Energy Resources, Economics, and Sustainability

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Week – 03

Lecture – 05

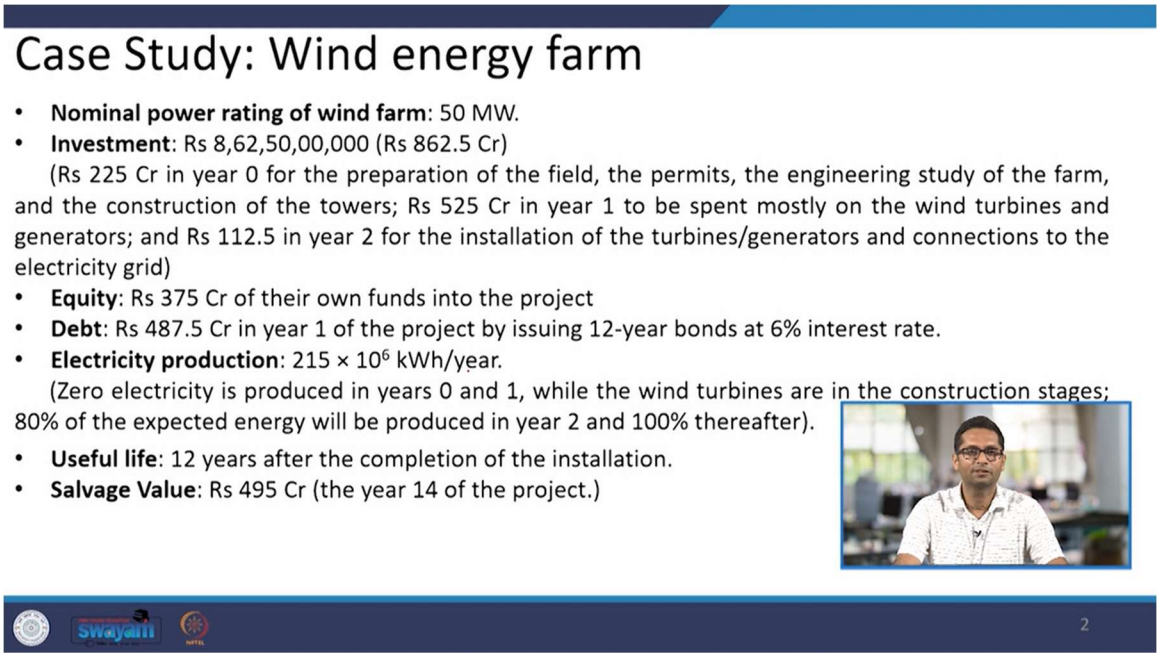
Lecture 15 - Wind Farm Financial Model-I

Hello everyone, welcome back to the course Energy Resources, Economics and Sustainable Sustainability. In the past few classes, we have been discussing the basics of economics, their applications to energy related projects. We have been discussing what are the different kinds of matrices or methods that might be used to understand the applicability, profitability of energy based project. Some of the models or some of the methodologies that we discussed included the net present value, the internal rate of return, the external rate of return, average return on books, the payback period, profitability index, the benefit to cost ratio. We tried to analyse what would be the relative advantages and disadvantages of each of the methodology. So, if you remember in the last few classes, we have been discussing that any process or any methodology for project appraisal or a financial appraisal should have three basic functions.

It should consider the whole lifetime of the project, it should consider the cash flows that are occurring throughout the life of the project and it should also be taking into account the time equivalence of money, the future value of money with respect to the present value and vice versa. Now, in today s class, I would want to put some of these lessons into practice. So, we will try to make a financial model for a tentative wind farm that is expected to come up. We will do the regulations together and for that I will be using the MS Excel tool and I would encourage you people to also work out this example with me using any spreadsheets software that would do.

Specifically I would be using the MS Excel but you are free to use any software and it might be of worth if you want to form this example with me as I proceed. So, what we

will be doing is we will take a case study of a wind farm that is supposed to come up in the neighbourhood. I am rating the wind farm having a nominal power rating of around 50 megawatt that might be good for a small city. The investment that it would require tends to be around 862.5 crores.

