Advanced Financial Instruments for Sustainable Business and Decentralized Markets

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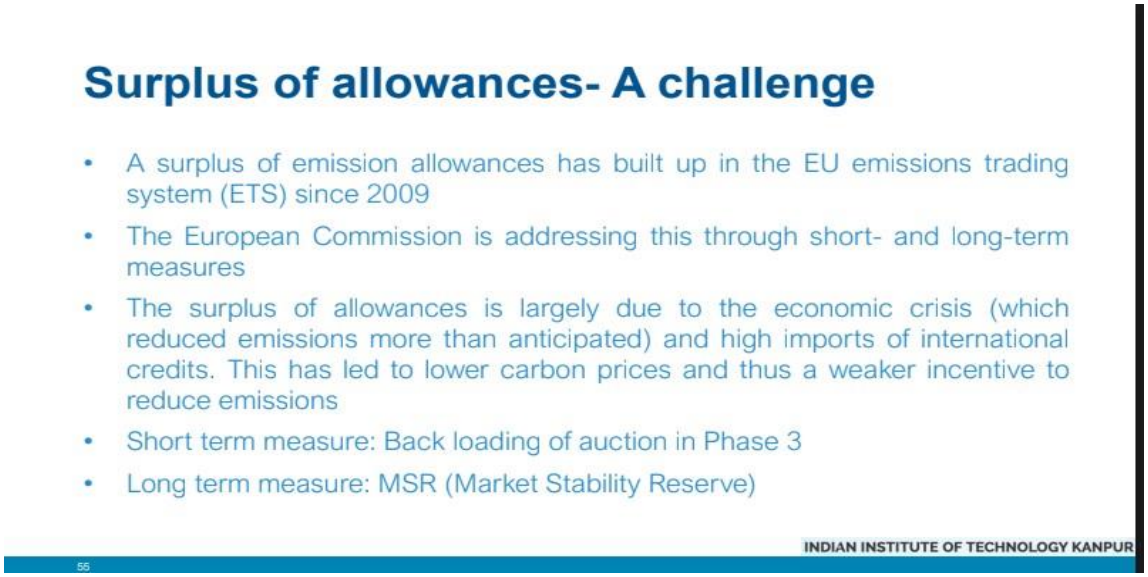
Lecture 17

Week 5

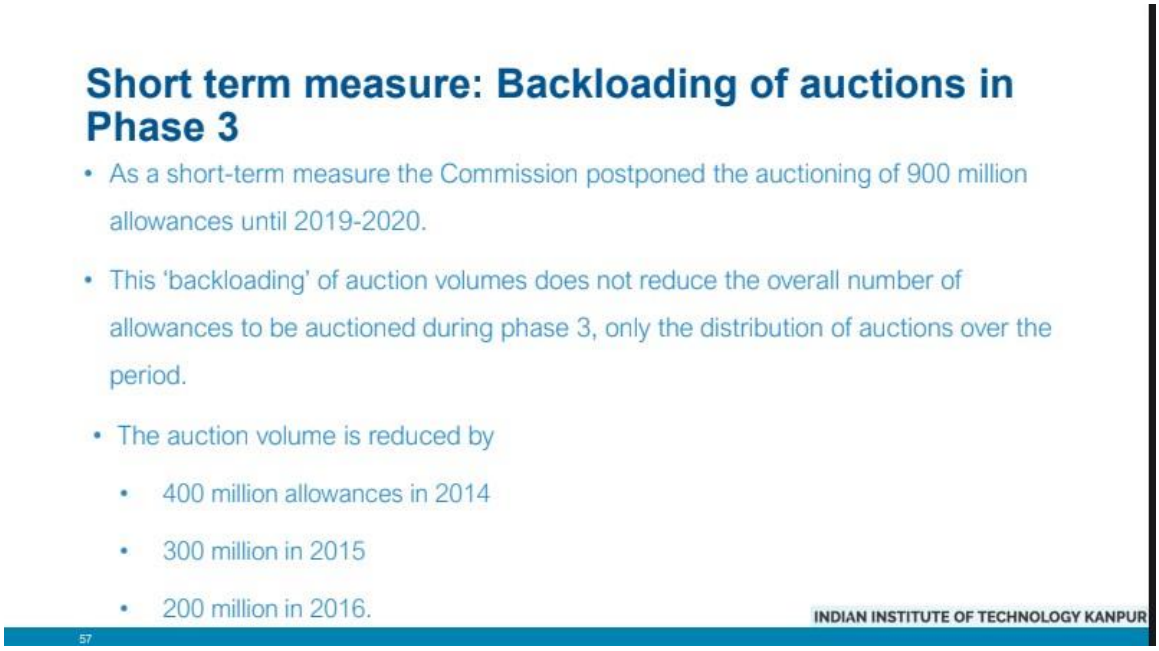
In this video, we will discuss the issue of surplus allowances at UTS that is European Union Emission Trading System and various reforms adopted by European Union Commission to resolve it. In this backdrop, the two most important measures adopted by UTS included short term measure that is back loading of allowances and long-term measure that is market stable reserve or MSR. We will discuss these two measures in detail. In addition, we also discuss how banking and borrowing of reserves help installations optimize their allowance requirements. Next, we discuss the key requirements behind the instruments traded at UTS. These included spots, future, forward, swap and options contracts.

Next, we discuss the price formation at UTS driven by supply demand forces. We also discuss the effectiveness of UTS on its key parameters including emission reduction, obtaining efficiency in operations with respect to emission levels. Lastly, we discuss the global ETS dynamics and its evolution. Surplus of allowances is a very important challenge in any carbon market, even more so for the European Union Emission Trading System.



In this video, we will discuss what is the cause of this problem and what are the implications for carbon price and climate change mitigation schemes in general. To begin with, let us define what is surplus of allowance. Surplus of allowances is defined as the difference between the cumulative amount of allowances available for the compliance at the end of given year and the cumulative number of allowances effectively used for the compliance with the emissions up to that given year. The negative amount would indicate a shortfall. So positive is surplus, negative is shortfall here.

Now a surplus of allowances has built up in the European Union Emission Trading System since 2009. The European Commission is addressing this through short- and long-term measures. The EUTS by the end of 2011 had a surplus of almost 1 billion allowances. Please note that this surplus of allowances is largely due to economic crisis which reduced the emissions more than anticipated, so economic activity went down and also high imports of international credits through schemes such as joint implementation, JI, Clean Development Mechanism, CBM and so on. And this has led to lower carbon prices and weaker incentives to reduce emissions.



What it means is that if carbon prices are weaker and lower, which essentially imposes a cost on more emitters and if prices are lower, there is less motivation to invest in clean and green renewable technologies in order to reduce emissions. In particular, in short term, the surplus risk undermining the orderly functioning of carbon market is one major challenge. In the long term, it could also affect the ability of ETS to meet more demanding emission reduction targets in a cost-effective manner. So overall, it remains a big challenge for any kind of emission trading system. Let's fill in some numbers here.

So, this surplus amounted to 2 billion allowances at the start of phase 3 and increased further to more than 2.1 billion in 2013. So 2 billion by the start of phase 3 around 2012-13 and increased to 2.1 billion allowances in surplus by 2013. And in 2015, it was further reduced to 1.

78 billion. This was rather a consequence of backloading. We will discuss this backloading more in detail, but essentially the backloading was employed to time delay the allowance volume to be optioned in a strategic manner to reduce the surplus of allowances. So this was an intentional action. Without this, in the absence of any backloading activity, the surplus would have been almost 40% higher by the end of 2015.

