TRUE NORTH INSTITUTE

Energy Transition Investment Framework
(Second edition)

The role of carbon taxation in the global energy transition

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Charity think tank OpenMinds, international strategy consultants Bain & Company and Clean Air Task Force are among the valued sources of insight on the Energy Transition.

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Contents

What will be the role of carbon taxation in the global energy transition?

Executive summary

The cost of carbon abatement by any company over the next two decades is a key determinant of that company's value today. Approximately half of the global economy or half the public companies in the world will see the cost of carbon abatement having a material impact on their valuation. With companies in the energy, power, industrial and transport sectors, the cost of carbon abatement poses existential risk.

The cost of carbon abatement can come in different forms including investments in low emission processes or products, purchasing carbon offsets, or paying carbon taxes. Carbon taxes include fuel duties that have been in place for 100 years, fixed price carbon taxes and variable priced taxes via an energy trading system (ETS) or other mechanism. Import taxes are another form which is gaining momentum in what governments are referring to as CBAM (carbon border adjustment mechanism).

To what extent are carbon taxes in place today and to what extent should we expect expansion of their scope and changes in the rate of tax (price of carbon)? Europe launched their taxing regime in 2006 and today has the most extensive system of carbon taxation. The EU has a clear plan for expanding its scope to cover most corporate emissions and will leave buildings and transport emissions to be dealt with through legislation. It appears to us that it is unlikely that the European system or any comprehensive carbon tax regime will be adopted by other major emitting countries including the US and China in the next decade. China boasts the most comprehensive ETS scope, but its implementation today results in 0.2% of Europe's ETS' trading volume. Washington has just seen the first carbon tax bill proposed last December, but consensus by Washington followers is that the US is highly unlikely to ever tax carbon domestically.

Many experts suggest that Europe's CBAM, when implemented in 2026, may force other major exporters to the EU (e.g., the US and China) to adopt EU-like domestic carbon tax regimes, but only over the longer term. In the short term, some form of global CBAM-like program convergence is unlikely, particularly in major industrialised economies such as the US. Emerging economies will call foul with the WTO, calling CBAM protectionist. Finally, disparity in carbon prices will make any convergence ineffective.

Investors today will need to look at global businesses using valuation models with different taxation and CBAM assumptions for each region. Companies operating inside the EU need to anticipate incurring a cost of carbon in their imported raw materials. Europe's CBAM will initially cover imports of cement, iron and steel, aluminium, fertilisers, electricity, and hydrogen.

High level summary of key facts on carbon taxation

In our opinion, the global energy transition will "stall" unless there is a significant economic incentive for consumers and corporations to change behaviour, or if they are legally forced to change that behaviour. Both of these paths are, and will continue to be, pursued in combination. Governments have, and will continue to, mandate building regulations, fuel efficiency and composition, appliance efficiency, lighting technology and other measures aimed at reducing emissions. But it is our belief that economic incentives in the form of taxation and subsidies will be the dominant influence on behaviour. Without a comprehensive, global system of taxation, the energy transition will fail to meet the Paris targets. Our reference to "taxation" includes the use of subsidies (that are funded with tax dollars), purchases of offsets or carbon credits, and straightforward tax on emissions.

Today, carbon taxation covers a wide range of tax and trading schemes, which in their simplest form, set a price that companies must pay per tonne of greenhouse gases emitted. The World Bank estimates that only 23% of global carbon emissions are covered in some way by a carbon tax. This covers 75 different country or regional regimes. The International Monetary Fund estimates that carbon prices need to be above $75 per tonne of CO2, to achieve a 23% reduction in emissions by 2030; a price level that covers less than 5% of global emissions as of today. Worldwide, carbon taxes are raising over $100B a year in government revenues[1], a figure that is a fraction of what is required. The IMF's 23% target reduction implies 11.5B tonnes of CO2 reduction. If this required $75/tonne of taxes, this would amount to $862B in annual carbon taxes.

The European Union has the most mature and extensive carbon taxing regime in the world today and already have detailed plans in place to expand this system and we expect they will have the political will to follow these plans through. The EU has legislated a phased tax regime, by gradually eliminating "free allowances" granted to emitters, from 2026 to 2034, co-incident with the imposition of carbon taxes on imported products that have not been burdened with such taxes from outside the EU (carbon border adjustment mechanism or "CBAM"). Europe's tax of choice is their emissions trading scheme, currently covering 45% of Europe's emissions, while raising approximately €45B per year in revenues. The EU's flagship climate policy is the Fit for 55 strategy. Under this, Europe have committed to reducing their greenhouse gas emissions by 55% from 1990 levels by the end of 2030. Aiming for a 55% reduction in greenhouse gasses by 2030 seems feasible, given the progress the continent has made already. If Europe pushes beyond Fit for 55 goals, we may see the same headwinds we expect to see elsewhere, until the cost of abatement for the hardest to abate sectors comes down. It is unlikely we see wholesale carbon pricing on buildings and road use, as the burden of such taxes will fall predominantly on those least able to pay. The industries covered by this tax include, power, heavy industry, aviation, and maritime. The ETS has a carbon price of varying between €60 and €100 per tonne of CO2. The revenues raised are used for investment in new low-carbon technologies and to ameliorate the impact of carbon pricing on low-income countries.

It helps that Europe is a politically diverse region, with a voter base that tends to lean in favour of environmental issues. Consumers in Europe are already used to paying higher energy prices compared to regions like the US. This means the voter base is more likely to accept a limited amount of economic pain, to achieve the regions' climate goals.

The US has mostly foregone a national carbon tax in favour of subsidising carbon reduction technology. The Biden Administration's flagship climate policy, the Inflation Reduction Act (IRA), combines a number of tax breaks and direct subsidies to the tune of $394B. With a stated aim of reducing emission in the US by 40% by 2030, the Act seeks to spur private investment in clean technology, mostly focused on batteries, renewables, clean energy, and carbon sequestration. As of 2023, some $110B in new clean energy projects had been announced. There are two main regional carbon taxes; on the West Coast (California, Oregon, and Washington), and the Northeast (12 States). The California tax covers power, industrial, and transport sectors, accounting for 85% of California's total greenhouse emissions. However, a carbon price of $36 per tonne is less than half of the equivalent EU tax. The Northeast region tax covers power stations with a capacity of 25 Megawatts or greater across 12 states. The scheme only covers roughly 14% of the member states emissions and has a price of carbon allowances of only $15 per tonne of CO2.

There are modest signs of bipartisan support for a nation-wide carbon tax as evidenced from the Clean Competition Act (Democrat led) and the Market Choice Act (bipartisan), bills which were both proposed in

[1] World Bank – State and Trends of Carbon Pricing Report 2023

December of 2023. However, the US is fighting the EU's CBAM on the basis of "equivalency," arguing that its own measures (IRA and others) are of equivalent effect on carbon emissions. Only 1% of US exports to the EU will be covered by CBAM prior to 2030, mostly within the steel or aluminium sectors. Tariffs on steel are nothing new. The Biden administration only recently suspended heavy tariffs on European steel, originally imposed back in 2018. So, a US carbon tax is likely to be introduced, but it is likely to be focused on whatever most effectively limits the impact of the EU's CBAM.

China has adopted a similar approach to Europe, to tax carbon. China has the world's largest emissions trading scheme by emissions covered, but only covers the power sector. While this corresponds to 40% of China's total emissions, the price of carbon is a lowly $8 per tonne of CO2 and free allowances are provided to power companies thus avoiding any significant tax burden. $1.5B of carbon credits were traded on China's national ETS in 2021-22, in sharp contrast to Europe's $958B traded in 2022 alone. China's emissions policy is to achieve peak carbon emissions by 2030, and achieve net zero by 2060. The current five-year plan, that covers 2021-2025, has as one of its six main targets, the goal of reducing greenhouse gas emissions by 18% compared to 2020 levels, as well as increasing the share of non-fossil fuels by 25% by 2030. It also contains plans to increase forestry stock and phase down coal consumption. China does have six pilot programs, that aim to test the viability of introducing a more widespread ETS, several of which have been operational since 2013.

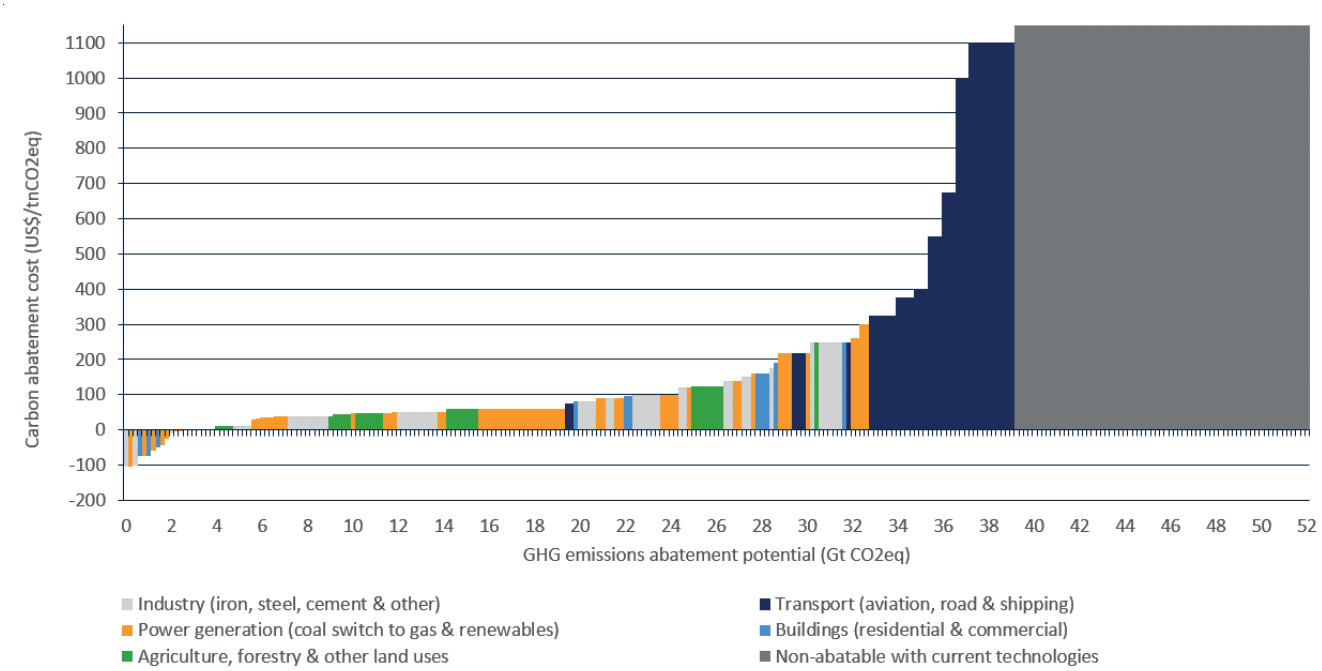
Taxation may be less important to motivating changes in corporate and consumer behaviour in China, given its one-party rule. In addition, the CCP needs to be seen as a leader on climate related issues for the sake of political stability, but this issue competes with the need to provide an improving living standard to the people. China tends to deliver on its five-year plans and does not set goals it cannot achieve. If the government say they will reduce emissions, they will probably be successful. How this is achieved though, is more likely through government regulation than market mechanisms.