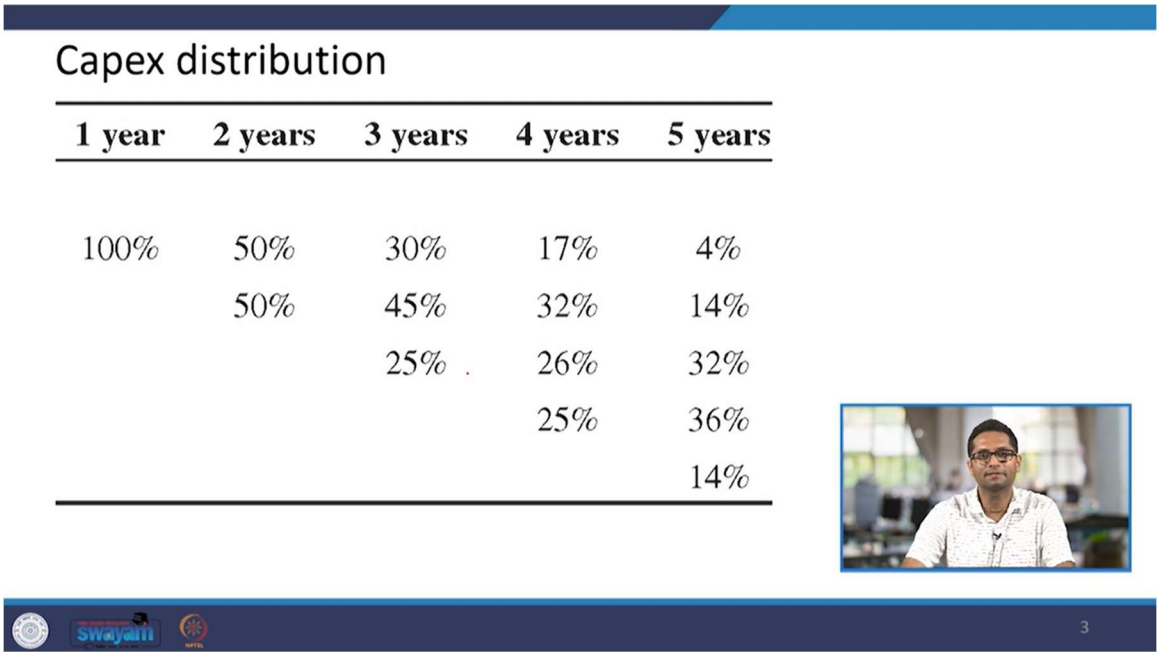


This is the normal range in which energy related projects are expected to happen. The normal expense spans over few hundred crores and this is what you can expect for a large wind based farm and this expenses won't be occurring at one instance. Basically these kinds of plant take a couple of years for the direction, commissioning and before that you have to make engineering drawing and the DPRs ready. So it happens over a span of 3 to 5 years. So in this particular example I would be assuming that this expense is occurring over the span of 3 years. So I will be spending around 225 crores of the total 862.5, envisioned 862.5 crores in the first year which will mainly go towards the preparation of DPRs, then the different permits, the different environmental clearances that you would need, the different studies that you would want to take in. Then the actual construction will start towards the end of the year and would mainly be accomplished in the second year and that is where I would be spending major chunk of the money. So in this case I have assumed like almost 525 crores would be spent in the second year and in this case I am mentioning it year 1 because the first year is normally mentioned as year 0.

So the second year would be mentioned as year 1 and that is when the most of the wind turbines and the generators would be installed. Then comes the final year where you would be having the pre-commissioning, you will be testing it for a good time to see everything is working nicely because any problem that occurs later on could have great financial implications and you would normally start with some kind of production towards the end of the second year, maybe not be 100%, maybe 50%, 60%, 80%, something like that and that is when the plant is expected to be half commissioned and after that it is expected to operate for around 12 years. Then since you would understand that 862 crores is not a small amount but it is a very heavy amount and no big corporate would want to put all of its own personal money and that is why like we have taken a debt to equity ratio. A majority of the money that would be needed to be invested will come from the debt which would be taken from the market. In this case it is assumed that almost 487.5 crores will be taken from the market with the help of 12 year bonds and it will be bearing 6% interest rate. So what is going to happen is I am going to issue bonds for this amount and will be selling this in the market and these bonds will be returned to the buyer at the end of 12 years and meanwhile every year the corporate will be giving a 6% interest rate on the amount of the bond. So this methodology how the amount of bond is calculated we have understood with the help of simple example in the last few classes and then the equity is something the corporate would want to put its own fund in and in this case we have assumed that the corporate would be putting around 375 crores of equity. So normally in the energy related projects you would have the debt to equity ratio as it is commonly known as 50-50 or 70-30 and for the projects that are of national importance and that are expected to give a very good return in the future and the debt to equity ratio may go even higher to around 80-20 and these kind of ratio would affect the overall economics as you will see in the business model. So normally you can assume that the equity debt to equity ratio for energy related projects would vary from 50-70 to 30 ratio.

Then we get most of the revenues from a project like this from the production of electricity and in this case it's an approximation that this plant will be able to produce around 215 x 10 to power 6 kilowatt hour of electricity I have used kilowatt hour because that is a normal understanding for a unit and that is going to happen per year. It is

assumed that zero electricity will be produced in the year 0 and 1 that is when like in the first year of the year 0 it's basically the engineering drawings that are taking place and in the first year it's mainly the erection taking place. It's just at the second year that we have the commissioning and the pre-commissioning and we can expect that plant would be working at 80% of its rated capacity and by the next year it should be able to function at 100% capacity. So this is a simple assumption again taken care in this business model. In reality we can expect that these kinds of plant would have some kind of degradation happening every year. So either that would call for a reduction in the plant operating capacity year wise or addition of more capacity as you proceed. So if you are going with power purchase agreement with a DISCOM you would want to keep the electricity production rate to be constant and you might want to install more turbines as there is degradation happening. Again as I mentioned the useful life for a project like this would be 12 years and we can assume that at the end of 14th year when the corporate has done away with the plant it can sell the plant to another corporate or any other entity who would want to run this plant and the salvage value in this case is assumed to be around 495 crores. This would depend upon like the predictions made by the managers or the engineering team how good the plant would be.



And if we see how the like how the capex is normally distributed so in the energy related field you can have different plants coming up in different span of time. So if you are

looking towards a plant like battery storage it might come in a relatively small amount of time say 1 year. So in that case you can assume like 100% of capex is going in 1 year. But in majority of cases you can see that it is going to span from 2 to 5 years. So in this case in case we are not aware how to distribute the capex which is normally coming from the DPRs we can make some informed choices and this is a normal process or the normal way in which distribution is taking place. So if the plant is getting installed in 2 years you can install you can basically attribute 50% to each year. In case it is taking 3 years you might want to attribute 30% to the first year then maximum goes to 45% to the second year and then the remaining 25% in the last year. If it goes for 4 years maybe it would increase to 32% in the second year and then reduce slightly towards the second and third year. Then in case of 5 years you would gradually increase till around 36% in the fourth year and 14% in the last year. So if you are looking towards a coal based or coal fired power plant it would typically take 4 to 5 years and these are the data for a coal based power plant. Other plants like solar plants might take between 1 to 2 years, hydropower plants again can take between 3 to 5 years into construction. So that is a huge time in itself and the capex needs to be divided accordingly.

Case Study: Wind energy farm

- **Fixed costs** (including the leases on the land): Rs 2,62,50,000 per year, starting in year 0 and increasing at an annual rate of 3%.
- **Operating (variable) costs**: Rs 3,00,00,000/year, starting in year 2 and increasing at 5% annually for the duration of the project.
- **Price of electricity**: Rs 3/kWh and is expected to increase at an annual rate of 2%.
- **Tax**: 28%
- **Depreciation**: A straight-line 10-year depreciation schedule is allowed for the entire investment.
- **Discount rate** r_d: 15%.