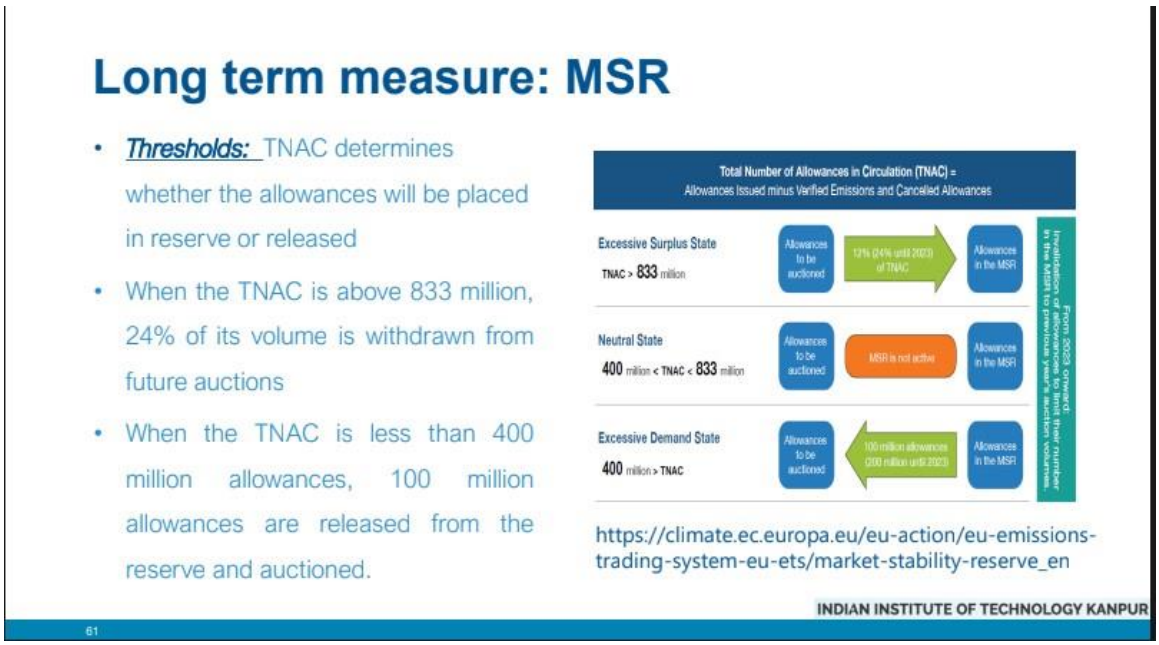
Long term measure: MSR

- The European institutions decided in 2015 to introduce a market stability reserve (MSR) by 2019
  - From 2021 onward, the annual linear reduction factor (LRF) of the emissions cap increases from 1.74% to 2.2%.
  - From 2019 till 2023, the intake rate of the MSR doubled from 12% to 24%
  - From 2023 onward, the MSR cannot contain more allowances than the total number of allowances auctioned during the previous year

In fact, even with all the efforts, this surplus is expected to grow, continue to grow and the likely continued impact of the economic crisis is a strong driver. So, because of the economic crisis and lowering economic activity, one may expect the demand of these allowances to be lower. So lower economic activity will lead to a lower demand of allowances and therefore further surplus. There are other elements also that contribute, for example, newly adopted energy and efficiency measures because of which emission have come down and adoption of more renewable energy sources which may lead to lower emissions and hence lower demand for allowances. But even with all these efforts, an overall surplus is expected in 2020 of about 2 billion allowances which may have adverse impact on carbon pricing.

Generally, it is argued that the economic and financial crisis of 2008 affected along with certain policy measures and UTS policy features affected and created sort of excess supply of allowances and therefore led to imbalance. What even carried on in phase 3, so it went on in phase 3 and further required measures such as backloading and market stability

reserve that we are going to discuss shortly. So excess supply of allowances weakens carbon prices. Essentially, it acts as a poor signal for carbon investment as we discussed, which is that investment in technologies that reduce emission will come down because there is not much motivation because carbon price which acted as a cost or sort of penalty to discipline emitters that price has come down. So if because of this excess supply, the prices come down, then the motivation to invest in those green and renewable technologies is lower.



Moreover, with the declining prices and lower liquidity, there is a lot of fearful environments about future trading and liquidity. And it may have some adverse effects on market microstructure also. What kind of effects? So for example, there are a lot of intermediaries who provide the market, perform the market making activity. If they feel that trading is going to be less, there is going to be less liquidity in the market. Their profits may be less and they may quit the market.

And they perform a very essential function of market making. So if the trading activity declines and then these market makers would not be able to generate reasonable profits to survive and therefore may quit the market. So because of all these challenges of excess allowance supplies, regulators have decided one short term measurement, very important short term measure which is backloading of auctions in phase three, which we are going to discuss in the long term measure which is market stability measure to reduce the excess supply to improve the market liquidity and decrease volatility. To summarize in this video, we discussed the problem of surplus of allowances. We noted how the economic crisis and various other policy features of EOTS led to surplus of allowances.

Banking of allowances

- Banking allows regulated entities to save unused allowances for use in future compliance periods
- Banking can facilitate cost-effective abatement
- Moreover, it can reduce price volatility by creating additional demand for allowances when prices are low
- In general, banking is central to the efficient functioning of most carbon markets
- Banking can however create some challenges: Unlimited banking can enable an excess supply of allowances in one compliance period to be carried over into future compliance periods

We noted that market regulator plans to take two particular policy measures to resolve this issue. One is short term measure which is backloading of auctions in phase three and the long term measure which is market stability reserve. We are going to discuss both of these measures in subsequent discussions. In this video, we will discuss the backloading of allowance auctions in phase three, which was a very important short term measure to manage the excess supply of allowances at UTS. To begin with, let us first define what is backloading of allowances.

Banking of allowances

- Banking means that changes in expectations of future market conditions can feed back to today's prices,
- In practical terms, there are several cases where policymakers have chosen to impose limits on the banking or holding of allowances
  - Prohibiting or limiting banking is a way to isolate a pilot phase from the subsequent phase
  - To control the ability of individual entities to acquire market power.

In order to address the excess supply of allowances and its continuance in phase three, the regulatory bodies at European Union Emission Trading System decided to postpone a certain auction volume of allowances. This strategic and intentional decrease of the annual auctioning volume in the early years of phase three, particularly 14, 15 and 16 and a corresponding increase in the later years is referred to as backloading. So, we delayed the auctioning volume in the early years, particularly in 14, 15, 16 and these delayed allowances were not cancelled, these were actually auctioned in later years and this is referred to as backloading. One of the key factors affecting this supply and demand of allowances is the auction time profile. So, if auction volume is relatively higher than the current demand, it may result in excess supply.

And then because of excess supply and imbalance of allowances in the UTS, all adverse consequences on carbon prices and UTS as a policy instrument itself follows as we have already discussed. So, let us discuss the specifics of this backloading with numbers. First and foremost, as a short-term measure, so it was a short term measure, the EU Commission or European Union Commission postponed auctioning of 900 million allowances until 2019-2020. So they delayed certain auction volume and this is what we are referring to as backloading of auction volumes. It does not involve the reduction of overall allowances to be issued or auctioned.

There is no cancellation as such or reduction. Only that as a part of phase three, the total volume of auctioned allowances, a certain portion has been back ended. So, only the distribution of auctions over the period is back ended to manage the excess supply. So, we are not reducing the overall volume or cancelling it, we are only back ending it, sort of delaying it. And to be more specific, the auction volume is reduced by 400 million allowances in 2014, 300 million in 2015 and 200 million in 2016.

And thus the auction of these 900 allowances is effectively delayed, not cancelled to manage the excess supply, which may result or would have resulted in imbalance of allowances in UTS and all the adverse consequences. So to summarize this backloading, essentially, we are delaying a certain volume of allowances to be auctioned at a later date so that current excess supply can be managed. It was anticipated early in the phase three that there would be excess supply because of certain issues, legacy issues such as economic crisis of 2008 and lower demand because of activity, lower economic activity, lower demand of allowances because of all those issues it was expected there would be supply and to manage this anticipated excess supply, backloading was proposed as a short term measure. In this video, we will discuss a very important long term measure to control demand and supply of allowances at UTS that is Market Stability Reserve or MSR. Having experienced low prices for about a decade, UTS or European Union Emission Trading System has been supplemented with Market Stability Reserve or MSR that adjust the supply of allowances to market outcomes.

It has also witnessed a lot of reforms over time, for example, in 2015, 2018, 2023 and so on. Coupled with other policy measures, this MSR reserve provides a very strong price signal for greenhouse gas emission abatement and also it strengthens the European Union, UTS. In its provisions, it includes allowance cancellation policy for excess allowances and also to increase the linear cap reduction factor from 1.7 to 2.2% after 2020 in order to basically fast track the cap reduction and achieve the emission reduction objectives.

So these are some of the features and we will discuss this Market Stability Reserve in more detail in this video. To begin with, the European institutions in 2015 and there onwards decided to introduce a Market Stability Reserve or MSR by 2019 to be implemented by

2019. This MSR or Market Stability Reserve absorbs part of the excess allowances in the market and those that are currently unallocated, excess allowances plus unallocated allowances and those allowances that are not auctioned in the 2014-2016, if you recall the previous sessions those that were part of backloading, so the backloaded allowances. Now in 2018, the European Council decided to strengthen UTS with MSR in three ways. Let us discuss these three important measures.

First from 2021 onward, the annual reduction factor of the emission cap increased from 1.74 to 2.2%. Second from 2019 till 2023, the intake rate of MSR was doubled from 12% to 24%.

