

Advanced Financial Instruments for Sustainable Business and Decentralized Markets

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Lecture No. 14

In this lesson, we start the discussion with the introduction to climate change and climate finance. Next, we discuss the concept of carbon pricing and its role in greenhouse gas emissions. We also discuss the concept of abatement cost. Next, we discuss the two very important direct pricing mechanisms. These are emission trading systems and carbon taxes. We compare and contrast these two direct carbon pricing mechanisms.

Next, we introduce the concept of emission trading systems and its role in climate change mitigation with the help of a simple illustrative example. In this video, we will introduce the subject of climate change and role of climate finance in mitigating it. Let us first try and answer the question what is climate change? So, climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, for example, large volcanic eruptions.

Climate Change

- What is climate change: Climate change refers to long-term shifts in temperatures and weather patterns
- Governments and international agencies are focusing on the projects and policy instruments that can take the global economy towards a low carbon emission and decelerate the pace of climate change risk
- In this regard, the United Nations Framework Convention on Climate Change (UNFCCC) has provided a basis for international climate negotiations

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But in the current scenario, human activities have become the main driver of climate change, mainly due to burning of fossil fuels like coal, oil, and gas, and therefore emission of greenhouse gases. Now, in the modern day, climate change has become a significant global challenge. And therefore, governments and international agencies are focusing on the projects and policy instruments that can take the global economy towards the path of low carbon emission and decelerate the pace of climate change risk. In this

regard, the United Nations Framework Convention on Climate Change, that is UNFCCC, has provided the basis for international climate negotiations, including landmark agreements such as the Kyoto Protocol in 1997 and Paris Agreement of 2015. The Convention has been ratified by 197 states who have committed to act on climate change to reduce their greenhouse gas emissions and regularly report on their progress.

Climate Finance

- UNFCCC officially recognizes this novel area as “Climate Finance” and defines it as “local, national, or transnational financing—drawn from public, private, and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change.”
- In this regards, Carbon pricing, specifically, emission trading schemes have emerged as an important market-based instrument for climate protection.

In this backdrop, climate finance has emerged as a very important area, that is study of approaches and policies that facilitate and attract investment towards green and renewable technologies by capturing the scarcity of environment and therefore putting a cost or premia on emission of harmful gases such as greenhouse gas emissions. For example, governments are focusing on the policies such as pricing carbon emissions through emission trading schemes and also taxation on emissions and other approaches such as reducing fuel subsidies, improving regulations and so on for reducing this carbon globally. There are market-driven approaches such as emission trading schemes, green bonds and also taxation-based approaches that allow nations to reduce carbon emissions to the targeted level with the least economic cost and in an efficient manner. And hence, such approaches are preferred over other approaches. This new area of climate finance is officially recognized by UNFCCC and this novel area of climate finance is defined by UNFCCC as the local, national or transnational financing drawn from public, private and alternative sources of financing that seeks to support mitigation and adaptation actions that will address the issue of climate change.

What is Carbon pricing

- Why price carbon?
- What is the role of abatement cost?
- What are the direct and indirect ways to price the carbon?
- Carbon pricing helps internalize the external costs of greenhouse gas (GHG) emissions
- This cost of carbon could, in principle, represent the abatement cost needed to meet a mitigation goal
- The abatement cost is simply the cost of an intervention that will reduce greenhouse gas emissions

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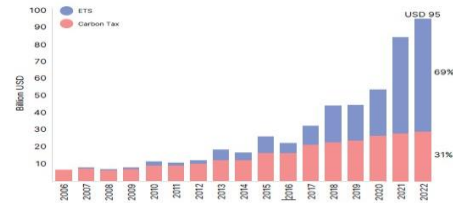
In this backdrop, in this regards, carbon pricing, more specifically emission trading schemes, have emerged an important market-based instrument and policy tool for climate protection and climate change mitigation. To summarize this video, we discussed what is climate change and, in this backdrop, how climate finance facilitates mitigation of climate change by inviting investments into green and renewable technologies and thus reflecting the scarcity of environment or the cost to polluting the environment and putting a premia on the same. In this video, we will discuss the concept of carbon pricing and its role in mitigation of climate change. We will also discuss the direct and indirect ways of pricing carbon. More precisely, we will try to answer the following questions.

