Energy Resources, Economics, and Sustainability

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Week – 03

Lecture – 06

Lecture 16 - Wind Farm Financial Model-II

Hello everyone, welcome back to the course Energy Resources, Economics and Sustainability. In the last class, we have been discussing a financial model, wherein we tried to understand the cash flows for a hypothetical wind farm that was to be set up. We tried to estimate what would be the capex, how the capex will be distributed for a span of 3 years, how the revenue will be generated through a span of 12 years or so, and how the capital would be raised in terms of issuing bonds to the market at an interest rate of 6%, how the depreciation would be calculated and based upon all these factors, what will be the final cash flows and how do we estimate the net present value of the wind farm. We came to the conclusion that the wind farm in the present characteristics or the present assumptions that we took had a negative NPV or we can say that the business was not very profitable or lucrative to be undertaken by any corporate. And in today's class, we will try to understand are there some incentives that could be provided by the government or through the state which could help us in the introduction of or in the propagation or the penetration of renewable energy because at the onset, many projects which might be wind, might be related to hydrogen energy, solar energy might not seem profitable or might not be able to compete with the conventional fuels in terms of solar, natural gas, coal or oil because the industry has been there for a couple of centuries, the setup is there and the markets are quite used to like the operations of these kind of energy fuels in the past. So what we will do today is try to begin with the same model that we have created in the last class and try to analyse what are the different kinds of policy interventions or what could be the different ways in which profitability could be induced.

Further, we will also try to understand what will be the effect of certain environmental effect or certain effects that could be propagated by like by some of the delays that are caused in the plant, how would that affect the profitability of the plant in the long run. These are some of the things that we will try to focus in the present class. So let us first go back to the financial model that we have created in the earlier class. So, I will be sharing the excel file with you guys.

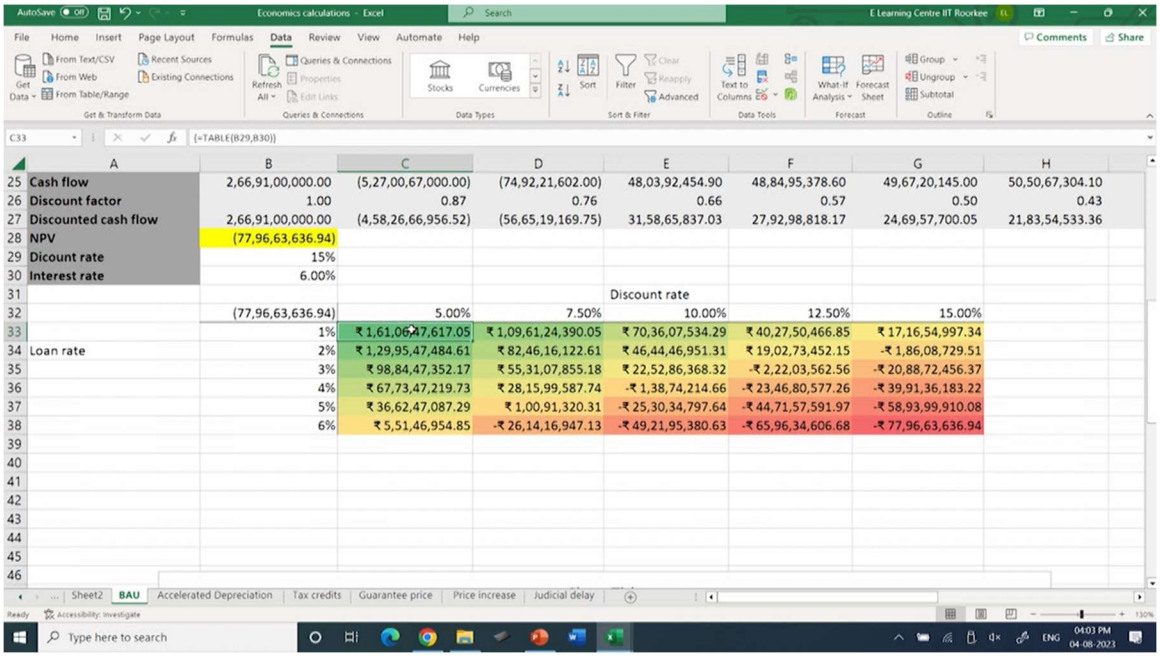
So what you see in front of you is the excel model for the typical wind farm that we have created, of course it's a hypothetical case but like this could help us understand some of the basic concepts. So just to a quick recap of the things that we have done, we have assumed the price of electricity to be 3, this is where the revenue will be generated and it is expected to increase at the rate of 2% every year. Then we have expected that the electricity production starts at the second year and this is where 80% of the electricity will be produced and then it will be running at 100% of the capacity from third year onwards. The revenue is just the multiplication of the two. For raising the capital, the corporate will be selling some bonds and then the plant would be sold at the end of 14th year which again will have a positive cash flow.

These are all the sources of revenue. In terms of cost, we will have the CAPEX being distributed for the first three years which we have assumed. Then we have assumed a certain fixed cost which would again be increasing at the rate of 3%, variable cost that starts from second year onwards when the plant comes into operation and then it is expected to increase at the rate of 5% per year. Further, the corporate would have to pay the interest on the bonds that it has issued for raising the capital and that goes at 6% and that goes on till the 12th year and on the 13th year, it will be returning the money back to the investors and a total of them will be giving us the total cost that is incurred by the entity. We have calculated the pre-tax income and then the depreciation is basically to take into account the distribution of CAPEX so as to calculate the taxable income.

This is the depreciation we have calculated and it is a straight line depreciation for the 10 years. It changes because the investment is made over a span of 3 years and accordingly there is a depreciation. We have calculated the taxable income which comes out to be

negative in many of the cases because the entity is not profit making. The tax is negative. The brackets I am using here basically reflects a negative cash flow.

So the taxes are negative in the sense that we are expecting that the corporate would have other verticals where it is having a profit generation and this negative tax is basically offsetting some of the tax that it would have been paying on the profit making businesses. Further, we have the total cash flows which will be discounted based upon the discount factor of around 15% which we have assumed and adding all the discounted cash flow gives us the NPV. Now let us try to understand the effect of two main things on the profitability.



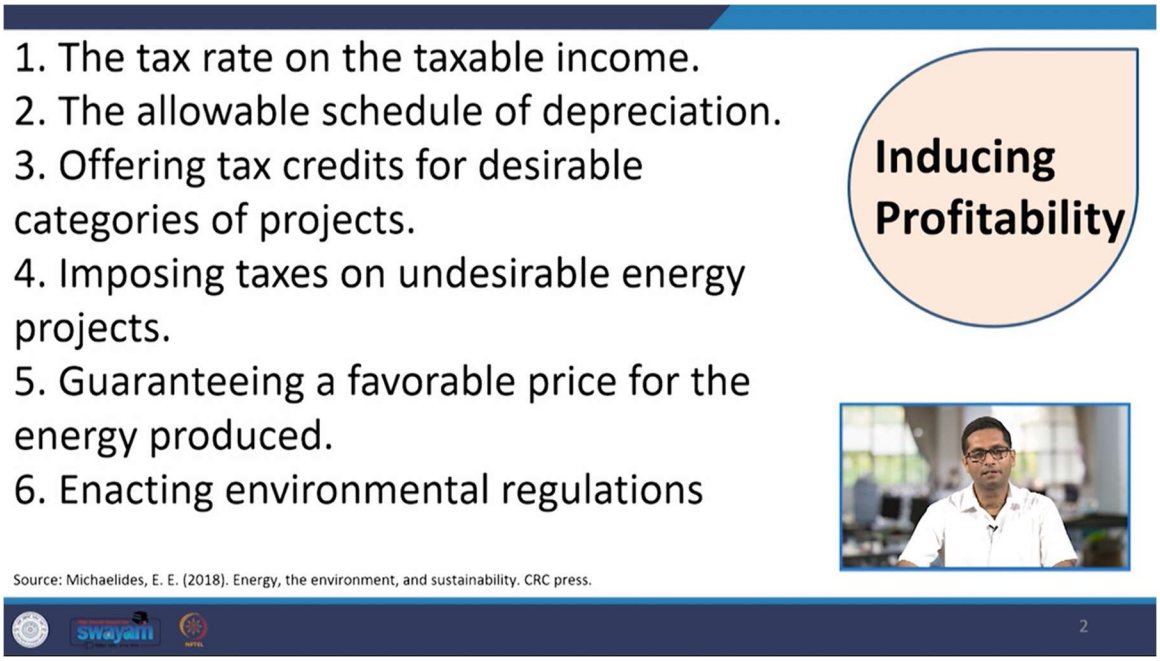
	A	B	C	D	E	F	G	H
25	Cash flow	2,66,91,00,000.00	(5,27,00,67,000.00)	(74,92,21,602.00)	48,03,92,454.90	48,84,95,378.60	49,67,20,145.00	50,50,67,304.10
26	Discount factor	1.00	0.87	0.76	0.66	0.57	0.50	0.43
27	Discounted cash flow	2,66,91,00,000.00	(4,58,26,66,956.52)	(56,65,19,169.75)	31,58,65,837.03	27,92,98,818.17	24,69,57,700.05	21,83,54,533.36
28	NPV	(77,96,63,636.94)						
29	Dicount rate	15%						
30	Interest rate	6.00%						
31					Discount rate			
32		(77,96,63,636.94)	5.00%	7.50%	10.00%	12.50%	15.00%	
33		1%	₹ 1,61,06,47,617.05	₹ 1,09,61,24,390.05	₹ 70,36,07,534.29	₹ 40,27,50,466.85	₹ 17,16,54,997.34	
34	Loan rate	2%	₹ 1,29,95,47,484.61	₹ 82,46,16,122.61	₹ 46,44,46,951.31	₹ 19,02,73,452.15	-₹ 1,86,08,729.51	
35		3%	₹ 98,84,47,352.17	₹ 55,31,07,855.18	₹ 22,52,86,368.32	-₹ 2,22,03,562.56	-₹ 20,88,72,456.37	
36		4%	₹ 67,73,47,219.73	₹ 28,15,99,587.74	-₹ 1,38,74,214.66	-₹ 23,46,80,577.26	-₹ 39,91,36,183.22	
37		5%	₹ 36,62,47,087.29	₹ 1,00,91,320.31	-₹ 25,30,34,797.64	-₹ 44,71,57,591.97	-₹ 58,93,99,910.08	
38		6%	₹ 5,51,46,954.85	-₹ 26,14,16,947.13	-₹ 49,21,95,380.63	-₹ 65,96,34,606.68	-₹ 77,96,63,636.94	

One is the discount rate that the entity has chosen that has been decided by the management of the entity based upon the past experience. So how sensitive are the results to the discounted that has been chosen? So, what I will do is I will make a pivot table wherein I have the different discount rates given here.

