

Power System Generation, Transmission and Distribution

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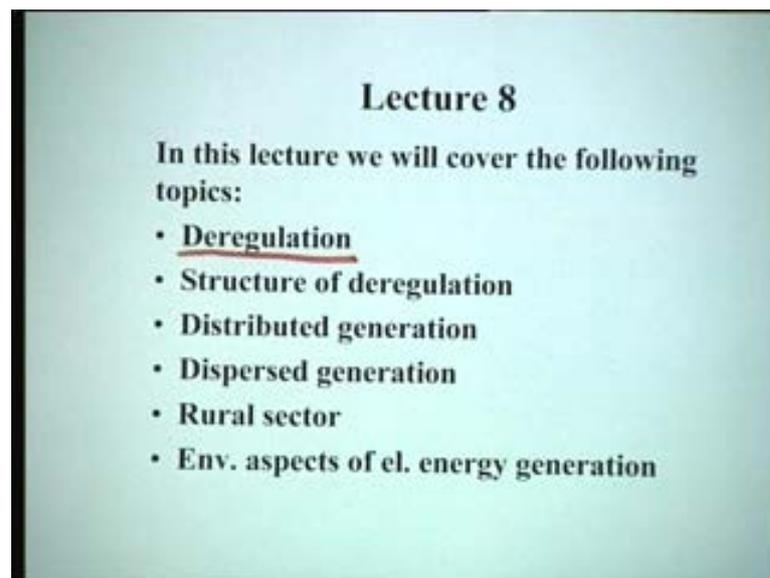
Indian Institute of Technology, Delhi

Lecture No. # 08

Deregulation

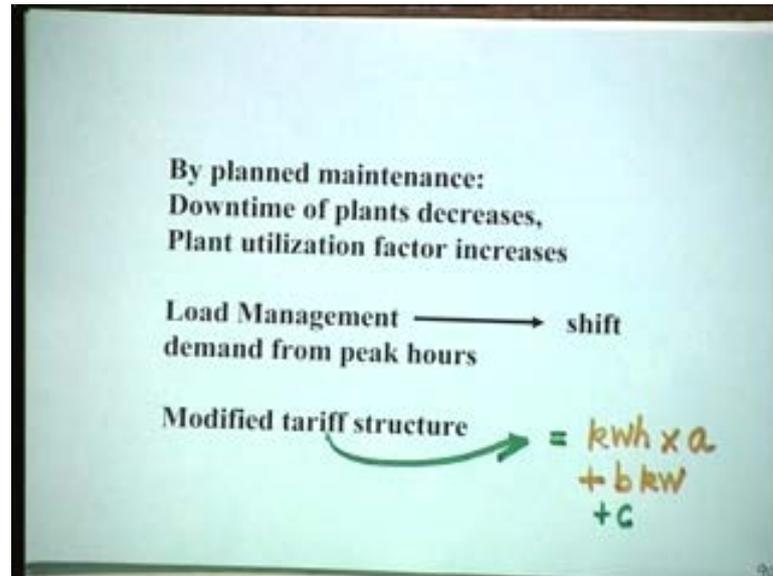
Good morning ladies and gentle man, now last time we talked about Energy Storage, how power systems grew in India and the multimillion dollar question, how to conserve energy in practice, not in theory.

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Today, we will be talking about entirely new concept Deregulation: structure of deregulation, distributed generation, dispersed generation, rural sector, and environmental aspects of electric energy generation, all these topics are extremely important for any one who has something to do with energy.

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I have already talked about maintenance, downtime of plants decreases, plant utilization factor increases; you get more power, save money, money you have already spent. And using load management techniques as I said earlier by reading Palodas papers, I do not know how many of you could see that reference, we can shift demand from peak hours with mutual consent and hence we can save power.

Modified tariff structured I told you, that I will talk to you this time today, now tariff normally should be on kilowatt hour consumes, just whatever kilowatt hours are shown in your energy meter multiply by some, let us say a rupees per kilowatt hour, rupees per unit, normal man knows kilowatt hour by unit how many units to you consume right.

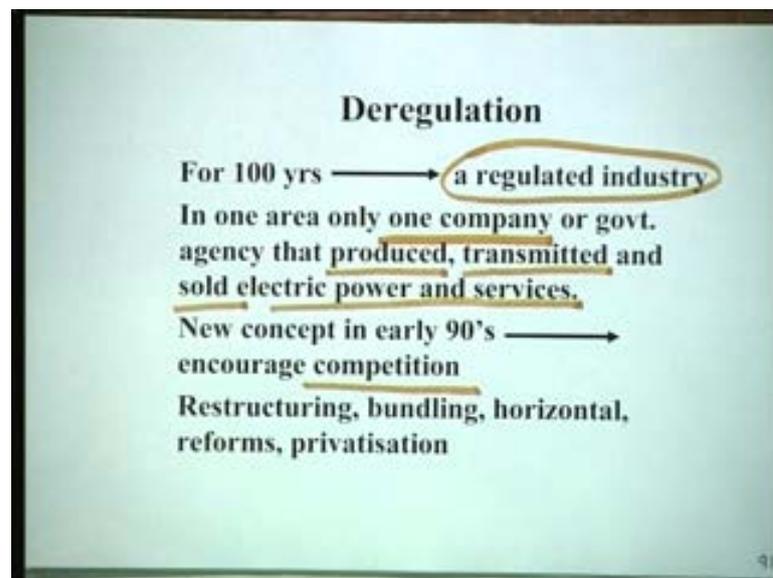
But this is not correct, because what about the penalty for low power factor, what about the charges for the connected load, you have in your house, in your company, in your industry, what is the connected load of this room; as many lights, fans if any or AC all you had that is connected load.

