



PRD 301 – Green Design
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THE DESIGNER'S FIELD GUIDE TO SUSTAINABILITY



01

QUESTION THE PREMISE OF THE DESIGN.

Consider other approaches to the problem at hand. Is the form factor that you had in mind really the best way of accomplishing the task? Is any form factor the best way of accomplishing the task? Maybe a service fits the mold better? Perhaps the answer lies within an existing product?



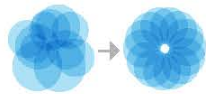
Example: Instead of designing a special armband to carry a runner's keys during a workout, design a running sock with a key pocket. People are going to buy socks anyway. Got a better example? Go to LUNAR's sustainability blog at <http://lunarelements.blogspot.com/> and post it for the world to see.

Watch out: Be sure to always consider a client's economic performance goals when applying this method. Even though a behavioral change could solve the problem at hand (like putting a key under the mat, in this example) the client would be left without a product. Suggesting that they move to a sock instead of an armband may still meet their financial objectives.

02

MAKE IT LESS COMPLEX.

Simple, elegant designs can reduce material, weight, and manufacturing processes. Simple designs usually also mean less material variety and can help make a product more recyclable.



Example: Benjamin stools from IKEA are a simple and elegant design. They are made of a single material, with a utilitarian but elegant form factor. This makes them lightweight and incredibly portable. They can be used as a sitting stool, a stepping stool, a coffee table, etc.

Watch out: Keeping designs simple can sometimes lead to overlooking an opportunity to increase the usefulness of a product without increasing its ecological impact (see below).

03

MAKE IT MORE USEFUL.

At first glance, this may seem to contradict point number 2, but there is a big difference between usefulness and complexity. Taking advantage of a natural or logical extra use for a product will not only make the product more desirable and interesting, it will also help reduce the number of products headed for landfills. Multiuse products can reduce consumption and increase convenience.



Example: The shape of the flat-head screwdriver on many pocket knives has been cleverly designed to also function as a bottle opener. The usefulness of the device has increased with no added material or complexity.

Watch out: Be careful not to let added usefulness detract from the functionality of the product. Poor functionality can lead a consumer to abandon the product altogether for a better functioning model.

04

REDUCE MATERIAL VARIETY.

Designing as many aspects of the product as you can from the same material makes recycling the product at its end of life easier, more efficient, and more profitable.



Example: At its Chupai, Taiwan plant, Philips Electronics designed the Typhoon, a high-end color monitor, using green product design techniques. As a result, the monitor requires 35 percent less time to manufacture than a conventional monitor due to a 42 percent reduction of material and components.

Watch out: Be sure to not use harmful materials in the name of reducing material variety. Non-recyclable, non-renewable and toxic materials should generally be avoided when possible. Deciding early on to use recycled, recyclable, renewable and biodegradable materials for major components of the design will help reduce material variety without negative side effects.

05

AVOID TOXIC OR HARMFUL MATERIALS AND CHEMICALS.

Materials like PVC, neoprene or polystyrene, and toxic chemicals and additives like bisphenol A and formaldehyde should be avoided when possible. Many of these materials have suitable non-toxic counterparts, like copolyesters or bioplastics, and additives can be eliminated by choosing materials wisely.



Example: Nalgene water bottles have recently switched one of their material selection (a polycarbonate that contained bisphenol A) to a copolymer with almost identical properties but without the associated health risks.

Watch out: Make sure to consider the energy input for the entire production cycle of the alternative material chosen and the likely disposal method for the product. If proper disposal or recycling can be guaranteed, less friendly materials may be a safe, best performing, lowest energy material choice for the job.

06

REDUCE SIZE AND WEIGHT.

Lightweight products can reduce carbon emissions and cost by making the shipping process more efficient. Weight can often be saved by focusing on choosing lightweight materials, simplifying designs, and eliminating unnecessary fasteners and components.



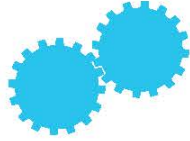
Example: The HP Pavilion Slimline PC is 1/3 the size and half the weight of a traditional tower PC. Using weight/space-saving design approaches, HP and LUNAR were able to create a design that delivers all the processing power and features of a regular PC with less impact on the planet.

Watch out: Don't sacrifice durability in the name of weight savings. Less durable products need to be replaced more often and shipping a lightweight item twice can cause more harm than shipping a heavier one once.

07

OPTIMIZE MANUFACTURING PROCESSES.

Determine which manufacturing processes make the most sense for your product. For lower volumes or less complex parts, consider vacuum forming instead of injection molding. For some complex metal geometries consider casting instead of machining.



Example: When a metal must be coated, consider powder coating instead of painting. The powder coating process allows for excess powder to be collected and reused in the coating process, as opposed to paint over-spray, which cannot be recovered.

Watch out: Manufacturing processes are complex systems and often energy or materials waste can be hidden within these systems. Talk with your manufacturer to make sure you understand the entire process and consult indexes like the OKALA 07 impact factors table to make sure that all aspects of the process are considered.

08

DESIGN PACKAGING IN PARALLEL WITH PRODUCTS.

