Energy Resources, Economics and Environment.
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Lecture-16.
Energy Projects Financing-Part 2.

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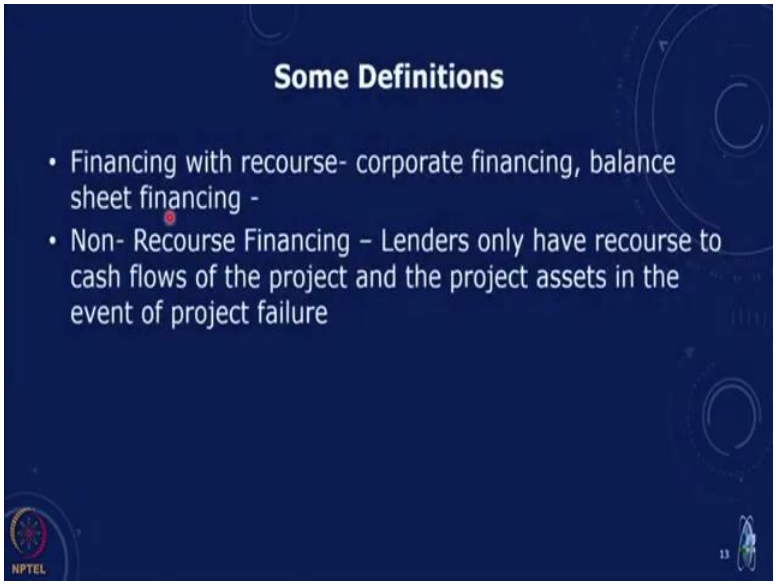

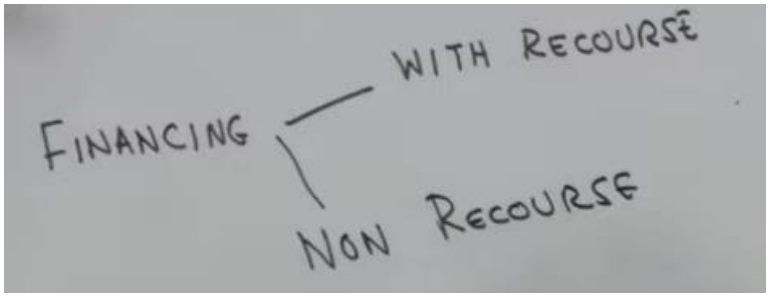

Now, we have we have to define the difference between financing with recourse and non recourse finance. So, financing with recourse means that, in case there is a problem and in case the funds have to be repaid, we can actually go ahead and we have recourse to the corporate balance sheet and the corporate financing and balance sheet financing. So, you have recourse to the rest of the funds of that company.

And non recourse financing means that the lenders only have recourse, they are only having access to the cash flows of the project and the assets and the project assets in the event of project failure. So, in case the project fails, the assets may be liquidated and those returns can be used to pay off the organizations that have given us the finance.

But in case that is not sufficient, the company is at, the corporate who has created that is at arm's length, risk is only to be met from the cash flows of the project and the project assets. So, this is the difference between recourse and non recourse financing.

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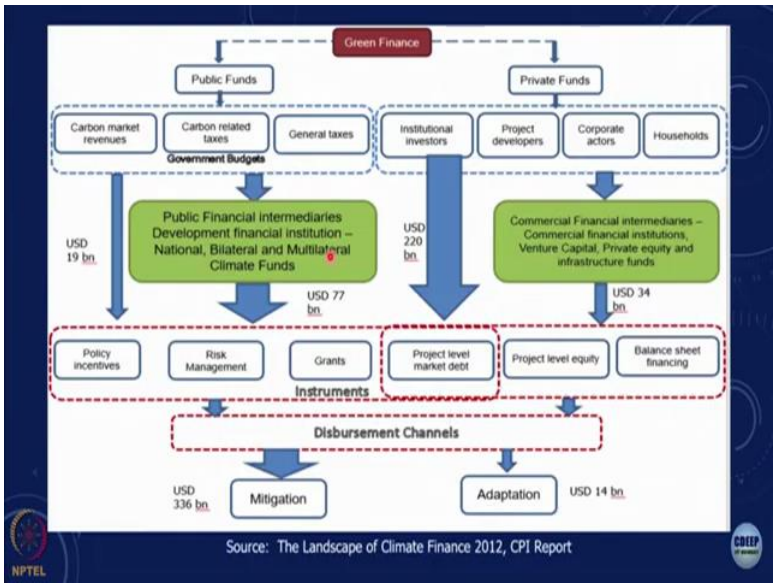

Let us move forward now, we would like to take a look and this is from the landscape of climate finance, it is a 2012 report, which gives you an idea of the different kinds of financing available for green energy and you can see that there are two types, you can differentiate between public funds and private funds and in the case of public funds there could be carbon market revenues, carbon related taxes and general taxes.

So, some part of the general taxes can be used to finance the, you provide funds to the public financial intermediaries, the Development Financial Institutions, national, bilateral and multilateral climate funds.

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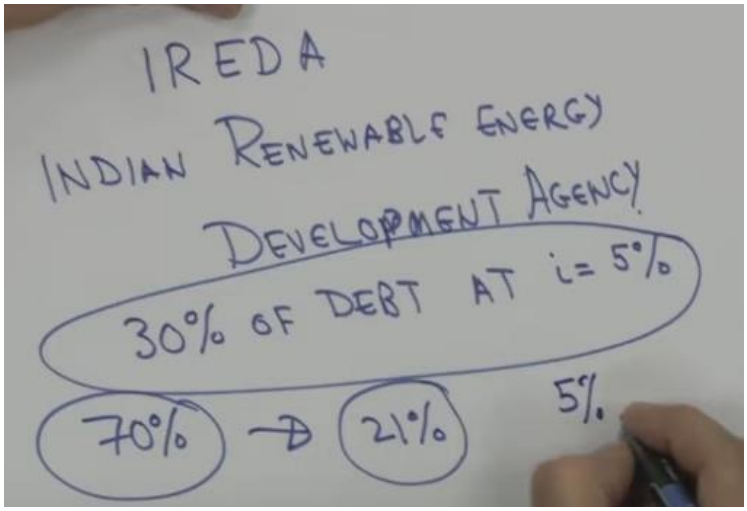

So, for instance, in the Indian case, we have an organization, a specialized organization called IREDA which is the Indian Renewable Energy Development Agency and this IREDA essentially can provide soft loans, which can provide loans at much lower interest rate. So, often what has been done is IREDA has a scheme where it will finance of part of the debt which is being given by some of the conventional banks

And if we look at that bank, we can provide, we are giving 30 percent of the debt, for example at an interest rate of 5 percent and if you are looking at a debt ratio fraction that is 70 percent, it will mean that 21 percent of the total amount required is being financed and is being financed at this low interest rate of 5 percent.

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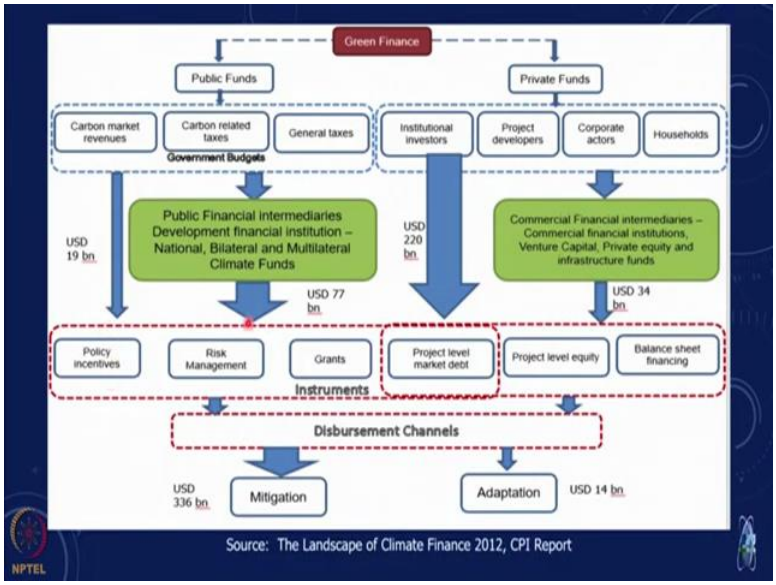

And we can look at this and this results in some, as a result of this we have some risk management, some grants, some instruments, which are their policy instruments. When we talk about policies and policy instruments we will come back to this. In the case of institutional investors, we can look at project level mass market debt, and then project level equity and then there could be balance sheet financing. Again, here in terms of private funds, institutional investors, the project developers, the corporate actors, the households everyone can provide funding.

And with this then we can have the disbursal channels and predominantly if you look at it, it has been mainly financing mitigation, the energy efficiency renewables projects, but also some amount of money going into adaptation, relatively smaller amount of money going in for adaptation.

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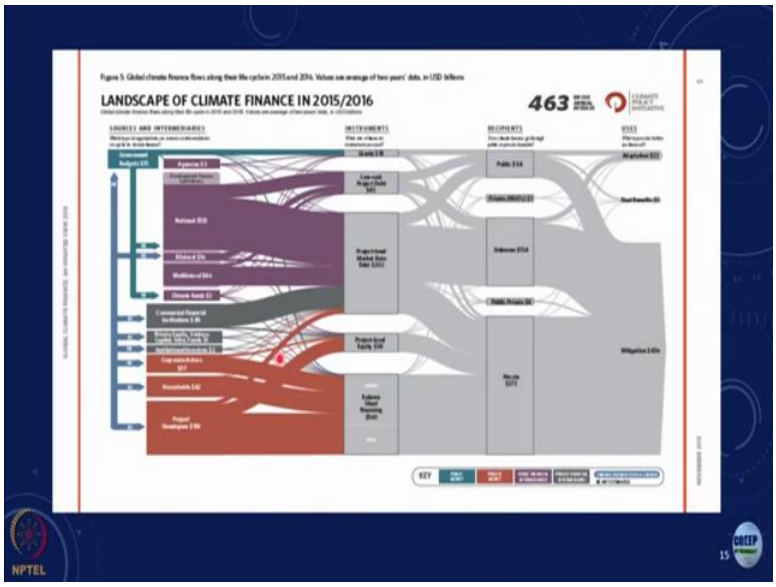

Now, if you look at the kind of numbers we are looking at, you will see that this is showing you, you can look at the landscape of climate finance in 2015-16, it shows you the different types of those, which are going from one end to the other and the kind of investments which are required and you will see that we are talking of us for 463 billion US dollars as the kind of order of magnitude of financing.

