

Product Engineering and Design Thinking
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Module - 05
Embodiment Design and Eco-design
Lecture - 24
Sustainability and Eco-design

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Sustainability

In 1987, the United Nations released the Brundtland Report, which included what is now one of the most widely recognized definitions:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

OUR COMMON FUTURE
THE WORLD COMMISSION
ON ENVIRONMENT
AND DEVELOPMENT

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So, when we talking about definition sustainability, the most important definition and most widely accepted definition among the researchers or the from this is this definition. “Sustainable development is development that meets the need of the present without compromising the ability of feature generation to meet their own need.” This is Brundtland Report. This is part of the Brundtland Report, 1987, Our Common Future is the book of the report name.

What it means is that sustainable development, it is development, it is development that meet the need of the present. So, we should meet our own need with resources and we should not compromise the need. So, our next generation should be or must have the resources which they need for their livelihood. And this is possible when we have responsible usage.

So, this that is why it is a we will learn about later on that 6 Rs, recycle, reuse, re-made vector, all these things are coming. Eco design policies, eco design standards, sustainability, sustainable manufacturing, sustainable design, all these are supposed to help both designers and users to live a better like design product, used product which are more sustainable. So, what are the measures of sustainability?

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Measures of sustainability

Triple bottom line (TBL) approach: also called: three pillars of sustainability

Planet (environment), People (social), and profit (Economic)

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There are 3 important measures of sustainability, social, environmental and economic. Environmental by this time we already understood that it is very important to makes product

which are sustainable with respect to the environment. Environment pollution should be as low as possible. Emission should be as low as possible. So, Environment is going to not get affected badly.

So, people should be able to happy happily use this product. They should be able to have a social impact on the society, the product or the process. There are multiple measures of course, these are the major measure things which is coming in our mind. Third thing, economic, there again multiple approaches; but the product should be able to make the company, the product when the company is making product; they should be able to make it profitably.

This is also called triple bottom line approach; it is called 3 pillars of sustainability, environment, social and economic. So, planet, it could be it is also called 3 piece, planet that is environment, people social and profit economic.

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Various sustainability initiatives at different levels

Mitigation and adaptation

Global initiatives

- Global collaboration through agreement (eg. Kyoto protocol & Montreal Protocol)
- Carbon Trading and carbon cap

Individual country initiative

- Supporting being green: Subsidary for being green and taxing for not.
- Implementing sustainability standards (e.g. ISO 14000)
- Implementing directives that restricts use of harmful substances (e.g. REACH, RoHS)
- Implementing best practices (e.g. WEEE for electronic disposal)
- Reporting initiatives (e.g. GRI)

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So, what are the initiatives? There are so many initiatives are possible. People have companies, governments, international organizations, even individual people they have understood the importance of sustainability, importance of eco design, importance of reduction of emission.

Kyoto protocol, many of you heard. I think in 2003, or 2004, company government, multi organization, multiple government organizations, multiple governments came together and they have taken decision that they are going to reduce the emission from these to these, 5 percent, 10 percent over multiple years.

Many other countries also joined in later on and this has become a very big GS GS summit, G put in then the Global Summits are has taken place. There are so many discussions, high level

discussions. All these are mainly to take and make some kind of policies which the countries can adhere to.

Now, this policy is going to come from the countries to the individual companies, right. So, from there came carbon trading and carbon cap concept. Carbon trading means now we have to understand why this required is this when you have this emission need to be reduced. So, take by them two companies, they are one company, they have reduced their emission by something like 20 percent.

So, when you have take to reduce the emission in terms of manufacturing, especially manufacturing or design, especially in manufacturing. So, we have to put effort, we have to put we have to make use of software tools, people who are expert in emission reduction, change the process, change the material. And what are these things which we are doing everything, whatever we do, it requires some kind of resources, time and money.

So, some companies are very keen to reduce, they have reduced. Some companies they have reduced more, much more reduction they did than what is expected by them. So, the extra emission reduction, extra carbon, they can they have is carbon credit, it is called. This credit they can sell to other companies in the open market.

There are certain companies who are not able to put their effort or they are not interested to put their effort introduction of the emission. So, they can buy this credit from other company and they can show that I have purchased this credit from this company and I have reduced the emission totally in calculation.

