

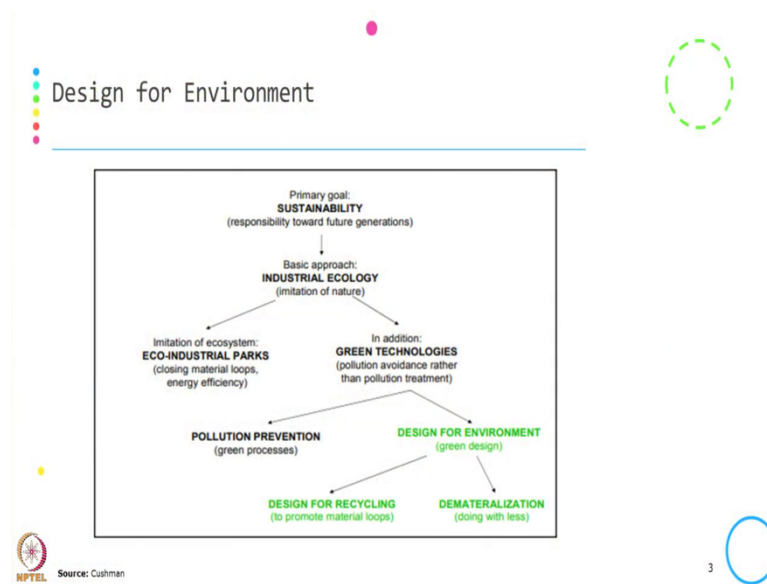
Business and Sustainable Development
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Lecture - 13
Design for Environment

So, we will try to understand now the management tool if you remember in the beginning when we are trying to understand what are the different tools what the company they are using to integrate sustainability into their day to day activity those are of three types. One is impact assessment tool, second one is the management tools and third one is the reporting tool.

So, under the category of the impact assessment tool in last two session we are understanding what is LCA. In this class we will understand what is the management tool, one of the management tool that is Design for Environment.

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Now going further let us see where the design for environment fits into our goal of the sustainability or the journey of the sustainability. Now, what is the primary goal? The primary goal over here is that sustainability that is responsibility towards the future generation. Now, what is the basic approach it is being followed, that is industrial ecology we try to imitate the imitate the nature or mimic the nature to conserve and reuse the resources.

So, in this case one we get into the imitation of the ecosystem, we get into the eco industrial park, closing the material loops, energy efficiency few of the action points, apart from this we can get into the green technology. And green technology talks about pollution avoidance rather than pollution treatment.

This green technology again can be into pollution prevention, we get into the green processes or we get into the design for environment green design; it means we from the design stage of the product we the so called sustainability concern, green concern or whatever way you put it that gets incorporated into the design of the product.

And here this design for environment is again into two types; one we do the product design we incorporate design in such a way that there is a recycling, there is a place for the recycling to promote the closed material loops. And second one is the dematerialization which typically doing with the less how we can design the product that we have to use less of the resources.

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Design for Environment

- Design for Environment (DFE) is a design approach to
 - Reduce the overall human health and environmental impact of a product, process or service
 - Impacts are considered across its life cycle.
- Effective DFE practice maintains or improves
 - Product quality and cost
 - Reduces environmental impacts
- DFE expands the traditional manufacturer's focus
 - From the production and distribution of its products to → closed-loop life cycle