You may not use connected load, all the connected load all the time; that is what the concept of diversity factor was and diversity factor is always more than one. It is defined as, total connected load upon the maximum load coming on the system at a given point of time. That is the diversity factor.

So, the tariff should have that and plus we should have another term b times kilowatt, one can add another term c times a constant, and this can be your modified tariff, c is for cost for the low power factor penalty or the cost for labor or cost for depreciation, cost of interest the power company has taken loan. So, naturally it has to be transferred to consumer in privatization resume, because this is not a charity resume or this is not a so called social service; he has to adjust in the market in competitions with other companies.

So, he cannot afford to be losses, he has to done his company, so this is called modified tariff structure; c will also for a penalty power, if you have a low power factor, if you have a low voltage that c can be a complicated function if you need b , but we can lump together in c , this is module tariff structure at the moment when in Delhi we have the now private power companies, so their tariff structure is much better than what you used to have the SO or DVB.

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Coming back to the current main topic of today's lecture is deregulation, all of you know regulated economy, we use to follow soviet union policy earlier on socialistic pattern, socialistic state everything was regulated. The energy was with the government of India, whatever prize they have fix that is a prize, whatever company they have the state electricity board, that board is the only fellow from where you can take, like in any other area, telephone I need not have to worry about MTNN, if you are not happy with that

give it back cylinder people have to started cylindering MTNN forms. And they have gone for Reliance, Tata's there are choices that is what is open market is all about market driven economy; for hundred years a regulated industry throughout the world, the power system throughout the world was a regulated industry as I said by government that particular country, the particular state.

In one area there was only one company, if you are in Delhi this was the only place where in, from where you get your power connected, because no other choice or government agency that used to produce power, transmit power and sold or distributed power and services there is no choice. New concept of deregulation has come in 1990s early 1990s that encourages competition, like for example you can have a choice between Pepsi, Coke, Fanta, Limca, lassi, [FL], so you are not dependent on one sort of cool drink, even in bottle water, we have several choices you do not like Bisleri, then there is Aqua then there is and so on.

Competition means, the consumer is the only beneficial; if there is a competition the beneficiary is consumer. There are institutions in the world where in there are multi section course is run same course in 300 students, 5 sections of 60 students buys in terms. What you is to happen, any teacher who is the best his class is to overflow is for 60, 90 are attended, people were sitting in the windows also, and the one who is not good only 10, 12.

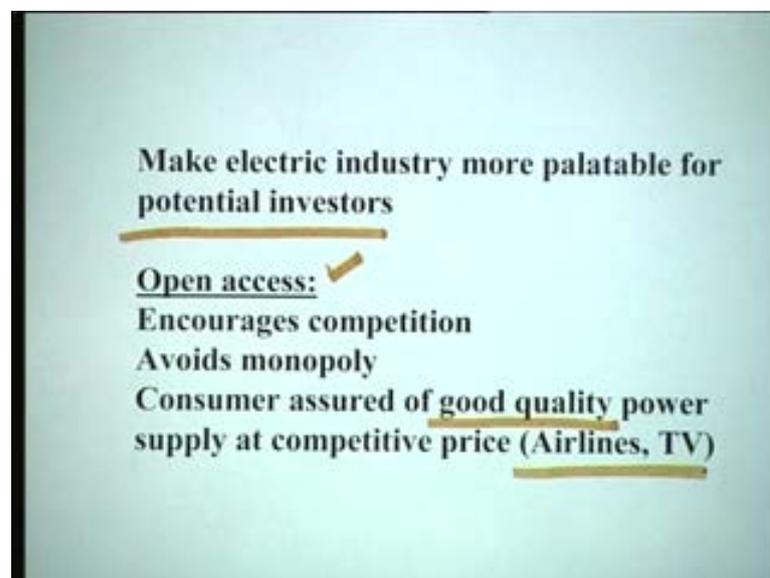
So, that there was danger that weaker teacher, poor teacher gets exposed, because there was the freedom for students to go and attend. So, those institutions got attendance role, your attendance can be given only in your class. So, that was another mechanism of forcing students to attend a particular class; any way we do not have an IIT such a problem because, more or less all teachers are good and there are hardly any multi section classes at least not for PG, your strength is hardly 30.

Restructuring, what is this restructuring; it use to be a vertical structure, now it is horizontal that is the restructure. Bundling it is opening up, what they have done, they have divided generation company separated Genco, transmission company separate Transco, distribution company separate distribution co, why? No single person can own such a, huge gigantic power company; that is why BHEL can never be privatized in its present form.

Who will have that sort of money to pay to the government, to purchase BHEL, so they have to privatized in parts; BHEL Jass is separate, BHEL Haridwar separate, BHEL Delhi separate, BHEL Hyderabad, whenever it is turn comes at the movement is not there, they are one among those Navratnas, these are the nine public sector units which are making profit.

But, the government may even sell profit making desired to companies some day. So, it is a horizontal, now it is for vertical these are reforms; you must have heard of reforms, reforms started in India in 1992 Narasimha Rao's government right, Sardarji was responsible Manmohan Singh, Doctor Manmohan Singh privatization.

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How can you achieve success in this, to achieve success, you make electric industry more palatable for potential investors. You have to attract people to come and invest in India; that is why DFI is very important in index now, what is DFI Direct Foreign Investment. The success of reforms lies in the fact, that you are able to attract, you have to tell people look this is the destination you are looking for; here is the place where in you can earn money. Otherwise why should you come, why you are coming to IIT, it is a brand name; you know that IIT degree means imagine, otherwise why should you come here.

