Life Cycle Assessment
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Lecture - 31
Design for Sustainability

So let us start looking at the week 7 materials from now. So we; so far we have finished until week 6. So, this is a week 7 material in this week we will be focusing on design for sustainability. So, far we said how to do in LCA exercise we went over little bit of a background about sustainability we looked at the risk assessment protocols how to do the risk assessment we also looked at some basics on toxicity and all that and the last week to we looked at how to what are the good points of doing an LCA then what are the good points of a good LCA like how to make sure you conduct a good at LCA exercise.

So, and also we looked at the material flow and all that green material sustainable materials with all those concepts now behind us as a engineer; however, this is an engineering course. So, as an engineer our goal is to always design something even if you are not an engineer you will be when you are working basically you are working in an organisation you are designing something. So, when we say design for sustainability what does that mean and what are the things we need to look for. So, this week we will be focusing on that like when we say something let us do some sustainable design. So, what we really mean by that most of it we have already covered so, but what are the how we go about it.

So, we have covered the basics of that, but now how to go about a design incorporating the sustainability factors what are the things we need to do what are the tools available out there. So, we will be discussing those aspects in this particular in this particular module in this particular week and starting with this particular module. So, when we say design for sustainability we will look at the economics we will look at environmental and social. So, and then examples of use of an LCA tool will try to do that. So, let us look at the first part of it in this particular module what is designed for sustainability. So, we will try to answer that in next 25-30 minutes this video when we say design for sustainability what exactly we mean. So, what does that mean?

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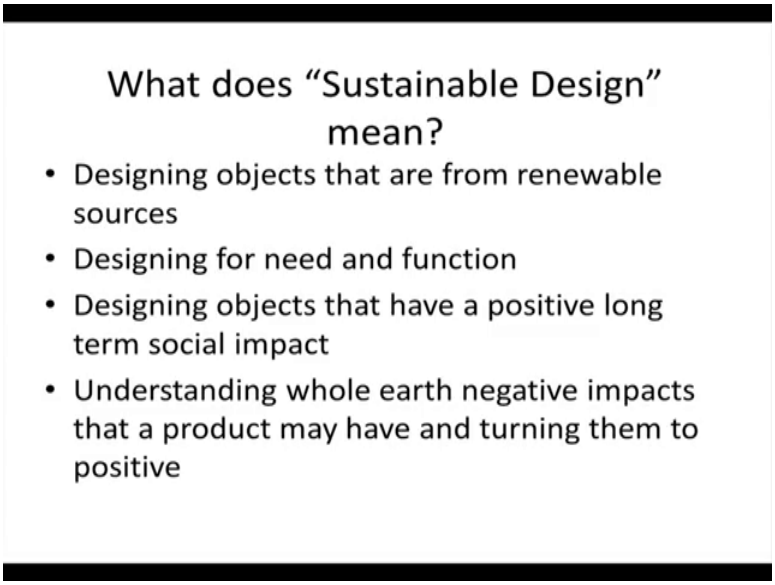

We means that designing objects that are from renewable sources remember we talked about earlier that what is the sustainability main sustainability means the use of resources today in such a way. So, that our future generation can make use of the same resource they can have the same amount of resource available for them for use. So, how that will happen it will it can happen if we if east we use lot of renewable material if we use renewable sources we can make that happen possibly in terms of for designing objects that are from renewable sources.

And then of course, any design we have to do it, it has to fulfil the need it has to do its function it has to otherwise the product is useless. So, if you design a product and if it does not able to do the function for which it is designed for there is no point having that product because it is not going to be used and then we want to design something which is a positive long term social impact. So, it helps socially it helps in skill development it helps in upliftment of the people it creates labourer it creates jobs.

So, all those things and some has a positive social impact coming out of that and whatever is the negative impact which is their minimise it and if possible turn them into a positive situation. So, as much as possible any activity will do there will always be some negative impact when I say negative even the environmental releases in terms of

the water waste or the solid waste liquid waste or solid waste, they are kind of a negative impact, but then if we can recover some material from these waste stream and make use of those material that kind of converting that from a negative to positive.

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So, these are some of the concept like what we should do in terms of the sustainable design and why it is good? Why we start talking about sustainable design for say last decade or so or may be almost 15 years kind of started in late nineteen late 90s. So, we can say almost 20 GDP years people are talking about the sustainable design.

