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ACCELERATING INDUSTRIAL DECARBONISATION

THE ROLE OF TAX INCENTIVES

Flurim Aliu
Sofia Berg
Luke Hatton
Patrick Lenain
Agustin Redonda
Magd Shamashan
Nirosha Elsem Varghese

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AUTHORS

Flurim Aliu is a Fellow with CEP where he focuses on fiscal policy. He is co-leading the Global Tax Expenditures Database (GTED) project, a joint initiative between CEP and the German Institute of Development and Sustainability (IDOS). In that capacity, he has also contributed to research at the IMF's Fiscal Affairs Department on the use of tax expenditures in special economic zones and participated in IMF country engagements. Prior to joining CEP, he worked at the World Bank Group, where he contributed to policy research at the Infrastructure Chief Economist's office.

Sofia Berg is a Research Analyst with CEP with a focus on fiscal policy. She has previously worked with WSP Advisory in Stockholm on regional development and evaluating the state of Swedish municipalities based on key indicators such as education level, labour market characteristics, and population size and demographics.

Luke Hatton is a PhD researcher at Imperial College London, working on assessing the economic and political barriers to energy system decarbonisation in the Science and Solutions for a Changing Planet Doctoral Training Partnership at the Grantham Institute at Imperial College London. He is currently on a secondment at the International Energy Agency, where he is modelling and tracking energy-related investment flows across regions and technologies.

Patrick Lenain is a Senior Associate with CEP. Prior to joining CEP, Patrick worked for 23 years with the OECD, where he led policy-advice work. He has co-founded the OECD Global Forum on Productivity, is a member of Luxembourg's National Productivity Council, and was an Adjunct Professor of Economics at Université de Paris-Est Créteil. Patrick also worked for the International Monetary Fund in several senior positions, as well as at the European Commission and the French Treasury.

Agustin Redonda is a Senior Fellow with CEP in the fiscal policy program, where he focuses on tax expenditures, and co-leads the Tax Expenditures Lab. Prior to that he has been a research and teaching assistant with the Economics Department (IdEP) of the University of Lugano (USI). He also worked with the OECD, as well as for the National Plan to Reduce Informal Activity (PNRT) at the Ministry of Labour, Employment and Social Security (MTSS) in Argentina. Agustin has worked as a consultant providing tax policy advice to different governments and international organizations.

Magd Shamashan is a master's student in International Economics and Development at the Université de Paris Dauphine-PSL. He holds a bachelor's degree in economics from Université de Paris 1 Panthéon-Sorbonne and has also worked in the financial sector.

Nirosha Elsem Varghese holds a PhD in Public Policy and Health Economics. She has previously been engaged with international institutions, including the OECD in Paris and the German Institute of Development and Sustainability (IDOS) in Bonn. Her research focuses on policy analysis, health economics, and sustainable development.

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ABBREVIATIONS

AII	Accelerated Investment Incentive
CCA	Capital Cost Allowance
CCUS	Carbon Capture, Utilisation and Storage
CIT	Corporate Income Tax
CT	Clean Technology
DRI	Direct Reduced Iron
DSIRE	Database of State Incentives for Renewables & Efficiency (USA)
EAF	Electric Arc Furnace
EPA	Environmental Protection Agency (USA)
ETE	Environmental Tax Expenditure
GHG	Greenhouse Gas
GTED	Global Tax Expenditures Database
IDOS	German Institute of Development and Sustainability
IEA	International Energy Agency
IF	Induction Furnace
IFC	International Finance Corporation
IRA	Inflation Reduction Act
IRENA	International Renewable Energy Agency
ITC	Investment Tax Credit
PIT	Personal Income Tax
PTC	Production Tax Credit
R&D	Research and Development
RISE	Recycling Investment Saves Energy
SR&ED	Scientific Research & Experimental Development
STTCL	Special Tax Treatment Control Law
TE	Tax Expenditure
UNDP	United Nations Development Programme
VAT	Value Added Tax
WHRS	Waste Heat Recovery System
ZEV	Zero-Emission Vehicle

SUMMARY

This discussion note examines how tax incentives can support industrial decarbonisation. Achieving net-zero targets in industrial sectors will require substantial investment in low-carbon technologies, especially in "hard-to-abate" industries such as steel, cement, and petrochemicals. In this context, tax incentives have emerged as a useful policy instrument, in combination with carbon pricing, regulation and further measures.

Countries are already deploying a wide range of targeted tax incentives to accelerate the adoption of low-carbon electricity. Examples include investment tax credits for clean energy equipment (e.g., France) and accelerated depreciation for investments into renewables (e.g., Canada).

Tax incentives are also a core pillar of decarbonisation efforts in the transport sector – including accelerated uptake of electric vehicles. Many countries support electric vehicles (EVs) with measures spanning from production tax credits (e.g., Japan) to consumer tax incentives (e.g., United States).

A similar wave of incentives is emerging to advance green hydrogen and lower-carbon technologies in steel, cement and petrochemicals. Many governments are supporting businesses investing to produce green hydrogen with tax credits and corporate income tax exemptions (e.g., Egypt). Several countries have introduced incentives for lower-carbon steel production including abatement via CCUS (e.g., Malaysia). Similar incentives pertain to green cement and petrochemicals (e.g., Finland).

Overall, tax incentives supporting industrial decarbonisation can open the door to a faster low-carbon transition. They can help in reaching the necessary production scale of new technologies to reduce costs. They can support the adoption of new products and services to trigger positive network effects. And they can reduce uncertainty around technological trajectories and related hurdles for investments.

To that end, clear objectives, effective design and robust evaluation frameworks are critical. Tax incentives can lead to high fiscal costs. They may trigger premature technology choices. When supporting demand, such as for electric vehicles and other consumer goods, they can exacerbate inequality. Transparency on goals, clear eligibility criteria, robust monitoring and evaluation, as well as sunset clauses are essential to address these challenges.

Alignment with broader industrial and decarbonisation strategies is also key. Tax incentives should not be used as stand-alone instruments, but rather as key components of broader policy packages for industrial decarbonisation. They are complements, not substitutes, for other measures, such as carbon pricing, phasing out fossil fuel subsidies, and direct investment in infrastructure

When deployed in that manner, tax incentives can be a critical catalyst to accelerate industrial decarbonisation.

1. HOW TO DESIGN TAX INCENTIVES FOR INDUSTRIAL DECARBONISATION?

The transition to a low-carbon, resource-efficient economy is a pressing global issue. It is not just an environmental goal; it is a critical economic transformation that requires shifts in production, energy, and consumption. International institutions estimate that meeting growing energy demand with affordable, secure and clean supply will require trillions of dollars in annual investment over the coming decade, with much of that going to decarbonised electrification, transport, housing, and industry (IEA, 2024a).

To foster this transformation, many economists have traditionally favoured carbon pricing as a pivotal policy instrument – either through a carbon tax or a mandatory carbon market. In essence, carbon pricing modifies relative prices, resulting in a market-driven adjustment in behaviour by economic agents that aligns private incentives with social welfare. However, recent empirical evidence indicates that the policy efficacy of carbon pricing exhibits sectoral variations and is contingent upon the specific carbon pricing instrument employed. Consequently, and also due to limited political acceptability, carbon pricing is implemented at a substantial scale only in a small subset of countries.

Furthermore, economists have advocated the phase-out of fossil fuel subsidies (FFSs), which encourage the production and consumption of coal, gas, and oil. Nevertheless, owing to social and political hurdles, progress has been slow.

Recognising the limitations of stand-alone carbon pricing, and the slow momentum in FFSs phase-out, policymakers are deploying multipronged policy packages (Lenain, 2024). These are based on portfolios of various fiscal measures (taxes, subsidies, investment, procurement) associated with regulation (standards, limits, bans and mandates). Tax incentives play a key role within these packages. They seek to encourage more climate-friendly practices by businesses and individuals (Redonda et al., 2025a), such as investment in equipment that emit less carbon, and more innovation in decarbonisation technologies.

