Commodity Derivatives and Risk Management
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Lecture 56
Carbon Credits (REC, ESCerts, CORSIA) & Carbon Derivatives

Welcome to the 56th lecture on Commodity Derivatives and Risk Management. And today we will continue with our discussion on different aspects of carbon credits. And as part of today's discussion, we will be discussing renewable energy certificates, energy saving certificates, we will also be discussing a very interesting concept related to CORSIA as well as carbon derivatives. In fact, if you recall in the previous session, we have discussed many initiatives taken at the international stage related to reduction in greenhouse gas emissions. In the context of India's initiative let us understand what exactly India has committed in terms of its intention to reduce carbon emissions into the earth's atmosphere. As you can see India very clearly in a black and white manner in articulated its intention to minimize the greenhouse gas emission. And this first panel of this particular slide indicates the India stand which was very clearly articulated in the COP 26. And this COP 26 was held during 31st October 2021 to 12th November 2021 and COP 26 was held at Glasgow. And as part of this COP 26 India came out with five nectar elements or Panchamrit, with this particular initiative India's initiative related to reduction in carbon emissions. India wants to reach 500 gigawatt of non-fossil energy capacity by 2030, 50 percent of its energy requirement from renewable energy will come by 2030. Similarly, reduction of total projected carbon emission by 1 billion tons from now that is from 2022 onwards till 2030. It was mentioned that the reduction of total projected carbon emission by 1 billion tons. Similarly, reduction of the carbon intensity of the economy by 45 percent by 2030 over the 2005 level. And very interestingly India also very explicitly mentioned that it is going to achieve the target of net zero emission by 2070. And in this context India's initiative related to reduction of carbon greenhouse gas emission can be categorized into three broader categories. The first category is promoting power generation through renewable sources. And the second and third category which are basically market-based initiatives creating a trading platform where renewable energy certificates can be traded. And also creating another same trading platform where energy saving certificates ES CERTs, ES CERTs stands for energy saving certificates. So, this energy saving certificate comes from initiative of promoting energy efficiency and trading. In the context of the first initiative that is promoting power generation through renewable sources, India has come up in a very significant way in terms of the quantity of electricity which is being generated from the renewable sources. Again, this particular image which shows almost an exponential growth of India's

renewable energy capacity. As you can see, hardly any renewable energy production was happening in the year 2002, but by 2020 we have almost increased to more than 138337-gigawatt hour of electricity. So, India's commitment towards renewable energy generation is very commendable. In this context I would also like to highlight that India is now the world's third largest producer of renewable energy. With this let us move to understand or discuss more on what is the renewable energy certificates and what are energy saving certificates. Now coming to the renewable energy certificate or REC mechanism, this particular mechanism has been created by Central Electricity Regulatory Commission or CERC. CERC introduced the renewable energy certificate mechanism in the year 2010. And basically, this mechanism aims at companies which are generating renewable energy are given REC. So, if a particular electricity producing company is also producing renewable energy will be given REC that is renewable energy certificates. Please note that these companies will be selling electricity and generate revenue like any other conventional power producer. And in addition to the revenue generation from selling electricity they will also be generating by selling they will also be generating revenue by selling renewable energy certificates. And one REC is issued to an electricity generator when that generator is producing 1 megawatt hour of electricity generated through a renewable source. So, this is the process by which renewable energy certificate will come into existence. Now the question is who will buy this renewable energy certificate. In this context CERC has also identified obligated entities who are going to be required to buy RECs. And this renewable purchase obligation policy of CERC mandates that all electricity producers produce some amount of renewable energy. And if a particular power producer is not able to is not able to produce renewable energy, then that particular power producer has to buy RECs. In addition to the power producer, the renewable purchase obligation also mandates electricity distribution companies to buy RECs depending on their extent of business they are doing. So, C ERC has facilitated the issuance of REC as well as created a necessity for some set of companies who have to buy these RECs. And please note that the RECs have to be purchased or sold by purchased by the obligated entities through a market-based structure. Market based structure means a particular mechanism will be developed where buyers and sellers will be coming to that platform and buying and selling the REC. Now let us understand how exactly the RECs are being bought and sold in Indian context. Please note that the buyers and sellers of RECs undertake buying and selling of RECs at energy exchanges in India. And this right-side panel indicates the contract specification of REC as given by India energy exchange. And please note that in a typical commodity futures or commodity contract specification the exchange decides what is going to be the contract parameter. However, in this case majority part of the contract parameter are governed by the CERC regulation. As you can see the REC denomination is when one party generates 1 megawatt hour of electricity from renewable energy sources will be given one REC. And this validity is for 1095 days after issuance means a particular power producer will be

