MODULE 1: INTRODUCTION TO SUSTAINABLE DEVELOPMENT

AARHUS
UNIVERSITY
DEPARTMENT OF ENGINEERING

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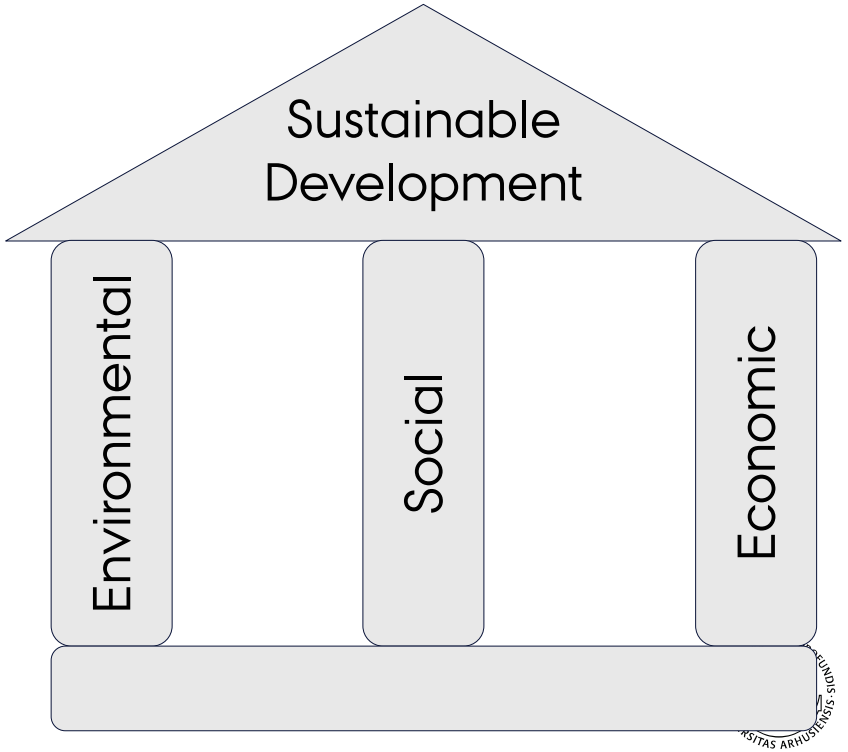
DEVARAJAN RAMANUJAN
ASSISTANT PROFESSOR

DEFINITION: SUSTAINABLE DEVELOPMENT

There are many definitions for sustainable development. One of the most common definitions comes from the 1987 report of the World Commission on Environment and Development (also called as the Brundtland Commission). In their report, they defined sustainable development as **"Meeting the needs of the present without compromising the ability of future generations to meet their own needs".** There are 3 key pillars that comprise sustainable development

- Environmental sustainability: Meeting our needs without exhausting our natural resources and avoiding damage to natural ecosystems
- Social sustainability: Meeting our needs in a manner that can achieve long term social well being of people and reduce societal inequalities
- Economic sustainability: Meeting our needs efficiently and ensuring that economic production can be maintained in the long term



UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals (SDGs) are a collection of 17 global goals put forward by the United Nations (UN) in the year 2015. The goals cover a wide variety of challenges we face in the context of sustainable development. The UN has set targets towards each goal to be achieved by the year 2030.

Activities

Explore the 17 SDGs on the UN website: https://www.un.org/sustainabledevelopment/sustainable-development-goals/. Identify

- An SDG we are close to achieving and an SDG we have made considerable progress on
- Challenges in achieving any 3 SDGs
- Ideas to achieve an SDG of your choice

Video

https://www.youtube.com/watch?v=o08ykAqLOxk

Explore the social progress index website & compare Denmark to other countries:

https://www.socialprogressindex.com/

READING MATERIAL

Read the following report by the UNEP Global Environmental Alert Service (GEAS) on the Earth's carrying capacity

https://na.unep.net/geas/archive/pdfs/geas_jun_12_carrying_capacity.pdf

Activities

- Write a summary highlighting the main points in the report in 100 word or less
- Revisit the ideas to achieve the SDGs (from the previous task). Would you make any changes to them based on the facts highlighted by this report?
- Do you think existing or future technology can play an important role toward sustainable development?
  - How should existing technology be changed?
  - What should future technologies focus on?

MODULE 2: INTRODUCTION TO ENVIRONMENTALLY SUSTAINABLE PRODUCT DESIGN & LIFECYCLE THINKING

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ENVIRONMENTALLY SUSTAINABLE PRODUCT DESIGN (ESPD)

What is environmentally sustainable product design (ESPD)?