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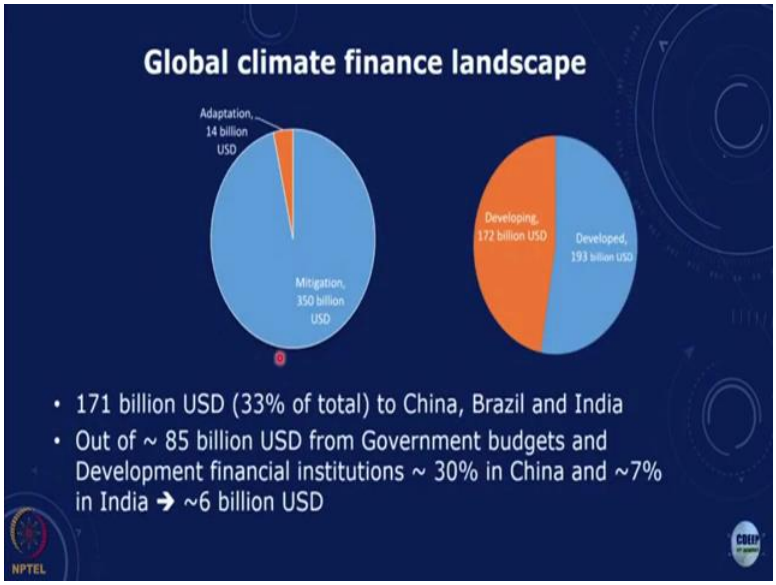

Most of that, we saw most of this is been for mitigation, that means for reducing the CO2 emissions and reducing the climate change or stop and increasingly what is happening is that a lot of this financing is now going to the developing countries and about one third going to the large developing countries, China, Brazil and India. Then, out of this 85 billion US dollars are coming from government budgets and development financial institutions. In the case of China, its development financial institutions accounted for 30 percent and in India about 7 percent.

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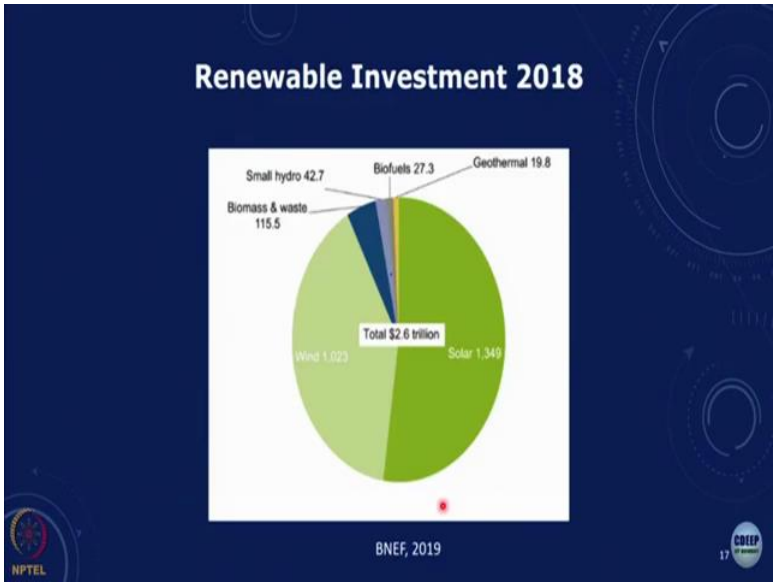

So, if we look at the distribution of the renewable based investment, in 2018, this is from the Bloomberg New Energy Finance report in 2019. You find that 2.6 trillion is the total amount

of investments in renewable, of which if you see solar is the largest chunk, little more than half because it is 1.3 trillion, and wind is another 1 trillion.

So, these are the two chunks, then you have some amount going to Geothermal, some biomass and waste, and small Hydro and biofuels. Of course, this can change as the as the technologies sort of change, but right now it is predominantly solar and wind.

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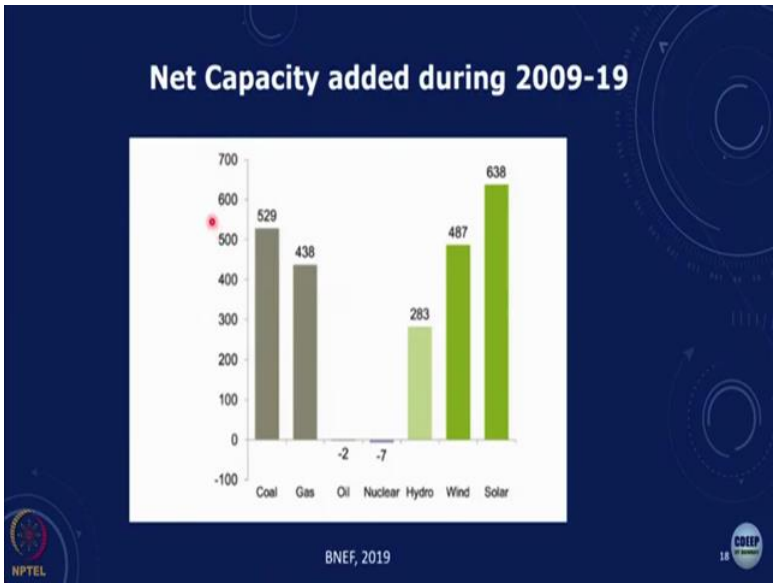

If we look at the net capacity added in renewables, again, this is from the Bloomberg New Energy financing report, you can see very clearly that in terms of installed capacity, solar 638 638 gigawatt and 467 gigawatt of wind and to 283 gigawatt of hydro. Interestingly, coal is about 529 gigawatt and gas 438 gigawatt, of course, this is talking about one decade. And the interesting thing to see is that in this particular decade, the renewable installed capacity outpaces the additional capacity from coal and gas.

Of course, this coal and gas has much higher capacity factors. So, in terms of generation, the picture will be a little more balanced, where maybe the thermal will be higher in terms of the generation. Of course, this is over a 10 year time period, as we go forward and we are looking at, if you look at only 2018 or 2019, you will find that the share of renewables has increased even more, especially by installed capacity and of course, now we are trying to report it more by the generation.

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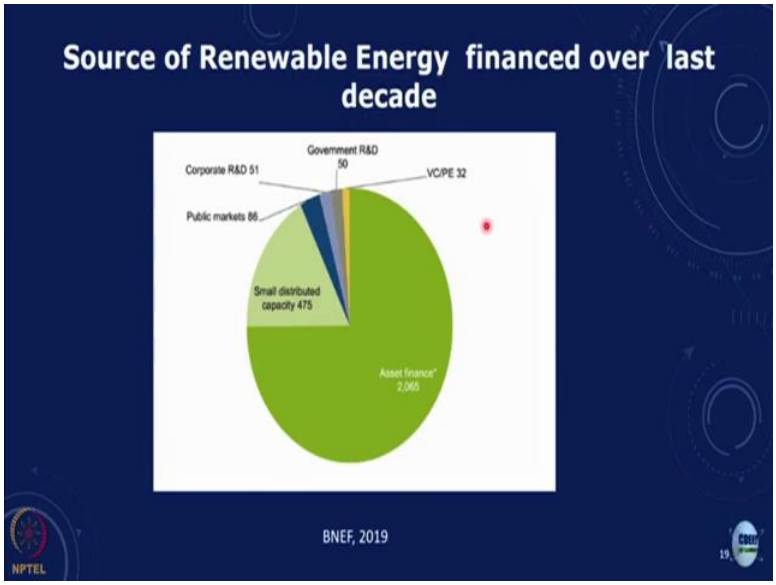

So, out of these, if you see the kind of sources of finance, you will find that the bulk of it, we said 2.6 trillion out of which more than 2 trillion is asset financing, which is where you are trying to build a power plant or you want to finance that asset and the value of asset is mortgage against that and you have an escrow, you can always sell that and get your money in case the project does not work properly.

Then small distributed capacity of funding, some government funding, some public markets and overseas R & D, corporate R & D, corporate R & D, a little bit from that, but predominantly asset finance.

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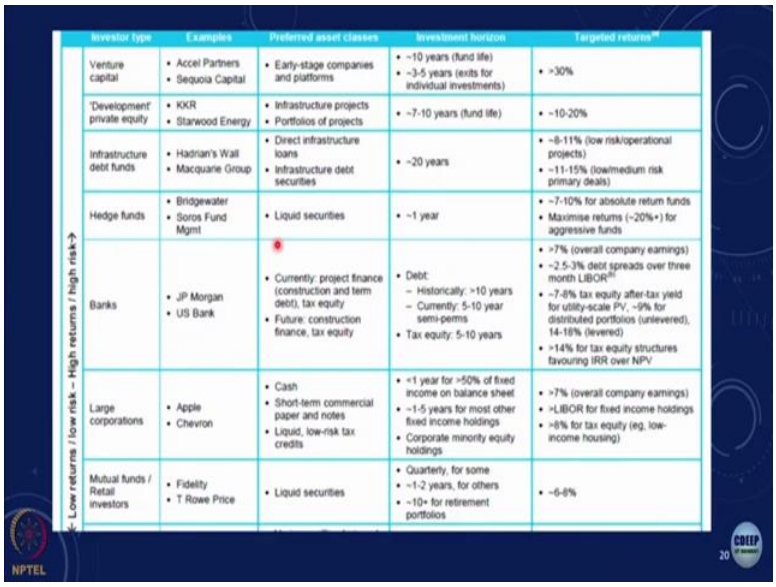

We can look at different sources. This is from a report, which talks about US solar and the way in which US solar has been financed and can be financed. And in this a number of different sources, for instance venture capital, the development, private equity, infrastructure, funds, hedge funds, banks, the large corporations, mutual funds and retail investors and then you can see what is the targeted rate of return, for instance, venture capital would target about 30 percent rate of returns.

Private Equity may have a slightly lower rate of return expected. Infrastructure funds have definitely rates of return less than about 11 percent and hedge funds for a period of about a year, and they would have lower rates of return, banks will have their commercial rates and these vary from country to country and so 7 percent, 5 percent, 8 percent, 9, 10, 11 percent that is the kind of order of magnitude which you are looking at.