The thing is that we are we are today live; we are living in an ever changing world the world is changing our planet is becoming important for generations that will follow our planet was important earlier as well, but now with the more population load more demand for resources. So, things are becoming much more complex how to manage our resources. So, that our future generation can sustain, we want make sure our population is going to increase we have more people coming into this planet by 20-50; almost 25 percent more increase we are expecting in terms of population we have to feed those people we have to give shelter to those people we have to have clothing for those people we have to have all those recreational activities that they can they will they will aspire to have as the GDP will go up everybody will try to have those kind of material. So, there

would be lot of demand of those materials. So, lot of demand of those resources. So, how to we have to look at this things in a in a very very holistic way now which we have not been doing for almost say for several centuries until now.

So, especially after the industrial revolution we need to reduce our carbon waste and that helps in protecting the planets ozone layer increase in ozone layer will leads us in problem in terms of more UV coming on into the we will have impact on climate change there would be a we do see that in polar regions we are seeing bigger ice melts and that is kind of creating problem a polar bears their habitat is endangered many of the islands even near nearby us we Maldives I think I may have told you earlier too if you if you want to visit Maldives we may not have many decades left for that because what has been predicted that the way the temperature of the world or the global temperature is increasing Maldives may not be there after a like a after couple of decades same thing for parts of Bangladesh and even some of this coastal areas of many cities around the world costal GDP areas of many countries around the world sorry.

So, we have to reduce our carbon emissions; that means, we have to that from its current status that we need to change our attitude to what we buy how we design we have been getting into the attitude of use and throw kind of concept more and more products we are producing just for used for few like a few months sometimes even for a day or like use and throw a material and then. So, we have to kind of think about what really is good and how to and we come up with the better design and then used materials there are from resources that will not run out and will benefit the planets are those things we need to do.

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So, when we deserve develop our design ideas or develop your sustainable design ideas its basically we are trying to reduce the carbon footprint and if you remember this whole exercise of LCA was to calculate carbon footprint and other footprint together. So, we call it a environmental footprint carbon footprint is this course is a big thing is that. So, here we can also generalize other than calling it a carbon footprint as it says on this particular bullet we can say that by developing our design ideas and find ways to reduce the environmental footprint and how. So, we already know how to calculate environmental footprint now we have had this we kind of looked at LCA exercise we understand that if you can which we covered in first like after fourth and fifth weeks module and. So, that that LCA exercise will help us design in improving our design in many ways we can look at how we can look at these different like processes calculate their environmental footprint the ones which shows of higher carbon environmental footprint we can go back and redesign that process and to reduce environmental footprint. So, it will be an iterative exercise, but we can achieve that.

So, there are some simple ways to develop our design ideas to reduce a product impact and, but any impact whenever you try to reduce the product impact you have to calculate that is it not and for calculating LCA is the tool which we already you should already be expert of that by this time since we have already cover that material.

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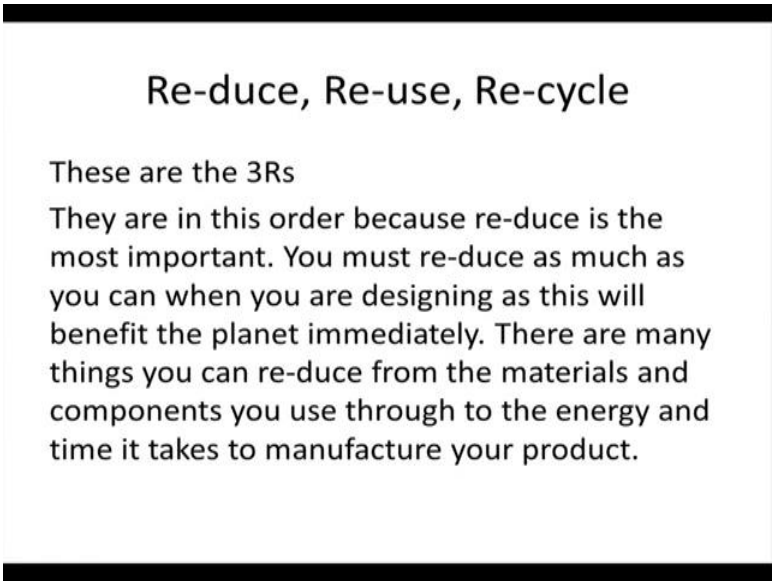