There should be open access, what is open access, they are not different generation company; there is a transmission company. Now, naturally generation Company is not

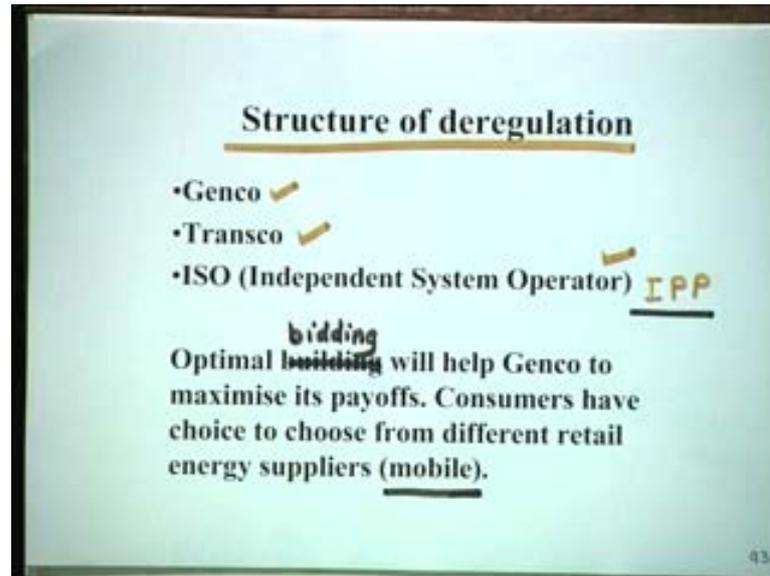
own transmission company in general so they have to request different generation companies have to request the transmission company, which has a transmission corridor look I will need to transmit my power on your transmission lines, so much amounts for so much time.

So, there is an open access, you will book. This avoids monopoly, once monopoly comes, even if it is very private and there is only one like blue line there are problems. So, what is done the government, government has at least had to answer to the people in election time at least, private company does not have to answer to anybody. So, where ever privatization is monopolized it is failed, failed or it has not done the desired purpose, it is not served the desired purpose, but when there is a competition like mobile it is customer all the way who is laughing, because he has a choice if airtel is not good, you will go for Hutch or whatever. This then consumer is also assured of good quality, suppose tomorrow you go to airtel look your cell is no good, I am not listening anything, what is happen, what what what is this this model you are having; it will be alright tomorrow it will be, he is worried because otherwise, you will not purchase next time prepaid card from airtel you may go somewhere else.

So, quality will be maintain if there is a competition, power supply will be at, do not think privatization will always increase the cost; that is the wrong notion and government means only decreasing cost no, mobile rates would not be so low hurried mean government company. Look at MTNN 250 rupees rent unnecessarily; even if you do not made single call you have to pay to 50 rupees that is a rent, and if more people go for private telephones this rate will come down again.

Look at what happen to in an Airlines, now they has started smiling edge of consumers, earlier they were not smiling only [FT], because they know if they do not do it, they will go to jail, they will go to Sahara. There are choices, there are alternatives, alternatively there is no smile. Power supply at competitive prize see I given the examples of TV and Airlines look at the quality of the doordharshan it is definitely be better; gone are the days when nobody used doordharshan, only doordharshan, but now they are forced to improve.

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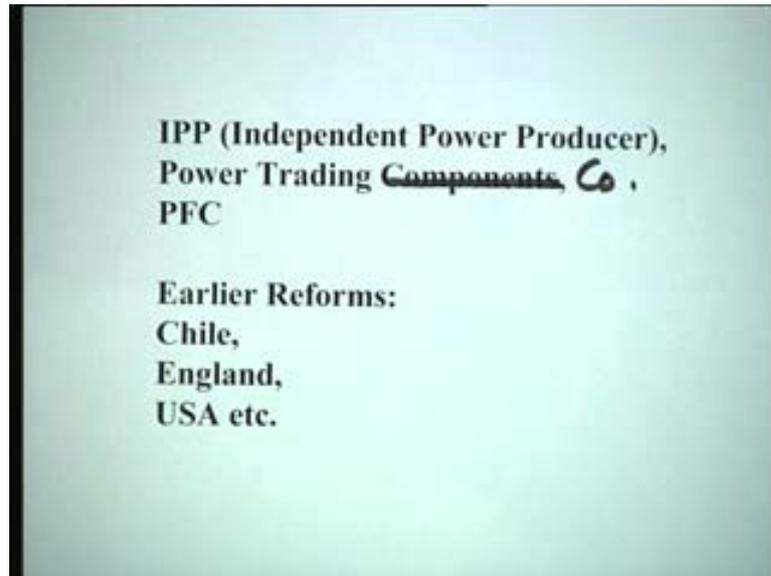


I already talked about structure of deregulation; I told you Genco, Transco, Independent System Operator; independent, there are so many names, IPP Independent Power Producer. Optimal bidding I know you I hope you know what is bidding will help Genco to maximize its payoffs, consumers have choice to choose from different retail energy supplier like mobile, I already given this example of mobile.

Nobody can force that you have to purchase airtel, if you like airtel service buy own needs, you do not like you do not have it. Such consumers is the winner he has the choice to choose from different retail energy suppliers at the movement it is not in Delhi like that other there is a BSNL or there is a Tata the whole delhi divided into two parts.