A carbon cost-based framework for thinking about carbon taxation in the future (for investors and policy makers)

The way any policy maker should think about carbon taxation is around what tax is required to motivate companies or consumers to change behaviour in ways that sees lower emissions. Accordingly, carbon tax rates or prices should be closely aligned with the cost of carbon abatement. If I am an oil company with methane leaking from my gas pipeline and it costs $10/tonne (of CO2 equivalent in methane emissions) to abate those emissions, I just need to be taxed $11/tonne to be economically incentivised to invest in the new valves to stop the leaks. If I am a company operating a natural gas power plant, I can install carbon capture equipment to capture and store carbon emissions at approximately $100/tonne of carbon emitted. From a purely economic perspective, I need taxes or subsidies amounting to something higher than $100/tonne to have me making the right decision to invest in what is likely to be a $1B capital investment in CCS equipment.

The cost of carbon abatement, in all its forms, varies across the spectrum of easy to abate (e.g., cycling, turning your thermostat down), low-cost to abate (methane leakage, coal to gas power plant conversion), to hard to abate (steel and cement manufacturing), to non-abatable (wetlands decomposition, volcanic activity, wildfires). As shown in Exhibit 1, half of the total GHG emissions cost less than $100/tonne to abate, the rest costs more than $100/tonne and some simply cannot be abated at any cost.

Exhibit 1: Half of the total GHG emissions cost less than $100/tonne to abate, the rest costs more than $100/tonne and some simply cannot be abated at any cost



Source: Goldman Sachs

At $100 per tonne of CO2 equivalent emissions, the total cost comes to approximately $5 trillion per year (50 gigatonnes of CO2e emissions x $100/t). This represents 5% of global GDP and, corresponds with what many experts estimate is the annual investment required to achieve net zero emissions.

The $5T annual price tag shared by 8B people comes to $625 or $2125/household or an increase of up to $50/MWh on our electricity bills. Retail electricity prices today average $11/MWh around the world.

These are big numbers highlighting that the largest single barrier to the energy transition is household affordability. The costs will very likely be shared progressively, meaning the wealthy will bear the bulk of the cost from either higher taxes or from higher energy prices for their higher energy usage. That being said, the greatest uncertainty to the pace and extent of global decarbonisation will be the will of governments, corporations and households in the face of reduced wealth. In developing markets, this involves trade-offs between reducing either poverty levels or emissions. Given the bulk of emissions are concentrated in the developing economies today, the greatest challenge will be in poorer nations such as China, India, and Indonesia, where we expect government commitments to wane in the face of the massive economic burden.

Companies are at the centre of the transition and are highly unlikely to make decarbonisation investment decisions that destroy shareholder value unless they are mandated to do so. Carbon taxation seems to be the key that will make it value-accretive for management to make investments in lower carbon processes or products. But the “trickle-down” cost (energy and tax) implications for consumers will test the commitment of governments, corporations, and households to decarbonising. Expect fits and starts.

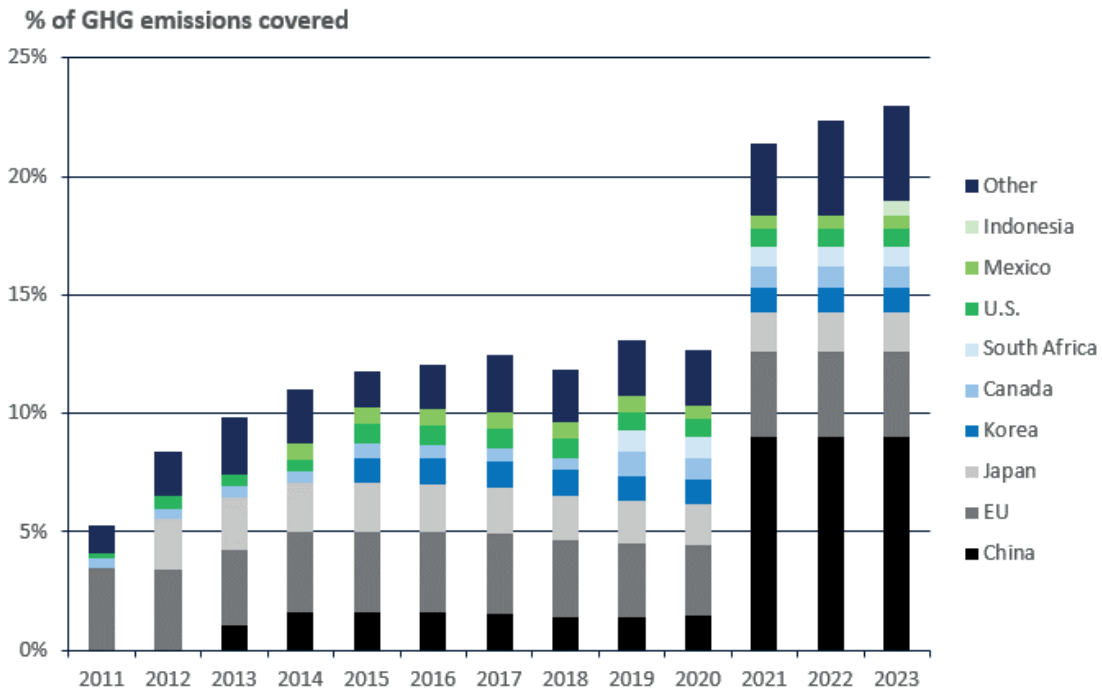
The investment implications of carbon taxation are obviously huge. Approximately half of the companies around the globe have a material value impact depending on the ultimate cost of their carbon abatement. That cost can come in the form of paying carbon taxes, investing in lower carbon processes or products, or shutting down carbon emitting parts of their businesses. In addition, the value of businesses that were built to be solutions to the energy transition (e.g., renewables, electric vehicles, storage batteries, electrolysers, CCUS, hydrogen, nuclear, bioenergy) will all have different prospects, margins, and values, depending on how carbon is effectively taxed.

1. What is the current state of carbon taxation in the major economies?

The World Bank estimates that only 23% of global carbon emissions are covered in some way by a carbon tax. This covers 75 different country or regional regimes. Secondly, not all carbon taxes are equal. While China has the largest carbon tax by emissions covered, it is a lightly regulated tax with a price of carbon equivalent to $9 per tonne of CO2. This compares to Europe that has a mandatory tax with a price in the region of $75 per tonne. Certain countries such as New Zealand and South Korea have gone the furthest in terms of sectors covered, but these countries are also producing only a fraction of total global emissions (0.2% and 1.7% of world emissions respectively).

China, the US, and Europe represent some 55% of all global emissions and nearly 60% of global GDP. What choices these regions make will ultimately determine the speed of the energy transition. As such, the remainder of this reports focuses on their actions around carbon taxes although it should be acknowledged that countries like Brazil and India have a large role to play as well.

Exhibit 2: 23% of Global GHG emissions are covered by carbon taxation as of 2023 (or 14% ignoring China's system at ~$8/tonne)



Source: https://carbonpricingdashboard.worldbank.org/map_data

Note: Other represents 64 regional and national carbon tax schemes that each account for less than 0.5% of global carbon emissions.

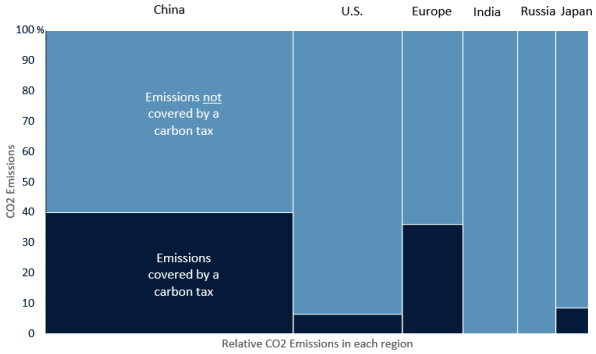


Exhibit 3: Of the six largest emitters of CO2, only China and Europe have a significant proportion of their emissions covered by a carbon tax (see comments below on China's very low price of Carbon)

Source: World Bank

Exhibit 4: The majority of carbon taxes cover power and industry sectors. Only a few countries, like New Zealand, have expanded the scope to include a sectors like forestry, waste, and buildings

	China	U.S.	CA, WA, OR	RGGI	EU	Japan	Germany	South Korea	Canada	Mexico	UK	Switzerland	New Zealand
Emissions of CO2 (Mtonne) Released Per Year	12,466	4,752	430	140	2,775	1,085	666	627	564	418	335	35	33
Power													
Industry													
Buildings													
Transport													
Aviation													
Waste													
Forestry													

Source: International Carbon Action Partnership – Emissions Trading in Practice Second Edition, 2021, RGGI Org, California Air Resources Board

Note: CA, WA, OR is shorthand for California, Washington, and Oregon states. RGGI is the Regional Greenhouse Gas Initiative that covers 12 U.S. states.

A brief taxonomy of carbon taxes

Carbon taxes come in three main forms: fuel duties, fixed price emissions tax and market priced emissions tax.

Fuel duties are a fixed price tax based on the volume of fuel consumed. They have an indirect influence on carbon emissions by increasing the cost of some fuels over cleaner alternatives. They primarily affect the transportation sector by taxing road users for every mile they drive.

A fixed rate emission tax is set by governments and is applied to emitters of CO2 uniformly to all covered entities. For example, Sweden applies a fixed rate of SEK1330 (€122) per tonne of CO2, France €65, and Canada CAD$50. They are typically levied on high-emission sectors covering things like fossil fuels usage. Fixed rate emissions taxes have a higher degree of certainty than alternatives because tax rates stay the same unless changed through policy decisions. Effectively, governments set the price of carbon dioxide and companies are left to determine the quantity of emissions to reduce.

While fixed taxes offer consistency of pricing, they are not market determined and as such may be limited in their effectiveness. If reducing emissions is the key to meeting global temperature targets, then not specifically focusing on emissions levels may result in missing those targets.

Market priced taxes on emissions work through emissions trading systems (ETS) which set the price. ETS's are established and run by government (at the regional level (e.g., EU), national level (e.g., China, Japan) or the state or province level (e.g., California).

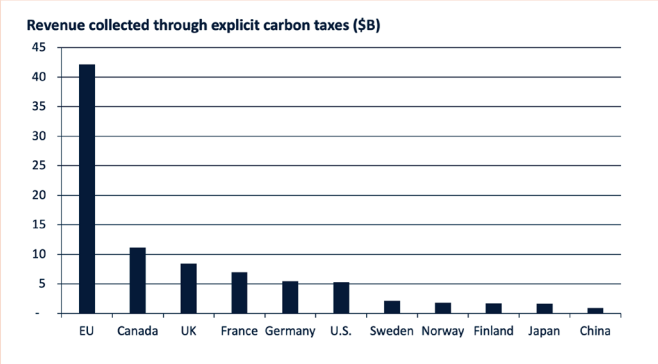
Under what is called a "cap and trade system," regulators set emissions cap each year for companies whose emissions fall within the scope of the scheme. The scheme may cover all sectors or apply a cap that covers individual sectors. Typically, they cover those sectors with the largest carbon footprint, such as the energy sectors and energy-intensive industries (such as the production of iron, aluminium, cement, glass, cardboard, acids, etc.). The cap on these emissions is expected to be reduced over time, often by a set rate each year. If the company emits less than the cap in a given year, it earns "allowances" or owns credits it can sell. If it emits more than the cap, the company must buy credits from the companies holding such allowances or, if permitted under the scheme, purchase carbon offsets. The credits are traded at a market-determined price per tonne of carbon emitted.