But, thing is that we should understand this is not a good idea because each and every company is supposed to reduce their emission. Is carbon trading? It is a good idea? Good concept in the and paper in terms of paper? But actually, reduction is required more than whatever is required to be done.

So, so the good thing is that these things in on a calculation basis, it is good, but we should also see that what can be done beyond that. Individual carbon company initiative, subsidiary of being green there are organizations who are making products which are green products.

There are also countries especially in India, they are if you take for example, if you use or if you purchase solar based systems, then there are some taxation benefits is there, reduction in prices are there, incentives are there from the government and several other initiative apart from solar also. So, government is trying to support initiatives which are eco-friendly.

Apart from this implementation sustainability standards so, many of you know about ISO 9000 standard. ISO 9000 is a quality standard. ISO 14000 is a sustainability standard, environmental standard. So, environmental emission, environmental substance standard, this is these are this is you are going to provide guidelines to us companies. That you can do these things or you can you follow this guideline and you are supposed to reduce the emission by this amount, you can also have some kind of measurement of these and find out how much reduction has taken place.

Implementation of directives that restricts use of harmful substances like REACH, RoHS. REACH is standard for chemicals. RoHS Restriction of Hazardous Substances. So, these chemicals are especially found in, especially electronics products. So, some of the harmful chemicals are cadmium, other chemicals there are some initially it was 6 chemicals and now it is 12 and more chemicals as ah metals as being added. So, why this is required?

So, take for example, electronic products, it while manufacturing these products, this some of the chemicals have been used in manufacturing. People are going to happily use it, after you say it is not working, may they will go and throw it out. It is going to good landfill, from landfill some of the things, from the chemicals is going to slowly seepage, slowly they are going to add to the water table.

From there again, it is going to come to the human health human. So, these are something which is really really worrying some. So, these standards tell ideally these chemicals should

not be used, but sometimes not possible because of manufacturing limitations; so, standard charge that you can use these chemicals, but till this amount per kg or per million, ppm, some measurement is there, depending upon the measurement.

So, these standards which are restricting these uses of these chemicals are there in place by various organization, basic government organizations. So, if you want to sell any product, any electronic product to the European market you have to follow or your product has to certify be certified as RoHS certification, REACH certification or WEEE certification. Otherwise, you cannot sell.

This was the rule few years back. However, now the same rule is applied to India. Same rule have applied to many other countries along with of course, European and US. So, these are some of the standards which are very important for making us aware that the companies has to adhere to the standard. Government organizations of multiple countries are really eager to make and enable people to use products which are sustainable and environmental friendly.

WEEE is another one waste electrical and electric disposal. The company is supposed to take care of the waste electrical and disposal. How to do it? So, they have to take this initiative, they have to have the standard, they have to take back some of the products and then it has to be certified.

Reporting initiative, GRI is very important, Global Reporting Initiative. So, this is the initiative which is a standard way of initiative, standard way of representing how much emissions is there, what are things you have done and what are the things can be done to reduce it.

And this is the report which is need to be generated by most of the bigger companies. And then, it has to be expressed, and this reporting initiative is going to help companies to understand where the emissions are taking place. And then, take some steps and actions to reduce this emission as low as possible and then standards are there in place also.

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Various sustainability initiatives at different levels

Mitigation and adaptation

Corporate/industry initiative

- Following Eco- design principles: Designing Eco-friendly products
- Designing products for reuse, remanufacture, and recycle

Individual country initiative

- Saving energy in house, travel and in office
- Recycling products

Design for sustainability

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So, from the corporate industry initiative, eco design principles we will learn little bit of that also, the designing eco-friendly products, products which are good for the environment.

There is a principle also on that. Designing product for use, reuse. Reuse means when you take for example, chair one portion of the chair is broken wooden portion, you repair it, that you can repair. You can use the chair again for same purpose, for another purpose reuse. Re-manufacture is take for example, one product is there, some portion of the product got damaged, you change the portion of the product and then reuse the product.

Many other engines are being reused for this. So, this is imagine the bigger engines. What they do? They reuse it after repairing, changing some of the some of the components. Re-cycle, when these reuse is not possible, remanufacture is not possible, re-cycle. Please understand re-cycle is required, but re-use and remanufacture is more important than re-cycle.