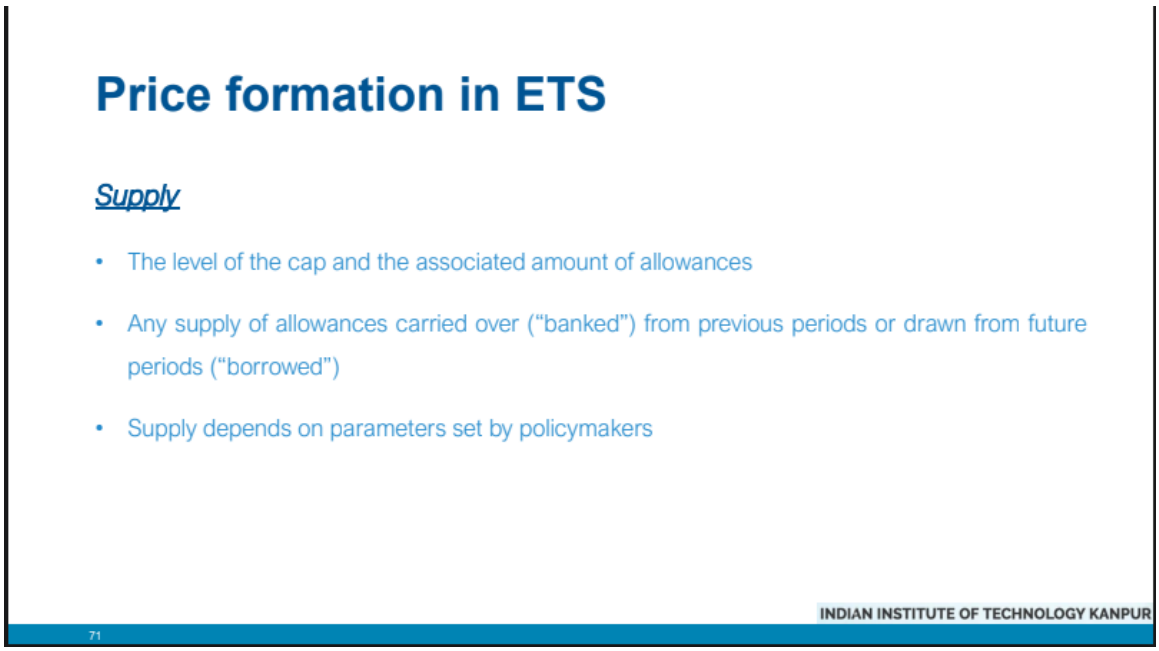
We will again discuss this. And third from 2023 onward, the MSR cannot contain more allowance than the total number of allowances auctioned during the year. In addition, there were some other measures also, for example, European Union recently adopted a binding renewable energy target of almost 32% of the final energy used by 2030. So this MSR, which was created in 2015, it essentially aims to maintain a certain supply demand in balance to address the current surplus of allowances in the UTS and also improve the system's resilience to major shocks. By targeting both the oversupply and undersupply in the secondary markets, this MSR seeks to avoid excessively low and high prices. And thus, this market stability reserve or MSR aims to provide stability for the European Union emission trading system by addressing the current surplus of allowances problem and also to improve systems' resilience to major shocks by adjusting the supply of allowances to be auctioned.

So in a way, it adjusts auction volumes according to some predefined thresholds of the total number of allowances in circulation. We will discuss this PNAC and its mechanism in more detail shortly, but effectively and essentially it adjusts the supply demand in balance. As a long term solution started operating actively from January 2019 as a part of FIT for 55 plan. In July 2021, the European Commission proposed the revision of this MSR under this FIT for 50-50 plan implemented from 2021. It was already running from 19 some important revisions were made in 2021 which were called as FIT for 55.

This FIT for 55 was part of the package of legislative proposals. It was initiated with a view to achieve climate neutrality objective of EU by 2050. So EU wanted to achieve climate neutrality by 2050 including the immediate target of at least 55% net reduction in the greenhouse gas emissions by 2030. So this FIT for 55 package aims to enable the EU to reduce its greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and then achieve climate neutrality by 2050. So one target for 2030 and one target for 2050.

For example, this decision prolongs beyond 2023 the increased annual intake rate of allowances by 24%. So the allowance intake rate of 24% was continued. It was supposed

to be decreased back to 12% as earlier but it continued. This MSR is the it started operating in 2019 and it intended to address the large market imbalances observed in the UTS in the past and to prevent such a buildup in future. Several factors were responsible for this imbalance as we have already discussed these included factors such as over allocation of free allowances, the financial crisis in 2008 and policy overlaps with the renewable energy and energy efficiency policies that have generated a surplus of allowances in the market which comprised approximately 140% almost 1.



4 times of the annual ETS emissions in 2018. So to address this glut the MSR adjusted allowance supply by transferring the excess allowances which were computed through a well-defined formula to the reserve allowances. These reserve allowances were withheld from auctions. These are either released or cancelled at a later stage. So this mechanism is governed by predefined rules and is meant to increase the system's resilience to major shocks and foster other climate policy.

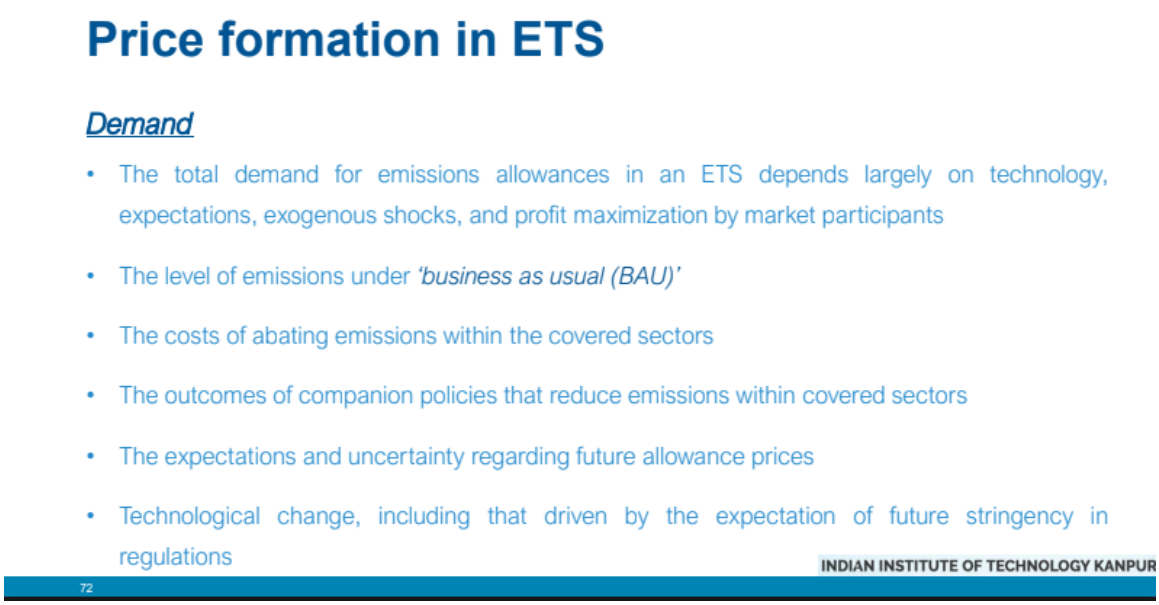
So effectively this reserve addresses the current surplus of allowances and also improves the system's resilience to major shock by adjusting the supply of allowances to be auctioned. To get to the specifics, the 900 million allowances that were part of backloading in 2014-16 will be transferred to the reserve rather than auction in 2019-20. So that is one important step in this MSR and also the unallocated allowances will be transferred to the reserve. The exact amount of these unallocated allowances will be known by 2020 only. However, market analysts estimate that around 550 to 700 million allowances could remain unallocated by 2020.

So the reserve operates entirely according to some predefined rules. There is no subjectivity. There's no discretion is left at the commission or member states in its

implementation. Now let us understand the workings of this MSR through its thresholds and key rules. So each year the European Union EU Commission publishes by 15th May the total number of allowances in circulation, what we call as TNAC.

What is this TNAC? Total number of allowances in circulation. This TNAC serves as the exclusive indicator whether allowances will be placed in the reserve, if so how many and whether allowances will be released from the reserve. So there are two guiding principles to be understood. First, under the MSR proposal each year 24% which is the intake rate which has been increased from 12% earlier, this 24% of the total number of allowances in circulation are transferred to the MSR provided that the total number of allowances is higher than 833 million allowances. So basically when the TNAC is above, so when this TNAC is above 833, 24% of the volume is withdrawn from the future auctions when it is greater than 23.

So allowances will be absorbed. And when this TNAC is less than 400 million, when it is less than 400 million, 100 million allowances are released from the reserve and auction. So when it is less than 400 million, then allowances are released and auctioned. So it is, if it is greater than 833, they are absorbed, if they are less than 400, they are released. So in this fashion, we can say that MSR adjust the supply by taking allowances from or releasing them to auctions thus affecting the short term scarcity or excess supply.



So in this way, it adjust the scarcity or supply. And this intake of allowances is determined by two key parameters, the total number of allowances in circulation that is TNAC and the intake rate that is 24%. So the TNAC here, let us understand this TNAC. This TNAC is the amount of allowances banked by the market participants for future use at the end of year.

And this TNAC is computed simply as the contemporaneous excess supply of allowances. So it is like supply minus demand plus those that are in reserve MSR, where the supply is given by the total number of allowances issued under ETS from the current phase plus the ones banked from the previous phase and also the international credits exercised by installation.

So there are international credits also as we discussed earlier. The demand side here, this demand side here is represented by the allowances and credits already surrendered for compliance or cancelled plus those allowances that are held in MSR also. The next parameter is the intake rate that we have discussed which was 24% increase from 12%. It determines this 24% intake rate, it determines what percentage of TNACs will be withheld from future auctions and moved into MSR. Those allowances that will be absorbed and depending on the TNAC, this MSR acts in one of the three models.