And then in this particular case we would also have certain fixed cost and one of the major fixed cost would be the lease or the rent of the land on which the windmills or the

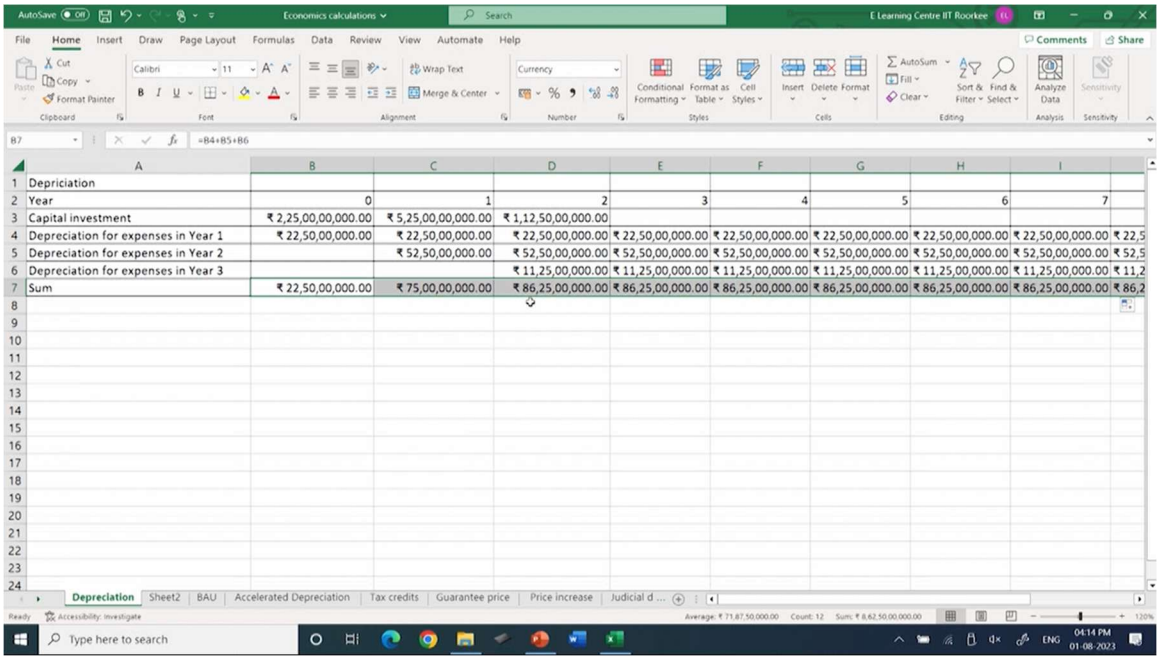
wind turbines are being installed and in this case that starts from year 0. So it doesn't depend upon when the plant starts operating it starts from the day you would have started the installation process and in this case we have assumed that this would amount to around 2.62 crores per year and starts from year 0 because the land rent and other facilities like some of the labors that would be involved, the managerial staff that would be involved would start from year 0 and it is expected that this would increase at a rate of 3% per year to counter inflation. So anything that you buy in the market would have yearly increase rate and in this case we have assumed that the fixed cost would increase at a nominal rate of 3%.

Then there is another cost which is called operating or the variable cost that would vary according to the operation of the plant and in this case I have assumed that this would be around 3 crores rupees a year and this starts from year 2 when the plant is in operation. So in the year 2 as we have understood the plant would be operating at around 80% of the capacity and then 100% of the capacity thereafter. So I am assuming around 3 crores a year is spent and this is mainly the operating cost in terms of the like the raw material if you are getting from another plant. In this case of course there will be no raw material but the salaries of some of the operating staff and one of the major things in the operating cost. Then you would derive with all of your revenue to say from the price of the electricity. Now you would need to sell the electricity at a good rate so that people are able to buy it and you can generate the revenue. So in this case I have assumed the rate of rupees 3 per kilowatt hour which is slightly on a lower end as far as conditions in India are concerned but still like this would be somewhat nearer to what you pay in your homes or lesser than what you pay in your homes. But I am just thinking of the generation one because after this there would be a supply and distribution and that has its own losses. By the time it reaches your houses or your offices it might have a greater value and again this electricity price I am expected would increase at a rate of 2% per year. Now this corporate who is making up this wind farm would also be liable to pay some taxes on the profit that it is generating.

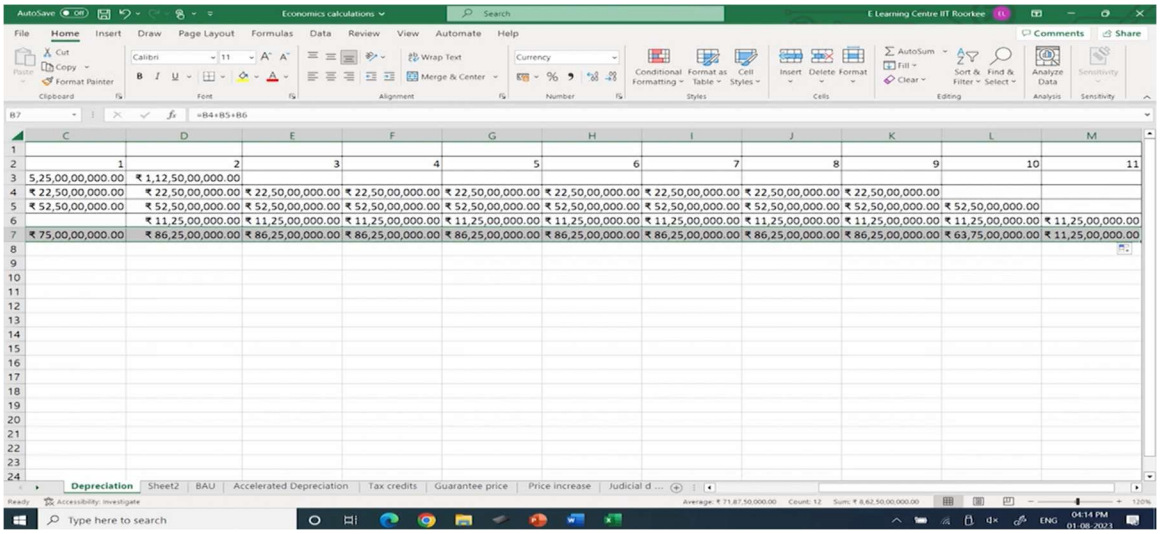
In this case I have assumed a tax of around 28% again this tax is normally governed by very complex tax laws. Normally the corporates have a couple of tax consultants or CA sitting who would guide the company to form certain policies so that they can derive the

maximum benefit from the tax policies of a particular country and this tax policies would be very different for two different countries. But in this case for the simplicity of understanding I have assumed the tax would be charged at 28% of the profit and then we also need to take into account the depreciation. Now depreciation will come into account when we would have to take the capex into the tax calculations. So, this is basically we would have to divide the capex at a rate in which it depreciates so that it can give a benefit to the corporate owner.