You hear this term again and again and again many places you see that reduce reuse recycle. So, these are they are in this order because we want to reduce first reduction of waste if you can do that and unfortunately as our GDP increases as we get into this more and more mall kind of cultures and online shopping and all that we have been producing more and more waste rather than reduce reducing the amount of waste we are actually producing more waste. So, if there are if you can somehow reduce the amount of waste that is we can we can redesigned the project we can designed the project in such a way that the product in such a way. So, that we can reduce the amount of waste that is produced to that will be that will be of course, benefit the planet immediately there are many things you can reduce from the materials and components you use through for to the energy and time it takes to manufacture your product.

So, these are there are many things that can be done. So, that is as in terms of reduction and then of course, you have reuse if you cannot reduce the in terms of the waste being produced let us try to reuse the material and if cannot be reused within the same system let us recycle and bring it back into the system and so that this can be used by something else in for something else so and for that we already kind of talked about this concept of life cycle.

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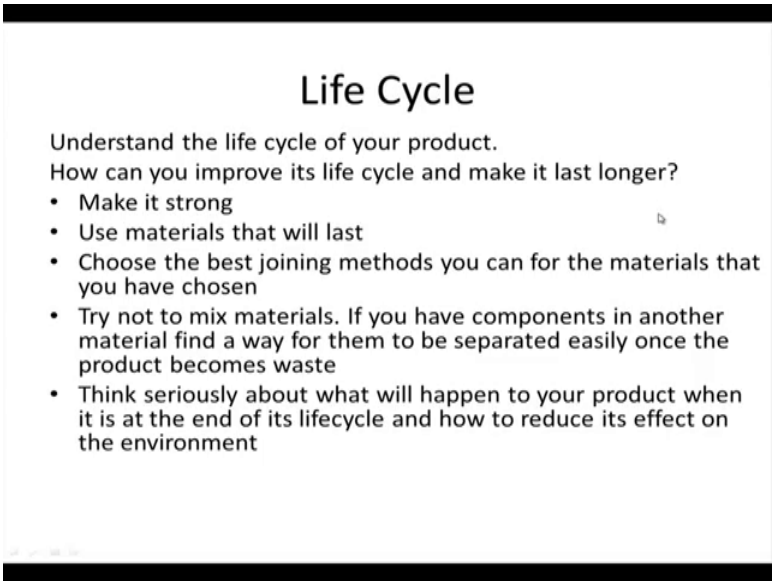

Understanding of the life cycle is important. So, how can you improve its life cycle and make it last longer last longer is your durability and for improvement of life cycle means to reduces environmental footprint. So, how we can do that we make it strong. So, make the product strong use materials that will last many times we do not want actually that way many many of this for example, I will give the specially if you think about certain fashion materials these days our people do not like to use certain one material for many times this not to offend anyone, but if I if you think about ladies shoes this just for this just for your information I do not want to create any controversy, but just if I if you look at even for men shoes as well we have a tendency you do not want to wear the same especially for ladies they do not; they want to change their shoes very frequently. So, they do not want to buy something which is very strong because then it will last for a long long time and have to wear that for a long period of time.

So, because they it will go out of fashion and. So, you basically buy it use it for few months and then throw it away and buy something buy something else and those products are available in the market there are products available in the market very fancy products and which are cheaper, but they do not last very long. So, and people buy them because they do not want it to last very long because newer and newer and newer design comes and newer and newer kind of colour combination comes in and people like to

those material, but that has a bigger if you look at from environmental footprint that is has a huge environmental foot print. So, if you have if you are kind of reusing if you are like a throwing materials out at a very like a at a frequent interval that its adds up in to environmental footprint.

So, use the material that will last choose the best joining methods. So, you can you can for the material that you have chosen that is and then when you are joining method should choose do not try to mix too much of a material see the recycling industry today they are always they have to struggle a lot when I am saying why they have to struggle a lot is if you think about the packaging these days because of to make things look cool if you have looked at the next time you are in supermarket or you are in any market where you are trying to buy some juice or those fizzy drinks you see there are some new bottles out there are some bottles like this is this is a typical like a reusable bottle, but you will find a juice bottle which will have the rapper all around it. So, there is a rapper which is all around this bottle now that that bottle with rapper all around it becomes a nightmare for a plastic recycler because here the plastic recycler person does not have any tool to remove that wrapper which is all around the bottle.