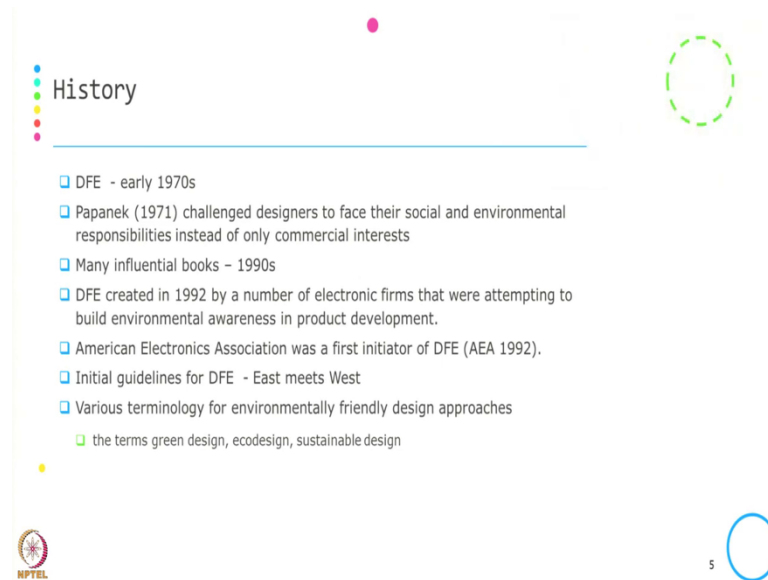
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So, design for environment is a design approach and this design approach is to reduce the overall human overall human health and environmental impact of a product process or service. So, this is a design approach which is typically used to reduce the overall human health, environmental impact of a product, process or service and these impacts are considered across the life cycle. So, it is not about designing for a specific part of the product life cycle, typically it is decided across the life cycle of the product.

And if the DFE is being planned well it is being designed well it is being incorporated in the product design in a better way, then it improves and maintains the product quality cost, reduce the environmental impact. And DFE expand the traditional manufacturer focus from the production distribution of its product to the closed loop cycle.

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The slide is titled "History" and features a list of bullet points detailing the development of Design for Environment (DFE). The text is as follows:

- DFE - early 1970s
- Papanek (1971) challenged designers to face their social and environmental responsibilities instead of only commercial interests
- Many influential books - 1990s
- DFE created in 1992 by a number of electronic firms that were attempting to build environmental awareness in product development.
- American Electronics Association was a first initiator of DFE (AEA 1992).
- Initial guidelines for DFE - East meets West
- Various terminology for environmentally friendly design approaches
 - the terms green design, ecodesign, sustainable design

The slide includes a vertical line on the right side, a dashed green circle in the upper right, and a solid blue circle in the lower right. The number "5" is visible near the bottom right. The NPTEL logo is in the bottom left corner.

The origin is in 1970s and Papanek 1971, he challenged the designer to face the social and environmental responsibility instead of the commercial interest, rather than only getting into the commercial interest in the product design also to incorporate those social and environmental responsibility.

There were many influential books published in 1990s about the need and the benefit of DFEs, it created by in by number of electronic firm in 1992 and they were attempting to build a environmental awareness in the product development.

And American Electronics Association was the first initiator of DFE. Initial guideline of DFE is made by a NGO East meet to West this is the NGO based out of New York. And there are various terminology used for this environmental friendly design approach that can be green design, eco design, sustainable design or the eco-friendly design.

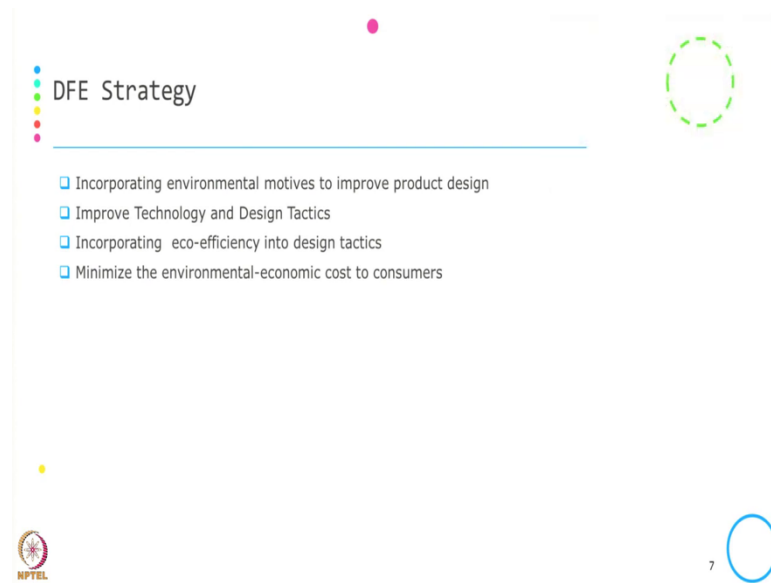
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Now, what are the driving forces for adopting or implementing this design for environment? The first one is risk management, to say whatever the risk associated with the product by incorporating all this in the design stage we can manage the risk. This is an action towards the product stewardship, the consumer gets satisfied with the incorporation of this and get a better product.

