Energy Economics and Policy
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Week - 06
Energy Market
Lecture - 02
Why Energy Market is not Perfectly Competitive?

In the previous video we have checked different components and different aspects of a perfectly competitive market. In this video we are going to look at whether or why the energy market can or cannot be perfectly competitive in nature. We are going to start with the question, why is perfect competition not observed in the energy market?

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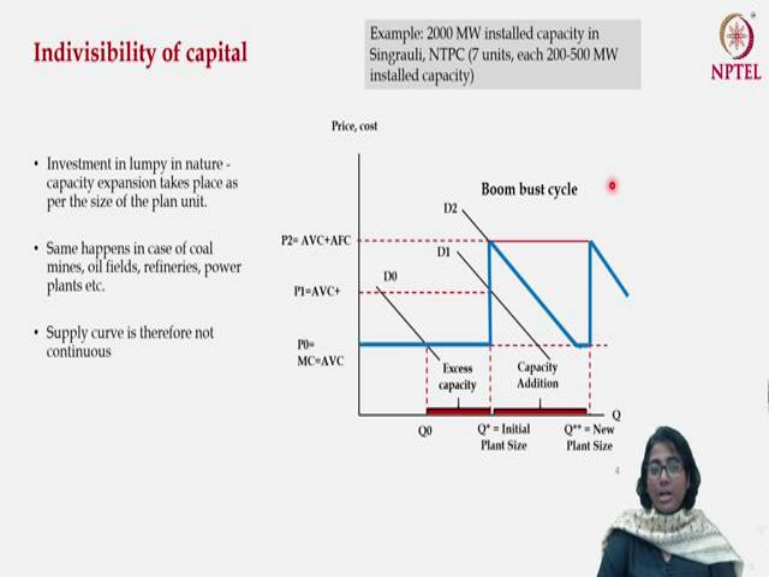

Let us start with the first characteristic of energy projects that prevents the market to be perfectly competitive in nature is the indivisibility of capital. Now, what do we mean by indivisibility of capital?

Let us start with the following example. If you think about the power plants, the NTPC has various power plants across India and the oldest one probably is in Singrauli and the capacity of this power plant is 2000 megawatt. This 2000 megawatt installed capacity is actually distributed across 7 units and each of them has the installed capacity of 200 to 500-megawatt hour and you can imagine the size of the operation of each unit.

At any point of time if NTPC decides to add one more unit to Singrauli power plant the size of the power plant is going to be something in the range of 200-500 megawatt and not less. In comparison the renewable energy projects have much less installed capacity to the tune of 15, 20 or 50.

Here we can see that if there is a need you can't probably set up the power plant on an incremental basis. You can't say that from 200 megawatt, I will make it 210 megawatt tomorrow, then the day after we will make it 220 megawatt, that is not really possible. If we want to make an investment, we have to invest probably on another 200-megawatt project. The capital is indivisible in nature and as a result it becomes lumpy as well. It is lumpy because at one time you have to spend a lumpy amount of money. So, the investment is lumpy and the capital is indivisible. This is one of the most basic characteristics of energy projects and this is true for any of the energy projects.

In the case of oil fields, mines, refineries the scale of operation is very big. The interesting fact about lumpy and indivisible investment in capital is that you have to wait a bit in order to understand that there is enough demand that can support capacity addition of another 200 megawatt. There should be a clear hint from the market to go ahead with the addition of capacity. This is the first point of departure from the perfectly competitive market structure.

What we assumed in case of perfect competition was that the marginal cost was smoothly rising. It meant that you can keep on incrementally adding to capacity as and when you want so that was giving a smooth line. But that is the first point of departure as in the case of energy projects you can't really have a smooth marginal cost curve. If you do not have a smooth marginal cost curve then obviously, you can't equate the market price with the marginal cost curve. If the marginal cost curve is not smooth then how does the pricing take place that is if we are not in a position to equate the price with marginal cost then how does the pricing take place.

