Infrastructure Planning and Management
Group 1
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Introduction to Power and Telecom Sector Part 2A
Power Sector in India

Student 1:

So I am Arjun from group one and the topic that we are presenting on is power infrastructure.

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So in this case what power means is mainly electricity for the most part and it is one of the major backbones of infrastructure that builds a country, makes it developed, pushes its economy forward and also gives more comfort to the inhabitance of said country. So I will give a quick introduction before my colleagues come and take up the rest of the presentation. So we have seen that electricity is considered to be the key driver for a targeted 8 to 10 percent of economic growth of India.

And it is also very important that we have electricity supply at globally competitive rates because that would make the country more lucrative for more industries to come and set up, for more FDI to come in and just make the entire economic growth much more easier and more accelerated. And as we know very well electricity is required both commercially and domestically.

So it is a lot of common sense but it boost commercial production, as in if you have a high like a better quality with less fluctuations and if you can meet the required demand it is very good for commercial production and also gives a better quality of life to the general populace. I will next call upon Sudeep to elaborate on the presentation.

Student 2:

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In India basically, first two parts constitute of power generation and later is transmission and last one is power distribution one.

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Now I will present some values related to this. In India about 3.44 lakh megawatts of power is generated every year and it is increasing at the rate of 5.35 percent in the year of 2017 and 2018. Mostly there is a large increase in renewable source of energy. In power transmission sector, it is completely public right now, it is following the rules according to the central electricity authority and power distribution, it's like interface between power generation and consumers.

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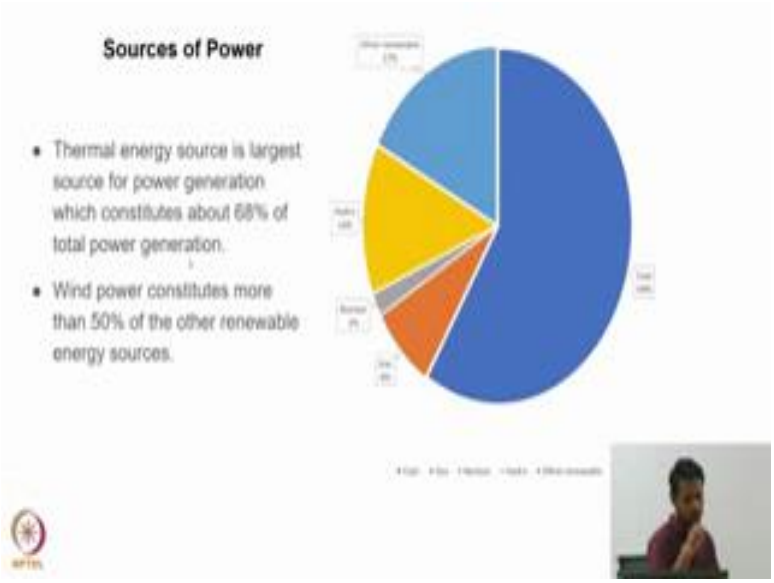

Now I will talk about sources of power, the largest source of power is thermal power, gas and coal constitute to thermal power and there are other sources like diesel as well. Diesel constitutes less than 1 percent, gas and coal constitute about 68 percent of the thermal complete energy and they are called as thermal power and next highest is hydro which constitutes about 14 percent and later comes the renewable sources and among them more than 50 percent of the other renewable sources it is wind power.

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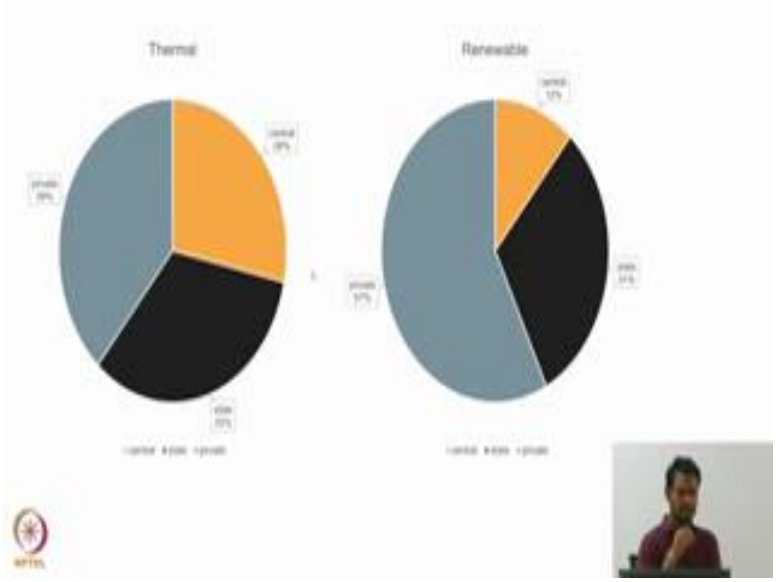

Actually I will in give more split about this. Thermal power as I already said that more than 68 percent is thermal power among them there is central, state and private partnerships as well. Long back there is only public but right now Adani power, Tata and Reliance has come into the thermal power and hence the private partnership has increased to 39 percent. But the thermal power is non-ecofriendly, so we have to move into the renewable sources as it is an eco-friendly one, but in renewable sources already the majority is in private sector, wind power is by Switzerland and many other companies are holding the wind power stations.