So, in this case I have taken a very basic case in which we have taken a depreciation that is straight line and that is happening for 10 years and since the plant is getting installed in 3 years the depreciation would have different values in different years. So, we will just try that with the help of an excel sheet and the discount rate I am considering in this case to be 15% so it might come that like these kinds of plants or investment are a bit risky so the corporate management would want to have a higher discount rate for this kind of investment and that is why it has been chosen to be 15%. So first thing let us try to see how the depreciation will take place in this kind of plant.



So let us move towards a simple excel sheet. So in the excel sheet that you can see in front of you, you can see the years on the top and then on the first column is the capital investment that is happening over the span of 3 years.



	C	D	E	F	G	H	I	J	K	L	M
1											
2	1	2	3	4	5	6	7	8	9	10	11
3	5,25,00,000.00	₹ 1,12,50,000.00									
4	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00	₹ 22,50,00,000.00		
5	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	₹ 52,50,00,000.00	
6		₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00	₹ 11,25,00,000.00
7	₹ 75,00,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 86,25,00,000.00	₹ 63,75,00,000.00	₹ 11,25,00,000.00

So, in the first year I am spending around 225 crores then 525 crores in the second year which is termed as year 1 and third year around 112.5 crore rupees. So if I say the depreciation of the first trench that is happening of the payment that is happening of around 225 crores in year 0 so this would be almost the initial amount divided by 10 and this would go on for the next 10 years and I would continue it till the year 9. So this is equal till the 9 years and then the second payment is happening of around 525 crores and this is happening in the year 1 and this again then I would be dividing into 10 different fractions equally divided upon the next 10 years. So this goes from year 1 till year 10 and it is equally divided among all the years and this is what I mean by straight line depreciation where the depreciation is happening linearly over the lifespan and finally the depreciation for the expenses in year 3 which happens to be around 112.5 crores again I will be dividing that for the next 10 years which starts from year 2 and goes all the way till year 11 and if I would have to take the cumulative depreciation that is happening over the years I will just add these three terms. So the total sum of the depreciation that will be taken care of would be a sum of or the depreciation for the first range of investment plus the second and plus the third and so the first year and the depreciation would be like 22 lakhs 50 thousand and not 22 lakhs like and then 22 crores and 50 lakhs and this will keep on increasing and it will increase and it will stabilize from the year 2 to year 9 then decrease and then finally decrease so you would have around 22 crores 50 lakhs for the first year then around 75 crores for the second year 86 crores point 25 lakhs for the second year onwards and it remains constant because there is no more investment

happening after that it stays similar for the year 9 and then it again decreases in year 10 and finally comes to around 11 crores in the year 11. So this is how I would be calculating the depreciation in which the investment is happening over the span of few years.

Depreciation

1. For year 0, the allowable depreciation is Rs 22,50,00,000
2. For year 1, the allowable depreciation is Rs 75,00,00,000
3. For years 2–9, the allowable depreciation is Rs 86,25,00,000
4. For year 10, the allowable depreciation is Rs 63,75,00,000
5. For year 11, the allowable depreciation is Rs 11,25,00,000

5

Again in the slides I am presenting the same things that the depreciation would start from the year 0 and then increase stabilize at around 86 crores 25 lakhs from the year 2 to 9 it would stay at 63 crores for the year 10 and around 11 crores for the year 11. Then further we also need to understand how the calculations would be made.

- **Total revenue** = (revenue from electricity) + (bond revenue) + (salvage value).
- **Total costs** = (capital investment) + (fixed costs) + (variable costs) + (interest on bonds) + (bond repayment).
- **Pretax income** = (total revenue excluding bond revenue) – (closing costs) – (fixed costs) – (variable costs) – (interest on bonds).
- **Taxable income** = (pretax income) – (depreciation).
- **Tax** = (taxable income) x (tax rate) – (tax credit). If the tax is negative, this implies that the corporation receives a benefit by having to pay less taxes in other projects.
- **Cash flow** = (total revenue) - (total costs) - (tax).
- **Discount factor for year *i*** = $1/(1 + r_d)^i$.
- **Discounted cash flow** = (cash flow of year *i*) x (discount factor for year *i*).
- **NPV** = sum of all discounted cash flows from the beginning to the end of the project.

Source: Michaelides, E. E. (2018). Energy, the environment, and sustainability. CRC press.

6

So the first calculation that would be interesting is the total revenue. Now the total revenue would be coming from three different aspects the first and the major one should be the revenue from the electricity. The electricity that you are generating and selling in the market for rupees 3 at the year 2 and then there is a subsequent increase then there would be a bond revenue that will happen in the year 0 when you are selling the bonds and taking capital from the market which you are going to use for the building of the plant. Finally there would be a salvage value which means you would be selling the plant after its useful life for the corporate and that is going to happen in the last year. So these will be the three major sources of revenue.

Then if you talk about the cost the cost will be in terms of the capital investment that is going to happen over the span of the first three years. Then the fixed cost an example would be the land leasing then the variable cost which in terms of the employment that you are generating in terms of the plant operators. You would also be paying an interest on the bonds that you have sold in the year 0 and finally in the one year from the last you would be also repaying the bond back to the people from whom you have taken the money and there is a bond repayment that will be happening. Then based upon this cost and revenue you would be able to get rid of pre-tax income. So pre-tax income is basically the profit on which you would be taxed by the tax laws of a particular country.

