Life Cycle Assessment
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Lecture – 33
Design for Sustainability (Contd.)

So welcome back. So, we were looking at how we can go about as a professional for sustainable design of any product processes and other stuff.

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So, let us look at some of these we will start with where we ended in the previous module. So, let us look at some of this useful tools and incentive. So in terms of the tools and incentive say from a federal government; from a government stand point. So, research government funding and incentive program. So, the people can start thinking about sustainable design these are many times these type of say it is an early science people are still going into this field. So, you we need to develop lot of data. For example, we were talking about LCA in the first up to like up to fourth and fifth week we have be we have event about discussing about life cycle analysis in a great detail look at some of the examples. And doing next week module which is the week 8 module we will again go back and do let lot of case studies of life cycle analysis from different like a spheres.

Ah, but like when you when we do this life cycle analysis as you saw for this inventory analysis we need data. Now this data has to come from somewhere, we will if we keep

on using data from say western European country and do the LCA in India that is actually not really true I would say next 2 representations of what is like we need India's specific data. And there are some data which is being developed there are some data developed in different universities, there are some organizations in India we were trying to bring the data together equal invent which is a global organization is also trying to develop some Indian base database which we like my research group is also part of that, but all these say when we do when we do this data collection that is not really pure research. Because in research people say it is it is more like a consulting job rather than a research job.

But unfortunately this consulting jobs nobody pays. So, because it is the no industry is interested in collecting this kind of database because this kind of database is needed, so that we can do that environmental footprint calculation. And unless the government comes up with the regulation where all the products and processes and everything has to be done LCA and then even in that case people say we will just use whatever the data is available, but as I think it the money for these kind of activity all though it may not be hundred percent pure research, but the money has to come from government agencies because that is where, but otherwise who will pay for it I do not see any other funding mechanism for these things to happen.

Similarly, if your trying to develop a for we have want a housing for all. So, housing for all requires lot of raw material so; that means better resource management. So, for better resource management one of the aspect is let us take some of these waste material and try to recycle. And see whether we can use it as a construction material. Now we are trying to use it as a construction material we have to be sure that of course, it is good is structural wise that is as a civil engineer we all know that though those of your not civil engineering you also know that that if you want to use any material it has to be it has to meet the structural property go for what it is intended for, but and then you also have to make sure that the product this material since it is coming from waste sources it is clean enough.

So, we have to do it is what is known as the beneficial reuse risk assessment. So, this beneficial reuse risk assessment this structural aspect and these days we have taking about this life cycle concept. So, all these 3 needs to if we can have built up all these 3 together and come up with a nice framework, which any waste industry or any

manufacturers can look at and say if I will go through this this this is step which is a structural aspect environmental aspect and also all see how much environmental footprint I am reducing and that is and then I will go and use this material for my construction purposes.

So, that is these kind of tool needs to be developed for India specific tool. And that again the funding for these kind of things has to come from government agencies and nobody else is going to pay for it. So, be otherwise if we do not have any other funding mechanism to pay in this particular country. So, the research funding has to be there research government funding has to be there for those kind of stuff. Same thing for the industry part also there the there should be some incentive program. So, you can tax program or other programs has to be there could be utility incentive programs where you get some tax (Refer Time: 04:55) you get some other stuff for example, there is a green building program there is there is there is we have that greenhouse program we also have LEED certification, we that energy start system.

So, all these different programs there are there should be some incentive building. So there are in some places we do already have it, but we need to kind of elaborate on that more and we need to incorporate many make it more practical make it more which works better. So, we need to have. So, like a if you look at some of the other programs which is going on around the world one of the program is this LEED program, which is the leadership in energy and environmental design credit system. So, that is a lead leadership in energy and environment design credit system many times you hear this is the LEED certified building.

So, that is what it is. So, that is it is a leadership in energy. So, they have gone through a certain process certain evaluation certain protocols and then if you meet those if you pass that particular process you become a LEED certified building.

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So, the LEED which is the what is the mission for LEED and it is the mission is having promote and accelerate adaptation of green awareness. So, we have to make it more and more green awareness. So, the what do you mean by green awareness to become more environmental friendly. So, and how we will do that we will try to create better buildings and communities healthy places to live work and play. So, it is healthy places to live work and play means indoor we should have a much as much less air pollution issues, we should have good ventilation our we should not use any chemicals which will leach off. So, that I am inhaling all these the be nastic chemicals while I am taking a nap in my house.

So, those things should not happen. So, that is that is it should be it is a healthy place it is an enjoyable place. So, that is it is. So, with that is what the LEEDs mission is. So, there are different levels of LEED certification depending on.