In northern western parts, many public sectors are holding the renewable sources. In southern states almost 50 percent and above is held by the private sector itself and other is solar power. Even households can keep solar panels and they can generate the power hence, solar power is about 5 percent of the complete power. Now even we have many other sources like tidal energy and all where we can invest and we can increase the amount of renewable sources of energy, but we need a lot of private investments to do this. So to talk about private partnerships Yamini will come.

Student 3:

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So everyone, we got to know that there are three parts in power - the generation, transmission and distribution. I will give a short guideline of how in each part the private sector is. Coming to the generation there is an act called electricity act wherein any generation can come, any generation company can establish its own generation station without any license. This reduces major problem and coming to the transmission part, right now government is looking to sell the successfully running companies in order to generate some funds. They can use these funds in like greenfield projects or it is also increases private investment. They already did some research by planting one PPP in Orissa and they found that, not opening bidding to everyone but each bidding company should have some government authority in it and so that the bidding cost will go so low but it will be like there will be competitive.

And they are also trying to replicate this PPP in transmission sector too, apart from generation and distribution. If we are using it in transmission too we will be able to have power in market, we can obtain power in market in competitive prices, so that it will be both beneficial to them and beneficial to the government too and even they are allowing 100 percent FDIs also in both in all the generation, distribution and transmission power sector. So there are more schemes in the power which my friend will continue.

Student 4:

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Inorder to ensure some private partnerships and to give the power to the people at low cost, government is implementing quite a few schemes. So I have listed some of them. The first one is Deen Dayal Upadhyaya Gram Jyoti Yojana. This one is mainly focusing on rural areas, the main aspect of this is, it separates the agricultural and non agricultural feeders and it also focus on the strengethening of sub transmission and distribution of distribution infrastructure.

And the second scheme in rural, that applied in rural areas is Saubhagya scheme. It deals in achieving a 100, achieving household units of household electrification by 2019. It also provides solar based stand alone systems. Then next one integrated power development scheme which is focused on rural areas, it mainly concentrates on the reducing the losses mainly the AT and C losses, it aims to reduce the losses to 15 percentage. It also enables the IT strength by implementing the IT in this field, Urja is an application that they provided.

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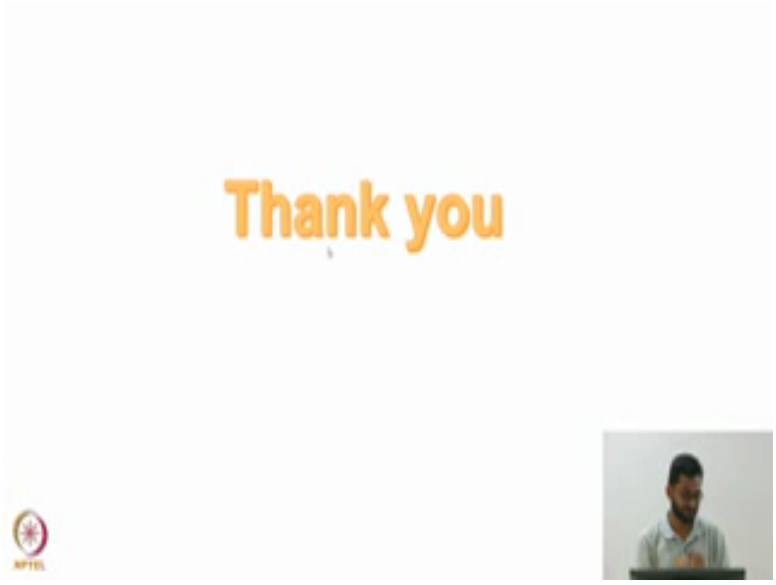

Now in order to improve the private participation in the power sector few financial schemes have been introduced. The financial restructuring schemes is an initiate of Government of India to provide DISCOM's like that distribution company to achieve their financial requirements, basically restructure short term liabilities. And other one is the national electricity fund, it also promotes the investment in distribution sector.