Let us start with the initial situation and assume that given is the power plant that we are talking about. At the initial phase what we are saying is that $P = MC$. Initially there is no demand supply mismatch, the price is equal to MC which is equal to average variable cost and the perfectly competitive market is there in order to supply as much as you want up to point $Q*$. Therefore $Q*$ gives the initial plant size.

The production cannot go beyond $Q*$ is the only constraint faced but up to $Q*$ production behavior is just like a perfectly competitive market. Let us start with the demand curve D_0, if the demand curve is D_0 then this horizontal line is the long run supply curve of energy which is pretty much similar to the perfectly competitive market structure. As we face the demand equal to D_0 the production of energy will be at Q_0.

As a result, there will be some excess capacity. The demand is not enough to utilize the entire energy generation capacity. Some excess capacity remains which is pretty much okay with the energy industry because it is such an industry that always has some sort of an excess capacity because it has to cater to some contingency situations. Therefore, having some excess capacity is not unusual with the energy market. Up to the given point we don't see any departure from the perfectly competitive behavior. The problem happens when the demand increases. Suppose the demand increases to D_1. In order to be in a perfectly competitive market structure the production would have taken place at this point and the price charged would have been P_0. But the problem is, in the short run this particular producer of energy or the market for energy sees that the supply is not enough or the capacity is not enough to meet the demand but the demand does not show up as high in order to go for another capacity addition. The firm anyway cannot produce more than Q^* because that is the constraint within which it is operating.

This has to be on the demand curve where $Q = Q^*$. The only point of equilibrium that is available with the firm is at this point, if the firm has to bring the market equilibrium at this point but there is the departure from perfectly competitive equilibrium. The perfectly competitive equilibrium would have been here but due to constraint by the plant size the market equilibrium is being shifted at another point.

If market equilibrium is shifted to another point then the price that you are charging from the consumer is higher than the competitive price and as a result some of the buyers will actually leave the market. The buyers who were willing to buy energy at price P_0 will actually leave the market when the price increases to P_1.

P_1 not only covers average variable cost but it covers something in addition to that because at P_0 average variable cost was already covered. At P_1 something more than average variable cost is being earned. Remember, this is not supernormal profit when the price exceeds the total average cost which is the composition of average variable cost and average fixed cost. However, you see sort of a ray of hope that you are exceeding your average variable cost.

After few days demand again increases and becomes D_2. The producer has to bring the price to P_2. At P_2, the price charged not only covers the average variable cost but it also actually covers the average fixed cost. The moment there is further increase in the demand then the price actually exceeds the average cost and the firm will start earning some supernormal profit. Once the demand reaches D_2, the other existing firms who are ready to enter the market but were not very sure about the increase in the demand get the signal that now the situation has come where you will not only recover your average variable cost that is the price is so high that you will not only recover average variable cost but will also recover average fixed cost if you don't end up earning supernormal profit.

At point P_2 the new entrants are interested and there will also be interest in the capacity addition in the energy market. Let us assume, the capacity addition happens and the new plant size is determined at point Q^{**}. When Q^{**} is the new capacity and if D_2 is the demand curve then instead of being at price P_2 the supply has increased, demand remaining constant. The price is going to fall and the new equilibrium will actually come to the perfectly competitive equilibrium position. Whenever you are on P_0 line, you are on perfectly competitive equilibrium. However, the moment you are deviating from this line you are actually deviating from the perfectly competitive equilibrium.

What is the movement of pricing this kind of a scenario? Initially you moved from one given point to another, price remaining unchanged at P_0 the quantity increased. Then there is a sudden increase in price up to P_2 and then again, the price declines.

The producer is on the perfectly competitive outcome up to full capacity. Then there is a departure from the perfectly competitive outcome then again, we come back to the perfectly competitive outcome probably to the point where we exhaust all capacity and again there is a shoot up in the price. There is a volatility in the price that you can see in the energy market which actually compels it to deviate from the perfectly competitive outcome.

This is one reason for the indivisibility of capital because there cannot be incremental increase in capacity addition and has to be done in a lumpy manner. This actually forces the energy market to deviate from perfectly competitive market outcomes.