I am changing the discount rate from 5% to 15%. 5% would be a discounted in which the corporate is very positive about the plant. It has been operating such kind of plant in the past. It has a good amount of experience and it knows like what kind of problems can be coming in the future and how to deal with these problems. Then further there could also be a reduction in the interest rate at which the bonds are sold to the market. So, the

government might come up with certain policies in which it is giving the money to the corporates like this at a very small interest rate. So in this case I have assumed interest rate of 6% but I am varying it from 1 to 6%. In case like these kinds of projects are important to the nation as well as very good for reaching the net zero targets. The government would want to come up with some incentives in terms of availability of finance for setting up a plant like this. So what I have tried to do is make up a pivot table where I have on the x axis and this is the changing of the discount rate and the y axis I have the changing at the rate at which the interest is paid on the borrowed capital from the market. So this borrowed capital is basically used for putting up the capital investment at the onset of the plant. Here we have the final result and I have just made this in a function where the discount rate is linked to this particular cell which is 15% and the interest rate which I am paying in here is also linked to the 6% that I have in here. So what I will essentially do is I will select this table, go to the data tab, what if analysis is a data table, so my input row is basically this, 15% is the discount rate, column is the interest rate and I press ok and this is how the NPV would vary with the changing of the discount rate and the interest rate. So what you see here is the value for the case that we have already simulated or modelled. It is exactly the same for 15% of the discounted and 6% of the interest rate on the market capital I am getting a very negative NPV. If I keep on reducing the rate at which the bonds could be issued, if it is 1% and still the discounted remains 15% I would have to work at 1% and the total NPV starts to get a bit positive. The same could be sent at the other extreme as well. If I reduce the discount rate to 5% which means the corporate is very optimistic about this process and towards the end if I decrease it to 5% and the bonds are issued again at 6% I can achieve NPV which is positive and these are two ways in which the plant could be profitable. If both of these are applied together positively and we can see it could be even more profit making. So these kinds of sensitivities are often done by the management of the particular entity to see what could be the trade-offs or what could be the sensitivity of the project with respect to the different kinds of rates or the assumptions that could be made. So, this is just one way of understanding. So the more the green side we got the more the profit the entity is making, the more towards the red we can see the NPV comes out to be negative

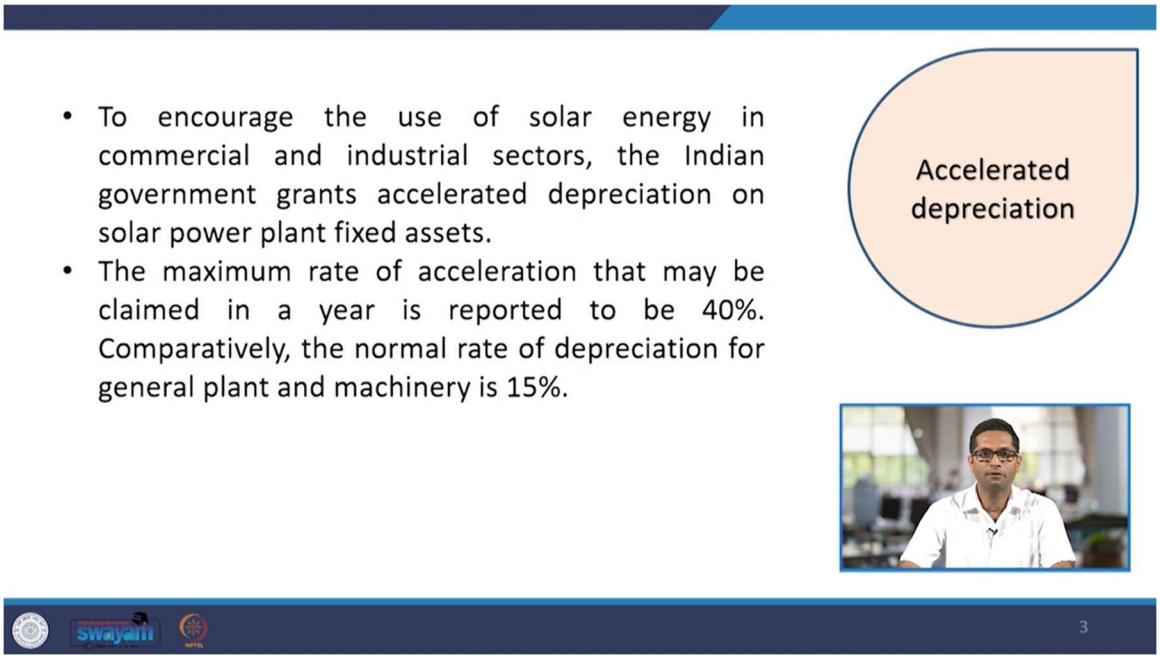
and it would not be profitable for the entity to undertake this particular project. Let us try to understand some other measures that might be undertaken.



So let us go back to the slides. So, there could be some of the policies or incentives that could be brought in by the government or the state. This could be the tax rate on the taxable income. The government might give in a tax concession. This tax concession can come in the form of an appreciated depreciation which means the depreciation of the CAPEX happens at a much faster rate and you can make use of it because any cost saving that you have in the years that are near to you would be much more than any cost saving that occurs maybe 15 years down the line. Then the government in the developed world normally also refers to some kind of credit called the tax credit which is normally a percentage of the total CAPEX that is invested. So, these tax credits could help the industry during the initial few years when it is making the capital investment to offset some of the taxes in its profit making businesses.

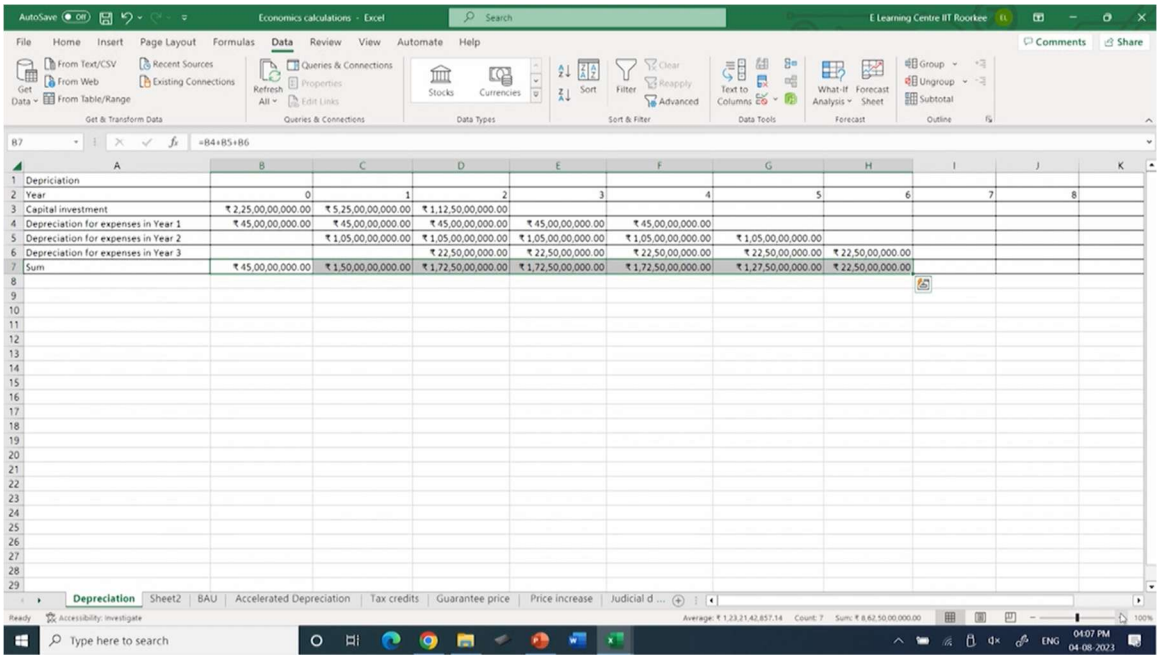
So that is one of the incentives that the state or the government can offer. Then there could be another way in which the government can impose taxes on the fuels which are not doing something good for the environment and in this case maybe the coal or the natural gas or the oil because these kind of fuels would eventually cause CO_2 emissions. The government would want to impose some kind of CO_2 tax on those kind of resources

so that they also become not very economically appealing and both the systems or both the energy production pathways can be seen at par. Another way could be the government can guarantee a favorable price for the energy that is produced from a green pathway the so called green pathway. In this case the government can subsidize some of the electricity that is produced or the government can put a price capping so that or the people could come up willfully and voluntarily to give up an excessive price for the green energy which can also happen. Then the government can also put in environmental regulations that basically prohibit for future setting of plants which have emissions which are not conducive for the environment. So in this case future plants which are relying on a technology that is not good for the environment might not be able to come up. So let us try to understand some of these like these of these methodologies and its effect on the business model for the wind farm that we have created.