able to hold or sell the REC within 3 years. As you can see 365 into 3 is your 1095 days. So, basically a particular power producer who has been given an REC that particular power producer has to hold or has to sell that particular unit within 1095 days. And RECs can be issued for solar power producer as well as non-solar power producer. And trading platform the buying and selling can happen only at the power exchanges. In the context of banking and borrowing please note that one particular energy producer renewable energy producer if it has been allocated one REC that has to be utilized within these 3 years it cannot be transferred to the next 3 years. So, banking not allowed means the RECs will have a maximum longevity of 3 years. Borrowing also not allowed in the sense if a particular obligated entity requires to have some RECs, they cannot borrow it from another counterparty they cannot borrow it they have to basically buy it. Now, coming to transfer type transfer type is single transfer means the RECs can be only bought or sold once. So, once the CERC assigns or gives a REC to a renewable power producer that particular power producer can sell that REC to only one entity only one time. And the party which has bought the REC will not be able to resell it. And coming to the two interesting aspect penalty for noncompliance and price guarantee. So, the floor price is the minimum price to be received by the seller and it basically gives a guarantee to the REC generator that if they produce one REC, they are assured of getting the minimum floor price. And forbearance price that is basically relates to the maximum price to be paid by the buyer that is the maximum penalty to be paid by the parties who are not able to fulfill the renewable generation targets. Please note that the floor price and forbearance price are specified by CERC. So, floor price ensures that the REC generators are getting some decent price. Similarly, forbearance price ensures that the buyers do not have to pay a very high amount of money to buy one particular REC. So, this is how the REC mechanism works in Indian context. Now, I would like to again take some snapshot from the India energy exchange to indicate the REC trading. Please note that the RECs are transacted through monthly auctions. So, basically India energy exchange creates a platform where buyers and sellers will be coming to a platform and different buy bid and sale bid will be giving and the cleared volume will be identified and as well as the clearing price will be identified and of course, the number of participants who have participated in a given auction is mentioned here. In the context of cleared volume and clearing price, please recall that we have discussed the concept of market clearing price and market clearing volume with respect to electricity market. Exactly the same methodology is used by the India energy exchange to arrive at what is going to be the cleared price. And please note that CERC from time to time has modified the floor price and the forbearance price. In fact, in a very recent development CERC has abolished the maximum validity period of 3 years for REC. Earlier a particular company which has generated renewable energy sources can hold the REC up to maximum 3 years. So, that particular limitation has been done away from the market. In this context I would also like to draw your attention to the quantity of buy bid as well as the quantity of the sale

bid. As you can see the quantity of buy bid is much lesser as compared to the sale bid that goes on to indicate that there are more number of RECs to be sold as compared to the number of buyers who are interested to buy RECs. Now, coming to the next mechanism that is your energy saving certificate mechanism that is part of the PAT mechanism. So, PAT stands for your Perform, Achieve and Trade mechanism. So, let us understand what exactly is a PAT mechanism with respect to energy saving certificates. In this context, please note that national mission for enhanced energy efficiency which is a body which is under your ministry of power that particular unit has initiated an initiative which is known as your Perform, Achieve and Trade mechanism or PAT mechanism. And this PAT mechanism is aims to incentivize efficiency in large energy intensive industries and units. So, basically the national mission for enhanced energy efficiency NMEEE has identified certain designated entities or consumers who have a high energy intensive who come from the high energy intensive sector such as thermal power, aluminum, cement, fertilizer, iron ore etcetera and even hotels. So, these are the bodies which energy consumption requirement is very high and through this PAT mechanism the government of India wants these entities to be much more energy efficient. Please note that these 8 sectors or 9 sectors account for about 45 percent of the India's primary energy consumption. So, the policy or the announcement related to which are the designated consumers that is available in this particular link. In this context I have also taken some snapshot from the link to explain what the meaning of the energy efficiency is. Now, let us take the unit, which is your thermal power plant, under the thermal power plant. Let us say Bongai Gaon thermal power plant of NTPC that has a current heat rate of 2631.52 and what the government want it to achieve is 2619.03. Please see this is the current as of 2016-17 the heat rate is which this particular power plant current heat rate is 2631.52, but the government wants it to achieve a heat rate of 2619.03 for the target year 2022-2021. Similarly, let us go to another example of commercial building, in this case the hotel that Leela palace airport road Bangalore. So, this has a specific energy consumption value of 17.22 unit per 1000 square meter and government want it to reduce the energy consumption to 16.7 unit per 100 square meter and 4 units per the same 1000 square meter. Now, this is the right panel right column of this particular table shows the limit set by the government of India. Now, if a particular company actually achieve this particular target basically the energy intensity increases and if they are able to achieve this target, they will be issued with energy saving certificates and those units will not be able to achieve this limit they have to buy the energy saving certificates from the counter parties. And this buying and selling has to be done through a market-based mechanism and in this case power exchanges of India are providing a platform where buyers and sellers of energy saving certificates converge and arrive at the price. Now, this is again the snapshot which I have taken from the India energy exchange. Please note that the depending on the extent of energy efficiency achieved BEE issues the energy saving certificates to designated consumers. And DCs who have achieved the reduction in