There is a competitive pressure other companies doing it and getting improving their brand into a better one, then at some point of time in order to do a compliance with the standard few company they take this as the DFE as one of the tool. And the biggest skill the end goal is the sustainable development or sustainability for that DFE should be part of the DFE should be part of the action point or part of the intervention.

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DFE Strategy

- Incorporating environmental motives to improve product design
- Improve Technology and Design Tactics
- Incorporating eco-efficiency into design tactics
- Minimize the environmental-economic cost to consumers

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Now, what are DFE strategy? There are four strategy of DFE, incorporating environmental motives to improve the product design, improve the technology and design tactics, incorporating eco-efficiency into the design tactics and minimize the environmental economic cost to the consumer.

So, if you look at the first two is mostly into keeping the space for recycling and how recycling whatever the recycling resources or the recycling product, how this can be part of the product. And second two is mostly about the dematerialization that is in incorporating the eco efficiency into the design tactics. So, that we produce more with less of resources and minimize the environmental economic cost to the consumer.

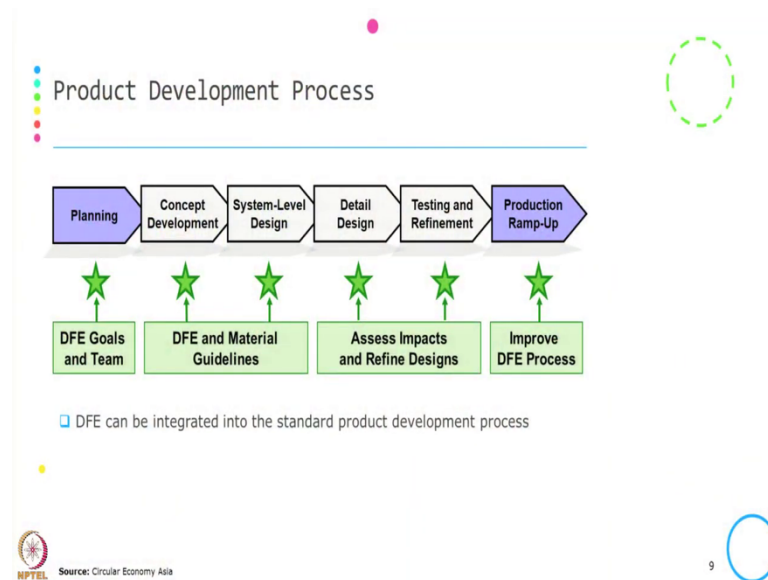
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This is the DFE practices that is be design for environmental processing and manufacturing that is one stage where the DFE is being practices where we get the raw material extraction, processing and manufacturing. Then this DFE can be part of the packaging getting into the environmental friendly packaging.

Then design for disposal and reuse where we address the product design is such that in the at the end of life of the product the impact the human health impact or the environmental impact is less. And design for also the energy efficiency how we should the how it should be the product design or technology that it can be more energy efficient.

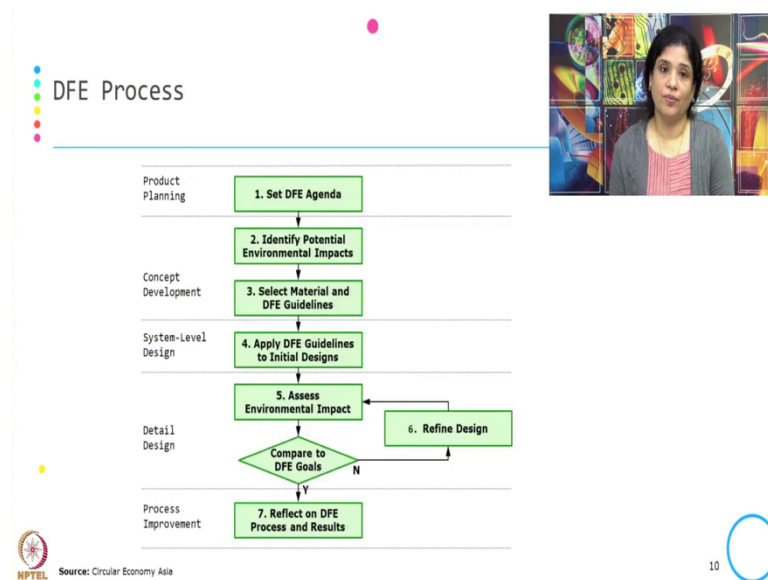
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So, this is the product development process it starts from planning to concept development, system level design, detail design, testing and refinement and production ramp up and here, the role of DFE get mapped into the each stage of the product development process.

