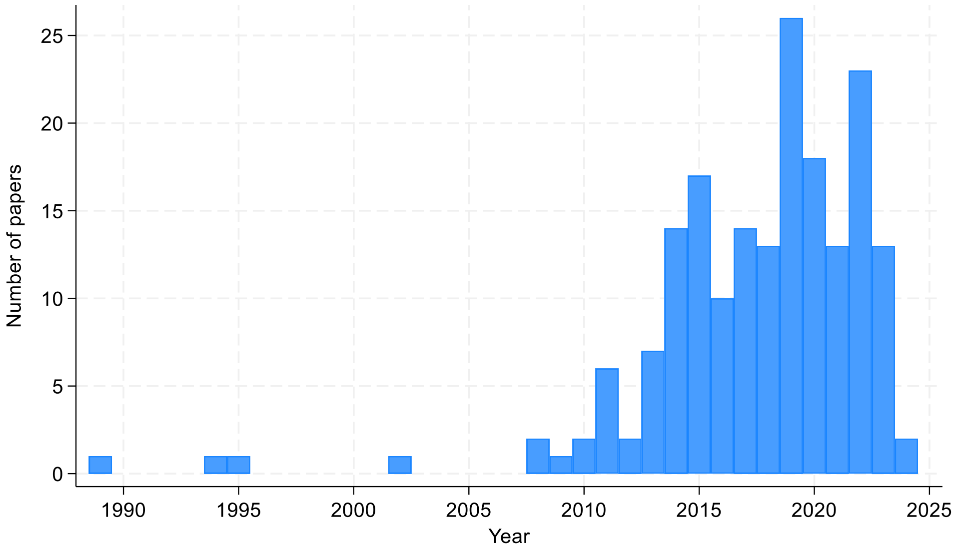
Panel B: Number of papers by sector



Note: Panel A shows the number of papers by region. Panel B shows the number of papers by sector. Source: Authors.

Few of the reviewed papers were published before 2008 (although some date back to the 1990s). After 2008, this review includes at least one published paper per year. The number of papers increase markedly in the early 2010s and, after 2015 with at least 10 papers published each year (Figure 2). In turn, most paper concern policies in place from the early 2000s onwards (Figure A B.3).

Figure 2. Number of papers by year of publication



Note: The figure shows the number of papers reviewed by year of publication.
Source: Authors.

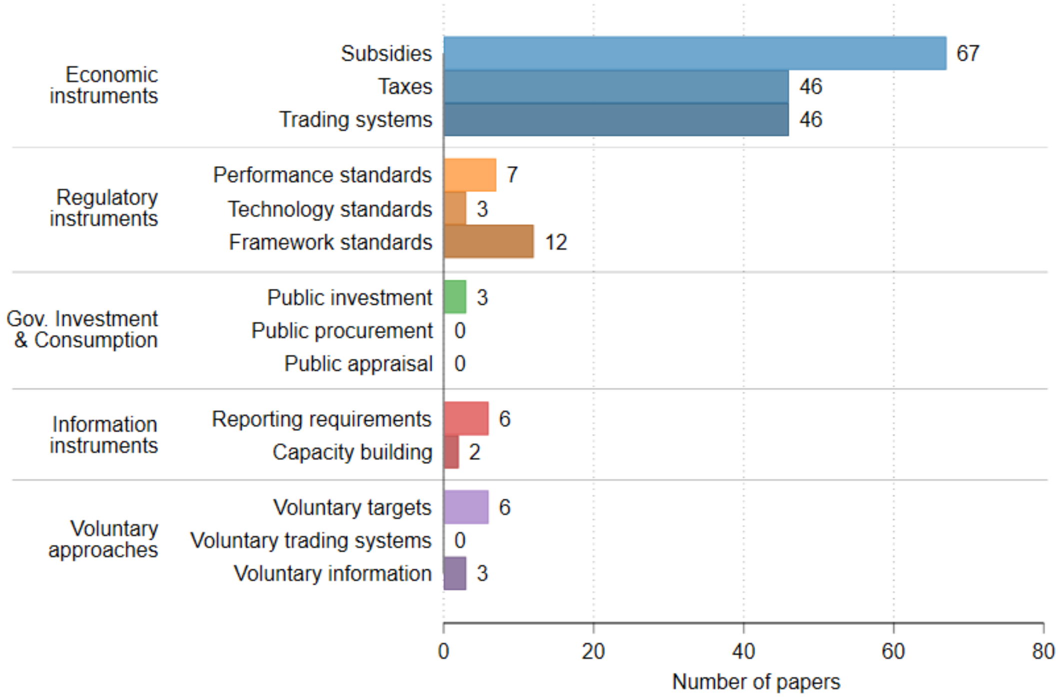
Analysis of evidence gaps in relation to policy implementation

This part of the analysis sheds light on the amount of empirical evidence available for different mitigation policies and compares it with the frequency of policy implementation across countries. To this end, in a first step, the policies considered in this review were first classified according to the IFCMA policy typology, as described in document IFCMA(2024)4/REV1. This shows how evidence is distributed across IFCMA policy categories. In a second step, policies were matched to the Climate Actions and Policies Measurement Framework (CAPMF), a comprehensive OECD database tracking mitigation policy implementation. This makes it possible to relate available evidence with the frequency of policy implementation across countries.

The IFCMA policy typology identifies five instrument categories: economic instruments, regulatory instruments, government investment and consumption, information instruments, and voluntary approaches. Each of those categories comprises distinct instrument types.

Following the IFCMA policy typology reveals that most of the reviewed papers focus on economic instruments, and more specifically subsidies, taxes, and ETSs. These papers account for more than 85% of the total (Figure 3). Regulatory instruments are the second most frequent instrument category, with however only 22 reviewed studies (compared to more than 150 for economic instruments). Most of the papers in this category evaluate framework standards in the AFOLU sector. Evidence on the remaining instrument categories – i.e. voluntary approaches, information instruments and government investment and consumption – is rather sparse, with less than 10 papers for each of these categories. No ex-post empirical study on some instrument types (i.e. public procurement, public appraisal, voluntary trading systems) has been identified that satisfy the criteria for selection, suggesting that the evidence gap is largest for these instruments.

Figure 3. The coverage of the reviewed paper across instrument categories is uneven, with most focusing on economic instruments



Note: The Figure shows the number of papers reviewed by IFCMA instrument category and IFCMA instrument types. One paper could cover more than one instrument type. The figure follows the proposed IFCMA policy typology of IFCMA(2024)4/REV1.
Source: Authors.

Relating the amount of available evidence to how often a policy was adopted across countries provide indications that more frequently evaluated policies are also those that countries more frequently adopt. This helps identifying evidence gaps granularly by sector and for specific policy instruments. The OECD CAPMF is the most comprehensive and harmonised mitigation policy inventory, tracking the implementation of 128 specific mitigation policies across most OECD and G20 countries from 2000 to 2022 (Nachtigall et al., 2024[19]). As such, the CAPMF allows for matching evaluated policies with their implementation frequency. This part of the analysis is limited to 50 countries covered in the CAPMF (OECD and G20 countries, with the exception of the United States and Brazil) and excludes the AFOLU sector, which the CAPMF database does not yet cover. IFCMA policy stocktaking will provide in due time a more comprehensive policy inventory to conduct this type of analyses.

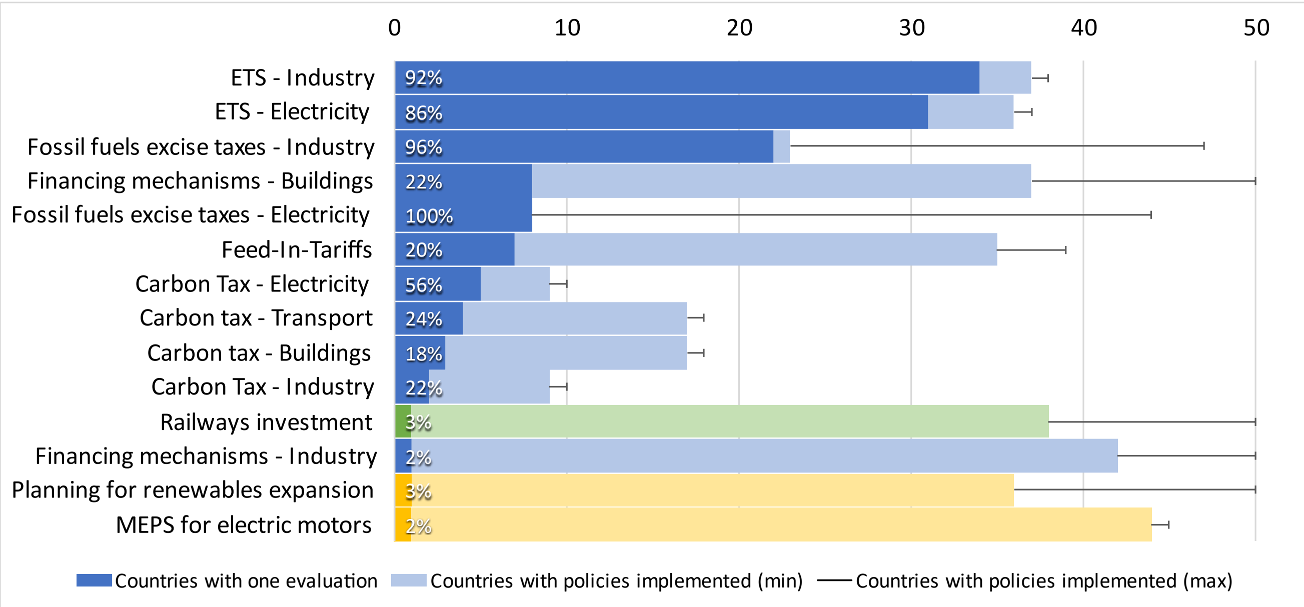
Figure 4 shows the evidence gaps across policies. It compares the number of countries that have implemented at least one specific policy within each CAPMF policy category (light-shaded bars) with the number of countries for which at least one policy – within each CAPMF policy category – has been evaluated by studies included in this systematic review (dark shaded bars).

Among the policies adopted, evaluations cover a larger share of economic instruments (dark blue bars in Figure 4) – especially ETSs and carbon taxes – than regulatory instruments (dark yellow bars). Evidence on ETSs is more abundant than on other policies. A policy evaluation of the instrument exists for more than 80% of countries that have an ETS in the industry or power sector. ETSs have often been gradually implemented in several countries and regions, e.g. the European Union, China and some states in the United States. Implementation often involves size thresholds for eligible firms, which facilitates causal analysis of such policies by comparing regulated and unregulated plants. In addition, several jurisdictions make publicly available verified ETS emissions for research purposes.

The evidence gap is larger for carbon taxes than ETS. For 44% of countries with a carbon tax in the electricity sector, no policy evaluation is available. The evidence gap is even larger for carbon taxes in transport (76%), buildings and industry (each at approximately 80%). Among subsidies, evaluations of feed-in tariffs (FIT) and financing mechanisms for energy efficient retrofitting in the buildings sector exist for only about 20% of countries that have implemented such policies.

Regulatory instruments – including technology and performance standards – are as common as economic instruments across countries, but only few evaluations of such policies exist. Evaluations of these policies cover less than 5% of countries that have such policies, pointing to a large evidence gap (Figure 4). Other regulatory instruments, such as minimum energy performance standards and building codes, which are implemented according to the CAPMF, are not evaluated and are not in the graph. Part of the reason for this evidence gap might be that regulatory instruments were often among the first mitigation-relevant policy instruments to have been implemented (as recorded by the CAPMF), some dating back to the 1970s. This might make the evaluation of such instruments challenging because credible causal evaluations often exploit the introduction of the instrument being evaluated. Furthermore, the lack of data going back so far in time may have proven to be a limiting factor.

Figure 4. Large evidence gaps remain for all policy categories but some economic instruments



Note: The figure shows, for a policy in the CAPMF database (vertical axis): in light shaded bars the minimum number of countries that have implemented it; in dark-shaded colours the number of countries that have at least one policy evaluated; in percentage the share of countries with an evaluation to countries with an implemented policy. Because of missing data in the CAPMF, the range of countries with implemented policies ranges between a minimum (light bars, assuming that a missing value denotes absence of the policy) and a maximum (whisker, assuming that a missing value denotes implementation of the policy). Blue bars are economic instruments, yellow bars are regulatory instruments and green bars are government consumption and investment. Policies in the CAPMF with no evaluation are excluded. The Figure includes 50 countries covered by the CAPMF (OECD and partner countries, with the exception of the United States and Brazil). The Figure excludes AFOLU sector policies as these are not covered in the CAPMF policy repository.
Source: Authors.

Estimates of the impact of policies on emissions

Policy effects on emissions are the main outcome of interest in this review, **but studies often report empirical estimates using different metrics.** For example, some papers report effects as changes in tonnes of emissions while others report them as percentage changes in emission or emission intensities (i.e., emissions per unit of output). Some other paper reports elasticities, i.e. the percentage change in emissions with respect to the percentage change in policy stringency.

Harmonising the size of estimates from the individual studies to a common metric is necessary to provide a transparent synthesis of the available empirical evidence. In this review, the harmonised effect is expressed as the annual percentage difference between the counterfactual emissions in a hypothetical scenario without the policy and the observed emissions of the regulated entities (e.g., firms, households, plants directly affected by the policy) when the policy is in effect. This provides an easily interpretable metric and allows for comparing effectiveness of different policies. A potential shortcoming of this approach is that it does not evaluate changes in absolute emissions and that, as a result, may attract attention to effective policies that only cover little emissions.

Reviewed papers typically report several estimates. One independent expert collected the estimates for this review according to the following steps, and a second expert checked them. The main or baseline estimate as reported by papers is taken first. If a range is provided as the baseline, both estimates are included. When effects are reported in percentage changes of emissions, these estimates are reported and prioritised over effects reported in different units or outcome variables. Finally, if per-period estimates are available but not averaged across time, they are included as such.

Reporting effects in percentage changes facilitates comparing the effectiveness of policies across studies, countries and sectors. Moreover, the majority of studies already report estimated effects in percentage changes, reducing the need to harmonise the estimates. Likewise, reporting effects in annual changes ease comparisons of estimates across studies spanning over several years and different time periods.

The harmonisation of estimates expressed in annual percentage change in emissions might require calculations and assumptions. This is especially the case if the studies report results for variables other than emissions (e.g. energy consumption). The preference has been to avoid such calculations and assumptions whenever possible. Based on this, the estimates are classified in three tiers described below:

- **Tier 1:** this includes estimates directly extracted from studies if these are already expressed as percentage change in emissions or if studies already convert the estimated effect on other variables into percentage changes of emissions.
- **Tier 2:** this includes estimates whose harmonisation has required some calculation steps or assumptions. For those estimates expressed as changes in emissions in absolute values (e.g. in tonnes of CO_2), these effects are converted into annual percentage changes relative to the counterfactual scenario, using either statistics reported in the paper or available from public

sources. If the study reports estimates on outcomes other than emissions (e.g. emission intensity), these estimates are converted to emissions following a transparent set of simple calculations and assumptions. (These are listed in Table A D.1.) For example, if effects are reported in terms of changes in emission intensities (e.g. emissions over output), the effects are converted to changes in emissions assuming the denominator stays constant in the analysis below. Tier 2 estimates are marked differently from Tier 1 estimates.

- **Tier 3:** this includes estimates whose conversion of the outcome variable into emissions would require modelling or strong assumptions. These estimates are reported separately along with their outcome variables. For example, some papers assess the effects of subsidies on home retrofitting expenditures. Estimating the effects of retrofitting expenditures on emissions would require additional estimates on the impact of home-retrofitting renovations on energy consumption caused.

3 Estimates of the effects of policies on emissions: cross-sectoral results

The 187 papers included in the final selection, yielded 457 estimates (Table 1). Out of these, 162 papers (87% of the total) report estimates expressed in percentage changes in emissions (tier 1: 293 estimates) or in other variables that can be converted into percentage changes in emissions (tier 2: 84 estimates), analysed below. Coefficients that are not statistically significant at 10% level are reported as zero effects in the main figures throughout this paper. Results do not differ meaningfully when considering the point estimates of such coefficients instead of reporting them as zero, as both the median and interquartile ranges do not significantly differ across sectors and policy instruments (Annex F). Estimates that are not statistically significant at 10% level account for 22% of all the estimates included in this review. As reported below, some policies in some sectors count few available estimates. The impact of converting statistically insignificant estimates to zero on the median and interquartile ranges of estimates is larger for these policies than for those for which several estimates are available. These differences, however, have no impact on the overall message of this paper.

The median annual effect of policies on emissions in the papers covered by the review is -5.4% (Table 1). The effect is fairly even across sectors, ranging from a median of -4.3% in the industry sector to -6% in the AFOLU sector. Most studies find that policies reduce emissions, though there is a large heterogeneity in point estimates within each policy instrument. Comparing the mean and median effects reveals that the distribution of estimates is skewed towards larger effects, especially for the AFOLU sector resulting in the largest average effect.

The evaluation period in the reviewed studies is on average six and a half years, with some variation across sectors. Evaluation periods in the buildings, industry and transport sectors are slightly below the mean at five and a half years. Studies in the power sector evaluate policies on average for about 7 years and studies in the AFOLU sector cover nearly 11 years on average (Table 1).

Table 1. Summary of papers reviewed and estimates by sector

	Buildings	Power	Industry	Transport	AFOLU	Total[(1)]
Papers in final selection	56	54	48	26	22	187
Papers in final selection (tier 1 or 2 estimates)	50	43	46	24	18	162
Number of estimates	122	114	93	75	53	457
Tier 1 estimates	23	110	84	59	17	293
Tier 2 estimates	70	4	9	0	1	84
Tier 3 estimates	29	0	0	16	35	80
Unique countries	21	16	17	11	13	40
Share of non-OECD countries	29%	6%	18%	9%	69%	40%
Annual effect on emission (percentage points)						
Median	-5.3	-5.0	-4.3	-4.8	-5.8	-5.4
Mean	-7.2	-8.0	-8.9	-6.2	-17.2	-8.2
p25	-13.0	-11.5	-12.0	-9.2	-13.0	-12.0

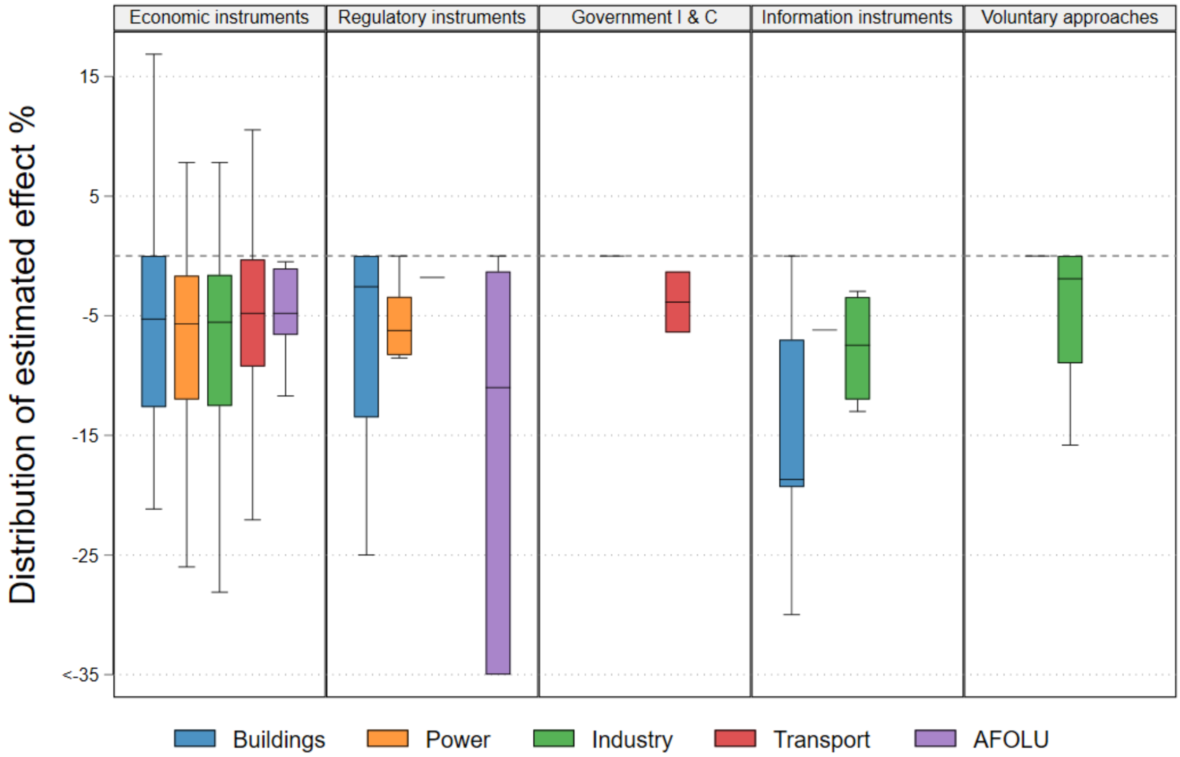
p75	0.0	-1.5	-1.5	-0.3	-1.0	-12.0
Mean (weighted)	-6.9	-8.8	-7.1	-4.1	-22.5	-7.6
Average length of evaluation period (years)	5.5	7.1	5.7	5.3	10.7	6.6

Note: (1) The total could be lower than the sum across columns, as some papers concern more than one sector. The table shows the number of papers and estimates separately for each sector, aggregating over different policy instruments. It also shows the median, mean and a weighted mean of the effect on emissions across 377 tier 1 and tier 2 estimates. The weighted mean is computed using the inverse of the number of estimates per paper as weights.
Source: Authors.