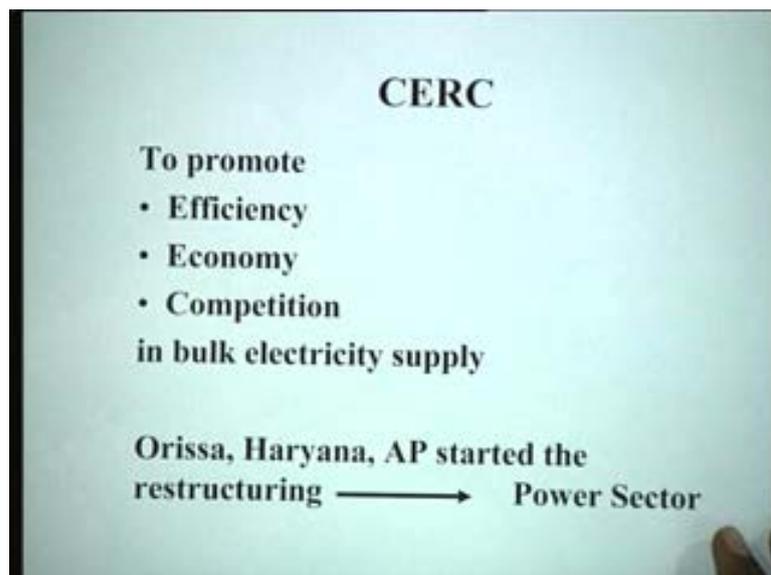
But who knows, tomorrow you may choice with great difficult, we got those two companies to take over from DVB this is the starting, tomorrow if power companies feel that yes, there is the money in it. And let me tell you, there are some cities where private companies have been operated, have been operating successfully for ages Bombay, Tata electric companies, whole of Bombay is supplied by Tata's and no pan cards. Calcutta is the, Calcutta electric supplier company which is the private company Ratlam Ahmedabad these are all private companies and they have been operating for ages IPP, I told you about independent power producer.

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Power Trading Corporation, Power Finance Corporation, these are the companies where you can get jobs also, they are all Delhi based and with your expectations you will be better persons for them to be selected, you can ask these our training and placement office to take this guys here for selection after when you are do for it. Earlier reforms would you believe started the first ten to start is Chile followed by England, US, etcetera, now it is practically the whole world.

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What is CERC, Central Energy Reform Commission sorry, Central Energy Regulatory Commission, you have to have a regulator; once you have a privatization like there is a TRAI, T R A I, telephone regulatory commission of India. So, similarly you have CERC is office in Delhi, then we have a state electricity reform commission in each state, what they do, is it let me tell you regarding energy audit, there is no efficient energy built.

So, they they have to you know regulate this energy efficiency and energy audit; there is a petroleum, PCRI they also similarly, there is the Terry Tata Energy Research Institute they are now guiding data institute for Phd also, and they can send you anywhere in abroad US, Java very good arrangement.

It will promote Efficiency; it will have Economy, better economy, more Competition in bulk electricity supply. Which was the first state in India adopting reforms, any idea? Which was that state, which went for the first time for opting for reforms, power reforms, and any idea? Orissa, of all states Orissa is one of the poorer state it may not compete with Bihar, but next to Bihar and reforms failed miserably it was total cause condition why, it was first time they are not knowing what to do with is it, just because the reforms are there you just cannot set of I mean it has to be implemented properly.

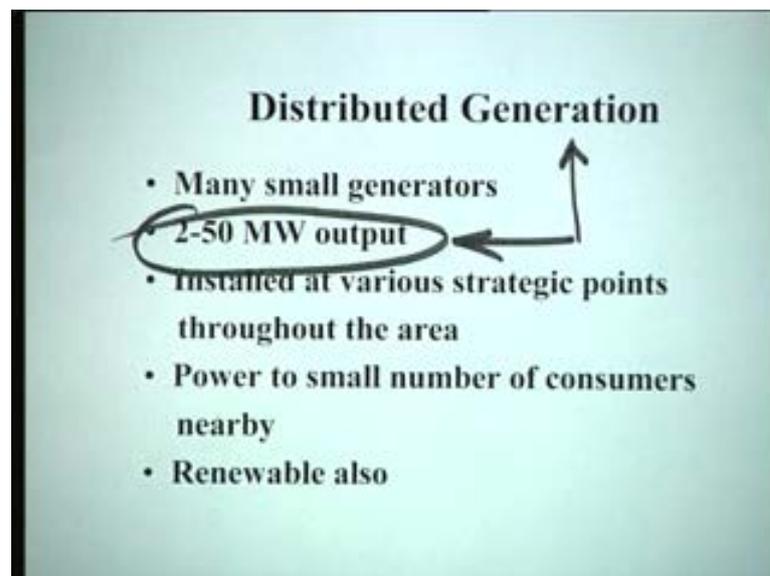
So, the Orissa is similarly California that was the first state, California is one of the state where white people are minority and there is a prediction by two thousand forty whole of US white people become minority. Thanks to this immigration there is Negroes and so on, so they will be in minority, anyway that as nothing to do with PAR Reforms. So, we where talking about the reforms in US, it is their states are more or less independent countries that is why it is called United States of America.

In fact, it is united countries of America each state can have a different loss altogether, some states hanging is allowed, some states hanging is not allowed, in some states, so many things. So, states are only currency is common, in defense is common and you know foreign affairs is common or even now income tax is different; if you go from Basten shire in city hardly half and hour there is no tax, there you work in Basten stay there no problem. California experiment also failed and there are papers and papers return why, California, but then one learns from failure, as someone is said failure is the first step to success.

You do no guarantee, batsmen get out very first ball that does not mean he has failed for ever; if it does not mean you are not going to get a grade, this always minor to this always major, but you have to work with double zeal, double enthuse you just two lose interest in that subject then of course, nobody can help you.