Because re-cycle what is happening is we are taking the product and breaking into small parts.

We are taking extracting the material, we are extracting the different kind of material and then making a new product, it is going to use lots and lots of energy. Anyway, this is much better than throwing in the dust bin and throwing in the land field, right. So, this is something which is important for a designers and a company also. Initially, in individual initiative same, saving energy in houses, travel in office, recycle products.

So, when next time you try to make yourself eco-friendly, see that you reduce your emission by reducing the amount of energy usage in terms of travelling. Unnecessary travelling, putting lights on, putting fan on, multiple ACs unnecessary spending time, unnecessary changing mobile every now and then, some people are having so many dresses, they do not need.

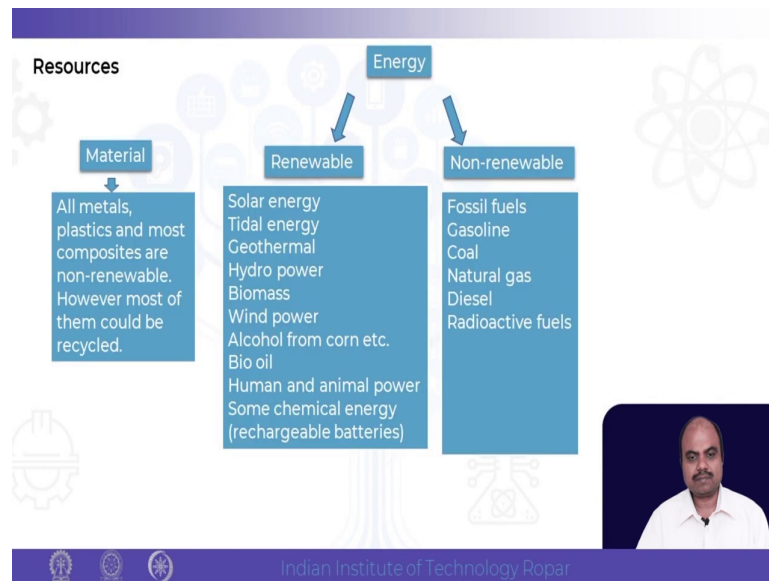
Do not recycle products and waste products as the people are creating. They are dumping, there has been rooms under the house, inside the house which is full of products which they do not use. What is this? So, now you may think that, ok I can change it, I can reduce it myself.

Now, what is the use? This company is creating lot of many machines , you see the chimneys of this company huge amount of emissions, why I should be worried about my style. But what if you understand the small small things effort is going to have a bigger impact on the society.

So, if all of us, personally, if we are environmental friendly, then while we are doing working, working also we will be more environmental friendly, our working style will change and we can become more and more environmental friendly. The design for sustainability it is important, we are going to come to this conclusion now.

We have to design product which are sustainable, otherwise no other way, we have to product sustainable, we have to make use of the sustainability, we have to make plant trees, all these things we need to do, we have to reduce emissions, we have to reduce energy usage.

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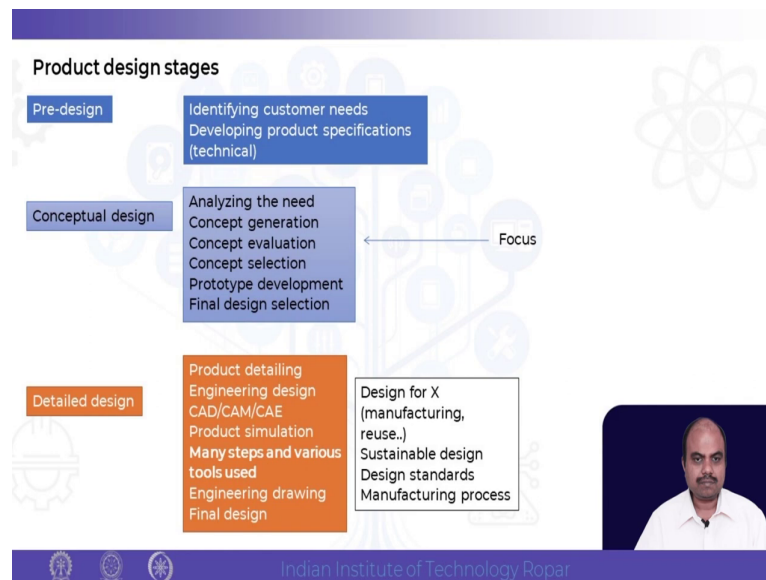
So, when we talk about resources, please understand materials are recyclable, but they cannot be made. So, please do not waste materials. All the materials, metals, plastic, most of them are recyclable. But these are not you cannot create it, create them especially metals.