The supply of credits is a by-product of just two inputs, the caps set by regulators and the emission levels of the regulated entities. If the cap is set too high, there is a surplus of credits generated with too few buyers, and prices are too low. If the cap is set too low relative to what companies can practically achieve within their emissions reduction programs, then there is excess demand and prices will rise substantially.

The ETS can be mandatory like in Europe, or voluntary like in Japan. In a mandatory ETS, companies must own sufficient allowances to offset all their emissions above the cap, otherwise they are subject to heavy fines. Allowances have expiry dates, forcing companies to either surrender them or sell them. In this way, those affected companies can forecast the impact on their businesses over time.

According to the World Bank, there are now 73 carbon tax schemes across the world, covering 23% of global emissions, operating in over 35 countries, with the largest found in Europe, the US (state level), the UK, Canada, China, Japan, and South Korea. The primary method by which revenue is raised in the EU ETS is through the auctioning of emission allowances. A significant proportion of the allowances is auctioned off to companies rather than being allocated for free. The auctioning process is managed by member states, and the revenue generated from these auctions flows back to the governments of the member states. The World Bank estimates that carbon taxes and emissions-trading schemes raised $100bn for governments in 2023 (ignoring fuel duties).

Exhibit 5: While China has the largest carbon tax by covered emissions, the total revenues raised by its main and pilot programs is still small in comparison to Europe.



Source: World Bank (2022)

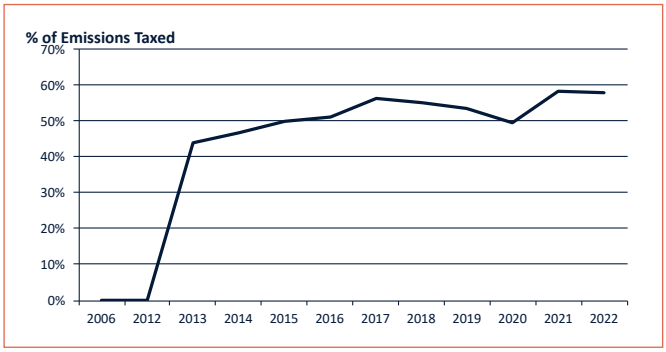
Note: China's ETS market turned over $1.5Bn in the first two years of launch, as such we have assumed it is raising approximately $750M per year. US revenue is from the California cap-and-trade scheme and the RGGI regional scheme.

The state of carbon taxation in Europe

The European Union has taken the lead on carbon taxes and implemented the world's most widespread plan as part of the EU Emissions Trading System (ETS) and Corporate Sustainability Reporting Directive, described in our climate corporate reporting chapter. The power and heavy industry sectors have been taxed since 2006 and aviation started in 2012. Today, the system covers more than 10,000 power plants and factories in the 27 EU member states plus Iceland, Liechtenstein, and Norway, encompassing around 40% of the EU's total greenhouse gas emissions[2] and raising approximately €45B per year in revenues. The industries covered by this tax today include, power, heavy industry, aviation, and maritime. It does not cover buildings and road transport emissions. The ETS has a carbon price of roughly $75 per tonne of CO2.

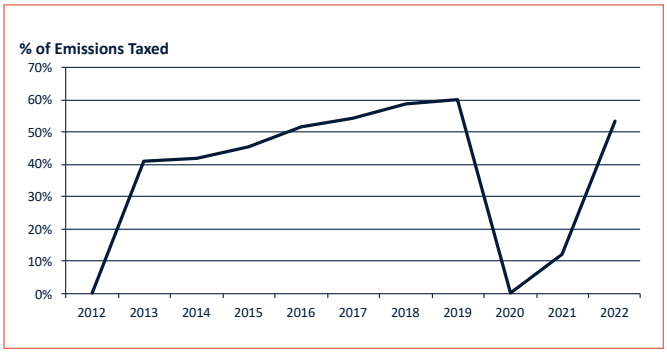
While 40% of emissions are theoretically "covered" by the EU system, to ease this system into the EU economy, tax exemptions in the form of "free allowances" or free credits have been allocated as part of the cap-and-trade system applied to all taxed sectors. In Exhibit 6, you can see that from 2006 to 2012, virtually all emissions for the power and heavy industry sectors were untaxed as free allowances were issued sufficient to cover all emissions. Free allowances were cut in half in the period since 2012, such that today nearly 60% of all emissions are taxed.

Exhibit 6: Power stations and heavy industry were the earliest sectors to be exposed to the EU cap-and-trade system, with free allowances being phased down resulting in the % of taxed emissions rising form 0% in 2006 to nearly 60% by 2022.



Source: European Environmental Agency

Exhibit 7: The Aviation industry has a different emissions cap to power and heavy industry. Like those sectors, there have been free allowances covering approximately 50% of EU aviation emissions.



Source: European Environmental Agency.

Note: % taxed dropped to zero in 2020 as the impact of covid on global flight volume reduced emissions below the free allowance allocation.

Since 2013, the EU has generated around €152B in tax revenue from its ETS. The amount of revenue generated increases every year as the proportion of free allowances falls and the price of carbon increases. In 2021 the ETS raised €31B, increasing to €40B in 2022. 80% of the revenues generated go directly back to member states. Each country then has discretion over how these funds are used, except that 50% is required to be spent on climate or energy related projects. This could include investment in new technologies, supporting vulnerable communities, or funding renewable energy projects. The remaining 20% (€8B in 2022) is held back by the EU and allocated to two climate action funds.

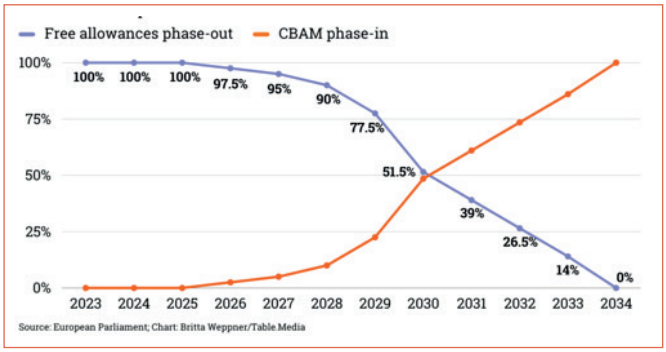
The first, called the Innovation Fund, aims to support the development of low-carbon technologies such as hydrogen fuels, renewable energy, and carbon capture. For example, the Innovation Fund invested in a green hydrogen project in the Netherlands, where hydrogen is produced using power supplied by offshore wind electricity. The Innovation fund is expected to raise €40Bn over the next 10 years based on an endowed allotment of carbon allowances. The fund awards grants to private companies based on the degree of innovation on offer, the expected effectiveness at reducing emissions, the scalability, and the cost efficiency. To date, the fund has made over 100 individual grants to

[2] EU Commission - https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_

companies across the EU. The second recipient of EU ETS revenue is the Modernisation Fund which aims to support low-income countries that are disproportionately affected by carbon prices.

In July of 2021, the future of carbon taxation in EU was clarified in the form of new legislation entitled "Fit for 55." These new policies clarified the timing of free allowance removal and introduced a border tax on carbon laden imported products. This is an ambitious set of policies aimed at reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. Shipping and aviation free allowances will be reduced to zero by 2026, while for other industries, the free allowances will be phased out by 2034. This will significantly increase the burden of carbon prices on those affected industries. More challenging is the possible introduction of carbon taxes on the building and road transport sectors in 2027. These are considered politically sensitive sectors because of the potential direct impact to consumers.

Exhibit 8: The issuance of free allowances under Europe's Fit for 55 policy will be phased out by 2034, meaning affected sectors will have to cover all their emissions with purchased allowances. At the same time, the EU CBAM comes into effect, rising to 100% of covered sector imports by 2034.



Source: European Parliament, Chart: Britta Weppner/Table Media

As part of the Fit for 55 policy, the EU also announced the implementation of the Carbon Border Adjustment Mechanism (CBAM), which came into force at the end of 2023. CBAM is a border tariff, which charges a carbon tax on imports from nations where business practices involve high carbon emissions and have no domestic carbon taxation equivalent to what is in place in the EU. The price of the CBAM carbon allowance will be linked to the weekly average price of carbon within the European Union ETS system, thus making the tax a comparable burden for outside companies to bear. This mechanism aims to equalise the impact of carbon emissions for domestic and international companies, thus making carbon leakage, a less likely prospect. Carbon leakage refers to the offshoring of carbon intensive production to jurisdictions that either have a lower carbon tax or none at all. The result of carbon leakage is that while emissions fall in one region, they increase in another. At its peak, CBAM is expected to tax over half of the emissions currently covered in EU taxed sectors[3].

The initial scope of CBAM is limited to embedded emissions in electricity and basic materials including hydrogen, cement, iron and steel, aluminium, and fertilisers. By 2030, CBAM will cover oil refining, all metals, pulp and paper, aviation, and shipping (see Exhibit 9). The EU are currently assessing whether to extend CBAM coverage to organic chemicals and polymers, to indirect emissions and to more downstream finished products.

Exhibit 9: Europe's CBAM will reach full implementation by 2034, at which point a wide range of sectors will be covered.

Source: Wood Mackenzie

CBAM is not without its critics. Notably, countries such as Brazil, Russia, India, and China have been vociferous in their condemnation of it[4]. In their view, CBAM is a trade barrier and as such it is discriminatory to those countries that are less economically advanced. Whilst an official complaint has yet to be made to the World Trade Organization (WTO), CBAM was a topic covered at last year's COP28 meeting. While no official declaration on CBAM was made, Brazil led the way in expressing serious concern over the impact of such taxes on developing economies.

[3] European Commission, https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