This discussion note focuses on tax incentives aimed at decarbonising key industrial sectors for the transition to net zero.[1] The scope of the paper is limited to the discussion of those tax incentives seeking to promote lower-carbon practices by incentivizing individuals and businesses to adapt their behaviours and make choices towards industrial decarbonisation.

CARROTS AND STICKS

Policy packages for industrial decarbonisation must include both "carrots and sticks". Carbon pricing (e.g., through carbon taxes) is often seen as a "stick" and can face considerable pushback by affected stakeholders. Tax incentives for decarbonisation are, instead, generally seen as "carrots" as they provide support to trigger a change in taxpayers behaviour by encouraging them to make decisions leading to lower emissions.

While carbon pricing is key to internalize negative externalities, tax incentives can help expand positive spillovers. Tax incentives for research and development (R&D) are a case in point. In Belgium, for example, a "Technology Deduction" is available for

[1] The term "tax incentive" is closely related and often overlaps with the term "tax expenditure" (TE). Indeed, the two terms are often used interchangeably. Yet, this can be misleading as they have different meanings and policy uses. Whereas the distinction is subtle, it is also an important one. A tax incentive is a specific type of TE designed to encourage or promote certain behaviours or activities. In other words, tax incentives are a subset of TEs, with a targeted behavioural objective

environmentally friendly investments in R&D and patents. The amount of the deduction jumps from 13.5 per cent if the deduction is applied as a "one shot" to 20.5 per cent if spread over the duration of the depreciation of the investment. As with other R&D-related tax incentives, the goal behind this provision is to encourage firms to invest more in environmentally-friendly R&D, and to increase the social benefits from positive externalities.

At the same time, tax incentives reduce government revenue, making it vital to disentangle which incentives are value for money and which ones are not effective or too costly. Cost-benefit analyses and other types of impact assessments should thus be at the core of the Tax Expenditures Policy Cycle. Ex-post evaluations are the main tool for governments to assess whether the objectives of a specific TE were met, considering cost-effectiveness, and also broader externalities and, ideally, the performance of TEs compared to alternative policy tools (Beer et al., 2022). However, TE evaluations can be time and resource consuming and are strikingly rare. In fact, most countries worldwide do not carry out TE evaluations at all, and only a few countries, such as Ireland, the Netherlands or the Republic of Korea, have ex-ante and ex-post evaluation frameworks in place (Redonda et al., 2023).

Given the limited availability of evaluations across most countries, it becomes particularly challenging to understand which tax incentives are cost-effective and which are redundant, or effective but simply too costly. The following section examines the cost-effectiveness of tax incentives for industrial decarbonisation by focusing on specific design features that are likely to impact their effectiveness.

TAX INCENTIVES LINKED TO CORPORATE INCOME TAX

Governments frequently use tax incentives linked to corporate income tax (CIT) as a tool to encourage investments, innovation and growth. CIT-related tax incentives cover a broad range of measures, such as reduced tax rates and tax holidays, higher deductions for R&D, as well as allowances for investments, and tax credits. As such, CIT-related tax incentives work through three channels: a reduction in corporate tax rates, lower taxable corporate income, and a direct reduction or exemption from tax liability.

Many governments have implemented CIT-related tax incentives with the explicit goal of incentivizing investments to boost industrial decarbonisation. Some of these incentives lower firms' tax liabilities by supporting the purchase of specific low-emission assets across sectors. Others cover the full range of activities of a firm, e.g., by incentivizing emission reductions across firms' operations. Sector-specific incentives are further cases in point.

When well designed, CIT-related tax incentives can be successful in attracting or directing investment for decarbonisation. The U.S. investment tax credit (ITC) and production tax credit (PTC), for example, were introduced in the early 1970s and 1990s, respectively, to directly support investment in wind and solar electric power. According to the Congressional Budget Office (CBO), these tax credits have supported growth in the wind and solar power industries throughout the 2010s and into the 2020s. If these two tax credits were not available, the CBO estimates investment in wind and solar facilities to be one third lower than the amount expected with the credits in place (CBO, 2025).

At the same time, as TEs in general, CIT-related incentives for decarbonisation can also have a significant negative impact on public coffers. The Canadian Parliamentary Budget Office (PBO), for example, has estimated the total fiscal costs across 13 years for six investment tax credits (ITC) in key clean energy and technology sectors at CAD 103 billion (Kpekou Tossou et al., 2024).

Moreover, when ill-designed, CIT-related tax incentives can remain ineffective and lead to market distortions as well as other types of undesired side effects. Whereas some TEs are implemented for simplicity reasons (e.g. the Régime Micro-enterprise in France, the Simples Nacional in Brazil and the Presumptive taxation scheme in India), some provisions can also significantly increase complexity as well as administrative and compliance costs (Muresianu, 2025).

Against this background, the design of CIT-related tax incentives is critical. The core pillar for that is a targeted definition of who and what is eligible for the incentive. Key further design elements include the decision on which channel – i.e., reduced tax rates, lower taxable income or a direct reduction of tax liability – to use. Further aspects to consider include timing, phase-outs and control of fiscal costs.

BOX 1: INVESTMENT AND PRODUCTION TAX INCENTIVES

Corporate tax incentives come in many forms. A key distinction is between investment and production tax incentives.

Investment tax incentives link the tax benefit to an investment and thus reduce the after-tax costs of capital formation. Examples include accelerated depreciation allowances that enable firms to deduct the cost of an investment more quickly, and "super deductions" that can sometimes exceed 100% of the actual investments. The incentive can also come, inter alia, in the form of a tax holiday or reduced tax rates on profits.

Production tax incentives, by contrast, link the benefit to the volume or value of output generated. They reward the actual production of targeted outputs rather than the investment that enables such production. They are offered, for example, as tax deductions or tax credits per unit of output or income.

At the core of each investment tax incentive are its eligibility criteria. A robust definition of the firms and activities that are in scope of a tax incentive is vital for its effectiveness. Setting clear goals is a critical first step for that. Defining key indicators reflecting these objectives – such as investment size, emission reductions, and green energy production – needs to follow. At the same time, administrative simplicity and accessibility are essential: overly complex tax rules can limit uptake, especially among small firms, and exacerbate the likelihood of tax avoidance and tax evasion.

A further design decision is whether to provide cost-based or profit-based incentives. OECD countries tend to rely more on cost-based CIT incentives for clean investment. These include tax credits or tax deductions for the acquisition costs of clean assets. Cost-based incentives allow for higher-than-regular deductions of costs that firms incur and thus for a reduction of taxable profits. Dressler et al. (2018), for example, found that 10 out of 36 OECD members and selected partner economies provide more generous depreciation schemes for carbon-neutral power generation technologies than for their carbon intensive alternatives. Profit-based incentives offer a direct reduction of tax liabilities through, e.g., reduced tax rates or tax holidays. Low- and middle-income economies also use CIT-related incentives for decarbonisation. Yet, these countries tend to rely more on profit-based tax incentives such as reduced rates as well as exemptions. Reduced tax rates and tax holidays for investments into renewable power generation in Rwanda and Vietnam are cases in point. (Celani et al., 2022).

The distinction between cost- and profit-based incentives is a key one within the broader context of investment promotion and foreign direct investment (FDI) attraction. Profit-based tax incentives are known to be expensive, can be one of the drivers for firms to shift profits to evade taxes, and have often been criticized for being an ineffective policy tool (IMF et al., 2015). This is also the case when the aim of the tax incentive is to increase investments in low carbon technologies since they do not tackle the main barriers to investment, e.g. access to finance, infrastructure risk and high upfront cost of capital. Cost-based instruments are generally preferred since they are better targeted at the policy goal they aim to achieve (World Bank, 2024).

A further key aspect is timing. One argument in favour of tax incentives for decarbonisation is "learning by doing" (OECD, 2024). The adoption of new technologies can be costly due to limited economies of scale and the need to go through a "trial and error" process, which can affect their profitability. Tax incentives can be an effective tool to raise after-tax profitability and thus attract private capital. One key design feature in this context regards the time span through which these tax provisions are granted. When tax incentives are justified at early stages of the technology adoption process, sunset clauses clearly limiting their life span are vital. When tax incentives remain in place after these initial stages, their effectiveness may shrink and their negative net impact on fiscal coffers can be exacerbated.

