Energy Resources, Economics and Environment.
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Energy Projects Financing-Part 1.

In this module we are going to talk about financing of energy projects. Previously we have been looking at energy economics.

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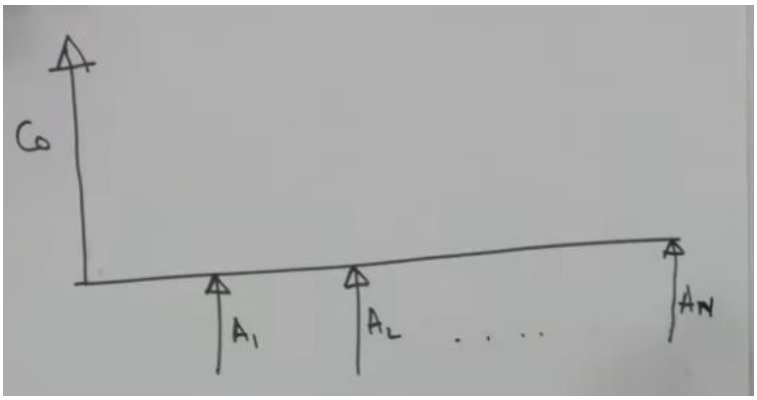

And in energy economics, we looked at how we can look at an upfront C0, which is an initial investment and then we were getting returns A1, A2, An. So, this was typically for a project where we are looking at a tenure of the project of n years, we had an upfront investment and we compared the benefits with the cost. And we looked at different ways of doing this, the net present value, benefit cost ratio, internal rate of return, the life cycle costing, annualized life cycle costing.

At that time, we did not bother about where we are getting this initial investment from the C0 and that is what we will be talking about in this module. How do we finance or get the investment required to actually implement or initiate a large energy project? So, let us start with seeing that, in that session we talked about building a solar thermal power plant.

And in a solar thermal power plant, you will have the solar field, that means you will have for instance you have parabolic concentrators, where you have the solar insolation coming in that is concentrating the energy to a working fluid, normally that is a heat transfer oil. That heat transfer oil is then heated to us high temperature, in some of these cases it may be 390-400 degrees centigrade, that heat transfer oil then is used to generate steam in a heat exchanger.

That heated steam then is used to drive a turbine and generate power that shaft power that is connected to a generator and you get electric generator, you have electricity which then is transmitted to the grid.

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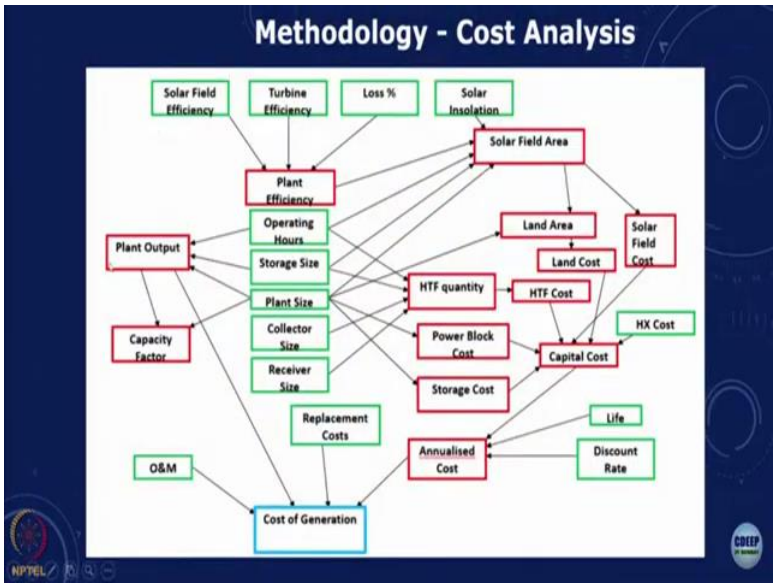

So, in all of these components, if you look at the components if we want to estimate the different cost components of this, we have different components the solar field, the turbine and the solar Insolation. So, we need to estimate based on the… So, we start by looking at for a given location, we will know what is the solar insolation, from that insolation for a particular output we can estimate what will be the solar field area, based on that you have the solar field costs, the land area, the land costs and the heat transfer fluid and its cost.