First, if TNAC exceeds 833 million, then MSR takes in the allowances into portion with the intake rate which is 24%. If it drops below 400 million allowances, then MSR releases 100 million allowances. For any TNAC values that lies in between these thresholds, the MSR remains idle. Now the 2018 revision of MSR doubled this intake rate from as we said from 12% to 24%. But most importantly, it also introduced an add-on feature to permanently cancel allowances from 2023 onwards.

So the 2023 simplified, this reform simplified the complex cancellation triggered and fixed it ex-ante. For example, in simple terms from 2023 onwards, the MSR will hold no more than 400 allowances. So it will result in cancellation of any quantity currently stored beyond this 400 million amount and also those allowances that are entering in reserve when it is at full capacity of 400, all of them will be cancelled. So just to quickly put some of these features in perspective, the efforts to address the market imbalance are also supported by a faster reduction of the annual emission cap agreed as a part of the UTS. So the overall number of emission allowances will decrease at a faster rate of 2.

2% from 1.7. So this was an auxiliary support measure from 2021 onwards. And this applies to the period 2020 onwards from 2013 to 2020, this factor was applicable. And this reduction rate is in line with the 2030 target. So this change in rate was to achieve the 2030 target of at least 40% cuts in the EU greenhouse gas emissions. So in the context of the revision of UTS, important changes were made to the functioning of MSR.

In 2019 to 2023, the percentage of total number of allowances in circulation determining the number of allowance were put in reserve if the threshold was greater than 833 million allowances. If it is exceeded, the rate was temporarily doubled from 12% to 24%. But it was continued, it was not revised back to 12%, it continued. Also in addition from 2023 onwards, allowances held in MSR above previous auction volume will no longer be valid.

So just to quickly summarize, the market stability reserve as a long term solution, it began operating in 2019.

And it is intended to address the large market imbalances observed in the UTS in the past and to prevent such a buildup in the future. As we noted several factors were responsible for this imbalance such as economic crisis, over allocation of allowances and so on. And this resulted in excess supply for example, almost 1.4 times or 140% of the annual emissions in 2018. So there was excess supply and to address this excess supply, the MSR adjust this allowance supply by transferring excess allowances to the reserve.

These reserve allowances are withheld from auctions. They are either released or cancelled at a later stage. And this mechanism is governed by predefined rules. And it is meant to increase the system's resilience to major shock and foster synergies with other policies. So essentially, the this MSR reserve addressed the current supply surplus of allowances and improve the system's resilience to major shocks by adjusting the supply of allowances to be auctioned. It is not to suggest that if there is a scarcity, then the allowances will be released.

So it is sort of liquidity balancing mechanism, it can be thought of as a indigenous liquidity balancing mechanism which absorbs allowances when they are in excess and releases when they are in short supply. In this video, we will discuss banking of allowances, which is a very important feature of any emission trading system and a part of market microstructure design. To begin with, banking allows regulated entities to save unused allowances for future use in compliance periods, in future compliance periods. It enables reduction in emissions today in exchange for increased emissions later, and it is a very vital component of all the existing emission trading systems. That means if you can reduce the emission today, you can save on allowances and in future if your emissions have increased, you can make use of those additional saved allowances.

Also banking can facilitate cost effective abatement by allowing those who wish to abate early in the flexibility to do so to prepare for stricter caps later. Moreover, banking can help reduce price volatility by creating additional demand for allowances when prices are low and once a bank established that means you have extra allowances, you have that flexibility that means these extra allowances will provide you with additional supply when prices are high. So at that point of time, you need not buy allowances from outside, you can make use of bank allowances. In general, banking is central to the efficient functioning of most carbon markets. Given this, policymakers have usually allowed full flexibility on banking across compliance periods within the same phase.

Though at EVTS, banking was prohibited across phase 1 and 2, particularly because phase 1 was pilot phase. There onwards across phases banking has been unlimited in the UTS

since 2008. So from second phase onwards banking has been unlimited. With all these benefits, however, banking can still create some challenges. What are these challenges? So for first, unlimited banking can enable an excess supply of allowances in one compliance period, which can be carried over into future compliance periods, which potentially prolongs an underlying imbalance between demand and supply and this may lead to excessively low prices.

Without banking, such imbalance would have been contained within the same compliance period, however, because banking is there. So if there is some kind of excess supply or some kind of imbalance in the allowances that may be carried to the future periods. Also another challenge is that while allowing banking can reduce volatility, there are cases where it can lead to adverse outcome. For example, in particular, banking means that changes in expectations of future market conditions can feed back to today's prices and thereby altering the value of bank allowances. Though this is a desirable outcome if future caps are credible and policy signals are clear, it can also create excess volatility in cases where there is a lack of certainty or future policies and this is more likely to emerge in cases where there is an oversupply of allowances in the present and so the primary driver of allowance demand is for future compliance.

In practical terms, there are several cases where policymakers have chosen to impose limits on banking or holding of allowances. Let us discuss some of these cases, particularly banking on trial phases. So prohibiting or limiting banking is a way to isolate a particular pilot phase as happened in the case of UTS in phase 1 to isolate the pilot phase from the subsequent phases. So this will create a potential for greater experimentation in that particular pilot phase without necessarily requiring that the allowances from the first phase or the pilot phase to be recognized as valid in the subsequent phases.

So this approach was adopted in phase 1 of the UTS emission trading system. However, as the UTS phase 1 experience shows, if there is excess oversupply or excess of allowances in the pilot phase, prices can fall very close to 0 and there will be no demand to buy and bank allowances for later use. So this is one such problem that may happen and a test case is a pilot phase. Also to control the ability of individual entities to acquire market power if we want to do that. For example, if individual institutions can acquire large number of allowances, there may be a concern that this could be used to distort market and this may provide a rationale for limiting the amount of allowances that an entity can hold that means an entity can bank. To summarize this video, we discussed the concept of banking of allowances in the context of emission trading systems.

We noted that while it is a very important policy tool and should be used judicially across different phases of emission trading systems. However, unlimited and excess of banking

can also have adverse outcomes for volatility and pricing efficiency. While when used in a judicious and controlled manner, it has a very positive impact on volatility and pricing efficiency, but when it is used in an unlimited and careless manner, it can create problems particularly as happened in the case of UTS in phase 1 when excess supply of allowances prices fell to 0. So because banking was polluted across phases that excess supply could not carry forward. However, if banking has been allowed across phases then that excess supply would have carried forward and created further adverse outcomes.

In this video, we discuss another very important concept of market microstructure of emission trading systems, which is borrowing of allowances. To begin with borrowing allows entities to use allowances that they will receive in future compliance periods within the current compliance period. This means regulated entities can emit more today and make up for this with larger emission reductions in the future. So essentially, the borrowing provides firms with flexibility to meet targets. For instance, it allows them that those installations that cannot easily abate immediately, they have the opportunity to make investments that will provide greater abatement in the future.

So it can also reduce short term price volatility. And in particular, it will help to provide market liquidity in times when allowances might be scarce and prices are high. So in a sense, it will help reduce volatility, provide more certainty and liquidity. However, there are certain challenges associated with providing this kind of intertemporal flexibility. For example, private actors are likely to face incentives to delay costs and behave in a short sighted manner. In particular, the challenges associated with allowing entities to borrow allowances are discussed here.

First and foremost, governments may not be able or have that capacity to assess the credit worthiness, have that kind of wherewithal. So the government may not be well equipped to assess the credit worthiness and solvency of firms that borrow allowances. Furthermore, there is likely to be adverse selection, which means that firms that are least solvent are likely to want to borrow more than the firms that are more solvent. Also, there are chances that increases in political pressure to delay action may be there. So for example, borrowing firms may like to delay abatement and therefore potentially creating an active interest to lobby for weaker targets may create political pressure as well.

Or even for scrapping of these emission trading schemes altogether so that their debts are reduced or cancelled. As a result of these disadvantages, most of the emission trading systems have either prevented explicitly borrowing or limited it in a quantitative manner. So in some of the emission trading system, there is a degree of short term implicit borrowing, which is facilitated by offering early access to future allowance allocations prior to the deadline for compliance in the current period. For example, in the EU, entities

receive allowances for the current compliance year by February 28, which is two months ahead of the end of the previous compliance period that is on ending on April 30. So in that way, they have this chance that limited period window from 28th of February to April 30, where they can use or in advance they can buy these allowances and borrow them for the previous compliance period.

So they can borrow the future, these allowances which were supposed to be used in the future periods and borrow them and make use of them in the previous period. Also there is no vintage associated with these allowance allocations. So for example, because there is no vintage associated with these allowance allocations or in other words, there is no activation date at which allowance can become valid for compliance. So therefore, these allowance that were purchased for the current period on February 28, these allowances can be used for the previous compliance period and hence that is what we implicitly call as borrowed without any limitation or penalty from the next year's allocation.