Provisions to phase out tax incentives as technologies become more competitive and widespread can mitigate against high redundancy ratios. As technology uptake advances, the share of investments that would have taken place without the tax incentive is likely to grow. Reducing tax incentives throughout this development can help retain effectiveness and reduce their fiscal cost. In the U.K., for instance, the Enhanced Capital Allowances (ECA) for Energy-Saving Equipment provided a tax incentive for energy-efficient equipment that phased out in 2020 as the government argued that energy-efficient technologies had become standard and no longer needed incentives. Similarly, a previous version of the U.S. Production Tax Credit (PTC) for wind and solar was subject to a step-down schedule: 100 per cent of the credit (2016), 80 per cent (2017), 60 per cent (2018), 40 per cent (2019), and full expiration (except for offshore wind) as from 2020.

All this said, in some cases the time span through which the tax benefit can be claimed needs to be long enough so that the policy can trigger the desired effect. In that context, an important design feature is the possibility to carry forward unused benefits. For example, an investment tax credit that can be carried forward for five years can be used to reduce the tax liability in the tax year in which investment takes place and the following four years. This is particularly relevant in industries where high up-front costs lead to insufficient taxable income in the early stages of an investment's lifetime to fully benefit from a tax incentive. Key sectors for industrial decarbonisation such as steel, cement and petrochemicals, are cases in point.

Uptake and the impact on the fiscal cost of tax incentives are additional dimensions to consider. Many countries try to limit the fiscal cost of tax incentives through the introduction of caps or similar mechanisms. In some cases, caps are implemented at the taxpayer level. In Japan, for instance, a CIT credit of JPY 400,000/unit (about USD 2,700) is available to support the production of battery-electric or hydrogen fuel cell vehicle, and the maximum tax credit in each year is 40 percent of the CIT liability, with a carryover period of four years. Likewise, in the U.S., the current version of the IRA includes a few tax credits with specific caps (e.g., Energy Efficient Home Improvement Credit (Section 25C) includes an annual cap of up to USD 1,200 per year for most qualifying improvements, and the Electric Vehicles Tax credit is capped at USD 7,500 for new EVs and USD 4,000. In other cases, the cap is implemented at the provision level. For instance, in the U.S., the total revenue forgone through the Advanced Energy Project Credit (Section 48C), an investment tax credit to support private sector investments in domestic clean energy manufacturing, has been capped at USD 10 billion. Other countries limit the total revenue forgone through TEs at the macro level. South Korea, for instance, has a fiscal rule linking the allowed yearly growth of revenue forgone through TEs to the growth of two macro variables: tax revenue and overall economic growth.

Zooming out, at the domestic level, there is a trade-off between the use of targeted tax incentives and the broadening of tax bases coupled with low marginal tax rates. The combination of expanding tax bases and lowering tax rates is frequently seen as a desired feature of optimal tax policy making (Auerbach and Summers, 1979). Tax incentives run counter to this recommendation.

In addition, at the international level, tax incentives for corporates, as any state aid, pose risks of a race to the bottom. Tax incentives may be granted to protect specific sectors under the broad justification of supporting other objectives including decarbonisation (Evenett et al., 2024). The growing use of such incentives within the recent wave of industrial policy packages can create economic distortions, lead to capital misallocation between countries, and reduce the fiscal space that countries need to provide core foundations for investments such as infrastructure, energy and education. It may also put countries who cannot afford such incentives at a competitive disadvantage. Recognizing these trade-offs and risks should be an integral component in the decision on the use of investment tax incentives.

Tax incentives related to personal income tax and Value Added Tax

CIT-related incentives can be an effective tool to support corporate investments in decarbonisation. Incentives granted through personal income tax (PIT) and value added tax (VAT) can also play a key role. Examples include PIT-related incentives and VAT-linked provisions to spur consumer demand for electric vehicles, renewables and housing retrofits.

As with CIT-related incentives, setting goals and defining eligibility is critical for PIT and VAT-related measures. For instance, the Swedish tax credit for green technology, introduced in January 2021, provides individuals with a tax credit for the installation of specific renewable energy systems, including solar cell systems, electricity storage solutions, and charging points for electric vehicles. The credit is available for costs related to labour and materials of installing such technology, with rates of 20 percent for solar cells and 50 percent for storage systems and charging points, up to a maximum of SEK 50,000 per person annually. To qualify, individuals must own the house or apartment where the installation is made, be at least 18 years old, and pay for the installation via electronic means. The Swedish Tax Agency processes the reduction following final payment and installation, and the credit is reflected in the individual's income tax return (Income Tax Law 67 kap. 36–45 §§).

Choosing an effective incentive mechanism is also vital. Tax incentives for energy-efficient home improvements granted through PITs are a case in point. These provisions seek to reduce taxpayers' tax liabilities for undertaking qualifying energy upgrades to their homes. The design of these tax incentives can have significant implications for their cost-effectiveness. Many governments use tax credits to incentivize these types of energy-efficient investments. These tax credits are often non-refundable and hence, the individual needs to have a tax liability large enough to benefit from the full tax credit, which limits uptake and their fiscal cost but very likely their impact as well. Instead of a tax credit (which reduces the tax liability), some governments allow taxpayers to deduct expenses related to energy efficiency or renewable energy investments from their taxable income. Besides cost-effectiveness, the choice between tax credits and tax deductions has significant implications when it comes to the distributive impact of these provisions. Using information from U.S. tax returns, Borenstein and Davis (2025) show that tax credits for buying heat pumps, solar panels, electric vehicles, and other "clean energy" technologies have been largely captured by higher-income households, with the bottom three income quintiles receiving about 10 per cent of all credits and the top quintile about 60 per cent. The authors found that the most regressive tax credit is the tax credit for EVs, for which the top quintile has received more than 80 per cent of all credits. To mitigate this regressive feature of tax credits, some governments implement refundable tax credits. On the one hand, refundability increases take-up ratios and mitigates the mechanical regressive effect of these provisions by allowing low-income earners to benefit from the full credit as well. On the other hand, refundability can significantly increase the fiscal cost of the provision.

As with CIT-related tax incentives, the trade-off between take-up ratios and fiscal cost is a further key issue for the design of tax incentives through PIT. As for CIT, the connection can go in both directions. In some cases, the main risk is too high a fiscal cost and, hence, governments implement caps or limits. In other cases, take-up ratios can be too low and hence, the desired behavioural change might not be achieved. In such cases, allowing for transferability – typically to contractors, financial institutions, or third-party investors – can be an effective tool to increase accessibility and uptake. The rationale is that these transferable tax benefits become more flexible and liquid, allowing them to be used in ways that better match taxpayers' needs and project financing structures.

As often the case, the devil is in the details and if monitoring is not done thoroughly, the outcome can be far from the expected one. Italy's "Superbonus 110 percent" is a case in point. The Superbonus is a generous tax subsidy seeking to incentivize energy-efficient renovation of residential buildings, which originally offered to pay homeowners 110 percent of the cost of energy saving renovations through tax credits. While the Superbonus seems to have triggered a positive effect on energy efficient construction, the fiscal cost was significant, and considerably beyond what the government had forecasted. While the government initially predicted the fiscal impact of the scheme at EUR 35 billion over a 15-year period, actual costs after the first four years were already estimated at EUR 160 billion. This gap in uptake (and cost) is not only explained by the generosity of the scheme, but also by the transferability feature and what then Finance Minister of Economy Daniele Franco called "one of the largest frauds in the history of the Republic". In a nutshell, the original version of the provisions allowed homeowners to claim the available tax credits directly against their taxes, have contractors claim them against invoices, or sell them to banks. These credits became a sort of fiscal currency and, because the monitoring was not effective, contractors often inflated renovation costs; sometimes, no work was carried out, and fraudulent credits were sometimes resold multiple times in an unregulated market of state-backed tax discounts (Garicano, 2025).

