Introduction to Environmental Economics
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Lecture - 60
Environmental Regulations and Basic Regulatory Instruments - Market Trading Systems – II

Hello everyone. So, today we will be continuing from our last lecture that is the Market Trading Systems. So, in the last lecture we talked about this cap and trade we defined, what is cap and trade as market trading system. So, today we have planned to describe what is the cap and trade example, certain examples we will be taking into account, then we will be explaining the marginal saving functions as polluting functions.

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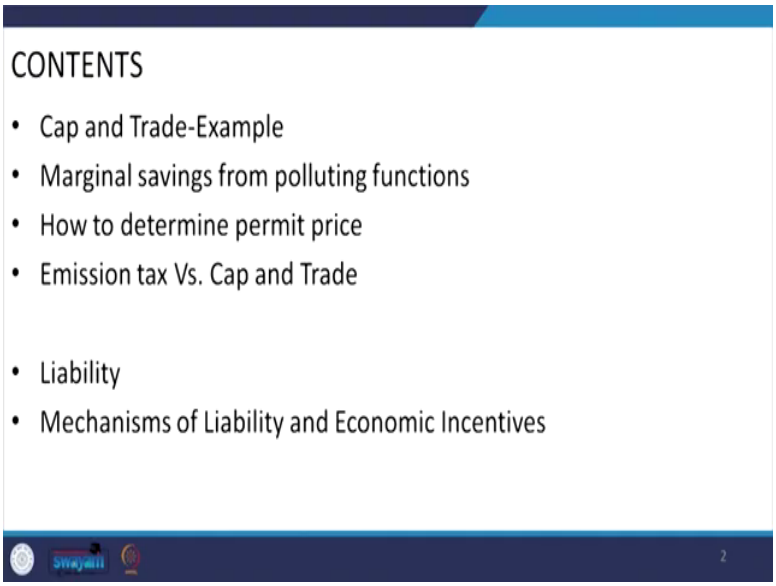

Then, how to determine the price for permit or how to determine the permit price that we will be explaining. And then we will be discussing the difference between this emission tax and the cap and trade. And finally, we will be discussing the last mechanism of this market based trading that is the liability, and we will be discussing what are the mechanisms of the liability and how this liability can also provide economic incentives, ok. So, let us start with some of the examples of cap and trade.

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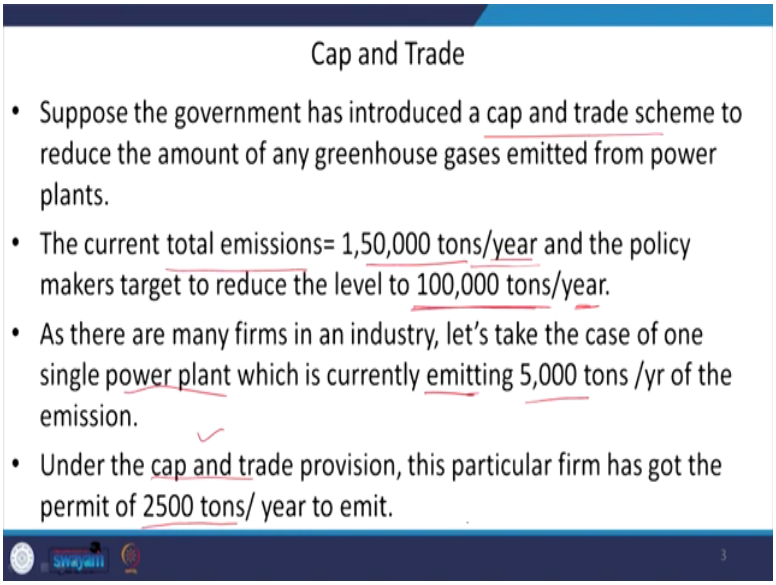

So, as you understand in cap and trade the government, puts a cap or upper limit and that allows trade among the quality entities. So, now, we can take this example suppose, the government has introduced a cap the upper limit of the emissions and this trades came then will be reduce the amount of this emissions.

So, now, let us take an example of cap and trade. Suppose a the government has introduced this scheme cap and trade scheme in order to reduce the greenhouse gas emissions that are emitted from the power plants, ok. And here the current total emissions that is estimated is 1,50,000 tons per year, right and the pollution makers they; obviously, want to reduce this level of emissions from this 1,50,000 tons per year to 1,00,000 tons per year, right. So, this is the cap the government has fixed. And; obviously, here in this a emissions there will be lots of firms in this industry power industry, power plants industries.

So, we can take a one single power plant, right and this one single power plant it is currently emitting 5000 tons of emissions, this greenhouse gas emissions per year, right. And under this cap and trade the upper limit; upper limit that is fixed for all the industries at a macro level or in total, the government needs to reduce this emission level from 1,50,000 to 1,00,000 tons per year.

However, for individual industries this cap provision is fixed; that means, a permit is allowed till 2500 tons of emissions per year right. So, here for individual firm the cap is fixed that is a the individual firm can emit 2500 tons of emissions per year, right.