Ujwal DISCOM assurance is again a kind of financial assistance for the distribution companies and one more scheme is Ujala. Ujala is something where government is providing LEDs so that they they can reduce the energy used and reduce the cost of providing electricity, thank you.

Professor: Thank you very much

Right fantastic, so first of all thank you very much. I think you guys hit the main points in that we wanted to talk about which is essentially what are the kinds of schemes that are in place, what is generally happening in power all of that. One thing that you did not answer and I will post that to you and you can answer now or you can and it is not just to this group, any of the groups can answer.

You spoke about a certain amount of power that was being generated and you gave a certain figure but you did not talk about is, is that power that is being generated adequate? So is the amount of power that is being generated adequate? Are we generating enough power, we are generating less power or we are generating surplus power that we should give elsewhere?

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So in general overall score card, I think we are not generating as much power as we require yet. Of course if you go back 10 years, 15 years etc and you look at the installed capacity it has gone up considerably, so we are doing a lot of work but we are still not there yet. One of the things is also that you want to understand about power is, when you produce power you more or less need to consume it right away. So when you generate power you know these electrons run and you essentially have to have an appliance on the other end.

We have not really cracked the ability to store power, where you can generate it, store it, transport it and distribute. The only way we can do it is using batteries and battery technologies is of course on the upward swing, but essentially we have not really developed these batteries where we can just whenever power is available generate power, store it, use it

later. So the problem is we have to use power more in most cases more or less as soon as been generated, right so it is very dynamic thing.

And so what happens is, there is often an imbalance. There are certain cases where you have a certain amount of power capacity but the power requirement there is higher. There are also cases where it is the other way around, you have a certain amount of power capacity installed capacity power requirements are lower. So it is very difficult to achieve perfect balance locally and therefore you now have these interconnected grids, where you are able to actually transport power over longer distances is still instantaneously.

But that is something important to understand about power is that, today in most cases more often or not you need to consume power more or less as soon as you generate it and that sort of is one of the challenges. I cannot generate today for tomorrow's needs necessarily beyond being able to store it in batteries. So that is the important point to think about, alright. Other things that some of you would have would like to add to this presentation that people did not talk about the grid connecting interconnectivity of grids is one point, any other?

Student is answering: Smart grid mission

So smart grid mission is is yet another scheme that is out there, ya what else? This is possibly a slightly more colourful version of the picture that you guys showed but more or less it is the same thing. So let us see, so you essentially have three parts to it. You have generation, alright this is where power gets generated. But today when you look at what you guys put up, that chart which was quite clear most of the power is coming from non-renewable sources, a lot of our installed capacities still thermal some of it, some of it is hydro all of that, these are all static.

So thermal power plants, where would you where do you think you would build a thermal power plant? Either near the sources of coal or sources of coal gas whatever or you would probably build it near the coast and you probably build it near the coast because you are importing the coal from somewhere and so as soon as it comes in it probably makes sense for you to use rather than transporting it you know miles and miles inland etc.

So you actually build these facilities, so these are relatively static facilities that do not move around and they sort of generate a certain amount of power. There are certain factors like plant load capacity that tell you how efficiently the generation is happening. So what is the

installed capacity, what is the production capacity all of that. So you have these large facilities, hundreds of kilowatts, thousands of sort of megawatts size, etc.

But because they are far away from the consumers, because this is more of a centralized system rather than a decentralized system, you have one centralized power plant that is actually feeding a vast area, you actually have to build these transmission networks, which is part 2. So if generation is part 1 you have got transmission which is part 2, and then so transmission essentially brings it into the city or whatever and here the Tamil Nadu electricity board or the distribution company which is here starts distributing it to schools and residences and you know IIT, elsewhere, so third part to this right, which is the distribution.

So there is generation, transmission and distribution three parts to this and there are efficiencies in all of these parts or inefficiencies in all of these parts. One of the parts where there is a lot of inefficiencies is in the transportation and this is the transmission part, so and essentially you have inefficiencies on account of two reasons. One is, there are physical inefficiencies, there are you know the lines are old, there is friction and all of that and therefore you get a slightly, I mean, I am not an electrical engineer, but they could probably tell you a little bit more about this but generally there is there are some engineering losses and possibly you can never completely eliminate those losses because physical systems tend to suffer some kind of loss anyway.

But those losses may while you may not be able to eliminate them, you might be able to temper them because if your lines are really really old and your frictional losses are very very high you could install better lines to ensure that you do not lose as much. The second component of these losses is theft, power theft which essentially means there are people who are not connected to the power system, who are not being metered or not being or not paying for power but who are essentially somehow drawing power from the power lines either the transmission level or at the distribution level.