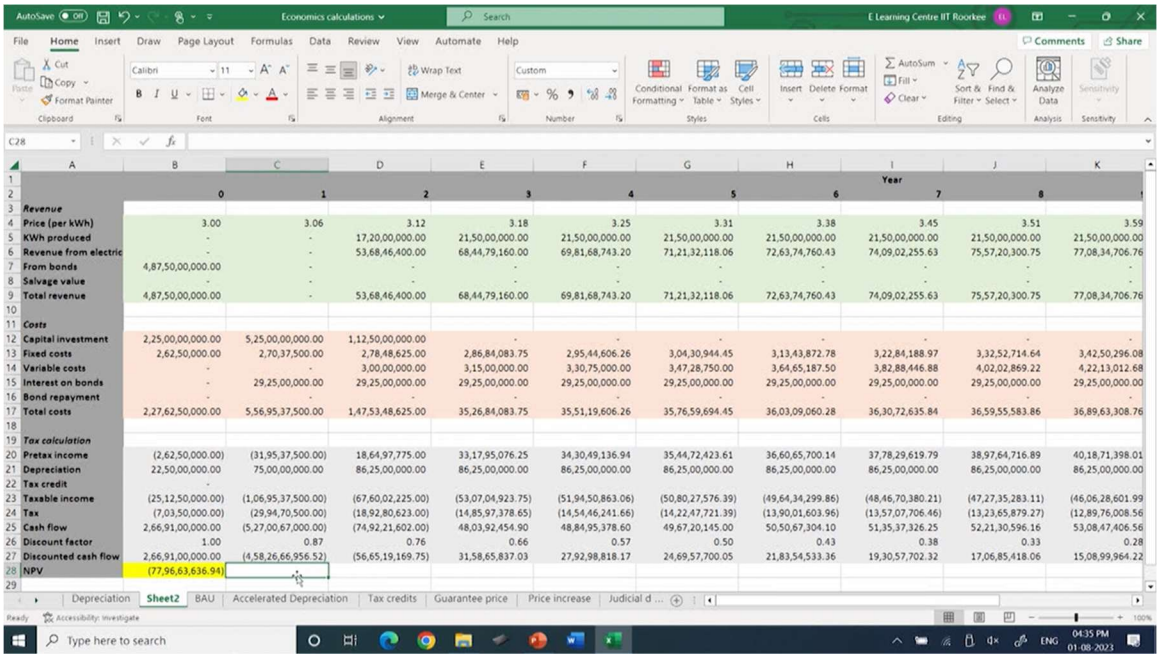
So in this case I am taking a very simple case in which you would have the total revenues except the bond revenue. Now bond revenue is something that is used for raising the capital and that I will be taking in the form of depreciation. So I will be excluding the bond revenue but I will be taking all the revenues which includes the electricity. Then I would be taking the closing cost of the plant if there is any. Then the fixed cost as well as the variable cost and the interest on the bond that I will be paying on the yearly basis.

So these are basically the yearly or the annual expenses or revenue that I am generating. Then my taxable income would basically be the pre-tax income minus the depreciation. So in this case depreciation is basically a methodology for spreading out the capex throughout the life so that it gives benefit to the plant owner. The tax would be the taxable income into the tax rate which is applicable to me. So in this case it has been assumed that the tax rate is 28%.

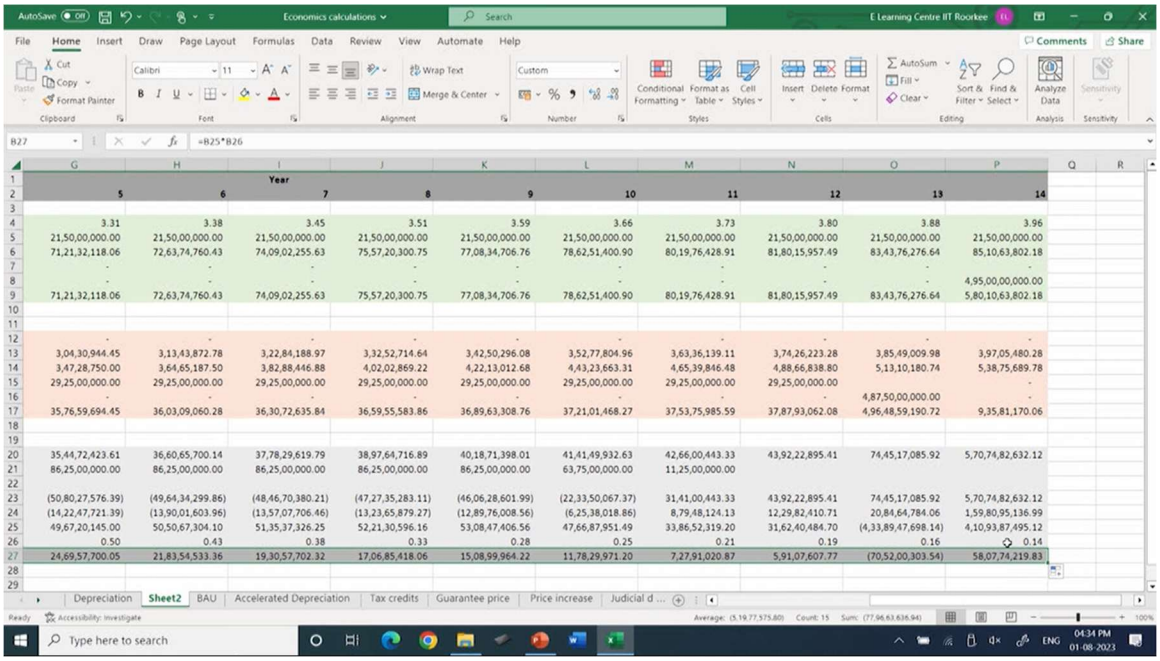
And in many countries you would also have a tax credit which is given by the specific countries. And the advantage of this tax credit is that it wants to encourage people to invest in energy related projects that could be used for the larger good of the people. So if there is any tax credit you would have subtraction of that. Plus it needs to be understand that in the first few years when you are making capital investment the tax comes out to be negative. And in this case if the corporate wants to make a utilization of these government policies it should have other businesses that are having a positive tax or that are profit making.

Unless the corporate has some other operations or some other verticals which are profit making the corporate might not be able to make use of the tax laws of a country in the present movement and it might want to take you make use of this in the future. But again that would be discounted by the changing value of money. So in this case I am assuming that the corporate in itself is a big entity which has many profit making businesses and this is just one of the ways, one of the places it has invested and so any negative tax that might come in the first few years it can take a benefit of those negative tax in some other businesses. Then the cash flows would be basically the total revenue minus the total cash cost that is that the corporate incurs minus the tax it pays. And the discount factor of an year we all understand would be 1 divided by 1 plus the discount rate which in this case I have assumed to be 15% and all of it should be raised to the number of years that has passed beyond which the plant has been into operation from the year that is present.