So, widely use it and ensure that all of them are reused or recycled. Energy there are two kinds of energy, one is renewable energy, another is non-renewable energy. Renewable energy basically solar energy from the sun, tidal energy from the sea, geothermal from the ground, hydro power water, biomass from natural resource, wind power, alcohol from corn, bio oil, human and animal power, some chemical energy. All these are re renewable energy.

We should try to use renewable energy as much as possible. Additionally, this is extremely important; we should also try to reduce the amount of energy required for this. Non-renewable energy is the fossil fuel that you already know. Gasoline, coal, natural gas,

diesel, radioactive fuels, all these are non-renewable energy. Try to reduce it as much as possible.

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So, now we are coming to product design in, especially in product design, how sustainable it is going to play an important role. The first thing is in any case, identifying customer need and develop product specification, then conceptual design which you already learnt, analyzing of need, concept generation, concept evaluation, concept selection, prototype testing. So, these are part of conceptual design.

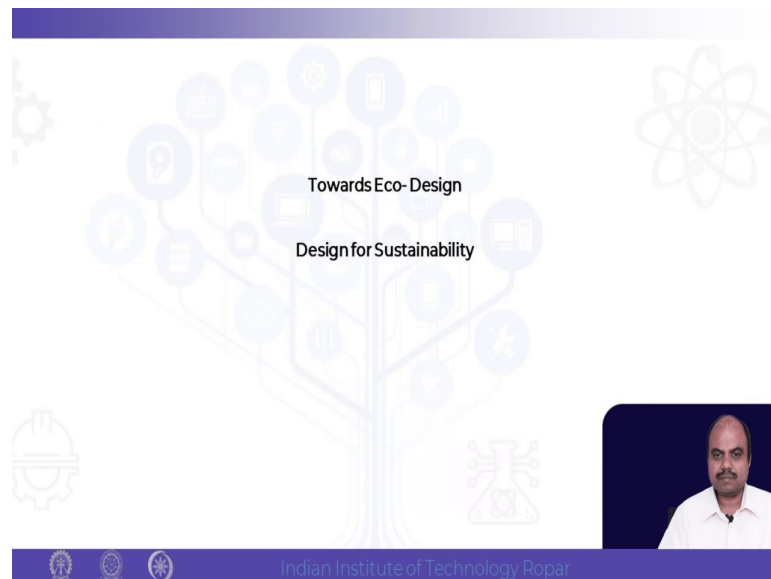
In detailed design, we have this product detailing, engineering design, CAD CAM, product simulation, many other engineering designs. So, in detailed designing, we design for X. So, D, F, D, design for D, F, S, so design for sustainability, generally we do. So, what we do? We

basically take a product, analyze it, the design which we have done, life-cycle assessment we do.

And once we have life-cycle assessment, we try to reduce it. But then, we are doing all these thing in design, detailed design. Detailed design is where we have already have the engineering drawing, design is already fixed. So, changing is expensive, many people do not want to change sometime.

So, when we need to make product which is sustainable or environmental friendly, please understand that working in detailed design is not a very good idea. So, researchers have to work and we are also working, many researchers are working now to focus on making products environmental friendly during the conceptual design stage itself. And that is very important because conceptual design is where we have lot of opportunity to change.

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So, why not focused there, make it more sustainable during that phase.

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Design for Sustainability

"Products can be considered as the embodiment of environmental harm caused by production, consumption and disposal."
[Eva Heiskanen, Finnish environmental economist]

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It is estimated that 70% of a product's environmental impact is **locked in at the design stage**.