The large heterogeneity of estimates within each policy instrument underlines the importance of policy design to achieve emission reductions (Figure 5). Some factors that may explain such large differences in effectiveness for a given policy instrument include policy design and degree of implementation, abatement costs, and monitoring and enforcement. Furthermore, the evaluation method and robustness of policy evaluations varies across papers and could affect the estimated effects. For example, less robust studies might find larger estimates compared to studies that control better for potential confounding factors. This could inflate the average estimated effects and thus overstate the effectiveness of policies. To account for study robustness, experts in empirical climate policy evaluations assessed each study using a common ranking from 1 (least robust) to 5 (most robust). A comparison between the range of effect sizes and the experts' assessment of the robustness of the study reveals no apparent correlation between the robustness of studies and the direction or magnitude of the reported effects (Figure A B.4).

Some studies find positive effects of policies on emissions, which may point towards possible rebound effects. For example, subsidies for the purchase of energy efficient appliances could increase energy consumption if households use the saved energy expenditures to purchase additional appliances, thus increasing energy consumption. Such positive effects are only observed for some economic instruments and limited to few outliers for subsidies in the buildings sector, ETSs in the industry and transport sectors as well as renewable portfolio standards in the power sector.

Figure 5. Estimated effects of policies on emissions vary widely for each policy instrument



Note: The Figure shows box-and-whiskers plot of the annual estimates for the effect of policies on emissions from 377 tier1 and 2 estimates across 162 papers. The coloured boxes show the interquartile range; the solid horizontal line within the boxes shows the median; the lower whisker is the 25th percentile minus 1.5 times the interquartile range; the upper whisker is the 75th percentile plus 1.5 times the interquartile range.
Source: Authors.

4 Estimates of the effects of policies on emissions: sector-specific results

This section reports and discusses sector specific results. For each sector, a graph reports the individual estimates organised by policy instrument as well as summary statistics about their distribution. Box 2 explains how to read the graphs.

Box 2. Visualisation of sector specific results

For each sector, one or more graphs visualise the effectiveness of different mitigation policy instruments based on estimates gathered from the literature. Figure 6 presents their common elements and provides a visual aid to interpret them. The horizontal axis represents the estimated effect of the policy instrument. Negative values to the left of zero indicate reductions in emissions, while values to the right of zero suggest increased emissions.

Instrument: The estimates are grouped by policy instrument and ordered in descending order according to their median. The number to the right indicates the total number of estimates (orange and empty dots) included for this policy instrument.

Estimate: Each estimate from a study in the literature is marked with an orange dot. These estimates vary in magnitude and sign, indicating the range of effectiveness of each instrument. Coefficients that are not statistically significant at 10% level are reported as zero effects.

Tier 2 estimates: They are identified by an empty dot. These estimates involve adjustments or assumptions to harmonise findings from specific outcome variables (e.g., energy use) into changes in emissions.

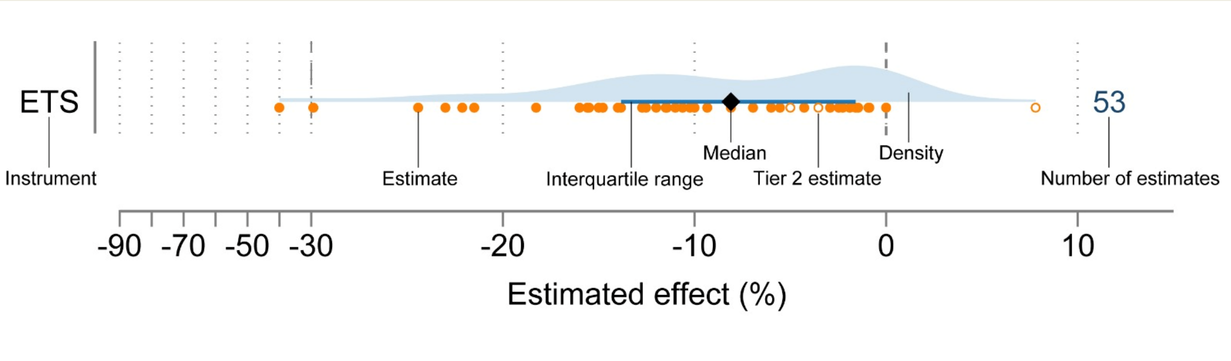
Median: The median estimate, represented by a black diamond marker, divides the estimates in half. The median provides a central measure of the estimated effect, showing a typical or most likely outcome across studies.

Interquartile range: The interquartile range, represented by the denser blue shading around the median, captures the middle 50% of estimates. This is the central range where half of the evidence falls, helping to identify typical outcomes. Estimates outside this range are still relevant, as they may indicate specific conditions or outliers in the application of the policy instrument.

Density curve: The blue shaded area above the orange dots represents the density of estimates. Where the blue shading is tallest, estimates are most densely concentrated, indicating where most results lie. The density curve helps to identify if estimates cluster around a particular effect size or spread widely. For example, Figure 6 shows a bimodal distribution, whereas estimates cluster around -3% and around -14%. Density curves are constructed using kernel estimates (i.e. k-density) and are cut at the extreme values.

A few graphs collect tier 3 estimates. These are estimates on mitigation-relevant outcomes other than emissions and cannot be converted in emissions without modelling or strong assumptions. One such example is the bottom panel of Figure 11, whereas the horizontal graph represents the estimated effect of a policy on deforestation.

Figure 6. How to read these graphs



Source: Authors.

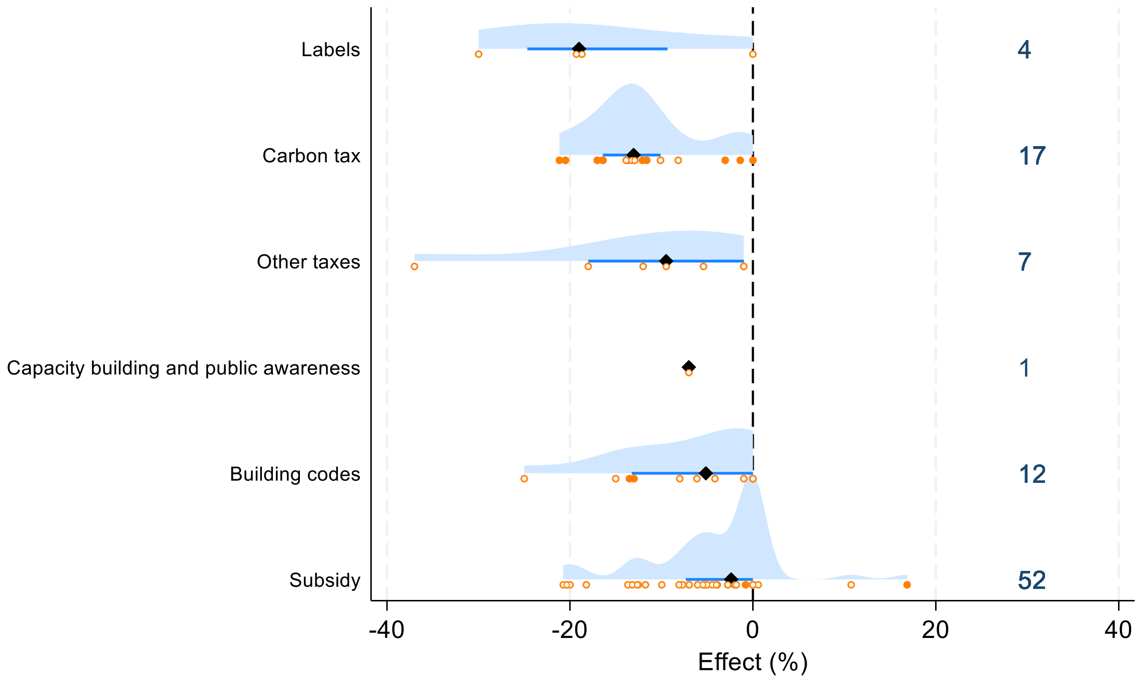
Buildings

This review includes 56 papers assessing polices in the building sector, for a total of 122 estimates. A large number of these estimates (52) concern subsidies, e.g. for energy saving retrofitting and for energy efficient appliances (Figure 7 and Figure A E.1). Significantly fewer estimates are available for carbon taxes and building codes (between 10 and 20 estimates) and even less for labels, other taxes, and capacity building and public awareness programmes (less than 10). The vast majority of estimates (80%) concerns policies for residential buildings (Figure A E.2).

Most of these estimates in the building sector are tier 2 estimates (75%). As explained above, these involve calculations and assumptions to convert the estimated effect of policies into annual percentage change in emissions (as the studies consider other outcome variables). Many studies consider as outcome variables electricity or gas use. To convert these estimates into changes in emissions, no change in the emission intensity of energy was assumed, as well as no switching from electricity to gas use or vice versa (or to other possible energy sources). Hence, a one percent change in energy consumption due to the policy is converted to a one percent change in emissions, as explained in Section 3. This assumption is more plausible for papers that evaluate short-term policy responses than for those that consider longer time horizons. In the long term, households are more likely to change their source of heating (e.g. from gas to electricity) and the carbon intensity of the electricity grid might change.

Other studies instead analyse effects of policies on investment in home retrofitting or the installation of rooftop photovoltaic panels. Converting those effects into emissions would require the use of behavioural models, so these effects are reported separately. These studies overall suggest that subsidies for rooftop-solar installation and for the purchase of home batteries are effective, with a median 50% increase in the uptake of rooftop solar installation, for instance (Figure A E.3 and Figure A E.4). Estimates, however, vary widely, likely because of specific policy design features such as the generosity of subsidies. Furthermore, the uptake of these measures does not necessarily imply a reduction in emissions because of possible rebound effects.

Figure 7. The effect of policies on emissions in the buildings sector



Note: Each orange dot is one estimate; the total number of estimates by category is reported on the right side; the shaded area are k-densities; black diamonds represent median by policy category; the dark blue horizontal bars are the interquartile distances; empty dots represent estimates that imply strong assumptions to be converted.
Source: Authors.

With regard to the size of the estimated effect, the median point estimate is higher for carbon tax and other taxes, such as fuel taxes (between 10 and 15%). The median estimate for building codes and subsides is lower, at below 5%. The evidence for labels (median effect just below -20%) could be highly context specific as only four estimates (from two studies) are available, focusing on California. Factors including the weather, type of housing and energy consumption patterns may be specific to this location and affect the results. More specifically, one study evaluates the effects of the voluntary Energy Star Programme and the Leadership in Energy and Environmental Design (LEED) program. Both aim at reducing emission in the building sector. Another study evaluates the effects of a public appeal for voluntary electricity conservation in San Diego.

Estimates concerning subsidies are highly heterogenous ranging from 18% to -20%, with more than a quarter of estimates on subsidies not being statistically significant at 10% (and reported as zero). Subsidies are the most studied type of policy for the building sector. The interquartile range for subsidies, which encompass 50% of the estimates, is between 0 and -7%. Most of the evidence concerning subsides cover energy efficient retrofitting programmes and energy efficient appliances (Figure A E.1).

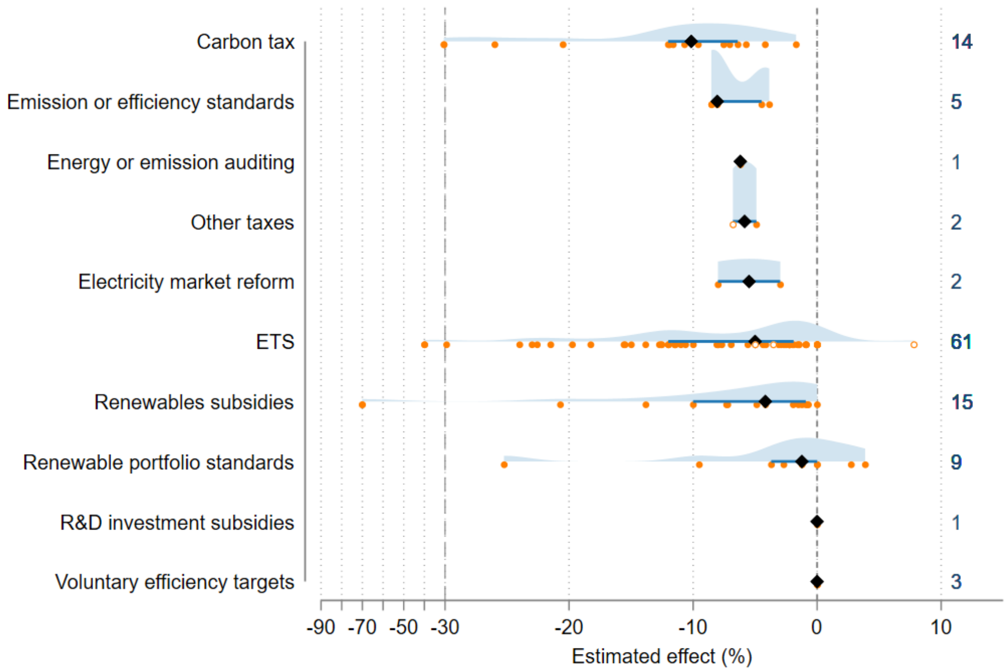
Several papers analysing the effects of subsidies in the buildings sector discuss the difficulties in achieving emission reductions through this policy (e.g. Fowlie, Greenstone and Wolfram et al. (2018[21]) for the United States and Risch (2020[22]) for France). Several factors can contribute to small emission reductions, despite generous subsidies for adopting retrofitting measures such as wall insulation or window replacement. This includes lack of awareness about the subsidies amongst some households, potentially resulting in subsidies being given to households that would have undertaken retrofitting measures anyway, thus resulting in non-additional measures being implemented (which is also referred to as “free-riding”). Some households may also be unwilling to implement retrofitting measures despite generous subsidies, due to disruptions to the daily life caused by renovations. In addition, misaligned incentives between landlords and tenants can result in limited uptake. For households that adopt retrofitting measures, the resulting emission savings are often lower than predicted by ex-ante engineering estimates, possibly due to rebound effects. For example, households may adjust indoor temperatures in response to better insulation, or in response to installing more efficient air conditioning appliances (Davis, Fuchs and Gertler, 2014[23]). Subsidies may thus lead to unintended effects which increase emissions. Combining subsidies with other policies, in particular carbon pricing policies or mandatory building codes, may be needed to achieve larger emission reductions.

Power

In the power sector, most estimates focus on economic instruments. These include carbon taxes (14 estimates), ETS (61), renewable subsidies (15), and renewable portfolio standards with tradable certificates (9). Few estimates refer to regulatory instruments, such as emission or efficiency standards (5) and electricity market reforms (2), classified as framework regulations. Voluntary efficiency targets are the only voluntary approach analysed (with only 3 estimates available); one estimate concerns emission audits, an information instrument. No study covers government investments and consumption.

Both economic instruments and regulatory instruments can be effective in reducing emissions in the power sector, while evidence is scant or inconclusive about voluntary instruments. Economic instruments include carbon taxes (showing the highest median effects on emissions, -10%), other taxes (such as fuel and environmental taxes, -5.8%), ETSs (-5%), renewable subsidies (-4.2%) and renewable portfolio standards (-1.2%). These instruments are also characterised by wide variation and the presence of outliers. Regulatory instruments can also help reduce emissions, with emission or efficiency standards (-6.2%) ranking second by median effect, and showing less dispersion than carbon taxes, with all the estimates comprised between -4.5% and -8.5%. Voluntary efficiency targets have the smallest median effect, as the three available estimates are not significantly different from zero at 10% level and were set to zero. Most estimates in the power sector are tier 1 and did not require any conversion.

Figure 8. The effect of policies on emissions in the power sector



Note: Each orange dot is one estimate; the total number of estimates by category is reported on the right-hand side; the shaded area are k-densities; black diamonds represent median by policy category; the dark blue horizontal bars are the interquartile distances; empty dots represent estimates that imply strong assumptions to be converted.
Source: Authors.

The evidence clearly suggests that carbon taxes are effective in reducing emissions from the power sector. The median emission reduction attributed to carbon taxes is the highest in absolute value across instruments (-10%). The distribution of estimates is wide, however, ranging from -2% to -30%. Most included studies on carbon taxes in the power sector investigate the Carbon Price Support introduced in the United Kingdom in 2013. This policy put a floor to the ETS price. Some papers show that coal-fired power plants reduced emissions more than gas-fired power plants, pointing to differences in abatement costs and possibly explaining differences across point estimates. The papers reviewed also indicate that fuel prices and power plant characteristics, such as size and efficiency, could explain the different estimated effects of carbon taxes on emission. Previous reviews point to other likely determinants of carbon tax effectiveness, including the tax rate, exemptions and rebates, in addition to effective communication about the tax and how revenues will be used (Köppl and Schratzenstaller, 2022[24]; Green, 2021[3]).

The evidence on ETSs effectiveness is the most heterogeneous in the power sector. Comparing the reviewed papers reveals that this large dispersion of estimates is not due to differences across schemes or countries. The estimated annual effects are in fact similar across different schemes, with the average effect on emissions of the three most studied schemes; -7% for the EU ETS, -12% for the Regional Greenhouse Gas Initiative (RGGI), and -11% for the regional Chinese pilots. This is despite different policy design. For example, allowances were free and based on production in Chinese pilots, auctioned in the RGGI and mixed in the EU ETS. Also, the EU ETS and RGGI use automatic reserves to adjust the supply of allowances and manage permits' price volatility, whereas the Chinese pilots do not.

Differences in ETSs permit prices do not seem to explain the variation in estimates. Studies focusing on later years of the EU ETS, when prices have been higher, do not tend to find larger effects than studies focusing on the initial phase. However, evidence on the later years is still limited when compared to the initial phase of the EU ETS. Instead, differences in estimates within one instrument remain, including when the same programme and emission price are considered. For example, one study applied the same methodology to investigate the effects of the EU ETS on different countries and its estimate range from a positive effect on emissions in the United Kingdom to a reduction by 40% in Norway. While prices were more than double in the EU ETS and RGGI compared to the Chinese pilots, the estimates are comparable across schemes.

The evidence on Renewable Portfolio Standards (RPS) show small size effects with some outliers. Renewable Portfolio Standards are state-level policies introduced in the United States starting in the 1990s. They mandate that electric utilities provide a minimum percentage of electricity using renewable energy sources. Utilities can meet their obligations generating renewable electricity or purchasing certificates from other producers. Only six reviewed papers estimate their effects on emissions, for a total of nine estimates that vary widely. As the papers investigate by and large the same states and time, these differences could rather be determined by methodological differences and modelling assumptions.