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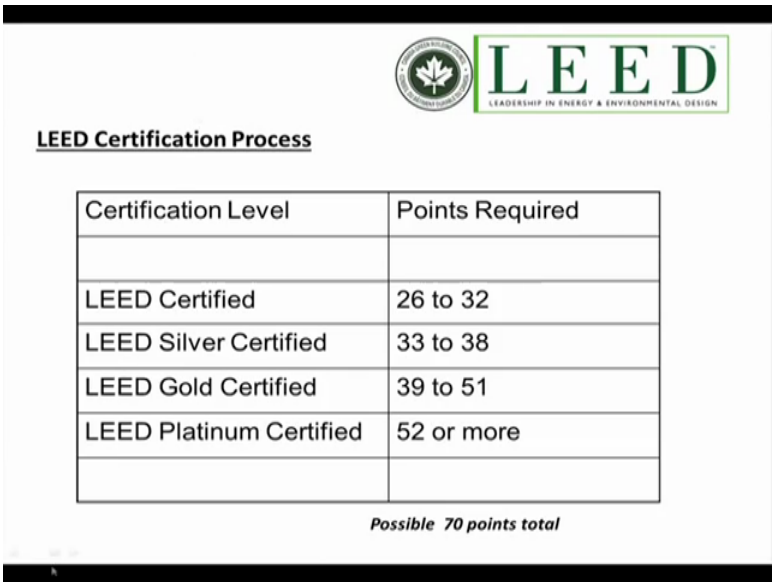

So, there is total 70 points we can have a score and if you are you can go and look at more details on LEED certification on this. There is have a wets website for LEED certification. So, the basic stuff is around 26 to 32 point. So, you have to is slightly less than half to have the basic and then silver gold and platinum that certification is there. So, as you can see it is not an it is seems to be very competitive certification, it is not that is you get that because even for platinum the score is only 52 which is around less than 80 percent.

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So, 75 percent. So, it is what is what is needed took at the platinum certified. So, it is it say requires lot of stuff. So, credit is are divided into 6 categories in terms of sustainable sites like how good is the site in terms of it is environmental and others environmental is aspect. Water efficiency how good is the water usage what how they are doing in terms of the energy and the atmosphere the material use least material and resources part material large part of the resources. Indoor environmental qualities innovation design process. So, all these different categories they are divided and for each category based on how that form. So, there are actually there is a standard template there are some standard questionnaire standard template standard forms that needs to be filled in.

So, and that is the same set of forms is used throughout the world. So, that you have and you have a uniformity in terms of which buildings are LEED certified. So based on these parameters they go about the certification.

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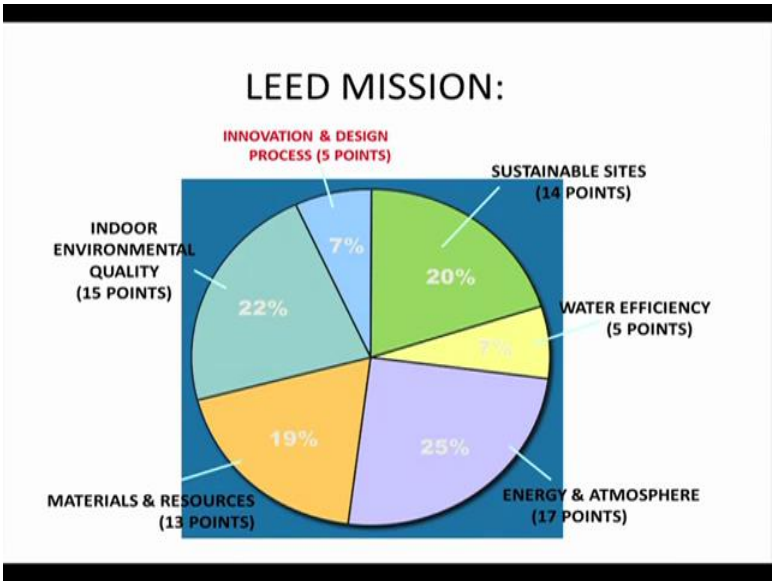

So, in terms of different point wise what is the break up innovation, and design that gets around 5 points sustainable sites that is one of the important one it is around 14 points indoor environmental quality 15 points which around 22 percent water efficiency is 5 percent energy in atmosphere is 25 percent and material and resources 19 percent.

So, this is how the different aspects has been divided for the LEED mission and this based on what they have come up in terms of the distribution. So, that is how it has been done. So, that is in terms of the LEED mission.

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So, what is the benefit is of LEED project they have they use less energy in water. So, it is less energy in water less energy food print less water food print. So, that is always better use of the material wisely. So, not too much of an over design which is again a we tend to do that like, we tend to work do too much of an over design of our structures and other stuff that since you have to use material wisely, you try to less over design it and you try to minimize the waste and if you try to recycle the waste within the system as well have longer economic life, try to use the material which will large for a long time cost less to operate that is another areas where we can try to improve upon generate less greenhouse gas pollutants are more comfortable occupants are healthier and more productive.

So, these are what is the kind of the focus in terms of the LEED mission. So, this is what we are trying to achieve.

