Strategies for Sustainable Design
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Lecture 30
Reduce, Reuse, Recycle

Hello everyone, in this lecture we will discuss about the strategies of three R reduce, reuse and recycle.

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You may have seen this logo and most of the logo products and packaging's and items. So, this represents the recyclability feature of that particular product or that package. So, this product is designed if you have seen this logo on something. So, that means this product is designed for reuse recyclability are reducing the impact in overall sense.

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So, we will see in detail life cycle environmental strategy and consideration. So, there are certain possibilities at different stages of the product at which this can be used for these kind of strategy. So, for example if you see over here at the product level the complete product. So, this talks about the end of the life strategies for the recovery options.

So, all of these are at the end of the life cycle of any cycle. So, mainly they are used at that stage. So, at the product level and the second one talks about the component level. So, on the product level the reuse of the product can be actually thought of a remanufacturing of the product can be thought of recycling recovery of the components can be thought of and dismantling and shredding and recycling of the product again can be thought of.

So, from the recovery if you see it goes into component level. So, from recovery we can again make use of the components of that product or we can again go for the remanufacturing of those components we can go for the recycling and dismantling and shredding of those components which are found. So, basically the same philosophies but at the whole product level and the whole component level only.

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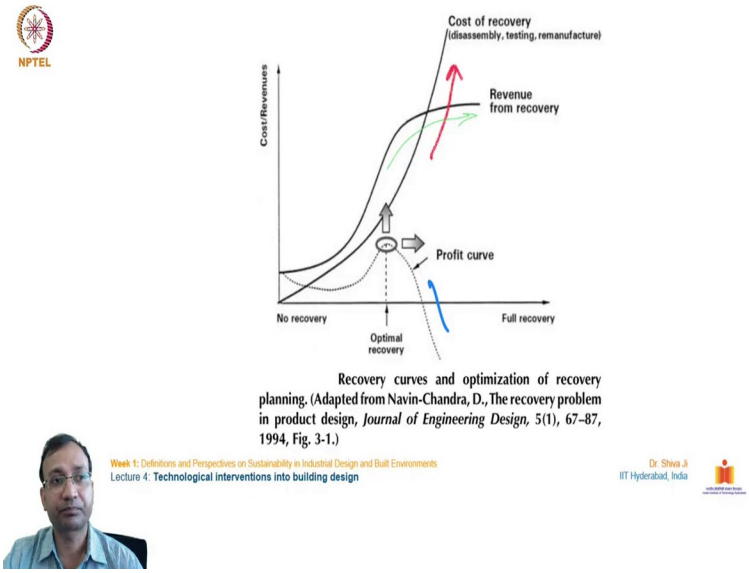

So, how this recovery curve and optimization of recovery planning can be. So, this is actually this paper suggest this illustration over here this graph you can see. So, it has on the x-axis it has no recovery to full recovery. So, if a product is able to be recovered completely or if a product is able to be in not record completely. So, on that we can have somewhere in the middle and on the y-axis there is this cost or the revenues. So, the when we go for the actual recovery process it takes certain amount of energy and certain amount of money. So, how that can be minimized or if it increases directly over the cell.

So, this goes for the if it increases if the cost of the recycling or the recovery is very high then it is starts going very up. So, we will see over here this line suggests the cost of the recovery. So, with the disassembly testing and remanufacturing as effort goes more and more the cost of starts increasing and this line talks about the revenue from the recovery.

So, we start getting a minimal amount from there it starts increasing and at a time it reaches that kind of stabilized recovery or the revenue which can take place from the recovery of that material this dotted line talks about here this profit curve. So, up to certain stage it can be profitable this is optimal recovery threshold of this particular chosen product for the recovery and after that the profit starts going down.

So, from here I think up till this stage one can go for responsible and optimized recovery after that recovery can still be done if the product is hazardous or toxic to be just let loose in the

ecosystem then even after it does not give desirable profit but it must be required and completely disposed for complete or the minimal possible impact on the ecology.

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So, there are some guidelines there are some approaches there are some strategies which talk about design for disassembly. So, what is the disassembly dismantling the we discussed in the previous lecture we will discuss here it in detail. So, at the different design levels for example frame design part design or joint design we can go for separate guidelines or strategies which suits the need at that particular time.