At the distribution level it is often one of the best ways of seeing this is, if you go right before a festival like Vinayak Chaturti or whatever it is, you will find all the lights in your house are burning a little bit at a slightly lower intensity like some local community has put in their, plugged in to that power supply and they have lit up their huge Ganesha and as a result of which right all of our fans and lights are, so that is essentially power theft in some ways.

So you have these two loses in transmission, which is the point that Chimai is bringing about is that, we need to do something about this. Now some time ago and I do not have figures for this year, but what do you think, what percentage of power do you think was being lost in the transmission process. So if x units of power are being sent from generation, what percentage of that do you think was getting lost?

So when I first started teaching this class about 10 years ago, it was about 50 percent, 40 percent to 50 percent. So essentially what you are saying is, half the amount of power that you are generating disappears and today it is not half, it is 15 percent, 20 percent, etc. So what that means is, when you say I have a power deficit and therefore I have to generate more power perhaps the answer is not always generating more power, perhaps by plugging these leaks you will actually be able to get that extra power that is required.

So this is what had this sometimes, they are called AT&C losses or AT&D losses, aggregate transmission and distribution losses, aggregate transmission and communication losses. These were about 40 percent and of course there are also some inefficiencies locally at the distribution level. So one of the schemes that we have had in the past is to really focus on the aggregate transmission and distribution losses and try to sort of see, if we can provide investment to these electricity boards to actually come up with better infrastructure so that they can they not only have better lines but they also have the better metering infrastructure.

So they know for instance exactly where the power is going, how much is being generated, all of this and now it has come down to 15 percent, which looks great but possibly can still come down. I mean you are still losing one sixth of your power in a power starved kind of country. So why were we not able to plug these leaks earlier? It is not that we did not know it was 40 percen, people knew it was 40 percent, why were electricity boards 10 years ago, 15 years ago not doing anything about it?

You know there are many reasons but one of the reasons is that the financial condition of these electricity boards was bad. Why is the financial conditions condition of these electricity boards bad? So yes revenues not being generated, power is being sold at a lesser cost. Why is power being sold at a lesser cost? We are all paying for power, right? So there are two parts to it, yeah so but listen sure it may be it is the same part but that is the keyword that some of you brought out which is subsidy.

So essentially power is subsidized for many parts of the population. So for one constituency of the population power is virtually free, which constituency is that? Who gets power for free? So the agricultural sector right in many cases power is given for free, right? So you are generating all this power but you are getting no revenue out of it and the agricultural sector is huge.

So there are two problems with regards to that, one is that you have got to makeup that cost somewhere if you want to be profitable. So that means, you go back go to other consumers and you perhaps charge them a higher rate. So users like us perhaps do not get charged that higher rates but although the electricity tariffs have increased in the past, but you go to industry and you charge them a much higher rate. Now the problem with doing that is, not all industries might want to pay. Some of them might set up their own generators, and as a result of it you are not necessarily getting money from industrial consumers as well and the rates that you are charging up probably not large enough to make up for the subsidy that you are giving to the agricultural sector. But the second thing is if I give you power for free what is likely to be your tendency what do you likely to do? Waste power, because it does not cost you anything, which means, there is more and more power that is being generated somewhere, that is being wasted in this sector. So they are not paying for it and they are not also efficient at consuming it and the person who is incharge of this is what we call the state electricity board. So these people, they have costs because they have to maintain the lines, they have staff, all of that. I mean they have to run the electricity system, they may not be generating the power that as you guys have pointed out could be generated by an NTPC or you know a Reliance or you know whoever, anyone can generate or Tata power can generate the power.

The electricity boards then are incharge of distributing some of this power and so they have costs but they do not necessarily get the revenues because they are unable to build their agricultural customers. They are billing the domestic customers, but the domestic customers are not paying that much and what they are billing the industrial customers does not seem to compensate for what they are losing to other sectors that are being subsidized. Therefore if you look at their balance sheets, they are all in the negative, so they are making losses year on year. They are probably being billed out by state governments every year in the budget you probably give some allocation to the electricity boards for them to top up and you know keep keep running. In such a scenario do you have the ability to invest in new infrastructure? There is no money, what are you talking and what investment are you talking about, if i had

surplus cash I would invest, I don't even have money to run my operations, so where am I going to invest? So therefore investment does not necessarily happen and therefore these assets continue to degrade and so frictional losses keep building up year on year, the balance sheets of these organizations start getting worst year on year. So this was the big problem that needed to be stopped at some point. About a decade ago there was something called the accelerated power reform and development program. I think it was called the APDRP accelerated power development and reform program APDRP.