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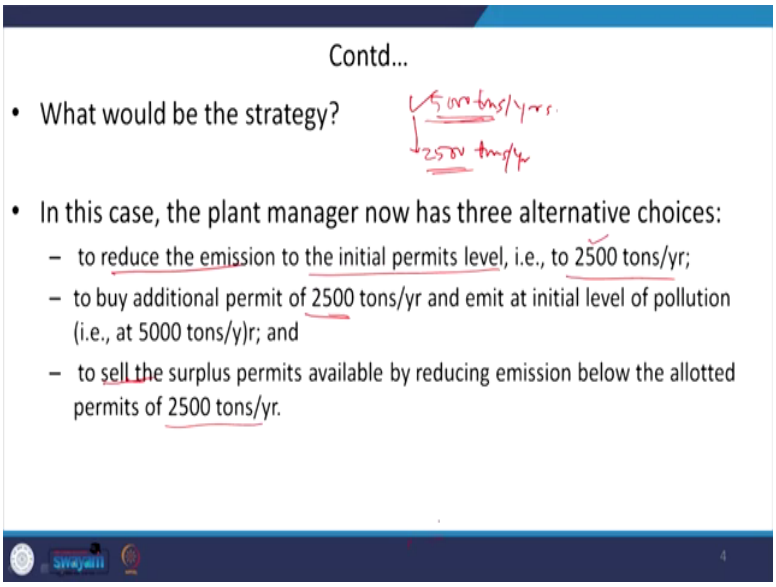

So, in this case, now the question is what would be the strategies that needs to be adopted by in the particular industry here?

So, now the this power plant manager he would be thinking about some alternatives. So, what are the alternative choices are available in the situations, let us see it. So, when the power plant it was it is right now producing 5000 tons of emissions per year and government has permitted till 2500 tons of emissions per year, right.

So, in this context the manager would be having some alternative choices. So, what are the alternative choices? The first can be the manager would be thinking to reduce the emissions to the initial permit level that is 2500 tons per year. So; that means, simply to reduce from 5000

tons of emissions to 2500 tons of emissions per year. So, this is the first option that will reduce the emission to the a permission level.

The second one could be and the manager would be thinking that let us maintain, let us continue with the same 5000 tons of emissions per year, but; obviously, the upper limit is 2500 that is allowed limit. So, for that reason the additional permit needs to be purchased. So, what is the additional limit, how much? So, it is 2500 is permit level and it is right now it is continuing with 5000 so; obviously, additional permit of 2500 tons per year needs to be purchased, right.

And it is the third alternative choice is that the manager can think of to reduce the its emissions below the allotted limit. So, what is the allotted limit, 2500 tons per year, right. So, now, the manager would be thinking to reduce this emission level below 2500 tons per year and the surplus can be sold in the market, ok. So, this is the three different alternative choices in this scenario of the cap and trade.

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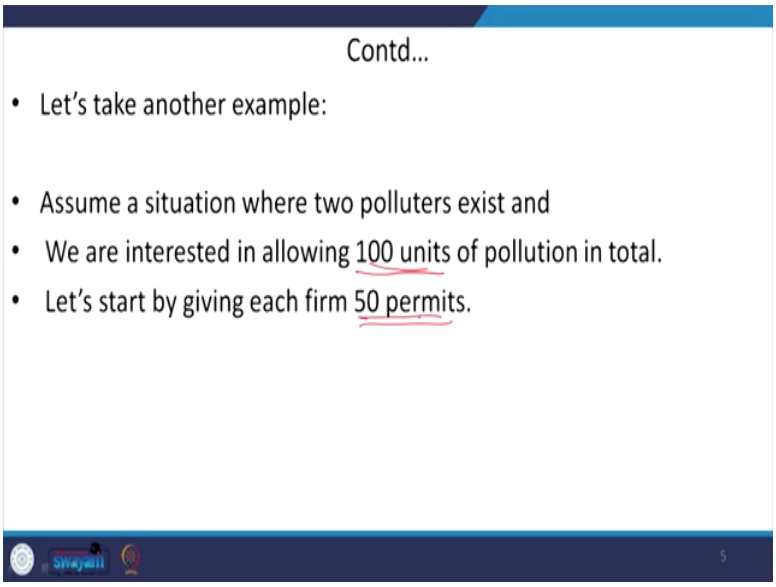

So, now, we can take another example right. So, let us assume a situation where 2 polluters are there. So, what the government is interested to reduce the pollution that the government can allow maximum 100 units of pollutions from both the industries, ok. And the, now the government is thinking that let us start with a 50 permits for each of the polluting industries.

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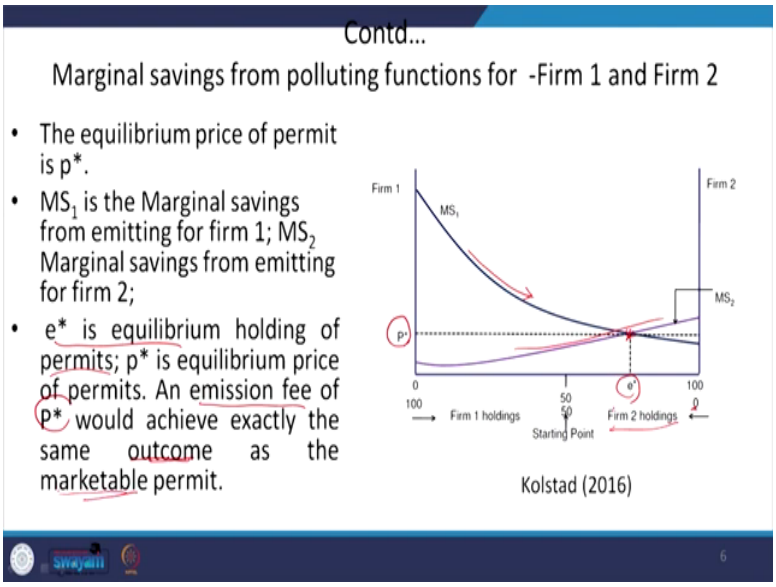

So, in this case what would be the marginal savings from polluting functions for both these firms? So, let us talk about firm 1 and firm 2.