Reductions in VAT are another type of tax incentive used by governments to spur demand-driven decarbonisation. These measures typically take the form of lower VAT rates or exemptions for certain goods and services that support the consumption of low-carbon goods and services such as home insulation materials, energy-efficient appliances, and renewable energy installations. For example, the EU VAT Directive allows member states to apply reduced rates to energy-saving materials. Kenya implements VAT exemptions for hydrogen producers. Other countries use VAT-related incentives to encourage sustainable transport, e.g., Norway exempts electric vehicles from VAT, and France and Germany offer reduced VAT rates for public transport. Likewise, Sweden implements a reduced VAT rate on repairs of bicycles to cut waste and emissions.

One key issue regarding the effectiveness of VAT-related measures regards the pass-through to consumers. Whereas VAT cuts can be fully passed through to consumers (Hindriks and Serse, 2022), there is evidence showing that, under some circumstances such as high levels of market concentration, VAT reductions can be fully captured by businesses, or only partially passed through (Dimitrakopoulou et al., 2024).

Tax incentives are only one among several policy instruments to support industrial decarbonisation. A growing body of research suggests that such incentives tend to be more effective when embedded in a broader policy mix including carbon pricing, regulation and other types of policies (Lenain, 2024). Hence, it is vital for governments to tackle the decarbonisation of the economy in a holistic approach, taking into consideration complementarities but also potential redundancies as well as the coordination of overlapping incentives that could jeopardize their effectiveness in terms of the expected behavioural impact they are supposed to trigger.

With this in mind, the following sections discuss the use of tax incentives for industrial decarbonisation across six selected sectors. Each section provides a (non-exhaustive) overview of existing practices regarding the use of tax incentives. These sector-specific sections also make reference to other relevant policy instruments that might be implemented by governments to account for the importance of policy coherence among different types of measures.

2. TAX INCENTIVES FOR DECARBONISATION: INSIGHTS FROM SIX INDUSTRIAL SECTORS

2.1. Decarbonising electricity

Main characteristics

Electricity production is the largest source of CO_2 emissions globally accounting for 36 percent of energy-related emissions (IEA, 2024b). Electricity demand is projected to continue on a steep upward trajectory. The IEA forecasts annual growth in power consumption to expand at close to 4 percent over the next years fuelled by accelerating electrification, industrial production, rising use of air conditioning and expanding data centres (IEA, 2025a). At the same time, the power generating sector is leading the net zero transition with a large and growing share of low carbon electricity, like solar and wind, in the mix, reaching 41 percent of global electricity generation in 2024 (Graham et al., 2025). Sustaining this development requires large-scale, affordable clean energy, making cost-effective production of renewable energy equipment, alongside continued innovation and adoption of clean technologies, essential.

Manufacturing capacity for renewable energy equipment has grown significantly over the last years. The rapid increase in production capacity for solar modules since 2020 has resulted in growing concerns of overcapacity and falling utilisation. At the same time, calls for the diversification of supplies add a further critical dimension (OECD, 2025a). Wind turbine manufacturing, on the other hand, needs increased investment to meet demand and avoid supply chain bottlenecks. While onshore wind turbine manufacturing capacity follows the projected demand, offshore wind manufacturing requires more policy attention (Wind Europe, 2024). Indeed, several EU member states are increasing support for offshore wind turbines, blades and nacelles to cover demand by 2030. Manufacturing equipment costs are determined not solely by production expenses and economies of scale, but also by the price and availability of essential inputs and raw materials. Targeted government interventions in upstream sectors, such as steel (critical for wind turbine manufacturing) or aluminium and glass (essential for solar modules), can provide indirect support for renewable energy equipment production.

EXISTING PRACTICES

Access to affordable, secure and clean electricity is a priority for governments worldwide. Given the falling costs of low-carbon power generation, renewables play a significant role in pursuing this objective. Against this background, many countries are offering tax incentives across the renewables value chain to safeguard access to the relevant technologies, materials and skills, and to accelerate deployment.

Tax incentives in support of manufacturing of renewables equipment are a central pillar of policy packages for the sector. As an example, France offers tax credits for investments in producing solar panels, wind turbines, batteries and heat pumps, as well as related key components and materials. The credit varies by firm size and investment location, and ranges from 20 percent to 60 percent of the investment, with a cap at EUR 150 million per firm. For investments in specified regional development zones the cap increases to up to EUR 350 million. Similarly, Finland has introduced a broad range of tax credits for clean transition investments – including investments into the production of solar panels, wind turbines and batteries.

Further down the value chain, many countries also provide tax incentives for the deployment of renewables. Canada, as an illustration, offers accelerated capital cost allowance for projects producing energy through renewable sources. Eligible equipment can be written off at 30 percent per year, thus allowing firms to claim a larger than usual depreciation and reduce taxable income in the early years of an investment. Investments before 2025 can be written off at 50 percent per year. Canadian firms can also claim the Clean Technology Investment Tax Credit (CTITC), which is a refundable tax credit for capital invested in eligible equipment, such as equipment used to produce electricity from solar, wind and water energy. The tax credit may go up to 30 percent of the cost of capital for the investment. Similarly, in the U.S., the Clean Electricity Investment Tax Credit (ITC) offers a base credit of 6 percent of qualified investments into zero-emission electricity and storage projects. The rate can increase up to 30 percent for smaller facilities, projects meeting certain wage and apprenticeship requirements, or investments begun before January 29, 2023. Bonus credits apply for domestic content, energy community siting, and certain fuel cell technologies (KPMG, 2025). In Brazil, investments into solar and wind energy benefit from an exemption from federal taxes levied for the "Contribution for the Financing of Social Security" (COFINS) and the "Social Integration Program" (PIS) (Marques Döbler and Silveira Araújo, 2025).

Production tax incentives for firms and households offer further examples. The Clean Electricity Production Tax Credit (PTC) in the U.S. provides a per-kilowatt-hour credit for zero-emission electricity that is sold to an unrelated person. The base rate is 0.3 cents/kWh, rising to 1.5 cents/kWh for smaller projects that meet certain wage and apprenticeship requirements. The credit applies for ten years and remains transferable.

Governments often combine tax incentives with various additional policies in support of low-carbon electricity. Price-based tools (e.g., feed-in tariffs, contracts for difference) and quantity-based tools (e.g., renewable portfolio standards) are cases in point. By guaranteeing a floor for producer revenue and raising demand, these measures can reduce investment risk and secure stable returns, encouraging private investment. Alongside targeted loans and further regulatory measures, they have significantly accelerated renewable energy deployment beyond what tax incentives alone could achieve (OECD, 2025a).

Policy considerations

Government support for clean technology manufacturing, particularly through producer subsidies, such as tax incentives, has played a significant but complex role in shaping global solar and wind industries. While such policy interventions have helped increase production capacity, supported innovation, and reduced costs, their impact has been mixed and context dependent. In some cases, subsidies prolonged the operation of struggling firms with limited long-term effects while, in others, they enabled producers to scale up and gain market share. This uneven impact highlights the importance of design and timing of targeted interventions. Moreover, excessive support has contributed to structural overcapacity, price pressures, and market concentration, particularly in China (the dominant supplier of renewable energy equipment), raising concerns about energy security and fair competition (OECD, 2025a**)**.

Design factors such as predictability, compliance and accessibility are essential for well-targeted tax incentives to increase investments in renewable energy. Moreover, targeted support for R&D helps address positive externalities, as private firms often underinvest in R&D relative to what is socially optimal (Greene and Braathen, 2014). Sustaining innovation in low-carbon technologies also depends on firms maintaining sufficient profit margins to reinvest in new solutions (OECD, 2025a). Incentives that encourage innovation can therefore yield broader economic and environmental benefits than would not occur through market forces alone.

Low-carbon electricity still faces major challenges, particularly the need for greater energy storage and smarter, more resilient grids. Because renewable sources like wind and solar are variable and decentralised, grids must become more flexible through improved balancing systems, additional generation capacity, advanced grid intelligence, and stronger transmission and distribution networks. (IEA, 2023). In this context, inadequate investment in grid infrastructure remains a key bottleneck, with 1,650 GW of renewable capacity currently awaiting connection (IEA, 2024c). Moreover, grid projects often require 5–15 years to plan and complete, compared to 1–5 years for renewable installations (IEA, 2023), underscoring the need for integrated, long-term planning. To ensure the effective deployment of renewable technologies, policies should align infrastructure development with broader energy strategies and guarantee priority grid access for low-carbon electricity.