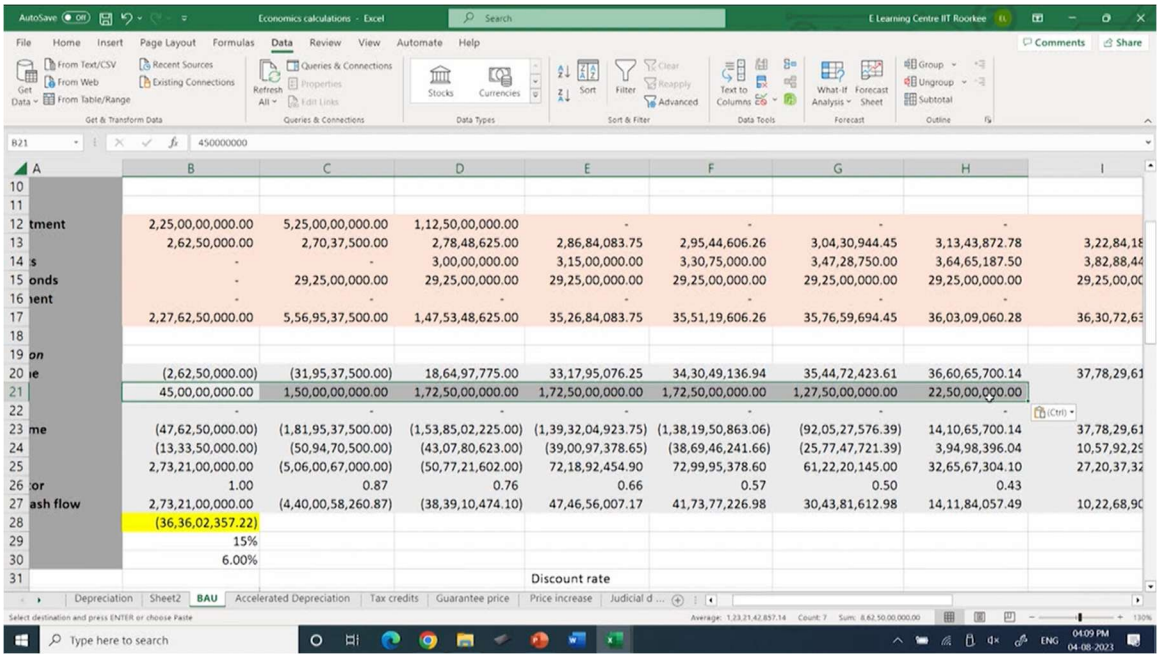
So the first thing that we can we will try to understand is accelerated depreciation. So, in this particular case we have taken in a straight-line depreciation that is happening for around 10 years. What if the government allows an appreciated depreciation for 5 years? What will be the effect on the cash flow? Let us try to understand that and also to understand like is that like is this normally adopted? Yes. In India normally comes up with a lot of accelerated depreciation for green energy assets. The particular case can be

taken as like one of the policies that came and gave in like an accelerated rate for depreciation for solar projects to be as high as 40%. So that their capital assets could be depreciated at very fast and the investor could make like make gains from the tax saving from this accelerated depreciation. Normally the normal rate of depreciation for normal plants is around 15%. So normally these kinds of guidelines are reported by the CERC which is the Central Electricity Regulatory Commission. And so let us go back to our final our original diagram in the form of Excel and let us try to understand the effect of accelerated depreciation. So going back to the Excel again.



This shows the depreciation that we have originally estimated in the form of 10 years and we have now updated it to 5 years. So, what I have done is like the investment was happening in the first 3 years. In the first year it was around 225 crores and 525 crores in the second year or the year one and then around 112.5 crores in the last year. So what I have divided it, I have divided it equally among the 5 trenches and divided it among the first 5 years. So this the first investment that was happening in the year 0 has been equally divided among the first 5 years. The investment that happened in the first year was equally divided among the consecutive 5 years divided by 5 and something similar happened for the next investment.

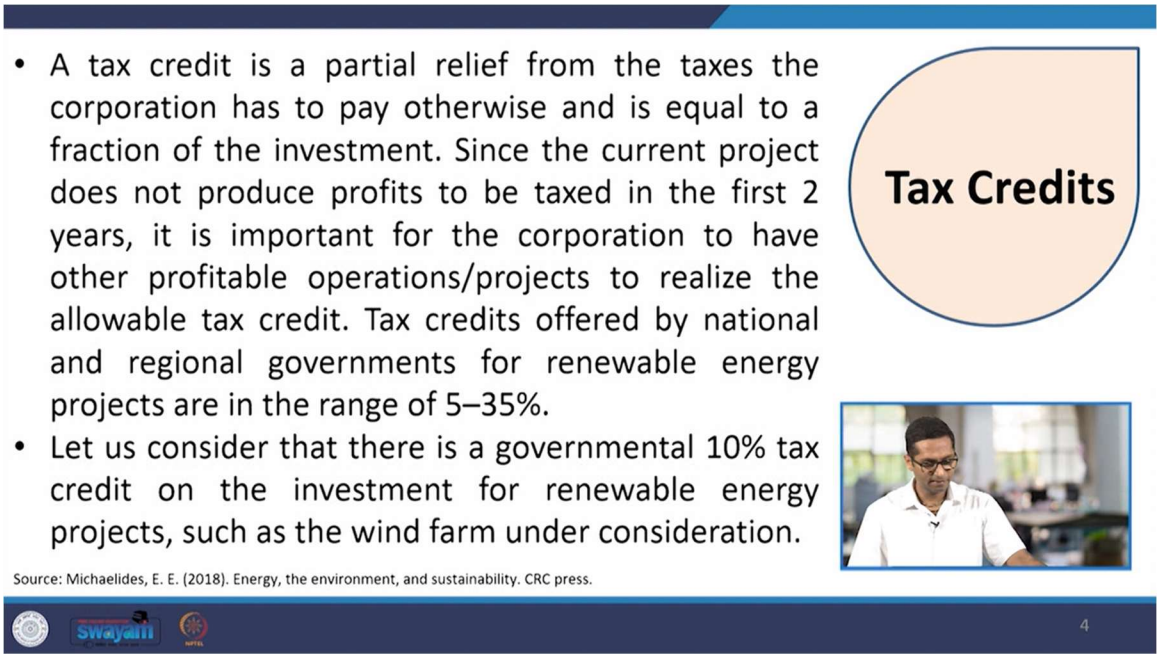
Adding that up gives me the total investment that is happening till the year 6. So we had this our case as for the business as usual and we had a depreciation that was straight line earlier and in which the depreciation was happening at a straight line for the 10 years. So you can see the depreciation continuing almost up till the 11th year. So let me replace that with an accelerated depreciation. So let me delete this and add in the values that I have calculated in here.