So, one learns from there are papers as a sets some of you can do your M.tech thesis in reforms, there is one lady in energy centre doing Phd on reforms, so you should contact her for greater details, because this lady is an . So, there her name is Thataco she sits on fourth floor, this is corner floor, so you can ask her to deliver and lecture on reforms. Of course, Haryana, Andhra Pradesh they all followed Delhi, and now, it is a success to it is no more failed story story.

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What is distributed generation? Why did we go for 500 megawatt one unit size in seventy's? As i told you one of my earlier lectures, for first 500 megawatt unit was imported from CEMAS, German. And then one thing good in India we try to duplicate it at our own home, whatever defense things we purchased from soviet union we use to done again the class was we will able to produce ourselves, so you become independent.

So, this was no different there is no exception for this and we started manufacturing 500 megawatt unit by BHEL In fact, we import as well as export, so many things sometimes it import, sometimes you have to export. You may wondering, we also give aids to certain small estates, smaller countries when bottle we arranging goes to Nepal, 1000

million dollars to give. You see wondering at you do not have a money you are giving to others, this you have to do in international diplomacy.

So, we a certain things are there which we import as well as export; lets for example, the wagons first wagons of metroware imported, but now we are started manufacturing our service in Punjab and Madras two factories, which we have. What was the aim of that large unit they where suppose to be cheaper, per kilowatt install as well as per kilowatt our generated. It is no longer, so times have change that was seventy's; now it is first decade of the new millennium twenty first century.

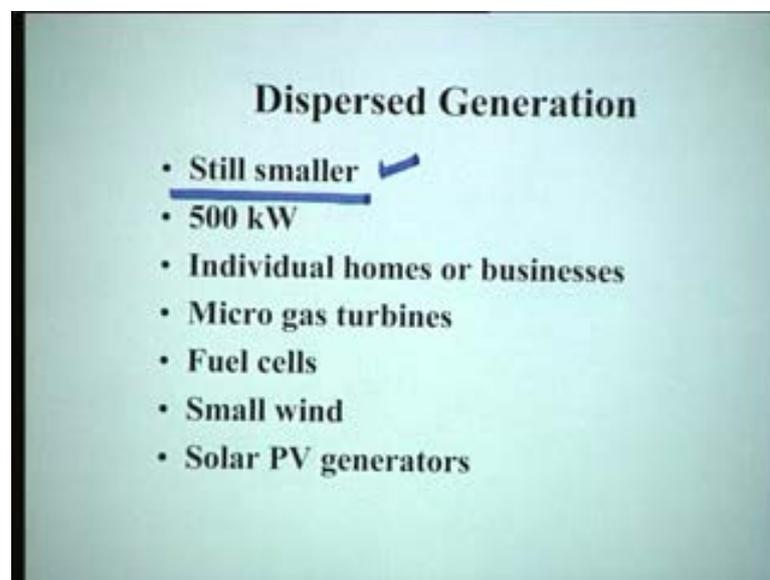
The difference is now, Shung to such an extent that we need not go for 500 megawatt, what are the drawbacks of 500 megawatt unit, you need 4000000 into 5 megawatt that much money which we do not have; second if such a unit fails it gives you bigger shock. If you lose the 100 rupee note may be 1000 rupee note, now your mood will be bad for two three days, but if you lose 10 rupee note may be tea lunch or may be for one hour, then we forget that your last 10 rupee are it is all right. So, that is the different between big unit and small unit; the small unit fails do not that much worried, but the big unit like a minor you do not do one caution is, but in major if you spoil it then it will have a major impact on your grade.

So, 2 to 50 megawatt this is the range for distributed generation, beyond 50 it is not distributed it is the main; like your main frame. That is the perfect analogy between power sector and computer sector, computer there where big I told you the story of baby computer did I tell you, in Manchester the first computer was born in 1948, by three scientist, I think I told you, that computer occupied this big room and they call it baby computer. At that time they thought this is baby, I have seen that computer in 1998, when there was celebrating 50 Th anniversary of that installation of that baby computer.

And those three scientists are still alive and they talk to us, I was in one of the delegation to UK, and still working. Then we come to mainframe computers smaller and smaller and you know, and now we have come to palmtop or even tomtop small thing put it somewhere and you start giving lectures. Same thing is happening here, 500 megawatt to 2 megawatt, install at various strategic points, camera placing they are at the strategic point, there is a strategy behind it; there is a calculation behind it from where you get the best picture.

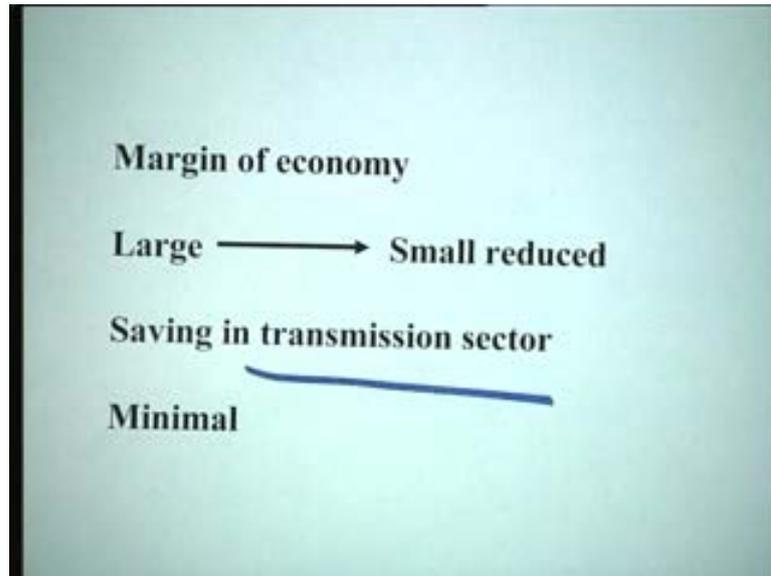
So, that is an optimal sites are selected to put those distributed generations. So, that the loads are not far of, so you minimize the transmission distance and so losses; power to small number of consumers nearby, so if there is a one generator in Malviya Nagar it takes care of Malviya Nagar or may be South Delhi rather than Indhraprastha and his brother taking care of whole Delhi. This is the difference between the vertical structure and horizontal structure no big power plants, but smaller power plants that various places. Well renewal energy can also be used 2 megawatt, you do have win power station of 5 megawatt now, even 10 megawatt.