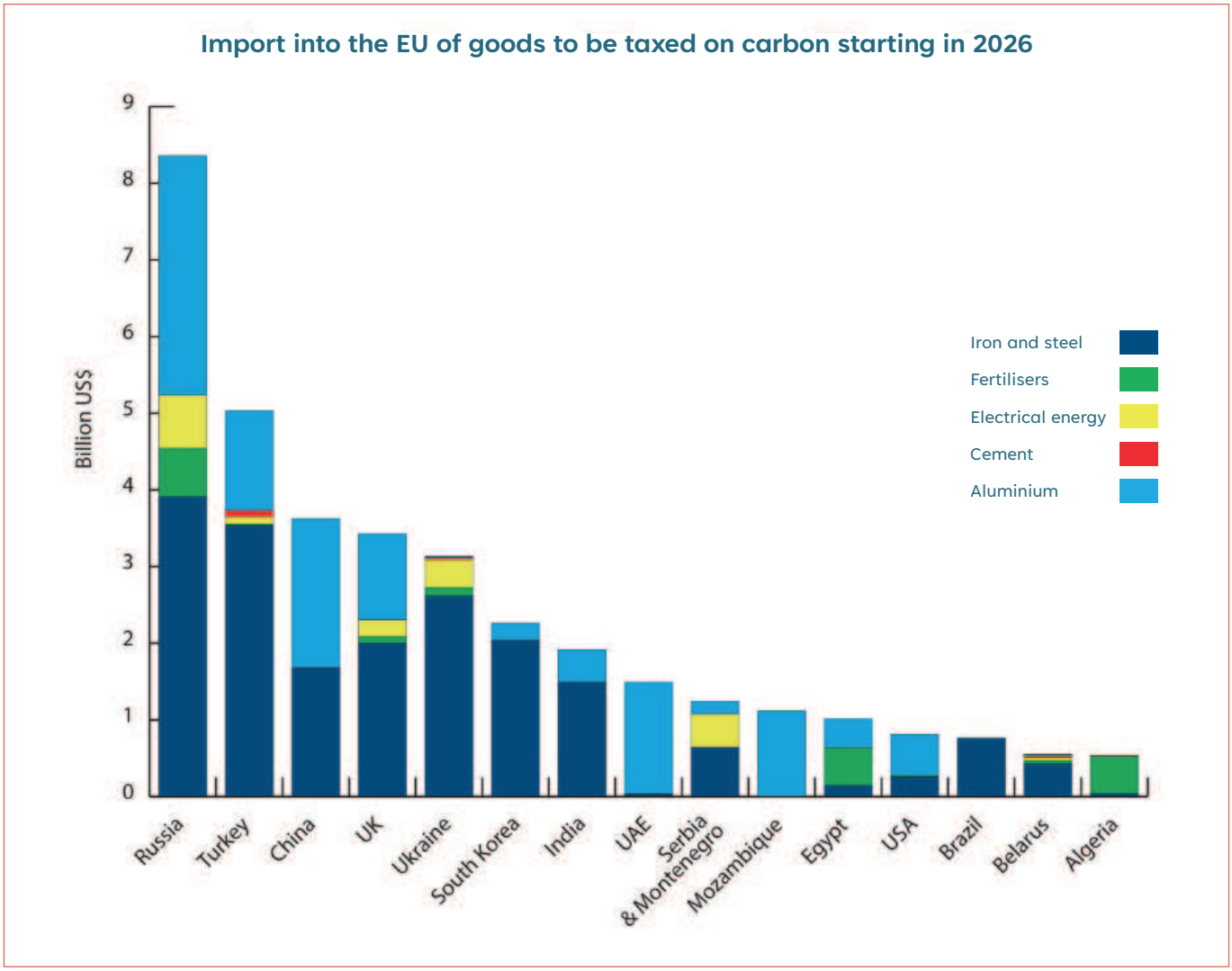
[4] https://www.ft.com/content/de7d12e2-0d04-43d4-b38c-cf795854a4a2

The success or failure of arguments against CBAM hinge on whether the WTO sees CBAM as a tax on trade or a tax on carbon. If the WTO is convinced CBAM's primary purpose is to generate revenue and protect EU businesses, i.e. it is a tax on trade, they may rule against it. Alternatively, if the WTO understand CBAM as primarily a tool to reduce emissions they may choose to waive judgment. For their part, the EU is adamant that CBAM complies with WTO rules as it is not technically an import tax and the uses of any revenues raised go directly towards carbon reduction programmes. Either way, the WTO objection process takes on average 12-15 months for relatively straightforward trade disputes. Something of the nature of CBAM, with all its complexities and political sensitivity could take years to process.

That Russia has condemned CBAM is not difficult to understand. Russia has by far the most to lose as it is the country with the largest quantity of imports due to be impacted by CBAM.

It is difficult to say how China will be impacted by Europe's adoption of CBAM. While China has been vocal in its opposition, only 2% of China's trade with Europe will be directly affected as seen in Exhibit 10[5]. Up to 18% of exports to the EU, however, may be indirectly affected as inputs to exported products are covered by CBAM, or are exported products which may be covered by future CBAM scope. The percentages are more meaningful on certain products. For example, 9% of China's aluminium exports, and 8% of China's iron and steel exports go, to the EU.

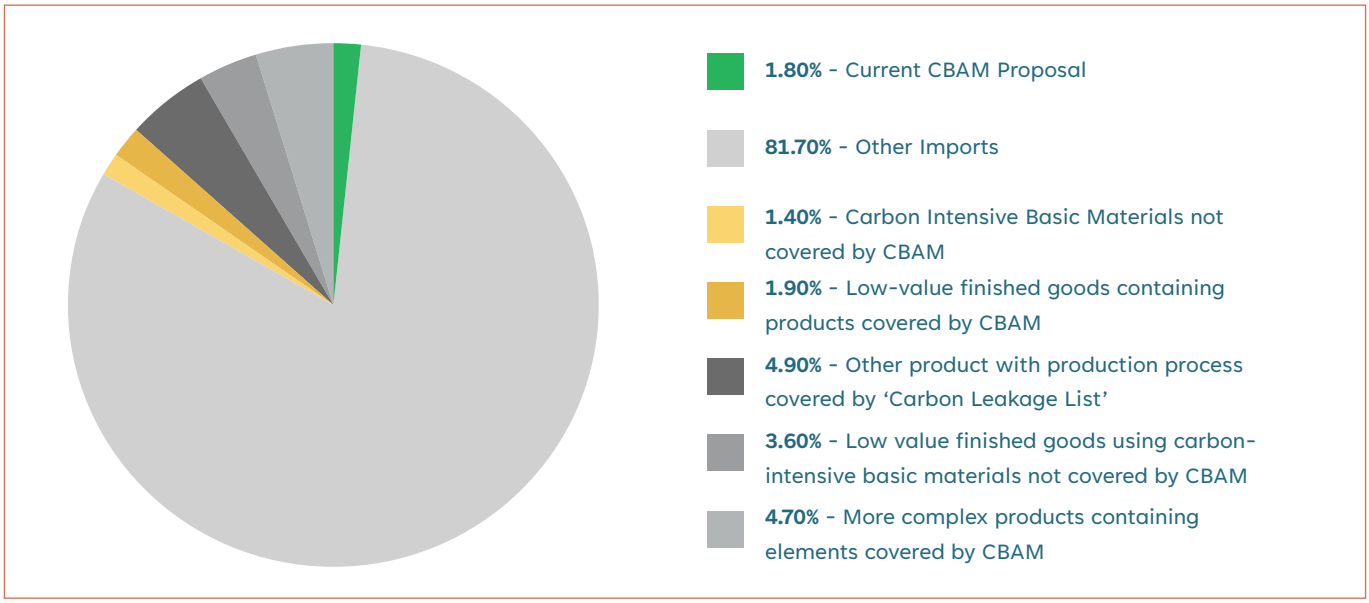
Exhibit 10: Russia is the country most impacted by proposed CBAM regulation, with over $8Bn of EU import goods exposed to carbon taxes in the future.



Source: Centre for European Reform

[5] Source: Energy Innovation Policy & Technology, LLC - China and the European Union's Carbon Border Adjustment Mechanism, 2022

Exhibit 11: CBAM covered goods make up only 1.8% of China's total EU exports, but 18% of China exports to the EU have some potential to be exposed to indirect carbon taxes (inputs covered by CBAM) or the future scope of CBAM



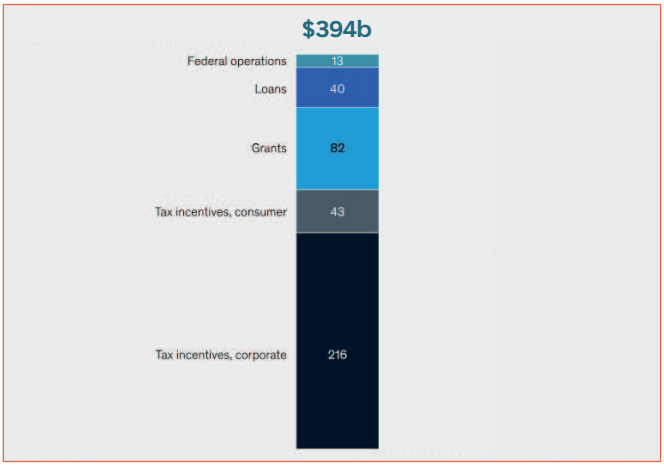
Source: Energy Innovation Policy & Technology, LLC - China and the European Union's Carbon Border Adjustment Mechanism, 2022

The state of carbon taxation in the US

There is no national carbon tax in the US, but 13 of the 50 states have their own ETS-based carbon taxation systems. Washington has largely foregone the carbon tax route in favour of subsidising carbon reduction technology. The Biden Administration's flagship climate policy, the Inflation Reduction Act (IRA), combines a number of tax breaks and direct subsidies to the tune of $394B spent over approximately 10 years. The implied $40B per year represents 0.67% of the $6 trillion annual government budget at present.

With a stated aim of reducing emission in the US by 40% by 2030, the Act seeks to spur private investment in clean technology, with a focus on batteries, renewable energy, clean fuels, and carbon extraction. As of 2023, some $110B in new clean energy projects had been announced. There is little joined-up thinking from state and national legislators. Several regional carbon pricing schemes exist, notably the 12 Northeastern states that are part of the Regional Greenhouse Gas Initiative (RGGI) and the California Cap-And-Trade scheme. Both schemes primarily cover utilities providers. The price of carbon used in each tax varies widely across these two schemes, with typical prices around $13 per tonne of CO2 in the RGGI, and up to $80 per tonne in the California scheme. While California's tax covers some 85% of the States emissions, the RGGI only covers approximately 14% of the 12 states' emissions.

Exhibit 12: Energy and climate change funding in the US Inflation Reduction Act ($B) (to be spent over approximately 10 years)



Note: This exhibit reflects analysis of the appropriation figures contained in the Inflation Reduction Act, as well as those reported by the Congressional Budget Office and Joint Committee on Taxation. This analysis may differ from other analysis due to difference in methodology.

Source: Inflation Reduction Act of 2022, H.R. 5376 177th Cong (2021-22)

At the national level, the political situation makes the legislative process very challenging for a comprehensive carbon tax to be imposed like Europe's. The Biden administration has attempted to address this with the IRA. Tax incentives for corporations and consumers

make up the majority of the IRA funding, with nearly $220 billion available to corporations and almost $50 billion available to consumers. For corporations, most incentives are direct pay, allowing entities to claim the full amount, even if their tax liability is less than the credit amount. On the individual consumer level, the IRA incentivises the purchase of EV's, rooftop solar, and energy efficient appliances.