2.2. Decarbonising road vehicles

Main characteristics

Road transport accounts for approximately 16 percent of global CO_2 emissions from energy use, making it the second largest source of carbon emissions after power generation (Jaramillo et al., 2022). Decarbonising the sector will thus be essential for a path to net zero and comes with many further benefits: local air quality will improve, especially in large cities; countries without sufficient oil resources will bolster their trade balance; car drivers will be less exposed to volatile oil prices; and energy security will strengthen.

Battery electric vehicles (BEVs) offer a clear decarbonisation pathway. BEVs are especially attractive for passenger cars and light-duty vehicles due to their rapidly improving range, declining costs, and expanding charging infrastructure. City buses are also shifting to electric energy. Lithium-ion batteries dominate the BEV market and continue to evolve, with innovation efforts resulting in higher energy, lower cost, enhanced safety, and faster charging. For long-haul heavy-duty trucks, hydrogen fuel cell vehicles represent an alternative solution – albeit one that continues to face key cost hurdles. Overall, fast adoption in several jurisdictions – such as California, China and Norway – highlight effective decarbonisation strategies for the sector and the critical role of policies on these pathways.

EXISTING PRACTICES

Investment tax incentives for automakers are a key channel for policy support. By reducing corporate tax liabilities in line with related investments, tax incentives can encourage automakers to make larger investments in the BEV supply chain and to allocate more resources to research and development. Support is often provided through tax credits or accelerated depreciation provisions, which let manufacturers write off capital investments (plants, machinery, tooling) faster than normal, yielding tax savings in the early phase of an investment. South Korea and Japan, for example, offer tax credits for investments into national priority sectors, including electric vehicles. In the European Union, even though tax credits for EV manufacturing are less common (OECD, 2025b), some countries offer them. Italy, Spain and Eastern EU states have provided tax incentives to attract battery gigafactories, such as reduced local taxes or lower social contribution credits (Transport & Environment, 2025). Czechia allows for reduced depreciation periods for investments into charging stations (acea, 2025).

Many countries also provide tax incentives linked to the production of electric vehicles. In the United States, the Advanced Manufacturing Production Credit can be used to offset businesses' CIT liability when they produce eligible battery components (electrodes, cells, modules, packs) (C2ES, 2025). The tax credit amounts to USD 35 per kWh for each battery cell made in the country, plus USD 10 per kWh for battery module assembly. In addition to offsetting CIT liabilities, the tax credit can also be used as "direct pay" and it can be transferred to other unrelated parties in exchange for cash. In Japan, a CIT credit of JPY 400,000/unit (about USD 2700) is available to support the production of battery-electric or hydrogen fuel cell vehicle (METI, 2024). The maximum tax credit in each year is 40 percent of the corporate tax liability, with a carryover period of four years. This incentive is part of a broader 10-year tax incentive program introduced by the government to promote domestic production in strategic sectors, including EVs and semiconductor devices. China has historically relied more on direct subsidies and low-interest loans, but also deploys tax incentives for producers in the transport sector (OECD, 2025b). Many EV manufacturers qualify for preferential CIT rates (15 percent instead of the standard 25 percent) under the policy supporting technology-advanced service enterprises. An incentive is also the "2+3 year tax holiday" through which new high-tech manufacturing enterprises may get 2 years of CIT exemption followed by 3 years at 50 percent reduced tax.

Tax incentives for electric vehicle purchases and private charging stations provide additional support. Although the total cost of ownership over the lifetime of an electric vehicle is attractive, upfront purchasing prices are often higher. In addition, as with any new technology, consumers face uncertainties, such as driving range, availability of charging points, and resale value. Several governments deploy tax incentives to encourage adoption in this context.

Reductions in personal income tax are cases in point. Spain allows for the deduction of 15 percent of the acquisition costs for an electric vehicle from taxable income. France and Belgium offer reductions in personal income tax for private homeowners installing a charging point (acea, 2025).

Incentives channelled through VAT cuts and further measures provide additional assistance for adoption. Indonesia offers VAT reductions for BEVs linked to the degree of domestic content of the purchased vehicle. For domestic shares above 40 percent, the VAT rate is reduced from the standard rate of 11 percent to 1 percent, for domestic content shares between 20-40 percent, the reduction is 5 percentage points (Faradina, 2025). Portugal offers corporate VAT deductions for the purchase of zero emission cars and on the electricity costs to power them. Japan offers tax incentives for electric vehicles through exemptions or reductions from acquisition tax, tonnage tax, and annual automobile tax. In the United Kingdom, zero emission vehicles (ZEVs) are subject to lower benefit-in-kind tax rates for company cars. The U.K. also offers capital allowances for businesses investing in electric fleets and charging infrastructure, which help reduce tax liabilities and operational costs (Hatton and Lenain, 2024).

Governments frequently combine tax incentives with further pre-existing and new action to promote the decarbonisation of road transport. Gasoline and diesel are subject to excise taxes in most countries, thus sending a price signal and encouraging the shift to electricity. In addition, regulatory measures require carmakers to increase the share of ZEVs in their sales, such as mandatory quotas in California, Canada, China, EU, and U.K. Some city centres with ultra-low emission zones are only open to ZEVs, which also benefit from free parking and bus lane access.

POLICY CONSIDERATIONS

Policies to encourage the production and adoption of BEVs have contributed to a rapid expansion of the market. Sales of electric cars are expected to surpass 20 million in 2025 (over a quarter of cars sold worldwide). Global EV production has surged, new factories are being built at a record pace, and competition has intensified (IEA, 2024d).

Tax incentives to boost investment in the EV supply chain remain a key topic on policy agendas. When they are offered, countries should reconsider supporting investment spending without predetermined conditions and instead explore the adoption of performance-related tax incentives, which reward manufacturers on results. Tax incentives granted depending on the volume of batteries produced or zero-emission vehicle assembled are a case in point.

On the demand side, tax incentives have accelerated the adoption of EVs, helping to move along the S-shaped curve beyond early adopters. Indeed, when Germany removed these tax incentives in early 2024, demand for EVs slowed markedly. Nonetheless, a debate remains on the risk of free riding, as high-income car buyers who have benefited from tax incentives are likely to have bought an EV also without government support (Sheldon and Dua, 2019). One option to mitigate this risk is for governments to prioritise support for decarbonising corporate car fleets through designs such as accelerated depreciation. This approach reflects that many car drivers, particularly lower income households, opt for second-hand cars rather than new vehicles. The accelerated adoption of EVs by companies will eventually enhance the availability of these vehicles in the second-hand market.

2.3. Decarbonising hydrogen

MAIN CHARACTERISTICS

In 2024, global hydrogen production reached close to 100 million tonnes (Mt). More than 99 percent of that supply derived from unabated fossil fuel processes such as steam methane reforming and coal gasification (grey hydrogen). This dependence on fossil-based hydrogen led to 920 million tonnes of CO_2-equivalent emissions, including those from upstream extraction, and contributed to more than 2 percent of global energy-related CO_2 emissions in 2023. Demand remains heavily concentrated in fossil fuel refining and the chemical industry, particularly for fertiliser production (IEA, 2025b; IEA, 2024e).

Low-emissions hydrogen is recognized as a potential solution to decarbonise hard-to-abate sectors. Examples include possible applications in steel and petrochemicals as well as long-haul shipping and aviation. New synthetic fuels are a further case in point. Production pathways include electrolysis powered by renewable energy (green hydrogen), and grey hydrogen combined with carbon capture and storage (blue hydrogen) (Cammeraat et al., 2022).