So, for example separate ability of toxic or harmful parts and materials the one we just spoke in the previous slide separate ability of high value parts and materials subdivision into easily separable subunits modularity of architecture simplification of the hierarchy of connections between parts pre-arrangement of accessible recognizable pathways for disassembly operations and on the part design if you see less variety or incompatibility of the materials.

So, this we have discussed few times earlier also the product should not be that difficult to dismantle or it should not be. So, rigid or strong that it becomes economically infeasible to segregate them for example alloys I have been giving example several times. So, there could some other types of compounds which become very difficult, very complex to bifurcate them into their other elemental components.

So, presence of flat surfaces in standardized handhold arrangement of handholds near the center of gravity provisions of lines or areas are preferential breakage and our provisions of cutting are fracture path along the interfaces of the incompatible materials highlighting breakage points to facilitate identifying and reaching them.

So, these are strategies or the approaches which we can adopt for part design for example in the geometries and materials and in the joint design if for example junctions of different materials or the same material. So, using like reversible junction system using junction elements that can be destroyed physically or chemically less variety of fasteners and fewer types of fasteners that are difficult to remove fasteners are very difficult to once they are planted in any concrete or big brick material they are going to be for always unless that wall or that concrete unit is broken because there is no mechanisms plug these fasteners out of that material.

So, we have to be very careful while planting these fasteners in the building structures less variety of fasteners and fewer types of fasteners that are difficult to remove fewer fastening system that to be opened require simultaneous actions. So, there are some fasteners which are available that are up to certain components of those fasteners can be taken out. So, those kind of recoveries are advisable to go ahead in the buildings.

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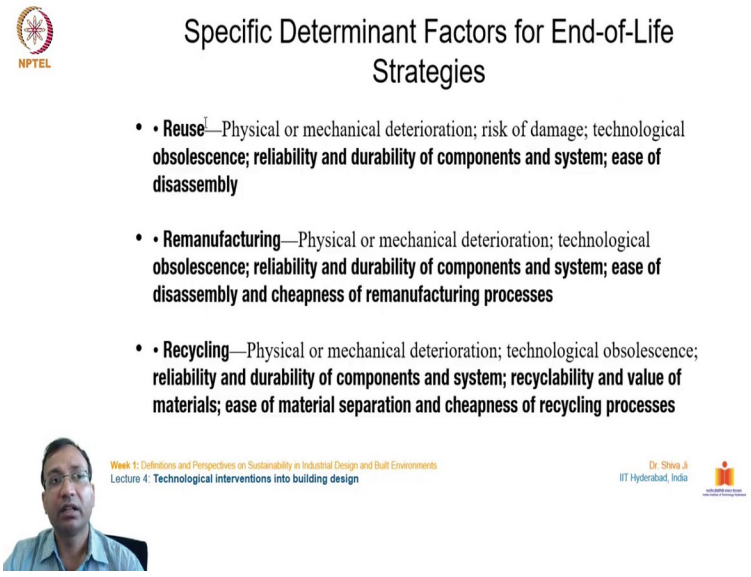

Well specific determinant factors for end-of-life strategies if you see like a reusing remanufacturing recycling we have been speaking of. So, physical or mechanical deterioration

risk of the damage and technological absolutions and reliability and durability of components and system ease of assembly.

So, these are characteristics and the factors for reusing product after the end of the life cycle stage for remanufacturing physical or mechanical derivation again technological absolute sense reliability, durability of components of the system ease of disassembly and cheapness of remanufacturing process.

So, the process has to be economically viable also going for remanufacturing otherwise if it is equal or more and then the new material itself it will be very difficult to apply such strategies or approaches in those cases for recycling physical, mechanical deterioration is of course there technological absence is there reliability and durability of components and system recyclability and value of the materials and ease of material separation and cheapness of recycling processes. So, these are factors to help this strategy of recycling.

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Well so, we can talk about some design experience over here choice of the material junction system and layout of the product. So, minimizing the number of different materials making sub-assemblies and parts irreversibly connected from a single material or from compatible materials use both recyclable and recycled materials avoid the use of toxic or dangerous materials, avoid metal, inserts or enforcing in plastic components.