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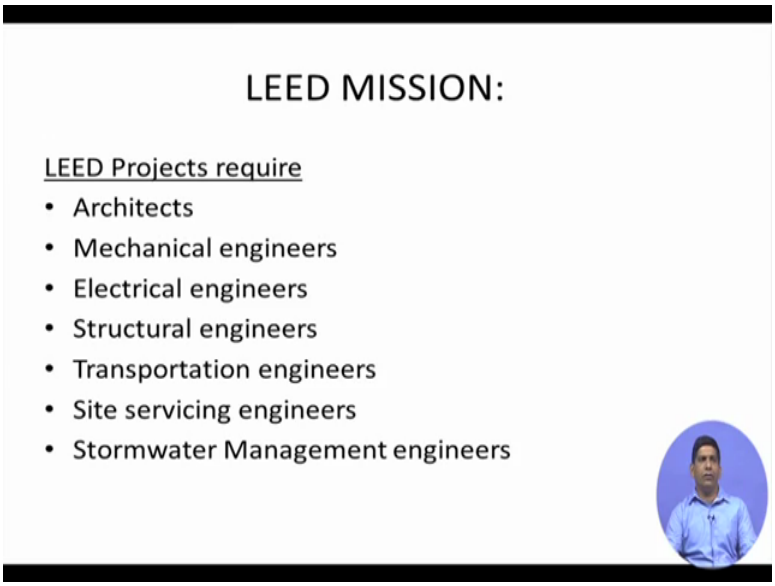

So, what and then they require they require architects mechanical engineers, civil engineers, electrical engineers, structural engineers, transportation site servicing engineers storm water management engineers. So, all these peoples are required in a LEED project. So, as we have saying to you earlier as well we ma as an engineering projects within the engineering, when we are a studying an engineering program we work too much into silos. So, like we get into silos, when I say silos we get compatible compartmentalized which is say you have a civil engineering people here mechanical is there electrical is there and they are not talking to each other.

But when they come up the real world project as you can see in those particular slide we have we need to all sorts of people to work on one particular sa one particular project just think about the room your sitting in right now if we just see around there is would be light there would electrical wiring there would be if your an a c there is an a c a c they are there would be as you work into the washroom there is a water connection in the kitchen you have a kitchen connection. So, you need lots of different kinds of people to help you build a as simple as a say like a very simple building. So, think about the big complicated commercial is commercial places or industrial places where all the different aspects of engineering is required.

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And there is there is always a myth, we call it that green cost more where there is a more cost to the green whatever we do in terms of green products they cost more, which is not really which is not really true because it is as you can see over here that in terms of academic buildings, which is tells you the cost per square feet and the gold certified is your is golden color the yellow color silver is grey green is your just the certification and the other grey that light grey are actually there silver one is the blue which is the dark grey showing up on the figure and the light grade is not certified.

So, as you can see from top to bottom the cost for a square foot it can a varies even for those even for the buildings which are not satisfied, we are saying pretty high cost and while the building which are certified you see the gold color once are actually low cost. So, it is low cost then many silver or many like satisfied buildings to. So, to have that that having a the green anything green will cost more that is not really true. And this graph came from yesterday which was almost 10 years old. So, now, the technology has improved so much. So, if you if you somebody does a similar study today you will it have my guesses that you will find even less cost say for something which is like a green certified or LEED certified.

So, it is not that anything you go for green is always cost more it actually cost much less if you look at the long term cost as well.

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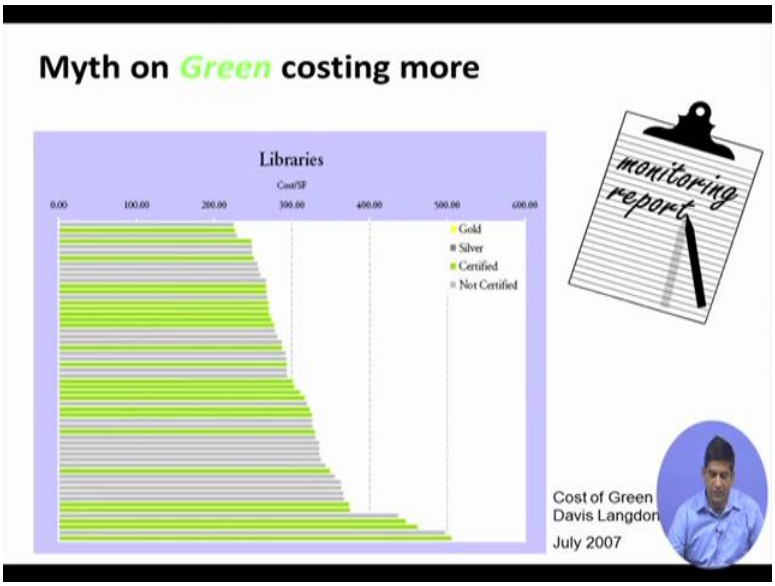

So, this is this is again for the earlier, earlier was for the academic building and this is for the library here again you see the same thing. It is the cost of a many of the cost which is not certified is more than what is certified buildings.

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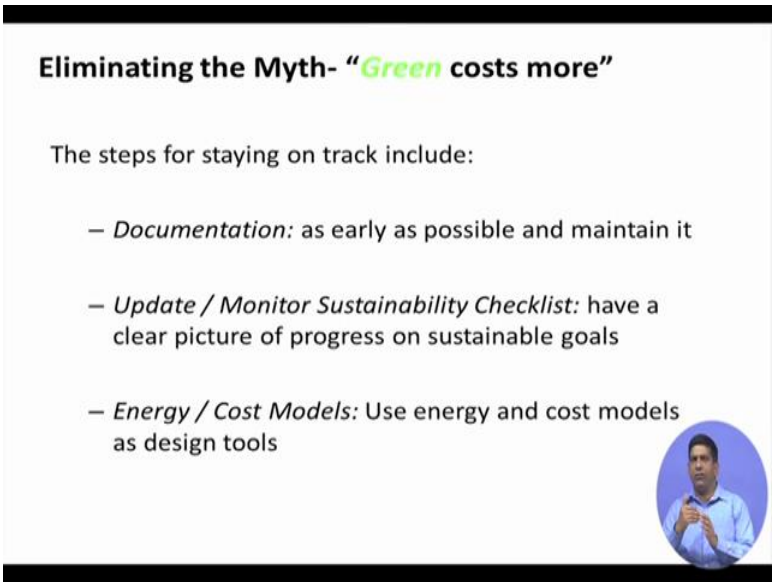