So, we can find that if in the original axis we are we are depicting the permits hold and in the vertical axis the price for it, right. Then, we are saying that this MS 1 is the marginal saving functions for firm 1, right and this image 2 this line, right is the marginal saving function for firm 2, right. And for the initial point for the first firm, firm 1 is starting from 0 till 100 and for the second firm the where we are we have depicted this marginal saving MS 2. The initial point for second firm is starting from here, it is 0 here and it goes on till 100, right.

So, in this exercise and the equilibrium price for permit to pollute is determined by the intersection point of this marginal saving function of the first firm and the marginal saving function of this second firm. And, at this point of intersections we are finding this e star is the

equilibrium holding of permit, right and corresponding to this e star the price is a known as the permit price right.

So, now, the equilibrium price that is p star is the permit price and e star is the equilibrium holding of the price holding of the permits, right. And now if you are thinking of a pollution tax or emission fee you are saying, then when the government is going to impose any emission fee, then this emission fee would be the amount of emission fee would be just equivalent to this p star, right. And so, you can say this emission fee of p star is going to achieve exactly the same outcome, right as the case of marketable permits, right.

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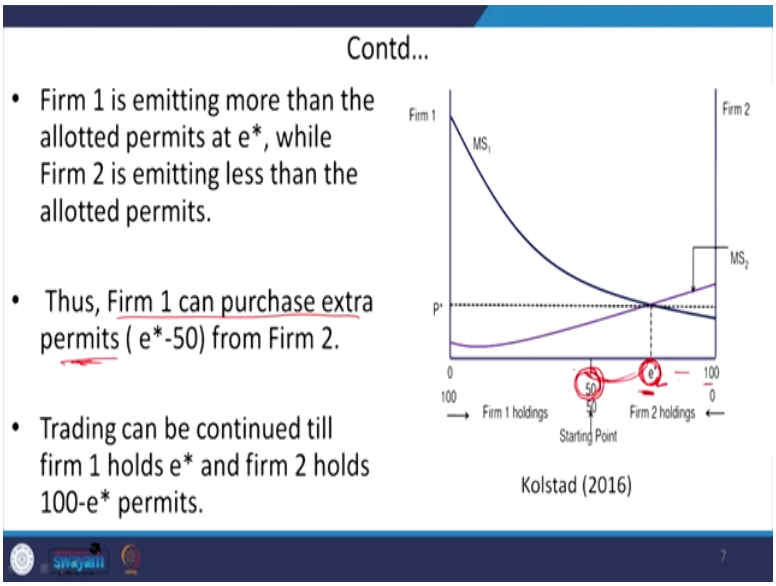

So, this is how we can say that we can compare with a this marketable permit with the emission fee, right. So, now we can find the equilibrium permit holding is e star; however, the government is deciding that only 100 permits can be allowed and for both the firms the

government has distributed the share of this firm is into 50-50. So; that means, first firm 1 is holding 50 units 50 permits and firm 2 which also holding 50 permits out of 100. But, what we are finding here that this equilibrium holding its e star; that means, the firm 1 is holding its polluting at e star which is much more than the 50 allotted permits, right.

And similarly, firm 2 it is allocated share is 50; however, it is producing much less than 50 that is at is at this e star right. So, in this case what will happen as firm 1 is producing much more pollutions than the permitted one, then in this case the firm 1 will be purchasing this extra profit sorry, extra permit from; obviously, firm 2. What is the extra permit? So, this level e star minus 50 is the extra permit that firm 1 needs to purchase right and; obviously, the firm 2 is going to sell because it is it is it is a using or it is polluting e star whereas, it has the apportionments share of 50 permits, right which is less than 50.

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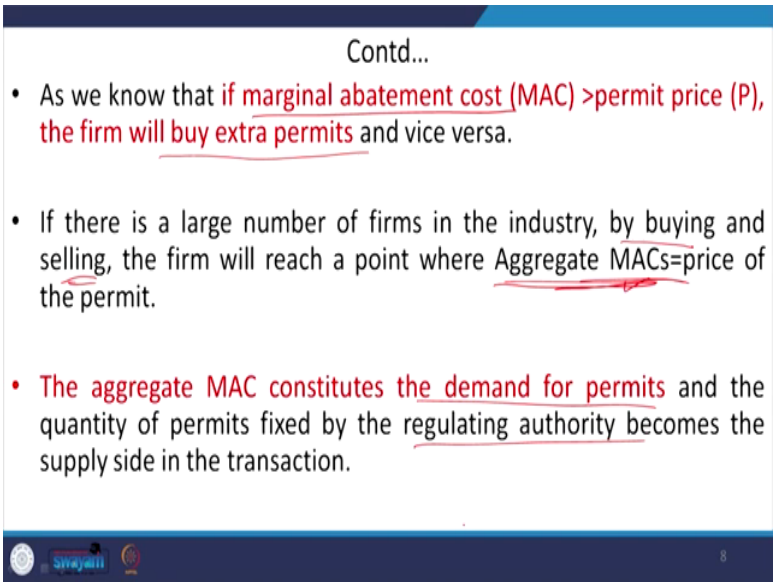

So, this trading procedure it can be continued till firm 1 holds e star of permits and firm 2 will be; obviously, holding how much, 100 minus e star of permits. So, till this point till this point is restored the transaction can be continued. So, from this what you understand is that if the marginal abatement cost it is greater than permit price. So, in this case whether the firm would be would be would be a purchasing the extra permits or it would be going to sell the permits.