So, these could be further better choice of the material and then if you go for the junction system minimizing the number of junctions and the number of different types of junctions because junctions and the joints complicate the structure. So, the lesser the number of joints and junctions are there the more efficient the system will be for design.

For disassembly and disposal use the rapidly reversible junctions especially for the connections of high value components or incompatible components make point of junction easily accessible use junction made from materials compatible with the connected parts provide for separation for breaking to accelerate the disassembly process simplify and standardize the junctions between the companies finally for the layout of the product minimize the number of parts make the architecture as modular as possible.

So, well you may be knowing already this modularity, modularity of the characteristics one of the strategies to design products with the component the multiplication of the component wise. So, that if we need more units of that product. So, the same product can come and join the first product and they can multiply in the number.

So, the application it offers the ease of applicability ease of flexibility and it offers in the same variety we can have multiple uses separating the functions component you locate non-recyclable parts. So, that they are easily detachable you know locate parts of the high value. So, that they are easily accessible and easily recoverable. So, these are the some strategies which are associated with these three hours and which we can take care of while of the design stage only of the product.

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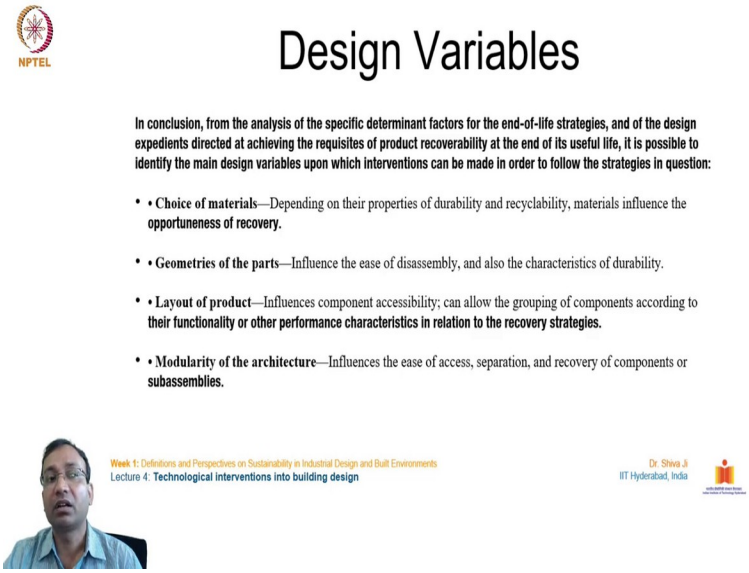

Some variables, some design variables you can see over here in conclusion from the analysis of the specific determinant factors for the end of life strategies and of the design experience dictated at achieving requisites of the product recoverability at the end of useful life it is possible to identify the main design variables upon which interventions can be made in order to follow the strategies in question.

So, for choice of material depending upon their product properties of the durability and recyclability material in influence up or opportunists of recovery geometries of the past if you see influence the ease of the disassembly and also the characteristics of durability layout of the products if you see influences component accessibility can allow the grouping of components according to their functionality or other performance characteristics in relation to the recovery strategies finally the modularity of the architecture if you see we discussed on the previous slide it influences the ease of the access separation and recovery of components are sub-assemblies.

So, when all of these together they provide this ease of disassembly ease pf dismantling, separating the components of the utilizing then and maybe manufacturing them into new goods or repurposing them for new purposes and new application. So, such activities can be taken off at the end of the life stage of that product.