So, and then that the thing is that we have to have elimi we have to document the steps for staying on track for any project we have to document has early as possible and maintain it. Monitor sustainability checklist have a clear picture of what is our goal in terms of sustainable goals. Energy and do the energy model do the cost model use energy

design tool to minimize the energy carbonate requirement minimize the cost and those things if you do properly you do not end up paying more by going for a green building actually as you saw from the previous 2 slides actually it for many cases having a green building or a LEED certified building is actually less costly than having the traditional building.

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So, then the budget how much more like budget point is should not be how much more it will cost, but we should rather focus on how will we do this. So, you ask early in the project and you considered and every part some design. Establish the team goal of course, it is all a team work explain establish team goal deal in the like a you should always not decentralize you should not that is another problem we have especially in developing countries we are too much power hungry people we always try to concentrate power in one place we do not want to delicate and which is the and that that that would makes lot of suffering a lot of suffering to everyone.

So, the person who has taken who does not want to delegate is also suffering, because he is working too much he has to work too hard and he has to spend too many hours and any human being after he or she has been working for 8 9 hours in a day they efficiency goes down. So, if somebody comes to you and tells you that I work 12 hours 14 hours per day great you might be working, but actually your not working very efficiently after 8 or 10 hours nobody has that capacity unless somebody is a superhuman.

They has been a studies done after several a studies done in this area where they have found that optimum that is why the working hour is 8 hours the reason to keep 8 hours work days that people can work efficiently for 8 hours after that they are brain does not really work very well. Some people can stretch it to 10 may be 12 or not more than that if somebody claims that they do more than that they have just I would faking it (Refer Time: 16:09) they are not really working over there or.

So, but we should we should establish the team goal we should we should have the expectation of the different like a people in there what is the what is really the expectation how the people what is the expectation of each and every team member, and what expertise who will can contribute what is the specific goal in the program, what do what is the what is our specific goal a line budget with the program what is the budget stay on track for design and construction especially for any project we are talking about.

So, these all these if we most of the time what the project gets once the project gets delayed there is a cost escalation. So, we have to always if the project is on time it is always you may end up actually pay spending less money than what you thought for that particular project. So, we should always focus on trying be on track be on track and be very clear we having a delegation of delegate I mean delegate the responsibilities delegate the powers have very transparent system of management and that is not only true for even for this just to for any management. And we will be whether your talk about any shots of management happening anywhere in the world, but that is at the same time it is also relevant for going to talking about this green building and other stuff.

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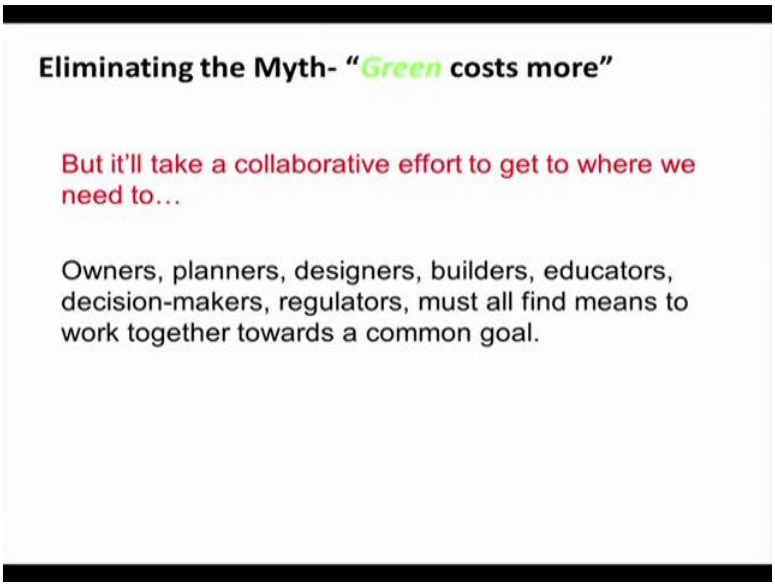

So, but it will take it takes a collaborative effort it is cannot be done by 5 person or 2 person it needs a collaborative effort. So, owners planners designers builders educators decision makers regulators all should fine means to work together and to towards a common goal because. If say if we are doing this, it is everybody is going to benefit from that. So, it is not one persons baby it is it is every ask every people who are involved in this project is going to benefit or the whole society is going to benefit actually if we because if you can save money, if we can do things better if we can make things go in our it is always good for the whole thing. So, in terms of the summary of that what to the world will not evolve past is current is state of I just what our time to say earlier.