Key principles of DfS

- Efficient design - keep the material and resource inputs to a minimum. Do more with less.
- Cyclic design - design to enable materials to be continuously cycled through natural or industrial systems.
- Safe design - avoid toxic and hazardous substances and processes. Keep human health in mind as well as ecological impacts.
- Communications design - ensure product and packaging related communications are informative and accurate. Encourage responsible consumer behaviour.



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So, now, design for sustainability towards eco-design. So, product can be considered as the embodiment of environment, harm caused by product consumption and disposal, they done by researchers. It is estimated the 70 percent product's environmental cost is locked in design stage that we have already known. So, as we are telling that conceptual design, sustainability and conceptual design is something which is very important.

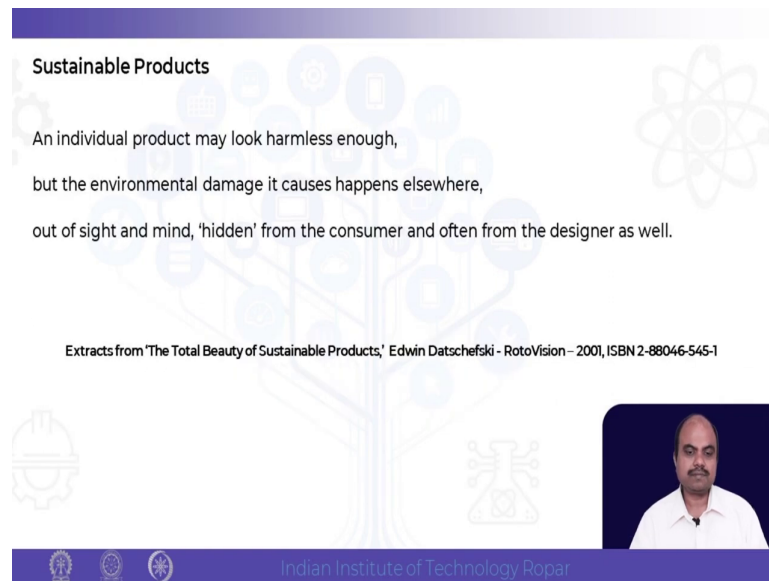
So, when we have these key principles of sustainable design for eco-friendly and sustainability, so one is this efficient design. Keep the material resources minimum to a minimum. Do more with less. So, product efficiency is important. So, nowadays if you see

the car 20 years back or now car, cars engine, car engine is much more efficient. We try to use the car which is having better mileage, better efficient system.

Reduce the material for usage. Cyclic design enable design for enabling this continuous cycle. You take this material and try to design that after this, what is going to happen? We want to take back the material and use it in other material. So, this is cyclic design that is we have need to achieve. Safe design, avoid toxic that is what is the standard is all about, toxic hazardous substances.

Keep out, do not use in the product. Human health is very important and ecological health is very also important. Communication design: so, idea, ensure that product and packaging related communications are informative and accurate. Packaging is nowadays all the products which you buy you will comes with packaging. Do you really think packaging things are environmental friendly? So much of packaging waste we create. So, what can we do for that? There are so many things can be done, right.

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Sustainable Products

An individual product may look harmless enough,
but the environmental damage it causes happens elsewhere,
out of sight and mind, 'hidden' from the consumer and often from the designer as well.

Extracts from 'The Total Beauty of Sustainable Products,' Edwin Datschewski - RotoVision – 2001, ISBN 2-88046-545-1

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So, sustainable products - an individual products may look harmless enough, but environmental change the damage it does is cause happen elsewhere. This is many products are there which are having issues. Sometimes the out of the site so, emissions which are not caused in front of us, we feel that oh these emissions are not there, but that is not the case. Emissions are there.

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Are current products are sustainable?

Need for sustainable design: Examples



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So, let us go through some of the examples.

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Are products sustainable?

Sustainable Products

Over 30 tonnes of waste are produced for every one tonne of product that reaches the consumer. And then 98 per cent of those products are thrown away within six months!



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It has been found over 30 tons of waste has been produced for every 1 ton of product that decrease in the customer and 98 of them, 98 percent of the production thrown away within 6 months. Just think, is it true or not. You see so much of waste is being created. Harpic, we use. Do you know what is going to happen in Harpic? You flash it, bottle throw it.