Hydrogen users are still reluctant to adopt green hydrogen due its high price premium. Without government support, green hydrogen is estimated to cost USD 4.5-6.0 per kilogram compared with USD 1.5-2.0 per kilogram for grey hydrogen. The cost gap is primarily driven by renewable electricity, which is ultimately related to the renewable resources of each region, as well as by the capital-intensive electrolysers which account for roughly 90 percent of total plant CAPEX (IEA, 2025b; IEA, 2024e). The IEA estimates that production must increase to about 500 million tonnes by 2050, with over 90 percent derived from low-emissions methods.

Existing practices

Many governments have adopted comprehensive strategies to foster the growth of a green hydrogen industry and achieve broader decarbonisation and energy security goals. These strategies include measures to expand production, stimulate demand, develop transport and storage infrastructure, and support international trade. To bridge the cost gap with grey hydrogen, policy packages often provide direct financial support such as grants, tax incentives and concessional loans. Carbon pricing – a key lever for shifting demand – remains underutilised.

Tax incentives for hydrogen investments and production are a key component of these strategies. Canada's Clean Hydrogen Investment Tax Credit (CHITC) is a case in point. It offers investors a tax reduction amounting to 15 percent of eligible project capex. The credit is available for investments into hydrogen production with lifecycle emissions below 4 kg of CO_2 per kg of hydrogen. It rises to 40 percent of capex for projects achieving emissions below 0.75 kg of CO_2 per kg of hydrogen. The CHITC extends to hydrogen produced via natural gas steam reforming equipped with CCS and may also be claimed by clean-ammonia facilities that use hydrogen from the same eligible project. Australia's Future Made in Australia package incentivizes hydrogen production through a refundable tax credit of AUD 2 per kilogram of eligible hydrogen for up to ten years of production starting in 2027. The tax credit is evaluated over time by tracking the number of covered facilities, the volume of production, the total credits claimed, and feedback from both the Australian Taxation Office and taxpayers on the scheme's administration. Egypt refunds 33-55 percent of the income tax paid on revenues from clean-hydrogen projects (and their expansions). The country also offers a VAT exemption on a broad range of inputs for hydrogen production, including machinery, raw materials, and vehicles. Kenya, meanwhile, grants hydrogen producers a full ten-year corporate-income-tax holiday as well as broad VAT exemptions, exemption from stamp duty and 100 percent investment depreciation (IEA, 2024f).

Auctions can enhance the mechanism to grant tax incentives. Brazil, as an example, has announced tax credits for hydrogen production that shall be allocated based on a competitive process reflecting two criteria: the average CO2 emissions per kg of hydrogen and the contribution to the development of a national hydrogen value chain (Homsy and Araújo de Souza, 2024).

Policy considerations

The IEA estimates cumulative announced public funding for low-emissions hydrogen at USD 38 billion. Support remains skewed toward the supply side, with USD 1.5 allocated to supply for every dollar targeting demand (IEA, 2025b). Many national hydrogen strategies project a future built around green hydrogen exports. Few address the role of hydrogen imports. At this early stage of industry development, international cooperation is critical to balance the global market while unlocking the production potential of developing countries, which often benefit from abundant renewable energy resources. Avoiding protectionist policies can help direct production where it is most cost-effective and enable developing economies to pursue export-oriented strategies (Reed, 2024).

Close coordination with policies in key demand sectors is also vital. As highlighted in the following sections, hydrogen is likely to play a key role in the decarbonisation of several industrial sectors, including steel and petrochemicals. A decline in costs for low-emission hydrogen will be critical for that.

To close the cost gap between low-emissions and grey hydrogen, combining incentives with carbon pricing for unabated fossil-based hydrogen will be key for effective policy strategies. This package approach can generate important synergies during the scale-up phase. Governments should also provide long-term visibility over the level and form of support so developers have clarity over future business cases and can attract investors. While early projects will require substantial financial backing, support can be gradually phased down as the sector matures and technology costs fall.

2.4. Decarbonising steel

MAIN CHARACTERISTICS

The iron and steel industry accounted for more than 7 percent of global energy-related CO_2 emissions in 2023 with a carbon footprint of more than 2 tonnes of CO_2 per tonne of steel produced. Steel is a hard-to-abate industry due to its two-step carbon-intensive production process. In primary steel production, iron ore is first reduced to iron in blast furnaces using coke, which releases CO_2 through a chemical reaction. The resulting iron is then refined into steel, typically via a basic oxygen converter. Both steps require temperatures over 1500 °C, which leads to further emissions when powered by fossil fuels (IEA, 2024b).

The production route greatly affects steel's carbon intensity. Primary routes use virgin iron ore in blast furnace–basic oxygen furnaces (BF–BOF) and direct reduced iron–electric arc furnaces (DRI–EAF) processes. Secondary production uses electric arc furnaces (EAF) to melt recycled scrap, avoiding iron ore reduction and coke use. These three routes together produce about 98 percent of global steel, with scrap-based EAF being the least carbon-intensive – especially when powered by clean energy.

Near-term decarbonisation in steel depends on efficiency, scrap use, and technology upgrades. Key levers include gains in technology performance, material efficiency, and increased use of scrap-based production. Analyses of the EU steel sector show that upgrades to best-available technologies on existing blast-furnace and EAF routes can reduce energy use and CO_2 emissions by around 15-20 percent relative to today's average plants. Over longer horizons, material-efficiency and circular-economy measures (higher yields, better scrap collection and sorting, longer lifetimes, improved design) provide on the order of 40-50 percent of total emissions reductions in net-zero pathways for basic materials (Gérardin and Ferrière, 2025).

Decarbonising primary steel is likely to be linked to one or several of four core technologies: gas-based DRI with CCUS; hydrogen-based DRI; smelting reduction with CCUS; and CCUS-equipped blast furnaces. Hydrogen-based routes are most effective where low-cost renewable electricity is abundant, while CCUS options are considered for retrofitting existing coal- and gas-based infrastructure in regions with CO_2 storage capacity. Transition strategies such as hydrogen blending and CCUS retrofits can help reduce emissions before large-scale deployment begins. From a cost-effectiveness perspective, material efficiency and scrap-based secondary production remain the lowest-cost strategies. Hydrogen DRI, although more expensive today is likely to play a critical role in the long term where renewable power is plentiful. The optimal pathway depends on regional conditions but scaling low-cost options now while preparing for CCUS and hydrogen is essential for a resilient net-zero transition (IEA, 2024g).

Existing practices

A number of countries offer tax incentives that directly cover green steel investments or production. Japan provides a tax credit for domestic production in strategic sectors, including green steel. The credit amounts to JPY 20,000 (USD 130) per tonne of low-carbon steel, capped at 40 percent of tax liability over ten years (Transition Asia, 2025). South Korea recently introduced a draft law, the "K-Steel Act", into parliamentary debates, in support of the country's steel sector, including tax incentives for green steel (Steel Reporter, 2025). Finland's tax credits for clean transition investments cover investments in the decarbonisation of industrial production processes and energy efficiency measures. The credit is available for investments of at least EUR 50 million. Eligibility is conditional on an investment resulting in a reduction of greenhouse gas emissions of at least 40 percent or an increase in energy efficiency of at least 20 percent. Similarly, the Advanced Energy Project Credit in the U.S. provides a tax credit of up to 30 percent of eligible investment costs to reduce greenhouse gas emissions in an industrial or manufacturing facility by at least 20 percent.

Support for green hydrogen, as a key input for low-carbon steel, can provide additional impetus. As costs for green hydrogen go down, the competitiveness of green hydrogen-based steel production goes up.

Tax incentives for carbon capture, utilization and storage can deliver further support. Canada's refundable CCUS investment tax credit, in place from 2022 to 2040, offers a tax credit amounting to 37.5-60 percent of eligible CCUS investments. In Asia, Malaysia provides a 10-year investment allowance and 70 percent income tax reduction for CCUS service providers, creating one of the region's most proactive industrial carbon management frameworks (Pramesti et al, 2025). In the United States, the § 45Q tax credit offers a base rate of USD 17/tCO_2 for permanent storage, USD 12/tCO_2 for utilisation, and 36 USD/tCO_2 for direct air capture. Credits are available for 12 years and are increased fivefold for eligible facilities meeting prevailing wage and apprenticeship requirements. Integrated steel plants, such as BFBOF mills, qualify if they capture at least 12,500 tCO_2 annually. Projects must ensure CO_2 is measured, verified, and either permanently stored or utilized under binding contracts.