And then we will be like multiplying this factor with the total cash flow and this gives us the discounted cash flow. I add the total cash flows and this gives me the net present value of all the cash flows that are occurring throughout the life of the project. Now let us try to understand this with the help of the same example where we are putting in or trying to analyse the wind farm and I have given you the different types of assumptions being made. Again let me put it this is a hypothetical case that we are putting up and the main aim of this example is to help us understand how these calculations are done. So this is not exactly the calculation will be done in the corporate which would have many complexities involved but this is a very simplistic way of showing how the calculations might be carried out.



		0	1	2	3	4	5	6	7	8
						Year				
	Revenue									
	Price (per kWh)	3.00	3.06	3.12	3.18	3.25	3.31	3.38	3.45	3.51
	KWh produced	-	-	17,20,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00
	Revenue from electric	-	-	53,68,46,400.00	68,44,79,160.00	69,81,68,743.20	71,21,32,118.06	72,63,74,760.43	74,09,02,255.63	75,57,20,300.75
	From bonds	4,87,50,00,000.00	-	-	-	-	-	-	-	-
	Salvage value	-	-	-	-	-	-	-	-	-
	Total revenue	4,87,50,00,000.00	-	53,68,46,400.00	68,44,79,160.00	69,81,68,743.20	71,21,32,118.06	72,63,74,760.43	74,09,02,255.63	75,57,20,300.75
	Costs									
	Capital investment	2,25,00,00,000.00	5,25,00,00,000.00	1,12,50,00,000.00	-	-	-	-	-	-
	Fixed costs	2,62,50,000.00	2,70,37,500.00	2,78,48,625.00	2,86,84,083.75	2,95,44,606.26	3,04,30,944.45	3,13,43,872.78	3,22,84,188.97	3,32,52,714.64
	Variable costs	-	-	3,00,00,000.00	3,15,00,000.00	3,30,75,000.00	3,47,28,750.00	3,64,65,187.50	3,82,88,446.88	4,02,02,869.22
	Interest on bonds	-	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00
	Bond repayment	-	-	-	-	-	-	-	-	-
	Total costs	2,27,62,50,000.00	5,56,95,37,500.00	1,47,53,48,625.00	35,26,84,083.75	35,51,19,606.26	35,76,59,694.45	36,03,09,060.28	36,30,72,635.84	36,59,55,583.86
	Tax calculation									
	Pretax income	(2,62,50,000.00)	(31,95,37,500.00)	18,64,97,775.00	33,17,95,076.25	34,30,49,136.94	35,44,72,423.61	36,60,65,700.14	37,78,29,619.79	38,97,64,716.89
	Depreciation	22,50,00,000.00	75,00,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00
	Tax credit	-	-	-	-	-	-	-	-	-
	Taxable income	(25,12,50,000.00)	(1,06,95,37,500.00)	(67,60,02,225.00)	(53,07,04,923.75)	(51,94,50,863.06)	(50,80,27,576.39)	(49,64,34,299.86)	(48,46,70,380.21)	(47,27,35,283.11)
	Tax	(7,03,50,000.00)	(29,94,70,500.00)	(18,92,80,623.00)	(14,85,97,378.65)	(14,54,46,241.66)	(14,22,47,721.39)	(13,90,01,603.96)	(13,57,07,706.46)	(13,23,65,879.27)
	Cash flow	2,66,91,00,000.00	(5,27,00,67,000.00)	(74,92,21,602.00)	48,03,92,454.90	48,84,95,378.60	49,67,20,145.00	50,50,67,304.10	51,35,37,326.25	52,21,30,596.16
	Discount factor	1.00	0.87	0.76	0.66	0.57	0.50	0.43	0.38	0.33
	Discounted cash flow	2,66,91,00,000.00	(4,58,26,66,956.52)	(56,65,19,169.75)	31,58,65,837.03	27,92,98,818.17	24,69,57,700.05	21,83,54,533.36	19,30,57,702.32	17,06,85,418.06
	NPV	(77,96,63,636.94)								



		5	6	7	8	9	10	11	12	13	14
				Year							
		3.31	3.38	3.45	3.51	3.59	3.66	3.73	3.80	3.88	3.96
		21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00
		71,21,32,118.06	72,63,74,760.43	74,09,02,255.63	75,57,20,300.75	77,08,34,706.76	78,62,51,400.90	80,19,76,428.91	81,80,15,957.49	83,43,76,276.64	85,10,63,802.18
		-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	4,95,00,00,000.00
		71,21,32,118.06	72,63,74,760.43	74,09,02,255.63	75,57,20,300.75	77,08,34,706.76	78,62,51,400.90	80,19,76,428.91	81,80,15,957.49	83,43,76,276.64	5,80,10,63,802.18
		-	-	-	-	-	-	-	-	-	-
		3,04,30,944.45	3,13,43,872.78	3,22,84,188.97	3,32,52,714.64	3,42,50,296.08	3,52,77,804.96	3,63,36,139.11	3,74,26,223.28	3,85,49,009.98	3,97,05,480.28
		3,47,28,750.00	3,64,65,187.50	3,82,88,446.88	4,02,02,869.22	4,22,13,012.68	4,43,23,663.31	4,65,39,846.48	4,88,66,838.80	5,13,10,180.74	5,38,75,689.78
		29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00	29,25,00,000.00		-
		-	-	-	-	-	-	-	-	4,87,50,00,000.00	-
		35,76,59,694.45	36,03,09,060.28	36,30,72,635.84	36,59,55,583.86	36,89,63,308.76	37,21,01,468.27	37,53,75,985.59	37,87,93,062.08	4,96,48,59,190.72	9,35,81,170.06
		35,44,72,423.61	36,60,65,700.14	37,78,29,619.79	38,97,64,716.89	40,18,71,398.01	41,41,49,932.63	42,66,00,443.33	43,92,22,895.41	74,45,17,085.92	5,70,74,82,632.12
		86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	86,25,00,000.00	63,75,00,000.00	11,25,00,000.00			
		(50,80,27,576.39)	(49,64,34,299.86)	(48,46,70,380.21)	(47,27,35,283.11)	(46,06,28,601.99)	(22,33,50,067.37)	31,41,00,443.33	43,92,22,895.41	74,45,17,085.92	5,70,74,82,632.12
		(14,22,47,721.39)	(13,90,01,603.96)	(13,57,07,706.46)	(13,23,65,879.27)	(12,89,76,008.56)	(6,25,38,018.86)	8,79,48,124.13	12,29,82,410.71	20,84,64,784.06	1,59,80,95,136.99
		49,67,20,145.00	50,50,67,304.10	51,35,37,326.25	52,21,30,596.16	53,08,47,406.56	47,66,87,951.49	33,86,52,319.20	31,62,40,484.70	(4,33,89,47,698.14)	4,10,93,87,495.12
		0.50	0.43	0.38	0.33	0.28	0.25	0.21	0.19	0.16	0.14
		24,69,57,700.05	21,83,54,533.36	19,30,57,702.32	17,06,85,418.06	15,08,99,964.22	11,78,29,971.20	7,27,91,020.87	5,91,07,607.77	(70,52,00,303.54)	58,07,74,219.83