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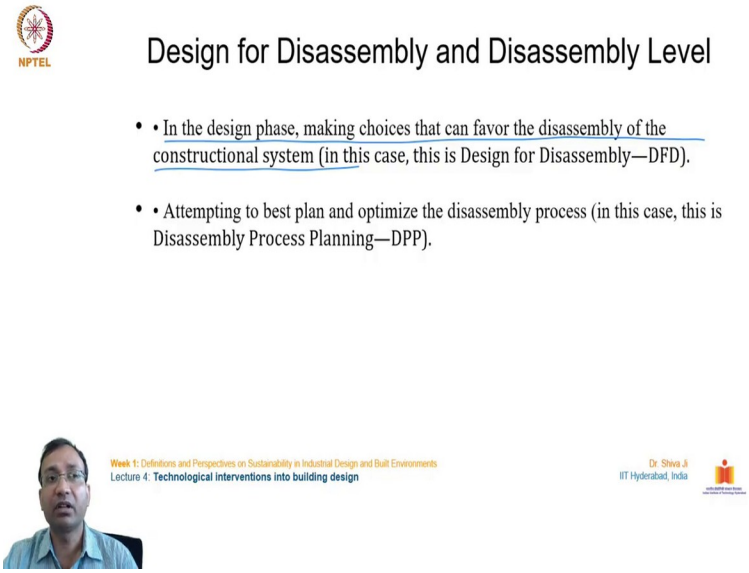

Design for disassembly and disassembly levels. So, in the design phase making choices that can favor the disassembly of the constructional system in this case is design for disassembly DFD attempting to best plan and optimize the disassembly process in this case, this is disassembly process planning DDP.

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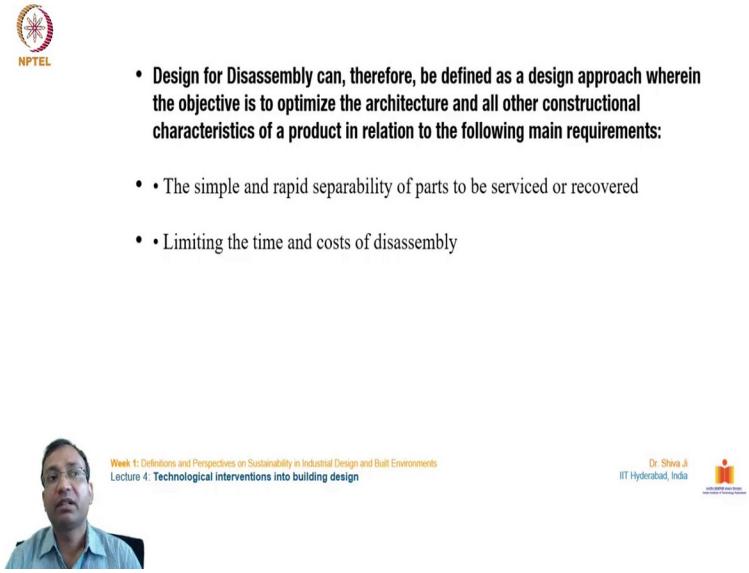

Design for disassembly can therefore be defined as a design approach wherein the objective is to optimize the architecture and all other construction characteristics of product in relation to the following main requirements those are the simply and rapid seperability of parts to be serviced or

required and second limiting the time and costs of disassembly. So, these are the two approaches the two main objectives of design for disassembly through which we can work for sustainable product and service system.

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Well, these three are you can see over here this is an illustration from WWF what we consume and the packaging it comes and creates over a ton of waste per household per day. So, it talks about creating the waste and also how these things can be these strategies can be applied in different scenarios. So, this talks about landfill relays large amount of methane gas is H 4 which contributes of course to the climate change this is universal flag now and how we can be part of this solution.

So, well there are some very simple solution and behavior based things behavior based values are given over here for example the first R it talks about refusing. So, we must know those hazardous upper products or items or substances which have the potential of damaging the ecosystem we should go we should always go for recycling of most other stuff.

So, whichever we can at least find some place for papers, you know plastics, you know cardboards excetra because these are easily recyclable materials they can easily go to those if it is paper and this thing that easily go to the paper processing pulp industry and can be reused for we can avoid non-recyclable items thermocol based utensils and things they are very bad, they are very hazardous you know we can reduce the amount that we can reduce consumption we can

make the move to clean the energy, we can move towards reducing the impact through this approach also, we can go for reducing the energy, we can go for reducing the use of the consumption of the material.

Now, we can go for composting at household level now this is one of the easier solution in the recent years there are several agencies and NGO's who are helping households to establish such facility within the premises of house and it does not require. So, much of investment it is just the intent you need and some maybe a few hundred bucks and that you will be having your own bio composter at your home you must look on the internet for some easily solutions.