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So, in terms of the sustainable development the world will not evolve past, it is current state of crisis by using the same thinking that created the situation. So, that is what albert Einstein said. So, we have to start thinking differently. And that is true for most of the scenarios. So, what you can apply immediately you any projects your working on that depends over any project that you are involving develop a sustainability checklist on, project you make a sustainability checklist, when you recommend sustainable solutions to clients at high to sustainable re principle in your work your sustainability resources. So, there are lots of resources out there use them and that and that resources, we will help you to make progress in your project in terms of different aspects of the project.

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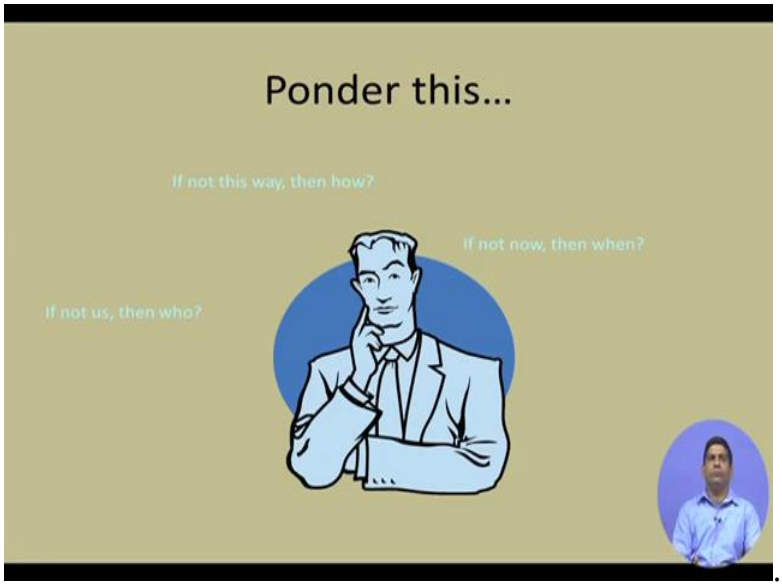

So, we need to think about that, that if not this way then how if not now then when if not us than who will do it. So, that many times we get that let us let us do this project in the old way and then from the next project, we will think and do it in a more sustainable way next project never comes. So, and every time we do the same thing. So, we need to start thinking about if not now then when we have to we have to manage this in a proper way. If we cannot do if we do not want to do it who else will do it like, if you do not want to do it I have no right to expect others to do it to. So, and if not if you we not go to the sustainable way then then, how we will make progress how the sustainable development goals will be achieved.

So, how to how we can come with solutions of different world problem. So in the in terms of the engineer we play a very important role.

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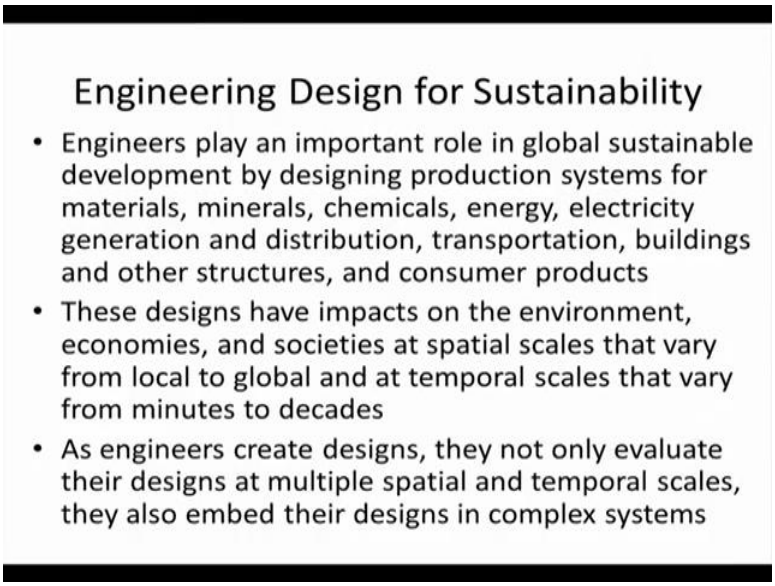

In the global sustainable development, but design in product systems the and like using materials chemicals and all those kind of stuff they have an impact on environment economy, and society at different like time interval spatial scale, they are also sorry a special as well as temporally scale. So, that is that very from local to global out from minutes to decade as engineer we create design and then not only evaluate the design, but also embed the design into the complex system. So, that is what we are trying to do.

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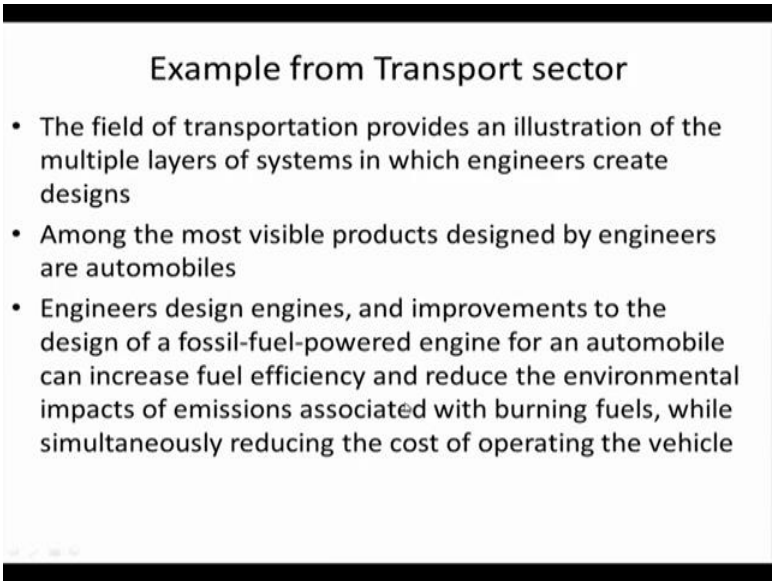