Based on the definition of environmental sustainability, we can define ESPD as designing products that meet our needs without exhausting our natural resources and avoiding the damage to natural ecosystems. However, this is an "ideal scenario" and is very hard to practically implement. Therefore, most companies which design and produce products focus on "minimizing" the harmful impact of the product on our environment (sometimes termed as environmental impact). Strategies for this can include,

- Reducing energy consumption during use
- Using lesser materials in the design
- Avoiding toxic materials

Activities

How would you measure the environmental impact of a product?

Take the example of a smartphone and list down the different impacts (harm) it can cause to our environment? How would you try and "minimize" these environmental impacts?

LIFECYCLE THINKING

To measure and mitigate the environmental impact of a product, it is often necessary to map out its entire lifecycle. A product's lifecycle usually begins with extraction of raw materials from the earth's crust or by cultivating natural resources. Next, the material's are transported to industries where they are refined and manufactured into products. The product's are packaged and distributed to consumers and they are used until they reach their end-of-life. After it is useful life, the product could be reused, remanufactured/upgraded, recycled, incinerated to produce energy, or disposed to a landfill. Each step in this lifecycle may consume energy and or other materials. It is also possible for a particular lifecycle step to dominate the overall environmental impact of the product.

VIDEO: Lifecycle of a T-Shirt

https://www.youtube.com/watch?v=BiSYoeqb_VY

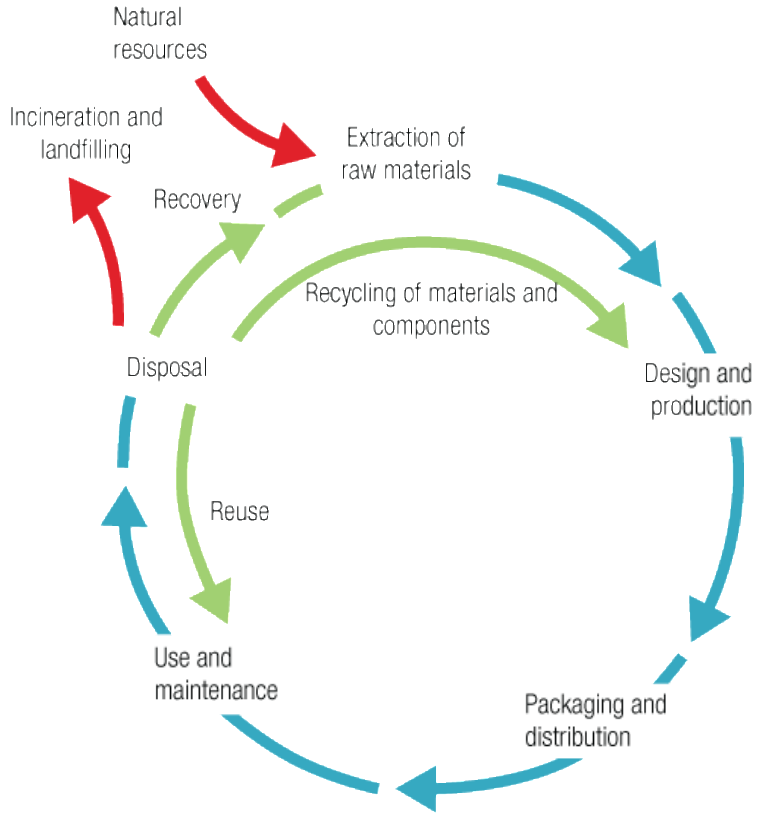

Image source:
www.lifecycleinitiative.org

ACTIVITIES

List environmental impacts that you think are significant in each lifecycle stage (Resource Extraction, Manufacturing, Transportation, Use, and End of Life) for a typical smartphone. Compare your list with this map:
https://kumu.io/majava/smart-mobile-phone-lifecycle#risk-catalogue/3

CIRUCLAR ECONOMY

VIDEO

https://www.youtube.com/watch?v=zCRKvDyyHml

Definition

A circular economy decouples economic production with consumption of finite natural resources and minimizes production of waste. There are three main principles in such a model:

- Reduce waste and pollution
- Retain products and materials in use
- Regenerate natural systems

