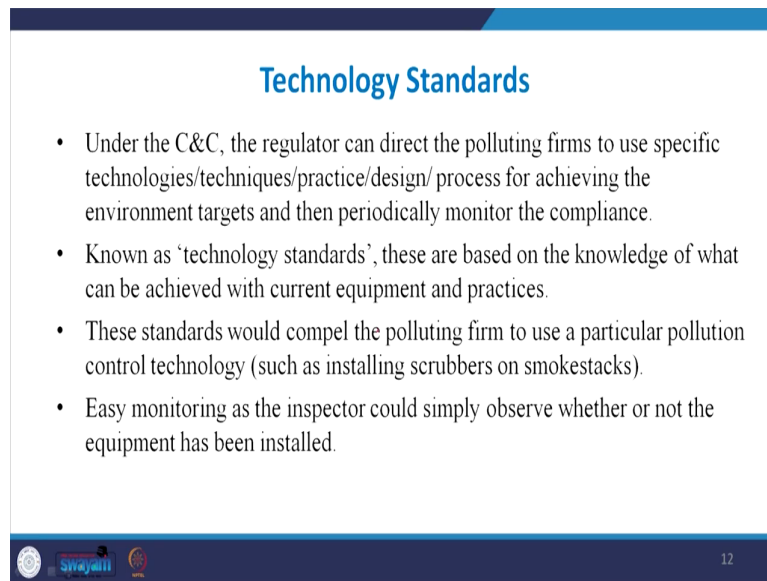**Introduction to Environmental Economics**
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Lecture – 54
Command and Control Approach: Type of Standards-II

Dear students, Environmental Regulation topic was in discussion I explained environmental standards like ambient standards, emission standards, in this lecture you will study about technology standards. So, these are the 3 key environmental standards, ambient standards, emission standards and technology standards.

Technology standards are very frequently use by the government to regulate the environment under the command and control system, the regulator can direct the polluters to use a specific technology or techniques or production practices or design or process for achieving the environmental targets and then periodically monitor the compliance.

Technology Standards

- Under the C&C, the regulator can direct the polluting firms to use specific technologies/techniques/practice/design/ process for achieving the environment targets and then periodically monitor the compliance.
- Known as 'technology standards', these are based on the knowledge of what can be achieved with current equipment and practices.
- These standards would compel the polluting firm to use a particular pollution control technology (such as installing scrubbers on smokestacks).
- Easy monitoring as the inspector could simply observe whether or not the equipment has been installed.

So, under technology standards government can direct the companies to use the specific technology or to use the specific techniques of production or to use the specific practice of production or a specific design and then through the governments regulatory mechanism. The government actually monitor whether that technology is used or not or the order is complained or not. This 'technology standards' are actually based on the knowledge of what can be achieved with current equipment and practices.
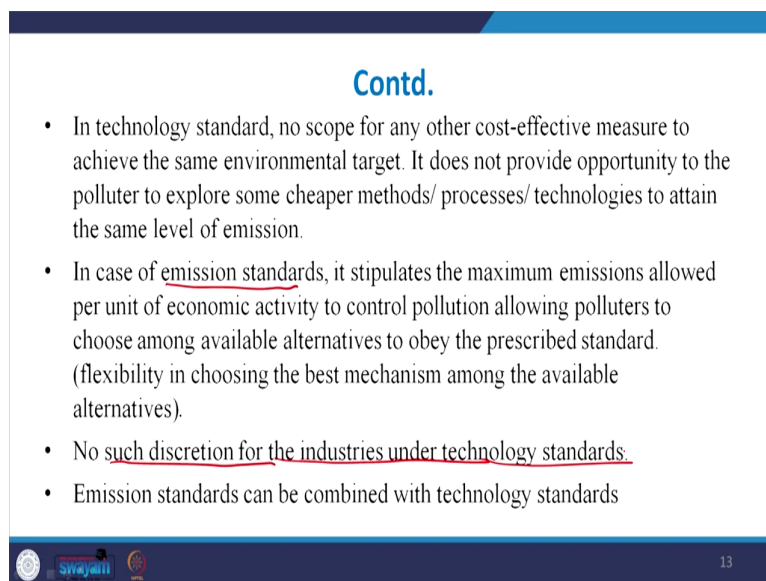
As I discussed earlier under this technology standard system government may recruit technologist engineers they can understand the available technologies to produce a particular product.