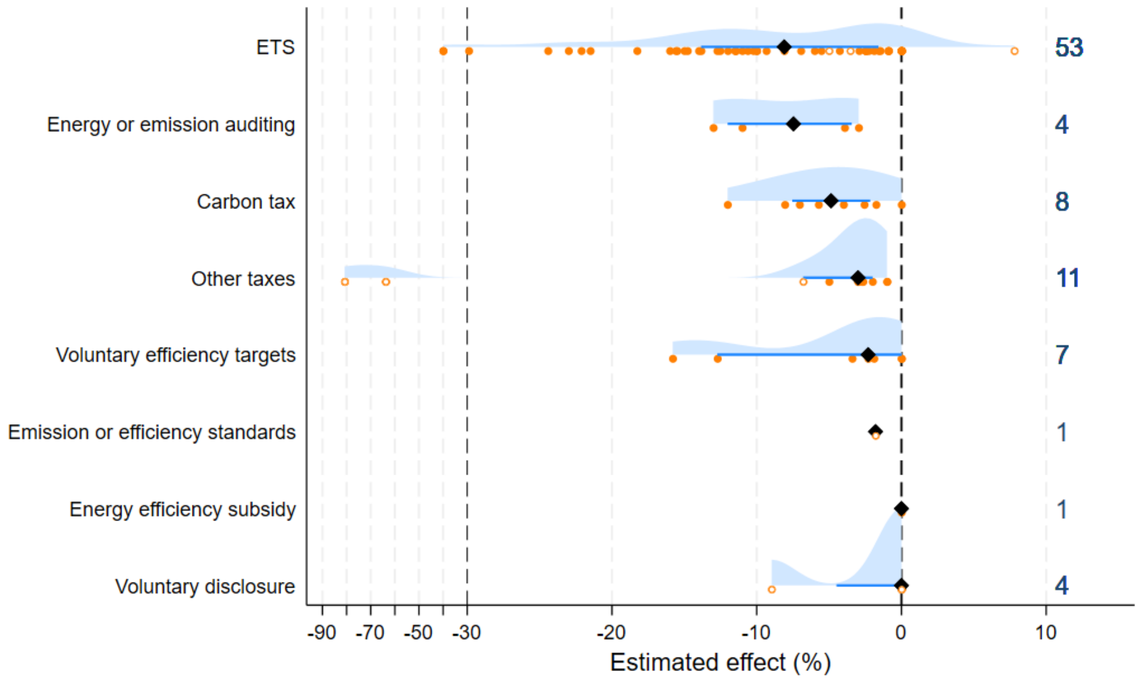
Large evidence gaps remain in power generation. Standards are widespread across countries; they mandate limits to emissions (as in Canada, Germany, China and some states in the United States), energy efficiency improvements (in Japan), and best available techniques (in the European Union). However, evidence is scant compared to carbon pricing. Other mitigation-relevant policies, such as energy audits, incentives to R&D investments, and electricity market reforms, while increasingly common, are evaluated by few papers.

Industry

In the industry sector, most estimates focus on economic instruments, particularly on **ETSs** (53), but also on **carbon taxes (8) and other taxes, such as fuel excise taxes (11).** Few papers studying ETS policies (16) and carbon taxes (2) report estimates relevant for both the power and industry sectors. Unlike the power sector, only one reviewed paper investigates the role of subsidies in reducing emissions. Only one study covers regulatory instruments, such as emission or efficiency standards. Instead, a few estimates cover information instruments (energy or emission auditing, 4) and voluntary instruments (voluntary efficiency targets, 7; voluntary disclosure, 4).

ETSs are the policy instrument with the highest median estimate (-8%), driving the overall effectiveness of economic instruments (-5.5%). Some studies on ETSs report large emission reductions (up to -40%), while others show modest or no effects (close to 0%). Energy or emission auditing, an information instrument, can also be effective (-7.4%). The median effect is smaller in absolute values for the other policies. Many studies in voluntary approaches report an insignificant effect, provisionally recorded as zero, and the category has an overall median estimate of -2%. Most estimates in the industry sector are tier 1 and do not require any conversion.

Figure 9. The effect of policies on emissions in the industry sector



Note: Each orange dot is one estimate; the total number of estimates by category is reported on the right-hand side; the shaded area are k-densities; black diamonds represent median by policy category; the blue horizontal bars are the interquartile distances; empty dots represent estimates that imply strong assumptions to be converted.
Source: Authors.

The evidence on ETSs reveals large differences across estimates. Several reviewed papers point to market mechanisms and design choices as important determinants of effectiveness. These include the initial allocation rule, the possibility to bank permits and robust emission monitoring and enforcement. Furthermore, the stringency of the emission cap and the associated emission prices could be key factors in determining the effectiveness of an ETS. However, as in the power sector, much of the variation in estimated effects comes from differences across estimates for the same policy, rather than differences between policies, possibly because of differences in the methodology, data and coverage across studies evaluating the same policy.

Contrasting the power and industry sectors, ETSs appear more effective in the former, possibly due to different exposure to international competition, the higher recourse to free allowances in industry or the higher abatement costs in heavy industries. One study contrasting the effects of the Korean ETS on industry and power suggests that electricity generators could adjust their fuel mix in response to carbon pricing, incorporating more low-carbon energy sources (Kim and Bae, 2022[25]).

The median estimate for carbon taxes and other taxes, such as environmental and fossil fuel excise taxes, is about -5% and -3% respectively. Carbon taxes generally lead to a reduction in emissions, often via a reduction of energy consumption and improved energy efficiency. For example, a study on the United Kingdom's Climate Change Levy, a carbon tax, found that it had a strong negative effect on energy intensity and electricity use in manufacturing plants. Variation in the estimates could come from tax-rate differences, as the evidence from the reviewed cross-country studies also suggests. Furthermore, a few studies mention the importance of industry differences, the availability of exemptions, and the use of revenues in explaining tax effectiveness. Finally, methodological differences could be another source of dispersion across estimates. For example, a few studies use energy price shocks to proxy for carbon and fuel taxes.

In addition, a few estimates in these categories are tier 2, including two outliers in other taxes, as they require assumptions to be converted from emission elasticities or effects on emission intensities into percentage changes in emissions.

Auditing policies can be effective in reducing emissions, as they help firms compare energy performance and identify inefficiencies. Yet, they are only a first step towards improving energy efficiency. The reviewed studies report meaningful reductions in industrial emissions (-7%), though the evidence is based on only four estimates, based on studies on Japan, Sweden and the United States. While the programmes differ in scope (regulated firms) and length, all the papers reviewed discuss the importance of offering the audits for free or providing financial incentive to undertake one. Furthermore, one paper discusses the importance of setting clear quantitative targets, providing information on methods for reducing emissions, rewards for good practices, rigorous inspection, and clear accountability structures in the firm (Yajima and Arimura, 2022[26]). These differences in policy implementation could help explain the differences in estimated effects.

Voluntary efficiency targets appear to have weaker effects on emissions than binding policies. Nevertheless, the reviewed studies found statistically significant negative effects on emissions from voluntary efficiency targets, such as the voluntary energy agreements in Denmark, the Netherlands and Sweden. The interquartile range of estimates is large, when compared to carbon taxes for a similar number of estimates. The difference in results across policies could reflect different policy designs. For example, the Danish scheme proposed a clearer quantitative target and rigorous monitoring, with large estimated emission reductions compared to other less specific schemes.

Most estimates on voluntary disclosure policies are not significantly different from zero. These policies include voluntary certifications, such as the Eco-Management and Audit Scheme (EMAS) employed in the European Union, and voluntary emission reporting schemes, such as those enacted in Canada and in the United States. The reviewed papers discuss possible reasons for the lack of effectiveness of these policies, citing problems of self-selection and greenwashing, the limited incentive structure, and insufficiently stringent targets. For comparison, Figure A A.1 in the Annex shows the distribution of raw estimates, without converting to zero the results that are not statistically significant at 10% level.

Transport

In the Transport sector, 26 papers are reviewed for 75 estimates. For 24 papers, 59 estimates are obtained on emissions (tier 1 estimates). Most evidence covers carbon taxes (35 estimates), followed by ETSs (14) (Figure 10). Less evidence is available for public investment, purchase subsidies, vehicle excise duties and vehicle registration taxes (with at most five estimates). The majority (70%) of estimates concerns policies for the road transport sector, specifically on carbon taxes, vehicles subsidies and registration and excise taxes. Some evidence (20%) is available for the air transport sector, notably from the EU ETS (Figure 10)

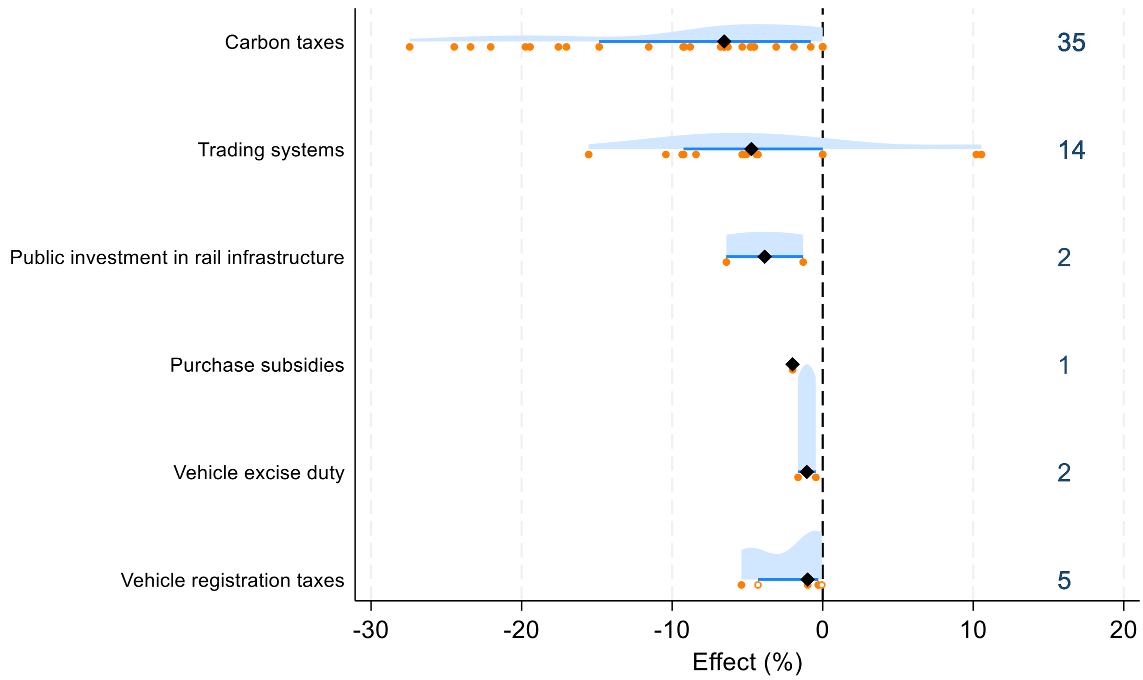
Carbon taxes have the highest median effectiveness at -7%, albeit with large heterogeneity (ranging from 0 to -27% and an interquartile range of -1 to -13%). ETSs also have a large median effect (-5%) and a large interquartile range (0 to -9%), with some evidence finding large positive effects (in air transport) (Figure 10). The evidence on public investments in rail infrastructure is limited to two studies evaluating policies in China. They find estimates ranging from -1 to -6%. One paper analyses the effects of vehicle purchase subsidies (also referred to as “Cash-for-clunkers”) in the United States on emissions, finding an effect of -2%. Additional evidence on the effects of vehicle purchase subsidies is available. This evaluates effects on vehicle purchases or changes in the fuel economy of vehicles, as discussed further below. Evidence from three papers is available on the effects of vehicle registration taxes on emissions for France, Germany, Norway and Sweden, with estimates ranging from -1 to -5%.

Evidence on the effect of vehicle excise duties on transport emissions is available for the United Kingdom, finding small effects of between -0.5 and -1.5%. The vast majority of studies are tier 1 estimates (96%) with the remaining estimates being tier 3. The tier 1 estimates in the transport sector typically exploit changes in fuel consumption, which are converted to changes in emissions using fuel emission factors. These studies are classified as tier 1 studies as fuel use maps linearly to carbon emissions. With increasing use of electric vehicles, a decline in fuel use may however translate to fewer emission reductions as cars are replaced by electric vehicles that are powered by non-renewable electricity sources.

Other studies assess the effect of car-purchase subsidies on electric vehicles' sales and on the fuel economy of cars (4% of estimates in the transport sector are tier 3). The evidence shows that subsidies can increase the sale of such vehicles (median effect of 20%) and can help improve the fuel economy of the fleet (Figure A E.6 and Figure A E.7). As for subsidies in other sectors, the increase in the sale of such vehicles may not imply a decline in emissions. For example, if the hybrid or electric vehicles do not replace combustion engine vehicles, but are used in addition to them, they may have limited or no effect on emissions. The effect on emissions also depends on the carbon intensity of the power grid. These indirect emissions (also referred to as scope 2 emissions) are often not considered.

Overall, there are few papers that evaluate the effects of national transport policies on emissions and important evidence gaps remain. Limited evidence is available on the effect of public transport infrastructure on emissions. Moreover, evidence is lacking on the effects of regulatory instruments. Many transport policies are implemented at a local level, such as congestion charges or ultra-low emission zones and some studies assess their effects on local air pollutants and health outcomes, which are beyond the scope of this review (Ma, Graham and Stettler, 2021[27]; Chamberlain et al., 2023[28]). In addition, a large literature estimates elasticities of gasoline demand to fuel price fluctuations. These papers largely do not evaluate the effects of policies, but the effects of fluctuations in fuel prices (for example driven by geo-political events) and are beyond the scope of this analysis (see for example (Kilian and Zhou, 2024[29]; Knittel and Tanaka, 2021[30]) for recent reviews).

Figure 10. The effect of policies on emissions in the transport sector



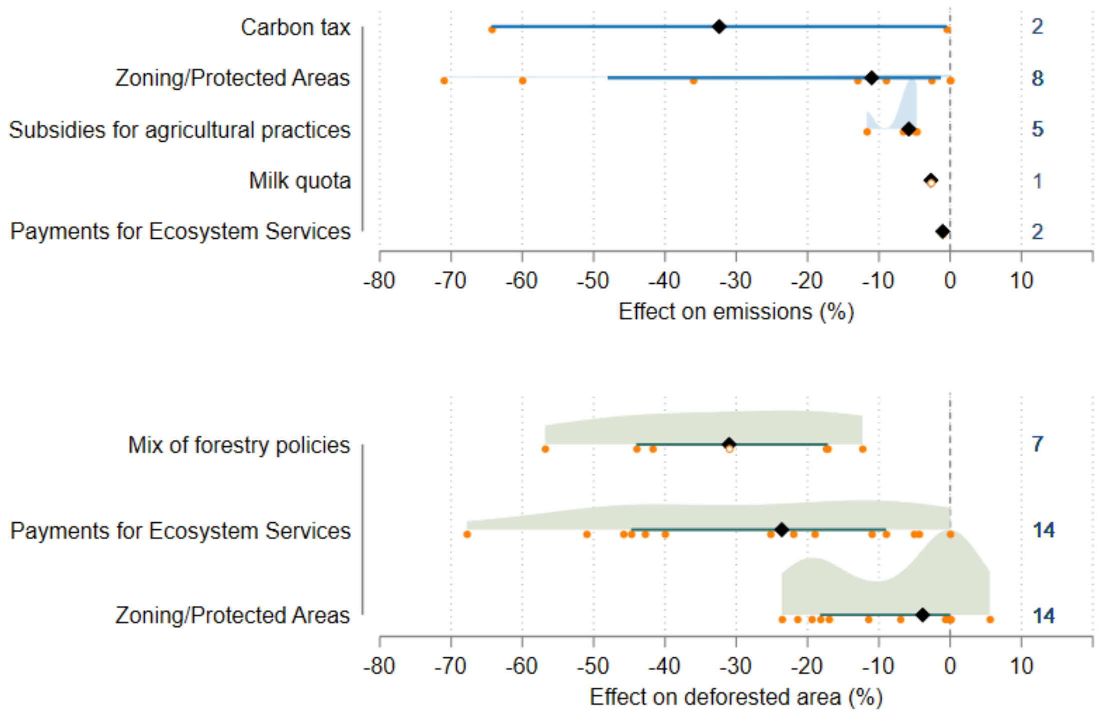
Note: Each orange dot is one estimate; the total number of estimates by category is reported on the right-hand side; the shaded area are k-densities; black diamonds represent median by policy category; the blue horizontal bars are the interquartile distances; empty dots represent estimates that imply strong assumptions to be converted.
Source: Authors.

AFOLU

This systematic review includes 18 papers assessing policies in the AFOLU sector, for a total of 53 estimates of policy effects on emissions (18 estimates) and forested/deforested areas (35, tier 3 estimates). This paper considers both outcomes as only few studies investigate the direct effects of AFOLU policies on emissions. Several investigate instead the impact of policies on deforestation, which has a direct relationship to emissions and climate change mitigation (Canadell and Raupach, 2008[31]). A significant share of these estimates (22) concerns zoning and protected areas, which restrict land use to curb emissions and deforestation (Figure 11). Fewer estimates are available for payments for ecosystem services (16) and subsidies for agricultural practices (5). Only a handful of studies examine the effect of carbon taxes on fuels in the AFOLU sector (2) and the impact of milk quotas (1). The estimates largely focus on policies related to forestry and land-use changes, with fewer estimates covering agricultural practices. Two estimates are tier 2, requiring strong assumption to convert the effects of policies on mitigation-relevant outcomes, such as emission intensity, into changes in emissions.

Both economic instruments and regulatory instruments can be effective in reducing emissions in the AFOLU sector. The two studies on carbon taxes find very different effects on emissions, so the high median estimate associated with this instrument could be misleading. Other than carbon taxes, zoning and protected areas (a type of framework standard) have the largest median effect on emission (-11%), albeit with large differences across studies. In contrast, the effect of protected areas on deforestation are small and more narrowly distributed around the median (-3.8%). Subsidies for agricultural practices have a more modest effect on emissions (-6.6%), but the interquartile range is narrow, with all the estimates close to the median. Forestry policy mixes are the most effective policy in reducing deforestation, with a median estimate of -31%. Payments for Ecosystem Services (PES) can have a large effect on deforestation, with a median of about -20% and interquartile range going from -45% to -10%. Only one study (two estimates) explicitly looked at the impact of PES on emissions through deforestation; founding modest effects (-1%).

Figure 11. The effect of policies on emissions in the AFOLU sector



Note: Each dot is one estimate; the total number of estimates by category is reported on the right-hand side; the shaded area are k-densities; black diamonds represent median by policy category; the horizontal bars are the interquartile distances; empty dots represent estimates that imply strong assumptions to be converted.
Source: Authors.

Protected areas could effectively reduce deforestation and its associated emissions, but several studies point to limited effectiveness due to implementation weaknesses. Studies in Ecuador and Thailand found that protected forests were less likely to be deforested than non-protected areas (Hayes, Murtinho and Wolff, 2017[32]; Ferraro et al., 2015[33]). Several studies suggest that the protection on of areas that face high deforestation pressure is effective in preserving forest cover and enhancing carbon storage. However, spatial leakage, i.e. economic activities shifting towards non-protected areas, can reduce the effectiveness of protected areas policies. Finally, several papers underline the importance of the regulatory and social context for policy effectiveness. This encompasses policy enforcement, community involvement, and complementary policies. Reynaert et al. (2024[34]) review the literature and also point to protection types (strict vs mixed-use) and land ownership rights as determinants of policy effectiveness.

Payment for Ecosystem Service programs, which provide financial incentives to landowners for conserving forests, show a positive impact on reducing deforestation. For example, a study in Ecuador found that forests enrolled in the Socio Bosque Program were 9% less likely to be deforested than non-enrolled forests over a six-year period. One study focusing on Indonesia's moratorium on forest concessions, which included a results-based payment scheme, estimates a reduction in deforestation, although with somewhat limited effects on emissions. As discussed in the reviewed papers, factors that can help explain the large differences in estimated effects on deforestation– ranging from statistical insignificance to almost -70% deforested areas – include enrolling forests with a low risk of deforestation, inadequate monitoring, and spatial leakage.

Mixes of forestry policies have been effective in reducing deforestation. Brazil's federal action plan is an example of such a policy mix. It includes intensified monitoring in a list of designated municipalities, increased fines for illegal deforestation and logging, public awareness campaigns and strengthened coordination across governmental agencies. One paper finds that this approach was successful in reducing deforestation because it involved different stakeholders in a coordinated manner (Arima et al., 2014[35]).

The ex-post evidence on carbon taxes is rather limited in the AFOLU sector, reflecting its limited use in the sector. The two reviewed papers consider the effect of carbon taxes on agricultural emissions via an increase in transportation costs. One study argues that a carbon tax applied on all emissions from deforestation (calculated as the difference in carbon stock sequestered in forested area compared to deforested areas) could help reforestation in the Amazon by reducing the returns of the unproductive agricultural land (Souza-Rodrigues, 2018[36]). The second study investigates the 2008 introduction of a carbon tax applied to fossil fuels in British Columbia (Canada), showing a small but significant decrease in transportation and agriculture emissions, albeit the author suggests caution in interpreting such large effects (Pretis, 2022[37]). The two studies find widely different effects of carbon taxes on emissions, possibly reflecting differences in the tax base (all emissions from deforestation vs only emissions from fossil fuels), in the price, context and estimation methodology. The planned metanalysis that will follow this study might shed light on the relative importance of these factors.