If you think about a bottle which is like a Kinley or Aquafina; we just have a label on the top that can be easily removed, but if there is a wrapper which is all through from here all the way to here all kind of wrapped around and you see some with some very nice coloured combination which looks really very cool, but it becomes a nuisance for recycling plastic recycling place because they do not have tools to remove those and then they become second terminant for other plastics. So, they have to take these plastics and separate it and separation itself requires more energy more manpower. So, they are losing money over there too. So, do not try to mix the material if you can come up with a simple design is always a better design, but unfortunately to make things look cool we mix different types of plastics together we mix things together and then it becomes very difficult to separate it or it takes lot of time and energy to separate it and then the economics of recycling does not work out very well.

So, think seriously when you design something think seriously about what will happen to your product at the end of its life cycle and this is true for any design whether you are

what kind of engineer you might be whatever things you design things at the end of its there will be a service life and at the end of the service life things will get disposed. So, always things from the point of view that when it is disposed what is going to how it will; how it is going to be managed? So, how to reduce its effects on the environment that is very very important.

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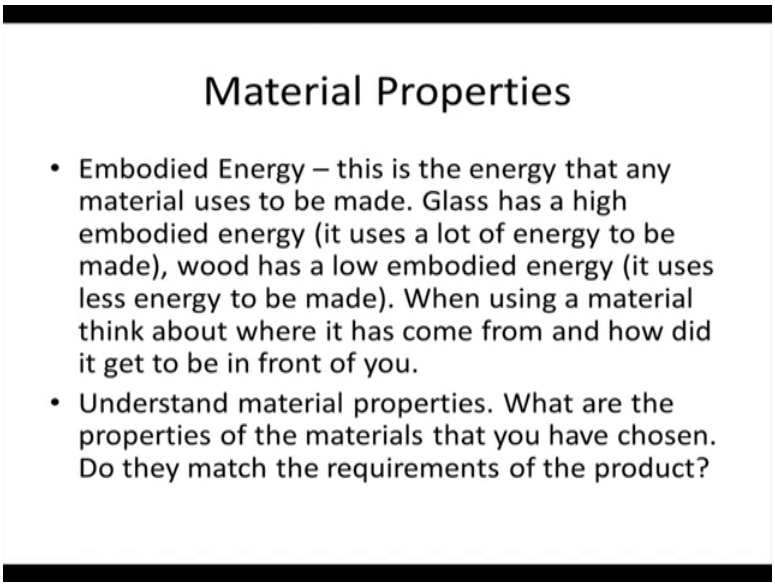

So, when we talked about all that any material that that we are trying to use the material has in embodied there are different types of material out there and the materials have embodied energy which term you may have heard about earlier as well its embodied energy is the energy that material uses to be made.

So, when we are trying to make a material because how much energy that goes into that there lower the embodied energy better it is because then it is easy to its more it requires less environmental footprint Let us carbon footprint glass has a high embodied energy it uses a lot of energy to be made where on otherwise wood is a low embodied energy it does not require that much energy to be made. So, when using a material think about where it is come from how did it get in front of you how much embodied energy it has whether we can use some other material which in case which will have lower environmental footprint, but gives the same properties same it would it provides the

similar function. So, those things are important. So, we have to look at what materials properties of the material that we have chosen do they match the requirement of the product and all that.

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So, with this all these information you come up with your design. So, you look at what is the need. So, for example, what you want to make out of its what is the need what is the objective of that particular product what will be the waste that is being produced what will be the recycle what would be the life cycle that is from a sustainable design point of view and at the same time you need to look at what is the function for the for example, with that is the number one part is it not, it has to serve its function.

So, but you can you can try to come up with your design concept and then you write down all the different factors associated with that then you make your decision which design comes out to be better. So, design need to be developed to reduce their impact think about ways in which you can change and develop your design to make it better for the environment. So, that is that is like a you have a sheet where you can write down all options you have option one option two option three and then the one which you can kind of feel like has a lower environmental footprint and the LCA exercise with the database and all those software that we talked about can help you to come up with which

option you can compare different options using LCA and then it kind of gives some idea about which is better option in terms of its environmental footprint.