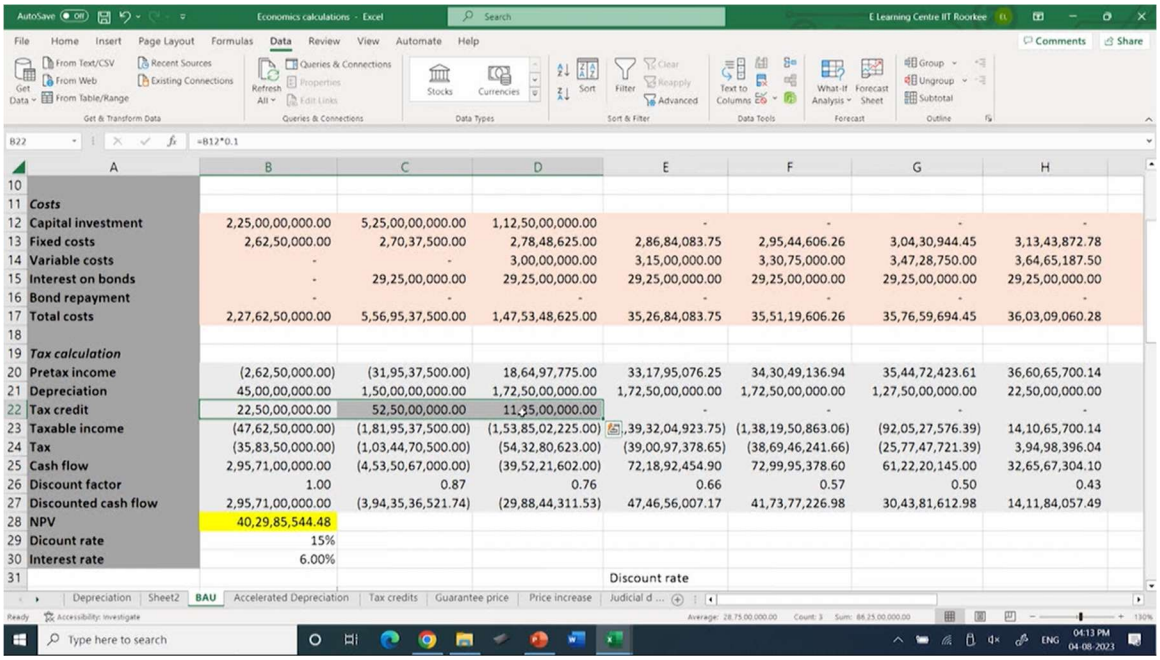
tment	2,25,00,00,000.00	5,25,00,00,000.00	1,12,50,00,000.00	-	-	-	-	
	2,62,50,000.00	2,70,37,500.00	2,78,48,625.00	2,86,84,083.75	2,95,44,606.26	3,04,30,944.45	3,13,43,872.78	3,22,84,18
s	-	-	3,00,00,000.00	3,15,00,000.00	3,30,75,000.00	3,47,28,750.00	3,64,65,187.50	3,82,88,44
onds	-	29,25,00,000.00	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	29,25,00,00
ent	-	-	-	-	-	-	-	
	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	36,30,72,63
on								
e	(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	37,78,29,61
	45,00,00,000.00	1,50,00,00,000.00	1,72,50,00,000.00	1,72,50,00,000.00	1,72,50,00,000.00	1,27,50,00,000.00	22,50,00,000.00	
	-	-	-	-	-	-	-	
me	(47,62,50,000.00)	(1,81,95,37,500.00)	(1,53,85,02,225.00)	(1,39,32,04,923.75)	(1,38,19,50,863.06)	(92,05,27,576.39)	14,10,65,700.14	37,78,29,61
	(13,33,50,000.00)	(50,94,70,500.00)	(43,07,80,623.00)	(39,00,97,378.65)	(38,69,46,241.66)	(25,77,47,721.39)	3,94,98,396.04	10,57,92,29
	2,73,21,000,000.00	(5,06,00,67,000.00)	(50,77,21,602.00)	72,18,92,454.90	72,99,95,378.60	61,22,20,145.00	32,65,67,304.10	27,20,37,32
or	1.00	0.87	0.76	0.66	0.57	0.50	0.43	
ash flow	2,73,21,000,000.00	(4,40,00,58,260.87)	(38,39,10,474.10)	47,46,56,007.17	41,73,77,226.98	30,43,81,612.98	14,11,84,057.49	10,22,68,90
	(36,36,02,357.22)							
	15%							
	6.00%							
				Discount rate				

So you can see the depreciation now happens only till the year 6 and the effect now has been that the NPV which was around say – 77000 Cr has now reduced to around – 36 Cr. So it has become slightly better as compared to the earlier case but the bracket shows the plant is still negative. So the one thing we need to understand is that accelerated depreciation does have a significant effect on the cash flows. The reason being because of discount factor because earlier these costs were being incurred later in the life and so any cost that is incurred later in the life because of discount factor becomes very less. So any cost in the present year has the value equal to 1 and whereas if you go to the last years the value becomes multiplied by a factor of 0.14. So that drastically reduces the value of a particular incentive. So it is better to get incentives earlier on the life of the plant so as to make maximum gains. So what we understood was like accelerated depreciation does have a significant effect and that is one of the reasons why government would want to

propagate that companies or entities to come up with the accelerated depreciation so as they make a maximum amount of profit that is possible. So let us try to understand some more of the effects going back to the slides.

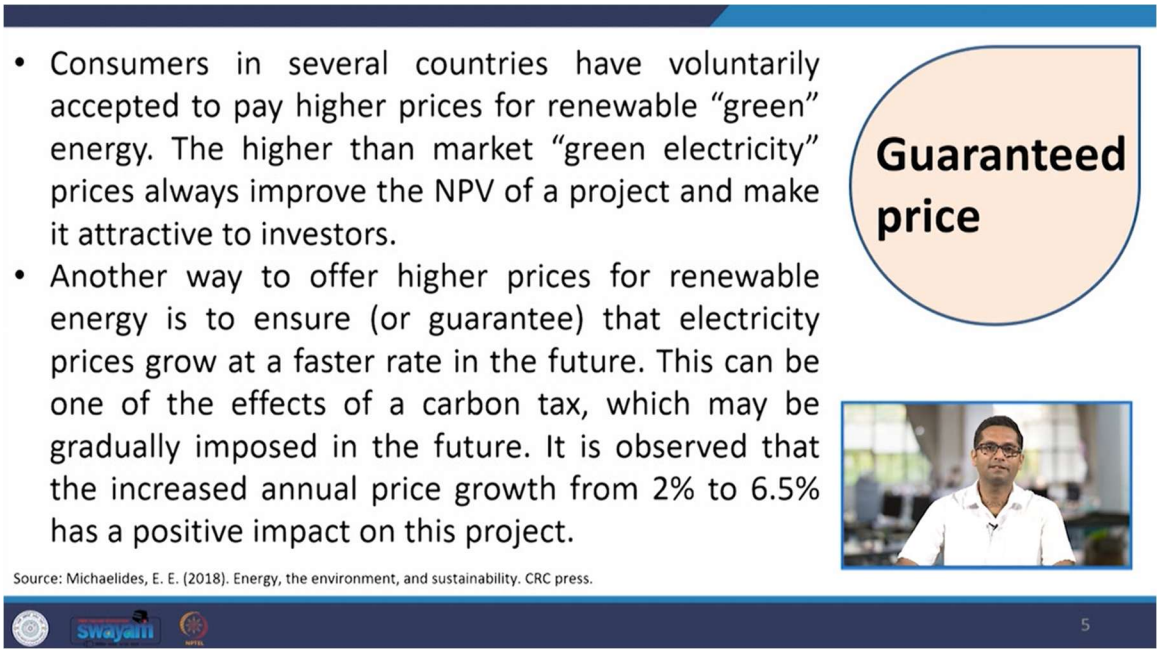


Another thing the government can do is give some kind of tax credits and this kind of policy is quite normal in the developed world where the governments would want to give some kind of tax credit in the form of the percentage of the capital that is invested. So what happens in this case is that government would give a certain percentage which could vary from 5 to 30% of the total capital investment for a particular year and that credit is something and the entity could subtract in terms of the tax that it pays on its profit making businesses. Again I would like to repeat here for these kinds of incentive to take place along with the accelerated depreciation the entity must have some kind of profit making businesses where it is liable to pay taxes. In case the entity does not have any other business lines where it is making profit it might happen that such kind of incentives are delayed to the later part of the delayed by a few years where they might not appear to be very lucrative. So let us go back again and try to understand the effect of tax credits. So in this case what we will try to will assume that the government is issuing around 10% of the tax credit for the investment that is made during the setting up of the wind plant.



	A	B	C	D	E	F	G	H
10								
11	*Costs*							
12	Capital investment	2,25,00,00,000.00	5,25,00,00,000.00	1,12,50,00,000.00	-	-	-	-
13	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
14	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
15	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
16	Bond repayment	-	-	-	-	-	-	-
17	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
18								
19	*Tax calculation*							
20	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
21	Depreciation	45,00,00,000.00	1,50,00,00,000.00	1,72,50,00,000.00	1,72,50,00,000.00	1,72,50,00,000.00	1,27,50,00,000.00	22,50,00,000.00
22	Tax credit	22,50,00,000.00	52,50,00,000.00	11,35,00,000.00	-	-	-	-
23	Taxable income	(47,62,50,000.00)	(1,81,95,37,500.00)	(1,53,85,02,225.00)	,39,32,04,923.75)	(1,38,19,50,863.06)	(92,05,27,576.39)	14,10,65,700.14
24	Tax	(35,83,50,000.00)	(1,03,44,70,500.00)	(54,32,80,623.00)	(39,00,97,378.65)	(38,69,46,241.66)	(25,77,47,721.39)	3,94,98,396.04
25	Cash flow	2,95,71,00,000.00	(4,53,50,67,000.00)	(39,52,21,602.00)	72,18,92,454.90	72,99,95,378.60	61,22,20,145.00	32,65,67,304.10
26	Discount factor	1.00	0.87	0.76	0.66	0.57	0.50	0.43
27	Discounted cash flow	2,95,71,00,000.00	(3,94,35,36,521.74)	(29,88,44,311.53)	47,46,56,007.17	41,73,77,226.98	30,43,81,612.98	14,11,84,057.49
28	NPV	40,29,85,544.48						
29	Dicount rate	15%						
30	Interest rate	6.00%						
31					Discount rate			