And essentially it was one of those programs where we said look, you guys need to professionalize your electricity boards which means you have got to make them self-sustaining, you have got to ensure that you do not have debts and all of that you have got, we probably bring in some new accounting systems and based on that, if you actually do that, then we will absorb some of your outstanding debts. So we will bring you to a net zero starting point from which you will actually have to start moving forward.

So power sector, while they generate a lot of power, reform is very very important particularly in tariffs and also in the subsidy regime and all of that because if you do not have that functioning then you are generating a lot of power, lot of it is getting wasted. The person who is distributing it is bankrupt, they are not able to invest in more power all of that. So those are some of the key aspects of power.

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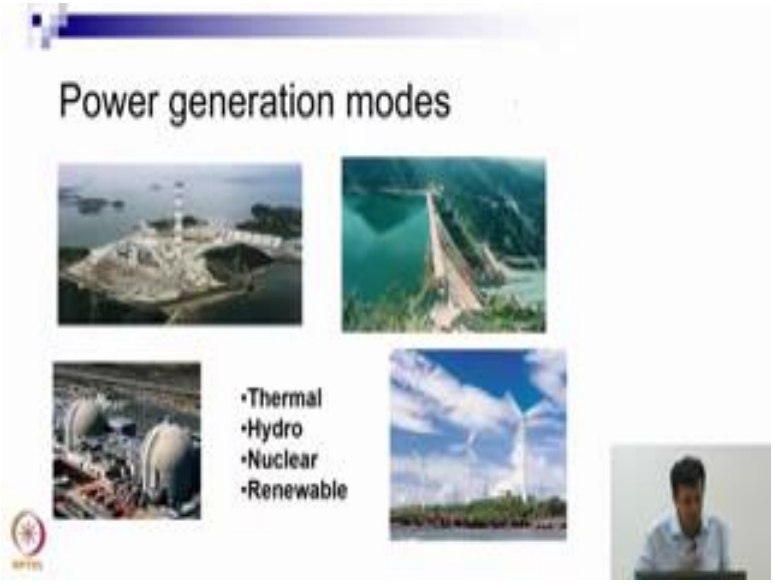

A couple of other things I just wanted to touch up on, you guys have talked about this several different power generation modes all of that and one of the things that we will talk about briefly is the whole renewable sector.

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Just quick historical note, initially power was private, a lot of private players generating power. After independence of course a lot of it, as we talked about in the last class, there is a whole nationalize movement, all of it became national and you know there was really that is when you had this national thermal power corporation, national hydro power corporation all of this being setup.

And then post ‘91 when we liberalized, we start privatising sectors including power. So again there is a question of how do I privatize power? Do I go to a private player and say you generate, you transmit and you distribute and that might be too big an elephant for people to really swallow. So essentially let us unbundle power, let us have distribution and let us have people generate power, just generate power, so generation, transmission, distribution just generate power, transmit power and distribution distribute power.

So when you generate power, okay that is a very simple business model. You are incharge of generating a certain amount of power, you build the power plant, you get the raw material, you generate the power and you sell it to somebody and most likely the person you will sell it to is the state electricity board, who will buy it from you. So here we have something called a a PPA, which stands for power purchase agreement. So essentially what you do if I am a private producer to minimize my risk is, I go to the state government electricity board and I say let us sign a power purchase agreement where you guarantee to buy so many units of power at this rate. So I am not going to be in a situation where I generate this power and we all know power has to be consumed right away, then you say look I do not need the power.

So I do not want to be in that situation, so we will sign what we call these PPAs so the power producer was called an Independent Power Producer an IPP and an IPP would sign a PPA in many cases and that also got well because on the governments perspective you have a fixed guaranteed supply of power. You are not sort of at the mercy of somebody who will give you X units one day, 2X units the third day, X by 3 units the fourth day because some private fellow somewhere is willing to pay you more, you are also sort of minimizing your risk.

So this arrangement worked and you can have a competitive bid to figure out who is offering you the best PPA. So I can say I want a 100 megawatt power plant, all of you bid and all of you tell me what is the power purchase agreement that you would like. All of you are going to give me a 100 watts of power, you say I will give it to you at 2 Rupees a unit, 1.75 Rupees a unit, 75 Paisa a unit or whatever it is and I can pick the cheapest person.

So I can compete, I can pick the most efficient bidder and on top of that I can have a guaranteed arrangement. So it worked relatively well for power generation there lot of power generation that is happening. Transmission, right the problem with transmission is that transmission is what we often call a natural monopoly. What that means is, there can be three different power producers, generators and I could choose to use one of them and the other person could supply to somebody else that kind of system is okay.