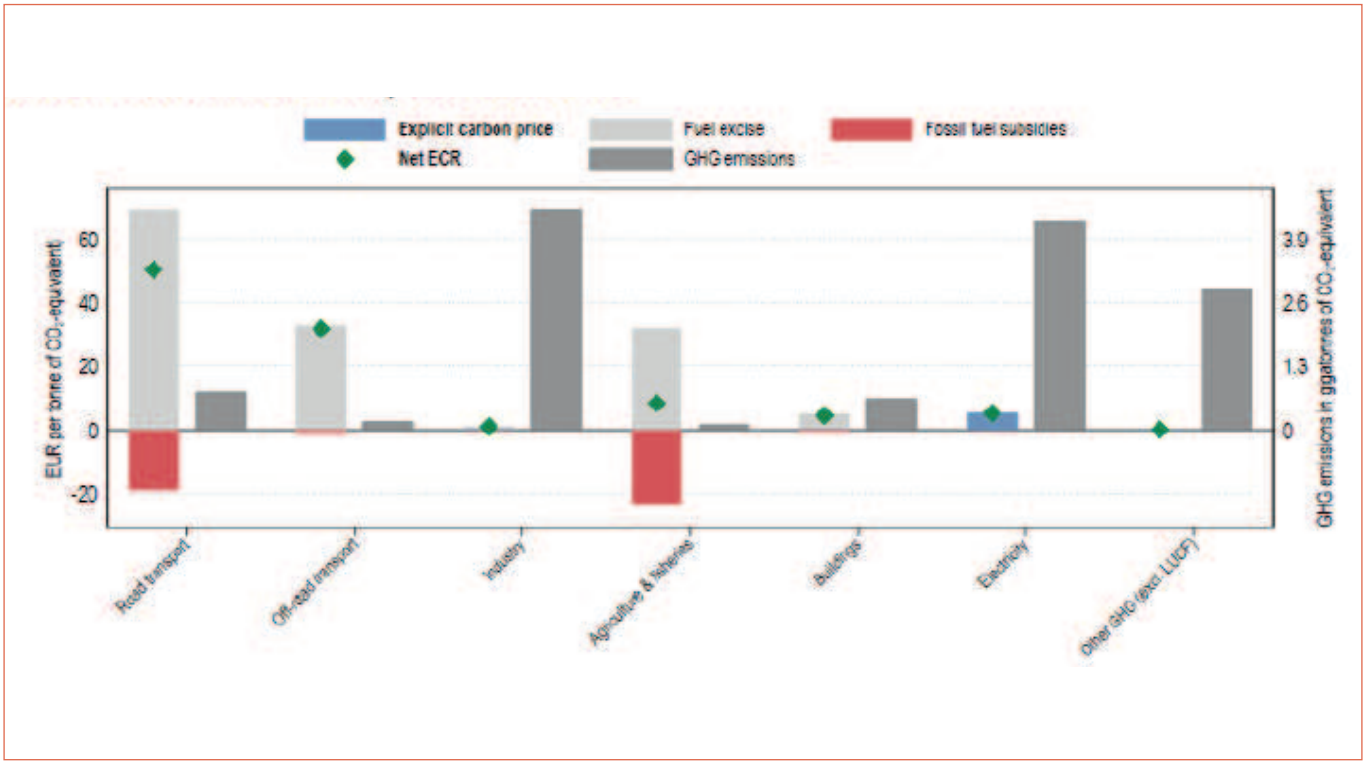
All that said, discussions on US carbon tax are taking place. In 2023 alone there were four carbon and trade related bipartisan bills, that made their way through congress. While the focus of these were all on foreign trade, carbon taxation is at least being discussed to some extent in Washington.

The state of carbon taxation in China

China has the world's largest carbon taxation system measured by volume of emissions covered but is largely "green washing" at this stage. An ETS covering 4 billion tonnes of carbon, entirely from the electricity generation sector which represents 40% of China's emissions, might be considered a tremendous accomplishment. However, the price of carbon on China's ETS is only $9 per tonne, far lower than Europe's roughly $75 per tonne of CO2, and almost all emissions are covered by free allowances. This limits any potential impact it might have.

Unlike other cap-and-trade schemes, China's ETS does not set a fixed cap on CO2 emissions. Instead, each site receives a free allowance for CO2 emissions based on its output and emission intensity benchmarks, which are measured in terms of emissions per unit of output and vary across different types and sizes of units. As of 16 July 2023, two years after its official launch, the cumulative turnover of China's ETS hit 11B CNY ($1.5B) and the cumulative volume of carbon emission allowances traded had reached 240M tonnes. This cumulative 2-years of tonnage traded is just 2% of the EU ETS' volume of 12.5B tonnes traded in 2022 alone. China's two years of ETS' turnover of $1.5B amounts to nearly 0.16% of the EU's $958B in 2022. We estimate that China is raising less than $1B of tax revenue through the ETS schemes, due to the majority of auction allowances being free allowances.

Exhibit 13: Average effective carbon prices (left axis) compared to GHG (right axis) by sector in 2021, show that the largest emitting sectors are taxed the least



Source: OECD – Pricing Greenhouse Gas Emissions - 2022

Interestingly, the launch of China's ETS came with their own CBAM. Importers in China are obligated to report emissions from October 2023 and to pay for them starting in 2026.

In Exhibit 13, you can see that the carbon tax rates net of subsidies (Net Effective Carbon rate - Net ECR) are all positive with the highest rates driven mostly from fuel excise taxes resulting in road transport taxes of €50 per tonne of C02 and off-road transport at €30 per tonne. Agriculture and buildings are also exposed to fuel taxes, with a minimal net effective carbon tax. Industry is also largely untaxed. There is an explicit carbon price of €8 per tonne for the power industry. So, while the coverage is notionally broad, carbon taxation beyond fuel taxes is minimal at present.

China is running several provincial carbon tax pilot schemes that cover the steel and cement sectors. These cover eight provinces, accounting for some 40% of China's cement and 20% of China's steel manufacturing. Details about the ultimate scope of these pilot schemes is not publicly available, so we do not know the price of carbon being used for these taxes or if free allowance are used.

That said, the two schemes could cover as much as 1B tonnes of CO2. The Chinese government have plans to expand these pilot schemes nationwide, but when this happens, and whether the system is designed in a more effective way than the current scheme, remains to be seen.

The state of carbon taxation in the rest of the world

Many other countries have either implemented or have plans to implement a carbon tax. Japan has two regional ETS and has a 10-year plan to introduce both a nationwide ETS and a tax on importers of fossil fuels. Japan's national ETS kicked off in 2023 as voluntary and will reach full scale mandatory deployment in 2026. India introduced a voluntary carbon credit trading scheme in 2023 which will not become mandatory until sometime after 2026 when it will be taxing high-carbon export industries in response to the EU CBAM. Indonesia is introducing a mix of fixed rate taxes and market priced schemes, in what they are calling "cap-and-trade-and-tax". Of course, without knowing the likely carbon tax rate or price, it is impossible to know what changes these tax regimes will motivate companies and consumers to make.

New Zealand has one of the most comprehensive carbon tax regimes, with taxes that cover power, industry, buildings, transport, and agriculture. Given the breadth of industries covered, other countries may be watching New Zealand closely, to assess the impact both on emissions but also the overall economy from such measures.

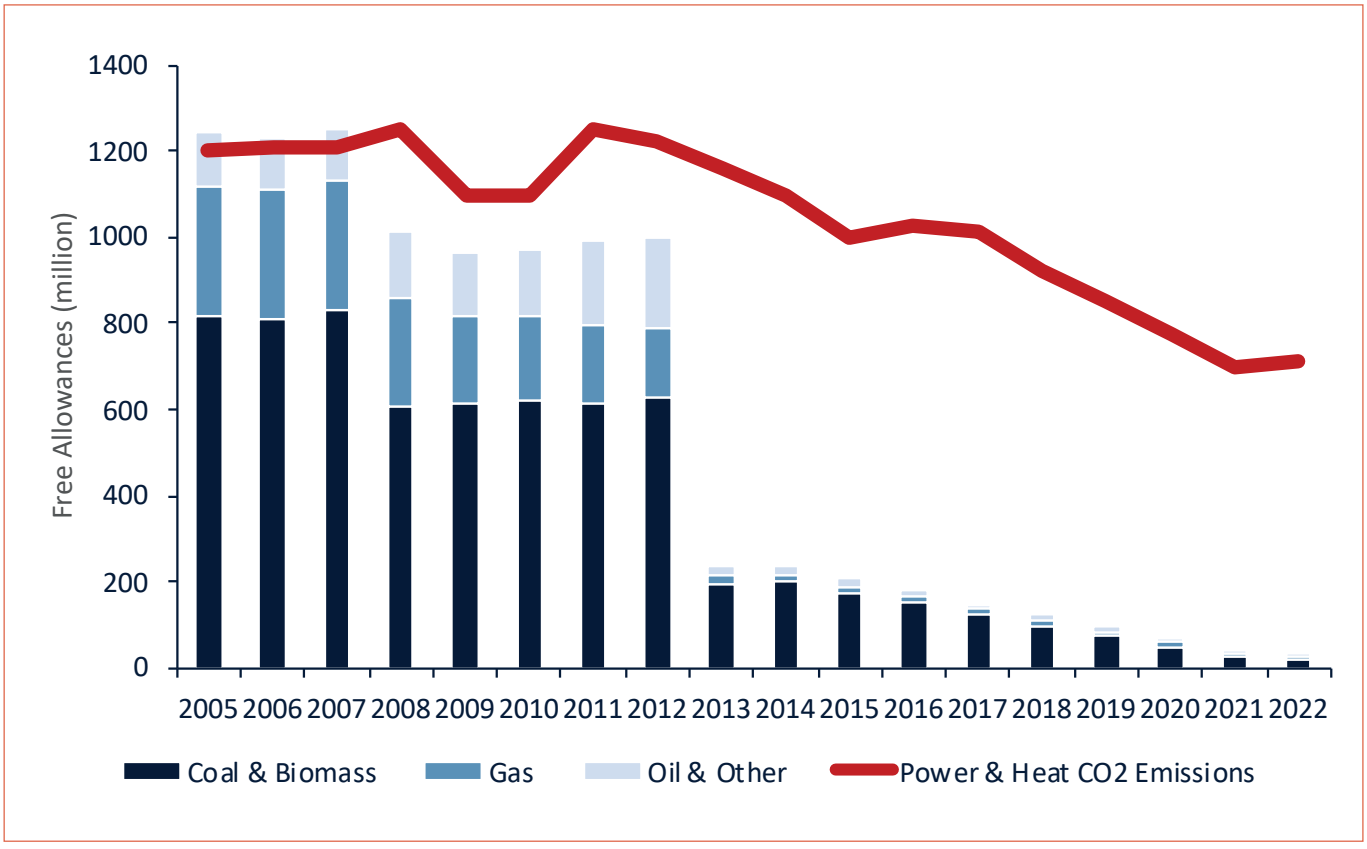
2. What impact can carbon taxes have on the energy transition?

The impact of carbon taxes could be transformational in effecting an accelerated pace of change to a low-carbon economy if companies are provided sufficient incentive to invest in lower carbon processes or product. Carbon taxes influence company behaviour as the cost of carbon becomes embedded into the profit and loss statements of affected companies. For example, under IFRS (International Financial Reporting Standards), the purchase of carbon allowances is recognised as an operating expense within cost of goods sold. This forces emitters to reflect the true cost of the goods they produce. The impact of this can then be directly assessed by investors in their valuations of these companies. If we assume that companies are focused on maximising shareholder value, carbon taxes should directly incentivise companies to decarbonise if the tax on carbon emissions is high enough to ensure the investment in low-carbon technology is accretive to shareholders.

The effectiveness of carbon taxes in reducing emissions is difficult to measure. Governments have taken a cautious approach by introducing carbon taxes slowly so as not to damage economic growth and to limit the impact on consumers by rising prices. This can be seen in EU ETS market as we discussed above, where the government issues free allowances to companies that can cover roughly 50% of emissions in some cases[6]. These free allowances minimise the effect of carbon taxes on the profitability of companies, thus delaying their need to invest in low-carbon technologies.

The longest standing carbon tax has been applied to the EU power sector which effectively only commenced in 2012 when free allowances were cut dramatically (Exhibit 14).

Exhibit 14: European power and heat emissions have dropped by a third since free allowances were reduced in 2012



Source: Berenberg Carbon Outlook Report, 2023

[6] EU Commission - https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/free-allocation_en

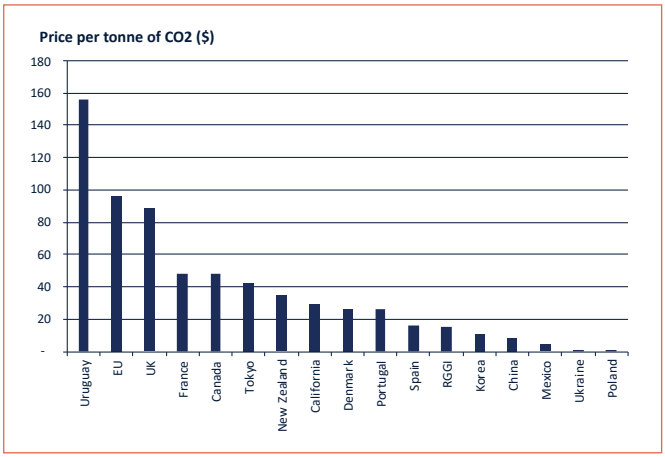
The effectiveness of any carbon tax system will obviously be tied to the tax rate or the carbon price that must be paid. In Exhibit 15, we show the recent history of EU carbon prices which have risen from very low levels to €20 per tonne during Covid, rising to €100 per tonne before the recent economic contraction in Europe, which decreased demand for carbon credits.