And large corporations also may provide funds and they would have slightly lower rates of return expected. The mutual funds, retail investors, again, relatively low rates of return and in each of these cases a comparison has been done in the characteristics of the funding and the funds source.

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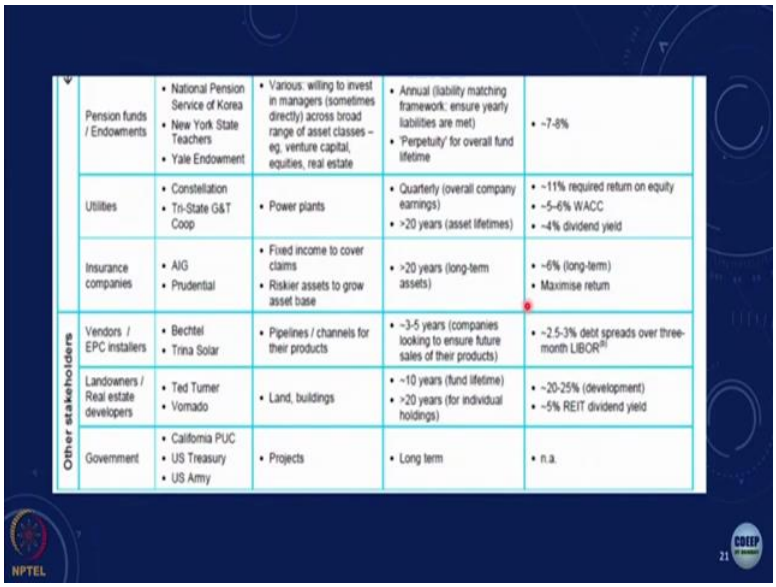

This table continues and you can look at increasingly pension funds and endowments which are maintained and these pension funds are invested in order to create the… see that we get the type of returns. And so, this has expectations of slightly lower returns 7 to 8 percent, but they normally will not invest in very risky projects.

The utilities again have some rates of return and these are for the US utilities. Insurance companies have quite a lot of funds, the vendors and the UPC installers, land loaners and of course the government. So, you can see very large number of different types of funding sources, and each one has slightly different characteristics.

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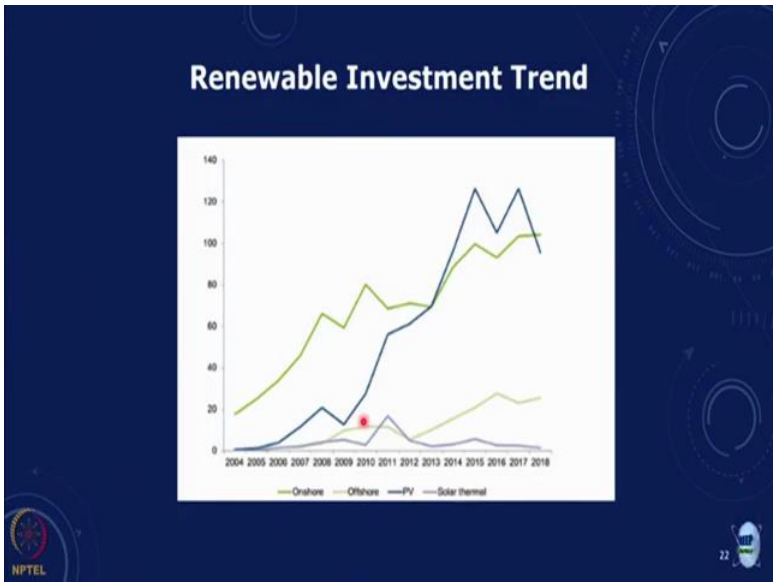

This is again from the BNEF and it just shows you a time series trend of the kind of renewable investments which have been made. And you can very clearly see that the largest chunk of these investment and it is been growing, has been in PV and in the case of onshore wind that has been growing at a reasonable rate, but it has been surpassed by PV in the recent times and then of course, one can look at other things like the offshore and the solar, thermal and so on. So, this is the sort of order of magnitude of the current trends.

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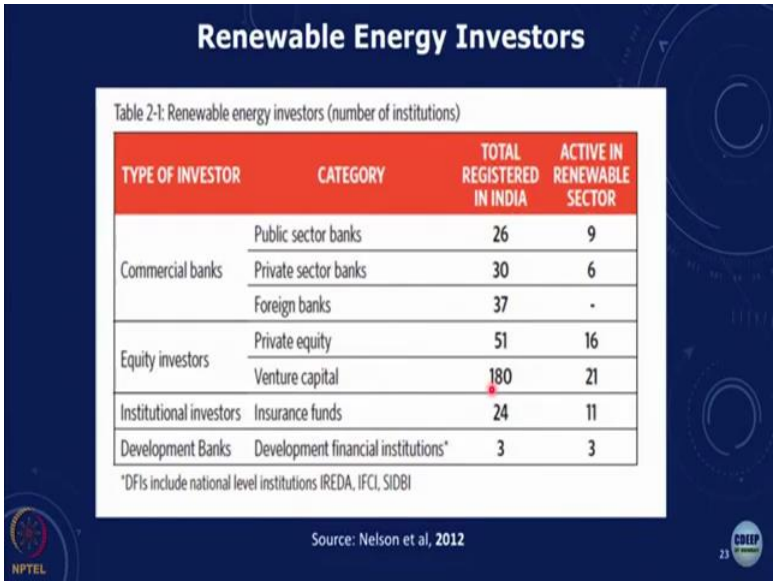

There is an interesting report by Shrimali and Nelson which compares the costs of financing renewables in India with US and Europe and in that, if you look at it, it talks about the different types of investors, we are talking of large scale commercial banks, some venture capital, private equity, insurance funds and development financial institutions and of the large number of such institutions which are there for financing or investors, the ones which are active in the renewable sector is a smaller subset of this.

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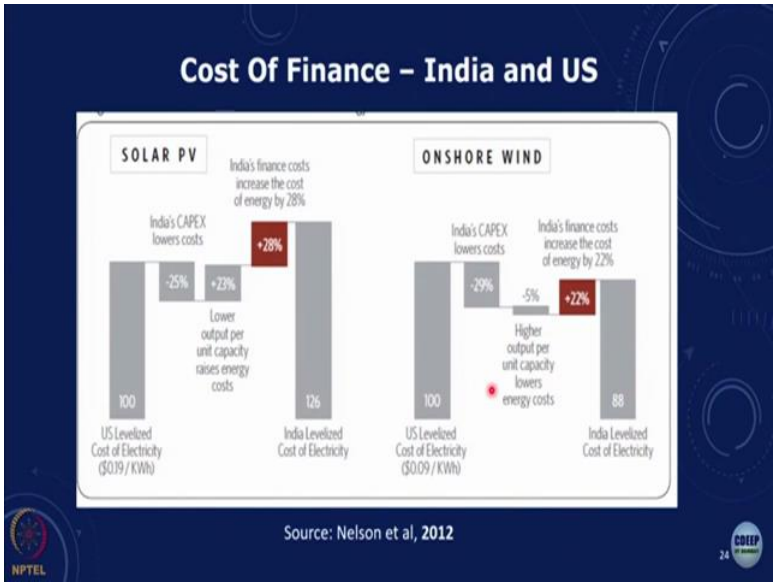

This comparison is being done by (Nelson et al) to try and see, when we talk about solar PV and wind, what are the different components which leads to the cost of electricity that we are getting. And as compared to running the same plant in India and the US, we can see that

essentially, the finance cost increases the cost of energy by a certain percentage, but there are many other factors which can decrease the costs of energy.

Similarly, if you are looking at the onshore wind and the CAPEX, India's lower CAPEX reduces the cost and so based on this, the India's financing cost increase the cost and by 22 percent, it is a reasonable chunk and so one can offset some of the improvements that we were getting, but then we can take a call of the kind of investment.

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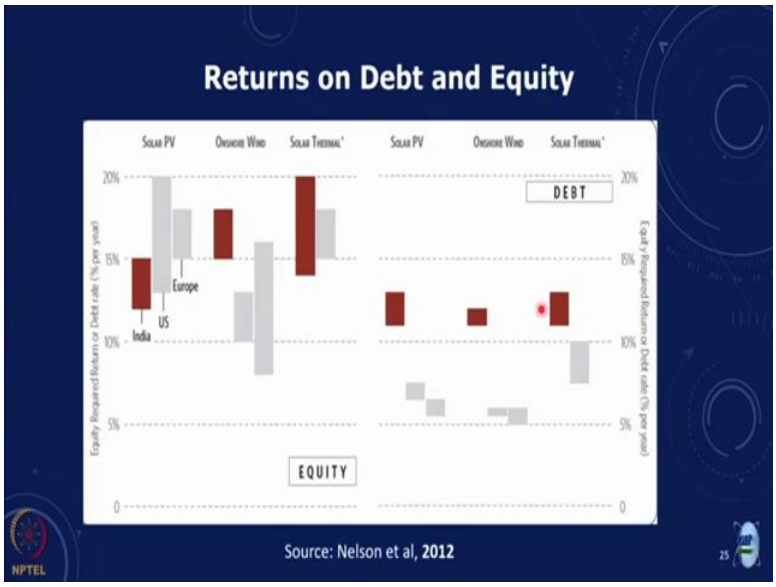

Similarly, on different projects. We have looked at the expectation in terms of rates of return for debt and equity and we can see very clearly that in the Indian context, the debt is available at much higher rates than in other countries of the world.