To summarize, in this video, we discussed the concept of borrowing of allowances. We noted while it provides the flexibility to plant manufacturing installations to meet their previous period, emission compliance targets by borrowing from the future period allowances issued. However, this kind of intertemporal flexibility can also have adverse consequences as we have discussed in this video. In this video, we will discuss some of the important traded products or securities about EUTS or European Union Emission Trading System and various other schemes also on organized exchanges such as EEX and ECX. To begin with spot, spot is a trade where the settlement of the trade that is payment and delivery is intended to take place on the spot that is right now. Generally speaking, the spot date should be within two business days after the trade date that is the date on which the sale is agreed and the settlement price in case of spot or the rate spot rate is called the spot price.

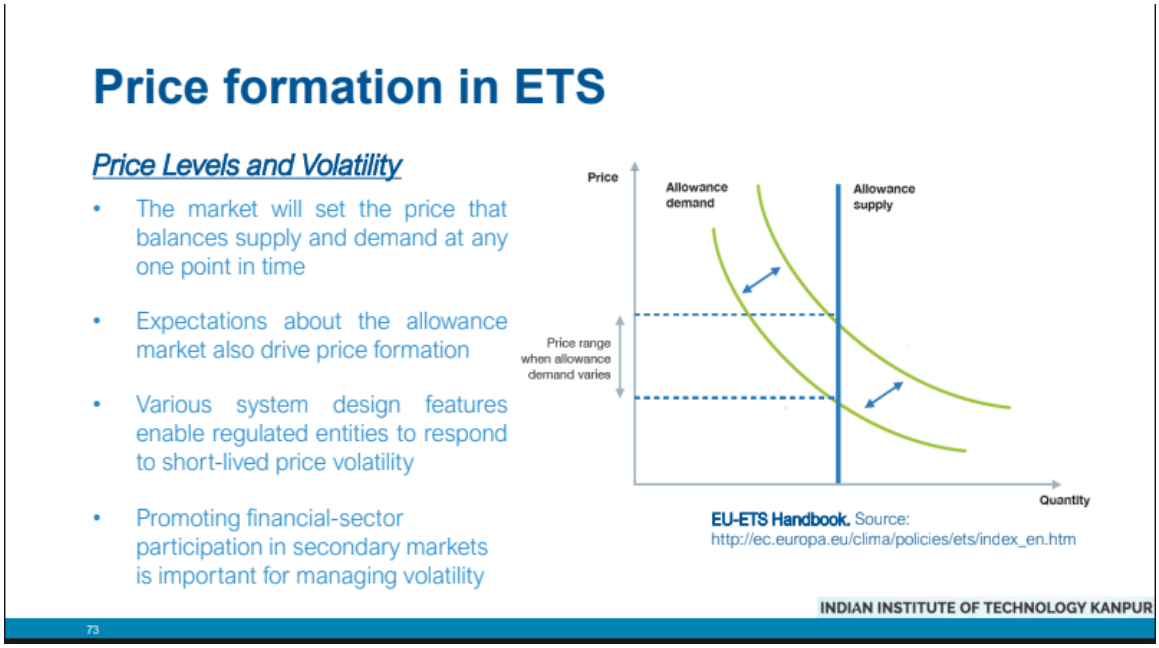
A spot contract is in contrast with the forward or future as we will discuss shortly. In future and forward, where contract terms are agreed now but delivery and payment will occur at a future date. So in that sense spot is different from future and forward. In general, spot contracts for EUTS are traded on EXEX. Then we have futures contracts or future securities. Futures is a more of a standardized contract between two parties to buy or sell a specified amount of carbon units for a price agreed today, which we call as future price or strike price.

With delivery and payment occurring at a specified future date, which is also called the delivery date. These contracts, these futures contracts are negotiated at a futures exchange and these are standardized contracts and exchange acts as an intermediary between the two parties. So in case of EUTS or European Union Emission Trading System, both EXEX and

ECX exchanges vaccinate the trading of EUA futures contracts. The contract size is generally 1000 UAs that means one lot is equivalent to 1000 UAs and each EUA contract being an allowance or each allowance is an entitlement to emit one ton of carbon dioxide equivalent gas which is also called one ton of carbon equivalent emission.

Next we have a forward contract or what we call also as OTC, over the counter product. So a forward contract is similar to futures contract in that the terms are agreed at the time of sale but delivery and payment occur at a future date. However forwards are different from futures in the sense that they are non standardized or what we call as over the counter product rather than by exchange. So they are more of a customized product. Unlike future where it is not much customizable, they are standard contract designed by the exchange, the futures.

Next we have SWAPS. SWAPS is a contract to exchange one security for another. In the commodities market or markets like EUTS, a swap allows a party to change its exposure or risk from floating prices to fixed prices or vice versa. However in the carbon market can also be as simple as swapping an amount of UAs for an equivalent number of due to carbon credits or something like that. And both of these types of units can be used for compliance in the EUTS but generally carbon credits like CDM, Clean Development Mechanism or JI credits sell at a discount to UAs. So generally these JI and CDM creates a letter discount to regular UAs and therefore the seller of UAs receives not only the credits in return but also that price differential, that delta price differential between UA and CDM between the two units thereby reducing the overall cost of complying with the EUTS.



Lastly we have options. Allowances are about giving buyers the option the right but not the obligation to buy or sell allowances at a fixed price upfront. For example a call option,

a call option gives the buyer of the call option the right but not the obligation to buy, buy the emission allowances at an agreed price. Similarly a put option allows the buyer of the put option the right but not the obligation to sell the allowances at a fixed price upfront agreed. Options are a very useful instrument, a very useful way of locking in a price or in avenue of sale when there is a risk that market conditions could move in opposite direction as originally anticipated. To summarize this video we discussed very important securities traded on organized exchanges for EUTS carbon trading scheme.

In particular we discussed the spot where the trade and settlement of the trade place immediately on the spot. We also discussed future which was a standardized contract between two parties to buy a sell specified amount of carbon units at an agreed price today but with the delivery and payment occurring at a specified future date. Forwards we also discussed forwards which are similar to futures but in that they are not standardized they are more customized and OTC. We also discussed the swap which is a contract to exchange one security for another and lastly we discussed options in particular we discussed the call and put options.

Call options give us the right to buy while put options gave us the right to sell. In this video we will discuss price formation in EUTS. This includes supply demand balancing and its impact on volatility. In practice various factors affect the demand and supply of emission allowances in an ETS and thus determine allowance prices and how they evolve over time. Let us start with the supply related factors that affect the price formation in ETS.

The total supply of emission units at any given point of time depends on various factors. These include first the level of cap and associated amount of allowances. These allowances are located either freely or through auctions. The next factor is the banked allowances that is the supply of allowances carried over from previous periods and also borrowed allowances that is the allowances that are drawn from future periods and lastly other sources may include mechanism such as CDM and GI that is Clean Development Mechanism and Joint Implementation Projects. Also supply depends on parameters set by policy makers. To a large extent supply depends on the parameters that are fixed by policy makers be it directly by the level at which the cap is set, UTS cap or through the rules of banking and borrowing.

So in short term the supply remains fixed and does not change with the levels of demand. Next we discuss the factors that affect demand and thus price formation in ETS. In contrast to the supply the total demand for emission allowances at UTS largely depends on technology expectations, exogenous shocks and profit maximization by market participants. Some of the specific factors determining allowance demand are discussed

here. For example the level of emissions under business as usual case that is case when there is no carbon price or emission trading system.