baseline specific energy consumption can sell those energy saving certificate to DCs who under achieve this target. And at IEX weekly auction is done by the buyers and sellers and forbidding energy saving certificates. Again, as you can see these are also the same process is done as per the market clearing price and market clearing volume. The sell bid is mentioned, purchase bid is mentioned, trade volume is mentioned again as you can see the sale bid is much higher as compared to the buy bid. And the trade volume is same as your purchased volume, and you can see the price discovered the discovered prices 1840 rupees in all this last 4 auctions being done and you can see the number of participants is also mentioned here. And for the auction which was recently conducted as you can see the supply and demand this particular right-side panel corresponds to the auction which was held on 27th June 2023. As you can see that the number of sale demand is substantially higher while the buy demand is much lower, and everybody has given a price quotation of 1840 because government of India has set the floor price and with a greater number of sellers buyers and sellers are participating in the auction at the floor price of 1840. In fact, there is no price discovery is happening there are many more sellers there are very few buyers and government of India has already set a price floor of 1840. So, obviously, every buyer is interested to buy at the minimum price of the floor price which is 1840. So, that is why this is a very typical supply demand curve interaction. If you compare the supply demand interaction curve which we had discussed in electricity this diagram will be very different compared to the typical demand supply interaction curve with respect to electricity. Now, coming to the third interesting aspect of today's discussion which is known as your CORSIA. So, CORSIA stands for or CORSIA is an acronym CORSIA stands for Carbon Offsetting and Reduction Scheme for International Aviation. Now, please note that the airlines greenhouse gas emission is around 2 percent of the world's total greenhouse gas emission. And in this context, I would also like to draw your attention that airlines if they fly, they have to use jet fuel there is no other way airlines will be able to minimize their greenhouse gas emission. Those some initiatives are currently being done with respect to sustainable aviation fuel, but as long as people are travelling by an aeroplane, aeroplanes will be running in jet fuel, which is basically nothing, but the kerosene. And greenhouse gas emission from airlines is about 2 percent of the world's total greenhouse gas emission. So, to reduce this total greenhouse gas emission from the earth’s atmosphere because of the international travel, the International Civil Aviation Organization that is ICAO which is basically a United Nations Agency. And the mandate of this particular agency is to assist 193 member countries of the United Nations to adopt international civilian flight standards and policy which is based on your Chicago convention. Now, in addition to promoting the major mandate of governing the policy related to international civilian flight standard, ICAO has initiated a new initiative which is known as the CORSIA. And this initiative came into existence in 2016 at a meeting held at Montreal. And this CORSIA is the first mandatory sector specific carbon pricing compliance scheme at a global level. Please