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We already looked at this definition before just to kind of re revisit this definition we have been talking about it again and again. So, sustainability is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. So, this was. So, based with this thing in mind we have to design what we say design for sustainability.

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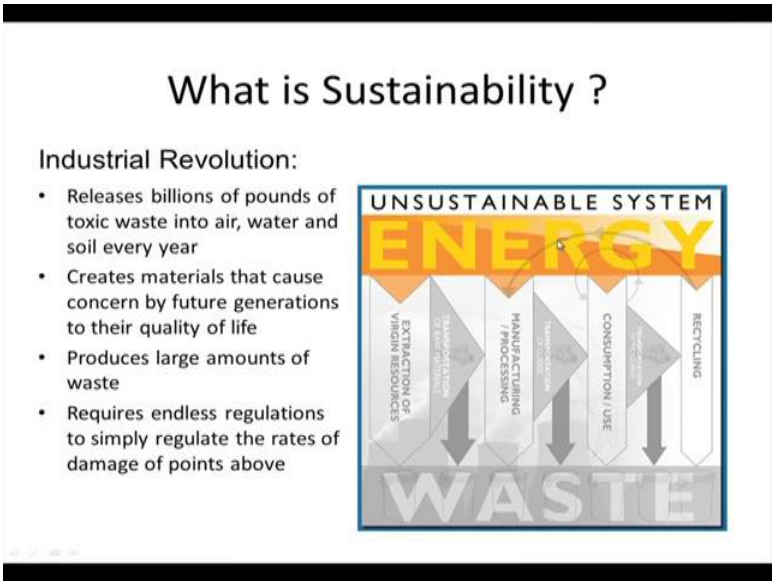

So, in terms of its other like in terms of the industrial revolution when we have been start started producing this is the figure that you are see over here is essentially what we call it linear economy.

So, linear economy is when you take extraction of virgin resources and on top you see the energy that orange colour on top it shows you the energy and then arrows kind of the small triangles coming out shows energy input in each of the system. So, there is an extraction of virgin resources that is again energy being imported to that then transportation of raw material manufacturing process transportation of goods consumption use transportation of recyclables recycling and part of it can go to waste as well. So, bottom you see waste all through the process and energy input all through this process there could be a circle within it where the consumption use and it could be reused and then recycling can put things back into the chain as well for most part this is what is known as the linear economy. So, what today we are talking about is the concept has change now and people are talking about circular economy that is where you here if you if you if you google or if you look at any of these environmental magazines or environmental websites these days there is a concept of circular economy is coming up.

So, how to how to like a take a material which came from the mining activity which got

the material and how to keep on re using it reusing it again and again how to make that happen. So, that is the concept of your circular economy. So, in terms of the industrial revolution for last say almost seventy some years it has released billion pounds of toxic waste into air water and soil every year we kind of talked about that creates GDP material that cause concern for future generation for the quality of life produces large amount of waste and then all these requires lots and lots of regulation to simply regulate the rates of damage of this different points that we talked about earlier. So, again this becomes a concern in terms of its environmental footprint.

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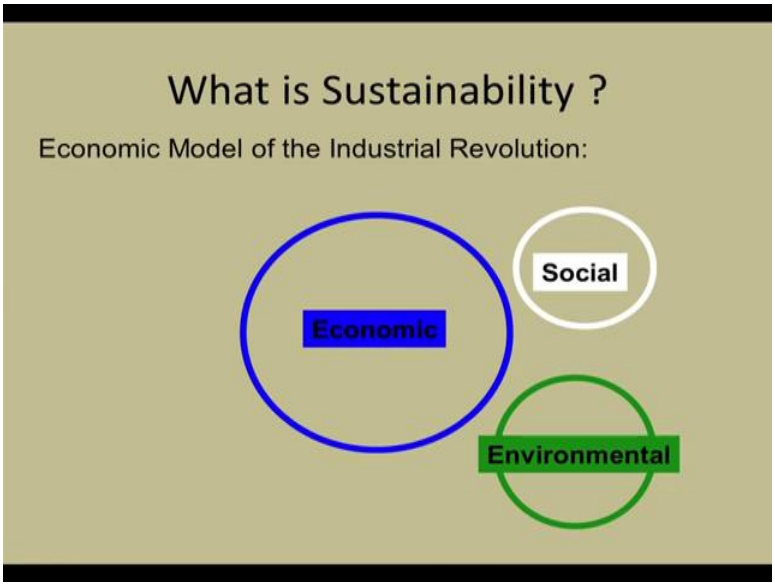