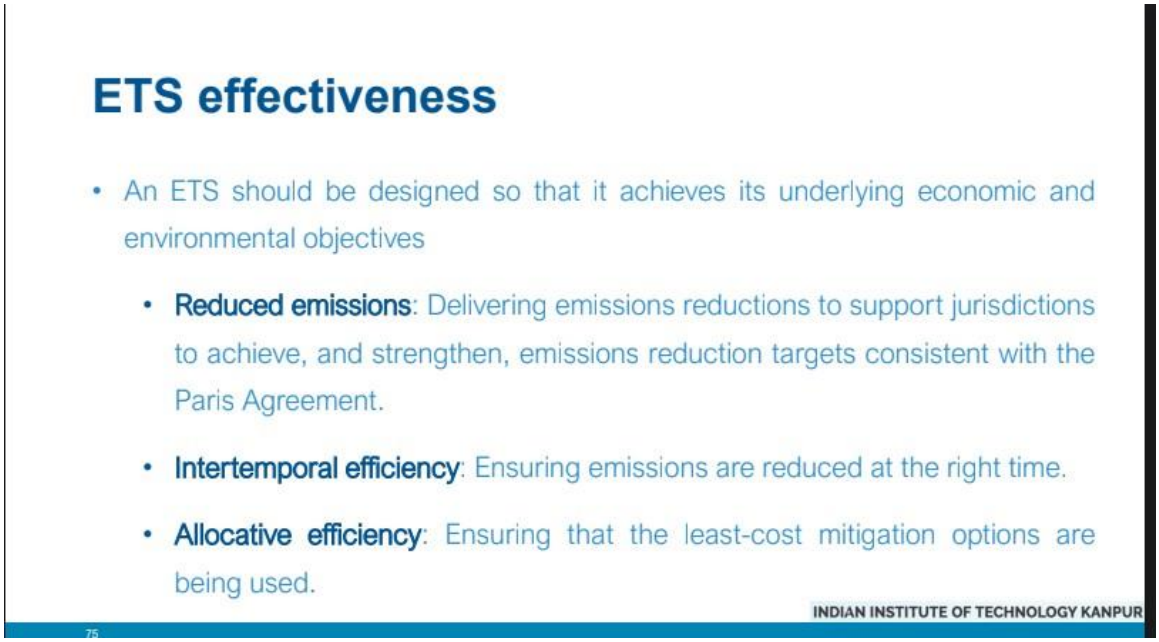
The next would be the cost of abating emissions with the covered sectors. These are costs that are driven by factors including weather, economic conditions, capital stock and availability of existing technologies. Next we have the outcomes of regulatory policies in a member nations that reduce emissions within the covered sectors such as renewable energy mandates or fuel economy standards related policies. Moreover the expectations or the uncertainty regarding the future allowance prices which determines the demand for banking emission allowances for use in future compliance and also for hedging risk that also affects the demand. Lastly technological change including that change driven by the expectation of future contingency of the program such as ETS and future demand for allowances or any other external demand for emission allowances from linked system may affect the overall demand in an emission trading system.

Overall the supply demand dynamics would affect the price level and volatility. Let us understand the demand supply dynamics and its impact on prices through the simple diagram. These green curves are allowance demands. On x axis we have quantity and on y axis we have prices. This is our conventional demand supply dynamics diagram and as the demand changes in short term the prices are affected. Please note in the short term as we discussed already the allowance supply is fixed so it is shown by a vertical straight line and as the demand changes in short term prices are affected.

So for example if demand increases prices increase from P1 to P2. If demand curve is shifted downwards prices decrease. So in short term supply remains fixed which is mostly exogenous. So supply is fixed by exogenous parameters by policy makers and so on while demand changes depending upon level of economic activity and various other factors as we discussed and price changes accordingly. Now there are certain aspects of price and volatility that can be managed and market quality can be improved that we are going to discuss here.

To begin with the market will set the price that balances supply and demand at any point of time. When the economy is strong and businesses are expanding operations there will be higher demand for products and thus higher associated emissions. This will put upward pressure on emissions and increase the total amount of abatement necessary to meet a given cap. In any emission trading system underlying economic and technological conditions interact with the cap to determine the price. For instance a faster rate of economic growth will result in higher carbon prices when the set of abatement technologies and other factors are held equal. Conversely a lower rate of economic growth under the same conditions will lead to a lower price and prices could even reach zero particularly if the banking is not available.

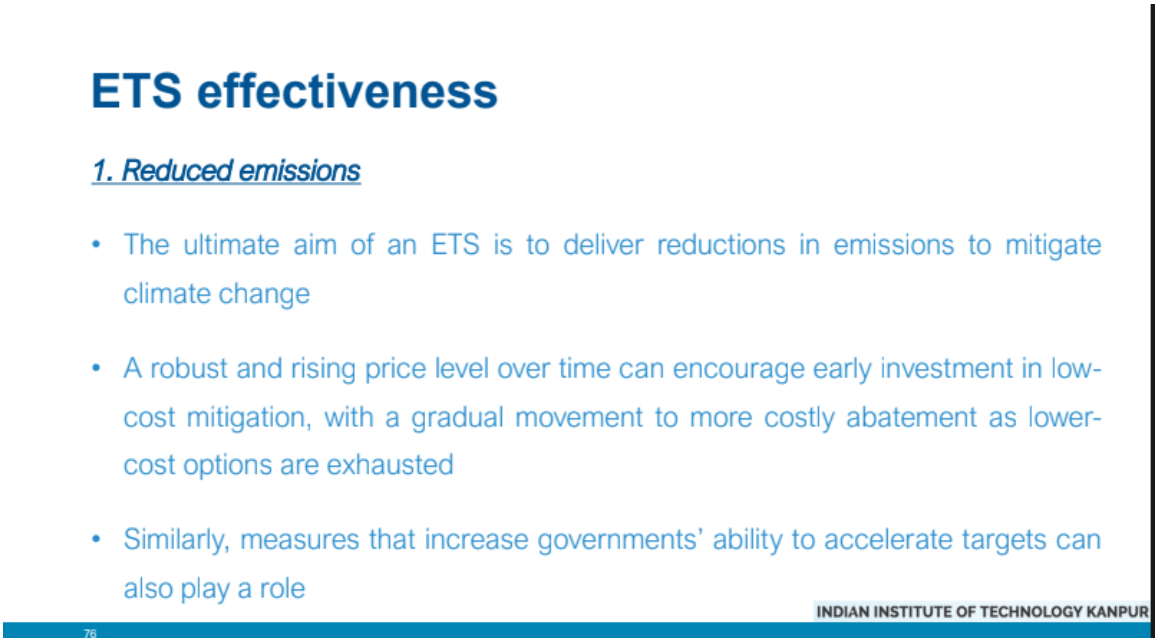
The next factor is expectations about the allowance market also drive formation of price. For example a low interest rate environment will reduce the cost of purchasing allowances today for future use and increase banking demand. In contrast regulatory uncertainty over the future of the ETS will temper such demand and therefore expectations can mean that even if in the short run the total demand for emission allowances associated with the current production levels fall below the given supply levels and therefore supply exceeds the demand. Supply that is number of allowances available in the marketplace. So then emission unit prices will still be non-zero if there is demand for banking.



So if banking is available the price will not go to zero even if supplies excess. Now expectations of economic and policy conditions also affect the expected profitability of investments in these climate change mitigation projects and research and development in new technologies and processes. Next various system design features enable regulated entities to respond to short-lived price volatility. For example broad scope intertemporal flexibility provisions, regularly held auctions, availability of offsets and allowances from linked systems and access to derivative under the hedging products can help reduce the degree of price fluctuations and their impact. In general moderate price volatility is not a serious concern for regulated entities and policy makers and can be managed if financial market instruments such as options, futures and other hedging projects that as we have discussed in the previous videos they are available similar to other commodity markets.

In other commodity markets also these products are used to manage volatility and avoid risk. Lastly promoting financial sector participation in secondary market is also important for managing volatility as it supports the development of financial instruments needed for

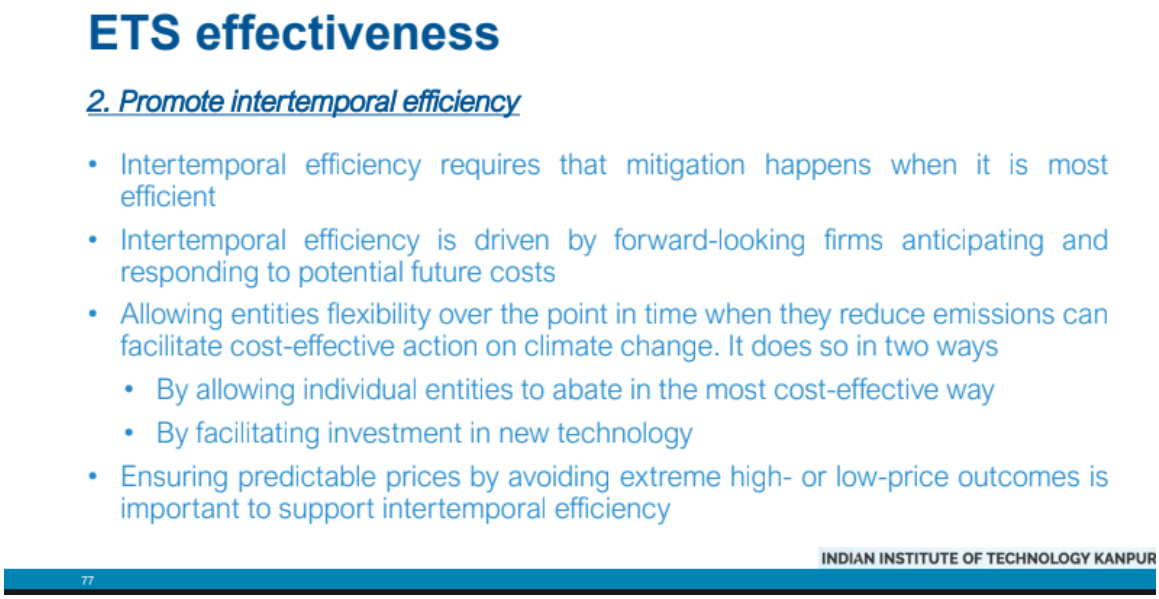
entities to manage price volatility. The financial sector can assist with creating products that regulated entities can use to hedge the risk of prices changing such as options and futures contracts. To summarize this video we discussed the supply and demand dynamics that leads to price formation. We also discussed the factor that affects supply and demand in an emission trading system and lastly we discussed how to manage the volatility through various instruments and ways and what factors are causing these volatile emission trading systems.