So, when you were saying the marginal abatement cost is greater than the permit price then; obviously, the pollution control or reducing the pollution is a costly appear than to purchase in terms of permit price, right. So, for this reason what the firm will be doing? The firm will be purchasing the extra permits, right and in the opposite case if the marginal abatement costs, it is less than the permit price then; obviously, the firm will be trying to abate more and more and it will be selling the permits, right.

And, in this case if you are assuming a pretty good number of a firms; polluting firms in an industry then this mechanisms of transactions buying and selling, right. It will actually push till the aggregate marginal abatement costs gets equivalent to the price of a permit. So, till this point is reached this procedure will be continued, right.

So, here this marginal abatement costs is taken as the demand for permits and what is the supply side? Supply of formats. So, it depends upon the regulating the regulating authority that how much permit is to be allowed for the industries itself. So, this in the demand side this aggregate marginal costs it will be constituting the demand for permits and in the supply side; it is it a supply side of the permits, it depends upon the regulating authority that how many a number of what is the amount of permits the regulating authority is going to allow.

So, now, after understanding this demand and supply factor, supply side of the permits we can determine the price and quantity in the permit market, right.

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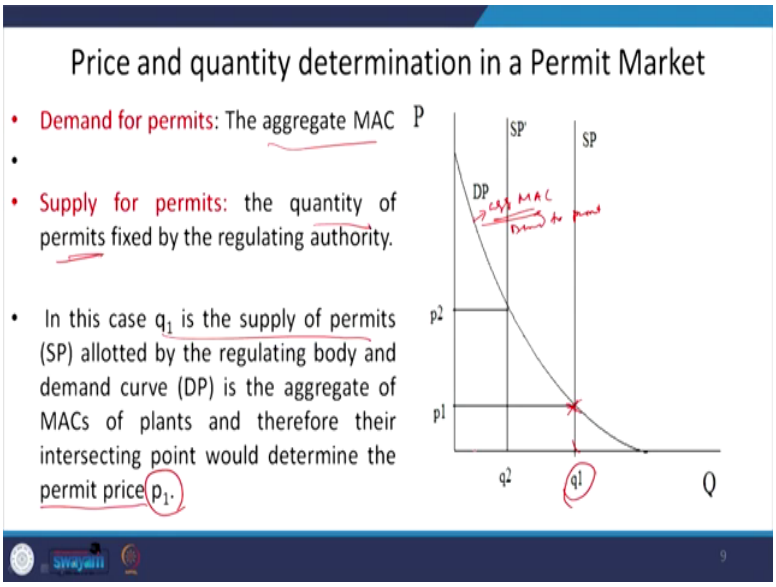

So, as you understand the demand for permits is represented by the aggregate marginal abatement cost function or the firms and the supply for permits it depends upon the quantity of permits that is allowed by the regulating authority itself, right.

So, if you if you are drawing this representing in a graphical manner, then we are finding this is the aggregate marginal abatement cost which is the demand for permits, ok. And, this SP is the Supply for Permits which is fixed by the regulating authority how many permits are allowed or what is the unit of pollution to be allowed.

So, in this case the intersection point of your demand for permits on the supply of permits, right ah. So, intersection point is here; so, the equilibrium quantities q 1 so, this and the

equilibrium price is p 1. So, what you can say that in this case q 1 is the supply of permits, right and that is how we are saying the price per permit or permits price is p 1,.

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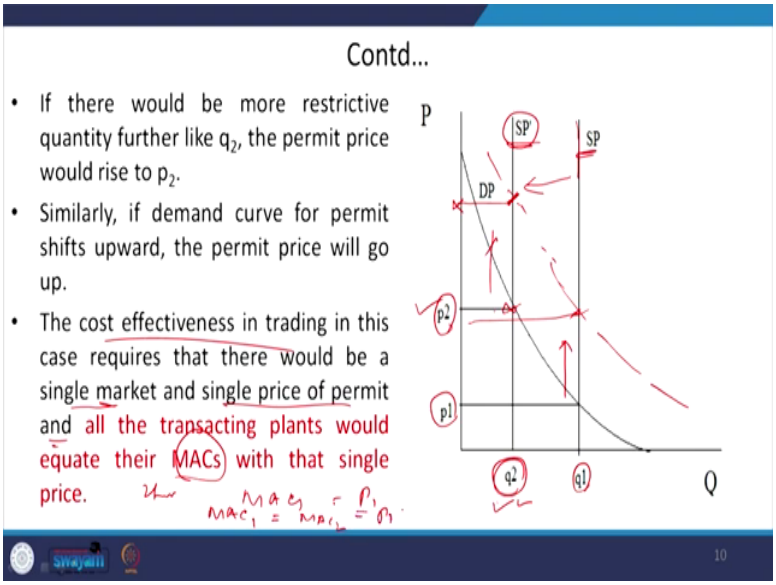

So, in this case if the government after finding that this is the equilibrium q 1 and equilibrium price is p 1, then if the government would be thinking to even restrict or even reduce further reduce the pollution amount then; obviously, it will be providing less number of pollution permit in comparison to the initial pollution permit that is SP, right.