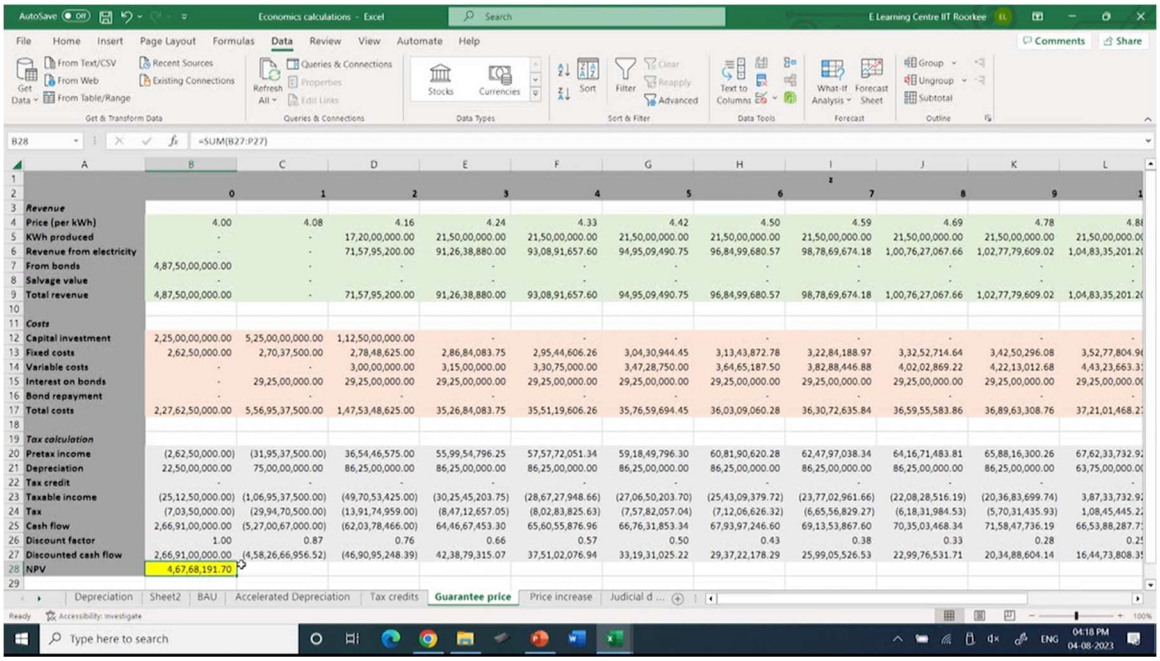
So returning to the excel sheet we see that like the plant is still negative and what will induce is we will take around the tax credit in here so we have a column which is empty and we will say equal to around 10% of the capital that is invested and we do that for the first three years when the capital investment is taking place. So what we see here is now the plant all of a sudden has now as a positive NPV and this NPV comes around to be around 40s here and this means that the entity would might want to now take further with this case where they are now expected to make a net profit at the end of 14 years of the plant and we can attribute this profit making to two basic policies one is the accelerated depreciation that is again inbuilt into this and plus a tax credit. So what is happening here is I am inputting around 10% of the tax credit and this is the percentage of the capital that is invested and this tax credit is added to the tax that the entity pays and I am using a negative sign so which means it is able to make avoid a good amount of tax in some of the profit making businesses. Overall because of the incentive that has been made the plant appears now to be positive and because these kinds of tax credit are awarded earlier in the life of the plant where the discount factors does not have a very significant effect on the cash flows and the corporate can make a good advantage of this tax credit and this is a normal practice in many of the countries where they would want to award certain kind of tax credits in order for the entity to make to help make a plant profitable.



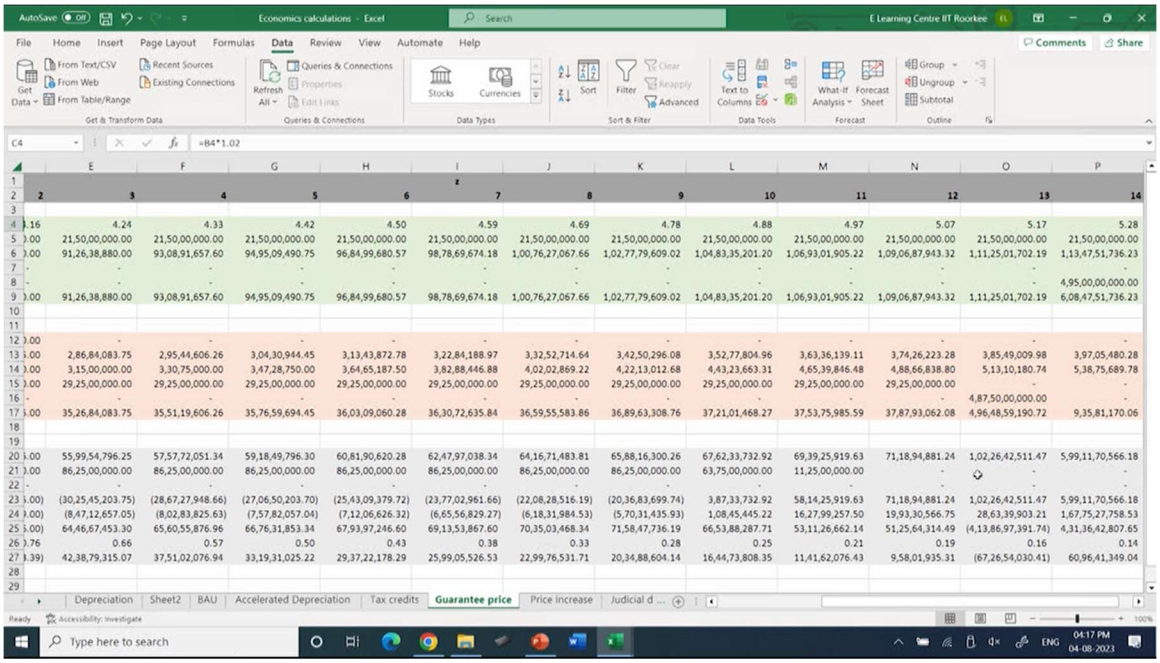
And let us go back to the slides apart from that there could be certain policies by the government in which it might want to give in a guaranteed price to be paid for the production of clean or greener power and in this case this could be this wind energy farm wherein the government might want to give and say if the normal electricity is available at 3 rupees a unit or 3 rupees a kilowatt hour might be the greener electricity the government would want to give at around 4 rupees per kilowatt hour and again the people knowing that going towards clean and green energy is important might be willing to pay for it. Such kinds of things are quite known to work in the developed part of the world where like people are affluent and they don't mind paying something extra the incentivization of green electricity in a country like India is sometimes question because like many like we have a lot lot amount of energy poor people and increasing the energy rate for them might not be taken as a positive step but the affluent part of the society can always opt for it.

Another methodology that can be adopted on the similar terms is like in the original case we have assumed that the electricity price would be growing at a rate of around 2% per year. What if I increase the rate at which the prices would grow? It would have a similar effect as increasing the price but the advantage is that the base case for the present year remains the same the only thing is in the future the electricity prices would be growing at a much faster rate and all both the things can help us achieve a target like of making the

plants which are based on green energy to be profitable and so that more such plants come up in the future which can help in negating the negative effects of the power plants or electricity production that comes traditionally from coal, natural gas or oil. So let us try to understand the effect of an increased price of the electricity as well as an increased rate at which the electricity prices might increase in the future.



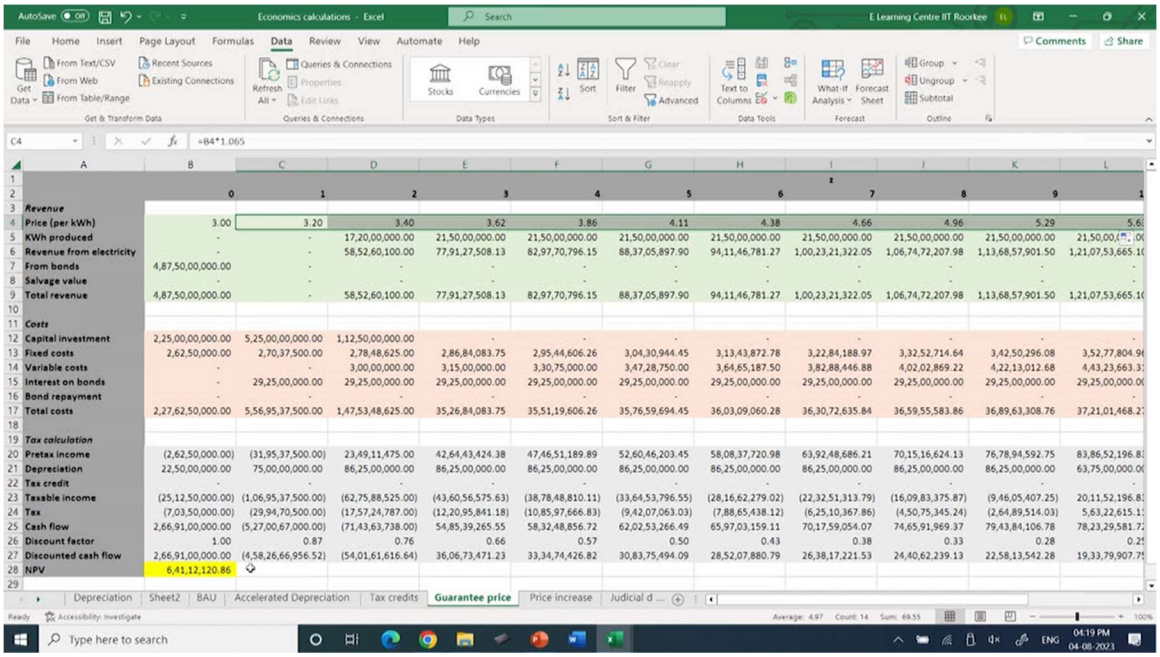
	A	B	C	D	E	F	G	H	I	J	K	L
2		0	1	2	3	4	5	6	7	8	9	1
3	*Revenue*											
4	Price (per kWh)	4.00	4.08	4.16	4.24	4.33	4.42	4.50	4.59	4.69	4.78	4.8
5	KWh produced	-	-	17,20,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.0
6	Revenue from electricity	-	-	71,57,95,200.00	91,26,38,880.00	93,08,91,657.60	94,95,09,490.75	96,84,99,680.57	98,78,69,674.18	1,00,76,27,067.66	1,02,77,79,609.02	1,04,83,35,201.2
7	From bonds	4,87,50,00,000.00	-	-	-	-	-	-	-	-	-	-
8	Salvage value	-	-	-	-	-	-	-	-	-	-	-
9	Total revenue	4,87,50,00,000.00	-	71,57,95,200.00	91,26,38,880.00	93,08,91,657.60	94,95,09,490.75	96,84,99,680.57	98,78,69,674.18	1,00,76,27,067.66	1,02,77,79,609.02	1,04,83,35,201.2
10												
11	*Costs*											
12	Capital investment	2,25,00,00,000.00	5,25,00,00,000.00	1,12,50,00,000.00	-	-	-	-	-	-	-	-
13	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	3,42,50,296.08	3,52,77,804.9
14	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	4,22,13,012.68	4,43,23,663.3
15	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	29,25,00,000.00	29,25,00,000.0
16	Bond repayment	-	-	-	-	-	-	-	-	-	-	-
17	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	36,89,63,308.76	37,21,01,468.2
18												
19	*Tax calculation*											
20	Pretax income	(2,62,50,000.00)	(31,95,37,500.00)	36,54,46,575.00	55,99,54,796.25	57,57,72,051.34	59,18,49,796.30	60,81,90,620.28	62,47,97,038.34	64,16,71,483.81	65,88,16,300.26	67,62,33,732.9
21	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	86,25,00,000.00	63,75,00,000.0
22	Tax credit	-	-	-	-	-	-	-	-	-	-	-
23	Taxable income	(25,12,50,000.00)	(1,06,95,37,500.00)	(49,70,53,425.00)	(30,25,45,203.75)	(28,67,27,948.66)	(27,06,50,203.70)	(25,43,09,379.72)	(23,77,02,961.66)	(22,08,28,516.19)	(20,36,83,699.74)	3,87,33,732.9
24	Tax	(7,03,50,000.00)	(29,94,70,500.00)	(13,91,74,959.00)	(8,47,12,657.05)	(8,02,83,825.63)	(7,57,82,057.04)	(7,12,06,626.32)	(6,65,56,829.27)	(6,18,31,984.53)	(5,70,31,435.93)	1,08,45,445.2
25	Cash flow	2,66,91,00,000.00	(5,27,00,67,000.00)	(62,03,78,466.00)	64,46,67,453.30	65,60,55,876.96	66,76,31,853.34	67,93,97,246.60	69,13,53,867.60	70,35,03,468.34	71,58,47,736.19	66,53,88,287.7
26	Discount factor	1.00	0.87	0.76	0.66	0.57	0.50	0.43	0.38	0.33	0.28	0.2
27	Discounted cash flow	2,66,91,00,000.00	(4,58,26,66,956.52)	(46,90,95,248.39)	42,38,79,315.07	37,51,02,076.94	33,19,31,025.22	29,37,22,178.29	25,99,05,526.53	22,99,76,531.71	20,34,88,604.14	16,44,73,808.3
28	NPV	4,67,68,191.70										
29												