So, what is happening? So much of waste we are creating. For each and every product we use; toothpaste same thing, carbonated water same thing, packaged material we especially go to the market, plastic cover which is the use that also same thing. We are creating product; we are creating waste and waste. So, similarly apart from this these are common products, there are so many other products which is which we use every day and most of these products are packaging or the especially the packaging in the product is going waste.



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Are products sustainable?

The Computer

About a quarter of a computer is plastic, mostly the casing. It's a candy coloured translucent plastic called polycarbonate, the same stuff that CD's are made from. It is made from phosgene, which was used as poison gas in the first world war, and Bisphenol A, an endocrine disruptor.

Extracts from 'The Total Beauty of Sustainable Products,' Edwin Datschewski - RotoVision - 2001, ISBN 2-88046-545-1




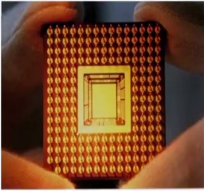
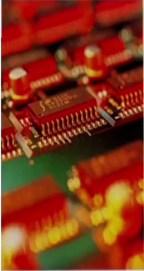
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Next is the computer. About a quarter of the computer is plastic and most of most of the casing. It is a candy coloured transparent plastic polycarbonate, the same stuff the CDs are made of. It is made of phosgene, which is used as a poisonous gas in the First World War, Bisphenol A, an endocrines. So, these are chemicals which are often used in the while making the many computer. So, we have to be very careful that we use the product wisely.

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Are products sustainable?

- The gold in circuit boards of a PC may have come from Romania, where a gold mining accident caused one of the worst river pollution accidents in Europe.
- Environmental damage due to gold extraction is high.
- For every ounce of gold extracted in Brazil, there are about nine tonnes of waste.



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Gold in the circuit board. Did you imagine how much emission is created while extracting the gold? Gold is not you know you like extract; there are lot of rocks will be there when they are up to in the extraction process. You will separate those, refine it, refine it and then gold comes. Is the gold extraction environmental effect is really really high?



So, 9 ton of waste every once ounce of waste so, little bit of waste in Brazil, if you are going to use there is so much of tons of waste is being created in the waste, in the gold extraction. Something you need worry about.

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Are products sustainable?

TeeShirts

- The manufacture of a T-shirt requires the use of 150g (1/3lb) of chemical fertilisers and pesticides.
- Cotton accounts for 25 per cent of the world's insecticide use.
- Farm workers exposed to excess toxins are at risk from poisoning and health problems.



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Tee-shirt most of us use it, right. The manufacturing, of T-shirt that requires use of 150 grams of chemical fertilizer and pesticides and apart from that the cotton which we use 25 percent of the world insecticides used in done is cotton. So, where we are going? So, much emission, so much of pollution and we use T-shirt for a few years and if you little bit of change in colour, we throw it out.



Is this right thing we are doing? Some people have so many, so many dresses, multiple of them. Is it really required? Apart from that workers, we do not think about them. They are people who are working day and night in these companies who are manufacturing these products. Their health issue is also a something which is important. They have health issues also because of these emissions in the local, in that in within the company.

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Are products sustainable?

A Desk Lamp

A typical desk lamp will use 1,200 kWh of electricity during its ten-year life. This would require about half a tonne of coal to be burnt at the power station, or in most countries a more complex mix of fuels such as oil, natural gas and uranium oxide.