But it becomes very difficult to have three people laying three transmission lines and then me deciding I will use this person, you deciding I will use that person, that does not really work out. So essentially if you want the economics of the business to work, there can be only one transmission line going from generation to distribution. So it becomes what we call a natural monopoly, there is no other way naturally only one person can can use. Now the problem with giving a monopoly out to a private sector is, you know what happens, how do you control prices? It is a monopoly, you do not have anybody else to go to and so for a long time transmission was considered to be something that only the public sector would do, that it could not be privatized. Now things are changing people are saying let us regulate the pricing, give it out to private sector because that person can probably maintain it more efficiently frictional losses will be less.

Distribution, it turns out that you can actually have multiple what people use to call DISCOS now they are calling DISCOMS I think because DISCOS sound flashy fun and all of that, so DISCOM probably gives you a better, but essentially it stands for distribution companies, it actually turns out that you can have multiple distribution companies, all of whom and you can actually compete. It is like in your mess, you have what multiple catering options and you can choose one this this time and if you do not like them you can choose one the next time. But all three of them are actually able to survive because there is enough demand out there that, even if you chose to ditch one person and go to the next, somebody else is actually switching the other way around and so therefore the mess example here is not a natural monopoly much like distribution, you can actually have multiple distributors and you can sort of choose, etc.

So distribution again there have been some experiments and privatising, Delhi I think tried it for a bit, there is some literature, so this is essentially so we, privatization is a big part of power and partly it is there because there is a lot of inefficiency in power generation. There are losses in generation but also a lot of losses in transmission, distribution and the idea is, can we bring the private sector in? Because they are more conscious of their profit they will ensure that they do not lose that much power, so the lot of privatization coming into power.

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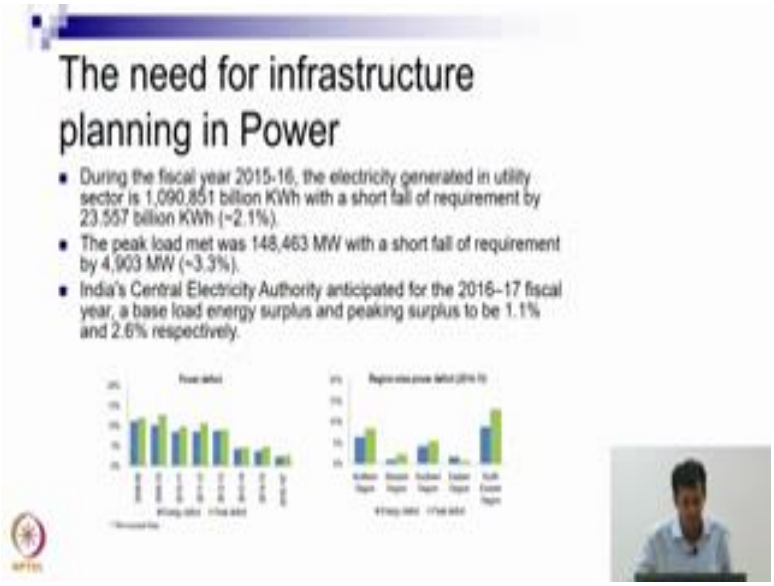

Most of my other slides are, I mean just sort of other details on what all of you had. So I am not going to go through all of these, etc.

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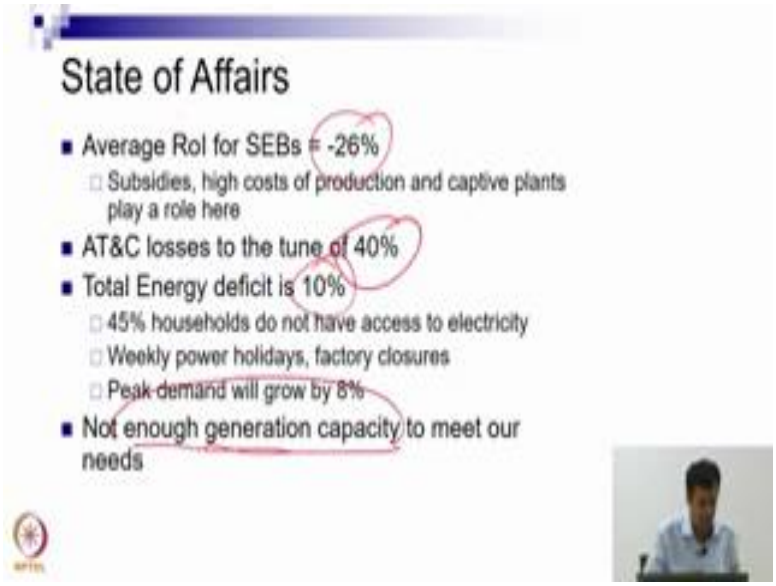

So this this slide tells you AT&C losses are to the tune of 40 percent, the total energy deficit is, there is an energy deficit, we talked about this. The average return on investment for state electricity board is minus 26 percent which means their balance sheet at the end of the year when you look at out flows and in flows and all of you know discounted cash flow basics, the the return on investment works out to minus 26 percent right on average and there is not enough generation capacity to meet our needs, so some of this data there all of you brought out.