In this video we will try to understand how to assess the effectiveness of an emission trading system. To begin with an emission trading system or ETS should be designed so that it achieves its underlying economic and environmental objectives. Good market design and the use of measures to promote market predictability can help achieve this. A well-designed well-functioning ETS market will have three key objectives. First reduce emissions, delivering emissions reductions to support jurisdictions to achieve and strengthen emission reduction targets consistent with the Paris agreement. Second intertemporal efficiency which entails ensuring emissions are reduced at the right time and then allocative efficiency which ensures that the least cost mitigation options are being used.

Let us discuss them in more detail one by one. Let us start with the first and foremost objective which is to reduce the emissions. An ETS is created to promote numerous objectives but ultimately its aim is to deliver reductions in emissions to mitigate climate change. For example the Paris agreement codifies the aim to limit global warming to well below two degrees above the pre-industrial levels which is to be delivered through a set of bottom-up targets with ambition gradually increasing over time. An implication of this goal

is that the global greenhouse gas emission should reach net zero levels by the middle of the century which is 2050 to achieve net zero by 2050. And reaching net zero level requires that carbon markets provide sufficient price incentives to mobilize investment in new emission reduction technologies and processes.



The second important aspect is that a robust and rising price level over time can encourage early investment in low cost mitigation with gradual movement to more costly abatement as lower cost options are exhausted. So designing a market that delivers a robust price signal reduces the price risk faced by investors and encourages investments that may pay off only for robust carbon prices maintained in the longer term. Lastly measures that increase government's ability to accelerate targets can also play a very important role. So the evidence from the ETS emission trading system to date suggests that emissions are often reduced for a lower cost than first anticipated because there is a learning curve involved here. So given these policies that maintain prices at a certain level at a steady level steady and stable prices can bring forward cost effective emission reductions and make it much easier to drive up and accelerate ambition over time.

So steady and stable and reliable processes are very important. The next objective is to promote inter temporal efficiency. Now this inter temporal efficiency requires that mitigation happens when it is most efficient. If it costs less to reduce emissions now rather in future then the ETS should support this substitution. This means that the quantity of mitigation must have some flexibility over time. So inter temporal efficiency is driven by forward looking firms anticipating and responding to potential future costs.

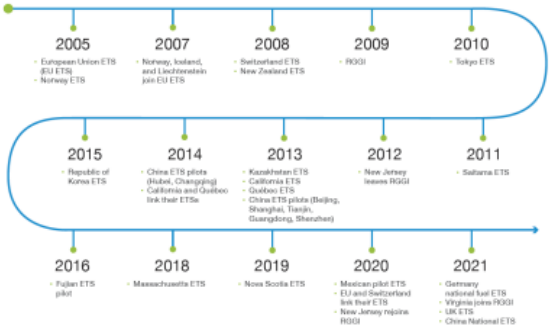
If firms expect prices to be higher in the future then they will be willing to pay more for an allowance today. However due to uncertainty about the future how much firms are willing to pay is discounted which is the time value of money concept. So discounted downward to reflect evaluation of this uncertainty alongside any borrowing cost. Currently through this mechanism currently prices reflect expected future prices in carbon markets allowing entities flexibility over the point in time when they reduce emission can facilitate cost effective action on climate change and there are two approaches to achieve it. First by allowing individual entities to obey it in most cost effective way which means the regulators timing of emission limits and associated allowance allocation over time may not match the most cost effective path for individual regulated entities. So the inter temporal flexibility allows heterogeneous firms to determine the most cost effective trajectory for new investments and to balance these with the optimal management of existing assets and infrastructure.

Next by facilitating investment in new technology which means fully addressing the challenge of climate change over the long term will also require technologies that may not exist yet so time is needed for new investments in research development and demonstration to pay off. So inter temporal flexibility can provide sectors and individual firms with the necessary time to invest in new technology and research and development. Lastly a very important aspect is ensuring predictable prices by avoiding extremely high or low price outcomes is important to support inter temporal efficiency as predictable prices provide markets with confidence and reduce the cost of investment in abatement technology. Under predictable allowance price path investments can be planned according to whether the costs of the project outweigh that of the cost of future avoided allowance purchases in addition to other savings and therefore this consideration becomes much more difficult if prices

follow an unpredictable price path and with enough uncertainty investments will be delayed or potentially not be made at all.

Global Emission Trading Market

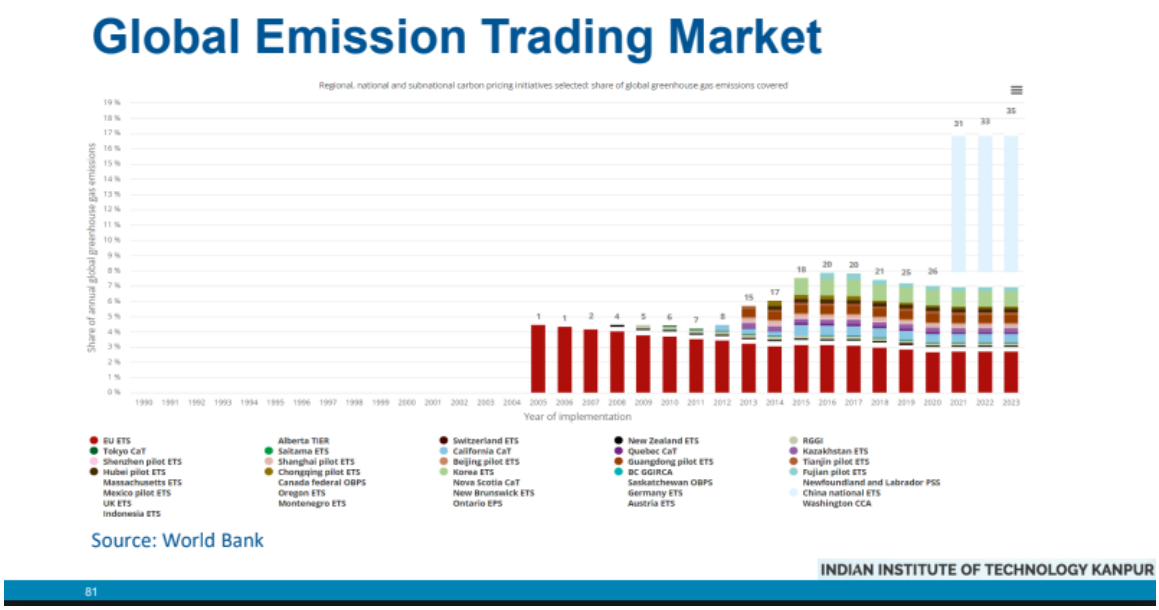
- Emissions trading for GHGs originated in attempts to control local air pollutants from power plants in the United States in the 1970s
- The 1997 Kyoto Protocol established provisions for the trading of emissions/emission reductions among its parties
- In 2005, the European Union (EU) and Norway established domestic ETSs



Source: EMISSIONS TRADING IN PRACTICE- A Handbook on Design and Implementation

Last but a very important aspect is to promote allocative efficiency. Now allocative efficiency here refers to whether the mitigation effort is appropriately split between regulated entities that is allocative efficiency ensures that the lowest cost mitigation options are used to reduce emissions in a given time period ensuring broad coverage can further support allocative efficiency across the economy and market design can also support allocative efficiency in two main ways first by ensuring liquidity and by reducing transaction costs. So first by ensuring sufficient liquidity first point and second is reducing transaction costs. Now here liquidity means that firms that wish to buy or sell allowances can do so at any point in a very swift manner enabling trade in allowances which helps ensure the right entity cuts emissions in a liquid market firms that can reduce their emissions at a low cost will do so and can choose to sell their allowances to those that cannot reduce their emissions. So in this fashion liquid markets also transmit a clear price signal to participants such that they can make informed choices regarding their trading strategies. Also a very important aspect here is the role of secondary markets for allowances as they can support allocative efficiency through reducing transaction costs both financial and administrative transaction costs can create barriers to trade in allowances which can lead to inefficient mitigation outcomes.