So, in terms of economics what would be in terms of the model which we want to make it happen we have economic model of. So, this is there is a part which is a part of the solution which is economically kind of make sense part of the solution would be which is a socially made sense and part of the solution which makes environmentally makes sense. So, in terms of the sustainability if you think if you remember from the very beginning we talked about that there are three pillars of sustainability there are three one is economical the other was social and then third was economic sorry economical social and environmental LCA gives as the environmental aspect in this week we will talk about little bit of economics and social aspect as well. So, when you look at these three these three they can be in isolation right now, but if we can bring it and I think it is you

can bring them together.

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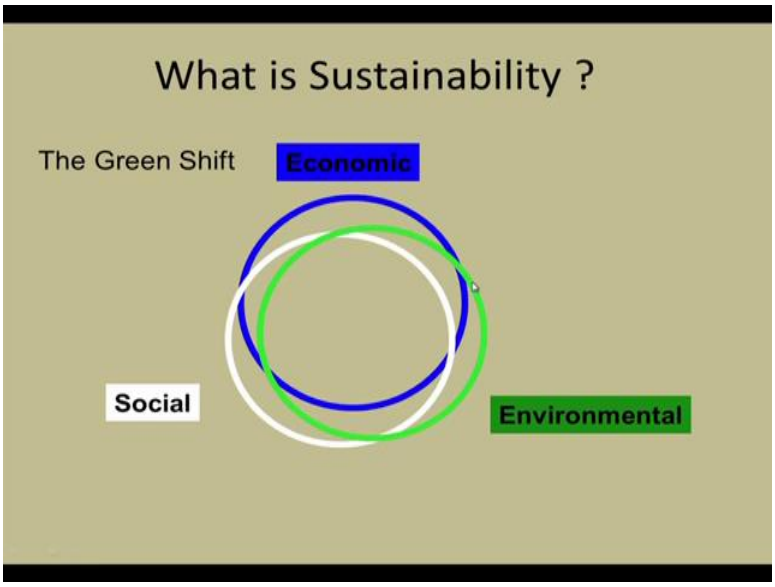

If you can have a green shift where things can move together with social economic and environmental they can move together and come up with a come up with a solution where this we find a condition where this these three conditions are made. So, that is our

sustainable system where our economic whatever we want to achieve from the economic angle social angle in environmental angle they kind of meet at one particular point and that becomes our sustainable solutions and we call it green shift. So, sustainable system is a cyclic system and. So, you have your raw material then you have product then you have consumers waste being produced and then for that also we have consumers and then again the row material is present is there and throughout the system there are some energy which is its being used and energy. So, if you look at the Mother Nature, this as you can in this particular figure you can see the Mother Nature has already kind of they have a system in place. So, there are the leaves are made and seeds are made and seeds are ate and then the waste is being produced and this waste degrades with the help of this microorganisms are very small organisms and then the raw material is produced again and then the new plants will come up.

So, there is that is a sustainable system is satellite system is already in place, but when we talked about in our it is in terms of the industrial system we have we have not done that way when we started looking at our industrial system like few several decades back when this industrial revolution after that it comes up we did not we did not paid much much attention to social and environmental aspect you are always looking at the economic aspect not that much on social and environmental aspect. So, gradually we kind of moving into looking at the environmental and social aspect which is very very important and to make things sustainable to make things last for a longer period of time.

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So, this constant development there was an agenda developed in June 13th of 1992 and from time to time you see this Kyoto protocol divorce this and that meetings are happening. So, representing ninety percent of the earth's population was there they send single largest gathering of heads of state of international diplomacy.

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And then they came up with six topic categories in terms of what is sustainability the quality of life on earth. So, what is the quality of life which I think I keep on telling earlier I think I have said that earlier too when we talk about GDP numbers are great, but GDP numbers by itself does not really tell me much you may have a very good g d p, but at the same time if you are having lot of environmental problems in my view in my personal view that is not really a good progress because without a healthy workforce you cannot have a healthy economy for a long time and I repeat that without a healthy workforce we cannot have a healthy economy for a longer period of time because if the if the workforce is unhealthy because of the environmental implications say you build lots of factories in all those things and you are did lot of productions are going of first of all the whatever you produce needs to be consumed.