So, that you can start doing this activity at your home only and there is another approach of reusing. So, we should not throw stuff if there is some potential of that product to be big as some other material or some other application. So, we must reuse it or maybe we can even upcycle it and at worst at least we can down cycle it we must choose responsible materials which are rated we can always go for reusing such stuff.

So, we can always go for refill packs of several products, we should not buy the main product the bar with the boxes and other packaging materials every time we can always go for refilling. So, in turn we can save lot on the packaging part.

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On the food waste if you see how the food waste can be taken care of. So, there are several systems already in place in different places you may have seen in your institutions and schools and colleges how the food waste from like dining halls they are being disposed.

So, well planning can be done in the first place beforehand to create this mechanism and the system in place we can do it at home also at smaller scale we can go for keeping it for safer, for some diet sometimes. So, that it can be if there is possibility of reusing it by somebody or the family itself and then we can go for composting at the household level and if not at least we can give it to some NGO's and some agencies who actually distributed to the needy.

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For regarding sustainable shopping if you see over here. So, in this one talks about the choices we make at the checkout can have considerable impact on our sustainable future showing retailers and manufacturers that we want sustainable options will create more demand for them. So, we must be having responsibility whenever we are in commercial establishments and we must put up this straight forward demand for using responsible materials and sustainable packaging and other stuff.

So, in turn this kind of demand will put the pressure on the shopkeepers and the suppliers and in turn they will be looking for such solutions to providing solutions. So, we must opt energy efficiency we opt recycling we should go to the local shops, we should go much as possible for being our naturals or sourcing natural we should not ear or early or even if you are eating then

we must eat very little of this red meat because this is one of the highest impacting food material in the entire food ecosystem that we have seen it in the preview one of the previous lectures.

Then we should help some animals also who are in the need, we should reduce waste, we should avoid sending our stuff to the landfills we should try disposing of properly on site itself we should go for reducing waste, we should inform, we should be aware of the things in and around these phenomena. So, these are literally some sustainable practices we can adopt ourselves.

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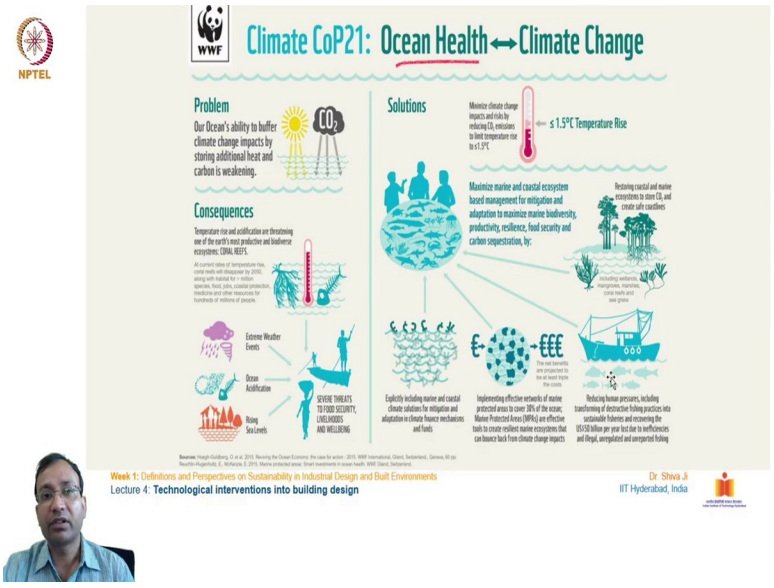

If you see here. So, this is the slide which talks about the health of the water body for example ocean. So, the problem if you see our oceans ability to buffer climate change impacts by storing additional heat and carbon is weakening. So, in the recent years there is lot of pressure being exerted on the oceans also in terms of excess like CO 2 well the consequence is the temperature rising and acidification the threating of the earth's most productive and biodiverse ecosystems coral reefs excetra also have been like endangered in the recent times extreme weather events are occurring at different places ocean edifice acidification is new phenomena which has been observed in the recent years rising sea levels are of course threatening to the several countries and communities who are thriving at the shows at the close to the Lakers seashores for generations.