Exhibit 15: EU ETS carbon prices have increased from €30/t to nearly €100/t in 2022, having fallen to €60/t

Source: Bloomberg

Globally there is a wide range of carbon prices. From Uruguay, with a price near $160 per tonne of CO2 to Poland with a price of less than $1 per tonne of CO2 (Exhibit 16).

Exhibit 16: Carbon prices vary widely across the globe, showing that they are tightly controlled by the regulators of each region

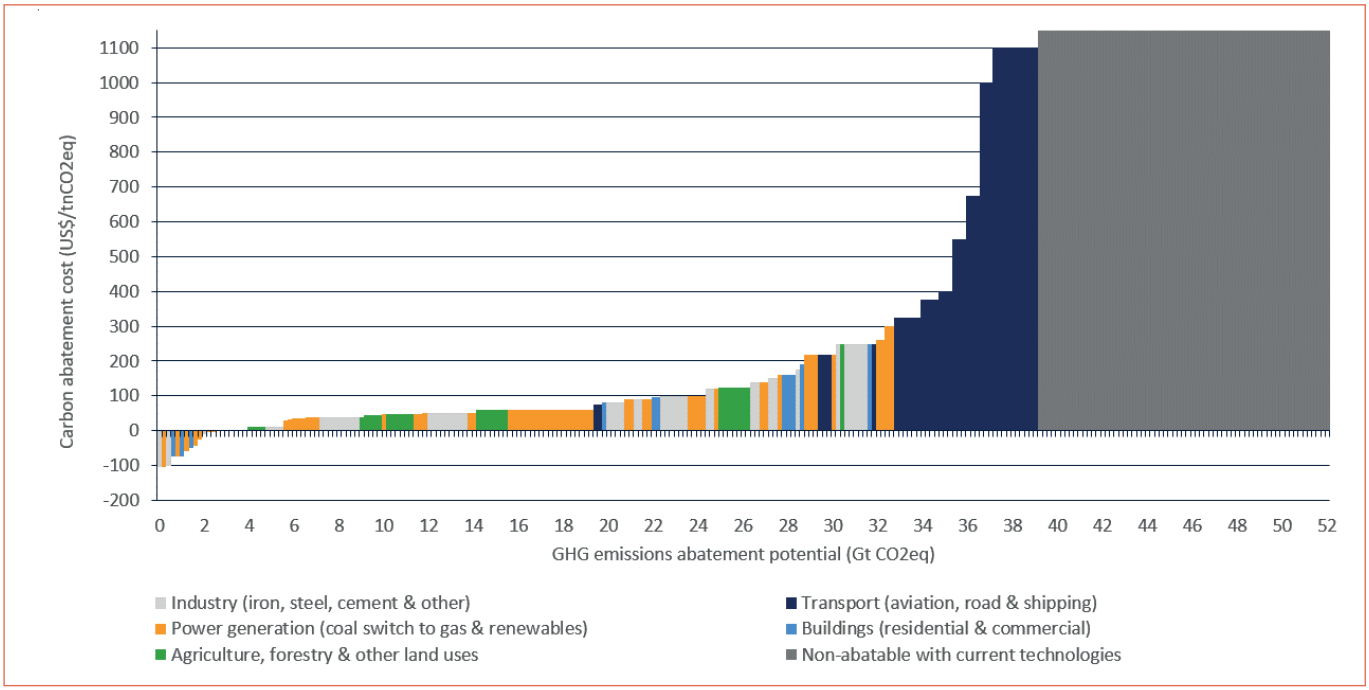


Source: World Bank, 2023

The optimal price of carbon should theoretically be the rate that motivates corporations to invest in lower carbon processes or products and the price or tax that motivates consumers to use less fossil fuel in transport, heating, and other uses. On this basis, carbon prices should vary widely from country to country and from sector to sector.

Exhibits 17 and 18 show the estimated cost of carbon abated across different industrial and consumer activities, from converting gas plants to wind and solar which is relatively inexpensive, to converting transport to clean fuels which is much more expensive, especially in shipping and aviation. If Goldman Sach's analysis here is correct, this suggests that half of the total GHG emissions cost less than $100/t to abate and the rest costs more than $100/t. In other words, taxes, or carbon prices below $100/t should motivate industry and consumers to shed over half of the world's emissions. The next 50% is the tough part.

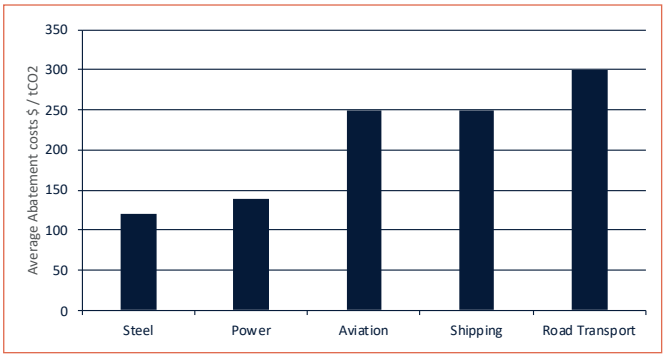
Exhibit 17: Half of the total GHG emissions cost less than $100/tonne to abate, the rest costs more than $100/tonne and some simply cannot be abated at any cost.



Source: Goldman Sachs

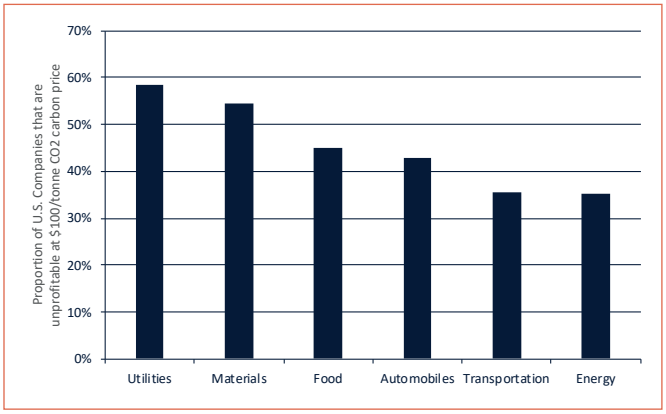
While there is a powerful case for a single global price, practically, we don't see this likely in the next decade. Establishing a global carbon price would require unprecedented levels of international cooperation. A single global carbon price would provide a clear economic signal to all market participants about the cost of emitting carbon, thereby incentivising reductions in carbon emissions uniformly across the globe. This incentivises reductions to occur wherever it is cheapest to do so. A global price would also provide a straightforward, transparent framework that could reduce administrative burdens and lower compliance costs for businesses operating internationally.

Exhibit 18: The cost of carbon abatement per tonne is most significant in the materials, energy, and transport sectors



Source: Goldman Sachs Carbonomics 2023

Exhibit 19: A $100 price of carbon makes the majority of companies across many affected industries unprofitable



Source: Compustat, Oxford University, Bloomberg, Responsible Investor – based on analysis of 3,000 US companies

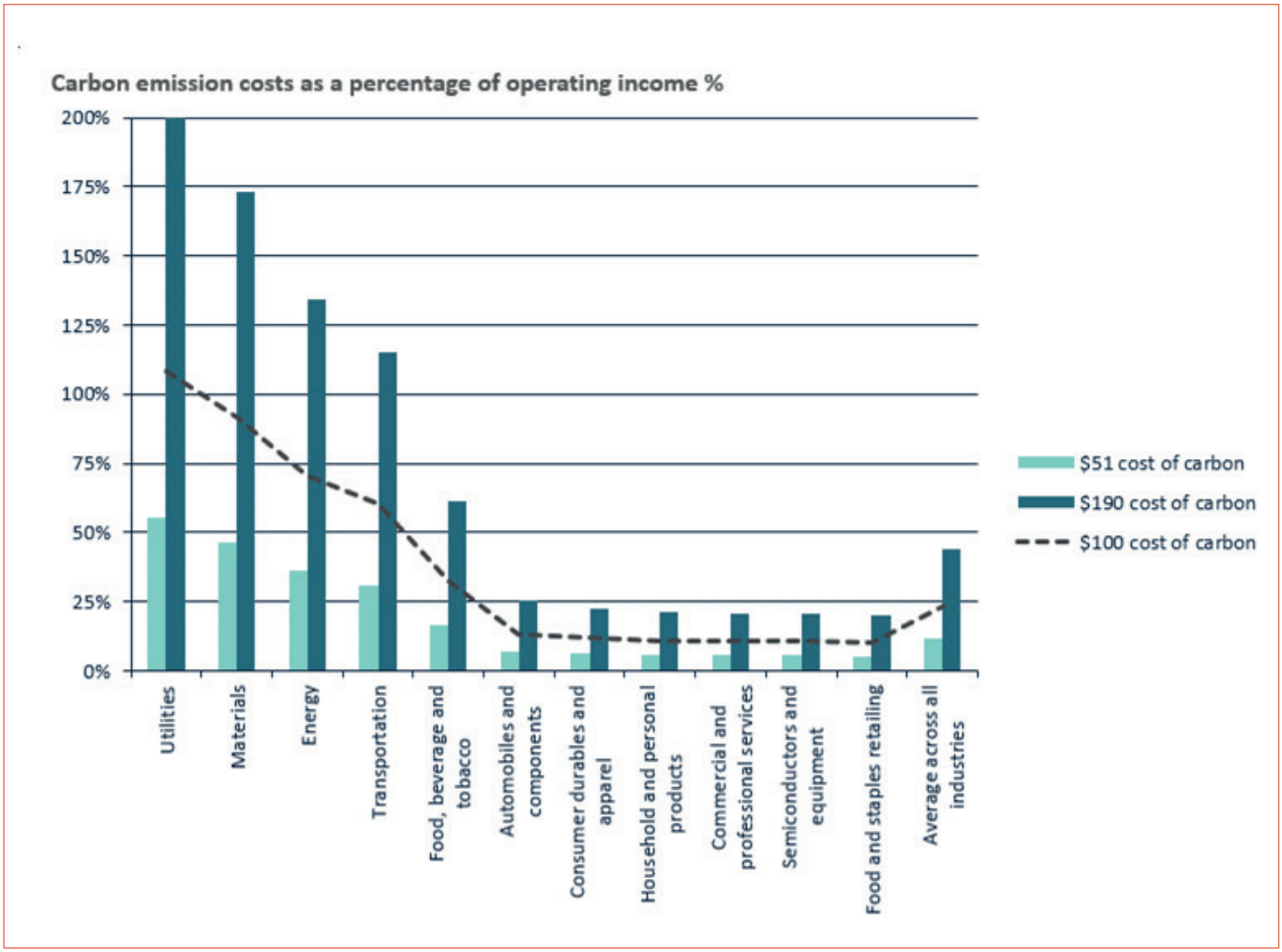
Today, most countries utilising carbon taxes, have carbon prices that are significantly below the cost of abatement for many technologies. While this situation continues there is little economic incentive for companies to reduce their emissions. This is evidenced in a recent study of the impact on emissions from carbon taxes. A meta-analysis from 2021[7], found that 37 studies have attempted to answer the question of

[7] Does carbon pricing reduce emissions? A review of ex-post analyses Jessica F Green 2021 Environ. Res. Lett. 16 043004

effectiveness, with the average impact on emission in the range of 0% to 2% per year. This is evidence that the price of carbon is still too low to incentivise most companies to act. The situation is similar for consumer motivation but varies significantly by country. In many countries, economics favour the move to electric vehicles and the installation of rooftop solar power. Building heat has a more mixed set of incentives around the world.