And then set the standards that if a new technology is available in the market that technology can be set as a standard and companies are asked to use that particular technology device

equipment etcetera. And if any company is not following that given technology then company can be punished under the command and control system. These standards would compel the polluting firms to use a particular pollution control technology such as installing scrubber on smokestacks.

It is easy to monitor as the inspector could simply observe whether or not equipment has been installed. So, this technology standard as an instrument of regulating the environment is easy to monitor the regulator can easily see whether the specific equipment has been used or not. So, inspectors can periodically visit the firm and try to understand whether the order is complied or not.

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In technology standards, no scope for any other cost - effective measures to achieve the same environmental target. So, it is very interesting to know that under technology standards the

company does not have any scope for evolving any cost effective measures to achieve the same level of emission standards. It does not provide opportunities to the polluters to explore some cheaper methods, processes, technologies to attend the same level of emission.

So, you can say that this is the drawback of these technology standards that the company or the polluting firm does not have any scope to evolve some other methods of production or to use other technologies or cheaper methods to produce output with this to maintain the same standard of environment. In case of emission standards, it stipulates the maximum emission allowed per unit of economic activity to control the pollution allowing polluters to choose among available alternatives to obey the prescribed standards.

So, when you compare the technology standard with emission standards then you will find that in case of emission standards the emission target are set and to some extent setting the standard may provide some flexibility to the companies to use any technology to achieve the given standards. But as far as technology standard is concerned they know such flexibility of level to the company to reduce the given level of emissions. So, here the company has to use the technology which is suggested or instructed by the regulators.

So, that is why emission standards is relatively flexible in choosing the best mechanism among the available alternatives as compared to the technology standard. So, in technology standards, they no such discretion for the industry to use any other technology to achieve the same level of emissions so, no such discretion for the industry to use any other technology under the technology standard to achieve the given level of emissions. Emission standards can be combined with technology standards.

So, in order to achieve a given ambient level in air or water these 2 standards can be combined together. So, emission standards can be combined together with technology standards.

Next is equi-marginal principle and command and control system or command and control approach. One of the major issues related to command and control system is that equi-marginal principle equi-marginal principle can not to be applied. Equi-marginal principle state that in order to get the optimum level of emissions different sources of emission must be controlled in such a way that they have the same marginal abatement cost.

So, if there are N companies then marginal abatement cost of one company should be equal to marginal abatement cost of second company up to the marginal abatement cost of N company so, this is called equi-marginal principle. So, equi-marginal principle if it is used can optimally utilize the resources and the pollution level can be efficiently determined. This implies that different sources of a pollutant need to be controlled by different degrees depending upon the shape of marginal abatement cost curve at each sources.

So, if different companies in the industries are having different marginal abatement cost then these different marginal abatement cost curve should be equated at the point of equilibrium to determine the different level of emission standards for different firms. Generally, a standards are designed to be applied uniformly across all polluting firms within the industry. So, this is the major problem with command and control system that under this system emission standards are uniformly applied.

And if there is a greater difference in the marginal abatement cost among different sources lower will be the performance of equi-marginal standard approach.

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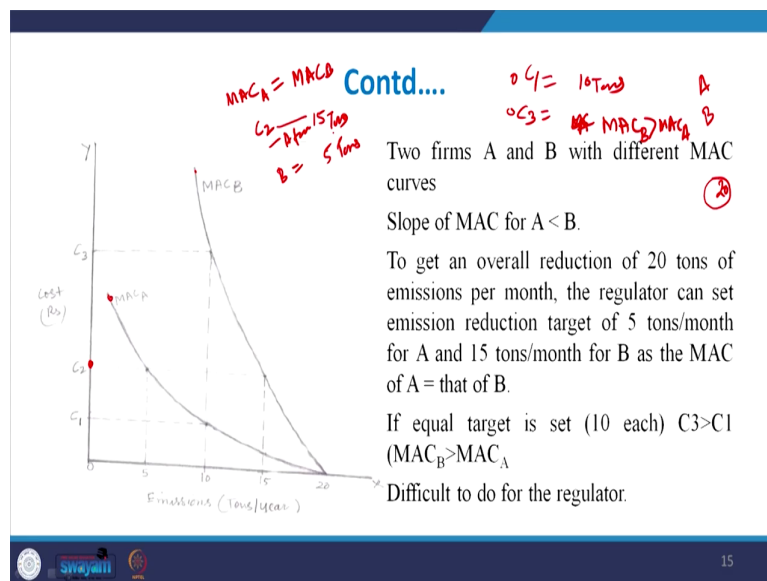
And that is why we have to see how to allocate the emissions level among the different firms according to their marginal abatement cost. So, this graph shows that there are 2 firms, A firm and B firm and A firms marginal abatement cost curve is shown here this is the marginal

abatement cost curve of A firm, then marginal abatement cost of B firm is shown this. And now on horizontal axis emission level is shown in tons of CO_2 equivalent per years and on vertical axis we are having cost.