Many countries provide subsidies and technical assistance for agricultural practices, but the evidence on country-wide policy is limited. This type of policy includes livestock emissions management (e.g. via dietary changes or implementing manure management technologies), wetland restoration, and sustainable land management (e.g. crop rotation and conservation). The estimates in this review are all from one study collecting evidence on a Chinese pilot, offering subsidies to adopt sustainable and low-emission agricultural practices. More evidence could shed light on the effectiveness of subsidies in reducing emissions, highlighting the most promising agricultural practices for climate mitigation.

Important evidence gaps remain regarding the effectiveness of AFOLU policies on cutting emissions. For example, no ex-post study has examined the impact of ETS on AFOLU emissions, whether through direct inclusion of AFOLU emissions in the system (as in the case of New Zealand) or through indirect coverage via fossil fuel pricing as the latter may influence emissions from the sector. Most studies in the AFOLU sectors investigating policy effects focus on outcomes other than emissions, such as local pollutants concentrations, food-security, harvest volumes, farmers' income, or innovation in agricultural techniques. This evidence gap might be due to challenges in data availability for the AFOLU sector, which have started to be addressed only recently through satellite technology. In contrast to ex-post evidence, some ex-ante modelling exists that assess the effects of AFOLU policies on emissions [COM/TAD/CA/ENV/EPOC(2024)2]. However, these studies are beyond the scope of this review.

5 Next steps and future work

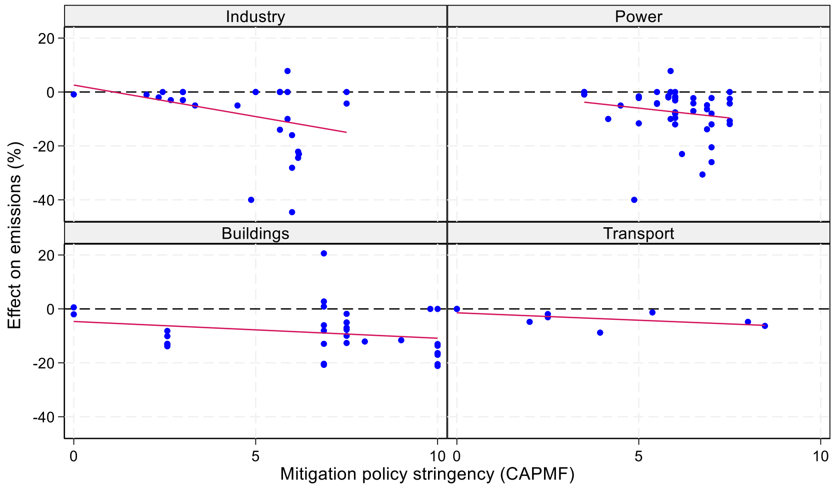
This systematic review provides a synthesis of the existing empirical evidence on mitigation policies. This is the first paper to collect, harmonise and compare the effects of climate policies across a wide range of sectors and policy instruments. One finding of the review is that the majority of climate policies that have been evaluated to date are effective in reducing GHG emissions. The median effectiveness of policies in reducing emissions is similar across instruments and sectors and is around -5% per year.

However, estimates differ greatly within the same sector and policy instrument. Overall, the descriptive analysis of the estimates included in this review suggest that the interquartile range of policy effects on emissions vary from -12% to -0.9%, with several outliers in both directions. Comparing evaluations of similar policies across countries reveals that their effectiveness varies widely. This large heterogeneity of estimates – within sectors and type of policies and across countries – suggests the importance of specific country- and policy-specific features determining policy effectiveness. Thus, policies that have successfully reduced emissions in one context might not work in a different one. In several cases, evaluations find heterogeneous effects for the same policy depending on the regulated entity, the period, or the regions considered.

This descriptive evidence synthesis points to three broad determinants that could explain the variation in estimates of policy effectiveness: policy design and stringency, contextual factors, and methodological differences across papers. First, specific policy attributes, such as exemptions and rebates, and other factors, such the degree of enforcement and governments' commitment in reducing emissions as expressed in clear targets, could shape behavior and expectations, thus affecting the ability of a policy to reduce emissions. In particular, mitigation policy stringency, intended as more intense or strict regulation, is likely to play a role, consistent with recent evidence (Frohm et al., 2023[38]; D'Arcangelo et al., 2022[39]). Second, mitigation policies do not act in a void and contextual elements, such as the existence of complementary policies, strong political support, or the availability of abatement technologies, are likely to be relevant. Overall, such factors could help explain policy effectiveness in reducing emissions. Finally, differences in the evaluation method might also explain differences in results.

Preliminary and exploratory analysis conducted by matching the policies in this review with the OECD CAPMF database shows the relationship between policy stringency and effects on emissions. In each of the four sectors covered by the CAPMF (which does not yet cover policies in the AFOLU sector), stricter climate policies are correlated with larger estimated effects of policies on emissions (Figure 12). However, a more formal and complete analysis is needed to assess the relative importance of the different factors, including policy stringency and its determinants (i.e. policy attributes such as level of subsidies or taxes, rebates, exemptions, degree of enforcement), stringency and the other factors in determining policy effectiveness.

Figure 12. The relationship between policy stringency and estimated effect on emissions



Note: The Figure shows the matched values of the effects on emissions (vertical axis) to the level-3 policy stringency values of the OECD CAPMF database. The CAPMF value is averaged over the evaluation period of the empirical studies. The analysis is limited to 49 countries covered in the CAPMF, which are largely OECD and G20 countries, with the exception of the United States and Brazil. The CAPMF database does not include AFOLU sector policies. It shows the correlation between the stringency of policies and the effect on emissions. The blue dots are estimates and the red line shows the linear trend.
Source: Authors.

A formal meta-analysis could provide the appropriate statistical framework to investigate the relative importance of factors affecting policy effectiveness. This would require preparing a dataset that enables meta-analysis regressions by coding or harmonising the required variables. Meta-analysis regression techniques performed on the data could then identify the relative importance of each determinant, while accounting for potential confounders

Developing a "living evidence" bank to keep track of accumulating evidence and facilitate the comparison of and access to available estimates would facilitate the continuous systematic assessments of climate policies. This could accelerate knowledge sharing and help in the design of effective mitigation policies in different contexts. This evidence bank could consist of an online platform and a protocol for researchers to submit their studies for inclusion following a predefined vetting process. Discussions with and feedback from IFCMA delegates could ensure that the evidence is collected, synthesised, and made available in a way that is most useful to policymakers. A machine learning approach (Callaghan, Minx and Forster, 2020[20]) may complement the approach used in this review and aid the identification of additional relevant papers to include in the evidence bank.

Future work may also consider expanding the scope to other socio-economic outcome variables. As environmental policies become more stringent, the joint outcomes of policies on emissions and socio-economic factors such as employment, trade, innovation, distributional effects and public acceptability are important to inform policymaking. Expanding the work to other socio-economic outcomes would help to identify the evidence gap and to document the existing evidence for effects of climate policies on socio-economic outcomes. Finally, complementing the evidence from the ex-post empirical literature with similar analysis from the ex-ante modelling literature could be envisaged. Because these approaches serve distinct but complementary purposes — ex-post analysis providing evidence on policy effectiveness based on past data and ex-ante modelling offering forward-looking insights — integrating both perspectives can enhance the robustness of climate policy assessments. This work would complement the IFCMA's work on ex-ante modelling by assessing and summarising the available evidence from the related literature.

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Annex A. List of literature reviews analysed for this review

Table A A.1. List of previous literature reviews consulted for this paper

#	Authors	Year published	Title of review	Publication of review
1	Anderson, S. T., and Sallee, J. M.	2016	Designing policies to make cars greener: a review of the literature.	Ann. Rev. Resour. Econ. 8, 157–180.
2	Dechezleprêtre, A., and Sato, M.	2017	The Impacts of Environmental Regulations on Competitiveness	Review of Environmental Economics and Policy
3	Dechezleprêtre, et al.	2019	Do Environmental and Economic Performance Go Together? A Review of Micro-level Empirical Evidence from the Past Decade or So	International Review of Environmental and Resource Economics
4	Delmas, M. A., Fischlein, M., and Asensio, O. I.	2013	Information Strategies and Energy Conservation Behavior: A Meta-Analysis of Experimental Studies from 1975 to 2012	Energy Policy 6: 729–39.
5	Döbbeling-Hildebrandt, et al.	2024	Systematic review and meta-analysis of ex-post evaluations on the effectiveness of carbon pricing	Nature Communications
6	Gerarden, T. D., Newell, R. G., and Stavins, R. N.	2017	Assessing the energy- efficiency gap	Journal of Economic Literature 55 (4): 1486–1525.
7	Giandomenico, L., Papineau, M., and Rivers, N.	2021	A Systematic Review of Energy Efficiency Home Retrofit Evaluation Studies	Annual Review of Resource Economics, 14:689–708
8	Gillingham, K., Keyes, A., and Palmer, K.	2018	Advances in Evaluating Energy Efficiency Policies and Programs	Annual Review of Resource Economics, 10:511-532
9	Gillingham, K., Keyes, A., and Palmer, K.	2006	Energy Efficiency Policies: A Retrospective Examination	Annual Review of Environment and Resources, 31:161-192
10	Gonzalez Parraro, C., et al.	2024	Land-use change and forestry programmes in low- and middle-income countries – An evidence gap map update	International Initiative for Impact Evaluation (3ie), Evidence Gap Map Report 3
11	Green, et al.	2021	Does carbon pricing reduce emissions? A review of ex-post analyses	Environmental Research Letters, 16 043004
12	Javaid, et al.	2022	Behavioural interventions change individual transport choices but have a limited impact on transport mode split. Evidence from a systematic review	Preprint
13	Khanna, et al.	2021	A multi-country meta-analysis on the role of behavioural change in reducing energy consumption and CO2 emissions in residential buildings	Nature Energy 6: 925–932 (2021)
14	Köppl, A., and Schratzenstaller, M.	2022	Carbon taxation: A review of the empirical literature	Journal of Economic Surveys
15	Lee, L., and Ignaciuk, A.	2024 (forthcoming)	Measuring policy progress on climate change mitigation in the Agriculture, Forestry and Land Use (AFOLU) sector	Forthcoming Working Paper of the Joint Working Party on Agriculture and the Environment
16	Lilliestam, J., Patt, A., and Bersalli, G.	2020	The effect of carbon pricing on technological change for full energy decarbonization: A review of empirical ex-post evidence	WIRES Climate Change
17	Raqitzer, D. A., Blondal, N., and Sibal, J.	2019	Impact Evaluation of Energy Interventions: A Review of the Evidence	Asian Development Bank

18	Reynaert, M., Souza-Rodrigues, E., and van Benthem, A	2024	The environmental impacts of protected area policy	Regional Science and Urban Economics, Volume 107,
19	Snilstveit, B., et al.	2016	Land-use change and forestry programmes: Evidence on the effects on greenhouse gas emissions and food security	International Initiative for Impact Evaluation (3ie), Evidence Gap Map Report 3

Source: Authors.

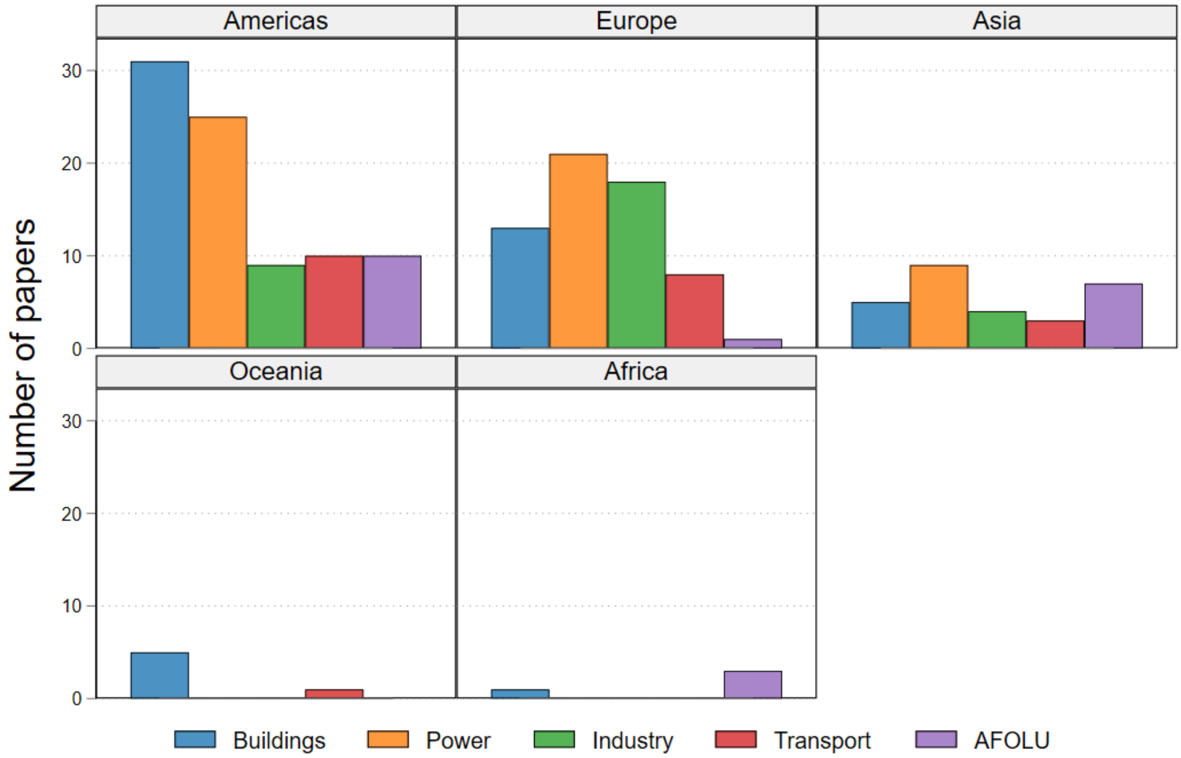
Annex B. Descriptive statistics

Table A B.1. Number of papers reviewed by sector and policy instrument

Instrument category	Instrument type	Buildings	Power	Industry	Transport	AFOLU	Total[1]
Economic instruments	Subsidies	38	14	1	4	10	67
	Taxes	8	9	13	17	2	46
	Trading systems	0	35	24	3	0	46
Regulatory instruments	Performance standards	5	2	0	0	0	7
	Technology standards	1	1	1	0	0	3
	Framework standards	0	1	0	0	11	12
Government investment & consumption	Public investment	0	1	0	2	0	3
	Public procurement						
	Public appraisal						
Information instruments	Reporting requirements	2	1	3	0	0	6
	Capacity building & awareness	2	0	0	0	0	2
Voluntary approaches	Voluntary targets	0	1	5	0	0	6
	Voluntary trading systems						
	Voluntary information instruments	0	0	3	0	0	3
Total[1]		56	54	48	26	22	187

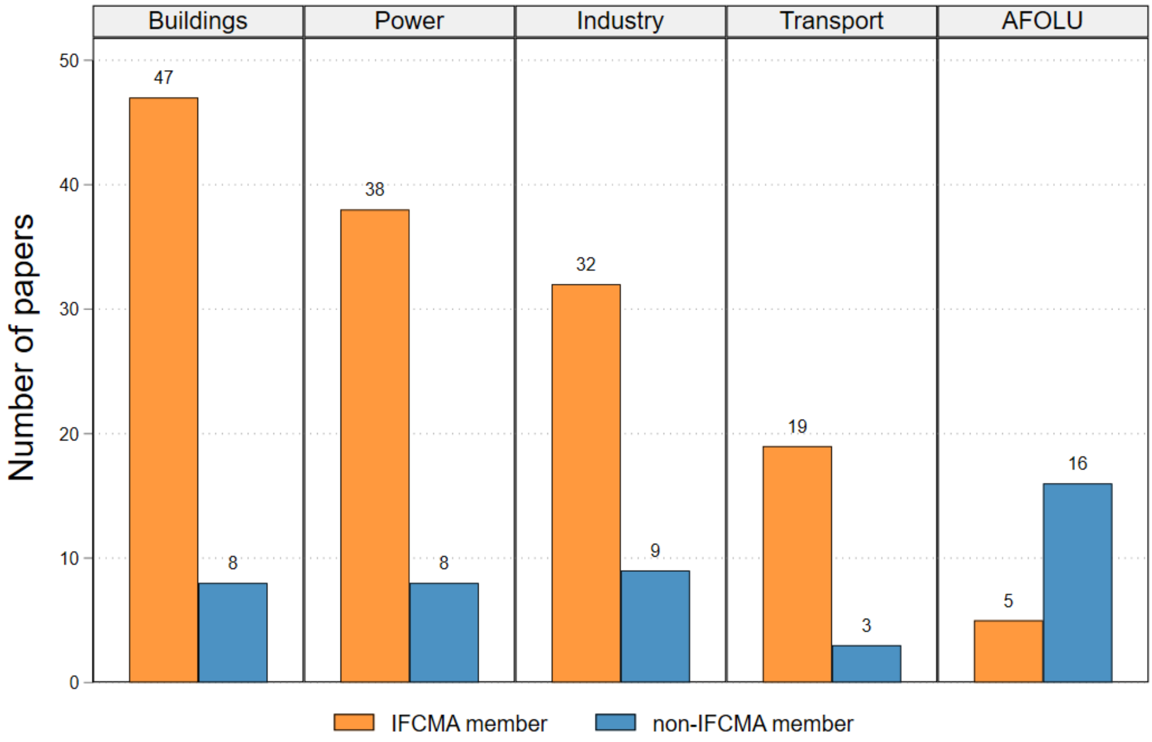
Note: [1] The Total is lower than the sum across sectors or instrument categories, as some papers provide estimates for multiple sectors or instrument categories. The table lists the number of papers reviewed for each sector, IFCMA instrument category and IFCMA instrument type.
Source: Authors.

Figure A B.1. Number of papers reviewed by sector and region



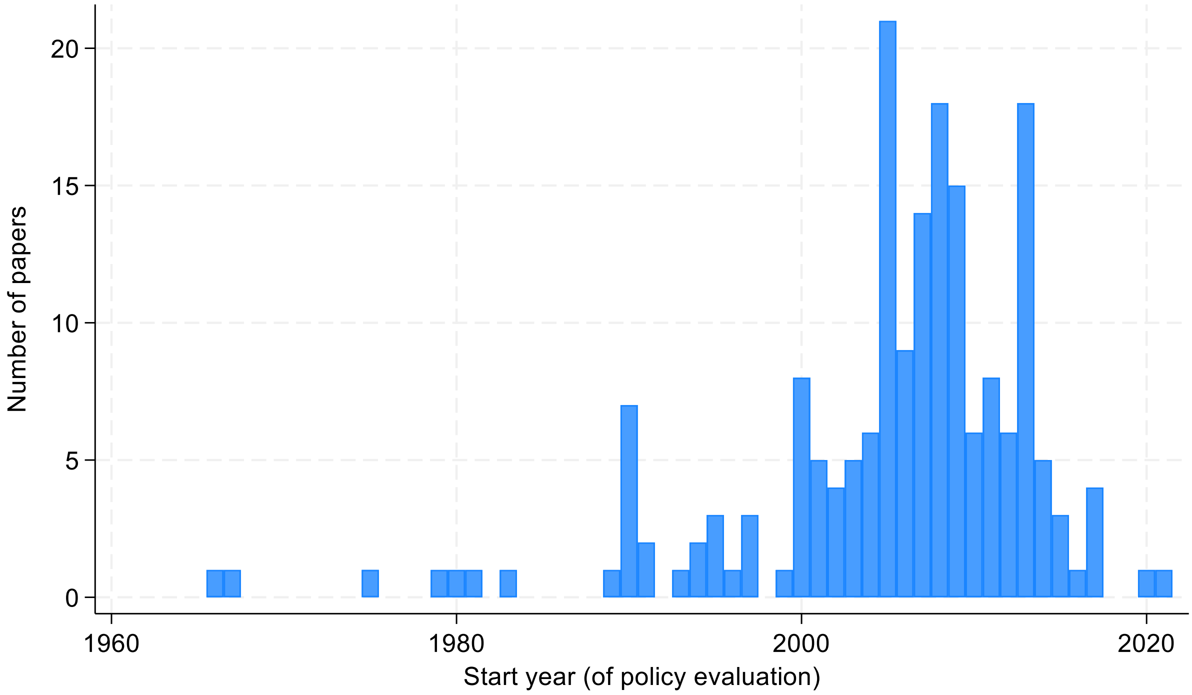
Source: Authors.