ACTIVITY

Redesign a smartphone based on circular economy principles

Bonus video:
https://www.youtube.com/watch?v=eyUqqA8wA0A

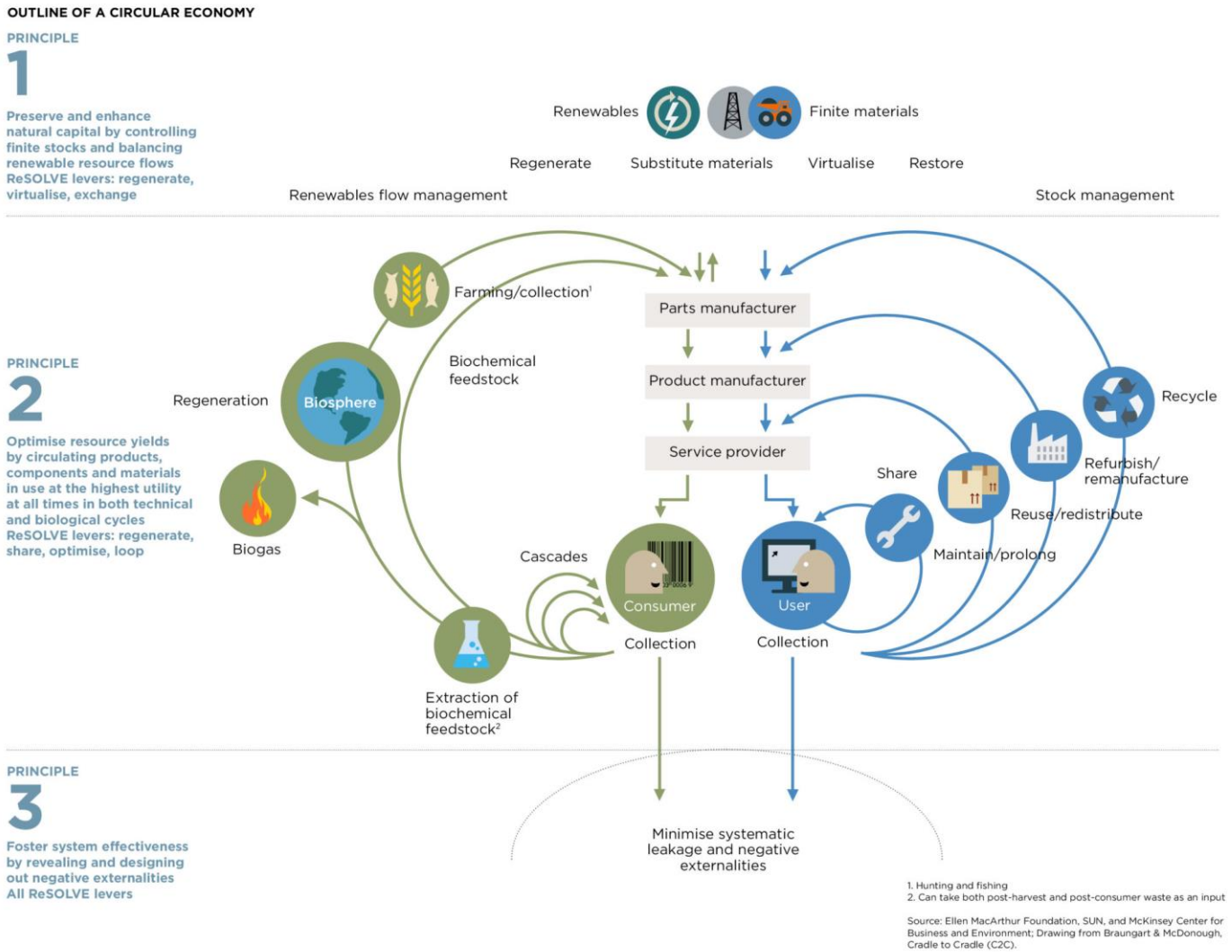

Image source: www.ellenmacarthurfoundation.org

MODULE 3: TOOLS FOR ENVIRONMENTALLY SUSTAINABLE PRODUCT DESIGN

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DESIGN FOR ENVIRONMENT

- Design for Environment or (DfE) principles help designers consider environmental concerns during the design of products and processes
- They suggest strategies that designers can implement in their products. However, they offer no guidance on what exactly to do as it varies on a case to case basis
- The checklist on the right presents an illustrative set of DfE principles

ACTIVITY

Redesign a smartphone by selecting one or more DfE strategies from each lifecycle stage in provided list.
Look at this link for inspiration*:*
https://www.fairphone.com/en/our-goals/?ref=header