If the government set a target of say 20 tons of CO_2 to be emitted and that 20 tons of CO_2 is to be allocated between A and B firms how to allocate efficiently. Under command and control system uniformly in emission standards are set and in that case if emission standards are set uniformly then each of the firm A and B will emit 10 tons of CO_2 emissions. And if you take this 10 tons of CO_2 then what you will find is that if a firm emit 10 tons of CO_2 or emission is abated then the C_1 will be the cost.

So, all CO_1 will be the cost when 10 tons are emitted and it is B firm also emitted 10 tons then OC_3 will be the cost for B firm. So, this clearly indicate that is since the slope of marginal abatement cost curve of the 2 firms are different B firm to emit 10 tons of CO_2 equivalent is having marginal cost equal to OC_3 which is. So, MC a marginal abatement cost marginal abatement cost of B firm is greater than marginal abatement cost of A firm.
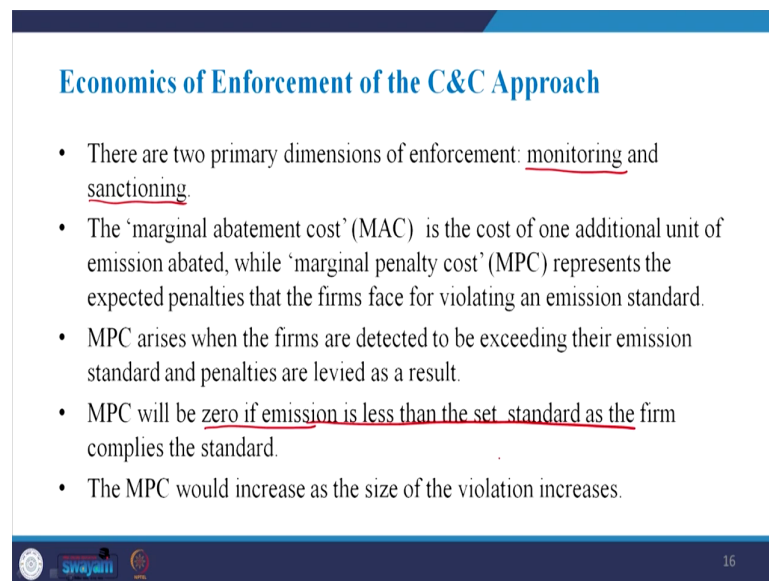
This clearly shows that equi-marginal principle is not applied and that is not a effective mechanism of allocating the emissions between the 2 firms, but if the marginal cost is equalized then marginal cost will be equalized at C_2 point this point and at this point what we observe from this graph A is that if both firms MAC marginal abatement cost of A is equal to marginal abatement cost of B then the uniform cost is C_2.

So, at cost C_2 marginal abatement cost of A is equal to marginal abatement cost of B and at this point firm a should emit this 15 tons of CO_2 A firm and B firm should emit only 5 tons note 10 each and in this way the overall efficiency can be improved.

So, but in reality what happens, we cannot apply marginal equi marginal principle while allocating the emission targets among different firms in a particular industry. So, this is the major problem with the regulator how to set standards for the individual firms because many times the regulators are not having knowledge about the cost of abatement.