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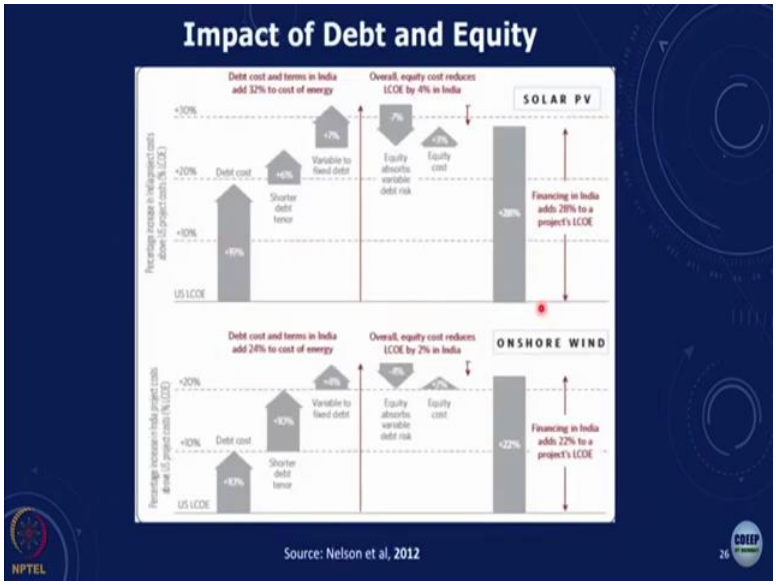

And because of that, we can see that there is a, when we talk about the increase, this result in some increasing costs. Of course, we have had big advantage in terms of reducing mitigating some of the risks, large projects being bid, we had this reverse bidding concept, and with all the facilities and land being provided.

And since those risks reduce, we have been able to actually reduce the price of electricity from such facilities. And in the case of renewables and photovoltaics that has actually gone down to less than 2 rupees 50 per kilowatt hour.

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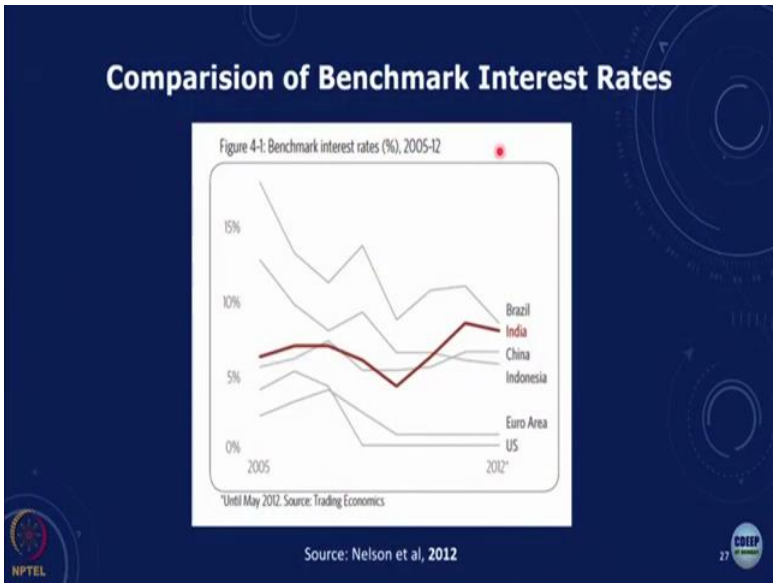

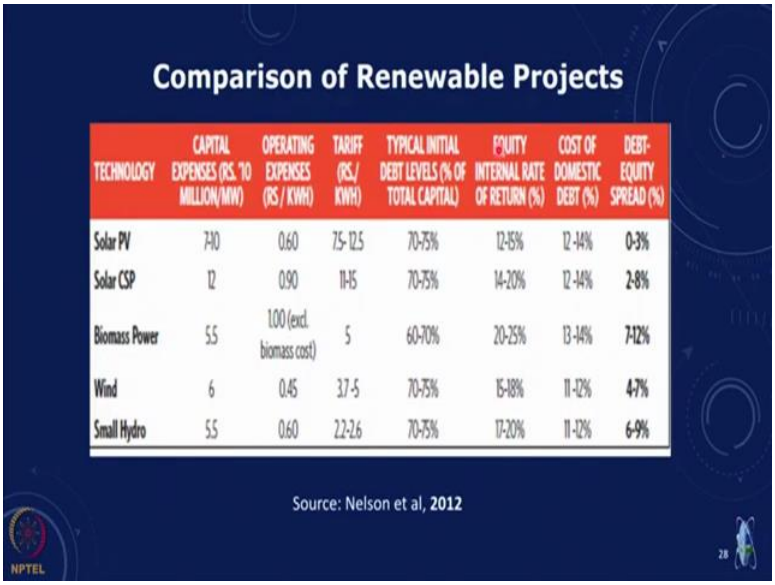

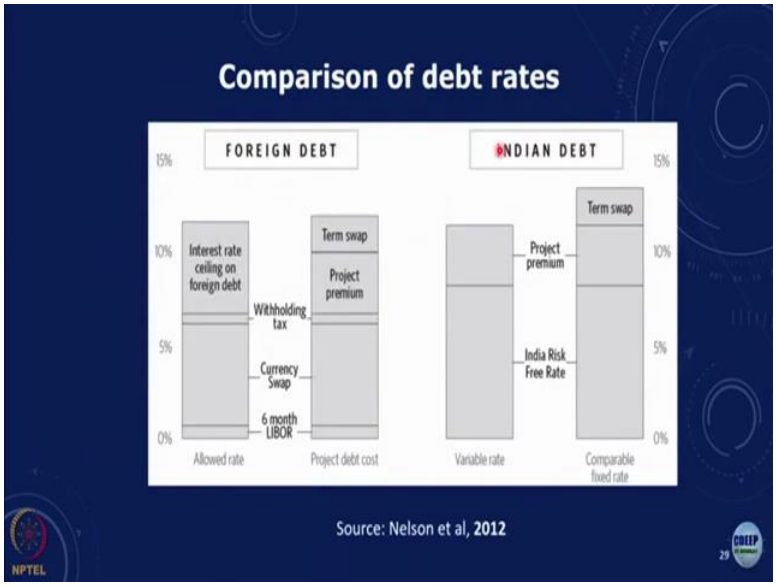

And of course, we can see in the case of India, the interest rates are higher than many of the other countries. Now the question which one may ask then is that should we be taking international debt. This itself has its own problems, because there is an interest rate ceiling on the foreign debt and then there are some issues related to swapping of the currencies and the exchange rate.

And with all of this, you see that some of the benefit that we could get by getting low interest foreign debt are actually wiped out, and the Indian debt and foreign debt are equivalent. We can look at a variable rate which is floating and over the time as the conditions change the rate could change or we can go for a fixed rate kind of debt.

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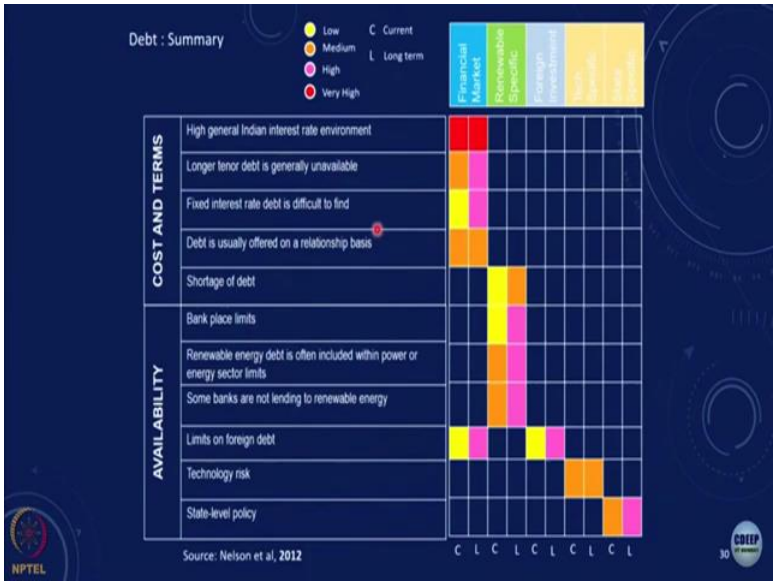

So, in general in this report, they have compared the different kinds of factors, which affect the availability, which affect the cost. and if you look at the main report, you will be able to see issues related to renewable specific issues, there are foreign investment and there is a tech specific issues, there is site specific and state specific and there is a financial market.

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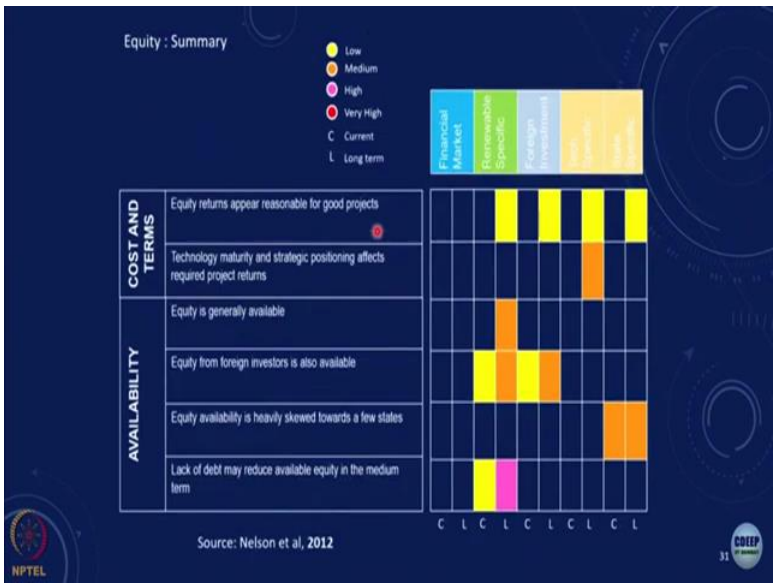

Similar thing that was for debt and similar thing is available also for equity. So, this will give us give you an idea if you go through it, it will give you an idea of what are the kind of issues related to debt and equity and what are the expected returns from both in the Indian context as compared to the global context and so this is the type of projects.