So, and then if even if you find the market for that and then locally if you have these lots of as part of your industrial process you are actually putting lot of environmental sorry concerned chemicals which creates environmental problem in water air and soil and that will make the people living around those factories sick and. So, if that those are the labourers those are the labour that goes into making the factory profitable. So, if you have your man of power sick men are like a man power are not 100 percent fit that leads to the reduction and efficiency of a production system because if the people are say do not work at hundred percent efficiency and that will impact the productivity of that industry as well. So, in kind of it is all kind of connected. So, the quality of life on earth is very very important in terms of when we look about the sustainability just not the see having good quality water having good quality water is very very important only having as I think I have said that earlier on looks at we have to make sure that we have good quality water without good water we cannot really survive for a long time. So, for any industry also good quality water so and that is those are very basic essential stuff the quality of life on earth efficient use of the earth's material how to make an efficient use no much wastage we do not have we do not afford to waste actually protection of our global commons we need to make sure we are we what we are doing is its actually good for our global stuff and then management of human settlements we have to make sure we are not creating lot of a social problem management of human settlement managing the waste and then economics. So, the first part you can see its quality of life on earth and management of human settlements protection of our global commons these are more in

terms of your social aspect.

Efficient use of earths material chemical and management of waste these are your mostly from environmental aspect sustainable economic growth is what is your like a economics aspects.

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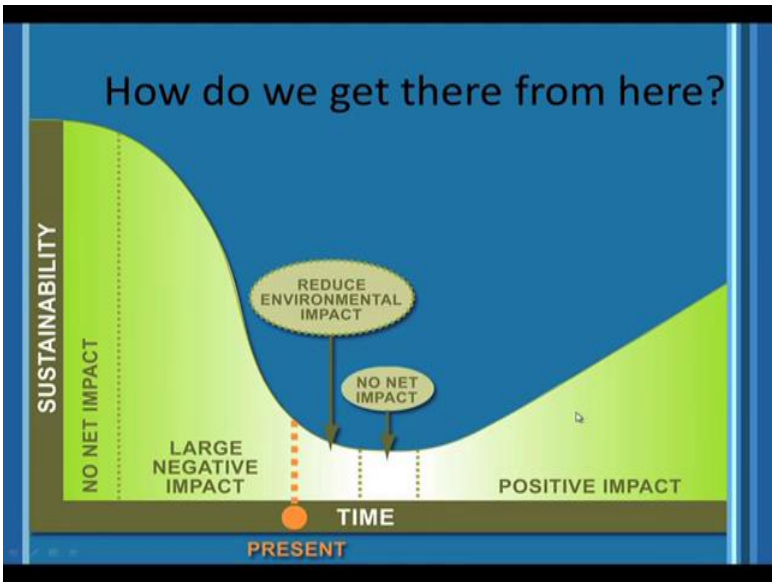

So, all these has to be there in terms of making it making it better in terms of more sustainable design more sustainable environment. So, how do we get there from here when we say here this kind of gives you the present scenario where we are trying to reduce the environmental impact we are this on this side we have the positive impact here we have the negative impact and with all these regulations and other things in place again this particular figure comes from in western European countries from an Indian contest, I would rather put this dot somewhere over here because we are still seeing a lots and lots of impacts coming into in terms of the large negative impact on the environment and we have to really start working very hard to take it to reduce environmental impact and then take it towards the positive impact where we go from negative to positive where with respect to time and how do we get from there from here by better design of the products by better design of the process by better control of our emissions. So, those things will help us to go in that area

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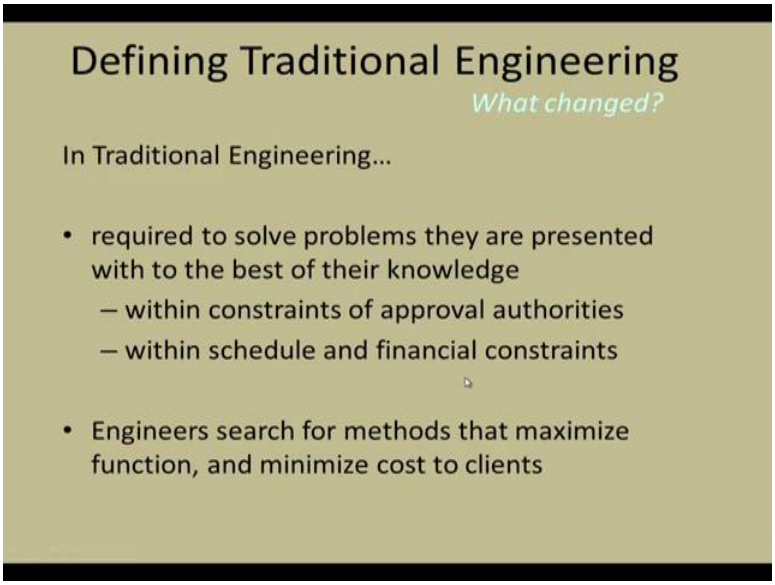