So, with all of this we get also the power plant, the power turbine and the generator and the heat exchangers and then you get the power block and the capital costs. And then from all this capital cost, then we can analyze it based on live discount rate and we can calculate the replacement cost, the capacity factor. This is in terms of the overall cost analysis.

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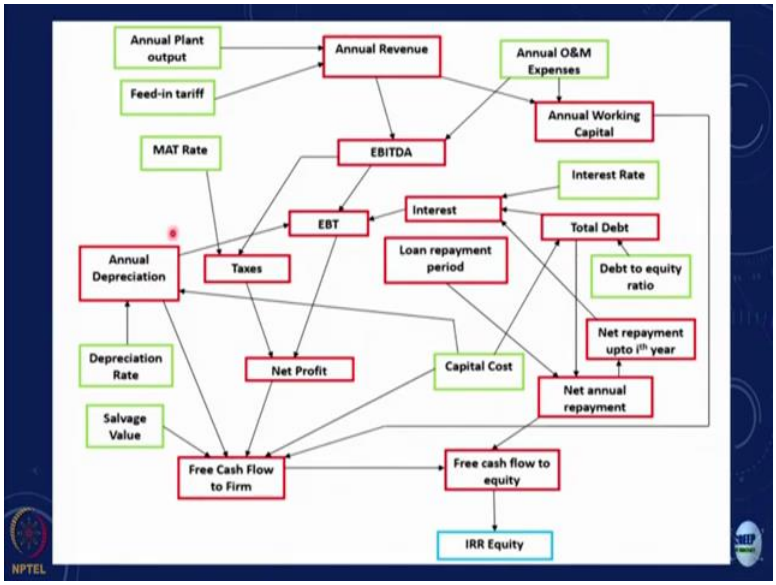

When we want to look at now the cost, the total capital cost, that can happen in terms of we may use our own finance, our own equity or the company itself puts in the money. Or we can take a loan and we can finance it and we have to, for the loan will have to repay the loan and then we can see for the equity, what is the rate of return on the equity. And So, typically when we look at this, we are trying to see whether or not the company should invest. And of course, in that there are choices in terms of where will the funds come from and typically, we are looking at funding coming from equity or debt, that means your own money or you are borrowing the money from somewhere.

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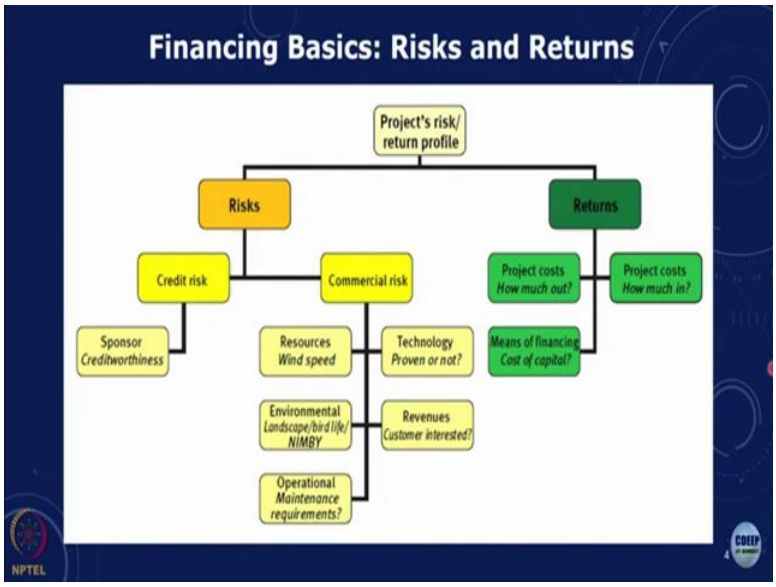

So, let us look now at a little bit of the basics of financing, when we talk about a project. A project is a well-defined entity, for instance, we talk about wind based by wind turbine, wind field, solar power generator, a particular heat, these are all specific projects. If you look at, let us say you are building a road, that is a fixed project for a particular goal with a particular time period, and then you can look at the investment. So, in each of these projects, there will be a profile of risks and returns that means there are some uncertainties or risks involved, especially if we are talking about new technologies.

And then based on the risks, based on making the investment, you will get returns based on the benefits that you get from the project. So, the whole issue when we talk about financing, is to estimate what kind of risks and what are the trade-offs between the risks and the returns.