So, let us look at an example from the transport sector for what we have been talking. So far we have been talking about the sustainable engineering and all that. So, what in from the transportation sector, how things are working right now. So, and this is an illustration for like a what is what is happened in last few decades. So, field of transportation provides an illustration of multiple layer of system with engineer creates and design among the most visible project is auto mobile. You see cars like you go to any nowadays even in the rural area semi urban area you see some cars in the urban if you go to best it is what is up cars.

So we see cars and then this car is made by unfortunately the engineers they are if you are if a too much worried about if a too much I am just joking here, but if you are stuck in a big traffic within blame the engineers. So, that is they have they if they have not created this car we would not have the traffic, but that that was a joke. So, that that was a joke. So, among the most visible product which is designed by engineers or automobiles the cars. So, engineer they design car when we say design car and say design different parts of the car parts which get assembled together.

So, we design engine we improve. So, we can improve the engine remember we have this in Indian context we see this euro 1 euro 2 euro 3 what are those euro 1 euro 2 euro 3. So, again you should always think as I said in in by in the previous module always have a habit of asking that question why and also try to think do not let your brain like a it become idol you should always ask that question what is euro 2 what is euro 3 or if there is a I am not sure whether euro 3 exist, but whatever is that euro that you have why they are there what are those requirements and why we should meet that requirement.

So, those requirements and needed because of the does we have this fossil fuel powered engine which creates lot of air pollutants. So, to increase their fuel efficiency and reduce the environmental impact of the emissions associated with the burning fuel which ones do we want to become it more fuel efficient. So, if you make an more fuel efficient what does it mean you are you are reducing the operation and maintenance cost. Because if the fast of fuel is less if you sorry if you make a fuel efficient so; that means, to go from point a to point b now it will use less fuel. So, if it uses less fuel; that means, I have boils if you less gasoline or less fuel it to put into my car and that saves me some money to go into my pocket. So, that is kind of helps in terms of the cost like reduction in the cost.

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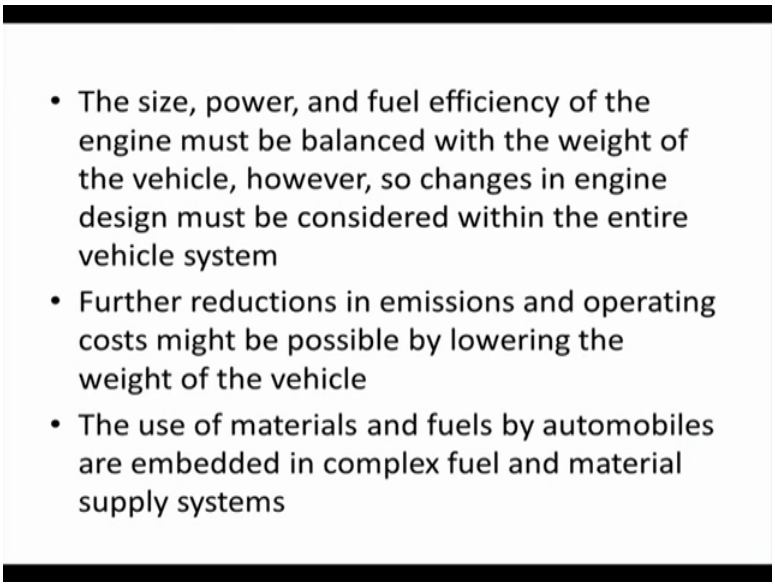

So, in terms of size power and the fuel efficiency of the engine they must be handled with the weight of the vehicle. So, our if you designed if you change the engine if you make the engine lighter. So, that will help reducing the weight of the vehicle that again helps it further. So, then it helps if the engine gets better we have the reduction and emissions an operating cost. So, if it that goes down we can produce possibly lower the way lower the weight lower the cost of the vehicle as well.

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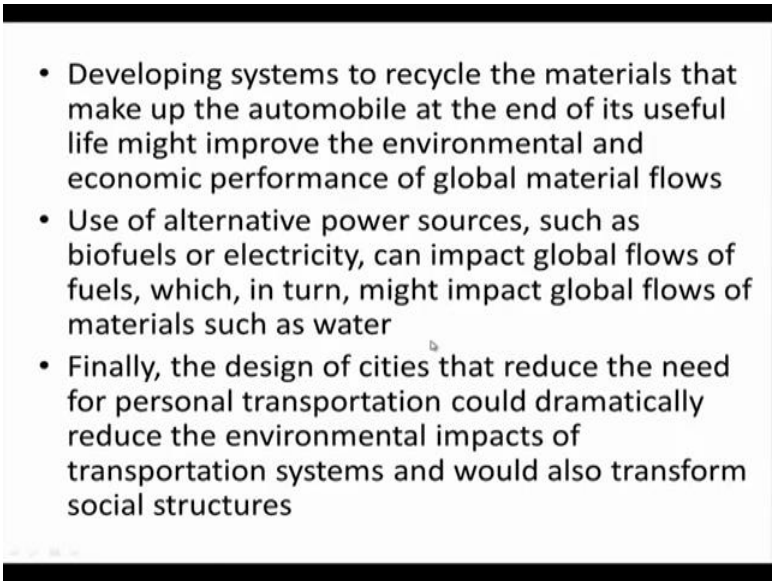