So, it will just look at couple of slides and then will stop for this particular module. So, in traditional engineering when we say traditional engineering where if say we are we are trying to solve problems that are presented to us based on our knowledge with the constraint of approval authority within schedule and financial constraints. So, we try to search for method that maximize function minimise cost because that is what mostly we do it try to maximize the function and minimise the cost to the client.

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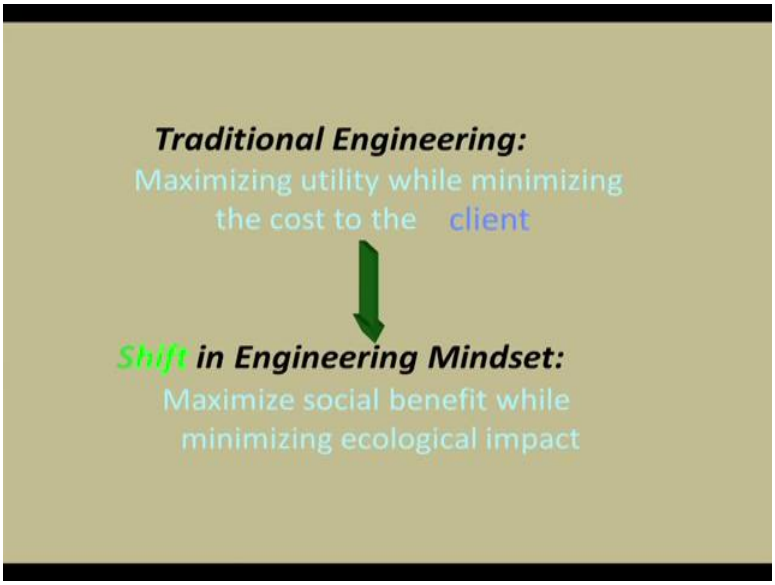

So, that that is, but now we need to start shift in the engineering mindset we have to look at maximizing utility while minimising cost, but at the same time maximize the social benefit while minimising the ecological impact. So, that is where we have to kind of a look at that we have to think about how to. So, we have to we have to need a change in our mind set as I think Einstein said once that we cannot solve the problem with the same mind set which was there which created this problem. So, the problem that we have today in terms of the environmental issues in terms of environmental contamination of like if you think about an Indian contest most of our rivers of contaminated river Ganga, Jamuna; Jamuna if you go near Delhi-Ghaziabad that area if you go passing through the train you get such stench smell.

So, most over rivers of contaminated many of our soils contaminated that is why we have the many of the food products we get to hear about contamination air is contaminated people are getting sick. So, all these things were created because of a; we had a mindset Let us maximize profit; GDP, we are not worrying too much on how to keep our water air and soil clean. In fact, keeping our water air and soil clean itself will actually in my view will help improve the GDP because first of all the people will get less sick people will be more productive and at the same time lots of green jobs would be created. So, this remediation system remediating of soil the groundwater trying to have

the air pollution control systems working the landfills are better design like engineered waste management systems composting anaerobic digestion whatever types of industrial system do you want reuse of the waste material for construction. So, that housing for all can be achieved skill development.

So, training of the people, so all these things will lead to actually lots and lots of jobs being created and with all these young people coming out from this is different in different universities they; we need lots of job. So, this will actually help in creating lots of jobs and will help in improving the g d p, but at the same time our industries have to start working in a little bit responsible manner. So, that we need to we can achieve these changes in the country. So, we will kind of continue this discussion in the next module like how we have to move from this traditional engineering to sustainable engineering. So, looking forward to seeing you again in the next module again thank you very much and Let us stop here for this module.

Thank you.