If a product is designed with a stylish and sustainable packaging scheme in mind, a client might absorb that idea. Lightweight packaging that uses sustainable (recycled, recyclable, or biodegradable) materials can reduce carbon emissions and raw materials waste alike.



Example: P&G's focus on packaging in the last 15 years has produced staggering results. According to bsr.org, "The company has used computer models to develop products that are more concentrated and require less packaging, such as bottles that are stronger yet lighter in weight, packages that do not require outer cartons, and the use of stronger lighter materials in place of heavier ones." The results of this packaging design blitz are that "overall packaging per case has been reduced by 27% and waste, air and water emissions have been reduced by 37%" since 1990.

Watch out: Always keep in mind that unnecessary packaging complexity, while sometimes creative, is unnecessary. Remember that all of the tips in this guide pertain to packaging design as well.

HOW IS IT USED?

09

DESIGN FOR UPGRADEABILITY.

In the electronics industry, the technology in a product can become obsolete long before the design. Designing products that can be upgraded to keep up with rapidly changing technical performance can save materials and money.



Example: The HP MediaSmart Server was designed with simple upgradeability at its core. Purchasable with varying starting amounts of storage, its capabilities can be upgraded by simply adding a drive when the time is right: a process that HP and LUNAR made sure was a simple task for all.

Watch out: Products that are designed to be upgradeable without being designed to be durable may break before they are ready for an upgrade. This could result in adding undue complexity to a design that won't be upgraded after all.

10

CREATE DURABLE AND HIGH QUALITY DESIGNS.

People want high quality products that will look and function beautifully long after the competing product has died, and they're willing to pay a little more for that type of design. Designed properly, products can transcend the "throw away" culture that dominates electronics today.



Example: Craftsman hand tools have established a well earned reputation for being built to last. While some brands of less expensive tools are cast with shoddy processes causing them to fail, Craftsman has built their brand on selling high quality, durable tools, and backing them up with a no questions asked lifetime warranty.

Watch out: Not all products should last forever. Inherently limited use or single use products, like medical disposables, food packaging, toothbrushes (the heads, at least) should be designed to be the opposite of durable. Design temporary items to be absorbed back into the technical nutrients chain by making them fully recyclable, or back into the earth by making them biodegradable or compostable.

11

DESIGN FOR LIFE AFTER DEATH.

Most products don't last forever. Products designed to have secondary usages after their primary function has lapsed can add value to the product, and may fill a need that would be filled by another purchased product instead.



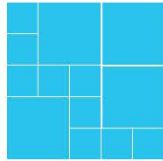
Example: Adding graduated lines to the side of a salad dressing bottle makes it useful as a measuring device after its initial use.

Watch out: Trying to work unnecessary second uses into a design can often increase the complexity. Design a product's second life such that it requires no extra parts or complexity that wouldn't be needed in the original design.

12

MAKE IT MODULAR.

Modular designs are not only more easily recycled at the end of their life but also more easily repaired, and therefore last longer. Modular designs can also be more efficiently manufactured and shipped, reducing energy consumption at the beginning of the product's life.



Example: An example of this principle is the Aeron Chair by Herman Miller. One of the design considerations for the Aeron was to make it "...sparing of natural resources, durable and repairable, designed for disassembly and recycling." As a result, Aeron chairs are not sent back to retailers for repair. Instead, if the chair breaks, replacement parts are ordered and the chairs are easily repaired on site.

Watch out: Making designs overly complicated in order to make them modular can do more harm than good. Adding extra fasteners, brackets, and materials opposes tips 3 and 4. Try to design for modularity that can be had for "free" using creative features on injection molded parts or pieces of sheet metal that can accomplish multiple tasks.

13

USE RECYCLED, RECYCLABLE, RENEWABLE, AND BIODEGRADABLE MATERIALS.

This one's obvious, but should always be kept in mind. Design with recycled or easily recyclable plastics (HDPE, PP, PS, PVC), biodegradable plastics (PLA, PHB, polyamide, bio-derived polyethylene), paper, cardboard, wood, stainless steel, aluminum, etc.



Example: San Francisco based Green Toys makes children's toys entirely out of recycled milk jugs from local recycling facilities. All of the Green Toys products are both recycled and recyclable.

Watch out: Sourcing sustainable materials from distant locations can sometimes prove more harmful than beneficial. Biodegradable plastics produced in Australia, molded in China, and then shipped to the US can be more detrimental than standard plastics produced and manufactured closer to the product's point of sale.

14

MINIMIZE FASTENERS.

Minimizing fasteners can make large portions of the product more easily recyclable at the end of life since removing snap-on parts can be done completely and quickly without the use of tools. This also eliminates multiple fasteners from the product BOM and reduces the amount of assembly time necessary to get products out the door, which reduces cost on two fronts.



Example: Dell computer bezels are assembled with snaps that are had for "free" by integrating them into the design of the part that is already being injection molded. This also allows them to be more easily accessed for maintenance and more easily separated for recycling at the end of their lives.

Watch out: Sometimes a single fastener can avoid large amounts of part complexity and material variety. Also, if the fastener is made of the same material as the parts it is joining, the entire assembly may be able to be recycled without disassembly.