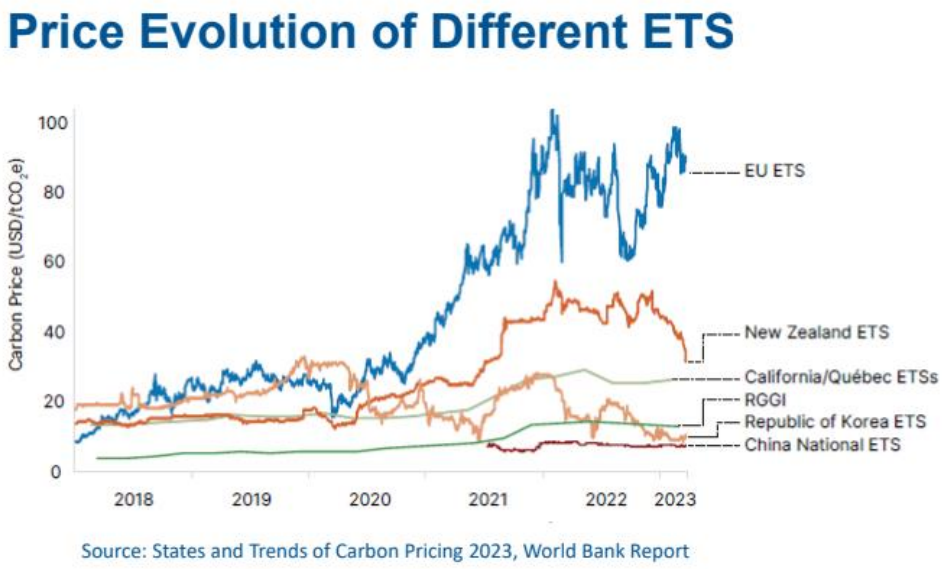
So if transaction costs are high for example a broker charge a large amount to facilitate a trade the firms that are initially allocated allowances may decide to keep them regardless of whether they need them or not. So this could mean that firms with higher mitigation costs which could otherwise purchase these firms allowances are not able to do so and this



results in mitigation efforts being split inappropriately across entities. Finally a liquid market with low transaction costs will support trading allowances and help ensure that prices reflect the latest information available to market participants. In general greater participation in the secondary markets will increase liquidity and spur competition that reduces transaction costs. To summarize this video we discussed three kind of FE objectives of any emission trading system one is to reduce emission and second is inter temporal efficiency which is ensuring emissions are reduced at the right time and third is allocative efficiency which is ensuring that the least cost mitigation options are being used.

Now these are three very important objectives of an ETS and to achieve this important objective it is critical that the ETS market has the requisite liquidity low transaction costs and also stable prices. In this video we will discuss the global emission trading market with some illustrations and also the pricing dynamics in the global emission trading systems. To begin with, Emission trading for greenhouse gases originated in attempts to control local air pollutants from power plants in United States in the 1970s. The US Clean Air Act amendments of 1990 established the first large scale trading program with an absolute limit on emissions of sulfur dioxide SO2 that was the first largest program emitted by power plants and soon thereafter the focus shifted towards climate and some countries began experimenting with greenhouse gas emission trading. Particularly the 1997 Kyoto Protocol established provisions for the trading of emission reductions among its member nations and in 2005 the European Union and Norway established domestic emission trading systems and Japan instituted a voluntary trading program to help implement its Kyoto commitments.

Greenhouse gas trading since then has spread a lot and jurisdictions have used a variety of different designs and approaches. For example here we can see starting from 2005 where we have European Union and Norway, then 2007 Norway Island they have joined UTS along with Nikesh time, then 2008 Switzerland, New Zealand, then Tokyo in 2010, Republic of Korea in 2015, then starting from 2014 China ETS pilots and California, Quebec, Ligney, RITSS, 2013 Kazakhstan and so many others are joining the schemes. So as we can see as time passes more and more member nations join these emission trading systems in one format or the other and there is a very exponential growth in the acceptance of this particular instrument. So as of 2020 almost 28 different emission trading systems have been implemented or are under development globally particularly in countries like China, India and so on. These are the new emerging markets of ETS. The development of ETS occurs within the broader global climate policy context and Article 6 of Paris Agreement in December 2015 affirm the role of voluntary mitigation cooperation between countries tying it to the provisions to ensure its environmental integrity and Article 6 therefore sends in very important signal that it is likely to accelerate the spread of carbon pricing establishment and linkage of ETS across different countries.



Source: States and Trends of Carbon Pricing 2023, World Bank Report

As we can see in this diagram in the initial phases starting from 2005 European Union Emission Trading Steam has the bulk of the volume share of the overall emission, it has the bulk of the share but gradually as we move ahead there are number of schemes that are coming up for example Tokyo, Shenzhen, Mexico, Shanghai, China pilot carbon markets and so on. As we see right now this light blue which is of China emission trading systems they have come up in a very big manner. So number of schemes are coming up and consolidating they are linking their emissions under different mechanism and lot of trading activities happening and we can see the overall share of global carbon is increasingly being

covered by these schemes we can see the overall as a share of overall emissions of global carbon emission these schemes are increasingly rising in volume. So there is a very exponentially increasing trend. So now let us look at the pricing trend across these schemes we have some of the major schemes here particularly the UNITS, then New Zealand, Korea, China's pricing dynamic slightly on the lower side though their volumes is high.

So in particular the energy prices and cost of living crisis were the major factors driving price trends and influencing the design and implementation of carbon taxes and emission trading systems in 2022. In particular if you look at this dynamics the very high volatility is driven by COVID in this period the COVID particularly affected and then there is geopolitical crisis energy crisis driven by Russia Ukraine war. So that is the reason of this high volatility. But despite this the policies appear to be weathering the challenging political, economic and geopolitical crisis circumstances relatively well. So these crises are reasonably contained while some countries directly intervene to keep carbon tax or ETS prices low most prices remain relatively stable and in some jurisdictions notably in Europe the prices increased which is a good sign.

So some ETS's experienced more volatility in 2022 as a result of fluctuating energy prices and geopolitical prices and to a lesser extent government responses to the energy crisis so government response also had a role to play there. High income countries like European region still see the highest direct carbon pricing coverage prices and revenues yet there is growing interest especially among low and middle income countries particularly like India especially in the light of potential for careful design and targeted use of carbon price revenue to support developmental growth like for example revenues from auction and so on. So to summarize this discussion on pricing the growth in prices in emission trading systems and carbon taxes have slowed following the years of steep growth but they have also showed the sign of resilience in the phase of challenging circumstances such as energy crisis geopolitical issues and COVID crisis. Overall these emission trading systems and carbon taxes have weathered the 2022 global energy crisis relatively well half of these instruments saw price increase while around third saw price unchanged which is a good sign showing robustness and steady level of pricing that has been attained for carbon but fewer than 15% of instrument also saw price decrease. The biggest increases were seen in Europe so as we can see here and in fact in Europe the UTS the price exceeded and crossed that psychological 100-euro mark which is around 109 USD or 100 euro which is a sort of one can feel psychological benchmark for the very first time in 2023.

Price movements in these markets were more volatile in 2022 compared to previous year however many emission trading systems saw price drop by as much as 35% for example in Korea. Only a few countries responded to the political pressures from high energy prices by deliberately lowering the carbon tax rates or postponing schedule increases. So just to summarize our discussion since 2005 since the inception of UTS a large number of emission trading systems have come up and they are doing fairly well particularly systems

in China, UK and so on so they are doing fairly well and carbon prices have been steadily increasing they have weathered the storm and challenges related to covid crisis and geopolitical crisis such as Russia, Ukraine but still the prices have secularly shown increases capturing the environmental scarcity reflecting the risk being associated with environmental risk so the carbon prices have been steadily increasing which is a good sign for all these emission trading systems and in future as more and more emerging markets such as India and pilot markets of China expected to come up the future looks bright from this vantage point. To summarize, one of the legacy issues from phase 1 and phase 2 affecting the carbon pricing was excess supply of allowances driven by economic crisis and relatively high supply of allowances.

To account for this excess supply two key measures were adopted. First the short-term measure is backloading of allowances. This measure delayed 900 million allowances of auctions by certain years thereby immediately absorbing excess allowances. A more long-term systematic measure was the market stability reserve or MSR. MSR operated by absorbing excess allowances if total net allowance in circulation exceeded by 833 million moreover if allowances were less than 400 million then they were absorbed from the system thus MSR mechanism maintained desirable optimum levels of liquidity between the two critical thresholds that is 400 million the lower threshold and 833 million the upper threshold in the system. Here TNSE is total net allowance in circulation.

In addition, for covered installations the provision of banking and borrowing helps them in optimizing their emission objectives. For example, banking allows covered installations to use unused allowances in future compliance periods. Similarly borrowing allows the use of allowance allocated in the current monitoring cycle to be used in the previous period compliance submissions thus both of these mechanisms help optimize the time pattern of carbon emissions and balance out excess supply demand if any. Two key exchanges for carbon trading included EEX and ECX. These exchanges facilitate spot future forward swaps and options trading.

These instruments contribute to carbon price efficiency by removing excess volatility associated with emission related uncertainties. The two key forces of supply demand affect carbon pricing in ETS. In the short-term supply is fixed and pricing is driven by demand-related factors such as level of economic activity and the level of energy efficient technologies employed by covered installations. The effectiveness of an ETS is judged by the level of emission reduction and levels of abatement cost, that is cost of reducing per ton of carbon equivalent emissions. As the inception of ETS a number of non-euro developed and emerging markets such as India, China are coming up with their own ETS. While early phases of these ETS are characterized by weak prices that are volatile,

gradually as the schemes mature prices are increasing and becoming more stable and less volatile reflecting the success of this policy instrument. Thank you.