So, if the government is taking some restrictive a permit, right from reducing from the first the original state of permit is SP. And, now it is reducing further then the quantity will be fixed or the equilibrium quantity will be determined by the intersection point of this supply curve this is SP dash with the demand curve of the pollution permit. So, at this point we are finding the q

2, right and this is the quantity and the price against this q 2 would be the p 2. So, the permit price would be p 2 and permitted quantity would be q 2, ok.

And likewise, if suppose say the demand curve for the permit it shifts upward like this, then what will happen? So; obviously, in case of this first supply curve, now the demand curve is shifting. So; obviously, the price given the quantity the same quantity is there, same quantity of permit should be there; however, the price should be rising from p 1 level to this level, ok.

So, likewise if I talking about this the second supply curve now, the demand curve has shifted, ok. So now, for the second one, the equilibrium point of intersection would be these and again given the same amount of permit q 2, the price would be rising from p 2 level to this level.

So, in this case the cost effectiveness in trading of this permit, right. It requires that there would be a single market and single price of the permit, right and all the transaction plants who are involved in this particular transactions. So, they will be trying to equate this marginally abatement costs with this single price.

So, if it is for the first case of limit if it is this p 1, then all these plants they will be trying to equate their marginal abatement cost to this price level, ok. So; that means, you are saying this equimarginal principle will be followed. So, if you are talking about 2 firms then you will be saying this marginal abatement cost or the first firm would be equal to marginal abatement cost of this second firm that is equal to the p 1, ok.

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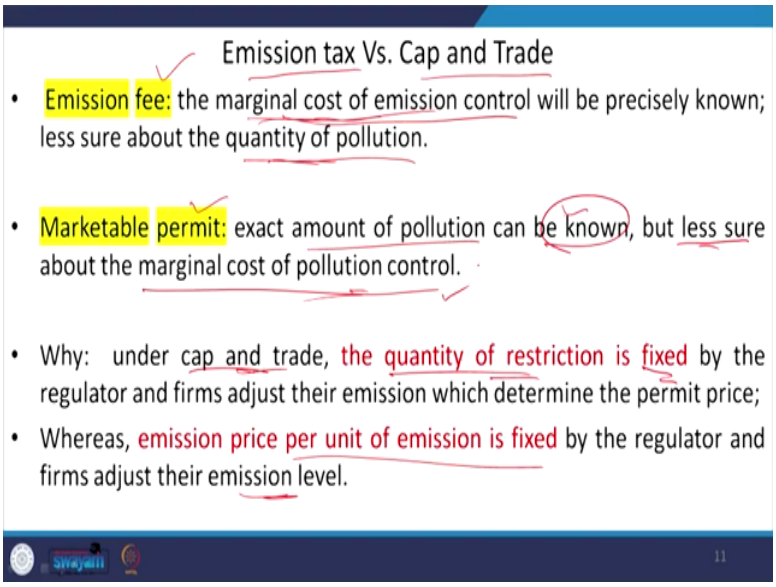

So, now let us understand the difference between this emission tax and the cap and trade. So, in our earlier discussions we have understood what is the emission fee or emission tax? So, in case of the emission tax what you are finding, you can just remember the case of emission fee.

So, in this case this under this emission fee, the marginal cost of emission control it can be known precisely, why? Because, when you are paying the fee then; obviously, the cost of controlling the emission is known, right and when you are going to reduce one more unit of pollutions then you have to pay some additional amount of cost, ok. So, that is how the marginal cost of emission control is it can be precisely known under the emission fee, but.

So, far as the quantity of pollution is concerned, right. So, in under this emission fee this quantity of pollution is less sure to be determined. Whereas, in case of marketable permit you can just remember what happens here, the upper limit or the permission for the pollution is

granted, right. So; that means, the amount of pollution it can be known, which is which one would be lesser known then the lesser known we can find that this marginal cost of pollution control it will be less your or will be less your about the marginal cost of pollution control.

So, why it is so, because you know that under this cap and trade this quantity of restrictions are what would be the upper limit of pollution it is fixed, right by the regulating regulator itself. And, all the polluting firms they are acts to adjust their emissions that determine the permit price; whereas, in case of emission fee the per unit if emission fee is fixed by the regulatory itself and the firms adjust their emission level.

So, that is that is why under this emission fee this marginal cost of emission control it is known whereas, this marginal cost of; whereas, the quantity of this pollution is lesser known and in case of marketable permit this amount of pollution is known, but the marginal cost of pollution control is less sure, ok.