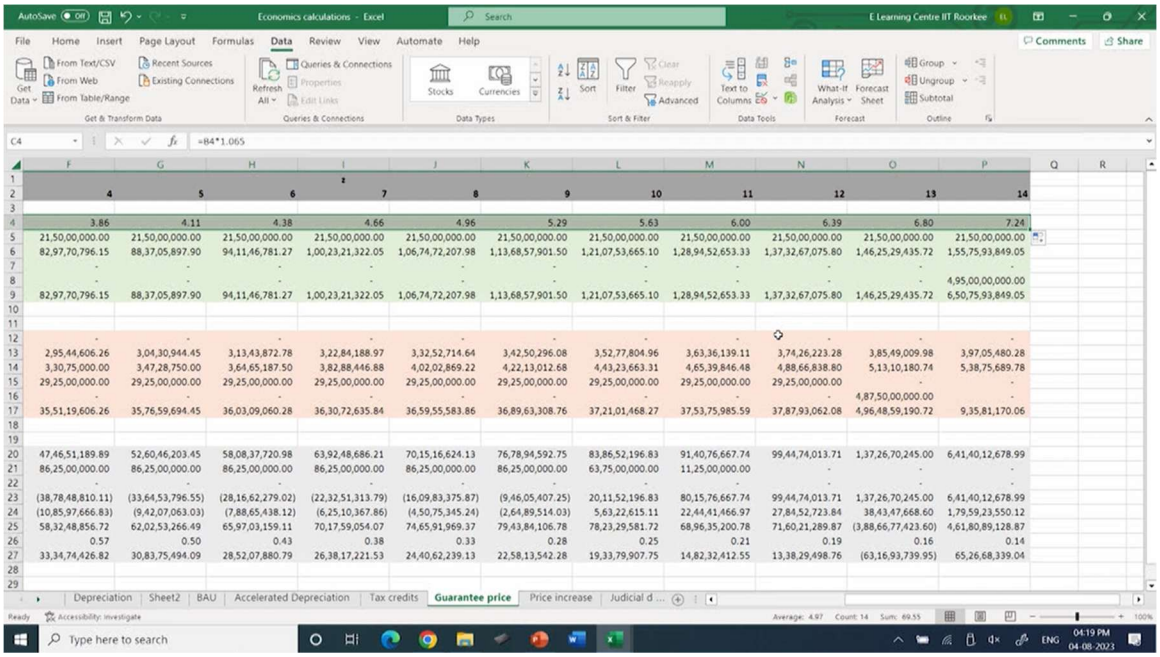


	E	F	G	H	I	J	K	L	M	N	O	P
2	3	4	5	6	7	8	9	10	11	12	13	14
4	4.24	4.33	4.42	4.50	4.59	4.69	4.78	4.88	4.97	5.07	5.17	5.28
5	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00	21,50,00,000.00
6	91,26,38,880.00	93,08,91,657.60	94,95,09,490.75	96,84,99,680.57	98,78,69,674.18	1,00,76,27,067.66	1,02,77,79,609.02	1,04,83,35,201.20	1,06,93,01,905.22	1,09,06,87,943.32	1,11,25,01,702.19	1,13,47,51,736.23
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	4,95,00,00,000.00
9	91,26,38,880.00	93,08,91,657.60	94,95,09,490.75	96,84,99,680.57	98,78,69,674.18	1,00,76,27,067.66	1,02,77,79,609.02	1,04,83,35,201.20	1,06,93,01,905.22	1,09,06,87,943.32	1,11,25,01,702.19	6,08,47,51,736.23
10												
11												
12	-	-	-	-	-	-	-	-	-	-	-	-
13	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	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
14	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	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
15	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	29,25,00,000.00	29,25,00,000.00	-	-
16	-	-	-	-	-	-	-	-	-	-	4,87,50,00,000.00	-
17	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	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
18												
19												
20	55,99,54,796.25	57,57,72,051.34	59,18,49,796.30	60,81,90,620.28	62,47,97,038.34	64,16,71,483.81	65,88,16,300.26	67,62,33,732.92	69,39,25,919.63	71,18,94,881.24	1,02,26,42,511.47	5,99,11,70,566.18
21	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	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	(30,25,45,203.75)	(28,67,27,948.66)	(27,06,50,203.70)	(25,43,09,379.72)	(23,77,02,961.66)	(22,08,28,516.19)	(20,36,83,699.74)	3,87,33,732.92	58,14,25,919.63	71,18,94,881.24	1,02,26,42,511.47	5,99,11,70,566.18
24	(8,47,12,657.05)	(8,02,83,825.63)	(7,57,82,057.04)	(7,12,06,626.32)	(6,65,56,829.27)	(6,18,31,984.53)	(5,70,31,435.93)	1,08,45,445.22	16,27,99,257.50	19,93,30,566.75	28,63,39,903.21	1,67,75,27,758.53
25	64,46,67,453.30	65,60,55,876.96	66,76,31,853.34	67,93,97,246.60	69,13,53,867.60	70,35,03,468.34	71,58,47,736.19	66,53,88,287.71	53,11,26,662.14	51,25,64,314.49	(4,13,86,97,391.74)	4,31,36,42,807.65
26	0.66	0.57	0.50	0.43	0.38	0.33	0.28	0.25	0.21	0.19	0.16	0.14
27	42,38,79,315.07	37,51,02,076.94	33,19,31,025.22	29,37,22,178.29	25,99,05,526.53	22,99,76,531.71	20,34,88,604.14	16,44,73,808.35	11,41,62,076.43	9,58,01,935.31	(67,26,54,030.41)	60,96,41,349.04
28												
29												

So going back to the excel sheet again so we have the same excel sheet back so let us go back and say that like we don't have any accelerated depreciation in this case and we also don't have a tax credit. So let us go to a sheet where we can see that the prices start from Rs 4 a kilowatt hour and that they are increasing at the rate of 2% every year.

So in the earlier case in the business as usual which you can see the prices start at Rs 3 and then they increase all the way to around Rs 4 at the end of 14th year. Whereas in this case what I am going to assume is that the price starts at Rs 4 it increases at the rate of 2% per year so the rate of increase remains the same and they end up at around Rs 5.3 at the end of 14 years. And if this was the assumption and if people are willing to pay a 30% premium on the electricity that is generated by a green and a green source we can again see that the net present value of the plant comes out to be positive with an NPV of around 4 CR and this is again an like like an indicator to the industry or the corporate to set up a plant like this. But again the people are willing to pay an extra price in this case and to repeat again in this case we don't have a government incentive in the form of accelerated depreciation or tax credits so we don't see we have the normal depreciation that is happening for around 11 years and there is no tax credit which you can see in the sheet in front of you.