Video

DfE in Boeing:
https://www.youtube.com/watch?v=7C_kAND4v8o

LC Stage	DfE strategies	Sub-criteria
Raw materials	Material use Optimization	**Design for resource conservation** • Reduction of used material • Use renewable material • Use recycled material **Design for low impact material** • Avoid toxics • Use material with lower energy content
Manuf-acturing	Clean manufacturing	**Design for cleaner production** • Minimize material variety • Avoid material waste • Select low impact materials and processes
Distribution	Efficient distribution	**Design for efficient distribution** • Reduce product weight • Reduce packaging weight • Use of reusable/recyclable packaging • Ensure efficient distribution
Product Use	Clean use/ operation	**Design for energy efficiency** **Design for material conservation** **Design for minimal consumption** **Avoidance of waste** **Design for low-impact use/operation** **Design for durability**
End of Life	End of Life optimization	**Design for re-use** **Design for re-manufacturing** **Design for disassembly** **Design for recycling** **Design for safe disposal**

Source: Brezet, H., and van Hemel, C., 2001

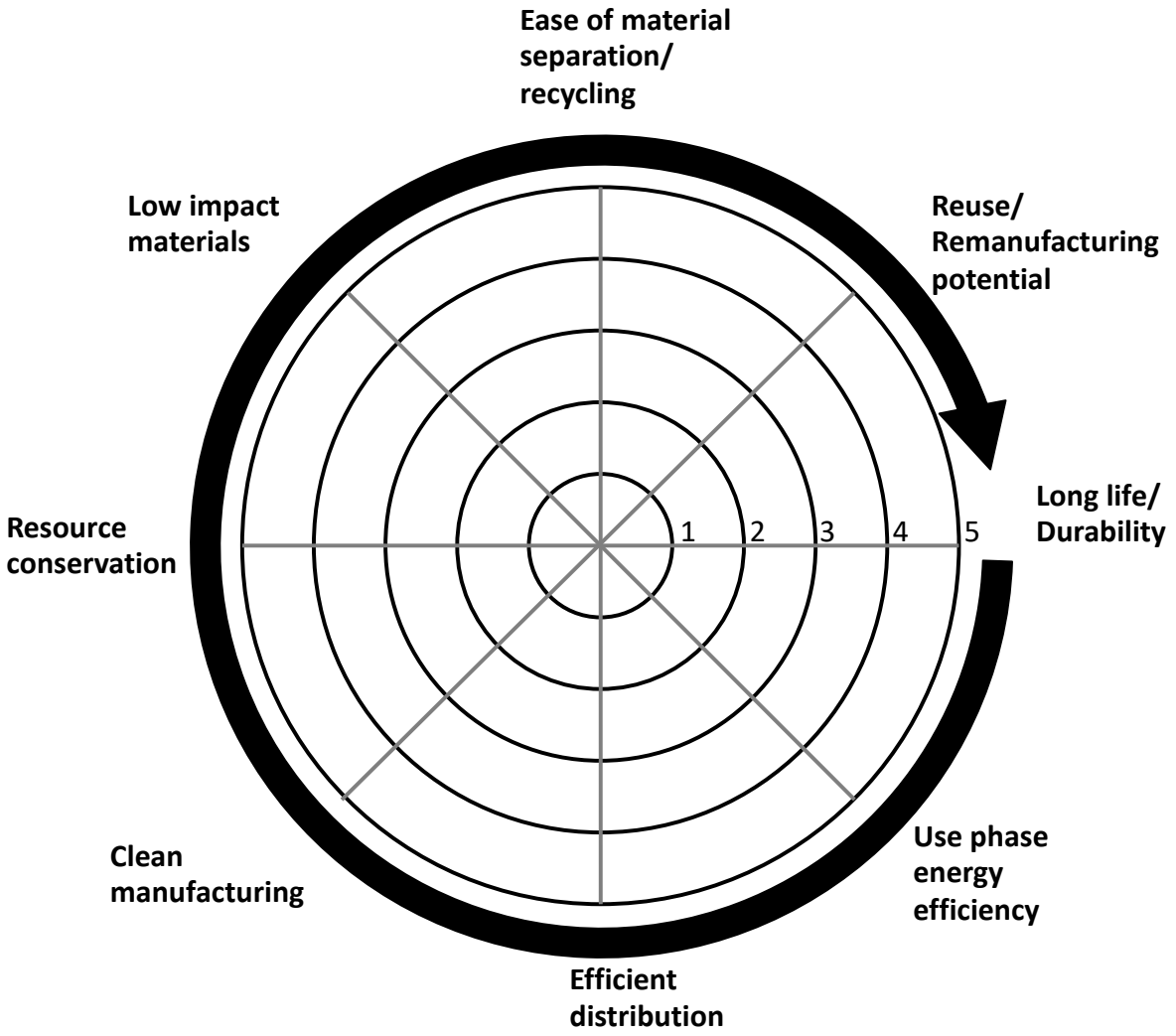
LIDS WHEEL

- The Lifecycle Design Strategies (LiDS) Wheel is useful for benchmarking two or more designs with regards to environmental performance