What is the price of carbon or carbon pricing? What is the role of abatement cost in climate change mitigation? And what are the direct and indirect ways to price carbon? Economically, any resource that is scarce and has some utility will be naturally priced by the market in a more organic manner. In a similar manner, carbon pricing aims to capture the scarcity of the capacity of environment to absorb greenhouse gases, emissions of greenhouses gases and polluting activity before reaching hazardous levels which can affect humankind in society. And thus, it requires pricing carbon in an efficient manner, which captures this environmental scarcity and incorporates it in society's investment and consumption decision more efficiently. And thus, carbon pricing helps internalize the external cost of polluting activity, such as greenhouse gas emissions, by incorporating this cost of carbon into production and consumption decisions. This carbon pricing or put it more specifically the cost of carbon because it goes as a cost into various industrial production and consumption decisions should in principle represent the abatement cost needed to meet climate change mitigation related objectives or sort of represent the societal cost or the cost borne by society because of these polluting activities such as

greenhouse gas emissions.

Forms of direct carbon pricing

- What is ETS and how it works
- How carbon taxation works as direct instrument of climate change mitigation
- What kind of revenues are generated from these direct carbon pricing mechanisms
- In an ETS, Carbon revenues are a function of the carbon price, the emissions covered, and other design features such as the method of allowance allocation or the availability of rebates.



Evolution of global revenues from Carbon Taxes and ETS over time

Source: STATES AND TRENDS OF CARBON PRICING 2023

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There is a broad landscape of carbon pricing instrument which ranges from direct to indirect ways of pricing carbon. The idea behind direct pricing of carbon is to attach or add a pricing component to a given product or activity that is directly proportional to the greenhouse gas emission or polluting activity generated by that product and activity. For example, direct carbon taxes or emission trading schemes. The two most common instruments are these carbon taxes and emission trading systems. Indirect carbon pricing schemes or policies include fuel excise taxes and fossil fuel subsidies.

These are not directly linked or represent the amount of polluting activity such as emissions from a given product or activity in its pricing component. Finally, let us discuss the abatement cost concept. The abatement cost is simply the cost of an intervention that will reduce greenhouse gas emissions by one ton. For example, an individual replacing a gas boiler with a heat pump will reduce their greenhouse gas emissions but they will also have to pay for the installation of the heat pump and the electricity needed to run it, but they will also save money by no longer purchasing the gas. So, essentially, if you divide the total additional cost, what is the additional cost here? The investment into the instrument plus also the difference in additional operating cost minus saving in operating cost by the avoided emissions, then you will have the abatement cost.

So, essentially, if you divide the total additional cost that you are incurring by the avoided emissions, you have sort of what you call as per ton of carbon not emitted, whatever is the dollar cost. So, essentially, this per ton of carbon not emitted, the dollar

cost is called abatement cost. To summarize this video, we discussed what is the carbon pricing and why it is needed to efficiently price the carbon. That is, if carbon is priced efficiently that it captures the scarcity of environment in its ability to absorb emissions and greenhouse gas emissions and polluting activity before reaching hazardous levels that are harmful to society and mankind, we need to price the carbon efficiently. We also discussed what are the direct and indirect ways to price carbon and it seems that the direct ways to price carbon are more efficient from environment perspective.

Lastly, we also discussed the abatement cost concept, which is essentially the total dollar investment or cost per ton of carbon not emitted or per ton of saving in carbon emissions, whatever is the dollar cost investment required is called abatement cost.

Difference between Carbon tax and ETS

Element	Carbon Tax	ETS
<i>Uncertainty in Price</i>	Price certainty; tax rate can be periodically adjusted	Price volatility; cap adjustments can limit price volatility.
<i>Certainty of Emission levels</i>	It is difficult to estimate emission reductions achieved through a tax ex ante rate, making it hard to align to an emission target.	The cap provides certainty on upper limit of emissions for ETS, enabling its alignment to certain policy target.
<i>Cost effectiveness</i>	A tax does not reap the economic efficiency gains of trading between entities and across sectors and offers less temporal price flexibility for regulated entities.	An ETS allows for economic efficiency between and within sectors (as a result of trading) and over time. However, market power, lack of liquidity, and excessive volatility in allowance prices can reduce cost-effectiveness.