	4	5	6	7	8	9	10	11	12	13	14
	3.86	4.11	4.38	4.66	4.96	5.29	5.63	6.00	6.39	6.80	7.24
	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	21,50,00,000.00
	82,97,70,796.15	88,37,05,897.90	94,11,46,781.27	1,00,23,21,322.05	1,06,74,72,207.98	1,13,68,57,901.50	1,21,07,53,665.10	1,28,94,52,653.33	1,37,32,67,075.80	1,46,25,29,435.72	1,55,75,93,849.05
	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	4,95,00,00,000.00
	82,97,70,796.15	88,37,05,897.90	94,11,46,781.27	1,00,23,21,322.05	1,06,74,72,207.98	1,13,68,57,901.50	1,21,07,53,665.10	1,28,94,52,653.33	1,37,32,67,075.80	1,46,25,29,435.72	6,50,75,93,849.05
	-	-	-	-	-	-	-	-	-	-	-
	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	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
	3,30,75,000.00	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	29,25,00,000.00	-	-
	-	-	-	-	-	-	-	-	-	4,87,50,00,000.00	-
	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	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
	47,46,51,189.89	52,60,46,203.45	58,08,37,720.98	63,92,48,686.21	70,15,16,624.13	76,78,94,592.75	83,86,52,196.83	91,40,76,667.74	99,44,74,013.71	1,37,26,70,245.00	6,41,40,12,678.99
	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	-	-	-
	-	-	-	-	-	-	-	-	-	-	-
	(38,78,48,810.11)	(33,64,53,796.55)	(28,16,62,279.02)	(22,32,51,313.79)	(16,09,83,375.87)	(9,46,05,407.25)	20,11,52,196.83	80,15,76,667.74	99,44,74,013.71	1,37,26,70,245.00	6,41,40,12,678.99
	(10,85,97,666.83)	(9,42,07,063.03)	(7,88,65,438.12)	(6,25,10,367.86)	(4,50,75,345.24)	(2,64,89,514.03)	5,63,22,615.11	22,44,41,466.97	27,84,52,723.84	38,43,47,668.60	1,79,59,23,550.12
	58,32,48,856.72	62,02,53,266.49	65,97,03,159.11	70,17,59,054.07	74,65,91,969.37	79,43,84,106.78	78,23,29,581.72	68,96,35,200.78	71,60,21,289.87	(3,88,66,77,423.60)	4,61,80,89,128.87
	0.57	0.50	0.43	0.38	0.33	0.28	0.25	0.21	0.19	0.16	0.14
	33,34,74,426.82	30,83,75,494.09	28,52,07,880.79	26,38,17,221.53	24,40,62,239.13	22,58,13,542.28	19,33,79,907.75	14,82,32,412.55	13,38,29,498.76	(63,16,93,739.95)	65,26,68,339.04

Further And there could be we can revert back to an electricity price of Rs 3 which makes the NPV again negative to around – 77 CR but what we can do is maybe the electricity prices are now increasing at the rate of 6.5% per year. So in this case I have now increased the rate at which the electricity prices would be increasing so if it's 3 rupees today maybe down 1 year it would be 3.2 rupees and if I do the same analysis whereas at the end of the 14th year the electricity prices rise to as high as 7.24 rupees which has more than doubled at the end of 14 years which was not the case in the earlier ones we see that the plant again can have a positive NPV with around 6 CR of the price but again to mind you in this case the electricity prices are increasing at a much faster rate and I would also like to point out like such kind of policies might not be very appreciated in a country like India because a lot of people are not very affluent where they can pay extra prices for the energy further these prices of energy would also reflect in the business and the price of commodities that we see in the market.

So this can also lead to a high inflation rates and the government would be very careful while adopting a policy like this but these kinds of incentives can help in making the plants which are based on green energy to be lucrative to be taken up by corporates.

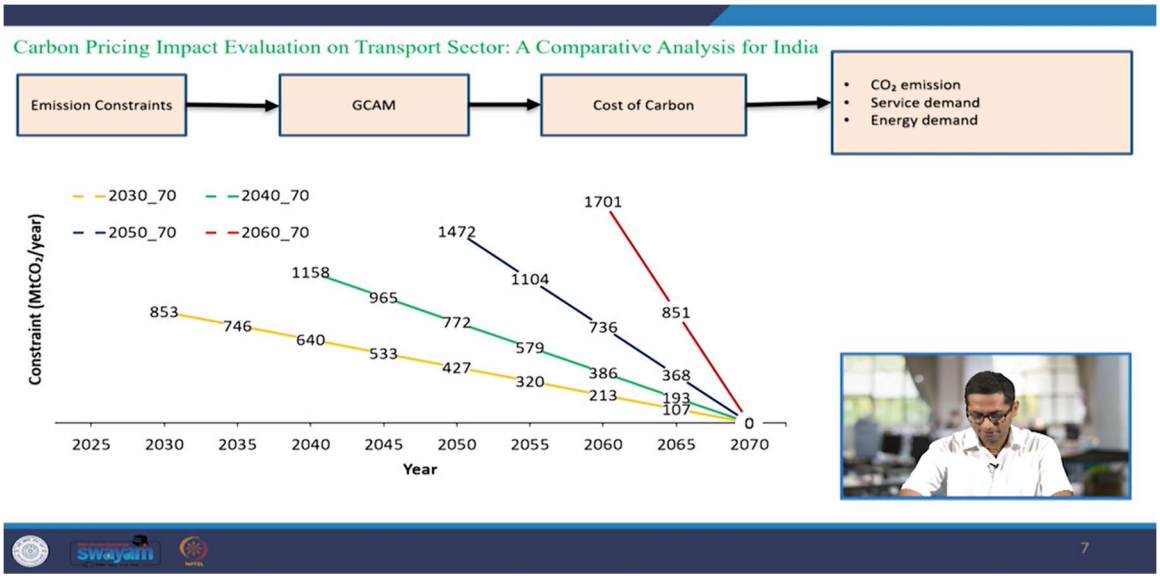
- The regulatory environment, which is largely controlled by central, regional, and local governments, may also impose incentives and disincentives to energy projects.
- An obvious disincentive is the taxation of alternative energy activities or by-products, such as the imposition of a disposal fee on nuclear and biomass waste products.
- A disincentive that seldom comes to the attention of the public is a prolonged delay in the commencement of an energy project.
- This delays the development of the project and the realization of the project revenue.
- A common cause of such delays is a lawsuit related to real or perceived environmental or ecological effects and local judicial decisions that delay the energy projects.

Regulatory disincentive

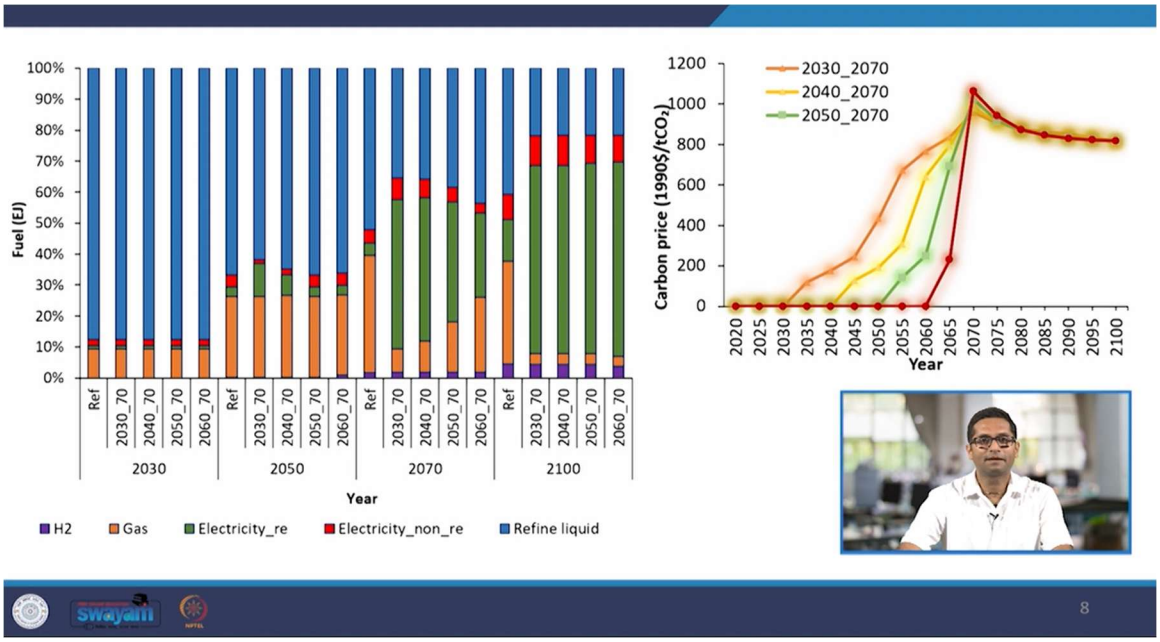
Source: Michaelides, E. E. (2018). Energy, the environment, and sustainability. CRC press.

Now let us also try to understand some other features so going back to the slides. Now further the government can issue some kinds of incentives or disincentives to the fossil fuel industry so as to make a competition or these kinds of incentives could be like the land could be available at very cheap rates or on the other front the government want to like put a disincentive on the traditional energy industry by putting on in a carbon tax wherein they have to pay certain amount of money for each molecule of CO2 or carbon that they release into the atmosphere. So by the imposition of these incentives or these disincentives the aim is to bring both the technologies at par because naturally the fossil fuel industry benefits from a very well set up supply chain and very well set up market mechanisms and these mechanisms are yet coming up in the case of renewable energy. So, to bring a level playing field for the renewable energy the governments or the state would want to put in certain incentives and disincentives.