So, planning mostly with the DFE goals and team, then in concept development and system level design the DFE and material guidelines can be given, in detail design and testing and refinement we can assess the impact and refine the designs and production ramp up typically improve the DFE process.

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So, DFE can be integrated into the standard product development process, this is the DFE process. So, in case in the stage of the product planning typically the DFE agenda is set. In case of concept development we identify the potential environmental impact and select the material and DFE guideline. In the system level design we apply the DFE guideline into the initial design.

Then after this DFE guideline is applied to the initial design again the environmental impact is assessed and then refine the design if needed compared to the DFE goal. If the environmental impact is more or it is not matching with the goal, the design is being refined and again assessed the environmental impact and finally, reflect the DFE on the process and result that is in the process improvement.

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Example: Herman Miller's Journey Towards DfE



Aeron, 1994 Mirra, 2004 Setu, 2009

NPTEL Source: Circular Economy Asia

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Then let us take the let us take few of the examples to understand this DfE or let us say few of the case study where this DfE is being used to make it a better product which is environmental friendly or there is impact to the health. So, typically Herman Miller they are into the office chairs and these are the 3 variant of their office chair which is and they are into the providing the ergonomic chairs and these are the 3 variant of the office chair that gives by the Herman Miller.

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Herman Miller's Environmental Goals

- ❑ Zero landfill
- ❑ Zero hazardous waste generation
- ❑ Zero air emissions (VOC)
- ❑ Zero process water use
- ❑ 100% green electrical energy use
- ❑ 100% of sales from DfE products
- ❑ Company buildings constructed to a minimum LEED Silver certification

NPTEL Source: Circular Economy Asia

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Now, what is Herman Miller's environmental goal? They tried for zero landfill, zero hazardous waste generation, zero air emission, zero process water use, 100 percent green electrical energy use, 100 percent sales from the DFE product and company building constructed to the minimum LEED silver certification.

So, we will see that what they have done in term of the DFE product. So, they take taken the case this is the case of the Setu multipurpose chair.

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And we will see that how based on this design for environment tool how they have made it as a environmental friendly chair. So, this is this typical chair is environmental friendly and non-toxic produce of non-toxic material which is 41 percent aluminum, then 41 percent polypropylene, 18 percent steel that is by weight and it is used produced from use of the recycled materials 44 percentage is from the recycled material that is by weight, 23 percent recycled post-consumer and 21 percent post - industrial.

Then there is a less material content this is lighter than the other task chairs that is easy to disassemble that is 86 percent easily separable material. And when you talk about the recyclability of this 92 percent by weight can be recycled and products line uses 100 percent of the green power, green energy, no air or water emission released in the production and this can be returnable and recyclable packaging.

So, whatever the packaging they use that is also returnable to the company and also this can be recyclable. So, if you look at starting from the materials they have used that is of environmental friendly, nontoxic and made from the recycled material, they have used green energy, there is no air and water emission and also the packaging what they have used that can be recycled.

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Herman Miller's DfE Protocol

Regulatory compliance to thoroughly evaluate new product designs :

- ☐ **Material Chemistry and Safety of Inputs**
 - ☐ What chemicals are in the materials specification?
 - ☐ are they the safest available?
- ☐ **Disassembly**
 - ☐ Is it possible to take the products apart at the end of their useful life to recycle their materials?
- ☐ **Recyclability**
 - ☐ Do the materials contain recycled content?
 - ☐ Can the materials be recycled at the end of the product's useful life?
- ☐ **LCA**
 - ☐ Optimized the product based on the entire lifecycle?