So let us go back to the excel sheet. So I hope everyone can see the excel sheet in front of you. So what we have on the top are the different years which start from year 0, year 1 and all the way till year 14 when the plant or the corporate would want to sell its business and we have divided the cash flows into three different sections. One is the first one is the revenue, the second one is the cost that would be incurred and final tax calculation and the NPV. So I have put in some tentative value to help us do this calculation faster. So the

first thing is the revenue and the majority of the revenue that we would this plant would see would come from these sale of electricity and for this the starting price of electricity as of today has been assumed to be 3 rupees and this is expected to increase at a rate of around 3% in the future.

So what we will do is we will have this factor being taken into account. So this would be into 0.3 not 3 but 2% increase per year. So we will have this electricity price increasing at 2% per year. So in the first year if the price was 3 rupees per kilowatt hour per unit this would increase to around 3.06 rupees per kilowatt hour and hence it would be increasing at a rate of 2% every consecutive year and by the end we reach the 14th year the price of electricity would be around 3 rupees 96 paisa or around 4 rupees. Now the second thing would be the electricity that is produced. So the electricity production was around 215 into 10 to power 6 kilowatt hour and this 100% capacity was reached third year onwards. For the second year we have assumed that almost 80% of this capacity would be reached and this is what I am putting it for the second year. So the second year around 172 into 10 to power 6 would be the number of units that would be produced and this remains constant at around 215 into 10 to power 6 units till the year 14.

And then in the revenue I have just multiplied the two factors which is the price of the electricity and the number of units being generated and this is something that you can see in here. So the generation would be 80% in the year 2 it becomes 100% in the year 3 and thereafter we can see there is an increase in the revenue because of the increase in the price of electricity which is increasing at a rate of 2% per year. Then another source of revenue for the company would be the bonds it would be selling. So in the first year it would be selling the bonds of around 487.5 cr. This is what I have taken into account in the year 0. Then again it would the plant at the end of the life would be sold at a salvage value of around 495 crores. So this is what you see in the year 14 happening. Let me repeat again there are going to be two more sources of income one will be the selling of the bonds for raising the capital and that is going to happen in the year 0. And then we are also going to get some value from the salvage value or selling of the plant after its useful life to the corporate and that would be around 495 crores and that happens at the last year which is 14th year.

If I talk about the total revenues this will be the sum of the three things which is the revenue from the electricity supply from the bonds that is primarily happening in the year 0 and the salvage value that is happening in the last year. So you can see we would have the income being generated we won't have an income in the second year and from third year when the electricity generation starts and this is how the revenue would increase and there is going to be a massive jump in the last year when we are selling the plant. Now when it comes to cost we would have the capital investment being spread out to three different year the first three years. So I have been investing around 225 crores in the year 1, 525 crores in the year 2 or like the year 1 in this case and then for the year 2 it would be 112.5 crores. Then the plant would also have the fixed cost and this fixed cost have been assumed to be around 2 crores 62 lakhs for the year 0 and then this is expected to increase at the rate of 3%. So let me put that again in here so we would have the cost occurring in at around 2 crores 62 lakhs for the year 0 and this would be increasing into at the rate of 3% and this continues till the last year. Then again we would have the variable cost that would start from the year 2 and this would be 3 crores and there would be again an increase in this and that yearly increment will be 5%. So I am assuming like it would be 3 crores at the year 2 and thereafter it increases at the rate of 5% and so let me increase that for the future years and this again continues till the last year which is the 14th year in this calculation and this is how it goes. Further we would also be paying an interest on the bonds that have been taken place and this interest would be 6%.

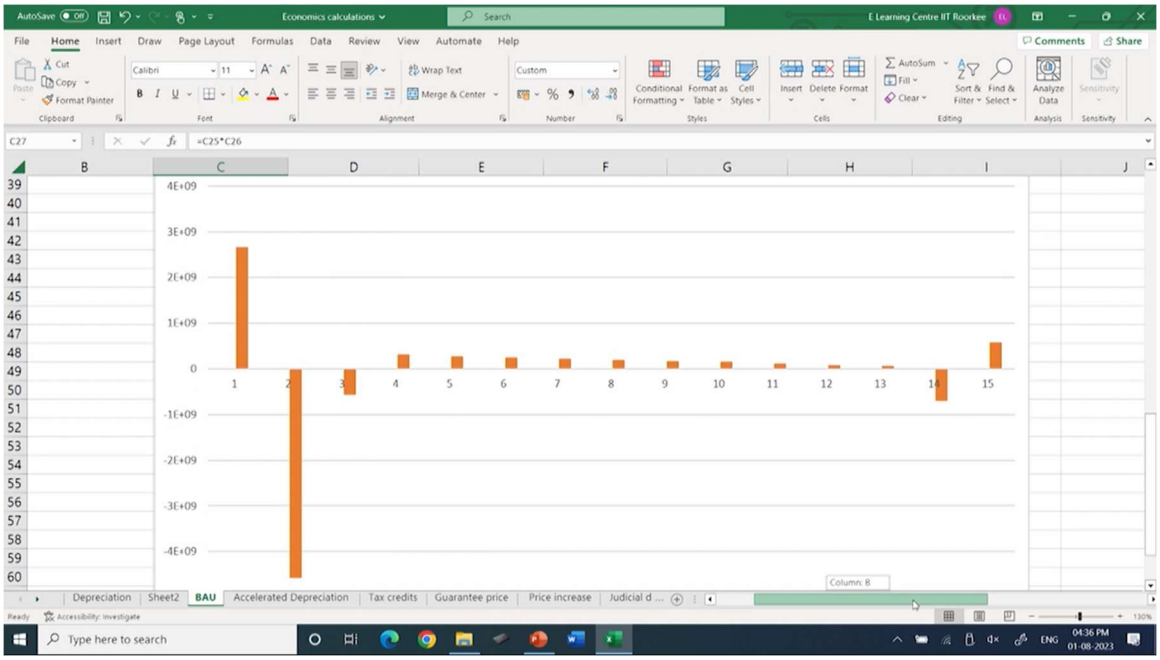
So what I will be doing is I know that and this is the bond that I have been selling and let me put in the dollar sign so that this cell does not change and I multiply that with 0.06 which is the interest that I would be paying on this bonds and this happens till the year I may be paying the bonds back or the year 13th. So year 13th is the year that I will be paying the bonds back and this payment I will be making till one year before that. So I will be taking 6% of the total amount from the bonds and I will be paying the interest for the years after which I have taken the bond and till one year before till which I have returned the bonds back which will be year 12th in this case and in 13th year I will be paying the same amount back which is 487.5 crores to the people from whom I have taken this money. So if I take the total cost for this particular project this would be the sum of like 5 different things which will be the capital investment which is happening