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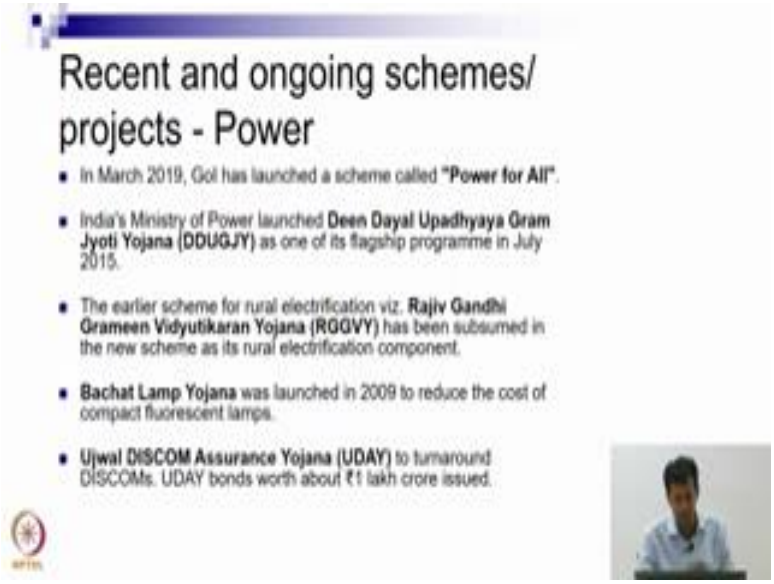

There are a number of schemes, I think you had all of these DDUGJY, UDAY, Rajiv Gandhi Grameen Vidyu Vidyutikaran Yojana all of this, so you guys and there are probably some more smart grids all of this and there are some challenges we have talked about most of these.

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One of the big challenges is also that we are dependent currently on coal and unfortunately while we seem to have a lot of quantity of coal in India, that coal does not have particularly high calorific value. So it is not the greatest coal to produce electricity with and therefore we are actually importing coal from many other parts of the world Malaysia, Indonesia and so on.

Therefore, we are also at the mercy of things happening outside, so for instance if they hike the price of the coal that they are selling to us, then obviously the whole power equation goes out of the room. So clearly one of the things that we are thinking about is, how can we move towards less polluting forms of energy for a number of reasons. One is of course, coal emits quite a bit of carbondioxide into the atmosphere global warming we want to reduce that, we want to reduce our dependence on coal to make it more environmentally friendly. We also want to reduce our dependence on external international financial markets and commodity markets for our generation.

Hydro power is to some extent less greenhouse gas emitting although it is not necessarily environmentally clean, you might be destroying forest and so on when you build dams, but again the problem with hydro power is, it is normally in places where as this points says here, it is normally in India's mountainous north and north east regions. There are a lot of environmental issues because when you dam a river, you are causing some amount of local flooding you are damaging peoples livelihoods, you are damaging ecosystems plants, animals, etc. These are also very very difficult places to construct it. Your cost of construction, all of that is also extremely high. So hydro power has been a big part of our equation but it is not necessarily the most obvious choice. We have tried nuclear power which experts will tell you is perfectly safe etc but try telling that to the people who are living next to the nuclear power plant right and you get different stories. So nuclear power is always very contentious, people always go back to Chernobyl and this and that and talk about disaster. So then we come to things like wind and solar, so which again we are now starting to tap. The thing with wind and solar is, right now solar energy is abundant and somebody sort of once said actually everything that we are consuming all energy forms are essentially solar energy.

So when you look at coal, coal is energy. So it is essentially solar energy over millions of years is actually baked earth into and crushed it into coal, so it is essentially solar energy that has been stored over millions of years which we are in some ways unleashing. So the potential for solar energy is huge and solar energy as the amount of energy that is emitted by the sun is enough to meet all of our needs and more, so there is no energy crisis. The problem is how good are we today at capturing that energy because essentially, the technology today is you have these photovoltaic panels where you have these elements that are inherently unstable, photon from the sun hits it, you have you know negative and positive essentially dispersing and then you can create a circuit so that the negative goes and reaches the positive and you get power, so that is the idea.