So, if the regulator is not having how much is the per unit cost or marginal cost of abatement for A firm B firm C firm up to N firm then this principle cannot be applied. So, it is very very difficult to apply equi-marginal principle under command and control system and this is the major flaws or drawbacks or limitation of introducing command and control system to regulate the environment.
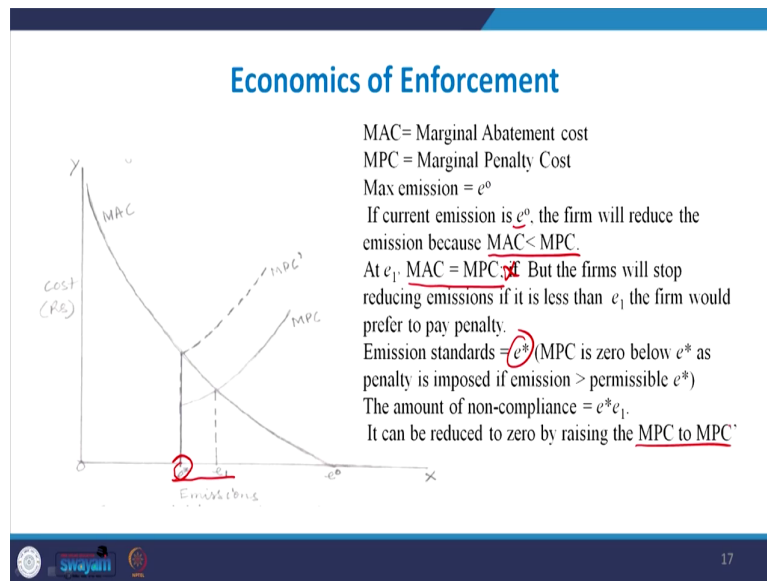
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Let me now discuss economics of enforcement of command and control approach, economics means how to under how to reduce the cost of abatement of pollution in any economy and here there are two primary dimensions of enforcement of command and control system. One is monitoring how to monitor the system and sanctioning means how to impose penalties etcetera.

So, here we can take marginal abatement cost that is the cost of one additional unit of emission abated, while 'marginal penalty cost', marginal penalty cost represents the expected penalties that the firm face for violating and emission standard. MP marginal penalty cost MPC arises when the firms are detected to be exceeding the emission standards and penalties are levied as a results. So, government can set the standard and if the standard is not met if any company is emitting the pollution beyond the standard then penalty can be imposed.

Marginal penalty cost will be 0 if emission is less than marginal penalty cost will be 0 if emission is less than set standard. So, if we set the standard a particular standard and if standard is met then they no need to spend money or there would be no need to give the penalty. So, penalty cost will be 0 marginal penalty cost would increase as the size of violation increases. So, as we violate the rules or we do not comply the standards then marginal penalty cost will increase.

I can explain it with a simple diagram.
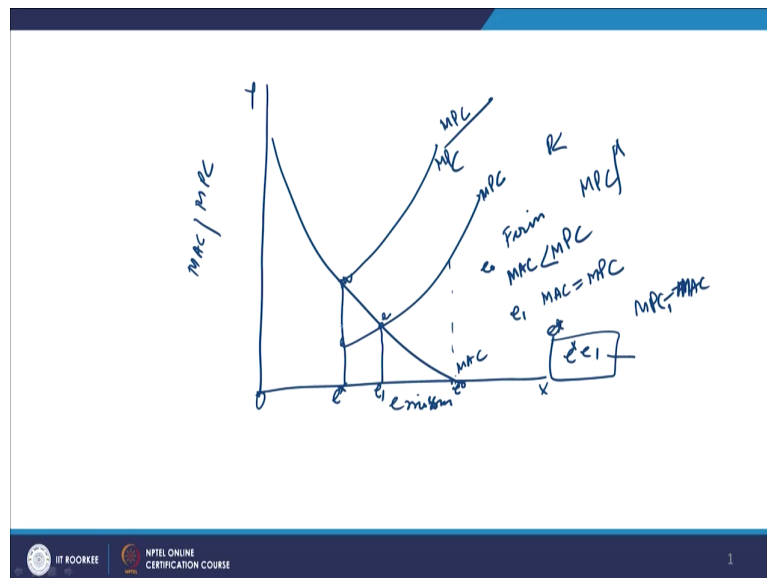
Let me take this is on vertical axis we take marginal abatement cost and marginal penalty cost, both cost are measured and emission level; emission level is taken on x axis. Here we can take this is the marginal abatement cost curve, now this marginal abatement cost curve is touching the x axis. So, we can say that e 0 is the maximum level of emission released by the firm if for example, if there is no regulation. So, maximum emission will be released.

So, this is now if government set the standard and the standard is say this is the e star the government is setting the environmental standard or emission standard and at this level the abatement cost is this vertical distance say a e a a e star a is the abatement cost. And now if we also know marginal penalty cost curve MPC and if this is the marginal abet marginal penalty cost curve MPC and this curve is intersecting the marginal abatement cost curve. So, socially desirable socially desirable or optimum level of emission is say e 1.

Now, if emission level is e 0 then you can see the firm under reference company firm will emit. So, if emission level is at e 0 because at e 0 or the MPC is much higher you can see at of this point MPC or penalty is much higher than the cost of abatement. So, since at this point cost of abatement this marginal abatement cost is lower than MPC at point e 0.

