

# Designing Sustainable Technology through Aesthetics

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**Lisa Accolla**

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Signature \_\_\_\_\_ Date \_\_\_\_\_

Lisa Accolla

Approved \_\_\_\_\_ Date \_\_\_\_\_

Sean Ferguson, Department of Engineering and Society

## **Designing Sustainable Technology through Aesthetics**

Engineering design is one of the most powerful tools in shaping human behavior and society as a whole. During the design stage of creating new technologies, engineers have the ability to provoke a specific response from the user in order to shape human interaction with technology—in turn, these explicit design decisions can cause users to alter their everyday lives. Engineers may have various goals and values when designing new technologies in anticipation of the user’s response: in the case of this research, the goal of sustainability and how engineers are able to design with the intent of provoking sustainable behavior through the use of technology will be analyzed. There are countless tactics in which sustainable behavior can be coaxed; however, this research will focus on one specific area of design—the use of aesthetics.

A set of sustainability goals will be developed within this research before evaluating several case studies, which are targeted at understanding the role of designing around aesthetic criteria to meet these sustainability goals. The conflict of sustainable product design within the United States economy will also be discussed in order to demonstrate the fundamental problem of creating sustainable technology inclusive to all sustainability goals. The objective of this research is to answer the following question: are aesthetics as a design objective useful for prompting sustainable user behavior?

### **Human-Object Interaction**

Before discussing the impact of designers on human behavior and interaction with technology, it is important to establish the fundamentally dependent relationship between humans and objects which is required to make technology functional. Actor-Network Theory is the framework which best describes this interdependency of technology and users through the idea that both humans and non-humans possess agency. As Sergio Sismondo (2010) writes,

humans and non-humans form linkages between one another, which causes the formation of large networks; these networks “might make machines function, when their components are made to act together to achieve a consistent effect. Or, they might turn beliefs into taken-for-granted facts, when their components are made to act as if they are in agreement” (Sismondo, 2010, p. 82). It is important to note that this applies to technoscience, which cannot be effectively driven without human/non-human associations and dependencies.

Prasad Boradkar (2010) continues with this reasoning to point out the interdependencies between “people and things” as well as how both entities shape one another. He describes this as a symbiotic relationship: “As things themselves have agency, they afford specific kinds of action, they encourage certain types of behavior and they can elicit particular forms of emotions. Therefore, in addition to being designed by us, things in turn design us” (Boradkar, 2010). The relationship Boradkar describes is important in considering the impact of design not just on non-human objects, but humans themselves. Not only do humans have the ability to design functional technologies, but in turn, these technologies have the ability to equally shape humans in their behavior, emotions, and society. The relationship between humans and technology is important to note because the interaction between the two is what creates function and therefore value—technology requires human interaction in order to fulfill its purpose.

### **Defining Sustainable Technology**

The way in which sustainable technology is defined for the purposes of this research is crucial to establish before trying to answer whether the use of aesthetics is an effective tactic in inciting sustainable user behavior. The working definition of sustainability for this research aligns with that developed by Desai and Mital (2020): “The gist of sustainability is that all commercial activity, including product development, should preserve the quality of ecological

and societal environment for future generations” (p. 1). Regarding technological creation and product design, a set of sustainability goals can be established to meet the criteria of a true sustainable technology. These goals stem from two sectors of sustainability—environmental and economic sustainability. Thus, sustainable technology goes beyond what we perceive as conventionally “eco-friendly” technology.

The goal of sustainable technology for this research is to address and find solutions to both sectors of sustainability. In terms of environmental sustainability, it is important to achieve the following goal, as Desai and Mital continue: “[maximize] value in the ‘triple bottom line’ sense, [and] simultaneously minimize resource consumption” (p. 2). The environmental category essentially addresses issues of resource consumption and exploitation of natural resources, as well as environmental footprint. Next, in terms of economic sustainability, the goal is to “estimate life cycle costs and benefits incurred during the lifecycle of a product” (p. 2) (Desai & Mital, 2020). Some of the questions that need to be considered are: Will the technology need to be replaced? How easily can the technology be maintained? What kind of monetary investment will need to be made for this technology?