note that till date no other specific sector at a global level has come to a common platform where they have commonly agreed to reduce the greenhouse gas emission. And CORSIA is the first mandatory I want all of you to pay attention to the word mandatory, CORSIA is the first mandatory sector specific carbon pricing compliance scheme at a global level. So, what CORSIA basically aims to do, CORSIA obliges most airlines to monitor and report their emissions from 2019 onwards. And based on the actual carbon dioxide emission airlines have to buy carbon credits. Please note that the airlines have to buy and surrender eligible carbon credits which is known as the carbon offsetting. And in addition to buying and surrendering the carbon credits airlines can increase the usage of sustainable aviation fuel. Airlines can do lot of initiative to become much more fuel efficient, they can buy more fuel-efficient aircrafts and take lot of initiative to reduce the greenhouse gas emission. In this context I would like to draw your attention to the right panel diagram as you can see this particular diagram, I have taken from the icao.int, this website the link to this particular link to the file is mentioned here. And as you can see the 2019 initial is the baseline and if a particular airline has greenhouse gas emission is more than the baseline that particular airline has to buy the carbon by the by that many carbon credits. So, basically if any airline is spending or airline is generating more greenhouse gases than the baseline, they have to buy carbon credits. So, that is the basic philosophy of the course here. So, as it mentioned the actual if the actual CO2 emission is higher than the baseline the airlines have to buy eligible carbon units. And the actual CO2 emission for a particular airline will be measured by revenue ton kilometers or RTK, the calculation related to the RTK is mentioned here. So, I am not going into the detail of the RTK calculation. Basically, revenue ton kilometer, higher the revenue ton kilometer for a particular airline higher is going to be the fuel consumption and higher the fuel consumption higher is going to be the greenhouse gas emission. In this context many airlines are now blending sustainable aviation fuel or biofuel as part of their fuel requirement. And it is very interesting to know that the sustainable aviation fuel reduces up to 80 percent of carbon emission compared to normal jet fuel. And these are produced from corn, oil seeds, windwood mill, waste even municipal solid waste streams are used to generate the sustainable aviation fuel. And sustainable aviation fuel is much more expensive as compared to the normal jet fuel because the cost of the production of this sustainable aviation fuel is much higher. In this context, please note that ICAO has also identified which are the carbon units or carbon credits the CORSIA members can buy to offset the greenhouse gas they are emitting. So, this particular table which shows the clean development mechanism initiative which is part of the CORSIA offset. As you can see ICAO has identified the list of carbon credits which are eligible for upsetting korsia requirement. So, some of the carbon credits which CORSIA members can buy can be from the American carbon registry can be from the China GSG voluntary emission reduction program and also the clean development mechanism. Please recall we have extensively discussed with respect to the clean development mechanism and as part of the

clean development mechanism, companies generate CERs and certified emission reduction units. So, certified reduction units can be bought by CORSIA members to offset their carbon limit. With this let us come to the derivative contracts related to carbon credits, many exchanges predominantly ICE futures exchange of USA and EEX. So, the IRG of European Union offers futures and option contracts on carbon credits. I have just taken two snapshots of the contract specification from ice futures USA. As you can see the first contract specification related to RGGI carbon dioxide futures. We have discussed about how the RGGI comes into picture in the previous session. So, that is the spot market and somebody who is interested to buy RGGI they can come to the exchange platform and do so through the futures market also. As you can see the contracts symbol is RJ3 vintage 2023. So, RJ3 relates to your RGGI carbon credits which are available in the RGGI carbon credits. We will come back to understand the meaning of vintage and settlement method is physical delivery, buyers and sellers of futures contract after the contract maturity have to deliver the sellers have to basically deliver the RGGI units. And the contract size is 1000 RGGI carbon dioxide allowances currency of trading is USD and here interestingly please note the deliverable instrument the del it indicates that the deliverable instrument is RGGI carbon dioxide allowance allowances which is equal to the contract size delivered through the RGGI CO2 allowance trading system. Please recall we had also very briefly discussed about the RGGI quotes. So, basically it is a platform which keeps the track record of which party has owning or which party is owning how many units of RGGI. So, whenever people are buying and selling futures contract the delivery related to this carbon unit is done at RGGI quotes. Similarly, I have also given the contract specification of EUA futures listed and traded at ICE futures exchange. So, details are very clearly mentioned I do not want to go into that detail. And with respect to European energy exchange, EEX also offers the futures contract which are based on EUA, that is European Union allowances. And based on the spot date as you can see for the different expiry month you have lot of futures contracts trading and as you can see from the open interest values and interestingly you can see that the futures contract standing in the year 2023 futures contract up to December 2026 is also being traded at EEX that is energy European energy exchange. In the context of the word many a times you will hear the word vintage with respect to carbon credit. So, the word vintage refers to the year in which the credits are issued. Now many companies try to buy carbon credits with vintage around the same time frame as the emissions they are looking to upset. Now basically let us come to this RJ3 vintage 2023 means this particular carbon credit or the underlying of this particular carbon credit is having been issued in the year 2023. And so, from the year we will be able to make out which year this particular carbon credit has been issued. Please note that the carbon credits are carbon credit will have a unique number for example, the RGGI codes will have a unique number associated with every carbon credit. And in this context please note that many companies when they are buying carbon credit to upset their own greenhouse gas emission, they try to buy that