In this video, we will discuss two very important components of direct carbon pricing that is emission trading schemes, which is a cap and trade-based system and direct carbon taxes. We will also discuss the revenue mechanisms from these direct carbon pricing instruments. More specifically, we will try to answer the question, what is an emission trading scheme and how does it work? How does carbon taxation work as a direct instrument of climate change mitigation and what kind of revenues are generated from these direct carbon pricing mechanisms? To put it simple, an emission trading scheme or what we call as ETS is a cap and trade based system which caps the total or aggregate level of greenhouse and other emissions such as sulfur dioxide, SO₂ emissions in a region and then subsequently the aggregate emissions are divided and distributed towards the installations or industrial installations, plant manufacturing units in the form

of right to emit what we call as emission allowances. These emission allowances essentially provide them with the right to emit.

Now, those installations that are more environment friendly and operate based on green and environment friendly technologies, they have naturally low emissions. So, they are in surplus of these allowances in terms of these allowances and then those installations that are more intensive in their emissions that are more heavy users of these emissions because their emissions are larger, they are always demanding these emissions. So, essentially those industries with low emissions sell their extra emissions to those with large emitters who are in demand. So, thus creating a supply and demand for these emission allowances, an emission trading scheme or ETS establishes a market price for carbon or what we call as these house gas emissions, which is a more market oriented or market driven price discovery of carbon. The idea behind setting the cap at the overall aggregate level is to ensure that required emission reduction targets are met and at the aggregate level, the emitters at the aggregate level, they have their emissions in the pre-allocated carbon budget.

So, the initial budget that was set at the beginning, the aggregate emissions which are essentially nothing but the overall sum of all the individual emitters should remain within the budget that was initially set and therefore, everything is aligned to the target that is set for this scheme. In contrast, carbon tax directly sets a price on carbon by defining this explicit direct tax rate on the emission activity such as emission of greenhouse gases or to put it more clearly a price on the carbon content of fossil fuels. In this way, it is different from an emission trading scheme that emission trading scheme linked to a certain emission reduction target, the pricing of carbon is more linked to an emission reduction target. Whereas in the carbon tax, the pricing of carbon is more linked to the output or volume of emission generated, it is not essentially linked to a pre-desired level of emission reduction outcome and therefore, in a carbon taxation regime, there is no guarantee that the targets that are set, the budget of carbon that is allocated will be necessarily met. While in general, in short to medium to long term, an emission trading scheme ensures that the desired carbon reduction outcomes are met.

Also, for an emission trading scheme, the carbon revenues through mechanisms such as auction revenues are a function of carbon price, the emission covered and other design features such as the method of allowance and location such as auctioning and the availability of rebates. If we look at the numbers in the chart here, compared to the year 2021, the global revenue from carbon taxes and emission trading schemes increased by around 10 billion in the year 2022. Moreover, revenues from carbon taxes and emission trading schemes grew by 10 percent in 2022, reaching almost USD 95 billion globally out of which 69 percent respond to emission trading scheme and relatively less amount of 31

percent was ascribed to carbon taxes. To summarize this video, we discussed two schemes of direct carbon pricing, emission trading scheme and carbon taxation. We noted that ETS or emission trading scheme is different from the carbon taxation in the sense that ETS price to price carbon based on certain emission reduction objective while the objective of carbon taxation or the *modus operandi* of carbon taxation in direct carbon pricing is to link it to some kind of activity, emission activity or level of emissions.

Lastly, we also noted that emission trading schemes have been found to be more successful, these are called cap and trade based trading schemes, which set an overall budget or target for emission reduction, they have been found to be more successful. As the revenues from these emission trading schemes have grown exponentially and much higher as compared to carbon taxation related revenues, which have stagnated and are more gradual in their increase in the last few years while ETS based revenues such as auctions from ETS auctions have exponentially grown. In the previous video, we discussed the concept of carbon pricing. We noted that carbon pricing aims to make emitting carbon dioxide and other greenhouse gases more expensive and ensures that market actors take account of the two costs of emissions when making commercial decisions. Businesses and households are expected to incentivize to change their production and consumption behavior promoting lower emission outcomes.

Firms and businesses are expected to seek to minimize the cost associated with carbon price by investing in the most cost-effective abatement solutions. At the same time, consumers will substitute lower emission products as these gain a relative cost advantage. Through these processes, over time, low emission producers will gain market share over high emission producers. Thus, carbon pricing is expected to play a critical role in decarbonizing the economy. Lastly, we also noted two key instruments of carbon pricing that is carbon taxes and emission trading systems.