15

DON'T USE PAINT.

Painting a material generally makes it harder to recycle at the product's end of life because the paint cannot be easily separated from the material. As a result, many painted products are either not recycled or are irresponsibly melted down to burn off the paint, creating toxic fumes and lower quality recycled material. Design products to take advantage of the natural beauty of materials.



Example: The HP Photosmart 7850 printer has plastic parts made almost entirely out of highly recyclable, non-painted plastics. In addition to making the plastic components more easily recyclable, having mold-in color means they can be scratched or worn without degrading their appearance. This choice also saves HP the costs associated with adding a painting stage in the manufacturing process.

Watch out: Eliminating paint on appearance parts could result in lower yields in the molding process. Discuss this with the part manufacturer to determine acceptable yield rates. Also verify that unusable parts will be reground and reused to make good parts.

Green design atau **eco design** adalah sebuah gerakan berkelanjutan yang mencita-citakan terciptanya perancangan dari tahap perencanaan, pelaksanaan dan pemakaian material yang ramah lingkungan serta penggunaan energi dan sumber daya yang efektif dan efisien

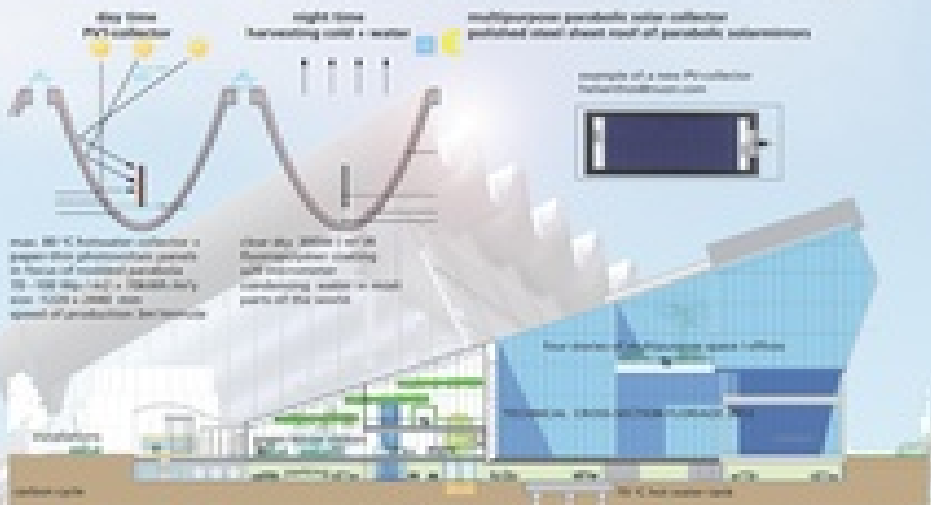
menurut arsitek, Riri Novriansyah, *green building* atau *green design* erat kaitannya dengan energi, terutama yang berdampak bagi lingkungan, sosial, masyarakat, serta ekonomi.

sosial, manusia, ekonomi, dapat diambil irisannnya, di sanalah *green design* berada. “*Green design* harus bisa menguntungkan, secara sosial menaikkan kualitas hidup manusia dan lingkungan tidak terbebani,” ujarnya.

Komponen untuk mewujudkan ide besar *green design* tersebut dapat melalui pengolahan energi, air, material, dan kesehatan penggunaannya.

THE GREENEST BUILDING IN THE NETHERLANDS

Integrated design Floriade 2012, International horticulture exposition at Venlo
no external fuel, electricity, water or sewage



new like wire heat exchangers, set of very low temperature
Energy Recovery Exchanger (ERX) + air heat exchanger (AHE) + air temperature (AT) + air humidity (AH) + air velocity (AV) + air pressure (AP) + air density (AD) + air mass (AM) + air volume (AVOL) + air flow (AF) + air speed (AS) + air direction (ADIR) + air quality (AQ) + air purity (APUR) + air cleanliness (AC) + air odor (AO) + air taste (ATAS) + air smell (ASML) + air sound (ASND) + air vibration (AVIB) + air noise (ANIS) + air pollution (APOL) + air contamination (ACONT) + air degradation (ADGR) + air deterioration (ADTER) + air deterioration rate (ADTERATE) + air deterioration index (ADTERINDEX) + air deterioration coefficient (ADTERCOEF) + air deterioration factor (ADTERFACT) + air deterioration constant (ADTERCONST) + air deterioration exponent (ADTEREXP) + air deterioration base (ADTERBASE) + air deterioration modulus (ADTERMOD) + air deterioration period (ADTERPER) + air deterioration phase (ADTERPHAS) + air deterioration amplitude (ADTERAMP) + air deterioration frequency (ADTERFREQ) + air deterioration period (ADTERPER) + air deterioration phase (ADTERPHAS) + air deterioration amplitude (ADTERAMP) + air deterioration frequency (ADTERFREQ)

new light weight concrete large open double floor
Two floors high open and water concrete slab supported by special structure of reinforcement, the main body of the floor is concrete. The use of the building's double floor and also available for other buildings.

self sufficiency of general utilities

Energy	100%
Water	100%
Waste	100%
Electricity	100%