Environmental sustainability may be unintentionally achieved by means of anti-consumption through the deliberation of economic sustainability—for example, if a technology is not necessarily created with careful consideration of environmental consequences, but it *is* intended to be a technology that lasts a user’s lifetime without replacement, this technology could have a relatively beneficial environmental footprint, since less resources would be used in creating less products. An example of this scenario would be a technology which may develop sentimental value for the user, causing it to be irreplaceable or possibly even passed down for generations. Not only is the “timeless” technology economically sustainable for the user, but it is

also limiting resource consumption and thus promoting environmental sustainability (Harper, 2017).

### **Economics and Sustainable Products**

Although there has been a large-scale turn in the emphasis of sustainability in technological production within the past decade, there is a major conflict between the existing economic structure in the United States and the ability to fulfill a promise of “sustainable” technology and product development. The health of our economy is driven by consuming beyond our means, while one of the crucial objectives of sustainable products is the emphasis of anti-consumption of resources in order to improve our environmental footprint. Clive Dilnot (2017) addresses the conflict between the economy and sustainability in his paper, “Sustainable Product Design: An Oxymoron?” He writes, “An economy...dependent for its (social and economic) stability on ‘using things up’ is the epitome of unsustainability. In relation to product design, the blunt truth is that, as an industrial category and practice it cannot but be aligned with this condition.” He continues and explains, “To call for sustainment is therefore, by definition, to place capitalism in doubt; or, better, it is, in effect, to declare structurally the necessity of a post-capitalist economy” (Dilnot, 2017, p. 85). The bottom line is that our economy is built on consuming beyond our means, and the promotion of anti-consumption through the surge of sustainable technology fundamentally conflicts with our existing economic structure.

In recent years, however, the turn towards sustainable product development has been addressed by many industries across the United States as environmental protection and anti-consumption have become more pressing issues globally. More specifically, sustainability as a business mission has drastically grown in popularity. This is not necessarily to say that companies are suddenly beginning to care about their environmental impact—rather,

sustainability has become so mainstream across the country that adapting to an “eco-friendly” business model is a more profitable business strategy in the long term. As Joseph Fiksel (2009) explains, “The motivation for adopting practices such as [Design For the Environment] goes beyond ethics and good citizenship—it is ultimately a strategic business decision. In simple terms, *business value is the most important driver of DFE*. In fact, corporations all over the world have recognized that sustainability makes good business sense and is essential for their survival and growth” (Fiksel, 2009).

Ultimately, businesses *may* be able to create new technologies that are considered environmentally sustainable—however, environmental sustainability often becomes a major trade-off to economic sustainability since businesses are regularly trying to maintain a profit. Thus, a business looking to profit off of their “green” products is not truly sustainable, especially with regards to anti-consumption: businesses need consumers to not only buy their products, but to *continue* buying their products.

This is not to discount all companies which have made a step in the right direction in creating more green technologies and consequently promoting sustainable user behavior. Many companies today are built on the ideals of sustainability with the consumer’s interest in mind, and they may even compromise parts of their revenue to maintain integrity and devotion to their “green” mission. Alternatively, companies may simply have to increase the price of their goods to compensate for the added expenses of creating more environmentally-friendly technologies: “Green pricing is thus a complex process. For if organizations are ‘selling’ green goods they need to ensure that environmental value is important to consumers and that when this value is built into the price this practice is also communicated to consumers” (Charter & Tischner, 2001, p. 290). Thus, a major challenge in developing a successful environmentally-conscious business

model is ensuring your customers are able and willing to pay for your goods—this is not always simple.