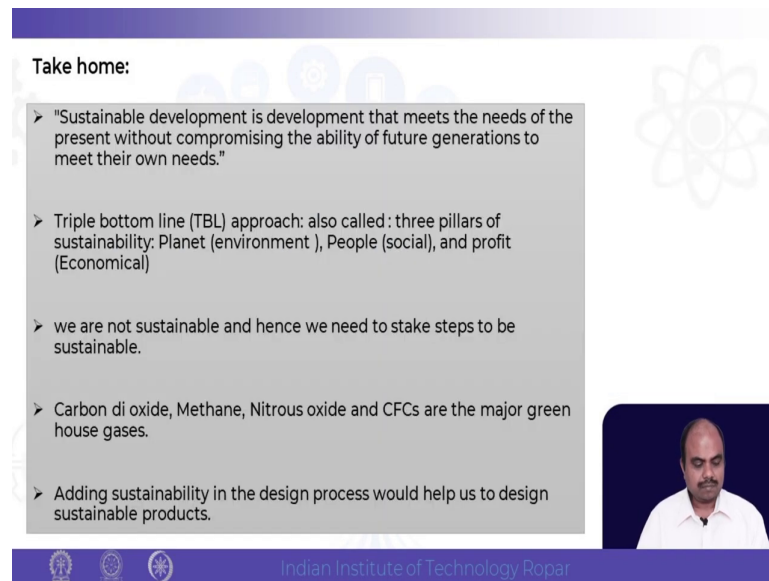


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Desk lamp, many of you are used through the two kinds of product, one is active product, one is passive products. Active product is one of the active products where it uses energy during the life of the usage also and Passive products which is only during manufacturing, but not during usage. So, take for example, pen. Pen is a passive product, while manufacturing the pen there are lot of emissions that happen, but while using there is no emission.

I mean it does not uses active energy. But lamp a table lamp it is not like that. So, a typical table lamp which uses 1000 kilowatt of energy during this 10 life 10 years life, this would require about half a ton of coal to be burned as the power station. Almost other countries a more complex mix of fuel such as oil, natural gas, and uranium ore. So much of, so much of resources are getting usage, used up slowly by these products.

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Take home:

- "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
- Triple bottom line (TBL) approach: also called : three pillars of sustainability: Planet (environment), People (social), and profit (Economical)
- we are not sustainable and hence we need to stake steps to be sustainable.
- Carbon di oxide, Methane, Nitrous oxide and CFCs are the major green house gases.
- Adding sustainability in the design process would help us to design sustainable products.

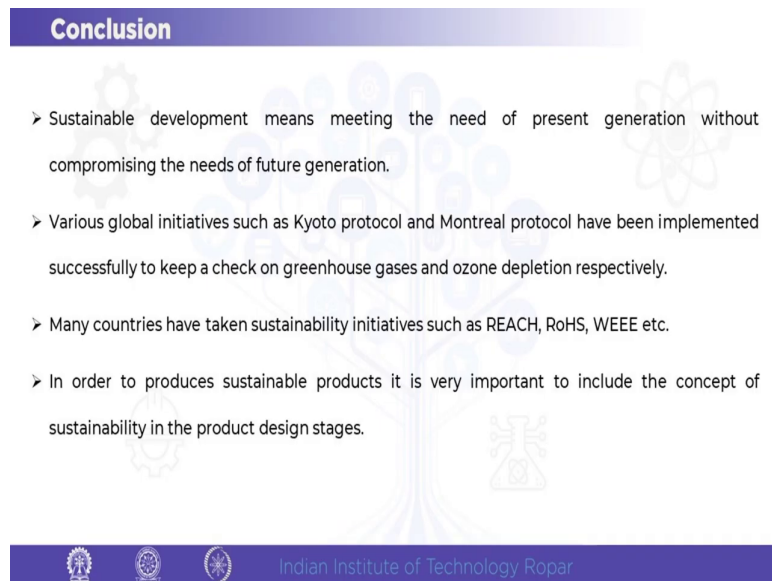
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So, what are the take home? Take home is sustainable development is development they need they meet so, then present without compromising the ability of the future generation to move their own need. This is the definition of the Brundtland report. And this is the definition generally followed by lot of researchers in the area of sustainability, and people are doing lot of research in this area and this is the definition which we should try to keep in mind when we are talking about sustainability.

Triple bottom line approach is called 3 pillar sustainability, p planet. So, the product should be good for the planet, that is environment, people social, profit economical. So, we are not sustainable, hence we need to stake steps to be sustainable that is the very important thing to understand.


Carbon dioxide, methane, nitrogen oxide, CFCs are the major greenhouse gases. And if you try to see that we reduce it. And adding sustainability in the eco design or design process will helped us to design products which are more sustainable.

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Conclusion

- Sustainable development means meeting the need of present generation without compromising the needs of future generation.
- Various global initiatives such as Kyoto protocol and Montreal protocol have been implemented successfully to keep a check on greenhouse gases and ozone depletion respectively.
- Many countries have taken sustainability initiatives such as REACH, RoHS, WEEE etc.
- In order to produces sustainable products it is very important to include the concept of sustainability in the product design stages.

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Thank you.