What does the trajectory look like? Initially the producer follows a given part then the price goes up, then the producer follows the demand curve, the price comes down, then again, the

producer is on the perfectly competitive part until you exhaust the new capacity that has been created. Again, there will be a price shot up, again this will continue falling following the demand curve.

In this kind of situation when there is a demand boost, the price actually increases, then there is a capacity addition and the price again declines, again the price increases and then falls. This is called a boom - bust cycle which is very common in case of the energy market and in the price mechanism of energy. Looking at the boom-bust we determine the situation in the energy market, whether the energy market has a very high supply as compared to the demand or whether it has low supply as compared to demand?

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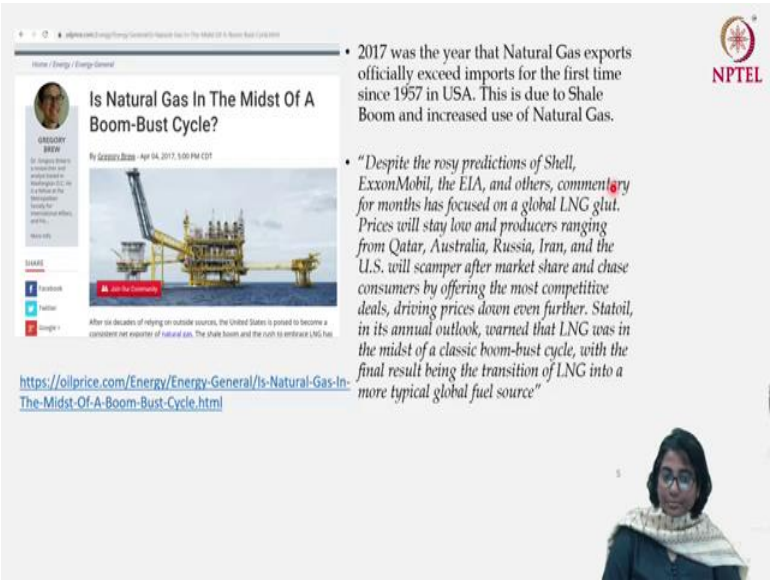

Let us take an example from the natural gas industry. This is from the internet and the website is given where you will find the whole report. It says that 2007 was the year that natural gas exports officially exceeded imports for the first time since 1957 in the USA. This is of course, due to the shale boom and increased use of natural gas.

After the natural gas was discovered, they not only started producing and supplying natural gas they also encouraged people to use natural gas. So, both the supply as well as the demand has increased.

If the demand increases then there is motivation for capacity addition and more exploration and more production of natural gas and this is what has happened in the US and this report is

saying that in 2007 for the first time US was reported to be the net exporter of the natural gas that is the export actually exceeded the import.

In earlier phases the US used to import natural gas from Canada and other countries. However, the interesting line is, it says, "Despite the rosy predictions of Shell, ExxonMobil and the EIA and others the commentary for months has focused on a global LNG glut. Prices will stay low and producers ranging from Qatar, Australia, Russia, Iran and US will scamper on the market share and chase consumers by offering the most competitive deals, driving the price down even further. Statoil in its annual outlook warned that LNG was in the midst of the classic bomb-bust cycle with the final result being the transition of LNG into a more typical global fuel source."

They are trying to tell that now you have the demand curve, that is, the demand curve has been discovered and everybody is trying to supply LNG. There is a glut of supplying energy and the market is flooded with LNG supply. Probably the path of LNG price will follow the cycle. That is why they are predicting that the price of energy is likely to come down in near future because of the classic boom-bust cycle. This is one of the classical examples of how the pricing of the energy market works.