So, it is it is those our those our can be can be achieved use of materials also if you and fuel automobile it is that is in terms of their fuel and material supply systems is there we can develop a system to recycle the material to at the end of his life there is even many countries they do that that at the end of (Refer Time: 24:08) the car is totally cannot be used anymore.

So, they are they use it they take at different parts of part and try to recycle as much as they possible. And part of it also goes to waste to energy plant use of alternative power source rather than using the gasoline can be use electric car which is already there we can use bio fuel which is being used. And if they are used, how they impact in terms of the global flow of fuel and whatever in terms of their environmental footprint. And if you can design the city is that reduce the need for personal transportation if you can come up with if you can come up with public transport. If you can come up with a very nice public transport, then people will not go for personal transportation.

So, if you go to many cities around the world with the public transport is. So, good the people avoid driving their own car because you to parking becomes a problem, parking charges are pretty high and they have been made in such a way. So, that people are people are kind of encourage to use public distribution say public transport system rather than like a rather than private transport.

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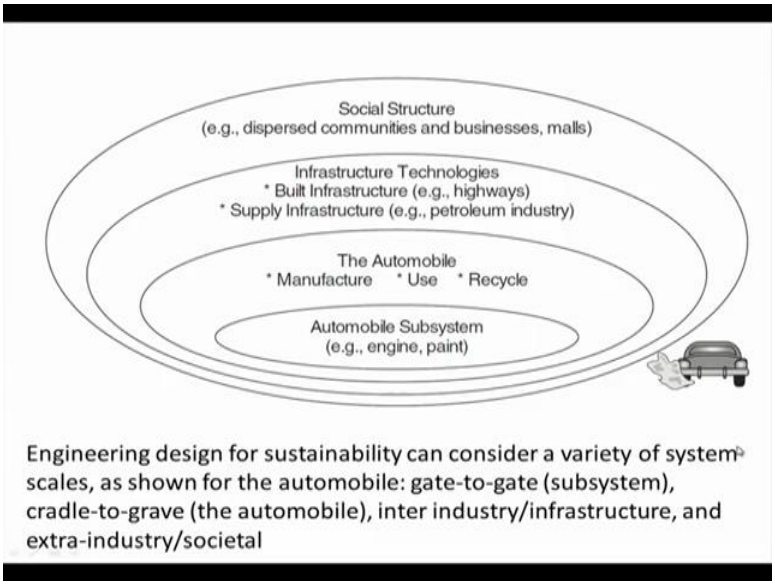

So, if you look at this particular sketch this is what we're talking about. Here you have their automobile sub system where engine and paint those things are there that goes into making the automobile where metabolic manufactured used recycle, that kind of goes into the infrastructure technology based on how the automobile will behave we have to design our highways you have to design our petroleum industries.

So, that is your infrastructure technology and based on how this whole thing behaves that kind of goes into the social structure, where disposed communities and businesses and moles. So, as you can see here that engineering design for they are variety of system is scale is here. So, we can go from just from the automobile part 2 to the automobile to infrastructure to even the socially structure. So, you can go at different level So, that is and within we can we can look at the system as well as get to get like we can have a subsystem, we can have a cradle to grave the automobile system or the inter industry infrastructure extra industry societal system that will be the whole thing. So, as you can see the different cy different circles in this particular image over there each circle can represent a system boundary for doing an LCA exercise.

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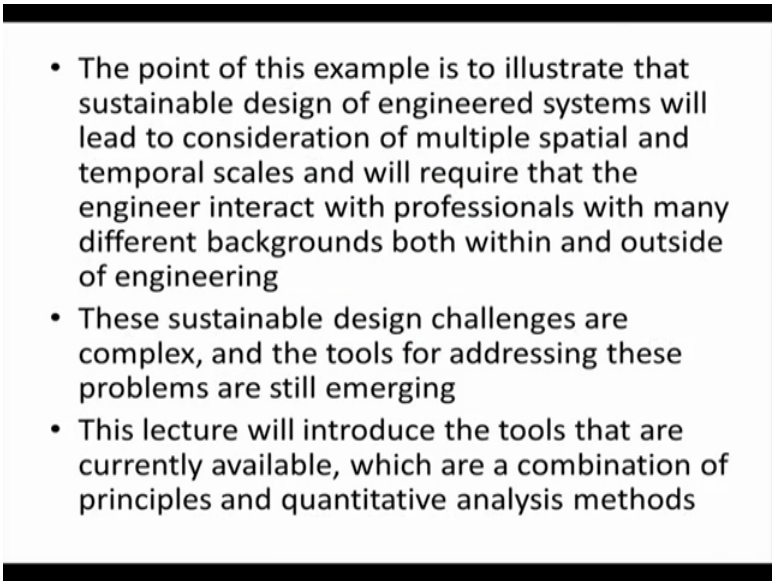

So, and that will be a different level of LCA exercise to do that. So, that would something which is important will be important to do. So, the point of this example is to illustrate that sustainable design of engineer system will lead to multiple spatial and temporally scale. And that requires lot of interaction with professionals. So, within many

different background within and outside engineering. So, it is not all they an engineering solu engineering problem and engineering solution. So, any problem even the transportation industry problem is transport like a transportation engineering issues main requires lots of import from non-transportation engineers because that is you saw that societal how the people will take the public transport whether people will go for that. So, all those things come in picture.