Difference between Carbon tax and ETS

Element	Carbon Tax	ETS
<i>Ease of administration and scope</i>	Like an ETS, a tax requires a robust monitoring, reporting, and verification (MRV) system. However, it does not require setting up an infrastructure for trading allowances, and the ability to rely on existing tax infrastructure makes it easier to implement in a broad range of sectors.	An ETS is more complex to implement because in addition to the infrastructure required for a tax it also involves a secondary market for trading allowances. The regulator and regulated entities therefore need to have additional capabilities. This might make it more difficult to include certain sectors in the scope.
<i>Price predictability</i>	The carbon price is set by predefined tax rates. This provides a stable price signal to inform investment decisions.	The carbon price is determined by the market forces. This automatically adjusts for economic conditions but might lead to price volatility.

In this video, we will provide a contrasting discussion between these two instruments and their implications for carbon pricing and the objectives related to climate change mitigation. Recall that in the context of carbon taxes, we said that these taxes set a fixed price per unit of emissions to help internalize the cost emissions and provide incentives for carbon emission reductions. In the context of emission trading systems or emission trading schemes that is ETS, we said that an ETS imposes a cap on the total emissions in one or more sectors of the economy. The regulatory issues a number of tradable allowances, what we call emission allowances, not exceeding the level of this aggregate cap. Each allowance typically corresponds to one ton of emissions and entities covered by the emission trading system are then allowed to trade these allowances resulting in a market for the allowances.

This type of emission trading scheme or emission trading system is also called a cap and trade-based system or scheme. A very important difference between ETS and carbon taxes is that in ETS, prices are not very certain, there is uncertainty in prices as they are driven by demand and supply. So, prices are volatile. We noted a very important theoretical difference between such ETS, and carbon taxes is that in the case of ETS, the level of emission reduction is more certain because the cap which is set in the ETS indicates the total emissions in the covered sectors. However, like I said earlier, in ETS, the price is not fixed and it is determined by the demand and supply of allowances.

In contrast to carbon taxes, the prices are rather fixed because it is a certain added component of the emission, total amount of emission and therefore the prices that is imposed is certain and different taxes, the tax rate can be adjusted periodically to achieve the desired price level. However, this is not so certain in the case of ETS where there is

some kind of price uncertainty. In the case of carbon taxes, it is difficult to estimate the emission reductions or how much emission reduction objectives can be met through the tax rate ex ante and therefore making it hard to align the emission target with the tax rate objective. In the context of ETS, this cap provides certainty on the upper limit of emissions for the ETS, which enables its alignment to a certain policy target depending upon the target or budget that has been set at the beginning of the period for overall emission. Between the two systems which is carbon tax and ETS, ETS has been found to be more cost effective.

This is so because ETS allows for trading of permits between and across entities. Thus, it allows for economic efficiency between sectors. How? Because the entity which is more cost efficient in mitigating emissions can do the same and then sell the excess permits to the entity which is less efficient in mitigating the emissions and meet its target. In contrast, a taxation-based regime does not allow trading and therefore across sectors of economy and therefore it does not allow the benefits of economic efficiency gains. Effectively, it imposes a fixed tax between all the entities across all the entities whether they are efficient in mitigating the emission or not and therefore they are uniformly taxed and this kind of taxation regime does not recognize the differentiation or the different abilities of entities to mitigate the emissions.

While an efficient system, an emission trading system is more complex to implement because it requires additional infrastructure in setting up a secondary market for trading of allowances. The regulator in this case needs to set up a market microstructure and market design that should result in efficient price discovery which links the carbon emission related objectives with the carbon pricing. Any inefficient pricing system or any system which results in inefficient price discovery may have very adverse consequences for such emission reduction objectives and the entire objective of the scheme in general. In contrast, setting a carbon tax system is very simple because already we have set up different kinds of taxation regimes in economy. Moreover, the objectives related to monitoring, reporting and verification which is very detailed and complicated in the case of ETS is not as much detailed and complicated and complex in the case of carbon tax system.

In fact, one can rely on existing system of different tax variants to implement carbon taxation regime across a broad range of sectors. Not much analysis and scrutiny and due diligence is needed as it is required in the case of ETS where particularly a very large due diligence requires across sectors depending upon the needs and requirements and emission characteristic of different sectors. Moreover, another very important difference between the two regimes is the price predictability. In case of ETS, price predictability is very difficult because the price is determined by the market forces of supply and demand

and therefore, it depends on the economic conditions and the amount of economic activity happening in the economy and therefore, the prices are volatile, they change. In the case of carbon taxation regime because of the fixed nature of taxation, the prices are less volatile and more predictable because one can set a predefined tax structure which provides some kind of stability to the price signal to make a more informed investment decisions by different entities covered in the scheme.