The policy environment for steel is shifting rapidly as governments bring together a broad range of instruments to support deeper emissions cuts. In the European Union, the combination of a tightening carbon price under the ETS and the incoming Carbon Border Adjustment Mechanism (CBAM) will penalize high-carbon imports, creating a strong market signal for low-emission steel producers. Carbon contracts for difference that provide firms with a minimum CO_2 price for industrial projects are a further addition to the mix. In the United States, a growing number of state-level "Buy Clean" policies are setting embodied-carbon limits for construction materials in public procurement, positioning green steel as a preferred material in infrastructure spending. India is aligning its steel industry with broader energy efficiency and low-carbon targets under its industrial performance schemes, while

China is expanding pilot programmes that link steelmaking emissions to compliance with national carbon markets and stringent energy-intensity standards.

POLICY CONSIDERATIONS

Steel decarbonisation policies are beginning to yield practical results. Early projects suggest the value of strong capital support, offtake certainty, and long-term price guarantees. In the United States, initiatives like Electra's electrolytic iron facility in Colorado and Boston Metal's molten-oxide electrolysis pilot were supported by funding and tax incentives, helping to foster commercial-scale low-emission methods. In Sweden, projects such as Hybrit and H2 Green Steel are advancing hydrogen-based DRI steelmaking with support from EU Innovation Fund grants and Swedish state aid, while Germany's Carbon Contracts for Difference (CCfDs) are emerging as a key policy tool to bridge the cost gap for similar green steel technologies.

Yet, much remains to be done. Green steel still accounts for less than 1 percent of global production, and high hydrogen and renewable energy costs hinder large-scale deployment. Studies linked to the EU's Emissions Trading System (ETS) reform and Carbon Border Adjustment Mechanism (CBAM) suggest a carbon price in the range of EUR 80–100/tCO_2 could meaningfully shift the competitiveness of low-carbon steelmaking routes, but many producers still lack access to secure demand and affordable inputs.

Accelerating low-carbon steel adoption requires a region-sensitive policy mix. Production incentives tied to verified emission reductions and stable procurement mandates are likely to be core components of such packages. Phased carbon pricing with targeted subsidies will also be key to modernising industry while preserving affordability and growth.

2.5. Decarbonising cement

MAIN CHARACTERISTICS

The cement industry generated 6.2 percent of global CO_2 emissions in 2023 – almost equivalent to the 6.5 percent emitted by EU countries in the same year (IEA, 2024b). The sector is considered among the hardest-to-abate sectors because roughly two-thirds of these emissions come from the process of calcining limestone to produce clinker, which cannot be reduced by switching to low-carbon energy. The remaining one-third is released by the combustion of fossil fuels – mainly coal – required to reach kiln temperatures of ~1450°C.

"Green cement" is any cementious binder that delivers products with a markedly lower quantity of life-cycle CO_2. It can be advanced through four main levers: (i) greater energy efficiency, (ii) lower-carbon thermal fuels, (iii) material efficiency by reducing the clinker-to-cement ratio, lowering overall demand, and using recycled cement, and (iv) carbon capture and storage (CCS) (Shivaprasad et al., 2024). Among emission reduction technologies currently at the demonstration stage, there is strong interest in CCS, while substituting fossil combustion with green hydrogen is often considered to have limited decarbonising potential due to its undesirable physical and chemical properties.

EXISTING PRACTICES

Echoing approaches in the steel sector, select countries also employ tax incentives for decarbonising cement. The above-mentioned Finnish tax credit for decarbonisation of industrial production processes and energy efficiency measure as well as the U.S. Advanced

Energy Project Credit are cases in point. The U.S. provision offers an investment tax credit of up to 30 percent – reduced to 6 percent if prevailing-wage and apprenticeship requirements are not met – for (i) retrofitting an existing cement plant to cut facility-level CO_2 by at least 20 percent, or (ii) building or re-equipping an "advanced-energy" facility that makes low-carbon cement or supplementary cementitious materials whose life-cycle intensity is at least 30 percent below the industry benchmark.

Tax incentives on the subnational level are further cases in point. In the U.S., New Jersey's first-in-the-nation Low-Embodied-Carbon Concrete Tax Credit (LECCLA) grants cement producers up to 5 percent of the cost of lower carbon concrete supplied to state-funded construction projects, plus an extra 3 percent if the mix incorporates CCS. The supplied amount must be at least 50 cubic yards of lower carbon concrete, Credits are capped at USD 1 million per producer and USD 10 million per year in total, awarded on a first-come, first-served basis for contracts executed from 2024 onward.

Similar to the steel sector, tax incentives for carbon capture and storage (CCS) – with less of a role for utilization – can provide additional support. In that context, it is important to recognize that CCS costs vary across industries due to, inter alia, different CO_2 concentrations, process designs, scale, and proximity to storage locations. With this in mind, an important issue facing policymakers is to identify the level of support to enable broader adoption of CCS in a specific industry. For the U.S., a recent study estimates CCS costs in the cement industry at over USD 100/t CO_2 (EFI Foundation, 2025).

POLICY CONSIDERATIONS

While there are positive signs, CO_2 emissions from the global cement sector are higher today than in 2015 (IEA, 2025c). Particularly worrisome is that emissions intensity has also increased in that time period, underlining the need for effective policy intervention. A well-designed policy mix – combining carbon pricing with further targeted measures such as tax incentives – is critical to accelerate the decarbonisation of the industry. To illustrate, given that cement production currently emits close to 0.6 tonnes of CO_2 per tonne of cement, a carbon price of USD 100 per tonne of CO_2 would reduce the cost gap to conventional cement by around USD 60. This would create stronger incentives for improving energy efficiency, shifting to lower-carbon energy sources, and using less carbon-intensive raw materials. These measures could be implemented through excise taxes on coal, direct CO_2 emission taxes, or the requirement to purchase allowances under an ETS. A gradual phase-in of such measures can be key to minimise disruptive effects on downstream sectors – in particular in developing countries where cement demand is high due to infrastructure and housing needs.

2.6. Decarbonising petrochemicals

MAIN CHARACTERISTICS

Petrochemicals, derived from oil and natural gas, are used to produce goods such as plastics, rubbers, fibres and solvents, which are widely used in the automobile, textile, construction and further industries. In 2023, the sector produced more than 3 percent of global CO_2 emissions (IEA, 2024b**)**. Growth in petrochemicals was the largest driver of oil demand in the last five years and is expected to remain the backbone of oil demand growth in the years ahead (IEA, 2025d). The sector uses fossil fuels in two main ways: to generate heat and power for industrial processes, and as direct feedstocks that generate emissions through chemical processes. Decarbonising petrochemicals therefore involves two dimensions: shifting to low-emissions energy sources and developing alternative production processes. Carbon capture and storage (CCS) is likely to play a critical role in decarbonising petrochemical processes where fossil fuels remain irreplaceable as feedstocks.

Decarbonisation of the sector can take the form of "green petrochemicals", which are identical to conventional petrochemicals but produced from renewable, recycled, or low-carbon sources. Pathways include using bio-based feedstocks (e.g., sugarcane ethanol for bio-ethylene), recycling plastic waste, and through electrification or carbon capture. The related technologies are often at an early stage and not yet cost effective.

EXISTING PRACTICES

Several countries offer investment-related tax incentives to support a low-carbon transition in the petrochemicals sector. Thailand provides corporate tax exemptions for a broad range of sectors, including petrochemicals. Biochemicals and bioplastics can qualify for up to eight years of corporate tax exemptions as well as an exemption from import duty on machinery and an exemption from import duty on raw materials used in the production for exports. The scheme also provides tax incentives for hydrogen production and CCS (Thailand Board of Investment, 2025). Malaysia offers, inter alia, corporate income tax exemptions for new companies as well as investment tax allowances for established firms that utilise oil palm biomass for bio-based chemicals (MIDA, 2024). In China, companies that are granted High and New Technology Enterprise (HNTE) status – including eligible chemical companies – can benefit from a reduced 15 percent corporate tax rate alongside a super deduction for qualified R&D expenses. South Africa provides tax incentives for improvements in energy efficiency and carbon emissions by offering an additional free allowance of 5 percent of emissions under its carbon tax to firms, including those in the chemical industry, that outperform their sector benchmark (OECD, 2025c).