Source: <https://www.hermanmiller.com/better-world/environmental-advocacy/design-for-the-environment/>

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Now, when it get into the Herman Miller's DFE protocol so, they have moved beyond the regulatory compliance to thoroughly evaluate the new product design and possibly that is how we get what we are checking in the previous slide how they have made a environmental friendly chair.

So, here what they have done in their protocol they are looking at the material chemistry and the safety of the inputs what they are using for the product. What chemicals are in there in the material specification? Are they safest available? Then they consider the disassembly.

Is it possible to take the product apart at the end of their useful life to recycle their materials? And recyclability, do the material contain recycled content? Can the material be recycled to end the at the end of the product's useful life? And LCA is that optimize the product based entire life cycle?

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Herman Miller - DFE Assessment Method

**Herman Miller
DFE Assessment Method**

Material Chemistry (33.3%)
Safest Low Hazard Uncertain High Hazard

Recycled Content (8.4%)
Post-consumer Post-Industrial Virgin Material

Disassembly (33.3%)
Separation Time (30 sec) Tools (common) Labeling

Recyclability (25.0%)
Up-cycle Down-cycle Not feasible

MPTEL Source: Rossi, Charon, Wing, and Ewell, "Incorporating Cradle-to-Cradle Design into Herman Miller Products", Journal of Industrial Ecology, 2006.

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So, based on that this is for the their DFE assessment method where 33.3 percentage is their material chemistry, recycled content is 8.4 percent, disassembly is 33.3 and recyclability is 25.4 percent.

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Nike Grind

- Nike Grind
 - emblematic of Nike's 30-year commitment to holistic sustainability
 - more circular future
 - turning what was once considered waste into new opportunities to create
- Collection of recycled materials developed by Nike
 - is composed of pre-consumer manufacturing scraps
 - recycled post-consumer shoes from the Reuse-A-Shoe program
 - and unsellable footwear
- The purpose
 - is to eliminate waste and close the loop on Nike's product lifecycle

MPTEL Source: Nikegrind.com, Picture source: Cone Communication

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Now, the second example what we take is Nike Grind and this is one of the initiative where they are scrap whatever the scrap is coming out of the post using the product what are the product that those are being developed from those scrap.

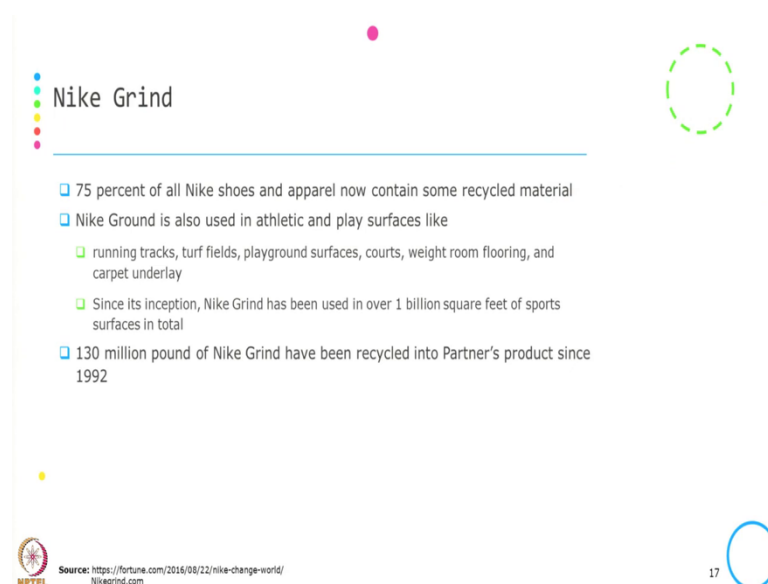
So, this Nike Grind is part of Nike's 30 years commitment to the holistic sustainability and this is for more circular future and it was what once was considered waste typically from the waste there is a new opportunity to create a new product or a different product from the waste of the one of the product.

So, in this Nike Grind what is being done is they collect the recycled material developed by Nike whatever their product Nike product they collect the recycled material from their product which is composed of pre-consumer manufacturing scrap, recycled post-consumer shoes from the Reuse-A-Shoe program and whatever the unsellable footwear what they could not sell in the market that also get into the recycled material.