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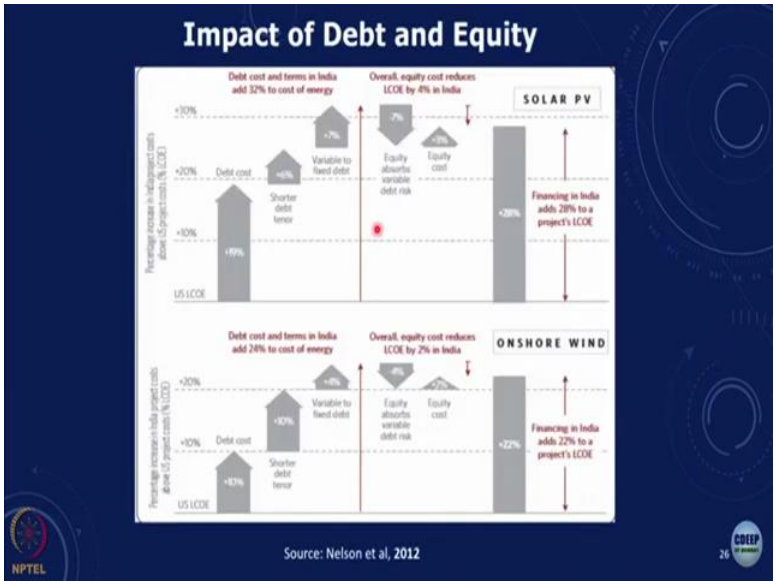

Based on this some calculations have been done with the debt and equity and the debt equity spread. Let us move forward with this and then see. So, financing in the case of Nelson et al they showed that the financing adds a significant proportion, about 20 more than 20-25 percent to the LCOE. And this is a problem, even the kind of high cost of debt result in this kind of an issue.

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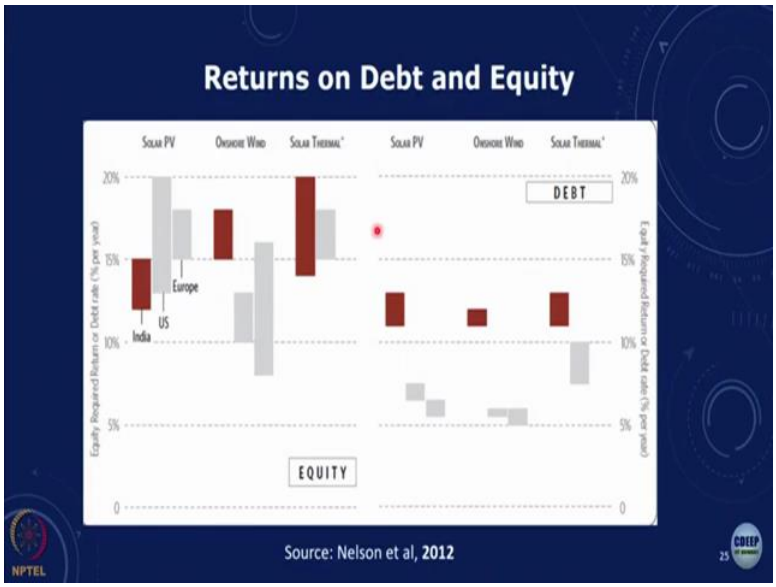

And you can see this is as we talked about the type of rates of return of debt and equity in India and Europe. And you can see very clearly in the case of debt and the case of equity if you see the equity rates of return which we are expecting and the equity return in the case of required return on the rate percentage per year, you can see that equity is in the same range. Actually,

Europe and US expect higher returns on equity. While in the case of debt, we can clearly see that much lower interest that is available in most of the countries of the world as compared to India.

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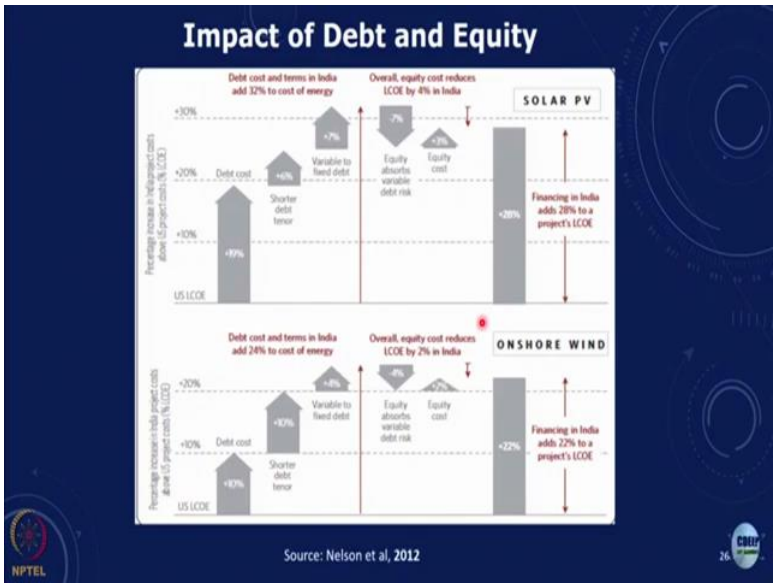

And because of that, this will add to our costs of power generation, costs of renewables and this has been added to see what happens in terms of financing and how much does it add to the overall cost.

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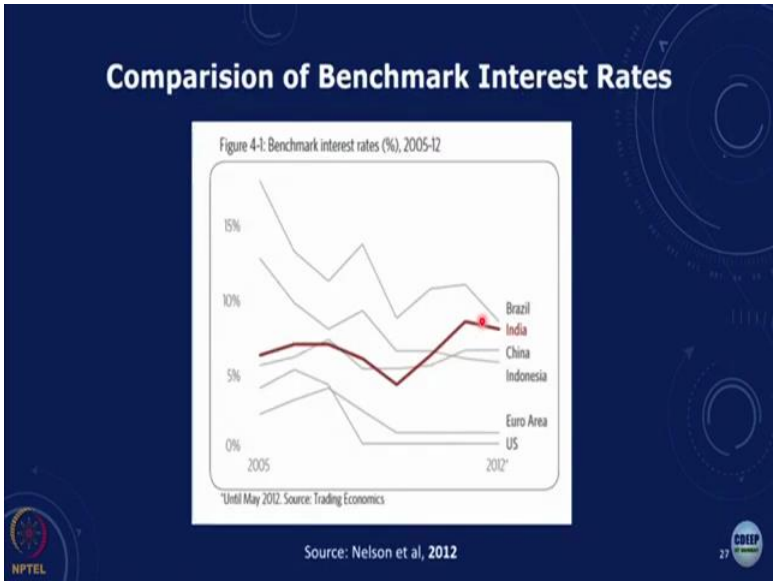

And then we also talked about the interest rates and the fluctuation in the interest rates and these can be used to make the calculations.

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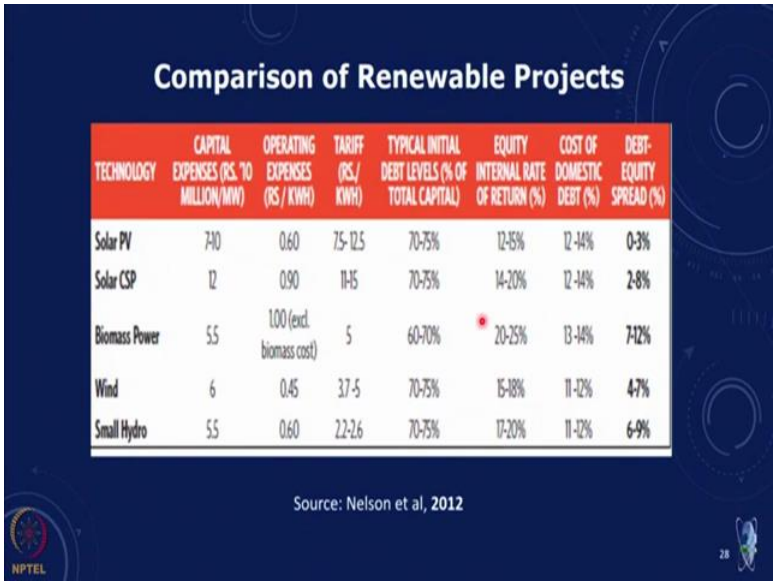

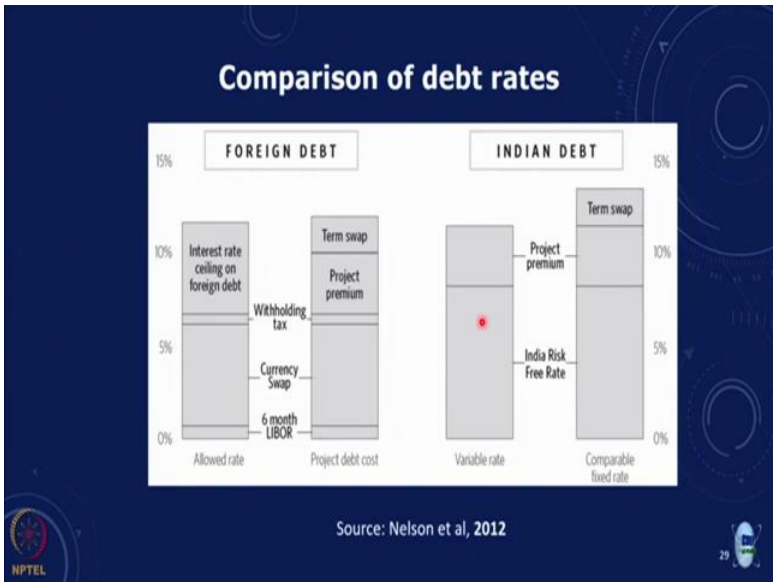

And then as we said, this is in terms of different kinds of sustainability. One can actually then calculate for a given amount of debt and equity, what would be the price of electricity, finally that we get in terms of rupees per kilowatt, and as I also told you that there is not much advantage to be you got by taking debt, international debt and the foreign exchange rate and the other issues related to international debt. It would result in the same cost finally and so there is not much incentive to go for this. We talked about the debt in summary and the Equity Summary.

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And finally, if you see, the feed-in tariffs was supposed to be, have been shown to be better. There are other mechanisms, the clean development mechanism, accelerated depreciation, generation based incentive and some income tax exemption. The mechanisms which are there, when we talk in terms of, there were initially, we started off with the preferential tariff which is a feed-in tariff.

But subsequently what has happened is that we now have the renewable purchase obligation and each of the distribution companies is mandated that it has to meet a minimum percentage of its generation of its supply, which is coming from renewables.

And if it is not possible to actually add that much generating capacity, then it is quite possible for the company to actually buy from other companies which have supplied that much and buy the renewable energy certificate, and that renewable energy certificate will enable it to meet its RPO requirement, Renewable Purchase Obligation requirement.

The renewable Purchase Obligation requirement percentages have varied from state to state and several of the states have not, distribution companies are not meeting that requirement and this has also been a struggle. So, the option we will, when we discuss policy we will discuss the feed in tariffs versus the RPO kind of issues.