This situation with corporations can only be remedied by straight forward legal mandates, higher carbon prices or government subsidies. All of these result in higher prices or higher taxes. Based on marginal abatement curve shown in Exhibit 17, a $100 price of carbon would be sufficient to incentivise many industries to begin decarbonising, particularly using technologies at the lower end of the cost curve. However, a carbon price of $100 is also the point at which many companies across a wide range of sectors will go out of business. As an example, estimates from Oxford University, show that a $100 price of carbon, would wipe out all profits from nearly half of all US based utilities, materials, food, transport, and energy companies (Exhibit 19). A higher

Exhibit 20: A $190 price of carbon wipes out the profitability from the majority of US energy, materials, and transport, utilities, and food companies.



Source: Department of Economics, University of Chicago, Chicago, IL, USA. 2National Bureau of Economic Research, Cambridge, MA, USA. Booth School of Business, University of Chicago, Chicago, IL, USA. Centre for Economic Policy Research, London, UK. Business School, University of Mannheim, Mannheim, Germany. August 2023 issue of Science magazine.

Notes: (1) these measured impacts of scope 1 emissions on a firm's 2019 pre-tax operating income by sector using a database of 12,711 global companies, using a cost of carbon of $51, $100, and $190. This chart reflects simple or straight-line averages, rather than profit-weighted averages. The profit-weighted averages tend to be lower than the simple averages, suggesting that firms with better operational performance have lower corporate carbon damages. However, such differences are not significant with the top four major emitting sectors. However, food & beverage, automobiles, consumer durables and household products fall to 15%, 6%, 5% and 4% respectively, using $190 / tonne.

(2) the social cost of carbon is the cost to society from the effects of climate change. The Obama administration estimated this at $51 / tonne of carbon, while the Biden administration updated this to $190 / tonne of carbon.

(3) the impact on profits of a $100 cost of carbon has been extrapolated from the sector averages and is shown as an illustration.

price, such as the $190 per tonne of CO2 “social cost of carbon” estimated by the US government, would be even more damaging. The social cost of carbon puts the natural effects of climate change, like rising sea levels, extreme weather events, and damage to ecosystems, into economic terms.

An analysis produced by the University of Chicago as shown in Exhibit 20 used this $190/t carbon price to show that the energy, materials, transport, utilities, and food sectors all see significant reductions in profitability. The average US company’s profit declines by 44%. Energy companies’ profits drop on average by 135%, and many go out of business. Utilities’ operating income falls by 205% on average, but again, with a very wide range of outcomes for individual companies. The analysis is repeated at $51/t carbon and $100/t carbon. $51/t is the Obama estimate for the social cost of carbon, while $100/t is our assumed ceiling for carbon prices. Profitability at both levels is severely impacted, although at $51/t carbon the majority of businesses remain profitable, albeit with material profitability consequences.

All of these exercises estimating the profit impact of paying for carbon emissions assume no ability to pass the cost of carbon through to customers. In reality however, this is happening today. SSAB, a Swedish steel company, is producing “green steel” today, where the iron pellets are produced from hydrogen fuelled heating before being refined into steel in an electric arc furnace powered from renewable electricity. Customers are paying 20% higher prices for green steel. A more balanced analysis of corporate impact should assume cost pass-through in the form of higher prices, and some volume reduction as the end product pricing meets a lower point on the demand curve. At the industry level, the total profit pool will be reduced, but not by as much as a cash flow model would suggest by simply assuming carbon taxes are paid on current emissions with no pass-through. At the company level, there will be winners and losers, with significant dispersion depending on structural situation of different companies and from making the right or wrong investment decisions.

As the spector of material carbon taxation looms ever closer to the present in the minds of the leaders of large carbon emitting companies, long-term corporate energy transition plans become more ambitious and concrete. It does appear that we are at a turning point where management teams and shareholders of energy, power, industrial, transport and materials companies fully appreciate that the value of their companies is materially affected by the cost of decarbonisation. While some owners and managers may doubt the inevitability of this “invoice” showing up for carbon emissions, most do not. Today, inaction is less about the likelihood of the cost, but due to uncertainty around technology solutions and the relative economics of various options to decarbonise.

[8] https://www.reuters.com/business/cop/carbon-needs-cost-least-100tonne-now-reach-net-zero-by-2050-2021-10-25/

[9] UN Adaptation Gap Report 2022

3. Where is carbon taxation likely to go over the next 10 years?

Europe is clearly leading the way on carbon taxation, if not on the overall energy transition pathway. It is possible, but not likely, that Europe's implementation of CBAM will force the US and China to embrace carbon taxation in a more comprehensive way. Washington DC experts are guiding us to believe that only in a Democratically controlled Congress in the US, will the California, Washington State and the 12 states making up the RGGI drag the US into national taxation. China's exports to the EU are not sufficient to influence the level of carbon taxation in China.

The future of carbon taxes in Europe

Europe is already set on a fairly clear path given the Fit for 55 program launched in 2021 to phase out free allowances and introduce CBAM covering the power, industry. But there are still large holes in their carbon tax system to the extent that the EU has yet to decide on whether to include buildings and road transport into its ETS.

The expansion of the EU's ETS to include road transportation from 2027 onwards is part of the broader "Fit for 55" package. A new emissions trading system named ETS 2 has been created, which is separate from the existing EU ETS and will specifically cover CO2 emissions from fuel combustion in buildings, road transport, and additional sectors. This initiative is designed to complement other European Green Deal policies in the covered sectors, helping Member States achieve their emission reduction targets under the Effort Sharing Regulation. The ETS 2 will become operational in 2027, with emissions monitoring and reporting beginning in 2025. It introduces a cap-and-trade system for fuel suppliers, setting a cap to reduce emissions by 42% by 2030 compared to 2005 levels. Emissions taxation will be expanded to cover road transport from 2027 on top of the EU setting stringent CO2 standards for new cars and vans, mandating zero emissions for new cars by 2035, and introducing mandatory targets for the deployment of electric recharging and hydrogen refuelling infrastructure.

We do not see building energy falling into the emission taxing regime in the EU. Policy will take the place of taxes. The Energy Performance of Buildings Directive (EPBD) has been revised to double renovation rates by 2030, focusing on buildings with poor energy performance. The Social Climate Fund will provide financial support to vulnerable citizens and small businesses investing in energy efficiency, clean heating and cooling, renewable energy integration and low emission mobility. The European Parliament and the Council of the EU have negotiated agreements to mandate that new buildings be zero-emission by 2030, and new public sector buildings by 2028. The agreement also outlines minimum energy performance requirements for existing buildings and phases out the use of fossil fuel boilers by 2040.

The future of carbon taxes in the US

For a national carbon tax to be implemented, there would need to be substantial bipartisan support or a dominant political coalition in favour of such measures, which has been challenging to achieve on climate issues to date. This is made obvious from the current threat to the IRA from a Trump-led Republican congress. Translating state-level success from California, Washington and the 12 RGGI states to the national stage requires overcoming regional differences in energy production, consumption patterns, and political attitudes towards climate policies, which may just be too difficult. Analysts such as Ray Dalio of Bridgewater go further than this. His view is that the US will never tax carbon. Such is the resistance to taxation. His view is that any solution to carbon emissions has to come from companies pursuing shareholder value accretive projects independent of tax incentives.

However, CBAM has the potential to radically change the game for carbon tax in the US to the extent that large US exporters want to level the playing field with foreign companies operating in jurisdictions with less stringent environmental regulations. In 2023, there were four bills introduced in US Congress related to climate and trade (Exhibit 21). The first, introduced with bipartisan support, calls for a study of the relative emissions intensity of merely traded goods produced in the US and in other countries. A second bill, the Foreign Pollution Fee Act, has been introduced by Republicans which would apply a fee on some imported goods whose emissions intensity exceeds that of the same goods produced in the US. A third bill, the Clean Competition Act, is a Democrat led bill which would apply a carbon intensity charge on some domestically produced and imported goods whose emissions intensity exceeds a certain benchmark. And finally, another bipartisan bill proposes to apply a broad tax on emissions from fossil fuel combustion, high emitting industrial facilities and products in certain sectors. Imports of fossil fuels and other covered products would be subject to a border tax adjustment. So, despite the energy industry's consensus view that the US will never tax carbon, it is on the table right now.

Exhibit 21: We are seeing some movement in Congress toward domestic carbon taxes.

Bill	Sponsors/Cosponsors	Introduced	Details
PROVE IT Act	Senators Chris Coons (D-DE), Kevin Cramer (R-ND), Angus King (I-ME), Lisa Murkowski (R-AK), Martin Heinrich (D-NM), Lindsey Graham (R-SC), Sheldon Whitehouse (D-RI), Bill Cassidy (R-LA), John Hickenlooper (D-CO), John Boozman (R-AR), Richard Durbin (D-IL)	June 7th, 2023	Marked up and out of committee with bipartisan support. Would require a study of the greenhouse gas (GHG) emissions intensity of certain industrial products produced in or imported into the U.S. An initial report would be required within two years of passage, with updates at least every five years.
Foreign Pollution Fee Act	Senators Bill Cassidy (R-LA), Lindsey Graham (R-SC)	November 2nd, 2023	Would apply a fee on some imported goods whose emissions intensity exceeds that of the same goods produced in the U.S.
Clean Competition Act	Senators Sheldon Whitehouse (D-RI), Brian Schatz (D-HI) and Martin Heinrich (D-NM) and Representatives Suzan DelBene (D-WA), Don Beyer (D-VA), Kathy Castor (D-FL) and Ami Bera (D-CA)	December 6th, 2023	Would apply a carbon intensity charge on some domestically produced and imported goods whose emissions intensity exceeds a certain benchmark.
MARKET CHOICE Act	Representatives Brian Fitzpatrick (R-PA), Salud Carbajal (D-CA)	December 7th, 2023	Would apply a tax on emissions from fossil fuel combustion, high emitting industrial facilities and products in certain sectors. Imports of fossil fuels and other covered products would be subject to a border tax adjustment.

Source: World Resources Institute

We would say that it is possible, but not likely, that either a Biden-led government or a Trump-led government (assuming one or the other wins the presidency in 2024) would support a domestic carbon tax. US consumers are used to paying some of the lowest energy prices in the world and could be highly sensitive to increases to living costs as a result of carbon taxes. While congress is no more or less productive than it has been in the past, it still seems a stretch to expect a Republican held house and a thinly controlled Democrat senate, to pass any meaningful carbon tax legislation.