So, there are three component of the recycled material what they use in the Nike Grind program that is part of it is the pre consumer manufacturing scrap what is the scrap generated during manufacturing, then the post-consumer scrap post-consumer shoe that is the scrap what they get from the Reuse-A-Shoe program and finally, whatever the footwear unsellable footwear the they also get into the scrap.

And the purpose of this goal or this program is to eliminate the waste and close the loop on the Nike product life cycle.

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Nike Grind

- 75 percent of all Nike shoes and apparel now contain some recycled material
- Nike Grind is also used in athletic and play surfaces like
 - running tracks, turf fields, playground surfaces, courts, weight room flooring, and carpet underlay
 - Since its inception, Nike Grind has been used in over 1 billion square feet of sports surfaces in total
- 130 million pound of Nike Grind have been recycled into Partner's product since 1992

Source: <https://fortune.com/2016/08/22/nike-change-world/nikegrind.com>

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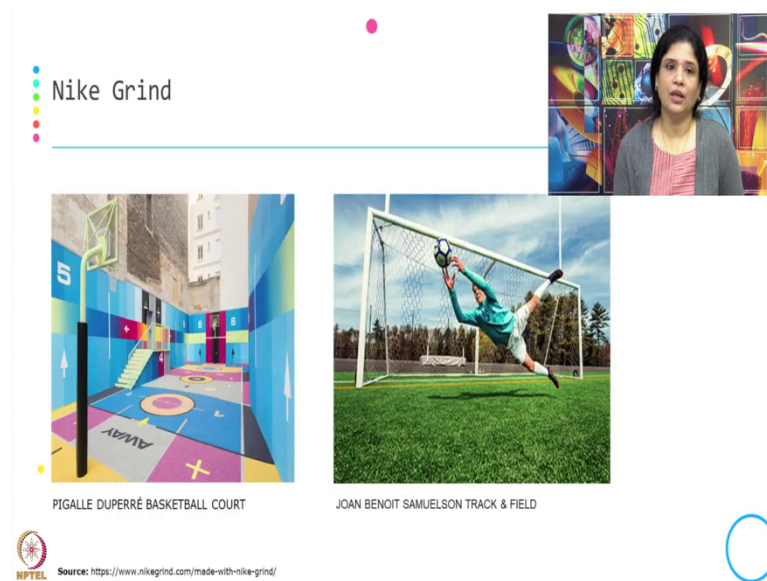
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So, if you get into the profile of this Nike product 70 percent of all Nike shoes and apparel now contain some recycled material at least 75 percent of the Nike shoe they

have some of the recycled material and Nike Grind is also used in athletic and play surface like running tracks, turf field, playground surfaces, courts, weight room flooring and carpet underlay.

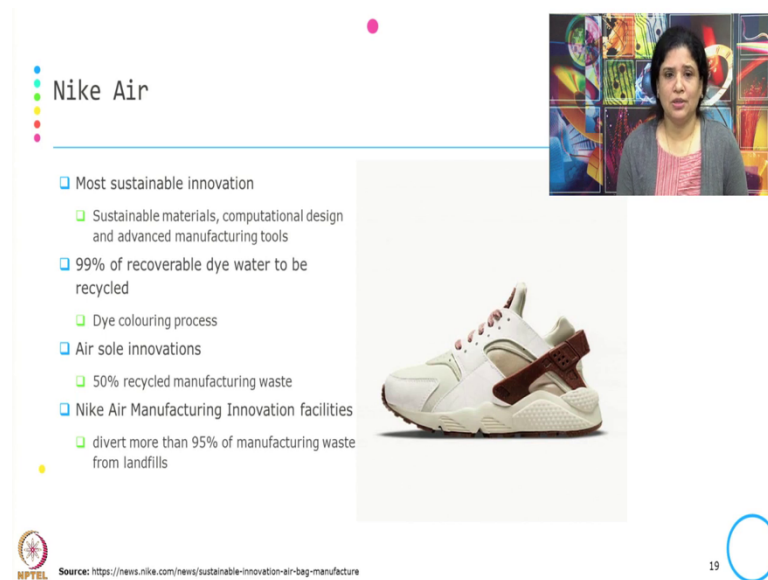
And since its inception Nike Grind has been used over 1 billion square feet of the sport surface in total and 130 million pound of Nike Grind have been recycled into partner's product since 1992.