It is giving threat to the food security and livelihood and well-being of the communities who are dependent on the oceans for their livelihood well the technical solutions minimizing the climate

change impact and risk by reducing CO 2 emissions and to limit temperature rise to less than 1 point 5 degrees centigrade. So, in that situation maximizing marine and coastal ecosystem based management for mitigation and adaptation to may maximize marine biodiversity productivity religions and food security and carbon sequestration by some means.

So, these are listed over here explicitly we can go for including marine and coastal climate solutions for migration and adoption and climate financial mechanisms and funds we can go for implementation effective network of marine protected areas to cover 30 of the oceans and we can go for reducing human presence in such places including transformation of destructive fishing practices into sustainable fisheries and receiving US dollar 150 billion per year to lost due to the inefficiency and illegal and unregulated and unreported fishing.

So, fishing has also the recent times has become one of the very high impacting activities from humans in the happening in the open oceans restoring coastal and marine ecosystem to store CO 2 and create safe coastline. So, there are the several efforts which we can put up from our side for well-being of our oceans.

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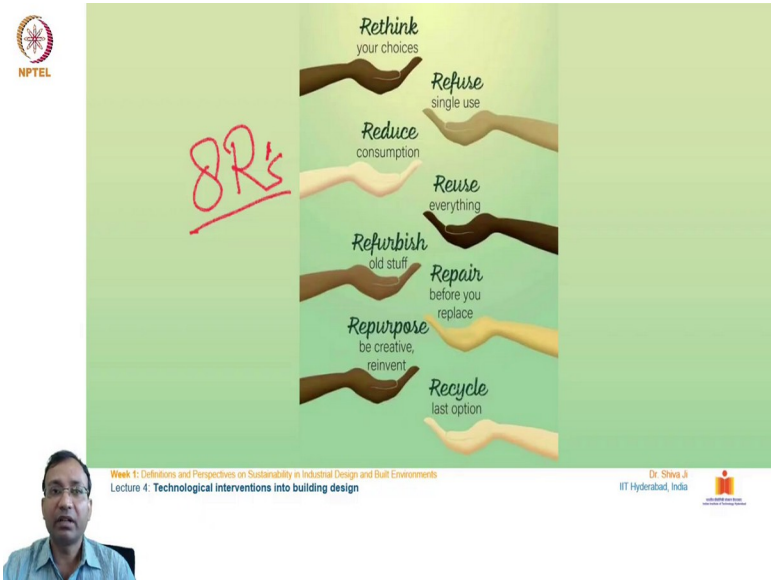

Well so, there are as we have been discussing there are several hours proposed for sustainable practices these are the strategies which can be utilized in the product planning and designing and manufacturing and the end of the life stages of those products by rethinking first of all rethinking

comes because we have seen in the previous lectures lot of things depend on our lack of behavior and in our consumption pattern.

So, we must check our consumption pattern we must check our behavior we should we must act as responsible citizen who cares about the environment. So, that is why this rethinking has come has been given over here a first choice then refusing well at least we can refuse taking poly bags from the liquor shops and other thermocol based packaging try at the shops that will in turn will lead to the finally closure of such products which are being given in the markets we can go for reducing the consumption we can go for reusing everything.

So, in turn we should not create waste, we should go for refurbishing or old stuff. So, that we can increase the longevity of that product we can always go for repairing before we throw the item out for example umbrella. So, in the earlier times there used to be several umbrella repairs on the street but nowadays the product chains have also adopted kind of strategy use and throw and this Eugene throw philosophy of these products the cheaper products made up of plastic and other materials they are the one of the major contributors of the waste which is generated in the recent years.

Well repurposing to be making these products turn into some other usability we can always be creative in handling this repurposing thing for any waste and of course the last one recycling as the last option we must recycle also we should not leave any product even after this stage and we should end the life of that product over here.

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So, for example like zero-waste kitchen. So, this is slight taking from commercial company in website where is has been like actually suggested for consumers and household people to go zero-waste kitchen. So, how we can minimize the waste from the kitchen. So, there are some solutions available for storing packaging, carrying excetra. So, these efforts are really laudable and these will in turn they are creating awareness on the overall topic.

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Well, there could be several other approaches also to refurbish to repurpose and recycle and reuse stuff. So, there are listed over here some ideas for creating gifts out of the waste material

out of the discarded other end of the life stage products. So, there are similar such efforts given by several agencies and these are being made available for public awareness and information through social media platforms. So, we can also utilize the potential of social media for spreading this awareness.