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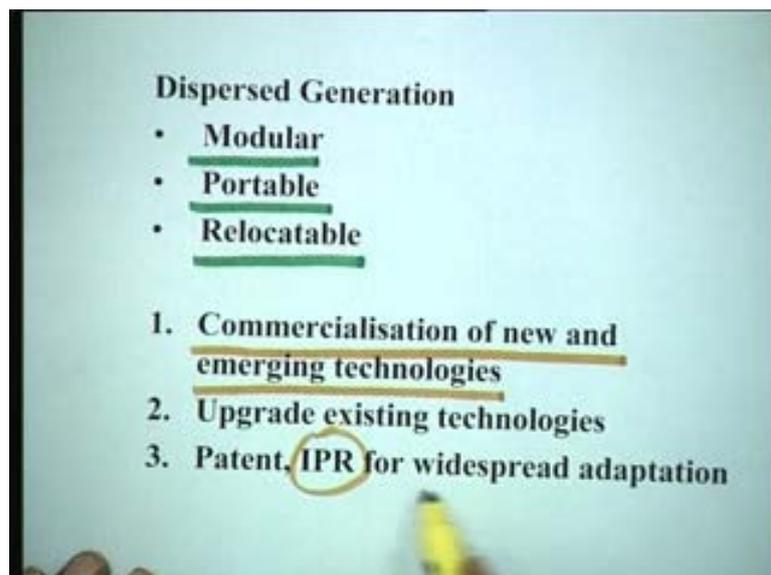
There is still smaller called disperse generation; that was distributed, this is disperse as the word shows still smaller and as they called small is beautiful it is not 2 megawatt any more it is 500 kilowatt below. Individual homes, businesses, buildings we talked about the roof top stations wind, did you visit synergy building are you go only after first floors, sip and bite whatever its name, do not go beyond first floor. Micro gas turbine, fuel cells we already talked about fuel cells, small wind, solar PV generators all this constitute dispersed generation.

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Margin of economy is now reduced, if you go from small to big, so we can go from large to small. Whatever loss is there, here is more than compensated by getting grid of transmission sector; transmission sector is no more required as big as it used to be, it will be minimal, there has to be some transmission, but it will be much much less than what it use to be in non reform based. What are the main advantages of disperse generation are even distributed generation.

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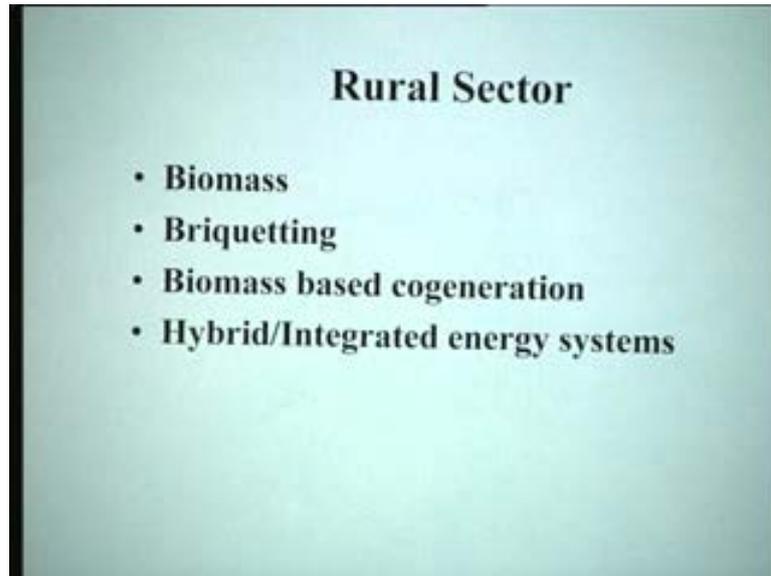


All these three words are very important: modular, portable, relocatable; what is modular, if it is 2 megawatt you can have another 2 megawatt almost in weeks time; go and adding that is modular, modules can you go and adding, perhaps no, very difficult can you add another Bakhra no; what is portable? Today, you are keeping the 2 megawatt in Malviya Nagar, tomorrow if Malviya Nagar has not given that congress candidate, let us forget about Malviya Nagar, and let us take it to get a clash that is the political reason.

Suppose, yesterday there was industrial unit working in Malviya Nagar closed, so there are no takers of power and wind your shop you start somewhere else where there is industry. So, it is poor tip you cannot take further from here to anywhere only perhaps Hanuman could do that, and it is not available today right. It is not easy to shift any big power plants somewhere else relocatable, you can relocate it this is different from portable relocatable means then it will be permanently somewhere else, it is only relocated.