If you can do that really efficiently you can generate a lot of power. So today our photovoltaic systems, the efficiency is continually improving, as it improves the cost comes down and also as we manufacture more and more panels to scale the cost will come down. So the costs are, I mean 5 years ago it was I think exorbitant, today it is not exorbitant anymore. The hope is that going forward, particularly countries like India where we are blessed with enough and more sunshine, in fact sometimes we wish we could export some of the sunshine to gloomy places like the UK, etc so that is one resource that we are not lacking in, should really be able to leverage.

So I think solar and wind and there is some they talk about tidal energy and so on I am not too familiar with where that is going are alternative forms of energy that we are looking at. Now in solar some of you might know some of the work that we are doing at IIT, professor Ashok Jhunjhunwala and his group and that is quite interesting to discuss in this context because everything we talked about here is centralized, large power plant in the centre produces a large amount of energy that a lot of people need and transmits it and distributes it all over the place. What you know the the group here in IIT is trying to do is, flip it on its head and say why don't we do a decentralized model? Why do you have to generate, have a huge asset that generates power from everybody for everybody? Why cannot we just generate the power that we need locally? So essentially and this is what you see in the rooftop solar kind of installations, but essentially the idea is you put a small panel on the roof that small panel generates a small amount of electricity, that electricity is not necessarily for anybody else but can use to run some of your functions, so it can be used to heat a little bit of water so you can have a nice hot water bath, although why anyone in Chennai will want a hot water bath I have never understood.

But you can do things like that and of course if there is surplus energy electricity you can export it back to the grid and may be you can earn money because when you put it back into the grid it is going somewhere somebody else is using it. So in some ways you are selling power to someone else. So maybe you can get some money out of it and if you supply during peak hours then maybe you can get more money out of it because people will be willing to pay more.

So there is sort of this model, so this is decentralized model that is evolving particularly with regards to solar, yes Arjun?

Student is questioning: (Audio not clear and volume too low)

Ya, so decentralized solar is sort of relatively well known, the innovation that the group here is working on is also saying, so one of the reasons for the inefficiency and again I am not on the authority on this but it goes back to the old you know Edison and Tesla wars about a 100 years ago on what was better alternating current or direct current and you know all of those kinds of you know Tesla was on one side, Edison was on one side and Edison found a general electric, he had more muscle, Tesla didn't.

So you guys can go back and read the the history, but we have, we came to a point where we said look we are actually going to transfer current through the alternating current mechanism, because that works well for transmission over long distances and therefore all our appliances will be AC appliances. So most of these appliances here probably run on alternating current.

But what happens when you generate power is, you often generate it as direct current, you convert it into alternating current and you send it out and there are all these sort of losses. So what the group here is doing is you generate direct current and then you actually put in appliances that take direct current which are different from these appliances. So then you can actually have a much more efficient system which so you can essentially run your televisions, your air conditioner, etc on much less power than you did earlier.

So in other words, earlier with the decentralized solar you could run lights and fans, now if you go to research park ground floor there is actually a demo of how you can, they actually have an LED TV, they have an I think an air conditioner, I think they have a fridge or they are going to sort of develop a fridge whatever so and this is very very useful in parts of rural India where you do not have connectivity.

So if I want to buy a refrigerator today I have only Kelvinator or whoever only gives me Godrej, I do not know Whirlpool I guess. I do not know who manufactures refrigerators these days, give you refrigerators that work on alternating current for which you need AC supply for which you need to be connected to the grid. I am a poor village in Rajasthan where do I get that connectivity. Whereas now if I have a refrigerator that runs on direct current I have a solar panel on my roof and I can translate that directly into direct current and connect it to my refrigerator then all of us and then people in rural Rajasthan or wherever it is can actually have power. So one of the things that is happening is that we are not only investing in centralized power generation, we are also investing in decentralized power generation.

So this in other words, is the score card. There is a lot of power that is being generated, we need more power, there are lots of inefficiencies and we are doing a number of things about it to reduce transmission and distribution losses, more generation capacity, try looking at decentralized, looking at alternate power sources so lots of things are going along. But the problem has not been solved yet. We are not one of the states where we have a smooth running power infrastructure that we do not have to do anything about it.

So that essentially is a quick whirlwind overview of power, power also needs to be regulated, so you have electricity regulation boards primarily because you have private players coming in, charging tariffs, so there is a regulator in power as well. And there is something called ultra-mega power projects that was there sometime ago essentially where the government said look let us try to build large generation capacity, we will sort of get land clearances all of that so that was scheme that took off. So there are a number of other schemes that was out there. So we will stop with power and we will move to telecom and so group 2 is, so where is group 2?