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This is some of the example what is being made from Nike Grind that is the basketball court and Samuelson track and field which is being created from the scrap that is generated under the Nike Grind.

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Nike Air

- Most sustainable innovation
 - Sustainable materials, computational design and advanced manufacturing tools
- 99% of recoverable dye water to be recycled
 - Dye colouring process
- Air sole innovations
 - 50% recycled manufacturing waste
- Nike Air Manufacturing Innovation facilities
 - divert more than 95% of manufacturing waste from landfills

Source: <https://news.nike.com/news/sustainable-innovation-air-bag-manufacture>

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Then the second example what comes again from Nike is Nike Air this is the product this is one of their shoe variant and this is considered as the most sustainable innovation because it is being produced from sustainable materials, computational design and advanced manufacturing tools and 99 percent of the recoverable dye water to be recycled, whatever they the dye colouring process, whatever water they use for the product out of those total water consumption 99 percent can be recoverable by to be recycled which can be recycled further.

Then the Air sole innovation they did that is from 50 percent of the recycled manufacturing waste those sole what they have plan for the shoe the air sole that is from the 50 percent of the recycled manufacturing waste and Nike Air manufacturing innovation facility they divert more than 95 percent of the manufacturing waste from the landfill.

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The impact because of this better packaging they use 65 percent less cardboard than the standard box, no laminated printing, no tissue paper, less weight and space in shipping and in new reusable bag replace the polyethylene little bag made of recycled pet which is also recyclable. So, whatever the reusable bag they have created that is also recyclable.

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**Better Packaging for Puma:
Clever Little Bag**

Impact

- approximately 8,500 tons less paper consumed
- 20 million Mega joules of electricity saved
- 1 million liters less fuel oil used
- 1 million liters of water conserved.
- 500,000 liters of diesel is saved
- replacing traditional shopping bags the difference in weight will save almost 275 tons of plastic.
- Little bag can have such a big impact...Clever

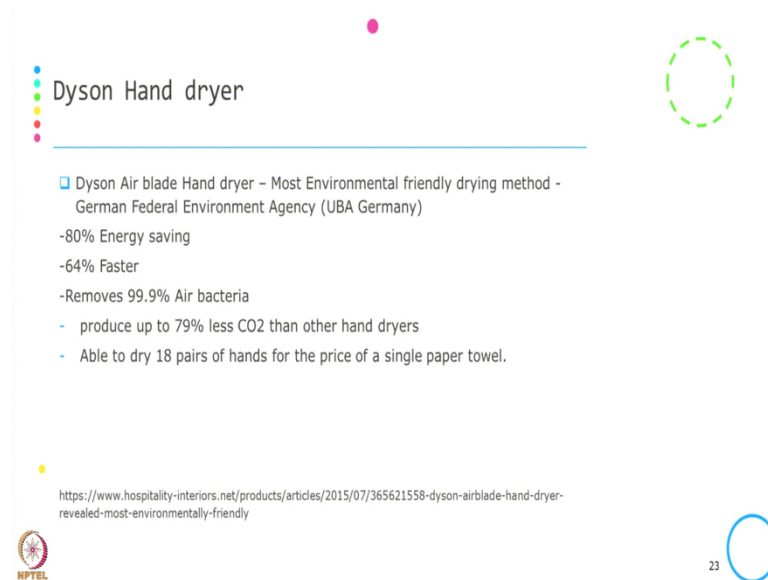
Source: vision.puma.com
www.fuseproject.com

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The impact of this clever little bag is that approximately 8500 tons less paper consumed in this packaging 20 million mega joule of electricity saved in the because it is less of consumption less of production, 1 million liter 1 million liter less fuel oil used, 1 million liter water conserved and this is the liter of diesel saved because in the logistic process.

And replacing the traditional shopping bags the difference in weight will almost save 275 tons of plastic and look at the impact the small little bag that is created and it is a little bag can have such a big impact and that is why possible this is known as the clever little bag.