To summarize in this video, we compared and contrasted the carbon taxation and emission trading systems on four broad parameters including certainty of emission levels and emission related objectives, cost effectiveness, ease of administration and price predictability. We noted that while ETS is more efficient in terms of ensuring emission related objectives and efficiency gains of economic activity vis-a-vis mitigation of emission reduction objectives and cost effectiveness, it is difficult in terms of administration and price predictability that is prices can be predictable and not very certain and design of market to achieve pricing efficiency in the ETS is difficult as compared to much easier administration and price predictability in the carbon taxation regimes. Previously, we noted that carbon pricing instruments help channel economic activities toward a low carbon future. In this backdrop, we noted that the attractiveness of an emission trading scheme or emission trading system is simple. It sets a limit on total emissions while providing incentives for mitigation to be achieved at the lowest possible cost.

Emission Trading Schemes (ETS)

- An ETS is a cap-and-trade based program
- The allowances to emit are distributed amongst the covered entities
- The supply and demand forces ensure price discovery process and promote investment into green and renewable energy technologies
- An ETS – as opposed to a tax – is a quantity-based policy, i.e., it offers certainty over the environmental outcome (i.e., “cap”) but leaves it to the market (i.e., “trade”) to set the price of carbon

In this video, we will try to understand the functioning of an emission trading system that is ETS. Please note that under an ETS, the government imposes a limit or cap on the total emissions in one or more sectors of the economy and issues a number of tradeable allowances not exceeding this level of cap. Each allowance typically corresponds to one

ton of emission. The regulated entities in an ETS are required to surrender one allowance for every ton of emissions for which they are accountable. Entities that hold additional allowances after surrendering the allowances needed for compliance can sell them or bank them for future use.

Entities that require additional allowances may buy them in the open market. Also, please note that placing a cap on allowances and establishing a market to trade them generates a uniform allowance price, which is also called the carbon price. This price incentivizes businesses to reduce the emissions from their operations if the cost of reducing emissions is lower than this price. This price reflects the stringency of the cap. For example, a more stringent cap means fewer allowances are issued.

All this being equal, this results in higher prices and therefore a stronger incentive for businesses to avoid the carbon price by reducing their emissions. In this manner, the allowance price acts as a signal that favors lower emission goods and services. Setting the cap in advance provides a long-term market signal so that participants can plan and invest accordingly in advance. In this backdrop, we note that an emission ETS or a Cap and Trade program is managed by a governing jurisdiction or regulatory body that sets a limit or cap on the total level of covered greenhouse gas emissions, including CO₂ or equivalent tons of CO₂. The allowances to emit are distributed to the liable or covered entities that must redeem allowances for every emitted ton of CO₂ or carbon with the possibility to buy additional allowances or sell the unused ones.

As the liable entities consider the cost of their emissions within their production processes and the possibility to buy or sell allowances, a market for CO₂ emerges, which leads to supply and demand forces. This sets the price on CO₂ that acts as a reduction incentive for all the liable entities. Thus, this price influences decisions both in the short-term management of existing assets and in the long-term direction of investments and the idea is to facilitate and promote investment into green or renewable energy technologies. Lastly, an ETS as opposed to a tax is a quantity-based policy, that is, it offers certainty over environmental outcome, which is the cap set in the policy, but also it leads to the market that is trading activity across market participants and generating supply and demand forces to set the price of the carbon. To summarize this video, we noted that an emission trading scheme or emission trading system is a cap and trade based program, where an overall target based on the emission reduction objectives is set by the regulatory body.