So, in general, there might be a credit risk, that means the project whoever is sponsoring the project, how credit worthy is that individual or company and what is the guarantee that they will actually return the money and once they get the revenues. So, there is a credit risk and there are commercial risks. So, in the case of commercial risks, there could be a risk related to the technology.

If you are trying out a new technology for the first time, it may be you have estimated how it will perform but actual performance may not be the same. So, it may be a proven technology or not. In some cases, there may be a risk in terms of resources. For instance, many of the new plants which were installed in the case of wind, the wind speeds were much lower than what was expected and so the capacity factors or the amount of generation that were being obtained were relatively less and with the result then the revenues were less.

Similar kinds of problems have happened with solar insolation. Sometimes there are have been sites where the solar insolation data has not been mapped over a long period. And after we installed, we expected a certain, we installed it based on certain design values of solar radiation incident and actual solar radiation was lower, with the result that the output was lower than expected and there could be environmental risks.

For instance, if we think in terms of large hydro project or let us say a large nuclear project. For instance, there is this project which was the VBERs with VBERs with Russian technology, in Kudankolam and the problem in that has been, there had been strong local opposition, with the result that there have been delays. And this has, this again associates with it a certain amount of risks.

There had the extreme and the project, the environmental impacts and the opposition to the project. The actual environmental impacts or the perceived environmental impact may result in the project actually getting installed, it may go to the courts and the courts may go against it. So, there could be various issues and that is another risk, which were the company or the project developer has to take.

There could be a problem in terms of revenues. For instance, in order to mitigate this risk, the government in the Indian context, created the National Solar Mission, and in the solar mission, it was decided that for all the new solar projects, there would be a separate entity called, which would be a joint venture set up jointly by the NTPC, which would guarantee that the project always got a fixed amount of revenue.

And this was the NVBN, which was buying the electricity from the new solar projects and it was sheltering it from the DISCOMs. However, finally, the NVBN has to have the DISCOMs or the distribution companies taking the solar electricity and one of the risks is that if for instance, the demand, we have created excess capacity and then there is not sufficient demand, then it is possible that there may not be companies who are interested in purchasing that electricity at that price.

So, even though there is a guaranteed price, there might be a problem in terms of revenue. The operational maintenance requirements. In case there are issues related to O & M and there are additional operation maintenance costs, if there are shutdowns or there are problems with some of these O & M, operation and maintenance problems, this can also be another source of risks.

In terms of the returns, the project costs, there could be cost overruns, there could be project delays, and we can look at how much costs are put and how much we have to actually pay out and how much we are getting in and then what is the mode of financing, there is a financing risk and what is the cost of capital. So, this is essentially overall picture of some of the kind of risks and returns.

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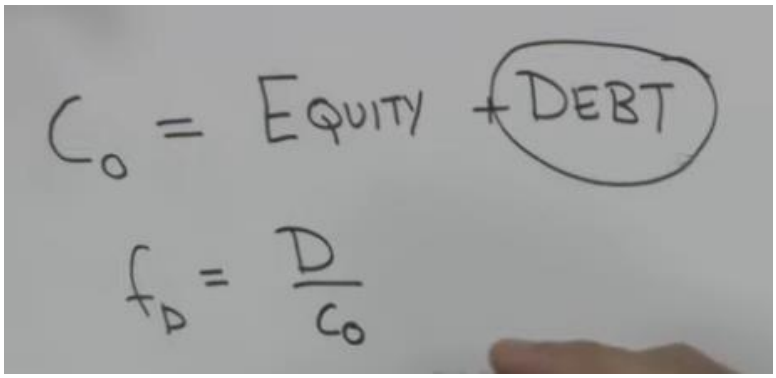

So, when we are talking of financing we are differentiating between. If you look at the C0, C0 will be equal to the sum of the equity plus debt, equity and debt. So, the fraction of debt is the D by C0 and depending on, normally whenever one thinks in terms of taking a loan, there will always be a certain minimum amount of equity or your own contribution that you need to pay. So, the debt by definition would be, the acquisition of funds by borrowing and this could be either cooperate or project loans or it could be a leasing arrangement.

And equity is the, is your own, is the promoter's own contribution. And it could also be done in terms of selling some of the shares for raising the capital, so that you give someone a share of the company. In addition to that, we could also have financing in the form of grants and guarantees. And this is especially true for relatively clean energy technologies.