However, a widespread strategy today in compelling consumers to pay for more sustainable goods is by targeting its aesthetics: using appearance, beauty, and marketing to draw consumers to a technology is a viable way to get consumers to pay more for a technology than necessary, even when the technology is not necessary more functional than its alternatives. Therefore, it is possible to look at how businesses and engineers have exploited aesthetics in order to make consumers purchase more sustainable products and develop more sustainable behavior.

### **Aesthetics Can Encourage Sustainable Behavior**

In this section, some specific case studies will be addressed in which sustainable technologies have enticed users to practice more sustainable behavior through the use of aesthetics. In these cases, the engineers who are designing these sustainable technologies are mainly responsible for provoking the user's response—engineers are able to anticipate the consumer's reaction to certain aesthetics and other explicit design decisions.

#### **Tesla, Inc.: The Ultimate Allure Towards Electric Vehicles**

One of the most notable examples of aesthetically-pleasing yet sustainable technologies today is the electric vehicle industry, which has grown in relevance within the past decade as Tesla, Inc. has surged in popularity. Tesla is known for their cutting-edge electric vehicles which have dominated the market over the past decade—although they certainly weren't the first to produce and sell EVs, Tesla is responsible for an abundant the shift towards EVs over gasoline-powered vehicles (MacDuffie & Light, 2021). There are many factors which went into Tesla becoming a success, and one of the most significant factors to mention is their strategic

consideration of appearance and aesthetic value. Not only did Tesla successfully market their EVs as having sleek, luxury vehicle-like designs, but they gave the aesthetics of their vehicles an even deeper meaning. As Matthew DeBord (2017) writes:

Tesla's aesthetics embody the company's futuristic attitude and the carmaker's embrace of a technological adventure, and people respond to that in a more emotional way that you might expect. They don't drop their jaws as they would if a Ferrari or Lamborghini rolled by. Instead, they nurture a feeling of respect for Tesla's nerdy ambition to change the world, but to do it without making their cars look like dreary virtue-mobiles.

Another important consideration of the aesthetics of Tesla's vehicles is their careful deliberation of functionality and efficiency in conjunction with their aesthetic design—as Franz von Holzhausen (2009), Chief Designer at Tesla claims, “Owning an environmentally efficient vehicle shouldn't require sacrificing anything.” Tesla's design mission is all about efficiency, beauty, and performance, as well as reminding their users of their environmental pursuit: “The interior volume essentially over delivers on the exterior promise...Recycled PET carpeting and vegetable tanned leather give a tactile sense to the environmental message” (von Holzhausen, 2009). In these cases, aesthetics has brought significant value to Tesla products, which sets them apart from alternative EVs.

A notable aspect of sustainability in Tesla's business model is how their product line only consists of four models: Model S, Model 3, Model X, and Model Y (Tillman, 2021). Initially, Tesla's targeted market in the United States was to produce luxury electric vehicles, and it was not until the Model 3 release in 2017 that the company produced its first high-volume, mass-market vehicle, thus beginning to appeal to a larger market of individuals. The Model 3 sedan was priced at \$35,000 base level, a much more economical alternative to their next cheapest



Tesla option, the Model S at approximately \$68,000 (Fullmer, 2017). Since developing these four different car models, Tesla's customer base has grown drastically, not only to include drivers looking for the best luxury car, but also to include customers looking for a relatively affordable and sustainable vehicle.

Using a simple product line, Tesla has been able to expand their market to a vast majority of automobile drivers—furthermore, this simple product line helps to challenge the modern stigma of influencing consumers to the move on to the “next generation” of technology and leave existing technology behind. By developing only four product models, Tesla can focus on improving their existing models, instead of creating new models, to accommodate the user's needs as best as possible: “But more importantly we listen to ideas and criticism, confident that the ongoing dialog with customers, prospective customers, media, politicians and others will lead to a better production car” (von Holzhausen, 2009). One strategic way in which Tesla is able to accommodate and adjust for user's needs is by improving maintainability of their vehicles, especially through their software-oriented design. This way, customers can upgrade their vehicles to newer features and technology without replacing the entire car (Dyer & Furr, 2020). This is a much more sustainable business approach on Tesla's behalf because it requires fewer physical parts and resource consumption in maintaining vehicles than in replacing them, especially when a large part of that maintenance is on software architecture.