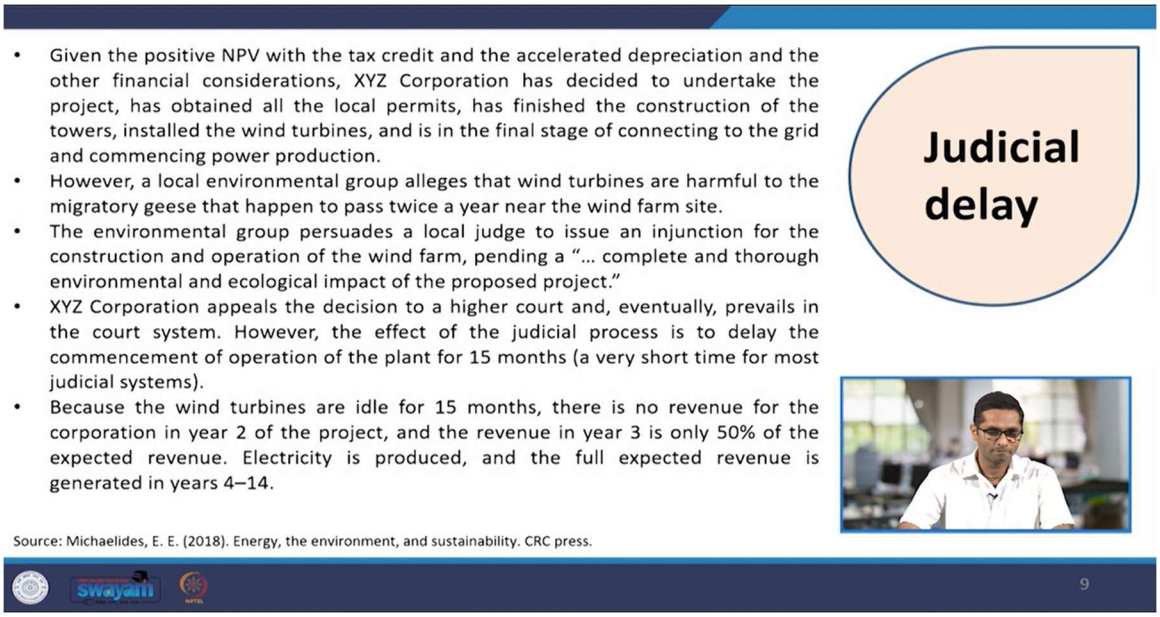
In this case is like there could also be coming in of certain policies incomes or in terms of certain lawsuits where there could be like people who are lobbying against the installation of certain kind of plants most fossil and non-fossil goods and we will try to understand the effect of those. But before that let us try to understand a simple study that we did and where we try to put in the emissions pricing or the carbon pricing on the transportation sector in India.



So we used a simple tool called GCAM and we went by the current target of net zero that is have been announced by the country of 2070. So if we would have to make the transportation sector which is one of the largest sectors or a consuming energy to be net zero by 2070 and that has to be done with the imposition of carbon tax and that this is the policy alone that we are putting in and we know what are the present emissions. So we started in thinking from the year 2030 and all the way to 2070 and we are also knowing what are the emissions from the transportation sector at that particular end and we want the emissions to be reducing linearly from that particular year. So what we wanted to see if we start a carbon tax maybe from 2030 what would be the carbon price that would have been imposed. And similarly, if I would be starting from the year 2065 that is just 5 years before the net zero what would be the carbon tax that would have to be imposed.

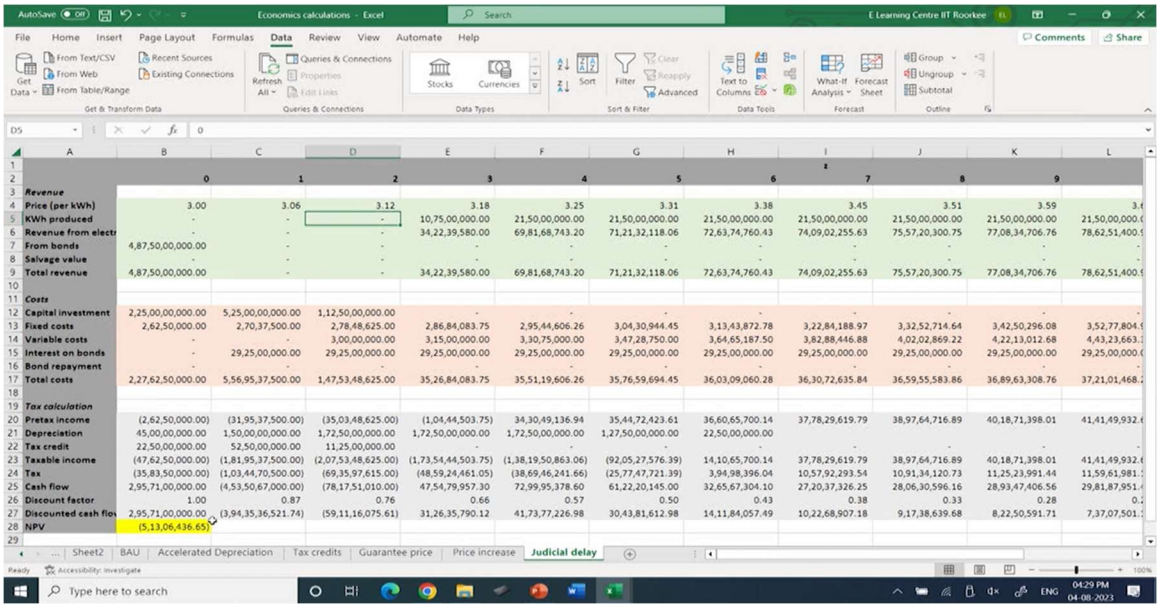


And we found that the earlier that we start the better because the later we start the carbon tax tends to be much more. So now the people have been arguing that people 15 or 20 years down the line might be much more affluent and they might want to pay more carbon tax. So that is the thinking in delaying of the carbon taxes but the study that we did brings out that we might want to start early because there are certain hard to abate sectors in the transportation sector like the aviation sector as well as the marine sector which would call for a very high carbon price if it has to be net zero by the year 2070. Further we see that the start date of the carbon price would also have an effect on the penetration of the different new technologies like the EVs or the hydrogen vehicles. The penetration would be different of all the dates we would start with the carbon pricing. So this was just an example like of the different scenarios that policymakers would want to create to understand the effect of different policies and carbon policies one of them.



Now let us try to understand the effect of certain judicial delays which is quite common in the energy sector and what would be the effect of such kind of delays on the overall profitability of the plant. So let us go back to the same example of the wind farm which we want to set up and now there comes an environmental firm who has an objection to setting up of the wind plant given that in the area in which the wind farm was being set up we experience a lot of migratory birds coming in and then going during some particular seasons and it might happen that there would be bird hits by the or the birds

hitting the wind farms and there would be a life there will be a loss of the avian life many birds might die or might get injured because of the bird hits bird hitting the wind farms and they and such kind of firm has approached a local magistrate or a local judicial body and convinced him that it could be not beneficial for the life of the birds and being convinced the particular judicial body has put in a need for setting up or setting up of a complete and investigation that brings up the environmental and ecological impacts of the proposed project. So what will happen is this project would be stalled for a few years and because the judicial processes take their own time and in this case let us assume that the whole judicial process takes place that the report is prepared and that is taken to a higher court where the entity is able to justify that there would not be a very significant effect in terms of the loss to the avian life and they are able to start running the plant but in this doing so what happens is the plant is unable to operate for a few years in the beginning. So what has happened is the entity has put in the infrastructure they have erected the wind farms but at that time there was this environmental advocacy firm or an NGO that came up and puts up the case that there might be some detrimental effects to the environment and because of their perceived notion there is put like the local court puts a delay on the start of the plant the corporate would have to take up the due process come up with the due reports which justify their claims on like if they are true or not and then they start the plant again after the case has been settled. So let us try to understand what happens in such a case.



So going back to the excel sheet so it is the same sheet that we see and we here in we have put in an assumption that the earlier plant which was being able to operate profitably because of the appreciated accelerated depreciation as well as tax credit would not be able to operate from the year 2 as it was earlier envisioned because of the judicial delay and further it would be able to delay it will be able to operate just 50% of the rated capacity in the third year. So we have expected a delay of around 15 to 18 months that would be taking place and if you consider the judicial processes this is particularly on the optimistic sides because these kinds of cases or litigations can span for a couple of years.

So in this case what we can see is the although the wind farm was erected it was not able to operate as per the rated capacity in the year 2 and almost on the 50% of the rated capacity in the year 3 and this would affect the revenue that is generated. So overall what we see is the case that it was positive in the earlier case but just because of not being operational for one and a half year the NPV has again come up to be a negative of around 5 CR. So a profit making plant has now turned to be a loss making plant and this is again one of the reasons why the corporates would want to attach a very high discount rate to a project like this because of the perceived notion that many people or many lobbies might not appreciate the coming of plants like this and might want to put up certain kind of litigations which might delay the plant. So this was a case that was undertaken to help us understand the effect of delays like this and this is something that you would have read in the popular literature as well wherein the plant which was estimated to be being erected at a particular cost but because of the delays that happens for many reasons the cost keeps on increasing as the years go by. So in this particular class we have tried to understand using hypothetical case of a wind energy farm how the different kinds of incentives and policies as well as different kinds of interventions could affect the profitability of a plant. And with this we end today's class. Thank you.