In the case of something that the government would like to do in new technologies, you may actually get a certain amount of your initial investment actually paid for in the form of a grant

which does not need to be repaid. In the case of debt, this is something which will result in some repayment in the future.

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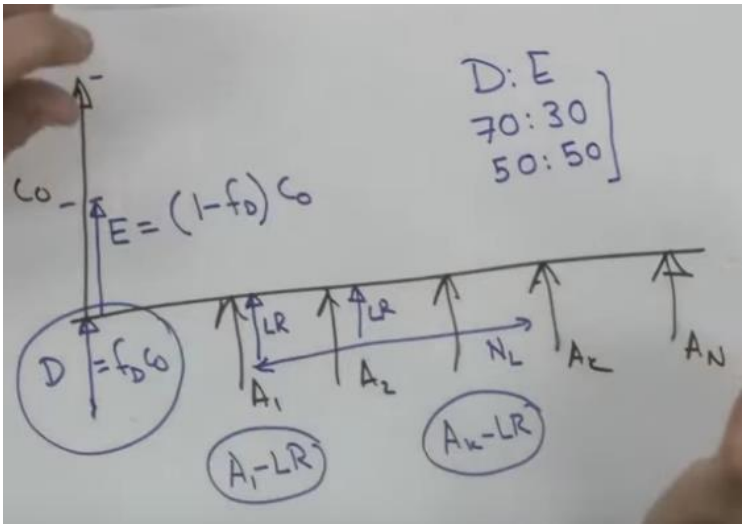

So, essentially, what will happen is that, if you look at the initial thing is we saw we had C0 and we had all of these, that is your AK, A1, A2, general Ak, An and this is C0. Now, if instead of putting the entire amount C0 here, we put only a fraction of this, which is the equity, which is nothing but 1 minus the fraction debt into C0 and this remaining amount is the amount which is being put by the company giving the loan and that is the debt. This is being invested and so actually we are only putting this equity.

As a result of this equity, we have to repay the loan, loan repayment, each year till the duration of the loan okay. So, whatever is the term of the loan in L, we have the loan repayment. So, the question then becomes that in each year what we will have is, we will have now the benefit stream will become A1 minus LR or Ak - LR. And the question is, should we take the loan, to what extent should we take the loan. In some cases, we may not have the option because we may not have enough money to pay C0.

And so, this is the kind of issue which is there. How much should I take in terms of debt and how much should be equity. And of course, in most of these cases what happens is that there is a leverage ratio, but there is a minimum amount of your own contribution. So, typically we will do some examples, we will see whether you have debt to equity. Let us say 70-30 or 50-50 and we will see the effect. And of course, this will depend on, for the loan, there will be an interest rate, and then we will convert that loan into equivalent annual payments.

And you can see in many of the cases even when you buy some, if you are buying a car, or you are buying high end phone, you can buy it out outright or you can also pay it in installments. So, we will see how to make that calculation of these payments in installments. So, typically what happens is, for large, well defined projects, we can have a way in which we can talk in terms of project financing and see where the money is going to come from.

In general, we can decide whether to choose between debt or equity and then we can see a way in which we can calculate and find out which ratio of debt-equity is good for us for a particular project. So, let us look at a little bit of background and history.

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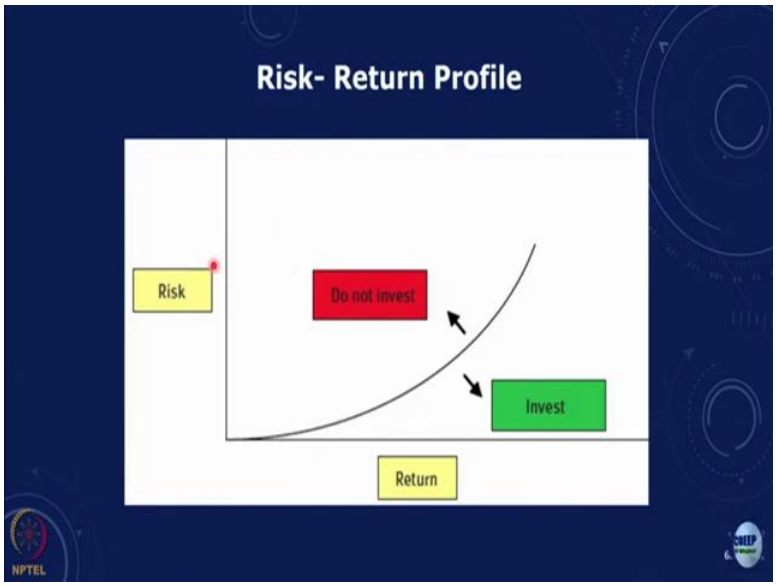