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Well, such awareness is also nowadays part of our schooling. So, children should be informed of such catastrophic repercussions at the early stage only. So, that they can be responsible citizen later.

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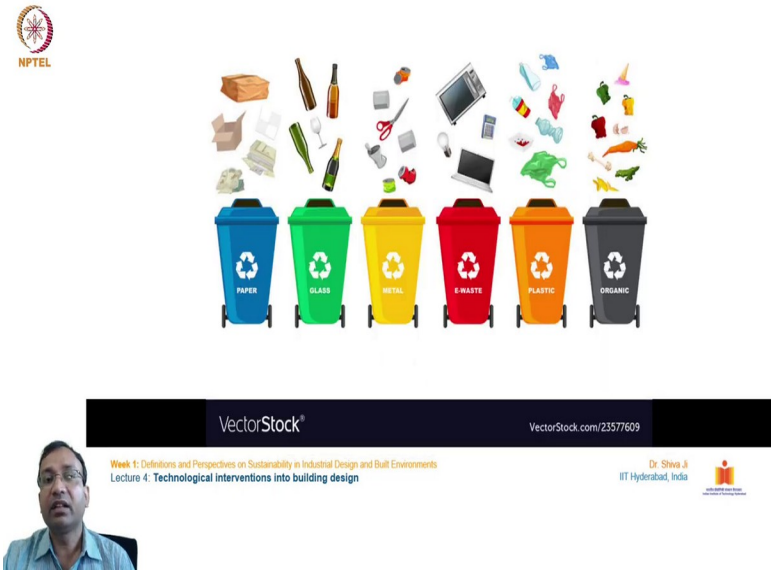

Well, you may have seen color-coded trash boxes. So, you must be behalf responsibly while you are throwing any waste which you could not recycle or reuse or reprocess at your home only. So, you should always keep the types of particular class of these goods and waste material in the particular color coded these waste bins.

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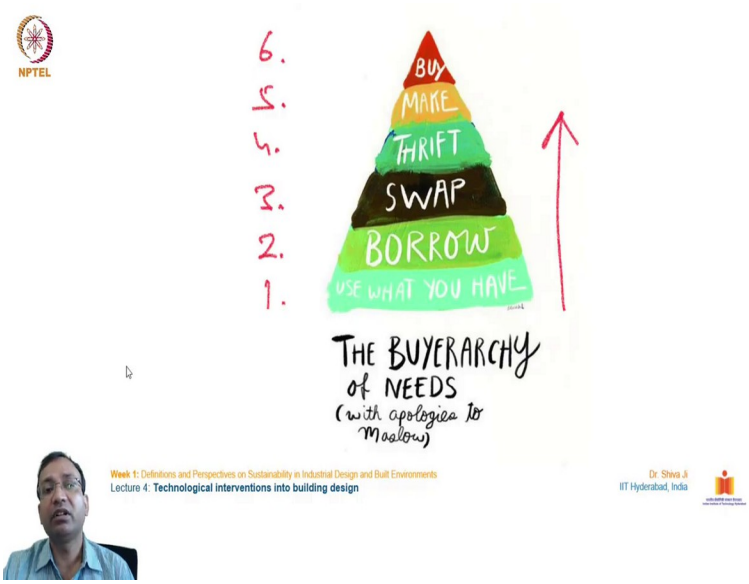

Finally, our habits choices they are the most important factors any product or approach will not actually fulfill will not produce such results whichever the change in the habits can do that. So, we must mend our ways and we must realize the need for that and we should adopt this strategy which is given by this researcher over here which talks about using whatever we have at least not simply going to the market and buying stuff at least if we can try borrowing it from someone in the neighborhood if they have it or maybe we can swap it against some article what we have, what we possess we can go for thrifting we can go for even making.

Finally, if it cannot be really belong these many efforts then only I think we should buy new stuff. So, we have to be the purpose of this last slide is to make us aware of the need and the change what we as Laker people can bring by mending our changes by bringing change in our behaviors in buying stuff. So, with this I would like to end this lecture over here. Thank you.