So, company will or polluters will comply the order and will emit this instead of paying the penalties and up to e 1 up to e 1 since at e 1 marginal abatement cost is equal to marginal penalty cost. So, up to e 1 the company will comply the order or will fill it economically relevant or economically more useful to abate the pollution rather than paying the penalty.

But if pollution level goes to e star that is the standard at this point what happens, the company now will not be able to comply e star e 1 portion of the emission. Instead of emitting it the company would prefer to pay the penalty, because at this point at e star you can see that the marginal cost of abatement is higher than the marginal penalty cost.

So, that is why e standard at e standard is o e star at this point company would prefer to pay the penalty rather than to emit and this is very interesting things you I can simply side an example recent example of motor vehicle act. So, under the motor vehicle act, so government of India has set up different penalties for violation of the rule.

So, if penalty is lesser than the cost of compliance the polluters would prefer or motor vehicle owner would prefer to pay the penalty rather than comply the order and that was happened earlier that if a person is violating a you see in order to using the seatbelt or not having a pollution certificate. So, they can simply pay the penalty rate was much lower, but now under the new act penalty is raised.

So, people would prefer to comply the order rather than paying the penalty, same things happened to the pollution and from this graph you can easily see that if penalty is marginal penalty cost is higher than the cost of abatement people will prefer to abet the pollution rather than paying the penalty, but when marginal abatement cost at point a is higher than marginal

penalty cost. So, company would prefer or polluter would prefer to pay a penalty rather than abating the this.

But now if this situation occurs so government can do one things that the penalty can be increase as recently done under the motor vehicle act. And if penalty marginal penalty cost curve shift upward and if penalty is increased then new point will be like this and that become MPC 1 and now under this both MPC 1 equal to marginal abatement cost; marginal abatement cost and therefore, now the polluter will comply the order.
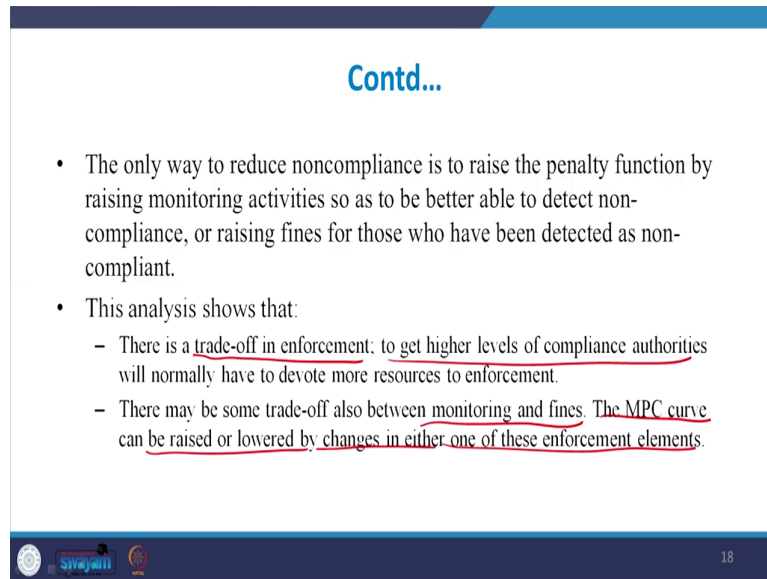
So, this can easily be known from this diagram that what exactly the economics or cost and benefit of compliance and not compliance. If cost is penalty cost is higher than the cost of abatement people will prefer to abet the pollution or they will treat the pollution before releasing it into the waste atmosphere and if marginal penalty cost is higher than the marginal abatement cost. So, instead of treating the waste and then releasing it into the atmosphere people will prefer to pay the penalty.

So, this is exactly I had shown in this graph, here in this graph we have a marginal abatement cost which is showing a negative slope indicating that as more or more emission is emitted marginal cost declines. Marginal penalty cost is showing upward slope indicating that the marginal penalty cost increases as the violation is increased. If the current emission level is e 0 the firm will reduce emission because marginal abatement cost at point e here is lesser than marginal penalty cost.

At e 1 marginal penalty cost is equal to marginal abatement cost and, but the firm will stop reducing emission if it is less than e 1. So, if pollution level is less than e 1 firm would prefer to pay penalty as I already told you. So, if standard is set at e star. So, this is the government set standard and at the government set standard M marginal penalty cost become 0 below it because, the no compliance is required if e standard is met.