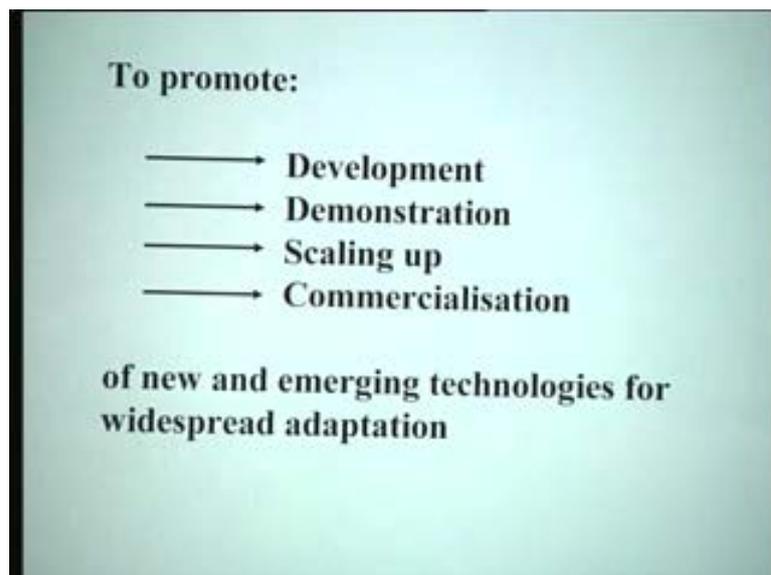
Where as this relocation is also not possible with main power stations, so these three are very important advantages of distributed and disperse power systems. So, what is the duty of new energy engineers like you, would not be passed engineer you will be called energy engineers, because you have now broad based knowledge of whole of energy sector just not electrical engineering. You to commercialize new and emerging technologies; fuel sets, hydrogen, even wind, photovoltaic, you need more factories like Saibaba, CEL you need more wind generating manufacturing companies in turbines generalization of that, upgrade the existing technologies; you have to do patenting even being or healthy patent we could not do, USA is done it. We should realize your potential and told to the world you look, you have done it even Basmati Chavan was patent in USA tomorrow they may Thulasi also you may still remain, here IPR everybody is talking of IPR, now a days in this intelligent proper derived for widespread adaptation. We have been talking of rural sector again and again because that is the only sector which needs more and more energy.

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So, that there is the ever migration, people start living Delhi and go to smaller places Biomass, Briquetting, Biomass based cogeneration, Hybrid or Integrated energy systems. This if they come in any rural sector it will become urban sector because, what makes you urban, you have education, you have hospital, medical facilities, educational facilities, good housing, good infrastructure, good roads. So, now, urban roads are become rural roads this is not much differences where as roads are concerned.

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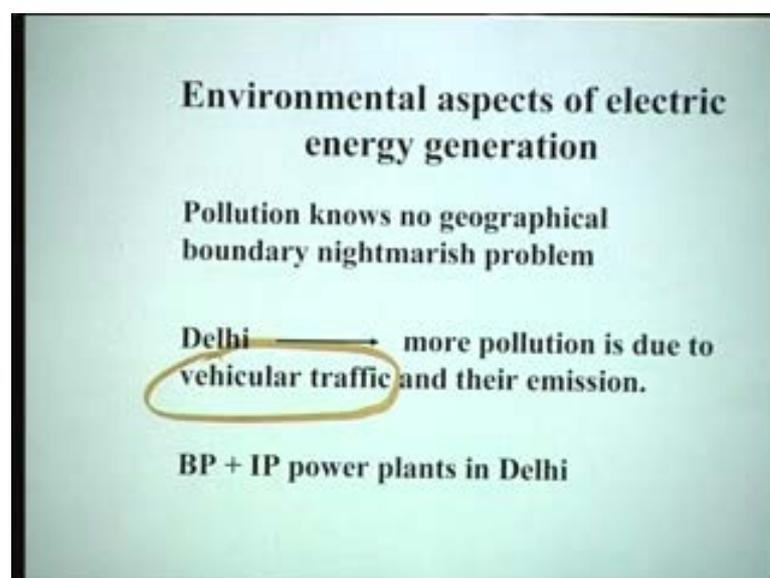


Your job is now, going to be when you go after two years to the market, to the field, to the world, to promote development, demonstration, scaling up, because first is a conceptual model, simulation, experimental model, pilot project, feasibility report, and then industry, these are the steps through which you have to pass, and finally, commercialization of any new emerging technology for widespread adaptation.

Let me tell you those of you knows, who know management; the beauty in management is create something whose demand is also not there; if demand is there and you are creating it selling it no wonder. I mean if there is a May and June and if you are drink coke or pepsi where is the problem, you should drink coke and pepsi even in January, this is December that is a beauty.

Sony, its goes to the credit of Sony the electronic giant to create a walkman without need, nobody knew what is walkman; there was need walkman now every alternate fellow is having walkman, even while doing morning walk, studies, and foreign countries even in his class room I cannot do anything if you are listening to walkman or you are eating your sandwich or burger, milk shake, no problem it is allowed. So, that walkman industry now look at that how much big industry throughout the world and nobody ask them, then there is a need for walkman, nobody; people are not aware of walk, so that is a management skill. So, there is the energy there is the need, this is nobody ask question why energy, why we cannot do that.