Figure A B.2. Number of papers for each sector by IFCMA-member and non-IFCMA member



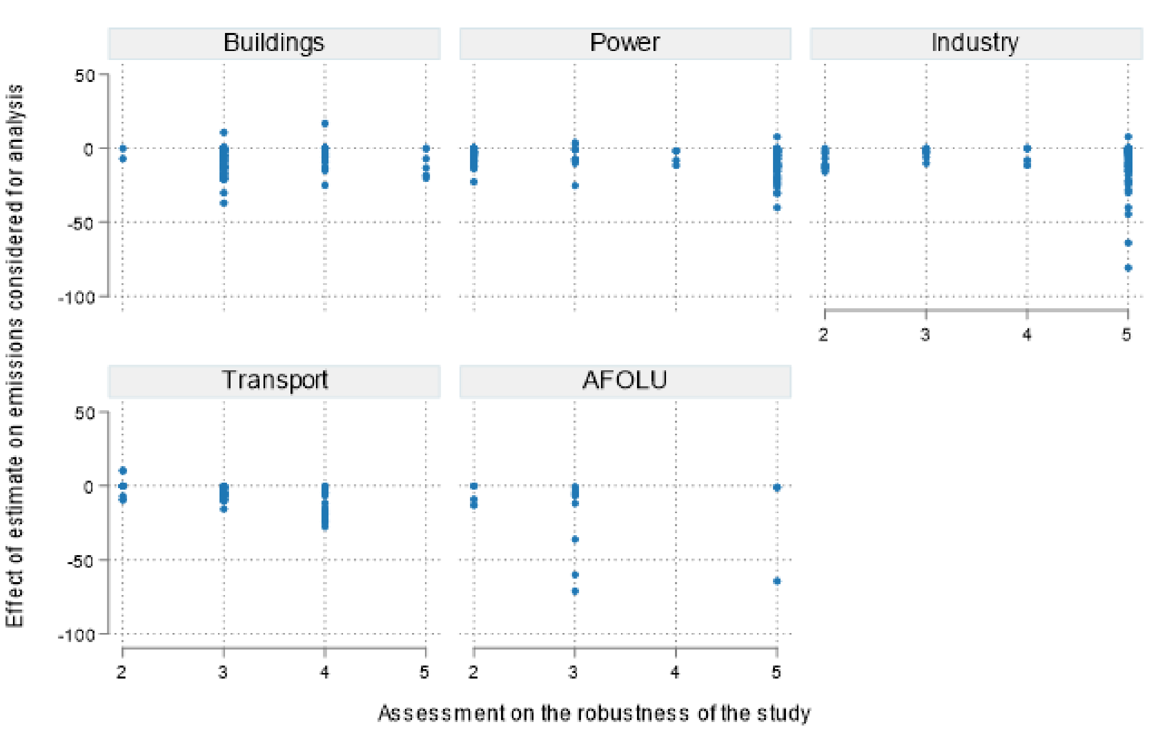
Note: The Figure shows the number of papers for each sector separately for IFCMA member and non-IFMCA member countries. It excludes papers that study both IFCMA and non-IFCMA countries.
Source: Authors.

Figure A B.3. Number of publications by start year of policy evaluation



Note: The Figure shows the number of papers by the start year of the policy evaluation.
Source: Authors.

Figure A B.4. The relationship between the assessment of the study robustness and the effect on emissions



Note: The Figure shows the expert assessment of the robustness of the study from 1 (least robust) to 5 (most robust) on the horizontal axis separately for each sector. The vertical axis shows the effect on emissions in percentage. Each dot corresponds to a coefficient.
Source: Authors.

Annex C. Preliminary IFCMA policy typology

Table A C.1. Proposed IFCMA policy typology

Economic instruments	Economic instruments refer to instruments that provide a direct monetary incentive on the levels of production or consumption, influencing prices or levels of production or consumption at the margin.
Subsidies	Subsidies are unrequited payments from government to non-government units.
Includes	Current unrequited payments on the basis of the levels of production or the quantities or values of the goods or services produced, consumed, sold or imported (European Commission et al., 2009[40]). Indirect payments from government to non-government units made through the tax system, such as tax rebates, reductions or exemptions. Lump-sum payments from government to non-government units that are not based on quantities or prices (e.g. energy vouchers, agricultural land payments), even though they do not change prices at the margin. Concessional loans through which a government unit lends to non-government units and the contractual interest rate is intentionally set below the market interest rate (European Commission et al., 2009[40]), if provided for goods or services produced, consumed, sold or imported. Feebates, i.e. systems in which a fee is levied on products or activities that produce high levels of GHG emissions, while a rebate is provided for those that produce low levels of emissions.
Excludes	Spending by a government unit towards forming fixed capital such as transport and energy infrastructure, or nature-based infrastructure solutions, as well as intangible assets such as research and development (R&D).
Examples	Electric vehicle purchase subsidies; feed-in-tariffs or premiums for renewable electricity; fossil fuel price ceilings (e.g. with compensation payments); motor vehicle feebates.
Taxes	Taxes are compulsory unrequited payments to a government unit (OECD, 2023[41]) (United Nations et al., 2014[42])
Includes	Taxes with their standard rates as well as tax incentives within that tax regime. Examples include reduced energy excise tax rates for agriculture. Fees and charges, defined as compulsory requited payments to the government that are levied more or-less in proportion to the services provided.
Excludes	Penalties: payments conditional on non-compliance. Payments for licenses and permits: i.e. requitted payments. Feebates, i.e. systems in which a fee is levied on products or activities that produce high levels of GHG emissions, while a rebate is provided for those that produce low levels of emissions. Tax incentives for R&D activities.
Examples	Carbon tax; electricity excise tax; fuel excise tax; tax incentives for clean technologies; incineration tax; motor vehicle feebates.
Trading systems	Trading systems cause changes in the relative costs or prices faced by economic agents by regulating the trade of permits or certificates, which may cause a direct financial benefit (e.g. by providing the options of selling them) or set a price on the behaviour of the regulated agents (e.g. by providing the options of purchasing them).
Includes	Cap-and-trade emissions trading systems (ETS): sets a limit on GHG emissions by specified sources, distributes tradable allowances approximately equal to the limit, and requires regulated emitters to submit allowances equal to their verified emissions (Dubash, 2022[43]).

	Baseline-and-credit ETS: GHG emitters that reduce their emissions beyond a baseline level can earn credits that can then be sold to other agents that need them to meet their regulatory obligations. There is no fixed limit on GHG emissions. Tradeable GHG and air emissions standards: set specific performance standards for each regulated agent, which can be traded with other regulated agents. There is no fixed limit on GHG or air pollutant emissions. Other standards where trading is a core characteristic, such as renewable electricity generation certificates. For consistency, even if such instruments exist without a trading component (e.g. a non-tradeable renewable electricity generation quota), they will still be classified under *Trading systems*. Offset credits: voluntary GHG emission reductions for which tradable credits are issued by a government body and can be used for compliance with a legal obligation (imposed e.g. by an ETS).
Excludes	Standards that typically do not include trading mechanisms, such as fuel economy standards. For consistency, if there are rare examples of tradable versions of these standards (e.g. tradeable fuel economy standards), these will be classified alongside their non-tradeable counterparts under *Performance standards*. Voluntary emission trading systems, which are classified under “voluntary approaches”; offset systems not mandated or regulated by the government.
Examples	ETS cap-and-trade; ETS baseline-and-credit; tradable renewable energy obligations.
Regulatory instruments	Regulatory instruments define allowable actions or set limits to drive the adoption of desired processes, technologies, products, or outcomes. They may take the form of direct mandates, prohibitions, or restrictions on certain goods or activities, establish maximum or minimum limits on various parameters (such as emissions), or require agents to obtain explicit permission or meet specific criteria before engaging in particular activities. Failure to comply typically incurs sanctions, including monetary penalties.
Excludes	Regulatory instruments that mandate the provision of information (which are classified under “information instruments”), instruments that mandate government spending and consumption (which are classified under “government investment and consumption”), and voluntary targets and activities (which are classified under “voluntary approaches”).
Performance standards	Performance standards mandate a specific outcome, giving regulated agents the freedom to choose technologies and processes to achieve the specified performance level.
Includes	Standards defined as a function of an output per unit of input. For example, energy efficiency regulations which mandate a minimum performance (e.g. hours of a working product per energy input such as brightness per hour per energy input, kilometres driven per fuel used, etc). Standards that have tradeable components in a small number of countries (e.g. tradeable fuel economy standards). Bans and Phase Outs: the instrument’s outcome mandate implies a complete prohibition of specific inputs or technologies altogether.
Excludes	Tradeable GHG emission and air pollution standards as well as other standards where trading is a core characteristic, such as renewable electricity certificates, which are classified under *Trading Systems*. Performance standards that apply to the government itself (classified under *Government investment and consumption*)
Examples	GHG emission standards; air emission standards; fuel economy standards; minimum energy performance standards for electric equipment or buildings; speed limits; etc.
Technology standards	Technology standards require or prohibit a specific input or technology, or design for production.
Includes	Bans and phase outs: the instrument’s input or technology requirement implies a complete prohibition of specific inputs or technologies altogether.
Excludes	Product mandates to be complied by the government (classified under *Government investment and consumption*).
Examples	Biofuel blending standards; electric vehicles sales mandates; bans/ phase outs of fossil fuel-based home heating or power generation plants; etc.
Framework regulations	Framework regulations prescribe requirements on production processes without mandating the use of specific inputs or technologies or prescribing a specific outcome. Often, these requirements are of

	qualitative nature and they may require case-by-case interpretation and application. They may also regulate the functioning of markets.
Includes	In industry: Regulations defining the environmental permitting process, e.g. mandate the implementation of an energy or environmental management system (e.g. ISO 50001), or adoption of best available technology (BAT). In the electricity market: regulations that establish rules for market structure and guidelines for market participation, grid operation, and transmission system planning (e.g. priority grid access, dispatch, or curtailment based on environmental conditions or cost-efficiency). In land use: protected areas or zoning requirements.
Excludes	Regulations that target decision making processes made by the government (classified under *Government investment and consumption*).
Government investment and consumption	Government investment and consumption instruments encompass the allocation of financial resources by government units towards goods, services, and facilities like infrastructure and R&D, as well as the implementation of policies and rules that shape government expenditure choices and decision-making processes.
Public investment	Public investment instruments refer to spending by a government unit towards forming fixed capital such as transport and energy infrastructure, or nature-based infrastructure solutions, as well as intangible assets such as research and development (R&D).
Includes	Government support provided to non-government units for R&D activities in the form of tax incentives. Government spending towards public transport and low-carbon mobility.
Excludes	Operating and maintaining costs that are not extending the assets lifetime. Lump-sum payments from government to non-government units which are included under *Subsidies*.
Public procurement	Public consumption refer to instruments that oblige or encourage public agents to consider climate change mitigation impacts when purchasing the goods, services and works from external suppliers or providers to fulfil public sector needs, deliver public services, and execute government projects and programmes.
Excludes	Budgetary transfers from government units to domestic non-government units related to public infrastructure and R&D activities, which are included under *Public investment*; Education and trainings organised by government units.
Examples	Green public procurement rules.
Public appraisal	Public appraisal processes prescribe requirements on the decision-making processes and operations of the government without mandating the use of specific inputs or technologies or prescribing a specific outcome. Rather, they specify the process to be followed in decision-making processes and operations or define qualitative outcomes that may require case-by-case interpretation.
Information instruments	Collect and disseminate information, raise awareness, and communicate knowledge to influence behaviour. These instruments typically promote voluntary technology choices and behavioural changes by firms and households, thereby allowing consumers to make better-informed choices.
Excludes	Instruments that are not part of government oversight, such as private information campaigns (e.g., marketing, private labelling initiatives).
Reporting requirements	Reporting requirements mandate agents to submit reports, conduct energy assessments, and provide environmental information.
Includes	Reporting requirements: obligations or mandates imposed on agents to submit regular reports, disclosures, or documentation to the regulating agents, oversight bodies, or stakeholders. Environmental auditing: requirements imposed on agents to conduct assessments or evaluations of their environmental performance, e.g. their energy consumption, efficiency, and performance. Labels**:** Mandate regulated agents to receive a label in exchange for information provision about the environmental performance, characteristics, or attributes of products, services, or activities. Labels are designed to inform end consumers.
Excludes	Voluntary labels and certifications.

Capacity building and public awareness	Government provides information to non-government units to disseminate information, raise awareness, and enhance understanding on specific issues, initiatives, or policies.
Includes	Public information campaigns and award schemes: systematic dissemination of information by government authorities or public agencies to raise awareness, educate the public, shape perceptions, influence attitudes, and promote behaviour change on specific issues or policy priorities. Capacity building, education and trainings: initiatives aimed at providing knowledge, skills, and learning opportunities to individuals, communities or organisations to enhance their understanding of specific issues, topics, or practices through formal government programmes or activities.
Voluntary approaches	Agreements between a government authority and one or more private parties to achieve climate objectives or to improve performance beyond compliance to regulated obligations. Especially for information instruments, they may also include frameworks established by governments to facilitate private action (e.g. energy efficiency labels that firms may decide to use).
Excludes	Private agreements where the government is not involved.
Voluntary targets	Specific self-imposed goals set by organisations or companies to achieve climate objectives or improve environmental performance beyond regulatory compliance in collaboration with the government. Examples: voluntary GHG emission reduction targets, voluntary energy performance targets.
Voluntary trading systems	Voluntary trading systems are established by government to allow organisations or companies to trade credits or allowances representing emissions reductions or other environmental benefits. Participation is voluntary, and these systems often operate parallel to or in the absence of mandatory trading schemes. Examples: voluntary GHG emission trading systems.
Voluntary information instruments	Voluntary information instruments are established by governments to facilitate private action towards climate objectives. Participation is voluntary. Firms can choose to adopt to inform stakeholders and consumers about their environmental performance. Examples: voluntary energy efficiency labels; voluntary reporting standards; voluntary audits.

Source: The IFCMA's climate policy database; A proposal for a policy instruments typology and data structure [IFCMA(2024)4/REV1], Annex B.

Annex D. Additional information on extraction of estimates from the reviewed papers

Table A D.1. Assumptions made to convert estimates to percentage changes in emissions

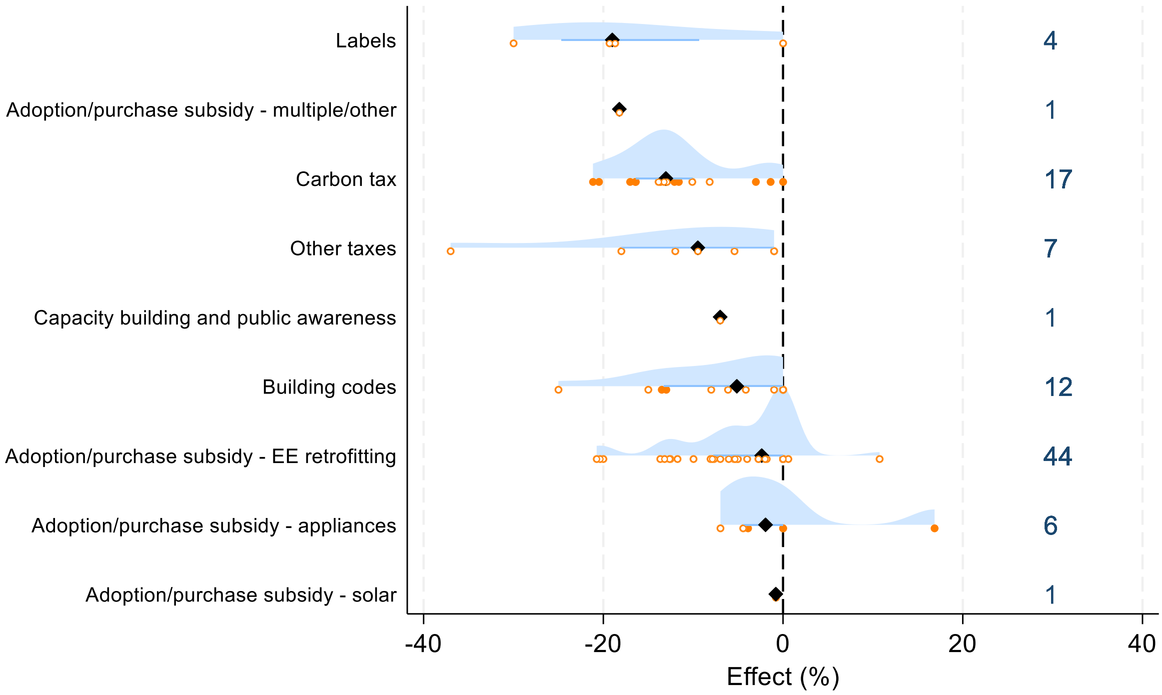
Outcome variable	Conversion	Assumption
Emission intensity (e.g. emissions/output; emission/gdp; emissions/revenue)	Changes in emission intensity convert one-to-one into emission changes	No change in the denominator (e.g. output, gdp, revenues)
Energy consumption	Changes in energy consumption convert one-to-one into emission changes	No change in the carbon content of the consumed energy
Electricity consumption	Changes in electricity consumption convert one-to-one into emission changes	No change in the carbon content of the consumed electricity and no switching to other forms of energy
Natural gas consumption	Changes in electricity consumption convert one-to-one into emission changes	No change in the carbon content of the consumed gas and no switching to other forms of energy
Gasoline consumption	Changes in gasoline consumption translate one-to-one into changes in emissions	No reduction in transport, switch to other transport choices or fuels

Note: The table lists the assumptions made to convert estimates to percentage change of emissions.
Source: Authors.

Annex E. Additional sector-specific results

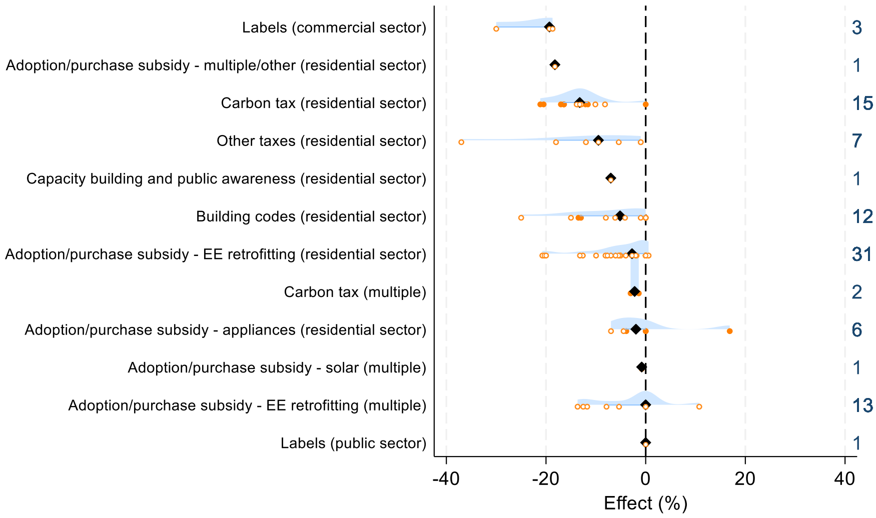
Buildings

Figure A E.1. The effect of policies on emissions in the buildings sector with more granular policy categories



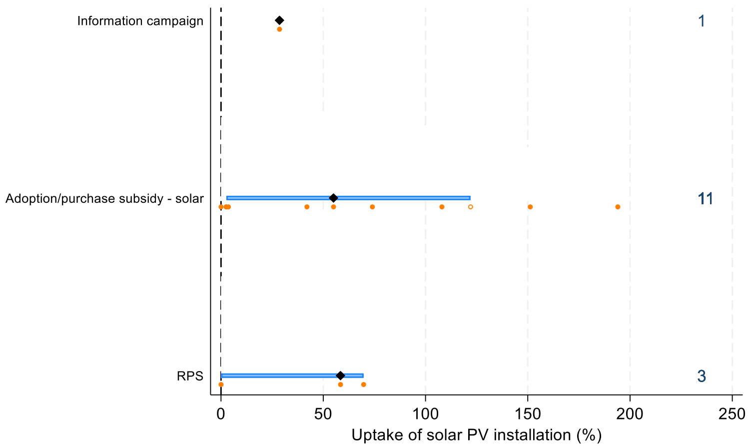
Source: Authors.