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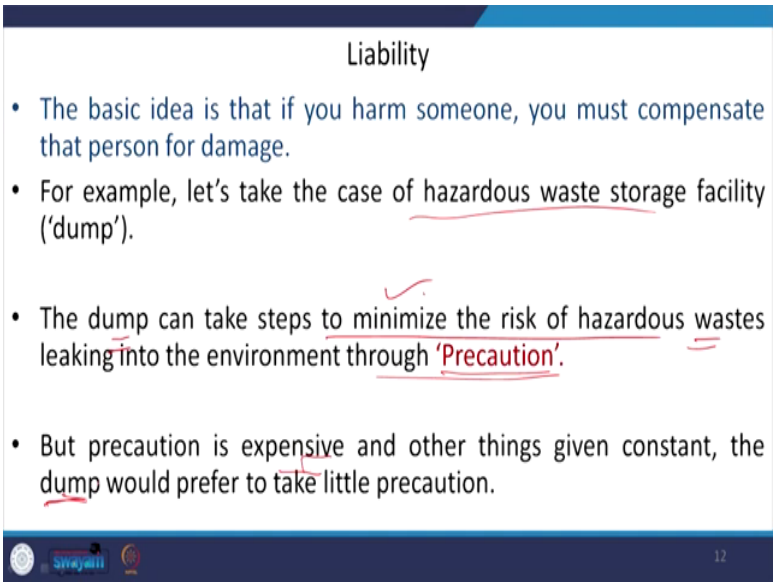

So, now, let us talk about the last method under this trading that is liability, ok. So, what is liability? So, here the basic argument of liability is that if you are doing any kind of harm to someone then; obviously, you have to pay for the damage that you are cutting; that means, you have to compensate that person for the damage you have cost, right.

So, let us take an example. So, when you are talking about the hazardous waste storage management facilities, right or simply saying simply we are saying we are when you are managing a dump, right. So; the task is that when you are maintaining a dump, right you need to take certain steps. So, what is the steps you need to take into account? You need to minimize the risk of this waste hazard.

So, how to minimize this risk hazards, because you are maintaining you are the owner of a dump then your priority or your task is to minimize the risk of hazards, but how? So, it

depends on how you are taking the to what extent you are taking the precautions to minimize the risk of this hazardous waste and you know that when you are going to take precautions it is costly appear.

So, precaution is very expensive and assume this (Refer Time: 23:50) assumptions or other things taken taking constant the dump owner; obviously, would be preparing to take less precaution because precaution is costly.

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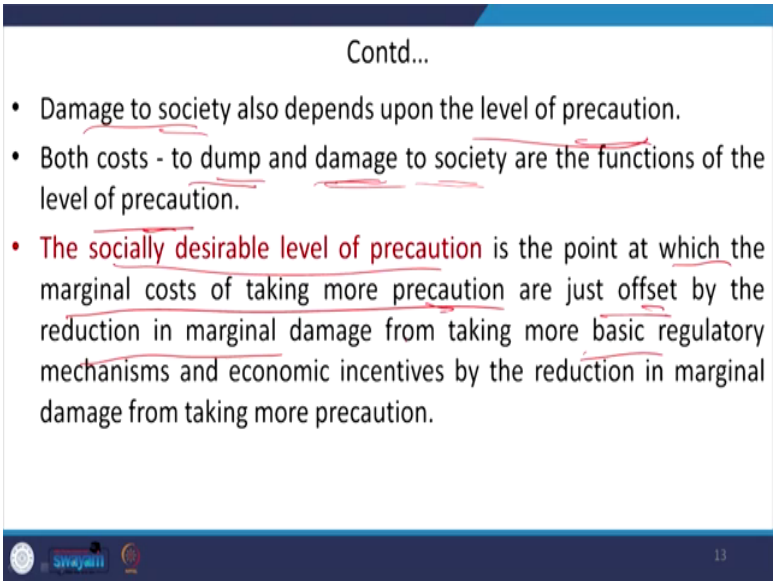

And moreover when the precaution is not taken the damage to the society would be more. So, the damage to the society it depends on the precaution level that the dump owner is taking into account, right. And; however, both these both costs; that means, to dump it is also costing you and if you are not taking into account the precaution it is also going to cost to this society. So, to dump and to dump and whatever, the damage we are getting to getting and at

the society is suffering from the damage. These are the functions of the level of precautions itself, ok

But now, the thing is that what is the sociality desirable level of or what is the social optimal level of precautions that the a dump owner needs to take. So, you need to find this socially desirable level of precautions right, we can determine it. So, this point can be determined at which the marginal cost of taking one more precautions are just balanced or just offset by the reduction in the marginal damage from taking more basic regulatory mechanisms. And, this will be giving economic incentives by reducing in the marginal damage from taking one more precautions, ok.

So, what is the point that we are finding? So, which is known as the socially desirable level of precautions. So, we are finding that point at which the marginal cost of taking more precautions it is just offset by reducing the marginal damage from taking some more basic regulatory mechanisms, ok.

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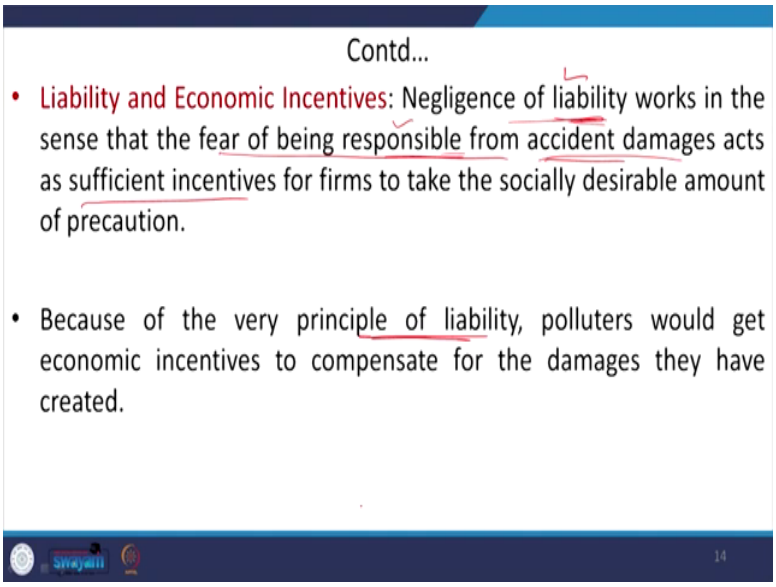