Subsequently, this overall cap is distributed amongst the covered installations and the installations with surplus are the supplying ones and those falling short are demanding ones. This supply and demand forces, they meet in the market and trade the permits

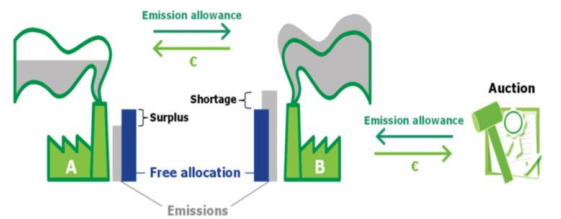
amongst each other. Thus, through the supply and demand forces, the carbon price naturally emerges, emerges organically and a fair price discovery and efficient price discovery occurs, which provides a price to carbon, which is market based and captures the scarcity of environment and also is aligned to the emission reduction objectives of the overall scheme. In this video, we will try to understand the functioning of EU-ETS with the help of a simple example. EU-ETS or European Union Emission Trading Scheme is a cap and trade based system, which works by capping the overall GHG emissions of all participants in the system.

The European Union Emission Trading Scheme or EUTS legislation creates allowances, which are essentially rights to emit greenhouse gas emissions equivalent to global warming potential of one ton equivalent of CO₂ or carbon. The level of cap here determines the number of allowances available in the whole system. The cap is designed to decrease annually from 2013, reducing the number of allowances available to businesses covered by new EVTS by 1.74% per year. This allows companies to slowly adjust and set their expectations to meet the target, which is increasingly ambitious and overall target for emission reductions.

Each year, a bulk of allowances are auctioned and a small proportion of allowances are also given to the participants for free, particularly in the sectors where there is a considerable potential risk if they pay the full cost of pollution allowances they need. That production and also pollution could shift to countries with less ambitious emission reduction action. At the end of the year, the participants must return an allowance for every ton of carbon to equivalent emission they make during that year. If a participant has insufficient amount of allowances, then they must either take measures to reduce their emissions or buy more allowances from the market or through auction. From market I mean trading from such EUETS trading scheme, they can trade among those who have surplus allowances, they can buy from them.

How does EU-ETS work?

- The EU ETS is a 'cap and trade' system, which works by capping overall GHG emissions of all participants in the system
- The level of the cap determines the number of allowances available in the whole system



EU-ETS Handbook

Source: http://ec.europa.eu/clima/policies/ets/index_en.htm

- At the end of a year the participants must return an allowance for every tonne of CO₂e they emit

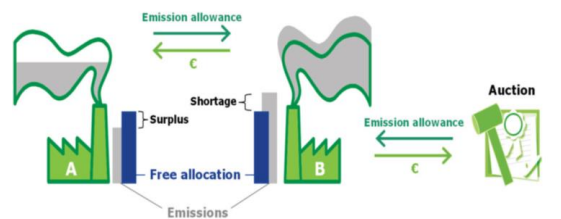
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Let us look at this simple example of factory installation A and B who are emitters. In this example, factory B does not have enough free allowances to cover its emissions. So, it can either comply with the cap by buying allowances from factory A or from the auction itself. If a participant's emission of greenhouse gases exceed the free allowances they were given at the start of the year, then they can buy allowances from the auctions from other participants in that trading scheme through the market. Who would be these participants? These are the participants who have reduced their emissions and therefore they have surplus allowances.

How does EU-ETS work?

- In this example, Factory B does not have enough free allowances to cover its emissions, so it can either comply with the cap by buying allowances from factory A or from the auction
- Participants can also decide to bank allowances for use in later years



EU-ETS Handbook

Source: http://ec.europa.eu/clima/policies/ets/index_en.htm

- Allowances have value because there is a limited or capped supply and there is demand for them from those participants for whom the cost of making reductions are higher than for other participants

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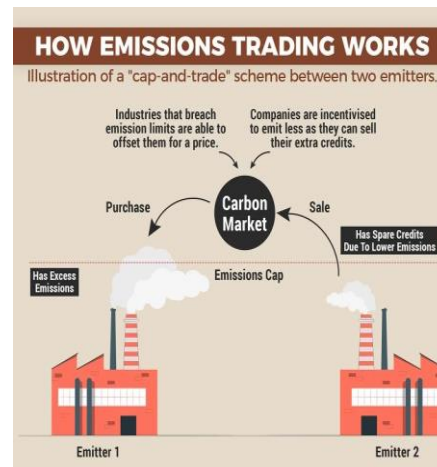
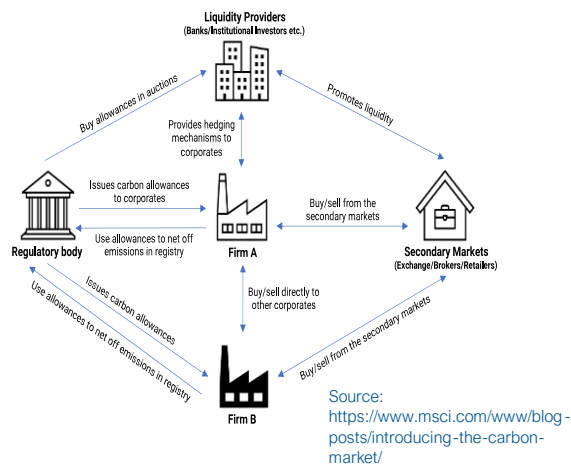
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Participants can also decide to bank the allowances. So, if you have surplus allowances, you can bank it for future years. This has also been allowed now. Now these allowances