Sustainable design challenge they get complex and then we need to have to tools there are some tools which is emerging LCA is one of the tool, but there are other are tools which are emerging to make. So, in this module the goal was to introduce the tool that are currently available which is a comb which is the combination of both principal and quantitative analysis method; next because the sustainable design must be able to compute in the marketplace.

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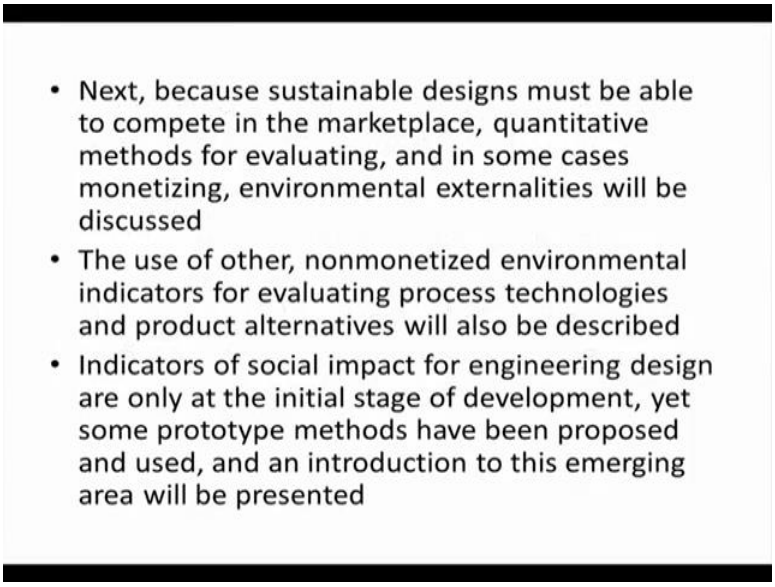

So, you need to have a quantitative method, so that you can monetize because you have to look at the monetary point of view how to make it competitive then environmental factors. So, that needs to be discussed then non monetize environmental indicators for said how the you may not put a money value for it, but you have the environmental footprint indicators of social impact for engineering.

So, those things are that that those things are the needs to be incorporated. These are in the social aspect as I said earlier it is an initially stage of development, but a still they are

trying to come up we have a social LCA kind of methodology already in place which is developed by UNUP and C Tech. So, we that can be looked into there as well.

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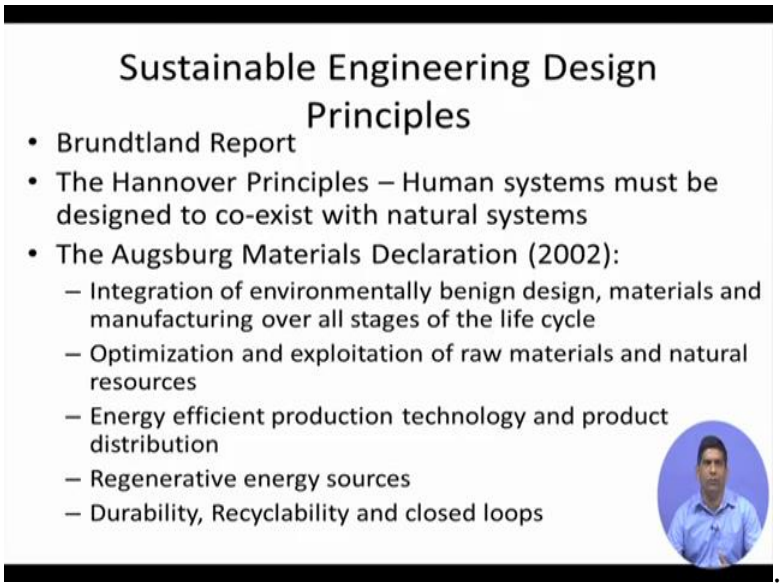

So, let us kind of will stop in this particular module over there. Where again we have what we have looked at in in this particular module we have try to see in terms of we looked at this transportation industry example. And we try to see that how we can achieve and some of the basics before that and the overall goal is to we have to make something may we have to design product processes to be more sustainable and the LCA part kind of tells you that how to evaluate sustainability, but then there are other aspect here we are start looking at the economic aspect and we which LCA does not do it. And also the social aspects. So, the social and else social and economic aspect also needs to be considered in terms of better product design or process design. So, with that we will have a closer of this particular module and then in the next module we will start looking at some of this sustainable engineering principle some of the some of the document which has been prepared. So, we will review some of those document like a brief summary and that would be in the next module. So thank you very much again I hope you are enjoying the course and I look forward to seeing again in the next module.

Thank you.