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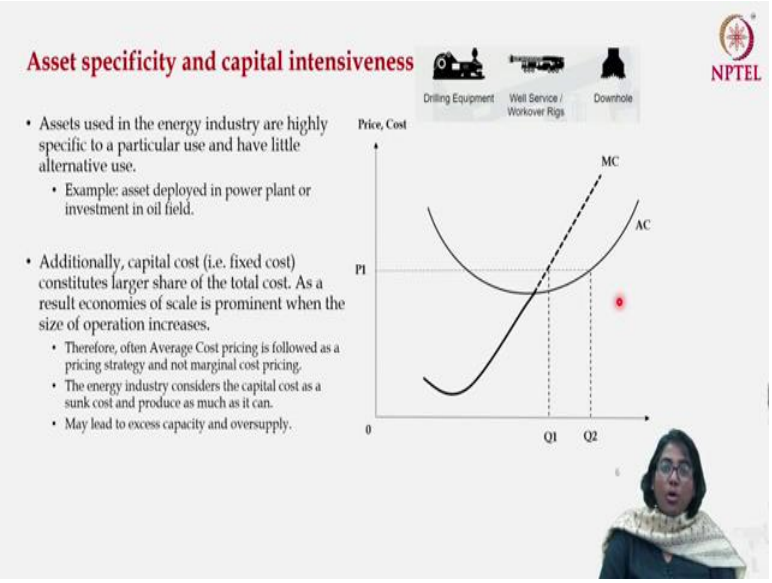

The second point that we want to talk about which again forces the energy market to deviate from perfect competition is the asset specificity and capital intensiveness. This is a little different from the indivisibility of investment. There we said that you have to make a big

investment, you can't make incremental investment. The capacity addition cannot be implemental, it has to be lumpy in nature.

Here we are saying that once the producer has spent money in buying some asset which is important in the production process of energy, that asset cannot be deployed anywhere else. For example, think about the machinery or the equipment that is deployed in the power plant, you suddenly can't take them out and bring them to the oil field or you think about the drilling equipment that are used in the oil field. Once they are bought, they have to be used in the oil field only.

This points that the alternative use of the equipment for this kind of project is very limited. It says that the money is stuck for a longer period of time and these are very investment intensive projects. Initially one has to spend a huge amount of money which will be stuck with the project and which will have very limited alternative uses. This is one of the very crucial features of energy projects. Additionally, we also mentioned that the capital cost that is the fixed cost is much higher as compared to the variable cost. As a result, the economics of scale is prominent only when the size of operation increases.

The concept goes on like this, I have already spent 1000 rupees at the beginning, now in order to run the operation every day I have to spend 1 rupee for production. If I increase my production then I will be quickly able to recover my fixed cost because the fixed cost is what matters, 1 rupee can anyway be recovered. The variable cost is too insignificant with respect to the huge capital cost that we have to incur.

If you look at the scenario, in a perfectly competitive market structure the producer in order to maximize the profit will equate the price with the marginal cost. Under this situation, imagine the case where the capital cost is really high. If the marginal cost is equated with the price, the equilibrium will take place at the given point. This is where the producer is producing but what is the objective of the producer? The objective of the producer is to produce as quickly as possible to retrieve the initial cost. The producer wants to produce more in order to retrieve the initial cost fast. The producer can do that if it does not equate the price with marginal cost but rather equates price with the average cost. If that is the case, then it will be able to produce Q_2 amount of output and this will actually increase the speed of recovery of the fixed cost that has been incurred. That is why we often say that in the projects where the fixed cost is much higher as compared to the variable cost it's often seen that the marginal cost pricing principle does not

hold. The pricing principle that comes into the force is mostly the average cost pricing principle and that is also true in case of energy projects and this is another reason why it deviates from the perfectly competitive market structure.

What is the drawback of this whole process? The drawback is that if you keep on indiscriminately producing energy there is no guarantee that everything will be sold out in the market. There will be excess capacity if there will be over supply. This kind of problem will be there and the market has found out the ways to tackle the oversupply or excess capacity problem.