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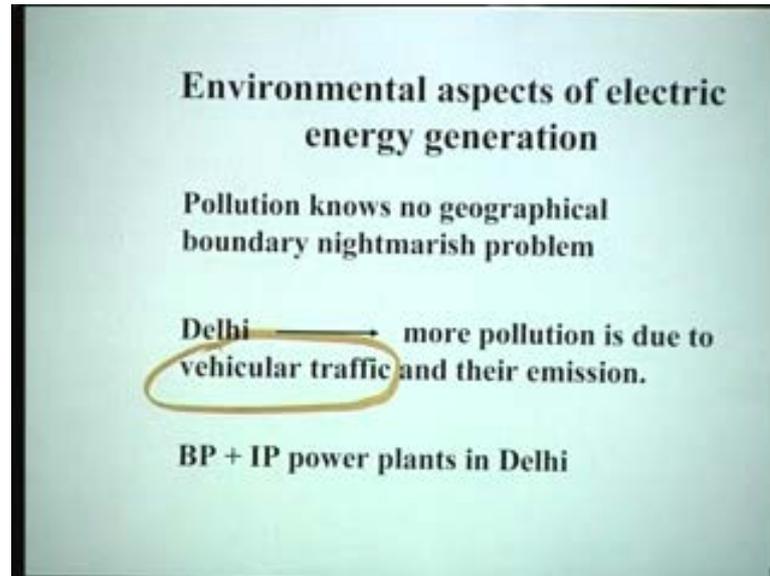
Now, we come to environmental aspects of electric energy generation. I am sure you must have been taught many such courses on environment. In fact, pollution has no geographical boundary like music, if a good music it remains good in Pakistan, England, US and India anywhere; you do not have to learn a language for it, it has no language. Similarly, if there is a pollution it would not say i will not cross Punjab IIT remain in Delhi only no.

So, pollution knows, no geographical boundary it is a nightmarish problem. Whatever, you may do any development pollution will follow, like a person like me if I eat anything I am adding calories except water, so you call all these low calorie diet and deccan diet calories are there it maybe low, but there are calories.

I have seen person like me in US ordering for pizza with lot of cheese and then says diet coke, what is to be point when her taking lot of cheese pizza with lot of cheese in it and then just small coke you are saying diet coke, diet coke is one which is low calorie which has failed in India nobody knows what is diet coke or diet pepsi low calories, low salt people are had to be very much worried about salt in takes also.

Even at your age these are called five white poisons salt, sugar, ghee, egg and rice we should consume this 5 white poisons less; specially once you cross 40, so you can enjoy another twenty years. Delhi is considered, was considered to be forth worst polluted cities in the world, after Mexico, Tokyo, New York; I think they where some list keeps on coming. Thanks to our CNG another major that we are taken no more you got somewhat below, but power industry is not the only industry which has to be blamed for pollution, it is a vehicular traffic which is the villain number one, as for as pollution in cities are concern. If you want to understand what I am talking, just go near a red light or a square stand there, because of red light you have to standard there, you to wait and if you are not in air condition car then you would not feel it, but if you are in scooter or walking or cycle, walking why should we stand, you would go any where, you are in a weaker. What you inhale those exhaust of that its arrival, it affects your lungs every 2 children out of 5 in Delhi are asthmatic why thanks to this vehicular pollution not pollution by Bather poor or Indraprasath, but why power industry gets blamed, because it is easily visible those chimneys are visible whenever you pass through that Mathura road or whenever you go to Faridabad you see that Bather poor power plant and those fuels coming out of it air pollutants, acid rain.

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I think I have already talked about acid rain, earlier on the SO_2 sulphur O_2 , SO_2 , SO_2O , SO_2 , SO_4 and this acid when it is formed up in the sky it falls, because of its weight and that is called acid rain, it impairs visibility the pollution you know if you go to Calcutta in winter season 4 o'clock it is dark and you have to do your eyes like that because, it is dust entering your eyes and impairs your visibility, damaged to buildings and vegetation you see main IIT building there are dark patches there blacken, because the road is very close and the you know smoke or they comes and spoils vegetation.

Sulphate concentration of 9 to 10 micro gram per meter cube of air aggravate asthma and lung and heart disease if an noise pollution can make you deaf, pollution you have, because of the aero planes passed there is there was one case of the Phd student who ran away next day why there is a lot of noise pollution; he cannot strains that noise of aero planes I think this today we finish. So, there is any question, whatever we have done we talked our regulation, we talked reforms, and then the dispersed generation, distributed generation. And now, we have initiated topics of environments pollutions which will continue on tuesday, so any question.

What is the portable and relocatable?

Portable is, need not relocated one place today you are Panipet tomorrow Sonapat then they will go to reward and so on. Relocatable means for square sometimes it is in Delhi, now you want relocate it to Bhopal like BHEL is where all shift to Bhopal because it was

state in very crowded it not there from Bhopal they when Nagpur now, but portable is you can take anywhere you have, relocation is normally from one place to another for quite sometime it will be stable there.

What is the brick?

That is a brick formal permission of bricks by fly ash and then uses that in house building the building material or road filling you know there are so many dash in the roads. In Bombay it was sold 3734, and that is very sad story for commercial capital of the country commercial capital of country.

Sir, now deregulation a new concept, there was a point horizontal, what is that meaning?

Now, this deregulation means you having smaller power plants that various places. So, you are progressive improving in horizontal direction rather than a vertical vertical means one big for example, now there is no space in Delhi, if you have build a building it has to be vertical you have to go vertical add more stories that is DDA fourth floor in two blocks, block two and block five we could not have another block, sixth floor was the last, there is no six th block when I am came an IIT there is no fifth block.

So, we could go up to some distance and then now only vertical we can go, because of next, next is road as seventh block has to be on the road palem road or outer ring road is it calls is no space, but here we are not going vertically now, we are going horizontal as per as power plants are concern to save money, to save transmission sector cost, anything else.

Sir, a smaller no of generator, the same demand to give a larger space

But space is not a problem in India as per as Australia, India, US, I can agree with Germen, if it is Lanka, or it is Nepal yes space is the problem, but in our country where ever the space is not a problem.

I told you the difference is very little now, there was the time when the cost was significant, but now difference and then saving in transmission cost of said that difference more than upsets. Yes anything else, if not then thank you very much.