Figure A E.2. The effect of policies on emissions in the buildings sector by sub-sector categories



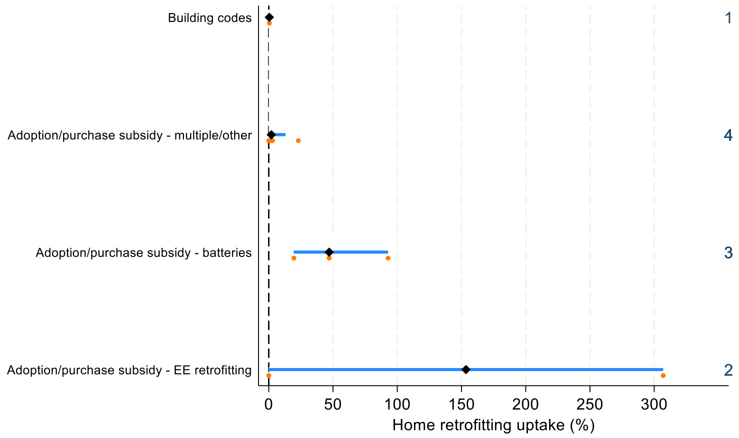
Source: Authors.

Figure A E.3. The effect of policies on uptake of solar PV installations in the buildings sector



Source: Authors.

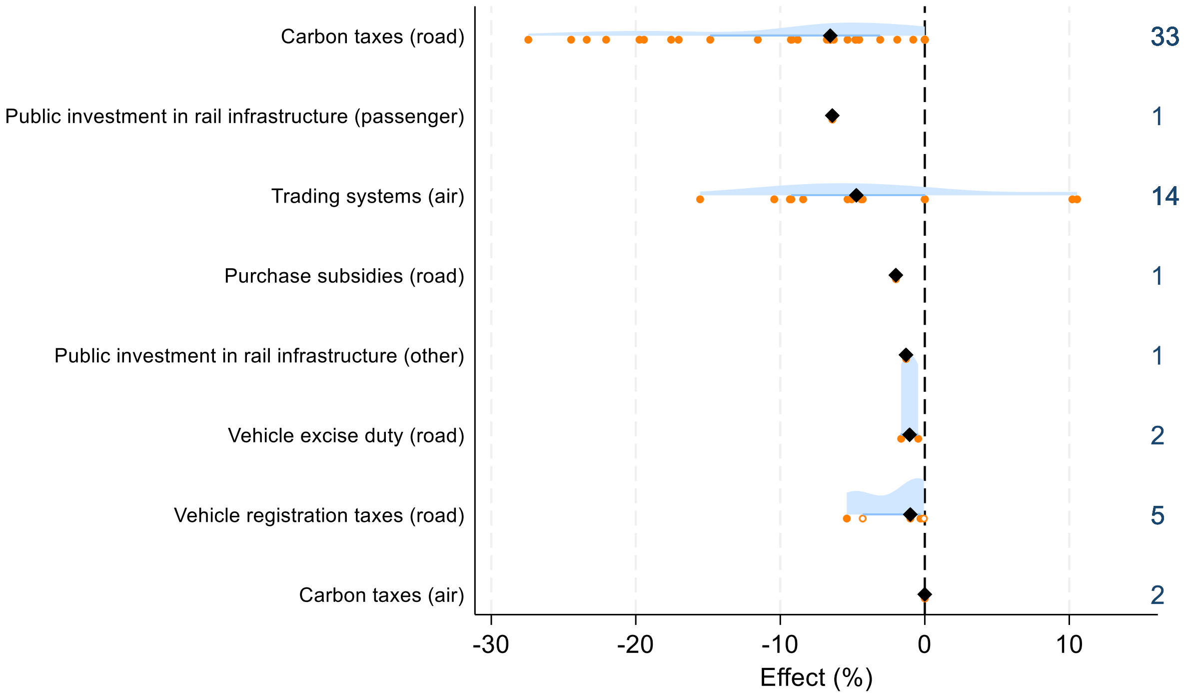
Figure A E.4. The effect of policies on home retrofitting uptake in the buildings sector



Source: Authors.

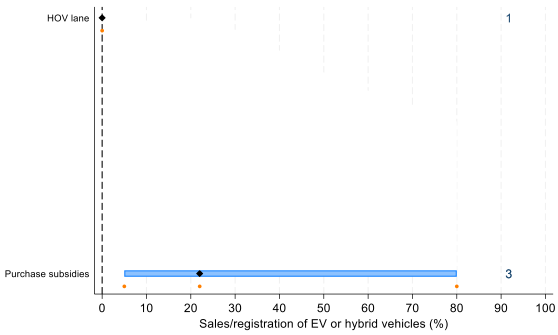
Transport

Figure A E.5. The effect of policies on emissions in the transport sector by sub-sector categories



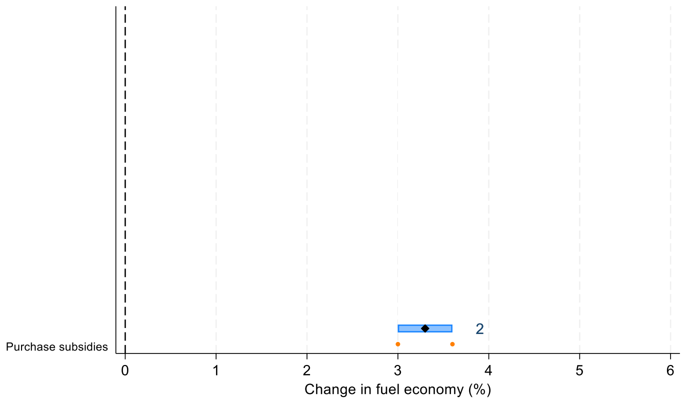
Source: Authors.

Figure A E.6. The effect of policies on the sale/registration of EV or hybrid vehicles in the transport sector



Source: Authors.

Figure A E.7. The effect of policies on changes in the fuel economy in the transport sector

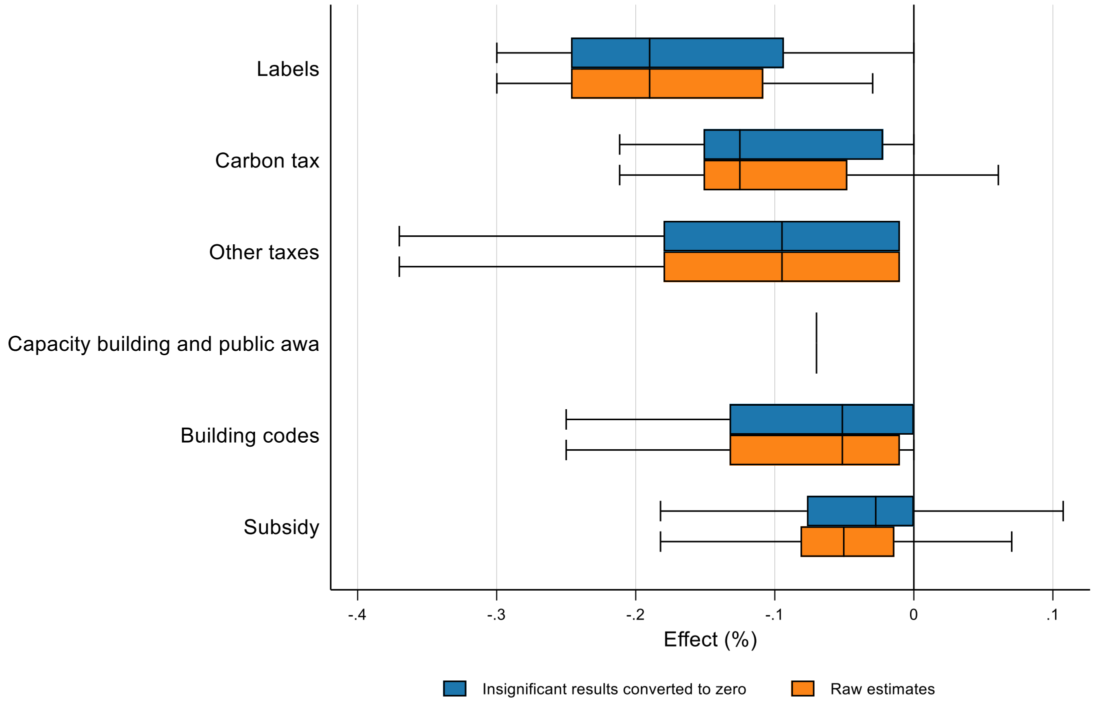


Source: Authors.

Annex F. Impacts of the statistically insignificant estimates on the results of this review

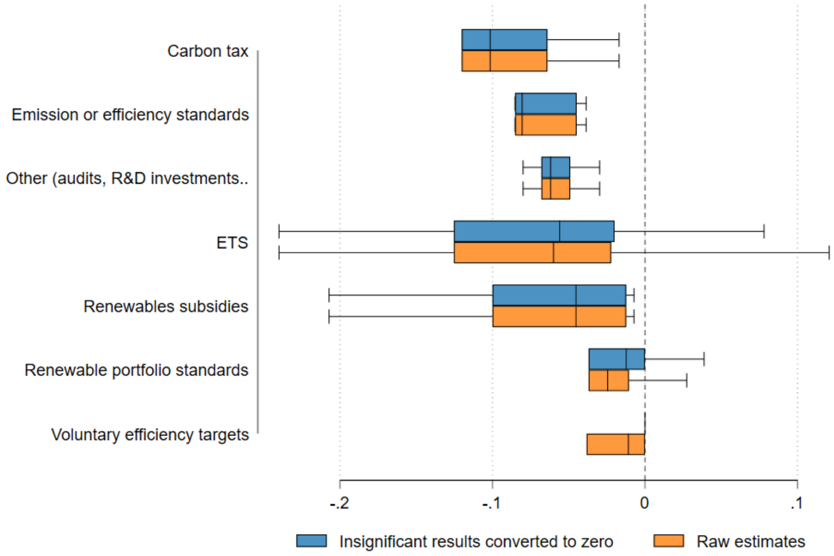
This annex compares the distributions of two sets of results: 1) results that report as zero the estimated coefficients that are not statistically significant at 10% level (as shown in the main text of this review); 2) results that report the point estimates of such statistically insignificant estimates. As shown below, differences are small, indicating that the treatment of the statistically insignificant estimates this review covers do not affect its conclusions.

Figure A F.1. Buildings sector



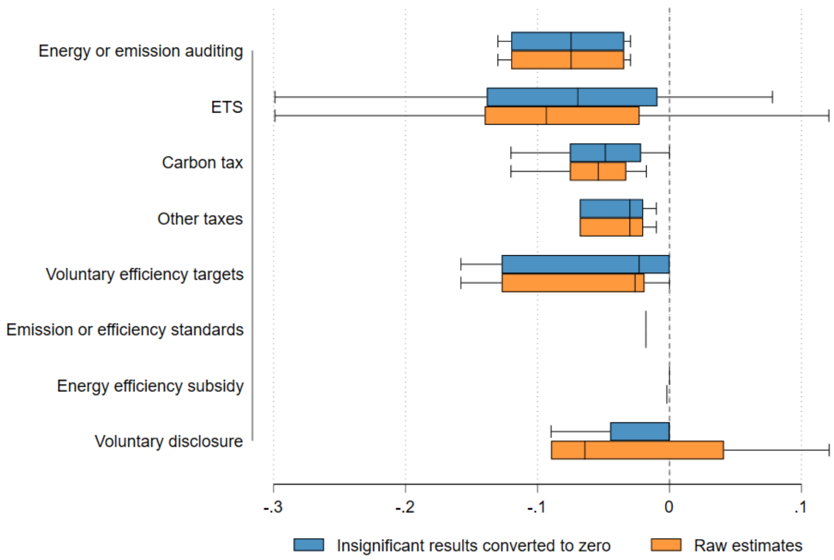
Note: The Figure shows box-and-whiskers plot of the annual effects when statistically insignificant results are converted to zero (blue bars) and when the same results are reported as their point estimate (orange bars). The coloured boxes show the interquartile range; the solid horizontal line within the boxes shows the median; the lower whisker is the 25th percentile minus 1.5 times the interquartile range; the upper whisker is the 75th percentile plus 1.5 times the interquartile range.
Source: Authors.

Figure A F.2. Power sector



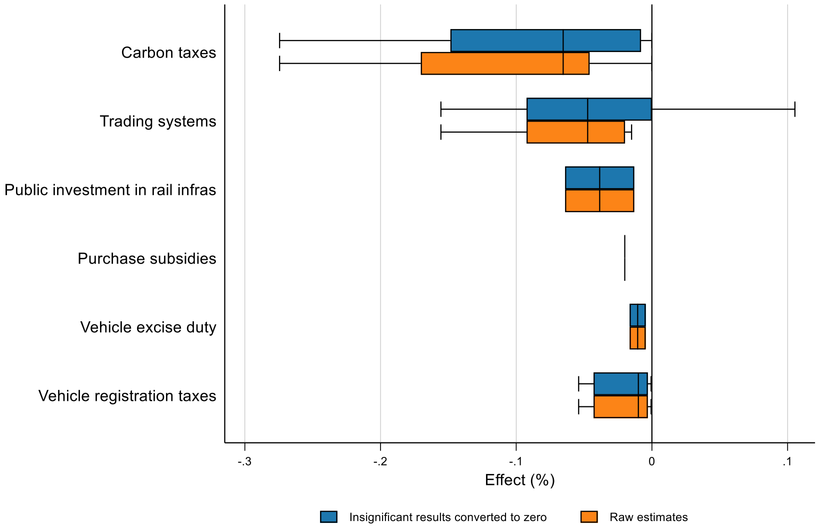
Note: The Figure shows box-and-whiskers plot of the annual effects when statistically insignificant results are converted to zero (blue bars) and when the same results are reported as their point estimate (orange bars). The coloured boxes show the interquartile range; the solid horizontal line within the boxes shows the median; the lower whisker is the 25th percentile minus 1.5 times the interquartile range; the upper whisker is the 75th percentile plus 1.5 times the interquartile range.
Source: Authors.

Figure A F.3. Industry sector



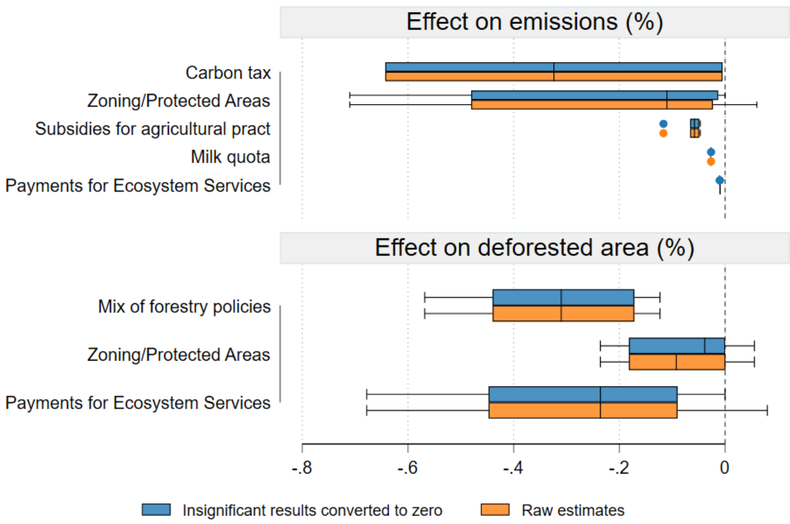
Note: The Figure shows box-and-whiskers plot of the annual effects when statistically insignificant results are converted to zero (blue bars) and when the same results are reported as their point estimate (orange bars). The coloured boxes show the interquartile range; the solid horizontal line within the boxes shows the median; the lower whisker is the 25th percentile minus 1.5 times the interquartile range; the upper whisker is the 75th percentile plus 1.5 times the interquartile range.
Source: Authors.

Figure A F.4. Transport sector



Note: The Figure shows box-and-whiskers plot of the annual effects when statistically insignificant results are converted to zero (blue bars) and when the same results are reported as their point estimate (orange bars). The coloured boxes show the interquartile range; the solid horizontal line within the boxes shows the median; the lower whisker is the 25th percentile minus 1.5 times the interquartile range; the upper whisker is the 75th percentile plus 1.5 times the interquartile range.
Source: Authors.

Figure A F.5. AFOLU sector



Note: The Figure shows box-and-whiskers plot of the annual effects when statistically insignificant results are converted to zero (blue bars) and when the same results are reported as their point estimate (orange bars). The coloured boxes show the interquartile range; the solid horizontal line within the boxes shows the median; the lower whisker is the 25th percentile minus 1.5 times the interquartile range; the upper whisker is the 75th percentile plus 1.5 times the interquartile range.
Source: Authors.

Annex G. List of papers reviewed

Table A G.1. Papers reviewed in the buildings sector

Authors	Year	Journal	Country (ISO3)	Sector	Start year of evaluation	Last year of evaluation	Policy type (IFCMA classification)	Policy name	url
Adan, Hassan, and Franz Fuerst	2015	Energy Efficiency	GBR	Buildings	2010	2012	Subsidies	Carbon Emission Reduction Target (CERT) and the Community Energy Saving Programme (CESP)	https://doi.org/10.1007/s12053-015-9418-3
Alberini, A, and C Towe	2015	Energy Economics	USA	Buildings	2008	2012	Subsidies	Empower Maryland - the Quick Home Energy Check-up (QHEC) and rebate specific program	https://doi.org/10.1016/j.eneco.2015.08.013
Alberini, A, and Gans, W, and C Towe	2016	The Energy Journal	USA	Buildings	2008	2012	Subsidies	Empower Maryland	https://doi.org/10.5547/01956574.37.1.aalb
Alberini, Anna, and Khymych, Olha, and Milan Scasny	2019	Working Paper	UKR	Buildings	2013	2017	Subsidies	Warm Loan Program, EBRD IQ Energy Program	https://dx.doi.org/10.2139/ssrn.3373720
Alberini, Anna, and Khymych, Olha, and Milan Scasny	2020	Energy Policy	UKR	Buildings	2013	2017	Taxes	Natural gas tariff increase	https://doi.org/10.1016/j.enpol.2020.111534
Alberini, A., Bigano, A., Boeri, M.	2014	Energy Efficiency	ITA	Buildings	2004	2009	Subsidies	Italy tax credit	https://link.springer.com/article/10.1007/s12053-013-9241-7
Alberinia, Anna, and Bezhanishvilid, Levan, and Scasny, Milan	2022	Energy Economics	GEO	Buildings	2014	2016	Taxes	Georgian electricity tariff	https://doi.org/10.1016/j.eneco.2022.106030
Ameli, N., and Pisu, M., and D.	2017	Applied Energy	USA	Buildings	2007	2012	Subsidies	Property Assessed Clean	https://doi.org/10.

M. Kammen								Energy (PACE)	1016/j.apenergy.2017.01.037
Asensio, Omar Isaac, and Magali A. Delmas	2015	Nature Energy	USA	Buildings	2005	2012	Reporting requirements	Better Buildings Challenge, ENERGY STAR program, Leadership in Energy and Environmental Design (LEED) program	https://doi.org/10.1038/nenergy.2017.33
Baradwaj, Bishal, and Dendup, Ngawang, and Pattanayak, Subhrendu K, and Peta Ashworth	2021	Working Paper	NPL	Buildings	2001	2011	Subsidies	Renewable Energy Subsidy Policy (RESP)	https://energyaccess.duke.edu/publication/impacts-of-solar-subsidy-evidence-from-geographic-regression-discontinuity-design-in-nepal/
Best, Rohan, and Burke, Paul J., and Shuhei Nishitateno	2019	Energy Economics	AUS	Buildings	2015	2018	Subsidies	Small-scale Renewable Energy Scheme	https://doi.org/10.1016/j.eneco.2019.104475
Best, Rohan, and Kent, Danielle, and Maggie Lee	2023	Energy Policy	AUS	Buildings	2020	2021	Subsidies	Victoria Solar Homes Program	https://doi.org/10.1016/j.enpol.2023.113594
Best, Rohan, and Rabindra Nepal	2022	Applied Economics	NPL	Buildings	2017	2017	Subsidies	Renewable Energy Subsidy Policy (RESP)	https://doi.org/10.1080/00036846.2022.2083570
Boomhower, Judson, and Davis, Lucas	2019	American Economic Journal: Applied Economics	USA	Buildings	2012	2015	Subsidies	SCE rebate program	https://doi.org/10.1257/app.20170505
Brown MA, Berry LG.	1995	Energy	USA	Buildings			Subsidies	Weatherization Assistance Program	https://doi.org/10.1016/0360-5442(95)00027-E
Bruegge, Chris, and Deryugina, Tatyana, and Erica Myers	2019	Journal of the Association of Environmental and Resource Economists	USA	Buildings	2009	2015	Performance standards	California building code	https://doi.org/10.1086/701189
Clay, Karen, and Severnini, Edson, and Sun, Xiaochen	2023	Journal of Environmental Economics and Management	USA	Buildings	1990	2019	Reporting requirements	ENERGY STAR Commercial Buildings	https://doi.org/10.1086/720952
Costa, F, and F. Gerard	2018	Journal of Political	BRA	Buildings	2002	2014	Taxes	Programa Emergencial de	https://www.nber.