And penalty is imposed if emission is greater than the permissible limit, the amount of noncompliance in this case is this is the noncompliance area e star e 1 and it can be reduced by reduced to 0 by raising the MPC to MPC desk.
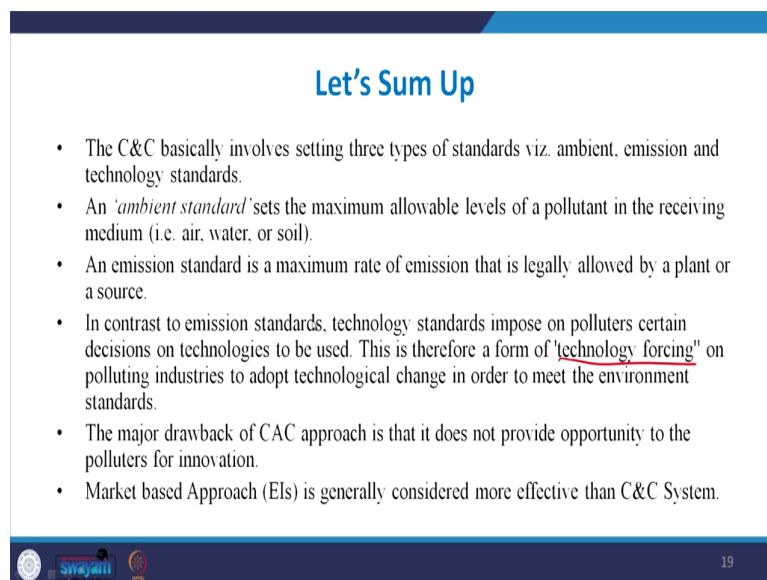
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The only way to reduce noncompliance is to raise the penalty function by raising monitoring activity so as to be better able to detect non-compliance or raising the fines for those who have been detected as non-compliant. And this is shown in the graph by shifting the marginal penalty cost curve from a initial level to marginal abatement cost desk.

This analysis shows that, there is a trade-off in enforcement; to get higher level of compliance authority will normally have to devote more resources of enforcement. So, this is one important influences that there is a trade off in the enforcement if because enforcement also imply additional cost. If you wanted to make effective enforcement of the standard to get

higher level of compliance authority will normally have to devote more resources for this purpose.

There may be some trade-off also between monitoring and fines. The MPC curve can be raised or lowered by chances in their in either one of these enforcement element. So, by increasing or decreasing the marginal penalty cost curve we can also create changes in the monitoring and fines.

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Let me now sum up the topic command and control basically involves setting 3 types of standards which have been explained in this lecture and the preceding lecture ambient standard emission standards and technology standards. And ambient standard set the maximum allowable level of pollutant in the receiving medium receiving medium maybe air, water or

soil. And emission standard is a maximum rate of emission that is legally allowed by a plant or a source.

In contrast to emission standards, technology standards imposed on polluters certain decisions on technologies to be used. This is therefore, a form of 'technology forcing' technology forcing on, in contrast to emission standards technology standards imposed on polluters certain decisions on technologies to be used. This is therefore, a form of "technology forcing" on polluting industry to adopt technological change in order to meet the environmental standards.

I have also explained you the different merits and demerits of command and control system and also we know the merits and demerits of technology standard which is just you had studied. In case of technology standards unlike emission standard there is no flexibility given to the polluters to use any technology.

So, technology is actually imposed on the polluters by the regulators, while in case of emission standards if emission standard are set to some extent there is a flexibility on the part of the polluters to achieve the set emission standards. They can use different methods to achieve the same emission standard, but same things is not feasible not allowed in case of technology standards.

So, command and control this is one approach of regulating the environment and in the several lectures you had studied about what is command and control system, how it is implemented, what are it is merits and demerits, what are the different standards which are used to achieve the command and control system. And you have observed that this command and control system is not as effective as the market based approach which you will study, because it does not allow a firm to innovate.

So, equi marginal principle cannot be applied, RND can not to be in the case under this system, because this is the kind of system under which the company has to comply the order of the regulators. So, market based approach is actually considered more efficient than the

command and control system, but my view is that both systems have their merits and demerits.

So, the regulator may use or generally use a combination of both command and control system, as well as market based approach which I introduced earlier that like taxes, subsidies, pollution permits, tradable permits liabilities. So, these are the different kinds of instruments under the market based approach which are generally used by the regulator to achieve the environmental goals.

So, both approaches are used and you will study in other lectures in detail, what are the main market based approach, how they are implemented, what are their merits and demerits.

Thank you very much