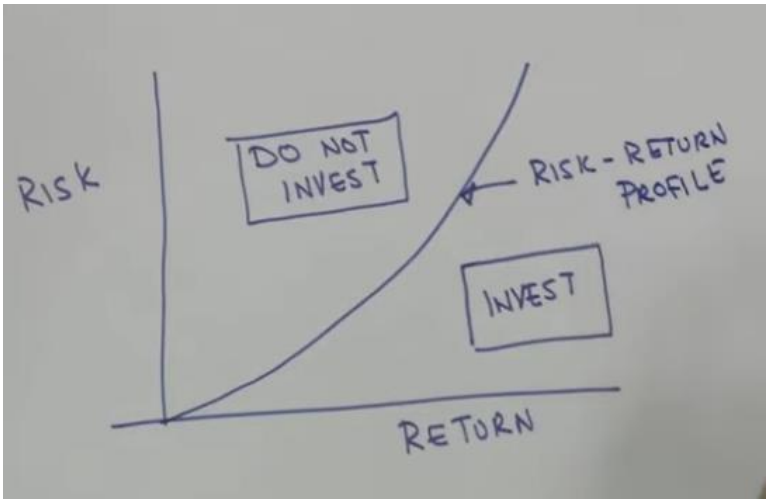

And before we do this, typically what will happen is that, in general, there will be a risk return profile. So, typically, for any project, we get some returns and then there are certain risks and typically, there will be, this is the acceptable risk for a given return and if your risk is less than

that, then we will invest and if it is more, do not invest. So, this is the risk return profile and this will be the characteristic of a particular individual or a company which is making these investments.

And then we will try and see what kind of risk. Of course, explicitly when you want to think in terms of risk and risk quantification, it is a little tricky and then there are uncertainties in all of this.

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So, let us, again, we have talked a little bit about the risk, but let us just list out all the risks which are there. So then, we talked about credit risk in terms of credit worthiness. Construction and development risk again, and sometimes when you are going ahead with the construction and development, especially, let us say we are talking Metro, there are certain areas where you need to get right of way, or you need to get the land being cleared.

And you need to and if that there is opposition and you do not get that, you may need to rework your plans and so that is a construction and development risk. Operating commercial risks. We saw that in terms of resources, we saw that in terms of technology, we saw that in terms of O & M , in terms of environment.

Political risk, now, this is you will see that often, that a particular government opts for a project, and if that is a high-profile project, which has had opposition, if the government changes, the new government can always reassess the project and so there is a risk in terms of that.

Normally, governments try to have continuity so that you try to honor commitments which are done, but sometimes there are issues. For instance, in Andhra Pradesh, the when a new government took over, in Telangana when the new government took over, they actually said that we will relook at all the power purchase agreements, which was signed with renewable companies.

Now these power purchase agreements were signed for a period of 25 years and now the developer or the company which is owning this has the issue of renegotiating the prices. And this has become a big issue, especially in the case of solar photovoltaics, where the prices have really come down drastically. When we started off the initial feed-in tariffs, we had electricity at 11 rupees per kilowatt hour, now we are signing agreements at 2 rupees 50 paisa per kilowatt.

Naturally many of the distribution companies want to relook at the agreements which were signed earlier. But, please remember these agreements were done in a regime where renewables were considered to be more risky, there was a technology risk, there was a market risk, and there was a legal process by which the developer and the distribution company signed an agreement at a particular price.

There could be financial risks and the risks could be in terms of some of the companies which are financing having problems, some of the companies which were participating in the project having a lot of outstanding funds. And there will be risks in terms of payments, especially this is true for many of the distribution companies which have large accumulated losses in the order of lakhs of crores.

And that means that, for instance, every unit of electricity which is sold to a distribution company, we actually do something like 80 paisa per kilowatt hour or 90 paisa per kilowatt hour. So, in such a case when such a company agrees to, comes up with a PPA, it is possible that the payments are delayed, or the payments do not happen in the way in which was contracted to be.