		Economy						Reduo do Consumo de Energia Eltrica (PERCEE)	org/papers/w24608
Coyne, Bryan, and Eleanor Denny	2021	Energy Policy	IRL	Buildings	2014	2017	Subsidies	Better Energy Homes scheme	https://doi.org/10.1016/j.enpol.2021.112576
Crago, C. L. and I. Chernyakhovskiy	2017	Journal of Environmental Economics and Management	USA	Buildings	2005	2012	Technology standards	Multiple - state and county level solar policies	https://doi.org/10.1016/j.jeem.2016.09.008
Davis, Lucas W., and Fuchs, Alan, and Paul Gertler	2014	American Economic Journal: Economic Policy	MEX	Buildings	2009	2011	Subsidies	Cash for Coolers	https://www.aeaweb.org/articles?id='10.1257'/pol.6.4.207
De Groote, Olivier, and Pepermans, Guido and Frank Verboven	2016	Energy Economics	BEL	Buildings	2006	2012	Subsidies	Local programmes, upfront invetment support, net metering, tax credit for renewables systems, Green Current Certificates subsidy program	https://doi.org/10.1016/j.eneco.2016.07.008
Drivas, Kyriakos, and Rozakis, Stelios, and Sofia Xesfingi	2019	Energy Policy	GRC	Buildings	2011	2015	Subsidies	"Saving in-house" energy savings program	https://doi.org/10.1016/j.enpol.2019.01.040
Fowlie, Meredith, and Greenstone, Michael and Catherine Wolfram	2018	The Quarterly Journal of Economics	USA	Buildings	2011	2014	Subsidies	Weatherization Assistance Program	https://doi.org/10.1093/qje/qjy005
Germeshausen, Robert, and von Graevenitz, Kathrine, and Martin Achtnicht	2022	Regional Science and Urban Economics	DEU	Buildings	2007	2014	Performance standards	EWaermeG (state mandate on renewable heating technology), Market Incentive Program (MAP)	https://doi.org/10.1016/j.regsciurbeco.2021.103753
Gillingham, K, and T Tsvetanov	2019	Quantitative Economics	USA	Buildings	2008	2014	Subsidies	"Residential Solar Investment Program" (RSIP)	https://doi.org/10.3982/QE919
Graff Zivin, Joshua, and Kevin Novan	2017	Energy Journal	USA	Buildings	2011	2012	Subsidies	The Energy Savings Assistance Program (ESAP) via San Diego Gas and Electric's (SDG&E)	http://dx.doi.org/10.5547/01956574.37.4.jziv
Grimes, Arthur, and Preval, Nicholas, and Young, Chris, and Arnold, Richard, and Denne, Tim, and Howden-Chapman, Philippa, and Lucy Telfar-	2016	The Energy Journal	NZL	Buildings	2009	2010	Subsidies	Warm Up New Zealand: Heat Smart	https://doi.org/10.5547/01956574.37.4.agri

Barnard									
Hammerle, Mara, and Paul J. Burke	2022	Energy Economics	AUS	Buildings	2015	2020	Subsidies	Energy Efficiency Improvement Scheme (EEIS)	https://doi.org/10.1016/j.eneco.2022.106050
Hassett, Kevin A., and Metcalf, Gilbert E.	1994	Journal of Public Economics	USA	Buildings	1979	1985	Subsidies	US federal energy tax credit (Energy Tax Act of 1978 (ETA78))	https://doi.org/10.1016/0047-2727(94)01452-T
Hughes, J. E. and M. Podolefsky	2015	Journal of the Association of Environmental and Resource Economists	USA	Buildings	2007	2012	Subsidies	California Solar Initiative (CSI)	https://doi.org/10.1086/681131
Iimi, Atsushi, and Elahi, Raihan, and Kitchlu, Rahul and Peter Costolanski	2019	The World Bank Economic Review	ETH	Buildings	2007	2012	Subsidies	CFL bulbs distribution program	https://doi.org/10.1093/wber/lhw068
Ito, Koichiro	2015	American Economic Journal: Economic Policy	USA	Buildings	2004	2005	Subsidies	California electricity rebate program	http://dx.doi.org/10.1257/pol.20130397
Jacobsen, G.D, and M. J. Kotchen	2013	The Review of Economics and Statistics	USA	Buildings	2004	2006	Performance standards	Florida buildings code	https://doi.org/10.1162/REST_a_00243
Kirkpatrick, A. J., and L. S. Bennear	2014	Journal of Environmental Economics and Management	USA	Buildings	2008	2010	Subsidies	Property Assessed Clean Energy (PACE)	https://doi.org/10.1016/j.jeem.2014.05.001
Kotchen, Matthew	2017	Journal of the Association of Environmental and Resource Economists	USA	Buildings	2004	2014	Performance standards	Florida buildings code	https://doi.org/10.1086/689703
Levinson, Arik	2016	American Economic Review	USA	Buildings	1993	2009	Performance standards	California building code	http://dx.doi.org/10.1257/aer.20150102
Liang, Jing, and Qiu, Yueming, and James, Timothy, and Ruddell, Benjamin L., and Dalrymple, Michael, and Earl, Stevan, and Castelazo, Alex	2018	Journal of Environmental Economics and Management	USA	Buildings	2008	2013	Subsidies	Energize Phoenix, U.S. Department of Energy's Better Buildings Neighborhood Program, American Recovery and Reinvestment Act of 2009	https://doi.org/10.1016/j.jeem.2017.09.001

Matisoff, D., and E. Johnson	2017	Energy Policy	USA	Buildings	2002	2012	Subsidies	State Incentives for Renewable Energy	https://doi.org/10.1016/j.enpol.2017.05.032
Nauleau, Marie-Laure	2014	Energy Economics	FRA	Buildings	2005	2011	Subsidies	French energy tax credit scheme	https://doi.org/10.1016/j.eneco.2014.08.011
Novan, K, and Smith, A, and T Zhou	2022	The Review of Economics and Statistics	USA	Buildings	2012	2013	Subsidies	Title 24 California buildings code	https://doi.org/10.1162/rest_a_00967
Ott, Laurent, and Weber, Sylvain,	2022	Energy Policy	CHE	Buildings	2016	2020	Taxes	Swiss carbon tax	https://doi.org/10.1016/j.enpol.2021.112698
Palm, Alvar, and Bjorn Lantz	2020	Energy Policy	SWE	Buildings	2017	2017	Capacity building and awareness	Nationella insatsprojekt sloar pv 2017	https://doi.org/10.1016/j.enpol.2020.111540
Rafaty, R, and Dolphin, G, and Pretis, F	2021	Resources for the Future	International	Buildings	1975	2016	Taxes	Multiple	https://www.rff.org/publications/working-papers/carbon-pricing-and-the-elasticity-of-co2-emissions/
Reiss, Peter C., and White, Matthew W.	2008	The Rand Journal of Economics	USA	Buildings	2001	2001	Capacity building and awareness	California retail price cap	https://doi.org/10.1111/j.1756-2171.2008.00032.x
Risch, Anna	2020	Energy Economics	FRA	Buildings	2001	2008	Subsidies	French energy tax credit scheme	https://doi.org/10.1016/j.eneco.2020.104831
Rivers, Nicholas, and Shiell, Leslie	2016	The Energy Journal	CAN	Buildings	2007	2011	Subsidies	The EcoEnergy Homes program (EEH), 2009 Federal Home Renovation Tax Credit, provincial grant programs.	https://doi.org/10.5547/01956574.37.4.nriv
Rohan Best and Paul J. Burke	2023	Economic Modelling	AUS	Buildings	2021	2021	Subsidies	Small-scale Renewable Energy Scheme	https://doi.org/10.1016/j.econmod.2022.106164
Ros, Augustin, and Sai, Sai Shetty	2023	Energy Economics	USA	Buildings	2008	2018	Subsidies	Net-energy metering state level policies	https://doi.org/10.1016/j.eneco.2022.106491
Runst, P., and Thonipara, A.	2020	Energy Economics	SWE	Buildings	2001	2016	Taxes	Swedish carbon tax	https://doi.org/10.

									1016/j.eneco.2020.104898
Sun, Bixuan, and Ashwini Sankar	2022	Energy Policy	USA	Buildings	2006	2017	Subsidies	Federal investment tax credits, California Solar Initiative (CSI), net metering policy, Los Angeles Department of Water and Power (LADWP), Solar Incentive Program	https://doi.org/10.1016/j.enpol.2022.112804
Taleb, Ali	2019	Working Paper	USA	Buildings	2007	2018	Subsidies	Property Assessed Clean Energy (PACE)	https://www.researchgate.net/publication/337835521_Renewable_Energy_and_Energy_Efficiency_Upgrades_Evidence_from_the_Property_Assessed_Clean_Energy_Program
Turdaliev, Salim	2023	Climate Change Economics	RUS	Buildings	2010	2016	Taxes	increasing block rate (IBR) tariff schemes	https://ideas.repec.org/p/fau/wpaper/wp2021_37.html
Walsh, M.J.	1989	Energy Economics	USA	Buildings	1981	1981	Subsidies	US energy federal and state tax credits	https://doi.org/10.1016/0140-9883(89)90043-1
Xiang, Di, and Lawley, Chad	2019	Energy Economics	CAN	Buildings	2008	2014	Taxes	British Columbia carbon tax	10.1016/j.eneco.2018.12.004
Zhang, Y., and Song, J., and S. Hamori	2011	Energy Policy	JPN	Buildings	1996	2006	Subsidies	Japanese regional subsidy programs	https://doi.org/10.1016/j.enpol.2011.01.021

Note: The table lists the papers reviewed in the buildings sector
Source: Authors.

Table A G.1. Papers reviewed in the power sector

Authors	Year	Journal	Country (ISO3)	Sector	Start year of evaluation	Last year of evaluation	Policy type (IFCMA	Policy name	url

							classificatio n)		
Andrew Meyer and Grzegorz Pac	2015	The B.E. Journal of Economic Analysis & Policy	Internatio nal	Power	2004	2009	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://doi.org/10.1515/bejeap-2014-0159
Bo Zhou, Cheng Zhang, Haiying Song, Qunwei Wang	2019	Science of The Total Environment	CHN	Power	2013	2016	Trading systems	ETS	https://doi.org/10.1016/j.scitotenv.2019.04.303
Brian C. Murray, Peter T. Maniloff	2015	Energy Economics	USA	Power	2009	2012	Trading systems	Regional Greenhouse Gas Initiative (RGGI)	https://www.sciencedirect.com/science/article/pii/S0140988315002273
Chi Kong Chyong, Bowei Guo, and David Newbery	2019	Cambridge Working Paper in Economics	GBR	Power	2012	2017	Taxes	Carbon Price Support (CPS)	https://www.jstor.org/stable/resrep30454
Daniel T. Kaffine, Brannin J. McBee, Jozef Lieskovsky	2013	Energy Journal	USA	Power	2007	2009	Trading systems	Renewable Portfolio Standards (RPS) + tradable Renewable Energy Certificate (REC)	https://www.jstor.org/stable/41969215
Di Cosmo, Valeria; Malaguzzi Valeri, Laura	2014	Working paper	IRL	Power	2008	2012	Subsidies	Feed in tariff	https://www.econstor.eu/bitstream/10419/129429/1/798982446.pdf
Duncan Callaway, Meredith Fowlie, and Gavin McCormick	2018	Journal of the Association of Environmental and Resource Economists	USA	Power	2010	2012	Subsidies	Subsidies for investments in renewable energy and energy efficiency	https://haas.berkeley.edu/wp-content/uploads/WP264.pdf
Federico Carlini, Bent Jesper Christensen , Nabanita Datta Gupta , Paolo Santucci de Magistris	2023	Energy Economics	DNK	Power	2005	2019	Trading systems	Green Certificate	https://doi.org/10.1016/j.eneco.2023.106821
Geoff Martin and Eri Saikawa	2017	Nature climate change	USA	Power	1990	2014	Voluntary targets	RGGI; Energy performance standards; cap and trade; voluntary agreements; renewable portfolio standards; and others	https://doi.org/10.1038/s41558-017-0001-0
Germà Bel, Stephan Joseph	2015	Energy Economics	Internatio	Power	2005	2012	Trading	EU ETS	https://doi.org/10.1016/j.eneco.2015.03.

			nal				systems		014
Gregory B. Upton Jr, Brian F. Snyder	2017	Energy Economics	USA	Power	2006	2012	Trading systems	Renewable portfolio standard (RPS)	https://doi.org/10.1016/j.eneco.2017.06.003
Han Wang, Zhoupeng Chen, Xingyi Wu, Xin Nie	2019	Energy Policy	CHN	Power	2013	2016	Trading systems	ETS	https://doi.org/10.1016/j.enpol.2019.03.007
Harrison Fell, Peter Maniloff	2018	Journal of Environmental Economics and Management	USA	Power	2009	2012	Trading systems	RGGI	https://doi.org/10.1016/j.jeem.2017.10.007
Hongtao Yi	2015	Utilities Policy	USA	Power	1990	2008	Trading systems	Renewable portfolio standard (RPS)	https://doi.org/10.1016/j.jup.2015.04.001
Inês Carrilho-Nunes, Margarida Catalão-Lopes	2022	Structural Change and Economic Dynamics	PRT	Power	2000	2019	Subsidies	FF support removal	https://doi.org/10.1016/j.strueco.2022.03.001
JAN ABRELL, ANTA NDOYE FAYE, AND GEORG ZACHMANN	2011	Working paper	International	Power	2005	2008	Trading systems	EU ETS	https://www.bruegel.org/sites/default/files/wp-content/uploads/imported/publications/WP_2011_08_ETS_01.pdf
Jan Abrell, Mirjam Kosch, Sebastian Rausch	2019	Journal of Public Economics	ESP	Power	2010	2015	Subsidies	Feed in tariff	https://doi.org/10.1016/j.jpubeco.2018.11.007
Jan Abrell, Mirjam Kosch, Sebastian Rausch	2022	Journal of Environmental Economics and Management	GBR	Power	2013	2016	Taxes	Carbon Price Support (CPS)	https://www.sciencedirect.com/science/article/pii/S0095069621001339
Jingchi Yan	2021	Energy Economics	USA	Power	2009	2018	Trading systems	Regional Greenhouse Gas Initiative (RGGI)	https://doi.org/10.1016/j.eneco.2021.105333
Joseph A. Cullen and Erin T. Mansur	2017	American Economic Journal: Economic Policy	USA	Power	2006	2012	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://www.aeaweb.org/articles?id='10.1257'/pol.20150388
Joseph Cullen	2013	American Economic Journal:	USA	Power	2005	2007	Trading systems	Renewable Portfolio Standards (RPS) + tradable	https://www.aeaweb.org/articles?id='10.

		Economic Policy						Renewable Energy Certificate (REC)	1257'/pol.5.4.107
Joseph Wheatley	2013	Energy Policy	IRL	Power	2011	2011	Subsidies	Feed in tariff	https://doi.org/10.1016/j.enpol.2013.07.123
Kevin Novan	2015	American Economic Journal: Economic Policy	USA	Power	2007	2011	Trading systems	Renewable Portfolio Standards (RPS) + tradable Renewable Energy Certificate (REC)	https://www.aeaweb.org/articles?id='10.1257'/pol.20130268
Klaus Gugler, Adhurim Haxhimusa, Mario Liebensteiner	2020	Journal of Environmental Economics and Management	DEU	Power	2011	2018	Subsidies	Feed in tariff	https://doi.org/10.1016/j.jeem.2020.102405
Klaus Gugler, Adhurim Haxhimusa, Mario Liebensteiner	2023	Energy Economics	GBR	Power	2012	2014	Taxes	Carbon Price Support (CPS)	https://doi.org/10.1016/j.eneco.2023.106655
Luke J.L. Eastin	2014	The Electricity Journal	USA	Power	1997	2011	Trading systems	Renewable portfolio standard (RPS)	https://doi.org/10.1016/j.tej.2014.07.010
Man-Keun Kim and Taehoo Kim	2016	Energy Economics	USA	Power	2009	2014	Trading systems	Regional Greenhouse Gas Initiative (RGGI)	https://www.sciencedirect.com/science/article/pii/S0140988316302316
Marion Leroutier	2022	Journal of Environmental Economics and Management	GBR	Power	2013	2017	Taxes	Carbon Price Support (CPS)	https://www.sciencedirect.com/science/article/pii/S0095069621001285
McGuinness, M., and A. D. Ellerman	2008	Working paper	GBR	Power	2005	2007	Trading systems	EU ETS	https://dspace.mit.edu/handle/1721.1/45654
Miroslav Hájeka, Jarmila Zimmermannová, Karel Helman, Ladislav Rozenský	2019	Energy Policy	International	Power	2005	2015	Taxes	Carbon tax	https://doi.org/10.1016/j.enpol.2019.110955
Mourad Ben Amor, Etienne Billette de Villemeur, Marie Pellat, Pierre-Olivier Pineau	2014	Energy	CAN	Power	2006	2011	Subsidies	Feed in tariff	https://doi.org/10.1016/j.energy.2014.01.059
Nathan W. Chan, John W. Morrow	2019	Energy Economics	USA	Power	2009	2016	Trading systems	Regional Greenhouse Gas Initiative (RGGI)	https://doi.org/10.1016/j.eneco.2019.01.007

Olivier De Jongh, Klaas Mulier, Glenn Schepens	2020	Working paper	International	Power	2017	2020	Trading systems	EU ETS	https://papers.ssrn.com/sol3/papers.cfm?abstract_id='3725061'
Paul Behrens, João F.D. Rodrigues, Tiago Brás, Carlos Silva	2016	Applied Energy	PRT	Power	2000	2010	Subsidies	Feed in tariff	https://doi.org/10.1016/j.apenergy.2016.04.044
Pyung Kim, Hyunhoe Bae	2022	Energy Policy	KOR	Power	2015	2017	Trading systems	ETS	https://doi.org/10.1016/j.enpol.2021.112773
Robert Germeshausen	2020	Journal of the Association of Environmental and Resource Economists	DEU	Power	2005	2012	Trading systems	EU ETS	https://doi.org/10.1086/708894
Rohan Best, Paul J. Burke, Frank Jotzo	2020	Environmental and Resource Economics	International	Power	2012	2017	Taxes	Carbon tax	https://doi.org/10.1007/s10640-020-00436-x
Rong Yuan, João F.D. Rodrigues, Arnold Tukker, Paul Behrens	2018	Applied Energy	CHN	Power	2002	2010	Subsidies	Subsidies for investments in renewable energy infrastructure	https://doi.org/10.1016/j.apenergy.2018.07.069
Rongxin Wu, Zhizhou Tan, Boqiang Lin	2023	Energy	CHN	Power	2013	2017	Trading systems	ETS	https://doi.org/10.1016/j.energy.2023.127743
Samantha Sekar and Brent Sohngen	2014	Working paper	USA	Power	1997	2010	Trading systems	Renewable portfolio standard (RPS)	https://papers.ssrn.com/sol3/papers.cfm?abstract_id='2432205'
Sebastian Schäfer	2019	Energy Policy	DEU	Power	2005	2015	Trading systems	EU ETS	https://doi.org/10.1016/j.enpol.2019.06.066
Simen Rostad Sæther	2021	Economic Analysis and Policy	International	Power	2000	2018	Public investment	Subsidies	https://doi.org/10.1016/j.eap.2021.06.011
Tiago Oliveira, Celeste Varum, Anabela Botelho	2019	Energy Economics	IRL	Power	2013	2017	Subsidies	Feed in tariff	https://doi.org/10.1016/j.eneco.2018.10.033
Vassilis Stavrakas, Nikos	2020	Energies	GRC	Power	2009	2013	Subsidies	Feed in tariff	https://www.mdpi.co