So, now let us talk about how this liability is also providing a economic incentives, ok. So, you know that when you are neglecting right, for this liability are negligence of the liability it will mean the fear of being responsible, ok. So, liability is fear of being responsible, but when you are neglecting; that means, you are not afraid of being responsible, right.

So, what is this fear? The fear is that if any accident damages occurs, right and this accident damage this liability, the very idea of liability that if some accident happens then you need to compensate for that it is actually acting as a sufficient incentives to take a right kind of precautions. So, that the society would not face any kind of damages or you can say the socially desirable amount of precaution can be taken and because of this very idea of the liability. So, the polluters now they would be getting economic incentives to compensate for the damages they have generated, right.

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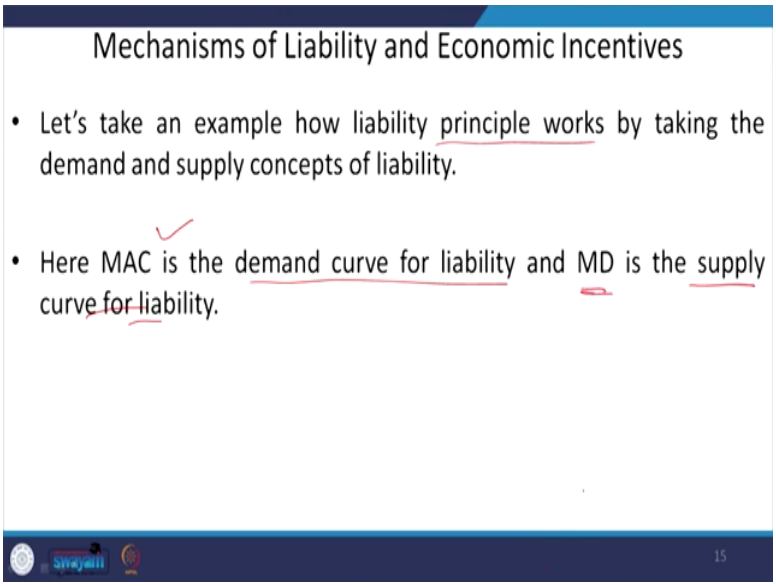

So, this is the basic understanding of liability that if you are action is creating any kind of damages then; obviously, you are responsible and you need to compensate the victim.

So, now, we need to understand what are the mechanisms of the liabilities that is leading to the economic incentives we can take this example that how this liability principle is working, right by taking into account the same demand and supply concepts of liability. So, as you understand that what is the demand curve for liability, it is the same marginal abatement cost and what is the supply curve for the liability, it can be represented by your marginal damage, right.

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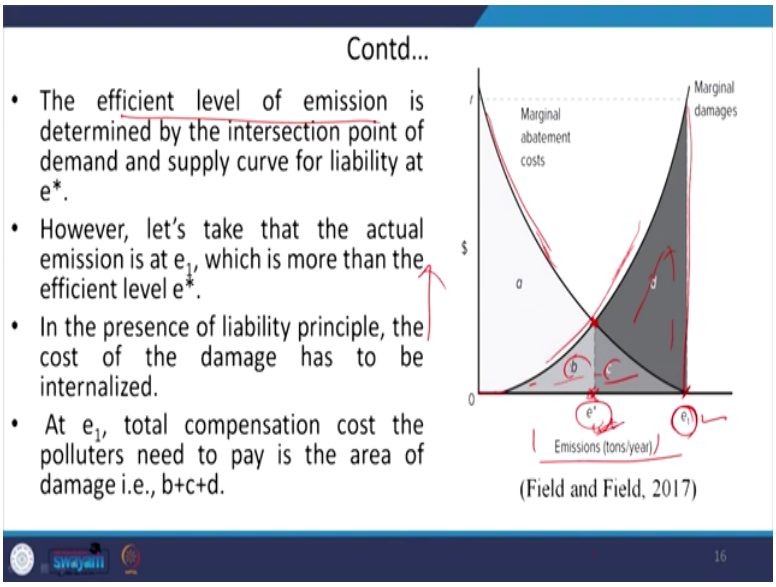

So, we can just graphically represent this, this is your marginal abatement cost right and this is your marginal damages. Why marginal damages are not starting from 0, because the nature is also having certain absorption capacity, that is why whenever the pollution starts it may not actually affect the society, it may not actually harm or damage the society itself. So, that is why after this point of this capacity natural absorption capacity we are finding this marginal damages, ok.

So, our task is to find out what is the efficient level of liability or efficient level of emissions. So, it is determined by the intersection point of this marginal abatement cost curve and marginal damage cost curve. So, this is determined at this equilibrium point. So, accordingly e star is the efficient level of emissions. So, here in the horizontal axis we are representing this amount of emissions and in the vertical axis we are representing the price for the same.