ACTIVITY

Use the LiDS wheel for comparing the 'old smartphone' and your 'new smartphone design' (from the previous DfE task). Try and answer the following questions

- Where does the new design perform better?
- Where does the old design perform better?
- Is it easy to create a new design that is better on all aspects? Why?



Fill out each category to make a spider chart. Note that
1- poor performance and
5 Is better performance

ECODESIGN PILOT

Activity

Go to the following weblink: http://pilot.ecodesign.at/pilot/ONLINE/ENGLISH/INFO/SITEMAP.HTM and go through topics under the “LEARN” category (Type A – Type E). Under each type, you will find detailed information about DfE principles to be applied for products depending on the lifecycle stage with high environmental impact (i.e., raw material intensive or disposal intensive).

Based on the topics you have learned about, revisit the ‘smartphone redesign’ task and think about any additional design changes that you would like to make.

WHAT IS THE SMARTPHONE INDUSTRY DOING?

Activity

Go through these smartphone company websites to learn about what they are doing with regards to environmentally sustainable product design

APPLE: https://www.apple.com/lae/environment/

SAMSUNG: https://www.samsung.com/uk/aboutsamsung/sustainability/environment/eco-conscious-products/

LG: http://www.lg.com/global/sustainability/environment

Summarize what you found on these links and how they compare to your ideas of redesigning the smartphone

MODULE 4: OTHER COMMERCIAL TOOLS FOR ENVIRONMENTALLY SUSTAINABLE PRODUCT DESIGN (ESPD)

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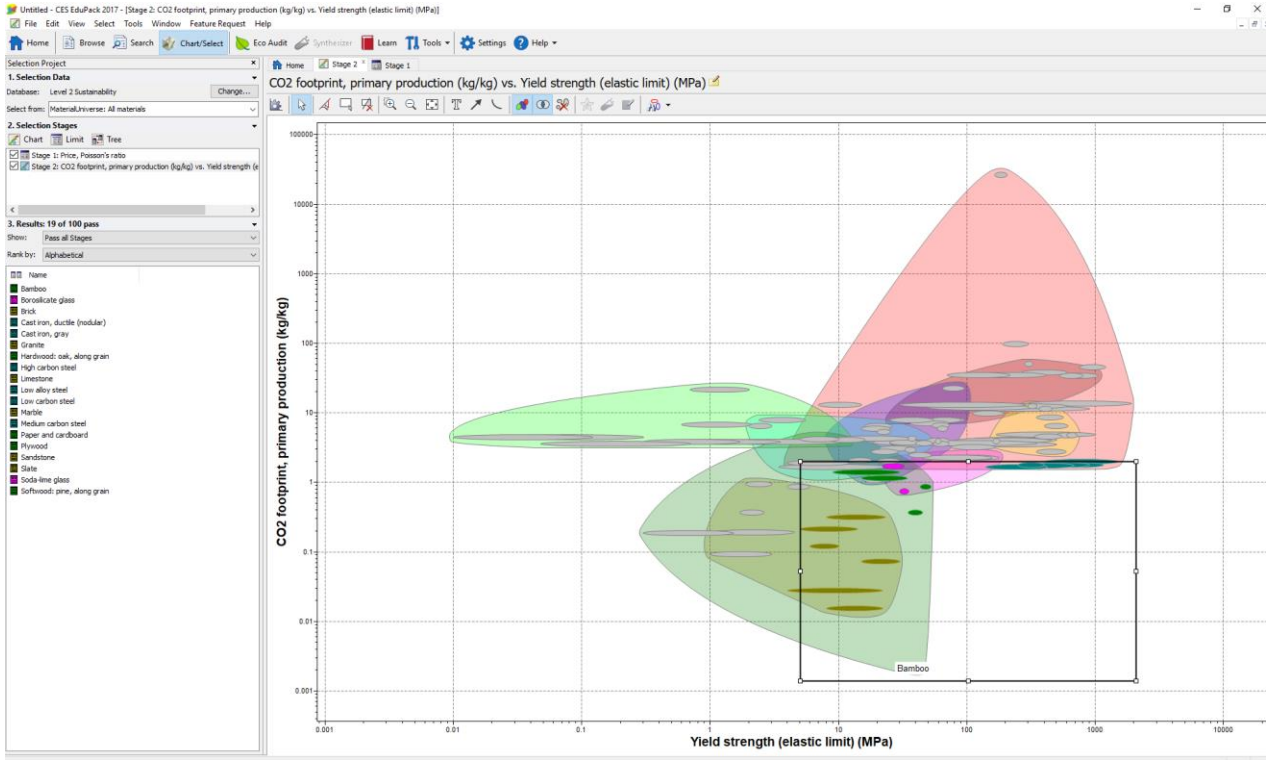
CES EDUPACK