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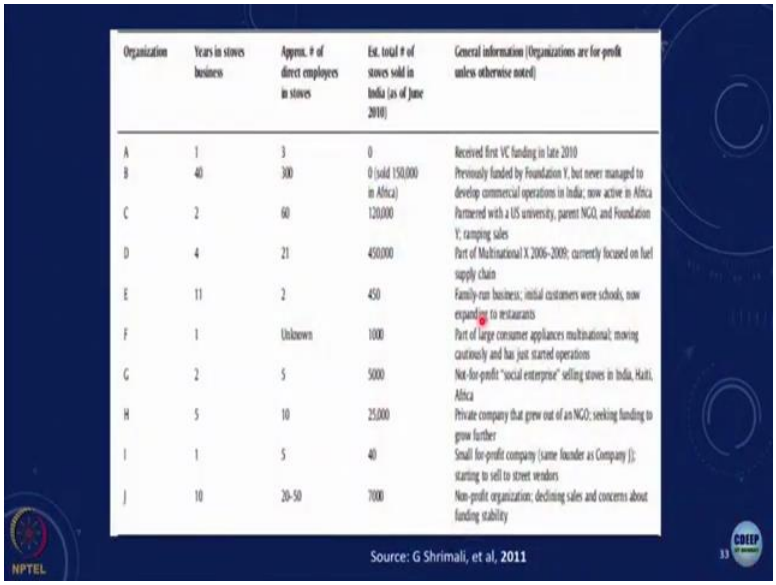

There is another interesting paper which you may want to look at is by Shrimali et al. It is an energy policy and we will send you the link, you can essentially compare a whole set of, what he has done in this paper is their authors have compared a whole set of different projects where they are looking at improved cook stoves and using business models and market mechanism to see the deployment of these in improved cook stoves.

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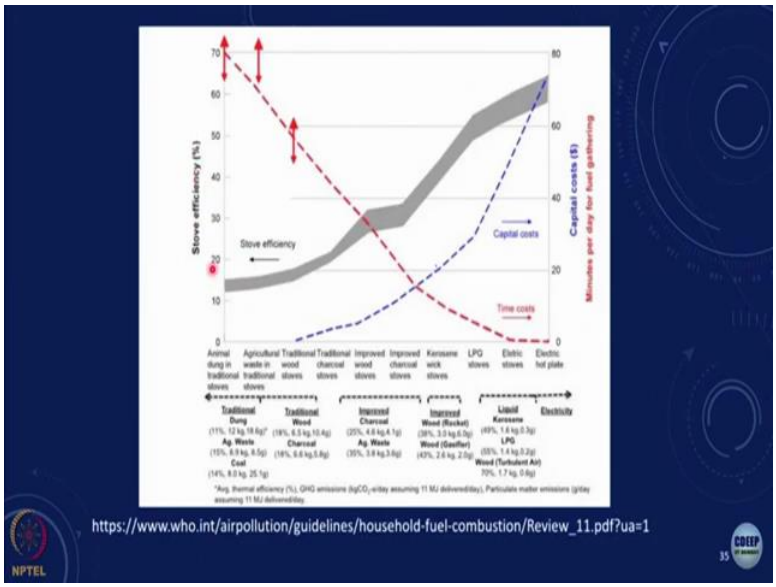

When we look at cooking, if you see the cooking, this is a nomogram, which is there in the World Health Organization, it is also part of the global energy assessment. And you can see that as we go from the traditional cook stoves and traditional stoves, then you go to wood stoves, charcoal stoves, improved charcoal and then you go to the LPG and the electric. And

in all of this, if you see there as we go down this line as you go in this direction, the amount of time taken for cooking would be significantly lower.

And so that is an important parameter. You can also see that the capital costs will increase as we move in this direction. And then of course, when we talk in terms of stove efficiencies, you will see that these correspond to higher stove efficiencies and so there are multiple trade-offs and one has to see how to manage these trade-offs.

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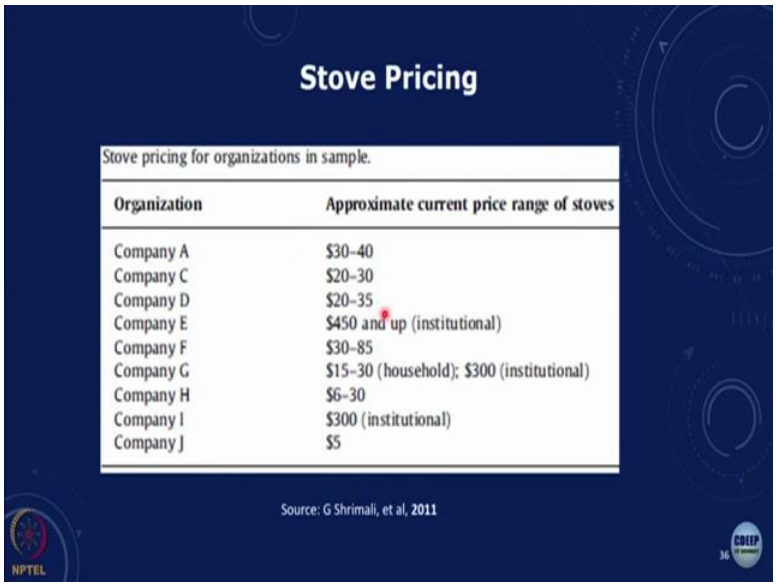

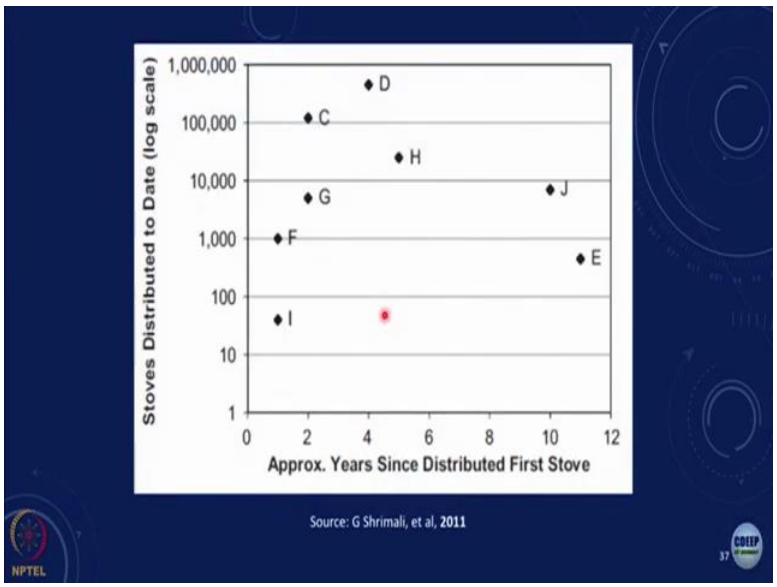

And for these companies, they have different kinds of price ranges and different kinds of mechanisms by which they would operate. And these mechanisms have been compared in this paper and I am not going to go into too much details of that. But the number of years when the first stove was disseminated and marketed and then you have a scatter in terms of the total

number of stoves which have been distributed and the kind of approximate years since the distribution of the first round.

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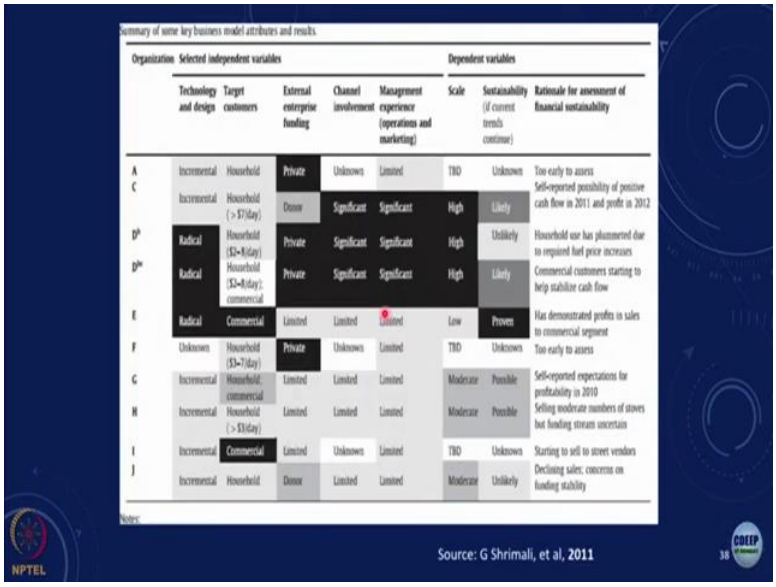

And interestingly, this is a table which shows the different kinds of comparison of these technologies. That means the technology in design, then the target customers, who are the target customers, are they household or commercial and based on that they would talk about different sizes. And then there is external enterprise building management experience and the scale at which you could operate and whether is sustainable or not, and the rationale for assessment of financial sustainability.

So, in all of these, you can look at the different models and there is a tableau and a matrix, which compares them on different basis. So, please take a look at this paper and this will give you an idea of how these different models can be compared and specially in terms of how the stoves are financed.