Kleanthis and Alexandros Flamos									m/1996-1073/13/17/4575
Wei Zhang, Jing Li, Guoxiang Li, Shucen Guo	2020	Energy	CHN	Power	2013	2016	Trading systems	ETS	https://doi.org/10.1016/j.energy.2020.117117
Widerberg and Wråke	2009	Energy Studies Review	SWE	Power	2005	2008	Trading systems	EU ETS	https://doi.org/10.15173/esr.v18i2.533
Yuning Gao, Meng Li, Jinjun Xue, Yu Liu	2020	Energy Economics	CHN	Power	2013	2015	Trading systems	ETS	https://doi.org/10.1016/j.eneco.2020.104872

Note: The table lists the papers reviewed in the buildings sector
Source: Authors

Table A G.2. Papers reviewed in the industry sector

Authors	Year	Journal	Country (ISO3)	Sector	Start year of evaluation	Last year of evaluation	Policy type (IFCMA classification)	Policy name	url
Antoine Dechezleprêtre, Daniel Nachtigall, Frank Venmans	2023	Journal of Environmental Economics and Management	FRA	Industry	2005	2012	Trading systems	EU ETS	https://www.sciencedirect.com/science/article/pii/S0095069622001115
Bjorner, T. B. and H. H. Jensen	2002	Resource and Energy Economics	DNK	Industry	1983	1997	Voluntary targets	Voluntary approaches	https://www.sciencedirect.com/science/article/pii/S0928765501000495
Lucas Bretschger and Ara Jo	2024	Working paper	FRA	Industry	1994	2015	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://doi.org/10.1016/j.jeem.2024.102934
Christiaan Abeelen, Robert Harmsen, Ernst Worrell	2013	Energy Policy	NLD	Industry	2006	2011	Voluntary targets	Long Term Agreement (LTA) on energy efficiency	https://doi.org/10.1016/j.enpol.2013.09.048
Christian Stenqvist, Lars J. Nilsson	2012	Energy Efficiency	SWE	Industry	2005	2010	Voluntary targets	Swedish voluntary agreement (VA) Programme for improving energy efficiency in energy-intensive industries	https://link.springer.com/article/10.1007/s12053-011-9131-9

Damien Dussaux	2020	Working paper	FRA	Industry	2014	2018	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://dx.doi.org/10.1787/b84b1b7d-en
Eun-Hee Kim, Thomas P. Lyon	2011	Journal of Environmental Economics and Management	USA	Industry	1995	2003	Voluntary information instruments	Voluntary Reporting of Greenhouse Gases Program (1605(b))	https://doi.org/10.1016/j.jeem.2010.11.001
Gale Boyd, Gang Zhang	2013	Energy Efficiency	USA	Industry	2000	2008	Reporting requirements	ENERGY STAR	https://papers.ssrn.com/sol3/papers.cfm?abstract_id='1925103'
Giovanni Marin, Francesco Vona	2021	European Economic Review	FRA	Industry	1997	2015	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://www.sciencedirect.com/science/article/pii/S0014292121000921
Hena Oak and Sangeeta Bansal	2022	Energy Economics	IND	Industry	2013	2015	Trading systems	Perform Achieve and Trade (PAT)	https://doi.org/10.1016/j.eneco.2022.106220
Hintermann, B., & Žarković, M	2021	Climate policy	CHE	Industry	2013	2018	Trading systems	ETS	https://doi.org/10.1080/14693062.2020.1846485
Jan Stede	2019	Working paper	DEU	Industry	2003	2014	Voluntary targets	energy efficiency networks	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3433639
Jonathan Colmer, Ralf Martin, Mirabelle Muûls, Ulrich J. Wagner	2023	Working paper	FRA	Industry	2005	2012	Trading systems	EU ETS	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3725482
Julien Hanoteau and David Talbot	2019	Carbon Management	CAN	Industry	2013	2015	Trading systems	ETS	https://amu.hal.science/hal-02151028/document
Jurate Jaraite-Kažukauske, Corrado Di Maria	2016	The Energy Journal	LTU	Industry	2005	2007	Trading systems	EU ETS	https://www.iaee.org/energyjournal/article/2675
Kathrine von Graevenitz and Elisa Rottner	2022	Working paper	DEU	Industry	2009	2017	Taxes	Energy price as a proxy for the stringency of climate policy	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=

								such as fuel taxes	4251564
Keith Brouhle · Donna Ramirez Harrington	2010	Environmental and Resource Economics	CAN	Industry	1995	2004	Voluntary information instruments	Voluntary Challenge and Registry (VCR)	https://link.springer.com/article/10.1007/s10640-010-9391-4
Kramer, Niklas and Lessmann, Christian	2023	Working paper	USA	Industry	2013	2019	Trading systems	ETS	https://mpra.ub.uni-muenchen.de/116796/
Luiz Augusto Horta Nogueira , Rafael Balbino Cardoso, Ceres Zenaide Barbosa Cavalcanti, Paulo Augusto Leonelli	2015	Energy for Sustainable Development	BRA	Industry	1999	2010	Technology standards	National Program of Electric Energy Conservation (PROCEL)	https://doi.org/10.1016/j.esd.2014.12.002
Marit E. Klemetsen, Knut Einar Rosendahl and Anja Lund Jakobsen	2020	Climate Change Economics	NOR	Industry	2005	2013	Trading systems	EU ETS	https://core.ac.uk/download/pdf/249953868.pdf
Masayo Wakabayashi & Osamu Kimura	2018	Climate policy	JPN	Industry	2010	2013	Trading systems	Tokyo ETS	https://doi.org/10.1080/14693062.2018.1437018
Naonari Yajima, Toshi H. Arimura	2022	Energy Economics	JPN	Industry	2007	2016	Reporting requirements	Emission Reduction Program	https://doi.org/10.1016/j.eneco.2022.106253
Patrick Bayer and Michaël Aklin	2020	The Proceedings of the National Academy of Sciences	International	Industry	2005	2016	Trading systems	EU ETS	https://www.pnas.org/doi/10.1073/pnas.1918128117
Petrick, Sebastian; Wagner, Ulrich	2014	Working paper	DEU	Industry	2005	2010	Trading systems	EU ETS	https://ideas.repec.org/p/zbw/vfsc14/100472.html
Felix Pretis	2022	Environmental and Resource Economics	CAN	Industry	1990	2016	Taxes	Carbon tax	https://link.springer.com/article/10.1007/s10640-022-00679-w
Ralf Martin, Laure B. de Preux, and Ulrich J. Wagner	2014	Journal of Public Economics	GBR	Industry	2001	2004	Taxes	Climate Change Levy (CCL)	https://www.sciencedirect.com/science/article/pii/S0047272714001078

Raphael Calel	2020	American Economic Journal: Economic Policy	GBR	Industry	2005	2012	Trading systems	EU ETS	https://www.aeaweb.org/articles?id='10.1257'/pol.20180135
Roland Kube, Kathrine von Graevenitz , Andreas Löschel , Philipp Massier	2019	Energy Economics	DEU	Industry	1995	2013	Voluntary information instruments	Eco-Management and Audit Scheme (EMAS)	https://doi.org/10.1016/j.eneco.2019.104558
Shuo Chen, Anna Shi, Xin Wang	2020	Journal of Clean Production	CHN	Industry	2013	2016	Trading systems	ETS	https://doi.org/10.1016/j.jclepro.2020.121700
Stefanie A. Haller and Marie Hyland	2014	Energy Economics	IRL	Industry	1991	2009	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://www.sciencedirect.com/science/article/pii/S0140988314001820
Subal C. Kumbhakar, Oleg Badunenko, Michael Willox	2022	Energy Economics	CAN	Industry	2004	2012	Taxes	Carbon tax	https://doi.org/10.1016/j.eneco.2022.106359
Svetlana Paramonova, Patrik Thollander	2016	Journal of Clean Production	SWE	Industry	2014	2014	Reporting requirements	Swedish Energy Audit Programme (SEAP)	https://doi.org/10.1016/j.jclepro.2016.06.139
Taisuke Sadayuki, Toshi H. Arimura	2021	Energy Economics	JPN	Industry	2010	2014	Trading systems	ETS	https://doi.org/10.1016/j.eneco.2021.105664
William A. Pizer, Richard Morgenstern, Jhih-Shyang Shih	2011	Energy Policy	USA	Industry	1994	2000	Voluntary targets	Climate Wise and Voluntary Reporting of Greenhouse Gases Program (1605(b))	https://doi.org/10.1016/j.enpol.2011.09.040
Younes Ahmadi, Akio Yamazaki, and Philippe Kabore	2022	Environmental and Resource Economics	CAN	Industry	2008	2012	Taxes	Carbon tax	https://link.springer.com/article/10.1007/s10640-022-00678-x
Yucai Hu, Shenggang Ren, Yangjie Wang, Xiaohong Chen	2020	Energy Economics	CHN	Industry	2013	2015	Trading systems	ETS	https://doi.org/10.1016/j.eneco.2019.104590
Žiga KOTNIK, Maja KLUN, Damjan ŠKULJ	2014	Transylvanian Review of Administrative Sciences	International	Industry	1995	2010	Taxes	Energy price as a proxy for the stringency of climate policy such as fuel taxes	https://www.researchgate.net/publication/286154717_The_Effect_of_Taxation_on_Greenhouse_Gas_Emis

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Note: The table lists the papers reviewed in the industry sector.
Source: Authors.

Table A G.3. Papers reviewed in the transport sector

Authors	Year	Journal	Country (ISO3)	Sector	Start year of evaluation	Last year of evaluation	Policy type (IFCMA classification)	Policy name	url
Alberini, A., & Bareit, M.	2019	Resource and Energy Economics	CHE	Transport	2005	2011	Taxes	Multiple circulation tax rules	https://doi.org/10.1016/j.reseneeco.2017.03.005
Andersson, Julius	2019	American Economic Journal: Economic Policy	SWE	Transport	1990	2005	Taxes	Swedish carbon and value add tax	10.1257/pol.20170144
Bernard, J. T., & Kichian, M.	2019	Energy Policy	CAN	Transport	2008	2016	Taxes	British Columbia carbon tax	https://doi.org/10.1016/j.enpol.2019.04.021
Best, R., Burke, P. J., & Jotzo, F.	2020	Environmental and Resource Economics	International	Transport	2007	2017	Taxes	Gasoline tax	https://doi.org/10.1007/s10640-020-00436-x
Cerruti, D., Alberini, A., & Linn, J.	2019	Environmental and Resource Economics	GBR	Transport	2005	2010	Taxes	Vehicle excise duty (VED)	https://doi.org/10.1007/s10640-018-00310-x
Chen, Chia-Wen, and Hu, Wei-Min, and Knittel, Christopher R	2021	American Economic Journal: Economic Policy	CHN	Transport	2009	2011	Subsidies		https://doi.org/10.1257/pol.20170098
Ciccone, Alice	2018	Transport Policy	NOR	Transport	2007	2009	Taxes	Norwegian Vehicle Registration Tax	https://doi.org/10.1016/j.tranpol.2018.05.002
Davis, Lucas W., and Kilian, Lutz	2011	Journal of Applied Econometrics	USA	Transport	1989	2008	Taxes	US gasoline taxes at federal and state level	10.1002/jae.1156
Elbaum, Jean-David	2021	Working Paper	FIN	Transport	1990	2005	Taxes	Finnish CO2 tax	DOI not found

Erutku, C, and Hildebrand, V	2018	Canadian Public Policy	CAN	Transport	2007	2011	Taxes	British Columbia carbon tax	10.3138/cpp.2017-027
Fageda, Xavier, and Teixidó, Jordi J.	2022	Journal of Environmental Economics and Management	International	Transport	2012	2016	Trading systems	EU ETS - aviation inclusion	https://doi.org/10.1016/j.jeem.2021.102591
Gallagher, K. S., & Muehlegger, E.	2011	Journal of Environmental Economics and Management	USA	Transport	2000	2006	Subsidies	Federal, state and local EV adoption incentives	https://doi.org/10.1016/j.jeem.2010.05.004
Heiaas, A.M.	2021	Rev. Bus. Econ. Stud. 1.	International	Transport	2013	2018	Trading systems	EU ETS - aviation inclusion	10.26794/2308-944X-2021-9-1-84-120
Kang, Yicheng, and Liao, Sha, and Jiang, Changmin, and D'Alfonso, Tiziana	2022	Transportation Research Part A	International	Transport	2012	2017	Trading systems	EU ETS - aviation inclusion	https://doi.org/10.1016/j.tra.2022.05.015
Klier T, and Linn, J.	2015	American Economic Journal: Economic Policy	SWE	Transport	2005	2010	Taxes	Passenger vehicle registration taxes in France, Germany and Sweden	10.1257/pol.20120256
Lawley, C, and Thivierge, V	2018	The Energy Journal	CAN	Transport	2008	2012	Taxes	British Columbia carbon tax	10.5547/01956574.39.2.claw
Li, S., Linn, J., & Spiller, E.	2013	Journal of Environmental Economics and Management	USA	Transport	2009	2009	Subsidies	Consumer Assistance to Recycle and Save (CARS) Act	https://doi.org/10.1016/j.jeem.2012.07.004
Li, Shanjun, and Linn, Joshua, and Muehlegger, Erich	2014	American Economic Journal: Economic Policy	USA	Transport	1966	2008	Taxes	Gasoline tax	10.1257/pol.6.4.302
Lin, B., and Du., Z.	2017	Energy Policy	CHN	Transport	2003	2013	Public investment	Rail transit establishment by municipal government	http://dx.doi.org/10.1016/j.enpol.2017.02.038
Lin, Yatang, and Qin, Yu, and Wu, Jing, and Xu, Mandi	2021	Nature Climate Change	CHN	Transport	2009	2016	Public investment	State rollout of high-speed rail network	https://doi.org/10.1038/s41558-021-01190-8
Markham, Francis, and Young, Martin, and Reis, Arianne, and	2018	Journal of Transport Geography	AUS	Transport	2012	2014	Taxes	Clean Energy Future	https://doi.org/10.1016/j.jtrangeo.2018.0

Higham, James									6.008
Mideksa, Torben K.	2021	Working Paper	FIN	Transport	1990	2003	Taxes	Finnish CO2 tax	Na
Pretis, Felix	2022	Environmental and Resource Economics	CAN	Transport	2008	2016	Taxes	British Columbia carbon tax	https://doi.org/10.1007/s10640-022-00679-w
Rivers, N., & Schaufele, B	2015	Journal of Environmental Economics and Management	CAN	Transport	2008	2011	Taxes	British Columbia carbon tax	http://dx.doi.org/10.1016/j.jeem.2015.07.002
West, J., Hoekstra, M., Meer, J., & Puller, S. L.	2017	Journal of Public Economics	USA	Transport	2009	2010	Subsidies	Consumer Assistance to Recycle and Save (CARS) Program (Cash for Clunker program)	https://doi.org/10.1016/j.jpubeco.2016.09.009
Yan, Shiyu, and Eskeland, Gunnar S.	2018	Journal of Environmental Economics and Management	NOR	Transport	2007	2011	Taxes	Norwegian car registration tax	https://doi.org/10.1016/j.jeem.2018.08.018

Note: The table lists the papers reviewed in the transport sector.
Source: Authors.

Table A G.4. Papers reviewed in the AFOLU sector

Authors	Year	Journal	Country (ISO3)	Sector	Start year of evaluation	Last year of evaluation	Policy type (IFCMA classification)	Policy name	url
Alix-Garcia, J. M., Shapiro, E. N., & Sims, K. R.	2012	Land Economics	MEX	AFOLU	2003	2006	Subsidies	PSAH	https://le.uwpress.org/content/88/4/613.short
Alix-Garcia, J. M., Sims, K. R., & Yañez-Pagans, P.	2015	American Economic Journal:	MEX	AFOLU	2007	2011	Subsidies	PSAH	https://www.aeaweb.org/articles?id='10.1257'/pol.20130139

		Economic Policy							
Arima, E. Y., Barreto, P., Araújo, E., & Soares-Filho, B.	2014	Land use policy	BRA	AFOLU	2009	2011	Framework standards	PPCDAm-II	https://www.sciencedirect.com/science/article/pii/S026483771400146X
Assunção, J., McMillan, R., Murphy, J., & Souza-Rodrigues, E.	2019	The Review of Economic Studies	BRA	AFOLU	2006	2010	Framework standards	Priority List	http://www.nber.org/papers/w25636
Assunção, J., McMillan, R., Murphy, J., & Souza-Rodrigues, E.	2023	The Review of Economic Studies	BRA	AFOLU	2006	2010	Framework standards	Priority List	https://doi.org/10.1093/restud/rdac064
Brandt, J. S., Nolte, C., & Agrawal, A.	2016	Land Use Policy	COG	AFOLU	2001	2013	Framework standards	Forestry law	https://www.sciencedirect.com/science/article/pii/S0264837715003919
Cheng, A. T., Sims, K. R., & Yi, Y.	2023	Journal of Environmental Economics and Management	CHN	AFOLU	1980	2010	Framework standards	China's Nature Reserves	https://www.sciencedirect.com/science/article/pii/S0095069623000669
Chervier, C., & Costedoat, S.	2017	World Development	KHM	AFOLU	2005	2012	Subsidies	Conservation Agreement	https://www.sciencedirect.com/science/article/pii/S0305750X15311864
Ferraro, P. J., Hanauer, M. M., Miteva, D. A., Nelson, J. L., Pattanayak, S. K., Nolte, C., & Sims, K. R.	2015	Proceedings of the National Academy of Sciences	THA	AFOLU	1997	2005	Framework standards	Protected Area	https://www.pnas.org/doi/abs/10.1073/pnas.1406487112
Groom, B., Palmer, C., & Sileci, L.	2022	Proceedings of the National Academy of Sciences	IDN	AFOLU	2011	2018	Subsidies	Forest moratorium	https://www.pnas.org/doi/abs/10.1073/pnas.2102613119
Grupp, T.E., Mishra, P., Reynaert, M., van Benthem, A.	2024	WP	International	AFOLU	1991	2020	Framework standards	Protected areas	https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/wp/2023/wp_tse_1490.pdf
Hayes, T., Murtinho, F., & Wolff, H.	2017	World Development	ECU	AFOLU	2008	2013	Subsidies	Programa Socio Bosque	https://www.sciencedirect.com/science/article/pii/S0305750X

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Jayachandran, S., De Laat, J., Lambin, E. F., Stanton, C. Y., Audy, R., & Thomas, N. E.	2017	Science	UGA	AFOLU	2005	2010	Subsidies	PES program	https://www.science.org/doi/full/10.1126/science.aan0568
Läpple, D., Carter, C. A., & Buckley, C.	2022	Agricultural Economics	IRL	AFOLU	2000	2017	Subsidies	Milk quota abolition	https://onlinelibrary.wiley.com/doi/full/10.1111/agec.12666
Liang, H., Meng, Y., & Ishii, K.	2022	Discover Sustainability	CHN	AFOLU	2011	2020	Subsidies	Low-carbon and circular agriculture pilot province	https://link.springer.com/article/10.1007/s43621-022-00107-5
Mazunda, J., & Shively, G.	2015	Ecological Economics	MWI	AFOLU	2002	2009	Framework standards	Forest Co-management Program	https://www.sciencedirect.com/science/article/pii/S0921800915003833
Miteva, D. A., Murray, B. C., & Pattanayak, S. K.	2015	Ecological Economics	IDN	AFOLU	2000	2010	Framework standards	Marine Protected areas	https://www.sciencedirect.com/science/article/pii/S0921800915003419
Mohebalian, P. M., & Aguilar, F. X.	2018	Ecological Economics	ECU	AFOLU	2008	2014	Subsidies	Programa Socio Bosque	https://www.sciencedirect.com/science/article/pii/S0921800916315488
Sims, K. R.	2010	Journal of environmental economics and management	THA	AFOLU	1967	2000	Framework standards	Protected areas	https://www.sciencedirect.com/science/article/pii/S0095069610000586
Sims, K. R., & Alix-Garcia, J. M.	2017	Journal of Environmental Economics and Management	MEX	AFOLU	2003	2010	Subsidies	PSAH	https://www.sciencedirect.com/science/article/pii/S0095069616304685
Souza-Rodrigues, E.	2019	The Review of Economic Studies	BRA	AFOLU	2002	2011	Taxes	Carbon tax	https://academic.oup.com/restud/article-abstract/86/6/2713/5232206

Note: The table lists the papers reviewed in the AFOLU sector.
Source: Authors

For more information:

www.oecd.org/climate-change/inclusive-forum-on-carbon-mitigation-approaches

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