There could be regulatory or legal risk because the regulatory regime might change, the legal frameworks may change. Environmental risks we already saw this, there could be also certain things, for instance, if we created a bus fleet in a city, which was running on diesel, and we created a diesel infrastructure to cater to this bus fleet, and because of the environmental emissions if it was decided to ban all diesel vehicles in that particular city and we went into CNG, then there will be an environmental risks for the diesel supply chain.

Force Majeure, is also known as an act of God. It is something on which we have no control. For instance, you have suddenly a flood or a Tsunami and some kind of an extreme weather event which causes severe disruptions and that results in, it affects the viability of many of the projects. This is not something one can anticipate by its very definition, but this is something that constitutes a significant risk. And of course, you can buy insurance to sort of cover for that risk.

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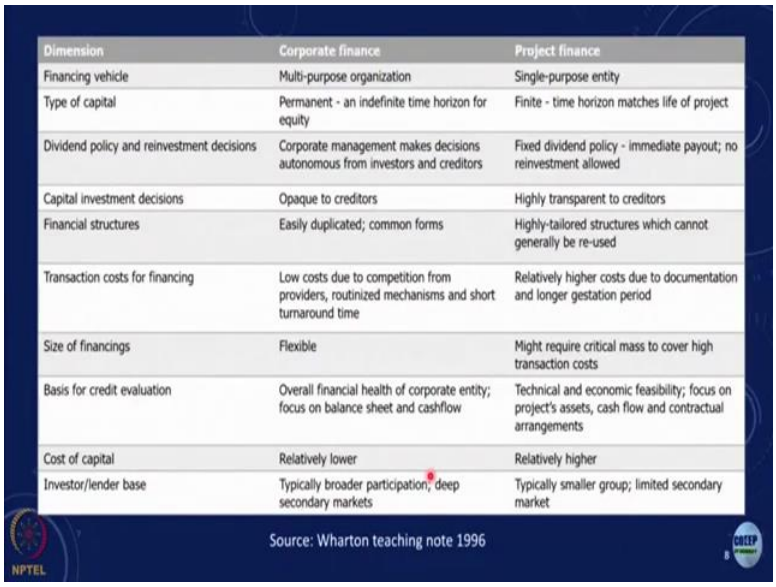

There are 2 types of different finances and if you look at it, we have a corporate finance which is financing a company. A company or which is a multipurpose organization has many different products, can get into different lines of business. On the other hand, there is a project the project is a single purpose entity, it has final goal, it has a specified timeline and that goal is to make a particular project with a particular output.

In the case of financing this, there should be permanent or an indefinite time horizon for the equity which has been put. In the case of project finance, is a finite project timeline and often it matches the life of the project and it may also so that you are getting the returns during the time, the life of the project. The different policies in terms of reinvestment and dividends, and the corporate management makes the decisions and it can make that decision, it is autonomous from the investors and creditors, of course investors and creditors are informed.

In the case of project finance, if there is a fixed policy immediate payout and no reinvestments are allowed. The capital investment decisions in corporate finance is opaque to creditors. But, in the case of project finance, it is supposed to be transparent to the creditors. The financial

structures have a common form in the case of corporate finance, and in the project finance it is very very tailor made, dependent on the structure of the type of project which is being built.

The transaction costs for corporate finance are relatively low due to competition from the providers and for routinized mechanism, short turnaround times. Project finance requires high cost due to documentation and longer gestation periods. Size of financing, for corporate finance could be flexible, but in project finance typically we need a critical mass to cover the high transaction cost so that usually they are in large chunks.

And that is why you have these large solar parks, you have insulations in the case of solar which are like 648 megawatts, one of the largest insulations in the world, in Tamil Nadu. And so, that means, that you have a large amount of financing which is required for this. Then the basis for the valuation of the project of the finance, in the case of corporate finance it depends on the overall financial health of the entity, the focus is on the balance sheet and the cash flows.

In the case of project finance, it depends on the technical and economic feasibility of the project, focus is on only on the project and the project assets, the cash flows and the contractual arrangements for the particular project. And corporate finance relatively has lower costs of capital, while project finances higher costs of capital. And the corporate finance has a larger, broader participation by the investor base and has the secondary markets.