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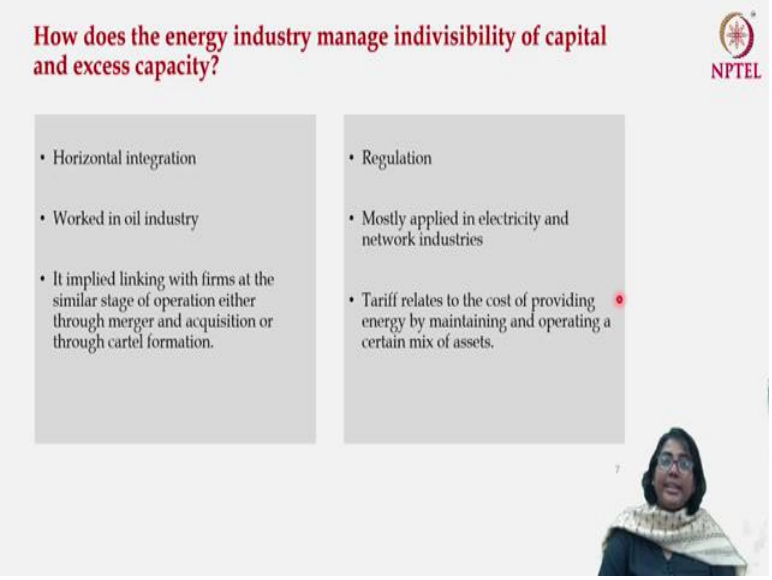

One way to do so is through regulation where we fix the price and this is mostly applicable in the electricity sector and the network industries. The tariff is actually directly linked to the production of energy and the operation of a particular level of asset. The price that is prevailing in the market is the regulated price that will ensure that a certain part of asset cost or a certain part of fixed cost is recovered, at the same time the running cost is also recovered. This is the regulating mechanism.

However, in those markets where these kinds of regulations are not there, horizontal integration is possible and this is visible in the oil market tremendously. If there are more than one producer operating at the same level of efficiency, maybe they are operating for the same number of years, with same experience, same expertise and so on, they can go for integration through merger and acquisition or it can also happen through cartel formation.

Cartel formation is something, we will devote some time on to understand the oligopolistic cartel. The oil industry operates in a cartel. The amount of supply that they are going to go for in the market is decided not only by one firm but jointly by the major supplier of the industry.

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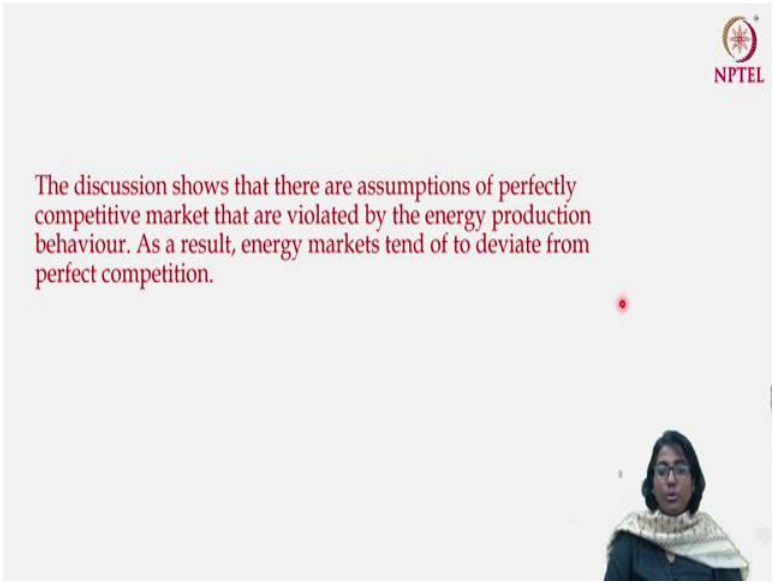

In a nutshell what we can see from this discussion is that energy projects do have characteristics that actually deviate strongly from perfectly competitive market outcomes. And you can also see this kind of very high fixed cost and lumpy investment also gives the hint that it's not possible for everybody to enter into the market as you have to have huge capital and certain other characteristics to be an investor in this market.

The number of investors, number of producers, number of suppliers will be limited in the market. That kind of gives us a hint that we think that monopoly is a better option to explain the energy market as compared to perfect competition.

This is the end of this lecture, in the next lecture we are going to talk about monopoly.