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The slide features a title 'Dyson Hand dryer' with a decorative vertical bar of colored dots to its left. Below the title is a list of bullet points detailing the benefits of the Dyson Air blade Hand dryer. A URL is provided at the bottom of the text area. The slide is decorated with a pink dot at the top center, a dashed green circle in the top right, and a blue circle in the bottom right. The NPTEL logo is in the bottom left corner.

Dyson Hand dryer

- Dyson Air blade Hand dryer – Most Environmental friendly drying method - German Federal Environment Agency (UBA Germany)
- 80% Energy saving
- 64% Faster
- Removes 99.9% Air bacteria
- produce up to 79% less CO₂ than other hand dryers
- Able to dry 18 pairs of hands for the price of a single paper towel.

<https://www.hospitality-interiors.net/products/articles/2015/07/365621558-dyson-airblade-hand-dryer-revealed-most-environmentally-friendly>

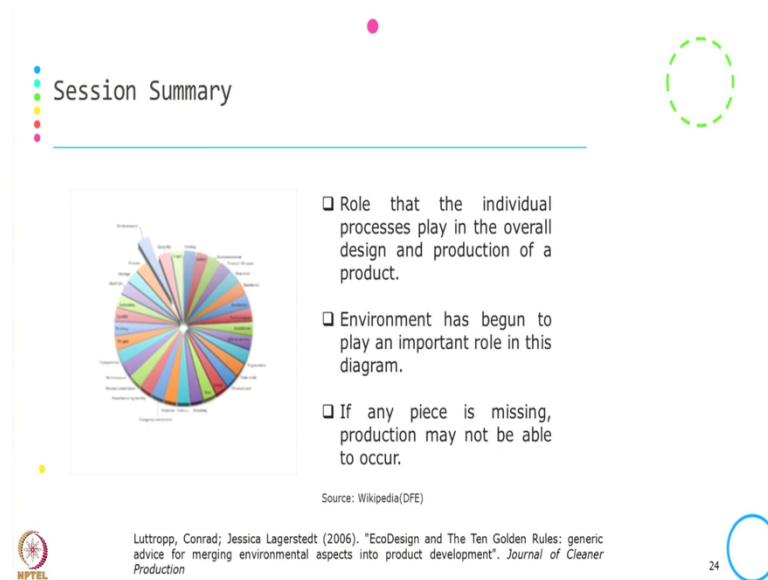
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Now, the other example is Dyson Air blade Hand dryer and this is from the German Federal Environmental Agency UBA Germany they have certified this as a most environmental friendly drying method comparing with paper towel, cotton towel and other standard dryers those are available in the market.

It is the energy saving from this Dyson air blade hand dryer is 80 percent, 64 percent faster, it removes 99.9 percent air bacteria and it produces up to 79 percent less CO₂ than other hand dryer and it able to dry 18 pairs of hand for the price of the single paper towel. So, it is not only environmental friendly, it is also has a implication on the cost whatever the price of the single paper towel with the same price with the help of this dryer the drying is done for the 18 pairs of the hand.

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Now, summarizing this session so, we have tried to understand what is this design for environment tool, what are the different we have taken the different product examples and understand that how design being incorporated is creating less environmental impact and less health impact.

So, while summarize we have taken this picture from Conrad and Jessica's in from their "Ecodesign and The Ten Golden Rules" paper which gives that in the production process what the individual process play in the overall design and production of the product. So, there are many parameter which is not coming out very clearly in the slide, but if you look at for a specific product there are many individual processes they plays a role.

And if you look at the one which is little bit raised over on the top length left hand side of the slide that typical in this pie chart the typical pie is representing the environment and which says that environment has also began to play important role in this diagram that in the process in the production apart from other individual process environment is also playing a role.

And if any piece is being missing from this diagram, possibly production will not occur and if so it is not about taking out environment the product would be a successful one or the product would be a feasible one that is what entirely the session what we have discussed that, summarizes that environment has to be incorporated in design, environment has to be incorporated in the process, environment has to incorporated in

the usage of the product and finally, environment has to be incorporated when the end of life happens for the product.

Thank you.