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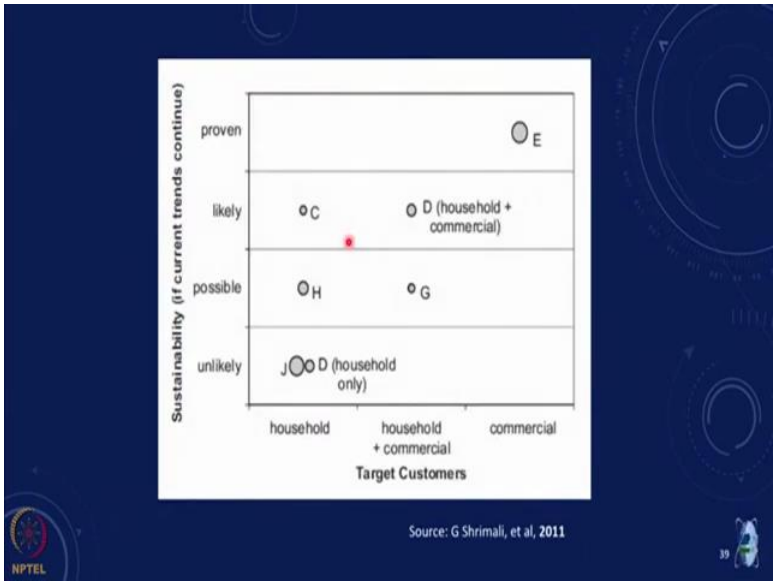

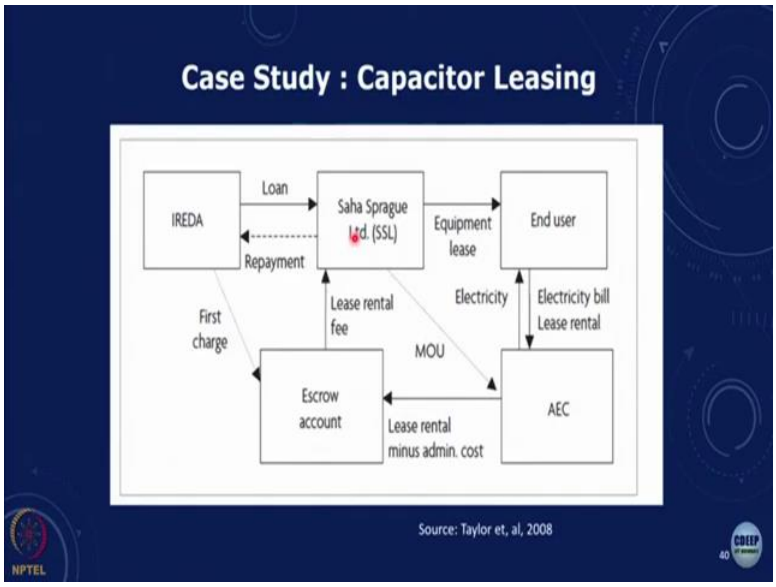

And then as we said, this is in terms of different kinds of sustainability. Now, let me talk to you about a couple of examples and then we will do some calculations in terms of financing. So, one example which is there in terms of financing is an example from the Ahmedabad electricity company.

Now, in the distribution companies, one of the issues is that you have to supply the active power, but based on the fact that many of the smaller industries and commercial establishments have essentially have low power factor and you have to supply much more reactive power to be able to meet the requirements and the active power that they need.

So, one of the simplest solutions is for the industry to compensate and to do static power factor correction and it could do static power factor correction, it could do automatic power factor

correction, but basically we need to put capacitor banks and this was be installed in the company. And so, the project here in Ahmedabad is to relatively smaller industries and companies which did not have the ability or the capital to be able to make the investments in a large set of capacitors.

So, instead of this, the capacitors were leased from the manufacturer. This is Saha Sprague Limited and these were least to the end user. As a result of this, since the maximum demand reduces, the electricity bill would reduce and some part of in on a monthly basis some part of the lease rental would be repaid to the distribution company that is the Ahmedabad electricity company. And this lease rental minus the administrational cost will go to some account, which is an escrow account and then the lease rental fee goes back to the company.

The IREDA provide take some charge from the escrow account. But finally, these lease rental fee is repaid and this is used to repay the loan. So that is the kind of mechanism, it is a very neat mechanism. What happens in this is that the end user benefits by the virtue of reduced bills.

Some part of that benefit is paid to the distribution company as an electricity bill lease rental. From this electricity company with the lease rental minus the administrative cost goes to an account on which the IREDA has the first right of taking the money so that they get a repayment on their loan.

Saha Sprague after getting the revenue from the lease rental fee also repays IREDA. And with the result that this is something where we are able to see a deployment, even though the end user does not have the ability to actually purchase all these capacitors. So, they lease the capacitors and over a period of time through the bill, this is recovered by the electricity company and then paid to the manufacturers and pay back the loan to the financing agency or IREDA.

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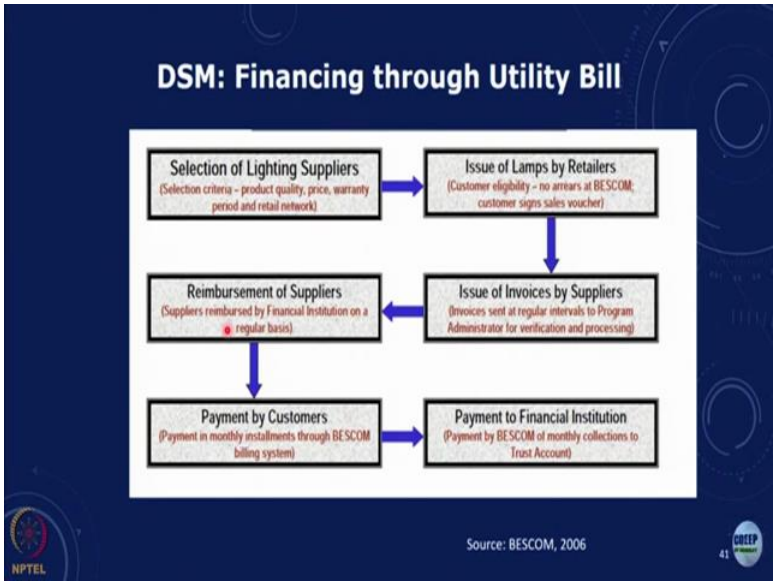

A similar kind of scheme was started for the switch from incandescent to compact fluorescents and so the idea, this was called the Bachat Lamp Yojna. And the idea was that the lamps were issued by the retailers, the invoices were made by the suppliers, the reimbursement was done, and there was some partial payment by the customers, which resulted in payment to the financial Institute.

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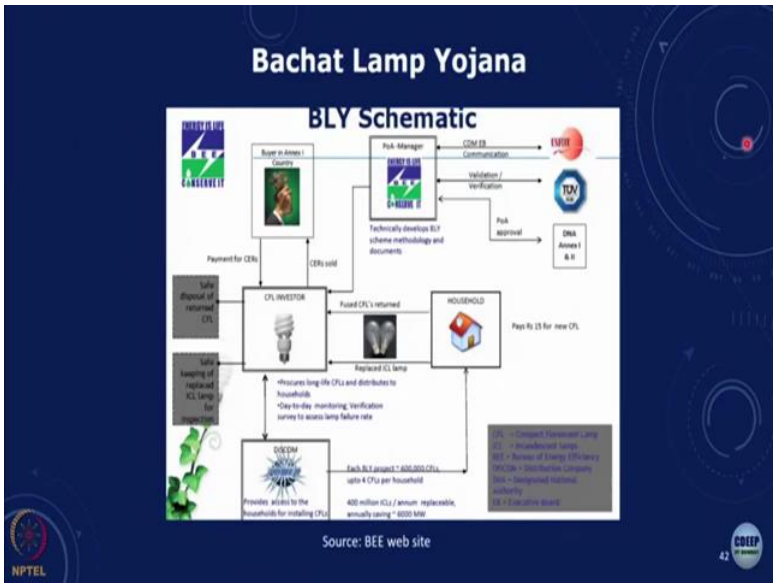

So, if you look at this scheme, this is what was proposed by the Bureau of Energy Efficiency. And you have these technologies, the compact fluorescent lamp, and then we had the CFLs being given at very low prices to the household and there was a guarantee also involved.

And when we aggregate all of this, because of the switch from incandescent to compact fluorescent so to say, this is aggregated and put in as a requirement, it is standardized. And we apply for carbon credits and get funding for the carbon credits. Now, this entire financing was dependent on a certain price for the CER or the Certified Emission Reduction. Using that price, can make this as viable option.

However, during this time when this happened, the CER market crashed and the CER prices came down, so that it was no longer viable to have this and there were relatively less stakeholders coming in for this in the districts and at the state level and with the result that of course. There is was also a technology change and a technology risk because essentially a LEDs took over from CFLs. And so, it was no longer worthwhile to sort of push CFLs but to go to the LED.

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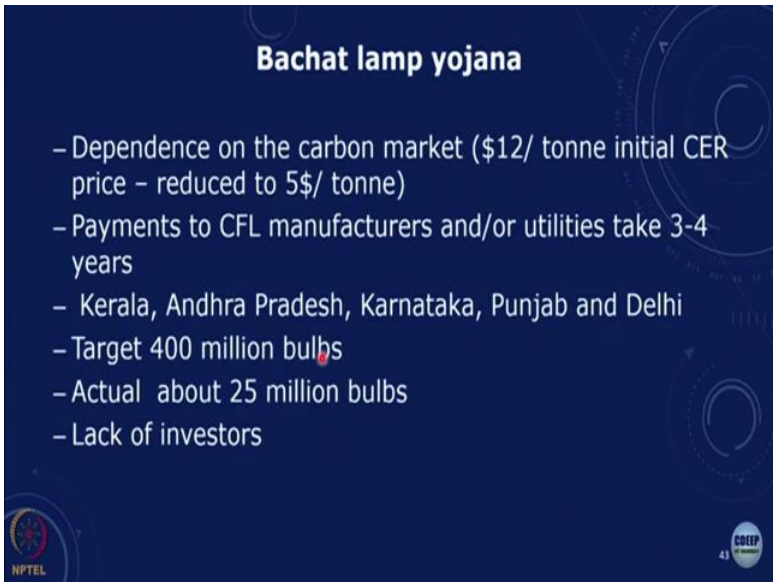

And the dependence on the carbon market resulted in 12 dollars per tonne initial CER price that is what was budgeted, but actually it came down to 5 dollars per tonne and the payments given the kind of complexity of the system, the manufacturers and utilities take 3 to 4 years. And the actual target was not, much much lower than what was targeted, and it was also one of the problems was the lack of investors. And I said that the risk because of the CER has also created.

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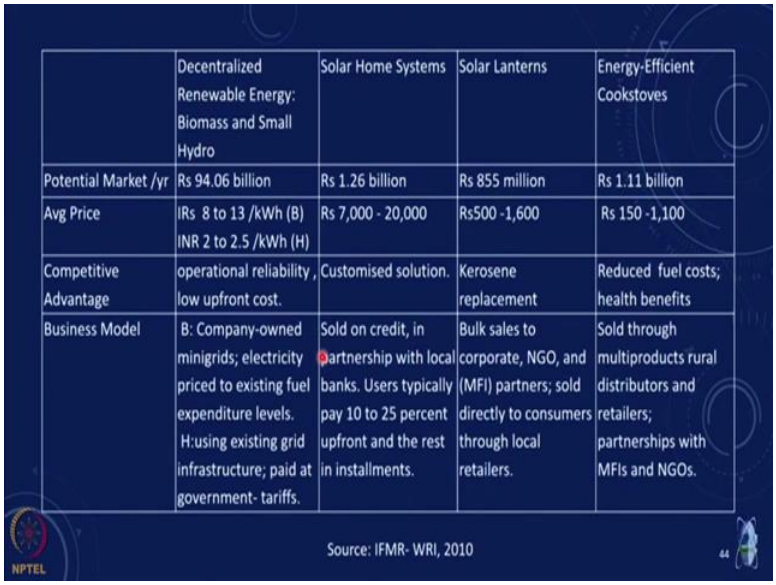

In the case of rural access and village electrification, free find the large number of small case studies, we also find a number of companies and startups operating in this domain and it is interesting to try to compare across this, we do not have time to go into details of this, but I will just show you some examples.