So, this is what, the society is needing this is the societal level of emissions, it is desirable. So; however, if you are taking into account the actual level of emission let us say the actual level of emissions it is not taken place here at the societal level of emissions say rather at a larger extent that is at the e 1.

So; obviously, this e 1 level of emission it is much more than the efficient level of emissions that is e star, right and when you will be saying that liability rule is here it is applicable ah. So, in this case what is the principle of liability; that means, if there is any kind of damage it needs to be compensated. So, following this liability principle, this damaged whatever the damage it has created because of its production at e 1 emissions at e 1. So, this damages has to be internalized, right.

So, what is the cost if the industry is producing at e 1 level of emissions, what is the cost or what is the damages? So, damages are this is damaged function. So, this is these under these, this is b area, c area, d area; the whole of these right it is the total damage, right damage costs. So; that means, this total damage cost needs to be compensated to the victim or the polluters needs to pay this b plus c plus d area of damage, right.

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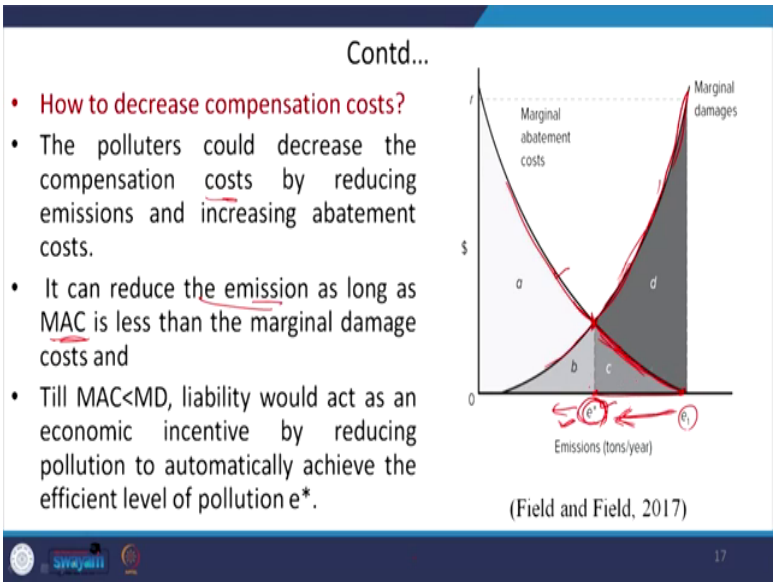

But now, the thing is not how to decrease this compensation costs because; obviously, the polluter would be thinking how to decrease this compensation cost. So, now, the polluters can decrease the compensation cost; obviously, by if the polluter is going to decrease the level of pollution from e 1 to less than e 1 and it can continue till e star is as it,.

So, polluters can actually decrease the compensation costs by reducing this emission from e 1 towards e star and thereby what will for the polluter would need to do, it has to go for investing in terms of abatement cost, right. So, it can reduce these emissions to a point, which point as long as this marginal abatement cost is less than the marginal damage.

So, this portion is the marginal abatement cost which is less than the abatement this marginal damage. So, after getting here, at this point marginal abatement cost is just equivalent to your

marginal damage cost. So, after reaching beyond e star what you will be finding, this marginal abatement cost is more than the marginal damage cost, right.

So, the polluter would be reducing the emissions till the marginal abatement cost is less than the marginal damage cost, ok. So, you can say this marginal abatement cost it is less than the marginal damage cost till this point. So, now, the liability would be acting as an economic incentives, by reducing the pollution automatically to e star level which is the efficient level of pollutions, ok.

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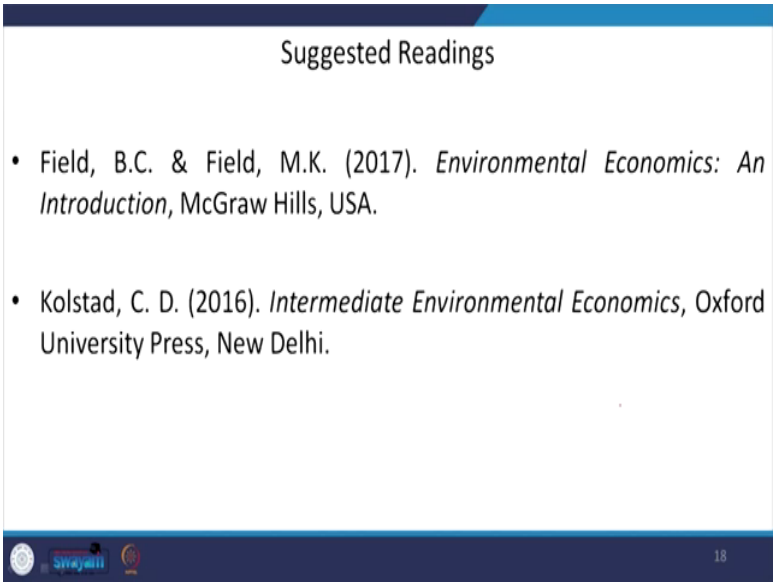

So, this is the principles of liability that if you are creating any harm or damages you must compensate. So, that is why, so the polluter needs to reduce in order to give less compensation against the damages. So, that is how it is the efficient level of productions, ok.

So, for liability portion you can you can follow this books environmental economics Field and Field, and also you can follow this Kolstad book intermediate environmental economics, ok.

Thank you very much.