over the 3 years. The fixed cost which is happening throughout the lifespan the same with the variable cost that starts from the year 2 and then continues to last year. The interest on bond that begins from the year that I have taken sold the bonds in the market till the last year and finally the bond repayment that will be happening and I have assumed that that happens in the year one year minus the final year of the project and this is how my total cost would look like. Now I would want to calculate my pre-tax income. So the pre-tax income as we have discussed in the slides before as well would include the revenue from the electricity, the salvage value so these are the only sources of income that I will consider and then the cost that incurred in the form of the fixed cost, the variable cost and the interest on bonds.

So this will be my pre-tax income and let me take that for the next 14 years or so. Then comes the depreciation. Now depreciation we have discussed in the earlier sheet how that is calculated so I will just copy paste that depreciation for the calculation for which we have already done. So this is the depreciation that we have assumed based on the straight line methodology and this depreciation would be happening till the last year or like till the year that till the year 11th as you have calculated and then in this particular case I am not taking a tax credit this will come on in the future class we will be discussing the different kind of policy so I am not taking the tax credit in here and if I talk about the taxable income, the taxable income would be the total income minus the depreciation. So depreciation basically represents the spreading out of the capex for a period and this is the capex only put on by the company either through debt or the equity and I would subtract this depreciation from the total income and so this is my taxable income and let me just put in the graph to calculate the taxable income and that goes in till the last year or the year 14th and finally I will be paying a tax which would be at the rate of 28% of the whole and let us do this calculation as well.

So for the tax I have assumed that it will be the taxable income into 28% and subtract any tax credit so in this case there are no tax credit so the B22 row remains empty so it is basically 28% of the taxable income and so an interesting thing that we see here that the tax that we have calculated here comes out to be negative in the first or many of the years and this is basically because the plant is unable to generate any profit. So as I have told earlier in order to derive benefit from this the company needs to have other businesses

which are profit making so that this negative tax could be adjusted against the other areas where the company can save tax where it is liable to pay tax so this is important in case you are talking about a start up or a small entity which might not have other profit making entities so this tax credits or the tax might be able to be utilized in the future years depending on the tax policy of a particular country. Then coming to the cash flow the cash flow would be nothing but the revenue subtracting the cost subtracting the tax so we have the total revenue the total cost and the total tax so I have the revenue that is where I am making getting the money and I am spending the money in terms of cost and also in terms of tax so this is my total cash flow that is happening and this cash flow can be seen for the total of 14 years. Finally I would also want to put in the time value of money or the time equivalence of money and this is where I would have to put in a discount factor so I would be starting from the present year and taking my discount rate of 15 years I would be calculating the discount factor and this normal formula would be 1 divided by 1 plus the discount rate raised to the present year and this is what we have in the formula bar above and I will just carry on this calculation for the next 14 years again and finally we would want to calculate the discounted cash flows which would be nothing but the cash flow multiplied by the discount factor which is happening in here so it stays as such in the year 0 but as we proceed in the future we can see that the value of depreciating or the money is depreciating and it is almost equivalent to just 14% of the total money when it comes to the last year and if I talk about the total NPV which will be nothing but the sum of all these cash flows so the cash flow taking place from the year 0 till the last year which is the year 14 and the sum of the total would be the total NPV and you see that it's negative so whenever I am using a bracket this means the value comes out to be negative and we can see that this whole process is not very profit making it has a negative cash flows and with the present conditions the corporate might not want to go for it again we can see that the cash flow would be changing throughout with the years.



So if you see a graph this is how the cash flows would look like for the different years you would have a big positive in the first year that is when you will be selling the bonds then a big negative when the investment is occurring and then you would have some cash flows because of the generation they keep on reducing because of the time value of money any profit that you make in the future would have very less value in the present and as we can see because of the discount rate it becomes very less and then towards the last year you would have the bond repayment as well as a salvage value expenses being occurring so we can see that there's a lot of factors that would affect the profitability of the project and this is something we'll be discussing in in in the next class but for this class let us try to understand that these kind of calculations are very sensitive to a discount rate that we would have chosen so in this particular case if I were to choose a discount rate of around 5% rather than 15% so in this case I make an assumption that the company has installed such kind of plants in the past and has a good amount of experience and has a good amount of experience and like and also has knows that like this kind of plant would be profit making in the future it can go for a smaller discount rate and if I update the discounted to around 5% rather than 15% and also update and the discount factors we can say that before the same cash flows this plant now comes out to be profitable so this is making a having an NPV of around 5 crores and 51 lakhs and the company but would want to go for it so these are some of the things that would affect the

cash flows of a particular plant and these are some of the aspects that are very unlike a very interesting to study so in this particular class we have tried to understand some of the basics of cash flow diagrams and we'll be discussing the same example in the next class as well wherein we will try to understand the effect of certain policies which can help make a plant that is unprofitable at the onset to be profitable with the help of certain policies which might be controlled by the government or some of the assumptions that might be taken in by the private entity so with this we end today's class thank you.