have value because their supply is limited or capped and there is demand from them particularly from those participants for whom the cost of making reductions are higher than other participants. So, in this manner, it allows the effort to be redistributed across participants so that emission reduction takes place in areas where it costs less which is the gain in efficiency. This is good for the business and economy and thus compliance ensured through the penalty and enforcement structure.

Significant fines are imposed if a plant manufacturing installation or a company fails to comply by surrendering sufficient allowances in time. This penalty is set at 100 euro per tonne equivalent of CO2 emission, and it rises with even inflation from 2013. In addition, firms face an obligation to surrender the allowances owed and thus the cap or what we call the target environmental target is maintained in an efficient manner. So now let's summarize our understanding. We said that carbon allowances are traded in primary and secondary market.

How does EU-ETS work?



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Regulators which is a regulatory body which is in this case can be thought of as EU. They typically auction or distribute for free these allowances to the regulatory entities through primary markets to comply with their emission limits. Once regulated companies are allotted this allowance they can trade it in secondary markets in line with their emission requirements. They can use they can make use of both spot and derivative contracts such as futures options and swaps.

Now let's look at this simple visualization. Here this regulatory body issues allowances to firms A and B. These allowances will be used by A and B to set off their emissions in a given year. However, it is possible that one of these installations is in surplus while the other one is falling short. For example, this one because it has less pollution it is in

surplus while this has excess emissions, so it is falling short for its allowances. Now the installation A let's say it may find cheaper to improve its technology.

This installation A might find cheaper to improve its technology and through these technical enhancements it can decrease its emission levels so it can have lower emission and thus ending up with surplus allowances. In contrast, installation B might find it difficult or costlier to improve the technology and thus while installation A ends up in surplus B ends up falling short of its allowance requirement corresponding to the respective emission levels. Now these two and more installations will meet in the designated marketplace so they will meet in the secondary marketplace and the ones with surplus will sell and benefit from the revenues while those falling short will buy these allowances. This market or emission trading scheme also has intermediaries which are essentially liquidity providers who would have probably bought these allowances during auctions and are willing to buy and sell these allowances in the secondary market to ensure continuous market making and smooth functioning of this emission trading scheme. So they are sort of market makers you can call them brokers or broker dealers or liquidity providers or market makers.

Overall this mechanism leads to efficiency gains that is those installations that are better placed to reduce emissions through technological advancements and those installations that find it difficult they simply pay for it in open market to buy allowances and thus in turn supporting it in the market. To summarize in simple terms climate change refers to man-made long-term shifts in temperature and weather patterns that have adverse consequences on the life on earth. In this backdrop financing of projects that support mitigation of climate change is referred to as climate finance. In this backdrop carbon pricing plays a very important role in quantifying these adverse effects of greenhouse gas emissions on the environment. Another very important concept is abatement cost which is the cost of intervention to reduce per ton carbon equivalent of greenhouse gas emissions.

In this backdrop two direct pricing mechanisms have emerged to link carbon with economic activity and thus emission of greenhouse gases. First is carbon taxes where resulting carbon price is known ex ante depending upon the level of taxes. However, in case of carbon taxes the emission reduction objectives are not well anchored. In contrast emission trading is more market-oriented approach that provides more and clarity on emission reduction objectives. However, the carbon prices resulting from emission trading systems are uncertain and volatile depending upon the market quality parameters such as liquidity and volatility.

Emission trading systems are generally cap and trade-based systems which employ a cap

on overall emissions then allowances equivalent to this cap are distributed amongst the permitted installations. These installations have to provide allowances equivalent to their emissions at the end of each operational year those installations that have excess allowances can sell those falling short can buy in an emission trading scheme including instruments such as direct market or OTC based trades.