Demonstration of CES eduPACK for material selection

VIDEO

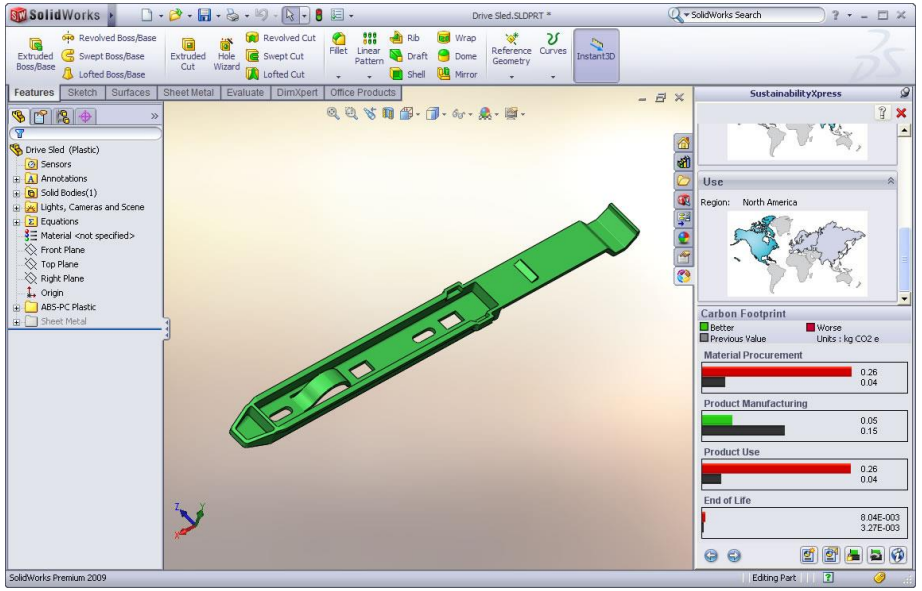
https://www.youtube.com/watch?v=_iTLJwAn49I



SOLIDWORKS SUSTAINABILITY XPRESS

OVERVIEW VIDEO

https://www.youtube.com/watch?v=qpNBLYIvT_g



AUTODESK SUSTAINBILITY WORKSHOP (1/2)

Lightweighting and Material Reduction

https://www.youtube.com/watch?v=20vShlZqUdQ&index=5&list=PL77813F5B6F2B6436

Green materials selection

https://www.youtube.com/watch?v=I3tfQeIzofE&index=7&list=PL77813F5B6F2B6436

Design for energy efficiency

https://www.youtube.com/watch?v=4q8ugvNZyrM&index=12&list=PL77813F5B6F2B6436

Design for disassembly and recycling

https://www.youtube.com/watch?v=vcFRvuOnWQ8&index=14&list=PL77813F5B6F2B6436

Design for repair and upgrade

https://www.youtube.com/watch?v=YFGgm0TiY1s&list=PL77813F5B6F2B6436&index=13

AUTODESK SUSTAINBILITY WORKSHOP (2/2)

Design for durability

https://www.youtube.com/watch?v=kAP0c25ApP0&index=15&list=PL77813F5B6F2B6436

Design for lifetime

https://www.youtube.com/watch?v=tlPlp_Kn7f4&list=PL77813F5B6F2B6436&index=16

Persuasive design

https://www.youtube.com/watch?v=pO755TmugCw&list=PL77813F5B6F2B6436&index=22

https://www.youtube.com/watch?v=pjeusm8PjSs&index=23&list=PL77813F5B6F2B6436

https://www.youtube.com/watch?v=IlmHyWDGx2c&list=PL77813F5B6F2B6436&index=24

Whole systems design

https://www.youtube.com/watch?v=7mC9xaJC2dQ

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