It is likely, however, that an international trade-focused tax, similar to the EU's CBAM, is implemented by 2030 in the US. 2030 is when the EU expands the range of products subject to CBAM and many large US export businesses (e.g., chemicals, oil and gas, metals, pulp and paper, glass and ceramics, aviation and shipping). The common ground for the two parties may well be a focus on international fairness. From our conversations with Washington insiders, the US will seek to change the focus of CBAM from the presence of domestic carbon taxes to actual emissions measures by industry. As long at the US can prove that their steel exports, for example, are emitting carbon at a rate similar to domestically produced EU steel, it should not be subject to CBAM import taxes. This is the so-called "equivalency test." If the emissions are similar or equivalent, there is no case for a tax on imported CO2 emissions. How will achieving equivalent emissions be possible if the EU is taxing its domestic producers and the US is not? The US makes the case that subsidies can achieve the same end result as taxes. Today, the Inflation Reduction Act (IRA) has put in place large subsidies for clean hydrogen production and carbon capture for example. If this has the result that steel is produced using clean hydrogen and carbon emissions are captured and stored, it is possible that the US could have "greener" steel than the EU without taxation driving the incentives to decarbonise.

Separately, several highly placed policy advisors have told us that a more likely avenue for US carbon taxes is that we see an increase in state-by-state taxation. For example, if the EU includes chemicals in CBAM, states such as Texas and Louisiana may be compelled to respond to avoid a loss of tax revenues overseas. If Texas, and Louisiana join those states already taxing carbon then the US will have some form of carbon tax covering 35% of all its emissions.

It seems that tax credits or straight subsidies are the more politically acceptable mechanism for US incentives for corporate carbon emitters. The $394B IRA is the largest single decision taken in that direction, although tax credits on pollution reduction have existed for many decades in the US. The obstacle to decarbonisation shifts from the cost to consumer to the cost to the taxpayer, when in the latter case subsidies add to government deficit spending. Cash flow models on large carbon emitting US companies will need to factor in assumptions about the growth of subsidies and the affordability of those subsidies in the context of US government deficits of 6-8% of GDP, already.

The future of carbon taxes in China

The miniscule trading volume on China's national ETS today does not bode well for any expectations of a meaningful system of carbon taxation that will affect corporate and consumer behaviour in the near future. The $9/t tax rate combined with massive free allowances today suggest that it will be many years before we see taxation affecting behaviour.

That being said, China is planning to have their national ETS cover other energy-intensive sectors beyond just the power sector, in the coming years, including petrochemicals, chemicals, building materials including cement, steel, non-ferrous metals, pulp and paper and aviation. However, this progress is reported to have been delayed due to poor emissions data. In August 2022, three Chinese government agencies released a guideline regarding the development of a national system for CO2 emissions accounting and verification[10].

The good news is that taxation may not be as important to China as it is in free economies like the US and the EU. China is an authoritarian regime which can change corporate and household behaviour without taxes or subsidies. President Xi Jinping, at the 75th session of the United Nations General Assembly in September 2020, announced that China would reach its carbon emissions peak before 2030 and become "carbon neutral" before 2060. However, it remains unclear if the latter goal refers to the neutrality of carbon dioxide (CO2) emissions or all greenhouse gas emissions. Additional targets include a 65% drop in CO2 emissions per unit of GDP compared to the 2005 level, by 2030.

Our assumption is that taxation will not be a major driver of decarbonisation in China. Domestic political will, combined with international pressure, is more likely to drive outcomes in China.

[10] https://interactive.carbonbrief.org/the-carbon-brief-profile-china

The future of carbon taxes in the rest of the world

The potential for meaningful carbon tax policies around the rest of the world, seems as equally unlikely. So far, some 75% of all climate related investing has happened in high income countries that only contain 15% of the worlds population. We are left with the grim conclusion that the energy transition will succeed in the western world but may ultimately fail to address the problem of climate change, due to continued high emissions in the emerging and developing countries. India, Indonesia, the rest of Southeast Asia and the African continent are today, and will be in the coming several decades, the largest net GHG emitters outside of China. Most of these nations simply do not have the money to invest in the needed energy transition and are highly unlikely to get money from the developed world to help them.

There may be no more important nut to crack than this one as we think about obstacles to global decarbonisation. CBAM will have the effect of significant consequences for commodity and other exports from developing to the developed world, which is putting a spotlight on the decarbonisation in the markets focused on merely feeding their populations in many cases. This has been on the agenda of virtually every COP meeting since COPs began, with more focus on practical solutions in the most recent COP28.

We address this topic in our upcoming whitepaper on how the transition will be financed. Quite simply, developed market capital, whether from investors or multilateral development banks (MDBs), attach a very high return requirement (i.e., cost of capital) to developing market renewables and similar decarbonisation investments for the additional risk of investing in unstable political regimes often fraught with corruption, weak economies and currencies. We cannot tar every developing economy with this brush, but the range of potential investment returns available today are clearly not attracting the capital.

MDBs do not have this sort of money either, even if only to fund the extra risk premium. There are solutions being discussed that involve carbon taxes or credits. One of many options we are exploring with our friends at the Clean Air Task Force is around hard-currency based carbon credits being earned by developing country renewables infrastructure. For example, an Ethiopian solar farm would be funded with developing country commercial lending or MDB capital with that loan guaranteed with carbon credits earned with each GWh of renewable electricity produced by the Ethiopian plant. Western companies operating in sectors with the hardest to abate emissions would be allowed to offset their emissions through the purchase of Ethiopian power credits in lieu of much less efficient capital spending inside their own businesses (e.g., aviation, shipping). In other words, third world carbon credits are purchased with hard currencies paid where developing world decarbonisation investments cost less per tonne of carbon than abating emissions in their own Western businesses.

We believe that carbon taxation and credits will no-doubt form part of the solution but will not tackle the entirety of the problem.

4. Key conclusions

- Economic factors will most prominently drive the pace of the energy transition and taxes (including credits and subsidies) are one of the most powerful economic tools for incentivising action.
- The EU has an excellent taxation model already in place with positive momentum. No other large emitting countries have anything that comes close.
- We do not expect to see the US or China adopting a domestic carbon tax system like the EU's in the next decade.
- CBAM should get past the WTO and force at least international (i.e., imports and exports) carbon taxation onto the agenda of other nations including the US and China.
- China has not done anything meaningful on domestic carbon taxation and no current policies in place are likely to change that. Interestingly, China has approved CBAM for implementation from 2027 on.
- The optimal carbon taxation model will never be just one global ETS, nor is that likely to ever happen. The most effective tax or pricing incentives will be tied to the cost of carbon removal for any given source of emissions. That cost varies from $0 to $400 per tonne, with some areas that are impossible to abate. Approximately 25 of the 50 gigatonnes of total global emissions can be abated for a cost of less than $100/tonne.
- We expect to see a "go-stop-retreat-go" process over the next decade with respect to carbon taxation. We are already seeing governments retreating from certain energy transition commitments (e.g., UK). Energy price hikes, product inflation and higher taxes will create social unrest around the energy transition.
- The biggest investment implication may be around companies that can reduce carbon emissions at relatively low cost per tonne of carbon abated. In most cases, taxes will come in the form of single regional ETS price on carbon. The sectors with the lowest cost to decarbonise will decarbonise, avoid the taxes, and not have to pass huge cost increases through to customers. These companies should be attractive to the extent that their current valuations overestimate the cost of abatement. On the flipside, investors should avoid the hard to decarbonise sectors like aviation. The market would appear not to have priced sufficiently high costs into the valuations of companies in hard-to-abate sectors.
- That being said, purchasing carbon offsets will be the cheaper way to go for hard to decarbonise sectors, and eventually, this will be tolerated by regulators and activists.

5. What are the investment implications of our forecast for carbon taxation?

If our conclusions were such that the scope and level of carbon taxation is highly predictable for any given company in any given country, then the dominant investment implication would be to incorporate such assumptions into valuations and carry on as usual. But uncertainty remains too high around the future of carbon taxation. Under some, not unreasonable assumptions, the level of value destruction to affected companies is extreme. Industries accounting for approximately 50% of the global economy have a level of carbon emissions that materially affects the value of the companies in such industries. All companies operating in such sectors cannot be properly valued without forecasting cash flows in various scenarios for the cost of carbon abatement – whether from paying the taxes or investing in lower emission processes and products. Companies in the energy, power, industrial, materials and transportation sectors are the most affected. While company analysis might point to winner-takes-all scenarios for certain companies better prepared for either higher carbon prices or already investing in advanced low-carbon technologies, investors need to draw a clear line under what is an investible level of certainty. Uncertainty is required for alpha generation, as certainty only brings consensus around valuations. **But the very essence of investing in the energy transition is around achieving sufficient certainty around something not well understood by most investors.**

Given the sheer complexity of the global energy transition, most institutional investors will not have sufficient insight into that 50% of the market most exposed to the cost of carbon abatement. Uncertainty is sufficiently high so as to ask whether these sectors are investible at all. But most institutional investors are not in a position to simply avoid investing in half of the public equity market or half of the private equity market. This involves taking significant tracking error against any usual performance benchmark. For some investors, who are truly benchmark agnostic, avoiding that 50% may be the most important

investment implication of this analysis. But for most active, benchmark-aware, institutional investors, the investment implication is to go to the effort necessary to assess the range of potential outcomes from the cost of carbon abatement for any company and to stress test company valuations using different carbon abatement cost assumptions – including the "just pay the tax" scenario. Many other factors relating to a company's energy transition strategy will of course be as important, if not more important. Specifically, assumptions about technology and the capital cost of low carbon processes or products will of course also be critical drivers of expected value.

The key to the analysis around carbon taxation is to know the cost of carbon abatement for any given company relative to likely taxes per tonne of carbon. Certain companies within a given sector will be positioned more favourably than others on the cost of carbon abatement. These companies could benefit from higher margins and capture market share as competitors are forced to push prices up or go out of business. An obvious example is a steel company who has an installed base of steel production facilities skewed toward electric arc furnaces vs higher carbon-emitting blast furnaces. Similarly with electric utilities, companies with an installed capacity of predominantly new coal and gas power plants vs nuclear, hydroelectric, wind and solar plants, will of course see a vastly different economic future in the face of high carbon taxes.

We think investors should focus on investing with companies in the high emitting sectors where there is the most certainty around their energy transition economics. Look for companies that can capture market share, whilst offsetting higher carbon prices. There may be winner-takes-all opportunities that create outsized return potential. Given that Europe has a more advanced and comprehensive carbon taxation policy, it makes sense for public equity focused stock pickers to focus their efforts there. Europe's more diverse political landscape also makes the likelihood of flipflopping on carbon schemes less likely.

In the near term, investors can consider relative value trades between jurisdictions like the US, with its lack of comprehensive carbon system, and Europe. Everything else being equal, US companies not subject to carbon taxes have a competitive advantage over European ones in the near term. While it is possible this is already priced into their respective valuations, it does offer another avenue to explore.

When picking companies within affected sectors, investors should focus on those companies with an abundance of free cash flow, higher margins, and a structurally advantaged strategic position based on their location, installed base of low emitting processes, revenue mix from low emitting products and low emissions in their supply chains.

Finally, this analysis should point investors toward a "brown to green" energy transition equities investment strategy -- or the so-called "improvers" strategy. This can be applied to public and private equity strategies. This strategy of investing in the largest decarbonisers should not be to the exclusion of investing in transition solutions companies such as lithium-ion batteries, solar and wind power, hydrogen electrolysers, etc. **But a brown-to-green strategy of investing in the most progressive and capable decarbonisers is likely to bring, what we believe to be, the most powerful combination of alpha and impact.**

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