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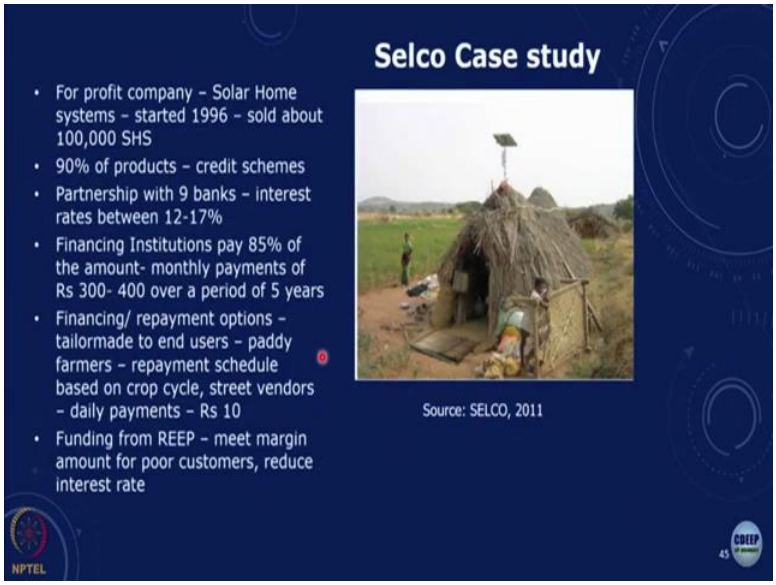

For instance, one of the successful companies is Selco, and that Selco was a for-profit companies, solar home systems started in 1996 and the idea in this is its main, it had some innovations in technology, but its main innovation was in financing and essentially they were doing this in an area in Karnataka which was known for large number of successful banks and

so they partnered with 9 banks and with a particular interest rate, and then they also the company also decided that the margin money.

That means the initial upfront payment which has to be given, which people found often in smaller, poorer households difficult to give, they would arrange for that, the household or the consumer. And financial institutions paid the largest chunk of this, monthly payments of 300 to 400 rupees over a period of about 5 years.

The financing and repayment options were tailor made to the end users. So, one of the interesting things which Harish Hande, Doctor Harish Hande talks about, he is the person who started Selco is that a street vendor is not able to pay 300 rupees per month but the street vendor is easily able to pay 10 rupees per day. So, if you have a collection mechanism for a street vendor, where you collect on a daily basis, then that is a benefit.

In some cases, if you had a farmer which had 2 crops, then you could have a payment schedule which is twice a year, coinciding with the crops being sold in the market. And then they also arranged for funding from different agencies to meet the margin amount for poor customers. One of the biggest benefits that they could do is they made customers bankable by providing them an incentive and by providing them some guarantees and ensuring that they interface with the bags.

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There is another model which is DESI Power, predominantly in Bihar. And their model was to aggregate, have local distributors and then they got government funding, they got some equity

which they put in and they looked at energy efficiency, they tried to tie up with enabling micro enterprises and tie up with telecom towers to increase the capacity factors.

And so, they many of the cases instead of putting meters they just charged the monthly rate and then based on the number of bulbs or loads, and they had a circuit breaker to limit the consumption. So, that means if you exceeded that limit over a couple of months you will be disconnected from the supply.

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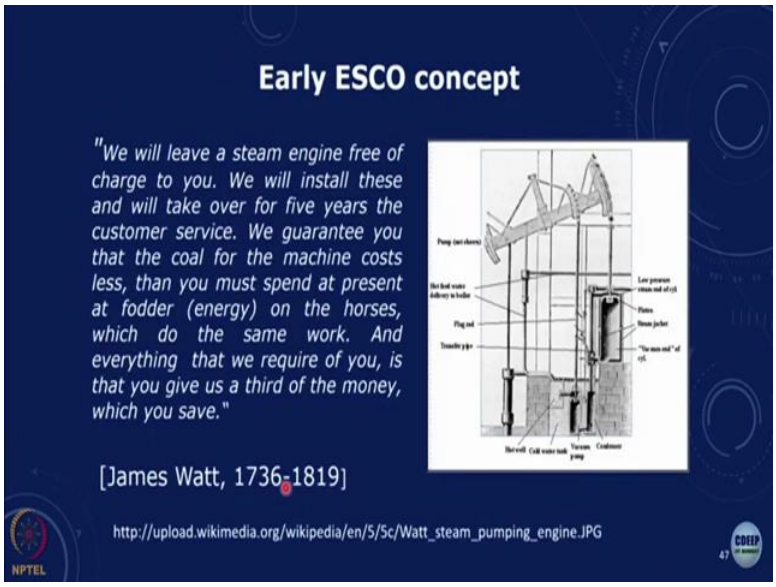

There is this concept of energy service company. Now as we saw, you know, we actually do not need energy per se, but we need the service that energy provides and energy service company essentially comes into the industry or commercial organization and says we will supply you energy you are currently paying a certain amount for your energy, continue to pay that amount we will invest in energy efficiency or in renewables and out of the savings, you share some of the savings with us and so we take some of the risk, and then we do this.

So, this is of course dependent on a whole host of things including contracting. It is an interesting concept, but it has not taken off much in the Indian context for a variety of reasons.

But just to tell you that the energy service concept ESCO energy service company concept is not old. The earliest known record of an ESCO is James Watts company, and his proposal was, we will leave a steam engine free of charge for you. We will install these and we will take over for 5 years the customer service.

So, that means 5 year annual maintenance contract of customer service. We guarantee you that the coal for the machine costs less, then you must spend at present as fodder on the horses, which do the same amount of work. So, this, if it is horse driven and then you are feeding the horses the amount of money that is paid to feed the horses, the number of horses, you get saving by, when we look at these kind of machines where we are looking at coal and then using that to get the steam engine.

And so, what is required in this case to what the agreement is, everything that we require of you is to that you give us a third of the money which you save. So, one third of the saving will go to James Watts' company and this was the kind of model as I told you the first known ESCO.

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We talked about Desi Power and the other model was Husk Power. Husk Power, of course started off by getting funding for their idea in terms of prize money and then they started directly reaching the end user and looked at doing the estimation of the demands accurately.

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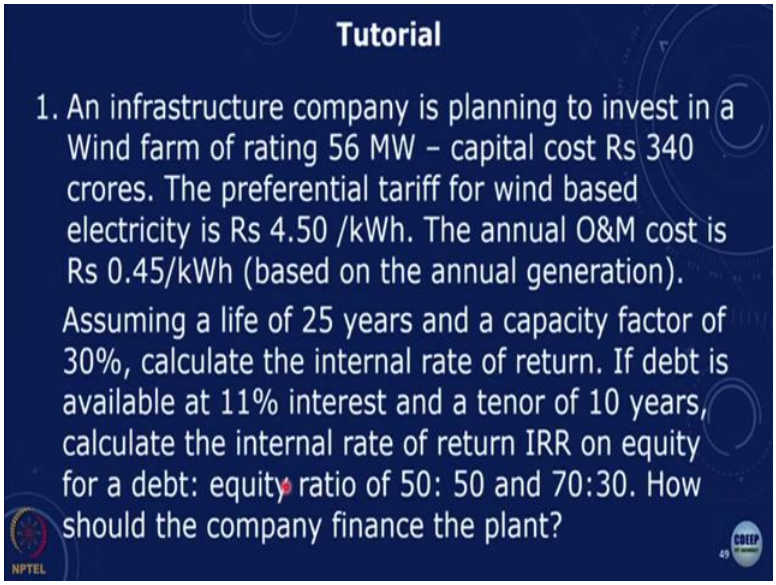

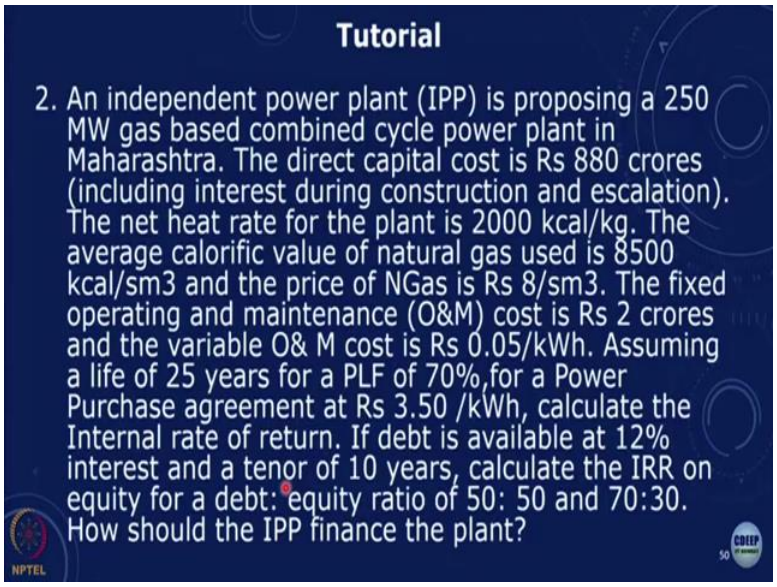

So, with this, we end the portion on financing. We are going to look at these concepts in terms of doing a couple of examples. So, with this, we have seen the overall history of project financing, we have looked at the different sources of finance, we have looked at debt and equity, risks and returns. We have also looked at the way in which you have either, you have recourse and non-recourse kind of financing.

We have looked at a couple of examples of how this financing is done. In the next module, we will take this forward and then do some calculations in terms of when we look at a loan how much do we have to repay and then take an example to decide how do we decide the debt equity ratio.