vintage which kind of a matches with the time frame as the emission they are looking to upset. Hence older vintage credits normally sell at a lower price as compared to recently issued carbon credits. So, the recent more or more recent carbon credits will come and a higher premium in the market as compared to the older carbon credits. Now coming to the pricing of the carbon credits. So, we will be discussing very briefly the pricing of the carbon credits. Please note that according to the World Bank, there are about 73 regional national and carbon pricing initiatives. We have discussed many carbon pricing initiatives such as EUAs, AAUs, CERs, ERUs, RECs energy saving certificates and many such initiatives. So, when we are talking about the carbon price that relates to a specific carbon unit because the specific carbon units will be governed by its own supply and demand. So, in general for example, if we are considering the CERs or ERUs that is which are generated when the countries undertake CDM or Clean Development Mechanism project or joint implementation projects. So, the number of registered CDM's and JI project will influence the supply of CERs or ERUs. If higher number of CDM or JI projects will be there, there will be higher number of CER's available. Also, the stringency with which the compulsory of setting requirement is followed by different bodies will also influence the buying demand and hence in turn will govern the price of the carbon credits. Interestingly demand from World Bank also decides what is going to be the price of a carbon credit. In this context I would like to draw your attention to the fact that World Bank carbon finance unit is a major purchaser of CERs and ERUs. So, from 2000 onwards this carbon fund of the World Bank has bought about 187 million ton of carbon dioxide equivalent. So, if the World Bank increases its effort in buying this CERs or ERUs then the demand for this these units will be increasing. In addition to the buying and selling demand, the price of natural gas and coal also affects the carbon credit price. Please note that the thermal power generation units whether they use coal or the natural gas they are the largest emitter of the greenhouse gas emission in the in the earth atmosphere. So, the way price of natural gas and coal moves that also that also influences the carbon credit price. Let us understand this aspect. So, basically higher if the price of natural gas is less than the coal prices power generation will be power generators will be switching to the gas. Let me repeat if the natural gas price is less than the coal price power generation units will be switching to the natural gas. And higher gas-based electricity generation leads to lower greenhouse gas emission. And when they have a lower greenhouse gas emission, there is availability of more carbon credits and the less price of carbon. So, you can see the dichotomy here, whenever the natural gas price goes down power generators will be shifting from coal to the natural gas and when power generator companies will be shifting to the natural gas their greenhouse gas emission is going to go down and hence there will be a more availability of carbon credits. In fact, some studies have shown that the fall in gas price from 6 dollar to 2 dollar holding the coal prices fixed leads to 10 percent drop in the aggregate a carbon dioxide emission. In this context I would also draw your attention to some interesting observation please recall

in the context of coal in the context of electricity we had discussed about the dark spread and the spark spread. Now we will introduce a new concept called a clean dark spread and a clean spark spread. So, clean dark spread is nothing, but the price of electricity minus the price of coal into heat rate of coal minus the price of carbon dioxide and intensity of carbon dioxide. So, basically clean dark spread and clean spark spreads are the profit of the power producer. Please note that whenever a power generator which is who is using the coal its profit is going to be the electricity price of electricity it will be generating by selling electricity and to generate electricity it will be buying coal and the heat rate of the coal will govern the cost of its input cost and the moment the company uses coal it will be generating basically carbon dioxide and it has to buy carbon offset for the heat rate for mitigating the greenhouse gas it will be generating. Hence the total profit is going to be price of electricity minus the price of coal into the minus the price of carbon dioxide and with respect to the IC and IG which stands for your in emission intensity carbon dioxide emission intensity of the natural gas for the coal and natural gas respectively and as you would know that the coal has a higher carbon dioxide emission intensity as compared to the natural gas. Hence, the clean dark spread or the clean spark spread which is the profit of the power producer after deducting the price of the carbon. So, if carbon prices are high, it motivates power producer to shift to the natural gas. So, if the price of the carbon credit is high then only it will be motivating power producer to go to the stop producing electricity from coal and start producing electricity from the natural gas. Hence in a maintaining a healthy price of carbon is very very important because if the carbon price is too low then companies will be motivated to produce electricity from the cheaper source of electricity which is predominantly the coal. Coal is normally cheaper as compared to natural gas and if the price of the carbon dioxide is low the companies will prefer to generate electricity by using coal and make enough profit to pay and buy the carbon dioxide pay and buy the carbon credit. So, with this we will end our discussion related to all things related to carbon. So, today's session we discussed about India's initiative related to a greenhouse gas emission. We discussed basically renewable energy certificates, we discussed energy saving certificates, we also discussed the global initiative for taken by airlines which is known as the CORSIA. We also briefly discussed about the futures trading and futures trading related to carbon credits in different exchanges and what factors also influence the price of the carbon credits. With this we will end our discussion today's session on carbon I we will be discussing more on the Freight rate derivative in the next session. So, thank you all of you.