Consequently, aside from Tesla's products being intrinsically environmentally conscious through their use of electric power, the company's business model continues to promote sustainable customer behavior through the maintainability of their vehicles, all by deliberate considerations of aesthetics during the design process. However, this is not to say that economic sustainability is exceptional for the user. Tesla products are still relatively expensive, but the

user's investment goes more towards maintaining and upgrading their existing vehicle and its features rather than an entire replacement of the car itself. Additionally, the customer's investment in a Tesla car diminishes at a slower rate than that of an alternative vehicle because of its maintainability. Tesla begins to address the argument of Russell and Vinsel (2020), who claim that aesthetics can be shifted towards consumption for maintainability and durability rather than innovation and creating new technologies, thus reducing consumption of resources overall (Russell & Vinsel, 2020).

### **Designing Timeless Technologies**

It is possible to analyze sustainable technologies on a smaller-scale than the electric vehicle industry which have provoked sustainable user behavior through the use of aesthetics. The types of technologies described in this section are those which are not necessarily designed to be environmentally sustainable, but ultimately designed in a meaningful way such that users are not inclined to replace them. Kristen Harper (2017) describes this technique as designing the “temporal object” as a means of allowing users to create an emotional bond with technologies. She mentions that it is difficult to control the recipient's experience with an object, but it is possible to analyze features which may trigger an emotional reaction from the recipients—this provides insight as to how to deliberately provoke those connections through intentional design choices, which could be as simple as material choices during the design process (Harper, 2017).

Examples of these types of technology are often easy to see in everyday life. Any type of technology or product which has developed sentimental or psychological value falls under this category—antique pieces of furniture or lighting fixtures; jewelry or watches that have been passed down for generations; records and record players which are no longer as efficient as digital music; reusable water bottles that are durable to last a lifetime—technologies such as

these are special because their aesthetic value does not diminish over time. Some may even argue that the aesthetic value of these technologies even increases with age as users continue to appreciate them beyond their individual functionality. An important design consideration for these types of technologies is to foresee how they will age over time (Harper, 2017): maybe these products are designed for durability such that their appearance can be protected throughout their usage, or maybe as these products age they appear to be even more beautiful as their imperfections emerge. In turn, technologies such as these help to promote sustainable user behavior economically and in terms of anti-consumption because users are not so willing to replace them, even if more functional and efficient solutions exist.

### **Aesthetics Cannot Fix a Broken System**

Although sustainable product development has become significant in recent years and some companies are trying to alter their business models to support more sustainable habits, there are certain industries which fundamentally conflict with sustainable technology. Because of the nature of these industries, there isn't any urgency to alter their business practices and become more sustainable. In this section, two of these dominating industries will be addressed to show how aesthetics are either incapable of fixing an existing unsustainable industry, or hinder the industries' ability to become more sustainable, even if they tried.

### **BIC: A Fundamentally Unsustainable Product Line**

Société Bic, commonly referred to as BIC, is a leading manufacturing corporation within the United States which thrives off of an inherently unsustainable product line—pens, pencils, lighters, and razors. These products are some of the most disposable products in consumers' everyday lives: because of their size and the plastic material they are made from, products such as these are inexpensive and easily replaceable, and consequently they are wasteful and harmful

for the environment. You would think that with the modern urgency to protect the environment, a company such as BIC would be going out of business as a result of their unsustainable business model. This is not the case, however, and BIC continues to thrive without much scrutiny for their unsustainable products.

To keep up with the modern trend of sustainable product development, BIC does mention sustainability as part of their mission. On their website the company writes, “BIC produces and markets consumer products that are lightweight, have a long performance life, and are affordable by everyone...the Group strives to reduce the impact of its manufacturing operations, optimize the shipping of its products and control the environmental footprint of its sales and support activities” (“Sustainable Development”, 2019). While this may be true, these statements glaze over the way in which users typically consume their products: how many people truly use up an entire pen, pencil, or lighter? Most of these products are lost or thrown away at any inconvenience.