As in other sectors, tax incentives are used in combination with a broad range of other policy instruments to support petrochemicals on their decarbonisation trajectory. Germany is offering Carbon Contracts for Difference to support industry, including chemical firms, in reducing CO_2 emissions. Finland had an investment aid program in support of large clean transition investments. Measures to increase the share of recycled feedstock are further cases in point. In the UK, businesses making or importing over 10 tonnes of plastic packaging pay a tax of GBP 224/tonne if the packaging contains under 30 percent recycled content. The EU's Plastic Levy charges EUR 0.80/kg of non-recycled plastic packaging waste produced in member states. Some countries, like Spain, exempt biodegradable and medical packaging and offers reductions for certified recycled content.

POLICY CONSIDERATIONS

Given the fast-rising demand for its products and its emission intensity, the petrochemicals sector plays a key role to advance on a net-zero transition pathway. This makes it crucial to pursue more ambitious policies such as more innovation support, larger incentives to recycling, and a faster shift to alternative uses. Expanding tax incentives for the adoption of clean technologies – such as using green hydrogen as a heating source and CCS – can improve their commercial viability and help steer the sector toward decarbonisation. Many of these measures already exist in other industrial sectors and could be adapted for petrochemicals. However, without addressing the continued growth in emissions driven by strong demand, such incentives alone will be insufficient. Crucially, new decarbonisation-focused tax measures should be coordinated with the gradual phase-out of policies that currently encourage the use of conventional, carbon-intensive energy sources such as fossil fuel subsidies. This package approach is essential to avoid undermining climate goals while fostering a transition to cleaner production (Lenain, 2024).

3. KEY INSIGHTS

Decarbonising heavy industries is critical for achieving climate goals. It is also recognized as a key pillar of national economic strategies, innovation and competitiveness. Sectors like steel, cement, and chemicals remain among the most difficult to transform. Emerging technologies such as hydrogen-based steelmaking, carbon capture for cement, or electrified chemical processes often involve high upfront investments and unproven economics.

Against this background, policymakers increasingly use tax incentives, in combination with further policy instruments, to lower after-tax costs, mobilize private capital, and speed deployment of low-carbon solutions. Tax incentives for investments are a case in point. By allowing firms to deduct capital outlays more quickly, investment-based incentives ease the cost barrier that deters adoption of innovative processes. Production-based tax incentives that reward clean outputs are an additional pillar in the policy mix. By linking incentives to the unit of output, such provisions ensure the benefit is tied to actual decarbonised production. Consumption-related tax incentives play another key role. Through PIT and VAT measures, governments have supported energy-efficient housing upgrades, electric vehicles, and clean appliances, though the impact sometimes skews toward higher-income households. Refundability, transferability, and clear eligibility rules can broaden access, while careful monitoring is needed to avoid excessive fiscal cost or fraud.

Whether targeting investments, production or consumption, tax incentives must be carefully designed to maximize both effectiveness and efficiency. On the investment and production side, poor targeting can subsidise projects that would have occurred anyway or exclude promising technologies or firms. On the consumption side, incentives risk being regressive if captured mainly by higher-income households, as seen with many EV or home retrofit credits. When it comes to incentives targeting consumption, credits are preferable to deductions since they can reach lower-income households more efficiently. Credit refundability can further mitigate the risk of regressivity and increase take-up but might trigger an increase in the fiscal cost. Tax incentives should be time-bound, performance-based, and aligned with clear policy objectives. At the same time, administrative simplicity and accessibility are essential: overly complex rules or high entry barriers can limit uptake, especially among smaller firms or poorer households, and exacerbate the likelihood of tax evasion and avoidance. Embedding evaluation, transparency, and sunset mechanisms into incentive design can help ensure that they remain cost-effective, equitable, and responsive to technological change.

In addition, and crucially, tax incentives are most effective when embedded in a broader policy mix. Industries respond to a broad range of policy measures that also include, inter alia, carbon pricing, regulation, and public investment. A cross-cutting insight is that tax measures should complement these other instruments**.** For example, a modest carbon price or emissions trading system sets a general incentive to cut emissions, while targeted tax credits can help firms invest in technologies to achieve those cuts or shift household behaviour towards lower-carbon practices. The key is complementarity: different tax incentives should work alongside each other and other tools to address different barriers across the value chain, rather than clustering on the same stage of investment, production or consumption. On the other hand, overlapping incentives aimed at the same objective add complexity, raise fiscal costs, and reduce overall effectiveness. In practice, this means industrial tax incentives should be coordinated with other policies (such as grants or green public procurement) to maximize impact.

Beyond design and coordination, the credibility and predictability of tax incentives are critical to their success. Firms investing in a steel plant or a cement kiln look at investment horizons of decades. If tax incentives are short-lived or uncertain, their ability to influence these decisions is limited. Across sectors, firms value clear and consistent policy signals. Thus, incentives must have defined durations, and remain available long enough to guide investment, even if phased down over time.

These cross-sector lessons point to several principles that can inform the design of effective tax incentives. Building on this foundation, the following policy recommendations offer practical guidance for leveraging tax incentives to support industrial decarbonisation:

1. Embed tax incentives in a balanced policy mix. Tax incentives should complement, not replace, carbon pricing, regulation, and direct support. In the EU, where the ETS and CBAM already create price signals, tax incentives can close specific gaps, by encouraging early-stage innovation or offsetting competitiveness risks. Temporary tax credits for breakthrough technologies (e.g. green steel or cement) can accelerate investments ahead of tighter ETS phases. Combining carbon pricing with incentives improves effectiveness and public acceptance.

2. Prioritize innovation and technology diffusion. Tax incentives should target key stages in the innovation cycle—from R&D to early deployment. Options include enhanced R&D credits for climate technologies, milestone-based tax bonuses, or incentives for industry-academic collaboration. To foster broad uptake, policies should support smaller firms through refundability or technical assistance. International learning and coordination can improve design and avoid fragmentation.

3. De-risk first-of-a-kind projects with time-limited incentives. To overcome hesitancy around novel industrial processes (like hydrogen-based steelmaking), offer temporary tax incentives or investment credits for early movers. These should have clear sunset clauses or project caps, functioning like "competition prizes" to spur near-term action and learning.

4. Ensure fiscal discipline and transparency. Use caps, phasedown mechanisms, and periodic reviews to contain costs. For example, sunset incentives based on key goals and quantifiable indicators. Require public reporting on revenue forgone and outcomes (e.g. emissions reduced, private capital mobilized). Thoughtful design – like using accelerated depreciation or performance-based credits – can balance ambition with fiscal sustainability.

5. Implement sound evaluation frameworks, including both ex-ante assessments as well as ex-post evaluations. Their worthwhile goals notwithstanding, it is vital that tax incentives for industrial decarbonisation are value for money. The evaluation of tax incentives can be resource intensive and challenging, for instance, regarding the availability of the required data and skills. Design a comprehensive and realistic evaluation strategy allowing for marginal but constant improvements and, ultimately, enhancing evidence-based policy making in the field.

6. Promote inclusivity and address distributional aspects. Align tax incentives with inclusive outcomes by offering bonus rates for investments in disadvantaged regions or linking credits to workforce development. Make support accessible to SMEs through upfront rebates and minimize barriers to entry. To ensure public value, consider basic eligibility norms (e.g. transparency, anti-avoidance) and track beneficiaries to refine re-distribution.

7. In the long run, adapt incentives as technologies evolve. As industrial decarbonisation progresses, incentives should be regularly reassessed. Support may shift from today's priorities (e.g. carbon capture) to emerging areas (e.g. electrification or material substitution). Establishing expert panels to evaluate and adjust incentives can help keep policies aligned with technological and economic developments.

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