Project finance typically of small group of funding agencies and there is a limited secondary market. So, you can see that there is a difference, distinct difference between corporate finance and project finance.

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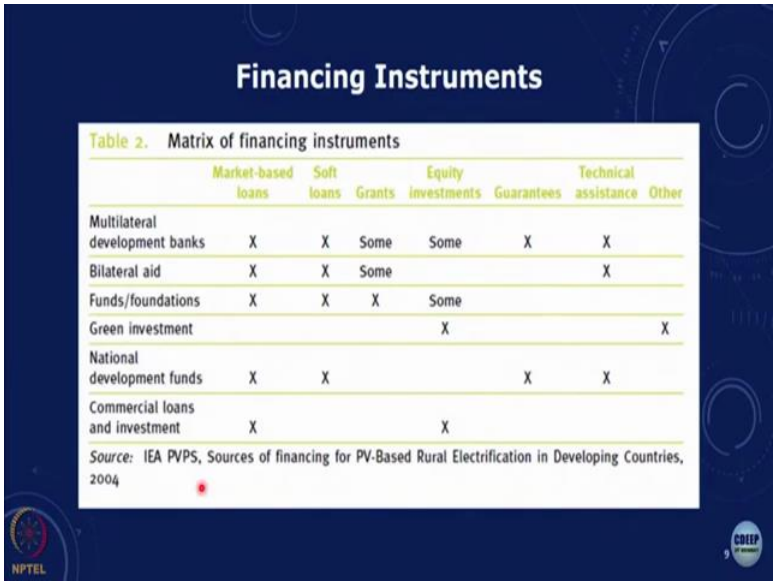

	Market-based loans	Soft loans	Grants	Equity investments	Guarantees	Technical assistance	Other
Multilateral development banks	X	X	Some	Some	X	X	
Bilateral aid	X	X	Some			X	
Funds/foundations	X	X	X	Some			
Green investment				X			X
National development funds	X	X			X	X	
Commercial loans and investment	X			X			

There are many different financing instruments and this is from an IEA report on PV projects. And you can see that we can get funding for large solar photovoltaic projects or small rural electrification projects and you can see they you can be from multilateral development banks like the World Bank, the IMF and the Asian Development Bank. It could be bilateral aid, that means Indo Germany, Indo US and these this can involve loans and soft loans. It can also involve some grants, it can also involve technical assistance.

And then we could look at many funds and foundations that are interested in the case of, for sustainable energy, for low carbon, for climate. And again, these are, they have loan soft loans, they also have grants and they have some possibility to do also equity investments. Green investments would be typically equity investments and then when we look at the national development funds, they could be again in the form of loans and guarantees and technical assistance. Commercial loans and investment will be typically market based loans. They can also be, we can also invest in equity. So, this gives you sort of an idea of the kind of financing modes.

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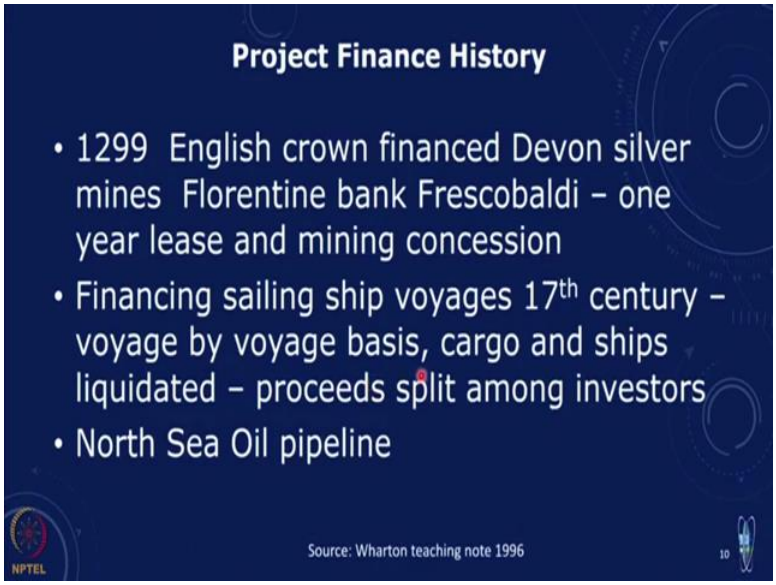

Historically, project finance has been around for quite some time for more than 700 years. The recorded historical case is in about 1300, 1299 the English Crown or the English government and in this case, it was the royalty which was ruling England, it financed in Devon a silver mine and this financing was done by an Italian Bank of Florentine Bank Frescobaldi and they provided the funds to actually mine and start the silver mine and take, extract the silver from it.