The BIC company is one instance in which aesthetics cannot be used to fix an inherently unsustainable system. Because the manufacturing of these products is so inexpensive and thoroughly utilized around the globe, the aesthetic value of more sustainable solutions like safety razors or refillable lighters is simply not enough to outweigh the convenience of their plastic alternatives.

### **Apple Inc.: The Unsustainability of the “Next Generation”**

The industry for consumer electronics and handheld devices has undoubtedly been dominated by Apple Inc. over the past two decades. According to Team Counterpoint, Apple held 65% of the overall market share for smartphones in the United States in Q4 of 2020, a significant increase to previous domination of the market at 40% in Q3 (“US Smartphone Market

Share: By Quarter”, 2021). Apple is the archetype of a company which continually puts out the next “best” generation of products in order to not only grow their customer base but also coax their existing customers into buy more of their products. Additionally, the way in which Apple has marketed their technologies is by emphasizing the aesthetic value of their products in each new generation just as much as the functional value: “There’s a lot of good-looking hardware out there, but most people agree that Apple has most of the competition beat...Its sleek and simple designs are impressively minimalist, while staying high-quality and highly functional. Everything from chargers to earbuds is carefully designed to look good while doing its job” (Ayers, 2017).

The aesthetic aspect of Apple’s products is a major component of customer acquisition and why customers continue to buy and replace their products. Apple products are unsustainable technologies as a result of their reliance on consumption of resources as new generations continue to emerge. Furthermore, in recent years Apple has made their products even more unsustainable by their inability to repair older generations of their products—this is not only because the hardware and software of their products change so rapidly, but also because Apple generally doesn’t care as much about fixing and maintaining older products as getting customers to buy new products (Conklin, 2020). “Broken, unrepaired electronics are an enormous environmental problem. Americans dispose of about 416,000 cell phones a day, or 151 million phones a year. Manufacturers use a number of ‘endangered’ elements to produce these devices, including at least five elements that could run out within 100 years if we continue to consume them at current levels” (Vinsel, 2020). Overall, it can be seen that Apple continues to succeed in selling their products although they are unsustainable in nature, and it is the aesthetic value of their products which aids their popularity and revenue. In this circumstance, aesthetics ultimately

hinder users' abilities to practice sustainable behavior—that is, by using Apple products, users are becoming more unsustainable.

### **Are Aesthetics a Useful Design Technique in Prompting Sustainable User Behavior?**

Various cases in which user behavior is targeted and impacted through the aesthetic design of technologies have been discussed throughout this paper in the hopes to answer the question: are aesthetics useful as a design objective in provoking sustainable user behavior? Although there have been instances in which engineers have been able to begin to create more sustainable technologies, it is most important to note that the structure of the United States economy and other capitalist economies around the globe fundamentally conflict with the idea of producing true sustainable technology which meet the entire criteria established within this research (Dilnot, 2017). Because of the dependence of our economy on consuming beyond our means, most private businesses are organized to try and get consumers to not only buy their products but *continue* to buy their products. Because of this, technology which is sustainable environmentally is often not so sustainable economically (Charter & Tischner, 2001). Perhaps a more viable solution to sustainable product design would be to target aesthetic value in the maintainability of technologies, rather than new product innovation—similar to what Tesla has begun to undertake (Russell & Vinsel, 2020).

Thus, although some engineers have put in efforts to begin to promote sustainable user behavior by targeting aesthetic design in emerging technologies, there is a far bigger structural concern which must be addressed before inherently sustainable technology can be created through new product innovation: “Companies need to rethink their conventional approach to new product innovation by putting sustainability more at the centre of the process. If companies ever

want to develop truly sustainable products, they need to start innovating around societal and environmental grand challenges instead of sales” (Bansal & Grewatsch, 2019).

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