Frescobaldi was given a contract for a concession in which one year's lease and mining, it was allowed on this Devon silver mines. So, the arrangement was that, the bank, the Florentine Bank Frescobaldi, provided the entire money for this development of the mine, with the understanding that whatever they could extract in the first year belonged to them and that was the full payment for the financing of the mine. So, this was the first example of project finance.

In a similar fashion in England in the 17th century, there used to be sailing ship voyages, and it was financed on voyage by voyage basis. So, in they would start with a voyage which was going to a particular targeted location and they would, during the voyage, they would accumulate different kinds of goods and wealth from various countries and locations and whatever was got and traded, whatever came back as cargo and ships, these were liquidated.

So, that means they were sold and the money collected, the proceeds were split among the investors based on the agreed upon formula or the contract which was done when the ship was financed. So, that gets, it gets, the ship goes, it acquires goods and it buys things it gets from various places, it then sells these, and then the proceeds are split amongst the investors. There

have been many large projects, including the North Sea Oil pipeline off the coast of the United Kingdom.

These are large projects with large investments, which involved a whole group of financers coming together for financing this and then they got revenue, which was staggered over time.

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So, in the public domain, there is a Wharton teaching note on project financing, and there is a paper by Wynant in the Harvard Business Review. So, this defines project finance as a financing of a major independent capital investment that the sponsoring company has segregated from its assets and its general purpose obligations. So that means this is a project which is sheltered from the rest of the things and it is, this represents a major independent investment and you can also look at the flows associated with that particular project and it is not connected with the rest of them.

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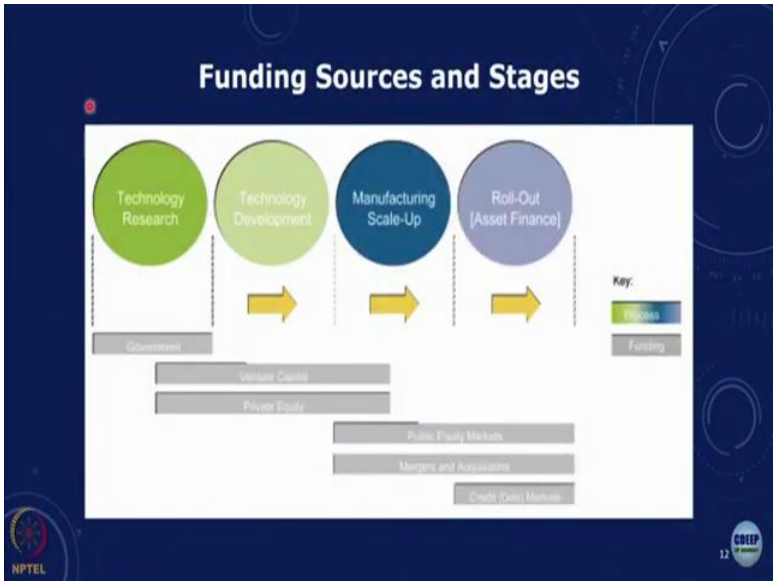

So, if you look at the funding sources and stages, we have, depending on the level and the technological readiness level of a particular technology. At the first point, when we started the early funding stage, you have what is the research stage, the R & D stage. And this is typically, this would be primarily funded by the government. Once you have the technology which is there and you do some basic experiments, you have shown something and you now have a prototype or we have the knowhow and then it has to be developed into a technology.

And then this is where you have the possibility of venture capital coming in. Some companies may be started and you might get private equity which comes into this, and you have the technology development. Then next step is you have this technology, it is demonstrated, it is developed and we need to think in terms of large-scale manufacturing and scale up. And that is the third stage.

This typically will require public utility funding, and may also have involve mergers and acquisition. And then finally, once this is done, we would roll it out and create the assets. This would be asset finance, and this could come from either credit or debt markets and it can also come from equity and mergers and acquisitions. So, you can see different kinds of, at different stages of the technology development, you have different possible funding sources.